

Lower Thames Crossing

6.3 Environmental Statement Appendices

Appendix 5.6 – Project Air Quality Action Plan

APFP Regulation 5(2)(a)

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

Volume 6

DATE: October 2022

Planning Inspectorate Scheme Ref: TR010032
Application Document Ref: TR010032/APP/6.3

VERSION: 1.0

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6.3 Environmental Statement Appendices

Appendix 5.6 – Project Air Quality Action Plan

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1 Executive summary

1.1 Introduction

- 1.1.1 The results of the air quality modelling are summarised in Environmental Statement (ES) Chapter 5: Air Quality (Application Document 6.1). These modelled results were provided to the competent expert for biodiversity to determine, following the advice in Design Manual for Roads and Bridges (DMRB) LA 105 Air quality (Highways England, 2019), whether the changes in Nitrogen (N) deposition as a result of the Project are significant. ES Chapter 8: Terrestrial Biodiversity (Application Document 6.1) provides the assessment of the N deposition changes and the determination of significance on the ecological designated sites within the affected road network (ARN).
- 1.1.2 Following the assessment approach outlined in Figure 2.98 of LA 105, the competent expert for biodiversity has concluded that there is the possibility of degradation of habitat quality on a number of the ecological designated sites affected by the Project, as a result of increases in N deposition and has concluded that there are significant effects. It should be noted that no significant effects have been identified for impacts on Human Health or compliance with air quality Limit Values.
- 1.1.3 As a result, a Project Air Quality Action Plan (PAQAP) is required in accordance with LA 105 to determine if the impacts on these ecological designated sites can be mitigated. This document is the PAQAP for the Project.

1.2 Sites assessed to be significantly affected

- 1.2.1 Thirty-six sites that have been assessed as likely to experience a significant effect as a result of the change in N deposition are presented in ES Appendix 8.14: Designated Sites Air Quality Assessment (Application Document 6.3). These sites predominantly consist of woodland and semi-natural grassland habitats, and the changes in N deposition are considered likely to adversely affect the sites' structure, function and composition to a degree which would compromise their integrity either temporarily or permanently

1.3 Mitigation considered

- 1.3.1 The Applicant has considered mitigation to avoid the effects and concluded that the Project could not be moved to avoid the effects of nitrogen deposition (hereafter referred to as N deposition).
- 1.3.2 The following mitigation measures have been considered to assess whether they would avoid and reduce the effects of N deposition on ecological designated sites.
- Physical barriers
 - Speed limit reduction
 - Speed enforcement management
 - Reduce the flows and/or volumes on the ARN

- e. Change of fleet mix
- f. Planting of trees to act as barrier or nitrogen scrubbing mechanism
- g. Scrubbing of pollutants from emissions at roadside
- h. Affected site management to reduce other nitrogen inputs
- i. Affected site management of other threats to improve resilience to N deposition effect

1.4 Compensation considered

1.4.1 The approach to determine the most appropriate strategy for compensation was firstly to establish the options available and which were most appropriate to address the risk of significant effects. The options considered were:

- a. Site-by-site basis, where each individual area of affected habitat has measures proposed directly associated with that area and which could potentially include:
 - i. Habitat management measures within the affected site; and/or
 - ii. Habitat creation or enhancement measures adjacent or near the affected site.
- b. Ecological network basis (also known as landscape-scale measures), where more comprehensive measures are proposed which are relevant to the network of habitats within which a number of affected areas of habitat lie.

1.5 Mitigation and compensation proposals

1.5.1 The assessment has confirmed that speed enforcement management measures are feasible mitigation for effects on sites adjacent to the M2 between junctions 3 and 4. This measure would be technically feasible, would not impact on traffic rerouting and resulted in significant effects being avoided for seven sites.

1.5.2 Mitigation has been proposed where feasible, but where there are no appropriate mitigation measures, the Applicant has identified how best to respond to the residual effects of N deposition by proposing compensation measures. Residual significant effects after consideration of mitigation are predicted on 29 sites, totalling 176.4 hectares (ha) of significantly affected habitat.

1.5.3 The Applicant has proposed a compensation approach of habitat creation at an ecological network scale, with a small number of larger compensation measures in carefully selected locations associated with identifiable habitat networks to provide the most suitable and certain available ecological option to compensate for the residual effect of N deposition. The compensation sites will be located as follows.

- a. Hole Farm East (75.2ha), located within Brentwood within a site owned by National Highways.
- b. Buckingham Hill (24.4ha), located within Thurrock on a former landfill site owned by Thurrock Council.
- c. Hoford Road (21.6ha), located within privately owned land in Thurrock, south of Orsett Golf course.
- d. Henhurst Hill (9.1ha), located south of the A2, close to Ashenbank Woods and Jeskyns community woodland and the site is privately owned and currently farmed.
- e. Fenn Wood (5.8ha), located south of Shorne Village adjacent to Fenn Wood and is a privately owned site which appears to be used for horse grazing.
- f. Court Wood (27.7ha) is privately owned agricultural land located in Shorne, in between Starmore Wood and Court Wood.
- g. Blue Bell Hill (72.2ha) is privately owned agricultural land located south of M2 in Blue Bell hill.
- h. Burham (9.7ha) is privately owned agricultural land east of Burham.

2 Introduction

2.1 Background

- 2.1.1 The results of the air quality modelling are summarised in ES Chapter 5: Air Quality (Application Document 6.1). These modelled results were provided to the competent expert for biodiversity to determine, following the advice in DMRB LA 105 Air quality (National Highways, 2019), whether the changes in N deposition as a result of the Project are significant. ES Chapter 8: Terrestrial Biodiversity (Application Document 6.1) provides the assessment of the N deposition changes and the determination of significance on the ecological sites within the ARN.
- 2.1.2 Following the assessment approach outlined in Figure 2.98 of LA 105, the competent expert for biodiversity has concluded that there is the possibility of degradation of habitat quality on a number of the designated sites affected by the Project, as a result of increases in N deposition and has concluded that there is a risk of significant effects. It should be noted that no significant effects have been identified for impacts on Human Health or compliance with Limit Values.
- 2.1.3 As a result, a PAQAP is required to determine if the impacts on these sites can be mitigated. This document is the PAQAP for the Project.
- 2.1.4 LA 105 sets out the structure the PAQAP should follow. This is summarised in Table 2.1 below with an explanation of where the information is located.

Table 2.1 LA 105 PAQAP structure requirements and Project response

Structure requirements	Location
A brief description of the Project	The description of the Project is set out in ES Chapter 2: Project Description (Application Document 6.1).
A brief description of the Project impacts over the study area	The results of the air quality modelling are summarised in ES Chapter 5: Air Quality (Application Document 6.1). ES Chapter 8: Terrestrial Biodiversity (Application Document 6.1) provides the assessment of the N deposition changes and the determination of significance on the ecological sites within the ARN. Section 32.1 of this PAQAP presents the ecological sites that are considered to be significantly affected by increases in N deposition and their designation type.
List all mitigation measures that have been considered in developing the PAQAP, and split by lead delivery authority i.e. Overseeing Organisation, local authority or Government and the change in NO2 concentrations at the effected receptors	Mitigation measures that have been considered are set out in Section 6 of this PAQAP. This includes an assessment of the feasibility of these measures.

Structure requirements	Location
A figure illustrating the single or combination of the identified viable mitigation measures and the receptors that effect	The sites that have been assessed as likely to experience a significant effect as a result of the change in N deposition are presented in ES Appendix 8.14: Designated Sites Air Quality Assessment (Application Document 6.3).

2.1.5 In addition to the requirements of LA 105, this plan also includes the Applicant’s full consideration of the mitigation hierarchy in response to identified significant effects, including compensation where avoidance and mitigation have been shown to be infeasible.

2.1.6 The purpose of the PAQAP is therefore to consider whether there are any measures that could be implemented by the Applicant to avoid or reduce the Project’s impact on designated ecological sites or compensate for any residual significant effects.

2.2 Consultation

2.2.1 A summary of the stakeholder engagement specific to the PAQAP is provided in Table 2.2.

Table 2.2 Stakeholder engagement

Stakeholder	Summary of engagement
Natural England	Engagement with Natural England has taken place throughout the assessment period. Discussions have covered the assessment methodology for N deposition effects (which resulted in ammonia being added to the assessment methodology, in addition to Nitrogen Oxide (NOx)). Discussions have also included preliminary assessment results, proposed mitigation and compensation measures and joint meetings with other stakeholders such as Kent Downs Area of Outstanding Natural Beauty (AONB) and Forestry England.
Kent Downs AONB	Discussions have centred on the likely impacts to the Kent Downs AONB and the mitigation and compensation strategy.
Forestry Commission	The Forestry Commission has been consulted on the methodology, mitigation and compensation strategy for N deposition.
Forestry England	Discussions with Forestry England have centred on the proposed Hole Farm Compensation area which will be delivered in partnership with Forestry England as part of the wider Thames Chase Community Forest network.
Local Planning Authorities (LPA)	LPA engagement has covered the revision in the N deposition methodology and the mitigation and compensation strategy. During the habitat creation site selection (Section 7.4), LPAs within the relevant search area were engaged with and asked to suggest potential sites that could feed into the long list assessment of compensation sites.
Public	Air quality impacts have been communicated to consultees through the various Project consultation stages. Details of Statutory and non-statutory Consultation and a summary of responses can be found in the Consultation Report (Application Document 5.1). Consultees comprised

Stakeholder	Summary of engagement
	<p>prescribed bodies, local authorities, people with an interest in land affected by the Project and local communities.</p> <p>Prior to the submission of this development consent order (DCO) application, Local Refinement Consultation was held between 12 May 2022 and 20 June 2022. This provided an update on refinements relating to N deposition (the revision in the N deposition methodology and the mitigation and compensation strategy).</p>
Landowners	<p>Landowners whose land fell within the sites that were considered suitable for N deposition compensatory habitat compensation have been consulted. Discussions have centred on the revision in the N deposition methodology, the mitigation and compensation strategy, in particular the habitat creation site selection methodology (Section 7.4).</p>

3 Sites assessed to be significantly affected

- 3.1.1 The sites that have been assessed as likely to experience a significant effect as a result of the change in N deposition are presented in ES Appendix 8.14: Designated Sites Air Quality Assessment (Application Document 6.3). These sites predominantly consist of woodland and semi-natural grassland habitats, and the changes in N deposition are considered likely to adversely affect the sites' structure, function and composition to a degree which would compromise their integrity either temporarily or permanently.
- 3.1.2 The reasons for the changes in N deposition are described in ES Chapter 5: Air Quality (Application Document 6.1) The majority of the changes are as a result of increases in traffic flow and changes in road alignment that lead to an increase in N deposition affecting the site.
- 3.1.3 Table 3.1 presents the sites that are considered to be significantly affected (without mitigation) by increases in N deposition and their designation type. The locations of these sites are shown in Figure 2 of ES Appendix 8.14: Designated Sites Air Quality Assessment (Application Document 6.3).

Table 3.1 Designated ecological sites where the Project is considered to have a significant effect without mitigation

Site name	Type of ecological designation	Site area (ha)	Extent of site affected (ha)
Andrews Wood (AW_Theme_ID 1499246) AW	Ancient woodland (AW)	11.88	1.19
AW_Theme_ID_1486679 (Object ID 9096) AW	AW	1.33	0.89
AW_Theme_ID_1486820 (A2/M2 ROUNDABOUT) AW	AW	0.60	0.60
AW_Theme_ID_1486860 (Shorne Woods) AW	AW	15.30	5.63
AW_Theme_ID_1486867 (Head Barn Wood) AW	AW	2.73	1.43
AW_Theme_ID_1486883 (Object ID 9151) AW	AW	0.32	0.32
AW_Theme_ID_1486891 (Between M2 carriageways) AW	AW	0.31	0.31
AW_Theme_ID_1486937 (Longhoes) AW	AW	4.72	0.98
AW_Theme_ID_1498717 (OBJECT ID 11749) AW	AW	0.88	0.47
AW_Theme_ID_1498718 AW	AW	1.29	1.07
AW_Theme_ID1420012 AW	AW	2.15	1.12
AW_Theme_ID1486951 AW	AW	8.82	0.05
AW_Theme_ID1494010 AW	AW	1.20	0.66
AW_Theme_ID1499144 AW	AW	1.34	0.73
AW_Theme_ID1499145 AW	AW	1.50	1.13

Site name	Type of ecological designation	Site area (ha)	Extent of site affected (ha)
AW_Theme_ID_1501634 (OBJECT ID 12881) AW	AW	0.60	0.20
Barber's Wood AW	AW	6.89	3.61
Bridge Woods AW	AW	135.39	15.98
Bridge Woods, Burham LWS	LWS	167.36	11.41
Cobham Woods SSSI	SSSI	242.75	14.54
Codham Hall Wood AW	AW	5.12	4.91
Codham Hall Woods LWS	Local wildlife site (LWS)	7.88	4.93
Frith/Impton Woods AW	AW	35.74	5.45
Frith Woods Etc., Kits Coty LWS	LWS	27.06	1.81
Great Wood AW	AW	140.73	13.12
Halling To Trottiscliffe Escarpment SSSI	Site of special scientific interest (SSSI)	600.58	3.22
Impton/Podkin Wood AW	AW	21.14	1.46
Merrals Shaw (AW_Theme_ID 1486881) AW	AW	10.40	6.11
Middlefield Shaw AW (AW_Theme_ID_1501447,1500825,1500821)	AW	8.87	0.82
Ockendon Railsides SINC	Site of importance for nature conservation (SINC)	14.63	2.52
Peartree Wood AW	AW	24.03	2.13
Reed's Shaw (AW_Theme_ID 1498441) AW	AW	1.10	0.10
Shorne And Ashenbank Woods SSSI	SSSI	197.44	53.90
Shorne/Brewers Woods AW	AW	65.91	11.24
Westfield Wood (AW_Theme_ID_150470) AW	AW	17.93	0.63
Wouldham To Detling Escarpment SSSI	SSSI	311.18	10.09
Total			184.73

4 Compliance with the mitigation hierarchy

4.1.1 In circumstances where a project is reporting significant adverse effects on habitats, the National Policy Statement for National Networks (NPSNN) at paragraph 5.25 states that:

‘As a general principle, and subject to the specific policies below, development should avoid significant harm to biodiversity and geological conservation interests, including through mitigation and consideration of reasonable alternatives. The applicant may also wish to make use of biodiversity offsetting in devising compensation proposals to counteract any impacts on biodiversity which cannot be avoided or mitigated. Where significant harm cannot be avoided or mitigated, as a last resort, appropriate compensation measures should be sought.’

4.1.2 Applying this hierarchy in compliance with the National Policy Statement (NPS) and other planning policy, the Applicant has considered in turn whether there is a reasonable alternative which would avoid the effect; whether feasible mitigation measures are available and what compensation should be provided. Accordingly, the Applicant’s view is that NPSNN paragraph 5.25 is engaged, i.e. appropriate compensation measures should be proposed where no, or insufficient, avoidance or mitigation is feasible. The Applicant has engaged with Natural England on this matter, given its status as statutory adviser to Government on matters of nature conservation. Natural England is supportive of the approach taken to the mitigation hierarchy.

5 Consideration of avoidance

5.1 Avoidance through design

- 5.1.1 The Project has been developed to avoid or minimise significant effects on the environment through design and mitigation measures. Avoidance through design (including location and route options) has been the primary approach to mitigating adverse impacts of the Project. The design and location of specific mitigation measures over and above these avoidance measures has been developed following an iterative process based on stakeholder feedback, Project design changes and the outcomes of the environmental assessment.
- 5.1.2 Moving the route to avoid N deposition effects on designated sites within 200m of the new road and ARN would not avoid N deposition. N deposition effects are as a result of changes in traffic flows due to the nature of the Project, not the location. Changes in N deposition at designated habitats have been calculated based on predicted changes in traffic flows. In addition, the Project route and design have been selected after extensive development, engagement, and consultation. The need for a solution to congestion at the Dartford Crossing has been subject to option studies since 2009, when a Department for Transport Study was released. Throughout the years there have been numerous studies into the options for the Project up to the submission of this application for Development Consent.
- 5.1.3 Details of the main alternatives identified and the reasons for their adoption or rejection by the Project are summarised in ES Chapter 3: Assessment of Reasonable Alternatives (Application Document 6.1). The chapter also includes details of reappraisal work carried out to check the ongoing validity of those decisions as time has passed. Full details of the decision-making process that led to the identification of the Preferred Route are included within the Planning Statement (Application Document 7.2). The subsequent design development and refinement is discussed in the Project Design Report (Application Document 7.4).

6 Consideration of mitigation

6.1 Description of mitigation measures considered

- 6.1.1 The standard in DMRB LA 105 states at paragraph 2.110 that any mitigation measures set out in the PAQAP shall be viable, and the change in concentrations (and in the case of designated sites, the change in N deposition) associated with the measure shall be quantifiable.
- 6.1.2 Mitigation measures that can be quantified for the purposes of LA 105 include erecting a barrier to physically stop N deposition, or measures to reduce emissions such as reducing speed limits or controlling speeds through speed enforcement management.
- 6.1.3 In addition, consideration has also been given to a number of non-quantifiable measures, that theoretically may mitigate additional N deposition.
- 6.1.4 Table 6.1 summarises the mitigation measures considered as part of the PAQAP.

Table 6.1 Mitigation measures considered

Potential mitigation measure	Consideration on potential to be included in the Project	Conclusion
Physical barriers	<p>LA 105 states that a barrier would need to be 9m in height based on National Highways research to be effective.</p> <p>It is theoretically possible to erect 9m barriers between the ARN and affected sites, but substantial constraints need to be assessed on a site-by-site basis.</p>	Considered on site-by-site basis (see Section 6.2)
Speed limit reduction	<p>National Highways research shows that the reduction of speed limits from 70mph to 60mph would reduce emissions. If the traffic conditions currently limit the speed limit to /or below 60mph then there would be no benefit in reducing the speed limit and no reduction in vehicle emissions.</p> <p>This measure is possibly effective where the following criteria are all met on the road affecting the designated site:</p> <p>The road is part of the national network (and so under control of National Highways – the Project would have no powers to implement changes to management of roads on the local network)</p> <p>The road currently has a speed limit of 70mph</p> <p>The current traffic speed is travelling at / or above the 70mph limit</p> <p>Where all above criteria are met, the measure's feasibility can be determined. This may include undertaking traffic modelling to identify whether a speed limit reduction would lead to unacceptable effects on the road network such as rerouting</p>	Considered on site-by-site basis (see Section 6.2)

Potential mitigation measure	Consideration on potential to be included in the Project	Conclusion
	<p>traffic onto the local network and so increasing safety risks.</p> <p>Where the measure is considered to be deliverable, air quality modelling can be used to determine the reduction in N Deposition that would be achieved by implementing the measure.</p>	
Speed enforcement management	<p>In addition to speed limit reduction, National Highways research shows that reducing emissions can also be achieved by additional enforcement of national speed limit. National statistics indicate that a significant proportion of the Light Duty Vehicles (LDV) exceed the speed limit (i.e. greater than 70mph). Improving the compliance to the speed limit can, therefore, improve emissions given that emissions increase with an increase in speed beyond the speed limit.</p> <p>The measure is possibly effective where the following conditions are met:</p> <ul style="list-style-type: none"> • The speed limit on the road currently is 70mph. • There is a significant proportion of LDVs that are travelling in excess of the 70mph speed limit. • There are additional enforcement measures available to put in place. <p>Where the measure is considered to be deliverable, air quality modelling can be used to identify what improvement in N deposition can be achieved with the measure.</p>	Considered on site-by-site basis (see Section 6.2)
Reduce the flows and/or volumes on the ARN	<p>Consideration has been given to whether measures are available to reduce the increase in traffic flow as a result of the Project, as a means of reducing emissions.</p> <p>This measure has been discounted for all affected sites as there are no measures at a Project level that would result in a substantial change to the flows or volumes of traffic on the ARN. The objective of the Project is to improve flows on the network and so no measures that would reduce the improvements to the network would be appropriate for the Project as they would not comply with the scheme objectives.</p>	Discounted for all affected sites
Change of fleet mix	<p>Consideration of what (if any) measures are available to be implemented by the Project that would facilitate replacement of current vehicles with less-polluting equivalents. For example, an increase proportion of electric vehicles would be effective at reducing emissions.</p>	Discounted for all affected sites

Potential mitigation measure	Consideration on potential to be included in the Project	Conclusion
	<p>There are no measures at a Project level that would result in a substantial change to the vehicle fleet on the ARN (such as an increase in electric vehicles beyond the transition that would be expected to take place regardless of the Project). National Highways does not have the necessary powers to designate clean air zones or Low Emission Zones on its network.</p>	
<p>Planting of trees to act as barrier or nitrogen scrubbing mechanism</p>	<p>Planting trees has been considered following consultation with stakeholders as planting trees could theoretically act as a physical barrier between the site and the road to reduce N deposition; or might increase uptake of nitrogen from the air and so act to ‘scrub’ nitrogen from the air.</p> <p>However, evidence suggests that planting trees as a barrier or nitrogen scrubber is unlikely to be effective in reducing N deposition on designated sites.</p> <p>Trees would take decades to establish as a suitably large physical barrier and so any such measure would not be active during the period of the effect and so would not mitigate the effect. Any consideration of the measure acting to build resilience in the long term would be considered to be compensatory in nature (i.e., not mitigatory) and therefore more appropriately considered under potential options for compensation.</p> <p>As a way of ‘scrubbing’ nitrogen from the air before it reaches the affected site, evidence suggests that trees are unlikely to be effective in removing any significant quantities of N deposition. Tree planting would, therefore, not be an effective mitigation measure.</p> <p>It should be noted that planting trees for the specific objectives as barriers and /or nitrogen scrubbers is different from planting trees for the objective of woodland habitat creation.</p>	<p>Discounted for all affected sites.</p> <p>Following the mitigation hierarchy, mitigation is considered first, and compensation considered as a last resort if required. This measure has been further considered below in the consideration of compensation.</p>
<p>Scrubbing of pollutants from emissions at roadside</p>	<p>Using pollution scrubbing technologies has been considered following consultation with stakeholders as new technologies may remove nitrogen from the air before it reaches the affected site.</p> <p>These technologies are considered to be unfeasible given the amount of air that would need to be cleaned. National Highways has tested a number of technologies that have the potential to reduce NOx including titanium oxide/mineral polymers. None are considered</p>	<p>Discounted for all affected sites</p>

Potential mitigation measure	Consideration on potential to be included in the Project	Conclusion
	effective for a motorway environment (where this is being considered along the ARN), given issues such as contact time between air and material.	
Affected site management to reduce other nitrogen inputs	<p>Managing affected sites differently to reduce other nitrogen sources has been considered following consultation with stakeholders as reducing other sources of nitrogen or removing nitrogen from the ecosystem may offset the effects of Project-induced N deposition. This could theoretically be achieved through measures such as removing biomass (e.g., holly understory) so the captured nitrogen could not be recycled.</p> <p>Whilst such measures could theoretically act to build resilience to N deposition, they would not avoid or reduce the nitrogen deposited from the Project itself and so such measures would be considered to be compensatory in nature (i.e., not mitigatory) and, therefore, more appropriately considered under potential options for compensation.</p> <p>This measure has, therefore, been discounted for all sites as ineffective as mitigation.</p>	<p>Discounted for all affected sites</p> <p>Following the mitigation hierarchy, mitigation is considered first, and compensation considered as a last resort if required. This measure has been further considered below in the consideration of compensation.</p>
Affected site management of other threats to improve resilience to N deposition effect	<p>Managing affected sites differently to reduce other threats than N deposition has been considered following consultation with stakeholders as reducing other threats to the habitat may make the habitat less sensitive to N deposition.</p> <p>Whilst such measures could theoretically act to build resilience of affected sites to threats including N deposition, they would not avoid or reduce the nitrogen deposited from the Project itself and so such measures would be considered to be compensatory in nature (i.e., not mitigatory) and, therefore, more appropriately considered under potential options for compensation.</p> <p>This measure has, therefore, been discounted for all sites as ineffective as mitigation.</p>	<p>Discounted for all affected sites</p> <p>Following the mitigation hierarchy, mitigation is considered first, and compensation considered as a last resort if required. This measure has been further considered below in the consideration of compensation.</p>

Measures discounted for all sites

- 6.1.5 As explained in Table 6.1 above, the mitigation measures listed below have been discounted for all sites as they are non-viable:
- a. Reduce the flows and/or volumes on the ARN
 - b. Change of fleet mix
 - c. Planting of trees to act as barrier or nitrogen scrubbing mechanism

- d. Scrubbing of pollutants from emissions at roadside
- e. Affected site management to reduce other nitrogen inputs
- f. Affected site management of other threats to improve resilience to N deposition effect

6.1.6 This PAQAP focuses on measures identified within DMRB LA 105 as quantifiable, speed limit reduction, speed enforcement management and physical barriers.

6.2 Assessment of mitigation feasibility

Site audit for mitigation potential

- 6.2.1 Following the review undertaken in Table 6.1, the potential mitigation types that have been considered further on a site by site basis are speed limit reduction, speed enforcement management and physical barriers.
- 6.2.2 The first stage was to review whether the mitigation options have the potential to be implemented as part of the Project. For example, is a barrier feasible in the location between the road and site or is a speed limit potentially effective because traffic travels at excessive speeds past the site and the road has a National Speed limit.
- 6.2.3 Once the potential to implement the measure has been identified, more work was undertaken to determine whether the measure would remove the significant effect, for example by assessing the reduction in emissions from a speed control intervention.
- 6.2.4 Where a measure was shown to have potential to mitigate the Project's impacts, the measures were assessed further to determine whether it was viable.

Speed limit reduction and speed enforcement

Potential to implement

- 6.2.5 As outlined in DMRB LA 105, speed limits are an option that can be used as a mitigation measure for air quality. The benefits in terms of emissions can be quantified and hence modelled to show the predicted impact of enforcing a speed limit on a section of road. However, for a speed limit to be a viable option the road needs to have a speed limit of 70mph with vehicles travelling close to or in excess of 70mph. Where speed enforcement and speed limit reduction are proposed additional measures to enforce the speed limit must be included. For example, if there are already measures to enforce the speed limit then enforcement of a 70mph would not be effective. Speed reductions could be implemented where there are current enforcement measures enforcing a 70mph limit as they could be utilised to enforce a reduction in speed limit to 60mph.
- 6.2.6 National Highways has undertaken research into vehicle emissions as a function of speed and has identified that the lowest emissions occur at speeds of around 60mph for LDVs. LDV emissions increase with speed with a sharp increase in emissions as vehicles travel in excess of 70mph. Department for

Transport (DfT) statistics (Department for Transport, 2022) suggest approximately 40% of LDVs exceed the 70mph speed limit on a motorway and, therefore, reducing vehicle speeds and improving compliance with the speed limit can lead to an emissions reduction.

- 6.2.7 National Highways has developed vehicle emission factors (based on the emission factor toolkit), which are incorporated into their speed band emissions tool, and represent a number of speed-related scenarios, including the following:
- a. High speed – motorway unconstrained and a proportion of the LDVs exceed 70mph.
 - b. 70mph enforced – enforced 70mph limit and as a result, an improvement in LDVs complying with the speed limit.
 - c. 60mph enforced – enforced 60mph, which results in a greater proportion of the fleet travelling at speeds close to 60mph and fewer vehicles travelling in excess of 70mph.
- 6.2.8 Emissions per vehicle reduce for LDVs as compliance with speed improves, from the highest emission rates at high speed through to lowest emissions at 60mph enforced.
- 6.2.9 Speed limits are only effective in reducing emissions where the traffic model suggests that vehicle speeds are in the high speed band and a 70mph or 60mph enforced speed limit could be introduced.
- 6.2.10 Annex A presents the significantly affected sites and the review as to whether there is the potential for speed enforcement or a reduced speed limit to be introduced to reduce vehicle emissions.
- 6.2.11 A speed limit reduction was discounted for all significantly affected sites where the adjacent road has a current speed limit below 70mph or if the current traffic speed was significantly less than 70mph as the measure would be ineffective in these circumstances. This was assessed by identifying the current speed limit and determining whether any of the speeds from the traffic model were allocated into the 'high speed' band, for any of the time periods modelled i.e., AM, IP, PM and OP (as described in ES Chapter 5: Air Quality (Application Document 6.1)).
- 6.2.12 Where the sites were identified next to roads with the conditions outlined in paragraph 6.2.7 and were considered viable, a review of actual speed data from Department of Transport was undertaken to determine whether there are sufficient LDVs (cars and vans) to influence with either a 70mph enforcement or 60mph speed limit, to lead to a reduction in emissions. This ensures that the benefit of speed management is not overpredicted.
- 6.2.13 A section of the M2 between junctions 3 and 4 and a section of the M25 south of junction 4 met the criteria of having a speed limit of 70mph with Department of Transport Teletrac¹ data indicating that a proportion of LDVs exceed the

¹ Department of Transport (DfT) Teletrac Navman data – GPS Journey Location Data collection to create Road Travel Time Data.

70mph speed limit, therefore the viability of implementing measures (i.e., speed cameras) to enforce the 70mph speed limit was considered for these sections.

- 6.2.14 Sections of the M2 between junctions 4 and 5 and M25 between junctions 4 and 5 and east of junction 6 had a speed limit of 70mph with Department of Transport Teletrac data indicating that a large proportion of LDVs travelled in excess of 60mph, therefore the viability of enforcing a 60mph speed limit was considered for these sections.
- 6.2.15 Department of Transport Teletrac data for a section of the M25 between junctions 28 and J29 show that average speeds on this section are already around 60mph suggesting that speed management would not provide any mitigation benefit as it would not meet the with the conditions outlined in paragraph 6.2.7.
- 6.2.16 Speed enforcement was considered to be a viable option for the junction 3 to 4 section of the M2. This was due to there being no speed enforcement measures on this section of the M2 (i.e., speed cameras). N deposition was calculated at the significantly affected sites near the M2 junction 3 to 4 for a 70mph speed enforcement scenario where any ‘high speed’ speed bands in Do Minimum (DM) and Do Something (DS) were changed to ‘70mph Speed Limit’. The modelling methodology for this scenario is presented in Annex B.

Viability of measures on the M2 and M25

- 6.2.17 A number of sites along the M2 and M25 motorway were identified as having the potential for emissions reductions as a result of speed management as shown in Annex A. A number of scenarios were identified that would reduce emissions, these included;
- a. A 60mph enforced limit on both eastbound and westbound carriageways between junctions 1 and 4 on the M2.
 - b. A 60mph enforced limit, eastbound between M2 junctions 3 and 4.
 - c. A 60mph enforced limit, eastbound and westbound between M2 junctions 3 and 4.
 - d. A 70mph enforced limit, eastbound between M2 junctions 3 and 4.
 - e. A 60mph enforced limit on eastbound and westbound carriageways between junctions 4 and 5 on the M2 and northbound and southbound carriageways between junctions 4 and 5 on the M25.
 - f. A 60mph enforced limit east of junction 6 on the M25.
 - g. A 70mph enforced limit on the northbound carriageway south of M25 junction 4.
- 6.2.18 To identify these scenarios the traffic data was first analysed to determine where the traffic model showed the links on these sections were set at High Speed. Actual traffic speeds collected from the Department of Transport Teletrac dataset was interrogated to determine the real-world situation in terms of compliance with the speed limits. This was undertaken to ensure that the

benefits of a speed limit were not being exaggerated. For example, if compliance in the real world was more representative of a 70mph enforced situation, then assuming the speeds were going from high speed to 70mph or 60mph enforced, would lead to an over-prediction in the improvements in emissions and the benefits of the speed limit on changes in N Deposition.

- 6.2.19 The Department of Transport Teletrac data was displayed by geographic information system to indicate the percentage of noncompliance with the speed limits. This was used as the basis to determine whether:
- The traffic speeds were currently representative of High Speed, 70mph enforced, or 60mph enforced.
 - The correct speed band could then be assigned to the relevant section of the M2 or M25 based on percentage noncompliance with the speed limit.
- 6.2.20 However, prior to the assessment of any benefits at the significantly affected sites these scenarios were passed to the competent traffic expert to run models and determine whether they were viable options.

Traffic and economics

- 6.2.21 The traffic model, Lower Thames Area Model (LTAM), was used to test the impact on the network of applying a 60mph speed limit on the:
- M2 J1-4 eastbound and westbound
 - M2 J3-4 eastbound only
 - M2 J3-4 eastbound and westbound
 - M2 J4 – J5
 - M25 J4 – J5
 - M25 J6
- 6.2.22 The modelling shows that when the speed limit on the M2 is reduced from 70mph to 60mph, some traffic is rerouted onto the local road network rather than the motorway. The local roads run through highly populated areas and there will be safety implications from increasing the traffic flow on these roads. These roads include:
- A289 eastbound
 - A289 Pier Road in Gillingham
 - Lidsing Road and Westfield Sole Road eastbound
 - North Dane Way southbound and northbound
 - A249 Detling Hill
- 6.2.23 The rerouting onto the local roads identified above would make speed limit reduction not a viable mitigation measure. This is due to the increased traffic

and emissions on local roads as motorists sought alternative routes as a result of increased journey times on the strategic road network.

- 6.2.24 For the M25 junction 6, traffic modelling showed no significant rerouting of traffic. However, the air quality calculations of the 60mph limit at this location show that there would be minimal benefit to the designated habitat as the reduction in N deposition would represent an imperceptible change.
- 6.2.25 For the M25 junctions 4 and 5, traffic modelling showed no significant rerouting of traffic based on an enforcement zone of 300m. An assessment of the potential implications of this option on road safety has been undertaken, this has been in line with the PIARC report '2019 R27 EN Road Safety Evaluation Based on Human Factors Method' (PIARC, 2019) which offers advice on the impact and effect of road design and operations on human factors. The road safety assessment has concluded that this option is not viable for this section of the road, as when considered in combination with the surrounding road types and road restrictions, the road user's driving behaviour could be impacted negatively, which has road safety implications.

Speed enforcement on the M2

- 6.2.26 Following traffic model runs any reduced speed limits of 60mph were discounted as discussed in paragraph 6.2.23, due to unacceptable consequences in terms of rerouting traffic on the local road network.
- 6.2.27 This left the 70mph enforced speed limit option which involved the installation of average speed cameras between junctions 3 and 4 of the M2. This scenario was modelled and the change in N deposition as a result of the measure was passed to the competent expert for biodiversity to determine whether the measure mitigated the impact on any of the sites located adjacent to the measure.
- 6.2.28 The total N Deposition from the 70mph speed enforcement scenario is reported in Table 6.2 for the significant receptors adjacent to the M2 speed enforcement. The N Deposition reported in ES Appendix 5.4: Air Quality Operational Phase Results (Application Document 6.3) is also included in the table for comparison. It should be noted that the speed bands were also amended in the Do Minimum scenario to ensure that they reflected the speeds in the Department of Transport Teletrac data and also to ensure that the predicted improvements from the measure were not overstated. This is the reason that there are slight differences in the Do Minimum scenario when compared to the outputs reported in the ES Chapter 5: Air Quality (Application Document 6.1).
- 6.2.29 Where the speed enforcement scenario modelling showed an imperceptible change in NO_x, no further modelling of N deposition was carried out as is the case for the assessment of all sites in the methodology. If the NO_x value is imperceptible, then the N deposition cannot be significant as the modelling of N deposition is based on the change in NO_x.

Table 6.2 Modelled N deposition for ecological designated sites near M2 speed enforcement in the mitigation scenario

Receptor ID and site name	X	Y	Environmental Statement total N Deposition (kg N ha ⁻¹ yr ⁻¹)			70mph speed enforcement total N Deposition (kg N ha ⁻¹ yr ⁻¹)			
			DM	DS	Change	Perceptible change in total NOx	DM	DS	Change
193_AW Impton/Podkin Wood AW (Also Frith Woods Etc., Kits Coty LWS)	575481	161798	40.90	41.39	0.48	Y	40.88	41.18	0.30
194_AW Frith/Impton Woods AW	575494	161872	41.29	41.79	0.50	N	N/A	N/A	N/A
195_AW AW_Theme_ID_1501634 (OBJECT ID 12881) AW	575911	161639	41.44	41.93	0.50	Y	41.42	41.72	0.30
196_AW Westfield Wood (AW_Theme_ID_150470) AW	577006	161536	42.64	43.19	0.56	Y	42.64	43.01	0.38
197_AW Frith/Impton Woods AW	577388	161574	39.88	40.30	0.42	N	N/A	N/A	N/A
198_AW Middlefield Shaw AW (AW_Theme_ID_1501447,1500825,1500821)	577785	161528	42.41	42.96	0.56	N	N/A	N/A	N/A
199_AW Middlefield Shaw AW (AW_Theme_ID_1501447,1500825,1500821)	578013	161540	41.53	42.04	0.51	N	N/A	N/A	N/A
201_AW Middlefield Shaw AW (AW_Theme_ID_1501447,1500825,1500821)	578288	161600	42.16	42.70	0.53	N	N/A	N/A	N/A
252_AW AW_Theme_ID_1498718 AW	574552	163051	41.44	42.99	1.55	Y	41.43	42.92	1.50
256_AW Frith/Impton Woods AW	574784	162875	48.56	51.80	3.24	Y	48.56	51.58	3.01
282_AW AW_Theme_ID_1498717 (OBJECT ID 11749) AW	575077	162421	40.39	40.89	0.50	Y	40.38	40.75	0.37
303_AW Frith/Impton Woods AW	576578	161633	47.60	48.41	0.81	N	N/A	N/A	N/A
Frith/Impton Woods AW	575201	162159	42.46	43.08	0.62	Y	42.29	42.53	0.25

Speed limit reduction and speed limit enforcement: conclusions of consideration

- 6.2.30 No speed limit reduction measures were considered to be viable, therefore none have been proposed for either the M2 or M25. This is due to potential rerouting of traffic onto local roads (for the M2), the imperceptible nature of the reduction in relation to the M25 junction 6 and potential safety and operational concerns in relation to the M25 junctions 4 and 5.
- 6.2.31 Following the analysis of the change in N Deposition with the implementation of the 70mph enforcement scenario the following sites were considered to be mitigated either by avoiding the effect or reducing the effect to below screening thresholds and, therefore, it can be concluded that they would not be significantly affected:
- a. AW_Theme_ID_1498717 (OBJECT ID 11749) AW
 - b. AW_Theme_ID_1501634 (OBJECT ID 12881) AW
 - c. Middlefield Shaw AW (AW_Theme_ID_1501447,1500825,1500821)
 - d. Westfield Wood (AW_Theme_ID_150470) AW
 - e. Frith Woods Etc., Kits Coty LWS
 - f. Frith/Impton Woods AW
 - g. Impton/Podkin Wood AW
- 6.2.32 For AW_Theme_ID_1498718 AW the N deposition was reduced by the mitigation, but significant effects were still concluded.
- 6.2.33 Details of residual effects following all mitigation measures are set out in Section 6.4.

Barriers

Potential to implement

- 6.2.34 DMRB LA 105 states that a barrier would need to be 9m in height based on National Highways research to be effective. Building a barrier next to a road would require substantial earthworks and new infrastructure, which would potentially do greater damage to the ecological site or have other unacceptable environmental implications. However, barriers have been considered in the PAQAP for all the sites affected on an individual basis as such constraints would be site-specific and may not be unacceptable at any individual site.
- 6.2.35 In line with the methodology set out in DMRB LA 105, the suitability of vertical barriers of at least 9m in height has been considered.
- 6.2.36 National Highways guidance (National Highways, 2019) states that to achieve air quality mitigation, air quality barriers need to be at least 9m high, impermeable and continuous (to prevent air passing through it). Beyond improving air quality, the barrier needs to:

- a. respect the character and sensitivities of the surrounding area and integrate into the landscape
- b. maintain views from high sensitivity landscape and visual receptors
- c. minimise environmental impacts on the land, water, animals and plants
- d. minimise impacts on people by ensuring visual experiences are enhanced and ensuring the barriers incorporate emergency escape doors from the carriageway where necessary

6.2.37 A two-stage approach has been applied to assess the feasibility of 9m barriers:

- a. Identification of suitable locations for vertical barriers using a Geographic Information System (GIS) filter to remove unviable areas
- b. Analysis of remaining potentially viable locations

Likelihood of measure mitigating significant effect

6.2.38 Based on air quality modelling it has been assumed that installing a 9m barrier on the ARN adjacent to the affected site would be effective in reducing N deposition on the affected designated site. For the purpose of this assessment, feasibility is defined as:

- a. Environmental feasibility: a barrier would not give rise to significant environmental impacts such that it would not be appropriate.
- b. Technical feasibility: there are no engineering limitations to the installation of the barriers. This includes sufficient space to install the barrier elements (plinth and foundations), will not cause structural issues to existing structures/features such as roads, gantries, safety barriers, vehicles, fences and existing shrubs and trees.

Viability of measure

Identification of suitable locations

Environmental constraints

6.2.39 The designated ecological sites within 200m of the ARN and where the N deposition change exceeded $0.4\text{kg N ha}^{-1}\text{ yr}^{-1}$ (and therefore assessed to have the potential to be significantly affected in the absence of mitigation) were mapped.

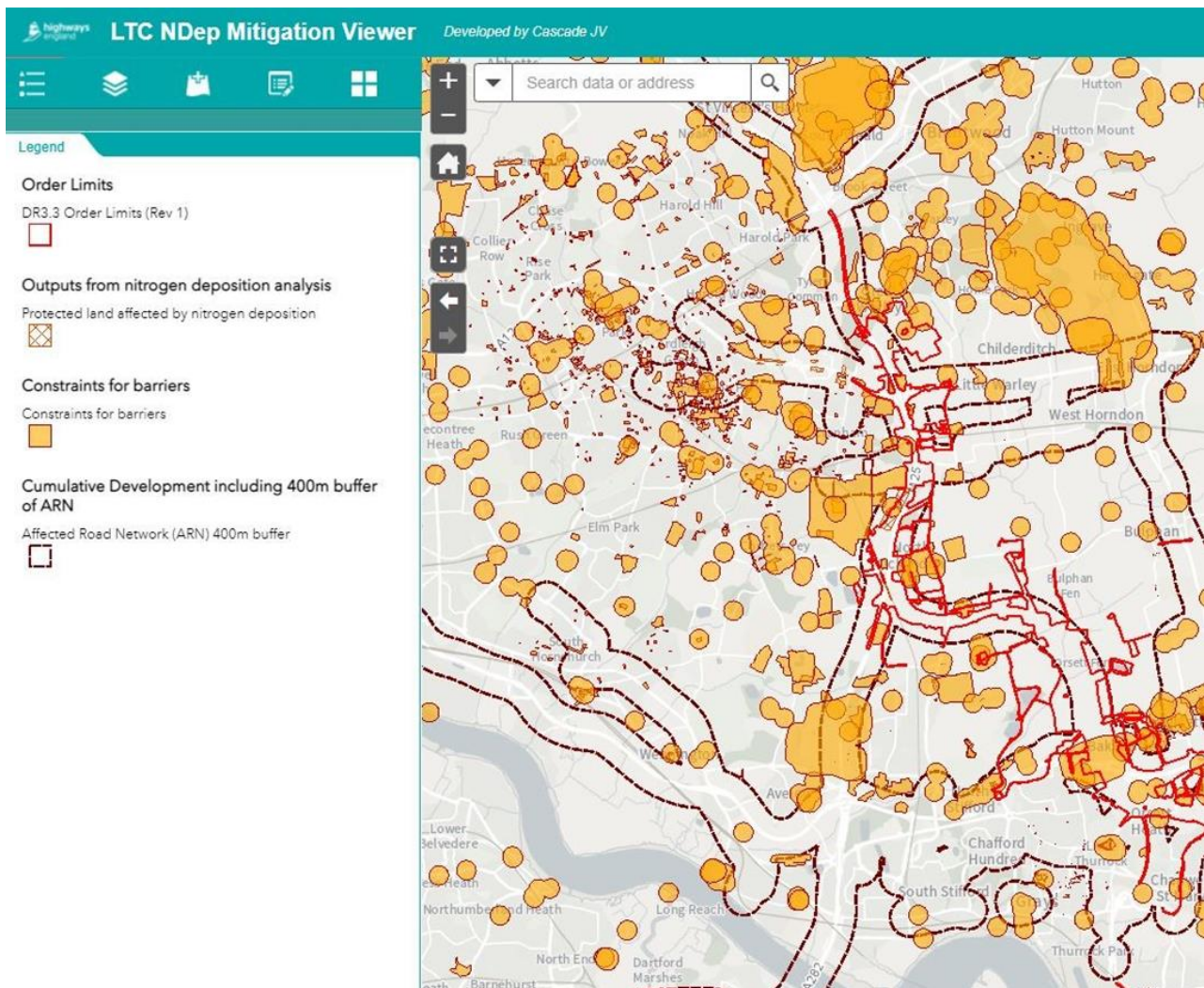
6.2.40 The ARN close to affected sites was reviewed to remove sections which would not be suitable for 9m barriers. These sections were identified using a GIS filter to exclude known environmental constraints which would be impacted by installation of barriers. These constraints are listed below:

- a. Cultural heritage constraints:
 - i. 200m buffer around scheduled monuments

- ii. 200m buffer around registered park and gardens
- iii. 200m buffer around listed buildings (Grades I and II* and Grade II)
- b. Landscape and visual constraints:
 - i. Avoid TPO trees – exclude within 2m
 - ii. Avoid Veteran Trees – exclude within 2m
 - iii. Minimum 15m from Ancient Woodland²

6.2.41 These constraints were used to create a GIS layer called ‘Constraints for Barriers’ which was overlain on the affected ecological sites and ARN. An extract of the output of the GIS filter is shown in Plate 6.1.

Plate 6.1 Extract from N-dep viewer - ‘Constraints for Barriers’ filter



² Natural England and Forestry Commission’s ‘standing advice’ (Natural England and Forestry Commission, 2022) for ancient woodland, ancient trees and veteran trees, states that for ancient woodlands, a buffer zone of at least 15m from the boundary of the woodland should be applied to avoid root damage (known as the root protection area).

- 6.2.42 Following application of the GIS filter of constraints, sites identified as fully constrained (i.e., located entirely within the ‘constraints for barriers’ area) were discounted. Sites that were identified as partly constrained by the filter were also discounted as installation of a barrier would not be feasible for the whole affected area, therefore, not fully mitigating the nitrogen deposition effects.
- 6.2.43 This resulted in one affected ecological site (an ancient woodland) remaining. Further analysis was undertaken of the remaining site based on the criteria in Table 6.3.

Table 6.3 Analysis of suitability criteria

Criteria	Details
Sufficient length of ARN: + 80m	Advice from the Air Quality team was that to ensure the whole ecological site is protected by the barrier, the barrier needs to extend along the road adjacent to the affected site plus 80m either end.
Potential environmental effects	Review of potential effects not identified by the GIS layer. Based on factors such as proximity to residential properties (not suitable within 10m), potential for effects on the landscape character, views and historic setting.
Utilities	Comment based on known existing and proposed utilities and restrictions relating to these such as easements
Planning	Comment on suitability based on any relevant planning policy requirements
Buildability and design	High level commentary provided on practicality of barriers at identified locations.

- 6.2.44 The results of the analysis of the site are presented in Table 6.4.

Table 6.4 Results of analysis

Affected ecological site	Comment on feasibility
AW_Theme_ID1494010 AW (AQ model code 174_AW) M25 J6 – General’s Grove Wood	<p>Not feasible: The site is located immediately south of the M25 junction 6, adjacent to A22 Godstone Hill. Installing the barriers would introduce issues associated with maintaining access to the M25, as the site is immediately adjacent to the M25 slip road. Two options:</p> <p><i>Option 1 - Install barrier alongside main M25 carriageway</i></p> <p>Practical issues: The barrier would be located in between the M25 carriageway and slip road. This would require breaks in the barrier, where the slip road joins the M25, which would not allow the barrier to be sufficient in length to provide the required mitigation. In addition, although the barrier could be designed to provide a level of visual transparency, due to the size of the barriers, transparency would not be possible at the bottom of the barrier due to the plinths, infill material and posts required to ensure the barrier would with stand load bearing. In this location the barrier would provide a visual risk for traffic joining the M25 from the slip road, as well traffic already on the road.</p>

Affected ecological site	Comment on feasibility
	<p><i>Option 2 - Install barrier on A22 slip road</i></p> <p>Practical issues: Installation of the barrier would encroach on the hard shoulder of the slip road.</p> <p>Landscape and visual impacts: Impact on existing trees and vegetation and potential visual impact on road users from the visual impact of barrier.</p>

Conclusions

- 6.2.45 Installing the 9m barriers would not be feasible for any of the affected ecological sites. The majority of the sites have been discounted through the initial filter of potential environmental effects on landscape and cultural heritage receptors (as identified through the GIS filter).
- 6.2.46 For the site which was not discounted by an initial filter of potential environmental effects, it has been considered further and the Project team has concluded that it would not be feasible for a variety of reasons. This includes technical feasibility, other impacts on the road network, potential visual effects, technical engineering issues with retrofitting on existing structures, and the barrier would not provide adequate mitigation because of access required to the slip road.
- 6.2.47 No physical barriers were considered to be viable, therefore none have been proposed.

Reassessment of impacts with inclusion of measure

- 6.2.48 As no physical barriers are proposed, no reassessment was necessary.

6.3 Conclusion on mitigation feasibility

- 6.3.1 Paragraph 6.1.5 sets out details of mitigation measures which have been discounted for all sites. The conclusions of the assessment of mitigation feasibility set out above for physical barriers; speed limit reduction and speed enforcement management are summarised below.

Barriers

- 6.3.2 Installation of barriers is not feasible for any site due to both environmental impacts and/or technical feasibility issues. This includes impacts on cultural heritage and landscape and visual.

Speed limit reduction

- 6.3.3 Based on traffic modelling results, there are no feasible speed limit reduction measures identified for any site considered to be significantly affected and therefore requiring mitigation.

Speed enforcement management

- 6.3.4 The assessment has confirmed that speed enforcement management measures are feasible mitigation for effects on sites adjacent to the M2 between junctions 3 and 4. This measure would be technically feasible, have negligible traffic impacts and reduce the level of N deposition for sites identified in Table 6.2.

6.3.5 The commitment to provide this mitigation measure has been included in the Register of Environmental Actions and Commitments (REAC). The REAC forms part of the Code of Construction Practice (CoCP), First iteration of Environmental Management Plan (Application Document 6.3, ES Appendix 2.2). This mitigation measure is covered under REAC commitment TB025 which states that appropriate technology and infrastructure would be provided to enable the enforcement of the current speed limit by the relevant Enforcement Authority.

6.4 Residual effects

6.4.1 Table 6.5 shows the sites which are considered to be mitigated following the analysis of the change in N Deposition with the implementation of the 70mph enforcement scenario. The table also identifies sites where impacts would remain and would therefore require compensation.

Table 6.5 Reassessment of impacts on designated sites with mitigation and sites which require compensation

Site name	Effect avoided by mitigation	Effect reduced by mitigation	Extent of site affected (ha)	Residual significant effect remains
Sites where proposed mitigation means that the site would no longer be significantly affected				
AW_Theme_ID_1498717 (OBJECT ID 11749) AW	Yes	N/A	0	No
AW_Theme_ID_1501634 (OBJECT ID 12881) AW	Yes	N/A	0	No
Middlefield Shaw AW (AW_Theme_ID_1501447,1500825,1500821)	Yes	N/A	0	No
Westfield Wood (AW_Theme_ID_150470) AW	Yes	N/A	0	No
Frith Woods Etc., Kits Coty LWS	No	Yes	1.81	No
Frith/Impton Woods AW	No	Yes	5.45	No
Impton/Podkin Wood AW	No	Yes	1.46	No
Sites where mitigation reduces the effect but does not change the conclusion that significant effects would occur				
AW_Theme_ID_1498718 AW	No	Yes	1.07	Yes
Sites where mitigation does not change the conclusion that significant effects would occur				
ANDREWS WOOD(AW_Theme_ID 1499246) AW	No	No	1.19	Yes

Site name	Effect avoided by mitigation	Effect reduced by mitigation	Extent of site affected (ha)	Residual significant effect remains
AW_Theme_ID_1486679 (Object ID 9096) AW	No	No	0.89	Yes
AW_Theme_ID_1486820 (A2/M2 ROUNDABOUT) AW	No	No	0.60	Yes
AW_Theme_ID_1486860 (Shorne Woods) AW	No	No	6.21	Yes
AW_Theme_ID_1486867 (Head Barn Wood) AW	No	No	1.43	Yes
AW_Theme_ID_1486883 (Object ID 9151) AW	No	No	0.32	Yes
AW_Theme_ID_1486891 (Between M2 carriageways) AW	No	No	0.31	Yes
AW_Theme_ID_1486937 (Longhoes) AW	No	No	0.98	Yes
AW_Theme_ID1420012 AW	No	No	1.12	Yes
AW_Theme_ID1486951 AW	No	No	0.05	Yes
AW_Theme_ID1494010 AW	No	No	0.66	Yes
AW_Theme_ID1499144 AW	No	No	0.73	Yes
AW_Theme_ID1499145 AW	No	No	1.13	Yes
Barber's Wood AW	No	No	3.61	Yes
Bridge Woods AW	No	No	15.98	Yes
Bridge Woods, Burham LWS	No	No	11.41	Yes
Cobham Woods SSSI	No	No	14.54	Yes
Codham Hall Wood AW	No	No	4.91	Yes
Codham Hall Woods LWS	No	No	4.93	Yes
Great Wood AW	No	No	13.12	Yes
Halling To Trottscliffe Escarpment SSSI	No	No	3.22	Yes
Merrals Shaw (AW_Theme_ID 1486881) AW	No	No	6.11	Yes
Ockendon Railsides SINC	No	No	4.44	Yes
Peartree Wood AW	No	No	2.13	Yes
REED'S SHAW(AW_Theme_ID 1498441) AW	No	No	0.10	Yes

Site name	Effect avoided by mitigation	Effect reduced by mitigation	Extent of site affected (ha)	Residual significant effect remains
Shorne And Ashenbank Woods SSSI	No	No	53.90	Yes
Shorne/Brewers Woods AW	No	No	11.24	Yes
Wouldham To Detling Escarpment SSSI	No	No	10.09	Yes

7 Consideration of compensation

7.1 Need for compensation

7.1.1 Mitigation has been proposed where feasible, but where there are no appropriate mitigation measures, the Applicant has identified how best to respond to the residual effects of nitrogen deposition by proposing compensation measures. Residual significant effects after consideration of mitigation are predicted on 29 sites, totalling 176.4 hectares (ha) of significantly affected habitat.

7.2 Guidance on the design of compensation

7.2.1 The development of the proposed compensation measures has been carried out consistently with the following guidance:

- a. Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine version 1.1 (Chartered Institute of Ecology and Environmental Management, 2018)
- b. Habitats regulations assessments: protecting a European site (Department for Environment, Food & Rural Affairs, Natural England, Welsh Government, and Natural Resources Wales, 2021)
- c. Best practice guidance for developing compensatory measures in relation to Marine Protected Areas, consultation version (Department for Environment, Food & Rural Affairs, 2021)

7.2.2 For the purposes of this assessment, and in light of the need to be consistent with a number of different guidance documents that, at times, use slightly different terminologies, the criteria considered during the development of the compensation proposals to ensure the overall coherence of designated sites and the integrity of the network were those set out below.

7.2.3 Measures should meet all the following criteria:

- a. Fully compensate the damage which will or could be caused to the site, including being sufficient in scale to be comparable with effects
- b. Be consistent with the conservation objectives and provide the same ecological function as the affected habitat
- c. Be 'additional', i.e. additional to the normal practices required for the protection and management of a site (maintaining/restoring favourable conservation status/favourable condition)
- d. Be resilient and sustainable
- e. Be technically deliverable, including how they would be carried out, managed and monitored
- f. Be financially viable and secured

- 7.2.4 Measures can include:
- a. creating or restoring the same or very similar habitat on areas of little or no conservation value:
 - i. within the same site (if it exists)
 - ii. at a suitable location outside the site

7.2.5 The guidance advises that measures closer to the site are generally preferred, unless measures further away will benefit the network of sites as a whole. There is no hierarchy of preference within the guidance as between measures in close proximity to affected sites or measures that will benefit networks and so both criteria were considered equally.

7.3 Compensation strategy

Development of appropriate strategic approach to compensation

- 7.3.1 Unmitigated effects from nitrogen deposition could result in a degradation of the condition of a habitat, where condition is a measure of the quality of the habitat. The conservation objectives of designated sites and habitats are to achieve 'good condition' where all attributes of condition are favourable and are likely to remain favourable. A degradation of condition would arise where one or more attributes of condition would be considered to have become unfavourable.
- 7.3.2 The purpose of mitigation is to avoid or reduce an attribute of condition becoming unfavourable on the affected area of habitat. The purpose of compensation is to provide ecological equivalence to the identified degradation of condition.
- 7.3.3 As significant effects from N deposition are predicted to cause degradation of an area of habitat (as opposed to the loss of an area of habitat) the area of habitat would still be present, albeit at a lower condition. A lower condition of the habitat would make that area of habitat (and therefore the site as a whole) less ecologically resilient to future threats and able to recover from damage. In the consideration of how compensation could achieve ecological equivalence therefore, the strategy considered how ecological resilience of the affected habitat could be enhanced. By enhancing the resilience of affected habitat, measures would compensate for the loss of resilience. As the habitat would still be present, any measures that would increase resilience of the habitat would perform the same ecological function as any resilience lost from nitrogen deposition impacts as it is the same area of habitat being supported by increased resilience as being affected by reduced resilience.
- 7.3.4 The options the Applicant has considered for providing ecological equivalence are presented below.

Strategic compensation options considered

- 7.3.5 The approach to determine the most appropriate strategy for compensation was firstly to establish the options available and which were most appropriate to address the risk of significant effects.

- 7.3.6 The options considered were as follows:
- a. Site-by-site basis, where each individual area of affected habitat has measures proposed directly associated with that area and which could potentially include:
 - i. habitat management measures within the affected site
 - ii. habitat creation or enhancement measures adjacent or near the affected site
 - b. Ecological network basis (also known as landscape-scale measures), where more comprehensive measures are proposed which are relevant to the network of habitats within which a number of affected areas of habitat lie

Consideration of options

7.3.7 The Applicant considered each of the options against the criteria set out above and overall whether it is ecologically preferable to promote multiple small-scale measures of habitat management or habitat creation or, to propose larger scale habitat creation measures.

7.3.8 Each potential compensation option was reviewed against the following questions to test against the criteria set for suitability:

- a. *Could the measure fully compensate the damage?* In answering this question, it was considered whether there are any quantitative measures that might demonstrate sufficiency of compensation for all significantly affected sites. If quantitative measures were not available, it was considered whether it could be reasonably concluded subjectively whether the measures would be sufficient to compensate all significantly affected sites.
- b. *Could the measure provide the same ecological function as the affected habitat?* In answering this question, it was considered whether the measures would build resilience of all the significantly affected areas of habitat and designated sites.
- c. *Could the option be 'additional'?* In answering this question, it was considered whether any new ecological benefit would be provided. If measures are already proposed through the management plans for a designated site, they were considered to be part of the future baseline and therefore assumed to be already being carried out. Any measure that was assumed to already be carried out was therefore discounted as not providing new benefits.
- d. *Could the option be resilient and sustainable?* In answering this question, it was considered whether the benefits accrued would be long-term in nature. Any measures that would only provide ephemeral or short-term benefits

were discounted as they would not be temporally comparable with the long-term nature of nitrogen deposition effects.

- e. *Could the option be technically deliverable?* In answering this question, it was considered whether there were actual actions that could be carried out to achieve the measure. Measures that were theoretical or where actions were not certain of effectiveness were discounted.
- f. *Could the option be financially viable and secured?* In answering this question, it was considered whether the measures were deliverable through the powers of the DCO or the operations of the Applicant, and whether or not the cost would be prohibitive.

Option a (i): Habitat management measures within affected sites

Description

- 7.3.9 Habitat management measures within individual affected sites could improve resilience of the affected site through reduction of other threats / pressures or improving condition of lower quality existing habitats. By improving overall resilience such measures could therefore compensate the risk of reduced resilience through nitrogen deposition.
- 7.3.10 Habitat management measures within affected sites could include the following:
 - a. Site-specific management plan of affected site to reduce other threats/pressures or improving condition
 - b. Reducing disturbance of the site
 - c. Planting to enhance habitats.
 - d. Removal of invasive alien species.
 - e. Removal of stored nitrogen or other pollutants from the ecosystem (e.g. removal of biomass).

Assessment against criteria

Could the measure fully compensate the damage?

- 7.3.11 Whilst positive habitat management would clearly provide some degree of improved condition of the designated site, it is not possible to quantify the condition of an individual site at a level of precision that could be related to individual threats, let alone quantifying the reduction of condition on one area of a site and comparing that against a quantum of improved condition on either that area or a different area of the site. Whilst methods such as UKHabs surveys (The UKHab Working Group, 2018) and the biodiversity metric provide some assessment of condition, the precision of these methods is very broad and cannot differentiate between different drivers of condition.
- 7.3.12 Habitat management measures would need to be identified for every significantly affected site as each site would have different threats and pressures acting on it. It is possible that some sites would have no threats or

pressures other than the additional nitrogen deposition, or that existing threats are limited in their reduction of condition or resilience and so such sites could not be compensated for by site management measures.

- 7.3.13 It cannot be concluded therefore that site management could fully compensate for effects on every significantly affected site. As it is uncertain that all sites could be compensated fully through site management measures, such measures were considered inappropriate at a strategic level in the context that measures were available that would definitely build resilience for all sites.
- 7.3.14 Additionally, even if suitable measures could be defined and delivered for some sites, multiple small measures associated with isolated sites within a wider network are likely to result in the network remaining largely fragmented with variable levels of compensation achieved for each site, dependent on opportunities available at the site.
- 7.3.15 On balance, it is considered that it would not be possible to conclude that habitat management measures within affected sites would fully compensate for the impact of nitrogen deposition on all affected sites.
- Could the measure provide the same ecological function as the affected habitat?*
- 7.3.16 The measures could lead to improvements in site condition that would build resilience of the same area of habitat and therefore provide the same ecological function. However, this would only be possible where opportunities for suitable management measures were available on each significantly affected site and as this is uncertain, it is therefore uncertain whether the same ecological function can be achieved on every significantly affected site.
- Could the option be 'additional'?*
- 7.3.17 For nationally designated sites, it is unlikely that such measures could be considered as 'additional' to the normal practices which are already required for maintaining / restoring site features, as any measures that would provide significant gains in resilience are likely to be part of the existing site conservation objectives and management plan. Whilst site management plans would necessarily relate to existing threats, it is highly unlikely that any site management measures would be available that would have sufficient precision to only relate to the threat posted by additional N deposition as management measures are necessarily broadly based on the macro attributes of habitat condition. For nationally designated sites, therefore, it would be difficult to deliver 'additional' habitat management measures which would qualify as compensation.
- 7.3.18 For sites not nationally designated, it is possible that such measures could provide 'additional' benefits, as maintenance / restoration plans are not legally required for those sites. However, it is unlikely that appropriate measures would be available for all significantly affected sites.
- Could the option be resilient and sustainable?*
- 7.3.19 Measures such as removing biomass or fencing to reduce disturbance would be one-off measures. Such measures could have longer term benefits but could not be considered as resilient and sustainable in perpetuity unless the measures were committed to on an ongoing basis. The deposition of nitrogen

into sites can be considered to be a temporary impact, but once deposition has occurred, the nitrogen would be locked into the nitrogen cycle of the ecosystem, so it can be considered as a permanent effect. Management measures could be resilient if committed to in perpetuity, if they are available for every site. It is unlikely, however, that suitable measures could be defined for every significantly affected site which are sufficiently additional.

Could the option be technically deliverable?

7.3.20 Habitat management measures are often technically deliverable where available as there is a large body of experience of managing habitats to improve habitat condition.

7.3.21 Habitat management measures within sites would necessarily progress on a site-by-site basis depending on the individual “needs” of a particular site as a whole in relation to the affected habitats. The measures would therefore need to demonstrate that they compensate the effects on individual sites through indirect means, balancing one threat with another on that site. It is uncertain whether sufficient measures could be provided for every site as a site with no existing threats and in good condition (apart from the potential effect of additional N deposition) would have no ‘needs’ and so there would be no ‘available’ measures to enhance its condition.

Could the option be financially viable and secured?

7.3.22 The cost of habitat management measures would not be disproportionately prohibitive and could be secured through the DCO either through acquisition or securing agreements with landowners.

Conclusion of suitability of the option

7.3.23 Although habitat management measures would perform the same ecological function, be deliverable and resilient where available on sites and be securable, it is concluded that such measures would not be suitable as a strategic approach. It is uncertain (and unlikely) that suitable habitat management measures could be identified on every affected site and so a strategy based on this approach would mean that significant effects on some sites could not be compensated. It would also be difficult to quantify that the measures would fully compensate the risk of significant effects and such measures would not be ‘additional’ for nationally designated sites.

Option a (ii): Habitat creation or enhancement measures adjacent or near the affected sites

Description

7.3.24 Habitat creation or enhancement measures adjacent or near the affected sites could improve the resilience of the affected site through reducing external effects - for example by creating barriers or extending the extent and connectivity of diverse semi-natural habitats linked to the affected site. Such measures could improve the overall resilience of the site and compensate the risk of reduced resilience through nitrogen deposition.

- 7.3.25 Habitat creation or enhancement measures adjacent or near the affected sites which could also improve resilience of the affected site include the following:
- a. Creation of new areas of habitat (ideally of the same habitat type) adjacent to the affected site to expand the area of habitat that the affected site lies in; act as a buffer from external influences; or increase ecological connectivity with other areas of habitat.
 - b. Changes in agricultural practices on land adjacent to the affected site that would reduce pollution pathways to the site, through changed land management, reduced inputs, or improved water management.

Assessment against criteria

Could the measure fully compensate the damage?

- 7.3.26 For habitat creation, if suitable land were available, it would be possible to quantify the scale of the created habitat and the number of additional connections to the wider ecological network. Habitat creation or enhancement measures adjacent or near the affected sites would need to be identified for each significantly affected site as each site would have different threats and pressures acting on it and/or opportunities for enhancement adjacent to the site. It is possible that some sites would have no threats or pressures other than nitrogen deposition, or that existing threats are limited in their reduction of resilience and so such sites could not be compensated for by such measures. It is also possible some sites may have no significant opportunities for enhancement outside the site that would significantly build resilience. It cannot be concluded therefore that habitat creation or enhancement measures adjacent or near the significantly affected sites could fully compensate for effects on all sites. As it is uncertain that all sites could be compensated fully through such measures, the measures were considered inappropriate at a strategic level in the context that other measures were available that would definitely build resilience for all sites.
- 7.3.27 Additionally, even if suitable measures could be defined and delivered, multiple small measures associated with isolated sites within a wider network are likely to result in the network remaining largely fragmented with variable levels of compensation achieved for each site, dependent on opportunities available at the site. As there is no preferential hierarchy for compensation measures to be in close proximity to affected sites where there are measures that would benefit the network of sites as a whole, it would not be appropriate to propose site by site habitat creation or enhancement measures outside some of the affected sites where there are network scale measures that would benefit the network that supports all the affected sites.
- 7.3.28 For changes in agricultural practice, it would not be possible to quantify the scale of the compensation change in resilience to show that the effects were fully compensated. Whilst reducing different negative external influences other than nitrogen deposition from traffic through changes in agricultural practice would clearly provide some degree of improved condition, it is not possible to quantify subtle long-term changes in condition within an individual site that would be likely to occur as a result of changed adjacent land management.

- 7.3.29 On balance, it is considered that it would not be possible to conclude that habitat creation or enhancement measures adjacent or near the affected sites would fully compensate for the impacts of the Project on all significantly affected sites.
- Could the measure provide the same ecological function as the affected habitat?*
- 7.3.30 The measures could lead to improvements in site condition that would build resilience of the same area of habitat and therefore provide the same ecological function.
- Could the option be ‘additional’?*
- 7.3.31 All such measures could be considered as ‘additional’ to the existing plans for maintaining / restoring site features, as they would necessarily occur outside the significantly affected site and therefore outside the remit of any existing site management plan.
- Could the option be resilient and sustainable?*
- 7.3.32 Habitat creation would provide benefits that would be resilient and sustainable as the capacity for ongoing management would be part of the design. However, multiple small measures associated with isolated sites within a wider network would only be able to provide limited resilience as small sites are inherently less resilient and multiple smaller sites would be likely to provide limited additional connectivity within the network. Networks with limited connectivity are inherently less resilient.
- 7.3.33 Measures to change adjacent land practices could have longer term benefits but could only be considered as resilient and sustainable in perpetuity if a commitment to the changed management was sufficient and made in-perpetuity.
- Could the option be technically deliverable?*
- 7.3.34 Habitat creation measures and changes in agricultural practices are plainly established as technically feasible and effective, through many case studies and experience of habitat managers.
- Could the option be financially viable and secured?*
- 7.3.35 The cost of habitat creation or enhancement measures would not be disproportionately prohibitive and could be secured through the DCO.
- Conclusion of suitability of the option*
- 7.3.36 Although habitat creation or enhancement measures adjacent or near the affected sites would perform the same ecological function and be additional and securable, such measures would not be suitable as a strategic approach. It is uncertain (and unlikely) that suitable measures could be identified for every affected site and so a strategy based on this approach would risk significant effects on some sites not being compensated.

Option b: Habitat creation measures at an ecological network scale

Description

- 7.3.37 Habitat creation within the wider ecological network that affected sites lie within could improve the resilience of the affected sites and the network as a whole by providing a larger net area of the relevant habitat than in the existing ecological network with greater connectivity to other areas of habitat within the network. Greater resilience would be achieved as larger sites with more connectivity are known to be more diverse and have the ability to regenerate more effectively in response to damage. Such measures could improve the overall resilience of any site within the ecological network being enhanced through habitat creation to compensate the risk of reduced resilience through nitrogen deposition.
- 7.3.38 Habitat creation within affected ecological networks could include the following:
- Large scale habitat creation through planting and/or natural regeneration, providing new permanent habitat resource that would develop additional diversity and ability for parts of the network to recover
 - Smaller scale habitat creation measures focused on linking existing areas of semi-natural habitats within the network that would provide more opportunities for the movement of species through the network and so build the ability of the network to expand features and recover from localised damage
 - Create mosaics of affected habitat and associated habitat types that would add diversity to the overall ecosystem, such as greater edge habitats

Assessment against criteria

Could the measure fully compensate the damage?

- 7.3.39 It would be possible to quantify the scale of the created habitat and the number of additional connections to the wider ecological network for habitat creation. As measures implemented at a network scale would build resilience for all sites within the network, all significantly affected sites within the networks would be compensated by enhancements to the network they are in, irrespective of whether they had existing threats or pressures.

Could the measure provide the same ecological function as the affected habitat?

- 7.3.40 The measures would build resilience of the same area of habitat through improved condition of the network and therefore provide the same ecological function.

Could the option be 'additional'?

- 7.3.41 All such measures could be considered as 'additional' to the existing plans for maintaining / restoring site features, as they would necessarily occur outside the site and therefore outside the current remit of a site management plan.

Could the option be resilient and sustainable?

7.3.42 Such measures would provide benefits that would be resilient and sustainable as ongoing management would be part of the design.

Could the option be technically deliverable?

7.3.43 Habitat creation measures are plainly established as technically feasible and effective, through many case studies and experience of habitat managers. Careful site selection enables appropriate habitat creation sites to be adopted.

7.3.44 Network-scale habitat creation is consistent with the majority of the ‘rebuilding nature’ objectives of the ‘Lawton Principles’ within Making Space for Nature: A review of England’s Wildlife Sites and Ecological Network (Lawton, et al., 2010) of “Bigger, better and more joined up”, creating a more robust network of habitats which build resilience into the ecosystem. It is also consistent with advice received from the Department for Environment, Food and Rural Affairs and Natural England in relation to strategic outcomes for the Project. Whilst the Lawton Principles also advocate improving the quality of existing sites and reducing threats to them, consistency with those objectives are considered above in relation to site by site measures and mitigation respectively.

Could the option be financially viable and secured?

7.3.45 The cost of habitat creation measures at an ecological network scale would not be disproportionately prohibitive and could be secured through the DCO.

Conclusion of suitability of the option

7.3.46 All criteria used to assess habitat creation measures at an ecological network scale as a strategic approach are met. The measures would provide the same ecological function as they would support the same affected habitats, would be additional and resilient and are technically deliverable and securable. The improved resilience could be quantified in terms of the additional habitat resource provided and the number of additional connectivities within the ecological network that the affected sites are supported by.

Conclusion on appropriate strategic compensation approach

7.3.47 A summary of the feasibility / suitability of the strategic options considered against the criteria of the assessment is presented in Table 7.1 below.

Table 7.1 Summary of feasibility of options

Option considered	Fully compensate?	Same type of ecological function?	Additional?	Resilient?	Technically deliverable	Viable / secured?	Suitable?
Habitat management measures within affected sites	Cannot quantify any aspect of the compensation. Unlikely all affected sites could be compensated as uncertain whether sufficient existing threats could be managed sufficiently to fully compensate.	Yes	Only for non-SSSI sites. Uncertain as a strategy	Only for significantly affected sites where there are existing threats that can be managed. Uncertain as a strategy	Yes (where available but uncertain as a strategy)	Yes	No
Habitat creation or enhancement measures adjacent or near the affected sites	Scale and additional connectivity could be quantified for habitat creation, but no quantification possible for amended management of adjacent sites. Unlikely all affected sites could be compensated as uncertain whether sufficient existing threats could be managed sufficiently to fully compensate.	Yes	Yes	Only for significantly affected sites where there are existing threats that can be managed. Uncertain as a strategy	Yes (where available but uncertain as a strategy)	Yes	No
Habitat creation measures at an ecological network scale	Scale and additional connectivity can be quantified. All sites within the networks would be compensated by enhancements to the network they are in.	Yes	Yes	Yes	Yes	Yes	Yes

- 7.3.48 The judgement of the competent experts advising the Applicant is that it is ecologically preferable to propose an approach of habitat creation at an ecological network scale for compensation measures. A small number of larger compensation measures in carefully selected locations associated with identifiable habitat networks would provide the most suitable and certain available ecological option for compensating for degradation across a number of sites within the ecological networks. This would provide permanent, meaningful, landscape-scale habitat creation areas that would be a long-term habitat resource of a comparable area to that affected by degradation. This would be a precautionary but proportionate response to the residual effects related to nitrogen deposition. A landscape scale approach to habitat creation is consistent with the Lawton Principles (Lawton, et al., 2010) and Department for Environment, Food and Rural Affairs advice (Department for Environment, Food and Rural Affairs, Natural England, Welsh Government and Natural Resources Wales, 2021) and is an approach supported by Natural England. The guidance followed (listed in paragraph 7.2.1) states that measures closer to the site are generally preferred, unless measures further away will benefit the network of sites as a whole. As the Project has multiple affected sites within identifiable ecological networks, the landscape approach is consistent with guidance.
- 7.3.49 On-site habitat management measures would be uncertain as to their efficacy and/or as to whether they would provide ‘additional’ benefits to existing management requirements or whether the measures would be sufficiently relevant to the potential effects of the Project. Additionally, it is unlikely that suitable measures would be available for all significantly affected sites, in contrast to landscape scale measures that would compensate for all sites. As there is no preferential hierarchy for compensation measures to be in close proximity to affected sites where there are measures that would benefit the network of sites as a whole, it would not be appropriate to propose site by site habitat management measures on some of the affected sites where there are network scale measures that would benefit the network that supports all the affected sites.
- 7.3.50 The guidance followed (listed in paragraph 7.2.1) does not consider a hierarchy of preference between measures in close proximity to affected sites or measures that will benefit networks however if a combination or hybrid strategy of some site-specific measures and some landscape measures was taken forward there is a risk that this could result in an inconsistent level of compensation for different sites, with some sites potentially being doubly compensated. If network scale measures were to be solely adopted, they would necessarily provide benefit to all the sites within the network.
- 7.3.51 Providing a series of separate measures to address impacts as close to the individually affected area as reasonably practical would bring some benefits but those are outweighed by the greater certainty and greater resilience benefits that larger scale habitat creation would accrue. Additionally, it is unlikely that appropriate site-specific measures would be available for all affected sites.
- 7.3.52 Providing landscape scale compensation is highly likely to achieve greater ecological gain as large areas of habitat provide clear additional value to the network, are more diverse and more resilient to threats and pressures. Smaller,

isolated sites, in contrast, are at a higher risk from negative influences as there is less overall resource to withstand influences and recover from them.

7.3.53 Greater connectivity facilitates a much larger available resource for species to move within to buffer against localise impacts and form a conduit for recovery.

7.3.54 The approach was discussed and agreed with Natural England in a series of meetings and supported in Natural England's response to the Project's Local Refinement Consultation in May 2022. In the view of the competent experts advising the Applicant therefore, and as agreed by Natural England, a landscape approach to habitat creation that provides permanent additional habitat resource. The landscape approach also, critically, provides multiple additional habitat connections within the existing network, provides the only strategic approach that would fully compensate the risk of nitrogen deposition effects on multiple designated sites and habitats.

7.4 Habitat creation site selection

Scale required

7.4.1 To provide a precautionary but proportionate response to the residual effects, the scale of habitat creation required was determined by considering the objectives of providing additional high-quality habitats within the ecological networks that currently support the affected sites, but crucially, also providing additional connectivity to areas of habitat within the network. The combination of additional habitat resource and additional connectivity provides the functionality of the measures to maintain the overall resilience of the network and the sites and habitats that it supports.

7.4.2 In order to fully compensate the residual effect, the quantum of new habitats had to be broadly comparable with the quantum of affected habitat, as well as acknowledging that the connectivity was a key function of that resource in maintaining resilience.

Site selection criteria

7.4.3 The methodology used to identify potential areas for compensation comprised the following:

- a. Identification of search areas through cluster analysis of potentially significant effects
- b. Overarching site feasibility within search areas - exclusion of land parcels with sufficient constraints to preclude habitat creation
- c. Analysis of ecological suitability of land parcels using a proximity analysis
- d. Site selection refinement through review of potential environmental effects and available information on land ownership and use

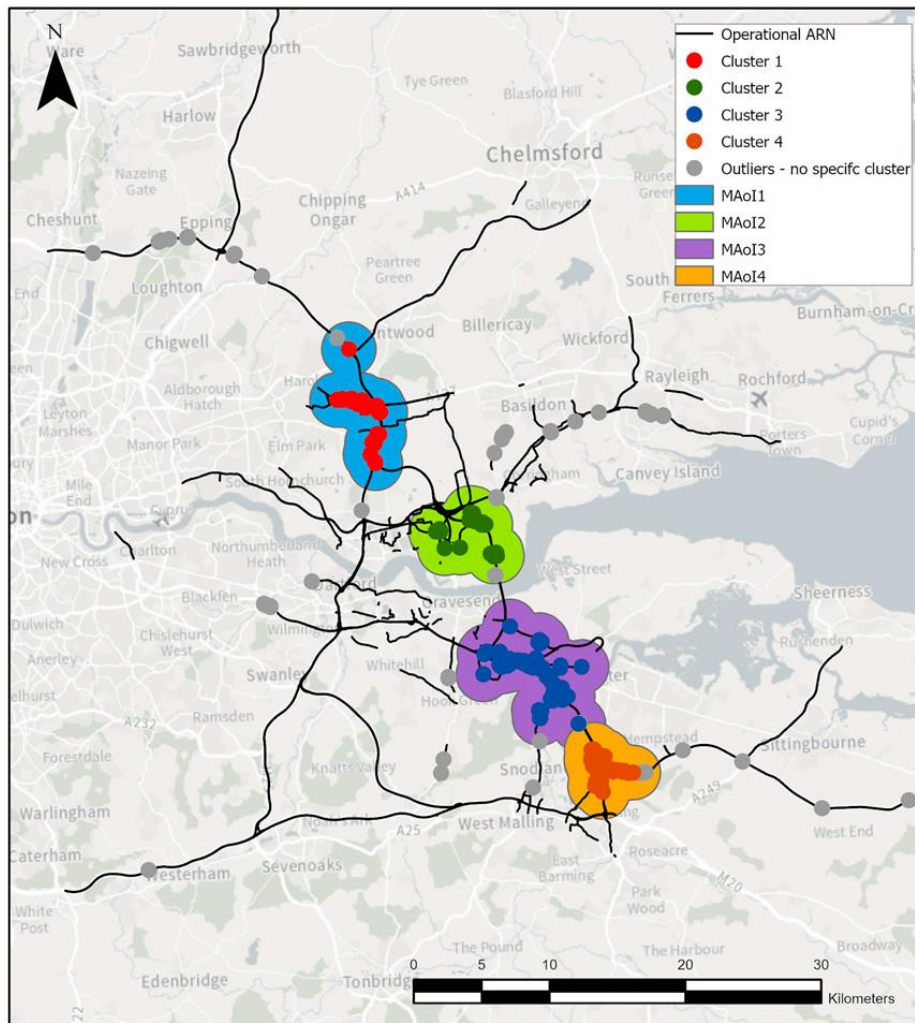
7.4.4 The approach to site selection was discussed with Natural England during its development.

7.4.5 All the mapping, analysis and processing of data was completed in Esri ArcGIS Pro, GIS software, unless otherwise described.

Identification of search areas

- 7.4.6 For a network approach, it is necessary to identify an appropriate scale of network. To achieve the best balance of network approach with connectivity to the affected habitats, the following network scales were considered:
- a. International – the entire habitat resource across its geographical range
 - b. National – the habitat resource within UK or England
 - c. Affected road network – the habitat resource across the ARN (the habitat network within which the Project is predicting significant effects on areas of the resource)
 - d. Clustered affected areas network – more localised networks of clusters of affected areas of habitat where proximity to each other within the cluster provides greater levels of ecological connectivity to each other than to other clusters of affected areas
- 7.4.7 The clustered affected areas network scale was preferred as it was considered to provide a proportionate amount of ecological connectivity between existing resource and proposed compensatory habitat creation. The ARN scale is artificial in ecological terms as it is identified through analysis of the traffic changes caused by the Project and not related to ecological metrics. It was also considered to be unlikely to deliver opportunities to fill gaps in the ecological network at that scale. National and international scales of network were considered unsuitable as they would not be directly relevant to the network of habitats that support the affected habitats – using a national network approach could, for example lead to a compensation site being considered in Scotland, which would clearly not be a suitable or effective measure.
- 7.4.8 To identify clustered affected areas networks, the ecological sites air quality (AQ) modelling points were mapped. The AQ points were filtered to only display those where the nitrogen deposition change exceeded $0.4\text{kg N ha}^{-1}\text{ yr}^{-1}$ and therefore illustrate the areas that would have the potential to be significantly affected.
- 7.4.9 A Density-based Clustering analysis tool, using the self-adjusting method with minimum features per cluster set at 100, was used to analyse the filtered AQ points. Plate 7.1 shows that the affected points are largely concentrated in four groupings.
- 7.4.10 To ensure any search areas were appropriate to ecological networks at a scale that would be resilient and support biodiversity, a buffer of 2km around the clustered points was calculated and mapped. These were defined as macro areas of interest (MAOI) and numbered uniquely MAOI1-4 as shown in Plate 7.1.

Plate 7.1 Results of the cluster analysis



- 7.4.11 The purpose of creating the MAoIs was to focus the search areas to where suitable compensation sites may exist. Any sites outside the MAoI would be inherently less connected to the ecological networks that support the affected sites and so less suitable for compensation measures. Sites further afield would have been considered in the eventuality that no suitable locations could be found within the macro search areas.
- 7.4.12 The four MAoIs lie within the following local authorities, with some spanning more than one local authority boundary:
- a. MAoI 1: London Borough of Havering, Brentwood Borough Council and Thurrock Council
 - b. MAoI 2: Thurrock Council
 - c. MAoI 3: Gravesham Borough Council, Medway Council and Tonbridge and Malling District
 - d. MAoI 4: Tonbridge and Malling District, Maidstone Borough Council and Medway Council

Overarching site feasibility

- 7.4.13 Within the MAoI the Ordnance Survey MasterMap (OSMM) data was used to create a Macro Plots of Interest layer in GIS. The OSMM data that intersected the MAoI was exported to a geodatabase, LandParcels_AQ_MAOI.gdb, and each OSMM polygon (land parcel) was assigned an attribute to identify which MAoI it intersected. Further attributes were then assigned to each land parcel according to whether or not it intersected the Project Order Limits (as of November 2021) and designated sites (as defined for use in AQ assessment). Each land parcel had a unique identifier (the 'TOID value' within the OSMM dataset) which all OSMM data is assigned with.
- 7.4.14 The OSMM data set was then refined to filter out polygons that would clearly not be suitable for woodland creation (as set out below). This was completed by adding an attribute named "Removed by DefQuery" which would be populated yes/no and used to filter the data set (using a definition query in Esri ArcPro) to only display polygons where planting could be feasible. i.e., all urban and developed land would be filtered out.
- 7.4.15 The following steps were used to select all the land parcels that would be removed by the definition query (i.e., assigned a yes):
- a. The OSMM polygon feature data has attributes such as a 'Theme' and a 'Descriptive Term', which were used to filter out areas that would not be suitable for woodland creation. The land parcels that were considered as clearly unsuitable included Urban/ developed land which for example incorporated the following 'Theme' attributes; "Buildings", "Rail", "Structures", "Road tracks and Paths", and "Water".
 - b. Areas of gardens and similar types of space for example were also removed and had the Theme = "Land" and Descriptive Term = "Multisurface".
- 7.4.16 These steps then allowed the data set to be filtered before the next review to assign habitat viability was carried out.
- 7.4.17 The remaining land parcels were then attributed with the local authority(s) name that they were within (to enable links to be made to landholding information and consultation).
- 7.4.18 The viability of the remaining land parcels was recorded by first creating an attribute called "Habitat_Vi" and it was populated with the following terms; "Viable- Agricultural Land", "Potential Viable – Further details required", "Non Viable – Existing Woodland" and "Not Viable". The OS attributes of each land parcel was reviewed assigned a feasibility description based on the following criteria held within the descriptive terms of the OSMM dataset:
- a. Non Viable – "Manmade and artificial features" e.g. buildings, tracks, bridges, watercourses, sand, shingle and reservoirs (GIS formula/code: (Make IN 'Manmade', 'Multiple') (DescriptiveTerm IN ('Bridge', 'Cliff', 'Drain', 'Track')).

- b. Non Viable - Areas that are already ecological important habitats e.g. intertidal, marsh, heath (DescriptiveTerm IN ('Heath;Nonconiferous Trees (Scattered);Rough Grassland', 'Heath;Rough Grassland', 'Marsh;Nonconiferous Trees', 'Marsh;Nonconiferous Trees;Scrub', 'Marsh;Rough Grassland', 'Mineral Workings (Inactive)', 'Mineral Workings (Inactive);Nonconiferous Trees (Scattered);Scrub', 'Mineral Workings (Inactive);Scrub', 'Mud', 'Mineral Workings (Inactive);Nonconiferous Trees;Scrub', 'Marsh;Scrub', 'Boulders', 'Reservoir', 'Sand;Shingle', 'Shingle', 'Slope')).
- c. Non-Viable Existing Woodland: Areas of existing woodland were highlighted specifically as no habitat creation would be possible in these areas (GIS formula/code: DescriptiveTerm IN ('Coniferous Trees', 'Coniferous Trees;Nonconiferous Trees', 'Coniferous Trees;Scrub', 'Nonconiferous Trees', 'Nonconiferous Trees (Scattered)', 'Orchard', 'Nonconiferous Trees;Scrub')).

7.4.19 Viable areas were split between agricultural land and other areas where there was potential for habitat creation (but further details would be required) such as scrub and rough grassland:

- a. Viable - Agricultural Land (DescriptiveTerm IN Agricultural Land).
- b. Potential Viable - Further Details Required (DescriptiveTerm IN ('Rough Grassland', 'Rough Grassland;Scrub', 'Scrub', 'Scrub;Coniferous Trees', 'Scrub;Coniferous Trees (Scattered);Nonconiferous Trees (Scattered)', 'Scrub;Coniferous Trees;Nonconiferous Trees', 'Scrub;Nonconiferous Trees', 'Scrub;Nonconiferous Trees (Scattered)', 'Scrub;Rough Grassland', 'Scrub;Rough Grassland;Nonconiferous Trees (Scattered)', 'Scrub;Nonconiferous Trees;Coniferous Trees')).

7.4.20 The land parcels that recorded non-viable habitat were filtered from the analysis process using a definition query. Remaining potentially viable habitats were categorised with regard to other potential constraints and recorded in the attribute table as follows. These were used in the Site Selection Refinement Workshops described in paragraph 7.4.32:

- a. Land parcels within 200m of the ARN
- b. Desirability of preserving existing land designations/uses, e.g., areas allocated for development, best quality agricultural land (Agricultural Land Classification 1 & 2), registered common land or land used for recreational purposes
- c. Land parcels that contain known environmental constraints such as nature conservation designations, flood risk areas or heritage designations e.g., areas within 200m of scheduled monuments, registered park or gardens or Grade I or II* listed buildings

- d. Land parcels that contained utilities constraints e.g., pylons, underground utilities, where known in areas close to the Project alignment and where the Applicant proposes to divert utilities
- e. Land parcels with potential mineral workings constraints where the land parcel intersected the British Geological Survey BritPits dataset (British Geological Survey, 2007)

Analysis of ecological suitability

- 7.4.21 The proximity of the land parcel to other important ecological features as well as to the ecological planting provided by the Project and the area affected by potentially significant nitrogen deposition changes was analysed. This was used to describe the ecological suitability of any particular land parcel, with those closest considered more suitable than those further away. The size of the land parcel was also factored in, with larger land parcels considered more suitable than smaller ones.
- 7.4.22 The GIS AQ land parcels database was filtered to all land parcels that were viable or potentially viable then ran proximity analysis using the Near (Analysis) tool. The distance in metres of each land parcel to the following was calculated:
- a. Important ecological features:
 - i. SSSI
 - ii. Ancient Woodland
 - iii. Local designation (LWS/SINC)
 - iv. Non designated woodland resource
 - b. Project ecological mitigation provision – Project Environmental Masterplan (Application Document 6.2, ES Figure 2.4) woodland planting (LE8.1³, LE8.3) and non-woodland planting (LE8.2, LE8.4, LE8.6)
 - c. habitat impacted by nitrogen deposition – Habitat extent impacted by change in nitrogen deposition $>0.4\text{kg N ha}^{-1}\text{ yr}^{-1}$
- 7.4.23 The attribute table was then opened in Microsoft Excel and each plot was assigned a descriptor of 'Close', 'Far' or 'Moderate' dependent on the relative proximity compared to all plots considered in the analysis. The descriptor categories were broadly based on the 25 and 75% quartiles, i.e., a 'Close' descriptor was assigned to the quarter of the plots that were the closest to ecological network features in the sample and 'Far' was assigned to the quarter of the pots that were the furthest from ecological network features in the sample. This allowed categorisation to be relative to the other land parcels studied rather than a preconceived quantum of close or far.

³ The planting codes (e.g. LE8.1) are the codes used to describe the proposals on the Environmental Masterplan (Application Document 6.2, ES Figure 2.4). 'LE' refers to 'Landscape Element'.

- 7.4.24 To do this, the minimum, maximum, 25% and 75% quartile, mean and median values (descriptive statistics) of the data set were calculated in Microsoft Excel to investigate the distribution (as shown in Table 7.2) of each distance category (a-c above) and allow a ‘close’, ‘far’ or ‘moderate’ descriptor to be assigned to each distance for each land parcel.
- 7.4.25 The size of the land parcel was investigated in the same way, i.e. a ‘small’ descriptor was assigned to the quarter of the plots that were the smallest in the sample and ‘large’ was assigned to the quarter of the pots that were the largest in the sample.
- 7.4.26 Table 7.2 sets out the summary data and Table 7.3 sets out the thresholds that defined for each descriptor.

Table 7.2 Summary of data, for the size and distances calculated, used to define descriptors in Table 7.3

Proximity/size factor	min	25% quartile	Mean	50% quartile (median)	75% quartile	max
Area (hectares)	0.0001	0.15	2.56	0.53	2.25	113.25
SSSI (m)	0.0	730.0	1923.1	1820.0	3040.0	5120.0
Ancient woodland (m)	0.0	490.0	1321.5	1040.0	1890.0	5570.0
Local designation (m)	0.0	140.0	573.8	440.0	890.0	3230.0
Other woodland (m)	0.0	0.0	64.8	10.0	90.0	1050.0
Environmental Masterplan woodland planting (m)	0.0	1360.0	3618.9	2370.0	4350.0	12930.0
Environmental Masterplan non-woodland planting (m)	0.0	1640.0	4601.7	3090.0	6620.0	15170.0
Habitat extent impacted (m)	0.0	470.0	964.2	960.0	1460.0	3230.0

Table 7.3 Thresholds used for assigning descriptors for each land parcel

	Area descriptor		
	Small (Area less than)	Medium	Large (Area greater than)
Area (hectares)	1.0	1.0–25.00	25.00
	Distance descriptor		
	Close (Distance < or =)	Moderate	Far (Distance >)
SSSI (m)	730.0	730–3040	3040.0
Ancient woodland (m)	490.0	490–1890	1890.0
Local designation (m)	140.0	140–890	890.0
Other woodland (m)	0.0	0–90	90.0
Environmental Masterplan woodland planting (m)	1360.0	1360–4350	4350.0
Environmental Masterplan non-woodland planting (m)	1640.0	1640–6620	6620.0
Habitat extent impacted (m)	470.0	470–1460	1460.0

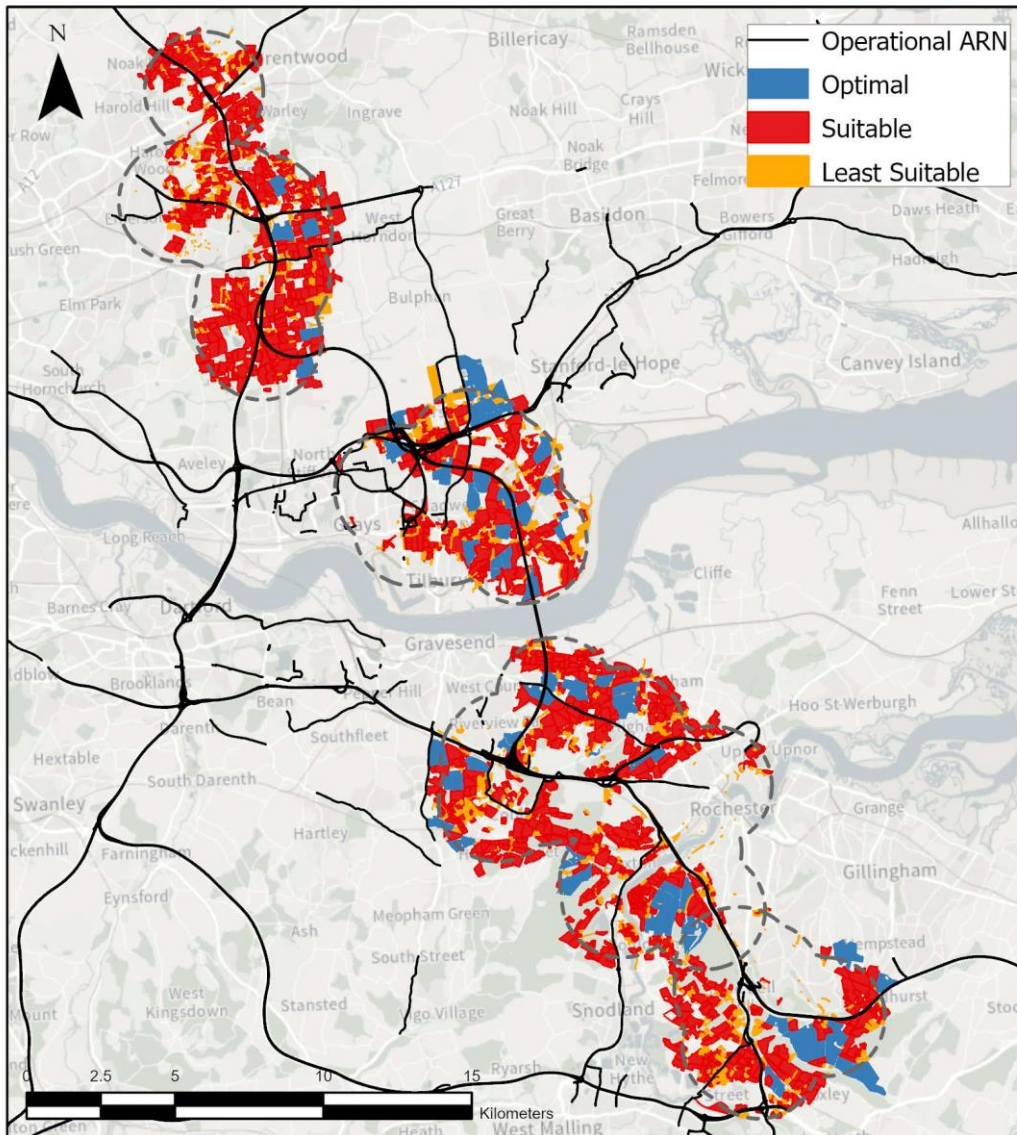
7.4.27 The analysis was continued within Microsoft Excel and the number (count) of Close, Moderate and Far categories were totalled for each land parcel. Each land parcel was then assigned a category of ‘Optimal’, ‘Least Suitable’ or ‘Suitable’ to differentiate between relative ecological preference between plots. The following thresholds were used to provide a single descriptor of ecological preference:

- a. Optimal: assigned to parcels with a count of more than three ‘Close’ descriptors and less than two ‘Far’ descriptors
- b. Least Suitable: assigned to parcels with a count of less than one ‘Close’ descriptors and greater than three ‘Far’ descriptors
- c. Suitable: assigned to all parcels not categorised as Optimal or Least suitable

7.4.28 The category was then finally checked against the area descriptor and any land parcels that had been recorded as both Suitable and Large were upgraded too Optimal and those that were Suitable and Small downgraded to Least Suitable.

7.4.29 The final data set was then re-joined to the AQ Land parcels geodatabase in GIS and the land parcels mapped according to the ecological suitability as shown on Plate 7.2.

Plate 7.2 Ecological suitability within the macro areas



Site selection refinement

LPA engagement

- 7.4.30 In parallel to the site feasibility and ecological suitability process described above, The Applicant engaged with the relevant LPAs within the search areas and asked them to suggest potential sites that could feed into the long list assessment of compensation sites, which met the following criteria:
- Within or adjacent to the search area of interest
 - Not already planted and suitable for habitat creation (i.e. where there was sufficient space to plant e.g. scattered trees were acceptable)
 - Not allocated for development

- d. Not within 200m of the ARN (as these areas could experience nitrogen deposition effects which were being compensated for)
- e. Not essential, but within existing fragmented woodland

7.4.31 Table 7.4 summarises the outcome of the engagement and identifies potential compensation sites identified by the LPAs. These sites were reviewed in Review Workshop 3 on 14th and 15th December 2021. Further information is provided in paragraph 7.4.32(d).

Table 7.4 Summary of engagement with LPAs

LPA	Potential compensation sites identified by LPAs
London Borough of Havering	<p>A request was issued to LB Havering Thurrock Council on 26th November 2021. A response was received on 8th December 2021 which included the following 9 parcels of land. All identified sites are south of M25 junction 29, are grouped east and west of the M25 and referenced P1 to P9.</p> <ul style="list-style-type: none"> • P1–P4: Four parcels of land adjacent to each other, totalling approximately 20ha. Located approximately 200m west of the Thames Chase Forest Centre Site of Importance Nature Conservation (SINC) • P5: 8ha parcel of land located west of junction 29 and immediately north of Franks Wood designated (ancient woodland) and Cranham Brickfields local nature reserve (LNR). • P6: 45ha parcel of land located south of Cranham Hall and immediately east of Cranham Marsh LNR and Spring Wood Ancient Woodland. Parcel includes existing woodland, Middle Wood and Bonus Wood. • P7–P9: three parcels close to each other, totalling approximately 35ha. Located east of M25. Nearest designated ecological site is Clay Tye Wood, located approximately 500m west.
Brentwood Borough Council (BBC) and Essex County Council (ECC)	<p>A request was issued to BBC on 24th November 2021. Joint meeting held with BBC and ECC on 15th December 2021 to discuss nitrogen deposition planting requirements, habitat creation site selection methodology and feedback from BCC and ECC on potential sites (in addition to Hole Farm which is owned by National Highways). The group discussed options to link with existing woodland:</p> <ul style="list-style-type: none"> • BCC noted they own land east of Holden's Wood and heading towards Thorndon plus a T shape going to the north of Hole Farm. • ECC highlighted that linking Hole Farm to Boyle's Court Farm to the north and Codham Hall to the south would be valuable.
Thurrock Council	A request was issued to Thurrock Council on 19 th November 2021. A response was received on 26 th November, with further

LPA	Potential compensation sites identified by LPAs
	<p>discussions throughout December 2021. The following sites were suggested by Thurrock on 26th November and 15th December:</p> <ul style="list-style-type: none"> • Suggested 26th November 2021 • Land south of Chadwell St Mary – approximately 6ha: This site is council-owned and is maintained as public open space. • Buckingham Hill Landfill – approximately 26ha: This council-owned site has been put forward previously as having potential for short-rotation coppice. • The Scrape – approximately 11ha: This site is just outside the area of interest. • Suggested 15th December 2021 • Langdon Hill – approximately 19ha: This site lies outside the search area identified for suitable habitat creation.
Gravesham Borough Council	<p>A request was issued to Gravesham Borough Council on 18th November 2021. A response was received on 2nd December 2021 which included.</p> <p><u>Eastern side of Gravesend (south of A2 Watling Street/west of Jeskyns Community woodland)</u></p> <ul style="list-style-type: none"> • Plot E1 – approximately 4.5ha - open grassland and some trees and probably HS1 owned • Plot E2 – approximately 5.8ha – agricultural land with southern boundary which is an existing field boundary • Plot E3 – approximately 12.1ha –agricultural land with a southern boundary that appears to follow a former field boundary <p>These plots would add up to approximately 22.4ha, with the opportunity to potentially expand south of Plot E2 (extra 14.1ha) if considered appropriate. Potential to connect to new planting assumed to be along the lines of the existing HS1 – i.e., trees/shrubs with glades.</p> <p><u>Western side of Gravesend (south of A2 Watling Street/ west of A227 Wrotham Road)</u></p> <ul style="list-style-type: none"> • Plot W1 – agricultural land approximately 3.9ha • Plot W2 – part of a much larger field with W4 and part of W3 – approximately 4.8ha • Plot W3 – agricultural land with an existing hedge line for part pf the southern boundary and an arbitrary line to meet W2 and existing HS1 planting – approximately 5.4ha • Plot W4 – agricultural land linking W2 and W3 but with bridleway NU27 splitting north – south and bridleway NU28 forming a southern boundary – approximately 5.7ha • Plot W5 – agricultural land with field boundary, taken bridleway NU28 as southern boundary but could expand slightly further to a field boundary to the south – approximately 8.6ha

LPA	Potential compensation sites identified by LPAs
	Gravesham considered that the approach could be expanded further west to Pepper Hill.
Medway Council	No potential sites proposed
Tonbridge and Malling District	No potential sites proposed
Maidstone Borough Council	No potential sites proposed

Multi-disciplinary Review

7.4.32 The land parcels that were mapped as Optimal or Suitable were then reviewed by a multi-disciplinary group of competent experts advising the Applicant, including heritage, landscape, utilities, land referencing and planning. The competent experts provided their opinions on the likely outcomes for their disciplines on the implications of habitat creation on the identified plots. The outputs from the specialist teams’ assessments were reviewed further in a series of workshops attended by each specialist team. A workshop was held for each Area of Interest, and sites reviewed individually. The series of workshops that refined the potential compensation areas in the following sequential phases comprised:

- a. Review Workshop 1 (6th to 9th December 2021) reviewed each of the Optimal and Suitable land parcels (see Plate 7.2) that was not already shown to be constrained by overlap with nature conservation designations, flood risk areas common land or cultural heritage assets (as described in paragraph 7.4.20) and assigned a category of ‘Acceptable’, ‘Acceptable with caveats’ or ‘Unacceptable’ based on the criteria in Table 7.5. Where assessments concluded that sites were unacceptable for one topic area the land parcels were discounted.

Table 7.5 Site selection refinement criteria

Topic/ suitability	Unacceptable	Acceptable with caveats	Acceptable	Unknown
Landscape and visual	Planting would detract from or be at odds with existing landscape character or landscape pattern or detract from valued views. For example, would propose woodland planting block any valued views in terms of views with special qualities of the Kent Downs AONB (Dramatic views); public right of way (PRoW), especially long-distance footpaths or community views, e.g., edge of settlement	Some constraints which could be managed, e.g. to maintain views so planting options need to be cognisant of this.	No obvious constraints. May be beneficial, e.g. reinforce existing landscape character.	Where sufficient information is not available on the site. For example, where there is no information on archaeology, or the site is located outside of study area do not have information
Cultural heritage	Planting would result significant change in setting of key heritage features such as listed buildings.	Recorded archaeology but can be mitigated or avoided by planting. No setting impacts. No information on archaeology. Adjacent to CA, so planting needs to be restricted at eastern end of parcel.	Site appears to have been previously disturbed so unlikely to have impacts to archaeology. No setting impacts likely.	
Agricultural Land Classification	Grade 1 agricultural land not adjacent to the Order Limits and currently not impacted by the Project.	Grade 1 agricultural land adjacent to the Order limits and currently not impacted by the Project /Grade 2 agricultural land	Not classified as agricultural land	
Topics which did not use suitability categories				
Ecology	Consideration of suitability based on connectivity/proximity to affected ecological sites/ existing ecology and link to objectives within the Project's Environment Masterplan.			
Planning	Consideration of suitability based on planning policy requirements, in some instances planting would support planning policy.			
Land and property	Consideration of known landowner information including where landowner has expressed desire to sell. Acknowledged that suitability would depend on engagement with landowners.			

Topic/ suitability	Unacceptable	Acceptable with caveats	Acceptable	Unknown
Soils and geology	In addition to agricultural land classification, consideration of known ground conditions/constraints.			
Utilities	Consideration of known existing utilities and restrictions relating to these such as easements.			

- b. Review Workshop 2 (10th and 13th December 2021) reviewed each land parcel that was identified at Workshop 1 as Acceptable or Acceptable with caveats (see Plate 7.3).
 - i. The rating allocated at Workshop 1 was reviewed to ensure consistency and refined to identify parcels that would provide sufficient ecological extent and connectivity to fully compensate impacts from nitrogen deposition in the network, but also pose minimal risk of causing unacceptable impacts, i.e., would be likely to have major significant effects on other receptors and so be unacceptable in planning terms if alternatives were available.
 - ii. The refinement considered the flexibility within each site in terms of the identified constraints (acceptable with caveats) to allow habitat creation with minimal risk of measures proving to be unacceptable.
 - iii. Land parcels considered to have minimal risk of unacceptable constraints were compared with the 'optimal' and 'suitable' ecological preference categories (see Section 7.4 on ecological suitability analysis).
 - iv. Parcels with the highest ecological preference were taken forward. Whilst 'optimal' and 'suitable' ecological preference categories were assessed, it was considered by the competent experts that multiple additional connectivity points were the core differentiator between parcels with acceptable constraint risks. All ecological preference categories were considered to have the potential for providing sufficient compensation during the whole analysis, but there would be less certainty for the lower preference categories that the measures would fully compensate the impacts. If no optimal ecological preference parcels had been available, lower preference parcels would have been proposed on the basis that the lower certainty would be the best available solution.
- c. The multi-disciplinary assessment reviewed the land parcels that were considered to have potential to provide a successful compensation site in workshops 1 & 2. Each of these land parcels or groups of land parcels were uniquely identified with the MAoI identifier and a letter, A, B, C, D (see Plate 7.4).
- d. Review Workshop 3 (14th and 15th December 2021) was the final review stage specifically reviewed each potential area to propose within the Order Limits as compensation areas to be subject to public consultation. The review included:
 - i. Further refinement of the ecological preference (connectivity and size).

- ii. The degree to which such parcels might impact on businesses (using knowledge of landownership and accessibility).
- iii. Feedback on the efficacy of compensation more generally provided during consultation with Natural England.
- iv. The degree to which parcels would need to be acquired compulsorily (e.g., whether the parcel was already owned by National Highways, was a site identified by the LPAs, or where consultation with landowners had indicated that agreement on acquisition might be possible). Not having to compulsorily acquire land was a differentiator where equally suitable options were available on ecological and constraints basis.
- v. A further review included assessing the number and size of land parcels that should be taken forward to ensure the overall package of proposed sites was comparable with the effects across the four search areas.

7.4.33 Plate 7.3 to Plate 7.5 illustrate the outputs created as result of each workshop.

Plate 7.3 GIS output of Review Workshop 1

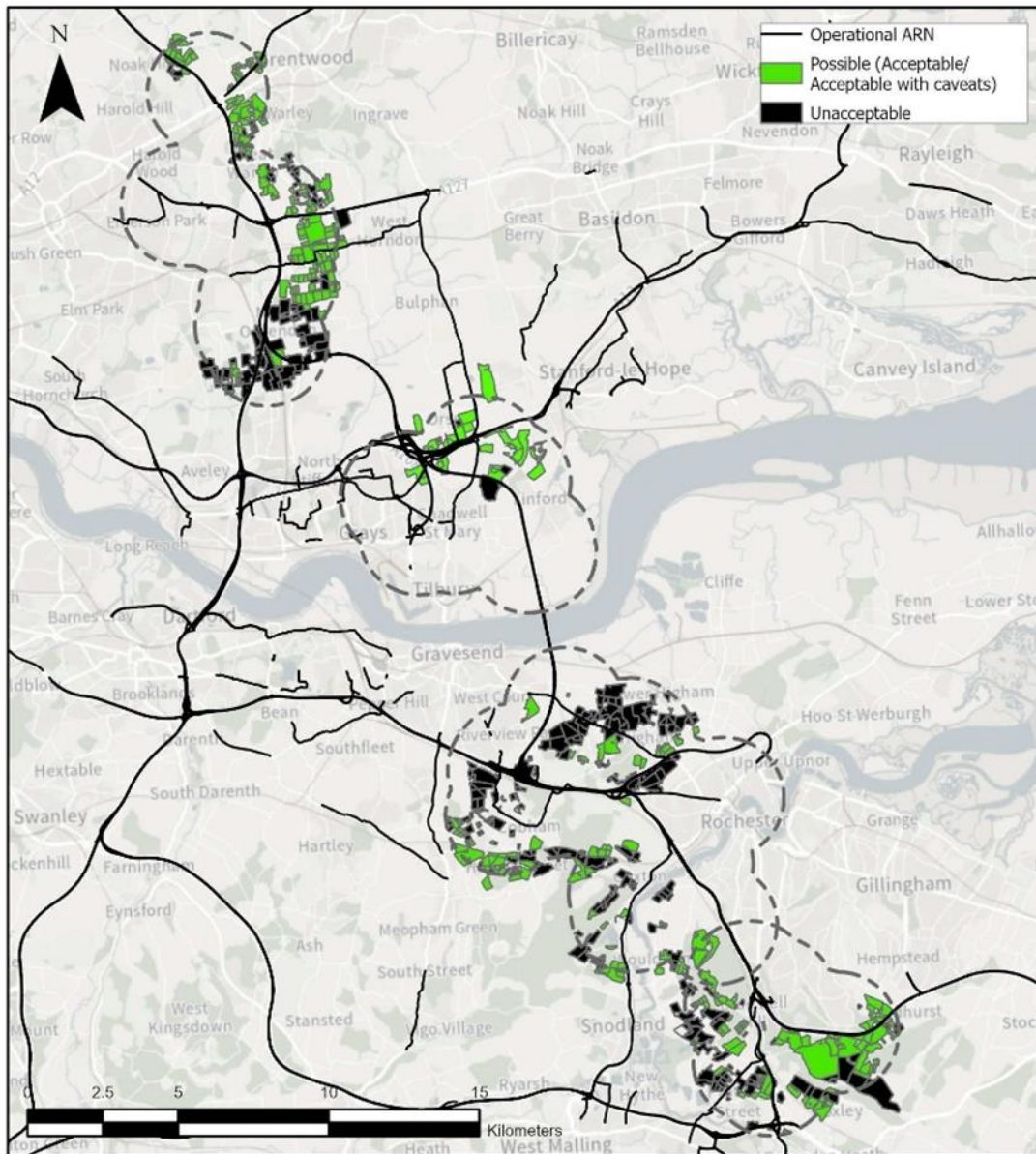


Plate 7.4 GIS output of Review Workshop 2

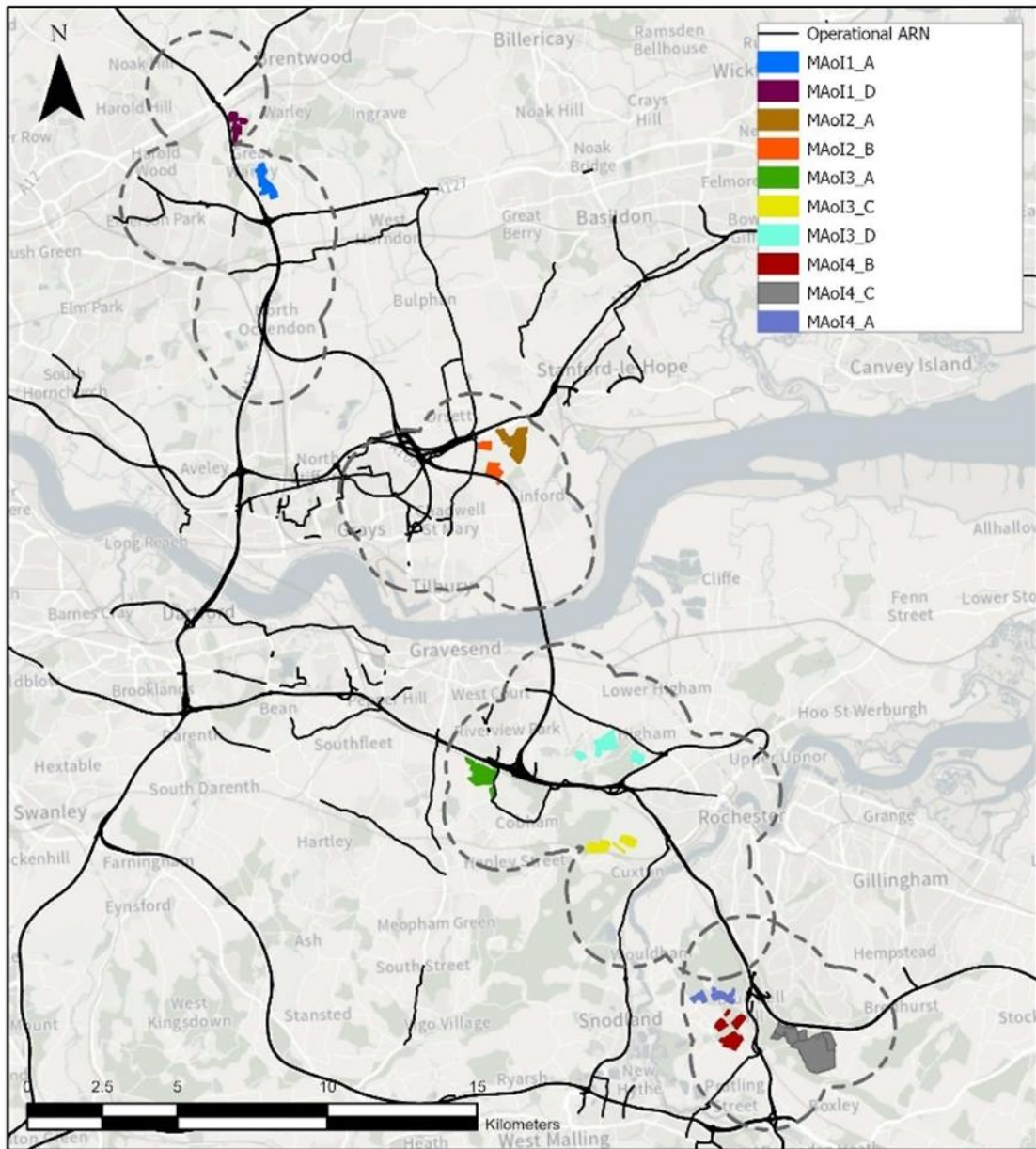
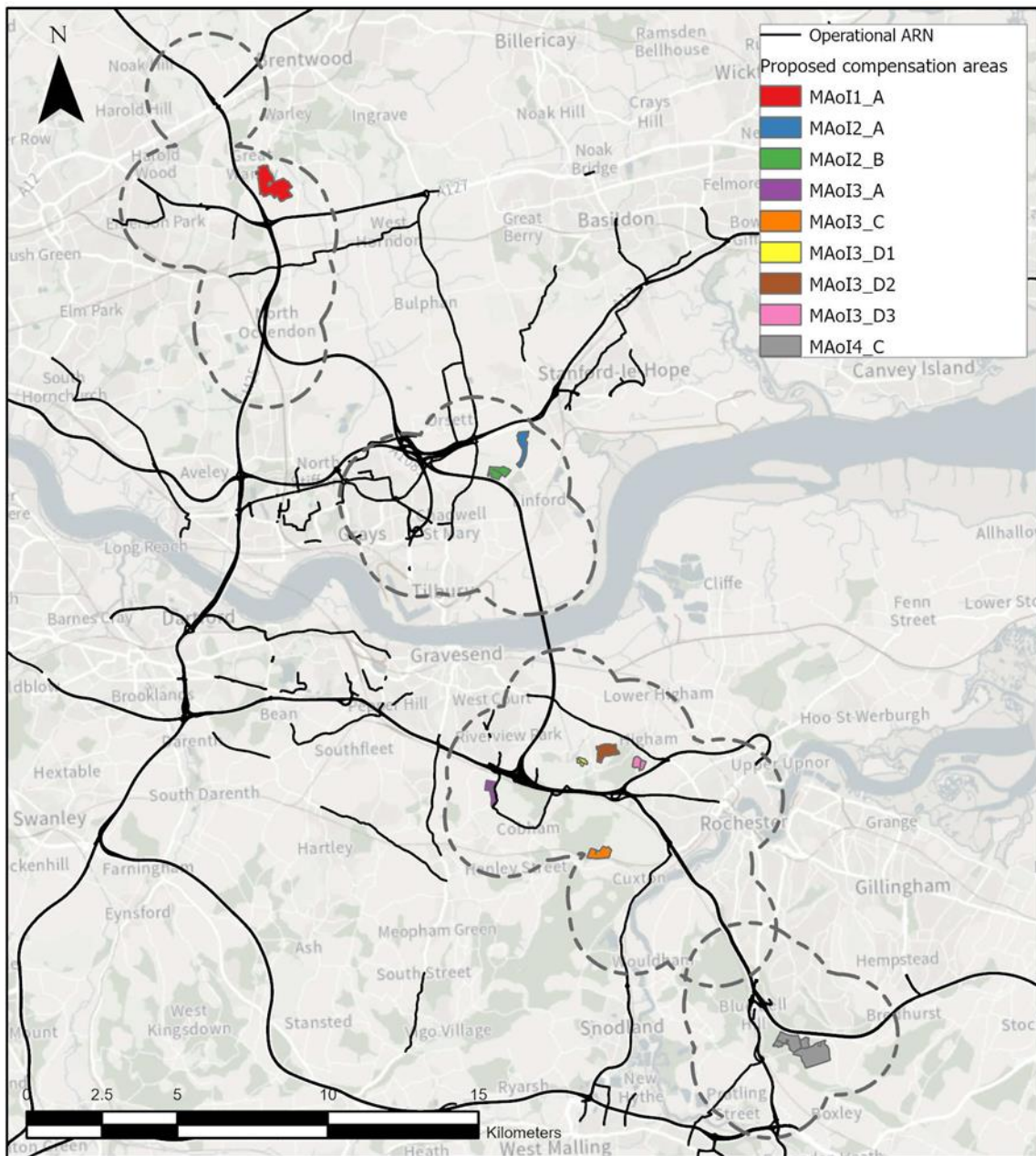


Plate 7.5 GIS output of Review Workshop 3



Post workshop refinements prior to public consultation

7.4.34

Prior to finalisation of proposals for consultation, selected parcels were refined after detailed checking against land registry and agreements with landowners, as well as in response to comments received from landowners who were contacted prior to the public consultation. Refinements included the following:

- a. Removal of land parcel MAoI3_C after consultation with the landowner and detailed checking identified it be unsuitable as it is a priority grassland habitat, which would preclude it as it has existing biodiversity value. The priority habitat dataset had not formed part of the selection criteria during the analysis and workshops.

- b. Minor boundary amendments to reflect commitments for landowners to retain land when National Highways originally bought the land.
- c. Minor boundary amendment to reflect the “on ground” reality of an ownership parcel which was not in line with land registry data.

7.4.35 Following these refinements, the Order Limits were amended for public consultation (See Table 7.6).

Table 7.6 Land parcels proposed for public consultation

Land parcel	Primary rationale for suitability (acknowledging that all sites proposed have minimal risk of resulting in significant impacts)	Compulsory acquisition considerations
MAoI 1_A Hole Farm	Large scale and multiple connections between existing ecological network features. Adjacent to other Project ecological measures. Benefits of dual functions available for enhancement of the Community Forest.	Already owned by National Highways
MAoI 2_A Thurrock 1	Multiple connections between existing ecological network features.	Suggested and owned by public body (Thurrock Council)
MAoI 2_B Thurrock 2	Multiple connections between existing ecological network features.	Privately owned. No (or insufficient) publicly owned land suitable in the area. No indication of willingness to sell at start of public consultation.
MAoI 3_A Shorne Woods 1	Multiple connections between existing ecological network features. Adjacent to other Project ecological measures.	
MAoI 3_D1 Shorne Woods 2	Multiple connections between existing ecological network features.	
MAoI 3_D2 Shorne Woods 3	Multiple connections between existing ecological network features.	
MAoI 3_D3 Shorne Woods 4	Multiple connections between existing ecological network features.	
MAoI 4_C Blue Bell Hill	Large scale and multiple connections between existing ecological network features. Part of a landholding (not entire business). Benefits of dual functions available for enhancement of the AONB.	

Amendments in the light of consultation responses

7.4.36 Consultation responses received included the following:

- a. Alternative sites for habitat creation proposed by consultees

- b. Significant impacts/concerns described by consultees
- c. Potential environmental implications
- d. Potential business extinguishment
- e. Potential loss of income and development potential
- f. Methodological concerns
- g. Alternative strategic approaches to compensation
- h. Assumptions made in methodology

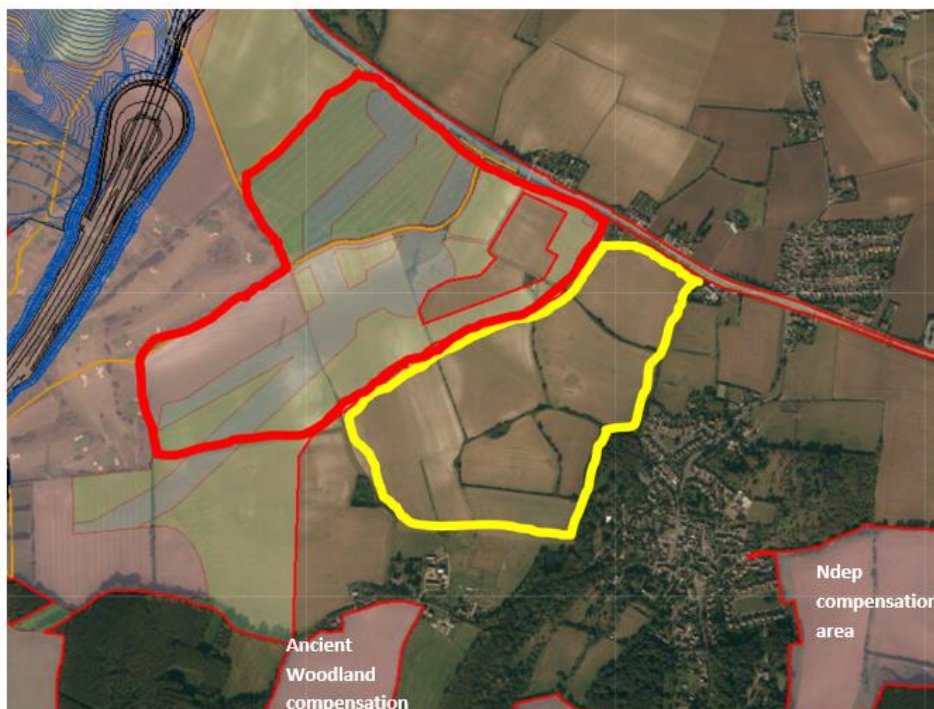
7.4.37 Alternative sites were reviewed by investigating the assessment undertaken during earlier stages of the site selection methodology to identify whether they had already been discounted.

Alternative sites for habitat creation proposed by consultees

7.4.38 Alternative sites for habitat creation were proposed by the owners of N deposition compensation areas proposed in the public consultation (two sites). One was located close to Shorne Woods (referred to as Site A shown in Plate 7.6) and the second close to the Blue Bell Hill Site (referred to as Site B shown in Plate 7.7).

Alternative site considered at Shorne Woods (Site A)

Plate 7.6 Alternative site considered at Shorne Woods (Site A)



7.4.39 The site outlined red and yellow shown in Plate 7.6 was proposed as an alternative to the compensation site shown on the bottom right of Plate 7.6. The

alternative site land is arable, measures approximately 93.4ha and was on the open market when considered.

Assessment of suitability:

(i) Landscape and visual

- 7.4.40 Site A comprises open arable land to the north-west of the distinctive wooded ridge along at Shorne Ridgeway, on the northern margin of the Kent Downs Area of Outstanding Natural Beauty (AONB). The three N deposition compensation sites located in Shorne Woods are contiguous with the wooded ridge and proposed woodland habitat on these sites would therefore reinforce the existing landscape character of the Shorne Wooded Slopes local landscape character area. By contrast, the alternative (Site A) occupies more open agricultural land, falling towards the A226. This open arable farmland provides a setting to the wooded ridge, also seen in distant views from across the River Thames.
- 7.4.41 The establishment of predominantly woodland habitat on Site A would be substantially at odds with existing local landscape character and is likely to trigger significant adverse landscape effects. It would also curtail dramatic panoramic views over the Thames Estuary from local PRoWs. Establishment of predominantly woodland habitat on this land is also likely to raise concerns with stakeholders in terms of changing the open landscape character, which forms part of the setting of the Kent Downs AONB. The AONB Unit feel strongly about retaining open views in accordance keeping with the existing landscape character, as do Gravesham Borough Council.
- 7.4.42 The only habitat likely to be acceptable in terms of maintaining the existing open landscape setting to the wooded ridgeline would be one which retained the openness i.e., only grassland. Other types of habitat, for example, scattered scrub, would change the existing farmland character. A predominantly grassland habitat would not achieve the ecology aims for the N deposition compensation (see below).

(ii) Cultural heritage

- 7.4.43 Site A lies to the west and northwest of the Shorne Conservation Area. The wider setting of the Conservation Area includes the gently rolling open agricultural landscape to the north, part of which is Site A. The visual enclosure of the Conservation Area, with the former heathland rising to the long-established wooded ridge also contributes to the setting of the Conservation Area.
- 7.4.44 The establishment of predominantly woodland habitat on Site A would adversely impact the setting of the Conservation Area.

(iii) Ecology

- 7.4.45 This site was considered in the assessment and discounted on ecological grounds (as well as the landscape and cultural heritage constraints above) as any habitat creation here would only extend existing woodland habitats / sites but add no significant connectivity to the network of woodland habitats. The proposed compensation sites in this area would connect currently isolated habitats / sites as well as extending the habitat area. The combination of additional extent and additional connectivity is what provides the additional

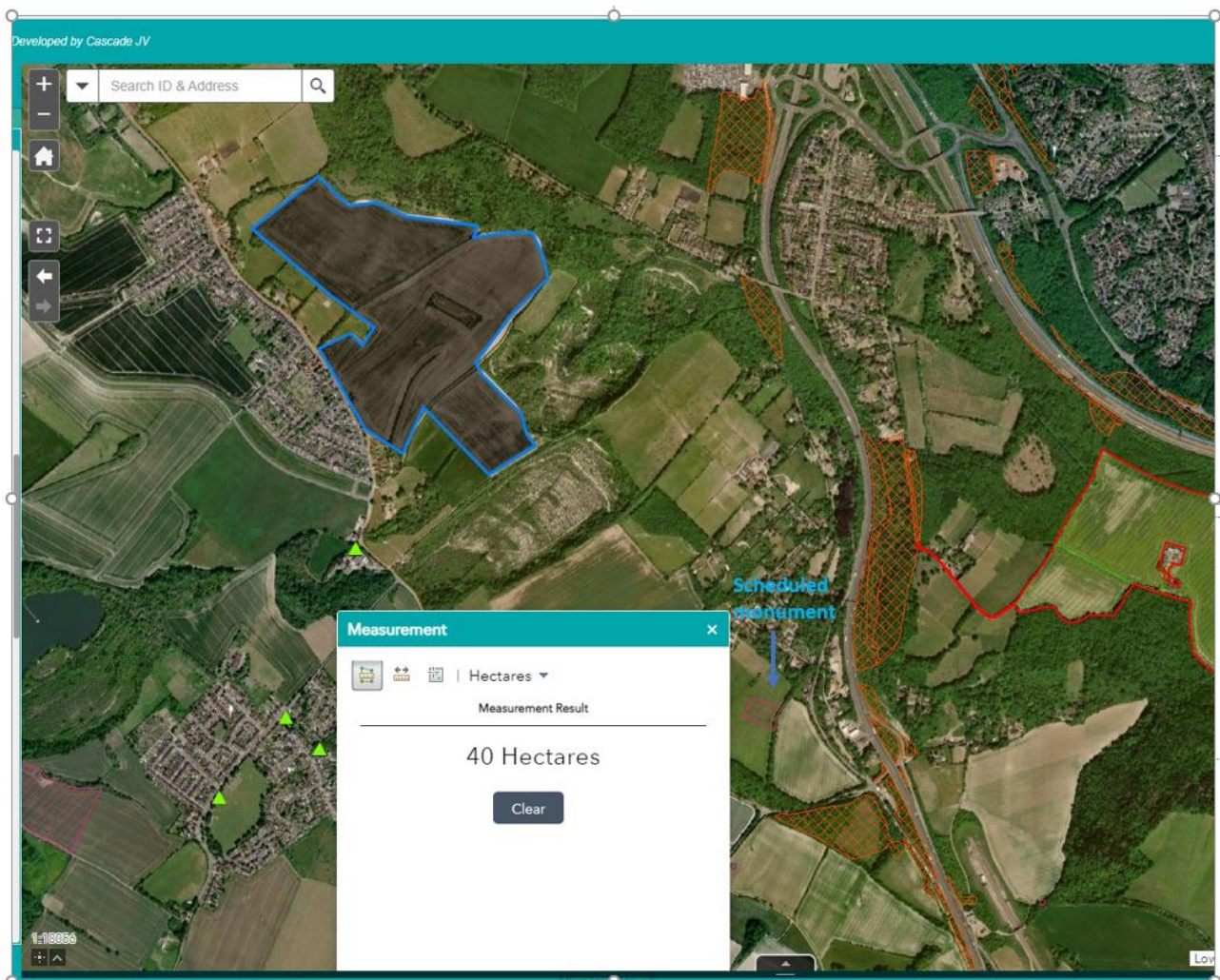
resilience to the habitat network and so compensate for the effects on designated sites.

Conclusion

7.4.46 The alternative Site A is not considered to be a viable alternative for N deposition compensation as the degree of additional ecological connectivity to enhance resilience of the network would be insignificant. Additional connectivity is a critical element of the N deposition compensation. Whilst any habitat creation would add biodiversity benefits, the methodology for identifying suitable land for the N deposition impact requires both additional extent and connectivity. Additionally, this alternative would result in significant adverse environmental visual effects on the openness of the landscape character and cultural heritage settings. The alternative would also result in effects on Shorne village conversation area. This alternative is not supported by Kent Downs AONB and unlikely to be supported by stakeholders such as the Gravesham Borough Council.

Alternative site considered at Burham (Site B)

Plate 7.7 Alternative site considered at Burham (Site B)



- 7.4.47 The site outlined blue shown in Plate 7.7 was proposed as an alternative by the landowner of the Blue Bell Hill compensation site, which is owned by the same landowner.
- Assessment of suitability:*
- (i) *Landscape and visual*
- 7.4.48 The alternative Site B ('land at Burham') comprises open arable land within the Kent Downs AONB, rising north-eastwards from Burham to a distinctive wooded scarp on the skyline. The combination of rising arable land and the backdrop wooded scarp comprises an attractive panoramic view seen from Rochester Road on the edge of Burham and from the PRoWs that cross existing fields.
- 7.4.49 The establishment of predominantly woodland habitat on Site B would result in the loss of attractive panoramic views and is likely to trigger significant adverse landscape and visual effects. It would not be practical to effectively mitigate this change in landscape character and consequent loss of views through landscape design principles, given the key landscape characteristics. The change in landscape character is also likely to raise concerns with stakeholders in relation to the Kent Downs AONB.
- 7.4.50 The only habitat likely to be acceptable in terms of maintaining the existing open landscape setting to the wooded ridgeline would be one which retained the openness i.e., only grassland. Other types of habitat, for example, scattered scrub planting, would change the existing farmland character. A predominantly grassland habitat would not achieve the ecological aims for the N deposition compensation (see below).
- (ii) *Cultural heritage*
- 7.4.51 There is a designated asset (Kit's Coty House Long Barrow Scheduled Monument) within approximately 1km of the boundary of the alternative site (see Plate 7.7). Despite the presence of the designated asset (Scheduled Monument), there are currently no views to or from the designated asset or the proposed alternative land at Burham site of the Scheduled Monument. Therefore, there will be no impact on the setting of the Scheduled Monument or the enjoyment of the monument. This means there are no limitations associated with using the alternative site from a cultural heritage perspective.
- (iii) *Ecology*
- 7.4.52 This site was considered in the assessment and discounted on ecological grounds (as well as the landscape constraints above) as any habitat creation here would only extend existing woodland habitats / sites but add no significant connectivity to the network of woodland habitats. The proposed site in this area would connect currently isolated habitats / sites as well as extending the habitat area. The combination of additional extent and additional connectivity is what provides the additional resilience to the habitat network and so compensate for the effects on designated sites.
- (iv) *Kent Downs AONB*
- 7.4.53 The alternative site proposed, Site B, is significantly smaller than the currently proposed Blue Bell Hill site. This would have an effect on the Applicant's ability

to deliver the landscape scale mosaic approach supported by Kent Downs AONB.

Conclusion

7.4.54 The alternative site proposed, Site B, is not suitable for N deposition compensation as a direct replacement for the proposed site at Blue Bell Hill. The land is not considered to be a viable alternative for N deposition compensation on its own as it is too small (compared to the site at Blue Bell Hill) and as the degree of additional ecological connectivity to enhance resilience of the network would be insignificant. Additional connectivity is a critical element of the N deposition compensation. Whilst any habitat creation would add biodiversity benefits, the methodology for identifying suitable land for the N deposition impact requires both additional extent and connectivity. Additionally, this alternative would result in significant adverse environmental visual effects on the openness of the landscape character and the Kent Downs AONB.

Hybrid option at Blue Bell Hill

7.4.55 In addition to reviewing the alternative land at Burham (Site B) as put forward by the landowner, a review was undertaken of the 105ha Blue Bell Hill site to see whether the extent of the site could be reduced to address comments made by the landowner. Two ‘hybrid’ options were considered (Plate 7.8).

Plate 7.8 Hybrid options considered at Blue Bell Hill



7.4.56 Option B1, would result in removing approximately 30ha from the southern field from the order limits. The boundary line for this option has been drawn based on the natural contour lines of the land. This removal would be offset by adding approximately 9.7ha from the proposed land at Burham option. This portion of

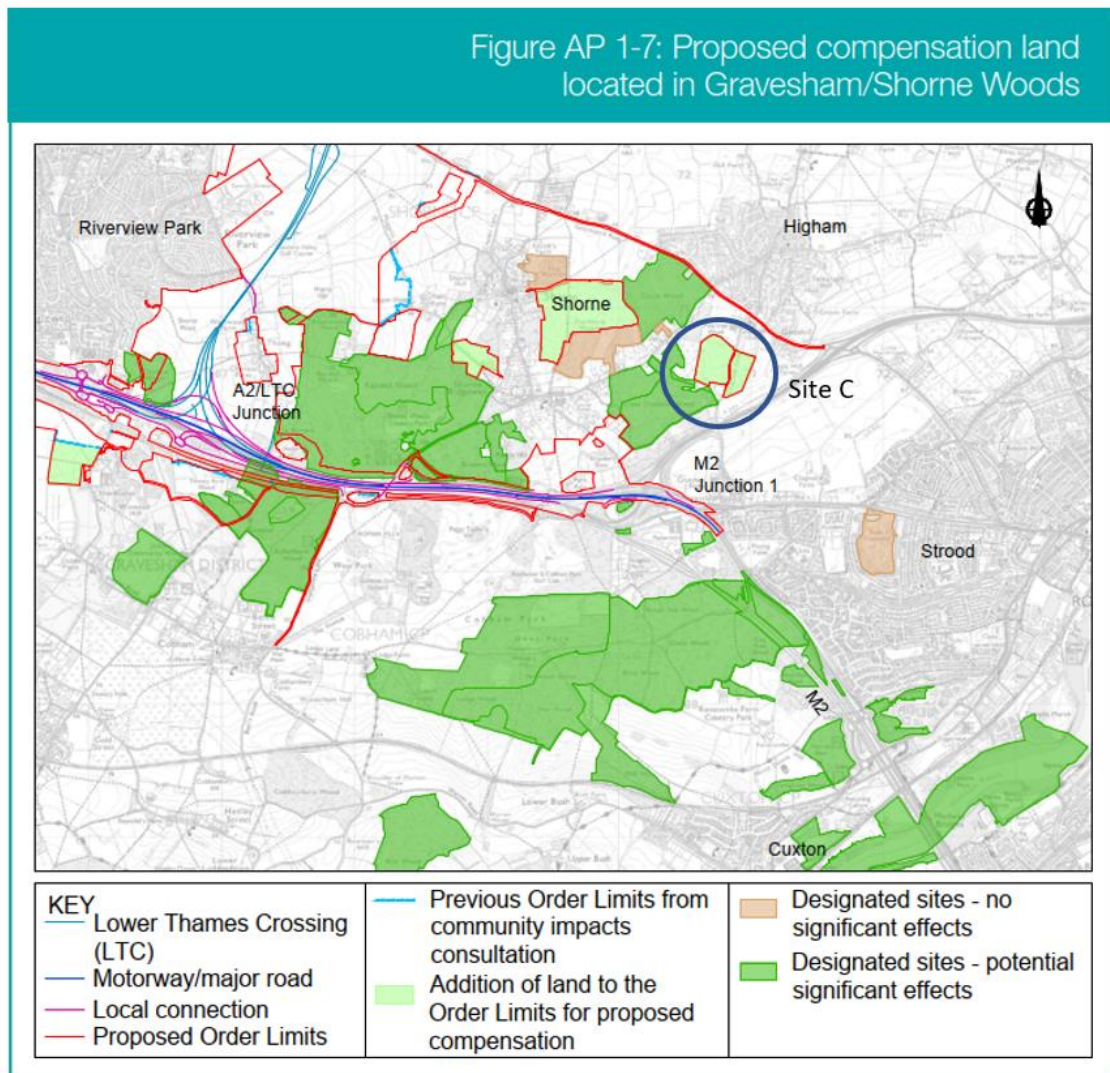
land at Burham is exempt from the environmental concerns raised in paragraphs 7.4.48 to 7.4.53 above

- 7.4.57 Option B2 is very similar to Option B1 with the difference being that the boundary line is based on the current boundary line. From a landscape and visual perspective this leaves a better shape field parcel to the south as it is more in keeping with existing farmland character; and also leaves a more viable shape of retained field to farm.
- 7.4.58 Reducing the land take from the southern field, as proposed in both options, would address comments by the landowner about the extent of land take. Additionally, this option would mean that the primary objective for N deposition would continue to be met through ecological connectivity.
- 7.4.59 The shape of Option B1 is least preferred from the landscape and visual perspective due to potential impacts on the views within the AONB as the southern field is currently relatively flat. As such option B1 was discounted in favour for Option B2.

Potential environmental implications

- 7.4.60 Natural England advised in their consultation response that one of the sites proposed at public consultation was in higher-level Stewardship and any implications of that should be considered.
- 7.4.61 A review of the implications of being within a higher-level stewardship agreement showed that the site (Site C, see Plate 7.9) would be unsuitable ecologically on the basis that land within such a scheme must be considered to have significant ecological value and to destroy that value to create a different habitat would be inappropriate. Earlier in the site selection process, sites with significant existing ecological value (such as designated sites and priority habitats) were discounted for the same reason.
- 7.4.62 It was concluded therefore that sites within higher level stewardship would be removed from the proposed compensation sites. Site C was therefore removed from the proposed compensation sites proposed.

Plate 7.9 Extract from Local Refinement Consultation Guide – location of Site C



Potential business extinguishment

- 7.4.63 Where consultation responses from landowners of proposed sites indicated a risk of business extinguishment, the boundaries of those sites were reviewed to investigate whether there were opportunities to reduce the amount of land acquired to minimise extinguishment risk, whilst still achieving the compensation objectives of maintaining the overall scale of the measures and ensuring additional ecological connectivity within the networks.
- 7.4.64 Two of the sites proposed at public consultation indicated the potential for business extinguishment.
- 7.4.65 Site C was reviewed for the potential to reduce the land acquired whilst maintaining the connectivity the original proposal achieved. It was identified that there were opportunities to reduce the acquisition of this site whilst maintaining the proposed connectivity, either by excluding one of the two fields or excluding the whole site. However, as the environmental considerations had led to the conclusion the whole site should be removed anyway, the options for minimising the acquisition were not progressed further as the business extinguishment risk had been removed.

- 7.4.66 The Blue Bell Hill site proposed at public consultation was also reviewed in the light of the potential to severely affect existing farming businesses which are based on the land. The landowner of this site suggested an alternative site (considered in paragraphs 7.4.47 to 7.4.54 above) and advised that business impacts would be reduced if the southern field at the Blue Bell Hill site were to be excluded from the acquisition. Options of excluding the whole or part of the southern field were reviewed (see paragraphs 7.4.55 to 7.4.59 above) for achievement of the N deposition objectives. Excluding the whole of the southern field was discounted as it would lead to reduced ecological connectivity. Additionally, it was considered that the southern field was the most likely area to create the highest quality new woodland due to it having been woodland habitat in relatively recent history.
- 7.4.67 Excluding part of the southern field was considered as an appropriate balance of achievement of the compensation objectives and minimising the business impacts. It was considered that reducing the acquisition of the southern field by approximately 30ha (Hybrid option at Blue Bell Hill, Option B2) would maintain all the additional ecological connectivity and maintain an overall scale of compensation to be comparable with the scale of significantly affected habitat. To facilitate the reduction in acquisition of the southern field, 5.5ha of land proposed by the landowner as an alternative site (Hybrid option at Blue Bell Hill, Option B2 above) was added to the proposals. This 5.5ha area was not excluded in the site selection process as being unsuitable, and so would provide suitable alternative to an equal area within the southern field.

Potential loss of income and development potential

- 7.4.68 A number of landowners of proposed compensation sites responded that the land held value for potential future development or ecological offsetting works for other developments in their ownership. The land acquisition process would include determination of the compensation payable for the acquisition of the land and no significant business impacts were identified.

Other alternatives considered at Blue Bell Hill

- 7.4.69 Ongoing engagement with landowners, following Local Refinement Consultation, resulted in other proposed alternatives being reviewed to ensure they had been discounted during previous stages of the site selection process.
- 7.4.70 Plate 7.10 and Plate 7.11 show the locations of the alternatives proposed by landowners and the constituent land plots that were used in the site selection process. These were grouped as; alternative sites east of the A229, site 1 to 3; and alternative sites west of the A229, site 1 and 2.

Plate 7.10 Alternative sites east of the A229 (proposed via landowner engagement)

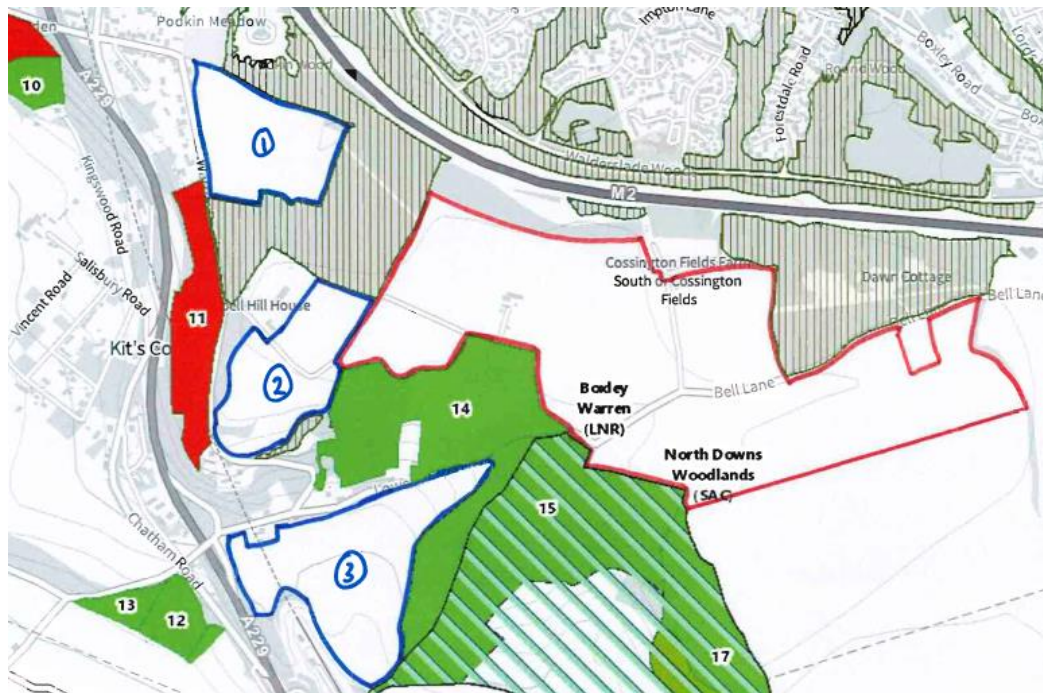
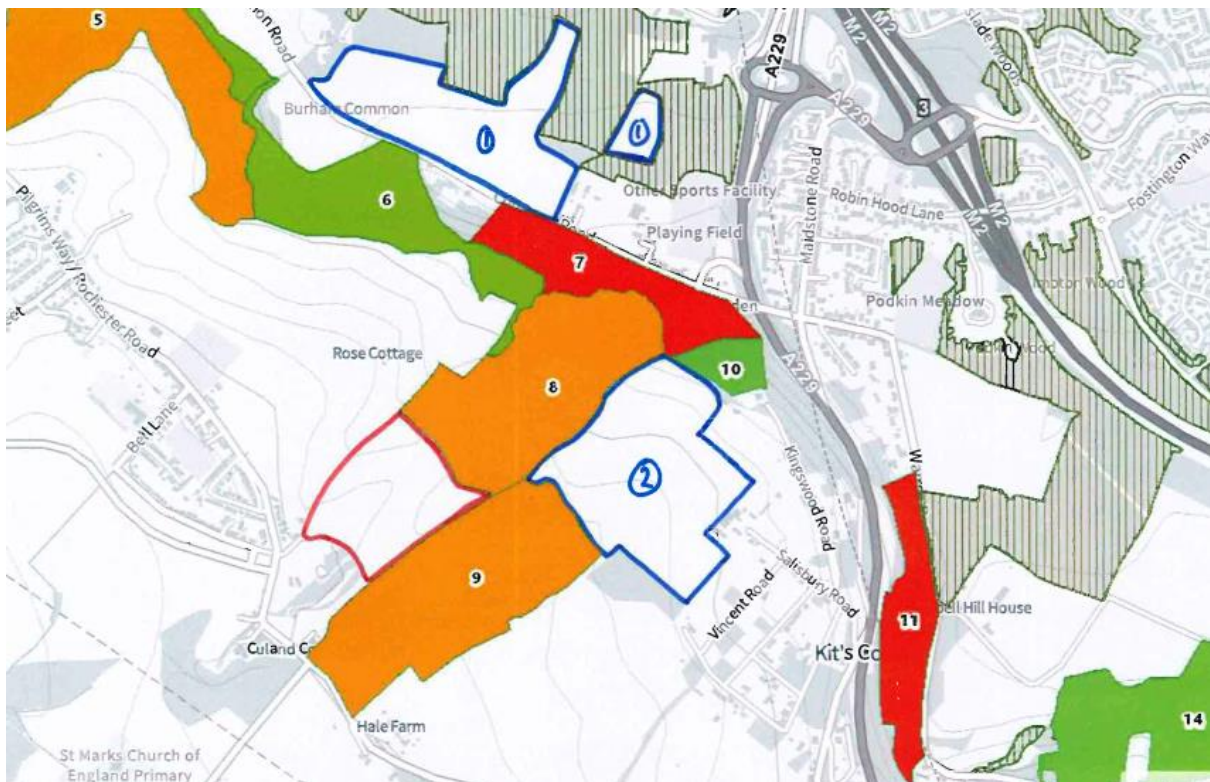


Plate 7.11 Alternative sites west of the A229 (proposed via landowner engagement)

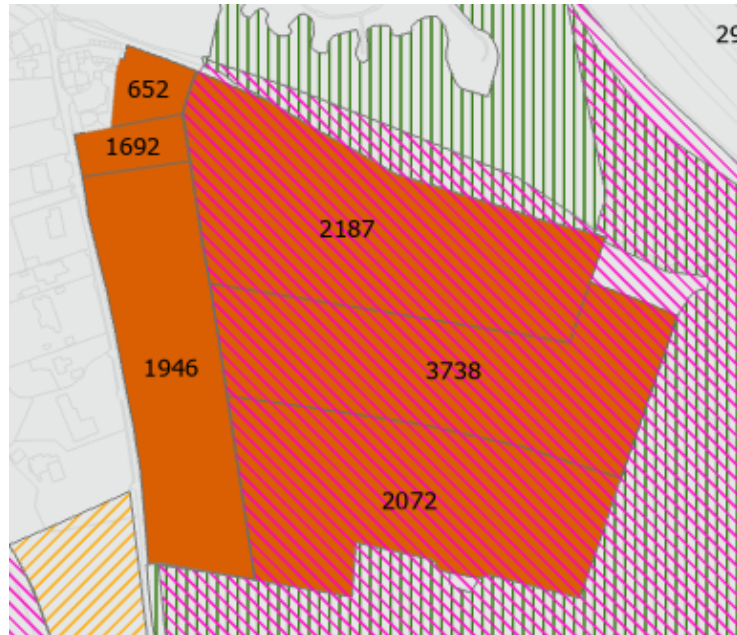


7.4.71 All the sites proposed were discounted during the site selection process as set out in the following paragraphs.

Alternative sites east of the A229

Site 1

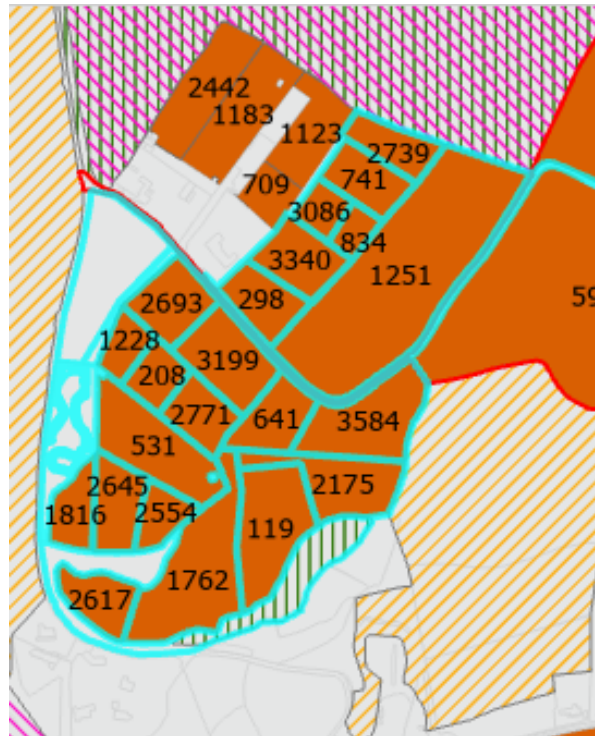
Plate 7.12 Site 1 east of the A229 – constituent land parcel IDs



- Constituent land parcels 652 and 1692 were in the least suitable ecological category and so would not provide sufficient additional connectivity.
- Constituent land parcel 1946 is a small site with no opportunity to make part of larger site and so would provide minimal additional habitat.
- Constituent land parcels 2187, 3739 and 2072 are part of a nature conservation designation (Frith Woods Etc., Kit's Coty LWS) therefore precluding from selection (see paragraph 7.4.32(a)).

Site 2

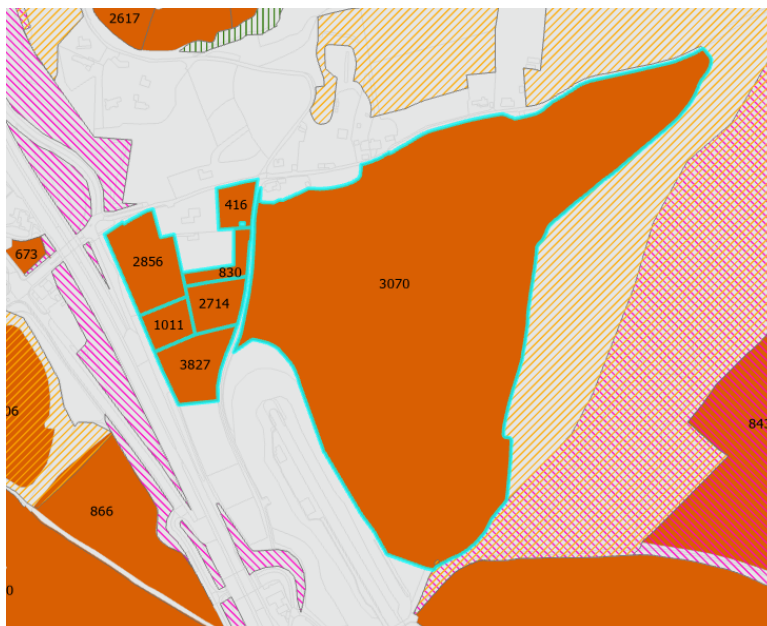
Plate 7.13 Site 2 east of the A229 – constituent land parcel IDs



- a. All constituent land parcels other than 1251 were in the least suitable ecological category and so would not provide sufficient additional connectivity.
- b. Constituent land parcel 1251 was considered to be unacceptable as a potential compensation site because of landscape effects of conflict with existing field pattern within the Kent Downs AONB.

Site 3

Plate 7.14 Site 3 east of the A229 – constituent land parcel IDs

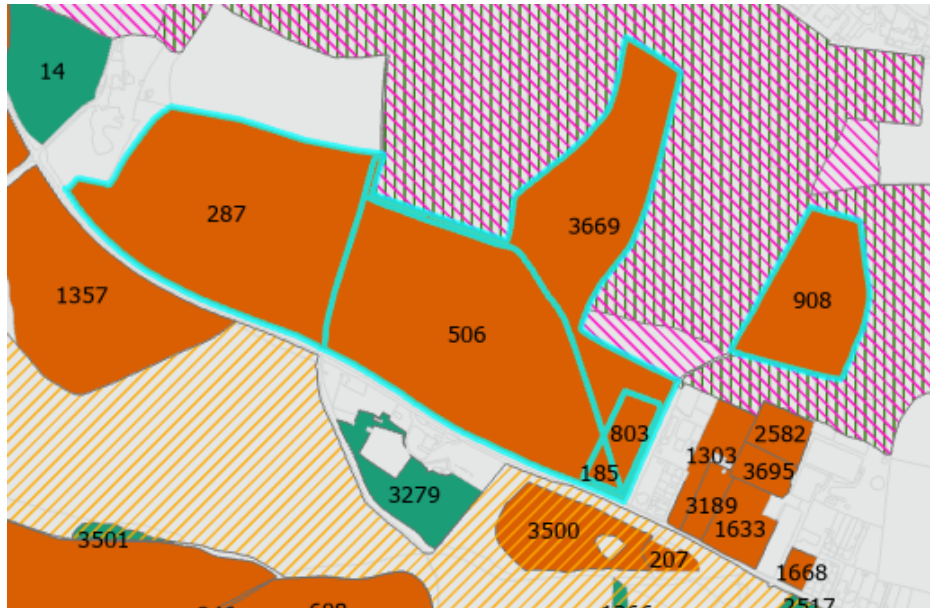


- a. All constituent land parcels other than 3070 were in the least suitable ecological category and so would not provide sufficient additional connectivity.
- b. Constituent land parcel 3070 part intersects a nature conservation designation (Wouldham to Detling Escarpment SSSI) therefore precluding it from selection (see paragraph 7.4.32).

Alternative sites west of the A229

Site 1

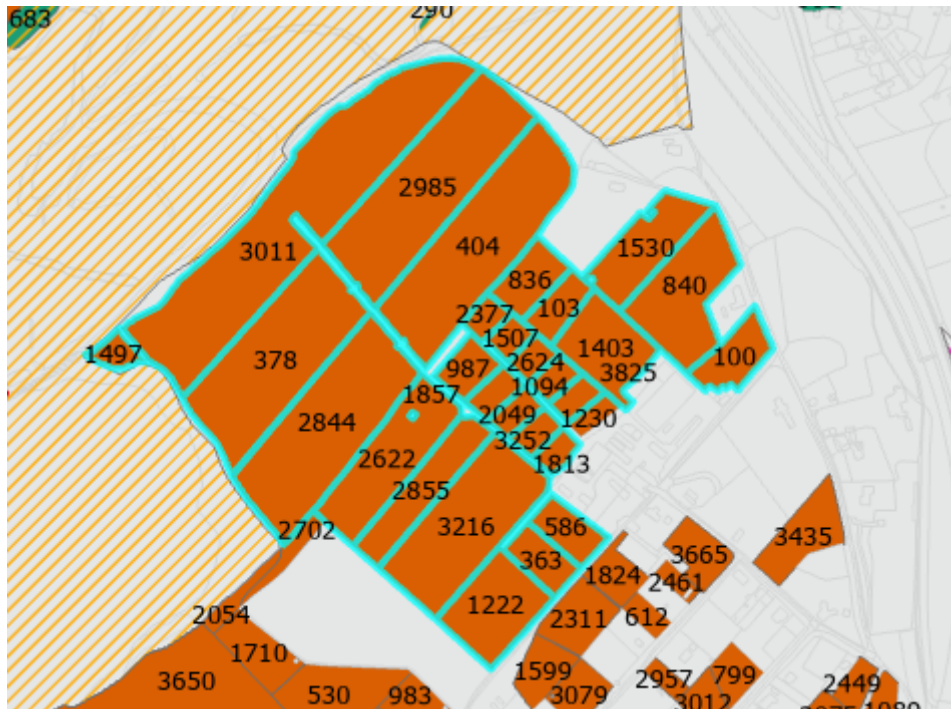
Plate 7.15 Site 1 west of the A229 – constituent land parcel IDs



- a. Constituent land parcels 287, 506 and 3669 were potentially constrained by landscape and utilities constraints and had limited additional ecological connectivity potential.
- b. Constituent land parcel 908 was considered to be unacceptable because of landscape effects of loss of variety within the Kent Downs AONB.
- c. Constituent land parcels 803 and 105 were in the least suitable ecological category and so would not provide sufficient additional connectivity.

Site 2

Plate 7.16 Site 2 west of the A229 – constituent land parcel IDs



- a. Constituent land parcels 2622, 2855, 122, 363, 586, 987, 1857, 2049, 3252, 1813, 2377, 1507, 2624, 1094, 3825, 1230, 836, 103, 1403, 1530, 840 and 100 were in the least suitable ecological category and so would not provide sufficient additional connectivity.
- b. Constituent land parcel 3216 was considered to be unacceptable because of landscape effects.
- c. Constituent land parcels 1497 part intersects a nature conservation designation (Wouldham to Detling Escarpment SSSI) therefore precluding it from selection (see paragraph 7.4.32(a)).
- d. Constituent land parcels 3011, 378, 2985, 2844 and 404 were considered as part of a possible grouping of smaller sites, but were discounted in favour of the proposed option due to there being clear business extinguishment risks for small livery yards and multiple small sites being less ecologically beneficial than larger sites.

Alternative strategic approaches to compensation

- 7.4.72 Landowner responses included questioning the methodology of site selection and suggesting alternative strategies such as managing other impacts on the affected designated sites rather than habitat creation. All such approaches have

been assessed and discounted, as reported in this document, and so no proposed changes in the compensation sites was considered appropriate.

Assumptions made in methodology

- 7.4.73 Landowner responses included questioning whether some assumptions in the site selection methodology were appropriate, such as questioning whether habitat creation worked or whether habitats mapped as priority habitats were actually of high value ecologically. The competent experts on biodiversity concluded that the assumptions used were valid and based on published guidance / case studies and/or data published by the government. No proposed changes to the compensation sites was considered appropriate.

Amendments to the public consultation proposals for N deposition compensation

- 7.4.74 In the light of the responses to the local refinement consultation, the proposals for N deposition compensation were refined as follows:
- a. Remove site C because of unacceptable environmental implications and risk of business extinguishment
 - b. Reduce the area of the Blue Bell Hill area to the south to minimise the risk of business extinguishment and add the part of the alternative site proposed by the landowner that had not been discounted during the site selection methodology

Review of proposals in light of final N deposition assessment results

- 7.4.75 The proposals for N deposition compensation, as amended in the light of the local refinement consultation, were then reviewed in light of the final N deposition assessment conclusions and survey work to ensure that the site selection methodology remained robust.
- 7.4.76 The distribution of sites assessed for significant effects from N deposition was remapped and a cluster analysis undertaken and compared to the cluster analysis carried out for the preliminary assessment. There was no significant difference in the clusters identified and therefore the original analysis was confirmed as still valid and appropriate for use to identify a search area and ecological networks to compensate within.
- 7.4.77 The extent of the final proposals for N deposition compensation was reviewed to ensure that the scale of habitat creation measures remained appropriate given the scale of significantly affected habitats, which is now assessed to be 176.4ha. The scale of habitat creation in the light of amendments in response to the local refinement consultation has been reduced from 279ha to 245.7ha. Whilst the gross area of N deposition compensation proposed exceeds the area of significantly affected habitat within designated sites, it is necessary to ensure that the land provides sufficient opportunity for new habitat creation, also taking account of its existing biodiversity value. Taking those factors into account, the area now proposed is considered sufficient to enable a broadly comparable scale of habitat creation to compensate for the scale of habitat impacted. It

should be noted that existing semi-natural habitats within the N deposition compensation areas would be enhanced where possible and managed to maximise biodiversity in the long term, which would add additional biodiversity benefits to the ecological network.

7.4.78 The additional connectivity created by the N deposition compensation proposals within the ecological networks was reviewed in light of the amendments to the proposals made in response to the local refinement consultation and the final N deposition assessment. No significant reductions in additional connectivity had occurred as a result of the amendments. As the review of the cluster analysis in light of the final N deposition assessment showed it had not changed significantly there was no requirement to provide additional connectivity than had been identified during the preliminary assessment.

7.5 Habitat management funding

Consideration of a N deposition Habitat Management Fund as additional compensation

7.5.1 As part of the Local Refinement Consultation in May 2022 the Applicant explained that it was considering establishing a habitat management fund to provide additional compensation for the risk of significant impacts from nitrogen deposition. The public consultation material stated, “If after carrying out additional assessment and engagement such a fund is considered necessary and appropriate, then details of the fund would be developed in conjunction with stakeholders, including engagement with specific landowners and managers”.

7.5.2 Following completion of the additional assessments and review of comments received from stakeholders on the Local Refinement Consultation, it is considered that the compensation proposals proposed as part of the Project are sufficient and a habitat management fund is not required in addition to support the compensation proposals.

7.6 Proposed compensation

7.6.1 The locations of the N deposition compensation areas are summarised in Table 7.7. Further information on these sites is provided in ES Chapter 2: Project Description (Application Document 6.1), the outline Landscape and Ecology Management Plan (oLEMP) (Application Document 6.7) and ES Appendix 8.22 Terrestrial Ecology Surveys at Nitrogen Deposition Compensation Sites (Application Document 6.3).

Table 7.7 Proposed compensation

Compensation site name (location)	Size (ha)	Details
Hole Farm East	75.2	Located within Brentwood. Site owned by National Highways.
Buckingham Hill	24.4	Site located within Thurrock. Former landfill site owned by Thurrock Council.
Hoford Road	21.6	Privately owned land located in Thurrock, located south of Orsett Golf course.

Compensation site name (location)	Size (ha)	Details
Henhurst Hill	9.1	Most western site within the Gravesham/Shorne cluster. Site is privately owned and currently farmed. Located south of the A2, close to Ashenbank Woods and Jeskyns community woodland.
Fenn Wood	5.8	Privately owned site which appears to be used for horse grazing, located south of Shorne Village adjacent to Fenn Wood.
Court Wood	27.7	Privately owned site agricultural land located in Shorne, in between Starmore Wood and Court Wood.
Blue Bell Hill	72.2	Privately owned site located south of M2 in Blue Bell hill.
Burham	9.7	Privately owned site east of Burham.

7.6.2 Plate 7.17 to Plate 7.20 show how the proposed compensation locations provide landscape scale habitat creation within existing ecological networks and how they provide additional ecological connectivity between existing ecological assets within the networks.

7.6.3 The Applicant continues to engage with stakeholders and landowners in developing the detailed design of the proposed habitat creation areas including in light of any further information that might become available. The Applicant will continue to engage with affected landowners to seek to mitigate impacts of land acquisition for N deposition compensation and reach voluntary agreements where practicable in consultation with Natural England and other stakeholders.

Plate 7.17 Hole Farm compensation site ecological network context

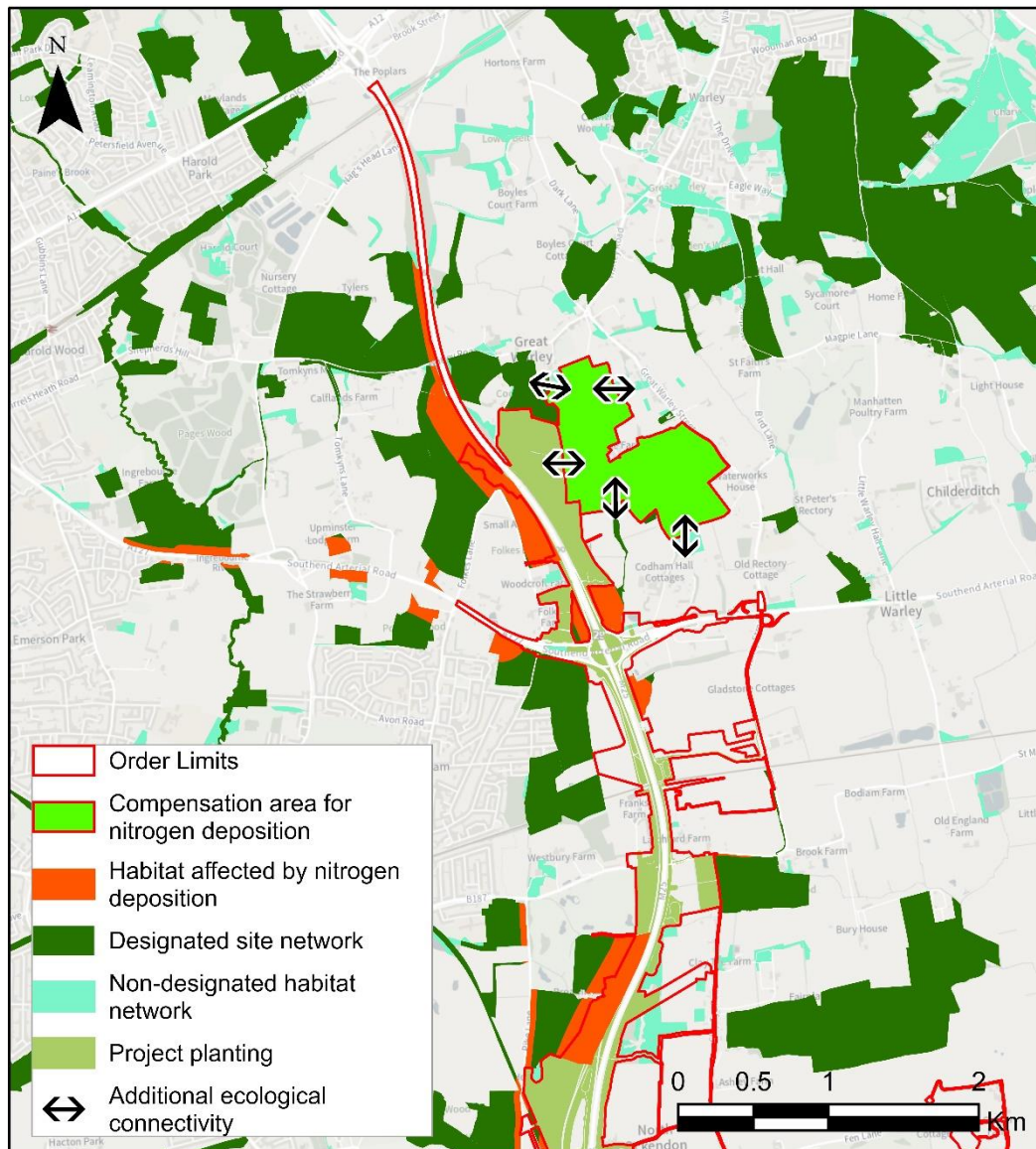


Plate 7.18 Buckingham Hill and Hoford Road compensation sites ecological network context

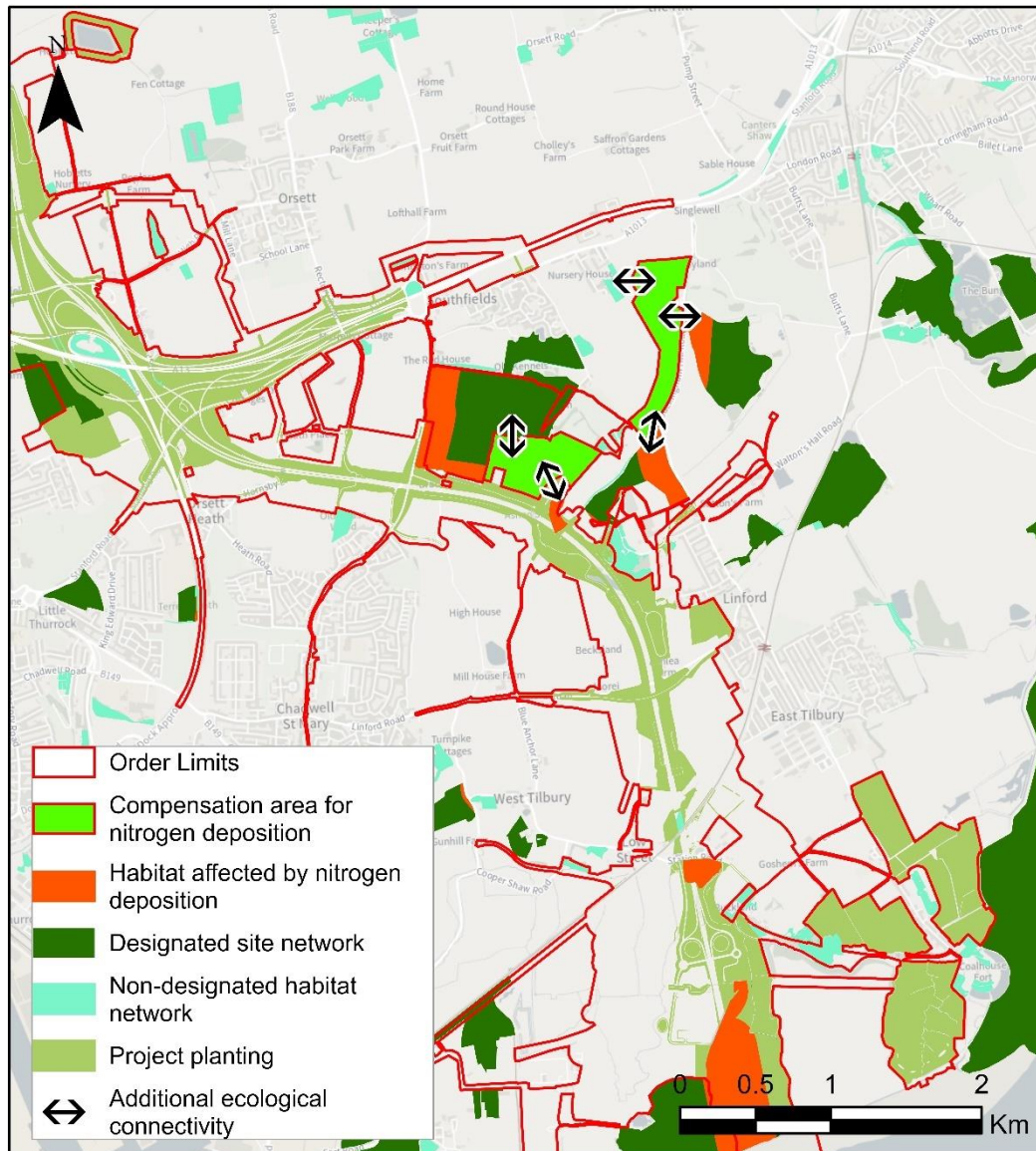


Plate 7.19 Henhurst Hill, Fenn Wood and Court Wood compensation sites ecological network context

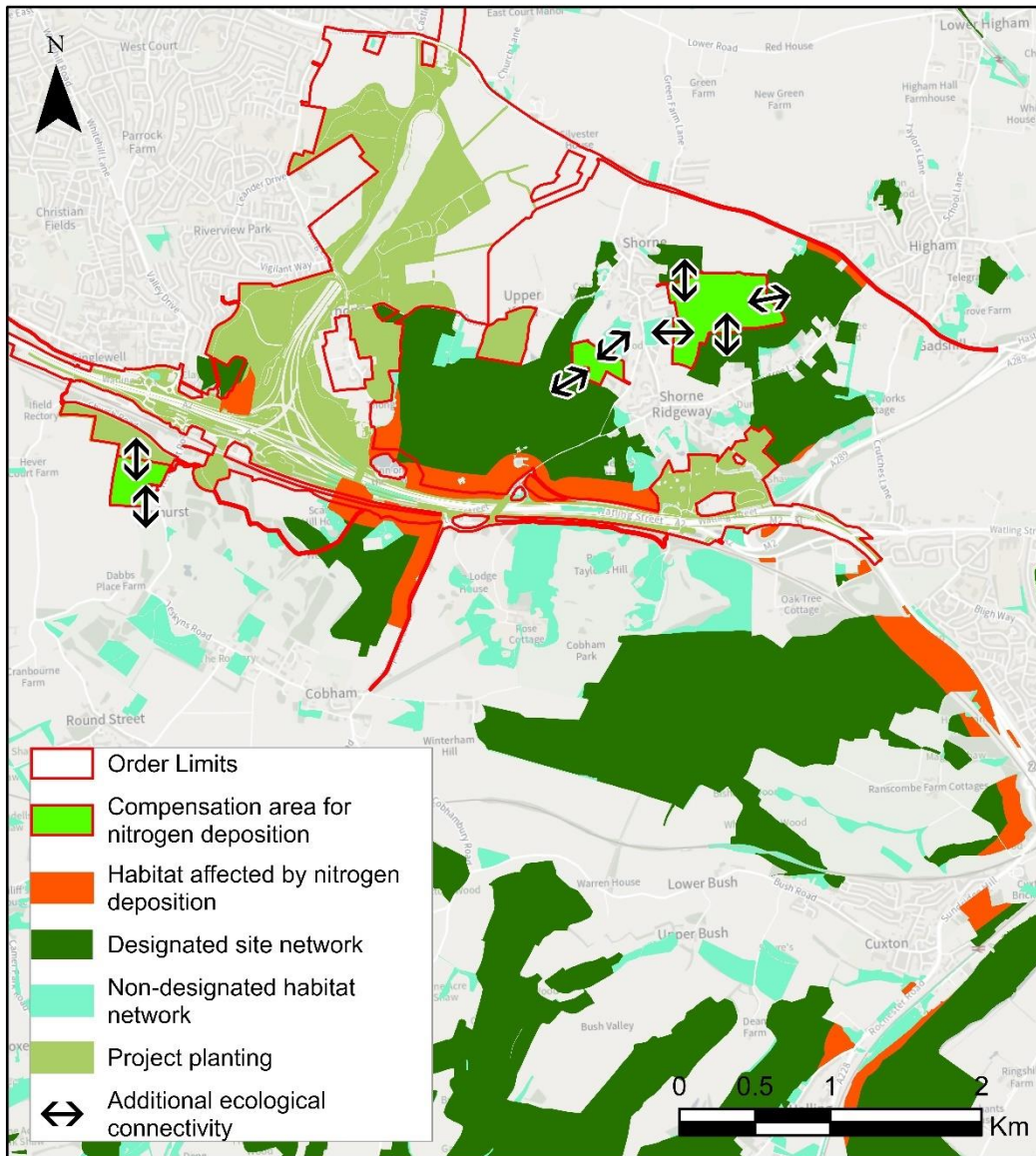
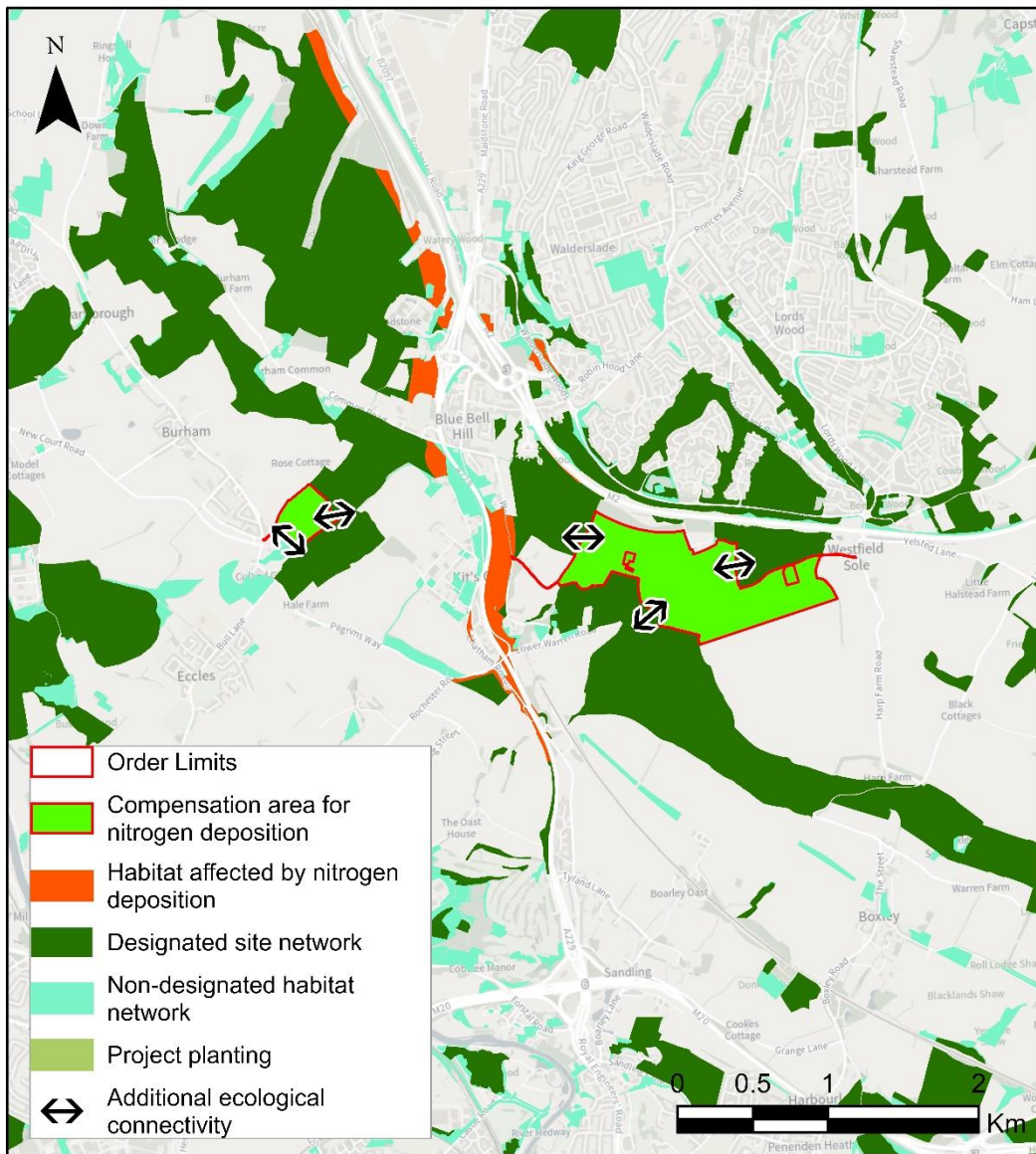


Plate 7.20 Blue Bell Hill and Burham compensation sites ecological network context



8 Conclusions

- 8.1.1 The Applicant considers the proposed measures for mitigation and compensation summarised below and as described in this document to be a precautionary and proportionate response to the risk of significant N deposition effects on designated ecological sites:
- 8.1.2 Thirty-six designated sites and habitats were identified as having a risk of significant effects without mitigation.
- 8.1.3 All feasible mitigation measures have been proposed, in the form of speed enforcement management on sections 3 to 4 of the M2.
- 8.1.4 Residual significant effects after consideration of mitigation are predicted on 29 sites, totalling 176.4ha of significantly affected habitat.
- 8.1.5 Compensation (245.7ha) for the residual effects in the form of habitat creation on eight sites has been proposed.

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Glossary

Term	Abbreviation	Explanation
A122		The new A122 trunk road to be constructed as part of the Lower Thames Crossing project, including links, as defined in Part 2, Schedule 5 (Classification of Roads) in the draft DCO (Application Document 3.1)
A122 Lower Thames Crossing	Project	A proposed new crossing of the Thames Estuary linking the county of Kent with the county of Essex, at or east of the existing Dartford Crossing.
A122 Lower Thames Crossing/M25 junction		New junction with north-facing slip roads on the M25 between M25 junctions 29 and 30, near North Ockendon.
A13/A1089/A122 Lower Thames Crossing junction		Alteration of the existing junction between the A13 and the A1089, and construction of a new junction between the A122 Lower Thames Crossing and the A13 and A1089, comprising the following link roads: <ul style="list-style-type: none"> • Improved A13 westbound to A122 Lower Thames Crossing southbound • Improved A13 westbound to A122 Lower Thames Crossing northbound • Improved A13 westbound to A1089 southbound • A122 Lower Thames Crossing southbound to improved A13 eastbound and Orsett Cock roundabout • A122 Lower Thames Crossing northbound to improved A13 eastbound and Orsett Cock roundabout • Orsett Cock roundabout to the improved A13 westbound • Improved A13 eastbound to Orsett Cock roundabout • Improved A1089 northbound to A122 Lower Thames Crossing northbound • Improved A1089 northbound to A122 Lower Thames Crossing southbound
A2		A major road in south-east England, connecting London with the English Channel port of Dover in Kent.
Ancient woodland	AW	Designated land that has been continuously wooded since at least 1600AD. Ancient woodland is regarded as irreplaceable habitat and is protected by the National Planning Policy Framework.
Application Document		In the context of the Project, a document submitted to the Planning Inspectorate as part of the application for development consent.
Construction		Activity on and/or offsite required to implement the Project. The construction phase is considered to commence with the first activity on site (e.g. creation of site access), and ends with demobilisation.
Design Manual for Roads and Bridges	DMRB	A comprehensive manual containing requirements, advice and other published documents relating to works on motorway and all-purpose trunk roads for which one of the Overseeing Organisations (National Highways, Transport Scotland, the Welsh Government or the Department for Regional Development (Northern Ireland)) is highway authority. For the A122 Lower Thames Crossing the Overseeing Organisation is National Highways.

Term	Abbreviation	Explanation
Development Consent Order	DCO	Means of obtaining permission for developments categorised as Nationally Significant Infrastructure Projects (NSIP) under the Planning Act 2008.
Development Consent Order application	DCO application	The Project Application Documents, collectively known as the 'DCO application'.
Environmental Statement	ES	A document produced to support an application for development consent that is subject to Environmental Impact Assessment (EIA), which sets out the likely impacts on the environment arising from the proposed development.
Highways England		Former name of National Highways.
Local Wildlife Site	LWS	Locally designated nature site protected through the planning system.
M2 junction 1		The M2 will be widened from three lanes to four in both directions through M2 junction 1.
M2/A2/Lower Thames Crossing junction		New junction proposed as part of the Project to the east of Gravesend between the A2 and the new A122 Lower Thames Crossing with connections to the M2.
M25 junction 29		Improvement works to M25 junction 29 and to the M25 north of junction 29. The M25 through junction 29 will be widened from three lanes to four in both directions with hard shoulders.
National Highways		A UK government-owned company with responsibility for managing the motorways and major roads in England. Formerly known as Highways England.
National Planning Policy Framework	NPPF	A framework published in March 2012 by the UK's Department of Communities and Local Government, consolidating previously issued documents called Planning Policy Statements (PPS) and Planning Practice Guidance Notes (PPG) for use in England. The NPPF was updated in February 2019 and again in July 2021 by the Ministry of Housing, Communities and Local Government.
National Policy Statement	NPS	Set out UK government policy on different types of national infrastructure development, including energy, transport, water and waste. There are 12 NPS, providing the framework within which Examining Authorities make their recommendations to the Secretary of State.
National Policy Statement for National Networks	NPSNN	Sets out the need for, and Government's policies to deliver, development of Nationally Significant Infrastructure Projects (NSIPs) on the national road and rail networks in England. It provides planning guidance for promoters of NSIPs on the road and rail networks, and the basis for the examination by the Examining Authority and decisions by the Secretary of State.
Nationally Significant Infrastructure Project	NSIP	Major infrastructure developments in England and Wales, such as proposals for power plants, large renewable energy projects, new airports and airport extensions, major road projects etc that require a development consent under the Planning Act 2008.
North Portal		The North Portal (northern tunnel entrance) would be located to the west of East Tilbury. Emergency access and vehicle turn-around facilities would be provided at the tunnel portal. The tunnel portal structures would accommodate service buildings for control operations, mechanical and electrical equipment, drainage and maintenance operations.

Term	Abbreviation	Explanation
Operation		Describes the operational phase of a completed development and is considered to commence at the end of the construction phase, after demobilisation.
Order Limits		The outermost extent of the Project, indicated on the Plans by a red line. This is the Limit of Land to be Acquired or Used (LLAU) by the Project. This is the area in which the DCO would apply.
Planning Act 2008		The primary legislation that establishes the legal framework for applying for, examining and determining Development Consent Order applications for Nationally Significant Infrastructure Projects.
Project road		The new A122 trunk road, the improved A2 trunk road, and the improved M25 and M2 special roads, as defined in Parts 1 and 2, Schedule 5 (Classification of Roads) in the draft DCO (Application Document 3.1).
Project route		The horizontal and vertical alignment taken by the Project road.
Site of importance for nature conservation	SINC	Locally designated nature site protected through the planning system
South Portal		The South Portal of the Project (southern tunnel entrance) would be located to the south-east of the village of Chalk. Emergency access and vehicle turn-around facilities would be provided at the tunnel portal. The tunnel portal structures would accommodate service buildings for control operations, mechanical and electrical equipment, drainage and maintenance operations.
The tunnel		Proposed 4.25km (2.5 miles) road tunnel beneath the River Thames, comprising two bores, one for northbound traffic and one for southbound traffic. Cross-passages connecting each bore would be provided for emergency incident response and tunnel user evacuation. Tunnel portal structures would accommodate service buildings for control operations, mechanical and electrical equipment, drainage and maintenance operations. Emergency access and vehicle turn-around facilities would also be provided at the tunnel portals.

Annex A Review of Speeds

A.1 Review of sites for suitability of speed limits

Sites where speed limits unlikely to be effective

- A.1.1 A review of the sites which have been assessed by the competent expert for biodiversity as being significantly impacted on by increases in N deposition were reviewed to determine the following:
- Were any of the sites next to roads where the speed limits were 70mph and operated by National Highways?
 - If so, were there any periods of the day where the traffic model predicted speeds in the High Speed Category (i.e. Unconstrained)?
 - If so, would a speed limit be deliverable (i.e. would it cause unacceptable rerouting of traffic)?
 - If there are High Speeds, and rerouting would not be an issue, do the measured speeds⁴ indicate sufficient non-compliance of speed limits to lead to an improvement in emissions?
- A.1.2 Table A.1 presents the overview of the review for each of the sites where a significant effect was identified.

Table A.1 Review of speed control for sites with a significant effect

Affected ecological site	Next to road speed limit is 70mph	Predicted high speed with the Project	Deliverable?	Measured speed indicates non-compliance of speed limit?	Taken forward to assessment
238_AW (AW_Theme_ID_1486679 (Object ID 9096) AW)	Yes	IP, PM and OP (M2 NB). AM, IP and OP (M2 SB).	No	N/A	N/A
235_AW (AW_Theme_ID_1486820 (A2/M2 ROUNDABOUT) AW)	Yes	AM, IP, PM and OP (M2 WB). AM, IP and OP (M2 EB)	No	N/A	N/A
233_SSSI_LWS_AW (AW_Theme_ID_14868)	Yes	IP, PM and OP (A2 WB), AM, IP	No	N/A	N/A

⁴ As provided within the Department of Transport (DfT) Teletrac Navman data

Affected ecological site	Next to road speed limit is 70mph	Predicted high speed with the Project	Deliverable?	Measured speed indicates non-compliance of speed limit?	Taken forward to assessment
60 (Shorne Woods) AW)		and OP (A2 EB)			
640_AW (AW_Theme_ID_14868 67 (Head Barn Wood) AW)	Yes	IP and OP (M2 NB). AM, IP and OP (M2 SB).	No	N/A	N/A
236_AW (AW_Theme_ID_14868 83 (Object ID 9151) AW)	Yes	AM, IP, PM and OP (M2 WB). AM, IP and OP (M2 EB).	No	N/A	N/A
641_AW (AW_Theme_ID_14868 91 (Between M2 carriageways) AW)	Yes	IP and OP (M2 NB). AM, IP and OP (M2 SB).	No	N/A	N/A
249_AW (AW_Theme_ID_14869 37 (Longhoses) AW, Merrals Shaw (AW_Theme_ID 1486881) AW)	No	N/A	N/A	N/A	N/A
251_AW (AW_Theme_ID_14987 17 (OBJECT ID 11749) AW)	No	N/A	N/A	N/A	N/A
282_AW (AW_Theme_ID_14987 17 (OBJECT ID 11749) AW)	Yes	AM, IP, PM and OP (M2 both directions).	Yes	Yes	Yes
252_AW (AW_Theme_ID_14987 18 AW)	Yes	AM, IP, PM and OP (M2 NB). AM, IP and OP (M2 SB).	Yes	Yes	Yes
195_AW (AW_Theme_ID_15016 34 (OBJECT ID 12881) AW)	Yes	AM, IP, PM and OP (M2 both directions).	Yes	Yes	Yes

Affected ecological site	Next to road speed limit is 70mph	Predicted high speed with the Project	Deliverable?	Measured speed indicates non-compliance of speed limit?	Taken forward to assessment
76_AW_LWS (AW_Theme_ID142001 2 AW)	Yes	OP (M25 both directions)	Yes	No	No
660_AW (AW_Theme_ID148695 1 AW)	No	N/A	N/A	N/A	N/A
119_AW (AW_Theme_ID149914 4 AW AW_Theme_ID149914 5 AW)	Yes	AM, IP, PM and OP (M25 NB). IP, PM and OP (M25 SB).	Yes	Yes	Yes
72_AW_LWS (Barber's Wood AW)	Yes	OP (M25 EB). IP, PM and OP (M25 WB).	No	N/A	N/A
181_AW (Bridge Woods AW)	Yes	AM, IP, PM and OP (M2 both directions)	No	N/A	N/A
254_LWS_AW, 439_LWS (Bridge Woods AW, Bridge Woods, Burham LWS)	No	N/A	N/A	N/A	N/A
240_SSSI (Cobham Woods SSSI)	Yes	IP, PM and OP (M2 NB). AM, IP and OP (M2 SB).	No	N/A	N/A
78_LWS_AW, 381_LWS (Codham Hall Wood AW, Codham Hall Woods LWS)	Yes	IP, PM and OP (M25 NB). AM, IP, PM and OP (M25 SB).	No	N/A	N/A
194_AW, 197_AW, 256_AW, 303_AW, 327_AW (Frith/Impton Woods AW)	Yes	AM, IP, PM and OP (M2 both directions).	Yes	Yes	Yes
258_AW, 373a_AW, 373b_AW, 258b_AW (Frith/Impton Woods AW)	No	N/A	N/A	N/A	N/A

Affected ecological site	Next to road speed limit is 70mph	Predicted high speed with the Project	Deliverable?	Measured speed indicates non-compliance of speed limit?	Taken forward to assessment
240_AW (Great Wood AW)	Yes	IP, PM and OP (M2 NB). AM, IP and OP (M2 SB).	No	N/A	N/A
348_SSSI, 392_SSSI (Halling To Trottiscliffe Escarpment SSSI)	No	N/A	N/A	N/A	N/A
193_AW (Impton/Podkin Wood AW)	Yes	AM, IP, PM and OP (M2 both directions).	Yes	Yes	Yes
261_AW (Impton/Podkin Wood AW)	No	N/A	N/A	N/A	N/A
239_AW (Merrals Shaw (AW_Theme_ID_1486881) AW)	Yes	IP, PM and OP (M2 NB). AM, IP and OP (M2 SB).	No	N/A	N/A
198_AW, 199_AW, 201_AW (Middlefield Shaw AW (AW_Theme_ID_1501447,1500825,1500821))	Yes	AM, IP, PM and OP (M2 both directions).	Yes	Yes	Yes
521_LWS (Ockendon Railsides SINC)	Yes	AM, IP, PM and OP (M25 NB). IP, PM and OP (M25 SB). IP, PM and OP (LTC NB). AM and OP (LTC SB).	No	N/A	N/A
521b_LWS, 775_LWS (Ockendon Railsides SINC)	No	N/A	N/A	N/A	N/A
232_SSSI, 233_SSSI_LWS_AW, 349_SSSI (Shorne And Ashenbank Woods SSSI)	Yes	AM, IP and OP (M2 EB). IP, PM and OP (M2 WB).	No	N/A	N/A

Affected ecological site	Next to road speed limit is 70mph	Predicted high speed with the Project	Deliverable?	Measured speed indicates non-compliance of speed limit?	Taken forward to assessment
248_SSSI (Shorne And Ashenbank Woods SSSI)	No	N/A	N/A	N/A	N/A
264_SSSI, 389_SSSI (Shorne And Ashenbank Woods SSSI)	Yes	AM, IP and OP (M2 EB). AM, IP, PM and OP (M2 WB).	No	N/A	N/A
234_AW (Shorne/Brewers Woods AW)	Yes	AM, IP and OP (M2 EB). AM, IP, PM and OP (M2 WB).	No	N/A	N/A
196_AW (Westfield Wood (AW_Theme_ID_150470) AW)	Yes	AM, IP, PM and OP (M2 both directions).	Yes	Yes	Yes
185_SSSI, 186_SSSI, 276_SSSI, 350_SSSI (Wouldham To Detling Escarpment SSSI)	No	N/A	N/A	N/A	N/A
121_AW_LWS (ANDREWS WOOD(AW_Theme_ID 1499246) AW)	Yes	AM, IP, PM and OP (M25 NB). IP, PM and OP (M25 SB).	Yes	Yes	Yes
174_AW (AW_Theme_ID1494010 AW)	Yes	AM, IP and OP (M25 EB). IP, PM and OP (M25 WB).	Yes	Yes	Yes
47_AW (Frith Woods Etc., Kits Coty LWS)	Yes	AM, IP, PM and OP (M2 both directions).	Yes	Yes	Yes
262_AW, 367_LWS_AW (Peartree Wood AW)	No	N/A	N/A	N/A	N/A
206_AW_LWS (REED'S	Yes	AM, IP and OP (M2 EB). IP and	Yes	Yes	Yes

Affected ecological site	Next to road speed limit is 70mph	Predicted high speed with the Project	Deliverable?	Measured speed indicates non-compliance of speed limit?	Taken forward to assessment
SHAW(AW_Theme_ID 1498441) AW)		OP (M2 WB).			

Annex B Modelled Results for Sites Where Speed Limits Likely to Be Effective

- B.1.1 Following the review of whether significantly affected sites could benefit from speed enforcement on adjacent roads, it was identified that speed enforcement may be a deliverable option on the M2 between junction 3 and 4 where a number of ecological sites are predicted to experience a significant adverse effect as a result of increase in N deposition due to the Project.
- B.1.2 The mitigation scenario has therefore been assessed in the air quality model to determine whether it is likely to be an effective mitigation measure.

B.2 Modelling methodology

- B.2.1 The same air quality model and methodology used for the Environment Statement has been used to model the mitigation scenario, except for adjustment of speed bands to better reflect the measures traffic speeds on the sections modelled. This was to ensure that the impact of the measures was not overestimated, e.g. if there was a high level of compliance with 70mph it would be inappropriate to assume there would be a benefit in emissions from a large proportion of LDVs.
- B.2.2 Annual mean NO_x concentrations were predicted at ecological receptor points within 200m of the M2 between junction 3 and 4. The modelled NO_x concentrations were used to calculate N deposition (from the NO₂ and ammonia components of the emissions).
- B.2.3 The following traffic datasets have been used for the air quality modelling:
- N108R1 – Base Year 2016
 - CM45 – Do-Minimum 2030
 - CS67 – Do-Something 2030
- B.2.4 It should be noted that the traffic data was modelled for the following periods (consistent with the modelling undertaken for the Environmental Statement):
- AM peak period (06:00 to 09:00)
 - Inter-peak (IP) period (09:00 to 15:00)
 - PM peak period (15:00 to 18:00)
 - Off-peak (OP) period (18:00 to 06:00)
- B.2.5 In the DS⁵ speed enforcement scenario, the eastbound and westbound carriageway on sections between junctions 3 and 4 were proposed to be 70mph speed limit, the DS traffic data was used and where the traffic modelling suggested 'High Speed' the speed band was set to 70mph Speed Limit. The 70mph Speed Limit was applied to links where the Department of Transport

⁵ DS = Do-Something Scenario (2030) i.e. with the Project in operation

Teletrac data suggested a high proportion of LDVs were non-compliant with the current 70mph speed limit.

B.3 Results

- B.3.1 The total NO_x and N Deposition from the 70mph speed enforcement scenario is reported in Table B.1 for the significant receptors adjacent to the M2 speed enforcement.
- B.3.2 Enforcing the 70mph speed limit on the section of the M2 between junction 3 and 4 is predicted to reduce the impact of the Project on ecological designated sites near this section of the M2. The modelling results indicate that a smaller impact at all modelled sites, with some no longer having a perceptible change in NO_x.

Table B.1 Modelled N deposition for ecological designated sites near M2 speed enforcement in the mitigation scenario

Receptor ID	X	Y	Site name	Total NOx ($\mu\text{g}/\text{m}^3$)				Total N Deposition ($\text{kg N ha}^{-1} \text{yr}^{-1}$)		
				DM	DS	Change	Perceptible Change	DM	DS	Change
193_AW	575481	161798	Impton/Podkin Wood AW	34.52	34.94	0.42	Y	40.88	41.18	0.30
194_AW	575494	161872	Frith/Impton Woods AW	35.38	35.5	0.12	N	N/A	N/A	N/A
195_AW	575911	161639	AW_Theme_ID_1501634 (OBJECT ID 12881) AW	35.65	36.07	0.42	Y	41.42	41.72	0.30
196_AW	577006	161536	Westfield Wood (AW_Theme_ID_150470) AW	38.23	38.78	0.55	Y	42.64	43.01	0.38
197_AW	577388	161574	Frith/Impton Woods AW	32.79	32.86	0.07	N	N/A	N/A	N/A
198_AW	577785	161528	Middlefield Shaw AW (AW_Theme_ID_1501447,1500825,1500821)	37.89	37.91	0.02	N	N/A	N/A	N/A
199_AW	578013	161540	Middlefield Shaw AW (AW_Theme_ID_1501447,1500825,1500821)	35.14	35.17	0.03	N	N/A	N/A	N/A
201_AW	578288	161600	Middlefield Shaw AW (AW_Theme_ID_1501447,1500825,1500821)	36.31	36.31	0	N	N/A	N/A	N/A
252_AW	574552	163051	AW_Theme_ID_1498718 AW	39.04	41.22	2.18	Y	41.43	42.92	1.50
256_AW	574784	162875	Frith/Impton Woods AW	53.21	58.15	4.94	Y	48.56	51.58	3.01
282_AW	575077	162421	AW_Theme_ID_1498717 (OBJECT ID 11749) AW	34.24	34.76	0.52	Y	40.38	40.75	0.37
303_AW	576578	161633	Frith/Impton Woods AW	48.28	48.16	-0.12	N	N/A	N/A	N/A
327_AW	575201	162159	Frith/Impton Woods AW	38.42	38.78	0.36	Y	42.29	42.53	0.25

Receptor ID	X	Y	Site name	Total NOx ($\mu\text{g}/\text{m}^3$)				Total N Deposition ($\text{kg N ha}^{-1} \text{yr}^{-1}$)		
				DM	DS	Change	Perceptible Change	DM	DS	Change
DM = Do-Minimum Scenario (2030) DS = Do-Something Scenario (2030) Perceptible Change = Change in NOx greater than +/- 0.3 $\mu\text{g}/\text{m}^3$ and so requires N deposition assessment.										

B.3.3 These results were provided to the competent expert for biodiversity to re-evaluate the impacts to determine whether the mitigation was effective in removing the significance of the Projects impacts.

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Registered office Bridge House, 1 Walnut Tree Close, Guildford GU1 4LZ

National Highways Company Limited registered in England and Wales number 09346363