Forest Heath District Council, Single Issue Review of CS7 and Site Allocations Local Plan – Updated Air Quality Assessment Regarding Breckland Special Area of Conservation (SAC), Breckland Special Protection Area (SPA) and Rex Graham Reserve Special Area of Conservation (SAC)

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Introduction

1.1.1 To support the Single Issue Review (SIR) of Core Strategy Policy CS7 and the Site Allocations Local Plan (SALP), traffic modelling and air quality impact assessment was undertaken in 2018 in line with the standard Design Manual for Roads and Bridges (DMRB) methodology[1] comparing the predicted change in vehicle flows on roads within 200m of Breckland SAC and SPA in Forest Heath District as a result of Local Plan development, with that which would be expected to occur over time due to background population growth. The report has been updated in February 2019 to include a discussion of the implications of the Court of Justice of the European Union (CJEU) rulings in the Dutch Nitrogen cases[2] and the Holohan case[3]. The technical analysis presented in this note has not changed from that presented in 2018.

1.1.2 The general long-term trend for NOx has been one of improvement (particularly since 1990) despite an increase in vehicles on the roads[4]. Total nitrogen deposition[5] to the UK decreased by 13% between 1988 and 2008, while NOx concentrations decreased by 50% over the same time period[6]. These results are the national manifestation of a trend which can also be discerned locally.

[1] Design Manual for Roads and Bridges, Volume 11, Section 3 Part 1 (HA207/07) and subsequent Interim Advice Notes, coupled with reference to Air Quality Technical Advisory Group (AQTAG) and Institute of Air Quality Management guidance

[2] Coöperatie Mobilisation for the Environment and Vereniging Leefmilieu v College van gedeputeerde staten van Limburg C-293/17 and C-294/17

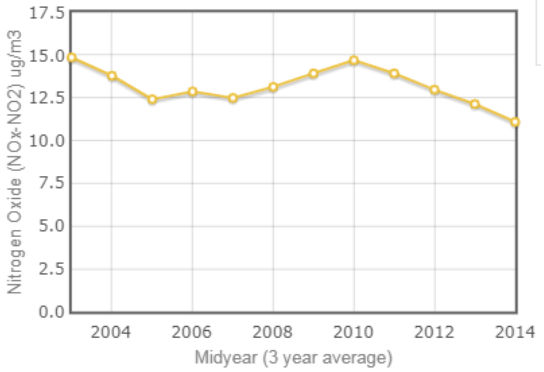
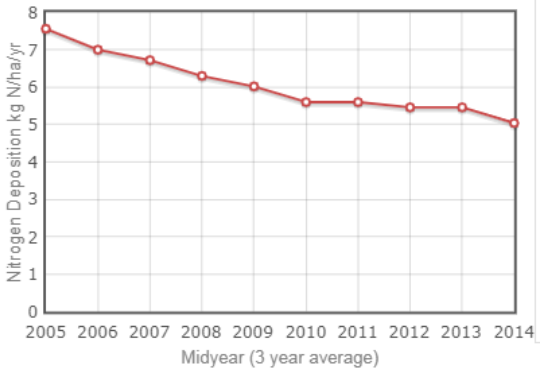
[3] Holohan et al vs. An Bord Pleanála (C-461/17)

[4] Emissions of nitrogen oxides fell by 69% between 1970 and 2015. Source: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/579200/Emissions_airpollutants_statisticalrelease_2016_final.pdf [accessed 04/07/18]

[5] Oxidised nitrogen derives from combustion, such as vehicle exhausts, while reduced nitrogen results from ammonia primarily from agriculture. Total nitrogen deposition is both oxidised and reduced nitrogen combined.

[6] Rowe EC, Jones L, Stevens CJ, Vieno M, Dore AJ, Hall J, Sutton M, Mills G, Evans CD, Helliwell RC, Britton AJ, Mitchell RJ, Caporn SJ, Dise NB, Field C & Emmett BA (2014) Measures to evaluate benefits to UK semi-natural habitats of reductions in nitrogen deposition. Final report on REBEND project (Defra AQ0823; CEH NEC04307)

Figure 1: Recent trends in NOx and oxidised nitrogen deposition at Breckland SAC/SPA (Source: APIS, 2019)

Trend in background NOx concentrations at Breckland SAC/SPA	Trend in background oxidised nitrogen deposition to short vegetation at Breckland SAC/SPA
	

1.1.3 The graphs in Figure 1 relate to the 5km grid square (for nitrogen deposition) and 1km grid square (for NOx) within which the relevant parts of the SAC/SPA in Forest Heath district are situated. They are the latest data taken from APIS in January 2019. They show that both NOx concentrations and oxidised nitrogen deposition rates fell over the c. 10 years to 2014 (the latest year for which data are currently available). This reduction occurred notwithstanding increased housing and employment development, including traffic growth, over the same time period and is most likely attributable to improvements in emissions technology in the vehicle fleet (i.e. motorists replacing more polluting vehicles associated with earlier Euro standards with less polluting vehicles associated with more recent Euro standards).

1.1.4 This improving trend can be expected to continue, and indeed steepen, as drivers continue to replace older cars with newer vehicles and as further improvements in vehicle emissions technology are introduced. For example, the latest (Euro6/VI) emissions standard only became mandatory in 2014 (for heavy duty vehicles) and 2015 (for cars) and the effects are not therefore visible in the data available from APIS because relatively few people will have been driving vehicles compliant with that standard as early as 2014. In contrast, far more drivers can be expected to be using Euro6 compliant vehicles by the end of the Local Plan period (2031) since vehicles that are not compliant with Euro6 ceased manufacture in 2015.

1.1.5 AECOM's modelling allows for these expected changes in the vehicle fleet and associated improvements in baseline NOx concentrations and nitrogen deposition rates in line with Highways England guidance (document HA207/07)[7] recommends reducing nitrogen deposition rates by 2% each year between the base year and assessment year ('*The total average deposition rates obtained from the Air Pollution Information System … should be reduced by 2% per year to estimate deposition rates for the assessment years'*). This is why the air quality in the 2031 Base and 2031 Scenario 3 columns of the assessment tables are lower than the current baseline concentrations.

1.1.6 With regard to the implications of the 'Dutch Nitrogen' CJEU ruling and the extent that autonomous measures (i.e. improvements in baseline nitrogen deposition that are not attributable to the Guildford Local Plan) can be taken into account in appropriate assessment, the CJEU ruled that it was legally compliant to take such autonomous measures into account provided the benefits were not uncertain (paras.130 & 132). Note that previous case law on the interpretation of the Habitats Directive has clarified that 'certain' does not mean absolute certainty but "*where no reasonable scientific doubt remains*."[8] In the 'Dutch Nitrogen' cases the CJEU recognised that the measures with which they were concerned had either *"not yet been taken or have not yielded any results, so that their effects are still uncertain"* (para. 127). It is in that context that the CJEU stated "*The appropriate assessment of the implications of a plan or project for the sites concerned is not to take into account the future benefits of such* [autonomous] *'measures' if those benefits are uncertain, inter alia because the procedures*

[7] http://www.standardsforhighways.co.uk/ha/standards/dmrb/vol11/section3/ha20707.pdf
[8] Case C239/04 Commission v Portugal [2006] ECR I10183, para. 24; Holohan et al vs. An Bord Pleanála (C-461/17), para. 33

needed to accomplish them have not yet been carried out or because the level of scientific knowledge does not allow them to be identified or quantified with certainty." (para. 130)

1.1.7 In contrast, as explained above, the allowance made for improvements in baseline NOx concentrations and nitrogen deposition rates in AECOM's modelling is in line with DMRB guidance, is justified by empirical evidence at a national and local level and is associated with measures that have already been implemented (i.e. the introduction of vehicles into the fleet which are compliant with increasingly stringent emissions standards up to Euro 6/VI). Therefore, the projected improvements have the requisite level of certainty.

1.1.8 It should be further noted that no specific allowance is made in the Local Plan modelling for the UK Government's decision to ban the sale of most new petrol and diesel vehicles from 2040, or the Government's new draft Clean Air Strategy, but those announcements illustrate the general long-term direction of travel for roadside air quality in the UK and underline that allowing for improvements in both vehicle emissions factors and rates of oxidised nitrogen deposition over long timescales is both appropriate and realistic.

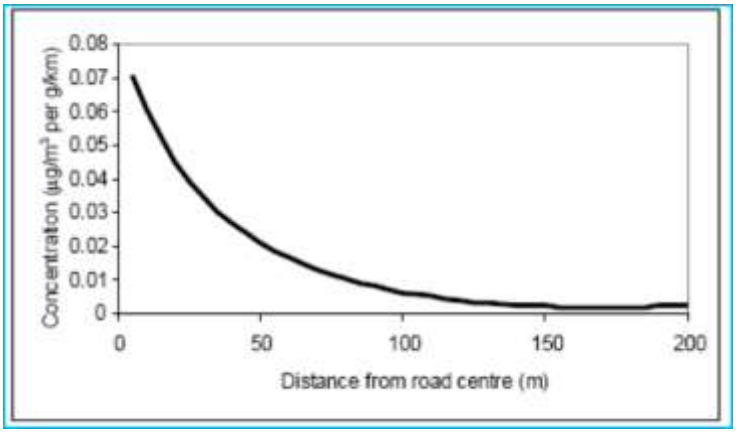
1.1.9 The CJEU ruling in the Holohan case confirmed that appropriate assessments should: (i) catalogue (i.e. list) all habitats and species for which the site is protected and (ii) include in its assessment other (i.e. non-protected) habitat types or species which are on the site and habitats and species located outside of the site if they are necessary to the conservation of the habitat types and species listed for the protected area. The air quality analysis undertaken in 2018 was already in line with this ruling in that it focussed on the habitats (assemblages of species) on which the bird species of the Breckland SPA depend where these are present within 200m of the modelled road links within the SPA. This is why the assessment considers impacts on arable land and plantation woodland despite the fact that these are common and widespread habitats that are not a basis for designating any European sites: arable land is a fundamentally important habitat for stone curlew while rotationally managed plantation is a fundamentally important habitat for nightjar and woodlark.

1.1.10 With regard to habitats outside the SPA boundary that may be used by SPA species, there are areas of arable land outside the SPA boundary which are used by stone curlew but, as identified in the analysis that follows, arable land is a naturally nitrogen rich habitat as well as one where suitable habitat structure is heavily dependent on human manipulation. As such, atmospheric nitrogen deposition has a negligible effect on the ability of such land parcels to support stone curlew. Moreover, this species is likely to generally avoid nesting close to significant existing roads like the A11, A1065 and A1101.

1.1.11 Methodology

1.1.12 Since vehicle exhausts are situated very close to the ground the principal area affected by emissions is a narrow band along the roadside, well within 200m of the road. Beyond 200m, emissions will have dispersed sufficiently that atmospheric concentrations are essentially background levels. The rate of decline is steeply curved rather than linear. In other words concentrations will decline rapidly as one begins to move away from the roadside, slackening to a more gradual decline over the rest of the distance up to 200m.

Figure 2: Example of traffic contribution to concentrations of pollutants at different distances from a road



1.1.13 There are two measures of relevance regarding air quality impacts from vehicle exhausts. The first is the concentration of oxides of nitrogen (known as NOx) in the atmosphere. The main ecological importance of NOx is as a source of nitrogen, which is then deposited on adjacent habitats. The deposited nitrogen can then have a range of effects, primarily growth stimulation or inhibition[9], but also biochemical and physiological effects such as changes to chlorophyll content. The guideline atmospheric concentration of NOx advocated by Government for the protection of vegetation is 30 micrograms per cubic metre (μgm^{-3}), known as the Critical Level. This is driven by the role of NOx in nitrogen deposition and in particular in growth stimulation and inhibition. It is important to note that the critical level is a generic threshold; in reality some habitats are more or less sensitive to nitrogen than others.

1.1.14 The second important metric is a direct determination of the rate of the resulting nitrogen deposition, related to the sensitivity of the habitat in question. Unlike NOx in atmosphere, the nitrogen deposition rate below which we are confident effects would not arise is therefore different for each habitat. The rate (known as the Critical Load) is provided on the UK Air Pollution Information System website (www.apis.ac.uk) and is expressed as a quantity (kilograms) of nitrogen over a given area (hectare) per year (kgN/ha/yr).

1.1.15 Eleven road links within 200m of Breckland SAC and SPA in Forest Heath District were identified for investigation. These links are illustrated in red on Figure 3. For each of these roads, transport modellers calculated 24-hr Annual Average Daily Traffic (AADT) flows for the following scenarios:

- Baseline (i.e. the situation at the start of the Local Plan period)
- Do Minimum (i.e. traffic flows expected by 2031, without new development identified within the Local Plan)
- Do Something (i.e. traffic flows expected by 2031 with the level of new development identified within the Local Plan, including Brandon)

1.1.16 Using these Scenarios and information on average vehicle speeds and percentage heavy duty vehicles (both of which influence the emissions profile) air quality specialists then calculated expected NOx concentrations and nitrogen deposition rates. The locations of the air quality transects are shown on Figure 3.

1.1.17 The difference between Do Something and Baseline shows the 'in combination' effect of both negative influences (e.g. traffic growth) and positive influences (i.e. improvements in vehicle emission factors). The difference between the Do Minimum and Do Something scenarios is the contribution of the Local Plan to that 'in combination' effect.

1.1.18 The predictions of nitrogen deposition and annual mean NOX concentrations for the PC are based on the assessment methodology presented in Annex F of the Design Manual for Roads and Bridges (DMRB), Volume 11, Section 3, Part 1 (HA207/07)[10] for the assessment of impacts on sensitive designated ecosystems due to highways works. Background data for the predictions for 2031 were sourced from the Department of Environment, Food and Rural Affairs (Defra) background maps projected forward to 2031[11]. Background nitrogen deposition rates were sourced from the Air Pollution Information System (APIS) website[12].

1.1.19 Guidance note HA207/07 advises that background rates are reduced by 2% per year to allow for an improvement in background air quality over the Local Plan period (to 2031) as a result of ongoing national initiatives to improve emissions and the expected improvement in vehicle emissions over that period. However, due to the uncertainty in the rate with which projected future vehicle emission rates and background pollution concentrations are improving, the assumption has been made that conditions in 2023 will be representative of conditions in 2031 (the year of assessment). This approach is accepted within the professional air quality community and accounts for known recent improvements in vehicle technologies (new

[9] The addition of nitrogen is a form of fertilization, which can have a negative effect on habitats over time by encouraging more competitive plant species that can force out the less competitive species that are more characteristic of such habitats.
[10] Design Manual for Roads and Bridges, HA207/07, Highways Agency
[11] Air Quality Archive Background Maps. Defra, 2013. Available from: http://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html
[12] Air Pollution Information System (APIS) www.apis.ac.uk

standard Euro 6/VI vehicles), whilst excluding the more distant and therefore more uncertain projections on the future evolution of the vehicle fleet.

1.1.20 Annual mean concentrations of NOx were calculated at 200m transects modelled at 0m, 5m, 10m, etc. back from all links. Predictions were made using the latest version of the ADMS-Roads pollution model using emission rates derived from the Defra Emission Factor Toolkit which utilises traffic data in the form of 24-hour Annual Average Daily Traffic (AADT), detailed vehicle fleet composition and average speed. The end of the Local Plan (2031) period has been selected for the future scenario as this is the point at which the total emissions due to Plan traffic will be at their greatest.

Traffic modelling results

1.1.21 The traffic modelling result for each link is shown below.

Link Number	Road Number	AADT Base	AADT 2031 Do Minimum (Consented Developments Only)	AADT 2031 Do Something (Scenario 3)	Do Something – Base (change 'in combination')	Do Something – Do Minimum (contribution of growth in Forest Heath District)
1	A1065 North of junction with Wangford Road	10652	12012	13636	2,984	1,624
2	A1065 South of junction with Wangford Road	9972	11246	12111	2,139	865
3	A1065 North of junction with B1112 Eriswell Road	9932	11560	14640	4,708	3,080
4	A1065 North of junction with B1112 (east)	13546	15018	15892	2,346	874
5	A1065 South of junction with B1112 (east)	11793	13069	13521	1,728	452
6	B1112 (east) East of junction with A1065	2160	2401	2839	679	438
7	A1065 North of Fiveways Roundabout	10755	12572	16078	5,323	3,506
8	A11 North of Fiveways Roundabout	31158	35017	40949	9,791	5,932
9	A1101 East of Fiveways Roundabout	4228	4685	5120	892	435
10	A11 South of Fiveways Roundabout	43433	51387	65605	22,172	14,218
11	A1101 West of Fiveways Roundabout	16846	21352	29214	12,368	7,862

1.1.22 In Spring 2017 the High Court ruled that, if the DMRB 1,000 AADT metric was to be used at all, it should be used to consider all growth (i.e. applied to the 'in combination' flows) rather than just the flows attributable to an individual plan or project. In light of this, the table above indicates that links 6 and 9 can be dismissed without further modelling since the forecast change in flows 'in combination' is less than 1,000 AADT. No other links can be dismissed at this point since their 'in combination' change in flows exceeds 1,000 AADT in each case. However, link 4 represents a very short section of road which lies close to another transect (link 3). For this reason, the results for link 4 are not reported below as this part of the modelled network is sufficiently represented by link 3.

Air quality calculations

Link 1: A1065 North of Junction with Wangford Road

1.1.23 Two transects were modelled here – one to the east of the road into the plantation woodland (part of the SPA) and one to the west of the road into the acid grassland at Wangford Fen (part of the SAC).

Plantation transect

1.1.24 For the plantation transect, a large net improvement in both NOx concentrations and nitrogen deposition rates is forecast by 2031 (compare column 'Scn3 2031' with column 'Baseline' for both NOx and nitrogen deposition). This is the case notwithstanding the expected 'in combination' growth in vehicle flows over the same time period and is due to expected reductions in NO_2 emission factors as vehicle technology improves. Moreover, the total NOx concentrations by 2031 are forecast to have fallen below the critical level (30 ug/m^3) even at the roadside, meaning that traffic is likely to have ceased to play a significant role in nitrogen deposition. Growth in Forest Heath District will retard this improvement but only to a small extent (by 1.9 ug/m^3 or 0.1 kg/ha/yr at the closest point to the road) and this falls to a negligible extent by 20m from the roadside (0.03 kgN/ha/yr). Therefore, no adverse effect will arise by virtue of a net deterioration in air quality or by virtue of a material retardation of improvement.

1.1.25 It is very unlikely that nightjar or woodlark would nest within 10m-20m of the roadside. Moreover, the tree belt in that location is likely to be preserved as a permanent woodland buffer to the road in line with typical forestry practice and as such would never constitute suitable habitat for SPA birds. For all these reasons, it is considered that there would be no significant air quality effect on the ability of the SPA to support nightjar or woodlark.

	Annual Mean NOx Conc. (ug/m^3)				**Annual Mean N Dep (k N/ha/yr)**			
From Road (m)	**Baseline**	**(Base 2031)**	**(Scn3 2031)**	**(DS-DM)**	**Baseline**	**(Base 2031)**	**(Scn3 2031)**	**(DS-DM)**
0	54.1	23.1	25.0	1.9	26.17	20.55	20.65	0.10
5	35.6	16.6	17.6	1.0	25.34	20.21	20.27	0.06
10	28.2	13.9	14.6	0.7	24.98	20.07	20.11	0.04
15	24.7	12.7	13.2	0.5	24.80	20.00	20.03	0.03
20	22.5	11.9	12.3	0.4	24.69	19.96	19.98	0.02
30	20.0	11.0	11.3	0.3	24.56	19.91	19.93	0.02
40	18.5	10.5	10.7	0.2	24.49	19.89	19.90	0.01
50	17.6	10.2	10.4	0.2	24.44	19.87	19.88	0.01
60	17.0	9.9	10.1	0.2	24.41	19.86	19.87	0.01
70	16.5	9.8	9.9	0.1	24.38	19.85	19.85	0.01
80	16.1	9.6	9.8	0.1	24.36	19.84	19.84	0.00
90	15.8	9.5	9.7	0.1	24.34	19.83	19.84	0.00
100	15.5	9.5	9.6	0.1	24.33	19.83	19.83	0.00
125	15.1	9.3	9.4	0.1	24.31	19.82	19.82	0.00
150	14.8	9.2	9.3	0.1	24.29	19.81	19.82	0.00
175	14.5	9.1	9.2	0.1	24.28	19.81	19.81	0.00
200	14.4	9.1	9.1	0.0	24.27	19.81	19.81	0.00

Acid grassland transect

1.1.26 For the acid grassland transect, a similarly large net improvement in both NOx concentrations and nitrogen deposition rates is forecast by 2031 (compare column 'Scn3 2031' with column 'Baseline' for both NOx and nitrogen deposition). Moreover, the total NOx concentrations by 2031 are forecast to have fallen well below the critical level (30 ug/m^3) even at the roadside, meaning that traffic is likely to have ceased to play a significant role in nitrogen deposition.

Growth in Forest Heath District will retard this improvement but to a negligible extent (0.9 ug/m^3 equating to a negligible 0.05 kg/ha/yr at the closest point to the road). Therefore, no adverse effect will arise by virtue of a net deterioration in air quality or by virtue of a material retardation of improvement.

1.1.27 The slight numerical difference in concentration and deposition rate between this and the plantation transect on the opposite side of the road is most likely a result of the prevailing wind direction. The meteorological data used in the assessment have the greatest winds primarily from the southwest, such that emissions from the road source are more likely to be pushed eastwards, giving slightly higher deposition rates on receptors to the east of the road (i.e. the plantation).

	Annual Mean NOxNOx Conc. (ug/m^3)				Annual Mean N Dep (k N/ha/yr)			
From Road (m)	Baseline	(Base 2031)	(Scn3 2031)	(DS-DM)	Baseline	(Base 2031)	(Scn3 2031)	(DS-DM)
0	31.6	15.0	15.8	0.9	25.14	20.13	20.17	0.05
5	26.6	13.3	13.9	0.6	24.90	20.04	20.07	0.04
10	23.7	12.3	12.7	0.5	24.75	19.98	20.01	0.03
15	21.7	11.6	12.0	0.4	24.65	19.94	19.96	0.02
20	20.4	11.1	11.5	0.3	24.59	19.92	19.94	0.02
30	18.7	10.5	10.8	0.2	24.50	19.89	19.90	0.01
40	17.6	10.2	10.4	0.2	24.44	19.87	19.88	0.01
50	16.9	9.9	10.1	0.2	24.40	19.85	19.86	0.01
60	16.6	9.7	9.9	0.1	24.37	19.84	19.85	0.00
70	16.2	9.6	9.7	0.1	24.35	19.84	19.84	0.00
80	15.9	9.5	9.6	0.1	24.34	19.83	19.83	0.00
90	15.6	9.4	9.5	0.1	24.32	19.83	19.82	0.00
100	15.4	9.3	9.4	0.1	24.31	19.82	19.82	0.00
125	15.0	9.2	9.3	0.1	24.29	19.81	19.81	0.00
150	14.8	9.1	9.1	0.1	24.28	19.81	19.81	0.00
175	14.6	9.0	9.1	0.0	24.27	19.81	19.80	0.00
200	14.4	9.0	9.0	0.0	24.26	19.80	19.80	0.00

Link 2: A1065 South of junction with Wangford Road

1.1.28 Both transects at this location (west and east of the road) are into areas of acid grassland. For both transects, a large net improvement in both NOx concentrations and nitrogen deposition rates is forecast by 2031. Moreover, the total NOx concentrations by 2031 are forecast to have fallen well below the critical level (30 ug/m^3) even at the roadside, meaning that traffic is likely to have ceased to play a significant role in nitrogen deposition. Growth in Forest Heath District will retard this improvement but to a negligible extent (0.7-0.9 ug/m^3 equating to a negligible 0.03-0.05 kg/ha/yr at the closest point to the road). Therefore, no adverse effect will arise by virtue of a net deterioration in air quality or by virtue of a material retardation of improvement.

Western transect

	Annual Mean NOx Conc. (ug/m^3)				Annual Mean N Dep (k N/ha/yr)			
From Road (m)	Baseline	(Base 2031)	(Scn3 2031)	(DS-DM)	Baseline	(Base 2031)	(Scn3 2031)	(DS-DM)
0	38.7	17.7	18.4	0.7	25.46	20.26	20.29	0.03
5	28.8	14.2	14.6	0.4	24.98	20.07	20.09	0.02
10	24.5	12.7	13.0	0.3	24.77	19.99	20.00	0.01
15	22.1	11.9	12.1	0.2	24.65	19.95	19.96	0.01
20	20.6	11.3	11.5	0.2	24.57	19.92	19.92	0.01
30	18.7	10.7	10.8	0.1	24.47	19.88	19.89	0.01
40	17.6	10.3	10.4	0.1	24.41	19.86	19.86	0.00
50	16.9	10.0	10.1	0.1	24.38	19.85	19.85	0.00
60	16.4	9.9	9.9	0.1	24.35	19.84	19.84	0.00
70	16.0	9.7	9.8	0.1	24.33	19.83	19.83	0.00
80	15.7	9.6	9.7	0.1	24.31	19.82	19.82	0.00
90	15.5	9.5	9.6	0.0	24.30	19.82	19.82	0.00
100	15.3	9.5	9.5	0.0	24.29	19.82	19.81	0.00
125	14.9	9.4	9.4	0.0	24.28	19.81	19.81	0.00
150	14.7	9.3	9.3	0.0	24.26	19.80	19.80	0.00
175	14.6	9.2	9.3	0.0	24.26	19.80	19.80	0.00
200	14.5	9.2	9.2	0.0	24.25	19.80	19.80	0.00

Eastern transect

	Annual Mean NOx Conc. (ug/m^3)				Annual Mean N Dep (k N/ha/yr)			
From Road (m)	Baseline	(Base 2031)	(Scn3 2031)	(DS-DM)	Baseline	(Base 2031)	(Scn3 2031)	(DS-DM)
0	48.0	20.9	21.8	0.9	25.88	20.42	20.47	0.05
5	34.3	16.1	16.6	0.5	25.25	20.17	20.20	0.04
10	28.4	14.0	14.4	0.4	24.96	20.06	20.08	0.03
15	25.0	12.8	13.1	0.3	24.79	20.00	20.01	0.02
20	22.9	12.1	12.3	0.2	24.69	19.96	19.97	0.02
30	20.3	11.2	11.4	0.2	24.56	19.91	19.92	0.01
40	18.8	10.7	10.8	0.1	24.48	19.88	19.89	0.01
50	17.9	10.4	10.5	0.1	24.43	19.86	19.87	0.01
60	17.2	10.1	10.2	0.1	24.39	19.85	19.85	0.00
70	16.7	10.0	10.1	0.1	24.37	19.84	19.84	0.00
80	16.3	9.8	9.9	0.1	24.35	19.83	19.84	0.00
90	16.0	9.7	9.8	0.1	24.33	19.83	19.83	0.00
100	15.8	9.7	9.7	0.1	24.32	19.82	19.82	0.00
125	15.3	9.5	9.5	0.0	24.30	19.82	19.81	0.00
150	15.0	9.4	9.4	0.0	24.28	19.81	19.81	0.00
175	14.8	9.3	9.4	0.0	24.27	19.81	19.80	0.00
200	14.7	9.3	9.3	0.0	24.26	19.80	19.80	0.00

Link 3: A1065 North of junction with B1112 Eriswell Road

1.1.29 Although an area of calcareous grassland designated as SAC does lie within 200m of the road at this location, the closest distance from the road is 194m and the modelling shows that nitrogen deposition rates will have declined to background levels well before that distance. Breckland SPA does lie immediately adjacent to the road in this location. However, the SPA at this location consists entirely of arable land, which does not have a critical load for nitrogen deposition. Direct applications of fertiliser and the land management measures taken to prepare, maintain and harvest arable land have a much greater effect on the structure of the vegetation than the relatively subtle inputs from atmosphere. Moreover, it is very unlikely that stone curlew will nest within 100m of the A1065. As such, no effect on the SPA at this location is expected.

	Annual Mean NOx Conc. (ug/m^3)				**Annual Mean N Dep (k N/ha/yr)**			
From Road (m)	**Baseline**	**(Base 2031)**	**(Scn3 2031)**	**(DS-DM)**	**Baseline**	**(Base 2031)**	**(Scn3 2031)**	**(DS-DM)**
0	51.2	24.1	27.9	3.8	26.02	20.57	20.76	0.19
5	35.5	17.8	20.0	2.2	25.30	20.24	20.36	0.11
10	28.9	15.2	16.8	1.5	24.98	20.10	20.18	0.08
15	25.3	13.8	15.0	1.2	24.80	20.03	20.09	0.06
20	23.2	13.0	14.0	0.9	24.70	19.99	20.03	0.05
30	20.7	12.0	12.7	0.7	24.57	19.93	19.97	0.04
40	19.3	11.5	12.0	0.5	24.50	19.90	19.93	0.03
50	18.4	11.1	11.6	0.4	24.45	19.88	19.90	0.02
60	17.7	10.9	11.2	0.4	24.42	19.87	19.89	0.02
70	17.2	10.7	11.0	0.3	24.39	19.86	19.87	0.02
80	16.9	10.5	10.8	0.3	24.37	19.85	19.86	0.01
90	16.6	10.4	10.7	0.3	24.36	19.84	19.85	0.01
100	16.3	10.3	10.5	0.2	24.34	19.84	19.85	0.01
125	15.9	10.1	10.3	0.2	24.32	19.83	19.84	0.01
150	15.6	10.0	10.2	0.1	24.30	19.82	19.82	0.00
175	15.3	9.9	10.1	0.1	24.29	19.82	19.82	0.00
200	15.2	9.9	10.0	0.1	24.28	19.81	19.81	0.00

Link 5: A1065 South of junction with B1112 (east)

1.1.30 The SPA in this location consists of pasture and arable land. A large net improvement in both NOx concentrations and nitrogen deposition rates is forecast by 2031. Moreover, the total NOx concentrations by 2031 are forecast to have fallen below the critical level (30 ug/m^3) even at the roadside, meaning that traffic is likely to have ceased to play a significant role in nitrogen deposition. Growth in Forest Heath District will retard this improvement but to a negligible extent (0.6 ug/m^3 equating to a negligible 0.03 kg/ha/yr at the closest point to the road). Moreover, direct applications of fertiliser and the land management measures taken to prepare, maintain and harvest arable land and pasture have a much greater effect on the structure of the vegetation than the relatively subtle inputs from atmosphere. It is also very unlikely that stone curlew will nest within 100m of the A1065.

1.1.31 Therefore, no adverse effect will arise by virtue of a net deterioration in air quality or by virtue of a material retardation of improvement.

	Annual Mean NOx Conc. (ug/m^3)				**Annual Mean N Dep (k N/ha/yr)**			
From Road (m)	**Baseline**	**(Base 2031)**	**(Scn3 2031)**	**(DS-DM)**	**Baseline**	**(Base 2031)**	**(Scn3 2031)**	**(DS-DM)**
0	60.7	27.1	27.7	0.6	26.40	20.71	20.74	0.03
5	39.6	19.1	19.4	0.3	25.47	20.30	20.31	0.01
10	31.9	16.2	16.5	0.2	25.10	20.14	20.16	0.01
15	27.8	14.6	14.8	0.2	24.90	20.06	20.07	0.01
20	25.3	13.7	13.9	0.2	24.78	20.01	20.02	0.01
30	22.4	12.6	12.7	0.1	24.63	19.95	19.95	0.00
40	20.7	12.0	12.1	0.1	24.54	19.92	19.92	0.00
50	19.6	11.6	11.7	0.1	24.49	19.89	19.90	0.00
60	18.9	11.3	11.4	0.1	24.45	19.88	19.88	0.00
70	18.3	11.1	11.1	0.1	24.42	19.87	19.87	0.00
80	17.8	10.9	11.0	0.1	24.40	19.86	19.86	0.00
90	17.5	10.8	10.8	0.1	24.38	19.85	19.85	0.01
100	17.2	10.7	10.7	0.1	24.36	19.84	19.84	0.00
125	16.7	10.5	10.5	0.0	24.33	19.83	19.83	0.00
150	16.3	10.3	10.4	0.0	24.32	19.83	19.83	0.00
175	16.1	10.3	10.3	0.0	24.30	19.82	19.82	0.00
200	15.9	10.2	10.2	0.0	24.29	19.82	19.82	0.00

Link 7: A1065 North of Fiveways Roundabout

1.1.32 The transect runs entirely through plantation woodland that constitutes part of the SPA. Once again, a large net improvement in both NOx concentrations and nitrogen deposition rates is forecast by 2031. Moreover, the total NOx concentrations by 2031 are forecast to have fallen below the critical level (30 ug/m^3) even at the roadside, meaning that traffic is likely to have ceased to play a significant role in nitrogen deposition. Growth in Forest Heath District will retard this improvement but to a fairly small extent (3.7 ug/m^3 equating to 0.19 kg/ha/yr at the closest point to the road). Therefore, no adverse effect will arise by virtue of a net deterioration in air quality or by virtue of a material retardation of improvement.

1.1.33 Moreover, it is unlikely that SPA birds (nightjar and woodlark) would nest within 15-20m of the road (the point at which the contribution of Forest Heath growth to nitrogen deposition becomes negligible). Moreover, it is likely that the 20m strip adjacent to the road is preserved as permanent woodland in line with normal forestry practice and such practice would render

this habitat unsuitable for nesting SPA birds. Therefore no effect on suitability of this part of the SPA for nightjar and woodlark is expected.

	Annual Mean NOx Conc. (ug/m^3)				Annual Mean N Dep (k N/ha/yr)			
From Road (m)	Baseline	(Base 2031)	(Scn3 2031)	(DS-DM)	Baseline	(Base 2031)	(Scn3 2031)	(DS-DM)
0	52.4	24.8	28.5	3.7	25.91	20.51	20.70	0.19
5	39.7	19.7	22.1	2.3	25.33	20.25	20.37	0.12
10	34.1	17.6	19.3	1.7	25.07	20.14	20.23	0.09
15	31.1	16.4	17.8	1.4	24.92	20.07	20.15	0.07
20	29.3	15.7	16.9	1.2	24.83	20.04	20.10	0.06
30	27.1	14.8	15.8	1.0	24.72	19.99	20.04	0.05
40	25.8	14.3	15.1	0.8	24.66	19.96	20.00	0.04
50	24.9	13.9	14.7	0.8	24.61	19.94	19.98	0.04
60	24.3	13.7	14.4	0.7	24.58	19.93	19.96	0.04
70	23.8	13.5	14.2	0.6	24.56	19.92	19.95	0.03
80	23.4	13.4	14.0	0.6	24.54	19.91	19.94	0.03
90	23.1	13.3	13.8	0.6	24.52	19.91	19.93	0.03
100	22.8	13.2	13.7	0.5	24.51	19.90	19.93	0.03
125	22.3	13.0	13.5	0.5	24.48	19.89	19.91	0.02
150	22.0	12.8	13.3	0.5	24.46	19.88	19.91	0.02
175	21.7	12.7	13.2	0.4	24.45	19.88	19.89	0.02
200	21.4	12.6	13.1	0.4	24.43	19.87	19.89	0.02

Link 8: A11 North of Fiveways Roundabout

1.1.34 The transect runs through a belt of plantation woodland that constitutes part of the SPA but also includes the calcareous grassland of Rex Graham Reserve SAC.

1.1.35 According to MAGIC this calcareous grassland lies 50m from the A11 at its closest point, with a belt of plantation woodland lying between it and the road. Woodland is more effective at intercepting pollution than grassland due to its greater surface area. As such the plantation belt will protect the grassland behind it to an extent. As can be seen from the data below, a large net improvement in both NOx concentrations and nitrogen deposition rates is forecast by 2031. Growth in Forest Heath District will retard this improvement to a modest extent at the roadside (4.7 ug/m^3 or 0.22 kg/ha/yr) but to a negligible degree at Rex Graham Reserve (0.8 ug/m^3 equating to a negligible 0.05 kg/ha/yr). Moreover, the total NOx concentrations by 2031 are forecast to have fallen well below the critical level (30 ug/m^3) by 5-10m from the roadside, meaning that traffic is likely to have ceased to play a significant role in nitrogen deposition except immediately adjacent to the road.

1.1.36 It is very unlikely that nightjar or woodlark would nest within 10m of the A11. Moreover, the tree belt in that location is likely to be preserved as a permanent woodland buffer to the road in line with typical forestry practice and as such would never constitute suitable habitat for SPA birds. Therefore, no adverse effect will arise by virtue of a net deterioration in air quality or by virtue of a material retardation of improvement.

1.1.37 Further north-east along the A11, the SPA becomes arable land. It is very unlikely that stone curlew would nest within 10m of the A11 and arable land management practices will have a much greater effect on habitat suitability for the species than air quality, given that perceptible increase in NOx concentrations is not accompanied by a similarly perceptible increase in nitrogen deposition rate.

1.1.38 Continuing further north-east along the A11 to Elveden, the A11 passes immediately adjacent to two large blocks of heathland that form part of both the Breckland SAC and SPA (Weather Heath and Horn Heath). Since total NOx concentrations are only predicted to exceed the

critical level within 10m of the roadside and are not accompanied by a perceptible increase in nitrogen deposition this removes the principal impact pathway for elevated NOx to affect vegetation. Therefore, no effect on this heathland is expected. Again, it is not expected that stone curlew would nest this close to the A11.

	Annual Mean NOx Conc. (ug/m^3)				Annual Mean N Dep (k N/ha/yr)			
From Road (m)	Baseline	(Base 2031)	(Scn3 2031)	(DS-DM)	Baseline	(Base 2031)	(Scn3 2031)	(DS-DM)
0	86.4	39.1	43.9	4.7	27.24	21.21	21.43	0.22
5	62.8	29.5	32.6	3.0	26.31	20.74	20.89	0.15
10	48.1	23.2	25.5	2.3	25.83	20.50	20.62	0.12
15	41.6	20.5	22.4	1.8	25.53	20.36	20.46	0.10
20	37.4	18.9	20.4	1.5	25.34	20.27	20.36	0.08
30	32.2	16.7	17.9	1.2	25.09	20.16	20.22	0.07
40	28.9	15.4	16.4	1.0	24.93	20.09	20.15	0.06
50	26.7	14.5	15.3	0.8	24.82	20.04	20.09	0.05
60	25.1	13.9	14.6	0.7	24.74	20.01	20.05	0.04
70	23.9	13.4	14.0	0.6	24.68	19.98	20.02	0.04
80	23.0	13.0	13.6	0.6	24.63	19.96	19.99	0.03
90	22.2	12.7	13.2	0.5	24.59	19.95	19.97	0.03
100	21.6	12.5	12.9	0.5	24.56	19.93	19.96	0.03
125	20.4	12.0	12.4	0.4	24.50	19.91	19.93	0.02
150	19.6	11.7	12.0	0.3	24.46	19.89	19.91	0.02
175	19.0	11.4	11.7	0.3	24.43	19.87	19.89	0.02
200	18.6	11.3	11.5	0.3	24.40	19.86	19.88	0.02

Link 10: A11 South of Fiveways Roundabout

1.1.39 This transect is immediately south of the roundabout and runs through plantation woodland that forms part of Breckland SPA.

1.1.40 Once again, a large net improvement in both NOx concentrations and nitrogen deposition rates is forecast by 2031. Moreover, the total NOx concentrations by 2031 are forecast to have fallen well below the critical level (30 ug/m^3) by the closest point of the SPA to the road (15m from the roadside), meaning that traffic is likely to have ceased to play a significant role in nitrogen deposition. Growth in Forest Heath District will retard this improvement to an extent (4 ug/m^3 or 0.2 kg/ha/yr at the closest point of the SAC to the road).

1.1.41 However, there are three elements that are very likely to prevent any effect on plantation clearing nesting opportunities for woodlark or nightjar in practice:

1. Firstly, the belt of permanent woodland preserved next to the road as standard forestry practice is very likely to intercept a large proportion of the emitted pollutants[13];
2. Secondly, for the vast majority of a forestry cycle the potential woodlark or nightjar habitat would be semi-mature or mature plantation, which will absorb a large proportion of any

[13] Xu, Y. (2008) Modelling the effects of roadside trees, results and conclusions. Report for the London Borough of Harrow. AEA, Harwell, Oxon.
Air pollution removal by urban trees and shrubs in the United States (2006). David J. Nowak, Daniel E. Crane, Jack C. Stevens. Urban Forestry & Urban Greening 4 115–123
Freer-Smith, P.H., Beckett, K.P. and Taylor, G. (2005). Deposition velocities to Sorbus aria, Acer campestre, Populus deltoides x trichocarpa 'Beaupre', Pinus nigra and x Cupressocyparis leylandii for coarse, fine and ultra-fine particles in the urban environment. Environmental Pollution 133, 157–167.

pollutants that do penetrate the permanent woodland shelterbelt for the c.90% of the forestry cycle when birds will be absent; and

3. Thirdly, the process of planting and felling the trees to create the succession of clearings will have a much greater and long-term effect on ground vegetation (and therefore its suitability for woodlark and nightjar) than the relatively subtle effects of atmospheric nitrogen deposition. The clearance and replanting process, coupled with the management deployed during early stage plantation (or simply to maintain a woodland clearing in permanent forestry), is likely to be the major factor on overall clearing structure.

1.1.42 Therefore, no adverse effect will arise by virtue of a net deterioration in air quality.

	Annual Mean NOx Conc. (ug/m^3)				**Annual Mean N Dep (k N/ha/yr)**			
From Road (m)	**Baseline**	**(Base 2031)**	**(Scn3 2031)**	**(DS-DM)**	**Baseline**	**(Base 2031)**	**(Scn3 2031)**	**(DS-DM)**
15	57.5	25.5	29.5	4.0	26.12	20.55	20.75	0.20
20	52.5	23.6	27.1	3.5	25.91	20.45	20.64	0.18
30	45.9	21.2	24.0	2.8	25.61	20.32	20.47	0.15
40	41.6	19.6	22.0	2.4	25.41	20.24	20.37	0.13
50	38.4	18.5	20.6	2.1	25.27	20.18	20.30	0.11
60	35.9	17.6	19.5	1.8	25.15	20.14	20.24	0.10
70	34.1	17.0	18.6	1.7	25.07	20.11	20.19	0.08
80	32.5	16.4	18.0	1.5	24.99	20.08	20.15	0.07
90	31.3	16.0	17.4	1.4	24.93	20.05	20.13	0.07
100	30.2	15.7	17.0	1.3	24.88	20.03	20.10	0.06
125	28.2	14.9	16.1	1.1	24.78	20.00	20.05	0.05
150	26.7	14.4	15.4	1.0	24.70	19.97	20.02	0.05
175	25.6	14.0	14.9	0.9	24.65	19.95	19.99	0.04
200	24.6	13.7	14.5	0.8	24.60	19.93	19.97	0.04

1.1.43 There are two other B roads that lie immediately adjacent to plantation that constitutes part of Breckland SPA in Forest Heath District: the B1106 from Brandon to Elveden and part of the B1106 from Elveden to Brockley Corner. Neither of these road links has been specifically modelled for this analysis. However, it will have become clear at this point in the analysis that as a general principle, the nature of the plantation and its management where it lies adjacent to roads means that a) nightjar and woodlark are less likely to nest in potentially affected areas even during suitable parts of the forestry cycle and b) the clearance and preparation of forestry ready for the next cycle will have a much more significant role in determining early forestry structure than the relatively subtle contribution of road traffic emissions.

Link 11: A1101 West of Fiveways Roundabout

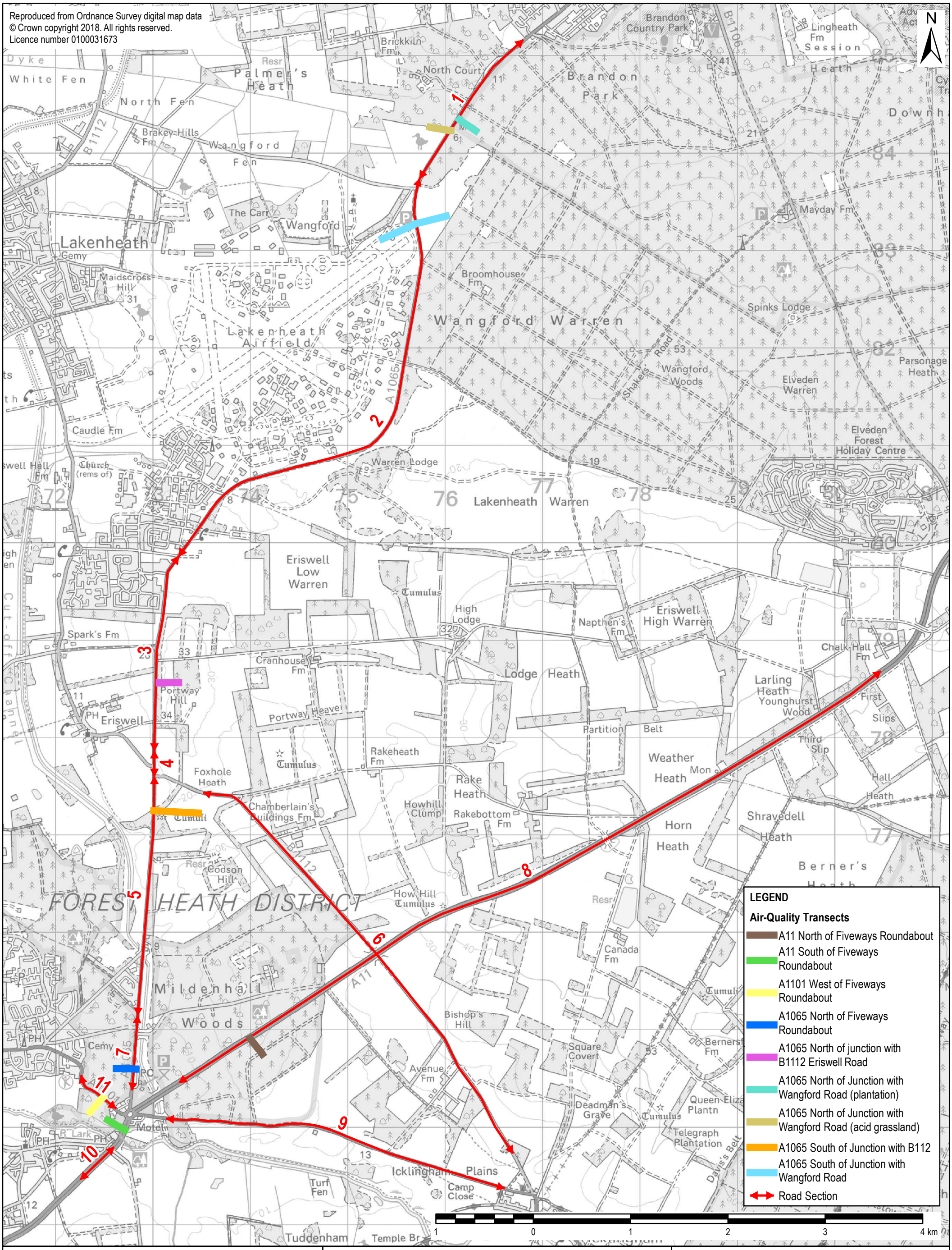
1.1.44 To the west of Fiveways Roundabout SPA plantation abuts the road on both sides. Once again, a large net improvement in both NOx concentrations and nitrogen deposition rates is forecast by 2031. Moreover, the total NOx concentrations by 2031 are forecast to have fallen below the critical level (30 ug/m^3) by 10m from the roadside, meaning that traffic is likely to have ceased to play a significant role in nitrogen deposition except immediately adjacent to the road. Growth in Forest Heath District will retard this improvement (9.5 ug/m^3 equating to 0.45 kg/ha/yr at the closest point to the road) but there is a belt of permanent woodland adjacent to this stretch of road, which occupies a 25m swathe either side of the road. Therefore the elevated nitrogen deposition would be entirely confined to this band of permanent woodland and it is therefore not expected that any effect on SPA bird nesting or foraging opportunities would occur.

	Annual Mean NOx Conc. (ug/m^3)				Annual Mean N Dep (k N/ha/yr)			
From Road (m)	Baseline	(Base 2031)	(Scn3 2031)	(DS-DM)	Baseline	(Base 2031)	(Scn3 2031)	(DS-DM)
0	80.5	38.0	47.5	9.5	27.05	21.17	21.62	0.45
5	56.9	27.8	33.7	5.9	26.10	20.67	20.95	0.29
10	46.1	23.1	27.3	4.2	25.63	20.43	20.63	0.21
15	40.6	20.7	24.1	3.4	25.37	20.30	20.47	0.17
20	37.0	19.1	21.9	2.8	25.20	20.22	20.36	0.14
30	32.6	17.3	19.4	2.1	24.99	20.12	20.23	0.11
40	30.2	16.3	18.0	1.7	24.88	20.07	20.16	0.09
50	28.6	15.6	17.1	1.5	24.80	20.03	20.11	0.08
60	27.6	15.1	16.4	1.3	24.75	20.01	20.07	0.07
70	26.7	14.8	16.0	1.2	24.70	19.99	20.05	0.06
80	26.1	14.5	15.6	1.1	24.67	19.97	20.03	0.06
90	25.6	14.3	15.3	1.0	24.65	19.96	20.01	0.05
100	25.3	14.1	15.1	1.0	24.63	19.95	20.00	0.05
125	24.6	13.8	14.7	0.8	24.59	19.94	19.98	0.04
150	24.1	13.6	14.4	0.7	24.57	19.93	19.96	0.04
175	23.8	13.5	14.2	0.7	24.56	19.92	19.95	0.03
200	23.6	13.4	14.1	0.7	24.55	19.91	19.95	0.03

Conclusion

1.1.45 In summary, it is concluded that no adverse effect on Breckland SAC, SPA or Rex Graham Reserve SAC is expected to occur from growth in Forest Heath District Council alone, or in combination with other projects and plans, due to a combination of the following factors:

- The nature of the SPA, with the areas closest to the road typically either permanent woodland buffer and/or unlikely to supporting nesting woodlark, nightjar or stone curlew due to disturbance;
- The fact that the forestry management practices necessary to keep the plantation suitable for nightjar and woodlark will have the dominant effect on forest clearing structure compared to the relatively subtle effects that may arise from atmospheric deposition;
- The fact that a net improvement in NOx concentrations and nitrogen deposition rates is actually forecast by 2031, even allowing for total traffic growth 'in combination', due to the expected improvement in vehicle nitrogen dioxide emission factors over the same time period; and
- The fact that background NOx concentrations and nitrogen deposition rates, although often currently high adjacent to the road, rapidly decline and are expected to fall below the critical level in the most relevant parts of the SPA/SAC over the Local Plan period.



File Name:K:\5004 - Information Systems\60534605_Forest_Heath_AQA\02_Maps\Figure 3 - Modelled road links and calculated air quality transects.mxd

Project Title/Drawing Title

SINGLE ISSUE REVIEW OF CS7 AND SITE ALLOCATIONS LOCAL PLAN AIR QUALITY ASSESSMENT REGARDING BRECKLAND SPECIAL AREA OF CONSERVATION (SAC) AND BRECKLAND SPECIAL PROTECTION AREA (SPA)

MODELLED ROAD LINKS AND CALCULATED AIR QUALITY TRANSECTS

Client: FOREST HEATH DISTRICT COUNCIL

Drawn	Checked	Approved
JW	BB	JR
Date	Scale @ A3	Purpose of Issue
25/02/2019	1:35,000	FINAL
Drawing Number		Rev
FIGURE 3		2

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