A66 Northern Trans-Pennine Project
TR010062

3.6 Habitat Regulations Assessment (HRA) Stage 2 Statement to Information Appropriate Assessment

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3.6 HABITAT REGULATIONS ASSESSMENT (HRA) STAGE 2

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Executive Summary

This report provides a Statement to Inform Appropriate Assessment (SIAA) in relation to the potential impacts of the A66 Northern Trans-Pennine Project (the Project) upon the River Eden Special Area of Conservation (SAC) and the North Pennine Moors SAC and Special Protection Area (SPA). This SIAA is the second stage of the Habitats Regulations Assessment for the Project. It relates only to these three European sites protected by the Conservation of Habitats and Species Regulations 2017 for which likely significant effects (LSE) as a result of the Project were not ruled out at the screening stage (i.e. the first stage) of the HRA. A separate Screening Report has been prepared (Document Reference 3.5: Habitats Regulations Assessment Stage 1: Likely Significant Effects Report).

The Project includes upgrading the existing single lane sections of the A66 to dual two-lane all-purpose roads with a speed limit of 70 miles per hour (mph), with the exception of a section of the A66 from the M6 junction 40 through Kemplay Bank which will have a speed limit of 50mph. The Project also includes amendments to existing junctions and accesses within these sections. As a Nationally Significant Infrastructure Project (NSIP), this report has been prepared to accompany an application for a Development Consent Order (DCO) for the Project, and to enable the competent authority, in this case the Secretary of State for Transport, to make an Appropriate Assessment when deciding whether to authorise the project, if so required.

The first stage of the SIAA, known as ‘screening’, is designed to identify whether there are elements of the project which are likely to give rise to significant effects on European sites which could compromise a European Site’s conservation objectives. The screening process identified five European sites with the potential to be affected by the Project, as follows:

- River Eden SAC (within 2km, crosses or lies adjacent to, upstream of, or downstream of, a watercourse which is designated in part or wholly as a European site, and within 200m of the Affected Road Network (ARN) in an area predicted to experience an increase in traffic flows resulting from the Project)
- Helbeck and Swindale Woods SAC (within 2km)
- Moor House-Upper Teesdale SAC (within 2km)
- North Pennines Moors SAC (within 2km, within 200m of the ARN in an area predicted to experience an increase in traffic flows resulting from the Project)
- North Pennine Moors SPA (within 2km, within 200m of the ARN in an area predicted to experience an increase in traffic flows resulting from the Project).

In the case of Helbeck and Swindale Woods SAC and Moor House-Upper Teesdale SAC, the screening stage concluded that the Project was not likely to have a significant effect on the qualifying interest features of the sites alone with no residual effect. Helbeck and Swindale Woods SAC and Moor House-Upper Teesdale SAC are located ~450m and ~900m respectively from Project at their nearest points. Both sites are located upstream of the Project with no credible

pathway for effect on any of the qualifying features. Further information is contained in the Screening Report (Document Reference 3.5: Habitats Regulations Assessment Stage 1: Likely Significant Effects Report).

For the three remaining sites, River Eden SAC, North Pennine Moors SAC and North Pennine Moors SPA (the North Pennine Moors SPA and SAC cover the same area), the potential for a LSE could not be ruled out at the screening stage, and these sites were therefore progressed to Stage 2 of the process (Appropriate Assessment), in order to assess whether the Project will adversely affect the integrity of the sites in view of their conservation objectives.

The River Eden SAC is designated for watercourses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation, alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*), white-clawed crayfish, sea lamprey, brook lamprey, river lamprey, Atlantic salmon and bullhead. The Project involves construction of a new watercourse crossing (Trout Beck) within the SAC and new outfalls discharging to the SAC. In addition, the Project will involve new watercourse crossings, culvert extension/replacement and new discharges in watercourses that have been shown to be functionally linked to the SAC. Based on consideration of the nature of the works and the qualifying features of the River Eden SAC, the Appropriate Assessment for the site assessed the potential for adverse effects resulting from:

- Land take / resource requirements / reduction of habitat
- Disturbance of mobile species and species fragmentation
- Species injury and mortality
- Introduction and/or spread of invasive non-native species
- Changes in surface and groundwater quality, quantity, and hydrogeology
- Changes in hydrology and fluvial geomorphological processes
- Changes in air quality

The North Pennine Moors SAC is designated for various habitats. European dry heaths, blanket bog, petrifying springs with tufa formation and siliceous scree of the montane to snow levels are present within unit 1, 2 and 3 of the Bowes Moor SSSI which forms a component to the SAC. The Appropriate Assessment for the site assessed the potential for adverse effects resulting from:

- Changes in air quality during operation (associated with the Affected Road Network (ARN)).

The North Pennine Moors SPA is designated for four species of bird: hen harrier (breeding), merlin (breeding), peregrine falcon (breeding) and European golden plover (breeding). The Appropriate Assessment for the site assessed the potential for adverse effects resulting from:

- A reduction in suitable breeding and foraging habitat (as a result of changes in air quality during operation associated with ARN).

The potential effects arising from Project are assessed in light of mitigation and the key design principles for the road. Potential changes in air quality, water quality, fluvial geomorphological and hydrogeology are underpinned by supporting technical assessments.

Subsequent to the full and proportionate Appropriate Assessment presented within this report, and in view of the relevant site conservation objectives, the potential for any adverse effect on the integrity of the River Eden SAC, North Pennine Moor SAC and North Pennine Moor SPA has been ruled out. The SIAA has concluded that no reasonable scientific doubt remains and in 'the light of the best scientific knowledge in the field', the project will not adversely affect the integrity of any European Site, alone or in combination with other plans or projects.

Therefore, the HRA can be concluded at Stage 2: Appropriate Assessment, and there is no requirement to move to HRA Stages 3 and 4 for the purposes of compliance with the Conservation of Habitats and Species Regulations 2017 (as amended).

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Purpose of this document

This report provides a Statement to Inform the Appropriate Assessment (SIAA) in relation to the impacts of the A66 Northern Trans-Pennine Project on European sites. This SIAA is the second stage of the Habitats Regulations Assessment (HRA) of the scheme (see Section 1.4 for over of HRA stages). It relates only to European sites protected by the Conservation of Habitats and Species Regulations 2017, as amended by the Conservation of Habitats and Species (amendment) (EU Exit) Regulations 2019[1], hereafter referred to as the Habitats Regulations 2017, for which likely significant effects (LSE) from the scheme were not ruled out at the screening stage of the HRA.

This report follows the principles of case law, both UK and EU, the methodology within the *Design Manual for Roads and Bridges (DMRB) LA 115 Habitats Regulations assessment (DMRB LA 115)* (Highways England, 2020)[2] and the *Planning Inspectorate (PINS) Advice Note Ten (AN10)* (Planning Inspectorate, 2017)[3] and is informed by *Habitats regulations assessments: protecting a European site (HRA: protecting a European site)* (Department for Environment, Food and Rural Affairs and Natural England, 2021)[4] and Department for Levelling Up, Housing and Communities guidance (Ministry of Housing, Communities and Local Government, 2019)[5].

[1] In general, the EU Exit Regulations (see Reg. 4) retain the requirements and interpretation of, and relevance of guidance that applied to the 2017 Regulations, but with adjustments necessary to reflect the UK's exit from the European Union.
[2] Highways England (2020) Design Manual for Roads and Bridges LA 115 Habitats Regulations assessment, Revision 1.
[3] Planning Inspectorate (2022) Advice Note Ten: Habitat Regulations Assessment relevant to Nationally Significant Infrastructure Projects. https://infrastructure.planninginspectorate.gov.uk/legislation-and-advice/advice-notes/advice-note-ten/ [accessed: 27/04/22]
[4] Department for Environment, Food and Rural Affairs and Natural England (2021) Habitats regulations assessments: protecting a European site. https://www.gov.uk/guidance/habitats-regulations-assessments-protecting-a-european-site [accessed: 27/04/22]
[5] Ministry of Housing, Communities & Local Government (2019) Appropriate assessment. https://www.gov.uk/guidance/appropriate-assessment [accessed: 27/04/22]

1 Habitats Regulations Assessment Stage 2: Statement to Inform Appropriate Assessment

1.1 Introduction

Legislative context

1.1.1 The Habitats Regulations 2017 set out the stages of assessment which must be undertaken to determine if a development project could significantly harm the designated features of a European site. European sites comprise Special Areas of Conservation (SACs) and Special Protection Areas (SPAs), designated under Council Directive 92/43/EEC ('the Habitats Directive') and Council Directive 79/409/EEC ('the Birds Directive'), as incorporated into UK law. Department for Environment, Food and Rural Affairs (Defra) guidance, *HRA: protecting a European site*, states that proposed SACs, potential SPAs, areas secured as sites compensating for damage to a European site, and wetlands of international importance designated under the Ramsar Convention (Ramsar sites) (both listed and proposed) are afforded the same protection as European sites in terms of the assessment required of any proposals that may affect them.

1.1.2 Regulation 63 of the Habitats Regulations 2017 states that any plan or project not directly connected with, or necessary to, the management of a European site, but which would be likely to have a significant effect on such a site, either alone, or in combination with other plans or projects, must be subject to appropriate assessment of its implications for the European site in view of its conservation objectives.

1.1.3 An in combination assessment is required for effects which are not significant alone, but when combined with other 'residual' effects could give rise to a likely significant effect. Whilst not explicit in Regulation 63(5), case law (European Court of Justice, 2004)[6] informs us that an in combination assessment is required at both Stage 1 (screening) and Stage 2 (appropriate assessment).

1.1.4 The competent authority for the HRA will be the Secretary of State for Transport, as the project is a Nationally Significant Infrastructure Project (NSIP).

1.1.5 Regulation 63 (2) of the Habitats Regulations 2017 states that as the applicant for this Project, National Highways must provide such information as the competent authority may reasonably require for the purposes of the assessment, or to enable it to determine whether an appropriate assessment is required.

1.1.6 Regulation 63 of the Habitats Regulation 2017 states that consent should only be granted for a plan or project once the relevant competent authority has ascertained that it will not adversely affect the integrity of European sites.

[6] European Court of Justice (2004) Case C – 127/02 Waddenzee 7 September 2004 (Para 45)

1.1.7 Regulation 64 describes that where an appropriate assessment has been carried out and it cannot be ascertained that a plan or project would not adversely affect the integrity of a European site, consent will only be granted if there are no alternative solutions and there are imperative reasons of overriding public interest (IROPI) for the development and compensatory measures have been secured.

1.1.8 The stages outlined below indicate that if harmful effects can be ruled out in either Stages 1 or 2, a project can be withdrawn from further scrutiny. In reality, the majority of projects are resolved in Stages 1 and 2 because the iterative assessment process drives design change to avoid or minimise effects, allowing issues to be resolved at this stage for the majority of projects. Projects can only pass Stages 3 and 4 if there are no feasible alternative solutions, IROPI has been demonstrated, and the necessary compensatory measures can be secured. This means that where issues cannot be resolved at Stage 2, few projects are taken forward to Stages 3 and 4.

1.1.9 The staged process of undertaking the above requirements of the legislation is referred to as a HRA and the applicant's role at each stage is summarised in *DMRB LA 115* as follows:

- Screening (Stage 1) – determination of whether there is risk for the Project to give rise to significant adverse impacts on the conservation objectives of the qualifying features (interest features) of the European site, alone or in combination with other plans or projects, i.e. determination of whether LSE can be ruled out.
- Informing the appropriate assessment (Stage 2) – where LSE cannot be rule out at Stage 1, or there is uncertainty as to whether LSE would occur, report on and provide evidence of examination of adverse effects on the integrity of a European site to inform the competent authority undertaking the appropriate assessment.
- If an adverse effect on the integrity of the site can be avoided, with or without mitigation, the project can be consented. If not, derogations would have to be sought through Stages 3 and 4 of the HRA process. These are considered only in exceptional circumstances, where a strict set of legal tests must be met[4].
- Assessment of alternatives (Stage 3) –formal assessment and reporting of alternative solutions if the proposal fails the integrity test as an adverse effect on site integrity cannot be rule out.
- Assessment of IROPI (Stage 4) – where the alternative solutions assessment reports that there are no alternative solutions to the project and this has been agreed with the relevant statutory environmental body (SEB) an assessment of IROPI shall be undertaken.
- Assessment of compensatory measures – where IROPI are established and reported an assessment of compensatory measures shall be compiled on measures to compensate for the adverse impact of the project. This should be used as basis for consultation with SEB to seek their representation on the sufficiency of the compensatory measures.

1.2 Background to the project

Project overview

1.2.1 The Project comprises eight schemes to improve the A66 between M6 J40 at Penrith and A1(M) J53 at Scotch Corner. The Project would involve improving the junctions on the M6 and A1 as well as improving six separate single carriageway lengths of road to dual carriageway standard and making improvements to the junctions within each of those lengths. The nature of the planned improvements includes online widening (adjacent to the existing road) of the carriageway as well as offline construction (new lengths of road following different routes but reconnecting into existing lengths of the A66 that are already dualled).

1.2.1 The eight schemes are identified as follows:

- M6 Junction 40 to Kemplay Bank
- Penrith to Temple Sowerby
- Temple Sowerby to Appleby
- Appleby to Brough
- Bowes Bypass
- Cross Lanes to Rokeby
- Stephen Bank to Carkin Moor
- A1(M) Junction 53 Scotch Corner

1.2.2 The eight schemes as shown in *HRA Appendix A: European Designated Sites Location Plan and the Project*. A detailed description of each scheme is presented in section 2.7.

Purpose and objectives of Project: strategic importance and Project vision

1.2.3 National Highways has been appointed by the Secretary of State (SoS) to be the strategic highways company and therefore highway authority, traffic authority and street authority for the Strategic Road Network Initial Report (SRN) (Highways England, 2017) and pursuant to the Infrastructure Act 2015. As such National Highways has set the objectives for the Project which are presented by theme in Table 1: A66 Project objectives.

Table 1: A66 Project objectives

Theme	Project Objectives
Economic	Regional: Support the economic growth objectives of the Northern Powerhouse and Government levelling up agenda.
	Ensure the improvement and long-term development of the SRN through providing better national connectivity including freight.
	Maintain and improve access for tourism served by the A66.
	Seek to improve access to services and jobs for local road users and the local community.
Transport	Improve road safety, during construction, operation and maintenance for all, including road users, non-motorised users (NMU), road workers, local businesses and local residents.

Theme	Project Objectives
	Improve journey time reliability for road users.
	Improve and promote the A66 as a strategic connection for all traffic and users.
	Improve the resilience of the route to the impact of events such as incidents, roadworks and severe weather events.
	Seek to improve NMU provision along the route.
Community	Reduce the impact of the route on severance for local communities.
Environment	Minimise adverse impacts on the environment and where possible optimise environmental improvement opportunities.

1.2.4 Part 4 Aims and Objectives of *Highways England: Licence* (Department for Transport, 2015)[7] states that Highways England (now National Highways) has a duty to *"minimise the environmental impacts of operating, maintaining and improving its network and seek to protect and enhance the quality of the surrounding environment" and "conform to the principles of sustainable development".*

Scheme description

1.2.5 The Project is made up eight schemes. The location of the Project and the ARN in relation to the River Eden SAC, North Pennine Moors SAC and North Pennine Moors SPA are shown in the *HRA Appendix A: European Designated Sites Location Plan and the Project*.

1.2.6 Descriptions of individual schemes where LSE could not be ruled are provided as part of the Appropriate Assessment in Sections 1.5 (River Eden SAC), 1.6 (North Pennine Moor SAC) and 1.7 (North Pennine Moors SPA).

Physical land take of the Project

1.2.7 No physical land take is required for the Project in any of the three sites subject to appropriate assessment: River Eden SAC, North Pennine Moors SAC and North Pennine Moors SPA.

Key stages of the Project and timescales

1.2.8 Subject to securing a DCO, preliminary works are planned to commence in 2024, with all schemes to be completed by 2029 or earlier. The high level programme and key milestones are:

- SoS DCO Decision - September 2023
- DCO Judicial Review period ends - October/November 2023
- Site establishment - Late 2023
- Start of main works - January 2024
- Project fully open to traffic - 2029

1.2.9 The HRA covers the construction and operation phases of the Project. It is considered highly unlikely that the Project would be decommissioned as

[7] Department for Transport (2015) Highways England: Licence

the road is likely to have become an integral part of the infrastructure in the area. Decommissioning would not be either feasible or desirable and therefore, no decommissioning impacts are discussed in this report.

1.3 Protected sites potentially affected by the proposals

1.3.1 The European sites included within the scope of the HRA were identified at stage 1 - screening, in accordance with *DMRB LA 115*. This states that the screening stage of HRA shall be completed for all European sites where a route corridor or project meets any of the following screening criteria:

- Is within 2km of a European site or functionally linked land.
- Is within 30km of a SACs, where bats are noted as one of the qualifying interests.
- Crosses or lies adjacent to, upstream of, or downstream of, a watercourse which is designated in part or wholly as a European site.
- Has a potential hydrological or hydrogeological linkage to a European site containing a groundwater dependent terrestrial ecosystem (GWDTE) which triggers the assessment of European sites in accordance *with DMRB LA 113 Road drainage and the water environment (DMRB LA 113)* (Highways England, 2020)[8].
- Has an Affected Road Network (ARN - the wider highway network where traffic volumes could be expected to change as an indirect result of the Project) which triggers the criteria for assessment of European sites *DMRB LA 105 Air Quality (DMRB LA 105)* (Highways England, 2019)[9].

1.3.2 As described in the HRA Screening (ES Document Reference 3.5: Habitats Regulations Assessment Stage 1: Likely Significant Effects Report) LSE could not be excluded for the following European sites:

River Eden SAC

1.3.3 The Project interacts with watercourses which are designated as part of the River Eden SAC and watercourses located upstream with hydrological or potential hydrogeological linkage to the SAC. LSE on the River Eden SAC could not be ruled out for the following schemes:

- M6 Junction 40 to Kemplay Bank
- Penrith to Temple Sowerby
- Temple Sowerby to Appleby
- Appleby to Brough

1.3.4 LSE could not be screened out as a result of:

- Land take / resource requirements / reduction of habitat
- Disturbance of mobile species and species fragmentation
- Species injury and mortality
- Introduction and/or spread of invasive non-native species

[8] Highways England (2020) Design Manual for Roads and Bridges LA 113 Road drainage and the water environment
[9] Highways England (2019) Design Manual for Roads and Bridges LA 105 Air quality

- Changes to surface and groundwater quality, quantity, and hydrogeology
- Changes to hydrology and fluvial geomorphological processes
- Air quality

North Pennine Moors SAC

1.3.5 The Project ARN interacts with habitats which are designated as part of the North Pennine Moors SAC. LSE could not be screened out as a result of:

- Air quality (associated with ARN)

North Pennine Moors SPA

1.3.6 The Project ARN interacts with habitats which are designated as part of the North Pennine Moors SPA. LSE could not be screened out as a result of:

- Reduction in suitable breeding and foraging habitat (as a result of changes in air quality associated with ARN)

1.3.7 The key characteristics of the European sites are summarised in Table 2: River Eden SAC, Table 3: North Pennine Moors SAC and Table 4: North Pennine Moors SPA.

Table 2: River Eden SAC

River Eden SAC (Joint Nature Conservation Committee, 2015)[10]	
Physical area of the European site	2,430.39ha
The qualifying interests of the European site	Annex I habitats that are a primary reason for selection of this site: • Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoëto-Nanojuncetea* (refers to Ullswater which is considered outside the Project zone of influence and was screened out at Stage 1)[11]. • Watercourses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation. • Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*) Annex II species that are a primary reason for selection of this site: • Atlantic salmon (*Salmo salar*) • Brook lamprey (*Lampetra planeri*) • Bullhead (*Cottus gobio*) • Otter (*Lutra lutra*) • River lamprey (*Lampetra fluviatilis*) • Sea lamprey (*Petromyzon marinus*)

[10] Joint Nature Conservation Committee (2015) Joint Nature Conservation Committee River Eden SAC standard Natura 2000 data form

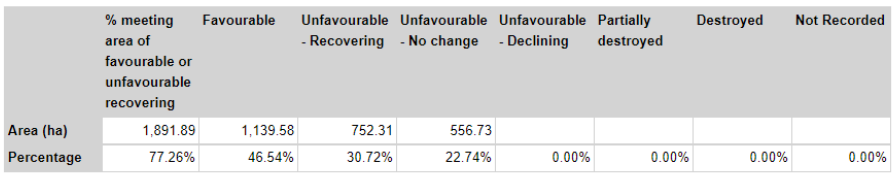
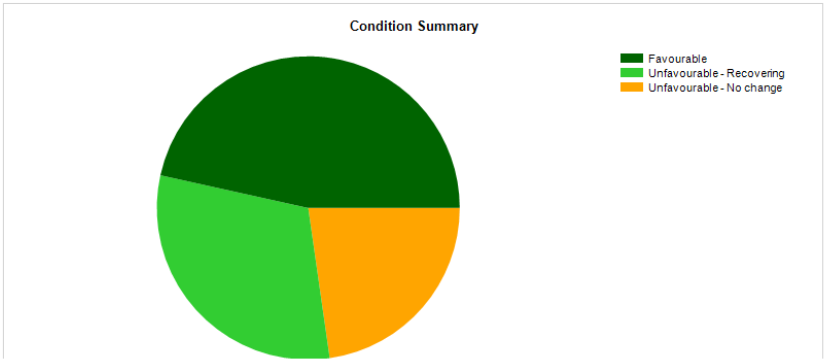
[11] Ullswater is approximately 7.5km upstream of the Project and there is considered to be no credible risk of LSE on this standing water as result of the project. Natural England is in agreement, based on their comments the Stage 1 HRA Screening Report, received as part of their statutory consultation response [22/10/21]

River Eden SAC (Joint Nature Conservation Committee, 2015)[10]	
	• White-clawed crayfish (*Austropotamobius pallipes*). Desk study and survey information obtained that is specific to the Project, including habitat/species presence and absence is described in Section 1.5. Table 5: Summary of River Eden SAC baseline surveys provides the key findings of ecological surveys pertaining to SAC qualifying species.
European site conservation objectives	The *European Site Conservation Objectives for River Eden Special Area of Conservation (River Eden SAC Conservation Objectives)* (Natural England, 2018)[12] aim to: Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the favourable conservation status of its qualifying features, by maintaining or restoring: • The extent and distribution of qualifying natural habitats and habitats of qualifying species • The structure and function (including typical species) of qualifying natural habitats • The structure and function of the habitats of qualifying species • The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely • The populations of qualifying species • The distribution of qualifying species within the site These *River Eden SAC Conservation Objectives* are underpinned by the *European Site Conservation Objectives: Supplementary advice on conserving and restoring site features River Eden Special Area (River Eden SAC Conservation Objectives Supplementary Advice)* (Natural England, 2019)[13]. This document presents attributes which are ecological characteristics of the designated species and habitats within a site. The listed attributes are considered to be those that best describe the site's ecological integrity and which, if safeguarded, will enable achievement of the *River Eden SAC Conservation Objectives*. Each attribute has a target which is either quantified or qualitative depending on the available evidence. The target identifies as far as possible the desired state to be achieved for the attribute. In many cases, the attribute targets shown in the tables indicate whether the current objective is to 'maintain' or 'restore' the attribute. This is based on the best available information, including that gathered during monitoring of the feature's current condition. Desk study and survey information obtained that is specific to the Project, including habitat/species presence and absence is described in Section 1.5.
Details of the existing baseline conditions of the European site	A desktop study of the SAC was undertaken in 2021 to establish the baseline conditions for qualifying interest features. This included assessing the *River Eden SAC Conservation Objectives*, the *River Eden SAC Conservation Objectives Supplementary Advice*, the *Site Improvement Plan River Eden (SIP*

[12] Natural England (2018) European Site Conservation Objectives for River Eden Special Area of Conservation Site Code: UK0012643 (v.3), available at: http://publications.naturalengland.org.uk/publication/5935614042046464 [accessed 27/04/22]
[13] Natural England (2019) European Site Conservation Objectives: Supplementary advice on conserving and restoring site features River Eden Special Area of Conservation Site Code: UK0012643, available at: http://publications.naturalengland.org.uk/publication/5935614042046464 [accessed 27/04/22]

River Eden SAC (Joint Nature Conservation Committee, 2015)[10]	
including details of data collection methodologies and consultations undertaken	*River Eden)* (Natural England, 2014)[14] and Natural England's *Designated Sites View* (Natural England, 2022)[15] for details on the condition of the Site of Special Scientific Interest (SSSI) management units underpinning the SAC. In addition, the appropriate assessment draws on information provided within the Environmental Statement Volume 1 (Main Report) (Application Document 3.2) and Volume 3 (Appendices) (Application Document 3.4), notably: • Appendix 6.19 Aquatic Macrophyte and River Corridor Survey • Appendix 6.17 Fish Habitat Assessment and MoRPh • Appendix 6.18 Fish • Appendix 6.21 White-Clawed Crayfish • Appendix 6.15 Otter Desk study and survey information obtained that is specific to the Project, including habitat/species presence and absence is described in Section 1.5. Table 5: Summary of River Eden SAC baseline surveys provides the key findings of ecological surveys pertaining to SAC qualifying species.
The value of the site and qualifying interests therein to the European site network (taken from *River Eden SAC Site Description* (Joint Nature Conservation Committee, 2022)[16])	The River Eden SAC citation states it is a floristically rich, northern river on sandstone and hard limestone. The variation in geology, altitude and flow result in an extremely high number of aquatic plant species, many uncommon and at the edge of their geographical range. In places on the Eden there are natural riparian habitats of wet woodland sedge swamp and oxbow lakes. The SAC is a north-western representative of sub-type 2 water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation. There is considerable geographic and ecological variation in this sub-type; however this site flows over both calcareous limestone and sandstone, giving a diversity of ecological conditions, ranging from oligotrophic to mesotrophic. This river has 184 recorded plant species, more than any other river in the UK. The *Ranunculus* species of the river system include stream water-crowfoot *Ranunculus penicillatus* ssp. *penicillatus* occurring here at the edge of its range, and others, such as *R. penicillatus* ssp. *pseudofluitans* and river water-crowfoot *R. fluitans*. Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*) stands of alder *Alnus glutinosa* and willow *Salix* spp. occur throughout the length of the site, associated with backwaters and seasonally-flooded channels. The least-disturbed stands are on the tributary River Irthing, where they occur on the shingle and gravels of actively-moving channels. The site has high water quality that supports a large population of white-clawed crayfish in the northern part of its range in England. As with the River Wye, the tributaries of the Eden, especially those flowing from limestone sources, are of particular importance. The sea, brook and river lamprey populations of the site are examples of lamprey populations associated with an extensive river system on a varied and

[14] Natural England (2014) Site Improvement Plan River Eden, available at: http://publications.naturalengland.org.uk/publication/5935614042046464 [accessed 27/04/22]
[15] Natural England (2022) Designated Site View, available at: https://designatedsites.naturalengland.org.uk/ReportUnitCondition.aspx?SiteCode=S2000215&ReportTitle=River%20Eden%20and%20Tributaries%20SSSI [accessed 10/05/22]
[16] Joint Nature Conservation Committee (2022) River Eden SAC Site Description, available at: https://sac.jncc.gov.uk/site/UK0012643 [accessed 27/04/22]

River Eden SAC (Joint Nature Conservation Committee, 2015)[10]	
	base-rich geology in northern England. The highly erodible nature of the rock results in extensive areas of gravel and finer silts being deposited throughout the system, providing conditions for spawning (gravel) and nursery areas (slit). A large and healthy population of sea lamprey is supported in the middle to lower regions of the river. Brook lamprey is supported widely within the catchment. The availability of, and accessibility to high quality habitats, even in the upper reaches, means that a large, healthy population of river lampreys occurs widely within the catchment. The Eden represents one of the largest populations of Atlantic salmon in northern England. It is an excellent example of a large river system that flows over varied, base-rich geology. This coupled with its large range in altitude, results in the development of distinct habitat types, supporting diverse plant and invertebrate communities. The high ecological value of the river system and the fact that the salmon are able to use most of the catchment (even above Ullswater, a large natural lake on the main river), mean that the Eden is able to maintain a large population of salmon. The Eden represents bullhead in a high-quality, relatively unmodified river in the northern part of its range in England. The presence of extensive areas of gravel and generally good quality water provides good habitat for bullheads, which are widely distributed throughout the system. The tributaries, in particular those flowing over limestone, hold abundant numbers of bullhead. The River Eden provides an example of lowland otter habitats in north-west England and complements the selection of the River Derwent and Bassenthwaite Lake.
Likely future changes in baseline conditions at the site in the absence of the Project	In the absence of the Project, future changes in baseline condition are likely to be in relation to identified threats and pressures as outlined in the *SIP River Eden* and changes in management measures. At the site scale, the current condition of the SSSI (the boundary of which is consistent with that of the SAC) is 46.5% Favourable, 30.7% Unfavourable - Recovering and 22.4% Unfavourable - No change (accessed 01/05/2022)[15].  % meeting area of favourable or unfavourable recovering / Favourable / Unfavourable - Recovering / Unfavourable - No change / Unfavourable - Declining / Partially destroyed / Destroyed / Not Recorded Area (ha): 1,891.89 / 1,139.58 / 752.31 / 556.73 / / / / Percentage: 77.26% / 46.54% / 30.72% / 22.74% / 0.00% / 0.00% / 0.00% / 0.00%  The SSSI units that interact with the Project (i.e. units within the Order Limits plus a 500m buffer and/or units within which rivers crossed by the Project

River Eden SAC (Joint Nature Conservation Committee, 2015)[10]	
	ultimately flow into) are shown in *HRA Appendix A: European Designated Sites Location Plan and the Project*. Current condition of individual SSSI units that interact with the Project (*Designated Sites View,* Natural England, 2022[15]) are as follows: • Unit 221 River Eamont (M6 Junction 40 to Kemplay Bank): Unfavourable - Recovering 07/12/2010) • Unit 216 River Lowther (upstream of Penrith to Temple Sowerby): Unfavourable - Recovering (07/12/2010). • Unit 222 River Eamont (Penrith to Temple Sowerby): Unfavourable - No change (30/03/2010) • Unit 215 River Eden (Temple Sowerby to Appleby): Unfavourable - Recovering [likely to change to No Change] • Unit 210 River Eden (Temple Sowerby to Appleby): Unfavourable - No Change (29/03/2010) • Unit 211 Trout Beck and Swindale Beck (Temple Sowerby to Appleby): Unfavourable - No Change (12/01/2022) • 207 River Eden (downstream of Moor Beck, Eastfield Sike, Lowgill Beck, Crooks Beck and Cringle Beck which are located within the Appleby to Brough scheme): Unfavourable - No Change (29/03/2010) • Unit 205 River Eden (downstream of the Appleby to Brough scheme): Unfavourable - No Change (09/03/2022) All units interacting with the scheme are in Unfavourable - No change condition and are therefore not meeting their conservation objectives. With the exception of Unit 221 (Trout Beck and Swindale Beck), where a river restoration project, may improve condition in future, the future baseline if anticipated to be unfavourable in the absence of the Project. Further information on pressures driving unit condition and species presence absence is provided in the Section 1.5 Desk study information Baseline Surveys. *SIP River Eden* lists water pollution, agricultural management practices, physical modification, invasive species, changes in species distributions, forestry and woodland management, hydrological changes, disease and air pollution as issues currently impacting or threatening the condition of the qualifying features.
Details of the key species, habitat dynamics and functional relationships that maintain the site integrity	The Annex I habitats and Annex II species which comprise the qualifying features of the SAC are dependent on maintaining the natural function and structure of the River Eden. This includes ensuring threats and pressures such as water pollution, physical modification, hydrological changes and non-native species are managed in order to not prevent the natural function of the watercourse. The habitats and processes result in the floristically rich aquatic flora and fauna recorded. Negative changes in water quality and flow velocities would result in a reduction in species diversity and the ability of habitats to support qualifying features.

Table 3: North Pennine Moors SAC

North Pennine Moors SAC (Joint Nature Conservation Committee, 2015)[17]	
Physical area of the European site	103,014.48ha
The qualifying interests of the European site	Annex I habitats that are a primary reason for selection of this site: • European dry heaths • Juniperus communis formations on heaths or calcareous grasslands • Blanket bogs[18] • Petrifying springs with tufa formation (*Cratoneurion*) • Siliceous rocky slopes with chasmophytic vegetation • Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles Annex I habitats present as a qualifying feature, but not a primary reason for selection of this site: • Northern Atlantic wet heaths with *Erica tetralix* • Calaminarian grasslands of the *Violetalia calaminariae* • Siliceous alpine and boreal grasslands • Semi-natural dry grasslands and scrubland facies on calcareous substrates *Festuco Brometalia* (includes the priority feature 'important orchid sites') • Alkaline fens • Siliceous scree of the montane to snow levels *Androsacetalia alpinae* and *Galeopsietalia ladani* • Calcareous rocky with slopes with chasmophytic vegetation Annex II species that are a primary reason for selection of this site: • Marsh saxifrage (*Saxifraga hiruculus*)
European site conservation objectives	The *European Site Conservation Objectives for North Pennine Moors Special Area of Conservation (North Pennine Moors SAC Conservation Objectives)* (Natural England, 2018)[19] aim to: Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the favourable conservation status of its qualifying features, by maintaining or restoring: • The extent and distribution of qualifying natural habitats and habitats of qualifying species • The structure and function (including typical species) of qualifying natural habitats • The structure and function of the habitats of qualifying species • The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely

[17]Joint Nature Conservation Committee (2015) Natura 2000 Standard Data Form: North Pennine Moors (UK0030033), available at: https://jncc.gov.uk/jncc-assets/SAC-N2K/UK0030033.pdf [accessed: 27/04/22]
[18] Priority habitat if active bog.
[19] Natural England (2018) European Site Conservation Objectives for North Pennine Moors Special Area of conservation Site Code: UK0030033 (version 3), available at: http://publications.naturalengland.org.uk/publication/6361191412662272 [accessed: 27/04/22]

North Pennine Moors SAC (Joint Nature Conservation Committee, 2015)[17]	
	• The populations of qualifying species • The distribution of qualifying species within the site.
Details of the existing baseline conditions of the European site including details of data collection methodologies and consultations undertaken	A desktop study review of the SAC was undertaken in 2022 to establish the baseline conditions for qualifying interest features. This included assessing the *North Pennine Moors SAC Conservation Objectives*, the *European Site Conservation Objectives: Supplementary advice on conserving and restoring site features for North Pennine Moors Special Area of Conservation (North Pennine Moors SAC Conservation Objectives Supplementary Advice*) (Natural England, 2019)[20], the Site *Improvement Plan North Pennines Group (SIP North Pennines)* (Natural England, 2014)[21] and Natural England's *Designated Sites View* (Natural England, 2022)[22] for details on the condition of the SSSI management units underpinning the SAC. A habitat survey using the Joint Nature Conservation Committee (JNCC) Phase 1 Habitat classification was undertaken of habitats within 200m of the ARN within the North Pennine Moors SAC boundary. The purpose of the survey was to determine the presence of Annex I and Annex II qualifying features. The results of the survey were able to confirm habitat types present and subsequently those which may be impacted by changes in air quality. Field notes were taken on habitat types and species composition. The survey was undertaken in September 2021. Full details are included Table 13 Baseline survey information to inform North Pennine Moors SAC.
The value of the site and qualifying interests therein to the European site network	The North Pennine Moors SAC supports much of the upland heathland of northern England. The most abundant heath communities are heather - wavy hair grass *Calluna vulgaris - Deschampsia flexuosa* heath and heather - bilberry *Vaccinium myrtillus* heath. At high altitudes and to the wetter west and north of the site complex, the heaths grade into extensive areas of blanket bog. A significant proportion of the bog remains active with accumulating peat. The main type is heath - hare's-tail cottongrass *Eriophorum vaginatum* blanket mire. The site contains other wetland habitats including wet heaths and calcium-rich fens, which support populations of yellow marsh saxifrage (*Saxifraga hirculus*). Tufa-forming springs are localised in occurrence, but where the habitat does occur it is species-rich with abundant bryophytes, sedges and herb including bird's-eye primrose (*Primula farinosa*) and marsh valerian (*Valeriana dioica*) (*North Pennine Moors SAC Citation,* Natural England, 2014)[23]. Acidic rock outcrops and screes are well-scattered across the North Pennine Moors and support a range of lichens and bryophytes. The site also contains base-rich rocks that support calcicole crevice vegetation communities.

[20] Natural England (2019) European Site Conservation Objectives: Supplementary advice on conserving and restoring site features for North Pennine Moors Special Area of Conservation Site Code: UK0030033, available at: http://publications.naturalengland.org.uk/publication/6361191412662272 [accessed: 27/04/22]
[21] Natural England (2014) Site Improvement Plan North Pennines Group http://publications.naturalengland.org.uk/publication/6534899699810304 [accessed: 27/04/22]
[22] Natural England (2022) Designated Site Viewer, available at: https://designatedsites.naturalengland.org.uk/SiteGeneralDetail.aspx?SiteCode=UK0030033&SiteName=north%20pennine%20moor&countyCode=&responsiblePerson=&SeaArea=&IFCAArea= [accessed: 27/04/22]
[23] Natural England (2014) North Pennine Moors SAC Citation, available at: http://publications.naturalengland.org.uk/publication/6361191412662272 [accessed: 27/04/22]

North Pennine Moors SAC (Joint Nature Conservation Committee, 2015)[17]	
	The site contains important areas of calcareous grassland, montane acid grassland and grasslands on soils rich in heavy metals, such as old lead mines. The JNCC *Standard Data Form* (JNCC, 2015)[17] states that qualifying features are considered the best in the areas in the UK or considered to support a significant presence.
Likely future changes in baseline conditions at the site in the absence of the Project	In the absence of the Project, future changes in baseline condition are likely to be in relation to identified threats and pressures and changes in management measures as outlined in the SIP North Pennines Group. The North Pennine Moor SAC comprises many SSSI, but the A66 bisects the Bowes Moor SSSI. At the site scale, the current condition of the SSSI is 80.05% Unfavourable - Recovering and 19.95% Unfavourable – No change (*Designated Sites View*, Natural England, 2022)[22]. The SSSI units that interact (located within 200m) with the Project ARN are shown in Figure D: European Designated Sites Location Plan and Project Schemes. Current condition (10/05/2022) of individual Bowes Moor SSSI units that interact with the Project ARN (i.e. within 200m of the ARN) are as follows: • Unit 001: Unfavourable - Recovering (30/03/2016) • Unit 003: Unfavourable - No change (02/03/2015) • Unit 004: Unfavourable - No change (29/02/2016) All units interacting with the Project are in Unfavourable condition and are therefore not meeting their conservation objectives. Based on current information, the future baseline for Units 001, 003 and 004 are considered to be Unfavourable. Managed rotational burning, inappropriate grazing, change in land management, hydrological changes, game management grouse moors, direct land take from development, air pollution, agricultural management practices and private and public access are all issues currently impacting or threatening the condition of the qualifying features as set out in the *SIP North Pennines Group.*
Details of the key species, habitat dynamics and functional relationships that maintain the site integrity	The Annex I habitats are dependent on maintaining the extent and reducing fragmentation and habitat loss which could occur as a result of factors such as managed rotational burning, hydrological changes, agricultural management practices and air pollution. The condition of these habitats supports the requirement for the Annex II qualifying feature. In particular, hydrological regime is important for wetland features such as blanket bog, wet heaths and fens.

Table 4: North Pennine Moors SPA.

North Pennine Moors SPA (Joint Nature Conservation Committee, 2015)[24]	
Physical area of the European site	147,276.11 ha

[24] Joint Nature Conservation Committee (2015) Natura 2000 Standard Data Form: North Pennine Moors (UK9006272), available at: https://jncc.gov.uk/jncc-assets/SPA-N2K/UK9006272.pdf [accessed: 27/04/22]

North Pennine Moors SPA (Joint Nature Conservation Committee, 2015)[24]	
The qualifying interests of the European site	The qualifying species (breeding): • Golden plover (*Pluvialis apricaria*) • Hen harrier (*Circus cyaneus*) • Merlin (*Falco columbarius*) • Peregrine (*Falco peregrinus*) Non-qualifying species of interest (breeding): • Montagu's harrier (*Circus pygargus*) • Short-eared owl (*Asio flammeus*)
European site conservation objectives	The *North Pennine Moors SPA Conservation Objectives* (Natural England, 2019)[25] aim to: Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Birds Directive, by maintaining or restoring: • The extent and distribution of the habitats of the qualifying features • The structure and function of the habitats of the qualifying features • The supporting processes on which the habitats of the qualifying features rely • The population of each of the qualifying features • The distribution of the qualifying features within the site.
Details of the existing baseline conditions of the European site including details of data collection methodologies and consultations undertaken	A desktop study of the SPA was undertaken in 2021 to establish the baseline conditions for qualifying interest features. This included assessing the *Conservation Objectives*[25], the *European Site Conservation Objectives: supplementary advice on conserving and restoring site features* (Natural England, 2019)[26], the *SIP North Pennines Group* (Natural England, 2014)[21] and *Designated Sites View* (Natural England, 2022)[27] for details on the condition of the SSSI management units underpinning the SPA.
The value of the site and qualifying interests therein to the European site network	The North Pennine Moors SPA includes parts of the Pennine moorland massif between the Tyne Gap (Hexham) and the Ribble-Aire corridor (Skipton). It encompasses extensive tracts of semi-natural moorland habitats including upland heath and blanket bog. During the breeding season the area regularly supports: hen harrier 2.2% of the GB breeding population (count as at 1993 and 1994), merlin 10.5% of the GB breeding population (estimated population), peregrine 1.3% of the GB

[25] Natural England (2019) European Site Conservation Objectives for North Pennine Moors SPA Site Code: UK9006272 (version 3), available at: http://publications.naturalengland.org.uk/publication/6079716435951616 [accessed 27/04/22]
[26] Natural England (2019) European Site Conservation Objectives: Supplementary advice on conserving and restoring site features North Pennine Moors SPA Site Code: UK9006272
[27] Natural England (2022) Designated Site Viewer, available at: https://designatedsites.naturalengland.org.uk/SiteDetail.aspx?SiteCode=S1001397&SiteName=north%20pennine%20moors%20spa&countyCode=&responsiblePerson=&unitId=&SeaArea=&IFCAArea= [accessed: 27/04/22]

North Pennine Moors SPA (Joint Nature Conservation Committee, 2015)[24]	
	breeding population (count as at 1991), golden plover [North-western Europe - breeding] at least 6.2% of the GB breeding population (estimated population).
Likely future changes in baseline conditions at the site in the absence of the Project	In the absence of the Project, future changes in baseline condition are likely to be in relation to identified threats and pressures in the *SIP North Pennines Group* (Natural England (2014)[21] and changes in management measures. The North Pennine Moor SPA comprises many SSSI, but the A66 bisects the Bowes Moor SSSI. At the site scale, the current condition of the SSSI is 80.05% Unfavourable - Recovering and 19.95% Unfavourable – No change (*Designated Sites View,* Natural England, 2022)[27]. The SSSI units that interact with the Project ARN are shown in *HRA Appendix A: European Designated Sites Location Plan and the Project*. Current condition of individual Bowes Moor SSSI units that interact with the Project ARN (i.e. within 200m of the ARN) are as follows: • Unit 001: Unfavourable - Recovering (30/03/2016) • Unit 003: Unfavourable - No change (02/03/2015) • Unit 004: Unfavourable - No change (29/02/2016) All units interacting with the Project are in Unfavourable condition and are therefore not meeting their conservation objectives. Based on current information, the future baseline for Units 001, 003 and 004 are considered to be Unfavourable. Managed rotational burning, inappropriate grazing, change in land management, hydrological changes, game management grouse moors, direct land take from development, air pollution, agricultural management practices and private and public access are all issues currently impacting or threatening the condition of the qualifying features as set out in the *SIP North Pennines Group* (Natural England, 2014)[21]. The units which are relevant to the Project relating to an air pollution impact pathway i.e. within 200m of the ARN, include unit 1 (unfavourable - recovering) and unit 3 and 4 (unfavourable - no change). The *SIP North Pennines Group (*Natural England, 2014*)*[21] cites low breeding success/poor recruitment, managed rotational burning, inappropriate grazing, change in land management, hydrological changes, game management grouse moors, direct land take from development, air pollution, agricultural management practices and private and public access as issues currently impacting or threatening the condition of the qualifying features.
Details of the key species, habitat dynamics and functional relationships that maintain the site integrity	The qualifying features of the SPA rely on suitable habitat within the SPA in which to breed. Consequently, the integrity of the site is maintained through maintenance of the Annex I qualifying habitats of the North Pennine Moors SAC, which provide suitable breeding habitat for qualifying feature of the SPA. Habitats of relevance include dry heaths, blanket bogs and grasslands.

1.4 Assessment methodologies and assumptions

Introduction

1.4.1 This SIAA has been prepared following the methodology set out in *DMRB LA 115* (Highways England, 2020)[2]. Appendix C of *DMRB LA 115* provides an example outline contents for an SIAA, which has informed the structure and content of this report. The HRA has also been carried out in accordance with *Advice Note Ten* (Planning Inspectorate, 2022)[3] and *Habitats regulations assessments: protecting a European site* (Defra and Natural England, 2021)[4].**Error! Bookmark not defined.** Plate 1-1 outlines the stages of HRA according to *DMRB LA 115* (Highways England, 2020)[2]. These stages correspond with *Advice Note Ten* (Planning Inspectorate, 2022)[3].

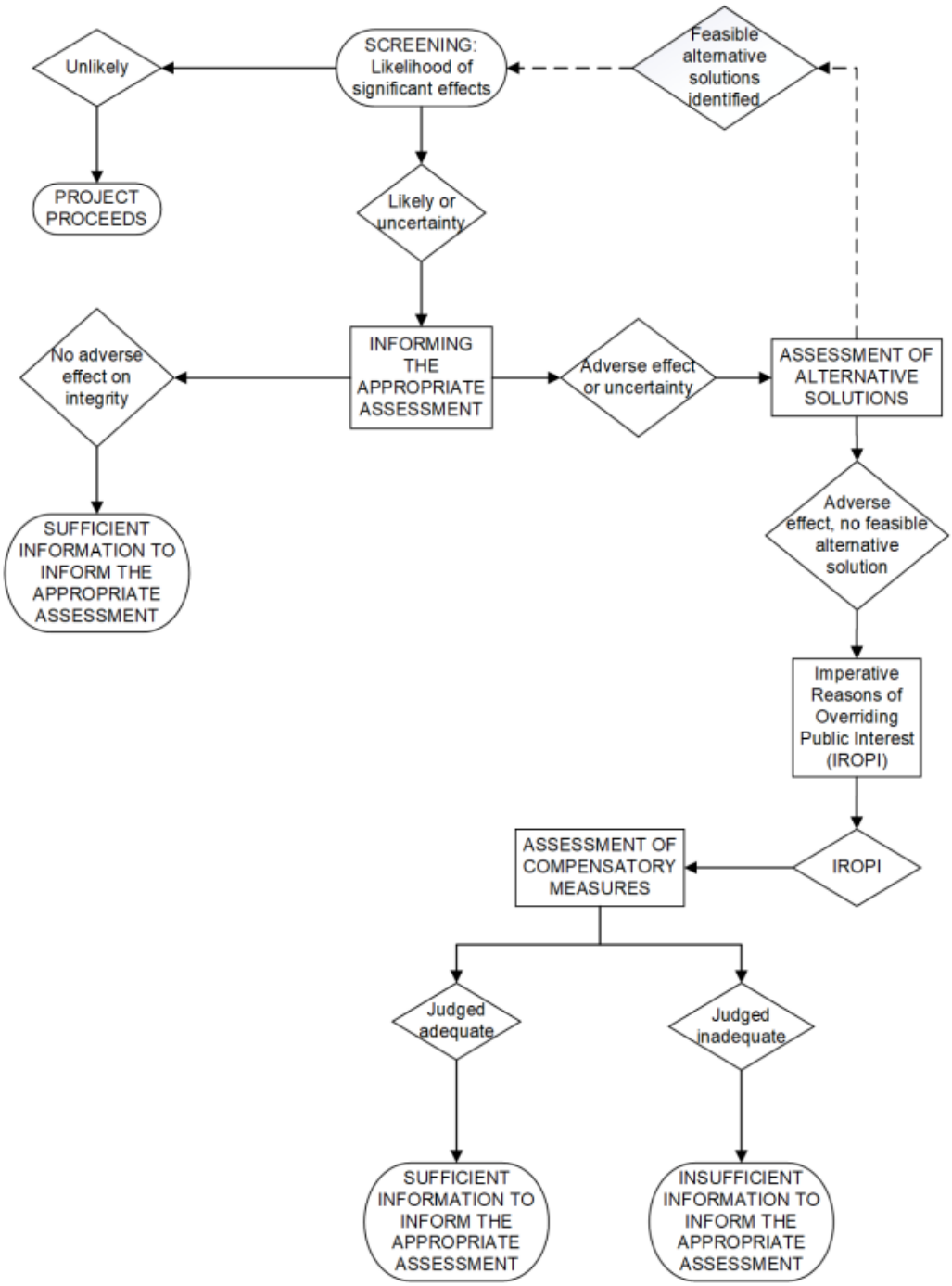


Plate 1-1: Generic HRA process. Taken from *DMRB LA 115*

1.4.2 The HRA covers the construction and operation phases of the Project. It is considered highly unlikely that the Project would be decommissioned as the road is likely to have become an integral part of the infrastructure in the area. Decommissioning would not be either feasible or desirable and therefore, no decommissioning impacts are discussed in this report.

Technical assessment methodology and assumptions

Air quality assessment

1.4.3 The potential for changes in air quality at sites screened into the appropriate assessment is underpinned by the air quality assessment (Chapter 5: Air Quality, ES Volume 1, Application Document 3.2). A full description of the methods used in the air quality assessment is provided in Chapter 5: Air Quality (Application Document 3.2) and its associated appendices.

1.4.4 Designated sites within 200m of the Project ARN were identified in line with sections 2.25 to 2.26.1 of *DMRB LA105 Air Quality* (Highways England, 2019)[9].

1.4.5 Effects at ecological receptors have been assessed in accordance with section 2.97 to 2.102 of *DMRB LA105 Air Quality* (Highways England, 2019)[9]. Receptor transects (receptor points every 10m away from the roadside) for each of the assessed designated sites up to 200m from the source have been included to allow assessment of the drop off in emissions and deposition at increasing distances from the road. All ecological receptor locations were modelled at a height of 0m.

1.4.6 NOx, NO2 and NH3 impacts from roads are unlikely to be discernible from background pollutant concentrations at distances of 200m. Pollutant concentrations from road traffic reduce rapidly from the roadside due to mixing of the plume over this distance.

1.4.7 A report published by the Defra *NO2 Concentrations and Distance from Roads* (Air Quality Consultants, 2008)[28] on the changes in NO2 concentrations with increased distance from roads, acknowledges that beyond 50m from the road, NO2 concentrations approach background levels. Therefore, at 100m or more from the road, the difference between the total concentration, including any contribution from the road, and the background concentration should be as close to zero as this will make virtually no difference.

1.4.8 The consideration of transects for the ecological assessment out to 200m from the road, represents a more precautionary approach then the 100m set out in Defra's report.

1.4.9 Whilst air quality models will show a level of change beyond 200m, this is in part due to the way the model algorithms in dispersion models work i.e. theoretical infinite end point. The actual monitoring indicates that the road component will be indiscernible from the background closer to the road than the 200m point.

1.4.10 It is important to recognise the limitations of models and to use the outputs appropriately. For instance traffic flows of less than a 1,000 Annual Average Daily Traffic (AADT) are not used in assessment as they are

[28] Air Quality Consultants (2008) NO2 Concentrations and Distance from Roads, available at: https://laqm.defra.gov.uk/documents/FallOffWithDistanceReptJuly08.pdf [accessed: 27/04/22]

below the confidence that can be attributed to a traffic model. In the same way that changes of less than 1% of NO2 (0.4µg/m³) and NOx (0.3µg/m³) are considered to be imperceptible and below the level of confidence that can be attributed to an air quality model, these are therefore not considered further in this assessment.

1.4.11 Differences in modelled NOx changes between the with and without scheme scenarios are therefore scoped out where they are less than 1% of 30µg/m³ NOx threshold for vegetation. This is the same principal applied to the assessment of both the impacts on human health and determining compliance with mandatory limit values.

1.4.12 Changes in N deposition from the model are not considered where the difference in NOX concentrations is imperceptible (as outlined above), given that this is the basis of the calculation of N deposition

1.4.13 National Highways have developed a tool to account for the additional contribution of ammonia (NH3) emissions from vehicles to deposited nitrogen. This has been used in the assessment to determine the nitrogen deposition at designated ecological sites within 200m of the ARN.

1.4.14 The assessment of likely significant effects in *DMRB LA105 Air Quality* (Highways England, 2019)[9] utilises Table 21 in *NECR21* (Natural England, 2016)[29] to determine if the change in nitrogen deposition (KgN/ha/yr) would bring about a change of a theoretical loss of one species. Table 21 is used in conjunction with other sources of information to undertake the assessment (e.g. habitat mapping and current pressures and condition of the site) to conclude on adverse effects on European site integrity.

Fluvial geomorphology assessment

1.4.15 The assessment of potential for changes in hydrology and fluvial geomorphological processes in watercourse affected by the Project is underpinned by detailed fluvial geomorphology modelling. The detailed methodology is described in ES Appendix 14.9: Detailed Geomorphological Modelling of Chapter 13: Road Drainage and Water Environment (ES Volume 3, Application Document 3.4). The modelling has been undertaken to assess the potential impacts that the Project would have on the morphological function of watercourses in the Temple Sowerby to Appleby (Trout Beck) and Appleby to Brough (Hayber Beck, Moor Beck, Eastfield Sike and Crooks Beck) schemes to support the findings of this HRA.

1.4.16 The hydraulic model was used to extract information on depths, flow and velocities and make interpretations on key geomorphological processes acting along Trout Beck (Sowerby to Appleby) and various watercourses in the Appleby to Brough scheme, which support qualifying species of the River Eden SAC and are therefore considered functionally habitats. The model was able to predict and quantify changes in fluvial geomorphological processes, flow across the floodplain, and sediment dynamics under

[29] Natural England (2016) Assessing the effects of small increments of atmospheric nitrogen deposition (above the critical load) on semi-natural habitats of conservation importance. Natural England Commissioned Report NECR210

various flood return periods. These are the supporting process which control the extent and distribution of aquatic habitats.

Hydrogeological impact assessment

1.4.17 The assessment of potential changes in groundwater quality, quantity, and hydrogeology is underpinned by the Hydrogeological Impact Assessment (HIA). The detailed methodology is described in ES Appendix 14.6: Hydrogeological impact assessment (ES Volume 3, Application Document 3.4). The HIA presents the baseline conditions of groundwater features and assesses potential impacts to groundwater flows, levels, and quality from the scheme.

Water quality assessment

1.4.18 The assessment of potential changes in surface quality and quantity is underpinned by the HIA, the Water Quality Assessment (ES Appendix 14.3: Water Quality Assessment, ES Volume 3, Application Document 3.4) and the accidental Spillage Risk Assessment (ES Appendix 14.5: Spillage Risk Assessment, ES Volume 3, Application Document 3.4). The detailed methodologies for these assessments are provided in the relevant appendices listed above.

1.4.19 The Water Quality Assessment has been conducted at the locations of existing and proposed highway drainage system outfall locations. The assessment of the potential impacts of routine runoff on surface water quality has been undertaken using the Highways England Water Risk Assessment Tool (HEWRAT) to determine whether the risk is acceptable following implementation of suitable drainage systems and mitigation measures, including the design of channel diversions.

Consideration of adverse effects on integrity

1.4.20 This SIAA focuses on the provision of evidence to enable the competent authority to ascertain that the Project will not adversely affect the integrity of European sites.

Mitigation

1.4.21 Where it cannot be concluded that there will be no adverse effects on a site's integrity, there is a need to consider potential mitigation. Mitigation measures are protective measures forming part of a project (embedded or otherwise) and are intended to avoid or reduce any direct adverse effects that may be caused by a plan or project, to ensure that it does not have an adverse effect on the integrity of a habitats site(s).

1.4.22 Government guidance (DEFRA and Natural England, 2021)[4] states that any measures used to inform the decision about the effects on the integrity need to be sufficiently secured and likely to work in practice. In the case of the DCO, measures used to inform the decision about the effects on the integrity will be secured through DCO itself, via (for example) the DCO Order Limits, Project Design Principles or Environmental Management Plan (EMP). Government guidance (MHCLG, 2019)[5], following European Court of Justice (CJEU) case law, states that measures aimed at

compensating for the negative effects of a project cannot be considered mitigation measures. The mitigation hierarchy[30] should apply and in the first instance effort should be made to avoid an adverse effect on site integrity altogether; but if this is not possible impact reduction measures should be applied. For example, this may involve:

- Switching to a less damaging method of construction
- Undertaking works at a less sensitive time of year (e.g. outside a breeding season)
- Not proceeding with some parts of the plan or project
- Incorporating additional works into the plan or project to avoid or reduce its impact.

1.4.23 In April 2018, the Court of Justice of the European Union delivered its judgment in Case C-323/17 People Over Wind & Peter Sweetman v Coillte Teoranta (European Court of Justice, 2018)[31]. The judgment clarified that when making screening decisions for the purposes of deciding whether an appropriate assessment is required, competent authorities cannot take into account any mitigation measures.

1.4.24 As a result, a competent authority may only take account of mitigation measures intended to avoid or reduce the harmful effects of a plan or project as part of an appropriate assessment itself (i.e. at Stage 2 of the HRA process, the stage presented in this Statement to Inform Appropriate Assessment report).

1.4.25 Construction mitigation is secured through the Project EMP (ES Application Document 2.7) and site-specific design mitigation, such as open span watercourse crossings at sensitive locations, are secured through the Project Design Principles (ES Application Document 5.11).

Consultation

1.4.26 Due to the programme which the Project was developed to, the Evidence Plan process (as developed by the Major Infrastructure Environment Unit (MIEU) of Defra (Major Infrastructure and Environment Unit, 2012)[32]) was identified as a tool that is potentially useful to aid consultation with key stakeholders and enhance agreements reached at the pre-application process.

1.4.27 National Highways adopted the principles of the Evidence Plan process to guide the consultation and development of the HRA for the Project, in relation to key areas of legislation and National Policy. The process has been led by the Integrated Project Team (IPT) (National Highways, their delivery partners and advisors).

[30] The mitigation hierarchy refers to a sequential process that should be adopted in order to first avoid and then mitigate and compensate negative ecological impacts and effects.
[31] European Court of Justice (2018) People Over Wind and Sweetman v Coillte Teoranta (C-323/18)
[32] Major Infrastructure and Environment Unit (2012) Evidence plans for Nationally Significant Infrastructure Projects, available at: https://www.gov.uk/government/publications/habitats-and-wild-birds-directives-evidence-plans-for-nationally-significant-infrastructure-projects [accessed: 27/04/22]

1.4.28 The process followed in the preparation of the HRA Evidence Plan was aimed at producing a non-legally binding agreement between the developer and the relevant statutory authorities and advisers, and other relevant stakeholders. This agreement aims to cover the matters to be addressed by the impact assessments undertaken, the data that will be used to support the assessments and the methodology to be applied. The agreement can also be extended to cover the outputs of the assessment and development of proposed mitigation, as appropriate.

1.4.29 An Evidence Plan is intended to be a working document that is developed by the parties involved on an on-going basis through the development of the HRA, continuing up to the point of application. The intention is for the process to be informed by the HRA scoping processes, and for it to inform and feed into the Statements of Common Ground (SoCG).

1.4.30 The Project Evidence Plan forms Appendix 1.1 of the ES (ES Volume 1, Application Document 3.4) This document provides a summary of the consultation undertaken in the TWG meetings held to date.

Other plans and projects that may act 'in combination'

1.4.31 *HRA: protecting a European site* states that if a proposal has an effect on a European site that is not significant (on its own), a check must be undertaken *as to whether there are* any other proposal*s*, planned or underway, that affect the same site, that *may act in combination with the proposal to result in a* significant effect.

1.4.32 In accordance with *Advice Note Ten* (Planning Inspectorate, 2022)[3] where there is potential for in combination effects, information should be gathered from publicly available sources and appraised for the following types of development:

- Projects that are under construction
- Permitted application(s) not yet implemented
- Submitted application(s) not yet determined
- All refusals subject to appeal procedures not yet determined
- Projects on the National Infrastructure's programme of projects
- Projects identified in the relevant development plan.

1.4.33 The in combination assessment and methods used to identify projects to assess in combination is included for the River Eden SAC from paragraph 1.5.294. As set out below, an in combination assessment is not required for either the North Pennine Moors SAC or North Pennine Moors SPA for the reasons set out below.

1.4.34 For the North Pennine Moors SAC, the only impact pathway identified was a change in air quality; the air quality assessment is inherently in combination as it considers other plans and projects when determining the future baseline (do minimum) scenario.

1.4.35 For the North Pennine Moors SPA, the only impact pathway identified was a change in air quality and potential for a reduction of habitat area and reduction of species (bird) density (as a result of changes in air quality affecting habitats used by the birds). It is considered that adverse effects

on the qualifying bird species can be ruled out (beyond reasonable scientific doubt) alone with no residual effect (see paragraph 1.7.24 to 1.7.25). As such, there is no residual effect to assess in combination.

1.5 River Eden SAC

Potential impacts on protected site

1.5.1 The following schemes were ruled out alone with no residual effects during screening: Bowes Bypass, Cross Lanes to Rokeby, Stephen Bank to Carkin Moor and A1(M) Junction 53 Scotch Corner, as these schemes are not hydrologically linked to the SAC and as such there is no credible pathway for effect, as described in the HRA Screening (ES Document Reference 3.5: Habitats Regulations Assessment Stage 1: Likely Significant Effects Report).

1.5.2 LSE(s) alone could not be ruled out for the following schemes:

- M6 Junction 40 to Kemplay Bank
- Penrith to Temple Sowerby
- Temple Sowerby to Appleby
- Appleby to Brough

1.5.3 The following sections include:

- *Desk study information* on the presence of SAC qualifying features in the SSSI units in the vicinity of the Project (i.e. the Order Limits plus a 500m buffer and/or units within which rivers crossed by the Project ultimately flow into) and the current condition of each SSSI unit according to Natural England. SSSI units within this area have been selected for the desk study as a) they provide context for habitat and species presence or absence in the vicinity of the Project and b) relevant construction activities within the SAC will occur within these units, or in functionally linked watercourses upstream of these units. This excludes units which are included as part of the air quality assessment of the River Eden SAC, which are included within Table 8: Locations where the ARN crosses the River Eden SAC or where the ARN come within 200m and associated changes in nitrogen deposition during construction and operation.
- *Baseline survey data* (Table 5: Summary of River Eden SAC baseline surveys) for SAC qualifying features in watercourses crossed by the Project.
- *Project description and potential impact pathways* associated with the construction and operation of the Project, for each scheme where LSE alone could not be rule out.

Desk study information

1.5.4 The following SSSI units occur within sections of the River Eden SAC in close proximity to the Project. They provide background on the potential for SAC qualifying species presence according to Natural England's *Designated Sites View* (Natural England, 2022)[15] and the current condition of the respective SSSI units, which form components of the SAC:

- 221 River Eamont (M6 Junction 40 to Kemplay Bank): According to Designated Sites View, this unit supports H3260 water course, white-clawed crayfish (WCC), brook lamprey, river lamprey, Atlantic salmon, bullhead and otter. The unit also supports sea lamprey (Natural England, pers. comm.). According to Natural England this unit is in Unfavourable - Recovering (07/12/2010) condition, thereby meeting the SAC conservation objective. The following comment was made by Natural England in relation to the condition assessment of this unit: "*this unit was investigated as part of the joint NE and Environment Agency (EA) River Restoration Strategy. Geomorphological studies have revealed that there are significant channel modifications that need addressing and the unit is now therefore subject to a River Restoration Plan remedy. Works on the River Restoration Strategy for the Eden are now underway elsewhere on the SSSI and there is a joint NE/EA commitment to this continuing across all failing units. Therefore, this unit is placed in recovering condition. However, this is subject to ongoing resources being available in the longer term as well as delivery of action on the ground - hence this unit is placed 'at risk'.*
- 216 River Lowther (upstream of Penrith to Temple Sowerby): According to Designated Sites View, this unit supports H3260 water course, WCC, brook lamprey, river lamprey, Atlantic salmon, bullhead and otter. According to Natural England this unit is in Unfavourable - Recovering (07/12/2010) condition.
- 222 River Eamont (Penrith to Temple Sowerby): According to Designated Sites View, this unit supports H3260 water course, WCC, brook lamprey, river lamprey, Atlantic salmon, bullhead and otter. The unit also supports sea lamprey (Natural England, pers. comm.). According to the Natural England this unit is in Unfavourable - No change (30/03/2010) condition.
- 215 River Eden (Temple Sowerby to Appleby): According to Designated Sites View, this unit supports H3260 water course, WCC, sea lamprey, river lamprey, Atlantic salmon and otter. According to the Natural England this unit is Unfavourable - Recovering (07/12/2010) condition, with the comment included above for Unit 221.
- 210 River Eden (Temple Sowerby to Appleby): This unit supports H3260 water course, WCC, sea lamprey, brook lamprey, river lamprey, Atlantic salmon, bullhead and otter. According to the Natural England this unit is Unfavourable - No Change (29/03/2010) condition.
- 211 Trout Beck and Swindale Beck (Temple Sowerby to Appleby). This unit supports H3260 water course, WCC, sea lamprey, brook lamprey, river lamprey, Atlantic salmon, bullhead and otter. According to Natural England this unit is in Unfavourable - No Change (12/01/2022) condition. The following comment was made by Natural England in relation to the condition assessment of this unit: "*this assessment has been made using data from the EA and the catchment data explorer. There has been no site visit. For the river*

habitat: Flow targets are being met - data in the EA catchment data explorer 2019 states that Water Framework Directive (WFD) high targets are being met. Phosphate targets are failing according to data received from EA in Jan 2020. Recent sediment monitoring has not been checked. This unit is included within the DWPP[33] [2014] due to its sediment issues, and whilst there is likely to have been some improvement as this is a sub catchment where CSF[34] and ERT[35] have been active, there are still some known issues. pH, Ammonia, Trophic Diatom Index and other pollutants as detailed in the CSMG[36] are all meeting WFD high targets and are therefore favourable for the SSSI. Whilst this unit was not included within the Jacobs report in 2010 that identified the most modified units within the SSSI, nevertheless there has been channel modification (straightening and river protection) particularly in the downstream end of the unit. There are also small weirs present, at least one of which is known to be impassable in dry weather. Whilst some restoration work has been done, there is further action to be carried out. Macrophyte communities have not been assessed. For the salmon: EA data from 2019, using data up to 2018 (stored on TRIM) shows that the Conservation Limit and egg deposition estimates have not been met for 4 years out of the last 5 years, therefore salmon are in unfavourable condition for the whole site. Furthermore, the trajectory for egg deposition estimates is in decline. The EA have classified the SSSI/SAC as probably at risk, now and this is also predicted in 5 years' time. Whilst, part of the decline will be due to issues at sea (which are being looked at in the national 5-point salmon plan), there are nevertheless issues that are affecting salmon in this site and unit. There are man made physical barriers to salmon migration where fish passage is not adequate, preventing salmon reaching their spawning grounds. Even where the barriers are passable there are multiple barriers where passage is possible but difficult, or not passable in certain flow conditions, and then condition of the salmon will deteriorate and there is likely to be reduced spawning success. Barriers are also hindering downstream migration of smolt. There is at least one barrier present in this unit that is impassable in drier weather. EA electrofishing data shows that there are poor to fair numbers of fry and parr. For brook lamprey, river lamprey and bullhead the CSM guidance for rivers states that the condition of this notified species should be the same as the supporting habitat. For this unit, the river is in unfavourable condition due to poor water

[33] Diffuse Water Pollution Plans (DWPP) are agreed jointly by the EA and NE as the 'remedy' for addressing failure of SSSI favourable condition as a result of diffuse water pollution.
[34] Catchment Sensitive Farming (CSF) is a joint project between Natural England, the Environment Agency & Defra, which aims to reduce diffuse water pollution from agriculture.
[35] Eden Rivers Trust.
[36] The process for setting targets that underpin the SAC conservation objectives, is described through Joint Nature conservation Committee (JNCC) approved 'Common Standards Monitoring Guidance' (CSMG). These targets are used by Natural England in assessing the condition of Natura 2000 and
SSSI protected sites

quality and modified geomorphology, therefore these species are also unfavourable. Other attributes and species have not been assessed.

- 207 River Eden (downstream of Moor Beck, Eastfield Sike, Lowgill Beck, Crooks Beck and Cringle Beck which are located within the Appleby to Brough scheme). According to Designated Sites View, this unit supports H3260 water course, WCC, sea lamprey, brook lamprey, river lamprey, Atlantic salmon and otter. The unit also supports bullhead (Natural England, pers. comm.). According to Natural England this unit is Unfavourable - No Change (29/03/2010) condition
- 205 River Eden (downstream of Moor Beck, Eastfield Sike, Lowgill Beck, Crooks Beck and Cringle Beck which are located within the Appleby to Brough scheme). According to Designated Sites View, this unit supports H3260 water course, WCC, sea lamprey, brook lamprey, river lamprey, Atlantic salmon and otter. The unit also supports bullhead (Natural England, pers. comm.). According to Natural England this unit is in Unfavourable - No Change (09/03/2022) condition.

1.5.5 Desk study electric fishing data provided by the Eden Rivers Trust indicated the presence of Atlantic salmon in the upper reaches of Moor Beck indicating that this watercourse is functionally linked to the River Eden SAC. A full fisheries desk study is included in the Fish Survey technical appendix (Environmental Statement Volume 3 (Appendices) (Application Document 3.4), Appendix 6.19: Fish Survey).

Baseline surveys

1.5.6 A summary of the findings of the ecology survey undertaken that are of relevance to the River Eden SAC and this HRA are described in Table 5: Summary of River Eden SAC baseline surveys. Survey locations are mapped in *HRA Appendix B: Freshwater Ecology Survey Locations (HRA) and Location of Natal Otter Holt*. The location of the Project schemes and ARN in relation to the River Eden SAC is shown in the *HRA Appendix A: European Designated Sites Location Plan and the* Project

1.5.7 Further detail, including full baseline survey methodologies can be found in the Environmental Statement (ES) Volume 2 (Main Report) (Application Document 3.2) and Volume 3: (Appendices) (Application Document 3.4):

- ES Appendix 6.20: Aquatic Macrophyte and River Corridor Survey
- ES Appendix 6.18: Fish Habitat Assessment and MoRPh
- ES Appendix 6.19: Fish
- ES Appendix 6.22: White Clawed Crayfish
- ES Appendix 6.16: Otter

Table 5: Summary of River Eden SAC baseline surveys

Qualifying Feature	Survey Methodology	Survey Results	ES Volume 3 (Appendices) Application Document 3.4
Watercourses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation.	• River Corridor Survey • Macrophyte (LEAFPACS)	The locations where River Corridor Survey and macrophyte survey were undertaken are shown in *HRA Appendix B: Freshwater Ecology Survey Locations (HRA) and Location of Natal Otter Holt*. Habitats meeting the description and ecological characteristics of 3260: Watercourses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation were confirmed within the following watercourses: • Trout Beck (Temple Sowerby to Appleby scheme): entire length surveyed from NGR: NY6593924042 to the confluence with the River Eden at NGR: NY6331225137 (~3.5km continuous survey, including the crossing point, ~1.5km upstream and 2km downstream to the confluence with the River Eden). Trout Beck is within the SAC boundary. • Light Water (Penrith to Temple Sowerby scheme): from NGR: NY5489728990, downstream of the existing A66 crossing, to the confluence with River Eamont and the SAC boundary at NRG: NY5545129356. Whilst this area of habitat lies outside the SAC boundary,[37] it is of note in relation to the conservation objectives for Atlantic salmon and bullhead (Atlantic salmon DNA was confirmed in Light Water) as "*vegetation structure: cover of submerged macrophytes"* is listed as a supporting process (on which the feature and/or its supporting habitat relies). Likewise, "*Headwater areas and tributaries may not fall within the site boundary, yet salmon may use these areas for spawning and juvenile development and be critical for sustaining populations within the site*". • No other watercourses surveys met the characteristics of this habitat type. One watercourse (Moor Beck) supported a single water crowfoot species (*Ranunculus aquatilis);* however this is not considered sufficient to qualify as 3260 watercourse habitat. In addition, the macrophyte expert who undertook the surveys considers Moor Beck to be to minor a watercourse to support other key indicator species of	ES Appendix 6.20: Aquatic Macrophyte and River Corridor Survey (Application Document 3.4)

[37] Light Water is located outside the SAC boundary, but is considered functionally linked due to the confirmed presence of qualifying fish species (Atlantic salmon DNA was recorded during baseline surveys).

Qualifying Feature	Survey Methodology	Survey Results	ES Volume 3 (Appendices) Application Document 3.4
		3260 habitat, even if it were in high condition. Water crowfoot was absent from all other watercourses surveyed.	
Alluvial forests with *Alnus glutinosa* and Fraxinus excelsior (*Alno-Padion, Alnion incanae, Salicion albae*)	• River Corridor Survey	This habitat type is not considered further in this HRA as LSE were ruled out at screening (ES Document Reference 3.5: Habitats Regulations Assessment Stage 1: Likely Significant Effects Report). No alluvial forest was recorded within the SAC during surveys as described in Appendix 6.20 Aquatic Macrophyte and River Corridor Survey Technical Appendix (ES Volume 3, Application Document Number 3.4,) and this habitat type is absent from the SSSI units affected by the Project (including the ARN) according to *Designated Sites View* (Natural England, 2022)[38]. The locations where River Corridor Survey and macrophyte survey were undertaken are shown in *HRA Appendix B: Freshwater Ecology Survey Locations (HRA) and Location of Natal Otter* Holt. Full results and methodologies are described in ES Appendix 6.20: Aquatic Macrophyte and River Corridor Survey (Application Document 3.4).	ES Appendix 6.20: Aquatic Macrophyte and River Corridor Survey (Application Document 3.4)
White-clawed crayfish (WCC)	• Manual search • eDNA	The locations where WCC surveys (manual search and eDNA) were undertaken are shown in *HRA Appendix B: Freshwater Ecology Survey Locations (HRA) and Location of Natal Otter Holt*. Full results and methodologies are described in ES Appendix 6.22: White Clawed Crayfish (Application Document 3.4) WCC were recorded in surveys (either during manual search and/or eDNA surveys) of the following watercourses: • Trout Beck (Temple Sowerby to Appleby scheme): whilst manual search surveys of this watercourse returned no catch, WCC DNA was recorded in a sample taken immediately downstream of the existing A66 (NGR: NY 6352125265) close to the confluence with the River Eden.	ES Appendix 6.22: White Clawed Crayfish (Application Document 3.4)

[38] Natural England (2022) Designated Site View, available at: https://designatedsites.naturalengland.org.uk/SiteSACFeaturesMatrix.aspx?SiteCode=UK0012643&SiteName=River%20Eden%20SAC [accessed: 27/04/22]

Qualifying Feature	Survey Methodology	Survey Results	ES Volume 3 (Appendices) Application Document 3.4
		• Keld Sike (Temple Sowerby to Appleby scheme): WCC DNA was recorded in this watercourse which is a tributary of Trout Beck at NGR: NY6538924682. • Unnamed Trib. of Mire Sike 6.12 (Appleby to Brough): WWC were recorded in the manual search and eDNA surveys. • Moor Beck (Appleby to Brough): WWC were recorded in the manual search and eDNA surveys. • Eastfield Sike (Appleby to Brough): WWC were recorded in the manual search and eDNA surveys. • Unnamed Trib. of Lowgill Beck 6.1 (Appleby to Brough): WWC were recorded in eDNA survey. • Lowgill Beck (Appleby to Brough): WWC were recorded in eDNA survey. • Woodend Sike (Appleby to Brough): WWC were recorded in the manual search and eDNA surveys. • Yosgill Sike (Appleby to Brough): WWC were recorded in eDNA survey. Based on the abundance categories adapted from *Monitoring the White-clawed Crayfish Austropotamobius pallipes* (Peay, 2003)[39], all sites where WCC were recorded had a low population density of WCC. On a precautionary basis, all watercourses where WCC were recorded are considered to be functionally linked to the SAC for this species, as they may provide a (potentially important) role in maintaining or restoring a protected population at, or to favourable conservation status within the SAC.	
Sea lamprey	• Electric fishing • eDNA	The locations where fish surveys (electric fishing and eDNA) were undertaken are shown in *HRA Appendix B: Freshwater Ecology Survey Locations (HRA) and Location of Natal Otter Holt*. Full results and methodologies are described in ES Appendix 6.19 Fish (Application Document 3.4).	ES Appendix 6.19 Fish (Application Document 3.4)

[39] Peay S (2003) *Monitoring the White-clawed Crayfish Austropotamobius pallipes*. Conserving Natura 2000 Rivers Monitoring Series No. 1, English Nature, Peterborough.

Qualifying Feature	Survey Methodology	Survey Results	ES Volume 3 (Appendices) Application Document 3.4
		No sea lamprey were recorded in electric fishing surveys; either during general electric fishing surveys, or the targeted juvenile (ammocoete) lamprey surveys. eDNA analysis was limited to determining presence of the genus *lampetra,* so this technique could not distinguish between the three species of lamprey present in the UK. Despite the absence of sea lamprey during electric fishing surveys, this species is assumed present, on a precautionary basis, in all rivers where river/brook lamprey were recorded. This is based on the fact that juvenile sea lamprey are considered rarer in the freshwater environments and may have been missed during survey and the fact that they have a similar life-cycle and occupy similar habitats in freshwater to river lamprey.	
Brook lamprey and River lamprey	• Electric fishing • eDNA	The locations where fish surveys (electric fishing and eDNA) were undertaken are shown in *HRA Appendix B: Freshwater Ecology Survey Locations (HRA) and Location of Natal Otter Holt*. Full results and methodologies are described in ES Appendix 6.19 Fish (Application Document 3.4).	ES Appendix 6.19 Fish (Application Document 3.4)

Qualifying Feature	Survey Methodology	Survey Results	ES Volume 3 (Appendices) Application Document 3.4
		Juvenile (ammocoete) and "transformer" stage river and brook lamprey cannot easily be disguised form one another in the field (Gardiner, 2003)[40]. River/brook lamprey were recorded during fish surveys (electric fishing and eDNA) of the following watercourses: • Trout Beck (Temple Sowerby to Appleby scheme): River / brook lamprey ammocetes, river / brook lamprey transformers or *lampetra* DNA was recorded at all sites surveyed in Trout Beck. • Moor Beck (Appleby to Brough scheme): River / brook lamprey ammocetes, river / brook lamprey transformers and *lampetra* DNA was recorded at two sites surveyed in Moor Beck. • Eastfield Sike (Appleby to Brough scheme): River / brook lamprey ammocetes, river / brook lamprey transformers and *lampetra* DNA was recorded in Eastfield Sike. • Lowgill Beck (Appleby to Brough scheme): River / brook lamprey ammocetes, river / brook lamprey transformers and *lampetra* DNA was recorded in Eastfield Sike. All watercourses where River / brook lamprey were recorded are considered to be functionally linked to the SAC for this species.	
Atlantic salmon	• Electric fishing • eDNA	The locations where fish surveys (electric fishing and eDNA) were undertaken are shown in *HRA Appendix B: Freshwater Ecology Survey Locations (HRA) and Location of Natal Otter Holt*. Full results and methodologies are described in ES Appendix 6.19 Fish (Application Document 3.4). Juvenile Atlantic salmon were recorded in surveys (electric fishing and eDNA) of the following watercourses: • Thacka Beck (M6 Junction 40 to Kemplay Bank): electric fishing only.	ES Appendix 6.19 Fish (Application Document 3.4)

[40] Gardiner R (2003). *Identifying Lamprey. A Field Key for Sea, River and Brook Lamprey*. Conserving Natura 2000 Rivers Conservation Techniques Series No. 4. English Nature, Peterborough.

Qualifying Feature	Survey Methodology	Survey Results	ES Volume 3 (Appendices) Application Document 3.4
		• Light Water (Penrith to Temple Sowerby): eDNA only. • Trout Beck (Temple Sowerby to Appleby scheme): electric fishing and eDNA. • Cringle Beck (Appleby to Brough): electric fishing only. • Moor Beck (Appleby to Brough): electric fishing and eDNA. • Eastfield Sike (Appleby to Brough): eDNA fishing only. All watercourses where Atlantic salmon were recorded are considered to be functionally linked to the SAC for this species.	
Bullhead	• Electric fishing • eDNA	The locations where fish surveys (electric fishing and eDNA) were undertaken are shown in *HRA Appendix B: Freshwater Ecology Survey Locations (HRA) and Location of Natal Otter Holt*. Full results and methodologies are described in ES Appendix 6.19 Fish (Application Document 3.4). Bullhead were recorded in surveys (manual search and eDNA) of the following watercourses: • Thacka Beck (M6 Junction 40 to Kemplay Bank): eDNA only. • Trout Beck (Temple Sowerby to Appleby): electric fishing and eDNA. • Unnamed Tributary of Mire Sike 6.12 (Appleby to Brough): electric fishing and eDNA. • Cringle Beck (Appleby to Brough): eDNA fishing only. • Moor Beck (Appleby to Brough): electric fishing and eDNA. • Eastfield Sike (Appleby to Brough): electric fishing and eDNA. • Lowgill Beck (Appleby to Brough): electric fishing and eDNA. • Woodend Sike (Appleby to Brough): eDNA fishing only (but electric fishing survey not undertaken). • Yosgill Sike (Appleby to Brough): eDNA fishing only (but electric fishing survey not undertaken). On a precautionary basis, all watercourses where bullhead were recorded are considered to be functionally linked to the SAC for this species, as they may provide a (potentially	ES Appendix 6.19 Fish (Application Document 3.4)

Qualifying Feature	Survey Methodology	Survey Results	ES Volume 3 (Appendices) Application Document 3.4
		important) role in maintaining or restoring a protected population at, or to favourable conservation status within the SAC.	
Otter	• Walkover survey • Camera trapping	Full otter survey results and methodologies are described in ES Appendix 6.16: Otter (Application Document 3.4). Evidence of otter presence was widespread within 250m of all schemes screened into this appropriate assessment (M6 Junction 40 to Kemplay Bank, Penrith to Temple Sowerby, Temple Sowerby to Appleby, Appleby to Brough) This evidence comprised spraints, prints, anal jelly, bedding, five confirmed holts, 10 unconfirmed holts, two confirmed resting sites and four unconfirmed resting sites. One confirmed natal holt was recorded under a large rock on Moor Beck (Appleby to Brough), north of Warcop Training Centre and immediately adjacent to the existing A66. Bedding and large quantities of spraint were recorded. Two cubs were recorded between June and August during camera trapping. The holt is located within the Appleby to Brough scheme footprint. The location of the natal holt is shown in *HRA Appendix B: Freshwater Ecology Survey Locations (HRA) and Location of Natal Otter Holt*.	ES Appendix 6.16: Otter (Application Document 3.4)

Project description and potential impact pathways

1.5.8 The following sections provide a summary of the Project components for each of the four schemes screened into the appropriate assessment. The construction and operation phase impact pathways identified are described on a scheme-by-scheme basis (from west to east) for ease. However, it should be noted that the appropriate assessment of the River Eden SAC considers the potential effects of the Project as a whole, as it is being delivered as a single Project. Therefore, whilst the impact pathways are identified scheme-by-scheme, the appropriate assessment considers the potential effects of the Project as a whole when considering potential for adverse effects on SAC integrity.

M6 Junction 40 to Kemplay Bank

1.5.9 The alignment and design of this scheme in the context of the SAC and functionally linked watercourses are shown in *HRA Appendix A: European Designated Sites Location Plan and the Project.*

1.5.10 A full description of this scheme is provided in Chapter 2 of the ES (ES Volume 1, Application Document 3.2). Key features of this scheme include:

- Three-lane circulatory carriageway with spiral markings, within the footprint of the current roundabout at M6 Junction 40.
- Widening of the A66 eastern arm from two to three lanes in each direction between the Junction 40 and Kemplay Bank Roundabout.
- Widening of the following five approach arms to M6 Junction 40 to provide additional lanes and a dedicated left turn facility, each controlled under its own signal phase: M6 North, M6 South, A66 East, A66 West, and A592 Ullswater Road.
- New on-slip and off-slip roads at the A6 and A686.
- New underpasses beneath Kemplay Bank Roundabout.
- The underpass off Carleton Avenue will be retained and extended to accommodate the widening of the A66.
- New signal controlled crossings for existing shared cycle/footway connections on the western side
- All existing accesses and cycleways and footways will be accommodated either through being retained or will be rerouted close by.
- Reduced speed limit to 50mph between Junction 40 and Kemplay Bank Roundabout.

1.5.11 Key features of this scheme with respect to the River Eden SAC and functionally linked watercourses include:

- Three temporary construction compound areas located between the existing A66 and the SAC boundary to the south. At their closest point the compounds are located at a distance of approximately 225m, 115m and 25m from the SAC boundary respectively.
- Three attenuation basins for the purposes of treatment of road run-off, with associated discharges to the River Eamont / River Eden SAC.

- Extension (by approximately 26m) of Thacka Beck at Carlton Hall underpass south of existing A66.
- Widening of existing cuttings and embankments.

Penrith to Temple Sowerby (03)

1.5.12 The alignment and design of this scheme in the context of the SAC and functionally linked watercourses are shown in *HRA Appendix A: European Designated Sites Location Plan and the Project*.

1.5.13 A full description of this scheme is provided in Chapter 2 of the ES (ES Volume 1, Application Document 3.2). Key features of this scheme include:

- Full dualling of the existing 5.2km length of single carriageway A66 between Penrith and Temple Sowerby. This would involve widening of the existing carriageway to form one side of the new dual carriageway and constructing the second side of the carriageway north of the existing A66.
- Removal of existing at-grade crossing points of the A66. An overpass and one underpass have been included to facilitate the safe crossing of the A66. The overbridge would serve as an agricultural access and as a Public Right of Way.
- New junction to replace the Center Parks junction.
- The existing access serving Whinfell Holme Wastewater Treatment Works would be converted to left-in/left-out.
- The existing farm buildings at High Barn would be demolished to accommodate the offline section of the A66 to the east of the new grade-separated junction. The proposals also include the demolition of the Lightwater Cottages to the south of the A66 to facilitate and accommodate a replacement left-in/left-out access to the Winderwarth Estate.

1.5.14 Key features of this scheme with respect to the River Eden SAC and functionally linked watercourses include:

- Minor extension of existing Light Water culvert; 5m of extension to the north, 3.5m extension to the south.
- One additional minor (7m in length) watercourse crossing of Light Water to the north of the A66, to enable access to the attenuation ponds for maintenance and the temporary construction effects.
- Two attenuation basins for the purposes of treating of road run-off, with associated discharges to Light Water which flows into the SAC.
- A temporary compound storage area construction compound adjacent to Light Water, south of the existing A66.
- One attenuation basin for the treatment of road run-off, with associated discharges to Unnamed Tributary of River Eamont 3.3 which flows into the SAC.
- One attenuation basin for the treatment of road run-off, with associated discharges to Unnamed Tributary of River Eamont 3.5 which flows into the SAC.
- One attenuation basin for the treatment of road run-off, with associated discharges to Swine Gill which flows into the SAC.

- The Whinfell Park Underpass which may require cutting into the underlying Penrith Sandstone in this scheme.

Temple Sowerby to Appleby (0405)

1.5.15 The alignment and design of this scheme in the context of the SAC and functionally linked watercourses are shown in *HRA Appendix A: European Designated Sites Location Plan and the Project*.

1.5.16 A full description of this scheme is provided in Chapter 2 of the ES (ES Volume 1, Application Document 3.2). Key features of this scheme include:

- A new offline bypass around the north of Kirkby Thore, and then pass to the north of Crackenthorpe parallel to the old Roman road before tying into the existing Appleby Bypass. This route would include a number of new junctions and improvements throughout its length to connect the scheme to the existing road network. The existing 8.5km A66 would be de-trunked.
- A multi-span viaduct over the Trout Beck and its floodplain.

1.5.17 Key features of this scheme with respect to the River Eden SAC include:

- A multi-span viaduct over the Trout Beck and its floodplain, consisting of seven bridge piers located in the Trout Beck floodplain; three piers located to the north of the watercourse and four located to the south.
- Temporary bridge crossing of Trout Beck to facilitate the construction of the permanent works.
- A cutting associated with the Kirkby Thore Bypass.
- Four construction compounds in close proximity to the SAC, and one that lies within the SAC boundary in the vicinity of the proposed Trout Beck crossing.
- One attenuation basin for the treatment of road run-off, with associated discharges to Unnamed Tributary of River Eden 4.0 which flows into the SAC.
- Four attenuation basins for the treatment of road run-off, with associated discharges to Trout Beck.
- One attenuation basin for the treatment of road run-off, with associated discharges to Unnamed Tributary of Trout Beck 4.6 which flows into the SAC.
- One attenuation basin for the treatment of road run-off, with associated discharges to Unnamed Tributary of Trout Beck 4.2 which flows into the SAC.
- One attenuation basin for the treatment of road run-off, with associated discharges to Unnamed Tributary of Trout Beck 4.3 which flows into the SAC.
- One attenuation basin for the treatment of road run-off, with associated discharges to Unnamed Tributary of River Eden 4.2 which flows into the SAC.
- One attenuation basin for the treatment of road run-off, with associated discharges to Unnamed Tributary of River Eden 4.3 which flows into the SAC.

Appleby to Brough

1.5.18 The alignment and design of this scheme in the context of the SAC and functionally linked watercourses are shown in *HRA Appendix A: European Designated Sites Location Plan and the Project*.

1.5.19 A full description of this scheme is provided in Chapter 2 of the ES (ES Volume 1, Application Document 3.2). Key features of this scheme include:

- Dualling an 8.3km length of single carriageway between Coupland Beck and Brough and a number of junction improvements.
- The western extent of the scheme comprises 2.6km of online widening with a new eastbound carriageway to the north of the existing carriageway. The westbound carriageway would follow the line of the existing A66. The dualled section includes junction improvements to enable access on and off the A66 to improve user safety and reduce congestion.
- De-trunking of sections of the existing A66.
- An improved left-in/left-out junction from the eastbound carriageway would be provided at Café 66.
- A new compact grade-separated junction would provide a link to the B6259 to Sandford/Warcop as well as providing links for Public Rights of Way. A new underpass is proposed to facilitate access to agricultural land on the south side of the new A66 and for footpath connectivity to be provided adjacent to Wheatsheaf Farm.
- New left-in/left-left out priority junctions at Warcop on the westbound and eastbound carriageways.
- A left-only T-junction at Langrigg with appropriate diverge and merge tapers on the westbound carriageway.
- New local roads to the south of the new A66 alignment to link with Flitholme and to the south of the new A66 from Langrigg Lane to the west to link with a new overbridge.
- Replacement underpasses at New Hall Farm, Far Bank End and Wheatsheaf Farm.

1.5.20 Key features of this scheme with respect to the River Eden SAC and functionally linked habitats include (west to east):

- Widening of the existing A66 culvert that conveys Unnamed Tributary of Mire Sike 6.12 under the road.
- Two attenuation basins for the purposes of treating of road run-off, with associated discharges to Unnamed Tributary of Mire Sike 6.12.
- New open span watercourse crossing of Cringle Beck and its floodplain.
- One attenuation basin for the purposes of treating of road run-off, with associated discharge to Cringle Beck.
- New viaducts over the Moor Beck and Cringle Beck and their associated floodplains.
- Two flood storage area adjacent to Moor Beck, north of Warcop that will fill in major flood events.
- One attenuation basin for the purposes of treating of road run-off, with an associated discharge to Moor Beck.

- Two open span bridges of Moor Beck; one upstream of the heritage railway and confluence with Eastfield Sike and a second upstream of the Warcop village access road.
- Replacement and widening the existing A66 culvert on Eastfield Sike.
- Three attenuation basins for the purposes of treating of road run-off, with associated discharge to Lowgill Beck.
- New culvert and minor channel realignment of Unnamed Tributary of Lowgill Beck 6.1.
- Extension of the existing A66 culvert at the confluence with Woodend Sike, Yosgill Sike and Lowgill Beck and minor channel realignment to shift the confluence of these watercourses slightly north and upstream of the extended culvert.
- A series of cuttings, that are typically extensions of existing cuttings, will be required in this scheme.

Affected Road Network (ARN)

1.5.21 The Project ARN in the context of the SAC and is shown in *HRA Appendix A: European Designated Sites Location Plan and the Project*.

1.5.22 The Project ARN intersects, or comes in close proximity (<200m), to the SAC at various locations. SAC qualifying habitat (3260: watercourses) within the SAC that is intersected by the ARN, or within 200m to the ARN, could be adversely affected by increased deposition of air pollutants from construction and operation of the road. Exceedance of critical values for air pollutants may modify the chemical status of its substrate, accelerating or damaging plant growth, altering its vegetation structure, and composition and causing the loss of sensitive typical species associated with it.

Identified potential impact pathways

1.5.23 This section should be read in conjunction with *HRA Appendix A: European Designated Sites Location Plan and the Project.*

Construction

Land take / resource requirements / reduction of habitat area

1.5.24 No land take is required within the River Eden SAC boundary, however shading of watercourses and associated loss of riparian and instream vegetation will occur at watercourses crossings, including Trout Beck (within the SAC). Alteration of the riparian zone will also occur associated with attenuation basins discharges, which will deliver treated runoff to watercourses through the riparian zone.

1.5.25 The M6 Junction 40 to Kemplay Bank scheme will require the extension of the existing Carlton Hall underpass; the existing culvert will be extended by approximately 26m, resulting in shading of Thacka Beck and associated loss of riparian and instream vegetation. The riparian zone of the River Eamont (part of the SAC) will also be altered as a result of the creation of three open ditch discharges which will deliver treated runoff from the three attenuation basins in the River Eamont. The ditches will discharge to the

River Eamont at the following locations: NRG: NY5089228447, NY5176928713 and NY5299929346.

1.5.26 The Penrith to Temple Sowerby scheme crosses Light Water, a tributary of the River Eamont (which forms part of the River Eden SAC). Light Water, downstream of the existing A66, conforms to habitat type 3260: Watercourses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation (hereafter referred to as 3260 watercourse habitat) and supports salmon (eDNA records only). The minor extension of the existing A66 culvert (approximately 5m of extension to the north and 5m to the south) in this location will result in shading of 3260 watercourse habitat and associated loss of riparian and instream vegetation. Alteration of riparian zone of Light Water will also occur, as a result of two open ditch discharges, which will deliver treated runoff from the two attenuation basins in the Light Water through the riparian zone.

1.5.27 The Temple Sowerby to Appleby scheme crosses Trout Beck south east of Kirkby Thore at NRG: NY6494924463. Trout Beck forms part of the River Eden SAC and flows into the River Eden south west of Kirkby Thore at NGR: NY6332625137. The entire of the surveyed section of Trout Beck (~3.5km continuous survey, including the crossing point, ~1.5km upstream and 2km downstream to the confluence with the River Eden) conforms to 3260 watercourse habitat.

1.5.28 The construction of the Trout Beck viaduct will not result in physical loss of 3260 watercourse habitat, as the viaduct piers will be set well back (a minimum of 8m from bank full bank top) from the bank top within the improved grassland / agricultural land. The viaduct will however result in a section (approximately 30m in length) of the river channel and riparian zone being shaded resulting in localised loss of riparian and instream vegetation. In the vicinity of the Trout Beck crossing, 3260 watercourse habitat is considered to constitute the river channel (bank top to bank top) as well as the riparian buffer. Whilst the floodplain beyond the riparian zone, which consists of heavily improved grassland on both banks, serves a key role in terms of supporting river process (discussed in detail later as part of the appropriate assessment), it does not form part of the 3260 watercourse habitat.

1.5.29 In addition to the impacts described for the Trout Beck crossing, there will be minor alteration of the riparian zone as a result of the four attenuation basin discharges, that will enter Trout Beck through the riparian zone.

1.5.30 Appleby to Brough This scheme involves multiple new watercourses crossings and extension, or replacement, of existing culverts that will result in shading of watercourses and associated loss of riparian and instream vegetation. No rivers surveyed in this scheme conform to 3260 watercourse habitat, however, the following rivers are considered functionally linked to the SAC as they support qualifying species (from west to east): Unnamed Tributary of Mire Sike 6.12, Cringle Beck, Moor Beck, Eastfield Sike, Unnamed Tributary of Lowgill Beck 6.1, Lowgill Beck, Woodend Sike and Yosgill Sike. In addition to shading, there will also be

localised alteration of the riparian zone as a result of the attenuation basin discharges that will enter the watercourses through the riparian zone.

Disturbance of mobile species and species fragmentation

1.5.31 During the construction phase, potential noise, vibration and lighting disturbance may impact on all SAC qualifying species (i.e. Atlantic salmon, brook lamprey, bullhead, river lamprey, sea lamprey, WCC and otter*)* as a result of works within close proximity of the river channel and river banks. Fragmentation of qualifying species populations (i.e. Atlantic salmon, brook lamprey, bullhead, river lamprey, sea lamprey, WCC and otter) may occur as a result of disturbance during the construction phase, as described above.

1.5.32 Works in the M6 Junction 40 to Kemplay Bank scheme may result in the disturbance of bullhead and otter associated with the culvert extension in Thacka Beck. There is potential for other fish species and otter to be disturbed/fragmented in the River Eamont as a result of construction activities.

1.5.33 Works in the Penrith to Temple Sowerby scheme may result in the disturbance of qualifying species (salmon and otter) associated the culvert extension in Light Water Beck. There is potential for other fish species and otter to be disturbed/fragmented in the River Eamont as a result of construction activities.

1.5.34 The construction of the Trout Beck viaduct may result in disturbance of all qualifying species as a result of works within close proximity of the river channel and river banks. Surveys indicated the presence of Atlantic salmon, brook lamprey, bullhead, river lamprey, WCC[41] and otter within Trout Beck. Fragmentation of these species may occur as a result of disturbance during the construction phase from increased noise, vibration and lighting.

1.5.35 The Appleby to Brough scheme requires the construction of numerous watercourse crossings, and the realignment of a section of one watercourse (Unnamed Tributary of Lowgill Beck 6.1). These activities could give rise to disturbance qualifying fish species and otter. Fragmentation of qualifying fish and otter may occur as a result of disturbance during the construction, as described above or through physical fragmentation as a result of temporary dewatering required for culvert extensions/replacement and river realignment.

Species mortality / injury:

1.5.36 Ground vibration as a result of construction activities, such as piling, can cause fatal injuries in fish and fish eggs/embryos. All the qualifying fish species (i.e. all lamprey species, Atlantic salmon and bullhead) are lithophilic spawners, meaning they lay their eggs in clean, oxygenated river gravels; vibration of these gravels could lead to egg/embryo mortality. In the absence of mitigation, mortality of fish eggs and embryos in spawning

[41] White-clawed crayfish were only recorded in the eDNA sample from the lower section of Trout Beck, downstream of the existing A66 crossings.

gravels as a result of vibration could have an adverse effect of the populations of, and distribution of qualifying fish species within the SAC.

Introduction and/or spread of invasive non-native species

1.5.37 Non-native species constitute a major threat to many river systems and could be introduced and/or spread during construction. Impacts may be on the river habitat itself (e.g. damage to banks and consequent siltation) or directly on characteristic biota (through predation, competition and disease), or a combination of these. Of particular relevance to the River Eden SAC are signal crayfish which have been responsible for much of the decline of native crayfish in the UK through competition, habitat damage, and the introduction of crayfish plague (*Aphanomyces astaci*) and Himalayan balsam (*Impatiens glandulifera*).

Changes in surface and groundwater quality, quantity, and hydrogeology

1.5.38 Construction activities have the potential to generate water-borne pollution (e.g. dust, fine sediment, fuels and oils) which in the absence of mitigation could give rise to an adverse effect on the qualifying features of the SAC. Construction activities, such as cutting, piling, temporary abstractions and discharges and floodplain utilisation, also have the potential to impact on the water environment through changes in surface and groundwater quality and quantity.

Changes in hydrology and fluvial geomorphological processes

1.5.39 Temporary watercourse crossings, such as that proposed to facilitate the construction of the permanent Trout Beck viaduct have the potential to alter fluvial geomorphological processes locally. This could alter habitats locally and have an adverse effect on the populations and distribution of qualifying fish.

Changes in air quality

1.5.40 The *River Eden SAC Conservation Objectives Supplementary Advice*[13] that underpins the River Eden SAC conservation objectives lists air quality as a supporting process upon which 3260 watercourse habitat relies. According to the SAC conservation objectives and the *UK Air Pollution Information System* (APIS, 2022)[42], this habitat type is considered sensitive to changes in air quality. Construction-related traffic would therefore give rise to an adverse effect at watercourse crossings. Exceedance of critical values for air pollutants may modify the chemical status of its substrate, accelerating or damaging plant growth, altering its vegetation structure, and composition and causing the loss of sensitive typical species associated with it.

Operation

Disturbance of mobile species and species fragmentation

1.5.41 During the operational phase, potential noise, vibration and lighting disturbance may impact on all qualifying species as a result of the

[42] Air Pollution Information System (APIS) (2022), available at: http://www.apis.ac.uk/select-feature?site=UK0012643&SiteType=SAC&submit=Next [Accessed 27.04.2022]

additional minor watercourse crossing of Light Water, associated with the attenuation basin maintenance access road to be located to the north of the existing A66. Watercourse crossings, if poorly designed have the potential to restrict the movement of aquatic and riparian species, both during low flow events (fish) and higher flow event (fish and otter).

Changes in surface and groundwater quality, quantity, and hydrogeology

1.5.42 In the absent of treatment road runoff during operation of the road has the potential to generate water-borne pollution (e.g. trace metals, hydrocarbons and other organic pollutants resulting from oil/petrol spills and tyre and brake wear) which, in the absence of mitigation, could enter the River Eden SAC resulting in adverse effects and qualifying features.

Changes in hydrology and fluvial geomorphological processes

1.5.43 Watercourse crossings, if poorly designed, have the potential to alter fluvial geomorphological processes in the vicinity of the crossing. This could alter habitat distribution locally and have an adverse effect of the populations, and distribution of qualifying fish species (i.e. brook lamprey, river lamprey, sea lamprey, salmon, bullhead and otter) within the SAC (Trout Beck) and watercourses which are functionally linked the SAC. Temporary and permanent floodplain utilisation also has the potential to alter key river and floodplain processes.

1.5.44 Two flood storage areas, located adjacent to Moor Beck, are required in this scheme to avoid increasing flood risk downstream in the village of Warcop. Flood storage areas could result in the deposition of sediment in the flood storage area, that would otherwise be transported downstream. This could result in alteration of the sediment regime of Moor Beck from that of the baseline conditions. In addition, fish seeking low velocity areas during flood events as refuge, may enter the flood storage area and become stranded as the flood recedes. In the absence of suitable embedded design mitigation, there is potential for the sediment regime to be altered and for fish to become stranded in the flood storage areas.

Changes in air quality

1.5.45 The *River Eden SAC Conservation Objectives Supplementary Advice*[13] that underpins the River Eden SAC conservation objectives lists air quality as a supporting process upon which 3260 watercourse habitat relies. According to this document and *APIS* (APIS, 2022),[42] this habitat type is considered sensitive to changes in air quality which could occur as a result of increased traffic during operation. Exceedance of critical values for air pollutants may modify the chemical status of its substrate, accelerating or damaging plant growth, altering its vegetation structure, and composition and causing the loss of sensitive typical species associated with it.

Summary of key potential impacts

1.5.46 Table 6: Key impact pathways, and SAC features potentially at risk from the Project and included in the appropriate assessment summarises the potential adverse effects and associated threat mechanism screened into

the appropriate assessment, and the features and Project scheme that they relate to.

Table 6: Key impact pathways, and SAC features potentially at risk from the Project and included in the appropriate assessment

Scheme	Key potential impact pathways	River Eden SAC features potentially at risk
M6 Junction 40 to Kemplay Bank	Thacka Beck culvert extension and associated loss of instream and riparian vegetation Additional discharges to the SAC and associated alteration of riparian habitats in the River Eamont Construction and operation changes in water quality	• 3260 watercourse habitat • Atlantic salmon • Bullhead • Brook lamprey • River lamprey • Sea lamprey • WCC • Otter
Penrith to Temple Sowerby	Light Water culvert extension and minor crossing and associated loss of instream and riparian vegetation Additional discharges to watercourses that ultimately flow into the SAC and associated alteration of riparian habitats Disturbance of mobile species and species fragmentation during construction	• 3260 watercourse habitat • Atlantic salmon • Bullhead • Brook lamprey • River lamprey • Sea lamprey • WCC • Otter
Temple Sowerby to Appleby	Shading of 3260 watercourse habitat resulting in loss of in stream and riparian vegetation associated with the Trout Beck viaduct Additional discharges to the SAC and associated alteration of riparian habitats in Trout Beck Additional discharges to watercourses that ultimately flow into the SAC Disturbance of mobile species and species fragmentation during construction Changes in hydrology and fluvial geomorphological processes	• 3260 watercourse habitat • Atlantic salmon • Bullhead • Brook lamprey • River lamprey • Sea lamprey • WCC • Otter

Scheme	Key potential impact pathways	River Eden SAC features potentially at risk
Appleby to Brough	Shading of functionally linked watercourses resulting in loss of in stream and riparian vegetation associated with watercourse crossings Shading of functionally linked watercourses resulting in loss of in stream and riparian vegetation associated with culvert extension New culvert and minor channel realignment of Unnamed Tributary of Lowgill Beck 6.1. Extension of the existing A66 culvert at the confluence with Woodend Sike, Yosgill Sike and Lowgill Beck and minor channel realignment to shift the confluence of these watercourses slightly north and upstream of the extended culvert. Disturbance of mobile species and species fragmentation during construction Changes in hydrology and fluvial geomorphological processes	• 3260 watercourse • habitat • Atlantic salmon • Bullhead • Brook lamprey • River lamprey • Sea lamprey • WCC • Otter
Project ARN	Construction and operation changes in air quality where Project ARN crosses the SAC	• 3260 watercourse • habitat

Appropriate Assessment

1.5.47 The appropriate assessment of potential impacts as a result of the Project on the River Eden SAC is outlined in this section.

1.5.48 The assessment draws on the following chapters and appendices of the Environmental Statement Volume 1 (Main Report) (Application Document 3.2) and Volume 3 (Appendices) (Application Document 3.4), which form part of the DCO submission:

- ES Appendix 6.20: Aquatic Macrophyte and River Corridor Survey
- ES Appendix 6.18: Fish Habitat Assessment and MoRPh
- ES Appendix 6.19: Fish
- ES Appendix 6.21: White Clawed Crayfish
- ES Appendix 6.16: Otters
- Chapter 5: Air Quality

- Chapter 14: Road Drainage and Water Environment
- ES Appendix 14.9: Detailed Geomorphological Modelling
- Chapter 12: Noise and Vibration

1.5.49 The assessment also draws from the following data sources, which do not form part of the DCO submission:

- River Eden SAC Conservation objectives and the *River Eden SAC Conservation Objectives Supplementary Advice* (Natural England, 2019)[13]
- The *APIS website* which provides information on habitat sensitivity to air pollution

Nutrient neutrality

1.5.50 The findings of this appropriate assessment have been made in light of recent caselaw. The European Court of Justice recently determined a case related to considering water quality in appropriate assessments. This is generally referred to as The Dutch Case[43].

1.5.51 In March 2022 Natural England provided Competent Authorities with advice (*Advice for development proposals with the potential to affect water quality resulting in adverse nutrient impacts on habitats sites,* Natural England 2022)[44] for development proposals that have the potential to affect water quality in such a way that adverse nutrient impacts on designated sites cannot be ruled out.

1.5.52 The advice Natural England advice highlighted that:

1.5.53 *In freshwater habitats and estuaries, poor water quality due to nutrient enrichment from elevated nitrogen and phosphorus levels is one of the primary reasons for habitats sites being in unfavourable condition*

1.5.54 Appropriate assessments should be made in light of the characteristics and specific environmental conditions of the habitats site. Where sites are already in unfavourable condition due to elevated nutrient levels, Natural England considers that competent authorities will need to carefully justify how further inputs from new plans or projects, either alone or in combination, will not adversely affect the integrity of the site in view of the conservation objectives. This should be assessed on a case-by-case basis through appropriate assessment of the effects of the plan or project. In Natural England's view, the circumstances in which a Competent Authority can allow such plans or projects may be limited.

1.5.55 Mitigation through nutrient neutrality offers a potential solution. Nutrient neutrality is an approach which enables decision makers to assess and quantify mitigation requirements of new developments. It allows new

[43] European Court of Justice (2018) Case 293/17 and C-294/17, Coöperatie Mobilisation for the Environment UA, Vereniging Leefmilieu V College van gedeputeerde staten van Limburg and Stichting Werkgroep Behoud de Peel v College van gedeputeerde staten van Noord-Brabant
[44] Natural England (2022) Advice for development proposals with the potential to affect water quality resulting in adverse nutrient impacts on habitats sites, available at: https://static1.squarespace.com/static/5f18301c875c48000cba2145/t/62386f8064b3fd465e5d55c6/1647865729238/NE+NN+Advice+16_03_2022-issue-1-final.pdf [accessed 27/04/22]

developments to be approved with no net increase in nutrient loading within the catchments of the affected habitats site. Where properly applied, Natural England considers that nutrient neutrality is an acceptable means of counterbalancing nutrient impacts from development to demonstrate no adverse effect on the integrity of habitats sites and we have provided guidance and tools to enable you to do this.

1.5.56 The Natural England advice states that:

1.5.57 A plan or project will be relevant and have the potential to affect the water quality of the designated site where:

- *It creates a source of water pollution (e.g. discharge, surface run off, leaching to groundwater etc) of either a continuous or intermittent nature or has an impact on water quality (e.g. reduces dilution) and*
- *There is hydrological connectivity with the designated site i.e. it is within the relevant surface and/or groundwater catchment and*
- *The designated sites interest features are sensitive to the water quality pollutant/impact from the plan/project.*

1.5.58 The River Eden SAC is listed in Table 2 of the Natural England advice as a site considered to be in unfavourable condition due to excessive nutrients (in the case of the River Eden SAC, this is listed as being due to phosphorous) which require an HRA and where nutrient neutrality is a potential solution to enable development to proceed.

1.5.59 *Section 4 - Plans and Projects Affected (development)* of the advice letter states that Nutrient Neutrality Methodology enables a nutrient budget to be calculated for all types of development that would result in a net increase in population served by a wastewater system. It covers all types of overnight accommodation including new homes, student accommodation, care homes, tourism attractions and tourist accommodation and permitted development (which gives rise to new overnight accommodation) under the Town and Country Planning (General Permitted Development) (England) Order 2015.

1.5.60 Annex D of the advice contains a nutrient assessment methodology decision tree (*Nutrient Assessment Methodology for Development which Generates Wastewater Decision Tree).* Question one of the decision tree asks does the development generate wastewater from overnight use? It then states that the answer is no that the nutrient assessment methodology is not applicable.

1.5.61 Whilst the potential for additional inputs of nitrogen to the River Eden SAC as a result the Project is considered fully in the appropriate assessment (in relation to air quality) when assessing adverse effects on site integrity, the Project does not include the provision of accommodation and does not require connection to the wastewater network. It is therefore considered that a nutrient neutrality assessment, which involves the calculation of population increase and the associated increase in wastewater production is not applicable to the A66 Project.

River Eden SAC

1.5.62 Features at risk:

1.5.63 Watercourses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation (3260 watercourse habitat)

- Atlantic salmon
- bullhead
- brook lamprey
- river lamprey
- sea lamprey
- WCC
- Otter

Assessment without mitigation

1.5.64 This part of the appropriate assessment considers the following potential effects on the River Eden SAC in the absence of mitigation:

- Land take / resource requirements / reduction of habitat
- Disturbance of mobile species and species fragmentation
- Species injury and mortality
- Introduction and/or spread of invasive non-native species
- Changes in surface and groundwater quality, quantity, and hydrogeology
- Changes in hydrology and fluvial geomorphological processes
- Changes in air quality.

Annex I habitat 3260: Watercourses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation.

Land take / resource requirements / reduction of habitat

1.5.65 Shading of 3260 watercourse habitat will occur as a result of the Project, associated with the Trout Beck viaduct. Baseline surveys confirmed the presence of this habitat along the entire of the surveyed section (~3.5km continuous survey, including the crossing point, ~1.5km upstream and 2km downstream to the confluence with the River Eden) of Trout Beck including the proposed crossing location.

1.5.66 The construction of the Trout Beck viaduct will not result in physical loss of 3260 watercourse habitat, as the viaduct piers will be set well back (a minimum of 8m from bank full bank top). In the vicinity of the Trout Beck crossing, 3260 watercourse habitat is considered to constitute the river channel (bank top to bank top), as well as the riparian vegetation buffer. Whilst the floodplain beyond the riparian zone, which consists of heavily improved grassland on both banks, serves a key role in terms of supporting river and floodplain processes (discussed in detail later in relation to *changes to hydrology and fluvial geomorphological processes*), it is not considered to form part of the 3260 watercourse habitat and lies outside the published SAC boundary. It should be noted that habitats beyond the site boundary are considered likely to be used by otter (the only terrestrial qualifying species of the SAC), however the presence of piers within the floodplain are not considered to adversely impact passage for this species

as described later for otter. Bridge piers will be located within areas of heavily improved grassland adjacent to the watercourse.

1.5.67 Nevertheless, there will be a loss of riparian vegetation and instream vegetation as a result of shading from the new viaduct (the area shaded by the viaduct, which will cover approximately 30m length of Trout Beck, will be approximately 0.17ha).

1.5.68 Whilst the riparian buffer is of high conservation value and is considered to form a key component of the 3260 watercourse habitat, it does not conform to 91E0 Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*) habitat, a qualifying feature of the SAC. No riparian habitats in the surveyed section of Trout Beck qualify as this habitat type, as summarised in Table 5: Summary of River Eden SAC baseline surveys and described in the ES Appendix 6.20: Aquatic Macrophyte and River Corridor Survey (Application Document 3.4).

1.5.69 In addition to the impacts described for the Trout Beck crossing, there will be localised alteration of the riparian zone as a result of the attenuation basin discharges to the River Eamont (M6 Junction 40 to Kemplay Bank) and Trout Beck (Temple Sowerby to Appleby) that will enter these SAC watercourses through the riparian zone. Where outfalls discharge to natural banks these will be designed to be open ditches (i.e. no new hard outfalls will be created). They will be designed to facilitate erosion patterns, in order to allow the natural migration of watercourses to continue. Where outfalls discharge at a location with existing hard banks, they will be designed to tie into the existing hard structure.

1.5.70 The estimated areas of 3260 watercourse habitat that will be shaded as a result of the viaduct, or altered as a result of new discharges, and the percentage of that habitat within the SSSI unit and the overall SAC are provided in Table 7: Areas of habitat shaded as a result of the proposed Trout Beck crossing and altered due to creation of attenuation basin discharges.

Table 7: Areas of habitat shaded as a result of the proposed Trout Beck crossing and altered due to creation of attenuation basin discharges

Habitat type	Impact Pathway	Area (ha)	% of SSSI unit	% of SAC
3260: Watercourses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation.	Shading by Trout Beck viaduct	0.06	0.18% of SSSI Unit 211	0.004%
3260: Watercourses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation.	Alteration of the riparian zone as a result of the attenuation basin discharges to the	0.015[45]	0.03 % of SSSI Unit 221	0.001%

[45] Precautionary estimate based on a 3m attenuation pond discharge channel, flowing through 10m of riparian zone.

Habitat type	Impact Pathway	Area (ha)	% of SSSI unit	% of SAC
	River Eamont and Trout Beck		0.02 % of SSSI Unit 211	

1.5.71 It is considered that the shading of Trout Beck associated with the viaduct, and alteration of the riparian zone of the River Eamont and Trout Beck associated with additional open ditch discharges would not give rise to an adverse effect on 3260 watercourse habitat. The area of shaded 3260 watercourse habitat represents 0.17% of SSSI Unit 211 (Trout and Swindale Becks)[46] and 0.004% of the potential surface area of this habitat within the SAC[47]. The area of riparian habitat subject to alteration as a result of the attenuation basin discharges to the River Eamont and Trout Beck represents 0.03% of SSSI Unit 221 (River Eamont) and 0.02 % of SSSI Unit 211 (Trout and Swindale Becks).

1.5.72 The changes are localised in their nature and it is considered that the shading and riparian alteration would not materially affect the structure and function of this habitat (including typical species, see later in the appropriate assessment). Areas of 3260 watercourse habitat that are naturally shaded, with no vegetation cover, are still considered part of this habitat type. The *River Eden SAC Conservation Objectives Supplementary Advice* (Natural England, 2019)[13] for 3260 watercourse state that "*between 30 and 50% riparian tree cover is generally considered optimal for in-channel and riparian habitats*. Consequently, there is no need for mitigation to be implemented.

1.5.73 ***In summary it is considered that (in the absence of any avoidance and/or mitigation measures), this will not lead to an adverse effect on this qualifying feature.***

Introduction and/or spread of invasive non-native species

1.5.74 Non-native species constitute a major threat to many river systems and in the absence of mitigation could be introduced and/or spread during construction adversely affecting 3260 watercourses within the SAC and functionally linked watercourses. The *River Eden SAC Conservation Objectives Supplementary Advice*[13] states that Himalayan balsam is abundant within the SAC and wider catchment. In places *it is* causing erosion of the banksides.

1.5.75 Himalayan balsam was shown to be absent from watercourses in the schemes included in the appropriate assessment, with the exception of Trout Beck, Tributary of River Eamont 3.3 and the River Eamont. Himalayan balsam grows in dense stands and can shade out and outcompete native species. Where it dominates riverbanks it can lead to

[46] The area of habitat impacted has been calculated as a percentage of the total potential area of 3260 watercourse within the SSSI unit 221 (34.6ha).
[47] The area of habitat impacted has been calculated as a percentage of the total potential area of 3260 watercourse within the SAC (1,573ha). This was calculated by taking the total area of the SAC (2463ha) and subtracting the area of Ullswater (890ha), which does not conform to this habitat type.

increased risk or erosion and fine sediment delivery, particularly in winter when it dies back and its shallow root system is not effective in stabilising the bare bank. Vegetation communities within the river could be affected by increased deposition of fine sediment, as could qualifying fish species using vegetation as cover habitat. The introduction of signal crayfish also has the potential to adversely affect 3260 watercourses as this species has been shown to reduce the area of aquatic plants through consumption of the plant material (Vaeben and Hollert, 2015)[48].

1.5.76 ***It is considered that (in the absence of any avoidance and/or mitigation measures), this may lead to an adverse effect on the qualifying feature.***

Changes in surface and groundwater quality, quantity, and hydrogeology

1.5.77 In the absence of mitigation construction activities and operation of the road have the potential to generate water-borne pollution (e.g. fine sediment, fuels and oils) that could give rise to an adverse effect on this feature. Construction activities, such as cutting, piling, temporary abstractions and discharges and floodplain utilisation, also have the potential to impact on the water environment through changes in surface and groundwater quality and quantity, which could give rise to an adverse effect on this qualifying feature. A cutting is proposed in the Appleby to Brough scheme, north of Trout Beck and a series of cuttings, that are typically extensions of existing cuttings, will be required in the Appleby to Brough scheme. There is potential for these cuttings to disturb groundwater flow paths, altering the quality and quantity of water entering Trout Beck and other functionally linked watercourse. Temporary and permanent floodplain utilisation has the potential to alter key river and floodplain processes. The vegetation communities associated with this feature and the supporting processes on which the habitats rely could be affected by increased silt deposition, diffuse and point source waterborne pollution.

1.5.78 ***It is considered that (in the absence of any avoidance and/or mitigation measures), this may lead to an adverse effect on the qualifying feature.***

Changes in hydrology and fluvial geomorphological processes

1.5.79 Watercourse crossings, if poorly designed, have the potential to alter fluvial geomorphological processes locally and the supporting processes on which this habitat relies. The natural flow regime both shapes and sustains characteristic biotope mosaics, affecting factors such as current velocities and bed hydraulics, water levels and depths, wetted area, temperature regime and dissolved oxygen regime. Structures which have an impoundment affect thereby have the potential to change the natural flow and sediment regime. The *River Eden SAC Conservation Objectives Supplementary Advice* (Natural England, 2019)[13] states that the natural

[48] Vaeben, S., Hollert, H. (2015) Impacts of the North American signal crayfish (*Pacifastacus leniusculus*) on European ecosystems. *Environ Sci Eur* 27, 33

flow regime of the River Eden has been altered by many in channel structures which have an impoundment affect thereby changing the natural flow regime.

1.5.80 ***It is considered that (in the absence of any avoidance and/or mitigation measures, in this case*** *suitable watercourse crossing design****), this may lead to an adverse effect on the qualifying feature.***

Changes in air quality

1.5.81 The screening exercise identified that air quality effects associated with the construction and operation the road could compromise the *River Eden SAC Conservation Objectives Supplementary Advice* (Natural England, 2019)[13] in relation to 3260 watercourse habitat within 200m of the ARN.

1.5.82 The ARN, as shown in *HRA Appendix A: European Designated Sites Location Plan and the Project*, extends beyond the DCO Order Limits and intersects, or comes in close proximity (<200m), to the SAC at various locations. *River Eden SAC Conservation Objectives Supplementary Advice* (Natural England, 2019)[13] lists air quality as a supporting process upon which this 3260 watercourse habitat relies, and this habitat type is considered sensitive to changes in air quality. Exceedance of critical values for air pollutants may modify the chemical status of its substrate, accelerating or damaging plant growth, altering its vegetation structure, and composition and causing the loss of sensitive typical species associated with it. The *River Eden SAC Conservation Objectives Supplementary Advice* (Natural England, 2019)[13] sets a target of maintaining or restoring the appropriate concentrations and deposition of air pollutants to at, or below, the site-relevant Critical Load or Level values indicated on APIS. However, *APIS* (APIS, 2022)[42] states that there are no critical loads available for this feature.

1.5.83 The locations where the ARN intersects, or comes in close proximity (<200m), to the SAC are outlined in Table 8: Locations where the ARN crosses the River Eden SAC or where the ARN come within 200m and associated changes in nitrogen deposition during construction and operation. A review of the SSSI units using the *Designated Sites View* (Natural England, 2022)[38] was undertaken to confirm whether 3260 watercourses habitat and/or 91E0 alluvial forest was listed as present within the unit. If 3260 watercourses habitat and/or 91E0 was confirmed present in the SSSI unit it was assumed to be present at the crossing location and was subject to assessment.

1.5.84 Based on *Designated Sites View* (Natural England, 2022)[38], 3260 watercourses habitat was confirmed present at all crossing locations within the SAC; 91E0 alluvial forest was confirmed to be absent within all SSSI units (Table 8).

1.5.85 In the absence of a critical load values for 3260 watercourse habitat, the air quality assessment presents nitrogen deposition as a percentage change from baseline and the change in nitrogen deposition (kg N/ha/yr) from a single point immediately adjacent to the road.

1.5.86 Table 8: Locations where the ARN crosses the River Eden SAC or where the ARN come within 200m and associated changes in nitrogen deposition during construction and operation presents the % change in nitrogen deposition rate from do minimum (future baseline without the Project) and do something (future baseline with the Project) at locations where the ARN crosses the River Eden SAC or where the ARN comes within 200m.

1.5.87 The Project results in an increase in nitrogen deposition in some locations within 200m of the ARN and a reduction in others, as shown Table 8: Locations where the ARN crosses the River Eden SAC or where the ARN come within 200m and associated changes in nitrogen deposition during construction and operation.

1.5.88 The modelling predicts perceptible changes in nitrogen deposition at only two locations where the ARN crosses the SAC during construction; at River Eamont (A66 at Castle Bridge) upstream, where a 1.64% (0.22 kgN/ha/yr) increase is predicted and at Trout Beck (A66 proposed new crossing) downstream, where a 1.18% (0.160.22 kgN/ha/yr) increase is predicted. No perceptible change in nitrogen deposition is predicted at any other locations the ARN crosses, or comes within 200m, of the SAC during construction.

1.5.89 During operation the most significant changes, as expected, are associated with the existing and proposed crossing of Trout Beck. A significant decrease in nitrogen deposition is predicted by the model at the existing A66 Trout Beck crossing as traffic follows the proposed offline section. A reduction in nitrogen deposition of -60.00% (-8.16 kgN/ha/yr) and -50.76 (-6.90 kgN/ha/yr) is predicted by the model upstream and downstream of the existing A66 crossing respectively.

1.5.90 A significant increase in nitrogen deposition is predicted by the model at the proposed new A66 Trout Beck crossing. An increase in nitrogen deposition of 31.12% (4.23 kgN/ha/yr) and 30.21% (4.11 kgN/ha/yr) is predicted by the model upstream and downstream of the propsed A66 crossing respectively.

1.5.91 Elsewhere increases in nitrogen deposition ranging from 1.66% (0.23 kgN/ha/yr) at River Belah (A685 at Belah Bridge) upstream, to 8.94% (1.22 kgN/ha/yr) at River Eden (A66 at Oglebird) downstream, are predicted by the model as a result of changes in traffic flow.

Table 8: Locations where the ARN crosses the River Eden SAC or where the ARN come within 200m and associated changes in nitrogen deposition during construction and operation

Watercourse	SSSI Unit	Location	3260 habitat present	% change in deposition rate from do minimum (construction)	Maximum change in nitrogen deposition (kgN/ha/yr) (construction)	% change in deposition rate from do minimum (operation)	Maximum change in nitrogen deposition (kgN/ha/yr) (operation)
River Eamont (A66 at Castle Bridge) upstream	222	NY5397229144	✓	1.64%	0.22	3.40%	0.46
River Eamont (A66 at Castle Bridge) downstream	222	NY5394529131	✓	imperceptible	imperceptible	8.45%	1.15
River Eden (A66 at Oglebird) upstream	210	NY6039227418	✓	imperceptible	imperceptible	8.32%	1.13
River Eden (A66 at Oglebird) downstream	210	NY6041327428	✓	imperceptible	imperceptible	8.94%	1.22
Trout Beck (A66 existing crossing) upstream	211	NY6354725304	✓	imperceptible	imperceptible	-60.00%	-8.16
Trout Beck (A66 existing crossing) downstream	211	NY6353825296	✓	imperceptible	imperceptible	-50.76	-6.90
Trout Beck (north of A66) within 200m	211	NY6464724482	✓	imperceptible	imperceptible	-3.65%	-0.50
Trout Beck	211	NY6497624474	✓	imperceptible	imperceptible	31.12%	4.23

Watercourse	SSSI Unit	Location	3260 habitat present	% change in deposition rate from do minimum (construction)	Maximum change in nitrogen deposition (kgN/ha/yr) (construction)	% change in deposition rate from do minimum (operation)	Maximum change in nitrogen deposition (kgN/ha/yr) (operation)
(A66 proposed new crossing) upstream							
Trout Beck (A66 proposed new crossing) downstream	211	NY6495624460	✓	1.18%	0.16	30.21%	4.11
River Eden (south of A66 at Chapel Wood) within 200m	207	NY6698921691	✓	imperceptible	imperceptible	-2.74%	-0.37
Coupland Beck (A66 at Coupland) upstream	208	NY7099318850	✓	imperceptible	imperceptible	8.60%	1.17
Coupland Beck (A66 at Coupland) downstream	208	NY7096318839	✓	imperceptible	imperceptible	7.06%	0.96
River Belah (A685 at Belah Bridge) upstream	204	NY7928112064	✓	imperceptible	imperceptible	1.66%	0.23
River Belah (A685 at Belah Bridge) downstream	204	NY7926612060	✓	imperceptible	imperceptible	1.69%	0.23

1.5.92 When considering the results of the air quality modelling it should be noted that whilst change in deposition rate is a useful metric to understand the net increase in pollutants in the air, this metric is less applicable to this aquatic habitat type. Aquatic plants, that are a component of the 3260 watercourse habitat vegetation community, are submerged for the majority of the year due to their growth form, consequently they are regularly inundated and flushed during modest flood events. Based on the air modelling for other designated sites within 200m of the Project ARN, where transects have been modelled, there is potential for the increases in nitrogen deposition to extend as far as 60m from the road. Assuming a worst case scenario, where impacts extend 60m, there is potential for 3260 watercourses to receive increased nitrogen deposition up to 60m from the road.

1.5.93 The local contributions to nitrogen deposition (kg N/ha/yr) for the River Eden SAC from sources (UK) shows that the largest contributor is livestock (56.4% 8.81kgN/ha/yr). The remaining sources of contribution (e.g. Europe import, fertiliser application) identified, which are unrelated to road transport, equate to 38.2%. Nitrogen deposition in relation to road transport is the smallest identified source of 4.0% 0.63kgN/ha/yr (APIS, 2022[49]). Based on this, it is considered that any increase in nitrogen deposition as a result of the Project, even a significant increase (i.e. over >1000 Annual Average Daily Traffic or >200 Heavy Duty Vehicles will not make a considerable impact on the overall source of nitrogen deposition that the SAC currently receives from various other sources.

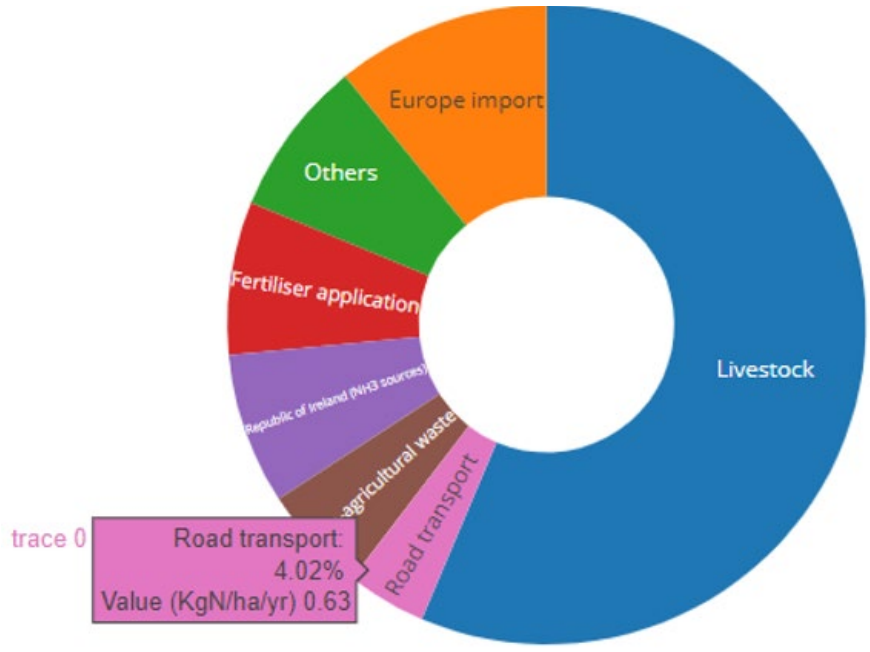


Plate 1-2: Contributions to Nitrogen deposition (KgN/ha/yr) for the River Eden SAC (accessed 27/04/22) from sources (UK)

[49] Air Pollution Information System (APIS) Designates Sites App (River Eden SAC), available at: http://www.apis.ac.uk/app [accessed: 27/04/22]

1.5.94 As discussed, *APIS* (APIS, 2022)[42] states that there are no critical loads available for 3260 watercourse habitat. Where insufficient information is available, the air quality attribute has been set to 'restore', as acknowledged in *LA 105 Air Quality* (Highways England, 2019)[9]. The conservation objective is therefore to restore (rather than maintain) the qualifying features.

1.5.95 In the *Habitats Regulations Assessment Handbook* (Tyldesley and Chapman, 2013)[50] the integrity test is considered to be *'the coherence of its ecological structure and function across its whole area, that enables it to sustain the habitat, complex of habitats and/or the levels of populations of the species which the site is (or will be) designated*'

1.5.96 An increase in nitrogen deposition was only predicted at two locations where the ARN interacts with the SAC during construction; this potential effect is considered temporary and localised (up to 60m upstream and downstream of the road).

1.5.97 An increase in nitrogen deposition was predicted at five locations where the ARN interacts with the SAC during operation; this potential effect is considered localised (up to 60m upstream and downstream of the road).

1.5.98 Whilst it is acknowledged that an increase in nitrogen deposition conflicts with the conservation objectives to restore the site, the contribution of nitrogen from road transport in the context of other catchment nitrogen sources (as discussed above) is modest, especially when considering the fact that aquatic plants are submerged for most of the year and where they are exposed they are regularly flushed with river water. The potential impacts are localised (limited to 60m from the road as a worst case assumption) and therefore, it is considered that nitrogen deposition would not result in an adverse effect on this feature within the respective SSSI units.

1.5.99 ***In summary, it is considered (beyond reasonable scientific doubt) that there will be no adverse effect on these qualifying habitats. Consequently, there is no need for mitigation to be imposed.***

Atlantic salmon, bullhead and lamprey species

1.5.100 Atlantic salmon are anadromous[51] migrants. The timing of upstream migrations ('salmon runs') is not as strongly seasonal as in lamprey and there is thought to have been a decline in spring migrations over recent decades (Hendry and Cragg-Hine, 2003)[52]. Adults spawn in 'redds', comprising excavated depressions in the river gravels. Spawning takes place in the winter (October - January), with the eggs hatching the following spring. Spawning typically takes place in clean, gravel-dominated substrates. In addition to the upstream migration of adult fish, the

[50] Tyldesley, D., and Chapman, C., (2013) The Habitats Regulations Assessment Handbook, November 2018 edition UK: DTA Publications.
[51] anadromous describes fish born in freshwater who spend most of their lives in the marine environment and return to freshwater to spawn.
[52] Hendry, K., & Cragg-Hine, D. (2003) Ecology of the Atlantic Salmon. Conserving Natura 2000 Rivers Ecology Series No. 7. English Nature, Peterborough.

downward migration of smolt (typically two-year-old fish but could be as old as four) occurs between April and June.

1.5.101 Bullhead are generally considered to be relatively sedentary and non-migratory, although they have been recorded making migrations of up to 260m (Knaepkens et al., 2004)[53]. They will inhabit a wide range of habitats, typically favouring stony substrates. Spawning takes place between February and June, with the males creating a nest under a stone or other piece of debris, to which they attempt to attract females (Tomlinson and Perrow, 2003)[54].

1.5.102 Sea and river lamprey are anadromous migrants, with adults inhabiting marine and estuarine habitats, before migrating upstream to spawn in gravel substrates. Brook lamprey do not migrate to sea and their entire life cycle is within freshwater, although localised upstream movements to find suitable spawning sites are thought to occur (Maitland PS., 2003)[55]. Sea lamprey spawning migration in Europe usually takes place in April and May when the adults migrate back into fresh water; spawning usually occurs, in clean gravels in late May or June in British rivers, when the water temperature reaches at least 15ºC. Mature river lamprey migrate upstream at night during winter and early spring when conditions are suitable, hiding under stones and vegetation during the day. Spawning in British rivers starts when the water temperature reaches 10–11ºC, usually in March and April. Brook lamprey spawning season in British rivers starts when the water temperatures reach 10–11ºC in April and May (having metamorphosed from July in the previous year). The young off all three lamprey species live in freshwater silt beds and are largely sedimentary for about 6.5 years.

1.5.103 Habitats suitable for all life stages (larval, juvenile, adult) of lamprey, salmon and bullhead have been recorded within the study area and in close proximity to the proposed works and watercourse crossings, as outlined the ES Appendix 6:18 Fish Habitat Assessment and MoRPh (Application Document 3.4). In addition, fish surveys (electric fishing and eDNA) have confirmed the presence of some/or all these species in Thacka Beck, Light Water, Trout Beck, Unnamed Tributary of Mire Sike 6.12, Cringle Beck, Moor Beck, Eastfield Sike, Lowgill Beck, Woodend Sike and Yosgill Sike, as summarised in Table 5: Summary of River Eden SAC baseline surveys and presented in detail in the ES Appendix 6.19: Fish (Application Document 3.4). These watercourses are therefore considered to be functionally linked to the SAC. According to Natural England, the term ‘functional linkage’ refers to the role or ‘function’ that land or sea beyond the boundary of a European site might fulfil in terms of supporting the populations for which the site was designated or classified. Such an area of

[53] Knaepkens, G., Bruyndoncx, L. and Eens, M., 2004. Assessment of residency and movement of the endangered bullhead (Cottus gobio) in two Flemish rivers. Ecology of Freshwater Fish, 13(4), pp.317-322.
[54] Tomlinson, M.L., & Perrow, M.R. (2003). Ecology of the Bullhead. Conserving Natura 2000 Rivers Ecology Series No. 4. English Nature, Peterborough.
[55] Maitland, P.S. (2003) Ecology of the River, Brook and Sea Lamprey. Conserving Natura 2000 Rivers Ecology Series No. 5. English Nature, Peterborough.

land or sea is therefore 'linked' to the site in question because it provides a (potentially important) role in maintaining or restoring a protected population at favourable conservation status (Chapman, C. & Tyldesley, D., 2016)[56].

Land take / resource requirements / reduction of habitat area

1.5.104 A reduction in habitat area for fish has been minimised through sensitive watercourse crossing design, where open span structures have been designed to safeguard instream habits and natural river process.

1.5.105 Table 9: Proposed watercourse crossings of the SAC and functionally linked habitats shows the proposed crossing details. The majority (five out of six) of the new watercourse crossings are open span (either viaducts or open span bridges) and will not result in a reduction in habitat area for fish within the SAC (Trout Beck) or functionally linked watercourses in Appleby to Brough.

1.5.106 New watercourse crossings of Cringle Beck, Moor Beck 1, Moor Beck 2 and Moor Beck 3 (functionally linked) in the Appleby to Brough scheme will be open span resulting in no in channel habitat loss. This design feature (open span watercourse crossing design), that has minimised the potential for a reduction of habitat area, is secured through the Project Design Principles (ES Application Document 5.11), which is a certified document under the DCO.

1.5.107 Unnamed Tributary of Mire Sike 6.12, Eastfield Sike, Woodend Sike and Yosgill Sike will be subject to culvert extension, whilst a new culvert to convey Unnamed Tributary of Lowgill Beck 6.1 will be required (note that this watercourse is minor; eDNA surveys demonstrate that this watercourse supports WCC but no qualifying fish species).

1.5.108 Culverts, if poorly designed, could result in a direct reduction of fish habitat area, or alteration of fish habitat, in the vicinity of the watercourse crossing locations. Indirect reduction of fish habitat area or alteration of fish habitat associated with changes in hydrology and fluvial geomorphological processes related to new crossings are discussed further below. Shading and the loss of riparian and in channel habitat as a result of culvert extension will occur in rivers functionally linked to the SAC.

1.5.109 ***It is considered that (in the absence of any avoidance and/or mitigation measures), this may lead to an adverse effect on qualifying fish species.***

Disturbance of mobile species and species fragmentation

1.5.110 Disturbance of mobile lamprey, salmon and bullhead in Trout Beck and functionally linked watercourses could occur during the construction phase, as a result of potential noise, vibration and lighting as a result of works within close proximity of the river channel and river banks. Physical disturbance of migration routes could also occur as a result of temporary

[56] Chapman, C. and Tyldesley, D. (2016) Functional linkage: How areas that are functionally linked to European sites have been considered when they may be affected by plans and projects - a review of authoritative decisions. Natural England Commissioned Reports, Number 207.

dewatering and/or over-pumping. These activities could give rise to an adverse effect on these species, by disturbing migrating fish during the periods set out above, or individuals using habitats adjacent the works. Delayed or disturbed spawning migration could give rise to an adverse effect on recruitment, which could affect the populations of lamprey, salmon and bullhead, and their distribution within the site.

1.5.111 ***It is considered that (in the absence of any avoidance and/or mitigation measures), this may lead to an adverse effect on qualifying fish species.***

Species injury and mortality

1.5.112 Vibration can cause damage or mortality of eggs and embryos in spawning gravels, which could have an adverse effect on the populations of lamprey, salmon and bullhead, and their distribution within the site. Ground vibration is measured in terms of Peak Particle Velocity (PPV) in the unit of mm/s. The PPV threshold beyond which damage to fish eggs and embryos in fish spawning habitat occurs varies within the scientific literature. Blast simulation data indicate that PPV causing 10% mortality in salmon eggs (considered the most sensitive salmonid egg to vibration impact) ranged from 145mm/s to 838 mm/s (Jenson, 2003)[57]. However, the guidelines for the use of explosives in or near Canadian fisheries waters (Wright and Hopky 1998)[58] recommend a far lower threshold of no greater than 13 mm/s in a spawning bed during the period of egg incubation. This threshold of 13 mm/s was also provided by the Environment Agency during written consultation on the assessment approach for this Project. A vibration assessment of key risk areas (i.e. sections of watercourses with potential spawning habitat adjacent to proposed high vibration construction activities) was undertaken to inform potential mitigation requirements in relation to vibration effects on fish eggs/embryos. The assessment results are outlined in Table 4 and Table 5 of Appendix 12.6 of ES Chapter 12: Noise and Vibration (Application Document 3.4) and discussed later in the appropriate assessment as part of the assessment with mitigation. In the absence of mitigation there is considered to be potential for damage or mortality of eggs and embryos in spawning gravels.

1.5.113 Dewatering associated with river realignment could give rise to an adverse effect on lamprey, salmon and bullhead through stranding and suffocation, or entrainment into the pumping arrangement used during dewatering. Entrainment of lamprey, salmon and bullhead into pumps could be associated with temporary abstractions for construction activities. In the absence of any avoidance and/or mitigation measures, this may lead to an adverse effect on the integrity of the SAC.

1.5.114 ***It is considered that (in the absence of any avoidance and/or mitigation measures), species injury and mortality arising from***

[57] Jensen, J.O.T. (2003) New mechanical shock sensitivity units in support of criteria for protection of salmonid eggs from blasting or seismic disturbance. Fisheries & Oceans Canada, Pacific Region, Science Branch, Pacific Biological Station.
[58] Wright, D.G. and Hopky, G.E. (1998) Guidelines for the use of explosives in or near Canadian fisheries waters. Fisheries and Oceans Canada.

vibration and pumping activities may lead to an adverse effect on qualifying fish species.

Introduction and/or spread of invasive non-native species

1.5.115 The introduction and/or spread of invasive non-native flora and fauna and associated pathogens/disease could give rise to an adverse effect on lamprey, salmon and bullhead. Bullhead populations are thought to be vulnerable to predation and competition from non-native signal crayfish, however there is little information concerning interactions between signal crayfish and salmon[59]. Introduction and/or spread Himalayan balsam is also of particular concern, as in areas where this species dominates the bank side vegetation assemblage, increased soil erosion can occur as rotting balsam roots leave river banks exposed. This can result in siltation of the riverbed, smothering fish spawning gravels and suffocating fish eggs and aquatic invertebrates. This could give rise to an adverse effect on recruitment and food source, which could affect the populations of lamprey, salmon and bullhead, and their distribution within the site.

1.5.116 ***It is considered that (in the absence of any avoidance and/or mitigation measures), this may lead to an adverse effect on qualifying fish species.***

Changes in surface and groundwater quality, quantity, and hydrogeology

1.5.117 In the absence of mitigation, construction activities and operation of the road have the potential to generate water-borne pollution (e.g. fine sediment, fuels and oils) which could give rise to an adverse effect on qualifying fish species. Construction activities such as cutting, piling, temporary abstractions and discharges and floodplain utilisation, also have the potential to impact on the water environment through changes in surface and groundwater quality and quantity, which could give rise to an adverse effect on qualifying fish species. A cutting is proposed in the Appleby to Brough scheme, north of Trout Beck and a series of cuttings, that are typically extensions of existing cuttings, will be required in Appleby to Brough scheme. There is potential for these cuttings to disturb groundwater flow paths, altering the quality and quantity of water entering Trout Beck and other functionally linked watercourse. Spawning gravel and coarser refuge habitat use by qualifying fish species could be affected by increased silt deposition and diffuse and point source waterborne pollution.

1.5.118 ***It is considered that (in the absence of any avoidance and/or mitigation measures), this may lead to an adverse effect on the qualifying fish species.***

[59] Marine Scotland Topic Sheet No.15 (v1). Signal crayfish – an unwelcome addition to Scottish streams, available at https://www.gov.scot/binaries/content/documents/govscot/publications/factsheet/2019/11/marine-scotland-topic-sheets-freshwater/documents/signal-crayfish---an-unwelcome-addition-to-scottish-streams-updated-october-2016/signal-crayfish---an-unwelcome-addition-to-scottish-streams-updated-october-2016/govscot%3Adocument/signal-crayfish.pdf [accessed: 27/04/22]

Changes in hydrology and fluvial geomorphological processes

1.5.119 Altered hydrology and fluvial geomorphological processes as a result of poorly designed watercourse crossings, both within the SAC (Trout Beck) and functionally linked watercourses, could give rise to an adverse effect on lamprey, salmon and bullhead and their habitat. Temporary and permanent floodplain utilisation has the potential to alter key river and floodplain processes. Culverts and artificial bed material associated with bridges have the potential to restrict the movement of lamprey, salmon and bullhead, either physically under low flow conditions (due to insufficient water depth) and/or under high flows condition (due to flow velocities that are beyond the swimming capability of the fish). In addition, habitat within the vicinity of watercourse crossings could be adversely affected by altered hydrology and associated fluvial geomorphological processes, such as changes in erosion and scour, sediment transport and deposition/siltation. Shading and the associated loss or riparian vegetation also has the potential to adversely affect the fluvial geomorphological processes. Two flood storage areas, located adjacent to Moor Beck, are required in the Appleby to Brough scheme to avoid increasing flood risk downstream in the village of Warcop. Poorly designed flood storage areas could result in the deposition of sediment (in the flood storage area), that would otherwise be transported downstream. This could result in alteration of the sediment regime of Moor Beck, and the SAC downstream, from that of the baseline conditions.

1.5.120 The *River Eden SAC Conservation Objectives Supplementary Advice*[13] states that "*natural levels of coarse sediment supply are critical to the maintenance of high quality juvenile and salmon habitat, maintaining spawning gravels and characteristic biotope mosaics*" and "*coarse sediment supply is essential for the stability of the river channel and for creating and sustaining key biotopes including riffles and exposed shingle banks. Coarse sediment supply can be interrupted by weirs and other impounding structures, and by dredging or extraction, and can result in channel incision and heavy bankside erosion that have consequences for both biodiversity and river management (e.g. flood risk)*". The advice note also states that given (the River Eden SAC) "*is not a whole river SAC and a significant proportion of the upper catchment is outside of the SAC boundary. These areas are known to generate a significant amount of sediment which in turn impacts upon and adds to that generated within the SAC".*

1.5.121 In addition to the potential for alteration of the sediment regime, fish seeking low velocity areas during flood events as refuge, may enter the flood storage area and become stranded as the flood recedes. In the absence of suitable embedded design mitigation, there is potential for the sediment regime to be altered and for fish to become stranded in the flood storage areas.

1.5.122 The conservation objectives list "*biological connectivity*", "*flow regime*", "*riparian zone*", "*sediment regime*" and "*integrity of off-site habitats*" as supporting processes on which qualifying fish rely. In the absence of suitable embedded design mitigation, new watercourse crossings, the

extension of existing culverts and the addition of offline flood storge areas, has the potential to undermine these attributes.

1.5.123 The estimated lengths of functionally linked river habitat that support one or more qualifying species that will be shaded and potentially subject to fluvial geomorphological change locally are provided in Table 9: Proposed watercourse crossings of the SAC and functionally linked habitats. Note that with the exception of Trout Beck, these watercourses do not conform to 3260 watercourse habitat and are not located within the SAC boundary, but are considered functionally linked to the SAC. ***In summary, it is considered that (in the absence of any avoidance and/or mitigation measures), changes in hydrology and fluvial geomorphological processes may lead to an adverse effect on qualifying fish species***.

Table 9: Proposed watercourse crossings of the SAC and functionally linked habitats

Watercourse	Crossing type	Impact Pathway	Length of channel shaded (m)
Trout Beck	Open span viaduct (new crossing) with piers set back a minimum of 8m from bank full bank top	Shading and potential fluvial geomorphological change as a result of the new viaduct that crosses the watercourse and floodplain	30
Unnamed Tributary of Mire Sike 6.12	Existing culvert - extension	Shading and potential fluvial geomorphological change as a result of existing culvert extension	58
Cringle Beck	Open span viaduct (new crossing) with abutments set back a minimum of 8m from bank full bank top	Shading and potential fluvial geomorphological change as a result of the new viaduct that crosses the watercourse and floodplain	30
Moor Beck 1	Open span viaduct (new crossing) with abutments set back a minimum of 8m from bank full bank top	Shading and potential fluvial geomorphological change as a result of the new viaduct that crosses the watercourse and floodplain	65
Moor Beck 2	Open span bridge (new crossing) with abutments set back a minimum of 8m from bank full bank top	Shading and potential fluvial geomorphological change as a result of the new open span bridge that crosses the watercourse and floodplain	22
Moor Beck 3	Open span bridge (new crossing) with abutments set back a minimum of 8m from bank full bank top	Shading and potential fluvial geomorphological change as a result of the new open span bridge that crosses the watercourse and floodplain	19
Eastfield Sike	Existing culvert - extension	Shading and potential fluvial geomorphological change as a result of the new open span bridge	31

Watercourse	Crossing type	Impact Pathway	Length of channel shaded (m)
		that crosses the watercourse and floodplain	
Unnamed Tributary of Lowgill Beck 6.1	New culvert - minor channel realignment (new crossing)	Shading and potential fluvial geomorphological change as a result of a new culvert and channel realignment	42
Lowgill Beck	Existing culvert - extension and minor channel realignment	Shading and potential fluvial geomorphological change as a result of the culvert and channel realignment to move the confluence north	0
Woodend Sike			16
Yosgill Sike			16

White-clawed crayfish

1.5.124 WCC populations in the UK are under sustained pressure from a number of sources, including reductions in water quality, the spread of invasive species including signal crayfish and out breaks of crayfish plague (usually associated with signal crayfish and other non-native crayfish species). WCC are present within rivers all year round. They can live for more than 10 years, and usually reach sexual maturity after three to four years. Breeding takes place in autumn and early winter (September to November) when the water temperature drops below 10°C for an extended period. The timing of release of juveniles varies from June in the south to August in the north. The presence of juveniles and a varied size range of adults is indicative of a breeding population.

1.5.125 Migration into deeper water may occur in the winter, for example in pools in rivers and the hypolimnion in lakes. There are records of the WCC burrowing into riverbanks; adult crayfish may dig numerous burrows in the soft mud of riverbanks, particularly during the winter (Holdich, 2003)[60].

1.5.126 Crayfish surveys (manual search and eDNA) confirmed presence in the WCC in the following watercourses: Trout Beck, Keld Sike, Unnamed Trib. of Mire Sike 6.12, Moor Beck, Eastfield Sike, Unnamed Trib. of Lowgill Beck 6.1, Lowgill Beck, Woodend Sike, Yosgill Sike. Based on the abundance categories adapted from (Peay, 2003) all sites where WCC were recorded had a low population density of WCC (ES Appendix 6.22: White Clawed Crayfish, Application Document 3.4). On a precautionary basis, all watercourses where WCC were recorded are considered to be functionally linked to the SAC for this species as they may provide a (potentially important) role in maintaining or restoring a protected population at favourable conservation status within the SAC.

[60] Holdich, D. (2003) Ecology of the White-clawed Crayfish. Conserving Natura 2000 Rivers Ecology Series No. 1. English Nature, Peterborough.

Land take / resource requirements / reduction of habitat area

1.5.127 Watercourse crossings and culverts, if poorly designed, could result in a direct reduction of WCC habitat area, or alteration of WCC habitat, in the vicinity of the watercourse crossing locations. Indirect reduction of WCC habitat area, or alteration of WCC habitat associated with changes in hydrology and fluvial geomorphological processes related to new crossings discussed above for fish also apply to WCC habitat. Shading and the loss of riparian and in channel vegetation as a result of watercourse crossings and culvert extension will also occur, both within the SAC and functionally linked watercourses. In addition, in the absence of sensitive watercourse crossing design that enable natural river processes, the realignment of Unnamed Tributary of Lowgill Beck 6.1 (a very minor watercourse that does not support fish, but does support WCC) could result in a reduction of habitat area associated with a minor loss of channel length through the realigned section.

1.5.128 ***In summary, it is considered that (in the absence of any avoidance and/or mitigation measures), this may lead to an adverse effect on WCC.***

Disturbance of mobile species and species fragmentation

1.5.129 Disturbance of WCC could occur during the construction phase, as a result potential noise, vibration and lighting as a result of works within close proximity of the river channel and river banks. Physical disturbance of WCC could also occur as a result of temporary dewatering and/or over-pumping resulting in a physical barrier to WCC movement. These activities could give rise to an adverse effect on this species, by disturbing spawning activity, which could affect the populations of WCC, and their distribution within the site.

1.5.130 ***It is considered that (in the absence of any avoidance and/or mitigation measures), this may lead to an adverse effect on WCC.***

Species mortality / injury

1.5.131 Dewatering associated with river realignment could give rise to an adverse effect on WCC through entrainment of individuals, and individuals carrying young, into the pumping arrangement used.

1.5.132 It is considered that (in the absence of any avoidance and/or mitigation measures), this may lead to an adverse effect on WCC.

Introduction and/or spread of invasive non-native species

1.5.133 The introduction of non-native species during construction could adversely affect WCC. WCC populations within the SAC and functionally linked habitats. Impacts may be on the river habitat itself (e.g. damage to banks and consequent siltation) or directly on characteristic biota (through predation, competition and disease), or a combination of these. Of particular relevance to the River Eden SAC are signal crayfish which have been responsible for much of the decline of native crayfish in the UK through competition, habitat damage, and the introduction of crayfish plague. Signal crayfish are thought to be absent from the four schemes

covered by this SIAA, but signal crayfish DNA was recorded in Mains Gill, a small watercourse in the Stephen Bank to Carkin Moor scheme.

1.5.134 ***It is considered that (in the absence of any avoidance and/or mitigation measures), the introduction and spread of invasive non-native species may lead to an adverse effect on*** *WCC.*

Changes in surface and groundwater quality, quantity, and hydrogeology

1.5.135 In the absence of mitigation, construction activities and operation of the new road has the potential to generate water-borne pollution (e.g. fine sediment, fuels and oils) that could give rise to an adverse effect on WCC and their habitat. Construction activities, such as cutting, piling, temporary abstractions and discharges and floodplain utilisation, also have the potential to impact on the water environment through changes in surface and groundwater quality and quantity, which could give rise to an adverse effect on WCC. A cutting is proposed in the Appleby to Brough scheme, north of Trout Beck and a series of cuttings, that are typically extensions of existing cuttings, will be required in Appleby to Brough scheme. There is potential for these cuttings to disturb groundwater flow paths, altering the quality and quantity of water entering Trout Beck and other functionally linked watercourse. Refuge habitat used by WCC could be affected by increased silt deposition, and diffuse and point source waterborne pollution.

1.5.136 ***It is considered that (in the absence of any avoidance and/or mitigation measures), this may lead to an adverse effect on the WCC.***

Otter

1.5.137 Evidence of otter presence was widespread within 250m of all schemes screened into this SIAA (M6 Junction 40 to Kemplay Bank, Penrith to Temple Sowerby, Temple Sowerby to Appleby, Appleby to Brough). One confirmed natal holt (NGR: NY7504516114) was recorded under a large rock on Moor Beck (Appleby to Brough), north of Warcop Training Centre and immediately adjacent to the existing A66. Bedding and large quantities of spraint were recorded. Two cubs were recorded between June and August during camera trapping. The holt is located within the Appleby to Brough scheme footprint. All other confirmed and unconfirmed holt and resting places identified during surveys are considered too far away to be disturbed by the scheme as described in ES Appendix 6.16: Otter (Application Document 3.4).

Disturbance of mobile species and species fragmentation

1.5.138 Site clearance and construction activities have the potential to disturb otters in the vicinity of the works. However, based on professional and past experience of similar projects, coupled with the fact that the identified natal holt is immediately adjacent to the existing A66 indicating that otters are already subject to disturbance in the area, it is considered likely that otters would quickly become habituated to increased levels of noise and disturbance associated with the construction of new bridge crossings and works in close proximity to watercourses. Therefore, general disturbance of

otter foraging and commuting habitat is considered unlikely to have an adverse effect on local otter populations.

1.5.139 The confirmed natal holt on Moor Beck (Appleby to Brough), located immediately adjacent to the existing A66 and under the proposed Moor Beck viaduct, will be subject to disturbance during the construction phase arising from potential noise, vibration and lighting as a result of works within close proximity of the river channel and river banks. Moor Beck is not within the SAC but is considered functionally linked for otter and the holt is located approximately 2.2km upstream of the SAC boundary.

1.5.140 Whist the holt will not be lost, it will be subject to high levels of disturbance. Disturbance or closure of the holt would occur under a European Protected Species Licence (EPSL), with agreement from Natural England. This licence will include certain mitigation measures, including the creation of additional holts, which will be dependent upon the exact impact of the Project on the natal holt. Whilst mitigation, that forms part of the EPSL will benefit the local otter population, is not required to avoid an adverse effect of the SAC. Disturbance or closure of this single holt is not considered to have an adverse effect on local otter populations, as abundant suitable habitat is present upstream and downstream of the confirmed holt location and across the wider catchment, where evidence of otter is widespread (as described in ES Appendix 6.16: Otter, Application Document 3.4). Disturbance or closure of a single holt in functionally linked habitat is not considered to adversely affect the core conservation objective for this species which is to "*maintain the continued presence of an actively-breeding otter population within the SAC, whilst avoiding deterioration from current levels*".

1.5.141 It is therefore considered that (in the absence of any avoidance and/or mitigation measures), disturbance of the natal holt on Moor Beck will not lead to an adverse effect on the local otter population. Consequently, there is no need for mitigation to be implemented to avoid an adverse effect on the otter population of the SAC.

1.5.142 In the absence of suitable watercourse crossing design, that facilitates the migration of otter, movement of otter could be restricted under high river flows, potentially forcing otters further away from the river during flood events. This potentially increases the risk of otter mortality, particularly as a result of increased interaction with the carriageway. The SAC conservation objective for otter has a target to "*reduce levels of mortality as a result of anthropogenic (manmade) factors so that they are not adversely affecting the overall abundance and viability of the population"* and *"connectivity within and to the site: ensure there are no significant artificial barriers to the safe passage and movement of otters into, within and away from the site"*.

1.5.143 ***It is considered that, in the absence of any avoidance through embedded design measures (suitable watercourse crossing design for otter), species and habitat fragmentation may lead to an adverse effect on otter.***

Species mortality / injury

1.5.144 Increased otter mortality could occur as a result of watercourse crossings, if the design does not facilitate otter movement, as outlined above. ***It is considered that, in the absence of any avoidance through embedded design measures, species mortality / injury may lead to an adverse effect on otter***.

Summary of assessment without mitigation

1.5.145 Based on the potential adverse effects described for the qualifying features screened into the assessment (i.e. 3260 watercourse habitat, Atlantic salmon, bullhead, brook lamprey, river lamprey, sea lamprey, WCC and otter), it is considered that (in the absence of any avoidance and/or mitigation measures) conflicts with the conservation objectives or the River Eden SAC are likely and adverse effects on the integrity of the River Eden SAC cannot be ruled out.

Assessment with mitigation

1.5.146 This part of the appropriate assessment considers adverse effects that could not be ruled out without mitigation. The following potential effects on the River Eden SAC are assessed with mitigation:

- Land take / resource requirements / reduction of habitat
- Disturbance of mobile species and species fragmentation
- Species injury and mortality
- Introduction and/or spread of invasive non-native species
- Changes in surface and groundwater quality, quantity, and hydrogeology
- Changes in hydrology and fluvial geomorphological processes
- Changed in air quality

Annex I habitat 3260: Watercourses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation

Introduction and/or spread of invasive non-native species

1.5.147 The introduction and/or spread of invasive non-native species will be managed through the strict implementation of an Invasive Non-Native Species Management Plan; a draft of this plan (Annex 15) is included in the EMP. This plan will be used by the Principal Contractor(s) (in consultation with specialist contractors), to develop the final Invasive Non-Native Species Management Plan as specified in the EMP. The plan will be informed by the desk study and baseline survey information and highlighted risk zones. Strict biosecurity measures will be included to cover workers, plant and equipment working in/or near watercourses, that adhere to the check-clean-dry protocol. In addition to the control measures set out below, pre-construction surveys will be undertaken of all areas within the construction footprint to identify the location of any invasive species not already identified.

1.5.148 The potential for spread of invasive species during construction activities and mitigation measures to prevent introduction and/or, in light of baseline surveys and species presence, has been discussed with Natural England

and the Environment Agency, as set out in the Evidence Plan (Appendix 1.1 of the ES, ES Volume 1 Application Document 3.4).

1.5.149 General control measures that will be included within the full Invasive Non-Native Species Management Plan are as follows:

- Details of invasive species shall be included within the Project induction and toolbox talks given to operatives (including the identification of sites where Himalayan balsam, signal crayfish and other invasive non-native species have been recorded in physical survey and eDNA monitoring).
- Strict protocol will be in place to ensure plant from sites known to contain invasive species or associated pathogens (e.g. crayfish plague pathogen *Aphanomyces astaci*) is not transferred between sites, be that other schemes on the A66 (e.g. Mains Gill, a small watercourse in the Stephen Bank to Carkin Moor scheme where signal crayfish DNA was recorded) or other projects, without adequate biosecurity measures and cleaning/drying.
- In relation to invasive plants, any early regrowth shall be reported and dealt with as per the methodology detailed below and within the Invasive Non-Native Species Management Plan. If the cells have been completed when new growth is discovered this shall be excavated and taken for offsite disposal at licenced facilities.
- There shall be a vehicle cleaning area adjacent to the burial zone and all vehicles used shall be cleaned prior to leaving this area. This area shall not be greater than 7m from the burial zone, material left in the clean down zone shall be collected and deposited into the burial cell.
- The excavation and transfer of invasive species contaminated material and haulage to the holding area shall be supervised by a suitably qualified consultant under the appropriate waste licence.
- Areas where invasive contaminated material is buried shall be accurately recorded.
- Excavation is to begin from the furthest point of the works and move backwards to avoid traffic on excavated, potentially contaminated ground.
- Vehicles collecting and removing material will be positioned over part of the geotextile prior to loading. Any material that may be dropped by the hopper will be caught by the geotextile.
- Once the works have been completed, the excavator is to be thoroughly cleaned and all arisings placed into the final load of contaminated material.
- In the event of material requiring storage prior to burial this shall be stored in a designated location on an impermeable membrane to prevent spread of the plants. This area will also have a clean down zone.
- If any material is to be removed for offsite disposal this will only be performed once a disposal location has been identified and this location has confirmed they will accept the waste. This will require ground investigation data and may need up to 10 days to obtain this information.

1.5.150 It is considered that, when incorporating the described avoidance and/or mitigation measures, an adverse effect on the qualifying feature can be ruled out (beyond reasonable scientific doubt) alone with no residual effect.

Changes in surface and groundwater quality, quantity, and hydrogeology

1.5.151 The River Eden and its various tributaries are likely to receive groundwater baseflow from the superficial deposits and bedrock formations, as well as surface water runoff. Cuttings that intercept the groundwater table may impact baseflow to surface water features downgradient. Where cuttings occur, groundwater may be intercepted and seasonally decant into drainage inverts and cuttings. However, all intercepted groundwater would be carried from the cuttings to a surface water discharge point; generally, within the same receiving water that the groundwater would naturally have discharged to. Although this will prevent a net change in total water quantities, this has the potential to shorten the pathway from ground to water courses, which may allow a component of groundwater to enter the water courses more rapidly.

1.5.152 3260 watercourse habitat will be protected during construction through the implementation of best practice construction techniques and pollution prevention. Construction methodologies and mitigation measures to prevent impacts on the SAC have been discussed with Natural England and the Environment Agency, as set out in the Evidence Plan (Appendix 1.1 of the ES, ES Volume 1 Application Document 3.4).

1.5.153 Site-specific measures, as secured in Annex B7 Ground and Surface Water Management Plan of the EMP (ES Application Document 2.7), will include:

- A surface water management system using measures such as temporary silt fencing, cut off ditches, settlement ponds and bunds set up early in the construction period to capture all runoff and prevent ingress of sediments and contaminants into existing drainage ditches where necessary. This will be managed by the EMP in accordance with Construction Industry Research and Information Association (CIRIA) guidelines[61] [62] [63] and the Environment Agency's approach to groundwater protection[64] and groundwater protection guidelines[65].
- Pollution prevention will apply to all watercourses, even minor stream, ditches and drains as these could convey pollution more sensitive sites (*HRA Appendix A: European Designated Sites Location Plan and the Project,* shows all watercourses that drain into the SAC, including watercourses unsuitable for qualifying species).

[61] CIRIA (2006) Control of Water Pollution from Linear Construction Projects (C648)
[62] CIRIA (2001) Control of Water Pollution from Construction Sites – Guidance for Consultants and Contractors (C532)
[63] CIRA (2002) Control of Water Pollution from Construction Sites – Guide to Good Practice (SP156)
[64] Environment Agency (2017) Protect groundwater and prevent groundwater pollution
[65] Environment Agency (2017) Groundwater protection technical guidance,

- Areas of exposed sediment deemed at risk of erosion during heavy rainfall or flood inundation will be protected using either temporary measures (e.g. sheeting) or semi-permanent measures (for example coir matting) until vegetation is able to establish on these surfaces.
- Dust emitting activities can be greatly reduced or eliminated by implementing site-specific mitigation measures via the EMP. These measures will be in line with *IAQM guidance* (Institute of Air Quality Management, 2014)[66].
- To ensure that there is no risk of pollution during flooding or intense rainfall, including requirements for the design of temporary and permanent drainage, flood risk monitoring and actions to be taken in the event of a flood will be implemented in accordance with the EMP (Application Document 2.7).
- A water quality monitoring programme prior to and during construction works will be agreed with the Environment Agency and adaptive management implemented as appropriate.
- Permanent or temporary drainage systems including water quality measures will be implemented prior to works starting at each location.
- No abstraction will be undertaken within the catchment of the SAC unless a hydrological assessment has been carried out to demonstrate no effect on water quality and quantity and qualifying species.
- Attenuation ponds will be constructed and set up to facilitate extraction of water for damping down during construction
- Water with a higher risk of contamination which requires discharge, including groundwater pumped out of pilings during concrete pouring, will be contained and treated using appropriate measures such as coagulation of sediments, dewatering and pH neutralisation prior to discharge. Such discharges will be regulated via environment permits issued by the Environment Agency.
- Consideration of local groundwater catchment and flow regimes that may be affected by dewatering design and discharging the abstracted water to the same groundwater catchment and down gradient of the dewatered element.
- Discharge from dewatering activities such as earthworks, works within a floodplain or within eight metres of a watercourse will have a tailored risk assessment, consent and licences from the Environment Agency. Dewatering abstractions may also require transfer licenses from the Environment Agency.
- Grouting may be required to treat voids encountered during earthworks and ground stabilisation works that may involve soil nailing or soil anchors. It is inherently difficult to prevent grout from entering fissures. Therefore, appropriate grouting methodology will be used to reduce risk to the water environment. This will include limitation of grout volumes, monitoring for pH spikes in monitoring

[66] Institute of Air Quality Management (2014) Guidance on the assessment of dust from demolition and construction, Institute of Air Quality Management, London

standpipes/surface flows, and specification of polymer grouts as required.

- A site-specific foundation works risk assessment (FWRA) for the construction of underground structures and ground improvement works.
- Design of underground structures will require drainage provisions to relieve hydrostatic pressure. These will allow for groundwater flow around the structure.
- Review and update of groundwater conceptual model as new, site-specific information is received.
- Review and update of the hydrogeological assessment as new, site-specific information is received.

1.5.154 During the operation phase, road runoff will be treated (zinc, copper and sediment) via a network of attenuation basins. The level of treatment is determined and tested using the National Highways (Highways England) Water Risk Assessment Tool (HEWRAT) which is used to assess the treatment design. Design of the attenuation basins is an iterative process whereby a 'pass' is only achieved if both the acute-soluble and the chronic-sediment assessments pass. All attenuation basins have achieved a pass, as described in the HEWRAT assessments in Appendix 14.3 Water Quality Assessment (Application Document 3.4).

1.5.155 ***It is considered that, when incorporating the described avoidance and/or mitigation measures, an adverse effect on the qualifying feature can be ruled out (beyond reasonable scientific doubt) alone.***

Changes in hydrology and fluvial geomorphological processes

1.5.156 The natural flow regime both shapes and sustains characteristic biotope mosaics, affecting factors such as current velocities and bed hydraulics, water levels and depths, wetted area, temperature regime and dissolved oxygen regime for this habitat type. Alteration of the natural flow regime and fluvial geomorphological processes in the vicinity of the Trout Beck crossing during operation has been minimised through the design of a viaduct that spans Trout Beck and its floodplain (three piers located to the north of the watercourse and four located to the south).

1.5.157 The viaduct will be built without needing to access in stream habitat; this non-intrusive construction methodology and mitigation measures to prevent impacts on the SAC have been discussed with Natural England and the Environment Agency, as set out in the Evidence Plan (Appendix 1.1 of the ES, ES Volume 1 Application Document 3.4). The requirement for a temporary bridge over Trout Beck to facilitate the construction of the permanent viaduct was discussed and it was agreed that this would need to be open span (i.e. from bank top to bank top) and that the haul road would need to be at flood plain level to reduce potential for changes to fluvial geomorphological process during construction.

1.5.158 Construction of temporary crossings and other temporary infrastructure such as haul roads and set down areas will be designed with due consideration, in the use of materials and techniques, to the sensitivity the River Eden SAC and functionally linked habitats. Temporary infrastructure

will avoid the introduction of foreign sediments into the floodplain or watercourses by using modular metal folding roads/grids rather than imported materials, so to not impact the geomorphology of the sensitive area.

1.5.159 Modelling was undertaken to inform the design of the viaduct with the objective of reducing adverse geomorphological changes to an acceptable level, that would not give rise to an adverse effect on the integrity of the SAC. This was an iterative process involving design changes led by the modelling and consultation with Natural England and the Environment Agency as described in the Evidence Plan (Appendix 1.1 of the ES, ES Volume 1 Application Document 3.2). The features of the viaduct design are set out in and secured through the Project Design Principles (ES Application Document 5.11), which is a certified document under the DCO. Specific design principle relating to the Trout Beck crossing are as follows:

- The structure crossing the Trout Beck must allow for full functionality of normal supporting river processes including flood flows and associated erosion/sediment regime, and the migration of the channel across its floodplain (these are important functions of its role as part of the River Eden Special Area of Conservation or SAC). This is to be achieved using an open multi-span structure, across the entire floodplain of the watercourse, unless otherwise agreed with the Environment Agency and Natural England. The span arrangements for the Trout Beck viaduct are to be designed such that the vertical clearance from the watercourse (in normal conditions) is a minimum of 2.5m.
- With the Trout Beck viaduct, the orientation of the piers must be informed by detailed flood modelling so that they do not influence the migratory nature of the river. All piers are to be designed as in-channel structures (even if they are not currently in-channel in the DCO scheme design), to allow for the movement of the river and avoid the need to add scour protection in future.
- The same design principles as for the Trout Beck crossing above must be applied to all watercourses which are functionally linked to the SAC – Moor Beck, Cringle Beck – and all crossings of such watercourses are to be open span structures.
- Crossings of the sensitive watercourses are to be open structures, ensuring no significant change to the fluvial geomorphological function of the watercourses. This is to retain their function as habitat supporting qualifying features of the River Eden SAC (fish, lamprey sp., white-clawed crayfish and otter) and to maintain supporting river processes including flood flows and associated erosion/sediment regime, unless otherwise agreed with Natural England and Environment Agency.
- Design of flood compensation at Trout Beck will be blended into the landscape. Hydromorphology and fluvial geomorphology assessments to be undertaken to determine requirements at the detail design stage. Flood compensation is to be located under the structure to reduce the footprint and visual impact of the proposals, and is to be designed sensitively with regard to existing ground

levels/profiles and local landscape characteristics. Viaduct piers will be designed and constructed to withstand river erosion, in order that no additional bank protection would be required under a future scenario where the river channel has migrated (laterally) and interacts with the piers.

- Any outfalls must not have headwalls and must be open ditches tying in with natural bank profiles and discharging via open ditches where there are natural bank profiles. Where there is an existing hard structure, they must tie into existing features.
- Design of any new, realigned, or improved watercourse channels is to be undertaken with hydromorphology and geomorphology principles considered in the design, in accordance with best practice[67]. Geomorphological diversity will be encouraged with techniques such as riparian planting, bank reprofiling, low flow channel creation and re-naturalisation of the watercourse planform. The design of watercourse crossings and drainage outfalls is to be undertaken with the involvement of experienced hydromorphology, geomorphology, and ecology professionals, with further hydraulic and geomorphological modelling of realigned sections of channel to be undertaken where required.

1.5.160 Full details of the modelling methodology, assumptions, and the field and desk study information used to inform and interpret the model are presented in the Geomorphology Modelling Report (Appendix 14.9: Detailed Geomorphological Modelling, Application Document 3.4). The findings of this report in relation to Trout Beck (which conforms to 3260 watercourse habitat, a qualifying feature of the SAC) are summarised below. The modelling provides the evidence base for the appropriate assessment, to demonstrate that any impact to qualifying habitats and species, and the supporting (geomorphological) process that control the quality and distribution of habitats are acceptable and will not give rise to an adverse effect on the integrity of the SAC.

1.5.161 Modelling covered the baseline scenario (i.e. existing conditions) for a number of flood return periods; the same return periods were modelled for the post-development scenario where the viaduct structure, flood storage and other features of the project (e.g. drainage channels), were incorporated into the model. This allowed for changes in fluvial geomorphological processes and hydrological parameters to be compared between the baseline and post-development scenarios.

1.5.162 Analysis of shear stress, mobile grain sizes, velocities and depth was undertaken to understand how sediment transport dynamics, riverbed scour and deposition, riverbank erosion and channel planform is likely to change under the post development scenario.

1.5.163 Detailed modelling was undertaken for the Temple Sowerby to Appleby scheme in relation to the Trout Beck crossing (within the SAC) and is presented below in relation to potential impacts on qualifying 3260 watercourse habitats in Trout Beck. Potential changes in hydrology and

[67] Manual of River Restoration Techniques (River Restoration Centre 2019)

fluvial geomorphological processes in watercourses in the Appleby to Brough scheme (outside of the SAC boundary, but functionally linked) are assessed later in relation to qualifying fish species.

1-in-2 year flood event in channel sediment entrainment

1.5.164 Site observations revealed that the typical bed substrate within the vicinity of the Trout Beck viaduct ranges from gravels to cobbles.

1.5.165 An increase in the maximum size of sediment that can be entrained at one cross section located upstream of the crossing was predicted. The maximum sediment size that can be entrained increases from coarse gravel to very coarse gravel (indicated by black circle). Site observations revealed that the typical bed substrate within the vicinity of the scheme piers ranges from gravels to cobbles. The hydraulic model results for this reach indicate that the maximum sediment size that can be entrained ranges between coarse gravels to fine cobbles.

1.5.166 As there is minimal change to the maximum sediment size that can be entrained, in the post-development scenario compared to the baseline scenario, there is unlikely to be any change to the bed substrate composition within as a result of the proposed crossing.

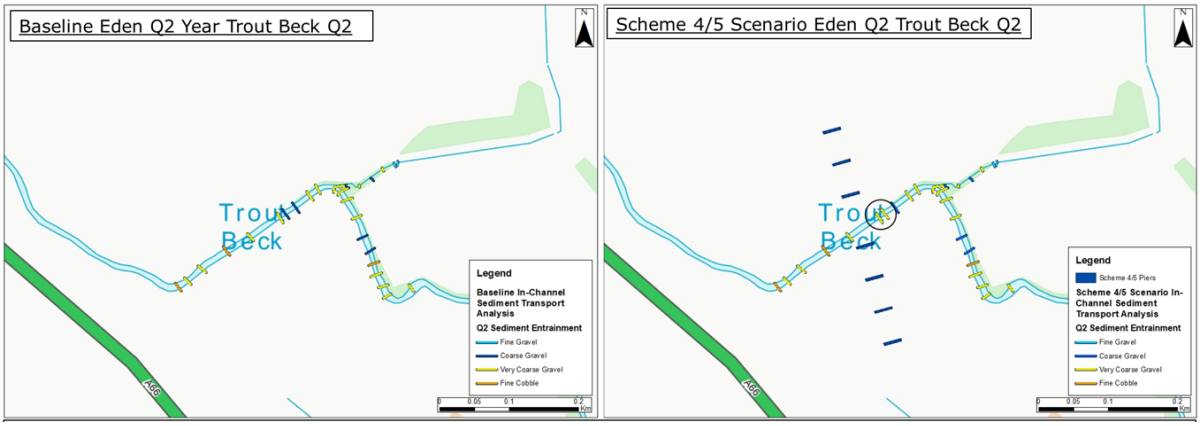


Plate 1-3: Comparison of hydraulically modelled sediment entrainment size for the River Eden 1-in-2 Year and Trout Beck 1-in-2 Year Flood Event

1-in-2 year flood event floodplain sediment entrainment

1.5.167 The installation of a flood compensation structure on the left bank floodplain (identified in black circle 1) generates a new overland flow route and variations in the size of material that can be mobilised.

1.5.168 The typical sizes of material that can be entrained in the new overland flow route on the left bank floodplain range from silts to sands. The establishment of this new overland flow route on the left bank means that more water is conveyed and stored on the left bank. The increased conveyance of water onto the left bank floodplain reduces the total volume of water conveyed on the right bank (identified in black circle 2). The result is reductions in the size of material that can be mobilised reducing from coarse to medium gravel in the baseline scenario, to very fine gravel to very coarse sand under the post-development scenario.

1.5.169 Water that previously spilled directly from the Trout Beck channel into the right bank floodplain now enters the drainage channel discharging from the right bank first (identified in black circle 3), leading to a reduction in flow velocities in the existing overland flow route. A new overland flow route is established further to the north. As a result, there are changes in the size of material that can be mobilised on the right side of bank floodplain of the Trout Beck, reducing from coarse to medium gravel in the baseline scenario, to very fine gravel to very coarse sand.

1.5.170 The drainage channel that has been installed along the access track in the north west (identified in black circle 4) disrupts overland flow routes. Water that previously spilled directly across the access track now enters this drainage channel first, which conveys more water back into the Trout Beck. This further contributes to the reduction in the sizes of material that can be mobilised.

1.5.171 No detrimental impacts are predicted; the right bank floodplain remains active during this flood event across a broadly similar extent. Therefore, the changes to sediment entrainment dynamics are unlikely to significantly impact existing geomorphological processes on the floodplain or in the channel.

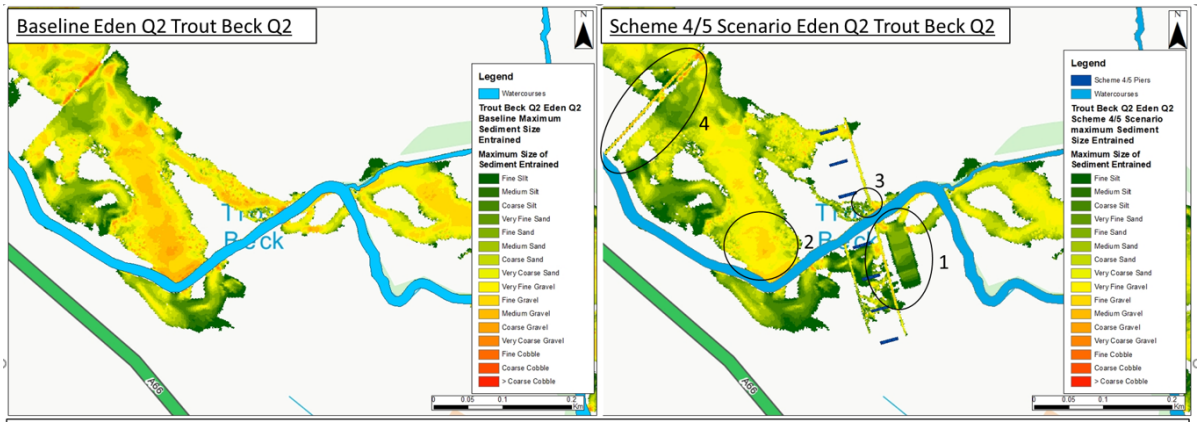


Plate 1-4: Comparison of hydraulically modelled sediment entrainment size on the floodplain for the River Eden 1-in-2 Year and Trout Beck 1-in-2 Year Flood Event

1-in-2 year flood event maximum floodplain velocities

1.5.172 Localised changes in flow velocities in the vicinity of the flood compensation structure on the left bank of the Trout Beck are predicted. Velocities increase as more water spills into the flood compensation structure from the channel, and subsequently decrease as water pools in the structure.

1.5.173 On the right bank of Trout Beck, flow velocities reduce significantly. The drainage channel discharging into the right bank of Trout Beck disrupts the existing overland flow route. Water that previously spilled directly from the Trout Beck channel into the right bank floodplain now enters this drainage channel first, leading to the reduction in flow velocities in the existing overland flow route.

1.5.174 The installation of a drainage channel along the access track in the north west of the map disrupts the existing overland flow route across the right

bank floodplain of the Trout Beck. Water that previously spilled directly across the access track now enters this drainage channel first, which conveys more water back into the Trout Beck. The result is a reduction in flow velocities in the existing overland flow route.

1.5.175 No detrimental impacts on are predicted; whilst there will be changes to flow velocities in overland flow routes, the right bank floodplain remains active during this flood event across a broadly similar footprint. Therefore, the changes to sediment entrainment dynamics are unlikely to impact existing geomorphological processes on the floodplain or in the channel.

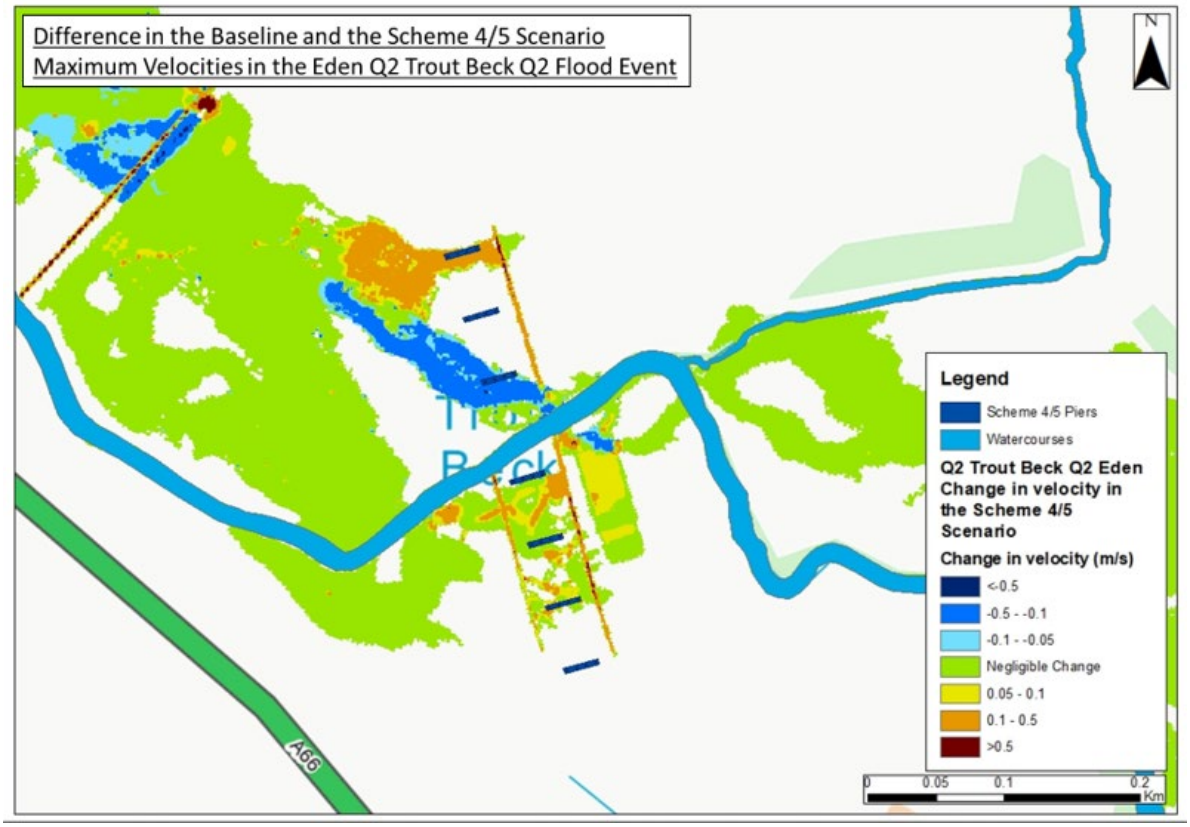


Plate 1-5: Comparison of hydraulically modelled velocities size on the floodplain for the River Eden 1-in-2 Year and Trout Beck 1-in-2 Year Flood Event

1-in-10 year flood event in channel sediment entrainment

1.5.176 Site observations revealed that the typical bed substrate within the vicinity of the scheme piers ranges from gravels to cobbles. The hydraulic model results for this reach indicate that the maximum sediment size that can be entrained ranges between coarse gravels to fine cobbles.

1.5.177 As there is negligible change to the maximum sediment size that can be entrained in the post-development scenario compared to the baseline scenario, there is unlikely to be any change to the bed substrate composition within the vicinity of the scheme and the impact of the project on in channel substrate is negligible.

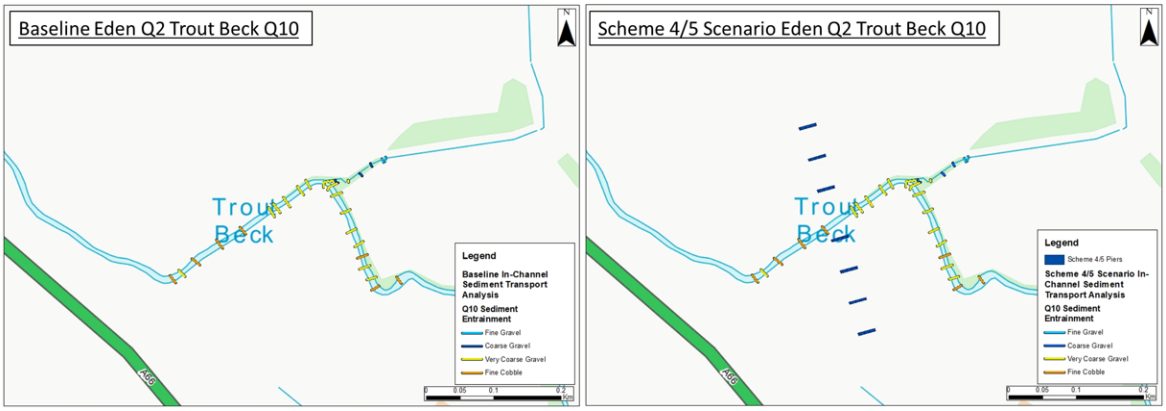


Plate 1-6: Comparison of hydraulically modelled sediment entrainment size for the River Eden 1-in-2 Year and Trout Beck 1-in-10 Year Flood Event

1-in-10 year flood event floodplain sediment entrainment

1.5.178 The installation of the flood compensation structure on the left bank floodplain (identified in black circle 1) encourages more water to enter the left bank and a new overland flow route is created. The establishment of this new overland flow route on the left bank means that more water is conveyed and stored on the left bank. The increased conveyance of water onto the right bank reduces the total volume of water conveyed on the right bank identified in black circle 2).

1.5.179 The result is reductions in the size of material that can be mobilised reducing from fine cobble and very coarse gravel in the baseline scenario, to medium gravel and fine gravel in the post-development scenario. The drainage channel discharging into the right bank of the Trout Beck (identified in black circle 3) disrupts the existing overland flow route. Water that previously spilled directly from the Trout Beck channel into the right bank floodplain now enters this drainage channel first, leading to the reduction in shear stresses in the existing overland flow route.

1.5.180 The installation of a drainage channel along the access track in the north west (identified in black circle 4) disrupts the existing overland flow route across the right bank floodplain of Trout Beck. Water that previously spilled directly across the access track now enters this drainage channel first, which conveys more water back into Trout Beck, and less water is conveyed across the floodplain to the west of the access road. This results in a reduction in shear stress values and the size of material that can be mobilised, reducing from fine cobble and very coarse gravel in the baseline scenario, to medium gravel to very fine gravel.

1.5.181 No detrimental impacts on are predicted; the right bank floodplain remains active during this flood event across a broadly similar footprint. Therefore, the changes to sediment entrainment dynamics are unlikely to significantly impact existing geomorphological processes on the floodplain or in the channel.

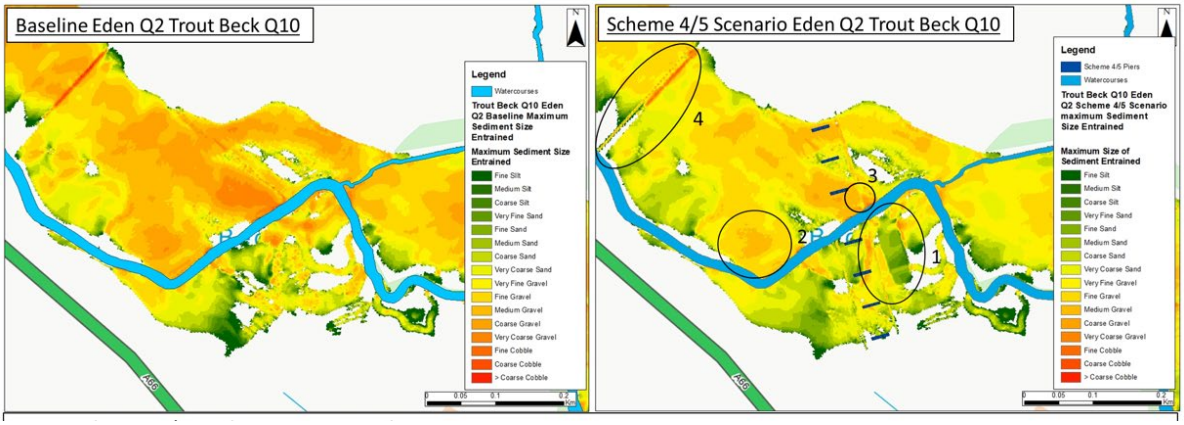


Plate 1-7: Comparison of hydraulically modelled sediment entrainment size on the floodplain for the River Eden 1-in-2 Year and Trout Beck 1-in-10 Year Flood Event

1-in-10 year flood event maximum floodplain velocities

1.5.182 There are significant changes in flow velocities in the vicinity of the flood compensation structure on the left bank of the Trout Beck. Velocities increase as more water spills into the flood compensation structure from the channel, and subsequently decrease as water pools in the structure. A new overland flow route is established to the west and south of the flood compensation structure, leading to increases in velocities on the left bank floodplain in this area. On the right bank of the Trout Beck, flow velocities change significantly. The drainage channel discharging into the right bank of the Trout Beck disrupts the existing overland flow route. Water that previously spilled directly from Trout Beck channel into the right bank floodplain now enters this drainage channel first, leading to the reduction in flow velocities in the existing overland flow route. A new overland flow route is established further to the north, leading to increases in flow velocities in this area.

1.5.183 The installation of a drainage channel along the access track in the north west of the map disrupts the existing overland flow route across the right bank floodplain of the Trout Beck. Water that previously spilled directly across the access track now enters this drainage channel first, which conveys more water back into the Trout Beck. The result is a reduction in flow velocities in the existing overland flow route.

1.5.184 No detrimental impacts on are predicted; whilst there will be changes to flow velocities in overland flow routes, the right bank floodplain remains active during this flood event across a broadly similar footprint. Therefore, the changes to sediment entrainment dynamics are unlikely to impact existing geomorphological processes on the floodplain or in the channel.

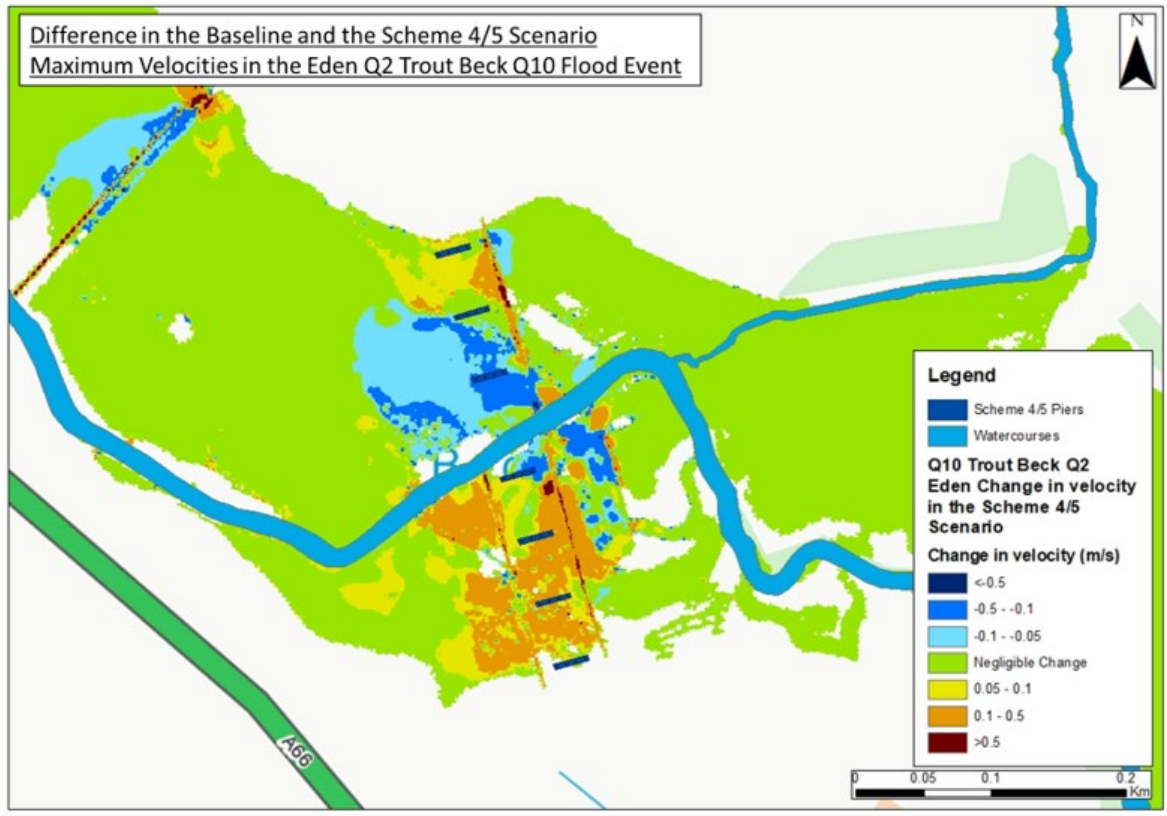


Plate 1-8: Comparison of hydraulically modelled velocities size on the floodplain for the River Eden 1-in-2 Year and Trout Beck 1-in-10 Year Flood Event

1-in-20 year flood event in channel sediment entrainment

1.5.185 Site observations revealed that the typical bed substrate within the vicinity of the scheme piers ranges from gravels to cobbles. The model predicts an increase in the maximum size of sediment that can be entrained at one cross section located upstream of the scheme; the maximum sediment size that can be entrained increases from very coarse gravel to fine cobble (indicated by black circle on map). The hydraulic model results for this reach indicate that the maximum sediment size that can be entrained ranges between coarse gravels to fine cobbles.

1.5.186 As there is minimal change to the maximum sediment size that can be entrained in post-development scenario compared to the baseline scenario, there is unlikely to be any change to the bed substrate composition within the vicinity of the scheme.

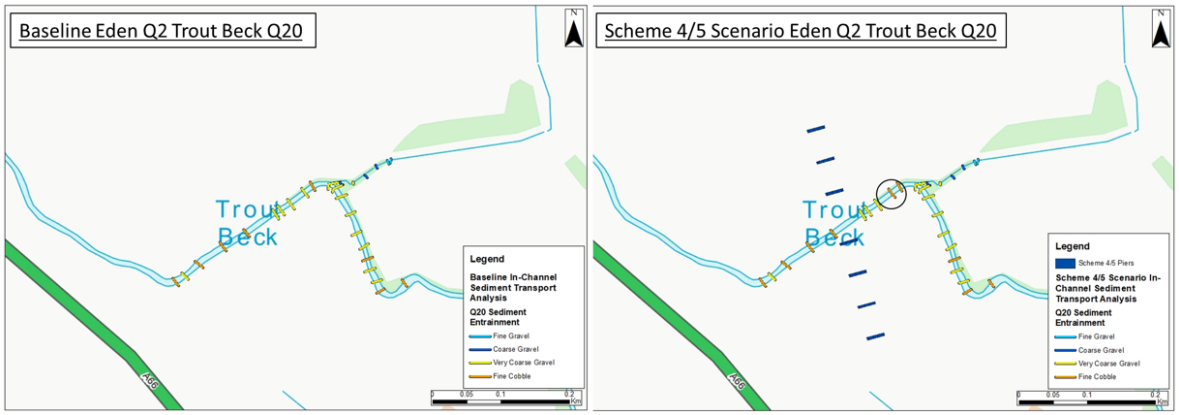


Plate 1-9: Comparison of hydraulically modelled sediment entrainment size for the River Eden 1-in-2 Year and Trout Beck 1-in-20 Year Flood Event

1-in-20 year flood event floodplain sediment entrainment:

1.5.187 The installation of the flood compensation structure on the left bank floodplain (identified in black circle 1) encourages more water to enter the left bank and a new overland flow route is created. The establishment of this new overland flow route on the left bank means that more water is conveyed and stored on the left bank.

1.5.188 The increased conveyance of water onto the right bank reduces the total volume of water conveyed on the right bank (identified in black circle 2). The result is reductions in the size of material that can be mobilised reducing from fine cobble and very coarse gravel in the baseline scenario, to medium gravel and coarse sand in the post-development scenario. The drainage channel discharging into the right bank of the Trout Beck (identified in black circle 3) disrupts the existing overland flow route. Water that previously spilled directly from the Trout Beck channel into the right bank floodplain now enters this drainage channel first, leading to the reduction in shear stresses in the existing overland flow route.

1.5.189 The installation of a drainage channel along the access track in the north west (identified in black circle 4) disrupts the existing overland flow route across the right bank floodplain of Trout Beck. Water that previously spilled directly across the access track now enters this drainage channel first, which slows the flow down and conveys more water back into the Trout Beck. This impounds water to the east of the drainage channel, resulting in a reduction in shear stress values and the size of material that can be mobilised.

1.5.190 No detrimental impacts on are predicted; whilst there will be changes to the size of material that can be mobilised in overland flow routes, the right bank floodplain remains active during this flood event across a broadly similar footprint. Therefore, the changes to sediment entrainment dynamics are unlikely to significantly impact existing geomorphological processes on the floodplain or in the channel.

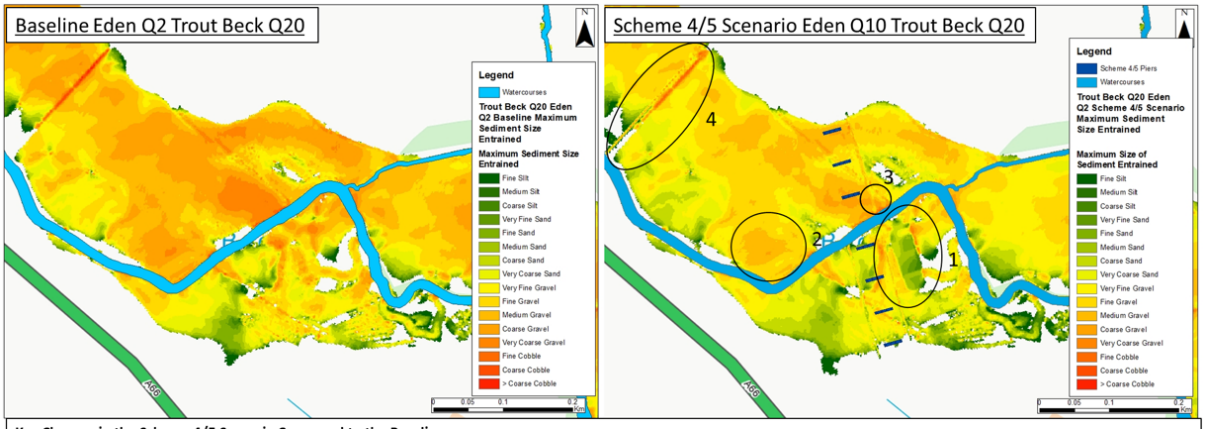


Plate 1-10: Comparison of hydraulically modelled sediment entrainment size on the floodplain for the River Eden '-in-2 Year and Trout Beck 1-n-20 Year Flood Event

1-in-20 year flood event maximum floodplain velocities

1.5.191 There are significant changes in flow velocities predicted in the vicinity of the flood compensation structure on the left bank of the Trout Beck. Velocities increase as more water spills into the flood compensation structure from the channel, and subsequently decrease as water pools in the structure. A new overland flow route is established to the west and south of the flood compensation structure, leading to increases in velocities on the left bank floodplain in this area.

1.5.192 On the right bank of the Trout Beck, flow velocities change significantly. The drainage channel discharging into the right bank of the Trout Beck disrupts the existing overland flow route. Water that previously spilled directly from the Trout Beck channel into the right bank floodplain now enters this drainage channel first, leading to the reduction inflow velocities in the existing overland flow route. A new overland flow route is established further to the north, leading to increases inflow velocities in this area.

1.5.193 The installation of a drainage channel along the access track in the north west of the map disrupts the existing overland flow route across the right bank floodplain of the Trout Beck. Water that previously spilled directly across the access track now enters this drainage channel first, which conveys more water back into the Trout Beck. The result is a reduction in flow velocities in the existing overland flow route.

1.5.194 No detrimental impacts on geomorphology are predicted; whilst there will be changes to flow velocities in overland flow routes, the right bank floodplain remains active during this flood event across a broadly similar footprint. Therefore, the changes to sediment entrainment dynamics are unlikely to impact existing geomorphological processes on the floodplain or in the channel.

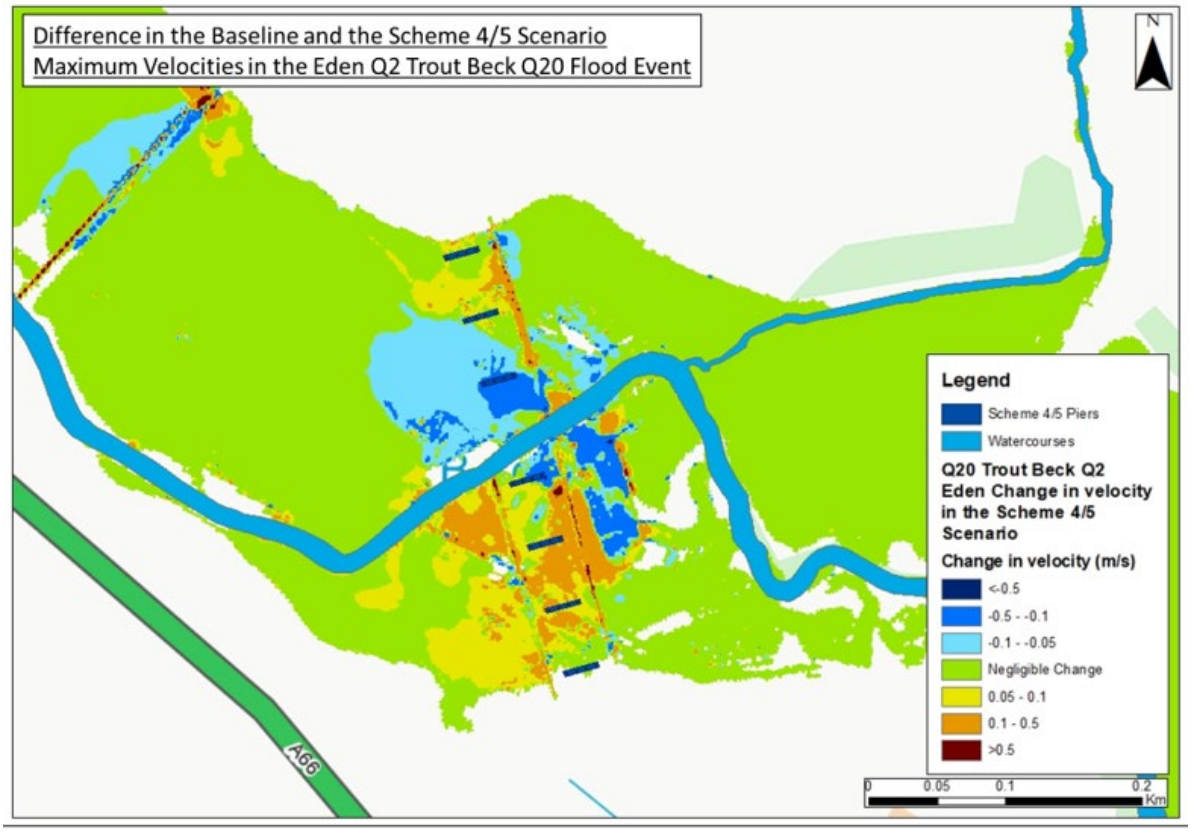


Plate 1-11: Comparison of hydraulically modelled velocities size on the floodplain for the River Eden 1-in-2 Year and Trout Beck 1-n-20 Year Flood Event

1.5.195 In summary, modelling data predicts with considerable certainty that fluvial geomorphological processes both within the channel and on the floodplain will not be significantly affected by the Trout Beck viaduct. Changes to sediment entrainment dynamics are unlikely to impact existing geomorphological processes on the floodplain or in the channel and as such the distribution and condition of 3260 watercourse habitat at the crossing point or downstream will not change. The modelling demonstrates that the open span structure achieves the objective of maintaining natural river processes and key attributes of the structure and function of the SAC, such as watercourse flow and sediment regime will be maintained. ***It is considered that, when incorporating the described avoidance and/or mitigation measures (open span watercourse crossing design), an adverse effect on the qualifying feature as a result of changes in hydrology and fluvial geomorphological processes can be ruled out (beyond reasonable scientific doubt) alone.***

Atlantic salmon, bullhead and lamprey species

Land take / resource requirements / reduction of habitat area

1.5.196 There will not be a reduction in habitat area within the SAC as a result of the Trout Beck viaduct which spans the river. This design feature has minimised the potential for a reduction of habitat area and is secured through the Project Design Principles (ES Application Document 5.11), which is a certified document under the DCO. The viaduct will be built without needing to access in stream habitat; this non-intrusive construction

methodology and mitigation measures to prevent impacts on the SAC have been discussed with Natural England and the Environment Agency, as set out in the Evidence Plan (Appendix 1.1 of the ES, ES Volume 1 Application Document 3.2).

1.5.197 The detailed fluvial geomorphology modelling results presented above for 3260 watercourse habitat demonstrate that fish habitat in Trout Beck will not be adversely affected during operation.

1.5.198 In addition to the Trout Beck viaduct, the majority (five out of six) of new watercourse crossings of functionally linked watercourses in the Appleby to Brough scheme are open span and will not result in loss of fish habitat (Table 9: Proposed watercourse crossings of the SAC and functionally linked habitats). There will be some localised shading of in stream and riparian habitats associated with the extension of existing culverts in functionally linked watercourses, but where new culverts are constructed or existing culverts are replaced, they will be sunken to enable natural substrate to form, thus maintaining the area of aquatic habitat.

1.5.199 This designed feature has minimised the potential for a reduction of habitat area and is secured through the Project Design Principles (ES Application Document 5.11). The shading of watercourses associated with culvert extension in the Appleby to Brough Scheme is considered negligible, as long as watercourse crossing design facilitates the free movement of fish through bridges and culverts (through maintained flow velocities as evidence below when assessing *changes in hydrology and fluvial geomorphological processes*) to the abundant habitat located upstream and downstream. The results of fish habitat assessment demonstrate that habitat suitable for all stages of Atlantic salmon, bullhead and lamprey species is abundant upstream and downstream of the of the crossing points, as referenced in ES Appendix 6:18 Fish Habitat Assessment and MoRPh (Application Document 3.4).

1.5.200 It is considered shading would not adversely affect the extent and distribution of qualifying fish or their habitats, and populations of qualifying fish, and their distribution within the functionally linked rivers and the SAC itself would be maintained.

1.5.201 ***In summary, it is considered that, when incorporating the described avoidance measures (sensitive watercourse crossing design to minimise habitat loss), an adverse effect on qualifying fish can be ruled out (beyond reasonable scientific doubt) alone.***

Disturbance of mobile species and species fragmentation

1.5.202 Potential disturbance of lamprey, salmon and bullhead has been significantly reduced as a result of best practice watercourse crossing design; as described below in the "*changes in hydrology and fluvial geomorphological processes"* section. All new watercourse crossings, with the exception of a culvert on Unnamed Tributary of Lowgill Beck 6.1, are either viaducts or open span bridges meaning that species will be able to freely migrate through the existing channel during construction. Dewatering activities and over pumping will be required to facilitate construction where existing culverts are to be extended or replaced, but these are limited to

functionally linked watercourses that lie outside the SAC boundary (i.e. Thacka Beck, Light Water, Eastfield Sike and Lowgill Beck/Woodend Sike). The construction programme is yet to be finalised in detail but disturbance arising from potential noise, vibration and lighting as a result of works within close proximity of the river channel and river banks will be minimised through the following measures:

- Instream works that could give rise to species fragmentation (e.g. culvert extension) will be undertaken outside the key salmonid breeding season (1st October to 31st May) and physical disturbance (e.g. from temporary over-pumping) will be minimised through best practice construction techniques (e.g. fish translocation, pollution control measures).
- Likewise, construction activities giving rise to excess noise and vibration will be sensitively timed to reduce the disturbance impacts on migrating fish, noting the limited window to avoid the migration period for all species and all life-stages.
- Many qualifying fish species / life stages, particularly lamprey and salmon smolts, are known to migrate at night. Night working will be avoided where practicable adjacent to watercourses. Night working will only be implemented where traffic management on a road necessitates it for safety. If this occurs in proximity to watercourses all lighting will be designed to be directed away from the watercourse. Avoiding works at night will avoid disturbance to nocturnal migrants, and should lamprey, salmon and bullhead be migrating during the day, their migration will only temporarily be delayed until the following evening.
- Construction sites will not be illuminated at night, where possible. Where this is not possible (e.g. due to security considerations in non-green field locations), lighting will be sensitive to nocturnal species using the river and riparian corridor and face away from the watercourse, thus reducing disturbance of nocturnal migrants.

1.5.203 The requirement for street lighting is an important consideration within the Project and its specification will be in line with best practice and appropriate safety assessments, as well as accounting for any mitigation identified in this ES with respect to ecological receptors. From the outset the design intention has been to minimise the amount of lighting throughout the Project, given its mostly rural setting. The only locations where additional lighting has been identified as being required for safety purposes are away from the main A66 at the new Bowes junction (Bowes Bypass scheme) and the new roundabout at Rokeby on the detrunked A66/ C165 (Cross Lanes to Rokeby scheme) which do not interact with the River Eden SAC.

1.5.204 No additional lighting is required for the operation of the Project in the Temple Sowerby to Appleby or Appleby to Brough, which cross the SAC.

1.5.205 ***It is considered that, when incorporating the described avoidance and/or mitigation measures, an adverse effect on the qualifying fish species as a result of disturbance can be ruled out (beyond reasonable scientific doubt) alone.***

Species injury and mortality

1.5.206 Vibration can cause damage or mortality of eggs and embryos in spawning gravels, which could have an adverse effect on the populations of lamprey, salmon and bullhead, and their distribution within the site. However, a vibration assessment of key risk areas (i.e. sections of watercourses with potential spawning habitat adjacent to proposed high vibration construction activities) concluded that piling will not give rise to an adverse effect on fish eggs/embryos. Ground vibration is measured in terms of Peak Particle Velocity (PPV) in the unit of mm/s. A threshold of 13 mm/s was provided by the Environment Agency during written consultation on the assessment approach for this Project. As part of the Project vibration assessment (Appendix 12.6 of ES Chapter 12: Noise and Vibration, ES Application Document 3.4), PPV values were modelled in key risk areas (i.e. sections of watercourses with potential spawning habitat adjacent to proposed high vibration activities). Modelling of construction activities has shown that the threshold was not breached by piling activities due to distance from the river bank, however, compaction activities at 1m from the river bank resulted in PPV value of 29mm/s breaching the threshold of 13mm/s.

1.5.207 Therefore, a mitigation action that of prohibits compaction (or other activities resulting in PPV of greater than 13mm/s within river substrates) within 5m of watercourses supporting gravel spawning species (salmon, trout, lamprey sp., bullhead) without prior consultation with the Environment Agency and Natural England was devised and is secured in the EMP (ES Application Document 2.7). The implementation of a 5m buffer results in PPV value in the river channel reducing to 11mm/s and under threshold.

1.5.208 Where instream works or dewatering are required, they will be carried out under the supervision of a suitably qualified Ecological Clerk of Works (ECoW) with a freshwater ecology and fisheries specialism and experience of overseeing construction activities in or near water. The ECoW role will involve overseeing the dewatering process and fish translocation to move fish from impacted areas. This would involve managing the drawdown rate, based on the abundance of fish, through liaison with the fish translocation team. Fish translocation would take place prior to dewatering in order to move fish from impacted areas to suitable habitat elsewhere. Netting and/or electric fishing techniques would be used, under a Salmon and Freshwater Fisheries Act (SaFFA) Section 27A exemption enabling the use of fishing instruments (other than rod and line) and/or removal of fish from inland waters, obtained from the Environment Agency. Fish translocation and dewatering methods are specified in the EMP.

1.5.209 ***It is considered that, when incorporating the described avoidance and/or mitigation measures, an adverse effect on the qualifying fish species as a result of species injury and mortality can be ruled out (beyond reasonable scientific doubt) alone.***

Introduction and/or spread of invasive non-native species

1.5.210 The introduction and/or spread of invasive non-native species will be managed through the strict implementation of an Invasive Non-Native

Species Management Plan. This plan will be produced by the Principle Contractor(s) (in consultation with specialist contractors), as specified within the outline EMP. More information on the management of invasive non-native species and biosecurity protocols relevant to qualifying fish species is provided above for 3260: Watercourses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation. ***It is considered that, when incorporating the described avoidance and/or mitigation measures, an adverse effect on qualifying fish can be ruled out (beyond reasonable scientific doubt) alone with no residual effect***.

Changes in surface and groundwater quality, quantity, and hydrogeology

1.5.211 Potential impacts on qualifying fish as a result of altered surface and groundwater quality, quantity, and hydrogeology will be manged through construction and operation through the implementation of best practice construction techniques and pollution prevention and treatment of road runoff as specified within the EMP. These measures are set out in detail above for 3260: Watercourses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation. ***It is considered that, when incorporating the described avoidance and/or mitigation measures, an adverse effect on qualifying fish can be ruled out (beyond reasonable scientific doubt) alone with no residual effect.***

Changes in hydrology and fluvial geomorphological processes

1.5.212 The results of the detailed fluvial geomorphology presented above for 3260: Watercourses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation that demonstrates that the fluvial geomorphological process that control the distribution of fish habitat will not be adversely affected by the Trout Beck crossing, as changes to sediment dynamics are unlikely to significantly impact existing geomorphological process on the floodplain or in channel.

1.5.213 This section of the appropriate assessment covers fluvial geomorphology modelling of functionally linked watercourses (Hayber Beck/Moor Beck, Eastfield Sike, and Crooks Beck) in the Appleby to Brough scheme.

1.5.214 These watercourse are considered functionally linked to the SAC as they support all qualifying fish species, WCC and otter and are subject to new watercourse crossings and two flood storage areas, located adjacent to Moor Beck, are required in this scheme to avoid increasing flood risk downstream in the village of Warcop.

1.5.215 Full details of the modelling methodology, assumptions, and the field and desk study information used to inform and interpret the model are presented in the Geomorphology Modelling Report (Appendix 14.9: Detailed Geomorphological Modelling, Application Document 3.4). The modelling provides the evidence base for the appropriate assessment, to demonstrate that any impact to functionally linked habitats and species, and the supporting (geomorphological) process that control the quality and distribution of habitats are acceptable and will not give rise to an adverse effect on the integrity of the SAC.

1.5.216 Modelling covered the baseline scenario (i.e. existing conditions) for a number of flood return periods; the same return periods were modelled for the post-development scenario where the watercourse crossings, flood storage area and other features of the project (e.g. drainage channels), were incorporated into the model. This allowed for changes in fluvial geomorphological processes and hydrological parameters to be compared between the baseline and post-development scenarios.

1.5.217 Analysis of shear stress, mobile grain sizes, velocities and depth was undertaken to understand how sediment transport dynamics, riverbed scour and deposition, riverbank erosion and channel planform is likely to change under the post development scenario.

1.5.218 A flood compensation structure will be added on the floodplain area between the left bank of Moor Beck and the right bank of the Moor Beck offtake, and on the left bank floodplain of the Moor Beck. Water will be captured and stored within this structure across a range of flood events, reducing the conveyance of flood water across the floodplain on the left bank of Moor Beck on the approach to the embankments associated with Warcop Junction.

1.5.219 An embankment will be installed on the eastern extent of the flood compensation structure to improve retention of flood waters. Stored flood water will be conveyed back into Moor Beck on the right bank of the channel, directly upstream of the embankment associated with the flood compensation structure. The existing banks of Moor Beck will not be modified to facilitate the installation of the flood compensation structure.

1.5.220 An overview of the flood compensation structure is presented in Plate 1-12.

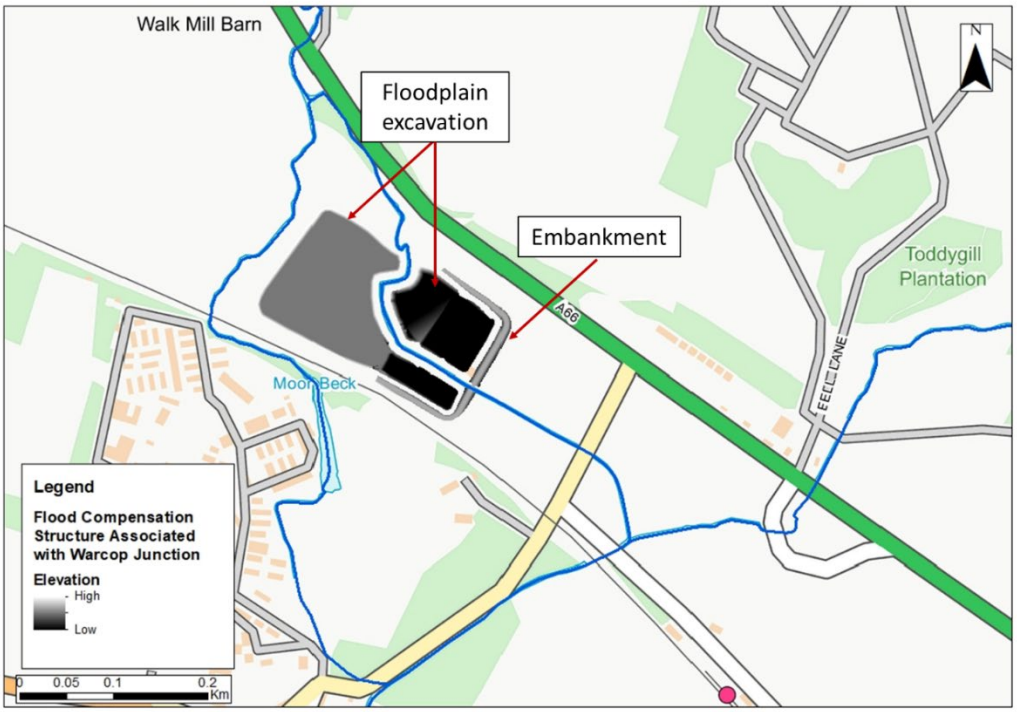


Plate 1-12: Overview of the flood compensation structure associated with Warcop Junction

1.5.221 The conservation objectives supplementary advice notes states that "*natural levels of coarse sediment supply are critical to the maintenance of high quality juvenile and salmon habitat, maintaining spawning gravels and characteristic biotope mosaics*" and "*coarse sediment supply is essential for the stability of the river channel and for creating and sustaining key biotopes including riffles and exposed shingle banks. Coarse sediment supply can be interrupted by weirs and other impounding structures, and by dredging or extraction, and can result in channel incision and heavy bankside erosion that have consequences for both biodiversity and river management (e.g. flood risk)*". The advice note also states that given (the River Eden SAC) "*is not a whole river SAC and a significant proportion of the upper catchment is outside of the SAC boundary. These areas are known to generate a significant amount of sediment which in turn impacts upon and adds to that generated within the SAC".*

1.5.222 In addition to the potential for alteration of the sediment regime, fish seeking low velocity areas during flood events as refuge, may enter the flood storage area and become stranded as the flood recedes. In the absence of suitable means of passage out of the flood compensation area as the flood recedes, there is potential for fish to become stranded in the flood storage areas. There is also potential for the flood storage areas to affect the sediment regime.

1-in-2 year flood event floodplain and in channel sediment entrainment

1.5.223 Under existing conditions in the 1-in-2 year flood event, minimal overland flow routes are observed on the floodplain in the vicinity of Warcop, as much of the flow within this flood return period is contained within the channel in both the baseline and post development scenarios, with the exception of the floodplain between Moor Beck and the Moor Beck (Offtake).

1.5.224 The typical size of material that can be mobilised on the floodplain between Moor Beck and the Moor Beck (Offtake) ranges between silts to medium gravels. In the post-development scenario, the addition of a flood compensation structure on the left and right bank of Moor Beck (Plate 1-12) generates localised variations in sediment transport dynamics on the floodplain.

1.5.225 The maximum size of material that can be mobilised on the floodplain in the vicinity of the flood compensation structure reduces. The flood compensation structure improves the lateral connectivity between the Moor Beck channel and floodplain, which improves the retention of water on the floodplain. As more flood water is captured and redistributed across the floodplain at the flood compensation structure, water pools and flow velocities reduce significantly. The hydraulic model results suggest that potential retention of fine material, ranging from silts to sands, is possible within the structure. The potential increased retention of fine material on the floodplain would represent improved geomorphological function, as this would limit the conveyance of fine material to downstream reaches on the Moor Beck and Crooks Beck, which could lead to the degradation of the riverbed substrate.

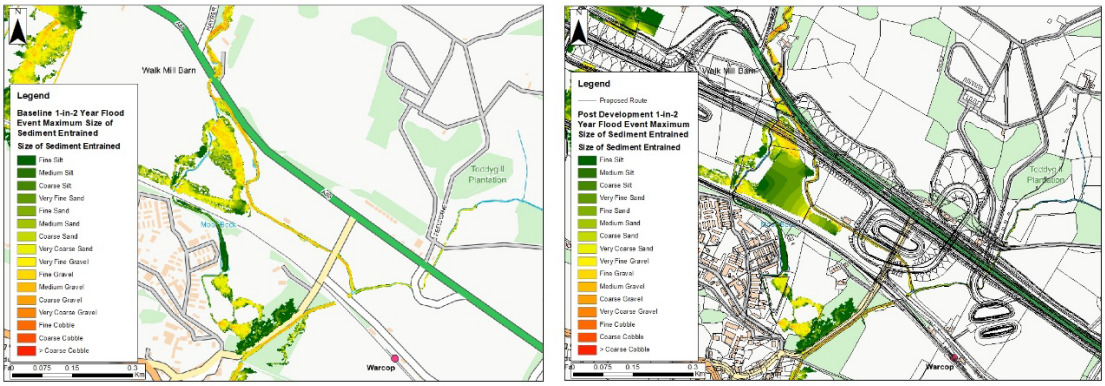


Plate 1-13: Maximum size of sediment entrained during baseline (left) and post-development (right) scenarios during a 1-in-2 year flood event

1-in-2 year flood event floodplain velocity comparison analysis

1.5.226 Plate 1-14 presents a comparison between maximum velocities on the floodplain in the post-development scenario and the baseline scenario. Minimal variations in maximum velocities were identified across the floodplain to the north of Warcop. Much of the flow during the 1-in-2 year flood event in both the baseline and post-development scenarios are contained within the channel (with negligible change in in channel velocity), with the exception of the floodplain between Moor Beck and the Moor Beck (Offtake). The addition of a flood compensation structure on the left and right bank of Moor Beck (Plate 1-12) generates localised variations in maximum flow velocities on the floodplain.

1.5.227 Maximum flow velocities reduce where water pools within the floodplain structure, and velocities increase where water is conveyed from the south eastern corner of the structure back into the Moor Beck on the right bank. Maximum increases in this area of the right bank of the Moor Beck are between 0.1 and 0.5m/s.

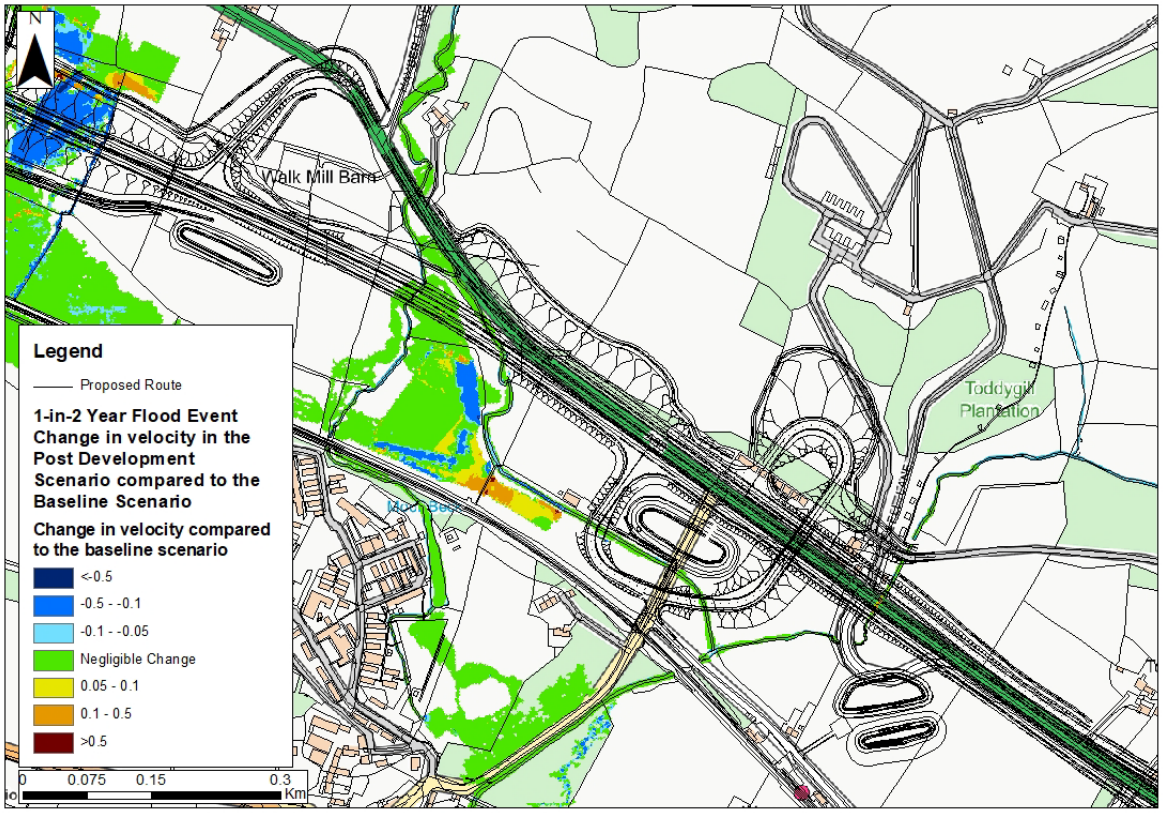


Plate 1-14: 1-in-2 year flood event change in Velocity in the post development scenario compared to the baseline Scenario

1-in-2 year flood event in-channel shear stress analysis

1.5.228 Plate 1-15 presents a comparison of the 1-in-2 year flood event in-channel maximum sizes of sediment entrained between the post development and baseline scenarios across Moor Beck and Crooks Beck (top) and Eastfield Sike (bottom).

1.5.229 The predicted maximum size of material that can be mobilised at each of the cross sections from the hydraulic model has been calculated for the Moor Beck and Crooks Beck and Eastfield Sike. Red circles indicate areas where the size of material that can be mobilised in the channel could increase in the post development scenario. In these locations slight changes to the composition of the riverbed could occur, with a small risk of scour. Green circles indicate areas where the size of the material that can be mobilised in the channel could decrease in the post development scenario.

1.5.230 No erosion is likely here, and there is the potential for a small increase in sediment deposition. All other areas have either no change, or changes in shear stress that are negligible meaning that the typical size of material that can be entrained will not change.

1.5.231 On Moor Beck and Crooks Beck, only two cross sections exhibited predicted changes in the maximum size of material that can be mobilised (Plate 1-15). Cross section CROO_01629D, located directly upstream of the confluence with the Eastfield Sike, experienced a small reduction in the

size of material that can be entrained, reducing from Coarse Gravel to Medium Gravel. On the Crooks Beck, cross section CR00_01394 experiences a small increase in the potential size of material entrained, increasing from very coarse gravel to fine cobble.

1.5.232 These changes are minor and localised in nature as demonstrated by all other cross sections existing no change. In summary, no significant changes to the size of sediment that can be entrained are predicted as a result of the Project on Moor Beck and Crooks Beck. The small variations predicted in the size of material that can be entrained at these two locations are unlikely to translate into significant increases to in-channel sediment deposition or erosion and as such fish habitat will not significantly change.

1.5.233 Site observations indicated that the typical size of material present on the riverbed on both Moor Beck and the Crooks Beck ranged between gravels to cobbles. As changes identified within the hydraulic model in both of these reaches are within the approximate ranges of typical sediment sizes already present on the riverbed, there is unlikely to be a change in the composition and structure of the riverbed and habitat for fish which will continue to offer spawning opportunities (gravel) and nursery habitat (cobble) qualifying fish species.

Model Cross Section	Baseline Q2 Sediment Size Moved	PostDev Q2 Sediment Size Moved
CROO_02656	Fine Cobble	Fine Cobble
CROO_02608	Very Coarse Gravel	Very Coarse Gravel
CROO_02605	Fine Cobble	Fine Cobble
CROO_02602	Fine Cobble	Fine Cobble
CROO_02570	Very Coarse Gravel	Very Coarse Gravel
CROO_02567	Very Coarse Gravel	Very Coarse Gravel
CROO_02518	Fine Cobble	Fine Cobble
CROO_02439	Fine Cobble	Fine Cobble
CROO_02408	Very Coarse Gravel	Very Coarse Gravel
CROO_02396	Fine Cobble	Fine Cobble
CROO_02332	Coarse Gravel	Coarse Gravel
CROK_00846B	Very Coarse Gravel	Very Coarse Gravel
CROO_02329	Medium Gravel	Medium Gravel
CROO_02329D	Coarse Gravel	Coarse Gravel
CROO_02324	Coarse Gravel	Coarse Gravel
CROO_02324D	Coarse Gravel	Coarse Gravel
CROO_02318	Fine Cobble	Fine Cobble
CROO_02250	Fine Cobble	Fine Cobble
UNN604_0515	Very Coarse Gravel	Very Coarse Gravel
CROO_02112	Fine Cobble	Fine Cobble
CROO_01997	Very Coarse Gravel	Very Coarse Gravel
CROO_01982	Fine Cobble	Fine Cobble
CROO_01965	Fine Cobble	Fine Cobble
UNN604_0240	Very Coarse Gravel	Very Coarse Gravel
CROO_01859	Very Coarse Gravel	Very Coarse Gravel
CROO_01838	Very Coarse Gravel	Very Coarse Gravel
CROO_01834	Very Coarse Gravel	Very Coarse Gravel
CROO_01834_U	Very Coarse Gravel	Very Coarse Gravel
CROO_01832	Fine Cobble	Fine Cobble
CROO_01765	Very Coarse Gravel	Very Coarse Gravel
CROO_01756	Very Coarse Gravel	Very Coarse Gravel
CROO_01629U	Medium Gravel	Medium Gravel
CROO_01629D	Coarse Gravel	Medium Gravel
CROO_01629D2	Medium Gravel	Medium Gravel
CROO_01629	Coarse Gravel	Coarse Gravel
CROO_01473	Very Coarse Gravel	Very Coarse Gravel
CROO_01394	Very Coarse Gravel	Fine Cobble
CROO_01394U	Medium Gravel	Medium Gravel
CROO_01394D	Medium Gravel	Medium Gravel
CROO_01321	Medium Gravel	Medium Gravel

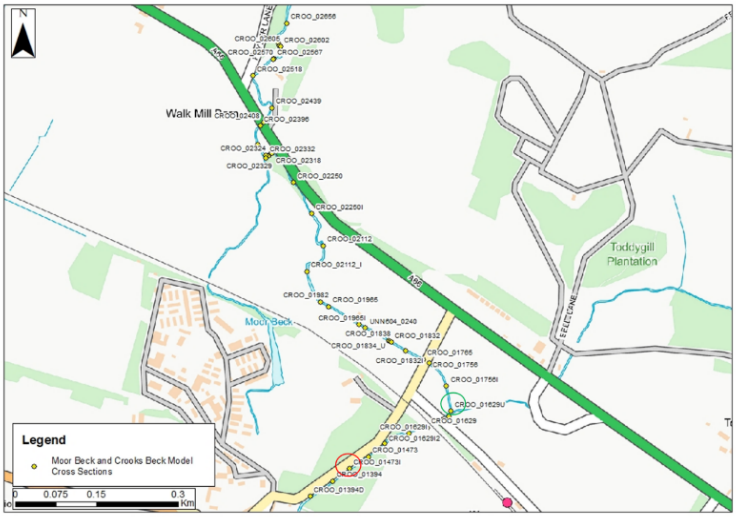
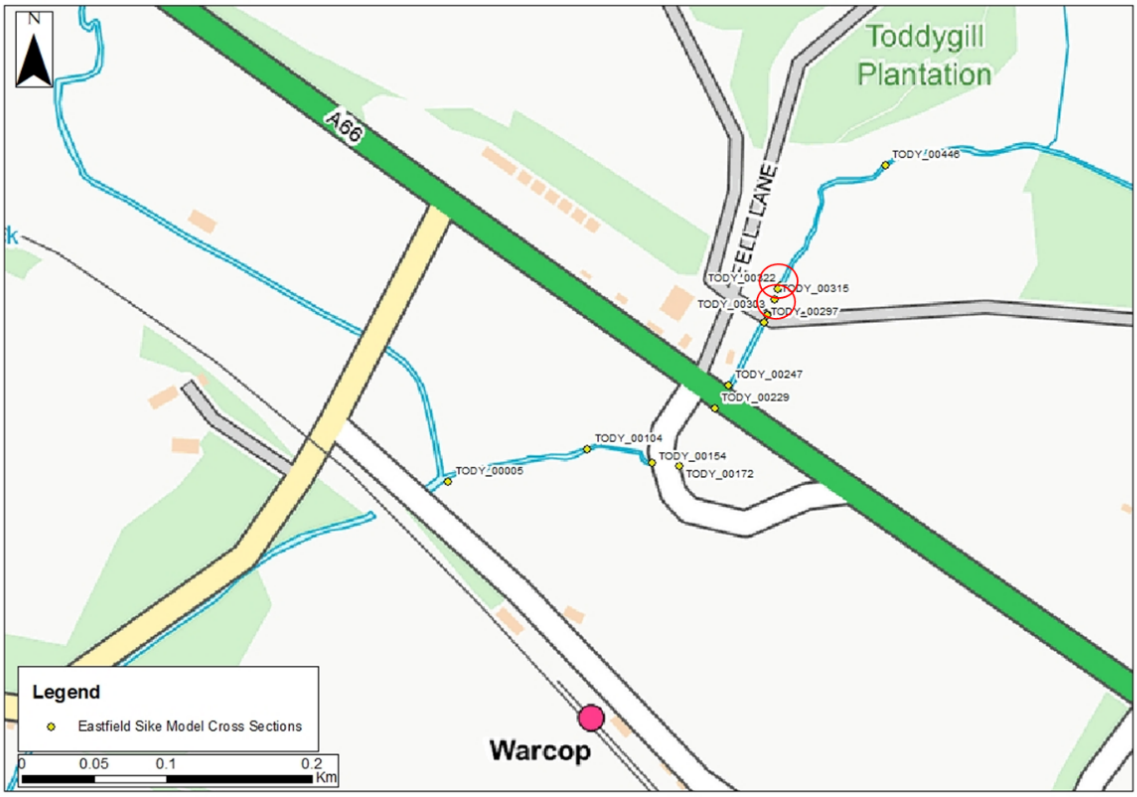


Plate 1-15: 1-in-2 year flood event comparison of in channel maximum size of sediment entrained on Moor Beck and Crooks Beck between the post development and baseline Scenarios

1.5.234 The model results for Eastfield Sike (Plate 1-16) predicts changes in the maximum size of material that can be mobilised at only two cross sections (TODDY_00297 and TODDY_00247); no change in the maximum size of material that can be mobilised is predicted at other cross sections. Cross section were changes are predicted are both located immediately upstream of the culvert that conveys the Eastfield Sike beneath the access road adjacent to Fell Lane (north of the existing A66). Both exhibited increases in the size of material that can be entrained, increasing from coarse gravel to very coarse gravel and fine gravel to coarse gravel. Increases in the size of material mobilised marked on the map are likely a result of the

replacement of the culvert beneath the existing A66 road with a new structure.

1.5.235 Removal of impoundment of flow upstream of the A66 road improves conveyance within the channel, leading to greater velocities and shear stress values. The predicted increase in the size of material that can be mobilised in this reach is unlikely to significantly impact existing sediment transport dynamics or the composition of the riverbed; no changes are predicted at all other cross-sections and habitat for fish which will continue to offer spawning opportunities (gravel), with some and nursery habitat (cobble) for qualifying fish species. Typical sizes of bed material noted on the Eastfield Sike during the site visit were predominantly gravels and some coarser material.



Model Cross Sections	Baseline Q2 Sediment Size Moved	PostDev Q2 Sediment Size Moved
TODY_00446	Fine Cobble	Fine Cobble
TODY_00322U	Coarse Gravel	Coarse Gravel
TODY_00322	Coarse Gravel	Coarse Gravel
TODY_00315	Fine Cobble	Fine Cobble
TODY_00303	Coarse Gravel	Coarse Gravel
TODY_00297	Coarse Gravel	Very Coarse Gravel
TODY_00247	Fine Gravel	Coarse Gravel
TODY_00229	Very Coarse Gravel	Very Coarse Gravel
TODY_00172	Very Coarse Gravel	Very Coarse Gravel
TODY_00154	Fine Cobble	Fine Cobble
TODY_00104	Very Coarse Gravel	Very Coarse Gravel

Plate 1-16: 1-in-2 Year Flood Event comparison of in channel maximum size of sediment entrained on the Eastfield Sike between the post development and baseline scenarios.

1-in-20 year flood event floodplain and in channel sediment entrainment

1.5.236 Under existing conditions in the 1-in-20 year flood event, an overland flow route is observed on the left bank floodplain, as water spills over the existing A66 carriageway and onto the floodplain. The same overland flow route observed in the 1-in-2 Year flood event between Moor Beck and Moor Beck (Offtake) is present (Plate 1-17).

1.5.237 The typical range of material that can be mobilised on the floodplain ranges between sands and coarse gravels. In the post-development scenario, the addition of a flood compensation structure on the left and right bank of the Moor Beck (as shown in Plate 1-12) generates localised variations in sediment transport dynamics on the floodplain (Plate 1-17). The maximum size of material that can be mobilised on the floodplain in the vicinity of the flood compensation structure reduces.

1.5.238 The flood compensation structure improves the lateral connectivity between Moor Beck channel and floodplain, which improves the retention of water on the floodplain. As more flood water is captured and redistributed across the floodplain at the flood compensation structure, water pools and flow velocities reduce significantly. The hydraulic model results suggest that potential retention of fine material, ranging from silts to sands, is possible within the structure. The potential increased retention of fine material on the floodplain would represent improved geomorphological function, as this would limit the conveyance of fine material to downstream reaches on Moor Beck and Crooks Beck, which could lead to the degradation of the riverbed substrate.

1.5.239 Water that previously spilled along the existing A66 road is diverted onto the floodplain between the Moor Beck and Moor Beck offtake and into the flood compensation area. This removes the overland flow route on the left bank of Moor Beck, and as a consequence the interaction between the proposed Moor Beck Junction and the overland flow route. This eliminates the risk of water backing up upstream of the junction, and additional water being conveyed through the underbridge structure. Therefore, the risk of scour on the left bank floodplain as a result of the installation of the Warcop Junction structure is significantly reduced. However, the loss of an overland flow route represents a change to the existing flow dynamics on the Moor Beck floodplain.

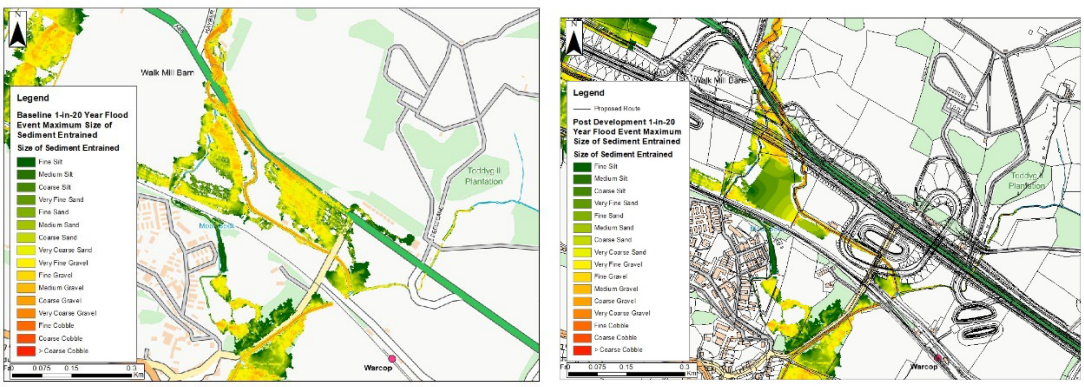


Plate 1-17: maximum size of sediment entrained under baseline scenario (left) and post development scenario (right) during a 1-in-20 year flood event

1-in-20 year flood event floodplain velocity comparison analysis

1.5.240 Plate 1-18 presents a comparison between maximum velocities on the floodplain in the post-development scenario and the baseline scenario. Significant variations in maximum velocities were identified across the floodplain to the north of Warcop. The most notable changes in flow velocities were identified on the left bank floodplain of Moor Beck in the vicinity of the proposed Warcop Junction structure (blue area to north of Moor Beck in Plate 1-18). Reductions in flow velocities in this area of the floodplain represent the removal of the overland flow route on the left bank of the Moor Beck in the post development scenario compared to the baseline scenario, and the loss of flow in this part of the floodplain.

1.5.241 Typical reductions in flow velocities range between 0.1 to 0.5m/s. Changes to the maximum velocities are unlikely to result in significant change to the morphological composition of the left bank floodplain, as these changes largely represent the loss of the overland flow route. The addition of a flood compensation structure on the left and right bank of Moor Beck (as shown in Plate 1-12) generates localised variations in maximum flow velocities on the floodplain. Maximum flow velocities reduce where water pools within the structure, and velocities increase on the right bank floodplain where water is conveyed from the south eastern corner of the structure back into Moor Beck. Maximum increases on the right bank of the Moor Beck are between 0.1 and 0.5m/s.

1.5.242 Whilst it is acknowledged that there is an increase to flow velocities, these changes are unlikely to result in significant change to the morphological composition of the floodplain. However, localised and simple measures can be taken to mitigate increases in flow velocities, such as riparian planting on the floodplain to increase roughness; these will be investigated further as part of detailed design.

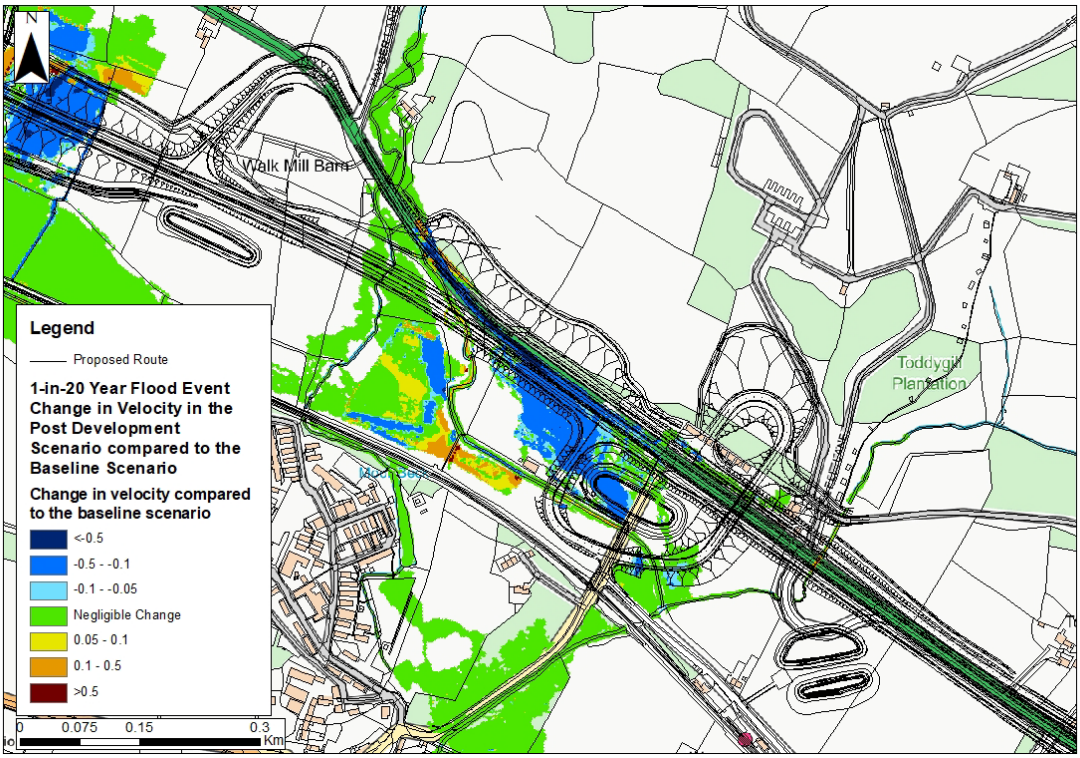


Plate 1-18: 1-in-20 year flood event change in velocity in the post development scenario compared to the baseline scenario

1-in-20 year flood event in-channel shear stress analysis

1.5.243 Plate 1-19 presents a comparison of the 1-in-20 year flood event in-channel maximum sizes of sediment entrained between the post development and baseline scenarios in Moor Beck and Crooks Beck.

1.5.244 The maximum size of material that can be mobilised at each of the cross sections from the hydraulic model has been calculated. Red circles indicate areas where the size of material that can be mobilised in the channel could increase in the post scenario. In these locations slight changes to the composition of the riverbed could occur, with a small risk of scour. Green circles indicate areas where the size of the material that can be mobilised in the channel could decrease in the post development scenario. No erosion is likely here, and there is the potential for a small increase in sediment deposition.

1.5.245 All other areas have either no change, or changes in shear stress that are negligible meaning that the typical size of material that can be entrained will not change. In Crooks Beck, the model predicts a small change in the maximum size of material that can be mobilised at only one cross section (CR00_01394, Plate 2-18), where a change from very coarse gravel to fine cobble in predicted. No changes to the maximum size of material that can be mobilised were observed on Moor Beck.

1.5.246 In summary, no significant changes to the riverbed composition arising from the scheme on the Moor Beck and Crooks Beck are predicted and habitat for fish which will continue to offer spawning opportunities (gravel) and nursery habitat (cobble) for qualifying fish species.

Model Cross Section	Baseline Q20 Sediment Size Moved	PostDev Q20 Sediment Size Moved
CROO_02656	Coarse Cobble	Coarse Cobble
CROO_02608	Very Coarse Gravel	Very Coarse Gravel
CROO_02605	Fine Cobble	Fine Cobble
CROO_02602	Coarse Cobble	Coarse Cobble
CROO_02570	Fine Cobble	Fine Cobble
CROO_02567	Very Coarse Gravel	Very Coarse Gravel
CROO_02518	Coarse Cobble	Coarse Cobble
CROO_02439	Fine Cobble	Fine Cobble
CROO_02408	Very Coarse Gravel	Very Coarse Gravel
CROO_02396	Fine Cobble	Fine Cobble
CROO_02332	Coarse Gravel	Coarse Gravel
CROK_00846B	Very Coarse Gravel	Very Coarse Gravel
CROO_02329	Medium Gravel	Medium Gravel
CROO_02329O	Coarse Gravel	Coarse Gravel
CROO_02324	Coarse Gravel	Coarse Gravel
CROO_02324O	Coarse Gravel	Coarse Gravel
CROO_02318	Fine Cobble	Fine Cobble
CROO_02250	Fine Cobble	Fine Cobble
UNN604_0515	Very Coarse Gravel	Very Coarse Gravel
CROO_02112	Fine Cobble	Fine Cobble
CROO_01997	Very Coarse Gravel	Very Coarse Gravel
CROO_01982	Fine Cobble	Fine Cobble
CROO_01965	Fine Cobble	Fine Cobble
UNN604_0240	Very Coarse Gravel	Very Coarse Gravel
CROO_01859	Very Coarse Gravel	Very Coarse Gravel
CROO_01838	Very Coarse Gravel	Very Coarse Gravel
CROO_01834	Coarse Gravel	Coarse Gravel
CROO_01834_U	Very Coarse Gravel	Very Coarse Gravel
CROO_01832	Fine Cobble	Fine Cobble
CROO_01765	Very Coarse Gravel	Very Coarse Gravel
CROO_01756	Very Coarse Gravel	Very Coarse Gravel
CROO_01629U	Medium Gravel	Medium Gravel
CROO_01629D	Medium Gravel	Medium Gravel
CROO_01629D2	Coarse Gravel	Coarse Gravel
CROO_01629	Coarse Gravel	Coarse Gravel
CROO_01473	Very Coarse Gravel	Very Coarse Gravel
CROO_01394	Very Coarse Gravel	Fine Cobble
CROO_01394U	Very Coarse Gravel	Very Coarse Gravel
CROO_01394D	Medium Gravel	Medium Gravel
CROO_01321	Medium Gravel	Medium Gravel

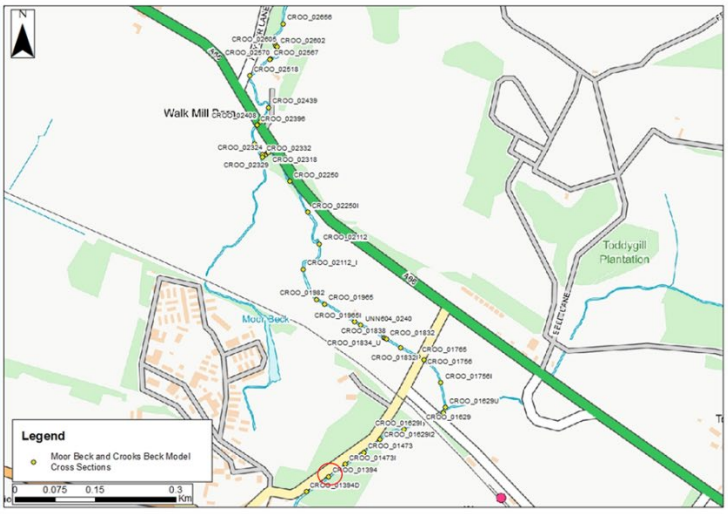


Plate 1-19: 1-in-20 year flood event comparison of in channel maximum size of sediment entrained on Moor Beck and Crooks Beck between the post development and baseline scenarios

1.5.247 In Eastfield Sike, only one cross section (TODDY_00297) was identified as experiencing change in the maximum size of material that can be mobilised (Plate 1-20). This cross section, located immediately upstream of the culvert that conveys the Eastfield Sike beneath the access road adjacent to Fell Lane (north of the existing A66), exhibited increases in the size of material that can be entrained, increasing from very coarse gravel to fine cobble. Increases in the size of material mobilised marked on the map are likely a result of the replacement of the culvert beneath the existing A66 road with a new structure.

1.5.248 Removal of impoundment of flow upstream of the A66 road improves conveyance within the channel, leading to greater velocities and shear stress values. The predicted increase in the size of material that can be mobilised in this reach is unlikely to significantly impact existing sediment transport dynamics or the composition of the riverbed. Typical sizes of bed material noted on the Eastfield Sike during the site visit were predominantly gravels and some coarser material.

1.5.249 No change in the maximum size of material that can be mobilised was any other cross sections (Plate 1-20).

Model Cross Sections	Baseline Q20 Sediment Size Moved	PostDev Q20 Sediment Size Moved
TODY_00446	Fine Cobble	Fine Cobble
TODY_00322U	Medium Gravel	Medium Gravel
TODY_00322	Medium Gravel	Medium Gravel
TODY_00315	Very Coarse Gravel	Very Coarse Gravel
TODY_00303	Medium Gravel	Medium Gravel
TODY_00297	Very Coarse Gravel	Fine Cobble
TODY_00247	Medium Gravel	Very Coarse Gravel
TODY_00229	Very Coarse Gravel	Very Coarse Gravel
TODY_00172	Very Coarse Gravel	Very Coarse Gravel
TODY_00154	Fine Cobble	Fine Cobble
TODY_00104	Coarse Gravel	Coarse Gravel

Plate 1-20: 1-in-20 year flood event comparison of in channel maximum size of sediment entrained on the Moor Beck and Crooks Beck between the post development and baseline scenarios

1-in-100 year + 94% climate change flood event floodplain and in channel sediment entrainment

1.5.250 Under baseline conditions in the 1-in-100 year + 94% climate change flood event, an overland flow route is observed on the left bank floodplain, as water spills over the existing A66 carriageway and onto the floodplain. This overland flow route crosses the existing road between the A66 carriageway and Warcop and re-enters the channel on the right bank of the Eastfield Sike and the left bank of Moor Beck upstream of the confluence between the two watercourses. The same overland flow route observed in the 1-in-2 year and 1-in-20 year flood event between Moor Beck and the Moor Beck (Offtake) is present (Plate 1-21).

1.5.251 The typical range of material that can be mobilised on the floodplain ranges between sands and coarse gravels. In the post-development scenario, there are minimal variations in the maximum size of material that can be mobilised within the flood compensation structure, in contrast with the

variations observed in smaller flood return periods (Plate 1-21). This is likely a result of the significant flow velocities associated with such a high flood return period across the floodplain between the Moor Beck and the Moor Beck (Offtake) negating the influence that the flood compensation has on the flow dynamics on this area of the floodplain. The typical size of material that can be mobilised within the flood compensation structure ranges between silts to gravels.

1.5.252 Water that previously spilled along the existing A66 road is diverted onto the floodplain between Moor Beck and the Moor Beck offtake and into the Moor Beck channel and the flood compensation structure. Despite this, water is still able to enter the left bank floodplain from the Moor Beck channel, as a consequence of the high volume of water conveyed in such a high flood return period.

1.5.253 The presence of the embankment associated with the flood compensation structure and the embankments associated with the Warcop Junction disrupt the conveyance of flow across the left bank floodplain, and water subsequently pools on the left bank floodplain. Water is able to enter the floodplain between the Warcop Junction West and Warcop Junction East as a consequence of the high volume of water conveyed in such a high flood return period. The typical size of material that can be mobilised on the left bank floodplain ranges between sands and gravels.

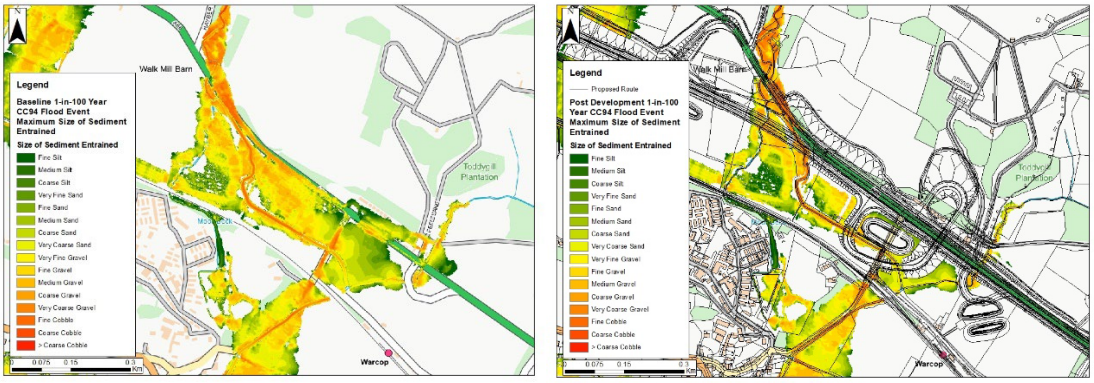


Plate 1-21: maximum size of sediment entrained under baseline scenario (left) and post development scenario (right) during a 1-in-100 year +94% climate change flood event

1-in-100 year +94% climate change flood event floodplain velocity comparison analysis

1.5.254 Plate 1-22 presents a comparison between maximum velocities on the floodplain in the post-development scenario and the baseline scenario during a1-in-100 year +94% climate change flood event. Significant variations in maximum velocities were identified across the floodplain to the north of Warcop. The most notable changes in flow velocities were identified on the left bank floodplain of Moor Beck in the vicinity of the proposed Warcop Junction structure (Plate 1-22).

1.5.255 The presence of the embankment associated with the flood compensation structure and the embankments associated with the Warcop Junction disrupt the conveyance of flow across the left bank floodplain, and water subsequently pools on the left bank floodplain. This results in significant

reductions in flow velocities on the floodplain upstream of the Warcop Junction Embankments, as the existing overland flow route observed in the Baseline Scenario is disrupted. Typical reductions in flow velocities range between 0.1m/s and 0.5m/s.

1.5.256 There are significant reductions in flow velocities within the extent of the Warcop Junction embankments and the flood compensation structure in the centre of the junction as a consequence of the loss of the overland flow route on the left bank of Moor Beck in the post development scenario compared to the Baseline scenario, and the loss of flow in this part of the floodplain. The addition of a flood compensation structure on the left and right bank of Moor Beck generates localised variations in maximum flow velocities on the floodplain.

1.5.257 Maximum flow velocities reduce where water pools within the structure, and velocities increase on the right bank floodplain where water is conveyed from the south eastern corner of the structure back into Moor Beck. Maximum increases in this area of the right bank of Moor Beck are between 0.1 and 0.5m/s, and in isolated areas are in excess of 0.5m/s. Increases in flow velocities of this magnitude could potentially cause scour of the right bank floodplain. Variations in flow velocities were observed on the floodplain in the vicinity of Eastfield Road, where the existing A66 culvert is to be modified. The replacement of this structure reduces flow impoundment upstream, facilitating the conveyance of more flow downstream and onto the floodplain. This has resulted in small increases and decreases in flow velocities on the floodplain, typically ranging between 0.1 and 0.5m/s.

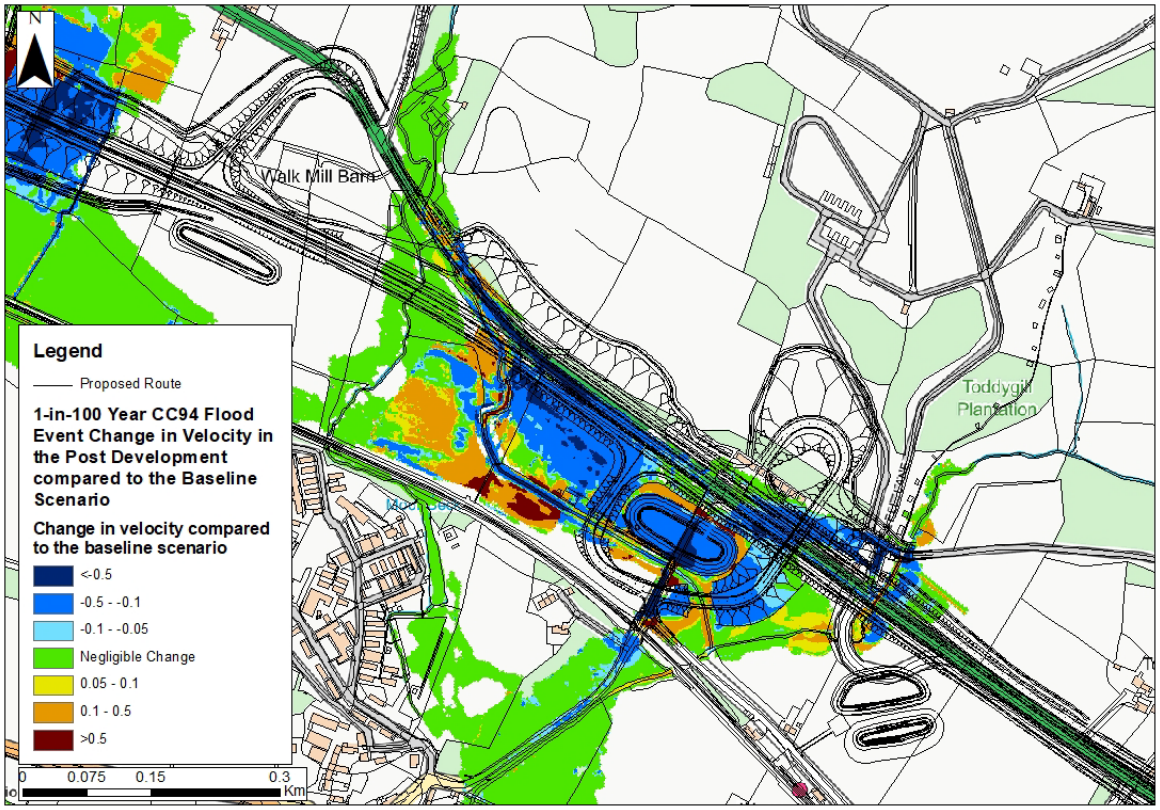


Plate 1-22: 1-in-100 year + 94% climate change flood event change in velocity in the post-development scenario compared to the baseline scenario

1-in-100 year +94% climate change event in-channel shear stress analysis

1.5.258 Plate 1-23 presents a comparison of the 1-in-100 Year +94% climate change flood event in-channel maximum sizes of sediment entrained between the post development and baseline scenarios for Moor Beck and Crooks Beck. The maximum size of material that can be mobilised at each of the cross sections from the hydraulic model has been calculated. Red circles indicate areas where the size of material that can be mobilised in the channel could increase in the post development scenario. In these locations slight changes to the composition of the riverbed could occur, with a small risk of scour. Green circles indicate areas where the size of the material that can be mobilised in the channel could decrease in the post development scenario. No erosion is likely here, and there is the potential for a small increase in sediment deposition.

1.5.259 All other areas have either no change, or changes in shear stress that are negligible meaning that the typical size of material that can be entrained will not change.

1.5.260 In Crooks Beck, the model predicts a small change in the maximum size of material that can be mobilised at only one cross section (CR00_01394, Plate 1-23), where a small change in the maximum size of material that can be mobilised is predicted, increasing from very coarse gravel to fine cobble. In summary, no significant changes to the riverbed composition arising from the scheme on the Crooks Beck are predicted.

1.5.261 In Moor Beck, six cross sections were identified where changes in the maximum sizes of material that can be mobilised are predicted (Plate 1-23). Cross sections CR00_01997, CR00_01982, CR00_01859, CR00_01838 and CR00_01756 all experienced reductions in the size of material that can be entrained, from either fine cobble to very coarse gravel, or coarse cobble to fine cobble.

1.5.262 Increases in water retention on the floodplain in the vicinity of the flood compensation structure, and the wide underbridge structures conveying Moor Beck beneath the Warcop Junction structure result in lower shear stress values in the channel. Conveyance of more flow onto the floodplain dissipates flow energy, reducing in-channel flow velocities and shear stresses. Wide underbridge structures improve the conveyance of flow on the floodplain to downstream reaches, mitigating the impoundment of flood waters on the floodplain upstream of the Warcop Junction structure. Therefore, the model predicts no increases in scour of the bed in the vicinity of the junction. Cross Section CR00_02112 experiences significant increases in the maximum size of material that can be mobilised, increasing from fine cobble to clasts greater than coarse cobble.

1.5.263 This significant increase is a result of the close proximity to the viaduct embankment to the left bank of Moor Beck. This results in an increase of both in-channel and floodplain velocities and shear stresses. Flow is

confined through the channel and a narrower floodplain area, which results in the increases in flow velocities and shear stresses. Such significant increases to the maximum size of material that can be mobilised will likely increase the risk of riverbed scour, which could ultimately lead to a change in the structure and composition of the riverbed as well as potential bank instability.

Model Cross Section	Baseline Q100CC94 Sediment Size Moved	PostDev Q100CC94 Sediment Size Moved
CROO_02656	>Coarse Cobble	>Coarse Cobble
CROO_02608	Fine Cobble	Fine Cobble
CROO_02605	Coarse Cobble	Coarse Cobble
CROO_02602	>Coarse Cobble	>Coarse Cobble
CROO_02570	Fine Cobble	Fine Cobble
CROO_02567	Very Coarse Gravel	Very Coarse Gravel
CROO_02518	Coarse Cobble	Coarse Cobble
CROO_02439	Fine Cobble	Fine Cobble
CROO_02408	Very Coarse Gravel	Very Coarse Gravel
CROO_02396	Coarse Cobble	Coarse Cobble
CROO_02332	Very Coarse Gravel	Very Coarse Gravel
CROK_008468	Very Coarse Gravel	Very Coarse Gravel
CROO_02329	Coarse Gravel	Coarse Gravel
CROO_02329D	Very Coarse Gravel	Very Coarse Gravel
CROO_02324	Coarse Gravel	Coarse Gravel
CROO_02324D	Very Coarse Gravel	Very Coarse Gravel
CROO_02318	Fine Cobble	Fine Cobble
CROO_02250	Coarse Cobble	Coarse Cobble
UNN694_0515	Very Coarse Gravel	Very Coarse Gravel
CROO_02112	Fine Cobble	>Coarse Cobble
CROO_01997	Fine Cobble	Very Coarse Gravel
CROO_01982	Coarse Cobble	Fine Cobble
CROO_01965	Fine Cobble	Fine Cobble
UNN694_0240	Fine Cobble	Fine Cobble
CROO_01859	Fine Cobble	Very Coarse Gravel
CROO_01838	Fine Cobble	Very Coarse Gravel
CROO_01834	Coarse Gravel	Coarse Gravel
CROO_01834_U	Coarse Gravel	Coarse Gravel
CROO_01832	Very Coarse Gravel	Very Coarse Gravel
CROO_01765	Very Coarse Gravel	Very Coarse Gravel
CROO_01756	Fine Cobble	Very Coarse Gravel
CROO_01629U	Medium Gravel	Medium Gravel
CROO_01629D	Medium Gravel	Medium Gravel
CROO_01629D2	Medium Gravel	Medium Gravel
CROO_01629	Very Coarse Gravel	Very Coarse Gravel
CROO_01473	Fine Cobble	Fine Cobble
CROO_01394	Very Coarse Gravel	Very Coarse Gravel
CROO_01394U	Coarse Gravel	Coarse Gravel
CROO_01394D	Coarse Gravel	Coarse Gravel
CROO_01321	Medium Gravel	Medium Gravel

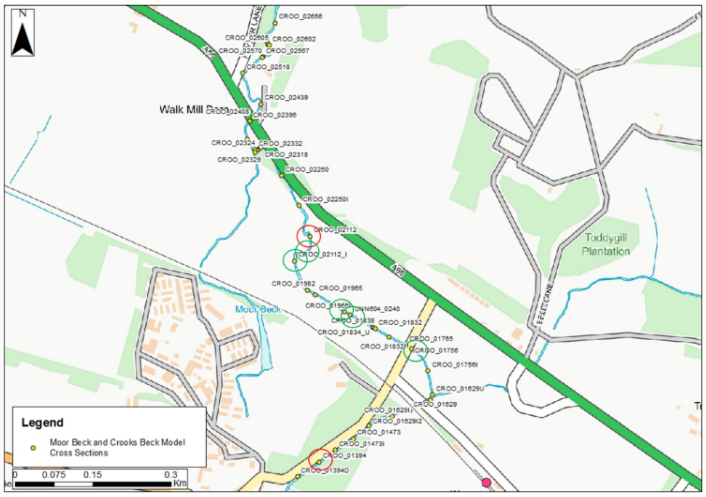
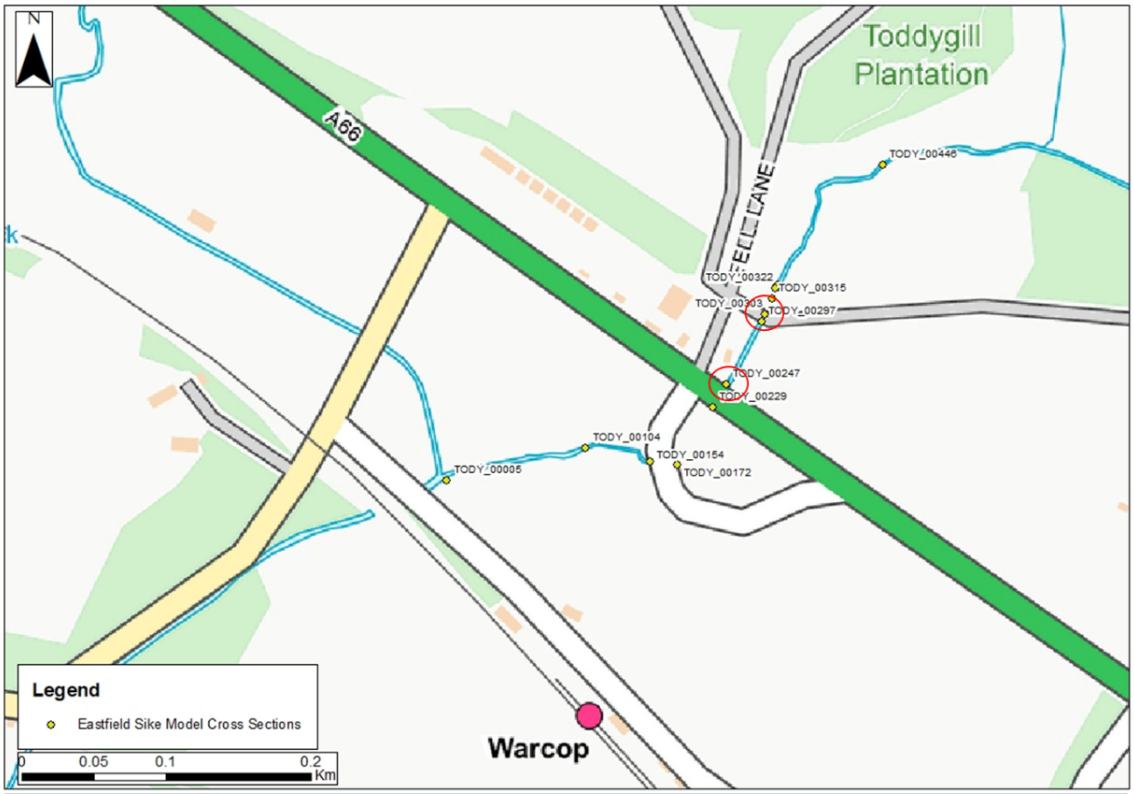


Plate 1-23: 1-in-100 Year +94% climate change flood event comparison of in channel maximum size of sediment entrained in Moor Beck and Crooks Beck between the post development and baseline scenarios

1.5.264 In Eastfield Sike, only two cross sections (TODDY_00297 and TODDY_00247) were predicted to experience a change in the maximum size of material that can be mobilised (Plate 1-24). The cross sections, located immediately upstream of the culvert that conveys the Eastfield Sike beneath the access road adjacent to Fell Lane and immediately upstream of the existing A66 culvert respectively, experienced increases in the size of material that can be entrained, increasing from very coarse gravel to fine cobble and medium gravel to very coarse gravel. Increases in the size of material mobilised marked (Plate 1-24) are likely a result of the replacement of the culvert beneath the existing A66 road with a new structure.

1.5.265 Removal of the flow impoundment upstream of the A66 road improves conveyance within the channel, leading to greater velocities and shear stress values. The predicted increase in the size of material that can be mobilised in this reach is unlikely to significantly impact existing sediment transport dynamics or the composition of the riverbed. Typical sizes of bed material noted on the Eastfield Sike during the site visit were predominantly gravels and some coarser material.



Model Cross Sections	Baseline Q100CC94 Sediment Size Moved	PostDev Q100CC94 Sediment Size Moved
TODY_00446	Fine Cobble	Fine Cobble
TODY_00322U	Medium Gravel	Medium Gravel
TODY_00322	Medium Gravel	Medium Gravel
TODY_00315	Very Coarse Gravel	Very Coarse Gravel
TODY_00303	Medium Gravel	Medium Gravel
TODY_00297	Very Coarse Gravel	Fine Cobble
TODY_00247	Medium Gravel	Very Coarse Gravel
TODY_00229	Very Coarse Gravel	Very Coarse Gravel
TODY_00172	Fine Cobble	Fine Cobble
TODY_00154	Coarse Cobble	Coarse Cobble
TODY_00104	Coarse Gravel	Coarse Gravel

Plate 1-24: 1-in-100 year +94% climate change flood event comparison of in channel maximum size of sediment entrained on the Eastfield Sike between the post development and baseline Scenarios

1.5.266 In summary, the fluvial geomorphology modelling presented demonstrates that during a 1-in-2 year flood event in Moor Beck:

- No significant changes to in-channel sediment transport dynamics across Moor Beck are predicted.
- No significant changes to floodplain sediment transport dynamics and flow velocities are predicted either; this is primarily down to the containment of much of the flow within the channel and as such minimal interaction with proposed structures on the floodplain.
- The flood compensation structure improves connectivity to the floodplain and could potentially result in fine material dropping out of transport within the structure. The potential retention of fine material on the floodplain would represent improved geomorphological functioning.

1.5.267 During a 1-in-20 year event in Moor Beck:

- No significant changes to in-channel sediment transport dynamics in Moor Beck are predicted.
- Minor changes to floodplain sediment transport dynamics and flow velocities are predicted. Water that previously spilled along the existing A66 road and onto the left bank floodplain is diverted onto the floodplain between Moor Beck and the Moor Beck offtake and into the flood compensation area. This removes the overland flow route on the left bank of Moor Beck and, as a consequence, the interaction between the Moor Beck Junction and the overland flow route.
- The flood compensation structure improves connectivity to the floodplain and could potentially result in fine material dropping out of transport within the structure. The potential retention of fine material on the floodplain would represent improved geomorphological functioning.

1.5.268 During a 1-in-100 Year + 94% climate change event in Moor Beck:

- Minor reductions in the size of material that can be entrained in the channel in the vicinity of the Warcop Junction structure are predicted. However, this is unlikely to result in changes to the composition of the riverbed, as changes in the size of material that can be entrained are within the ranges observed on site.
- Significant increases in the size of material that can be entrained in the channel in the vicinity of the Moor Beck viaduct are predicted. This has the potential to result in increases in riverbed scour and a change in the composition of the riverbed as well as bank instability.
- There are significant reductions to flow velocities on the left bank floodplain. The overland flow route is disrupted by the presence of the embankments associated with the Warcop Junction and flood compensation structure. Flow velocities reduce significantly, as water is impounded on the floodplain upstream, and flow is unable to pass through the structure. However, this is unlikely to result in significant change to the composition of the floodplain.
- There are significant increases in flow velocities on the right bank of Moor Beck where flow is conveyed from the flood compensation structure back into the channel. These increases have the potential to increase scour of the floodplain and riverbanks.

1.5.269 In the case of Eastfield Sike, the hydraulic modelling results across all three flood events assessed, no significant changes are predicted associated with the Eastfield Sike channel and floodplain.

- Small increases in the size of sediment that can be entrained in the channel are predicted, as the modification of the existing A66 carriageway culvert reduces flow impoundment, increases conveyance of flow in the channel and leads to small increases to in channel flow velocities. However, this is unlikely to result in changes to the composition of the riverbed, as changes in the size of material that can be entrained are within the ranges observed on site.
- Small variations in flow velocities on the Eastfield Sike floodplain are predicted. The modification of the existing A66 carriageway culvert reduces flow impoundment upstream, facilitating the conveyance of

more flow downstream and onto the floodplain. This has resulted in small increases and decreases in flow velocities on the floodplain. However, these are insignificant.

1.5.270 The modelling results demonstrate that changes in changes in-channel hydrology and fluvial geomorphological processes in functionally linked watercourses as a result of the Project are not significant under the 1-in-2 and 1-in-10 flood scenarios. Where increases or decreases in the size of the material that can be mobilised have been identified, they are minor (small changes in clast size predicted) and localised (predicted changes are restricted to only a few cross-sections). The predicted changes in the size of material that can be mobilised are considered unlikely to significantly impact existing sediment transport dynamics or the composition of the riverbed and the habitat it offers fish.

1.5.271 In an extreme event (1-in-100 year + 94% climate change flood event) significant increases in the size of material that can be entrained in the channel in the vicinity of Moor Beck viaduct are predicted. This has the potential to result in increases in riverbed scour and a change in the composition of the riverbed as well as bank instability.

1.5.272 A number of options have been proposed to mitigate the risk of floodplain and riverbank scour during higher flood return periods. The feasibility and design development of these options will be undertaken during detailed design and any future plans will be developed to ensure there is no change to the conclusions set out within this SIAA. This may include additional geomorphological modelling on a iterative basis to inform detailed design of mitigation. It will be used to demonstrate that the detailed design achieves the outcomes relied upon within this HRA.

1.5.273 The following mitigation measures, secured by the Project Design Principles (Application Document 5.1.1) and Environmental Management Plan (Application Document 2.7), which are certified documents under DCO, will be implemented at detailed design stage:

- Green scour protection measures will be implemented on the left bank of Moor Beck in the vicinity of Moor Beck Viaduct structure to mitigate the risk of floodplain and riverbank scour.
- Green scour protection measures will be implemented on the right bank floodplain of Moor Beck in the vicinity of the Warcop Junction West structure to mitigate the risk of floodplain and riverbank scour.
- Increasing the roughness of the floodplain, by planting riparian tree cover and floodplain tree cover will be implemented. This will act to slow flow conveyance on the floodplain, reducing flow velocities and mitigating the risk of scour on the floodplain and on the riverbanks of the Moor Beck.
- Increasing the roughness within the flood compensation structure will be implemented. This will improve the storage of fine material during flood events, as well as provide habitat benefits.
- Realignment of Moor Beck in the reach between the Moor Beck Viaduct and the Warcop Junction structure. This will reduce flow velocities and redirect flow energy away from the embankment

associated with the Moor Beck Viaduct. This will reduce the risk of scour in the vicinity of the embankment in the 1-in-100 Year + CC94 Flood Event.

1.5.274 The flood compensation structure, which is required to Protect the village of Warcop downstream, results in improves connectivity to the floodplain and could potentially result in fine material dropping out of transport within the structure as result of slower flow velocities. It should be noted that no significant changes to floodplain sediment transport dynamics and flow velocities were predicted during the 1-in-2 year flood event. This demonstrate that under normal flow conditions (i.e. a 1-in-2 year flood event or less) channel and floodplain sediment transport dynamics are maintained and as such there will be no change as a result of the Project.

1.5.275 During detailed design the design of flood storage areas will be optimised to minimise the risk of fish stranding during extreme flood events. No additional hard structures will be introduced to the riparian zone (associated with new attenuation basin discharges) in to the SAC or functionally linked watercourses; discharge outlets will be open ditches where currently existing natural bank structures enable the free river migration / geomorphological change to occur.

1.5.276 ***In summary, it is considered that, when incorporating the described avoidance and/or mitigation measures, an adverse effect on qualifying fish as a result of changes in hydrology and fluvial geomorphological processes can be ruled out (beyond reasonable scientific doubt) alone*.**

White-clawed crayfish

Land take / resource requirements / reduction of habitat area

1.5.277 There will not be a reduction in WCC habitat area within the SAC as a result of the Trout Beck viaduct which spans the river. This designed feature has minimised the potential for a reduction of habitat area and is secured through the Project Design Principles (ES Application Document 5.11), which is a certified document under the DCO. Likewise, the majority (five out of six) of new watercourse crossings of functionally linked watercourses in Appleby to Brough scheme are open span and will not result in loss of WCC habitat. There will be some localised shading of in stream and riparian habitats associated with the extension of existing culverts in functionally linked watercourses (see Table 9: Proposed watercourse crossings of the SAC and functionally linked habitats), but where new culverts are constructed or existing culverts are replaced, they will be sunken to enable natural substrate to form, thus maintaining the area of aquatic habitat.

1.5.278 This designed feature has minimised the potential for a reduction of habitat area and is secured through the Project Design Principles (ES Application Document 5.11). The shading of watercourses associated with culvert extension is considered negligible, and as long as watercourse crossing design facilitates the free movement of WCC through bridges and culverts (as prescribed in the Project Design Principles, ES Application Document 5.11) to the abundant habitat upstream and downstream, this would not

adversely affect the extent and distribution of WCC or their habitats, and populations of WCC, and their distribution within the functionally linked rivers and the SAC itself will be maintained.

1.5.279 ***In summary, it is considered that, when incorporating the described avoidance measures (through sensitive watercourse crossing design to minimise habitat loss and facilitate migration), an adverse effect on WCC can be ruled out (beyond reasonable scientific doubt) alone.***

Disturbance of mobile species and species fragmentation

1.5.280 As described above, potential disturbance to WCC has been significantly reduced as a result of best practice watercourse crossing design; the majority (five out of six) of new watercourse crossings are viaducts and open span bridges, as shown in Table 9: Proposed watercourse crossings of the SAC and functionally linked habitats, meaning that dewatering activities and over pumping will only be required generally not be required for watercourses supporting qualifying WCC.

1.5.281 WCC are nocturnal and move to feed at night. Night working will be avoided where practicable adjacent to watercourses. Night working will only be implemented where traffic management on a road necessitates it for safety. If this occurs in proximity to watercourses all lighting will be designed to be directed away from the watercourse.

Species mortality / injury

1.5.282 Where instream works or dewatering are required, they will be carried out under the supervision of a suitably qualified ECoW with a freshwater ecology and fisheries specialism with experience of overseeing construction activities in or near water. The ECoW's role will involve overseeing the dewatering process and translocation of WCC under a Natural England CL23 maintenance licence (to move WCC for maintenance between 1 July and 30 September) and/or a Natural England CL11 (survey or research licence) as appropriate. This would involve managing the drawdown rate based on the abundance of individuals to be translocated through liaison with the dewatering team. WCC translocation would take place prior to dewatering in order to move fish from impacted areas to suitable habitat elsewhere. Fish translocation and dewatering methods would be secured through the EMP.

1.5.283 It is considered that, when incorporating the described avoidance and/or mitigation measures, an adverse effect on WCC as a result of species injury and mortality can be ruled out (beyond reasonable scientific doubt) alone.

Introduction and/or spread of invasive non-native species

1.5.284 The introduction and/or spread of invasive non-native species will be managed through the strict implementation of an Invasive Non-Native Species Management Plan. This plan will be produced by the Principal Contractor(s) (in consultation with specialist contractors), as specified within the EMP. More information on the management invasive non-native species and biosecurity protocols relevant to qualifying fish species is

provided above for 3260: Watercourses of plain to montane levels with the *Ranunculion fluitantis* and Callitricho-Batrachion vegetation.

1.5.285 ***It is considered that, when incorporating the described avoidance and/or mitigation measures, an adverse effect on WCC can be ruled out (beyond reasonable scientific doubt) alone with no residual effect.***

Changes in surface and groundwater quality, quantity, and hydrogeology

1.5.286 Potential impacts on WCC as a result of changes in surface and groundwater quality, quantity, and hydrogeology will be managed throughout construction and operation through the implementation of best practice construction techniques and pollution prevention and treatment of road runoff as specified within the EMP. These measures are set out in detail above for 3260: Watercourses of plain to montane levels with the *Ranunculion fluitantis* and Callitricho-Batrachion vegetation.

1.5.287 ***It is considered that, when incorporating the described avoidance and/or mitigation measures, an adverse effect on WCC can be ruled out (beyond reasonable scientific doubt) alone.***

Otter

Disturbance of mobile species and species fragmentation

1.5.288 Species and habitat fragmentation of otter will be avoided during operation through the incorporation of best practice watercourse crossing design (in line with DMRB, 2011)[68] to enable the free movement of otter, maintaining the connectivity within and to the SAC.

1.5.289 Where new bridges and culverts are constructed at locations where the road dissects a watercourse, these will be designed in line with the Project Design Principles (ES Application Document 5.11) to allow the safe passage of otters during spate conditions.

1.5.290 ***It is considered that, when incorporating the described embedded avoidance and/or mitigation measures, an adverse effect on otter can be ruled out (beyond reasonable scientific doubt) alone.***

Species mortality / injury

1.5.291 The potential for increased otter mortality as a result of the Project has been mitigated through the design of effective temporary and permanent watercourse crossings, that will facilitate the movement of otter, as covered above.

1.5.292 ***It is considered that, when incorporating the described embedded avoidance and/or mitigation measures, an adverse effect on otter can be ruled out (beyond reasonable scientific doubt) alone.***

[68] DMRB. Nature Conservation Advice in Relation to Otters. 2011. Vol. 10, Sect. 4, Part 4, HA81/99. [4] Highways Agency (2008). Design manual for roads and bridges, HA116/08. Nature conservation.

Summary of assessment with mitigation

1.5.293 ***In summary, it is considered that given the implementation of the avoidance and/or mitigation measures proposed for the Project, that adverse effects on the integrity of the River Eden SAC can be ruled out alone (beyond reasonable scientific doubt).***

In combination assessment

1.5.294 It is a requirement of the Habitat Regulations to examine the potential for a plan or project to have a significant effect either alone or in combination with other plans and projects. Where residual effects which are not considered significant alone, but when combined with other 'residual' effects could give rise to an adverse effect site integrity are identified, an in combination assessment is required. Whilst not explicit in Regulation 63(5), case law (European Court of Justice, 2004)[69] informs us that an in combination assessment is required at both Stage 1 (screening assessment) and Stage 2 (appropriate assessment).

1.5.295 The appropriate assessment for the Project identified the following effects during construction that are considered to have residual impacts and may give rise to an adverse effect in combination with other plans and projects:

- Land take / resource requirements / reduction of habitat
- Disturbance of mobile species and species fragmentation
- Species injury and mortality
- Changes in surface and groundwater quality, quantity, and hydrogeology

1.5.296 The appropriate assessment for the Project identified the following effects during construction that are considered to have residual impacts and may give rise to an adverse effect in combination with other plans and projects:

- Changes in hydrology and fluvial geomorphological processes

1.5.297 The air quality assessment is inherently in combination as it considers other plans and projects when determining the future baseline (do minimum) scenario.

Identification of Other Plans and Projects

1.5.298 The *Habitats Regulations Assessment Handbook* (Tyldesley and Chapman, 2013)[50] *states that plans or projects at the following stages may be relevant to an in combination assessment:*

- Applications lodged but not yet determined, including refusals subject to an outstanding appeal or legal challenge
- Projects subject to periodic review e.g. annual licences, during the time that their renewal is under consideration
- Projects authorised but not yet started
- Projects started but not yet completed
- Known projects that do not require external authorisation
- Proposals in adopted plans

[69] European Court of Justice (2004) Case C – 127/02 Waddenzee 7 September 2004 (Para 45)

- Proposal in draft plans formally published or submitted for final consultation, examination, or adoption

1.5.299 Projects identified for consideration of in combination effects are outline in Table 10: Identified developments and projects with potential for in combination effects.

1.5.300 Not all the identified in combination plans and projects are considered to have the potential to add in combination effects with the A66 Project. This is based either on anticipated effects of those projects alone, spatial separation, or because the temporal scope of the plans and projects does not align (i.e. the impacts will occur at different times and will therefore not cause in combination effects).

Table 10: Identified developments and projects with potential for in combination effects

Development	Planning ref	Location and distance from Project	Status	Construction period	Description
Flakebridge River Restoration, Frith Beck	20/0094	Flakebridge, 1.8km north east	Full approval	Completed 2020	River restoration of 400m of channel of Frith Beck (a tributary of Trout Beck). Including 2 New Channels, 3 Chutes and In Channel features to include Riffles and Bars.
Appleby Flood Risk Scheme	21/0869	Appleby, 500m south Temple Sowerby to Appleby, within River Eden SAC	Full approval (22/01/2022)	03/06/2021 to 12/01/2022	Development of a new pumping station control building within Broad Close Car Park, a new outfall structure in the River Eden and reconfiguration of Broad Close Car Park.
Residential development of up to 149 dwellings	19/0426	Land off Carleton Road, 155m north of M6 Junction 40 to Kemplay Bank (250m from SAC boundary)	Full approval (05/02/2020)	Not defined, development has not yet commenced.	The project includes development of the site into a residential area with associated hard and soft landscaping and a sustainable urban drainage (SUD's) scheme.
Eden Rivers Trust Trout Beck Restoration	n/a	Within the Temple Sowerby to Appleby	n/a	n/a	River restoration project to include construction of a secondary channel

Development	Planning ref	Location and distance from Project	Status	Construction period	Description
		scheme, immediately adjacent to the proposed Trout Beck crossing			with riffles, backwater and scrapes adjacent to existing Trout Beck channel and addition of riffles, pool and other channel features in the existing Trout Beck channel.

Flakebridge River Restoration, Frith Beck (20/0094)

1.5.301 This river restoration scheme was completed by the Eden Rivers Trust in summer 2020 and so there is considered to be no risk of in combination effects during construction of the Project. The river restoration project involved enhancement and habitat creation in Frith Beck (a tributary of Trout Beck); there are considered to be no residual adverse effects (from construction or operation) resulting from the river restoration project to assess in combination with the Project because there will no longer be any potential residual effects from the construction of the restoration project by commencement of construction of the Project.

Appleby Flood Risk Scheme (21/0869)

1.5.302 This project is located along the left bank within a meander bend of the River Eden, to the west of Appleby Town Centre Appleby (500m south of the Temple Sowerby to Appleby scheme and located within River Eden SAC). The project consists of a new pumping station control building within Broad Close Car Park, a new outfall structure in the River Eden and reconfiguration of Broad Close Car Park. The project will reduce flood risk in Appleby by enabling flood flows to be discharged into the River Eden during high water levels, providing an improved level of protection to around 65 properties.

1.5.303 An HRA appropriate assessment has been undertaken for the project, *Stage 2 Habitat Regulation Assessment* (Environment Agency, 2019)[70]. The assessment identified the following potential risks to qualifying features:

1.5.304 WCC:

- Direct injury / mortality due to creation of a dry works area which could result in a reduction in the population of the qualifying species.

[70] Environment Agency (2021) Stage 2 Habitats Regulations Assessment, available at: https://plansearch.eden.gov.uk/fastweb_upload/2021%20Planning%20Applications/21-0869/Plans-and-Supporting-Documents/21-0869_HRA_24-09-21.pdf [accessed: 24/04/22]

1.5.305 *Fish (*Atlantic salmon*, s*ea lamprey*, r*iver lamprey*, b*rook lamprey*, b*ullhead*)*:

- Habitat damage / loss due to creation of a dry works area which could result in a change in the extent and distribution of habitats of qualifying species
- Altered velocities and flow regime due to the creation of a dry works area and operation of the scheme which could result in a change in the structure and function of the habitats of qualifying species
- Disturbance during construction within and adjacent to the watercourse that could result in changes in the distribution of qualifying species within the site
  Direct injury / mortality during creation of the dry works area which could result in a reduction in the population of the qualifying species.

1.5.306 The appropriate assessment concluded that adverse effects of the integrity of the SAC could be avoided during construction through mitigation, which included avoiding in-channel works during the most sensitive times for the qualifying fish species, no night-time working within or adjacent to the watercourse and fish removal prior dewatering. Any potential impacts were considered to affect only a small area (approximately 18 $m^{2)}$ of habitat and will be temporary. The habitat affected was considered abundant throughout the surrounding reach and has been assessed as not suitable for spawning fish or juvenile lamprey. The permanent outfall structure will be out of the river channel.

1.5.307 The construction period for the works was due to run from July 2021 to January 2022 but is expected to be completed later in 2022 and so works will not be concurrent with the Project, which is expected to commence in 2024. As such any residual construction effects do not need to be assessed in combination with the Project.

1.5.308 No adverse effect on site integrity during the operation of the proposed flood scheme were identified in the appropriate assessment for any of the qualifying features. As such there are considered to be no known effects to consider in combination with the Project during operation.

Carleton Road Housing Development (19/0426)

1.5.309 This project is located 155m north of M6 Junction 40 to Kemplay Bank scheme and 190m from SAC boundary. The project includes development of the site into a residential area with associated hard and soft landscaping and a sustainable urban drainage (SUD's) scheme. No formal HRA screening or appropriate assessment has been produced, however, the project ecological assessment concludes that *nearby designated sites (including the River Eden SAC) are considered to be sufficiently distanced and partially barriered from the (housing development project) site by infrastructure such as the busy A66 main carriageway. It is considered that the proposed development is unlikely to result in significant negative impact on these sites so long as management of construction practices and pollution is adhered to throughout. The report also concludes that no watercourses were present on or within proximity to the site with suitability for use by otter; it is considered that otter are absent from the site.*

1.5.310 In addition, the *Supporting Planning Statement - Detailed Planning Application* (Story Homes, 2019)[71] states in relation to SUDs that *the proposed development includes a SUDs pond as part of the surface water drainage scheme. This will mitigate impact on Carleton Beck as the receiving watercourses, and will effectively mimic the pre development conditions.*

1.5.311 Based on the above there are no defined potential effects on qualifying features of the SAC as result of construction and operation, that can be assessed in combination with the A66 Project.

Eden Rivers Trust Sleastenhowe (Trout Beck) Restoration

1.5.312 The only project identified that could potentially overlap with the A66 and give rise to disturbance of mobile species and species fragmentation in combination is the Eden Rivers Trust Trout Beck Restoration. The project is located within the SAC in the Temple Sowerby to Appleby scheme, immediately adjacent to the proposed Trout Beck crossing.

1.5.313 The outline design of this project has been discussed with the Eden Rivers Trust during consultation. The Trust shared the outline design, which the Project considered during the design of the proposed Trout Beck crossing. The restoration project, which involves creation of a secondary channel with riffles, backwaters and scrapes adjacent to existing Trout Beck channel and addition of riffles, pool and other channel features in the existing Trout Beck channel downstream of the proposed new Trout Beck crossing, will not be affected by the Project or inhibit the scheme success. The Project and possible implications for the Sleastenhowe (Trout Beck) restoration was discussed with the Eden Rivers Trust in a meeting in July 2021. The alignment options at the time of the meeting were discussed with the Eden Rivers Trust. Whilst options located away from the Sleastenhowe (Trout Beck) restoration project corridor (located immediately adjacent to the proposed viaduct location) were preferred, as they would not interact with the restoration project, it was confirmed by the Trust that none of proposed alignments would preclude the restoration project being delivered and the objectives being achieved.

Assessment of potential in combination effects with the identified plans or projects

Land take / resource requirements / reduction of habitat (construction)

1.5.314 Works in relation to Appleby Flood Risk Scheme (21/0869) predicted temporary habitat damage / loss due to creation of a dry works area which could result in a change in the extent and distribution of habitats of qualifying species. The works were considered to affect only a small area (approximately 18 m^2) of habitat and will be temporary. This project, scheduled to finish in January 2022, will not overlap so any construction-

[71] Story Homes (2019) Supporting Planning Statement - Detailed Planning Application, available at: https://plansearch.eden.gov.uk/fastweb_upload/2019%20Planning%20Applications/19-0426/Plans-and-Supporting-Documents/AMENDED%20PLANS%20AND%20DOCS%2027-09-2019/19-0426-Supporting%20Planning%20Statement%20September%202019.pdf [accessed: 24/04/22]

related effects will not overlap. No land take / resource requirements / reduction of habitat is anticipated for any other projects identified for the in combination assessment. ***As such in combination effects in relation to habitat losses are not considered likely to lead to an adverse effect on the integrity of the SAC.***

Disturbance of mobile species and species fragmentation (construction)

1.5.315 For the purposes of this assessment, it has been assumed that the Project and Eden Rivers Trust restoration scheme are to be delivered concurrently, with the implementation of standard best practice avoidance and/or mitigation measures. Given the fact that much of the river restoration construction work involves the creation of a secondary channel (which would be offline during construction) and that the A66 viaduct design will not require in channel works, significant disturbance and fragmentation of mobile species in combination are unlikely. Any disturbance impacts will be temporary and localised. ***In summary, it is considered that when incorporating best practice avoidance and/or mitigation measures, an adverse effect on qualifying features giving rise to an adverse effect on the integrity of the SAC through disturbance of mobile species and species fragmentation (in combination) can be ruled out (beyond reasonable scientific doubt).***

Species injury and mortality (construction)

1.5.316 For the purposes of this assessment, it has been assumed that both projects were to be delivered concurrently, with the implementation of standard best practice avoidance and/or mitigation measures. Given the fact that much of the river restoration construction work involves the creation of a secondary channel (which would be offline during construction) and that the A66 viaduct design will not require in channel works, significant injury and mortality to mobile species in combination are unlikely. ***In summary, it is considered that when incorporating best practice avoidance and/or mitigation measures, an adverse effect on qualifying features giving rise to an adverse effect on the integrity of the SAC through species injury and mortality (in combination) can be ruled out (beyond reasonable scientific doubt).***

Changes in surface and groundwater quality, quantity, and hydrogeology (construction)

1.5.317 For the purposes of this assessment, it has been assumed that both projects were to be delivered concurrently, with the implementation of standard best practice avoidance and/or mitigation measures. Given that fact that much of the river restoration construction work involves the creation of a secondary channel (which would be offline during construction) and considering the pollution control measures set out in the appropriate assessment significant changes in surface and groundwater quality, quantity, and hydrogeology in combination are unlikely. ***In summary, it is considered that when incorporating best practice avoidance and/or mitigation measures, an adverse effect the integrity of the SAC through changes in surface and groundwater quality,***

quantity, and hydrogeology (in combination) can be ruled out (beyond reasonable scientific doubt).

Changes in hydrology and fluvial geomorphological processes (operation)

1.5.318 No projects identified for the in combination assessment are considered to give rise to residual effects during operation, including changes in hydrology and fluvial geomorphological processes. Consequently, an in combination assessment of this effect is not required.

Integrity of site checklist

River Eden SAC

1.5.319 Table 11: Integrity of site checklist - River Eden SAC and Table 12: Other indicators - River Eden SAC.

Table 11: Integrity of site checklist - River Eden SAC

Conservation objectives	Yes/No
Does the Project have potential to:	
Cause delays in progress towards achieving the conservation objectives of the site?	No
Interrupt progress towards achieving the conservation objectives of the site?	No
Disrupt those factors that help to maintain the favourable conservation objectives of the site?	No
Interfere with the balance, distribution and density of key species that are the indicators of the favourable condition of the site?	No

Table 12: Other indicators - River Eden SAC

Other indicators	Yes/No
Does the Project have the potential to:	
Cause changes to the vital defining aspects (e.g. nutrient balance) that determine how the site functions as a habitat or ecosystem?	No
Change the dynamics of the relationships (between, for example, soil and water or plants and animals) that define the structure and/or function of the site?	No
Interfere with predicted or expected natural changes to the site (such as water dynamics or chemical composition)?	No
Reduce the area of key habitat?	No
Reduce the population of key species?	No
Change the balance between key species?	No
Reduce the diversity of the site?	No
Result in disturbance that could affect population size or density or the balance between key species?	No
Result in fragmentation?	No
Result in loss or reduction of key features (e.g. tree cover, tidal exposure, annual flooding etc.)?	No

1.6 North Pennine Moors SAC

Potential impacts on protected site

1.6.1 The location of the North Pennine Moor SAC in relation to the Project schemes and ARN is shown in *HRA Appendix A: European Designated Sites Location Plan and the* Project.

1.6.2 The North Pennine Moors SAC is classified for supporting Annex I habitats outlined in Table 3: North Pennine Moors SAC.

1.6.3 M6 Junction 40 to Kemplay Bank, Penrith to Temple Sowerby, Temple Sowerby to Appleby, Cross Lanes to Rokeby, Stephen Bank to Carkin Moor and A1(M) Junction 53 Scotch Corner, are located over 2km from North Pennine Moors SAC. Appleby to Brough is located approximately 902m south and Bowes Bypass is located approximately 255m south-east. Accordingly, due to these distances and lack of pollution pathways, these schemes have been screened out alone with no residual effects (Document Reference 3.5: Habitats Regulations Assessment Stage 1: Likely Significant Effects Report).

1.6.4 The air quality criteria for assessment within *DMRB LA105* (Highways England, 2019)[9] states designated habitats within 200m of the ARN should be included within the air quality assessment. Accordingly, LSE(s) alone and in combination could not be screened out for the ARN (ES Document Reference 3.5: Habitats Regulations Assessment Stage 1: Likely Significant Effects Report) and has been taken forward for stage 2 assessment, as presented in this report.

Desk study information

1.6.5 The Bowes Moor SSSI units which occur within 200m of the ARN are unit 1, unit 3 and unit 4. According to the Designated Sites View (Natural England, 2022)[72], the SAC qualifying features that are recorded to be within all three of these units are:

- European dry heaths
- Blanket bog
- Petrifying springs with tufa formation
- Siliceous scree of the montane to snow levels.

1.6.6 On review of historical habitat mapping in the *Conservation objectives and definitions of favourable condition for designated features of interest* (Natural England, 2009)[73], habitat mapping of the NVC communities within the SAC was undertaken in 2002. The mapping confirms the results of the habitat survey undertaken in 2021 that areas of blanket bog within 200m of the A66 (within units 1 and 3) were very limited in extent and the majority of habitat was recorded to be one of the calcifugous grassland and montane

[72] Natural England (2022) Designated Sites Viewer, available at: https://designatedsites.naturalengland.org.uk/SiteSACFeaturesMatrix.aspx?SiteCode=UK0030033&SiteName=North%20Pennine%20Moors%20SAC [accessed: 05/05/22]
[73] Natural England (2009) Conservation objectives and definitions of favourable condition for designated features of interest.

communities. No blanket bog was recorded within 200m south of the existing A66 (within unit 4).

1.6.7

Baseline Surveys

1.6.8 A habitat survey was undertaken aligned to Phase 1 Habitat survey methodology *Handbook for Phase 1 habitat survey – a technique for environmental audit* (JNCC, 2010)[74] on areas within the North Pennine Moors SAC which were located within 200m of the ARN to determine the presence and extent of cover of qualifying features of the SAC (Table 13: Baseline survey information to inform North Pennine Moors SAC and HRA Appendix E: North Pennine Moors Survey Map & Species List).

1.6.9 Blanket bog was the only qualifying feature recorded within the survey area. For the purpose of this assessment, areas of recorded blanket bog are assumed to be Annex I. Blanket bog was often recorded in a mosaic with acid and marshy grassland. Areas of blanket bog were recorded to be on the edge of the SAC. The majority of habitat areas adjacent to the A66 were recorded to be acid grassland. Areas of blanket bog were recorded across unit 1 and unit 3. Two small, isolated areas of blanket bog (totalling approximately 0.05ha) were recorded within the area of unit 4 south of the A66 within the habitat survey area. The remaining 12 habitats and one Annex II species for which the SAC is designated (as primary reasons for selection and qualifying features) were not recorded within the survey area (Table 13: Baseline survey information to inform North Pennine Moors SAC).

1.6.10 It should be noted that the areas of unit 1, unit 3 and unit 4 extend much further into the North Pennine Moors SAC (relating to Bowes Moor SSSI) and that the habitat survey was undertaken within 200m of the existing A66 only, in line with *DMRB LA 105* (Highways England, 2019)[9].

Table 13: Baseline survey information to inform North Pennine Moors SAC

Qualifying Feature	Survey Methodology	Survey Results	Appendix
H7130 Blanket bog	Habitat mapping	Areas of blanket bog (assumed to be H7130) were confirmed within 200m of the ARN. Areas of blanket bog were recorded across unit 1 and unit 3. Two small isolated areas (totalling approximately 0.05ha) of blanket bog were recorded within the area of unit 4 south of the A66 within the habitat survey area. Species present included *Sphagnum spp., Dicranum scroparium, Rhytidiadelphus squarrosus, Calluna vulgaris, Erica cinerea, Vaccinium*	*HRA Appendix E: North Pennine Moors Survey Map & Species List*

[74] JNCC (2010) Handbook for Phase 1 habitat survey – a technique for environmental audit

Qualifying Feature	Survey Methodology	Survey Results	Appendix
		myrtillus, Galium palustre, Potentilla erecta and *Eriophorum vaginatum*.	
H4030 European dry heaths	Habitat mapping	The species and vegetation communities recorded within 200m of the ARN did not meet the Phase 1 habitat classifications which meet the description and ecological characteristics of these qualifying features.	*HRA Appendix E: North Pennine Moors Survey Map & Species List*
H5130 Juniperus communis formations on heaths or calcareous grasslands			
H7220 Petrifying springs with tufa formation (Cratoneurion)			
H8110 Siliceous rocky slopes with chasmophytic vegetation			
H91A0 Old sessile oak woods with Ilex and Blechnum in the British Isles			
H4010 Northern Atlantic wet heaths with Erica tetralix			
H6130 Calaminarian grasslands of the Violetalia calaminariae			
H6150 Siliceous alpine and boreal grasslands			
H6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates Festuco Brometalia (includes the priority feature 'important orchid sites')			
H7230 Alkaline fens			
H8110 Siliceous scree of the montane to snow levels Androsacetalia alpinae and Galeopsietalia ladani			
H8210 Calcareous rocky with slopes with chasmophytic vegetation			
S1528 Marsh saxifrage			

Summary of potential impacts

1.6.11 Based on the survey information within Table 13: Baseline survey information to inform North Pennine Moors SAC and the desk study information (the SSSI unit information and historical mapping information (Natural England, 2009)[73]) the following qualifying features can be removed from further consideration:

- European dry heaths
- Juniperus communis formations on heaths or calcareous grasslands
- Petrifying springs with tufa formation (Cratoneurion)
- Siliceous rocky slopes with chasmophytic vegetation
- Old sessile oak woods with Ilex and Blechnum in the British Isles
- Northern Atlantic wet heaths with *Erica tetralix*
- Calaminarian grasslands of the *Violetalia calaminariae*
- Siliceous alpine and boreal grasslands
- Semi-natural dry grasslands and scrubland facies on calcareous substrates *Festuco Brometalia* (includes the priority feature 'important orchid sites')
- Alkaline fens
- Siliceous scree of the montane to snow levels *Androsacetalia alpinae* and *Galeopsietalia ladani*
- Calcareous rocky with slopes with chasmophytic vegetation
- Marsh saxifrage.

1.6.12 Subsequently, the qualifying feature taken forward for the appropriate assessment is detailed in Table 14: Summary of potential impacts on North Pennine Moors SAC.

Table 14: Summary of potential impacts on North Pennine Moors SAC

Potential impact	Threat mechanism	Features at risk	Relevant scheme
Air quality	Nutrient enrichment as a result of nitrogen deposition	Blanket bog	ARN

1.6.13 For the avoidance of doubt, whenever 'blanket bog' is mentioned hereafter, this is reference to the qualifying Annex I feature 'H7130 blanket bog'.

Sources of information

1.6.14 The assessment of potential impacts of air quality as a result of the Project on the North Pennine Moors SAC is outlined in Table 13: Baseline survey information to inform North Pennine Moors SAC, with reference to the following sources of information:

- Amey-Arup undertook a habitat mapping survey in September 2021 as evidence to inform this HRA Appropriate Assessment, refer to *HRA Appendix E: North Pennine Moors Survey Map & Species List*.
- Appendix 5.3 of Chapter 5 Air Quality (ES Application Document 3.4) of the potential air quality impact as a result of the Project on habitats within North Pennine Moors SAC.

- North Pennine Moors SAC Conservation objectives supplementary advice, which identifies air quality as a supporting process on which the qualifying feature being assessed i.e. blanket bog, relies.
- The APIS website which provides critical load levels for the qualifying feature being assessed, i.e. blanket bog.
- Natural England (2009) Conservation objectives and definitions of favourable condition for designated features of interest.

Appropriate Assessment

Assessment without mitigation

1.6.15 The SAC is located outside of all schemes, however, it is located within 200m of the ARN (HRA Appendix A: European Designated Sites Location Plan and the Project) for approximately 6.1km. The traffic modelling for this section of the ARN predicts the following increase in construction and operations phase traffic volumes.

- Construction - No change in AADT as a result of the Project
- Operation - An increase in 5941 AADT

1.6.16 In line with *DMRB LA115* (Highways England, 2020)[2] increased (in combination) traffic volumes of more than 1000 AADT have potential for impacts and are subject to further assessment. Increased air pollution associated with the additional emissions have the potential to increase nutrient nitrogen deposition on habitat within 200m and are subject to air quality modelling.

Baseline condition

1.6.17 As outlined in Paragraph 1.6.8 to 1.6.10, during the habitat survey, the majority of habitat areas adjacent to the A66 were recorded to be acid grassland or mosaics of acid and marshy grassland, or mosaics of blanket bog with acid and marshy grassland. areas of blanket bog were recorded within 200m of the ARN across SSSI unit 1 and unit 3. Two small isolated areas of blanket bog were recorded within SSSI unit 4, within the habitat survey area. Areas of blanket bog were considered to be at the edge of their polygon area due to the boundary of the SAC being bisected by the existing A66 and the majority of areas being recorded as habitat mosaics as well as being subject to sheep grazing and associated pressures e.g. grazing, trampling and dunging. No other Annex I habitat which the SAC is designated for was recorded within this area. Subsequently this is the only feature considered at risk from an increase in nitrogen deposition as a result of the Project.

1.6.18 The SSSI units which occur within 200m of the ARN are unit 1, unit 3 and unit 4. Unit 1 is stated as in unfavourable - recovering condition following the last Common Standards Monitoring (CSM) assessment in 2016, the condition of the blanket bog has improved, since the previous CSM assessment. The unit comprises a range of blanket bog habitats. Grazing pressure, burning practices and vehicle access damage were the pressures identified. In addition, the species composition and structure had been affected by an outbreak of heather beetle (*Lochmaea suturalis*). The

CSM assessment states that "*following discussions with the farmer, all sheep were to be offwintered for the remainder of the management agreement, subsequently this would have reduced grazing pressure"*. In order to achieve conservation objectives of maintaining or restoring the structure and function of habitats (vegetation community composition), these land management pressures have been identified to be addressed within the *Conservation Objectives Supplementary advice* (Natural England, 2019)[20] and *North Pennines Group SIP* (Natural England, 2014)[21]. This information is the most up to date at the time of writing.

1.6.19 Unit 3 is in unfavourable - no change condition. The unit comprises extensive areas of blanket bog in the north and central area. Areas of dry heath and degraded bog were recorded in the eastern part of the unit. The last CSM assessment, undertaken in 2015 identified the following pressures "*localised heavy grazing pressure and associated winter feeding remaining on the heather, vehicle access damage and burning on sensitive no burn areas"*. In order to achieve conservation objectives of maintaining or restoring the structure and function of habitats (vegetation community composition), these land management pressures have been identified to be addressed within the *Conservation Objectives Supplementary advice* (Natural England, 2019)[20] and *North Pennines Group SIP* (Natural England, 2014)[21]. This information is the most up to date at the time of writing.

1.6.20 Unit 4 was noted to be unfavourable - no change. Blanket bog covers the majority of the unit, although surveys to inform this assessment, undertaken within 200m of the road identifies only two small, isolated areas of blanket bog. The last CSM assessment undertaken in 2016 identified the following pressures "*localised heavy grazing pressure and associated fodder locations, burning on sensitive no burn areas and vehicle access damage were the pressures identified during. Numerous active drains were identified within the unit which required blocking"*. Management measures relating to these pressures were identified within *Conservation Objectives Supplementary advice* (Natural England, 2019)[20] and *North Pennines Group SIP* (Natural England, 2014)[21].

Threats

1.6.21 The following threat was identified:

- Reduction in qualifying habitat as a result of changes in air quality along the ARN i.e. 200m of habitat adjacent to the ARN.

1.6.22 The *Conservation Objectives Supplementary advice* (Natural England, 2019)[20] details important targets which require attention in order to maintain or restore blanket bog. The majority of these threats and pressures are related to management of the habitat e.g. grazing pressure, burning and vehicle access, which are not considered further within the assessment as the Project is unrelated to these pressures and threats. Furthermore, the supporting processes; hydrology and conservation management will also be unaffected by the Project due to there being no pathway for effect. The supporting process considered further is regarding air quality.

1.6.23 The specific air quality attribute which supports processes within the SAC indicates that blanket bog is considered sensitive to changes in air quality. Exceedance of critical loads for nitrogen deposition may modify the chemical status of its substrate, accelerating or damaging plant growth, altering its vegetation structure, and composition and causing the loss of sensitive typical species associated with it. The *Conservation Objectives Supplementary advice* (Natural England, 2019)[20] sets a target of maintaining or restoring the appropriate concentrations and deposition of air pollutants to at, or below, the site-relevant Critical Load or Level values indicated on *APIS* (APIS, 2022)[75]. This equates to 5-10kgN/ha/yr for blanket bog within the SAC. The current levels of nitrogen deposition on the SAC are exceeded with an average 19.4kgN/ha/yr.The outcome of this exceedance is that the levels of current nitrogen deposition conflict with the conservation objectives which are to restore as necessary the concentrations and deposition of air pollutants to below the site-relevant Critical Load.

1.6.24 Appendix 5.4 of Chapter 5 Air Quality (ES Application Document 3.4) details the change in AADT and exceedance of 1% critical load as a result of the Project, which includes an in combination assessment of proposed road schemes and committed development. The modelling accounts for increases in nitrogen from cars, lorries and HDV. The modelled points which fall within the North Pennine Moors SAC show an exceedance of 1% during operation up to 60m from the road within the SAC north of the existing A66 and 30m from the road within the SAC south of the existing A66. The total area of blanket bog only (not recorded as a mosaic with acid/marshy grassland) within 60m was 4.01ha. No blanket bog was recorded within 30m of the SAC located south of the existing A66. Consequently, the total area of habitat which qualifies as Annex I impacted by a change in air quality is 4.01ha.

1.6.25 As outlined above, the habitats within 200m of the existing A66 (this section of which falls within the ARN of the Project) are subject to existing levels of deposition from road transport. In addition, areas of habitat within close proximity to the existing A66 will be subject to impacts associated with the maintenance of the existing road (e.g. localised drainage for the road, salt spray, compaction from road maintenance vehicles and roadside vegetation maintenance). The distance at which these impacts affect vegetation will be dependent on variables such as season and speed of road traffic. The additional air quality emissions arising from the Project does not make a significant contribution to the meeting (or not) of the conservation objectives, particularly the attribute of ensuring the component vegetation communities of the feature follow relevant National Vegetation Classification (NVC) communities within these areas of habitat in close proximity to the A66.

1.6.26 In line with *DMRB LA105 Air Quality* (Highways England, 2019)[9], the site air quality attribute is considered to be 'restore'. This is a result of the site-relevant critical load for bog at the North Pennine Moors SAC already

[75] APIS (2022), available at: http://www.apis.ac.uk [accessed: 27/04/22]

exceeding the lower critical load of 5kgN/ha/yr. The current levels of nitrogen deposition on the SAC are exceeded with an average 19.4kgN/ha/yr (APIS, 2022)[75].

1.6.27 Using Table 21 *NECR210* (Natural England, 2016)[29], the change in nitrogen deposition required to result in the theoretical loss of one species for bog habitat is 3.3kg, with no variation in rates relating to background long-term nitrogen deposition levels.

1.6.28 The modelling output predicts that the increase in nitrogen deposition as a result of the Project is a maximum of 0.9kgN/ha/yr (Appendix 5.4 of chapter 5 Air Quality (ES Application Document 3.4)) which does not exceed the 3.3kg threshold.

1.6.29 It is acknowledged that this threshold is high and does not account for varying levels of background deposition levels. In addition, Table 21 *NECR210* (Natural England, 2016)[29] is used in conjunction with other sources of information to undertake the assessment including habitat mapping, current pressures and condition of the site data. Professional judgement and ecological principles are then applied in concluding the assessment.

Conclusion

1.6.30 To provide further context as to the approximate area of blanket bog within the North Pennine Moors SAC, the *Conservation Objectives Supplementary Advice* (Natural England, 2019)[20] states that approximately 38% of the site supports blanket bog. The SAC covers an area of approximately 103,109.42ha. Therefore, blanket bog covers an area of approximately 39,181.58ha. The area of blanket bog potentially impacted by changes in air quality will be within 60m north of the existing A66 and 30m south. Areas of blanket bog only (not recorded as a mosaic) within 60m was 4.01ha. No blanket bog was recorded within 30m of SAC located south of the existing A66. This equates to 0.01% of the blanket bog within the whole SAC.

1.6.31 *T*he *Habitats Regulations Assessment Handbook* (Tyldesley and Chapman, 2013)[50] considers the integrity test is to be *'the coherence of its ecological structure and function across its whole area, that enables it to sustain the habitat, complex of habitats and/or the levels of populations of the species which the site is (or will be) designated'.* The structure and function attributes on which the integrity of the SAC rely include maintaining or restoring as appropriate. The attribute that has the potential to be affected by the Project is air quality - a supporting process on which the qualifying feature (blanket bog) relies. The target within the *Conservation Objectives Supplementary Advice* (Natural England, 2019)[20] requires: *restore as necessary the concentrations and deposition of air pollutants to below the site-relevant Critical Load*. As discussed, the current Critical Load is already exceeded. Whilst the air quality modelling results show a change in 1% critical load along the ARN adjacent to the North Pennine Moors SAC, the actual area of impact in the context of the whole SAC is considered negligible (approximately 0.01% of total blanket bog area). Due to the current exceedance of critical load, the conservation

objective would be to restore (rather than maintain) the qualifying feature. Whilst it is acknowledged that an increase in nitrogen deposition does not equate to restoring the site, the contribution made by the Project in the context of nitrogen sources (as discussed above) from air pollution is negligible. Consequently, there is no need for mitigation to be imposed and no need for an in combination assessment.

1.6.32 ***In summary it is beyond reasonable scientific doubt that there will be no adverse effect on the integrity of the site as a result of a change in air quality alone and in combination.***

Assessment with mitigation

1.6.33 ***It is considered that adverse effects on the integrity of the North Pennine Moors SAC can be ruled out (beyond reasonable scientific doubt) alone and in combination from air pollution. Consequently, no mitigation and no further assessment is required.***

Integrity of site checklist

North Pennine Moors SAC

1.6.34 Table 15: Integrity of site checklist - North Pennine Moors SAC and Table 16: Other indicators - North Pennine Moors SAC

Table 15: Integrity of site checklist - North Pennine Moors SAC

Conservation objectives	Yes/No
Does the Project have potential to:	
Cause delays in progress towards achieving the conservation objectives of the site?	No
Interrupt progress towards achieving the conservation objectives of the site?	No
Disrupt those factors that help to maintain the favourable conservation objectives of the site?	No
Interfere with the balance, distribution and density of key species that are the indicators of the favourable condition of the site?	No

Table 16: Other indicators - North Pennine Moors SAC

Other indicators	Yes/No
Does the Project have the potential to:	
Cause changes to the vital defining aspects (e.g. nutrient balance) that determine how the site functions as a habitat or ecosystem?	No
Change the dynamics of the relationships (between, for example, soil and water or plants and animals) that define the structure and/or function of the site?	No
Interfere with predicted or expected natural changes to the site (such as water dynamics or chemical composition)?	No
Reduce the area of key habitat?	No
Reduce the population of key species?	No
Change the balance between key species?	No

Other indicators	Yes/No
Reduce the diversity of the site?	No
Result in disturbance that could affect population size or density or the balance between key species?	No
Result in fragmentation?	No
Result in loss or reduction of key features (e.g. tree cover, tidal exposure, annual flooding etc.)?	No

1.7 North Pennine Moors SPA

Potential impacts on protected site

1.7.1 The location of the North Pennine Moor SPA in relation to the Project schemes and ARN is shown in *HRA Appendix A: European Designated Sites Location Plan and the Project*.

1.7.2 The North Pennine Moors SPA is classified for supporting qualifying features outlined in Table 4: North Pennine Moors SPA.

1.7.3 M6 Junction 40 to Kemplay Bank, Penrith to Temple Sowerby, Temple Sowerby to Appleby, Cross Lanes to Rokeby, Stephen Bank to Carkin Moor and A1(M) Junction 53 Scotch Corner, are located over 2km from North Pennine Moors SPA. Appleby to Brough is located approximately 902m south and Bowes Bypass is located approximately 255m south-east. Accordingly, due to these distances and no functionally linked habitat providing suitable breeding habitat for qualifying species, these were screened out from this Stage 2 assessment as having no residual effects (ES Document Reference 3.5: Habitats Regulations Assessment Stage 1: Likely Significant Effects Report).

1.7.4 The air quality criteria for assessment within *DMRB LA 105* states designated habitats within 200m of the ARN should be included within the air quality assessment. LSE(s) alone and in combination could not be ruled out for the ARN (Document Reference 3.5: Habitats Regulations Assessment Stage 1: Likely Significant Effects Report).

Baseline surveys

1.7.5 The North Pennine Moors SPA is classified for supporting the following breeding birds: hen harrier, merlin, peregrine falcon and golden plover.

1.7.6 A summary of the habitats recorded within 200m of the ARN, with the potential to support qualifying bird species is detailed Table 13: Baseline survey information to inform North Pennine Moors SAC

Summary of potential impacts

1.7.7 The conservation objectives for the SPA are to "ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring:

- The extent and distribution of the habitats of the qualifying features
- The structure and function of the habitats of the qualifying features

- The supporting processes on which the habitats of the qualifying features rely

1.7.8 Based on the conservation objectives and *HRA Appendix E: North Pennine Moors Survey Map & Species List*, all qualifying bird species are taken forward for the appropriate assessment as detailed in Table 17: Summary of potential impacts on North Pennine Moors SPA.

Table 17: Summary of potential impacts on North Pennine Moors SPA.

Potential impact	Threat mechanism	Features at risk	Relevant scheme
Air quality	Nutrient enrichment of habitat supporting breeding qualifying feature as a result of nitrogen deposition	Golden plover Hen harrier Merlin Peregrine	ARN

Sources of information

1.7.9 The following sources of information were used to undertake the assessment:

- Amey-Arup habitat mapping survey in September 2021 as evidence to inform this HRA Appropriate Assessment (*HRA Appendix E: North Pennine Moors Survey Map & Species List*).
- Appendix 5.4 of Chapter 5 Air Quality (ES Application Document 3.4)
- *North Pennine Moors SPA Conservation objectives and supplementary advice* (Natural England, 2019)[26]
- The APIS website (APIS, 2022)[75] which provides critical load levels for the qualifying feature being assessed, i.e. hen harrier (Breeding), merlin (Breeding), peregrine falcon (Breeding) and golden plover (Breeding).
- Natural England (2009)[73] Conservation objectives and definitions of favourable condition for designated features of interest.

Appropriate Assessment

Assessment without mitigation

1.7.10 The SPA is located outside of all schemes, however, it is located within 200m of the ARN (HRA Appendix A: European Designated Sites Location Plan and the Project) for approximately 6.1km. The traffic modelling for this section of the ARN predicts the following increase in construction and operations phase traffic volumes.

- Construction - No change in AADT as a result of the Project
- Operation - An increase in 5941 AADT

1.7.11 In line with *DMRB LA 115* (Highways England, 2020)[2] increased (in combination) traffic volumes of more than 1000 AADT have potential for impacts and are subject to further assessment. Increased air pollution associated with the additional emissions have the potential to increase nutrient nitrogen deposition on habitat within 200m and are subject to air quality modelling.

Baseline condition

1.7.12 As detailed in Table 4: North Pennine Moors SPA., the SSSI units occurring within 200m of the ARN are unit 1, unit 3 and unit 4.

Threats

1.7.13 The following threats were identified:

- Reduction in suitable breeding and foraging habitat for qualifying birds species as a result of changes in air quality along the ARN i.e. 200m of habitat adjacent to the ARN.

1.7.14 The *Conservation objectives and supplementary advice* (Natural England, 2019)[26]details important targets which require attention for the structure and function of the habitats which support the qualifying features. This include the need to "maintain the extent, distribution and availability of suitable breeding habitat which supports breeding for qualifying bird species for all necessary stages of its breeding cycle (courtship, nesting, feeding):

- Extent of cliffs and crags with low disturbance (peregrine falcon only)
- Maintain 61,094.00ha of blanket bog
- Maintain 618.09ha of wet heath
- Maintain 46,502.82ha of dry heath
- Maintain 369.00ha of montane heath (golden plover only)

1.7.15 As detailed in *HRA Appendix E: North Pennine Moors Survey Map & Species List*, blanket bog was the only qualifying habitat recorded within 200m of the ARN which may provide suitable breeding habitat for all qualifying birds species. The majority of habitat areas adjacent to the A66 were recorded to be grazed acid grassland with suboptimal structure to support breeding qualifying species.

1.7.16 The Conservation Objectives detail restoring as necessary the concentration and deposition of air pollutants to below the site-relevant Critical Load. The critical loads for habitats related to qualifying features within 200m of the ARN include blanket bog. The critical load for blanket bog indicated on APIS (APIS, 2022)[75] equates to 5-10kgN/ha/yr. The current levels of nitrogen deposition on the SPA are exceeded with an average 18.9kgN/ha/yr. The outcome of this exceedance is that the levels of current nitrogen deposition conflict with the conservation objectives which are to restore as necessary the concentration and deposition of air pollutants to below the site-relevant Critical Load.

1.7.17 Appendix 5.4 of Chapter 5 Air Quality (ES Application Document 3.4) details the change in AADT and exceedance of 1% critical load as a result of the Project, which includes an in combination assessment. The modelling accounts of increases in both nitrogen and ammonia from cars, lorries and HDV. The modelled points which fall within the North Pennine Moors SAC show an exceedance of 60m from the road during operation. The area of habitat which qualifies as Annex I impacted by a change in air quality is 4.01ha equating to approximately 0.01% of the total area of blanket bog within the SAC.

1.7.18 The habitat areas within 60m of the existing A66 were mostly recorded to be grazed acid grassland with suboptimal structure for supporting breeding qualifying features. Whilst it is considered small numbers of golden plover may utilise this habitat for breeding, hen harrier and merlin prefer areas of heather. Peregrine falcon typically utilise cliff-ledges and crags for breeding, subsequently would not be found breeding within this habitat.

1.7.19 APIS details exceedance impacts of nutrient deposition results in an increase in vascular plants, altered growth and species composition of bryophytes, increased nitrogen in peat and peat water. Any potential impacts of increased nitrogen on suboptimal habitat is less likely to impact on existing structure given the dominance of grass within the community. Subsequently, no adverse effects are identified on opportunities for foraging i.e. invertebrates or small bird species which qualifying features would feed on, within the existing habitat.

1.7.20 In line with *DMRB LA105 Air Quality* (Highways England, 2019)[9], the site air quality attribute is considered to be 'restore'. This is a result of the site-relevant critical load for bog at the North Pennine Moors SPA already exceeding the lower critical load of 5kgN/ha/yr. The current levels of nitrogen deposition on the SPA are exceeded with an average 18.9kgN/ha/yr for blanket bog (APIS, 2022)[75].

1.7.21 Using Table 21 *NECR210* (Natural England, 2016)[29] the change in nitrogen deposition required to result in the theoretical loss of one species for bog habitat is 3.3kg, with no variation in rates relating to background long-term nitrogen deposition levels.

1.7.22 The modelling output predicts that the increase in nitrogen deposition as a result of the Project is a maximum of 0.9kgN/ha/yr (Appendix 5.4 of Chapter 5 Air Quality (ES Application Document 3.4)) which does not exceed the 3.3kg threshold.

1.7.23 It is acknowledged that this threshold is high and does not account for varying levels of background deposition levels. In addition, Table 21 is used in conjunction with other sources of information to undertake the assessment including habitat mapping, current pressures and condition of the site data. Professional judgement and ecological principles are then applied in concluding the assessment.

Conclusion

1.7.24 The exceedance of nitrogen deposition as a result of the Project will result in a change of vegetation, however this will not have a measurable effect on the structure and function of the habitat (bog) that supports qualifying bird species. This is as a result of the majority of habitat existing adjacent to the A66 which is grazed acid grassland which is suboptimal for breeding. The areas of blanket bog which provide more optimal opportunities were at the edge of this habitat type within the SAC and whilst the vegetation assemblage may be altered by increased nitrogen deposition, it is considered that these potential changes within such a small area of optimal habitat will not adversely affect the breeding qualifying species. Any potential impacts of increased nitrogen on suboptimal habitat is less likely

to impact on existing structure given the dominance of grass within the community. Subsequently, no adverse effects are identified on opportunities for foraging i.e. invertebrates or small bird species which qualifying features would feed on, within the existing habitat. Consequently, there is no need for mitigation to be imposed and no need for an in combination assessment.

1.7.25 In summary it is beyond reasonable scientific doubt that there will be no adverse effect on the integrity of the site as a result of a change in air quality alone and in combination.

Assessment with mitigation

1.7.26 It is considered that adverse effects on the integrity of the North Pennine Moors SPA can be ruled out (beyond reasonable scientific doubt) alone and in combination from air pollution. Consequently, no mitigation and no further assessment is required.

Integrity of site checklist

1.7.27 Table 15: Integrity of site checklist - North Pennine Moors SAC and Table 19: Other indicators - North Pennine Moors SPA.

Table 18: Integrity of site checklist - North Pennine Moors SPA.

Conservation objectives	Yes/No
Does the Project have potential to:	
Cause delays in progress towards achieving the conservation objectives of the site?	No
Interrupt progress towards achieving the conservation objectives of the site?	No
Disrupt those factors that help to maintain the favourable conservation objectives of the site?	No
Interfere with the balance, distribution and density of key species that are the indicators of the favourable condition of the site?	No

Table 19: Other indicators - North Pennine Moors SPA.

Other indicators	Yes/No
Does the Project have the potential to:	
Cause changes to the vital defining aspects (e.g. nutrient balance) that determine how the site functions as a habitat or ecosystem?	No
Change the dynamics of the relationships (between, for example, soil and water or plants and animals) that define the structure and/or function of the site?	No
Interfere with predicted or expected natural changes to the site (such as water dynamics or chemical composition)?	No
Reduce the area of key habitat?	No
Reduce the population of key species?	No
Change the balance between key species?	No
Reduce the diversity of the site?	No

Other indicators	Yes/No
Result in disturbance that could affect population size or density or the balance between key species?	No
Result in fragmentation?	No
Result in loss or reduction of key features (e.g. tree cover, tidal exposure, annual flooding etc.)?	No

Mitigation

1.7.28 Mitigation measures are described throughout this SIAA and have considered in respect to specific areas of the assessment. These mitigation items are secured in the EMP (ES Application Document 2.7) and Project Design Principles (ES Application Document 5.11).

Proposals for monitoring and reporting

1.7.29 As adverse effects on the integrity of the European sites assessed have been ruled out, there is no requirement for monitoring and reporting specific to HRA matters.

1.7.30 Nonetheless, the EMP (ES Application Document 2.7) commits to monitoring to ensure the mitigation set out in the HRA is effective. Of particular reference is the Invasive Non-Native Species Management Plan and the Ground and Surface Water Management Plan. A water quality monitoring programme prior to and during construction works will be agreed with the Environment Agency and Natural England. To ensure that the River Eden SAC is afforded additional protections, the scope of monitoring may be more intensive in scheme hydrologically connected to the River Eden SAC.

Consultations

1.7.31 The Projects approach to consultation is set out from Paragraph 1.4.26 in Section 1.4. National Highways adopted the principles of the Evidence Plan process to guide the consultation and development of the HRA for the Project, in relation to key areas of legislation and National Policy. The process has been led by the Integrated Project Team (IPT) (National Highways, their delivery partners and advisors).

1.7.32 Relevant areas of consultation are discussed within this HRA. A full record of areas discussed, actions ongoing and details of relevant meetings and correspondence is provided in Table 2: Evidence Plan log – HRA, of Appendix 1.1 of the ES (ES Volume 1 Application Document 3.4).

1.7.33 Appendix 1.1 of the ES (ES Volume 1, Application Document 3.4) also includes the meeting minutes from the HRA TWG meetings held to date.

Conclusions

1.7.34 Based on the information presented, it is considered that the Project:

- Is not directly connected with or necessary to site management for nature conservation
- Will not, in view of the relevant site conservation objectives, have a significant adverse effect on any qualifying feature of the River Eden SAC, North Pennine Moors SAC or North Pennine Moors SPA, either alone or in combination with other plans and projects
- Will not have adverse implications for the River Eden SAC, North Pennine Moors SAC or North Pennine Moors SPA site conservation objectives and will not delay or interrupt progress towards achieving the site objectives

- Will not adversely affect the integrity of the River Eden SAC, North Pennine Moors SAC or North Pennine Moors SPA, beyond reasonable scientific doubt

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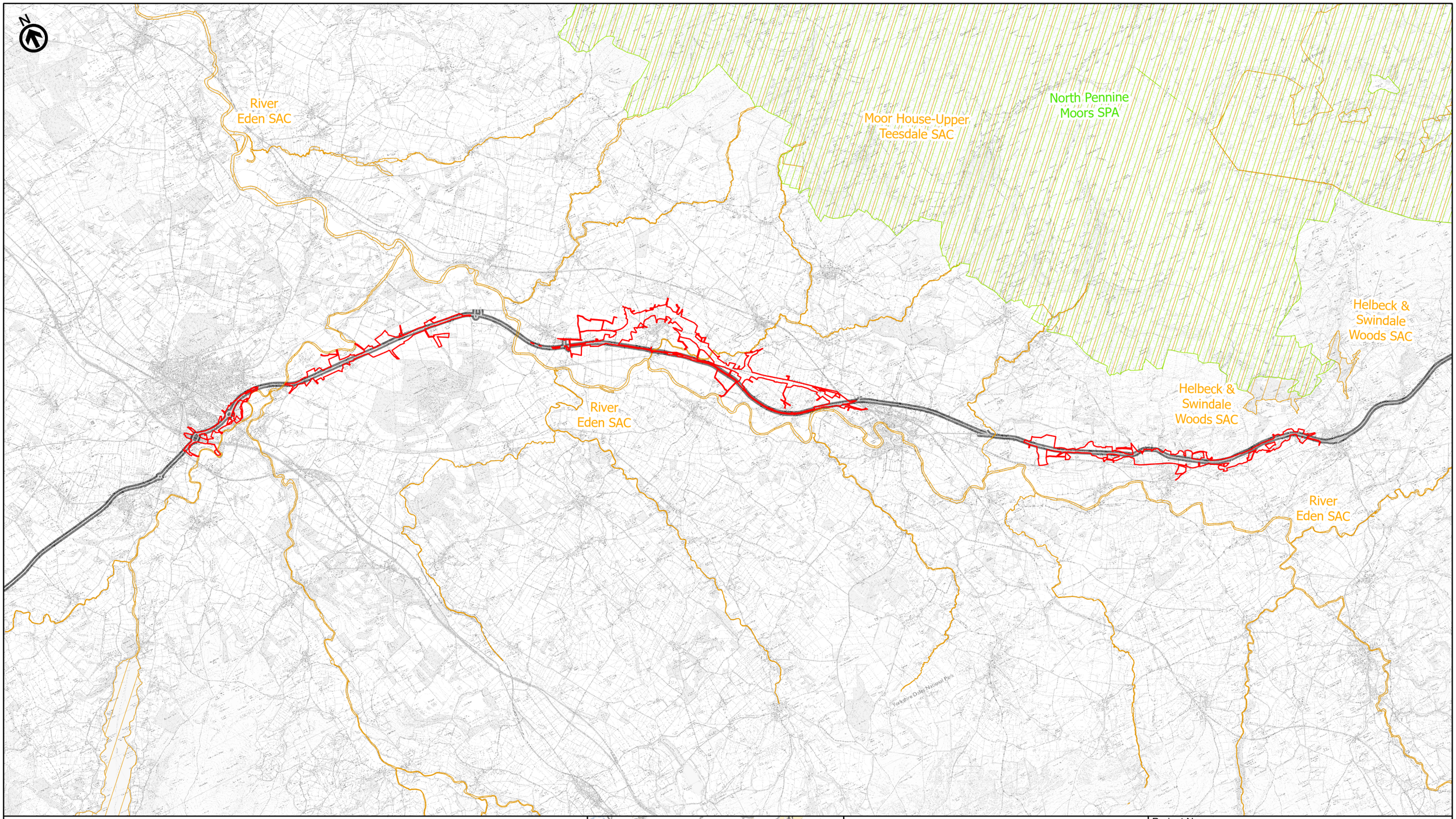
A.1 HRA Appendix A: European Designated Sites Location Plan and the Project



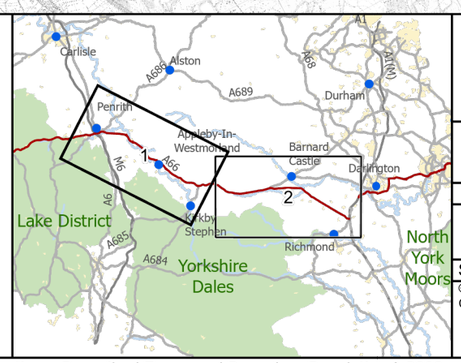
Order Limits

Existing A66

Statutory Designated Sites

Special Protection Areas (SPA)

Special Area of Conservation (SAC)



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P02	KBIG	PKEL	THOU	AMIT	KWHA
	10/03/22	14/03/22	21/03/22	20/04/22	20/04/22
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Scale @ A3:1:100,000 | Project Ref No HE565627 | Stage: Stage 3

Project Name
A66 Northern Trans-Pennine Project

Map Title

Figure 1.1
Appendix A European Designated Sites Location Plan and the Project
Scheme: 0106, M6 Junction 40 to Brough
Sheet 1 of 13

Map Number

Project	Originator	Volume	Location	Type	Role	Number
HE565627	AMY	EBD	S00	MP	LB	003326

Suitability	Suitability Description	Revision
S4	FIT FOR STAGE APPROVAL	P02

This Environmental Statement Figure meets the requirements of Regulation 5(2)(g) &5(2)(l)(i) of the Infrastructure Planning (Applications: Prescribed Forms and Procedure Regulations) 2009.

PINS Reference Number: TR010062/APP/3.6

North Pennine Moors SPA
North Pennine Moors SAC
North Pennine Moors SAC
North Pennine Moors SPA
North Pennine Moors SAC
North Pennine Moors SPA
North Pennine Moors SPA
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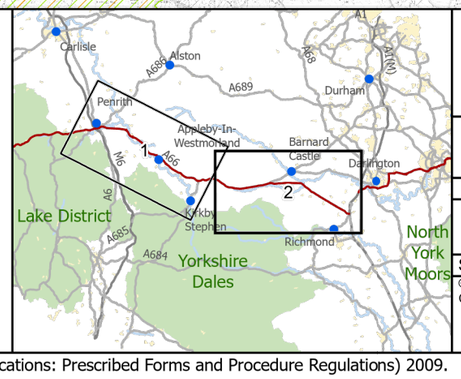
North Pennine Moors SPA

Order Limits
Existing A66

Statutory Designated Sites

Special Protection Areas (SPA)
Special Area of Conservation (SAC)



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	10/03/22	14/03/22	21/03/22	20/04/22	20/04/22

Kilometres
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Scale @ A3:1:100,000 | Project Ref No HE565627 | Stage: Stage 3

Project Name
A66 Northern Trans-Pennine Project

Map Title

Figure 1.1
Appendix A European Designated Sites Location Plan and the Project
Scheme: 0711, Bowes Bypass to A1(M) Junction 53 Scotch Corner
Sheet 2 of 13

Map Number

Project	Originator	Volume	Location	Type	Role	Number
HE565627	AMY	EBD	S00	MP	LB	003327

Suitability	Suitability Description	Revision
S4	FIT FOR STAGE APPROVAL	P02

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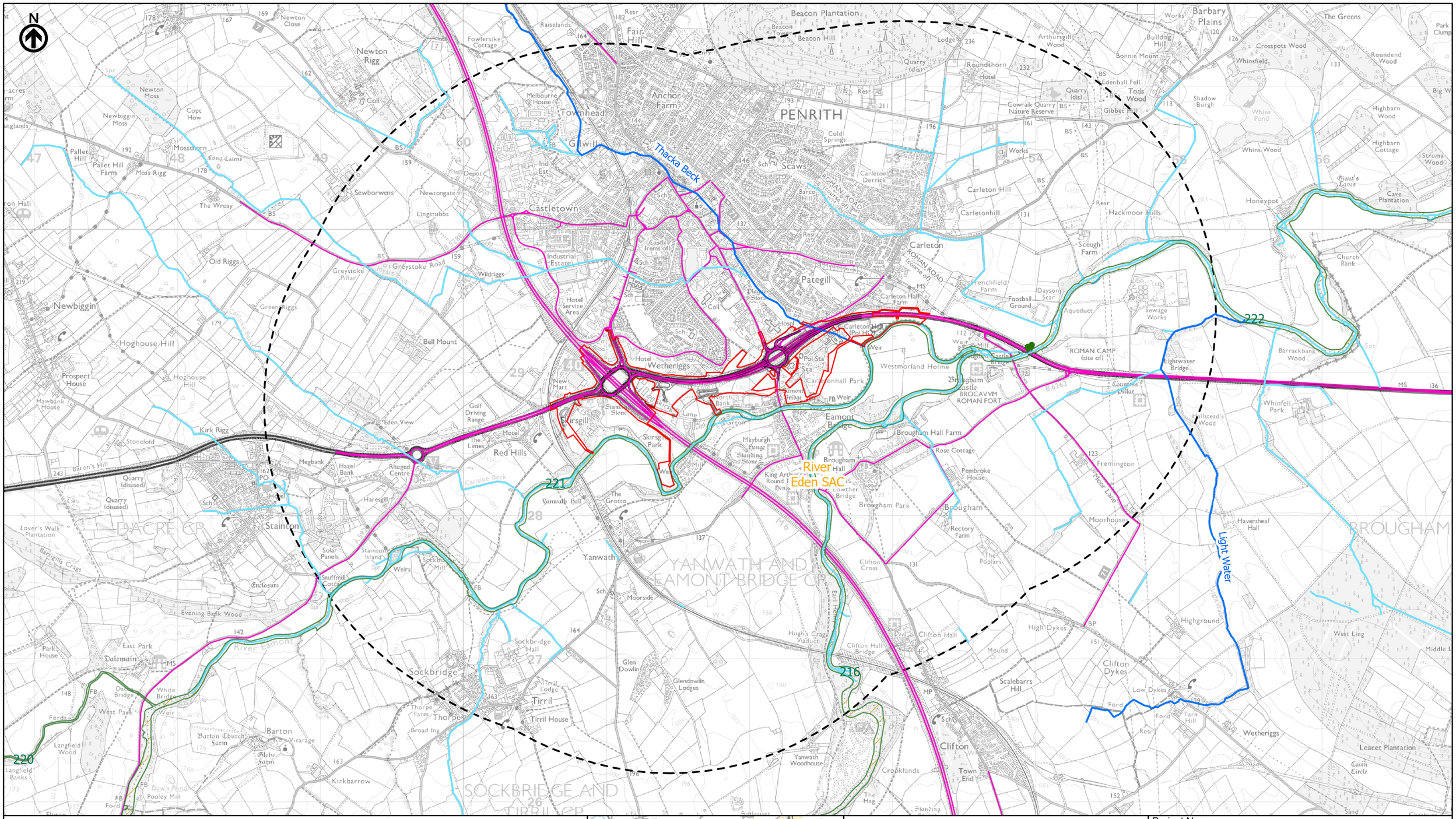

- Route Alignment
- Existing A66
- Affected Road Network ES
- Order Limits
- Study Area 2000m
- River Eden SAC Affected Road Network Crossing Point

Statutory Designated Sites

- Special Protection Areas (SPA)
- Special Area of Conservation (SAC)
- Site of Special Scientific Interest Units (WIth IDs)

Watercourses

- Watercourses Functionally Linked To The SAC That Interact With The Project
- Other Watercourse

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Scale @ A3: 1:25,000 | Project Ref No HE565627 | Stage: Stage 3

Project Name
A66 Northern Trans-Pennine Project

Map Title
Figure 1.1
Appendix A European Designated Sites Location Plan and the Project
Scheme: 0102, M6 Junction 40 to Kemplay Bank
Sheet 3 of 13

Map Number

Project	Originator	Volume	Location	Type	Role	Number
HE565627	AMY	EBD	S00	MP	LB	003328

Suitability	Suitability Description	Revision
S4	FIT FOR STAGE APPROVAL	P02

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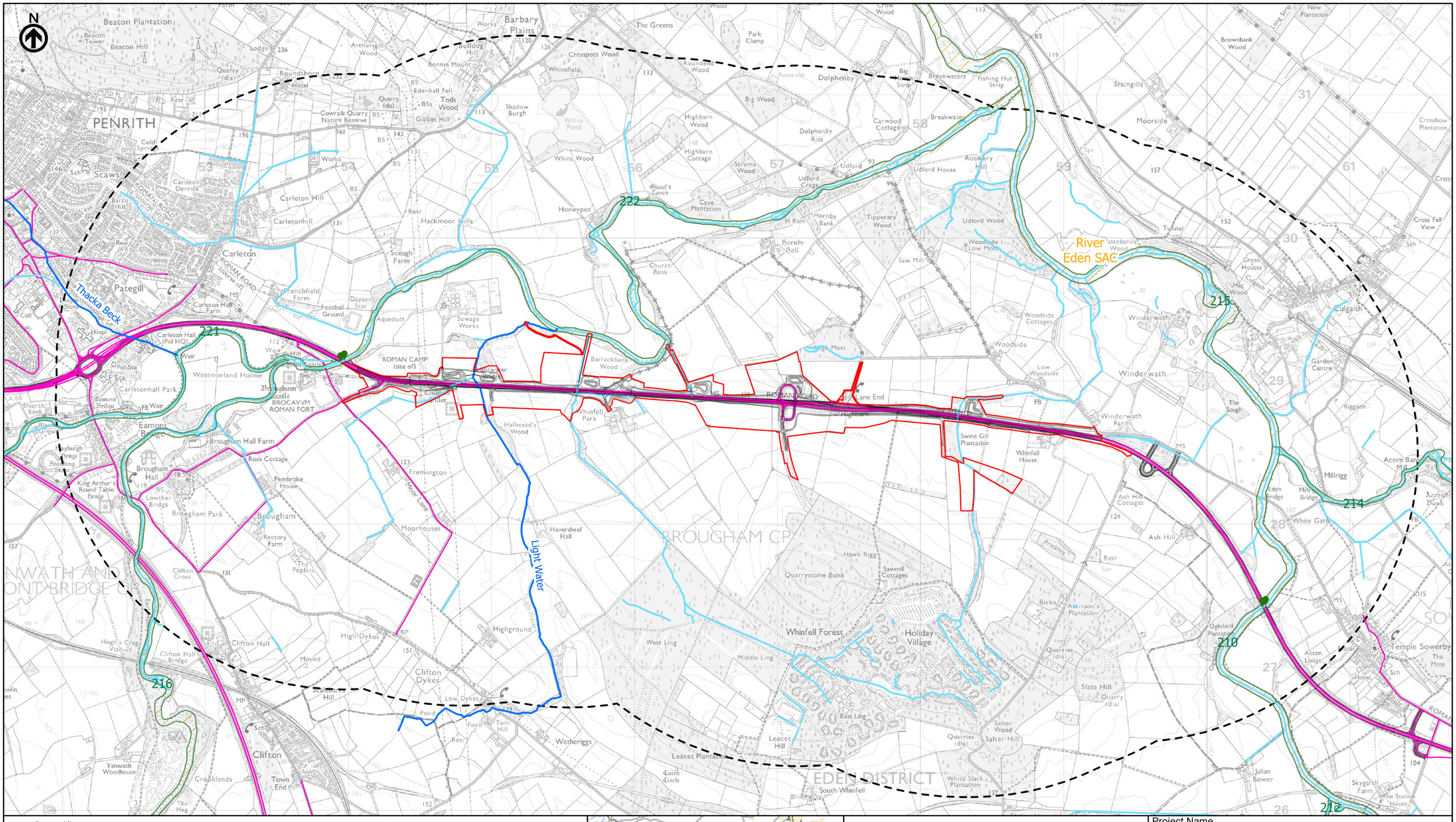

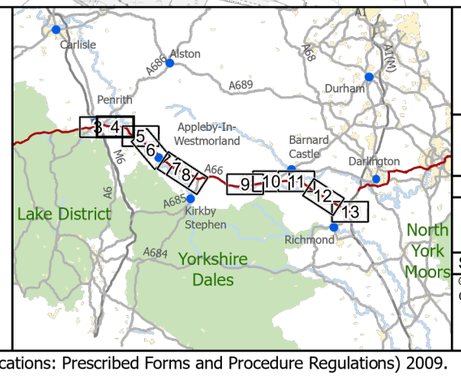

- Route Alignment
- Existing A66
- Affected Road Network ES
- Order Limits
- Study Area 2000m
- River Eden SAC Affected Road Network Crossing Point

Statutory Designated Sites

- Special Protection Areas (SPA)
- Special Area of Conservation (SAC)
- Site of Special Scientific Interest Units (WIth IDs)

Watercourses

- Watercourses Functionally Linked To The SAC That Interact With The Project
- Other Watercourse

This Environmental Statement Figure meets the requirements of Regulation 5(2)(g) &5(2)(l)(i) of the Infrastructure Planning (Applications: Prescribed Forms and Procedure Regulations) 2009.

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First Issue: KBIG | PKEL | THOU | AMIT | KWHA

Kilometres: 0 1 2

Scale @ A3: 1:25,000 | Project Ref No HE565627 | Stage: Stage 3

Project Name
A66 Northern Trans-Pennine Project

Map Title
Figure 1.1
Appendix A European Designated Sites Location Plan and the Project
Scheme: 03, Penrith to Temple Sowerby
Sheet 4 of 13

Map Number

Project	Originator	Volume	Location	Type	Role	Number
HE565627	AMY	EBD	S00	MP	LB	003329

Suitability	Suitability Description	Revision
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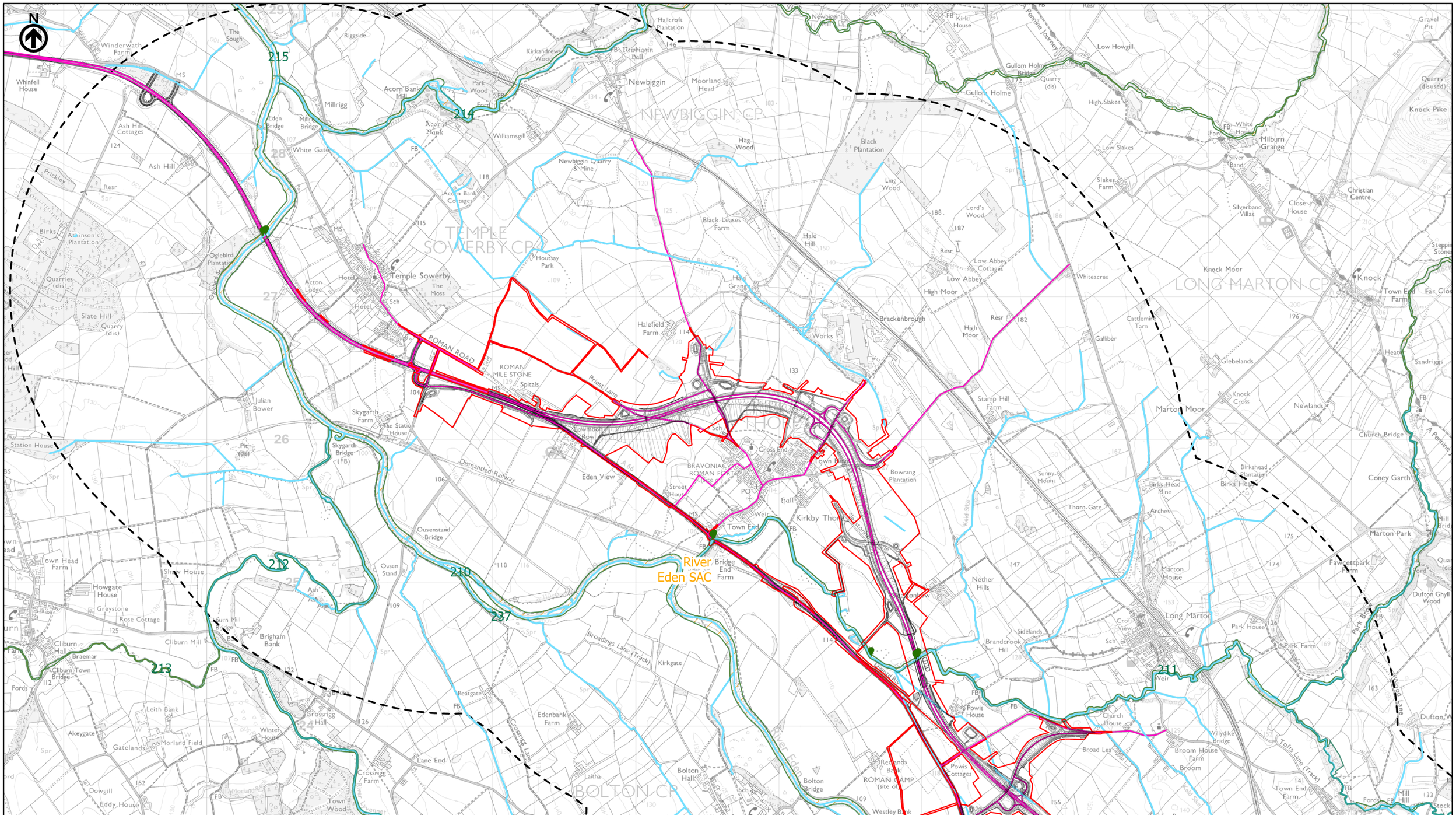

- Route Alignment
- Existing A66
- Affected Road Network ES
- Order Limits
- Study Area 2000m
- River Eden SAC Affected Road Network Crossing Point

Statutory Designated Sites

- Special Protection Areas (SPA)
- Special Area of Conservation (SAC)
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Watercourses

- Watercourses Functionally Linked To The SAC That Interact With The Project
- Other Watercourse

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P02	10/03/22	14/03/22	21/03/22	20/04/22	20/04/22

First Issue | KBIG | PKEL | THOU | AMIT | KWHA

Kilometres: 0 — 1 — 2

Scale @ A3: 1:25,000 | Project Ref No HE565627 | Stage: Stage 3

Project Name
A66 Northern Trans-Pennine Project

Map Title
Figure 1.1
Appendix A European Designated Sites Location Plan and the Project
Scheme: 0405, Temple Sowerby to Appleby
Sheet 5 of 13

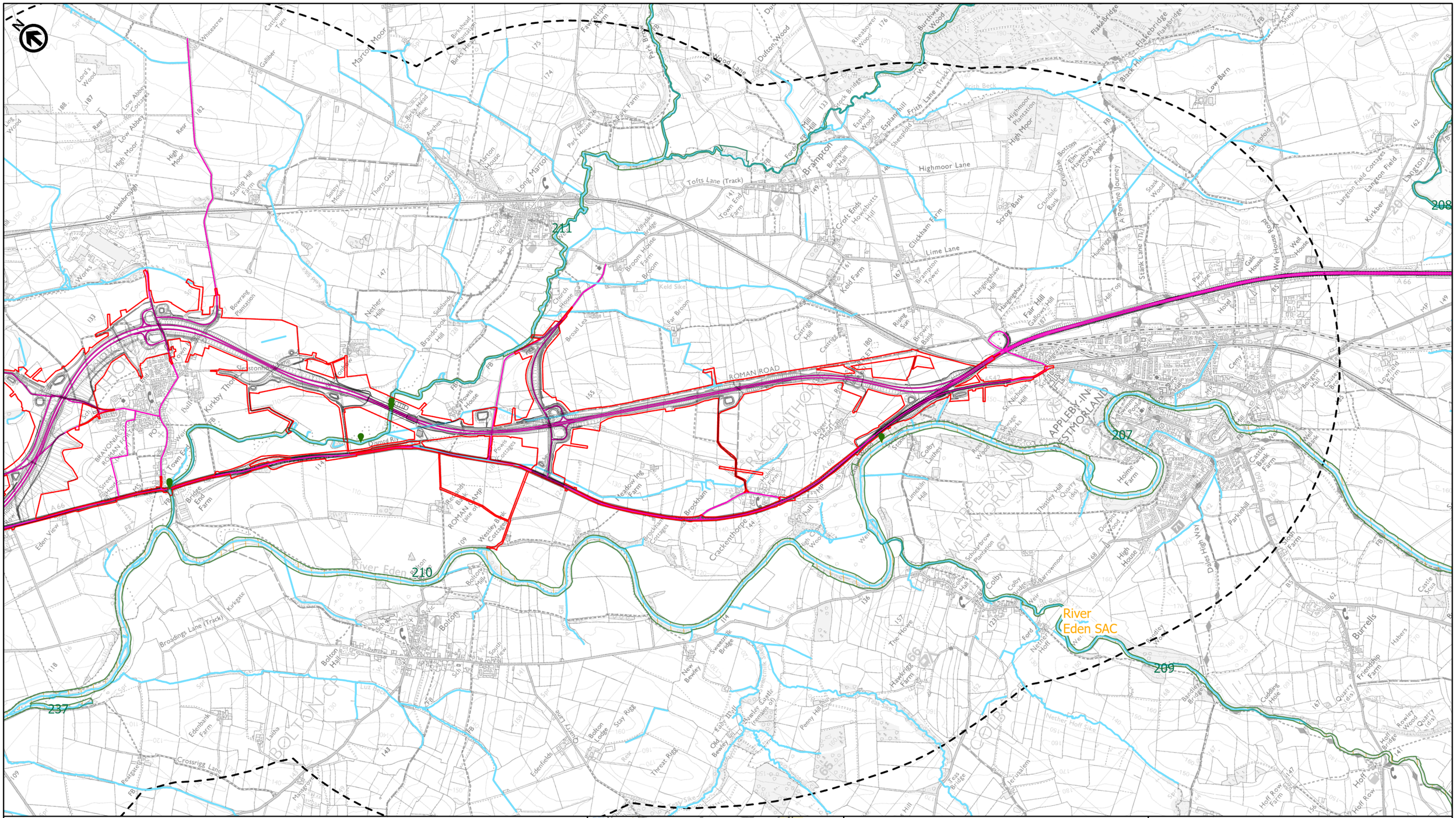
Map Number

Project	Originator	Volume	Location	Type	Role	Number
HE565627	AMY	EBD	S00	MP	LB	003330

Suitability	Suitability Description	Revision
S4	FIT FOR STAGE APPROVAL	P02

This Environmental Statement Figure meets the requirements of Regulation 5(2)(g) &5(2)(l)(i) of the Infrastructure Planning (Applications: Prescribed Forms and Procedure Regulations) 2009.

PINS Reference Number: TR010062/APP/3.6



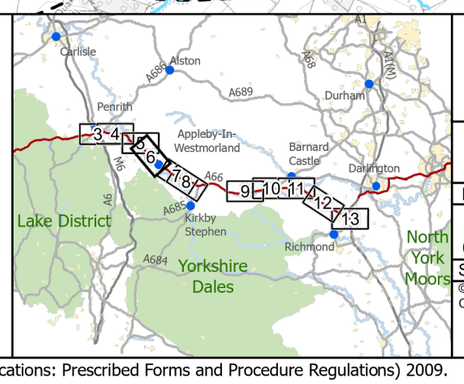
- Route Alignment
- Existing A66
- Affected Road Network ES
- Order Limits
- Study Area 2000m
- River Eden SAC Affected Road Network Crossing Point

Statutory Designated Sites

- Special Protection Areas (SPA)
- Special Area of Conservation (SAC)
- Site of Special Scientific Interest Units (WIth IDs)

Watercourses

- Watercourses Functionally Linked To The SAC That Interact With The Project
- Other Watercourse



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	First Issue				
P02	KBIG	PKEL	THOU	AMIT	KWHA
	10/03/22	14/03/22	21/03/22	20/04/22	20/04/22
Revision	Created	Checked	Reviewed	Approved	Authorised

Kilometres
0 1 2

Scale @ A3: 1:25,000 | Project Ref No HE565627 | Stage: Stage 3

Project Name
A66 Northern Trans-Pennine Project

Map Title
Figure 1.1
Appendix A European Designated Sites Location Plan and the Project
Scheme: 0405, Temple Sowerby to Appleby
Sheet 6 of 13

Map Number

Project	Originator	Volume
HE565627	AMY	EBD

Location	Type	Role	Number
S00	MP	LB	003331

Suitability	Suitability Description	Revision
S4	FIT FOR STAGE APPROVAL	P02

This Environmental Statement Figure meets the requirements of Regulation 5(2)(g) &5(2)(l)(i) of the Infrastructure Planning (Applications: Prescribed Forms and Procedure Regulations) 2009.

PINS Reference Number: TR010062/APP/3.6

North Pennine Moors SPA

Moor House-Upper Teesdale SAC

North Pennine Moors SPA

Helbeck & Swindale Woods SAC

Cringle Beck

Hayber Beck

Moor Beck

Eastfield Sike

Lowgill Beck

Woodend Sike

Yosgill Sike

Unnamed Tributary of Mire Sike 6.12

Mire Sike

River Eden SAC

Crooks Beck

Eden Valley Railway

A66

ROMAN ROAD (course of)

Warcop Training Centre

WARCOP CP

MUSGRAVE CP

River Eden

A Pennine Journey

Lake District

Yorkshire Dales

North York Moors

- Route Alignment
- Existing A66
- Affected Road Network ES
- Order Limits
- Study Area 2000m
- River Eden SAC Affected Road Network Crossing Point

Statutory Designated Sites

- Special Protection Areas (SPA)
- Special Area of Conservation (SAC)
- Site of Special Scientific Interest Units (WIth IDs)

Watercourses

- Watercourses Functionally Linked To The SAC That Interact With The Project
- Other Watercourse

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Revision	First Issue				
	KBIG	PKEL	THOU	AMIT	KWHA
P02	10/03/22	14/03/22	21/03/22	20/04/22	20/04/22
Revision	Created	Checked	Reviewed	Approved	Authorised

Kilometres
0 1 2

Scale @ A3: 1:25,000 | Project Ref No HE565627 | Stage: Stage 3

Project Name
A66 Northern Trans-Pennine Project

Map Title
Figure 1.1
Appendix A European Designated Sites Location Plan and the Project
Scheme: 06, Appleby to Brough
Sheet 7 of 13

Map Number

Project	Originator	Volume	Location	Type	Role	Number
HE565627	AMY	EBD	S00	MP	LB	003332

Suitability	Suitability Description	Revision
S4	FIT FOR STAGE APPROVAL	P02

This Environmental Statement Figure meets the requirements of Regulation 5(2)(g) &5(2)(l)(i) of the Infrastructure Planning (Applications: Prescribed Forms and Procedure Regulations) 2009.

PINS Reference Number: TR010062/APP/3.6

North Pennine Moors SPA

Moor House-Upper Teesdale SAC

North Pennine Moors SPA

Helbeck & Swindale Woods SAC

Helbeck & Swindale Woods SAC

Warcop Training Centre

Cringle Beck

Hayber Beck

Moor Beck

Eastfield Sike

Woodend Sike

Yosgill Sike

Lowgill Beck

Unnamed Tributary of Mire Sike 6.12

Mire Sike

Crooks Beck

Eden Valley Railway

ROMAN ROAD

WARCOP CP

MUSGRAVE CP

BROUGH CP

BROUGH SOMERBY CP

VERTERIS ROMAN FORT

A Pennine Journey

205

204

206

River Eden SAC

River Eden SAC

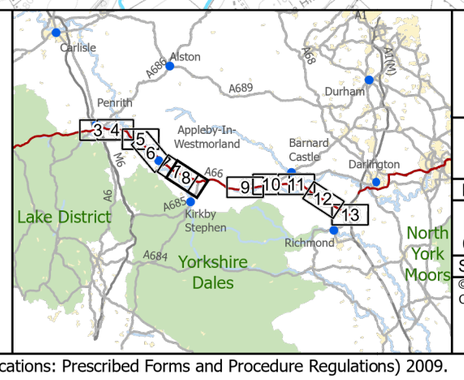
Route Alignment
Existing A66
Affected Road Network ES
Order Limits
Study Area 2000m
River Eden SAC Affected Road Network Crossing Point

Statutory Designated Sites

Special Protection Areas (SPA)
Special Area of Conservation (SAC)
Site of Special Scientific Interest Units (WIth IDs)

Watercourses

Watercourses Functionally Linked To The SAC That Interact With The Project
Other Watercourse



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Revision	First Issue				
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Kilometres
0 1 2

Scale @ A3: 1:25,000 | Project Ref No HE565627 | Stage: Stage 3

Project Name
A66 Northern Trans-Pennine Project

Map Title
Figure 1.1
Appendix A European Designated Sites Location Plan and the Project
Scheme: 06, Appleby to Brough
Sheet 8 of 13

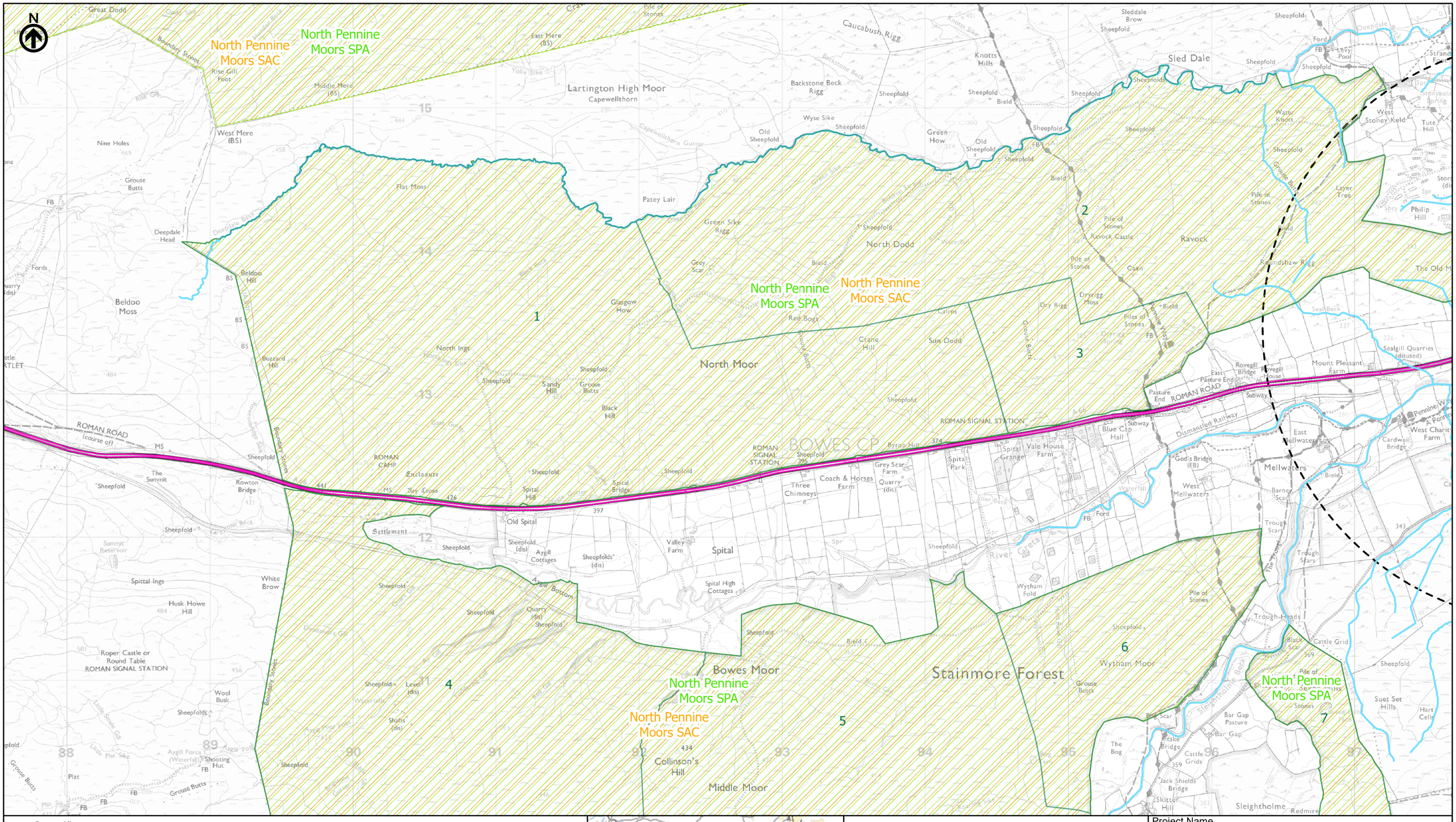
Map Number

Project	Originator	Volume			
HE565627	AMY	EBD			
Location	Type	Role	Number		
S00	MP	LB	003333		

Suitability	Suitability Description	Revision
S4	FIT FOR STAGE APPROVAL	P02

This Environmental Statement Figure meets the requirements of Regulation 5(2)(g) &5(2)(l)(i) of the Infrastructure Planning (Applications: Prescribed Forms and Procedure Regulations) 2009.

PINS Reference Number: TR010062/APP/3.6



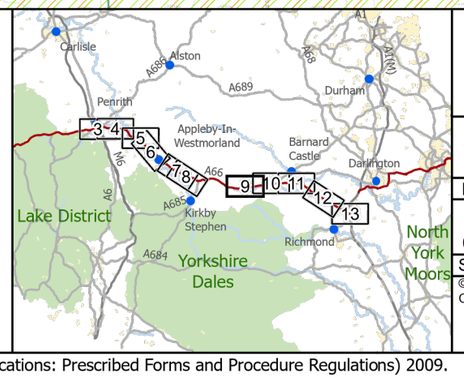
Route Alignment
Existing A66
Affected Road Network ES
Order Limits
Study Area 2000m
River Eden SAC Affected Road Network Crossing Point

Statutory Designated Sites

Special Protection Areas (SPA)
Special Area of Conservation (SAC)
Site of Special Scientific Interest Units (WIth IDs)

Watercourses

Watercourses Functionally Linked To The SAC That Interact With The Project
Other Watercourse



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P02	First Issue				
	Created	Checked	Reviewed	Approved	Authorised
	10/03/22	14/03/22	21/03/22	20/04/22	20/04/22

Kilometres
0 1 2

Scale @ A3: 1:25,000 | Project Ref No HE565627 | Stage: Stage 3

Project Name
A66 Northern Trans-Pennine Project

Map Title
Figure 1.1
Appendix A European Designated Sites Location Plan and the Project
Scheme: 07, Bowes Bypass
Sheet 9 of 13

Map Number

Project	Originator	Volume	Location	Type	Role	Number
HE565627	AMY	EBD	S00	MP	LB	003334

Suitability	Suitability Description	Revision
S4	FIT FOR STAGE APPROVAL	P02

This Environmental Statement Figure meets the requirements of Regulation 5(2)(g) &5(2)(l)(i) of the Infrastructure Planning (Applications: Prescribed Forms and Procedure Regulations) 2009.

PINS Reference Number: TR010062/APP/3.6

North Pennine Moors SAC

North Pennine Moors SAC
North Pennine Moors SPA

North Pennine Moors SPA 6

North Pennine Moors SAC

North Pennine Moors SPA 7

LARTINGTON CP

STARTFORTH CP

BOLDRON CP

GILMONBY CP

Deep Dale

Greta Valley

LAVATRIS ROMAN FORT

ROMAN ROAD

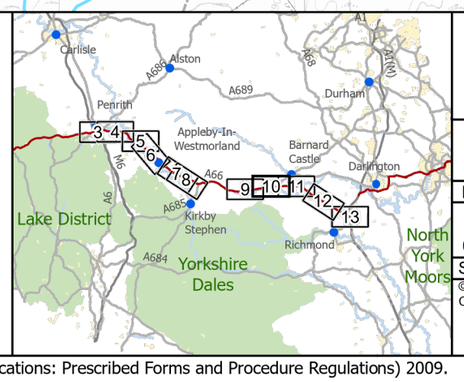
Route Alignment
Existing A66
Affected Road Network ES
Order Limits
Study Area 2000m
River Eden SAC Affected Road Network Crossing Point

Statutory Designated Sites

Special Protection Areas (SPA)
Special Area of Conservation (SAC)
Site of Special Scientific Interest Units (WIth IDs)

Watercourses

Watercourses Functionally Linked To The SAC That Interact With The Project
Other Watercourse



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Revision	First Issue				
P02	KBIG	PKEL	THOU	AMIT	KWHA
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Kilometres
0 1 2

Scale @ A3: 1:25,000 | Project Ref No HE565627 | Stage: Stage 3

Project Name
A66 Northern Trans-Pennine Project

Map Title
Figure 1.1
Appendix A European Designated Sites Location Plan and the Project
Scheme: 07, Bowes Bypass
Sheet 10 of 13

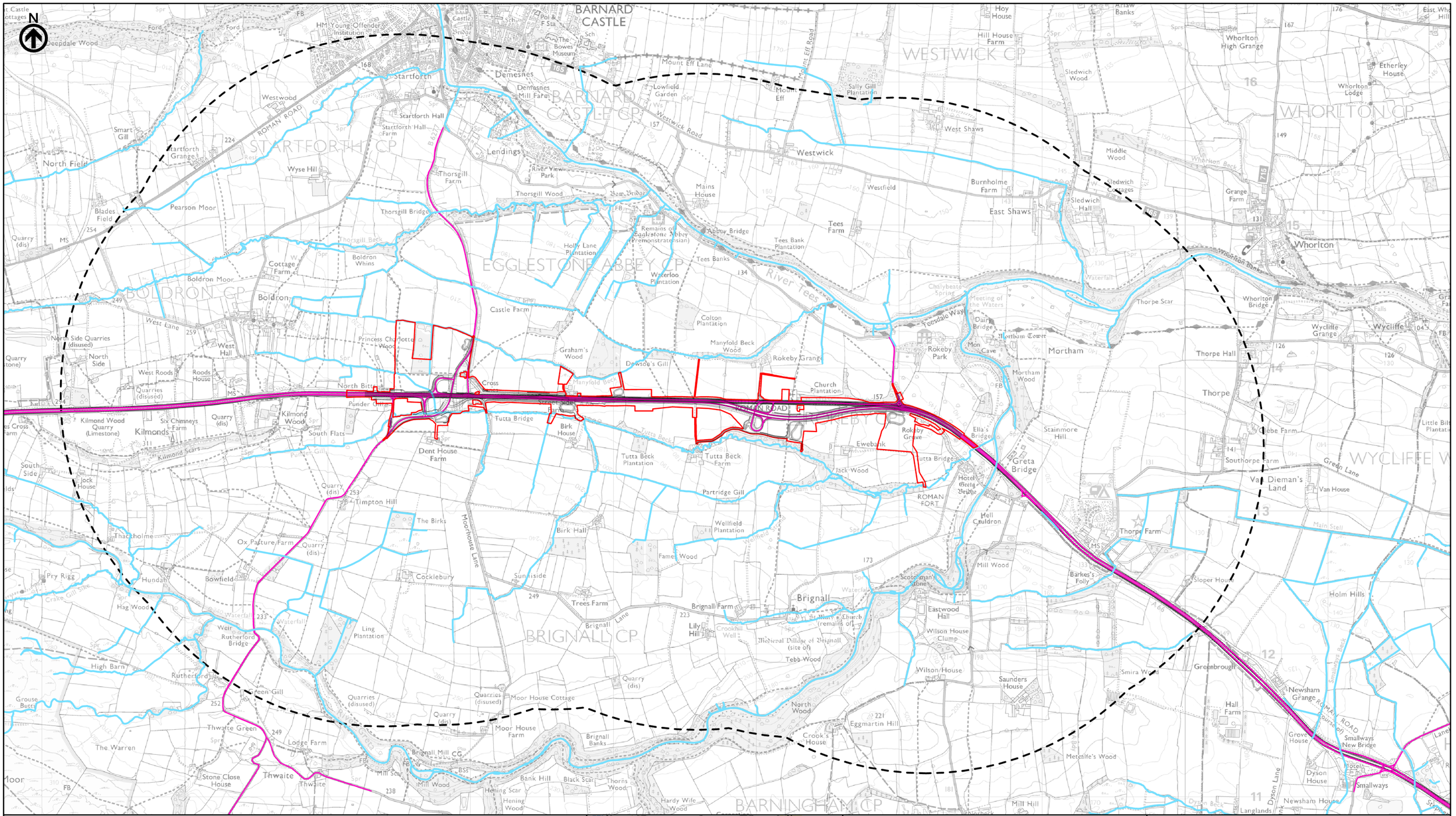
Map Number

Project	Originator	Volume	Location	Type	Role	Number
HE565627	AMY	EBD	S00	MP	LB	003335

Suitability	Suitability Description	Revision
S4	FIT FOR STAGE APPROVAL	P02

This Environmental Statement Figure meets the requirements of Regulation 5(2)(g) &5(2)(l)(i) of the Infrastructure Planning (Applications: Prescribed Forms and Procedure Regulations) 2009.

PINS Reference Number: TR010062/APP/3.6



- Route Alignment
- Existing A66
- Affected Road Network ES
- Order Limits
- Study Area 2000m
- River Eden SAC Affected Road Network Crossing Point

Statutory Designated Sites

- Special Protection Areas (SPA)
- Special Area of Conservation (SAC)
- Site of Special Scientific Interest Units (WIth IDs)

Watercourses

- Watercourses Functionally Linked To The SAC That Interact With The Project
- Other Watercourse

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	First Issue				
P02	KBIG	PKEL	THOU	AMIT	KWHA
	10/03/22	14/03/22	21/03/22	20/04/22	20/04/22
Revision	Created	Checked	Reviewed	Approved	Authorised

Kilometres
0 1 2

Scale @ A3: 1:25,000 | Project Ref No HE565627 | Stage: Stage 3

Project Name
A66 Northern Trans-Pennine Project

Map Title
Figure 1.1
Appendix A European Designated Sites Location Plan and the Project
Scheme: 08, Cross Lanes to Rokeby
Sheet 11 of 13

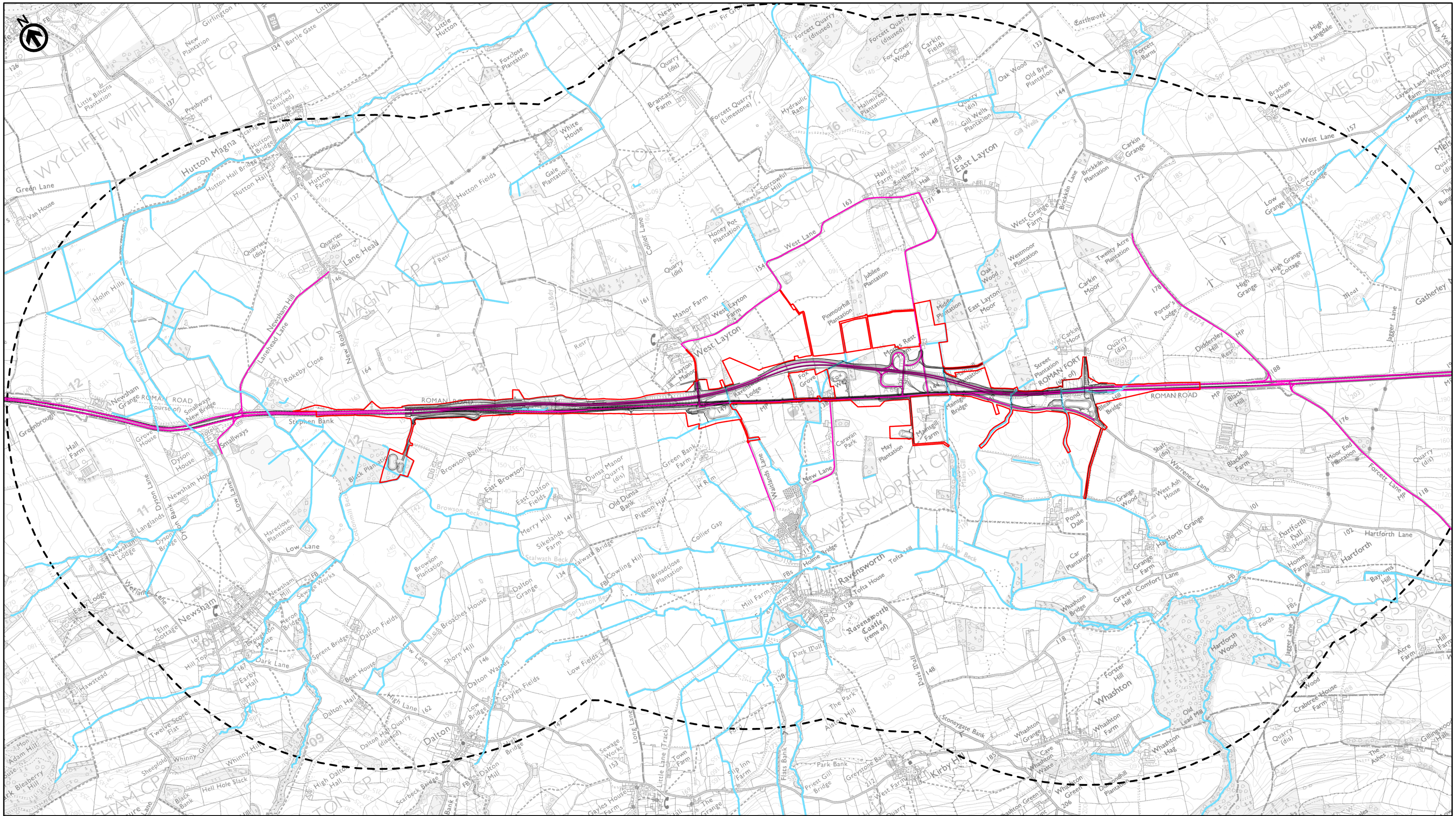
Map Number

Project	Originator	Volume			
HE565627	AMY	-	EBD	-	
S00	-	MP	- LB	-	003336
Location		Type	Role	Number	

Suitability	Suitability Description	Revision
S4	FIT FOR STAGE APPROVAL	P02

This Environmental Statement Figure meets the requirements of Regulation 5(2)(g) &5(2)(l)(i) of the Infrastructure Planning (Applications: Prescribed Forms and Procedure Regulations) 2009.

PINS Reference Number: TR010062/APP/3.6



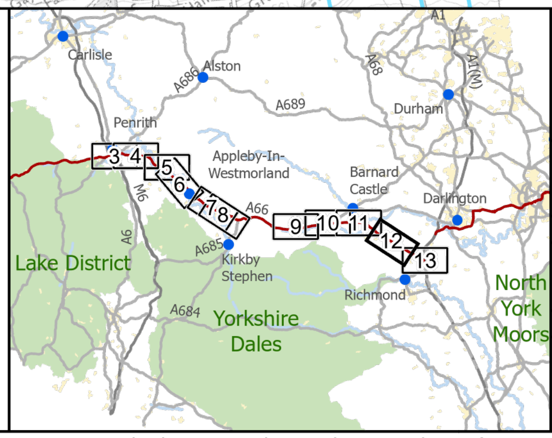
- Route Alignment
- Existing A66
- Affected Road Network ES
- Order Limits
- Study Area 2000m
- River Eden SAC Affected Road Network Crossing Point

Statutory Designated Sites

- Special Protection Areas (SPA)
- Special Area of Conservation (SAC)
- Site of Special Scientific Interest Units (WIth IDs)

Watercourses

- Watercourses Functionally Linked To The SAC That Interact With The Project
- Other Watercourse



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Revision	First Issue				
P02	KBIG	PKEL	THOU	AMIT	KWHA
	10/03/22	14/03/22	21/03/22	20/04/22	20/04/22
Revision	Created	Checked	Reviewed	Approved	Authorised

Kilometres: 0 — 1 — 2

Scale @ A3: 1:25,000 | Project Ref No HE565627 | Stage: Stage 3

Project Name
A66 Northern Trans-Pennine Project

Map Title
Figure 1.1
Appendix A European Designated Sites Location Plan and the Project
Scheme: 09, Stephen Bank to Carkin Moor
Sheet 12 of 13

Map Number

Project	Originator	Volume	Location	Type	Role	Number
HE565627	AMY	EBD	S00	MP	LB	003337

Suitability	Suitability Description	Revision
S4	FIT FOR STAGE APPROVAL	P02

This Environmental Statement Figure meets the requirements of Regulation 5(2)(g) &5(2)(l)(i) of the Infrastructure Planning (Applications: Prescribed Forms and Procedure Regulations) 2009.

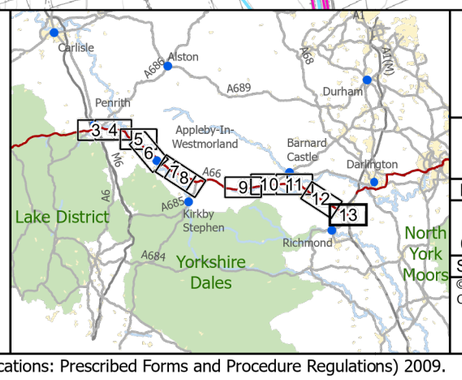
- Route Alignment
- Existing A66
- Affected Road Network ES
- Order Limits
- Study Area 2000m
- River Eden SAC Affected Road Network Crossing Point

Statutory Designated Sites

- Special Protection Areas (SPA)
- Special Area of Conservation (SAC)
- Site of Special Scientific Interest Units (WIth IDs)

Watercourses

- Watercourses Functionally Linked To The SAC That Interact With The Project
- Other Watercourse



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	First Issue				
P02	KBIG	PKEL	THOU	AMIT	KWHA
	10/03/22	14/03/22	21/03/22	20/04/22	20/04/22
Revision	Created	Checked	Reviewed	Approved	Authorised

Kilometres
0 1 2

Scale @ A3: 1:25,000 | Project Ref No HE565627 | Stage: Stage 3

Project Name
A66 Northern Trans-Pennine Project

Map Title
Figure 1.1
Appendix A European Designated Sites Location Plan and the Project
Scheme: 11, A1(M) Junction 53 Scotch Corner
Sheet 13 of 13

Map Number

Project	Originator	Volume
HE565627	AMY	EBD

Location	Type	Role	Number
S00	MP	LB	003338

Suitability	Suitability Description	Revision
S4	FIT FOR STAGE APPROVAL	P02

This Environmental Statement Figure meets the requirements of Regulation 5(2)(g) &5(2)(l)(i) of the Infrastructure Planning (Applications: Prescribed Forms and Procedure Regulations) 2009.

PINS Reference Number: TR010062/APP/3.6

A.2 HRA Appendix B: Freshwater Ecology Survey Locations (HRA) and Location of Natal Otter Holt

Route Alignment
Existing A66
Order Limits
Natal Otter Holt
Macrophyte Survey
Fish Survey - Electric Fishing
Fish Survey - eDNA
White-clawed Crayfish Survey
Manual search & eDNA
Manual search only
eDNA only

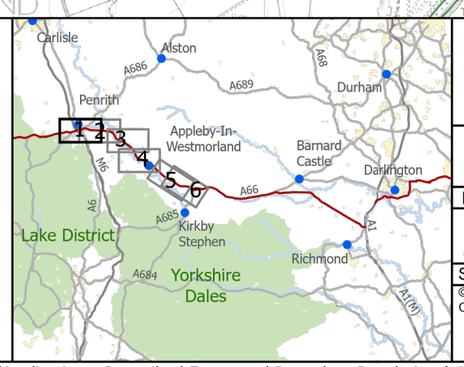
River Corridor Survey
Downstream
Upstream

Watercourses

Watercourses Functionally Linked To The SAC That Interact With The Project
Other Watercourse

Statutory Designated Sites

Special Protection Areas
Special Area of Conservation
Site of Special Scientific Interest Units (With IDs)



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Revision	Created	Checked	Reviewed	Approved	Authorised
P02	KBIG 24/02/22	LHAN 22/03/22	THOU 29/03/22	AMIT 05/04/22	KWHA 06/04/22

First Issue

Kilometres
0 1 2

Scale @ A3: 1:25,000 | Project Ref No HE565627 | Stage: Stage 3

Project Name
A66 Northern Trans-Pennine Project

Map Title
Figure 1.1
Appendix B: Freshwater Ecology Survey Locations and Location of Natal Otter Holt
Scheme: 0102, M6 Junction 40 to Kemplay Bank
Sheet 1 of 6

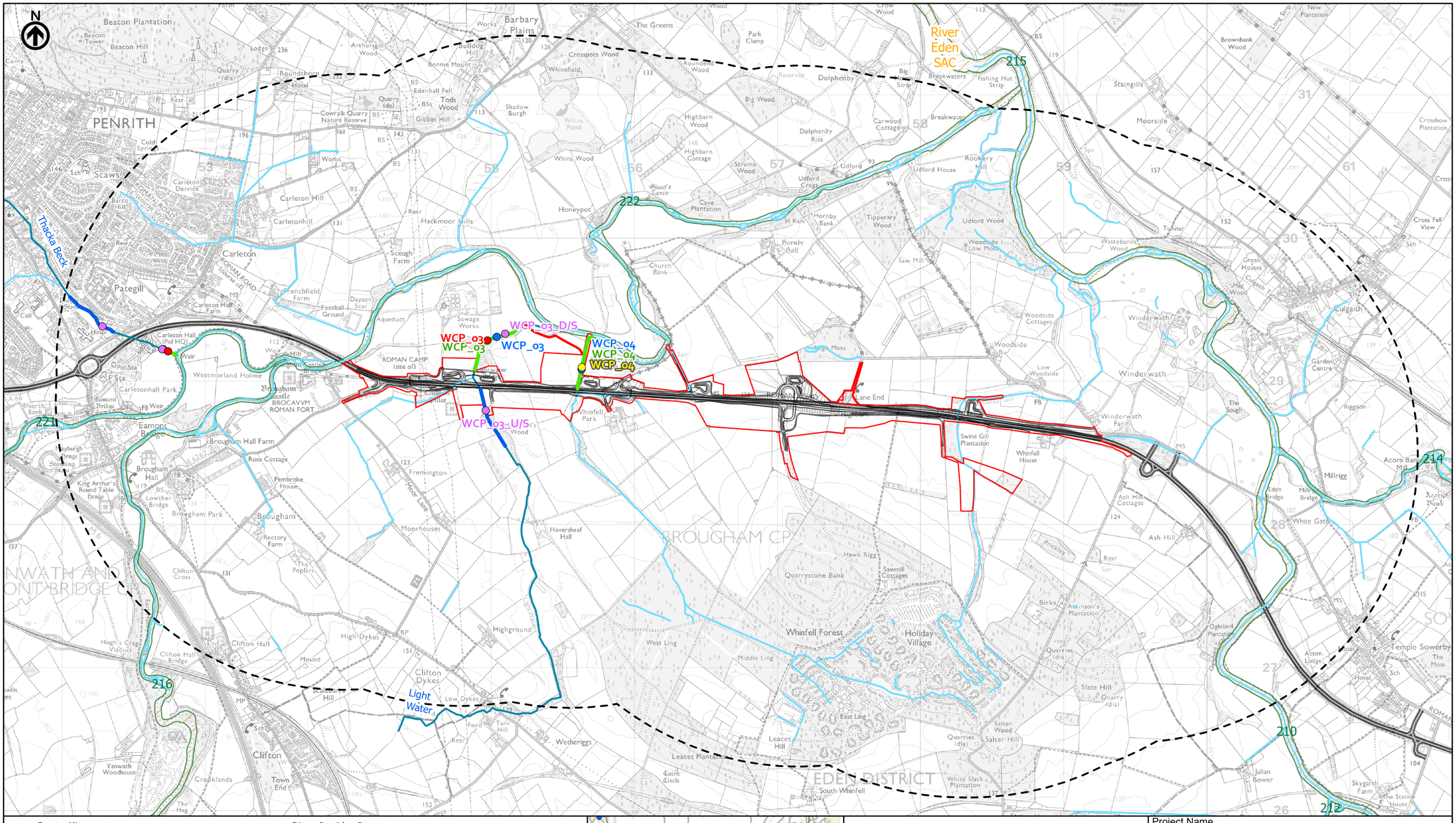
Map Number

Project	Originator	Volume	Location	Type	Role	Number
HE565627	AMY	EBD	S00	MP	LB	003339

Suitability	Suitability Description	Revision
S4	FIT FOR STAGE APPROVAL	P02

This Environmental Statement Figure meets the requirements of Regulation 5(2)(g) and 5(2)(l)(i) of the Infrastructure Planning (Applications: Prescribed Forms and Procedure Regulations) 2009.

PINS Reference Number: TR010062/APP/3.6

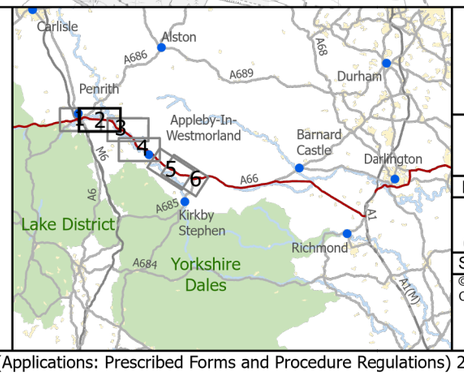


Route Alignment
Existing A66
Order Limits
Natal Otter Holt
Macrophyte Survey
Fish Survey - Electric Fishing
Fish Survey - eDNA
White-clawed Crayfish Survey
Manual search & eDNA
Manual search only
eDNA only

River Corridor Survey
Downstream
Upstream

Watercourses
Watercourses Functionally Linked To The SAC That Interact With The Project
Other Watercourse

Statutory Designated Sites
Special Protection Areas
Special Area of Conservation
Site of Special Scientific Interest Units (With IDs)



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Revision	Created	Checked	Reviewed	Approved	Authorised
P02 First Issue	KBIG 24/02/22	LHAN 22/03/22	THOU 29/03/22	AMIT 05/04/22	KWHA 06/04/22

Kilometres
0 1 2

Scale @ A3: 1:25,000 | Project Ref No HE565627 | Stage: Stage 3

Project Name
A66 Northern Trans-Pennine Project

Map Title
Figure 1.1
Appendix B: Freshwater Ecology Survey Locations and Location of Natal Otter Holt
Scheme: 03, Temple Sowerby
Sheet 2 of 6

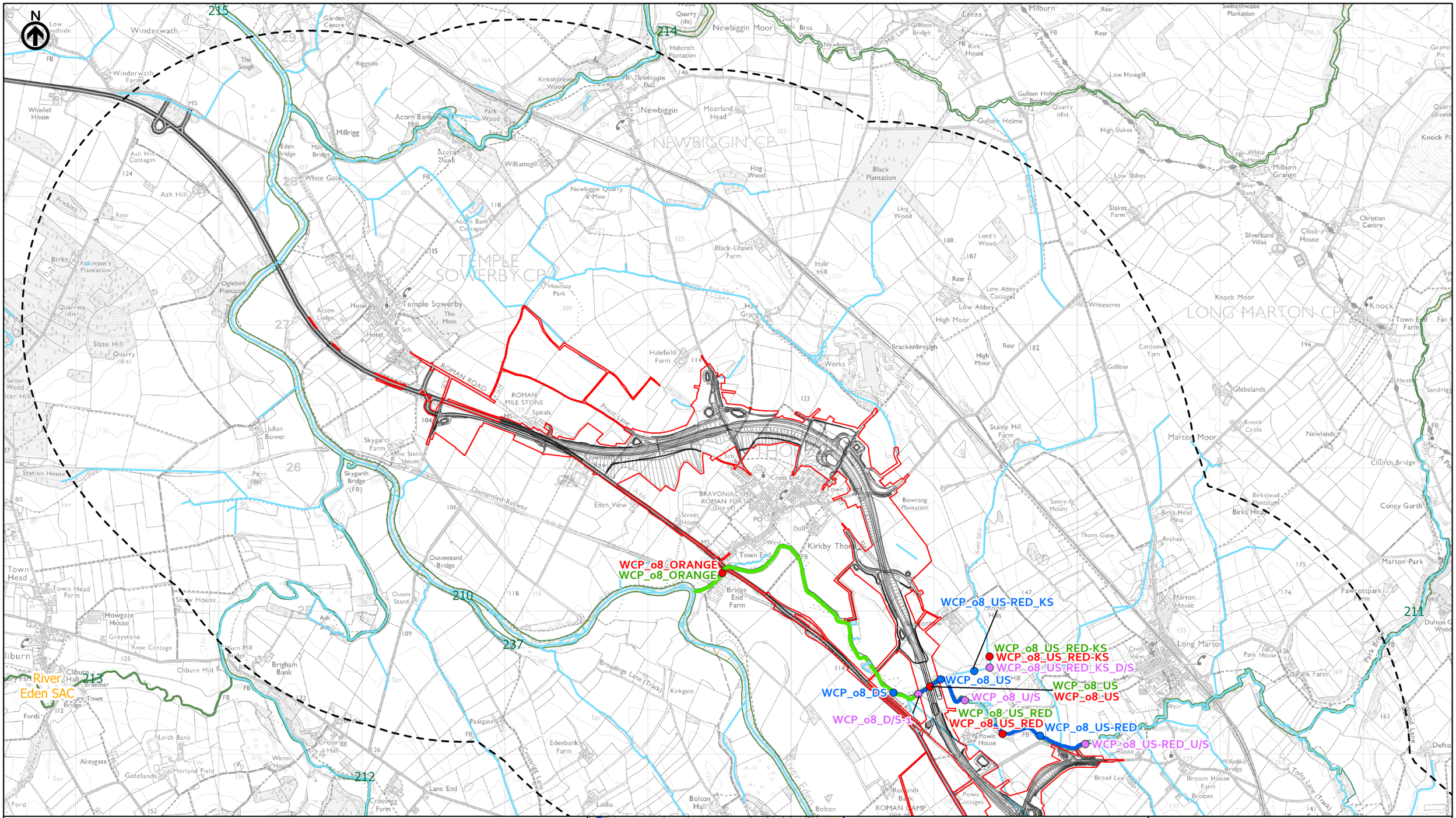
Map Number

Project	Originator	Volume	Location	Type	Role	Number
HE565627	AMY	EBD	S00	MP	LB	003340

Suitability	Suitability Description	Revision
S4	FIT FOR STAGE APPROVAL	P02

This Environmental Statement Figure meets the requirements of Regulation 5(2)(g) and 5(2)(l)(i) of the Infrastructure Planning (Applications: Prescribed Forms and Procedure Regulations) 2009.

PINS Reference Number: TR010062/APP/3.6



- Route Alignment
- Existing A66
- Order Limits
- Natal Otter Holt
- Macrophyte Survey
- Fish Survey - Electric Fishing
- Fish Survey - eDNA

White-clawed Crayfish Survey

- Manual search & eDNA
- Manual search only
- eDNA only

River Corridor Survey

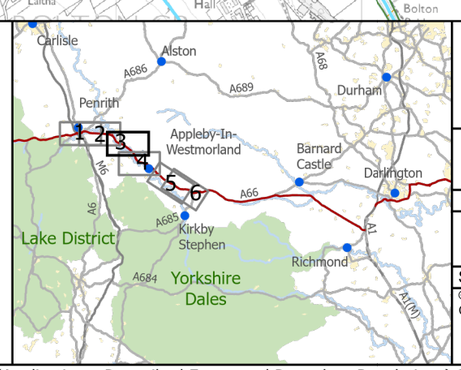
- Downstream
- Upstream

Watercourses

- Watercourses Functionally Linked To The SAC That Interact With The Project
- Other Watercourse

Statutory Designated Sites

- Special Protection Areas
- Special Area of Conservation
- Site of Special Scientific Interest Units (With IDs)



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	First Issue				
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Revision	Created	Checked	Reviewed	Approved	Authorised

Kilometres
0 1 2

Scale @ A3: 1:25,000 | Project Ref No HE565627 | Stage: Stage 3

Project Name
A66 Northern Trans-Pennine Project

Map Title
Figure 1.1
Appendix B: Freshwater Ecology Survey Locations and Location of Natal Otter Holt
Scheme: 0405, Temple Sowerby to Appleby
Sheet 3 of 6

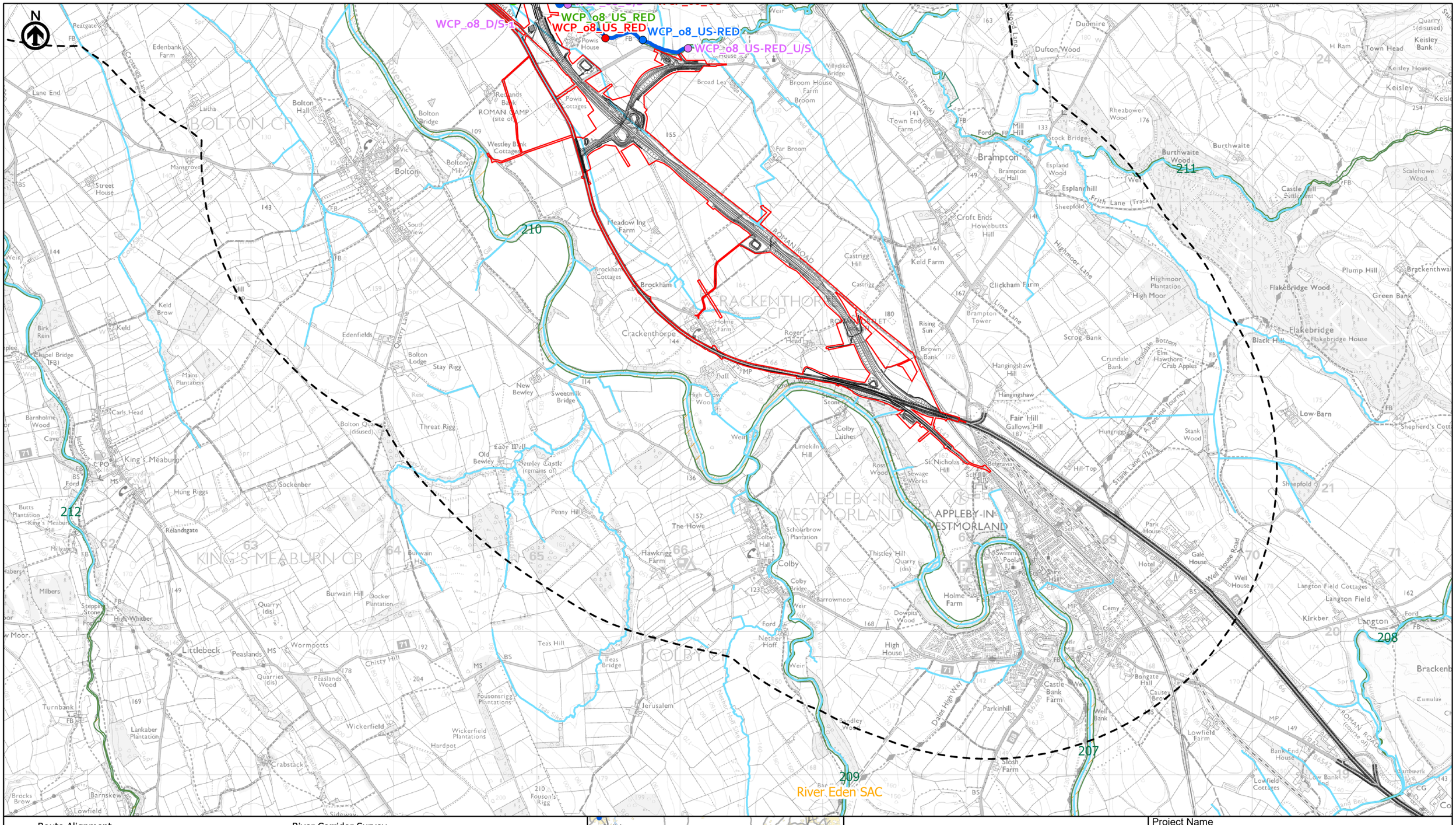
Map Number

Project	Originator	Volume	Location	Type	Role	Number
HE565627	AMY	EBD	S00	MP	LB	003341

Suitability	Suitability Description	Revision
S4	FIT FOR STAGE APPROVAL	P02

This Environmental Statement Figure meets the requirements of Regulation 5(2)(g) and 5(2)(l)(i) of the Infrastructure Planning (Applications: Prescribed Forms and Procedure Regulations) 2009.

PINS Reference Number: TR010062/APP/3.6



- Route Alignment
- Existing A66
- Order Limits
- Natal Otter Holt
- Macrophyte Survey
- Fish Survey - Electric Fishing
- Fish Survey - eDNA

White-clawed Crayfish Survey

- Manual search & eDNA
- Manual search only
- eDNA only

River Corridor Survey

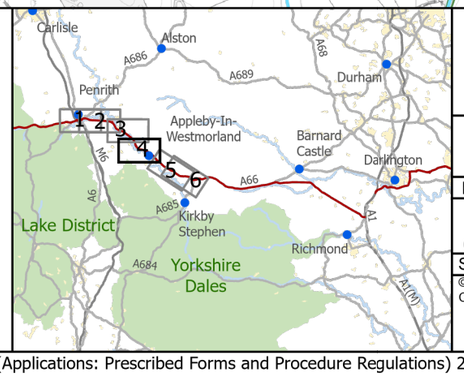
- Downstream
- Upstream

Watercourses

- Watercourses Functionally Linked To The SAC That Interact With The Project
- Other Watercourse

Statutory Designated Sites

- Special Protection Areas
- Special Area of Conservation
- Site of Special Scientific Interest Units (With IDs)



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Revision	First Issue				
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P02	24/02/22	22/03/22	29/03/22	05/04/22	06/04/22
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Kilometres: 0 1 2

Scale @ A3: 1:25,000 | Project Ref No HE565627 | Stage: Stage 3

Project Name
A66 Northern Trans-Pennine Project

Map Title
Figure 1.1
Appendix B: Freshwater Ecology Survey Locations and Location of Natal Otter Holt
Scheme: 0405, Temple Sowerby to Appleby
Sheet 4 of 6

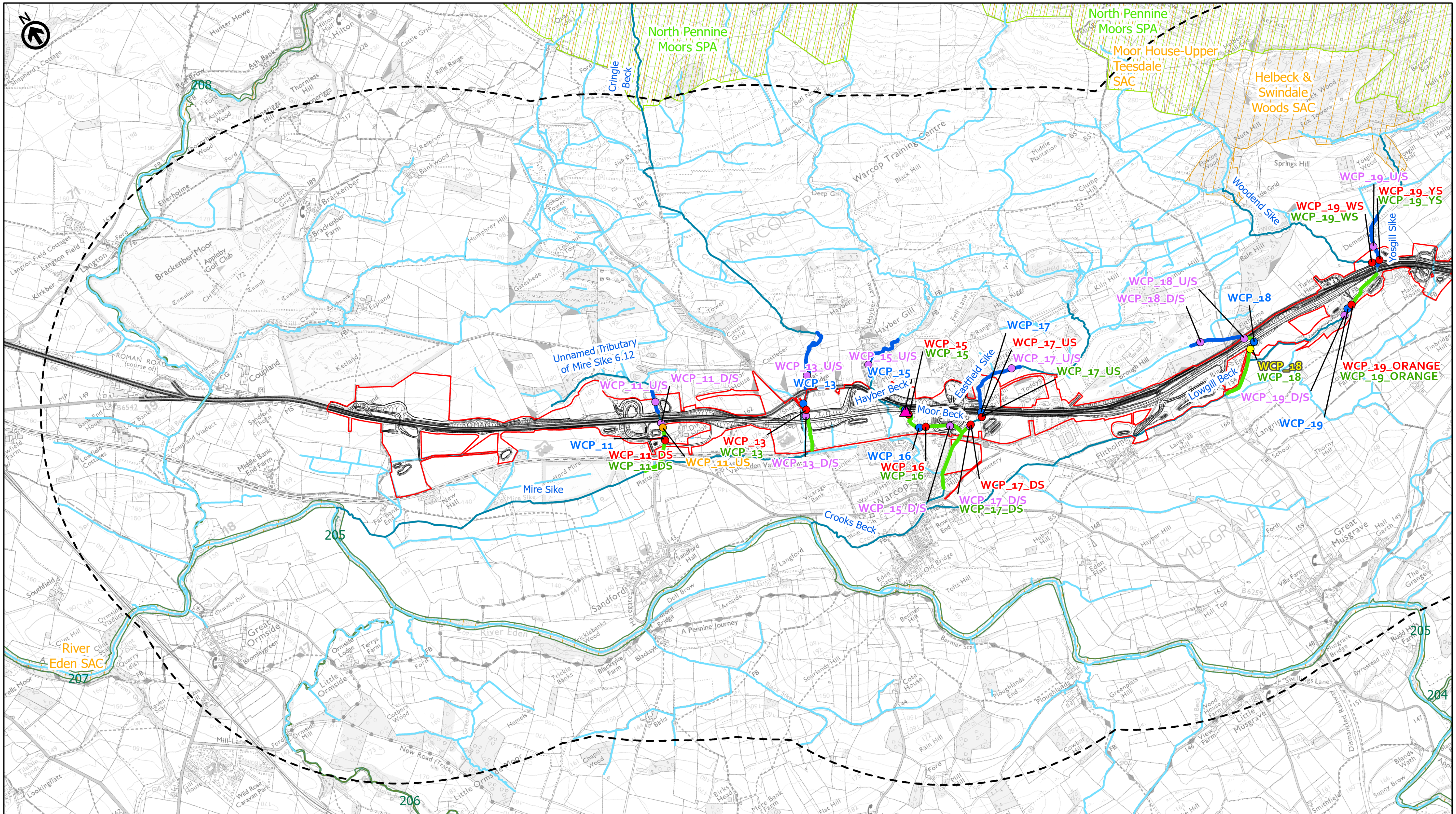
Map Number

Project	Originator	Volume	Location	Type	Role	Number
HE565627	AMY	EBD	S00	MP	LB	003342

Suitability	Suitability Description	Revision
S4	FIT FOR STAGE APPROVAL	P02

This Environmental Statement Figure meets the requirements of Regulation 5(2)(g) and 5(2)(l)(i) of the Infrastructure Planning (Applications: Prescribed Forms and Procedure Regulations) 2009.

PINS Reference Number: TR010062/APP/3.6



Route Alignment

Existing A66

Order Limits

Natal Otter Holt

Macrophyte Survey

Fish Survey - Electric Fishing

Fish Survey - eDNA

White-clawed Crayfish Survey

Manual search & eDNA

Manual search only

eDNA only

River Corridor Survey

Downstream

Upstream

Watercourses

Watercourses Functionally Linked To The SAC That Interact With The Project

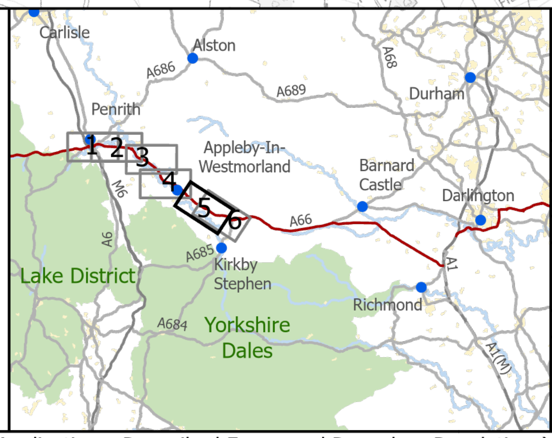
Other Watercourse

Statutory Designated Sites

Special Protection Areas

Special Area of Conservation

Site of Special Scientific Interest Units (With IDs)



national highways

3 Piccadilly Place
Manchester
M1 3BN

Revision	Created	Checked	Reviewed	Approved	Authorised
P02	First Issue KBIG 24/02/22	LHAN 22/03/22	THOU 29/03/22	AMIT 05/04/22	KWHA 06/04/22

Kilometres 0 1 2

Scale @ A3: 1:25,000 | Project Ref No HE565627 | Stage: Stage 3

Project Name
A66 Northern Trans-Pennine Project

Map Title
Figure 1.1
Appendix B: Freshwater Ecology Survey Locations and Location of Natal Otter Holt
Scheme: 06, Appleby to Brough
Sheet 5 of 6

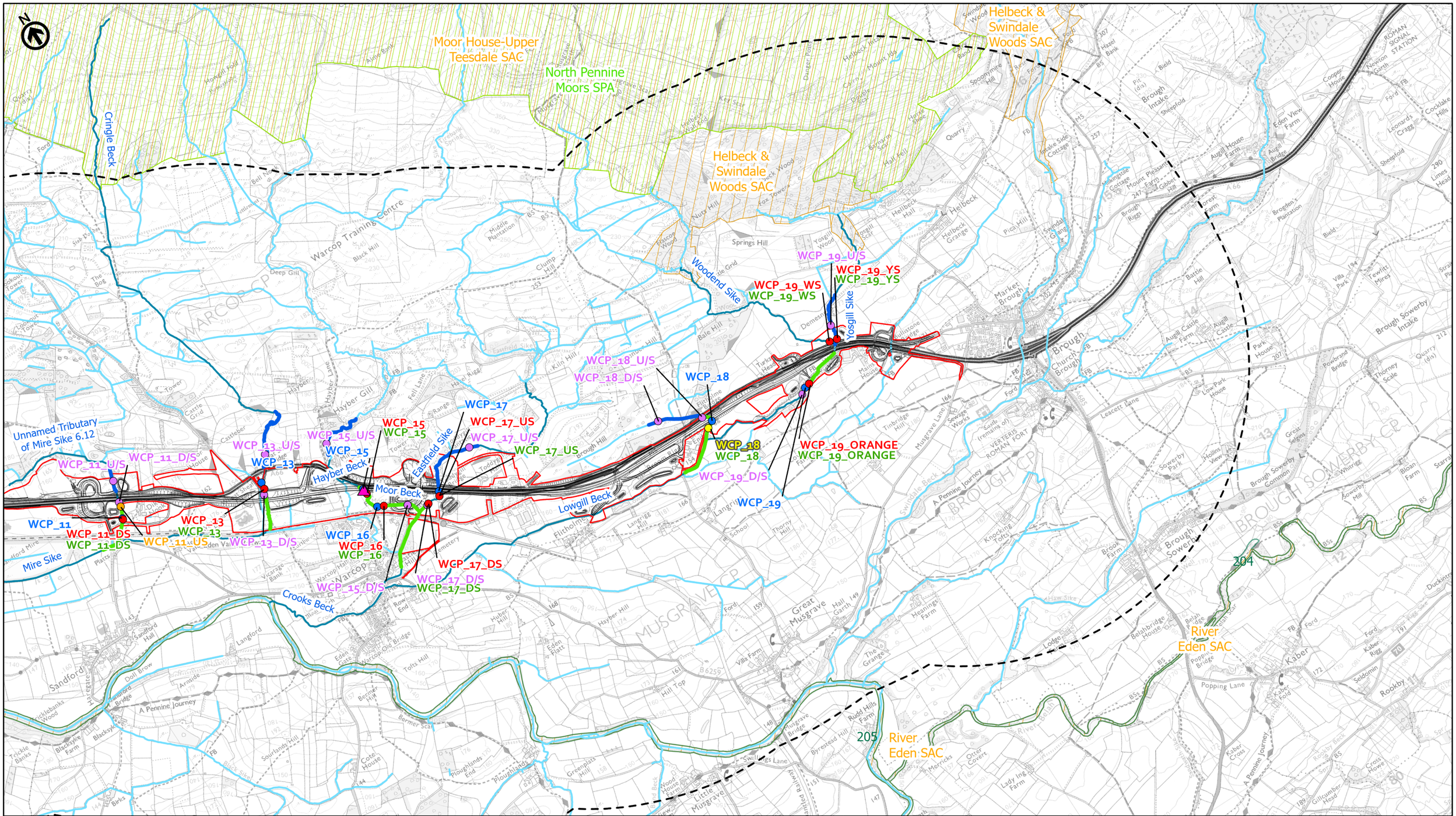
Map Number

Project	Originator	Volume
HE565627 -	AMY	- EBD -

Location	Type	Role	Number
S00	- MP	- LB	- 003343

Suitability	Suitability Description	Revision
S4	FIT FOR STAGE APPROVAL	P02

This Environmental Statement Figure meets the requirements of Regulation 5(2)(g) and 5(2)(l)(i) of the Infrastructure Planning (Applications: Prescribed Forms and Procedure Regulations) 2009.



- Route Alignment
- Existing A66
- Order Limits
- Natal Otter Holt
- Macrophyte Survey
- Fish Survey - Electric Fishing
- Fish Survey - eDNA

White-clawed Crayfish Survey

- Manual search & eDNA
- Manual search only
- eDNA only

River Corridor Survey

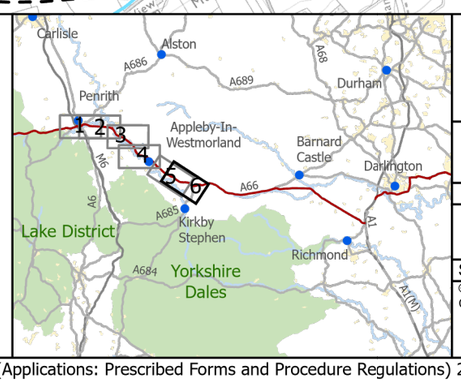
- Downstream
- Upstream

Watercourses

- Watercourses Functionally Linked To The SAC That Interact With The Project
- Other Watercourse

Statutory Designated Sites

- Special Protection Areas
- Special Area of Conservation
- Site of Special Scientific Interest Units (With IDs)



national highways

3 Piccadilly Place
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Revision	Created	Checked	Reviewed	Approved	Authorised
P02	First Issue				
	KBIG	LHAN	THOU	AMIT	KWHA
	24/02/22	22/03/22	29/03/22	05/04/22	06/04/22

Kilometres: 0 1 2

Scale @ A3: 1:25,000 | Project Ref No HE565627 | Stage: Stage 3

Project Name
A66 Northern Trans-Pennine Project

Map Title
Figure 1.1
Appendix B: Freshwater Ecology Survey Locations and Location of Natal Otter Holt
Scheme: 06, Appleby to Brough
Sheet 6 of 6

Map Number

Project	Originator	Volume	Location	Type	Role	Number
HE565627	AMY	EBD	S00	MP	LB	003344

Suitability	Suitability Description	Revision
S4	FIT FOR STAGE APPROVAL	P02

This Environmental Statement Figure meets the requirements of Regulation 5(2)(g) and 5(2)(l)(i) of the Infrastructure Planning (Applications: Prescribed Forms and Procedure Regulations) 2009.

PINS Reference Number: TR010062/APP/3.6

A.3 HRA Appendix C: PINS Screening Matrices

Potential effects

Potential effects upon the European site(s) (as defined in Advice Note 10[3]) which are considered within the submitted HRA report are provided in the Table F.1: Effects considered within the screening matrices.

Table F.1: Effects considered within the screening matrices

Designation	Effects described in submission information	Presented in screening matrices as
River Eden SAC	Land take / resource requirements / reduction of habitat Disturbance of mobile species and species fragmentation Species injury and mortality Introduction and/or spread of invasive non-native species Changes in surface and groundwater quality, quantity, and hydrogeology Changes in hydrology and fluvial geomorphological processes Changes in air quality.	Land take / resource requirements / reduction of habitat Disturbance of mobile species and species fragmentation Species injury and mortality Introduction and/or spread of invasive non-native species Changes in surface and groundwater quality, quantity, and hydrogeology Changes in hydrology and fluvial geomorphological processes Changes in air quality.
North Pennine Moors SAC	Air quality	Air quality
North Pennine Moors SPA	Air quality Reduction in suitable breeding and foraging habitat for qualifying birds species as a result of changes in air quality along the ARN	Air quality Reduction in suitable breeding and foraging habitat for qualifying birds species as a result of changes in air quality along the ARN

STAGE 2: Effects on Integrity

Likely significant effects have been identified for the following sites:

- River Eden SAC
- North Pennine Moors SAC
- North Pennine Moors SPA

These sites have been subject to further assessment in order to establish if the NSIP could have an adverse effect on their integrity. Evidence for the conclusions reached on integrity is detailed within the footnotes to the matrices below.

Decommissioning will not be either feasible or desirable and is therefore not proposed to be considered and is consequently not included in the screening matrices below.

Matrix Key:

✓ = Adverse effect on integrity cannot be excluded

× = Adverse effect on integrity can be excluded

C = construction

O = operation

Table F.2: River Eden SAC PINS matrix.

Name of European site and designation: River Eden SAC																
EU Code: UK0012643																
Distance to NSIP: Within Temple Sowerby to Appleby (closest point)																
European site features	Likely effects of NSIP															
Effect	Land take / resource requirements / reduction of habitat		Disturbance of mobile species and species fragmentation		Species injury and mortality		Introduction and/or spread of invasive non-native species		Changes in surface and groundwater quality, quantity, and hydrogeology		Changes in hydrology and fluvial geomorphological processes		Changes in air quality.		In combination	
Stage of Development	C	O	C	O	C	O	C	O	C	O	C	O	C	O	C	O
3130 Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or of the Isoëto-Nanojuncetea	×*a	×*a					×*a	×*a	×*a	×*a	×*a	×*a	×*a	×*a	×*a	×*a
3260 Watercourses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation.	×*b	×*b					×*g	×*h	×*i	×*j	×*k	×*k	×*l	×*l	×*n	×*n

Name of European site and designation: River Eden SAC															
91E0 Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae)	×*a	×*a					×*a	×*a	×*a	×*a	×*a	×*a	×*a	×*a	×*a	×*a
Atlantic salmon	×*c	×*c	×*d	×*d	×*f	×*f	×*g	×*h	×*i	×*j	×*k	×*k	× *m	× *m	×*n	×*n
Brook lamprey	×*c	×*c	×*d	×*d	×*f	×*f	×*g	×*h	×*i	×*j	×*k	×*k	× *m	× *m	×*n	×*n
Bullhead	×*c	×*c	×*d	×*d	×*f	×*f	×*g	×*h	×*i	×*j	×*k	×*k	× *m	× *m	×*n	×*n
Otter	×*c	×*c	×*e	×*e	×*f	×*f	×*g	×*h	×*i	×*j	×*k	×*k	× *m	× *m	×*n	×*n
River lamprey	×*c	×*c	×*d	×*d	×*f	×*f	×*g	×*h	×*i	×*j	×*k	×*k	× *m	× *m	×*n	×*n
Sea lamprey	×*c	×*c	×*d	×*d	×*f	×*f	×*g	×*h	×*i	×*j	×*k	×*k	× *m	× *m	×*n	×*n

*a 3130 Oligotrophic to mesotrophic standing waters refers to Ullswater which is considered outside the Project zone of influence and was screened out at Stage 1 (Screening) (Document Reference 3.5: Habitats Regulations Assessment Stage 1: Likely Significant Effects Report). 91E0 Alluvial forests: No alluvial forest was recorded within the SAC during surveys as described in Appendix 6.20 Aquatic Macrophyte and River Corridor Survey Technical Appendix (ES Volume 3, Application Document Number 3.4,) and this habitat type is absent from the SSSI units affected by the Project (including the ARN) according to the designated sites viewer (Natural England, 2022)[15].

*b ***Adverse effect on integrity can be excluded***. Shading of 3260 watercourse habitat will occur as a result of the Project, associated with the Trout Beck. In addition there will be localised alteration of the riparian zone as a result of the attenuation basin discharges to the River Eamont (M6 Junction 40 to Kemplay Bank) and Trout Beck (Temple Sowerby to Appleby) that will enter these SAC watercourses through the riparian zone. The area of shaded 3260 watercourse habitat represents 0.17% of SSSI Unit

211 (Trout and Swindale Becks)[76] and 0.004% of the potential surface area of this habitat within the SAC[77]. The area of riparian habitat subject to alteration as a result of the attenuation basin discharges to the River Eamont and Trout Beck represents 0.03% of SSSI Unit 221 (River Eamont) and 0.02 % of SSSI Unit 211 (Trout and Swindale Becks). The changes are localised in their nature and it is considered that the shading and riparian alteration would not materially affect the structure and function of this habitat (including typical species) as described from paragraph 1.5.65.

*c ***Adverse effect on integrity can be excluded***. There will not be a reduction in habitat area within the SAC as a result of the Trout Beck viaduct which spans the river. The detailed fluvial geomorphology modelling results presented from paragraph 1.5.65 for 3260 watercourse habitat demonstrate that fish habitat in Trout Beck will also not be adversely affected during operation. In addition, the majority (five out of six) of new watercourse crossings of functionally linked watercourses in the Appleby to Brough scheme are open span and will not result in loss of fish habitat (Table 9: Proposed watercourse crossings of the SAC and functionally linked habitats). There will be some localised shading of in stream and riparian habitats (associated with the extension of existing culverts and the new bridges) in functionally linked watercourses, but when considering mitigation, this is not considered to result in an adverse effect on qualifying fish species or otter, as described from paragraph 1.5.196.

*d ***Adverse effect on integrity can be excluded***. Disturbance of mobile species and species fragmentation during the construction and operation phase (from potential noise, vibration and lighting disturbance) has been reduced as a result of best practice watercourse crossing design, that has minimised the need for instream works. All new watercourse crossings, with the exception of a culvert on Unnamed Tributary of Lowgill Beck 6.1 (that does not support fish), are either viaducts or open span bridges meaning that species will be able to freely migrate through the existing channel during construction. Where instream works that could give rise to species fragmentation (e.g. culvert extension) are required, they will be undertaken outside the key salmonid breeding season (1st October to 31st May) and physical disturbance (e.g. from temporary over-pumping) will be minimised through best practice construction techniques (e.g. fish translocation, pollution control measures). Likewise, construction activities giving rise to excess noise and vibration will be sensitively timed to reduce the disturbance impacts on migrating fish (noting the limited window to avoid the migration period for all species and all life-stages) and night working will be avoided where practicable adjacent to watercourses. Construction sites will not be illuminated at night, where possible. Where this is not possible (e.g. due to security considerations in non-green field locations), lighting will be sensitive to nocturnal species

[76] The area of habitat impacted has been calculated as a percentage of the total potential area of 3260 watercourse within the SSSI unit 221 (34.6ha).
[77] The area of habitat impacted has been calculated as a percentage of the total potential area of 3260 watercourse within the SAC (1,573ha). This was calculated by taking the total area of the SAC (2463ha) and subtracting the area of Ullswater (890ha), which does not conform to this habitat type.

using the river and riparian corridor and face away from the watercourse, thus reducing disturbance of nocturnal migrants. No additional lighting is required for the operation of the Project in the Temple Sowerby to Appleby or Appleby to Brough, which cross the SAC.

*e ***Adverse effect on integrity can be excluded.*** It is considered likely that otters would quickly become habituated to increased levels of noise and disturbance associated with the construction of new bridge crossings and works in close proximity to watercourses. Therefore, general disturbance of otter foraging and commuting habitat is considered unlikely to have an adverse effect on local otter populations. The disturbance of a single holt, which will be made under a relevant licence, is not considered to have an adverse effect on local otter populations, as described from paragraph 1.5.138. Species and habitat fragmentation of otter will be avoided during operation through the incorporation of best practice watercourse crossing design enabling the free movement of otter, maintaining the connectivity within, and to, the SAC, as described from paragraph 1.5.288.

*f ***Adverse effect on integrity can be excluded***. Species injury and mortality will be mitigated during construction through mitigation actions that of prohibits compaction (or other activities resulting in PPV of greater than 13mm/s within river substrates) within 5m of watercourses supporting gravel spawning species (salmon, trout, lamprey sp., bullhead) without prior consultation with the Environment Agency and Natural England; this will be employed to remove the vibration risk to fish eggs/embryos. Where instream works or dewatering are required, they will be carried out under the supervision of a suitably qualified Ecological Clerk of Works who will oversee the fish translocation and implementation of best practice dewatering methods. Further detail on mitigation to avoid fish injury and mortality is described from paragraph 1.5.206. The risk of increased otter injury mortality during construction and operation will be manged through the design of effective temporary and permanent watercourse crossings, that facilitate the free movement of otter. Further detail is provided from paragraph 1.5.288.

*g ***Adverse effect on integrity can be excluded***. The introduction and/or spread of invasive non-native species will be managed through the strict implementation of an Invasive Non-Native Species Management Plan; a draft of this plan (Annex 15) is included in the EMP (ES Application Document 2.7). This plan will be used by the Principal Contractor(s) (in consultation with specialist contractors). The plan will be informed by the desk study and baseline survey information and highlighted risk zones. Strict biosecurity measures will be included to cover workers, plant and equipment working in/or near watercourses, that adhere to the check-clean-dry protocol. Pre-construction surveys will be undertaken of all areas within the construction footprint to identify the location of any invasive species not already identified. Further detail on the Invasive Non-Native Species Management Plan is provided from paragraph 1.5.147.

*h ***Adverse effect on integrity can be excluded***. The spread of non-native species is only considered during the construction phase.

*i ***Adverse effect on integrity can be excluded***. Changes in surface and groundwater quality, quantity, and hydrogeology will be mitigated during construction through the implementation of best practice construction techniques and pollution prevention, as secured in Annex B7 Ground and Surface Water Management Plan of the EMP (ES Application Document 2.7). Further detail on how aquatic habitats and the species they support will be protected during construction are described from paragraph 1.5.151.

*j ***Adverse effect on integrity can be excluded***. During the operation phase, road runoff will be treated via a network of attenuation basins. The level of treatment is determined and tested using the National Highways (Highways England) Water Risk Assessment Tool (HEWRAT) which is used to assess the treatment design. All attenuation basins have achieved a pass under HEWRAT. Further detail on how aquatic habitats and the species they support will be protected during operation are described from paragraph 1.5.154.

*k ***Adverse effect on integrity can be excluded***. Changes in hydrology and fluvial geomorphological processes will be minimised during construction through the implementation of best practice construction methodologies (including the use of an open span temporary bridge to facilitate the construction the Trout Beck viaduct and haul roads that are not elevated from the level of the flood plain) to reduce potential for changes to fluvial geomorphological process, as described from paragraph 1.5.157. Detailed fluvial geomorphology modelling of watercourses crossings under various post-development flood scenarios are presented from paragraph 1.5.156 for Trout Beck (within the SAC) and from paragraph 1.5.212 for functionally linked watercourses in the Appleby to Brough scheme. The modelling data predicts with considerable certainty that fluvial geomorphological processes both within the channel and on the floodplain will not be significantly affected by the Trout Beck viaduct. Likewise, changes in changes in-channel hydrology and fluvial geomorphological processes in functionally linked watercourses as a result of the Project are not considered to have an adverse effect on site integrity.

*l ***Adverse effect on integrity can be excluded***. The modelling predicts perceptible increases in nitrogen deposition at only two locations where the ARN crosses the SAC during construction. During operation the Project results in an increase in nitrogen deposition in some locations and a reduction in others (as shown Table 8). The contribution of nitrogen from road transport in the context of other catchment nitrogen sources is considered modest (especially when considering the fact that aquatic plants are submerged for most of the year and where they are exposed, they are regularly flushed with river water) and would not give rise to an adverse effect on the integrity of the site. Further analysis is provided from paragraph 1.5.81.

*m ***Adverse effect on integrity can be excluded***. Air quality impacts are considered on 3260: watercourses habitat only.

*n ***Adverse effect on integrity can be excluded***. The in combination assessment is described from paragraph 1.5.294. The identified in combination projects were either complete, or scheduled to be complete prior to construction of the Project or were not considered to give rise to an adverse effect of site integrity in combination.

Table F.3: North Pennine Moors SAC PINS matrix.

Name of European site and designation: North Pennine Moors SAC		
EU code: UK0030033		
Distance to NSIP: Within the ARN (closest point)		
European site features	Likely effects of NSIP	
Effect	Air quality	
Stage of Development	C	O
Annex I habitats	×*a	×*a
Marsh saxifrage	×*a	×*a

*a Adverse effect on integrity can be excluded. Blanket bog was the only qualifying habitat recorded within 60m of the existing A66 that will be impacted by changes in air quality. The majority of habitat within 60m were recorded to be a mosaic of acid and marshy grassland. Areas of blanket bog recorded within 60m were considered to be at the edge of the habitat area for the SAC due to the grassland habitat mosaic it was frequently recorded with. Areas of blanket bog only (not recorded as a mosaic) within 60m was 4.01ha which equates to 0.01% of the blanket bog within the whole SAC. Due to the small area of one qualifying feature which is being affected by air quality and no further effects on the conservation objectives or other qualifying features, adverse effect on integrity can be excluded as a result of air quality.

Table F.4: North Pennine Moors SPA PINS matrix.

Name of European site and designation: North Pennine Moors SPA				
EU code: UK9006272				
Distance to NSIP: Within the ARN (closest point)				
European site features	Likely effects of NSIP			
Effect	Air quality		Air quality Reduction in suitable breeding and foraging habitat for qualifying birds species as a result of changes in air quality along the ARN	
Stage of Development	C	O	C	O
Annex I species (qualifying breeding birds)	×*a	×*a	×*b	×*b

*a Adverse effect on integrity can be excluded. Blanket bog was the only qualifying habitat recorded within 60m of the existing A66 that will be impacted by changes in air quality. The majority of habitat within 60m were recorded to be a mosaic of acid and marshy grassland. Areas of blanket bog recorded within 60m were considered to be at the edge of the habitat area for the SAC due to the grassland habitat mosaic it was frequently recorded with. Areas of blanket bog only (not recorded as a mosaic) within 60m was 4.01ha which equates to 0.01% of the blanket bog within the whole SAC. Due to the small area of one qualifying feature which is being affected by air quality and no further effects on the conservation objectives or other qualifying features, adverse effect on integrity can be excluded as a result of air quality.

*b Adverse effect on integrity can be excluded. The habitat areas within 60m of the existing A66 were mostly recorded to be grazed acid grassland with suboptimal structure for supporting breeding qualifying features. Whilst it is considered small numbers of golden plover may utilise this habitat for breeding, hen harrier and merlin prefer areas of heather. Peregrine falcon typically utilise cliff-ledges and crags for breeding, subsequently would not be found breeding within this habitat. APIS details exceedance impacts of nutrient deposition results in an increase in vascular plants, altered growth and species composition of bryophytes,

increased nitrogen in peat and peat water. Any potential impacts of increased nitrogen on suboptimal habitat is less likely to impact on existing structure given the dominance of grass within the community. Subsequently, no adverse effects are identified on opportunities for foraging i.e. invertebrates or small bird species which qualifying features would feed on, within the existing habitat.

A.4 HRA Appendix D: European Site Citations

EC Directive 92/43 on the Conservation of Natural Habitats and of Wild Fauna and Flora

Citation for Special Area of Conservation (SAC)

Name:	River Eden
Unitary Authority/County:	Cumbria
SAC status:	Designated on 1 April 2005
Grid reference:	NY).462237
SAC EU code:	UK0012643
Area (ha):	2463.23
Component SSSI:	River Eden and Tributaries SSSI

Site description:

The Eden is an outstanding floristically rich, northern river on sandstone and hard limestone. The catchment includes headwaters running off the Yorkshire Dales, the North Pennines and the eastern fells of the Lake District District and the major standing water body of Ullswater. Streams flowing from limestone are calcareous, whilst those flowing off the Pennines and the Lake District fells are more acidic. The nutrient status gradually changes along the Eden's length as nutrient loadings naturally increase in the lower reaches.

The variations in the physical and chemical character of the Eden result in an unusual and exceptionally rich aquatic flora. Upstream from Appleby, it is typical of nutrient poor, rapid upland rivers, and bryophytes and algae are the main components. The middle reaches support an aquatic flora characteristic of sandstone and limestone rivers. Water-crowfoots dominate the faster flowing sections with river water-crowfoot *Ranunculus fluitans* and common water crow-foot *R. aquatilis*. Slower flowing stretches have associated species such as water-milfoils *Myriophyllum spp*, and various pondweeds including perfoliate pondweed *Potamogeton perfoliatus* and various-leaved pondweed *P. gramineus*. In the lower reaches the algae *Hildenbrandia rivularis, Nostoc parmelioide* and the lichen *Collema fluviatile* appear in the river. The tributaries support a variety of stream water-crowfoot *R. penicillatus ssp* in association with marginal plants such as lesser water parsnip *Berula erecta* and pink water-speedwell *Veronica anagallis-aquatica.*

Throughout the length of the River Eden stands of alder *Alnus glutinosa* and willow *Salix* spp. occur associated with backwaters and seasonally-flooded channels. The least-disturbed stands are on the tributary River Irthing, where they occur on the shingle and gravels of actively-moving channels. The ground flora includes patches of common nettle *Urtica dioica*, butterbur *Petasites hybridus* and hogweed *Heracleum sphondylium* that grade into hollows with greater tussock-sedge *Carex paniculata*.

Ullswater is a relatively deep lake with both oligotrophic (nutrient poor) and mesotrophic (moderate levels of nutrients) elements in its fauna and flora. The south-western part of the lake is surrounded by high fells of the Borrowdale Volcanics with enclosed farmland confined to the valley bottoms. The north-eastern arm is in gentler terrain with deeper soils and a greater extent of enclosed farmland. The lake flows into the River Eamont, one of the major tributaries of the River Eden. The lake has an extremely rich aquatic flora, including eight species of *Potamogeton*. These include various-leaved pondweed *P. gramineus*, red pondweed *P. alpinus* and long-stalked pondweed *P. praelongus*. The nationally scarce six-stamened waterwort *Elatine hexandra* is also found in some of the bays. Ullswater supports one of the few populations of schelly *Coregonus lavaretus* in the UK.

The fish fauna of the River Eden includes Atlantic salmon *Salmo salar*, bullhead *Cottus gobio*, and sea *Petromyzon marinus*, river *Lampetra fluviatilis* and brook lampreys *L. planeri*. The high ecological value of the river system and the fact that the salmon are able to use most of the catchment (even above Ullswater) mean that the Eden is able to maintain a large population of salmon. The highly erodible nature of the rock results in extensive areas of gravel and finer silt being deposited throughout the system, providing conditions for spawning and nursery areas. Brook and river lampreys are supported widely within the catchment and a large and healthy population of sea lamprey is supported in the middle to lower regions of the river. The presence of extensive areas of gravel and generally good quality water provides good habitat for bullheads, which are widely distributed throughout the system. The tributaries, in particular those flowing over limestone, hold abundant numbers of bullhead.

The River Eden system is important for otters *Lutra lutra* which favour areas of undisturbed riparian habitat and associated features. The headwaters comprise one of the most important remaining sites in Britain for the native white-clawed crayfish *Austropotamobius pallipes*, a species characteristic of calcareous streams with high water quality.

Qualifying habitats: The site is designated under **article 4(4)** of the Directive (92/43/EEC) as it hosts the following habitats listed in Annex I:

- Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*). (Alder woodland on floodplains)*
- Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoeto-Nanojuncetea*. (Clear-water lakes or lochs with aquatic vegetation and poor to moderate nutrient levels)
- Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation. (Rivers with floating vegetation often dominated by water-crowfoot)

Qualifying species: The site is designated under **article 4(4)** of the Directive (92/43/EEC) as it hosts the following species listed in Annex II:

- Atlantic salmon *Salmo salar*
- Brook lamprey *Lampetra planeri*
- Bullhead *Cottus gobio*
- Otter *Lutra lutra*
- River lamprey *Lampetra fluviatilis*
- Sea lamprey *Petromyzon marinus*
- White-clawed (or Atlantic stream) crayfish *Austropotamobius pallipes*

Annex I priority habitats are denoted by an asterisk (*).

This citation relates to a site entered in the Register of European Sites for Great Britain.
Register reference number: UK0012643
Date of registration: 14 June 2005
Signed: Trevor Salmon
On behalf of the Secretary of State for Environment, Food and Rural Affairs

EC Directive 92/43 on the Conservation of Natural Habitats and of Wild Fauna and Flora

Citation for Special Area of Conservation (SAC)

Name:	North Pennine Moors
Unitary Authority/County:	Cumbria, Durham, Northumberland, North Yorkshire
SAC status:	Designated on 1 April 2005
Grid reference:	SE137749
SAC EU code:	UK0030033
Area (ha):	103109.42
Component SSSI:	Allendale Moors SSSI, Arkengarthdale, Gunnerside and Reeth Moors SSSI, Bollihope, Pikestone, Eggleston and Woodland Fells SSSI, Bowes Moor SSSI, Cotherstone Moor SSSI, East Nidderdale Moors (Flamstone Pin - High Ruckles) SSSI, Geltsdale and Glendue Fells SSSI, Hexhamshire Moors SSSI, Lovely Seat - Stainton Moor SSSI, Lune Forest SSSI, Mallerstang - Swaledale Head SSSI, Muggleswick, Stanhope, Edmundbyers Commons and Blanchland Moor SSSI, West Nidderdale, Barden and Blubberhouses Moors SSSSI, Whitfield Moor, Plenmeller and Ashholme Common SSSI

Site description:

The North Pennine Moors hold much of the upland heathland of northern England. The most abundant heath communities are heather – wavy hair-grass *Calluna vulgaris – Deschampsia flexuosa* heath and heather – bilberry *Vaccinium myrtillus* heath. At higher altitudes and to the wetter west and north of the site complex, the heaths grade into extensive areas of blanket bog. A significant proportion of the bog remains active with accumulating peat. The main type is heather – hare's-tail cottongrass *Eriophorum vaginatum* blanket mire. The site contains other wetland habitats including wet heaths and calcium-rich fens, which support populations of yellow marsh saxifrage *Saxifraga hirculus*. Tufa-forming springs are localised in occurrence, but where the habitat does occur it is species-rich with abundant bryophytes, sedges and herbs including bird's-eye primrose *Primula farinosa* and marsh valerian *Valeriana dioica*.

Acidic rock outcrops and screes are well-scattered across the North Pennine Moors and support a range of lichens and bryophytes, such as *Racomitrium lanuginosum*, and species like stiff sedge *Carex bigelowii* and fir clubmoss *Huperzia selago*. The site also contains base-rich rocks that support calcicole crevice vegetation communities.

Birk Gill Wood (within East Nidderdale SSSI) is an example of western acidic oak woodland in a sheltered river valley. It supports rich bryophyte and lichen communities under a canopy of sessile oak *Quercus petraea*, birch *Betula* sp. and rowan *Sorbus aucuparia*. The slopes are boulder-strewn, with mixtures of heather, bilberry and moss carpets in the ground flora. The North Pennine Moors includes one major stand of juniper *Juniperus communis* scrub in Swaledale as well as a number of small and isolated localities. The Swaledale site grades into heathland and bracken *Pteridium aquilinum* but there is a core area of juniper woodland with scattered rowan and birch.

In addition, the North Pennine Moors contain important areas of calcareous grassland, montane acid grassland and grasslands on soils rich in heavy metals, such as old lead mines.

Qualifying habitats: The site is designated under **article 4(4)** of the Directive (92/43/EEC) as it hosts the following habitats listed in Annex I:

- Alkaline fens. (Calcium-rich springwater-fed fens)
- Blanket bogs*
- Calaminarian grasslands of the *Violetalia calaminariae*. (Grasslands on soils rich in heavy metals)
- Calcareous rocky slopes with chasmophytic vegetation. (Plants in crevices in base-rich rocks)
- European dry heaths
- *Juniperus communis* formations on heaths or calcareous grasslands. (Juniper on heaths or calcareous grasslands)
- Northern Atlantic wet heaths with *Erica tetralix*. (Wet heathland with cross-leaved heath)
- Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles. (Western acidic oak woodland)
- Petrifying springs with tufa formation (*Cratoneurion*). (Hard-water springs depositing lime)*
- Semi-natural dry grasslands and scrubland facies: on calcareous substrates (*Festuco-Brometalia*). (Dry grasslands and scrublands on chalk or limestone)
- Siliceous alpine and boreal grasslands. (Montane acid grasslands)
- Siliceous rocky slopes with chasmophytic vegetation. (Plants in crevices on acid rocks)
- Siliceous scree of the montane to snow levels (*Androsacetalia alpinae* and *Galeopsietalia ladani*). (Acidic scree)

Qualifying species: The site is designated under **article 4(4)** of the Directive (92/43/EEC) as it hosts the following species listed in Annex II:

- Marsh saxifrage *Saxifraga hirculus*

Annex I priority habitats are denoted by an asterisk (*).

This citation relates to a site entered in the Register of European Sites for Great Britain.
Register reference number: UK0030033
Date of registration: 14 June 2005

Signed: Trevor Salmon

On behalf of the Secretary of State for Environment, Food and Rural Affairs

EC Directive 79/409 on the Conservation of Wild Birds: Citation for Special Protection Area (SPA)

Name: North Pennine Moors

Unitary Authority/County: Cumbria, Durham, North Yorkshire and Northumberland.

Consultation proposal: The 17 Sites of Special Scientific Interest (SSSIs) listed below have been recommended as a Special Protection Area because of their European ornithological importance. The SPA supports breeding populations of three birds of prey and one wading bird in numbers of European significance. The boundary of the SPA includes all or parts of the following SSSIs: Allendale Moors SSSI; Appleby Fells SSSI; Arkengarthdale, Gunnerside and Reeth Moors SSSI; Bollihope, Pikestone, Eggleston and Woodland Fells SSSI; Bowes Moor SSSI; Cotherstone Moor SSSI; East Nidderdale Moors (Flamstone Pin - High Ruckles) SSSI; Geltsdale and Glendue Fells SSSI; Hexhamshire Moors SSSI; Lovely Seat - Stainton Moor SSSI; Lune Forest SSSI; Mallerstang - Swaledale Head SSSI; Moorhouse and Cross Fell SSSI; Muggleswick, Stanhope and Edmundbyers Commons and Blanchland Moor SSSI; Upper Teesdale SSSI; West Nidderdale, Barden and Blubberhouses Moors SSSI; Whitfield Moor, Plenmeller and Ashholme Commons SSSI. See SPA map for further detail of boundary.

Site description: The North Pennine Moors SPA includes parts of the Pennine moorland massif between the Tyne Gap (Hexham) and the Ribble-Aire corridor (Skipton). It encompasses extensive tracts of semi-natural moorland habitats including upland heath and blanket bog. The southern end of the North Pennine Moors SPA is within 10 km of the South Pennine Moors SPA, which supports a similar assemblage of upland breeding species. The North Pennine Moors includes Moor House SPA, a site that was subject to separate classification. The latter site has been subsumed within the North Pennine Moors SPA for reporting purposes.

Size of SPA: The SPA covers an area of 147,246.41 ha.

Qualifying species:
The site qualifies under **article 4.1** of the Directive (79/409/EEC) as it is used regularly by 1% or more of the Great Britain populations of the following species listed in Annex I, in any season:

Annex I species	Count and Season	Period	% of GB population
Hen Harrier *Circus cyaneus*	11 pairs - breeding	Count as at 1993 and 1994	2.3%
Merlin *Falco columbarius*	136 pairs - breeding	Estimated population during 1993 and 1994	10.5%
Peregrine *Falco peregrinus*	15 pairs - breeding	Count as at 1991	1.3%
Golden Plover *Pluvialis apricaria*	1,400 pairs - breeding	Minimum based on densities recorded 1960 - 1993	6.2%

Hen Harrier figures from: Nattress, M. & Clement, P. 1996. *Summary of the analysis of English Nature licences issued in 1994 for Schedule 1 birds*. English Nature unpublished report, Peterborough.
Merlin figures from: Rebecca, G. & Bainbridge, I.P. 1998. The status of breeding merlin *Falco columbarius* in Britain in 1993-94. *Bird Study* **45**: 172-187.
Peregrine figures from: Crick, H.Q.P. & Ratcliffe, D.A. 1995. The peregrine *Falco peregrinus* breeding populations of the United Kingdom. *Bird Study* **42**: 1-19.
Golden Plover figures represent a minimum (assuming 1.0 pair/km^2), with no full census available. Based on a range of recorded densities from 1.0 pair/km^2 within East Nidderdale Moors SSSI to 5.0-5.2 pairs/km^2 within Upper Teesdale SSSI.
Density figures from:
Ratcliffe, D.A. 1976. Observations on the breeding of the Golden Plover in Britain. *Bird Study* **23**: 63-116.
Percival, S. & Smith, C. 1992. *Habitat requirements of Golden Plover: A pilot study*. English Nature Research Report No. 1, Peterborough.
Winder, F. 1992-94. *Yorkshire Dales National Park Committee Moorland Bird Surveys 1992-1994.* Unpublished.

Non-qualifying species of interest

Within the North Pennine Moors SPA, two pairs of Montagu's Harriers *Circus pygargus* are known to have bred, while numbers of breeding Short-eared Owls *Asio flammeus* have still to be ascertained. Both species are listed in Annex I.

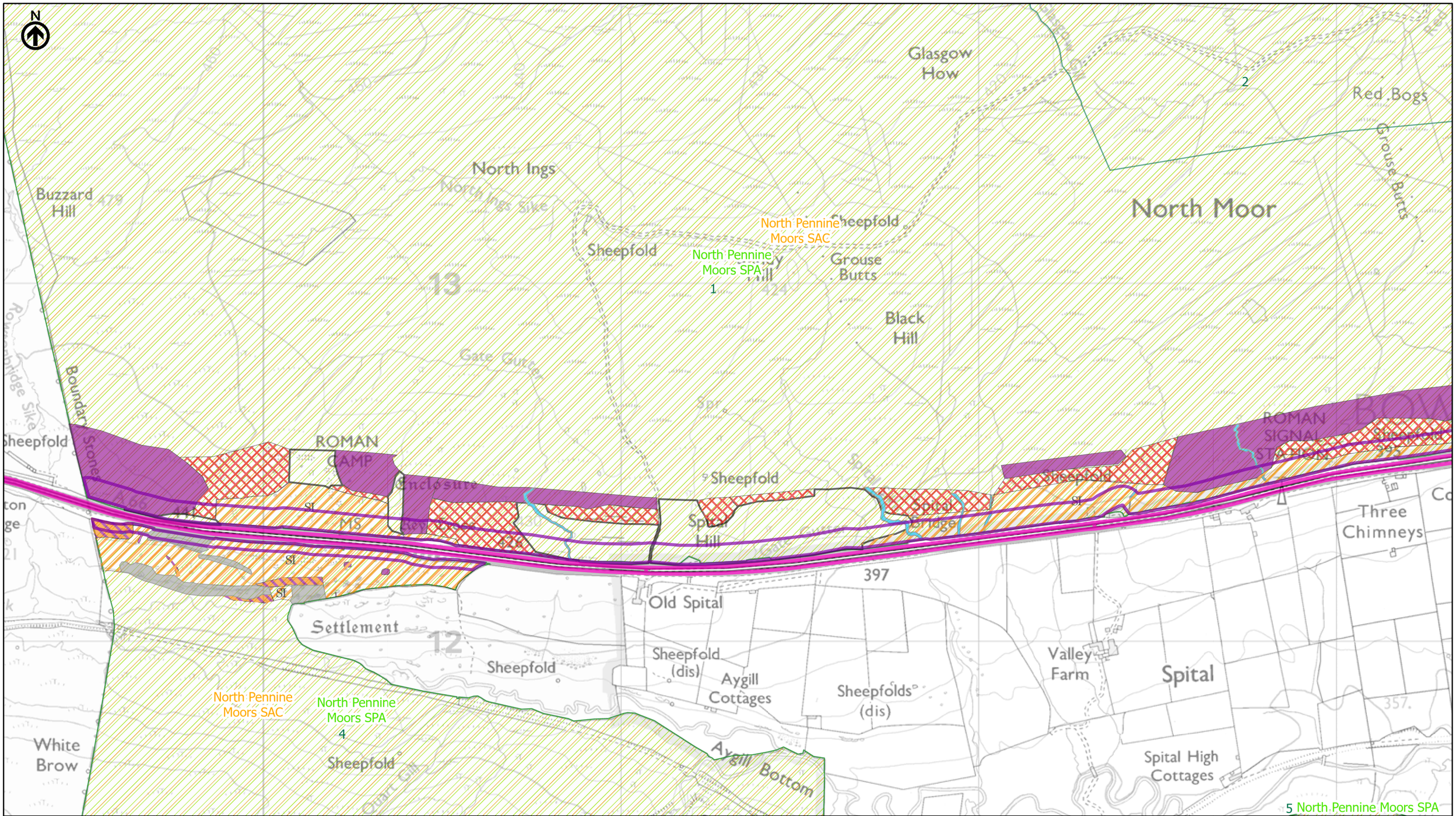
Status of SPA:

i) Moor House was classified as a Special Protection Area on 31 August 1982.

ii) North Pennine Moors (including the subsumed site at Moor House) was classified as a Special Protection Area on 9 February 2001.

A.5 HRA Appendix E: North Pennine Moors Survey Map & Species List

Habitat type	Species recorded
Blanket bog	*Sphagnum spp., Dicranum scroparium, Rhytidiadelphus squarrosus, Calluna vulgaris, Erica cinerea, Vaccinium myrtillus, Galium palustre, Potentilla erecta and Eriophorum vaginatum*
Marshy grassland	*Juncus spp., Juncus effuses, Juncus squarrosus, Juncus acutiflorus*
Acid grassland	Nardus stricta, *Juncus squarrosus, Potentilla erecta, Galium palustre, Juncus effuses, Deschampsia flexuosa, Rhytidiadelphus spp., Festuca ovina, Agrostis spp., Euphrasia nemorosa, Thymus polytrichus.*



Existing A66

Affected Road Network (ARN)

Area Where a Change in Nitrogen Deposition Exceeds 1% of the Critical Load, as Defined by the Air Quality Modelling Data

Statutory Designated Sites

- Special Area of Conservation
- Special Protection Areas
- Site of Special Scientific Interest Units (With IDs)

SAC Survey Habitat Description

- Blanket Bog - Assumed to be Annex 1 following Phase 1 survey methodology
- Blanket Bog Habitat Mosaic
- Acid Grassland
- Acid/Marshy Grassland Mosaic
- Marshy Grassland
- Rock Exposure and Waste
- Watercourse
- Flush and Spring

national highways

3 Piccadilly Place
Manchester
M1 3BN

	First Issue				
P02	CESL	LHAN	THOU	AWAR	KWHA
	12/04/22	19/04/22	20/04/22	21/04/22	21/04/22
Revision	Created	Checked	Reviewed	Approved	Authorised

Kilometres
0 0.25 0.5

Scale @ A3: 1:10,000 | Project Ref No HE565627 | Stage: Stage 3

Project Name
A66 Northern Trans-Pennine Project

Map Title
Figure 1.1
Appendix E: North pennine Moors Survey Map
Appleby to Brough to Bowes Bypass
Sheet 1 of 2

Map Number

Project	Originator	Volume	Location	Type	Role	Number
HE565627	AMY	EBD	S00	MP	LB	003354

Suitability	Suitability Description	Revision
S4	FIT FOR STAGE APPROVAL	P02

This Environmental Statement Figure meets the requirements of Regulation 5(2)(g) and 5(2)(l)(i) of the Infrastructure Planning (Applications: Prescribed Forms and Procedure Regulations) 2009.

PINS Reference Number: TR010062/APP/3.6

Existing A66

Affected Road Network (ARN)

Area Where a Change in Nitrogen Deposition Exceeds 1% of the Critical Load, as Defined by the Air Quality Modelling Data

Statutory Designated Sites

Special Area of Conservation

Special Protection Areas

Site of Special Scientific Interest Units (With IDs)

SAC Survey Habitat Description

Blanket Bog - Assumed to be Annex 1 following Phase 1 survey methodology

Blanket Bog Habitat Mosaic

Acid Grassland

Acid/Marshy Grassland Mosaic

Marshy Grassland

Rock Exposure and Waste

Watercourse

Flush and Spring

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Kilometres

0 0.25 0.5

Scale @ A3: 1:10,000 | Project Ref No HE565627 | Stage: Stage 3

Project Name
A66 Northern Trans-Pennine Project

Map Title
Figure 1.1
Appendix E: North pennine Moors Survey Map
Appleby to Brough to Bowes Bypass
Sheet 2 of 2

Map Number

Project	Originator	Volume	Location	Type	Role	Number
HE565627	AMY	EBD	S00	MP	LB	003324

Suitability	Suitability Description	Revision
S4	FIT FOR STAGE APPROVAL	P02

This Environmental Statement Figure meets the requirements of Regulation 5(2)(g) and 5(2)(l)(i) of the Infrastructure Planning (Applications: Prescribed Forms and Procedure Regulations) 2009.

PINS Reference Number: TR010062/APP/3.6