A1 in Northumberland: Morpeth to Ellingham

Scheme Number: TR010041

6.7 Environmental Statement – Appendix 9.27 Biodiversity DMRB Sensitivity Test

Part A

APFP Regulation 5(2)(a)

Planning Act 2008

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

June 2020

Infrastructure Planning

Planning Act 2008

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

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

Environmental Statement - Appendix

Regulation Reference:	APFP Regulation 5(2)(a)
Planning Inspectorate Scheme Reference	TR010041
Application Document Reference	TR010041/APP/6.7
Author:	A1 in Northumberland: Morpeth to Ellingham Project Team, Highways England

Version	Date	Status of Version
Rev 0	June 2020	Application Issue

CONTENTS

TABLES

1 INTRODUCTION

1.1.1. This Appendix identifies the key changes in the assessment methodology and presents the assessment of the potential for additional likely significant environmental effects of Part A: Morpeth to Felton (Part A) on biodiversity with regard to air quality impacts as a result of the updated Design Manual for Roads and Bridges (DMRB) guidance LA 105 Air Quality (**Ref. 1**). This was undertaken as part of the DMRB sensitivity test, as detailed in **Chapter 9: Biodiversity, Volume 2** of this ES (**Application Document Reference: TR010041/APP/6.2**).

1.1.2. A full description of Part A is provided in **Chapter 2: The Scheme, Volume 1** of this ES (**Application Document Reference: TR010041/APP/6.1**).

2 ASSESSMENT METHODOLOGY

SCOPE OF ASSESSMENT

2.1.1. 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) as determined by the air quality modelling (**Appendix 5.8: Air Quality DMRB Sensitivity Test, Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)). 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 (which were not considered within the original air quality assessment presented in **Chapter 9: Biodiversity, Volume 2** of this ES (**Application Document Reference: TR010041/APP/6.2**)) have been scoped into the assessment.

METHODOLOGY

Guidance

2.1.3. The ecological assessment detailed within this Appendix has been undertaken using the approach detailed in LA 108 Biodiversity (**Ref. 5**),the CIEEM Guidelines for Ecological Impact Assessment (**Ref. 3**), and LA 105 Air Quality (**Ref. 1**).

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 existing ecological impact assessment presented within **Chapter 9: Biodiversity, Volume 2** of this ES (**Application Document Reference: TR010041/APP/6.2**).

2.1.5. A desk study exercise was undertaken in March 2020 to identify Nature Improvement Areas and ancient/veteran trees. 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 presented within **Appendix 7.5: Arboricultural Report, Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**).

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. As detailed in **Section 5.4** of **Chapter 5: Air Quality**, **Volume 2** of this ES (**Application Document Reference: TR010041/APP/6.2**), 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. While the determination in **Chapter 5: Air Quality, Volume 2** of this ES was a result of analysis against the now superseded DMRB HA207/07 (**Ref. 8**) scoping criteria, the DMRB sensitivity test for **Chapter 5: Air Quality, Volume 2** of this ES determined that this conclusion remained valid under the updated guidance (LA 105 Air Quality (**Ref. 1**)). 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 were considered where the change in total nitrogen deposition (kg N/ha/yr.) with Part A only ("Do Something" (with Part A) scenario) in comparison to the future baseline ("Do Minimum" (without Part A) 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 Part A. Critical loads for sites and / or habitats were ascertained

[1] APIS (**Ref. 10**) 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*".

from the Air Pollution Information System (APIS) database (**Ref. 9**). Where a range in the critical load was provided for a particular designated habitat, the 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 Part A 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 **Appendix 5.8: Air Quality DMRB Sensitivity Test, Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**).

2.1.11. Where the change in nitrogen deposition is greater than 1 % of the critical load, LA 105 Air Quality (**Ref. 1**) 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 Appendix. 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. 11**). 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

[2] It should be noted that the information presented in Table 21 of NECR210 (**Ref. 11**) 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 NECR210.

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 dunes, shall be used to inform the judgement of significant air quality effects*."

2.1.13. Using the 'Restore' approach, as prescribed in LA 105 Air Quality, represents a precautionary 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 precautionary worst-case approach. 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.

2.1.14. **Table 2-2**, which is 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. Longhorsley Moor SSSI/LWS is designated for lowland heath. As such, **Table 2-2** remains applicable.

2.1.15. In accordance with LA 105 Air Quality, 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 determination of a potentially significant effect.

2.1.16. In accordance with LA 105 Air Quality, 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 (**Table 2-2**). Where the background nitrogen deposition falls between two categories, the lower category has been used, as a precautionary approach.

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

[3] Which represents 5km average deposition data taken from APIS.
[4] Based on Table 21 of the Natural England dose response report (**Ref. 11**)

Increase in Nitrogen (N) Deposition (kg N/ha/yr.) Required to Reduce Measured Species Richness by One at Different Background N Deposition Levels					
0.4	0.8	1.3	1.7	2.0	2.4

2.1.17. Where Part A would result in a theoretical reduction in species richness equivalent to the loss of one plant species, this is identified as a potentially significant effect. Where this threshold would not be exceeded, no significant effect is identified. Where potentially significant effects are identified, professional judgement has been used to provide a qualified statement regarding the potential level of significance of the effects 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 LA108 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 LA105 as described above have then been characterised against the impact and effect descriptors used in paragraph 3.10 and Table 3.11 of LA108 Biodiversity (**Ref 5.**), and applicable CIEEM guidance (**Ref. 11**). The approach to describing each impact characteristic that informs overall Level of Impact under LA108, is set out below. These headings are subsequently used to summarise the predicted impacts and effects of nitrogen deposition from Part A on each designated habitat in **Table 8-2**.

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, Volume 2** of this ES (**Application Document Reference: TR010041/APP/6.2**). 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 Part A 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 vehicle fleet decarbonises. As the point in time at which Part A would generate no additional emissions relative to the do-minimum scenario cannot be forecast with any degree of certainty, the impact of Part A on nitrogen deposition is considered ‘**permanent**’ for all habitat’s sites.

2.1.21. There have also 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. 16**). Part A 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 Part A) typically take years or even decades to lead to detectable change to habitats and individual plant species. Given the substantial historic declines in NOx emissions from road transport and that these are predicted to decrease in the future, the impact of Part A on nitrogen deposition is considered '**reversible**' for all habitat's sites.

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 potentially significant air quality effect after applying the methodology in Figure 2.98 in LA105 Air Quality (**Ref. 1**). In the case of ancient or veteran trees, where a potentially significant air quality effect may occur at the location of a tree's central grid reference, this is considered to occur across the whole tree.

Magnitude

2.1.23. Magnitude is categorised as the maximum predicted dose of nitrogen onto a designated site that would result from operation of Part A. This is expressed in kg N/ha/yr and is presented alongside the habitats threshold as determined through Table 2.98 of LA105 Air Quality (**Ref. 1**). The predicted maximum dose from Part A occurs in the opening year; as taken from the air quality modelling presented in **Appendix 5.8: Air Quality DMRB Sensitivity Test, Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**).

Frequency

2.1.24. 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 Part A, 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 Part A and overall nitrogen deposition rates are predicted to reduce during the operational period.

Timing

2.1.25. As described above under 'frequency', the impact would occur continuously from the opening year. Timing is therefore categorised as ongoing during the operational period. Where the effects of Part A would delay predicted future reductions in overall nitrogen deposition rates within a reasonable time period (less than ten years) this is highlighted in the assessment of individual sites.

Integrity and Key Characteristics of the Resource

2.1.26. Potential effects on the integrity and key characteristics of each designated site 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.
c. The likely biophysical responses of the designated habitats subject to a potentially significant effect, and whether these responses could undermine the ecological coherence, functioning, and conservation status of the features for which the site is designated, and hence it's integrity.

Level of Impact

2.1.27. Level of impact is categorised against the criteria set out in Table 3.11 of LA108 (**Ref. 5**), which includes determining whether an impact will be beneficial or adverse, and whether the integrity or key characteristics of the designated habitat will be affected.

Effect Significance

2.1.28. Table 3.13 of LA108 (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. LA108 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 the permanence and/or reversibility of the impact, the extent and magnitude of the effect, and information on the nature and condition of the resource affected.

MITIGATION

2.1.29. The same approach to mitigation has been followed, as detailed in **Section 9.4** of **Chapter 9: Biodiversity, Volume 2** of this ES (**Application Document Reference: TR010041/APP/6.2**).

3 ASSESSMENT ASSUMPTIONS AND LIMITATIONS

3.1.1. The assessment assumptions in relation to the air quality modelling is provided within **Appendix 5.8: Air Quality DMRB Sensitivity Test, Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**).

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 will 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 (**Appendix 7.5: Arboricultural Report, Volume 7** of the ES (**Application Document Reference: TR010041/APP/6.7**)).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. 11**) 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 (**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**) and presented in **Figure 5.1: Air Quality Affected Road Network, Volume 5** of this ES (**Application Document Reference: TR010041/APP/6.5**).

5 BASELINE CONDITIONS

5.1.1. In addition to ecological receptors (designated habitats) identified in **Tables 9.7 and 9.8** of **Chapter 9: Biodiversity, Volume 2** of this ES (**Application Document Reference: TR010041/APP/6.2**), 22 ancient and / or veteran trees were identified within the Study Area and are presented in **Table 5-1** below. As ancient and veteran trees are irreplaceable habitat, they are considered of comparable importance to ancient woodland. As such, ancient and veteran trees are considered of **National importance.**

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

Table 5-1 – 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
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

Tree Reference	Tree Type	Grid Reference	Distance from ARN (m)
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
T701	Potential veteran oak	NU1754400863	52

6 POTENTIAL IMPACTS

6.1.1. The assessment for Part A 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. 12**).

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 Part A, that are applicable to all receptors. This characterisation has been completed with due regard to the impact assessment descriptions in LA108 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. 18***)* 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. 19***)* 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 25kg 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 30kg N/ha/yr to 50kg 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. 20**). 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. 21**).

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. 22**). 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. 23**).

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 Part A.

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. 24)**. The effects were confounded 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. 11**). 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 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 1200 woodland plots (**Ref. 25**), 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 when habitat-specific critical loads are already exceeded. Responses to increases in nitrogen deposition such as would be generated by Part A are likely to be subtle, leading to imperceptible levels of change within the affected habitats or to individual trees.

7 ASSESSMENT OF LIKELY SIGNIFICANT EFFECTS

7.1.1. This section identifies changes in nitrogen deposition that may lead to potentially significant effects as a result of Part A.

7.1.2. The following designated habitats would not experience a change in nitrogen deposition greater than 1 % of the critical load. 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. Bothal Burn and River Wansbeck LWS
b. Park Wood/Bothal Banks Ancient Woodland
c. Cotting Wood LWS and 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

7.1.3. Those designated habitats that are predicted to experience a change in nitrogen deposition greater than 1 % of the critical load and a summary of where potential significant effects may occur are presented in **Table 8-1**. Qualified statements including ecological interpretation are presented below for those designated habitats where the increase in nitrogen deposition may theoretically lead to a reduction in species-richness equivalent to the loss of one species. The ecological assessment of significance in accordance with LA108 Biodiversity (**Ref. 5**) and LA104 Environmental Assessment and Monitoring (**Ref. 4**) for these sites is set out in Table 8-2. 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 2.1.17** and **2.1.18**), a significant effect would not occur, effects are considered **Neutral** (**not significant**) and the designated habitat is not discussed further.

OPERATION

River Coquet and Coquet Valley Woodlands SSSI

7.1.4. 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 (**Figure 5.2.3: Air Quality Receptors, Volume 5** of this ES (**Application Document Reference: TR010041/APP/6.5**)). The SSSI is located both east and west of the ARN at each of the 3 locations.

7.1.5. 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 was raised during consultation with Natural England.

7.1.6. 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.

7.1.7. 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 Part A in relation to unit 13.

7.1.8. At Eco1, Part A 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 the **Ancient Woodland Strategy** (**Appendix 9.21, Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)). 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, approximately 25 m distance to the east and 7.5 m to the west of the ARN.

7.1.9. At Eco1, the potential increase in levels of nitrogen deposition as a result of Part A to the east of the ARN are a maximum of 1.1 kg N/ha/yr. at 25 m along the transect, the closest transect point where impacts may occur, decreasing with distance from the road (**Appendix 5.8: Air Quality DMRB Sensitivity Test, Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)). The increases in nitrogen deposition experienced to the west of the ARN are between 0.1 and 0.2 kg N/ha/yr.(**Ref. 1**) (**Appendix 5.8: Air Quality DMRB Sensitivity Test, Volume 7** of this ES).

7.1.10. As detailed within the methodology section of this Appendix (**paragraph 2.1.13**), 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 (see Figure 2.98 in LA 105 Air Quality (**Ref. 1**)).

7.1.11. 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*."

7.1.12. 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.

7.1.13. 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*."

7.1.14. 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.

7.1.15. 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.

7.1.16. The following evidence has been identified to inform the air quality attribute for unit 13 of the River Coquet and Coquet Valley Woodlands SSSI.

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

7.1.17. Unit 13 of the SSSI has been assigned a 'Favourable' condition by Natural England (**Ref. 13**). 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. 14**).

7.1.18. Whilst the condition status 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. 15**). 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

7.1.19. The National Atmospheric Emission Inventory (NAEI) identifies that total NOx 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. 16**). 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 to the nitrogen deposition to unit 13

than today. Nevertheless, the condition of the unit 13 during the last 21 years has remained as 'Favourable'.

7.1.20. 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 (**Chapter 5: Air Quality**, **Volume 2** of this ES (**Application Document Reference: TR010041/APP/6.2**)). 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. 17**), whereas emissions from road transport have halved over the same time period (**Ref. 16**). 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.

7.1.21. According to APIS Trends for this SSSI (**Ref. 17**), nitrogen deposition for 'Forest' habitat in 2005[5] 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 7-1**. Therefore, it can be reasoned that this trend is applicable to unit 13 of the River Coquet and Coquet Valley Woodlands SSSI.

Table 7-1 – 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

[5] Earliest record available.

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					
2017	24	24	20	19	15	24

7.1.22. 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

7.1.23. LA 105 Air Quality refers to Table 21 in the Natural England dose response report (**Ref. 11**) 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 is considered to lead to a significant effect under LA 105 Air Quality (**Ref. 1**).

7.1.24. '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 7.1.14**).

7.1.25. 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. 11**). This change corresponds to a background nitrogen deposition rate of 5 kg N/ha/yr. This is the critical load where the theoretical loss of one species could occur.

7.1.26. 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. 17**). 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. 10**). In accordance with the definition of critical load, this suggests nitrogen deposition below a rate of 15 kg N/ha/yr. would not lead to harm to the woodland habitat.

7.1.27. Nitrogen deposition levels for unit 13 are approximately 22.96 kg N/ha/yr. (5 km average deposition from APIS) (**Table 8-1**). Even though the background is higher than the lower critical load, 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.

7.1.28. Using Table 21 in the Natural England dose response report (**Ref. 11**), **Table 7-2** 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 unit 13 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 7-2 - 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. 11) (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

7.1.29. The increase in nitrogen deposition that may be experienced by unit 13 as a result of Part A, which is a maximum of approximately 1.1 kg N/ha/yr. (**Table 8-1**) (decreasing as the distance increases into the SSSI away from the ARN) falls below both the thresholds 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

7.1.30. 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.

7.1.31. 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. (**Table 8-1**) equating to a background

deposition of 20 kg N/ha/yr. (**Ref. 11**)) 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 15 m to the east of the ARN. This distance falls within the Order Limits, within the area of habitat lost to Part A. 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

7.1.32. Air quality modelling (**Appendix 5.8: Air Quality DMRB Sensitivity Test, Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)) showed that there would be an increase in nitrogen deposition as a result of Part A. 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. In relation to air quality, the Ancient Woodland site is located east and west of Part A at Eco1 (**Figure 5.2.3: Air Quality Receptors, Volume 5** of this ES (**Application Document Reference: TR010041/APP/6.5**)).

7.1.33. 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 7.1.10** to **7.1.30** 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.

7.1.34. 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. (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

7.1.35. Air quality modelling (**Appendix 5.8: Air Quality DMRB Sensitivity Test, Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)) showed that there would be an increase in nitrogen deposition as a result of Part A. Coquet River Felton Park LWS is 18.02 ha in size and located to the east and west of Part A where it crosses the River Coquet, model reference of Eco1 (**Figure 5.2.3: Air Quality Receptors, Volume 5** of this ES (**Application Document Reference: TR010041/APP/6.5**)). The LWS includes the woodland on the northern bank of the river that has been considered as ancient woodland within this ES.

7.1.36. Part A 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** (**Appendix 9.21, Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)). 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.

7.1.37. At Eco1, the potential increase in levels of nitrogen deposition as a result of Part A to the east of the ARN are a maximum of 1.6 kg N/ha/yr. at 15 m along the transect, the closest transect point where impacts may occur, decreasing with distance from the road (**Appendix 5.8: Air Quality DMRB Sensitivity Test, Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)). The increases in nitrogen deposition experienced to the west of the ARN are between 0.1 and 0.2 kg N/ha/yr. (**Appendix 5.8: Air Quality DMRB Sensitivity Test, Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)).

7.1.38. 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.

7.1.39. A National Vegetation Classification (NVC) survey was undertaken in April 2017 (**Appendix 9.2: National Vegetation Classification (NVC) Survey Report, Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)). 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 'Favourable' condition indicates the need to maintain the current condition of the LWS habitats, rather than instigate restorative measures.

7.1.40. As the LWS is contiguous with that of the 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 7.1.10** to **7.1.30** above for determining the air quality attribute of the SSSI applies.

7.1.41. 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.

7.1.42. 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. equating to a background deposition of 20 kg N/ha/yr. (**Ref. 11**)) 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 15 m to the east of the ARN. This distance is at the Order Limits, and therefore the affected area falls within the area of habitat lost to Part A. As the threshold of significance is not exceeded beyond 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 the LWS in accordance with the 'Maintain' approach.

Wansbeck and Hartburn Woods LWS/Borough Wood Ancient Woodland/Borough Wood LNR

7.1.43. Air quality modelling (**Appendix 5.8: Air Quality DMRB Sensitivity Test, Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)) showed that there would be an increase in nitrogen deposition as a result of Part A (Eco7). Wansbeck and Hartburn Woods LWS (161.6 ha), which encompasses Borough Wood ancient woodland (16.1 ha), is bisected by the existing A1 (ARN) to the south of Part A. As such, modelling was undertaken to both the east and west of the existing A1. Borough Wood LNR (18.35 ha) is only located to the east of the existing A1.

7.1.44. 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. To the west of the ARN, the increase in nitrogen deposition exceeds 0.4 kg N/ha/yr. (the 'Restore' approach threshold) at 5 m, falling below this threshold at 10 m. To the east of the ARN, the increase in nitrogen deposition exceeds 0.4 kg N/ha/yr. up to a distance of 15 m into the designated habitats. As the impact exceeds the 'Restore' threshold under LA105 (Ref. 1) and is therefore potentially significant, characterisation of the impact in accordance with LA108 is required.

7.1.45. 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). Overall nitrogen deposition rates are however predicted to decline during operation and have declined considerably since 1999 (refer to **paragraph 7.1.19**). As such, the effects of Part A are considered **reversible**. The maximum **magnitude** of the impact is 0.8kg N/ha/yr, covering an **extent** of habitat of approximately 0.1ha. This is equivalent to 0.38% of the identified ancient woodland habitats, 0.45% of the LNR habitats, and 0.14% of the LWS habitats.

7.1.46. The **frequency** of the impact is **annual,** with the **timing** of the impact being during the **operational** period of Part A. The competent expert for Air Quality estimates that nitrogen deposition from Part A would delay predicted overall declines in nitrogen deposition rates onto the designated habitats by approximately eight years.

7.1.47. As described above, a limited proportion of the designated habitats sites would be affected, with Part A delaying long-term reductions in overall nitrogen deposition rates rather than leading to long-term increases in these relative to the current baseline. Part A 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 or key features of the designated habitats. Whilst taking a precautionary view based on the 'Restore' approach (in the absence of information to determine an air quality attribute), in accordance with LA108 Part A would therefore result in a **minor adverse** impact on Borough Woods ancient woodland, leading to a **Slight adverse** effect (**not significant**). Part A would also result in a **minor adverse** impact on Wansbeck and Hartburn Woods LWS and Borough Woods LNR, leading to a **Neutral (**not significant) effect on these two habitats sites.

Well Wood Ancient Woodland

7.1.48. Air quality modelling (**Appendix 5.8: Air Quality DMRB Sensitivity Test, Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)) showed that there would be an increase in nitrogen deposition as a result of Part A (Eco8). Well Wood Ancient Woodland (approximately 52.7 ha in size) is located to the east of the existing A1 (ARN).

7.1.49. 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 only 0 m, falling below this threshold at 5 m.

7.1.50. Given the area of the woodland affected by the increases in nitrogen represents a negligible proportion of the designated habitat (occurring at the boundary only in the opening year), whilst taking a precautionary view based on the 'Restore' approach (in the absence of information to determine an air quality attribute), Part A would result in **no change**, leading to **a Neutral** effect (not significant) to Well Wood Ancient Woodland.

Ulgham Meadow LNR

7.1.51. A decrease in nitrogen deposition (-1.3kg N/ha/yr) was predicted for Ulgham Meadows LNR (Eco10) in the opening year. This is due to the increase in capacity for vehicular traffic along the A1 (Part A), drawing traffic off other roads and thereby reducing associated vehicular emissions in proximity to the LNR. The decrease in nitrogen deposition would result in a **minor positive** impact, leading to a **Neutral** effect (**not significant**).

Cawledge Burn LWS

7.1.52. Air quality modelling (**Appendix 5.8: Air Quality DMRB Sensitivity Test, Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**)) showed that there would be a potential increase in nitrogen deposition as a result of Part A. 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 (10 km north of Part A). 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.

7.1.53. 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. To the west of the ARN, the increase in nitrogen deposition exceeds 0.4 kg N/ha/yr. (the 'Restore' approach threshold) at 5 m, falling below this threshold at 10 m. To the east of the ARN, the increase in nitrogen deposition exceeds 0.4 kg N/ha/yr. up to a distance of 10 m into the designated habitat. As the impact exceeds the 'Restore' threshold under LA105 (**Ref. 1**) and is therefore potentially significant, characterisation of the impact in accordance with LA108 is required.

7.1.54. 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). Overall nitrogen deposition rates are however predicted to decline during operation and have declined considerably since 1999 (refer to **paragraph 7.1.19**). As such, the effects of Part A are considered **reversible**. The maximum **magnitude** of the impact is 0.7kg N/ha/yr, covering an **extent** of habitat of approximately 0.15ha.

7.1.55. The **frequency** of the impact is **annual,** with the **timing** of the impact being during the **operational** period of Part A.

7.1.56. As described above, a limited proportion of the designated habitats sites would be affected, with Part A delaying long-term reductions in overall nitrogen deposition rates rather than leading to long-term increases in these relative to the current baseline. Part A 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 6.1**) or on the health of trees within the woodland. Any subtle effects that do occur are therefore not predicted to compromise the integrity or key features of the designated habitats.

Whilst taking a precautionary view based on the 'Restore' approach (in the absence of information to determine an air quality attribute), in accordance with LA108 Part A would therefore result in a **minor adverse** impact on Cawledge Burn LWS, leading to a **Neutral (**not significant) effect on this designated habitat.

Ancient/Veteran Trees

Tree T66872

7.1.57. As Tree T66872 is located within the boundaries of the River Coquet and Coquet Valley Woodlands SSSI, the information presented in **paragraphs 7.1.10** to **7.1.30** 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.

7.1.58. The air quality modelling predicts a maximum increase in nitrogen deposition of 0.5kg N/ha/yr from Part A. The nitrogen deposition arising from Part A does not exceed the threshold of significance for the 'Maintain' approach (an increase of 1.7 kg N/ha/yr. equating to a background deposition of 20 kg N/ha/yr. (**Ref. 11**). 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.

Tree 682

7.1.59. There is insufficient information to determine an air quality attribute Tree T682. As such, the assessment of likely significant effects has been determined based on the 'Restore' approach. Air quality modelling predicts increases in nitrogen deposition of 0.4 kg N/ha/yr. (the 'Restore' approach threshold) at the location of tree T682. Tree 682 is a potential veteran oak, that was assessed during the arboricultural surveys for Part A and found to be in good physiological and structural condition (**Appendix 7.5: Arboricultural Report, Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**); (refer to **Table 8-1 & Table 8-2**). The arboricultural assessment estimated the remaining lifespan of the tree to exceed 40 years.

7.1.60. On review of the air quality modelling for Part A with the competent expert for Air Quality, it was established that the maximum impact of nitrogen deposition from Part A to two decimal places was 0.36kg N/ha/yr (opening year). As such the habitat threshold is not predicted to be exceeded, with the impacts of Part A also declining following the opening year.

7.1.61. Given there would be no exceedance of the designated habitats threshold (whilst applying the 'Restore' approach under LA105), Part A would result in **no change**, leading to **a Neutral** effect (not significant) to Tree T682.

Tree 701

7.1.62. There is insufficient information to determine an air quality attribute Tree T701. As such, the assessment of likely significant effects has been determined based on the 'Restore' approach. Air quality modelling predicts increases in nitrogen deposition of 0.5 kg N/ha/yr. (against the 'Restore' approach threshold of 0.4kg N/ha/yr) at the location of tree T701. As the impact exceeds the 'Restore' threshold under LA105 (Ref. 1) and is therefore potentially significant, characterisation of the impact in accordance with LA108 is required.

7.1.63. 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). Overall nitrogen deposition rates are however predicted to decline during operation and have declined considerably since 1999 (refer to **paragraph 7.1.19**). As such, the effects of Part A are considered **reversible**. The maximum **magnitude** of the impact is 0.5kg N/ha/yr, at the location of the tree.

7.1.64. The **frequency** of the impact is **annual,** with the **timing** of the impact being during the **operational** period of Part A.

7.1.65. Tree T701 is a veteran ash, that was assessed during the arboricultural surveys for Part A and found to be in fair physiological and poor structural condition (**Appendix 7.5: Arboricultural Report, Volume 7** of this ES (**Application Document Reference: TR010041/APP/6.7**); (refer to **Table 8-1** and **Table 8-2**). The arboricultural assessment estimated the remaining lifespan of the tree to exceed 40 years.

7.1.66. As set out above, Tree T701 would experience an impact that marginally exceeds the significance threshold in LA105 (a maximum impact of 0.5kg N/ha/yr compared to a threshold of 0.5kg N/ha/yr). Part A would delay predicted long-term reductions in overall nitrogen deposition rates rather than leading to long-term increases in these relative to the current baseline.

7.1.67. The literature review completed above (refer to **paragraph 6.1.3**) identified that increased deposition of nitrogen can lead to a range of effects on individual trees, with both beneficial and adverse effects identified. Effects (whether beneficial or adverse) were identified in relation to much larger changes in nitrogen deposition rates than would result from Part A.

7.1.68. Part A nitrogen deposition impacts are therefore unlikely to lead to long-term perceptible changes in the health or condition of trees within the woodland. Any subtle effects that do occur are therefore not predicted to compromise the integrity or key features of Tree T701. Whilst taking a precautionary view based on the ‘Restore’ approach (in the absence of information to determine an air quality attribute), in accordance with LA108 Part A would therefore result in a **minor adverse** impact on Tree T701, leading to a **Slight adverse** effect (**not significant**).

8 CONCLUSION

8.1.1. The assessment in relation to LA 105 Air Quality (**Ref. 1**) demonstrated that there would be no significant effects on ecological receptors (designated habitats) due to operational air quality.

8.1.2. **Table 8-1** below summarises the initial assessment of air quality impacts on designated habitats through application of the methodology in LA105 Air Quality (**Ref. 1**). Table 8-2 summarises the subsequent assessment of impacts and effects on designated habitats under LA108 Biodiversity (**Ref. 5**), where the initial assessment under LA105 identified potentially significant effects.

Table 8-1 - Summary of Ecological Receptors and Likely Significance of Effects Under LA105

Transect Reference	Designated Habitat(s)	Lowest Critical Load (kg N/ha/yr.)	Air quality attribute used in assessment	Background nitrogen deposition (5km 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	Significance of effect
Eco1E	River Coquet and Coquet Valley Woodlands SSSI – unit 13 Duke's Bank Ancient Woodland	15	Maintain	22.96	1.7	1.1	Not exceeded	Neutral (not significant)
Eco1W	River Coquet and Coquet Valley Woodlands SSSI – unit 13 Duke's Bank Ancient Woodland	15	Maintain	22.96	1.7	0.2	Not exceeded	
Eco1E	Coquet River Felton Park LWS	15	Maintain	22.96	1.7	1.6	Not exceeded	Neutral (not significant)
Eco1W	Coquet River Felton Park LWS	15	Maintain	22.96	1.7	0.2	Not exceeded	
Eco2	Longhorsley Moor SSSI Longhorsley Moor LWS	10	Restore	N/A	0.4	-0.4	Not exceeded	Neutral (not significant)
Eco5	Davies Wood LNR Davies Wood Ancient Woodland	10	Restore	N/A	0.4	0.2	Not exceeded	Neutral (not significant)
Eco7E	Borough Wood LNR Borough Wood Ancient Woodland Wansbeck & Hartburn Woods LWS	10	Restore	N/A	0.4	0.8	15 m	Potentially significant
Eco7W	Borough Wood Ancient Woodland Wansbeck & Hartburn Woods LWS	10	Restore	N/A	0.4	0.6	5m	
Eco8	Well Wood Ancient Woodland	10	Restore	N/A	0.4	0.4	0m	Potentially significant
Eco10	Ulgham Meadow LNR	10	Restore	N/A	0.4	-1.3	Not exceeded	Potentially significant
Eco11	Weldon Wood Ancient Woodland	10	Restore	N/A	0.4	-0.2	Not exceeded	Neutral (not significant)

Transect Reference	Designated Habitat(s)	Lowest Critical Load (kg N/ha/yr.)	Air quality attribute used in assessment	Background nitrogen deposition (5km 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	Significance of effect
Eco17W	Cocklaw Dene LWS	10	Restore	N/A	0.4	0.2	Not exceeded	Neutral (not significant)
Eco18E	Cawledge Burn LWS	10	Restore	N/A	0.4	0.7	10m	Potentially significant
Eco18W	Cawledge Burn LWS	10	Restore	N/A	0.4	0.7	5m	
Eco19	Coney Garth Pond LWS	5	Restore	N/A	0.4	0.3	Not exceeded	Neutral (not significant)
Eco_VT3	Tree 156557	10	Restore	N/A	0.4	-0.1	Not exceeded	Neutral (not significant)
Eco_VT9	Tree 156556	10	Restore	N/A	0.4	-0.2	Not exceeded	Neutral (not significant)
Eco_VT16	Tree 68872	10	Maintain	N/A	1.7	0.5	Not exceeded	Neutral (not significant)
Eco_VT20	Tree T457	10	Restore	N/A	0.4	0.2	Not exceeded	Neutral (not significant)
Eco_VT23	Tree T684	10	Restore	N/A	0.4	0.3	Not exceeded	Neutral (not significant)
Eco_VT24	Tree T682	10	Restore	N/A	0.4	0.4	At location of tree	Potentially significant
Eco_VT25	Tree T681	10	Restore	N/A	0.4	0.3	Not exceeded	Neutral (not significant)
Eco_VT27	Tree T701	10	Restore	N/A	0.4	0.5	At location of tree	Potentially significant

Table 8-2 - Summary of Assessment of Ecological Receptors Under LA108

Designated Habitat(s) and Air Quality Attribute (from LA105)	Resource Importance	Duration and Reversibility	Extent	Magnitude	Frequency	Timing	Integrity and key characteristics of resource	Level of Impact	Effect Significance
Borough Woods ancient woodland (Restore)	National	Permanent, reversible	Area; 0.1ha	Maximum Total nitrogen deposition; 0.8kg N/ha/yr, habitat threshold; 0.4kg N/ha/yr	Annual	Operational Ongoing from 2024, delaying future reductions in overall deposition rate by ~8yrs	This site is included on the ancient woodland inventory which identifies it as an Ancient and Semi-natural Woodland site. The citation for the associated Wansbeck and Hartburn Woods 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 0.38% of the designated habitat (which has a total area of 16.1ha) would be subject to an impact that exceeds the habitat threshold, delaying predicted future reductions in overall nitrogen deposition rates by approximately eight years. 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, minimal extent, and reversibility of the effects, the integrity of the designated habitat resource is not predicted to be affected.	**Minor adverse**	**Slight adverse** (not significant)

Designated Habitat(s) and Air Quality Attribute (from LA105)	Resource Importance	Duration and Reversibility	Extent	Magnitude	Frequency	Timing	Integrity and key characteristics of resource	Level of Impact	Effect Significance
Borough Woods LNR (**Restore**)	County	Permanent, reversible	Area; 0.1ha	Maximum Total nitrogen deposition; 0.8kg N/ha/yr, habitat threshold; 0.4kg N/ha/yr	Annual	Operational Ongoing from 2024, delaying future reductions in overall deposition rate by ~8yrs	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 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 0.45% of the designated habitat (which has a total area of 18.35ha) would be subject to an impact that exceeds the habitat threshold, delaying predicted future reductions in overall nitrogen deposition rates by approximately eight years. 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, minimal extent, and reversibility of the effects, the integrity of the designated habitat resource is not predicted to be affected.	**Minor adverse**	**Neutral** (not significant)

Designated Habitat(s) and Air Quality Attribute (from LA105)	Resource Importance	Duration and Reversibility	Extent	Magnitude	Frequency	Timing	Integrity and key characteristics of resource	Level of Impact	Effect Significance
Wansbeck and Hartburn Woods LWS (**Restore**)	Local	Permanent, reversible	Area; 0.1ha	Maximum Total nitrogen deposition; 0.8kg N/ha/yr, habitat threshold; 0.4kg N/ha/yr	Annual	Operational Ongoing from 2024, delaying future reductions in overall deposition rate by ~8yrs	The citation for Wansbeck and Hartburn Woods 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 0.14% of the designated habitat (which has a total area of 161.6ha) would be subject to an impact that exceeds the habitat threshold, delaying predicted future reductions in overall nitrogen deposition rates by approximately eight years. 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, minimal extent, and reversibility of the effects, the integrity of the designated habitat resource is not predicted to be affected.	**Minor adverse**	**Neutral** (not significant)

Designated Habitat(s) and Air Quality Attribute (from LA105)	Resource Importance	Duration and Reversibility	Extent	Magnitude	Frequency	Timing	Integrity and key characteristics of resource	Level of Impact	Effect Significance
Well Wood ancient woodland (**Restore**)	National	Permanent, reversible	Area; 0.0ha (impact occurs at the boundary only).	Maximum Total nitrogen deposition; 0.4kg N/ha/yr, habitat threshold; 0.4kg N/ha/yr	Annual	Operational Ongoing from 2024.	Well Wood is an area of 52.7ha of replanted ancient woodland immediately east of the existing A1 (affected road) to the south of Morpeth. Potentially significant doses of nitrogen deposition (0.4kg N/ha/yr) are not anticipated to occur within this designated site, as the modelling predicts nitrogen deposition at this rate to occur only at the boundary of the site in the opening year. The magnitude of the impact will also decline after the opening year. As such, perceptible effects on the key characteristics of the ancient woodland and therefore the integrity of this area of woodland are not predicted to arise.	**No change**	**Neutral** (not significant)

Designated Habitat(s) and Air Quality Attribute (from LA105)	Resource Importance	Duration and Reversibility	Extent	Magnitude	Frequency	Timing	Integrity and key characteristics of resource	Level of Impact	Effect Significance
Cawledge Burn LWS (**Restore**)	Local	Permanent, Reversible	Area; 0.15ha	Maximum Total nitrogen deposition; 0.7kg N/ha/yr, habitat threshold; 0.4kg N/ha/yr	Annual	Operational Ongoing from 2024.	The LWS is designated for its geological interest. Although DMRB 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. Woodland species described in the citation for the LWS are widespread throughout Britain. The area of woodland covered by the extent of the effect represents a small proportion of similar woodland in the site and a small total area of woodland (estimated 0.15ha maximum). 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, minimal extent, and reversibility of the effects, the integrity of the designated habitat resource is not predicted to be affected.	**Minor**	**Neutral** (not significant)

Designated Habitat(s) and Air Quality Attribute (from LA105)	Resource Importance	Duration and Reversibility	Extent	Magnitude	Frequency	Timing	Integrity and key characteristics of resource	Level of Impact	Effect Significance
Tree T682 (**Restore**)	National	Permanent, Reversible	Local to the tree	Maximum Total nitrogen deposition; 0.4kg N/ha/yr, habitat threshold; 0.4kg N/ha/yr	Annual	Operational Ongoing from 2024.	Tree 682 is a potential veteran oak. The tree is in good physiological and good structural health, with a predicted future lifespan in excess of 40 years. On review of the air quality modelling for Part A with the competent expert for Air Quality, it was established that the maximum impact of nitrogen deposition to two decimal places was 0.36kg N/ha/yr (opening year). As such the habitat threshold is not predicted to be exceeded, with the impacts of Part A also declining following the opening year. In light of the above, perceptible effects on the features of this tree that contribute to its potential veteran status, key characteristics and therefore its integrity are not predicted to arise.	**No change**	**Neutral** (not significant)
Tree T701 (**Restore**)	National	Permanent, Reversible	Local to the tree	Maximum Total nitrogen deposition; 0.5kg N/ha/yr, habitat threshold; 0.4kg N/ha/yr	Annual	Operational Ongoing from 2024	Tree 701 is a veteran ash. The tree is in fair physiological and poor structural health, with a predicted future lifespan in excess of 40 years. 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. Given the marginal exceedance of the habitat's threshold (0.5kg N/ha/yr predicted maximum impact against the designated habitats threshold of 0.4kg N/ha/yr) and reversibility of the impact, the integrity and key features of Tree T701 is not predicted to be affected.	**Minor**	**Slight adverse** (not significant)

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