

Appendix 8.2: Assessment of Ecological Impacts

- 8.2.1 The IAQM 'A guide to the assessment of air quality impacts on designated nature conservation sites' guidance [1] states that:

"The DMRB provides a series of traffic screening criteria. These include the change in Annual Average Daily Traffic (AADT) flows on a given road of 1,000 vehicles or 200 heavy duty vehicles (HDVs). These thresholds have been widely used to screen out the need for quantitative assessment of projects/plans in the absence of any other thresholds recognised as being applicable in this context."

- 8.2.2 The Proposed Development generates sufficient traffic volume during the operational phase whereby the 200 HDV threshold, as AADT, is exceeded on the following road links (where a designated habitat site is also situated within 200m of the road):

- Crawley Road (A264);
- Horsham Road (A264); and
- A24 north of Warnham Road.

- 8.2.3 This appendix considers the impact of NO_x (Nitrogen Oxides) and NH₃ (Ammonia) concentrations, nutrient nitrogen deposition and acid deposition from operational traffic emissions, associated with the Proposed Development, at the following designated habitat sites along the A264 and A24:

- Warnhan LNR,
- Sparrow Copse AW,
- Hooks Copse AW,
- Spruce Hill AW,
- Buchan Hill Ponds SSSI,
- Three parcels of unnamed Ancient Woodland.

- 8.2.4 The locations of the modelled points within the aforementioned designated habitat sites can be found in Figures 8.5 - 8.9.

Approach

- 8.2.5 Concentrations of NO_x and NH₃ have been predicted using the same model and methodology as used in the assessment of human-health receptors (see ES Chapter 13: Air Quality). The receptor points have been modelled at ground level. Emission rates for NH₃ were calculated using Air Quality Consultants' Calculator for Road Emissions of Ammonia (v2A).
- 8.2.6 The process contribution (PC), i.e. the difference between the with and without development concentrations have been calculated for comparison with the relevant critical level/load. Note that an in-combination assessment, as outlined within Natural England's '*Air pollution and development: advice for local authorities*' guidance, has been undertaken for the Buchan Hill Ponds SSSI.

Critical Levels

- 8.2.7 Critical levels are maximum atmospheric concentrations of pollutants for the protection of vegetation and ecosystems and are specified within relevant European air quality directives and corresponding UK air quality regulations.

Critical Loads

- 8.2.8 Critical loads (CL) refer to the quantity of pollutant deposited, below which significant harmful effects on sensitive elements of the environment do not occur, according to present knowledge. Nutrient nitrogen deposition and acid deposition are considered in this appendix.

Critical Loads – Nutrient N Deposition

- 8.2.9 Percentage contributions to total nutrient nitrogen deposition have been derived from the modelled NO_x (converted to NO₂ using Defra's NO_x to NO₂ calculator – v9.1) and NH₃ concentrations. Deposition rates have been calculated using empirical methods recommended by the Environment Agency, as follows:
- The dry deposition flux ($\mu\text{g.m}^{-2}.\text{s}^{-1}$) has been calculated by multiplying the ground level NO₂ concentrations ($\mu\text{g.m}^{-3}$) by the deposition velocity of 0.003 m.s⁻¹ for forests/tall vegetation habitats. Units of $\mu\text{g.m}^{-2}.\text{s}^{-1}$ have been converted to units of kg.ha⁻¹.year⁻¹ by multiplying the dry deposition flux by the standard conversion factor of 96 for NO₂.
 - The NH₃ dry deposition flux ($\mu\text{g.m}^{-2}.\text{s}^{-1}$) has been calculated by multiplying the ground level NH₃ concentrations ($\mu\text{g.m}^{-3}$) by the deposition velocity of 0.03 m.s⁻¹ for forests/tall vegetation habitats. Units of $\mu\text{g.m}^{-2}.\text{s}^{-1}$ have been converted to units of kg.ha⁻¹.year⁻¹ by multiplying the dry deposition flux by the standard conversion factor of 260 for NH₃.
 - Predicted contributions to nutrient nitrogen deposition have been calculated from the sum of the NO₂ and NH₃ contributions and compared with the relevant critical load range for the habitat types associated with the assessed designated sites. These have been derived from the APIS database [2].

Critical Loads – Acidification

- 8.2.10 The acid deposition rate, in equivalents keq.ha⁻¹.year⁻¹, has been calculated by multiplying the dry deposition flux (kg.ha⁻¹.year⁻¹) by a conversion factor of 0.071428 for N. This takes into account the degree to which a chemical species is acidifying, calculated as the proportion of N within the molecule.
- 8.2.11 Wet deposition in the near field is not significant compared with dry deposition for N [3] and therefore for the purposes of this assessment, wet deposition has not been considered.
- 8.2.12 Predicted contributions to acid deposition have been calculated and compared with the critical load function for the habitat types associated with the designated sites as derived from the APIS database.

Significance Criteria

- 8.2.13 Maximum PCs of NO_x, NH₃ and N/acid deposition have been compared against the relevant critical levels/loads for the relevant habitat type/interest feature. The 1% assessment criterion (the PC expressed as a percentage of the relevant critical level/load) has been applied in accordance with both Natural England (*Air pollution and development: advice for local authorities*) and IAQM ('A guide to the assessment of air quality impacts on designated nature conservation sites') guidance.

Results

- 8.2.14 The predicted annual-mean NO_x PC concentrations are compared with the critical level in Table 8.2.1.
- 8.2.15 The predicted annual-mean NH₃ PC concentrations are compared with the critical level in Table 8.2.2.

- 8.2.16 The predicted nutrient N deposition PC rates are compared with the critical load in Table 8.2.3.
- 8.2.17 The predicted acid deposition PC rates are compared with the critical load function in Table 8.2.4.
- 8.2.18 The predicted in-combination annual-mean NO_x PC concentrations are compared with the critical level in Table 8.2.5 for the Buchan Hill Ponds SSSI.
- 8.2.19 The predicted in-combination annual-mean NH₃ PC concentrations are compared with the critical level in Table 8.2.6 for the Buchan Hill Ponds SSSI.
- 8.2.20 The predicted in-combination nutrient N deposition PC rates are compared with the critical load in Table 8.2.7 for the Buchan Hill Ponds SSSI.
- 8.2.21 The predicted in-combination acid deposition PC rates are compared with the critical load function in Table 8.2.8 for the Buchan Hill Ponds SSSI.

Table 8.2.1 Predicted NO_x Concentrations at Designated Site

Designated Site	Distance from nearest road (m)	Annual Mean CL (µg.m⁻³)	Annual Mean NO_x PC (µg.m⁻³)	NO_x PC as % of CL
Warnham LNR 1	25	30	0.38	1.3
Warnham LNR 2	30	30	0.33	1.1
Warnham LNR 3	35	30	0.30	1.0
Warnham LNR 4	45	30	0.25	0.8
Warnham LNR 5	55	30	0.22	0.7
Warnham LNR 6	75	30	0.17	0.6
Warnham LNR 7	125	30	0.12	0.4
Warnham LNR 8	225	30	0.08	0.3
Warnham LNR 1a	25	30	0.49	1.6
Warnham LNR 2a	30	30	0.45	1.5
Warnham LNR 3a	35	30	0.41	1.4
Warnham LNR 4a	45	30	0.36	1.2
Warnham LNR 5a	55	30	0.31	1.0
Warnham LNR 6a	75	30	0.26	0.9
Warnham LNR 7a	125	30	1.15	0.6
Warnham LNR 8a	175	30	0.18	0.5
Sparrow Copse 1	8	30	0.21	0.7
Sparrow Copse 2	13	30	0.16	0.5
Sparrow Copse 3	23	30	0.12	0.4
Sparrow Copse 4	33	30	0.09	0.3
Sparrow Copse 5	53	30	0.07	0.2
Sparrow Copse 6	103	30	0.04	0.1
Sparrow Copse 7	183	30	0.03	0.1

Hooks Copse 1	10	30	1.15	3.8
Hooks Copse 2	15	30	0.88	2.9
Hooks Copse 3	20	30	0.71	2.4
Hooks Copse 4	30	30	0.52	1.7
Hooks Copse 5	40	30	0.40	1.3
Hooks Copse 6	60	30	0.27	0.9
Hooks Copse 7	110	30	0.15	0.5
Hooks Copse 8	160	30	0.10	0.3
Spruce Hill 1	5	30	0.63	2.1
Spruce Hill 2	10	30	0.46	1.5
Spruce Hill 3	15	30	0.36	1.2
Spruce Hill 4	25	30	0.26	0.9
Spruce Hill 5	35	30	0.21	0.7
Spruce Hill 6	55	30	0.15	0.5
Spruce Hill 7	105	30	0.10	0.3
Spruce Hill 8	155	30	0.08	0.3
Buchan Hill Ponds SSSI 1	5	30	0.49	1.6
Buchan Hill Ponds SSSI 2	10	30	0.38	1.3
Buchan Hill Ponds SSSI 3	15	30	0.32	1.1
Buchan Hill Ponds SSSI 4	25	30	0.24	0.8
Buchan Hill Ponds SSSI 5	35	30	0.20	0.7
Buchan Hill Ponds SSSI 6	55	30	0.15	0.5
Buchan Hill Ponds SSSI 7	105	30	0.11	0.4
Buchan Hill Ponds SSSI 8	155	30	0.09	0.3
Buchan Hill Ponds SSSI 9	5	30	0.44	1.5
Buchan Hill Ponds SSSI 10	10	30	0.31	1.0

Buchan Hill Ponds SSSI 11	15	30	0.24	0.8
Buchan Hill Ponds SSSI 12	25	30	0.18	0.6
Buchan Hill Ponds SSSI 13	35	30	0.14	0.5
Buchan Hill Ponds SSSI 14	55	30	0.11	0.4
Buchan Hill Ponds SSSI 15	95	30	0.08	0.3
Buchan Hill Ponds SSSI 16	135	30	0.06	0.2
AW 1 A	8	30	0.17	0.6
AW 2 A	13	30	0.21	0.7
AW 3 A	18	30	0.15	0.5
AW 4 A	28	30	0.12	0.4
AW 5 A	38	30	0.10	0.3
AW 6 A	58	30	0.08	0.3
AW 7 A	108	30	0.05	0.2
AW 8 A	158	30	0.04	0.1
AW 1 B	25	30	0.24	0.8
AW 2 B	30	30	0.21	0.7
AW 3 B	35	30	0.19	0.6
AW 4 B	45	30	0.16	0.5
AW 5 B	55	30	0.14	0.5
AW 6 B	75	30	0.12	0.4
AW 7 B	125	30	0.08	0.3
AW 1 C	10	30	0.32	1.1
AW 2 C	15	30	0.39	1.3
AW 3 C	20	30	0.27	0.9

Table 8.2.2 Predicted NH₃ Concentrations at Designated Sites

Designated Site	Distance from nearest road (m)	Annual Mean CL (µg.m⁻³)	Annual Mean NOx PC (µg.m⁻³)	NH₃ PC as % of CL
Warnham LNR 1	25	3	0.07	2.3
Warnham LNR 2	30	3	0.06	2.0
Warnham LNR 3	35	3	0.06	1.8
Warnham LNR 4	45	3	0.05	1.5
Warnham LNR 5	55	3	0.04	1.3
Warnham LNR 6	75	3	0.03	1.0
Warnham LNR 7	125	3	0.02	0.7
Warnham LNR 8	225	3	0.01	0.4
Warnham LNR 1a	25	3	0.07	2.4
Warnham LNR 2a	30	3	0.07	2.2
Warnham LNR 3a	35	3	0.06	2.0
Warnham LNR 4a	45	3	0.05	1.7
Warnham LNR 5a	55	3	0.04	1.4
Warnham LNR 6a	75	3	0.03	1.1
Warnham LNR 7a	125	3	0.02	4.2
Warnham LNR 8a	175	3	0.02	0.8
Sparrow Copse 1	8	3	0.04	0.6
Sparrow Copse 2	13	3	0.03	1.4
Sparrow Copse 3	23	3	0.02	1.1
Sparrow Copse 4	33	3	0.02	0.8
Sparrow Copse 5	53	3	0.01	0.6
Sparrow Copse 6	103	3	0.01	0.4
Sparrow Copse 7	183	3	0.00	0.3

Hooks Copse 1	10	3	0.13	0.2
Hooks Copse 2	15	3	0.10	3.3
Hooks Copse 3	20	3	0.08	2.7
Hooks Copse 4	30	3	0.06	2.1
Hooks Copse 5	40	3	0.05	1.7
Hooks Copse 6	60	3	0.04	1.2
Hooks Copse 7	110	3	0.02	0.7
Hooks Copse 8	160	3	0.02	0.5
Spruce Hill 1	5	3	0.12	3.8
Spruce Hill 2	10	3	0.08	2.8
Spruce Hill 3	15	3	0.07	2.2
Spruce Hill 4	25	3	0.05	1.6
Spruce Hill 5	35	3	0.04	1.2
Spruce Hill 6	55	3	0.03	0.9
Spruce Hill 7	105	3	0.02	0.6
Spruce Hill 8	155	3	0.01	0.4
Buchan Hill Ponds SSSI 1	5	3	0.09	2.9
Buchan Hill Ponds SSSI 2	10	3	0.07	2.3
Buchan Hill Ponds SSSI 3	15	3	0.06	1.9
Buchan Hill Ponds SSSI 4	25	3	0.04	1.4
Buchan Hill Ponds SSSI 5	35	3	0.03	1.1
Buchan Hill Ponds SSSI 6	55	3	0.03	0.9
Buchan Hill Ponds SSSI 7	105	3	0.02	0.6
Buchan Hill Ponds SSSI 8	155	3	0.01	0.5
Buchan Hill Ponds SSSI 9	5	3	0.08	2.6
Buchan Hill Ponds SSSI 10	10	3	0.06	1.8

Buchan Hill Ponds SSSI 11	15	3	0.04	1.4
Buchan Hill Ponds SSSI 12	25	3	0.03	1.0
Buchan Hill Ponds SSSI 13	35	3	0.02	0.8
Buchan Hill Ponds SSSI 14	55	3	0.02	0.6
Buchan Hill Ponds SSSI 15	95	3	0.01	0.4
Buchan Hill Ponds SSSI 16	135	3	0.01	0.3
AW 1 A	8	3	0.03	1.0
AW 2 A	13	3	0.04	1.2
AW 3 A	18	3	0.03	0.9
AW 4 A	28	3	0.02	0.7
AW 5 A	38	3	0.02	0.6
AW 6 A	58	3	0.01	0.4
AW 7 A	108	3	0.01	0.3
AW 8 A	158	3	0.01	0.2
AW 1 B	25	3	0.04	1.4
AW 2 B	30	3	0.04	1.3
AW 3 B	35	3	0.03	1.1
AW 4 B	45	3	0.03	1.0
AW 5 B	55	3	0.02	0.8
AW 6 B	75	3	0.02	0.7
AW 7 B	125	3	0.01	0.5
AW 1 C	10	3	0.06	1.9
AW 2 C	15	3	0.07	2.3
AW 3 C	20	3	0.05	1.6

Table 8.2.3 Predicted Nutrient N Deposition at Designated Sites

Designated Site	Distance from nearest road (m)	CL (kgN.ha ⁻¹ .yr ⁻¹)	NOx PC (kgN.ha ⁻¹ .yr ⁻¹)	NH3 PC (kgN.ha ⁻¹ .yr ⁻¹)	Total N Dep	PC/CL (%)
Warnham LNR 1	25	10	0.02	0.36	0.38	4
Warnham LNR 2	30	10	0.02	0.32	0.34	3
Warnham LNR 3	35	10	0.02	0.29	0.31	3
Warnham LNR 4	45	10	0.02	0.23	0.25	3
Warnham LNR 5	55	10	0.01	0.20	0.21	2
Warnham LNR 6	75	10	0.01	0.16	0.17	2
Warnham LNR 7	125	10	0.01	0.11	0.11	1
Warnham LNR 8	225	10	0.01	0.07	0.07	1
Warnham LNR 1a	25	10	0.03	0.38	0.41	4
Warnham LNR 2a	30	10	0.03	0.34	0.37	4
Warnham LNR 3a	35	10	0.03	0.31	0.33	3
Warnham LNR 4a	45	10	0.02	0.26	0.28	3
Warnham LNR 5a	55	10	0.02	0.22	0.24	2
Warnham LNR 6a	75	10	0.02	0.18	0.19	2
Warnham LNR 7a	125	10	0.01	0.12	0.13	1
Warnham LNR 8a	175	10	0.01	0.09	0.10	1
Sparrow Copse 1	8	10	0.01	0.22	0.23	2
Sparrow Copse 2	13	10	0.01	0.17	0.18	2
Sparrow Copse 3	23	10	0.01	0.12	0.13	1
Sparrow Copse 4	33	10	0.01	0.09	0.10	1
Sparrow Copse 5	53	10	0.00	0.07	0.07	1
Sparrow Copse 6	103	10	0.00	0.04	0.04	0
Sparrow Copse 7	183	10	0.00	0.02	0.03	0

Hooks Copse 1	10	10	0.07	0.65	0.72	7
Hooks Copse 2	15	10	0.05	0.51	0.57	6
Hooks Copse 3	20	10	0.05	0.43	0.47	5
Hooks Copse 4	30	10	0.03	0.32	0.36	4
Hooks Copse 5	40	10	0.03	0.26	0.28	3
Hooks Copse 6	60	10	0.02	0.19	0.20	2
Hooks Copse 7	110	10	0.01	0.11	0.12	1
Hooks Copse 8	160	10	0.01	0.08	0.09	1
Spruce Hill 1	5	10	0.04	0.60	0.64	6
Spruce Hill 2	10	10	0.03	0.44	0.47	5
Spruce Hill 3	15	10	0.02	0.34	0.37	4
Spruce Hill 4	25	10	0.02	0.24	0.26	3
Spruce Hill 5	35	10	0.01	0.19	0.21	2
Spruce Hill 6	55	10	0.01	0.14	0.15	1
Spruce Hill 7	105	10	0.01	0.09	0.10	1
Spruce Hill 8	155	10	0.01	0.07	0.07	1
Buchan Hill Ponds SSSI 1	5	10	0.03	0.45	0.49	4.9
Buchan Hill Ponds SSSI 2	10	10	0.03	0.35	0.38	3.8
Buchan Hill Ponds SSSI 3	15	10	0.02	0.29	0.32	3.2
Buchan Hill Ponds SSSI 4	25	10	0.02	0.22	0.24	2.4
Buchan Hill Ponds SSSI 5	35	10	0.01	0.18	0.19	1.9
Buchan Hill Ponds SSSI 6	55	10	0.01	0.14	0.15	1.5
Buchan Hill Ponds SSSI 7	105	10	0.01	0.09	0.10	1.0
Buchan Hill Ponds SSSI 8	155	10	0.01	0.07	0.08	0.8
Buchan Hill Ponds SSSI 9	5	10	0.03	0.41	0.44	4.4
Buchan Hill Ponds SSSI 10	10	10	0.02	0.29	0.31	3.1

Buchan Hill Ponds SSSI 11	15	10	0.02	0.22	0.24	2.4
Buchan Hill Ponds SSSI 12	25	10	0.01	0.16	0.18	1.8
Buchan Hill Ponds SSSI 13	35	10	0.01	0.13	0.14	1.4
Buchan Hill Ponds SSSI 14	55	10	0.01	0.10	0.10	1.0
Buchan Hill Ponds SSSI 15	95	10	0.01	0.07	0.07	0.7
Buchan Hill Ponds SSSI 16	135	10	0.00	0.05	0.06	0.6
AW 1 A	8	10	0.03	0.41	0.44	4.4
AW 2 A	13	10	0.02	0.29	0.31	3.1
AW 3 A	18	10	0.02	0.22	0.24	2.4
AW 4 A	28	10	0.01	0.16	0.18	1.8
AW 5 A	38	10	0.01	0.13	0.14	1.4
AW 6 A	58	10	0.01	0.10	0.10	1.0
AW 7 A	108	10	0.01	0.07	0.07	0.7
AW 8 A	158	10	0.00	0.05	0.06	0.6
AW 1 B	25	10	0.01	0.16	0.17	1.7
AW 2 B	30	10	0.01	0.19	0.21	2
AW 3 B	35	10	0.01	0.14	0.15	1
AW 4 B	45	10	0.01	0.11	0.12	1
AW 5 B	55	10	0.01	0.09	0.09	1
AW 6 B	75	10	0.01	0.07	0.07	1
AW 7 B	125	10	0.00	0.05	0.05	0
AW 1 C	10	10	0.00	0.04	0.04	0
AW 2 C	15	10	0.02	0.22	0.24	2
AW 3 C	20	10	0.01	0.20	0.21	2

Note:

Critical loads (CLs) for nutrient nitrogen deposition are provided as a range. In this case, the lower limit of the CL range has been used in the assessment. Note that in the absence of site-specific APIS data for the LNR and AW sites, the woodland CLs for the Buchan Hill Ponds SSSI has been applied. Vegetation is assumed to be short.

Table 8.2.4 Predicted Acid Deposition at Designated Sites

Designated Site	Distance from nearest road (m)	CL Max N (keq.ha ⁻¹ .yr ⁻¹)	PC (keq.ha ⁻¹ .yr ⁻¹)	PC/CL (%)
Warnham LNR 1	25	2.10	0.03	1.30
Warnham LNR 2	30	2.10	0.02	1.15
Warnham LNR 3	35	2.10	0.02	1.04
Warnham LNR 4	45	2.10	0.02	0.86
Warnham LNR 5	55	2.10	0.02	0.73
Warnham LNR 6	75	2.10	0.01	0.58
Warnham LNR 7	125	2.10	0.01	0.39
Warnham LNR 8	225	2.10	0.01	0.25
Warnham LNR 1a	25	2.10	0.03	1.40
Warnham LNR 2a	30	2.10	0.03	1.27
Warnham LNR 3a	35	2.10	0.02	1.14
Warnham LNR 4a	45	2.10	0.02	0.96
Warnham LNR 5a	55	2.10	0.02	0.83
Warnham LNR 6a	75	2.10	0.01	0.66
Warnham LNR 7a	125	2.10	0.01	0.45
Warnham LNR 8a	175	2.10	0.01	0.34
Sparrow Copse 1	8	2.10	0.02	0.78
Sparrow Copse 2	13	2.10	0.01	0.60
Sparrow Copse 3	23	2.10	0.01	0.43
Sparrow Copse 4	33	2.10	0.01	0.34
Sparrow Copse 5	53	2.10	0.01	0.24
Sparrow Copse 6	103	2.10	0.00	0.14
Sparrow Copse 7	183	2.10	0.00	0.09
Hooks Copse 1	10	2.10	0.05	2.46
Hooks Copse 2	15	2.10	0.04	1.93
Hooks Copse 3	20	2.10	0.03	1.60

Hooks Copse 4	30	2.10	0.03	1.22
Hooks Copse 5	40	2.10	0.02	0.97
Hooks Copse 6	60	2.10	0.01	0.70
Hooks Copse 7	110	2.10	0.01	0.41
Hooks Copse 8	160	2.10	0.01	0.29
Spruce Hill 1	5	2.10	0.05	2.18
Spruce Hill 2	10	2.10	0.03	1.59
Spruce Hill 3	15	2.10	0.03	1.24
Spruce Hill 4	25	2.10	0.02	0.89
Spruce Hill 5	35	2.10	0.01	0.70
Spruce Hill 6	55	2.10	0.01	0.51
Spruce Hill 7	105	2.10	0.01	0.33
Spruce Hill 8	155	2.10	0.01	0.24
Buchan Hill Ponds SSSI 1	5	2.10	0.03	1.66
Buchan Hill Ponds SSSI 2	10	2.10	0.03	1.29
Buchan Hill Ponds SSSI 3	15	2.10	0.02	1.08
Buchan Hill Ponds SSSI 4	25	2.10	0.02	0.80
Buchan Hill Ponds SSSI 5	35	2.10	0.01	0.65
Buchan Hill Ponds SSSI 6	55	2.10	0.01	0.50
Buchan Hill Ponds SSSI 7	105	2.10	0.01	0.33
Buchan Hill Ponds SSSI 8	155	2.10	0.01	0.27
Buchan Hill Ponds SSSI 9	5	2.10	0.03	1.49
Buchan Hill Ponds SSSI 10	10	2.10	0.02	1.05
Buchan Hill Ponds SSSI 11	15	2.10	0.02	0.82
Buchan Hill Ponds SSSI 12	25	2.10	0.01	0.60
Buchan Hill Ponds SSSI 13	35	2.10	0.01	0.47
Buchan Hill Ponds SSSI 14	55	2.10	0.01	0.35
Buchan Hill Ponds SSSI 15	95	2.10	0.01	0.25
Buchan Hill Ponds SSSI 16	135	2.10	0.00	0.20

AW 1 A	8	2.10	0.01	0.58
AW 2 A	13	2.10	0.01	0.71
AW 3 A	18	2.10	0.01	0.50
AW 4 A	28	2.10	0.01	0.39
AW 5 A	38	2.10	0.01	0.32
AW 6 A	58	2.10	0.01	0.25
AW 7 A	108	2.10	0.00	0.17
AW 8 A	158	2.10	0.00	0.13
AW 1 B	25	2.10	0.02	0.81
AW 2 B	30	2.10	0.02	0.72
AW 3 B	35	2.10	0.01	0.65
AW 4 B	45	2.10	0.01	0.55
AW 5 B	55	2.10	0.01	0.47
AW 6 B	75	2.10	0.01	0.38
AW 7 B	125	2.10	0.01	0.27
AW 1 C	10	2.10	0.02	1.09
AW 2 C	15	2.10	0.03	1.32
AW 3 C	20	2.10	0.02	0.93

Note:

Note that in the absence of site-specific APIS data for the LNR and AW sites, the woodland CLs for the Buchan Hill Ponds SSSI has been applied.

Annual-mean NO_x

8.2.22 The annual-mean NO_x PC exceeds 1% of the critical level of 30 µg.m⁻³ at the following designated habitat sites:

- Warnham LNR up to 35m from the A24;
- Hooks Copse AW up to 40m from the A264;
- Spruce Hill AW up to 15m from the A264; and
- Buchan Hill Ponds SSSI up to 15m north of the A264 and 10m south of the A264.

8.2.23 At all other modelled points, the annual-mean NO_x PC was 1% or below. The impacts on ancient woodland and LNR sites can be considered insignificant as they fall below 100% of the critical level. The impacts on the SSSI cannot be scoped out as insignificant based on the PC alone as they are above 1% of the CL at a number of receptors. However when the highest PC at the SSSI is added to the background concentrations of 13.5 µg.m⁻³, the resulting PEC is 14.0 µg.m⁻³ which is 47% of the CL and the impacts can be screened out as insignificant based on the PEC.

Annual Mean NH₃

8.2.24 The annual-mean NH₃ PC exceeds 1% of the critical level of 3 µg.m⁻³ at the following designated habitat sites:

- Warnham LNR up to 125m from the A24 ;
- Sparrow Copse AW up to 23m from the A24;
- Hooks Copse AW up to 60m from the A264 ;
- Spruce Hill AW up to 35m from the A264 ;
- Buchan Hill Ponds SSSI up to 35m to the north of the A264 and 25m to the south of the A264;
- Un-named AW parcel A up to 13m from the A264;
- Un-named AW parcel B up to 35m from the A264; and
- Un-named AW parcel C up to 20m from the A264 (all modelled points).

8.2.25 At all other modelled points, the annual-mean NH₃ PC was 1% or below. The impacts on ancient woodland and LNR sites can be considered insignificant as they fall below 100% of the critical level. The impacts on the SSSI cannot be scoped out as insignificant based on the PC alone as they are above 1% of the CL at a number of receptors. When the highest PC at the SSSI is added to the background concentrations of 1.0 µg.m⁻³, the resulting PEC is 1.1 µg.m⁻³ which is 37% of the CL and the impacts can be screened out as insignificant based on the PEC.

Nutrient N Deposition

8.2.26 The annual-mean nutrient nitrogen deposition PC exceeds 1% of the lower critical load at the following designated habitat sites:

- Warnham LNR up to 75m from the A24 ;
- Sparrow Copse AW up to 23m from the A24;
- Hooks Copse AW up to 60m from the A264 ;
- Spruce Hill AW up to 35m from the A264 ;

- Buchan Hill Ponds SSSI up to 35m to the north of the A264 and 25m to the south ;
- Un-named AW parcel A up to 13m from the A264;
- Un-named AW parcel B up to 45m from the A264 ; and
- Un-named AW parcel C up to 20m from the A264 (all modelled points).

8.2.27 At all other modelled points the annual-mean nutrient nitrogen deposition PC was 1% or below. The impacts on ancient woodland and LNR sites can be considered insignificant as they fall below 100% of the critical load. The impacts on the SSSI cannot be scoped out as insignificant based on the PC alone as they are above 1% of the CL at a number of receptors. When the highest PC at the SSSI is added to the background concentrations of $23.8 \text{ kgN.ha}^{-1}.\text{yr}^{-1}$, the resulting PEC is $24.3 \text{ kgN.ha}^{-1}.\text{yr}^{-1}$ which is 243% of the lower CL.

Acid Deposition

8.2.28 The annual-mean acid nitrogen deposition PC exceeds 1% of the critical load at the following designated habitat sites:

- Warnham LNR up to 35m from the A24;
- Hooks Copse AW up to 30m from the A264;
- Spruce Hill AW up to 15m from the A264;
- Buchan Hill Ponds SSSI up to 15m to the north of the A264 and 10m to the south; and
- Un-named AW parcel C up to 15m from the A264.

8.2.29 At all other modelled points the annual-mean acid nitrogen deposition PC was 1% or below. The impacts on ancient woodland and LNR sites can be considered insignificant as they fall below 100% of the critical load. The impacts on the SSSI cannot be scoped out as insignificant based on the PC alone as they are above 1% of the CL at a number of receptors. When the highest PC at the SSSI is added to the background concentrations of $1.0 \text{ keq.ha}^{-1}.\text{yr}^{-1}$, the resulting PEC is $1.04 \text{ keq.ha}^{-1}.\text{yr}^{-1}$ which is 50% of the lower CL and the impacts can be screened out as insignificant based on the PEC.

Assessment of In-Combination Impacts on Buchan Ponds SSSI

Table 8.2.5 Predicted NO_x Concentrations at Designated Site

Designated Site	Annual Mean CL (µg.m ⁻³)	Annual Mean NO _x PC (µg.m ⁻³)	NO _x PC as % of CL	AC (µg.m ⁻³)	PEC (µg.m ⁻³)	PEC/Critical Level (%)
Buchan Hill Ponds SSSI 1	30	0.71	2.4	13.52	14.23	47
Buchan Hill Ponds SSSI 2	30	0.56	1.9	13.52	14.08	47
Buchan Hill Ponds SSSI 3	30	0.47	1.6	13.52	13.99	47
Buchan Hill Ponds SSSI 4	30	0.35	1.2	13.52	13.87	46
Buchan Hill Ponds SSSI 5	30	0.29	1.0	13.52	13.81	46
Buchan Hill Ponds SSSI 6	30	0.23	0.8	13.52	13.74	46
Buchan Hill Ponds SSSI 7	30	0.16	0.5	13.52	13.68	46
Buchan Hill Ponds SSSI 8	30	0.13	0.4	13.52	13.65	45
Buchan Hill Ponds SSSI 9	30	0.64	2.1	13.52	14.16	47
Buchan Hill Ponds SSSI 10	30	0.45	1.4	13.52	13.97	47
Buchan Hill Ponds SSSI 11	30	0.35	1.1	13.52	13.87	46
Buchan Hill Ponds SSSI 12	30	0.26	0.8	13.52	13.78	46
Buchan Hill Ponds SSSI 13	30	0.21	0.6	13.52	13.73	46
Buchan Hill Ponds SSSI 14	30	0.16	0.4	13.52	13.68	46
Buchan Hill Ponds SSSI 15	30	0.11	0.3	13.52	13.63	45
Buchan Hill Ponds SSSI 16	30	0.09	0.2	13.52	13.61	45

Table 8.2.6 Predicted NH₃ Concentrations at Designated Sites

Designated Site	Annual Mean CL (µg.m ⁻³)	Annual Mean NH ₃ PC (µg.m ⁻³)	NH ₃ PC as % of CL	AC (µg.m ⁻³)	PEC (µg.m ⁻³)	PEC/Critical Level Lower (%)
Buchan Hill Ponds SSSI 1	3	0.16	5.5	0.98	1.1	38
Buchan Hill Ponds SSSI 2	3	0.13	4.2	0.98	1.1	37
Buchan Hill Ponds SSSI 3	3	0.11	3.6	0.98	1.1	36
Buchan Hill Ponds SSSI 4	3	0.08	2.7	0.98	1.1	35
Buchan Hill Ponds SSSI 5	3	0.07	2.2	0.98	1.0	35
Buchan Hill Ponds SSSI 6	3	0.05	1.7	0.98	1.0	34
Buchan Hill Ponds SSSI 7	3	0.03	1.1	0.98	1.0	34
Buchan Hill Ponds SSSI 8	3	0.03	0.9	0.98	1.0	34
Buchan Hill Ponds SSSI 9	3	0.15	4.9	0.98	1.1	38
Buchan Hill Ponds SSSI 10	3	0.10	3.5	0.98	1.1	36
Buchan Hill Ponds SSSI 11	3	0.08	2.7	0.98	1.1	35

Buchan Hill Ponds SSSI 12	3	0.06	2.0	0.98	1.0	35
Buchan Hill Ponds SSSI 13	3	0.05	1.6	0.98	1.0	34
Buchan Hill Ponds SSSI 14	3	0.04	1.2	0.98	1.0	34
Buchan Hill Ponds SSSI 15	3	0.03	0.8	0.98	1.0	34
Buchan Hill Ponds SSSI 16	3	0.02	0.7	0.98	1.0	33

Table 8.2.7 Predicted Nutrient N Deposition at Designated Sites

Designated Site	CL (kgN. ha ⁻¹ .yr ⁻¹)	NOx PC (kgN.ha ⁻¹ .yr ⁻¹)	NH3 PC (kgN.ha ⁻¹ .yr ⁻¹)	Total N Dep	PC/CL (%)	AC (kgN. ha ⁻¹ .yr ⁻¹)	PEC (kgN. ha ⁻¹ .yr ⁻¹)	PEC/ CL % Lower
Buchan Hill Ponds SSSI 1	10	0.05	0.85	0.90	9.0	23.80	24.70	247
Buchan Hill Ponds SSSI 2	10	0.04	0.66	0.70	7.0	23.80	24.50	245
Buchan Hill Ponds SSSI 3	10	0.03	0.56	0.59	5.9	23.80	24.39	244
Buchan Hill Ponds SSSI 4	10	0.02	0.42	0.44	4.4	23.80	24.24	242
Buchan Hill Ponds SSSI 5	10	0.02	0.34	0.36	3.6	23.80	24.16	242
Buchan Hill Ponds SSSI 6	10	0.02	0.26	0.28	2.8	23.80	24.08	241
Buchan Hill Ponds SSSI 7	10	0.01	0.18	0.19	1.9	23.80	23.99	240
Buchan Hill Ponds SSSI 8	10	0.01	0.15	0.16	1.6	23.80	23.96	240
Buchan Hill Ponds SSSI 9	10	0.04	0.76	0.81	8.1	23.80	24.61	246
Buchan Hill Ponds SSSI 10	10	0.03	0.54	0.57	5.7	23.80	24.37	244
Buchan Hill Ponds SSSI 11	10	0.02	0.42	0.44	4.4	23.80	24.24	242
Buchan Hill Ponds SSSI 12	10	0.02	0.31	0.33	3.3	23.80	24.13	241
Buchan Hill Ponds SSSI 13	10	0.01	0.25	0.26	2.6	23.80	24.06	241
Buchan Hill Ponds SSSI 14	10	0.01	0.19	0.20	2.0	23.80	24.00	240
Buchan Hill Ponds SSSI 15	10	0.01	0.13	0.14	1.4	23.80	23.94	239
Buchan Hill Ponds SSSI 16	10	0.01	0.11	0.11	1.1	23.80	23.91	239

Note:

Critical loads (CLs) for nutrient nitrogen deposition are provided as a range. In this case, the lower limit of the CL range has been used in the assessment.

Table 8.2.8 Predicted Acid Deposition at Designated Sites

Designated Site	CL Max N (keq.ha⁻¹.yr⁻¹)	PC (keq.ha⁻¹.yr⁻¹)	PC/CL (%)	PEC (keq.ha⁻¹.yr⁻¹)	PEC/CL %
Buchan Hill Ponds SSSI 1	2.10	0.06	3.1	1.07	51
Buchan Hill Ponds SSSI 2	2.10	0.05	2.4	1.06	50
Buchan Hill Ponds SSSI 3	2.10	0.04	2.0	1.05	50
Buchan Hill Ponds SSSI 4	2.10	0.03	1.5	1.04	50
Buchan Hill Ponds SSSI 5	2.10	0.03	1.2	1.03	49
Buchan Hill Ponds SSSI 6	2.10	0.02	0.9	1.03	49
Buchan Hill Ponds SSSI 7	2.10	0.01	0.6	1.02	49
Buchan Hill Ponds SSSI 8	2.10	0.01	0.5	1.02	49
Buchan Hill Ponds SSSI 9	2.10	0.06	2.8	1.07	51
Buchan Hill Ponds SSSI 10	2.10	0.04	1.9	1.05	50
Buchan Hill Ponds SSSI 11	2.10	0.03	1.5	1.04	50
Buchan Hill Ponds SSSI 12	2.10	0.02	1.1	1.03	49
Buchan Hill Ponds SSSI 13	2.10	0.02	0.9	1.03	49
Buchan Hill Ponds SSSI 14	2.10	0.01	0.7	1.02	49
Buchan Hill Ponds SSSI 15	2.10	0.01	0.5	1.02	49
Buchan Hill Ponds SSSI 16	2.10	0.01	0.4	1.02	48

CL = Critical Load

Annual-mean NO_x

- 8.2.30 The annual-mean NO_x PC exceeds 1% of the critical level at the Buchan Hill Ponds SSSI at up to 25m to the north of the A264, and up to 15m to the south. The PEC is less than 100% of the CL and the impacts on the SSSI can be scoped out as insignificant on this basis.

Annual Mean NH₃

- 8.2.31 The annual-mean NH₃ PC exceeds 1% of the critical level at the Buchan Hill Ponds SSSI at up to 105m to the north of the A264, and up to 55m to the south. The PEC is less than 100% of the CL and the impacts on the SSSI can be scoped out as insignificant on this basis.

Nutrient N Deposition

- 8.2.32 The annual-mean nutrient nitrogen deposition PC exceeds 1% of the critical load at the Buchan Hill Ponds SSSI at up to 155m to the north of the A264 and up to 135m to the south (all modelled points). The PEC exceeds the CL and the impacts cannot be screened out as insignificant at this stage and has been considered further in the following section.

Acid Deposition

- 8.2.33 The annual-mean acid nitrogen deposition PC exceeds 1% of the critical load at the Buchan Hill Ponds SSSI at up to 15m to the north of the A264 and up to 25m to the south.
- 8.2.34 The PEC is less than 100% of the CL and the impacts on the SSSI can be scoped out as insignificant on this basis.

Further Analysis of Nutrient Nitrogen Deposition

- 8.2.35 Following on from this modelling analysis, the receptors at the Buchan Ponds SSSI were further analysed due to the predicted exceedances modelled. Initially, the road was modelled as a simple road with no barrier between the road and the receptor. In reality however, a raised earth bank and tree barrier separating the road from the receptors on both sides will affect pollution dispersion. Therefore, a sensitivity test has been conducted, using a range of variables to determine the impact of these barriers on receptor concentrations. The roads were modelled using the advanced street canyon feature of the model, as recommended by the model developer. The canyon was modelled with an average height of 6 m, assuming 25%, 50% and 75% porosity to account for the porosity of the tree barrier. The noise barrier feature of the model was also used, which effectively assumes 0% porosity to give a range of potential results.
- 8.2.36 Following conversations with the project's ecologist, Derek Finnie Associates, it was determined that the sensitive habitat within the SSSI is Douster Pond, located 95m to the south of the A264 (modelled receptor: Buchan Hill Ponds SSSI 15). On this basis, it has been assumed that the vegetation in the habitat is short.
- 8.2.37 The table below show the process contributions as a percentage of the critical levels.

Table 8.2.11. Nitrogen Deposition Process Contribution as Percentage of Critical Load

Designated Site	Distance from road source	No barrier - Site Only	75% Porosity Canyon - Site Only	50% Porosity Canyon- Site Only	25% Porosity Canyon- Site Only	Noise Barrier- Site Only	No Barrier - In Combination	75% Porosity Canyon- In Combination	50% Porosity Canyon- In Combination	25% Porosity Canyon- In Combination	Noise Barrier- In Combination
Buchan Hill Ponds SSSI 1	5	4.9	4.4	3.9	3.4	2.5	9.0	8.1	7.2	6.4	4.7
Buchan Hill Ponds SSSI 2	10	3.8	3.5	3.1	2.8	2.4	7.0	6.4	5.8	5.2	4.4
Buchan Hill Ponds SSSI 3	15	3.2	2.9	2.7	2.4	2.2	5.9	5.4	5.0	4.5	4.0
Buchan Hill Ponds SSSI 4	25	2.4	2.2	2.1	1.9	1.8	4.4	4.1	3.9	3.6	3.4
Buchan Hill Ponds SSSI 5	35	1.9	1.8	1.7	1.6	1.6	3.6	3.4	3.2	3.0	2.9
Buchan Hill Ponds SSSI 6	55	1.5	1.4	1.3	1.3	1.3	2.8	2.7	2.5	2.4	2.4
Buchan Hill Ponds SSSI 7	105	1.0	1.0	0.9	0.9	0.9	1.9	1.9	1.8	1.8	1.8
Buchan Hill Ponds SSSI 8	155	0.8	0.8	0.8	0.8	0.8	1.6	1.5	1.5	1.5	1.5
Buchan Hill Ponds SSSI 9	5	4.4	3.9	3.4	3.0	2.0	8.1	7.2	6.4	5.6	3.6
Buchan Hill Ponds SSSI 10	10	3.1	2.8	2.5	2.2	1.8	5.7	5.2	4.6	4.2	3.4
Buchan Hill Ponds SSSI 11	15	2.4	2.2	2.0	1.8	1.6	4.4	4.1	3.7	3.4	3.0
Buchan Hill Ponds SSSI 12	25	1.8	1.6	1.5	1.4	1.3	3.3	3.1	2.9	2.7	2.5
Buchan Hill Ponds SSSI 13	35	1.4	1.3	1.2	1.2	1.1	2.6	2.5	2.3	2.2	2.1
Buchan Hill Ponds SSSI 14	55	1.0	1.0	1.0	0.9	0.9	2.0	1.9	1.8	1.7	1.7
Buchan Hill Ponds SSSI 15	95	0.7	0.7	0.7	0.7	0.7	1.4	1.4	1.3	1.3	1.3
Buchan Hill Ponds SSSI 16	135	0.6	0.5	0.5	0.5	0.5	1.1	1.1	1.1	1.0	1.1

- 8.2.38 The results show that the considering the tree belt as a solid barrier with 0% porosity predicts the lowest concentrations. When the tree belt is modelled as a noise barrier, the PC is less than 1% approx. 105 m north of the road and 55 m south of the road when considering traffic from the proposed development alone. When in combination traffic is considered, the PC does not fall below 1%.
- 8.2.39 With no barrier modelled, the PC falls below 1% approximately 105 m north of the road and 55 m south of the road when considering traffic from the proposed development. When in combination traffic is considered, the PC does not fall below 1%.
- 8.2.40 At receptor 15, the sensitive pond habitat, the PC is less than 1% when considering traffic emissions from the proposed development alone, but when considering in-combination traffic the PC is between 1.3 and 1.4% of the CL depending on the which model parameters are considered.
- 8.2.41 The results of the ecological assessment of impacts have been considered further within Sections 7.7.4 – 7.7.9 of Chapter 7 Biodiversity of the ES by the project ecologist (Derek Finnie Associates).

REFERENCES

- 1 IAQM, 2020. A guide to the assessment of air quality impacts on designated nature conservation sites
- 2 Air Pollution Information Systems, **www.apis.ac.uk**
- 3 Approaches to modelling local nitrogen deposition and concentrations in the context of Natura 2000 - Topic 4