A1 in Northumberland: Morpeth to Ellingham

Scheme Number: TR010059

Updated Biodiversity Air Quality DMRB Sensitivity Assessment

Rule 8(1)(c)

Planning Act 2008

Infrastructure Planning (Examination Procedure) Rules 2010

February 2021

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Development Consent Order 20[xx]

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TABLES

1 INTRODUCTION

1.1.1. An application for a Development Consent Order (DCO) was made by Highways England (the 'Applicant') on 07 July 2020 to the Secretary of State for Transport via the Planning Inspectorate (the 'Inspectorate') under the Planning Act 2008 (the '2008 Act'). If accepted, the DCO would grant consent for the A1 in Northumberland: Morpeth to Ellingham (the 'Scheme'). The Scheme comprises:

a. Part A: Morpeth to Felton ('Part A') is located along the A1 carriageway between Warrener's House Interchange at Morpeth and the existing dual carriageway at Felton. Part A is approximately 12.6 km in length.
b. Part B: Alnwick to Ellingham ('Part B') starts approximately 15 km north of the northern extent of Part A and is located along the A1 carriageway between Alnwick and Ellingham and is approximately 8 km in length.

1.1.2. A detailed description of the Scheme can be found in **Chapter 2: The Scheme** of the Environmental Statement ('ES') [**APP-037**].

1.1.3. An assessment of the impacts and likely significant effects of the Scheme on ecological receptors as a result of air quality in compliance with updated Design Manual for Roads and Bridges (DMRB) guidance was completed and submitted with the DCO application (**Appendix 16.7: Biodiversity DMRB Sensitivity Test: The Scheme** of the ES **[APP-333]**).This assessment is hereafter referred to as the 'existing assessment'. A detailed description of the relationship between the "original" and updated DMRB guidance and how this has been applied within the ES is detailed in paragraphs 4.1.2, 4.1.3 and 4.3.2 to 4.3.5 of **Chapter 4: Environmental Assessment Methodology [APP-039]**.

1.1.4. This document presents the methodology and results of an updated assessment of potential impacts of the Scheme on ecological receptors as a result of air quality (the 'updated assessment') in response to:

a. the change in the opening year from 2023 to 2024 (with associated changes to traffic flows and speeds); and
b. the release of updated air quality datasets (with associated changes in speed-banded vehicle emission rates and background concentrations).

1.1.5. The Design Manual for Roads and Bridges (DMRB) guidance that informs this assessment (see **paragraph 2.1.3**) is relatively new (released between July 2019 and March 2020). As a result, in preparing this updated assessment the Applicant has reflected and reviewed how this guidance has been applied within the assessment of impacts of the Scheme on ecological receptors as a result of air quality presented within the existing assessment. In particular, this updated assessment has reconsidered the classification of reversibility of the impact (amended from reversible within the existing assessment to irreversible) and also the level of impact (amended from Minor within the existing assessment to Major) in accordance

with LA 108 Biodiversity (**Ref. 5**). There are no other changes to the methodology followed for the updated assessment in comparison to the existing assessment.

1.1.6. This updated assessment shall supersede the DMRB sensitivity air quality assessments presented in **Appendix 16.7: Biodiversity DMRB Sensitivity Test: The Scheme** of the ES **[APP-333]**, **Appendix 9.27: Biodiversity DMRB Sensitivity Test Part A [APP-253]** and **Appendix 9.12: Biodiversity DMRB Sensitivity Test Part B [APP-310]**.

2 ASSESSMENT METHODOLOGY

SCOPE OF ASSESSMENT

2.1.1. The updated assessment included all ecological receptors ('designated habitats') previously assessed within the existing assessment. The updated assessment did not present any new designated habitats compared to the existing assessment. In accordance with LA 105 Air Quality (**Ref. 1**), the air quality assessment should include an assessment of the impacts on 'designated habitats' of international, national and local ecological conservation interest for protected / notable species and habitats within 200 m of the Affected Road Network (ARN) (the 'Study Area') as determined by the air quality modelling presented in **Air Quality Updated Assessment (Scheme Opening Year 2024)** (document reference 6.35, submitted at Deadline 3). In accordance with LA 105 Air Quality, designated habitats include Ramsar sites, Special Protection Areas (SPAs), Special Areas of Conservation (SACs), Sites of Special Scientific Interest (SSSIs), Local Nature Reserves (LNRs), Local Wildlife Sites (LWSs), Nature Improvement Areas, ancient woodland and veteran trees.

2.1.2. Whilst LA 105 Air Quality makes reference to veteran trees only, standing advice published by the Forestry Commission and Natural England (**Ref. 2**) states that "*all ancient trees are veteran trees."* Ancient and veteran trees are of similar and high ecological importance and are considered irreplaceable (much the same as ancient woodland). As such, both ancient and veteran trees were scoped into the assessment.

METHODOLOGY

Guidance

2.1.3. The ecological assessment detailed within this document has been undertaken in accordance with LA 105 Air Quality (**Ref. 1**), LA 108 Biodiversity (**Ref. 5**) and with the wider requirements and advice provided in LA 104 Environmental Assessment and Monitoring (**Ref. 4**).

Desk Study

2.1.4. With the exception of Nature Improvement Areas and ancient / veteran trees, all other designated habitats were identified as part of the ecological impact assessments for Part A **Chapter 9: Biodiversity Part A [APP-048]** and Part B **Chapter 9: Biodiversity Part B** of the ES **[APP-049]**.

2.1.5. A desk study exercise was undertaken in March 2020 to identify Nature Improvement Areas and ancient / veteran trees in the Study Area. Nature Improvement Areas were identified from the Natural England website (**Ref. 6**). Ancient / veteran trees were identified from the Woodland Trust Ancient Tree Inventory (**Ref. 7**) and baseline information collected for Part A (refer to **Appendix 7.5: Arboricultural Report Part A [APP-220]** of the ES) and Part B (refer to **Appendix 7.1: Arboricultural Report Part B** of the ES **[APP-286]**).

Nature Conservation Evaluation

2.1.6. The importance of an ecological receptor (designated habitat) has been established using the guidance presented in Table 3.9 in LA 108 Biodiversity (**Ref. 5**). **Table 2-1** below presents the applicable importance classifications for those designated habitats assessed.

Table 2-1 – Biodiversity resource importance

Importance Classification	Designated Habitat
National importance	SSSI, ancient woodland, ancient / veteran trees
County importance	LNR
Local importance	LWS

Characterisation of Potential Impacts

2.1.7. It was determined that the potential local air quality impacts from construction traffic emissions would be unlikely to give rise to significant effects and therefore no further assessment was required in relation to construction. This is evidenced in **Appendix 16.4: Air Quality Likely Significant Effects of the Scheme** of the ES **[APP-330]**. This statement remains unchanged for the updated assessment, as stated in paragraph 5.5.1 of **Air Quality Updated Assessment (Scheme Opening Year 2024)** (document reference 6.35). As such, only operational impacts on air quality are considered.

2.1.8. The assessment in this appendix had due regard to Figure 2.98 of LA 105 Air Quality (**Ref. 1**).

2.1.9. For designated habitats, nitrogen deposition is used as the main basis for evaluating significant effects in relation to air quality. Significance of effects was considered where the change in total nitrogen deposition (kg N/ha/yr.) with the Scheme ('Do Something' scenario; including both Part A and Part B) in comparison to the future baseline ('Do Minimum' (without the Scheme) scenario) was greater than 1% (as an absolute number) of the critical load[1] for the site / habitat and the critical load is exceeded. In all instances, the critical load of the designated habitat was exceeded with or without the Scheme. Critical loads for sites / habitats were ascertained from the Air Pollution Information System (APIS) database (**Ref. 8**). Where a range in the critical load was provided for a particular designated habitat, the

[1] APIS (**Ref. 9**) cites the definition of the critical load as "*a quantitative estimate of exposure to one or more pollutants below which significant harmful effects on specified sensitive elements of the environment do not occur according to present knowledge*".

lowest value in the range was used to give a worst-case assessment (known as the lower critical load). Where the lower critical load of a site or habitat is exceeded with the Scheme but an increase in deposition of less than 1% of the critical load occurs, the impact is considered imperceptible and unlikely to be significant (**Ref. 1**).

2.1.10. For each designated site, the air quality assessment modelled predicted changes in air quality along 200 m length linear transects perpendicular to the affected road starting from the nearest point of the designated habitat. The modelling was undertaken at 5 m intervals between 0 m and 50 m and at 10 m intervals between 50 m and 200 m. For ancient / veteran trees, nitrogen deposition at the location of the tree was modelled. Further details and the findings of the air quality modelling are presented within **Air Quality Updated Assessment (Scheme Opening Year 2024)** (document reference 6.35).

2.1.11. Where the change in nitrogen deposition is greater than 1% of the critical load, LA 105 Air Quality prescribes a need to identify whether the designated habitat air quality attribute is either 'Restore' or 'Maintain'. Air quality attributes are publicly specified for European designated sites (those protected at an international level) but not for locally or nationally designated sites for nature conservation or for ancient woodland. As such, air quality attributes are not available for the designated habitats considered within this assessment. Where information is available, this has been used to inform a professional judgement to determine the air quality attribute for the designated habitat. The justification for the attribution has been presented within this document. Where insufficient information is available, the air quality attribute has been set to 'Restore', as acknowledged in LA 105 Air Quality (**Ref. 1**).

2.1.12. LA 105 Air Quality (**Ref. 1**) requires an assessment to determine if the change in nitrogen deposition would lead to the theoretical loss of one plant species, using Table 21 of the nitrogen deposition dose response report published by Natural England (**Ref. 10**). The study within the Natural England report only considered certain habitats: upland and lowland heath, sand dune grassland, bog (raised and blanket) and acid grassland. With the exception of Longhorsley Moor SSSI / LWS, the designated habitats considered within this assessment are designated for their woodland habitat. The Natural England study does not provide comparable data to inform the dose of nitrogen deposition that would theoretically lead to the loss of one species[2]. Therefore, in accordance with LA 105 Air Quality, using the Natural England dose response report, "*the habitat with the lowest change in nitrogen deposition likely to lead to the loss of one species, excluding nutrient impoverished sand*

[2] It should be noted that the information presented in Table 21 of NECR210 (**Ref. 10**) does not actually refer to doses of nitrogen that would theoretically lead to the loss of one species. The data presented refers to doses of nitrogen, based on a combination of experimental data reviewed in the report, that would reduce species richness in each habitat by one. This is an important distinction which should not be lost sight of when interpreting Table 21 of NECR 210.

dunes, shall be used to inform the judgement of significant air quality effects." Habitats used as a proxy include upland and lowland heath.

2.1.13. **Table 2-2**, based on Table 21 of the Natural England dose response report, summarises the criteria used to determine if the change in nitrogen deposition would lead to the theoretical loss of one plant species. It should be noted that Table 21 provides the lowest change in nitrogen deposition likely to lead to a reduction of species-richness of one at different background nitrogen levels, to be used for those designated habitats covered by the Natural England dose response report. This is not the same as causing the loss of one species. Longhorsley Moor SSSI / LWS is designated for lowland heath, for which the criteria summarised in **Table 2-2** remains applicable.

2.1.14. Using the 'Restore' approach, as prescribed in LA 105 Air Quality (**Ref. 1**), represents a reasonable worst-case assessment. This is because using the most sensitive habitat to nitrogen deposition as a proxy for the designated habitat being considered, is already a reasonable worst-case approach. In contrast, using the actual background deposition levels[3] (as for the 'Maintain' approach) rather than a theoretical deposition level of 5 kg N/ha/yr. (as for the 'Restore' approach) is likely to better reflect the conditions at the designated habitats considered within this assessment.

2.1.15. In accordance with LA 105 Air Quality (**Ref. 1**), for the 'Restore' scenario the lowest change in nitrogen deposition that would bring about a change theoretically equivalent to the loss of one plant species (0.4 kg N/ha/yr.) is used regardless of background nitrogen deposition. Therefore, an increase of 0.4 kg N/ha/yr. is used as the threshold for the theoretical loss of one plant species and to identify when a significant effect may occur.

2.1.16. In accordance with LA 105 Air Quality (**Ref. 1**), for the 'Maintain' scenario the lowest change in nitrogen deposition that would bring about a change theoretically equivalent to the loss of one plant species corresponding to the background nitrogen deposition is used as the threshold (refer to **Table 2-2**). Where the background nitrogen deposition falls between two categories, the lower category has been used, as a precautionary approach.

[3] Which represents 5 km average deposition data taken from APIS.

Table 2-2 - Nitrogen Deposition Changes that may Result in the Theoretical Loss of Species Richness[4]

Increase in Nitrogen (N) Deposition (kg N/ha/yr.) Required to Reduce Measured Species Richness by one at Different Background N Deposition Levels					
5 kg N	**10 kg N**	**15 kg N**	**20 kg N**	**25 kg N**	**30 kg N**
0.4	0.8	1.3	1.7	2.0	2.4

2.1.17. Where the predicted change in nitrogen deposition does not exceed the threshold, no significant effect is identified. Where the Scheme would result in a change in nitrogen deposition in excess of the threshold, professional judgement has been used to provide a qualified statement regarding the potential level of significance of the effects. These have been identified in accordance with the categories presented in LA 104 Environmental Assessment and Monitoring (**Ref. 4**) (Neutral, Slight, Moderate, Large or Very Large). This has been underpinned through use of the impact and effect significance descriptors in LA 108 Biodiversity (**Ref. 5**), as described below.

CHARACTERISATION OF NITROGEN DEPOSITION IMPACTS

2.1.18. Nitrogen deposition impacts and their effects that may be significant following application of LA 105 as described above have then been characterised against the impact and effect descriptors used in paragraph 3.10 and Table 3.11 of LA 108 Biodiversity (**Ref. 5**), and applicable CIEEM guidance (**Ref. 3**). The approach to describing each impact characteristic that informs overall Level of Impact under LA 108, is set out below. These headings are subsequently used to summarise the predicted impacts and effects of nitrogen deposition from the Scheme on each designated habitat in **Table 9-2**.

Resource Importance

2.1.19. The same method of determining the importance of an ecological receptor (designated habitat) has been followed, as detailed in **Section 9.4** and **Table 9-4** of **Chapter 9: Biodiversity Part A [APP-048]**. The methodology for assigning importance complies with the approach in the updated DMRB guidance presented in LA 108 Biodiversity (**Ref. 5**).

Duration and Reversibility

2.1.20. Duration is categorised as either ‘permanent’ or ‘temporary’. The impacts of the Scheme would continue for the duration of operation from the opening year (2024), although they would decline year on year due to forecast reductions in ‘per vehicle’ emissions as the UK

[4] Based on Table 21 of the Natural England dose response report (**Ref. 10**).

vehicle fleet decarbonises. There have been considerable declines in total NOx emissions from road transport over the last two decades, with the National Atmospheric Emission Inventory (NAEI) identifying that total NOx emissions from road transport in 2018 were approximately a third of the level experienced in 1999 and have approximately halved since 2005 (**Ref. 15**). The Scheme delays rather than reverses future predicted decreases in the road contribution to nitrogen deposition and would not lead to a long-term increase in nitrogen deposition over current levels. Relatively small additional doses of nitrogen (as would result from the Scheme) typically take years or even decades to lead to detectable change to habitats and individual plant species. However, as the point in time at which the Scheme would generate no additional emissions relative to the do-minimum scenario cannot be forecast with any degree of certainty, the Scheme's impact on nitrogen deposition is considered '**permanent**' on a precautionary basis for all designated habitats.

2.1.21. As a **permanent** impact, in accordance with LA 108 Biodiversity (**Ref. 5**), the impact of nitrogen deposition because of the Scheme is classified as '**irreversible**' for all designated habitats.

Extent

2.1.22. In the case of designated sites (ancient woodland, LNR, LWS), the extent is categorised as the area of the designations' interest feature(s) that experience a change in nitrogen deposition that exceeds the threshold, after applying the methodology in Figure 2.98 in LA 105 Air Quality (**Ref. 1**). The air quality modelling is assessed at fixed 10 m intervals along a transect perpendicular to the affected road (see **paragraph 2.1.10**). Therefore, the point at which predicted nitrogen deposition falls below the threshold may be located between two intervals of the transect. To ensure a worst-case value of extent is assessed, the area of the designated habitat has been measured up to the first interval along the transect where the change in nitrogen deposition is below the threshold.

2.1.23. In the case of ancient or veteran trees, where the change in nitrogen deposition may exceed the threshold identified (either 'Restore' or 'Maintain') at the location of a tree's central grid reference, this is considered to occur across the whole tree.

Magnitude

2.1.24. Magnitude is categorised as the maximum predicted dose of nitrogen onto a designated habitat that would result from operation of the Scheme. This is expressed in kg N/ha/yr. and is presented alongside the habitats threshold as determined through Table 2.98 of LA 105 Air Quality (**Ref. 1**). The maximum predicted dose occurs at the nearest point of the designated habitat to the affected road, decreasing with distance from the road. The predicted maximum dose from the Scheme occurs in the opening year (2024) and is taken from the air quality modelling presented in **Air Quality Updated Assessment (Scheme Opening Year 2024)** (document reference 6.35).

Frequency

2.1.25. Frequency is described as '*the number of times an activity occurs'* in the CIEEM Guidelines (**Ref. 3**). The impact arises from increased traffic flows during operation of the Scheme, which would occur on an ongoing basis from the opening year. As the impact would be continuous and is assessed against an annual metric (kg N/Ha/yr), the frequency is categorised as '**annual**' for all habitats sites, notwithstanding that impacts from the Scheme and overall nitrogen deposition rates are predicted to reduce during the operational period.

Timing

2.1.26. As described above under 'frequency', the impact would occur continuously from the opening year. Timing is therefore categorised as ongoing during the operational period.

Integrity and key characteristics of the resource

2.1.27. Potential effects on the integrity and key characteristics of each designated habitat are assessed with consideration of:

a. The type and condition of the habitats for which the designated habitats have been designated;
b. The characterisation of the impact as described above; and
c. The likely biophysical responses of the designated habitats subject to nitrogen deposition levels that exceed the identified threshold ('Restore' or 'Maintain'), and whether these responses could undermine the ecological coherence, functioning, and conservation status of the features for which the habitat is designated, and hence its integrity.

Level of Impact

2.1.28. Level of impact is categorised against the criteria set out in Table 3.11 of LA 108 (**Ref. 5**), which includes determining whether an impact would be beneficial or adverse, and whether the integrity or key characteristics of the designated habitat would be affected.

Effect Significance

2.1.29. Table 3.13 of LA 108 (**Ref. 5**) was used to determine the significance of effect. Table 3.13 includes two possible significance categories (for example '*Slight or moderate'*) for some combinations of Resource Importance and Levels of Impact. LA 108 states at paragraph 3.13.1 that '*where Table 3.13 includes two significance categories, evidence should be provided to support the reporting of a single significance category*'. The evidence that has been considered when choosing the significance categories includes secured mitigation.

2.1.30. Where mitigation measures have been secured that would reduce the impacts of nitrogen deposition from the Scheme, the significance of effect has been reduced and justified appropriately.

2.1.31. Where significant effects are predicted with or without secured mitigation, compensation has been explored (as detailed in **paragraph 2.1.32** below). Where compensation has been secured, the level of significance remains the same as the level reported without

compensation, as the impact to the designated habitat would still occur but is being “offset” by the proposed compensation measures.

MITIGATION

2.1.32. The same approach to mitigation has been followed, as detailed in **Section 9.4, Chapter 9: Biodiversity Part A [APP-048]** and **Chapter 9: Biodiversity Part B [APP-049]**. This involves the application of the principles of the mitigation hierarchy when considering potential impacts and subsequent effects, through the following sequential actions:

a. Avoidance
b. Mitigation
c. Compensation
d. Enhancement

3 ASSESSMENT ASSUMPTIONS AND LIMITATIONS

3.1.1. The assessment assumptions in relation to the air quality modelling is provided within **Air Quality Updated Assessment (Scheme Opening Year 2024)** (document reference 6.35).

3.1.2. A critical load cannot be given for nitrogen with respect to rivers and streams, as quantitative relationships between biology and nitrogen concentrations are largely dependent on the status of the concentrations of other nutrients. The River Coquet and Coquet Valley Woodlands SSSI includes the River Coquet, and Wansbeck and Hartburn Woods LWS includes the River Wansbeck. Both rivers are surrounded by arable farmland and therefore will be subject to water-run off and consequent introduction of nutrients. As such, nitrogen is unlikely to be the limiting nutrient and increased aerial nitrogen deposition would be dwarfed by agricultural inputs. Furthermore, in accordance with Section 2.26.1 of LA 105 Air Quality (**Ref. 1**), it is not necessary to include sites designated as a watercourse in the assessment. As such, effects to the river component of the designated habitats have not been explored.

3.1.3. Due to the size of the Study Area, the identification of ancient/veteran trees was informed by the Woodland Trust's Ancient Tree Inventory (**Ref. 7**) and baseline data gathered for Part A (refer to **Appendix 7.5: Arboricultural Report Part A [APP-220]**) and Part B (refer to **Appendix 7.1: Arboricultural Report Part B [APP-286]**). This is considered proportionate and appropriate for this assessment.

3.1.4. The majority of designated habitats considered within this assessment are designated for their woodland habitat. As such, the Natural England study (**Ref. 10**) does not provide directly comparable data to inform the dose of nitrogen deposition that would theoretically lead to a reduction in species richness equivalent to the loss of one species. In accordance with LA 105 Air Quality, the lowest change in nitrogen deposition likely to trigger this criterion from Table 21 of the Natural England dose response report was used as a proxy threshold (refer to **Table 2-1**).

4 STUDY AREA

4.1.1. The Study Area is defined as 200 m from the ARN as required under LA 105 Air Quality (**Ref. 1**), which is shown on **Figure 1: 2024 Affected Road Network, Air Quality Updated Assessment (Scheme Opening Year 2024)** (document reference 6.35).

5 BASELINE CONDITIONS

5.1.1. A summary of designated habitats scoped into the assessment is detailed in **Table 5-1** (statutory and non-statutory designated sites for nature conservation), **Table 5-2** (ancient woodland) and **Table 5-3** (ancient / veteran trees) below.

5.1.2. The relative nature conservation importance of statutory and non-statutory designated sites is detailed in **Table 5-1**. Ancient woodland and ancient / veteran trees are irreplaceable habitat and considered of **National (High) importance.**

5.1.3. At present, there are no Nature Improvement Areas located within the Study Area.

Table 5-1 - Statutory and Non-Statutory Designated Sites within the Study Area

Site Name	Reason for Designation	Nature Conservation Importance	Distance from ARN (m)
Statutory Designated Sites			
River Coquet and Coquet Valley Woodlands (SSSI) and Duke's Bank Wood ancient woodland (contained within the boundaries of the SSSI)	River Coquet is an unmodified, fast-flowing upland river of importance to migratory and spawning salmon. Woodlands near to the river include semi-natural and ancient woodland sites. SSSI Units 5 (Swarland Burn to Coquet Mouth) and 13 (Duke's Bank Wood) of the SSSI are within the Order Limits. Unit 13 is classified as 'broadleaved, mixed and yew woodland – upland' habitat in a favourable condition. The woodland is also designated as ancient woodland. Unit 5, 'rivers and stream' habitat is in an unfavourable recovering condition due to sources of diffuse pollution affecting water quality, woodland management practices and deer grazing.	National (High) importance	0
Longhorsley Moor (SSSI)	A site of sub-Atlantic heath dominated by dry heath surrounded by a mosaic of habitats (scrub, woodland, bracken and grassland).	National (High) importance	0
Ulgham Meadow (LNR)	Deciduous woodland and riparian habitat (River Lyne)	County (Medium) importance	0

Site Name	Reason for Designation	Nature Conservation Importance	Distance from ARN (m)
Borough Wood (LNR)	Area of ancient semi-natural woodland.	County (Medium) importance	0
Davies Wood (LNR)	Mature broadleaved woodland (ancient semi-natural) of value to nesting birds and small mammals.	County (Medium) importance	35
Carlisle Park (LNR)	Deciduous woodland, including an area of ancient semi-natural woodland (Castle Wood), in addition to formal gardens and amenity space (bowling greens and tennis courts).	County (Medium) importance	195
Non-Statutory Designated Sites			
Coquet River Felton Park (LWS)	Parkland site contiguous with the River Coquet.	Local (Low) importance	0
Longhorsley Moor (LWS)	Mix of heathlands, scrub and woodland that adjoin Longhorsley Moor SSSI.	Local (Low) importance	0
Wansbeck and Hartburn Woods (LWS)	Semi-natural and ancient woodland. White-clawed crayfish in the River Wansbeck and tributaries.	Local (Low) importance	0
Cocklaw Dene (LWS)	Ancient and broadleaved woodland with marshy patches by the stream and lakeside.	Local (Low) importance	0
Cawledge Burn (LWS)	Primarily designated for its geology, with some ornithological interest.	Local (Low) importance	0
Coney Garth Pond (LWS)	Open water habitat supporting large numbers of wildfowl and wading birds.	Local (Low) importance	10
Bothal Burn and River Wansbeck (LWS)	Ancient woodland along the River Wansbeck, known to support white-clawed crayfish.	Local (Low) importance	35
Cotting Woods (LWS)	Woodland (broadleaved and coniferous), including an area of ancient semi-natural woodland.	Local (Low) importance	65

Table 5-2 - Ancient Woodland Sites within the Study Area

Ancient Woodland Site Name	Associated Statutory or Non-Statutory Designation	Distance from ARN (m)
Duke's Bank Wood	River Coquet and Coquet Valley Woodlands SSSI	0
Borough Wood	Borough Wood LNR and Wansbeck & Hartburn Woods LWS	0
Unnamed (Stobswood)	N/A	0
Well Wood	N/A	0
Davies Wood	N/A	10
Weldon Wood	N/A	20
Park Wood/Bothal Banks	Bothal Burn & River Wansbeck LWS	35
Cotting Wood	Cotting Wood LWS	65
Unnamed (Scotch Gill Wood)	N/A	180
Burnie House Dean Wood	N/A	190

Table 5-3 - Ancient and Veteran Trees within the Study Area

Tree Reference	Tree Type	Grid Reference	Distance from ARN (m)
156339	Veteran common sycamore *Acer pseudoplatanus*	NZ1464194563	31
153195	Veteran beech *Fagus sylvatica*	NU1058113660	50
133417	Ancient alder *Alnus glutinosa*	NU1198805338	136
68541	Veteran hybrid sessile and English oak *Quercus petraea x Q. robur*	NZ1755199810	97
132902	Veteran sweet chestnut *Castanea sativa*	NU1812300006	191

Tree Reference	Tree Type	Grid Reference	Distance from ARN (m)
133031	Veteran sweet chestnut	NZ1808799959	195
98458	Veteran beech	NZ1543694324	142
153192	Veteran lime *Tilia* × *europaea*	NU1059113680	58
153524	Veteran oak *Quercus* sp.	NU1198112370	126
156556	Veteran lime	NZ1464594604	5
156557	Veteran poplar *Populus* sp.	NZ1465594592	11
68872	Veteran common sycamore	NZ1752199790	68
153193	Veteran lime	NU1059113690	66
68555	Veteran alder	NU1231102630	124
68534	Veteran ash *Fraxinus excelsior*	NZ1446196440	91
153191	Veteran common horse chestnut *Aesculus hippocastanum*	NU1058113690	72
T91	Potential veteran ash	NZ1824589720	10
T457	Potential veteran sycamore	NZ1888694696	101
T681	Veteran oak	NU1763500387	169
T682	Veteran ash	NU1756400406	99
T684	Veteran sycamore	NU1766300454	196
T690	Potential veteran oak	NU1765200668	80
T701	Potential veteran oak	NU1754400863	52
93294	Veteran common sycamore	NU1882118160	185
93296	Veteran common horse chestnut	NU1881118140	168
T195	Ancient beech	NU1725721405	98
T196	Veteran sycamore	NU1729721417	58

6 POTENTIAL WITHIN TOPIC COMBINED IMPACTS

6.1.1. The assessment considered increased nitrogen deposition. Nitrogen is a major growth nutrient and changes in nitrogen deposition can result in negative impacts on biodiversity, including: loss of sensitive species, changes to habitat structure and function, the homogenisation of vegetation types, changes in soil chemistry and an increased sensitivity to abiotic and biotic stresses (such as pests and climate) (**Ref. 11**).

6.1.2. A summary of pertinent literature reviewed during production of this assessment is set out below ('nitrogen deposition literature review'). This is followed by a characterisation of the nitrogen deposition impacts from the Scheme, that are applicable to all receptors. This characterisation has been completed with due regard to the impact assessment descriptions in LA 108 Biodiversity (**Ref. 5**) and the CIEEM Guidelines (**Ref. 3**).

NITROGEN DEPOSITION LITERATURE REVIEW

6.1.3. Exceedance of critical loads for nitrogen deposition can lead to effects on individual trees. For example, Waldner *et al* (**Ref. 17***)* found that nutritional imbalances in soils and tree foliage and signs of reduced tree health were more likely to be reported in forest plots where the critical loads for woodland habitats were exceeded for several decades, than where they were not.

6.1.4. Thimonier *et al (***Ref. 18***)* reported correlations between nitrogen deposition rates and leaf nitrogen concentrations in pedunculate oak *Quercus robur* and beech *Fagus sylvatica*, but found that foliage of these species was within the optimum nitrogen nutrient range for seven out of eight sites studied, including some sites where critical loads were exceeded. The one site where foliar nitrogen concentrations exceeded the optimum nutritional range experienced nitrogen deposition rates in excess of 25 kg N/ha/yr. This study also found no correlation between crown defoliation of oak or beech and foliar concentrations of nitrogen.

6.1.5. Increased nitrogen deposition across a large range (from 30 kg N/ha/yr to 50 kg N/ha/yr) has been found to positively correlate with increased stem growth in mature beech trees of 43% (hypothesized to be a consequence of resultant increased soil nitrogen) (**Ref. 19**). Conversely, increased soil nitrogen availability may promote reduced root growth, predisposing affected trees to increased drought stress and risk of damage during storm events (**Ref. 20**).

6.1.6. Increased nitrogen content in foliage of trees can also lead to alterations in the communities of invertebrates feeding on tree foliage and increase abundance of some herbivore invertebrates. A study of oak trees in high versus low-nitrogen environments found evidence that these were relatively resistant to increased pressure from 'pest' species, possibly due to the relatively high tannin content of the leaves (**Ref. 21**). The authors of the study also hypothesized that longer term exposure to elevated nitrogen levels was required before foliar nitrogen content increased sufficiently to attract altered communities of invertebrate herbivores.

6.1.7. The effects of increased nitrogen availability on individual trees may take several decades to manifest, and be exacerbated, negated, or subsumed by a range of other factors such as availability of other nutrients, soil pH, grazing by wild animals and livestock, and land management practices (**Ref. 22**).

6.1.8. The studies reported above have reported statistically significant changes to tree structure and functioning in relation to increased nitrogen deposition rates that exceed those that would be generated by the Scheme.

6.1.9. Woodland ground flora may also be affected by nitrogen deposition. Long-term studies of Wytham Wood in Oxfordshire (which has been subject to a suite of ecological monitoring since 1974) reported evidence that historical nitrogen deposition and acidification may have contributed to changes in the composition of woodland ground flora, with a shift towards increased grass cover and reduced woodland herb cover in the field layer (**Ref. 23**). The effects were compounded by other factors, including increased herbivore (deer) grazing and changes in the canopy structure over time. Effects on vegetation structure were more clearly attributable to grazing by deer than to historic or current levels of nitrogen deposition. The same study also reported recoveries of soil pH and nutrient nitrogen levels, although it was unclear whether these trends reflected recovery from historic agricultural inputs, reduced atmospheric deposition following peak emissions in the early 1990's, or a combination of both.

6.1.10. Natural England has also published research assessing the effects of small changes in nitrogen deposition onto a variety of habitats (**Ref. 10**). Although woodland habitats were excluded from the study, the authors considered their findings against other research on deciduous broadleaf woodlands. The Natural England study identified some synergies with other research, for example the potential for wavy hair grass *Deschampia flexuosa* and ruderal woodland species to increase under higher nitrogen deposition loadings, whilst other species including woodland forbs[5] declined. Changes to the communities of epiphytic lower plants (mosses and lichens) have also been linked to altered nitrogen deposition regimes, with a shift to nitrophytes (nitrogen-loving) types that correlates with increased nitrogen deposition rates. Other studies, including a study of data from 1,200 woodland plots (**Ref. 24**), have been unable to correlate changes in woodland vegetation communities over time with changes in nitrogen deposition rates.

6.1.11. The research examined demonstrates that while adverse effects to woodland and tree habitats can occur as a result of increased nitrogen deposition, these effects are difficult to detect even with comparatively large doses of nitrogen. Some species/groups of plants may also benefit rather than being adversely affected by increased deposition rates, including

[5] A herbaceous flowering plant that is not a grass, sedge or rush.

when habitat-specific critical loads are already exceeded. Responses to increases in nitrogen deposition such as would be generated by the Scheme are likely to be subtle, leading to imperceptible levels of change within the affected habitats or to individual trees.

7 DESIGN, MITIGATION, COMPENSATION AND ENHANCEMENT MEASURES

7.1.1. In accordance with the ES (see **paragraph 9.9.2, Chapter 9: Biodiversity Part A [APP-048] and Part B [APP-049]**), the terms 'mitigation' and 'compensation' are defined as follows:

a. Mitigation – the methods, processes and actions put in place to avoid or reduce the potential adverse impacts of the Scheme on designated habitats.
b. Compensation – the measures taken to offset the effects as a result of the loss of, or permanent damage to, designated habitats despite mitigation.

7.1.2. LA 105 Air Quality (**Ref. 1**) states in paragraph 2.110.1 that "*the following mitigation measures should be assessed for suitability, alongside any other proposed viable mitigation measure for the project:*

a. Vertical barrier of at least 9 m in height;
b. Speed limits adjusted for air quality."

7.1.3. The Applicant has considered the above design and mitigation measures in consultation with Natural England and Northumberland County Council. Vertical barriers of at least 9 m in height are not considered viable due to landscape constraints and visual obstruction issues. The adjustment of speed limits is also not considered viable as this action would compromise the objectives of the Scheme to improve journey times and improve network resilience and journey time reliability (as detailed in **paragraph 2.2.1, Chapter 2: The Scheme [APP-037]**).

7.1.4. At present, the Applicant continues work to secure mitigation measures to reduce the impacts of increased nitrogen deposition during the operational stage of the Scheme. As such, the assessment of likely significant effects presented in **Section 8** has been completed in the absence of mitigation – i.e. on a worst-case basis.

7.1.5. Nonetheless, the Applicant continues to investigate other viable mitigation measures, in accordance with LA 105 Air Quality (**Ref. 1**). If viable mitigation measures are identified, this has the potential to reduce the significance of effect.

7.1.6. Further, where likely significant effects are predicted, the Applicant is exploring compensation measures to offset the predicted impacts of the Scheme. The Applicant is currently exploring the viability of the following measures:

a. Installation of stock or protective fencing to reduce potential adverse effects of livestock grazing;
b. Measures to reduce nitrogen inputs from other sources, such as agricultural inputs. This may include a reduction in stocking levels (of livestock), a change to the approach of manure storage (i.e. covering manure piles to reduce ammonia run off) and/or a reduction in levels of fertiliser use;

c. Measures to reduce the effects of other pressures, such as recreation. This may include maintenance of footpaths and rubbish bins where footfall and littering are known pressures; and
d. Compensatory planting to increase the extent of a designated site and offset that area that may be "degraded" as a result of increased nitrogen deposition.

7.1.7. The Applicant has discussed the above compensation measures with Natural England and Northumberland County Council in relation to significant effects identified in **Section 8**. The Applicant continues to engage with both parties to explore the viability of such measures and opportunities to secure these as part of the DCO.

7.1.8. There are no design, mitigation, compensation or enhancement measures relevant to this assessment.

8 ASSESSMENT OF LIKELY SIGNIFICANT EFFECTS

8.1.1. This section identifies changes in nitrogen deposition that may lead to a significant effect as a result of the Scheme. The following designated habitats would not experience a change in nitrogen deposition greater than 1% of the critical load, which is the same conclusion as that identified during the existing assessment. As such, the change in nitrogen deposition would result in **Neutral** (**not significant**) effects and these designated habitats are not considered further within this assessment:

a. Cotting Wood LWS and Ancient Woodland
b. Bothal Burn and River Wansbeck LWS
c. Park Wood/Bothal Banks Ancient Woodland
d. Unnamed (Scotch Gill Wood) Ancient Woodland
e. Unnamed (Stobswood) Ancient Woodland
f. Burnie House Dean Wood Ancient Woodland
g. Carlisle Park LNR
h. Tree 133417
i. Tree 133031
j. Tree 132902
k. Tree 153192
l. Tree 98458
m. Tree 153524
n. Tree 68534
o. Tree 153191
p. Tree 153195
q. Tree 156339
r. Tree 68555
s. Tree 153193
t. Tree T91
u. Tree T195
v. Tree T196

8.1.2. For those designated habitats predicted to experience a change in nitrogen deposition greater than 1 % of the critical load, the identified air quality attribute ('Restore' or 'Maintain') and whether the applicable nitrogen deposition threshold has been exceeded are presented in **Table 9-1**.

8.1.3. Where information is available to inform a professional judgement to determine the air quality attribute for the designated habitat (as discussed in **paragraph 2.1.11**), the justification is set out below. Qualified statements, including ecological interpretation, are also presented below for those designated habitats where the increase in nitrogen deposition exceeds the applicable 'Restore' or 'Maintain' threshold. The ecological assessment of significance in accordance with LA 108 Biodiversity (**Ref. 5**) and LA 104 Environmental Assessment and Monitoring (**Ref. 4**) is summarised in **Table 9-2**.

8.1.4. In accordance with LA 105 Air Quality (**Ref. 1**), where the change in nitrogen deposition does not exceed the appropriate threshold (determined by the air quality attribute applied, as explained in **paragraphs 2.1.15** and **2.1.16**), a significant effect would not occur. In such cases, effects are considered **Neutral** (**not significant**) and the designated habitat is not discussed further.

OPERATION

River Coquet and Coquet Valley Woodlands SSSI

8.1.5. The River Coquet and Coquet Valley Woodlands SSSI is located within 200 m of the ARN at three locations, hereafter referenced as Eco1, Eco9 and Eco12 (refer to **Figure 5.2: Human and Ecological Receptors Assessed Part A [APP-076]**). The SSSI is located both east and west of the ARN at each of the three locations.

8.1.6. SSSIs are broken down into units, which may be designated for different criteria. In order to understand the impacts to the River Coquet and Coquet Valley Woodlands SSSI, it is necessary to determine the impacts at the unit level. This approach was considered during consultation with Natural England.

8.1.7. Eco9 and Eco12 relate to units 4 and 5 of the SSSI, respectively. In addition, Eco1 is also within proximity to unit 5. Both units 4 and 5 of the SSSI are designated for their rivers and stream habitat. As per **paragraph 3.1.2**, effects to the river component of the SSSI are not explored further.

8.1.8. Eco1 also relates to unit 13 of the SSSI, which is designated for its broadleaved, mixed and yew woodland – upland habitat. An assessment has been made in relation to the potential impact of the Scheme in relation to unit 13.

8.1.9. At Eco1, the Scheme addresses the loss of all SSSI woodland (ancient woodland) within the Order Limits adjacent to the existing A1 (0.27 ha) and provides woodland planting as compensation (detailed within **Appendix 9.21: Ancient Woodland Strategy Part A [APP-247]**). The area for which compensation has been provided is excluded from the assessment because habitat that has been removed can no longer be affected by operational changes in air quality. As such, the closest point affected by increased nitrogen deposition from the existing A1 is at the Order Limits boundary, approximately 25 m distance to the east and 7.5 m to the west of the ARN.

8.1.10. At Eco1, the potential increase in levels of nitrogen deposition as a result of the Scheme to the east of the ARN are a maximum of 1.3 kg N/ha/yr. at 25 m along the transect[6], the closest transect point where impacts may occur. Impacts then decrease with increasing

[6] 1.2 kg N/ha/yr. within the existing assessment.

distance from the road (refer to **Air Quality Updated Assessment (Scheme Opening Year 2024)** (document reference 6.35)). The increases in nitrogen deposition experienced to the west of the ARN are between 0.1 and 0.3 kg N/ha/yr.[7] (refer to **Air Quality Updated Assessment (Scheme Opening Year 2024)** (document reference 6.35)).

8.1.11. As detailed within the methodology section of this appendix (refer to **paragraph 2.1.13** and **2.1.16**) a key part of the assessment and determination of a significant air quality effect on a designated habitat is to determine whether the designated habitat has a 'Restore' or 'Maintain' air quality attribute (refer to Figure 2.98 in LA 105 Air Quality (**Ref. 1**)).

8.1.12. A note in LA 105 Air Quality, under Figure 2.98, states that:

"The presumption is that the air quality attribute for most designated habitats has been set to restore and the air quality assessment is completed on this basis."

8.1.13. Therefore, in the absence of a site-specific air quality attribute status, a 'Restore' attribute should be initially considered. However, as explained in **paragraph 2.1.13** of this appendix, air quality attributes are publicly specified for European designated sites (those protected at an international level) but not for locally or nationally designated sites for nature conservation or for ancient woodland.

8.1.14. Paragraph 2.100 of LA 105 Air Quality states that:

"The competent expert for biodiversity shall conclude whether the changes in nitrogen deposition are likely to trigger a significant air quality effect."

8.1.15. This means that whilst LA 105 Air Quality suggests that the presumption for designated habitats is a 'Restore' status in the absence of other information, the professional opinion of the competent expert for biodiversity has to be applied. That opinion must be informed by the information available to the competent expert.

8.1.16. In this case, the competent expert's opinion is that evidence available demonstrates that a 'Maintain' status can be attributed to the River Coquet and Coquet Valley Woodlands SSSI. The evidence and reasoning that justifies the conclusion of a 'Maintain' status by the competent expert for biodiversity is presented below.

The 'Favourable' Condition Status of the SSSI Unit where the Impact Would Take Place

8.1.17. Unit 13 of the SSSI has been assigned a 'Favourable' condition by Natural England (**Ref. 12**). As defined by Natural England, "favourable condition means that the SSSI's habitats and features are in a healthy state and are being conserved by appropriate management" (**Ref. 13**).

[7] Between 0.1 and 0.2 kg N/ha/yr. within the existing assessment.

8.1.18. Whilst the condition status of unit 13 does not refer specifically to air quality pressures, the 'Favourable' condition indicates that the current nitrogen deposition rates are not leading to the site needing to be reclassed as having an 'Unfavourable' condition. Unit 13 has been classed as being in 'Favourable' condition since at least 1999 (**Ref. 14**). There is no reason to suppose that this would change in the future baseline as a result of air quality.

Change in Background Nitrogen Levels Over Time

8.1.19. The National Atmospheric Emission Inventory (NAEI) identifies that total NO_x emissions from road transport in 2018 are approximately a third of the level experienced in 1999 (earliest date where unit 13 was known to be of 'Favourable' condition) and have approximately halved since 2005 (**Ref. 15**). It is therefore reasonable to conclude that road emissions from the ARN were higher in the past than they are today. This means that historically there would have been larger contributions from the A1 to nitrogen deposition to unit 13 than today. Nevertheless, the condition of unit 13 during the last 21 years has remained as 'Favourable'.

8.1.20. The competent expert for air quality also advised that NO_2 concentrations within the affected area have been monitored as part of the assessment, and the concentration is already low in this area (in the region of 25 µg/m³ at the roadside and less than 10 µg/m³ at background locations (refer to **Appendix 16.4: Air Quality Likely Significant Effects of the Scheme [APP-330]**). NO_2 concentrations are used in the calculation of nitrogen deposition. APIS Trends for this SSSI indicate relatively little change in nitrogen deposition between 2005 and 2017 (latest figures) (**Ref. 16**), whereas emissions from road transport have halved over the same time period (**Ref. 15**). It is therefore concluded that most of the nitrogen deposition over the SSSI is due to other sources and the local road component of the nitrogen deposition is a small contributor.

8.1.21. According to APIS Trends for this SSSI (**Ref. 16**), nitrogen deposition for 'Forest' habitat in 2005[8] was 27 kg N/ha/yr. and showed a peak in 2010 of 28 kg N/ha/yr. The APIS data also shows that nitrogen deposition for this SSSI was consistently above 26 kg N/ha/yr. in and prior to 2014 and latest figures (2017) indicate this has decreased to 24 kg N/ha/yr. Comparable trends are observed for other SSSIs in Northumberland, refer to **Table 8-1**. Therefore, it can be reasoned that this trend is applicable to unit 13 of the River Coquet and Coquet Valley Woodlands SSSI.

[8] Earliest record available.

Table 8-1 - Trends in Nitrogen Deposition for a Sample of SSSIs in Northumberland

Year	SSSI					
	River Coquet and Coquet Valley Woodlands SSSI	Longhorsley Moor SSSI	Simonside Hills SSSI	Bewick and Beanley Moors SSSI	Northumberland Shore SSSI	Willow Burn Pasture SSSI
	Nitrogen deposition (kg N/ha/yr.) for Forest habitat					
2005	27	25	25	21	17	25
2010	28	27	23	23	17	28
2014	26	24	22	20	15	25
2017	24	24	20	19	15	24

8.1.22. The decrease in deposition in the APIS data for the River Coquet and Coquet Valley Woodlands SSSI between 2005 and 2017 is 3 kg N/ha/yr. Moreover, the decrease in deposition at the roadside is likely to be even greater as a result of the significant decrease in vehicle emissions over the same period, and this trend is expected to continue. Therefore, the competent expert for air quality concludes that future deposition rates from road transport will be below historic rates when unit 13 was classed as being in 'Favourable' condition.

The Evidence Relating to the Appropriate Threshold to Determine a Significant Effect

8.1.23. LA 105 Air Quality refers to Table 21 in the Natural England dose response report (**Ref. 10**) to determine whether the change in nitrogen deposition is likely to lead to a significant air quality effect. A significant effect would occur where the change in nitrogen deposition would lead to the theoretical loss of one species. The air quality attribute of the designated habitat (i.e. 'Restore' or 'Maintain') affects what change in nitrogen deposition could lead to a significant effect under LA 105 Air Quality (**Ref. 1**).

8.1.24. 'Restore' and 'Maintain' air quality attributes are determined for European sites in response to site-specific air quality criteria. There are no site-specific criteria relating to air quality for the SSSI and therefore no air quality attribute. In accordance with LA 105 Air Quality, a 'Restore' status would be applied in the absence of other information indicating the contrary (refer to **paragraph 8.1.14**).

8.1.25. If a designated habitat has a 'Restore' air quality attribute, the lowest change in nitrogen deposition of 0.4 kg N/ha/yr. from Table 21 of Natural England's dose response report

(excluding sand dunes) is used as the threshold to determine a significant effect (**Ref. 10**). This change corresponds to the amount of additional nitrogen deposition that would theoretically reduce species richness by one against a background nitrogen deposition rate of 5 kg N/ha/yr.

8.1.26. However, the critical load for W9 woodland associated with this particular SSSI; unit 13, which is in 'Favourable' condition; is between 15 and 20 kg N/ha/yr. (**Ref. 16**). APIS considers the definition of the critical load as "*a quantitative estimate of exposure to one or more pollutants below which significant harmful effects on specified sensitive elements of the environment do not occur according to present knowledge*" (**Ref. 9**). In accordance with the definition of critical load, this suggests nitrogen deposition below a rate of 15 kg N/ha/yr. will not lead to harm to the woodland habitat.

8.1.27. Nitrogen deposition levels for unit 13 are approximately 22.96 kg N/ha/yr. (5 km average deposition from APIS) (refer to **Table 9-1**). Even though the background is higher than the lower (and higher) end of the critical load range, the designated habitat has maintained a 'Favourable' condition over the last 21 years. This further supports adopting and using the 'Maintain' approach in this instance.

8.1.28. Using Table 21 in the Natural England dose response report (**Ref. 10**), **Table 8-2** below shows the change in nitrogen deposition required to result in the theoretical loss of one species in relation to the lower critical load for the woodland of this SSSI and the background nitrogen levels experienced by unit 13. Both are significantly greater than the threshold of 0.4 kg N/ha/yr. required for the 'Restore' approach.

Table 8-2 - Increase in Nitrogen Deposition Required to Result in the Theoretical Loss of One Species at Different Background N Deposition Levels

Scenario	Respective background nitrogen level category in NECR210 (Ref. 10) (kg N/ha/yr.)	Increase in nitrogen deposition required to result in the theoretical loss of one species (kg N/ha/yr.)
Lower critical load of SSSI woodland – 15 kg N/ha/yr.	15	1.3
Background nitrogen levels at this SSSI – 22.96 kg N/ha/yr.	20	1.7

8.1.29. The increase in nitrogen deposition that may be experienced by unit 13 as a result of the Scheme, which is a maximum of approximately 1.3 kg N/ha/yr. (refer to **Table 9-1**) (decreasing as the distance increases into the SSSI away from the ARN) does not exceed

either threshold of 1.3 and 1.7 kg N/ha/yr. This leads to the conclusion that no significant effect would occur.

Concluding Opinion of the Competent Expert

8.1.30. Taking account of all the evidence described above, it is the professional opinion of the competent expert for biodiversity that a 'Maintain' air quality attribute is appropriate for unit 13 within this SSSI.

8.1.31. The increased nitrogen deposition levels do not exceed the threshold of significance for the 'Maintain' approach (an increase of 1.7 kg N/ha/yr. (refer to **Table 9-1**) equating to a background deposition of 20 kg N/ha/yr. (**Ref. 10**)) to the west of the ARN. As such, nitrogen deposition to the west of the ARN at Eco1 is not considered further. The increased nitrogen deposition falls below the 1.7 kg N/ha/yr. threshold beyond 20 m to the east of the ARN. This distance falls within the Order Limits, within the area of habitat lost to the Scheme. As the threshold of significance is not exceeded at the Order Limits (the closest point to the ARN affected by increased nitrogen deposition), the change in nitrogen deposition would result in a **Neutral** (**not significant**) effect to unit 13 of the SSSI in accordance with the 'Maintain' approach.

Duke's Bank Wood Ancient Woodland

8.1.32. Air quality modelling (refer to **Air Quality Updated Assessment (Scheme Opening Year 2024)** (document reference 6.35)) showed that there would be an increase in nitrogen deposition as a result of the Scheme. Duke's Bank Wood Ancient Woodland is 9.43 ha in size and located within the boundaries of the River Coquet and Coquet Valley Woodlands SSSI. The Ancient Woodland site is located east and west of the existing A1 (ARN) at Eco1 (refer to **Figure 5.2: Human and Ecological Receptors Assessed, Volume 5** of this ES **[APP-076]**).

8.1.33. As Duke's Bank Wood Ancient Woodland is located within the boundaries of the River Coquet and Coquet Valley Woodlands SSSI, the information presented in **paragraphs 8.1.10** to **8.1.30** for determining the air quality attribute of the designated habitat applies. It is therefore considered that a 'Maintain' air quality attribute is appropriate for Duke's Bank Wood Ancient Woodland.

8.1.34. Considering the information presented above in relation to the River Coquet and Coquet Valley Woodlands SSSI, the threshold of significance for the 'Maintain' approach (an increase of 1.7 kg N/ha/yr. (refer to **Table 9-1**)) is not exceeded at the Order Limits (the closest point to the ARN affected by increased nitrogen deposition). Therefore, the change in nitrogen deposition would result in a **Neutral** (**not significant**) effect to Duke's Bank Wood Ancient Woodland in accordance with the 'Maintain' approach.

Coquet River Felton Park LWS

8.1.35. Air quality modelling (refer to **Air Quality Updated Assessment (Scheme Opening Year 2024)** (document reference 6.35)) showed that there would be an increase in nitrogen deposition as a result of the Scheme and the change in nitrogen deposition is marginally

greater than that predicted within the existing assessment, as detailed in **paragraph 8.1.37** below. Coquet River Felton Park LWS is 18.02 ha in size and located to the east and west of the existing A1 (ARN) where it crosses the River Coquet, model reference of Eco1 (refer to **Figure 5.2: Human and Ecological Receptors Assessed Part A** of the ES **[APP-076]**). The LWS includes the woodland on the northern bank of the river.

8.1.36. The Scheme addresses the loss of all LWS woodland within the Order Limits adjacent to the existing A1 (0.41 ha) and provides woodland planting as compensation (detailed within the **Ancient Woodland Strategy** (refer to **Appendix 9.21: Ancient Woodland Strategy Part A** of the ES **[APP-247]**). The area for which compensation has been provided is excluded from the assessment because habitat that has been removed can no longer be affected by operational changes in air quality. As such, the closest point affected by increased nitrogen deposition from the existing A1 is at the Order Limits boundary, approximately 15 m to the east and 7.5 m to the west of the ARN.

8.1.37. At Eco1, the potential increases in levels of nitrogen deposition as a result of the Scheme to the east of the ARN are a maximum of 1.8 kg N/ha/yr. at 15 m along the transect[9], the closest transect point where impacts may occur. Impacts decrease with increasing distance from the road (refer to **Air Quality Updated Assessment (Scheme Opening Year 2024)** (document reference 6.35)). The increases in nitrogen deposition experienced to the west of the ARN are between 0.1 and 0.3 kg N/ha/yr.[10] (refer to **Air Quality Updated Assessment (Scheme Opening Year 2024)** (document reference 6.35)).

8.1.38. The competent expert's opinion is that evidence available demonstrates that a 'Maintain' status can be attributed to the Coquet River Felton Park LWS. The evidence and reasoning that justifies the conclusion of a 'Maintain' status by the competent expert for biodiversity is presented below.

8.1.39. A National Vegetation Classification (NVC) survey was undertaken in April 2017 (refer to **Appendix 9.2: National Vegetation Classification Survey Report Part A [APP-228]**). The survey included the Coquet River Felton Park LWS and the River Coquet and Coquet Valley Woodlands SSSI (containing Duke's Bank Wood Ancient Woodland) and concluded that "*the woodland as a whole fits well with W9.*" The survey recorded a greater number of ancient woodland indicator species within the LWS when compared to the SSSI, implying that the environmental conditions of the LWS are in a similar, if not better, condition when compared to the SSSI. In addition, the LWS is located adjacent to the SSSI. Given the proximity of the LWS to the SSSI and the likely comparable condition of the habitats (informed by the NVC data), the habitats of the LWS are also considered to be in a 'Favourable' condition. Whilst this does not refer specifically to air quality pressures, a

[9] 1.7 kg N/ha/yr. within the existing assessment.
[10] Between 0.1 and 0.2 kg N/ha/yr. within the existing assessment.

'Favourable' condition indicates the need to maintain the current condition of the LWS habitats, rather than instigate restorative measures.

8.1.40. As the LWS is contiguous with the River Coquet and Coquet Valley Woodlands SSSI and both represent the same type of woodland habitat (as identified by the NVC survey), it is reasonable to conclude that the same lower critical load of 15 kg N/ha/yr. can be applied on a precautionary basis for the LWS. Therefore, information presented in **paragraphs 8.1.10** to **8.1.30** above for determining the air quality attribute of the SSSI applies.

8.1.41. Taking account of the evidence available, it is the professional opinion of the competent expert for biodiversity that a 'Maintain' air quality attribute is appropriate for the LWS and a similar assessment outcome is predicted in respect of significance.

8.1.42. The increased nitrogen deposition levels do not exceed the threshold of significance for the 'Maintain' approach (an increase of 1.7 kg N/ha/yr. (refer to **Table 9-1**) equating to a background deposition of 20 kg N/ha/yr. (**Ref. 10**)) to the west of the ARN. As such, nitrogen deposition to the west of the ARN at Eco1 is not considered further.

8.1.43. The increased nitrogen deposition exceeds the 1.7 kg N/ha/yr. threshold to the east of the ARN at the Order Limits, 15 m along the transect, but falls below this threshold at 20 m. Within the existing assessment, the threshold was not exceeded at the Order Limits. As the impact exceeds the 'Maintain' threshold under LA 105 (**Ref. 1**), characterisation of the impact in accordance with LA 108 is required.

8.1.44. The **duration** of the impact is considered **permanent**, as increased NOx emissions and hence contributions to nitrogen deposition would continue until and beyond the design year (2039), although they would be expected to be substantially reduced by this time as the UK vehicle fleet decarbonises. As a **permanent** impact, in accordance with LA 108 Biodiversity (**Ref. 5**), the impact is also classified as **irreversible**.

8.1.45. The maximum **magnitude** of the impact is 1.8 kg N/ha/yr., with the exceedance of the threshold covering an **extent** of habitat of approximately 0.05 ha.

8.1.46. The **frequency** of the impact is **annual,** with the **timing** of the impact being during the **operational** period of the Scheme.

8.1.47. As described above, a limited proportion of the designated habitats site would be affected, with the Scheme delaying long-term reductions in overall nitrogen deposition rates rather than leading to long-term increases in these relative to the current baseline. The Scheme nitrogen deposition impacts are unlikely to lead to long-term perceptible change of the composition and species richness of the woodland ground flora based on the literature review completed (refer to **Section 6**) or on the health of trees within the woodland. Any subtle effects that do occur are therefore not predicted to compromise the integrity the designated habitat. However, the key characteristics of the LWS (woodland habitat) may be adversely impacted.

8.1.48. In accordance with Table 3.11 of LA 108, the Scheme would result in a permanent/irreversible impact that may negatively impact the key characteristics of the resource and therefore the impact level is classified as **Major adverse**.

8.1.49. In accordance with Table 3.13 of LA 108, as a Major adverse impact on a resource of Local importance[11], the Scheme would result in a **Slight adverse (not significant)** effect to the Coquet River Felton Park LWS as a result of operational air quality.

Wansbeck and Hartburn Woods LWS / Borough Wood ancient woodland / Borough Wood LNR

8.1.50. Air quality modelling (refer to **Air Quality Updated Assessment (Scheme Opening Year 2024)** (document reference 6.35)) showed that there would be an increase in nitrogen deposition as a result of the Scheme (Eco7), with differences to the existing assessment identified in **paragraph 8.1.52** below. Wansbeck and Hartburn Woods LWS (161.6 ha), which encompasses Borough Wood ancient woodland (16.1 ha), is bisected by the existing A1 (affected road) to the south. As such, modelling was undertaken to both the east and west of the existing A1. Borough Wood LNR (18.35 ha) is located to the east of the existing A1. The majority of the LNR overlaps with the boundaries of the Wansbeck and Hartburn Woods LWS and Borough Woodland ancient woodland, although discrete areas extend beyond the boundaries of the LWS and ancient woodland. All three designated habitats are designated for their woodland habitat.

8.1.51. There is insufficient information to determine an air quality attribute for the three designated habitats. As such, the assessment of likely significant effects has been determined based on the 'Restore' approach.

8.1.52. To the west of the ARN, the increase in nitrogen deposition exceeds 0.4 kg N/ha/yr. (the 'Restore' approach threshold) up to 5 m, falling below this threshold at 10 m[12]. To the east of the ARN, the increase in nitrogen deposition exceeds 0.4 kg N/ha/yr. up to a distance of 20 m[13] into the designated habitats. As the impact exceeds the 'Restore' threshold under LA 105 (**Ref. 1**), characterisation of the impact in accordance with LA 108 is required.

8.1.53. The **duration** of the impact is considered **permanent**, as increased NOx emissions and hence contributions to nitrogen deposition would continue until and beyond the design year (2039), although they would be expected to be substantially reduced by this time as the UK vehicle fleet decarbonises. As a **permanent** impact, in accordance with LA 108 Biodiversity (**Ref. 5**), the impact is also classified as irreversible.

[11] As identified in Table 9-7, **Chapter 9: Biodiversity Part A [APP-048]** and detailed within the Applicant's response to BIO.1.18 of the Examining Authority's first written questions **[REP1-032]**.
[12] No change to the existing assessment.
[13] 15 m within the existing assessment.

8.1.54. The maximum **magnitude** of the impact is 1.0 kg N/ha/yr. to the west of the ARN and 0.7 kg N/ha/yr. to the east of the ARN, with the exceedance of the threshold covering an **extent** of habitat of approximately 0.34 ha, constituted of approximately 0.09 ha of the ancient woodland, approximately 0.11 ha of the LNR (encompassing the same area as the 0.09 ha of ancient woodland) and approximately 0.34 ha for the LWS (encompassing the affected area of both the ancient woodland and LNR).

8.1.55. The **frequency** of the impact is **annual,** with the **timing** of the impact being during the **operational** period of the Scheme.

8.1.56. As described above, a limited proportion of the designated habitats site would be affected, with the Scheme delaying long-term reductions in overall nitrogen deposition rates rather than leading to long-term increases in these relative to the current baseline. The Scheme nitrogen deposition impacts are unlikely to lead to long-term perceptible change of the composition and species richness of the woodland ground flora or on the health of trees within the woodland. Any subtle effects that do occur are therefore not predicted to compromise the integrity of the designated habitats. However, the key characteristics of the designated habitats (woodland habitat) may be adversely impacted.

8.1.57. In accordance with Table 3.11 of LA 108, the Scheme would result in a permanent/irreversible impact that may negatively impact the key characteristics of the resource and therefore the impact level is classified as **Major adverse**.

8.1.58. In accordance with Table 3.13 of LA 108, a Major adverse impact on a resource of National importance (Borough Woods ancient woodland) would result in a Large or Very Large adverse effect. A Major adverse impact on a resource of County importance (Borough Woods LNR) would result in a Slight or Moderate adverse effect and on a resource of Local importance (Wansbeck and Hartburn Woods LWS) would result in a Slight adverse effect. At present, mitigation has not been secured that would reduce the level of impact identified for each of the three designated habitats. It is therefore determined that, in accordance with Table 3.13 of LA 108 Biodiversity (**Ref. 5**), the increase in nitrogen deposition would result in a **Very Large adverse** effect to Borough Woods ancient woodland, a **Moderate adverse** effect to Borough Woods LNR and a **Slight adverse (not significant)** effect to Wansbeck and Hartburn Woods LWS as a result of operational air quality.

Well Wood Ancient Woodland

8.1.59. Air quality modelling as part of the updated assessment (refer to **Air Quality Updated Assessment (Scheme Opening Year 2024)** (document reference 6.35)) showed that there would be an increase in nitrogen deposition as a result of the Scheme (Eco8). The increase in nitrogen deposition remains the same as the existing assessment, as detailed in **paragraphs 8.1.60 and 8.1.62** below. Well Wood Ancient Woodland (approximately 52.7 ha in size) is located to the east of the existing A1 (ARN).

8.1.60. There is insufficient information to determine an air quality attribute for the designated habitat. As such, the assessment of likely significant effects has been determined based on

the ‘Restore’ approach. The increase in nitrogen deposition exceeds 0.4 kg N/ha/yr. (the ‘Restore’ approach threshold) at 0 m west of the ARN only, falling below the threshold at 5 m (no change to the existing assessment). As the impact exceeds the ‘Restore’ threshold under LA 105 (**Ref. 1**), characterisation of the impact in accordance with LA 108 is required.

8.1.61. The **duration** of the impact is considered **permanent**, as increased NOx emissions and hence contributions to nitrogen deposition would continue until and beyond the design year (2039), although they would be expected to be substantially reduced by this time as the UK vehicle fleet decarbonises. As a **permanent** impact, in accordance with LA 108 Biodiversity (**Ref. 5**), the impact is also classified as **irreversible**.

8.1.62. The maximum **magnitude** of the impact is 0.5 kg N/ha/yr. (**Table 9-1**) (same as the existing assessment), with the exceedance of the threshold covering an **extent** of habitat of approximately 0.09 ha.

8.1.63. The **frequency** of the impact is **annual,** with the **timing** of the impact being during the **operational** period of the Scheme.

8.1.64. As described above, a very limited proportion of the designated habitat would be affected, with the Scheme delaying long-term reductions in overall nitrogen deposition rates rather than leading to long-term increases in these relative to the current baseline. The Scheme nitrogen deposition impacts are unlikely to lead to long-term perceptible change of the composition and species richness of the woodland ground flora based on the literature review completed (refer to **Section 6**) or on the health of trees within the woodland. Any subtle effects that do occur are therefore not predicted to compromise the integrity of the designated habitats. However, the key characteristics of the designated habitat (woodland habitat) may be adversely impacted.

8.1.65. In accordance with Table 3.11 of LA 108, the Scheme would result in a permanent/irreversible impact that may negatively impact the key characteristics of the resource and therefore the impact level is classified as **Major adverse**.

8.1.66. In accordance with Table 3.13 of LA 108, a Major adverse impact on a resource of National importance would result in a Large or Very Large adverse effect. At present, mitigation has not been secured to reduce the level of impact. It is therefore determined that the Scheme would result in a **Very Large adverse** effect to Well Wood ancient woodland as a result of operational air quality.

Ulgham Meadow LNR

8.1.67. Air quality modelling as part of the updated assessment (refer to **Air Quality Updated Assessment (Scheme Opening Year 2024)** (document reference 6.35)) predicted a decrease in nitrogen deposition for Ulgham Meadows LNR (Eco10) in the opening year (2024) that is marginally greater than that predicted within the existing assessment, as detailed in **paragraph 8.1.70** below. This is due to the increase in capacity for vehicular traffic along the A1 (the Scheme), drawing traffic off other roads and thereby reducing

associated vehicular emissions in proximity to the LNR. Ulgham Meadows LNR is approximately 3.62 ha in size and designated for its woodland habitat.

8.1.68. There is insufficient information to determine an air quality attribute for the designated habitat. As such, the assessment of likely significant effects has been determined based on the 'Restore' approach. The decrease in nitrogen deposition exceeds 0.4 kg N/ha/yr. (the 'Restore' approach threshold) up to 20 m from the ARN, falling below the threshold at 25 m. As the beneficial impact exceeds the 'Restore' threshold under LA 105 (**Ref. 1**), characterisation of the impact in accordance with LA 108 is required.

8.1.69. The **duration** of the impact is considered **permanent**, given the considerable declines in total NOx emissions from road transport over the last two decades (as detailed in **paragraph 2.1.19**), and the predicted continuation of these decreases in the future due to forecast reductions in 'per vehicle' emissions as the UK vehicle fleet decarbonises.

8.1.70. The maximum **magnitude** of the impact is -1.4 kg N/ha/yr.[14] (**Table 9-1**), with the exceedance of the threshold covering an **extent** of habitat of approximately 0.22 ha.

8.1.71. The **frequency** of the impact is **annual,** with the **timing** of the impact being during the **operational** period of the Scheme.

8.1.72. As described above, a limited proportion of the designated habitat would be beneficially affected. The beneficial impacts of the Scheme are unlikely to lead to long-term perceptible change of the composition and species richness of the woodland ground flora based on the literature review completed (refer to **Section 6**) or on the health of trees within the woodland. Any subtle effects that do occur are therefore not predicted to positively affect the integrity of the designated habitats. However, the key characteristics of the designated habitat (woodland habitat) may be positively impacted.

8.1.73. In accordance with Table 3.11 of LA 108, the Scheme would result in a permanent beneficial impact that would positively impact the key characteristics of the resource and therefore the impact level is classified as **Major beneficial**.

8.1.74. In accordance with Table 3.13 of LA 108, a Major beneficial impact on a resource of County importance would result in a Slight or Moderate beneficial effect. Paragraph 3.13.1 of LA 108 Biodiversity states that where there are "*two significance categories, evidence should be provided to support the reporting of a single significance category.*" There is no known evidence to distinguish between the two significance categories provided and therefore, on a precautionary basis, the lower level of significance has been attributed. It is therefore determined that the Scheme would result in a **Slight beneficial (not significant)** effect to Ulgham Meadow LNR as a result of operational air quality.

[14] -1.4 kg N/ha/yr. within the existing assessment.

Cocklaw Dene LWS

8.1.75. Air quality modelling as part of the updated assessment (refer to **Air Quality Updated Assessment (Scheme Opening Year 2024)** (document reference 6.35)) showed that there would be an increase in nitrogen deposition marginally greater than that predicted within the existing assessment, as detailed in **paragraph 8.1.76** below. Cocklaw Dene LWS (approximately 44.6 ha in size) is located approximately 8 m to the west of the ARN (Eco17W) near Warenford, approximately 6.5 km to the north of the Scheme, and designated for its woodland habitat. An area of the LWS supports ancient woodland, although this falls outside the Study Area and is therefore not considered within this assessment.

8.1.76. There is insufficient information to determine an air quality attribute for the designated habitat. As such, the assessment of likely significant effects has been determined based on the 'Restore' approach. The increase in nitrogen deposition exceeds 0.4 kg N/ha/yr.[15] (the 'Restore' approach threshold) at 0 m west of the ARN only, falling below the threshold at 5 m. As the LWS is approximately 8 m from the ARN and therefore an exceedance of the threshold is not predicted within the boundaries of the LWS, it is predicted that the Scheme would result in **Neutral** (**not significant**) effects to Cocklaw Dene LWS.

Cawledge Burn LWS

8.1.77. Air quality modelling (refer to **Air Quality Updated Assessment (Scheme Opening Year 2024)** (document reference 6.35)) showed that there would be a potential increase in nitrogen deposition as a result of the Scheme of the same magnitude as the existing assessment (see **paragraph 8.1.80** below), although the impact is experienced over a reduced extent of the LWS, as detailed in **paragraph 8.1.78** below. Cawledge Burn LWS (approximately 10 ha in size) is located either side of the existing A1 (ARN; Eco18E and Eco18W) to the south of Alnwick. The LWS is designated primarily for its geological interest, although the citation does include biological features of interest. LA 105 Air Quality states that sites designated for geological purposes need not be assessed. However, given that the LWS supports biological interest, the site has been scoped in to ensure a robust assessment.

8.1.78. There is insufficient information to determine an air quality attribute for the designated habitat. As such, the assessment of likely significant effects has been determined based on the 'Restore' approach. The increase in nitrogen deposition exceeds 0.4 kg N/ha/yr. (the 'Restore' approach threshold) up to 15 m west of the ARN and 20 m east of the ARN[16]. As

[15] Increase was 0.3 kg N/ha/yr, within the existing assessment and therefore did not exceed the 0.4 kg N/ha/yr. threshold.
[16] 20 m west and 25 m east of the ARN within the existing assessment.

the impact exceeds the 'Restore' threshold under LA 105 (**Ref. 1**), characterisation of the impact in accordance with LA 108 is required.

8.1.79. The **duration** of the impact is considered **permanent**, as increased NOx emissions and hence contributions to nitrogen deposition would continue until and beyond the design year (2039), although they would be expected to be substantially reduced by this time as the UK vehicle fleet decarbonises. As a **permanent** Impact, in accordance with LA 108 Biodiversity (**Ref. 5**), the impact is also classified as **irreversible**.

8.1.80. The maximum **magnitude** of the impact is 1.0 kg N/ha/yr, on both sides of the ARN (same as the existing assessment), with the exceedance of the threshold covering an **extent** of habitat of approximately 0.54 ha.

8.1.81. The **frequency** of the impact is **annual,** with the **timing** of the impact being during the **operational** period of the Scheme.

8.1.82. As described above, a limited proportion of the designated habitats site would be affected, with the Scheme delaying long-term reductions in overall nitrogen deposition rates rather than leading to long-term increases in these relative to the current baseline. The Scheme nitrogen deposition impacts are unlikely to lead to long-term perceptible change of the composition and species richness of the woodland ground flora based on the literature review completed (refer to **Section 6**) or on the health of trees within the woodland. Any subtle effects that do occur are therefore not predicted to compromise the integrity of the designated habitats. However, the key characteristics of the LWS (woodland habitat) may be adversely impacted.

8.1.83. It should be noted that an assessment made by vehicle in September 2020 recorded the woodland within the LWS to the west of the A1 (affected road) to have been clear-felled as part of forestry operations. It is therefore likely that management operations, at least within woodland of the LWS to the west of the A1, will have a substantially greater effect on the designated habitat that those experienced from the increase in nitrogen deposition as a result of the Scheme. However, as management practices across the extent of the LWS are not fully understood at this stage, for the purpose of this assessment and to ensure a robust assessment, this factor has not been considered within the assessment of likely significant effects arising from operational air quality.

8.1.84. In accordance with Table 3.11 of LA 108, the Scheme would result in a permanent/irreversible impact that may negatively impact the key characteristics of the resource and therefore the impact is classified as **Major adverse**.

8.1.85. In accordance with Table 3.13 of LA 108, as a Major adverse impact on a resource of Local importance, the Scheme would result in a **Slight adverse (not significant)** effect to Cawledge Burn as a result of operational air quality.

Ancient / Veteran Trees

8.1.86. Tree 682 is a veteran ash. The tree is in fair physiological condition and a poor structural condition, although has a predicted future lifespan in excess of 40 years (see **Appendix A,**

Appendix 7.5: Arboricultural Report Part A [APP-220]). Tree 701 is a potential veteran oak. The tree is in good physiological and structural condition, with a predicted future lifespan in excess of 40 years (see **Appendix A, Appendix 7.5: Arboricultural Report Part A [APP-220]**).

8.1.87. There is insufficient information to determine an air quality attribute for Trees T682 and T701. As such, the assessment of likely significant effects has been determined based on the 'Restore' approach.

8.1.88. Air quality modelling (refer to **Air Quality Updated Assessment (Scheme Opening Year 2024)** (document reference 6.35)) predicts an increase in nitrogen deposition of 0.4 kg N/ha/yr. at the location of Tree T682, equal to the 'Restore' approach threshold (same as the existing assessment). On review of the air quality modelling for the Scheme with the competent expert for Air Quality, it was established that the maximum impact of nitrogen deposition from the Scheme to two decimal places was 0.44 kg N/ha/yr. (opening year)[17]. As such, whilst the threshold is not exceeded to a single decimal place, to ensure a robust assessment is undertaken it is assumed that the habitat threshold is predicted to be exceeded.

8.1.89. Air quality modelling (refer to **Air Quality Updated Assessment (Scheme Opening Year 2024)** (document reference 6.35)) predicts an increase in nitrogen deposition of 0.6 kg N/ha/yr. at the location of Tree T701[18].

8.1.90. As the predicted impact exceeds the 'Restore' threshold under LA 105 (**Ref. 1**) for both trees, characterisation of the impact in accordance with LA 108 is required.

8.1.91. As shown by the literature review presented in **Section 6**, the effects of low doses of nitrogen on trees are unlikely to lead to detectable changes in the health of individual trees and therefore it is unlikely that the integrity of the veteran tree would be adversely affected. However, as detailed in **paragraph 6.1.11**, the research examined demonstrates that the effects of increased nitrogen deposition are difficult to detect. CIEEM Guidelines (**Ref. 3**) defines the "precautionary principle" and states that "*the evaluation of significant effects should always be based on the best available scientific evidence ... In cases of reasonable doubt, where is not possible to robustly justify a conclusion of no significant effect, a significant effect should be assumed.*" In light of the above and in consideration of the precautionary principle (**Ref. 3**), a significant effect has been assumed for both Tree T682 and T701.

[17] 0.36 kg N/ha/yr. to two decimal places within the existing assessment and therefore did not exceed the threshold of 0.4kg N/ha/yr.
[18] 0.5 kg N/ha/yr. within the existing assessment.

8.1.92. The **duration** of the impact is considered **permanent**, as increased NOx emissions and hence contributions to nitrogen deposition would continue until and beyond the design year (2039). As a **permanent** Impact, in accordance with LA 108 Biodiversity (**Ref. 5**), the impact is also classified as **irreversible**.

8.1.93. The maximum **magnitude** of the impact is 0.4 kg N/ha/yr. for Tree T682 and 0.6 kg N/ha/yr. for Tree T701, with the exceedance of the threshold covering the entire tree (**extent**, in accordance with **paragraph 2.1.22**).

8.1.94. The **frequency** of the impact is **annual,** with the **timing** of the impact being during the **operational** period of the Scheme.

8.1.95. In accordance with Table 3.11 of LA 108, the Scheme would result in a permanent/irreversible impact that may negatively impact the key characteristics of the resource and therefore the impact level is classified as **Major adverse**.

8.1.96. In accordance with Table 3.13 of LA 108, a Major adverse impact on a resource of National importance would result in a Large or Very Large adverse effect. At present, mitigation has not been secured to reduce the level of impact to either tree. It is therefore determined that the Scheme would result in a **Very Large adverse** effect to veteran trees T682 and T702.

9 CONCLUSION

9.1.1. The updated assessment identified increases in operational nitrogen deposition as a result of the Scheme that are generally marginally greater than those predicted in the existing assessment.

9.1.2. Following identification of changes in nitrogen deposition that exceed the applicable habitat threshold and characterisation of the impacts, including ecological interpretation in line with LA 108 Biodiversity (**Ref. 5**), increases in operational nitrogen predicted for the following designated habitats would result in significant effects:

a. Borough Woods LNR and ancient woodland (**Moderate** and **Very Large adverse**, respectively)
b. Well Wood ancient woodland (**Very Large adverse**)
c. Veteran tree T682 (**Very Large adverse**)
d. Veteran tree T701 (**Very Large adverse**)

9.1.3. As detailed in **Section 7**, mitigation measures to avoid or reduce the potential adverse impacts of the Scheme arising from operational nitrogen deposition have been considered. However, no viable mitigation measures have yet been identified. As detailed in **paragraph 7.1.5**, the Applicant continues to investigate viable mitigation measures, in accordance with LA 105 Air Quality (**Ref. 1**). If viable mitigation measures are identified, this has the potential to reduce the significance of effect.

9.1.4. The Applicant also continues to investigate potential compensation measures (as detailed in **paragraph 7.1.6**) where significant effects are predicted. Compensation measures would not reduce the significance of effect but would seek to offset the predicted impacts of the Scheme.

9.1.5. Whilst an increase in nitrogen deposition that exceeds the applicable habitat threshold was recorded for the following sites, in accordance with LA 108 Biodiversity (**Ref. 5**), effects are identified as **Slight adverse (not significant)**:

a. Coquet River Felton Park LWS
b. Wansbeck and Hartburn Woods LWS
c. Cawledge Burn LWS

9.1.6. A decrease in predicted nitrogen deposition above the applicable habitat threshold was predicted for Ulgham Meadows LNR, as a result of the increase in capacity for vehicular traffic along the A1 (the Scheme), drawing traffic off other roads and thereby reducing associated vehicular emissions in proximity to the LNR. This is predicted to result in a **Slight beneficial (not significant)** effect.

Table 9-1 – Summary of Assessment of Ecological Receptors Under LA 105

Transect Reference	Designated Habitat(s)	Lowest Critical Load (kg N/ha/yr.)	Air Quality Attribute used in Assessment	Background Nitrogen Deposition (5 km Average Deposition from APIS (kg N/ha/yr.)) 'Maintain' only	Nitrogen Deposition threshold (kg N/ha/yr.) Resulting in Theoretical Loss of 1 Species (Threshold)	Maximum Change in N Deposition (kg N/ha/yr.) Between Do Minimum and Do Something Experienced by the Designated Habitat	Distance along the Transect the Increase in N Deposition (kg N/ha/yr.) Between Do Minimum and Do Something Exceeds Threshold
Eco1E	River Coquet and Coquet Valley Woodlands SSSI – unit 13 Duke's Bank Ancient Woodland	15	Maintain	22.96	1.7	1.3	Not exceeded
Eco1W	River Coquet and Coquet Valley Woodlands SSSI – unit 13 Duke's Bank Ancient Woodland	15	Maintain	22.96	1.7	0.3	Not exceeded
Eco1E	Coquet River Felton Park LWS	15	Maintain	22.96	1.7	1.8	15 m (at the Order Limits)
Eco1W	Coquet River Felton Park LWS	15	Maintain	22.96	1.7	0.3	Not exceeded
Eco2	Longhorsley Moor SSSI Longhorsley Moor LWS	10	Restore	N/A	0.4	-0.4	Not exceeded
Eco5	Davies Wood LNR Davies Wood Ancient Woodland	10	Restore	N/A	0.4	0.1	Not exceeded
Eco7E	Borough Wood LNR Borough Wood Ancient Woodland Wansbeck & Hartburn Woods LWS	10	Restore	N/A	0.4	1.0	20 m
Eco7W	Borough Wood LNR Borough Wood Ancient Woodland Wansbeck & Hartburn Woods LWS	10	Restore	N/A	0.4	0.7	5 m
Eco8	Well Wood Ancient Woodland	10	Restore	N/A	0.4	0.5	5 m
Eco10	Ulgham Meadow LNR	10	Restore	N/A	0.4	-1.4	Not exceeded
Eco11	Weldon Wood Ancient Woodland	10	Restore	N/A	0.4	-0.3	Not exceeded

Transect Reference	Designated Habitat(s)	Lowest Critical Load (kg N/ha/yr.)	Air Quality Attribute used in Assessment	Background Nitrogen Deposition (5 km Average Deposition from APIS (kg N/ha/yr.)) 'Maintain' only	Nitrogen Deposition threshold (kg N/ha/yr.) Resulting in Theoretical Loss of 1 Species (Threshold)	Maximum Change in N Deposition (kg N/ha/yr.) Between Do Minimum and Do Something Experienced by the Designated Habitat	Distance along the Transect the Increase in N Deposition (kg N/ha/yr.) Between Do Minimum and Do Something Exceeds Threshold
Eco17W	Cocklaw Dene LWS	10	Restore	N/A	0.4	0.6	0m. Not exceeded within LWS
Eco18E	Cawledge Burn LWS	10	Restore	N/A	0.4	1.0	20 m
Eco18W	Cawledge Burn LWS	10	Restore	N/A	0.4	1.0	15 m
Eco19	Coney Garth Pond LWS	5	Restore	N/A	0.4	0.3	Not exceeded
Eco_VT1	Tree 93294	10	Restore	N/A	0.4	0.1	Not exceeded
Eco_VT2	Tree 93296	10	Restore	N/A	0.4	0.1	Not exceeded
Eco_VT3	Tree 156557	10	Restore	N/A	0.4	-0.1	Not exceeded
Eco_VT9	Tree 156556	10	Restore	N/A	0.4	-0.2	Not exceeded
Eco_VT16	Tree 68872	10	Maintain*	N/A	1.7	0.6	Not exceeded
Eco_VT18	Tree 68541	10	Maintain*	N/A	1.7	0.4	Not exceeded
Eco_VT20	Tree T457	10	Restore	N/A	0.4	0.3	Not exceeded
Eco_VT23	Tree T684	10	Restore	N/A	0.4	0.2	Not exceeded
Eco_VT24	Tree T682	10	Restore	N/A	0.4	0.4	At location of tree
Eco_VT25	Tree T681	10	Restore	N/A	0.4	0.2	Not exceeded
Eco_VT26	Tree T690	10	Restore	N/A	0.4	0.2	Not exceeded
Eco_VT27	Tree T701	10	Restore	N/A	0.4	0.6	At location of tree

* Tree located within the boundaries of the River Coquet and Coquet Valley Woodlands SSSI. As such, the information presented in paragraphs 8.1.10 to 8.1.30 for determining the air quality attribute applies and the air quality attribute is therefore identified as 'Maintain'.

Table 9-2 - Summary of Assessment of Ecological Receptors Under LA 108

Designated Habitat(s) and Air Quality Attribute (from LA105)	Resource Importance	Duration and Reversibility	Extent	Magnitude and Habitat Threshold	Frequency	Timing	Integrity and key characteristics of resource	Level of Impact	Effect Significance (in accordance with LA 108 Biodiversity)
Coquet River Felton Park LWS (Maintain)	Local	Permanent, irreversible	Area; 0.05 ha	Maximum predicted nitrogen deposition; 1.8 kg N/ha/yr. Habitat threshold; 1.7 kg N/ha/yr.	Annual	Operational Ongoing from 2024	This site is designated for its woodland habitat. The Scheme addresses the loss of all LWS woodland within the Order Limits adjacent to the existing A1 (0.41 ha) and provides woodland planting as compensation (detailed within the **Appendix 9.21: Ancient Woodland Strategy Part A [APP-247]**). The area for which compensation has been provided is excluded from the assessment because habitat that has been removed can no longer be affected by operational changes in air quality. As such, the closest point affected by increased nitrogen deposition from the existing A1 is at the Order Limits boundary, approximately 15 m distance to the east and 7.5 m to the west of the ARN. Up to 0.05 ha of the designated habitat (which has a total area of 18.02 ha) would be subject to an impact that exceeds the change nitrogen deposition threshold. As shown by the literature review, the effects of low doses of nitrogen on trees and woodland ground flora are unlikely to lead to detectable changes in the composition, species-richness, or health of trees and ground flora within the woodland community. Given this and the magnitude and minimal extent of the effects, the integrity of the designated habitat resource is not predicted to be affected. However, the key characteristics of the resource (woodland habitat) may be negatively impacted by the increased nitrogen deposition.	Major adverse	Slight adverse (not significant)

Designated Habitat(s) and Air Quality Attribute (from LA105)	Resource Importance	Duration and Reversibility	Extent	Magnitude and Habitat Threshold	Frequency	Timing	Integrity and key characteristics of resource	Level of Impact	Effect Significance (in accordance with LA 108 Biodiversity)
Borough Woods ancient woodland (Restore)	National	Permanent, irreversible	Area; 0.09 ha	Maximum predicted nitrogen deposition; 1.0 kg N/ha/yr. Habitat threshold; 0.4 kg N/ha/yr.	Annual	Operational Ongoing from 2024	This site is included on the ancient woodland inventory which identifies it as an Ancient and Semi-natural Woodland site. The ancient woodland site falls entirely within the boundary of the Wansbeck and Hartburn Woods LWS. The citation for the associated Wansbeck and Hartburn Woods LWS records the presence of ancient woodland indicator species including wild garlic *Allium ursinum*, woodruff *Galium odoratum*, wood-sedge *Carex sylvatica*, bluebell *Hyacinthoides non-scripta*, wood anemone *nemerosa* and dog's mercury *Mercurialis perennis*. The only tree species recorded in the citation is field maple *Acer campestre.* Tree species including ash, hazel *Corylus avellana* and hawthorn are present adjacent to the ARN. The key characteristics of the site are the ground flora and largely continuous tree cover, supporting its classification as a broadleaved deciduous woodland. Up to 0.09 ha of the designated habitat (which has a total area of 16.1 ha) would be subject to an impact that exceeds the habitat threshold. As shown by the literature review, the effects of low doses of nitrogen on trees and woodland ground flora are unlikely to lead to detectable changes in the composition, species-richness, or health of trees and ground flora within the woodland community. Given this and the magnitude and minimal extent of the effects, the integrity of the designated habitat resource is not predicted to be affected. However, the key characteristics of the resource (woodland habitat) may be	Major adverse	Very Large adverse

Designated Habitat(s) and Air Quality Attribute (from LA105)	Resource Importance	Duration and Reversibility	Extent	Magnitude and Habitat Threshold	Frequency	Timing	Integrity and key characteristics of resource	Level of Impact	Effect Significance (in accordance with LA 108 Biodiversity)
							negatively impacted by the increased nitrogen deposition.		
Borough Woods LNR (Restore)	County	Permanent, irreversible	Area; 0.11 ha	Maximum predicted nitrogen deposition; 1.0 kg N/ha/yr. Habitat threshold; 0.4 kg N/ha/yr	Annual	Operational Ongoing from 2024	This site is a designated LNR (no citation information available) and falls entirely within the boundary of the Wansbeck and Hartburn Woods LWS. The citation for Wansbeck and Hartburn Woods LWS records the presence of ancient woodland indicator species including wild garlic, woodruff, wood-sedge, bluebell, wood anemone and dog's mercury. The only tree species recorded in the citation is field maple. Tree species including ash, hazel and hawthorn are present adjacent to the ARN. The key characteristics of the site are the ground flora and largely continuous tree cover, supporting its classification as a broadleaved deciduous woodland. Up to 0.11 ha of the designated habitat (which has a total area of 18.35 ha) would be subject to an impact that exceeds the habitat threshold. As shown by the literature review, the effects of low doses of nitrogen on trees and woodland ground flora are unlikely to lead to detectable changes in the composition, species-richness, or health of trees and ground flora within the woodland community. Given this and the magnitude and minimal extent of the effects, the integrity of the designated habitat resource is not predicted to be affected. However, the key characteristics of the resource (woodland habitat) may be negatively impacted by the increased nitrogen deposition.	Major adverse	Moderate adverse

Designated Habitat(s) and Air Quality Attribute (from LA105)	Resource Importance	Duration and Reversibility	Extent	Magnitude and Habitat Threshold	Frequency	Timing	Integrity and key characteristics of resource	Level of Impact	Effect Significance (in accordance with LA 108 Biodiversity)
Wansbeck and Hartburn Woods LWS (Restore)	Local	Permanent, irreversible	Area; 0.34 ha	Maximum predicted nitrogen deposition; 1.0 kg N/ha/yr Habitat threshold; 0.4 kg N/ha/yr	Annual	Operational Ongoing from 2024	The citation for Wansbeck and Hartburn Woods LWS records the presence of ancient woodland indicator species including wild garlic, woodruff, wood-sedge, bluebell, wood anemone and dog's mercury. The only tree species recorded in the citation is field maple. Tree species including ash, hazel and hawthorn are present adjacent to the ARN. The key characteristics of the site are the ground flora and largely continuous tree cover, supporting its classification as a broadleaved deciduous woodland. Up to 0.34 ha of the designated habitat (which has a total area of 161.6 ha) would be subject to an impact that exceeds the habitat threshold. As shown by the literature review, the effects of low doses of nitrogen on trees and woodland ground flora are unlikely to lead to detectable changes in the composition, species-richness, or health of trees and ground flora within the woodland community. Given this and the magnitude and minimal extent of the effects, the integrity of the designated habitat resource is not predicted to be affected. However, the key characteristics of the resource (woodland habitat) may be negatively impacted by the increased nitrogen deposition.	Major adverse	Slight adverse (not significant)

Designated Habitat(s) and Air Quality Attribute (from LA105)	Resource Importance	Duration and Reversibility	Extent	Magnitude and Habitat Threshold	Frequency	Timing	Integrity and key characteristics of resource	Level of Impact	Effect Significance (in accordance with LA 108 Biodiversity)
Well Wood ancient woodland (Restore)	National	Permanent, irreversible	Area; 0.09ha	Maximum predicted nitrogen deposition; 0.5 kg N/ha/yr. Habitat threshold; 0.4 kg N/ha/yr.	Annual	Operational Ongoing from 2024.	This site is included on the ancient woodland inventory which identifies it as an Ancient and Semi-natural Woodland site. Up to 0.09 ha of the designated habitat (which has a total area of 52.7 ha) would be subject to an impact that exceeds the habitat threshold. As shown by the literature review, the effects of low doses of nitrogen on trees and woodland ground flora are unlikely to lead to detectable changes in the composition, species-richness, or health of trees and ground flora within the woodland community. Given this and the magnitude and minimal extent of the effects, the integrity of the designated habitat resource is not predicted to be affected. However, the key characteristics of the resource (woodland habitat) may be negatively impacted by the increased nitrogen deposition.	Major adverse	Very Large adverse

Designated Habitat(s) and Air Quality Attribute (from LA105)	Resource Importance	Duration and Reversibility	Extent	Magnitude and Habitat Threshold	Frequency	Timing	Integrity and key characteristics of resource	Level of Impact	Effect Significance (in accordance with LA 108 Biodiversity)
Ulgham Meadow LNR	County	Permanent improvement	Area; 0.22 ha	Maximum predicted nitrogen deposition; -1.4 kg N/ha/yr. (reduction) Habitat threshold; 0.4 kg N/ha/yr.	Annual	Operational Ongoing from 2024	The citation document for the LNR records the presence of woodland that supports over 10 ancient woodland indicator species. The air quality modelling predicts a decrease in nitrogen deposition for Ulgham Meadows LNR. This is due to the increase in capacity for vehicular traffic along the A1 (the Scheme), drawing traffic off other roads and thereby reducing associated vehicular emissions in proximity to the LNR. Up to 0.22 ha of the designated habitat (which has a total area of 3.62 ha) would be subject to the beneficial impact that exceeds the habitat threshold. Given the small extent of the effects, the integrity of the designated habitat resource is not predicted to be positively affected. However, the key characteristics of the resource (woodland habitat) may be positively affected by the decrease in nitrogen deposition.	Major beneficial	Slight beneficial (not significant)

Cawledge Burn LWS (Restore)	Local	Permanent, irreversible	Area; 0.54ha	Maximum predicted nitrogen deposition; 0.7 kg N/ha/yr. Habitat threshold; 0.4 kg N/ha/yr.	Annual	Operational Ongoing from 2024.	The LWS is designated for its geological interest. Although the DMRB (LA 105 Air Quality) states that sites designated for geological purposes need not be assessed, the citation does include biological features of interest, and is therefore included to ensure this assessment is robust. The site supports bird species, and also has "little botanical interest", mainly in woodland extending to the east of the A1, dominated by beech. This woodland is extensive; aerial photography shows woodland of similar structure to extend over several hectares and connect with woodland occupying the majority of the site, which follows the line of Cawledge Burn. It should be noted that an assessment made by vehicle in September 2020 recorded the woodland within the LWS to the west of the A1 (affected road) to have been clear-felled as part of forestry operations. It is therefore likely that management operations, at least within woodland of the LWS to the west of the A1, will have a greater adverse impact on the designated habitat that those experienced from the increase in nitrogen deposition as a result of the Scheme. Woodland species described in the citation for the LWS are widespread throughout Britain. Up to 0.54 ha (including 0.26 ha within the area clear-felled in 2020) of the designated habitat would be subject to an impact that exceeds the habitat threshold. As shown by the literature review, the effects of low doses of nitrogen on trees and woodland ground flora are unlikely to lead to detectable changes in the composition, species-richness, or health of trees and ground flora within the woodland community. Given this, magnitude and extent of the impact and the management operations known for	Major adverse	Slight adverse (not significant)

Designated Habitat(s) and Air Quality Attribute (from LA105)	Resource Importance	Duration and Reversibility	Extent	Magnitude and Habitat Threshold	Frequency	Timing	Integrity and key characteristics of resource	Level of Impact	Effect Significance (in accordance with LA 108 Biodiversity)
							woodland habitat of the LWS to the west of the A1, the integrity of the designated habitat resource is not predicted to be affected. However, the key characteristics of the resource (woodland habitat) may be negatively impacted by the increased nitrogen deposition.		

Designated Habitat(s) and Air Quality Attribute (from LA105)	Resource Importance	Duration and Reversibility	Extent	Magnitude and Habitat Threshold	Frequency	Timing	Integrity and key characteristics of resource	Level of Impact	Effect Significance (in accordance with LA 108 Biodiversity)
Tree T682 (Restore)	National	Permanent, irreversible	Local to the tree	Maximum predicted nitrogen deposition; 0.4 kg N/ha/yr. Habitat threshold; 0.4 kg N/ha/yr.	Annual	Operational Ongoing from 2024.	Tree 682 is a veteran ash. The tree is in fair physiological condition and a poor structural condition, although has a predicted future lifespan in excess of 40 years (see **Appendix A, Appendix 7.5: Arboricultural Report Part A [APP-220]**). The maximum predicted increase in nitrogen deposition is equal to, as opposed to greater than, the threshold of 0.4 kg N/ha/yr. As such, the air quality modelling for the Scheme has been reviewed with the competent expert for Air Quality, which established that the maximum impact of nitrogen deposition to two decimal places is 0.44 kg N/ha/yr. (opening year). As such, it is determined that the habitat threshold is predicted to be exceeded. As shown by the literature review, the effects of low doses of nitrogen on trees are unlikely to lead to detectable changes in the health of individual trees and therefore it is unlikely that the integrity of the veteran tree would be adversely affected. However, as detailed in **paragraph 6.1.11**, the research examined demonstrates that the effects of increased nitrogen deposition are difficult to detect. As such, it is not possible to robustly justify a conclusion of no significant effects. In light of the above and in consideration of the precautionary principle (**Ref. 3**), a significant effect has been assumed.	Major adverse	Very Large adverse

Designated Habitat(s) and Air Quality Attribute (from LA105)	Resource Importance	Duration and Reversibility	Extent	Magnitude and Habitat Threshold	Frequency	Timing	Integrity and key characteristics of resource	Level of Impact	Effect Significance (in accordance with LA 108 Biodiversity)
Tree T701 (Restore)	National	Permanent, irreversible	Local to the tree	Maximum Total nitrogen deposition; 0.6 kg N/ha/yr. Habitat threshold; 0.4 kg N/ha/yr.	Annual	Operational Ongoing from 2024	Tree 701 is a potential veteran oak. The tree is in good physiological and structural condition, with a predicted future lifespan in excess of 40 years (see **Appendix A, Appendix 7.5: Arboricultural Report Part A [APP-220]**). The habitat threshold for nitrogen deposition (0.4 kg N/ha/yr.) is predicted to be exceeded. As shown by the literature review, the effects of low doses of nitrogen on trees are unlikely to lead to detectable changes in the health of individual trees and therefore it is unlikely that the integrity of the veteran tree would be adversely affected. However, as detailed in **paragraph 6.1.11**, the research examined demonstrates that the effects of increased nitrogen deposition are difficult to detect. As such, it is not possible to robustly justify a conclusion of no significant effect. In light of the above and in consideration of the precautionary principle (**Ref. 3**), a significant effect has been assumed.	Major adverse	Very Large adverse

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