Air Quality Assessment for Permit Variation: Melton Foods, Melton Mowbray

February 2024

Experts in air quality management & assessment

Document Control

Client	Melton Foods – A Division of Samworth Brothers Limited	**Principal Contact**	Jack Large

Job Number	J10/14744A/10

Report Prepared By:	Frances Marshall

Document Status and Review Schedule

Report No.	Date	Status	Reviewed by
J10/14744A/10/1/F2	2 February 2024	Final	Adam Clegg (Technical Director)

Air Quality Consultants Ltd
23 Coldharbour Road, Bristol BS6 7JT Tel: 0117 974 1086
24 Greville Street, Farringdon, London, EC1N 8SS Tel: 020 3873 4780
aqc@aqconsultants.co.uk

Registered Office: 23 Coldharbour Road, Bristol BS6 7JT
Companies House Registration No: 2814570

Contents

Tables

Figures

1 Introduction

1.1 This report describes the air quality assessment for the Melton Foods manufacturing facility at 3 Samworth Way in Melton Mowbray. The assessment has been prepared to support the Environmental Permit variation, which is made in accordance with the Environmental Permitting (England and Wales) Regulations 2016 (EPR), as amended. The assessment has been carried out by Air Quality Consultants Limited on behalf of Melton Foods (a division of Samworth Brothers Limited).

1.2 Melton Foods holds an existing environmental permit (EPR/GP3548QT) which requires a variation to reflect existing operations and incorporate future development. The existing emission sources associated with Melton Foods will all be retained (TP1 – 5), however, a new steam boiler (TP6), natural-gas fired tray wash and natural-gas fired oven will also be incorporated into the facility as part of the permit variation.

1.3 The site is located directly adjacent to another food manufacturing facility, Kettleby Foods, which also holds an environmental permit. Owing to the proximity of the sites to one another, the air quality assessment has considered the Melton Foods emission sources alongside the emission sources from the Kettleby Foods installation to provide a more robust estimate of the total Predicted Environmental Concentrations (PECs). Input data relating to Kettleby Foods are provided in Appendix A1.

1.4 The detailed modelling of emissions associated with these plant is described within this report. The model input files have been packaged as a zip file and sent alongside this report.

1.5 The assessment focuses on nitrogen dioxide (NO_2) impacts on human health, and on nitrogen oxides (NOx) and nutrient and acid nitrogen deposition for ecological impacts. These are the principal pollutants of concern with respect to emissions from natural gas fuelled plant. Natural gas fuelled plant will not have significant emissions of other pollutants like particulate matter, sulphur dioxide or volatile organic compounds.

1.6 Emissions of carbon monoxide (CO) from the new plant (steam boiler, tray wash and oven) are considered to be small compared to the environmental standards, however an assessment of CO from the existing Melton sources and the new plant is provided in Appendix A2 for completeness.

1.7 Table 1 gives the site location. Table 2 summarises the modelled scenarios and sensitivity tests that have been carried out.

Table 1: Site Location

Parameter	Entry
Site Name	Melton Foods
Site Address	3 Samworth Way, Leicester Road, Melton Mowbray, Leicestershire, LE13 1GA
Grid Reference (Centre of Facility) (O.S. X,Y)	473437, 318045

Table 2: Summary of Model Scenarios and Sensitivity Tests

Parameter	Entry
Year for Baseline Conditions	Most recent year of available measurements/predictions – no improvement assumed into the future (see Section 5)
Operating Hours	All plant are assumed to operate continuously throughout the year.
Meteorological Conditions	Five separate years of meteorological data modelled. Receptor-specific maxima out of the five years are reported (see Section 6)
Building Wake Effects	Model run with and without nearby buildings. Receptor-specific maxima from the two tests are reported (see Section 6)

2 Site Description

Nearby Sensitive Features

2.1 The Melton Foods manufacturing facility is 2.2 km to the west of the centre of Melton Mowbray, a town in Leicestershire.

2.2 Figure 1 shows the site location and identifies the area within 10 km of the facility, highlighting the locations of nearby internationally-designated ecological sites (Rutland Water Special Protection Area (SPA) and Ramsar), Local Authority Air Quality Management Areas (AQMAs) and Local Authority boundaries. The Rutland Water SPA and Ramsar is further than 10 km from the facility and has therefore not been considered in the assessment.

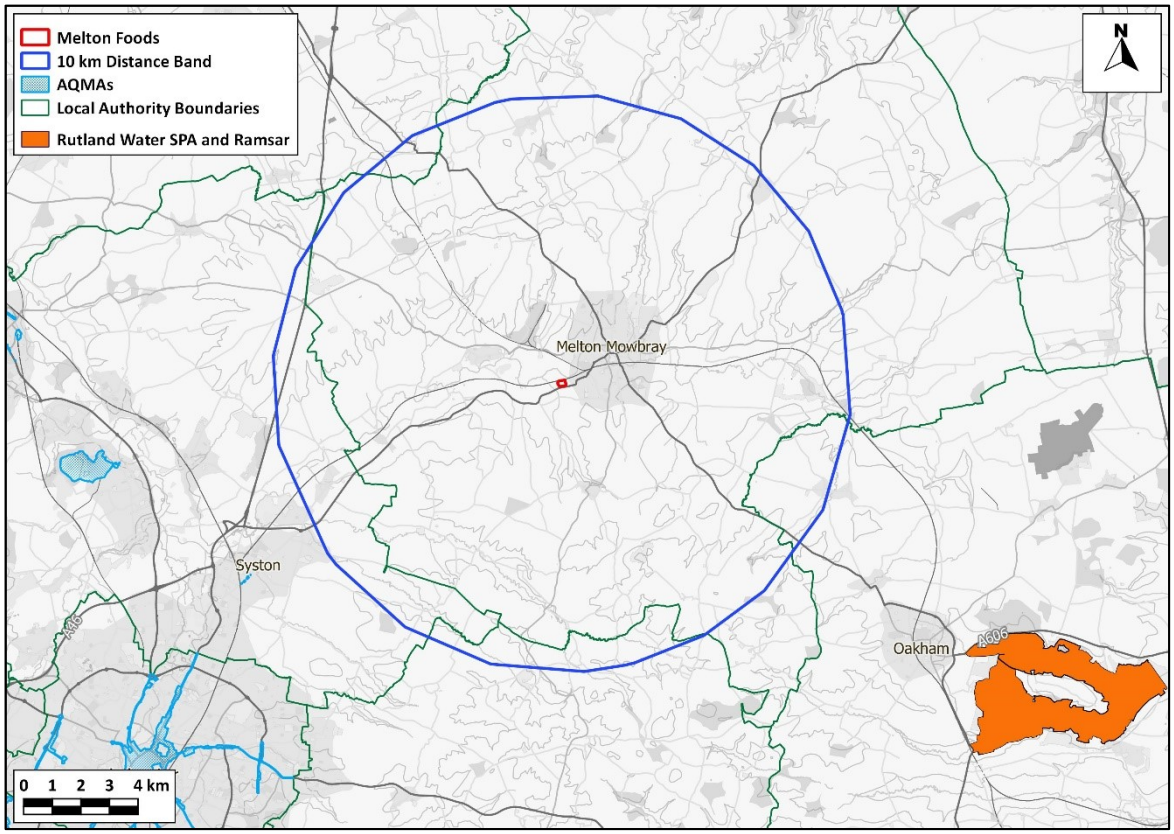


Figure 1: Application Site, Nearest Internationally-Designated Ecological Sites, AQMAs, and Local Authority Boundaries

2.3 Figure 2 presents similar information as Figure 1 but only focussing on the area within 2 km of the site where there are several Local Wildlife Sites (LWS). The nearest nationally-designated sites

(Frisby Marsh Site of Special Scientific Interest (SSSI) and River Eye SSSI) are over 2 km from the facility, thus have not been considered further.

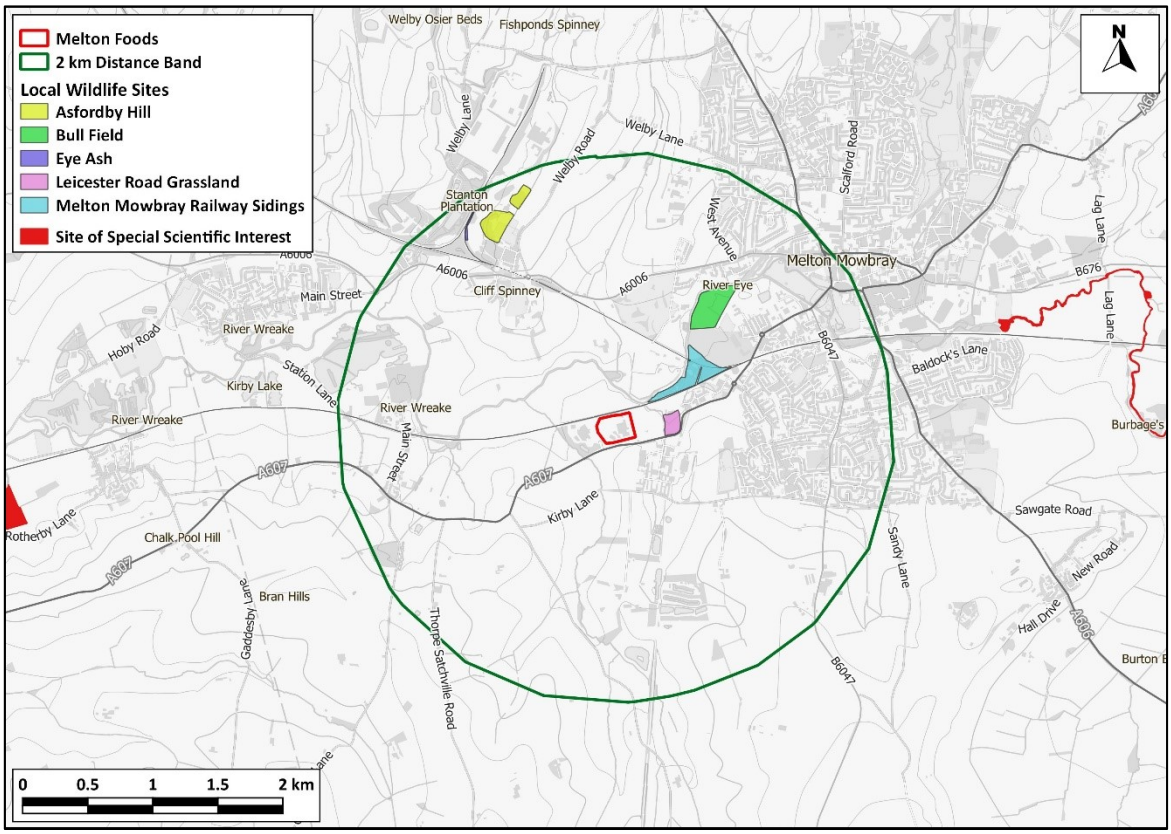


Figure 2: Application Site and Surrounding Area within 2 km, Including Locally-Designated Ecological Sites

2.4 Table 3 summarises the proximity of nearby sensitive features.

Table 3: Summary of Nearby Sensitive Features

Feature	Description	Distance from Site Boundary
Nearest Roadside [a] Human Receptor	New residential properties on Badger Avenue / A607	450 m
Nearest Non-roadside Human Receptor	Residential property (2 White House Farm Cottages) to the southeast of the application site [b]	20 m
Nearest SAC, SPA, Ramsar Site or SSSI	River Eye SSSI	2,930 m
Nearest Locally-Designated Site	Melton Mowbray Railway Sidings LWS	160 m

Feature	Description	Distance from Site Boundary
Receptors within the Downwash Cavity Length from the Nearest Edge/Side of the Building?	There are no receptors downwind of the building within the region of potential downwash effects (38 m)	n/a
Sensitive Receptor Setting	Rural	n/a
Sensitive Receptors Near an A Road or Motorway Network?	Yes, the A607	n/a
Sensitive Receptors within an AQMA Declared for NO_2?	No AQMAs declared within the study area	n/a

[a] 'Roadside' is defined as within 15 m of narrow congested streets, busy streets (10,000 vehicles per day), junctions (10,000 vehicles per day) or bus and coach stations that are not fully enclosed.

[b] Whilst the property is adjacent to the A607, it is set back from the kerbside by 18 m.

Topography and Terrain

2.5 Figure 3 shows the terrain across the modelled study area using Ordnance Survey (OS) Terrain 50 data. The area immediately surrounding the site is broadly flat, such that facility buildings from which the plant exhaust are approximately at the same elevation as the nearest human health receptors. However, as elevations in the wider domain exceed the height of the stack, digitally mapped terrain data have been included in the model set up.

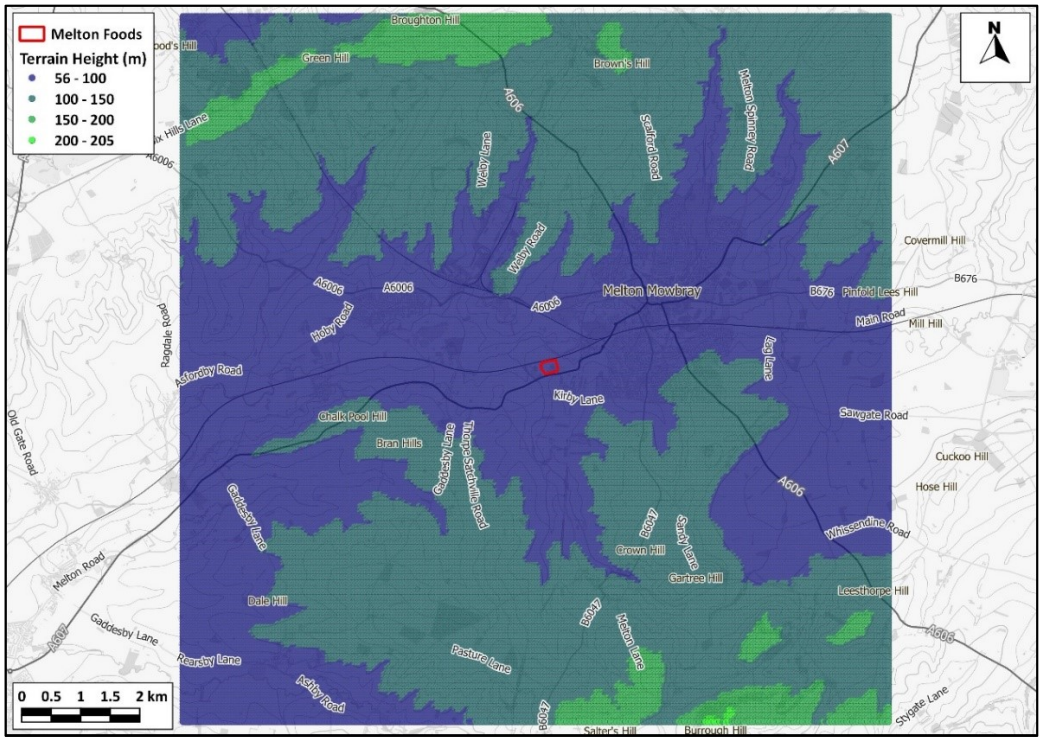


Figure 3: Terrain across Modelled Area

3 Description of Process

New Plant

3.1 Three new plant are proposed as part of the permit variation:

- A steam boiler (TP6) at the south of the facility, with a dedicated vertical flue, terminating 5.8 m above ground level, and 1.3 m above the roof;
- a new oven in the west of the facility, with a dedicated vertical flue terminating 11.8 m above ground level, and 1.3 m above the roof; and
- a new tray wash in the east of the facility, with a dedicated vertical flue terminating at 11.8 m above ground level, and 1.3 m above the roof.

3.2 All plant will operate continuously throughout the year. Basic plant details are given in Table 4, whilst the locations of the plant are shown in Figure 4.

Table 4: New Plant Information

Parameter	Value		
	TP6	Tray Wash	Oven
Operational Hours per Year	Continuous (8,760)		
Stack Height Above Ground	5.8 m	11.8 m	11.8 m
Internal Flue Diameter at Point of Release	0.3 m	0.18 m	0.18 m
Is there One or More Buildings within 5L and with Heights More than 40% of the Stack Height?	Yes		
Height of Tallest Building within 5L	10.5 m		
Length of Tallest Building within 5L	150 m		
Width of Tallest Building within 5L	99 m		

Existing Melton Foods Emissions Points

3.3 In addition to the new plant, there are several existing emission points listed in the current environmental permit which mostly exhaust from the roof of the main Melton manufacturing building. These sources will be retained in the new environmental permit and thus have been included in the assessment to ensure the impacts of the facility are not underestimated.

3.4 The locations of the emission points relative to the new plant are shown on Figure 4, and basic operating details are provided in Table 5.

Table 5: Existing Emission Sources Information

Emission Point	Process	X, Y Coordinate	Operational Hours per Year	Stack Height above Ground (m)	Flue Diameter at Point of Release (m)
TP1	Gas boiler	473411.9, 318073.3	Continuous	12.7	0.35
TP2	Gas boiler	473409.0, 318072.5	Continuous	12.7	0.35
TP3	Oven	473463.3, 317982.1	Continuous	12.0	0.30
TP4	Bar Marker	473439.8, 317973.6	Continuous	12.0	0.30
TP5	Tray Wash	473425.9, 318003.1	Continuous	10.3	0.18

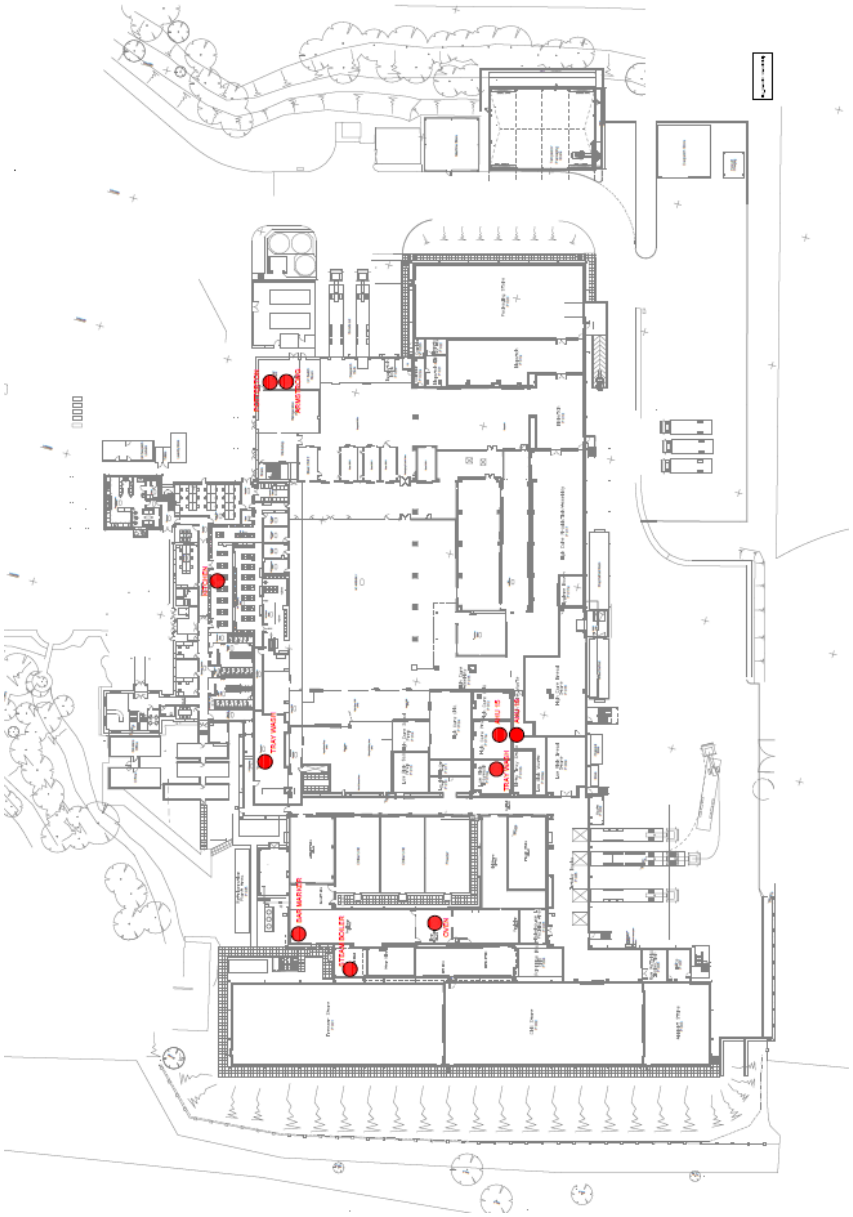


Figure 4: Flue Outlets Across the Melton Foods Facility

Imagery provided by Melton Foods, drawing number Img_331060B2.

4 Environmental Standards for Air

4.1 The relevant Air Quality Standards (AQS) for human health impacts are set out in Table 6 (EA, 2024).

Table 6: AQS for Human Health

Pollutant	Averaging Period	AQS (µg/m^3)	Acceptable Exceedance Criteria
NO_2	Annual Mean	40	Zero exceedances
	1-hour	200	Not to be exceeded more than 18 times a year

4.2 The AQS for NO_2 are defined as UK objectives within the Air Quality (England) Regulations (2000) and the Air Quality (England) (Amendment) Regulations (2002). The same numerical values are also set as European Limit values (The European Parliament and the Council of the European Union, 2008).

4.3 The objectives apply at locations where members of the public are likely to be regularly present and are likely to be exposed over the averaging period of the objective. Defra explains where these objectives will apply in its Local Air Quality Management Technical Guidance (Defra, 2022). The annual mean objectives are considered to apply at the façades of residential properties, schools, hospitals etc.; they do not apply at hotels. The 1-hour mean objective for nitrogen dioxide applies wherever members of the public might regularly spend 1-hour or more, including outdoor eating locations and pavements of busy shopping streets. In the UK, only monitoring and modelling carried out by UK Central Government meets the specification required to assess compliance with the limit values and specific monitor and receptor siting requirements apply. Neither the objectives nor limit values apply in places of work where members of the public have no free access and where relevant provisions concerning health and safety at work apply (AQC, 2016).

4.4 Table 7 sets out the relevant critical levels and critical loads assumed for the LWS in the study area, as taken from the Air Pollution Information System (APIS) website (APIS, 2024). Since it is not known exactly which habitats are present within each LWS, the most stringent critical load for any habitat from any of the 1 x 1 km grid squares within which the LWS are located have been used. In this instance, the lowest critical load for nutrient nitrogen deposition applies to Coniferous Woodland, whilst the lowest critical load for acid nitrogen deposition applies to Raised and Blanket Bogs; using these values provides a worst-case assessment.

4.5 The AQS for designated ecological sites apply within the boundary of each designated site.

Table 7: AQS for LWS

Site	Maximum 24-hour Mean NOx	Annual Mean		
		NOx	Nutrient Nitrogen Deposition	Acid Deposition [a]
LWS	75 µg/m^3	30 µg/m^3	3 kgN/ha/yr	0.489 keq/ha/yr

[a] MinCLMaxN

5 Baseline Conditions

Human Health

5.1 Figure 5 sets out the background annual mean NO_2 concentrations in the study area taken from Defra's published maps for 2023 (Defra, 2024a).

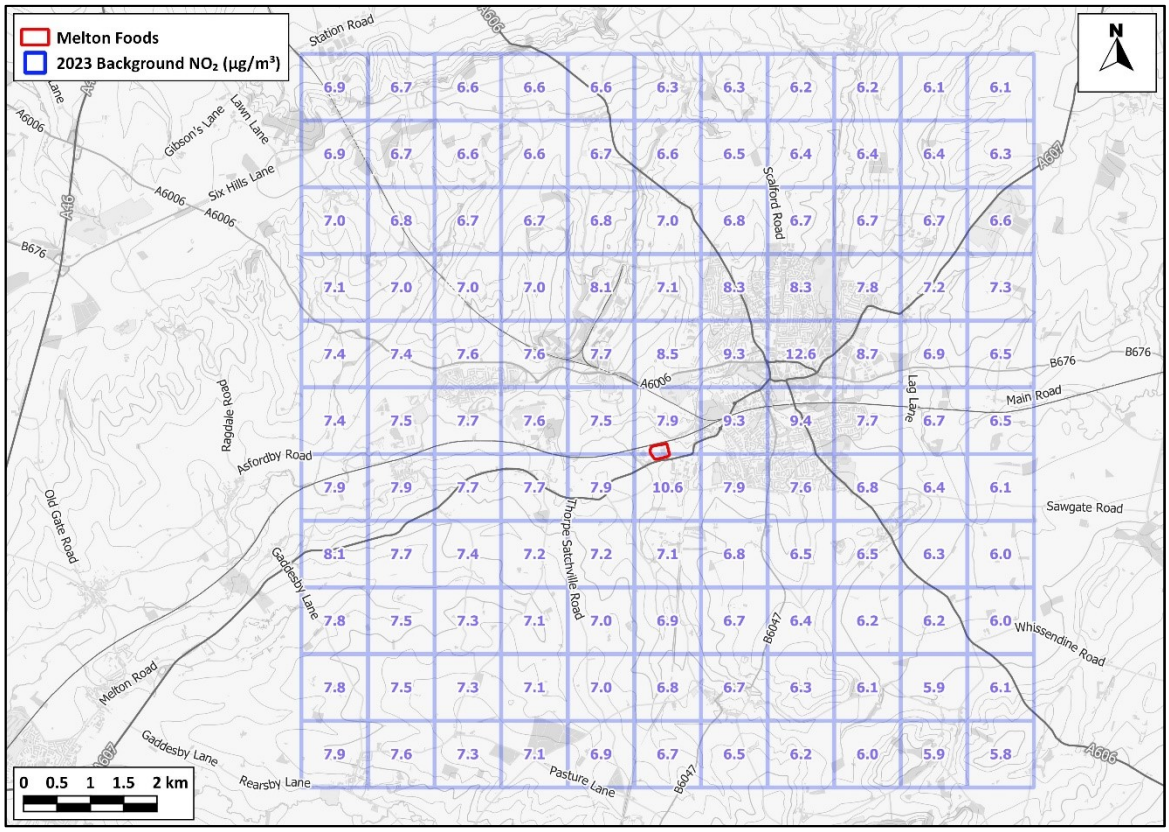


Figure 5: Defra's Predicted NO_2 Background Concentrations in 2023 (µg/m³)

5.2 Figure 6 shows the annual mean NO_2 concentrations in the study area, as measured by Melton Borough Council in 2019; whilst data for 2020 are available, concentrations measured in these years were affected by the Covid-19 pandemic[1] and therefore have not been utilised in the assessment.

5.3 Measurements made by the Council are also tabulated in Table 8. These include sites within Melton Mowbray town centre, where traffic may be congested, and sites adjacent to the roads leading into the town centre where traffic may be more free flowing.

[1] Owing to travel restrictions in place throughout the pandemic, concentrations of nitrogen dioxide generally reduced.

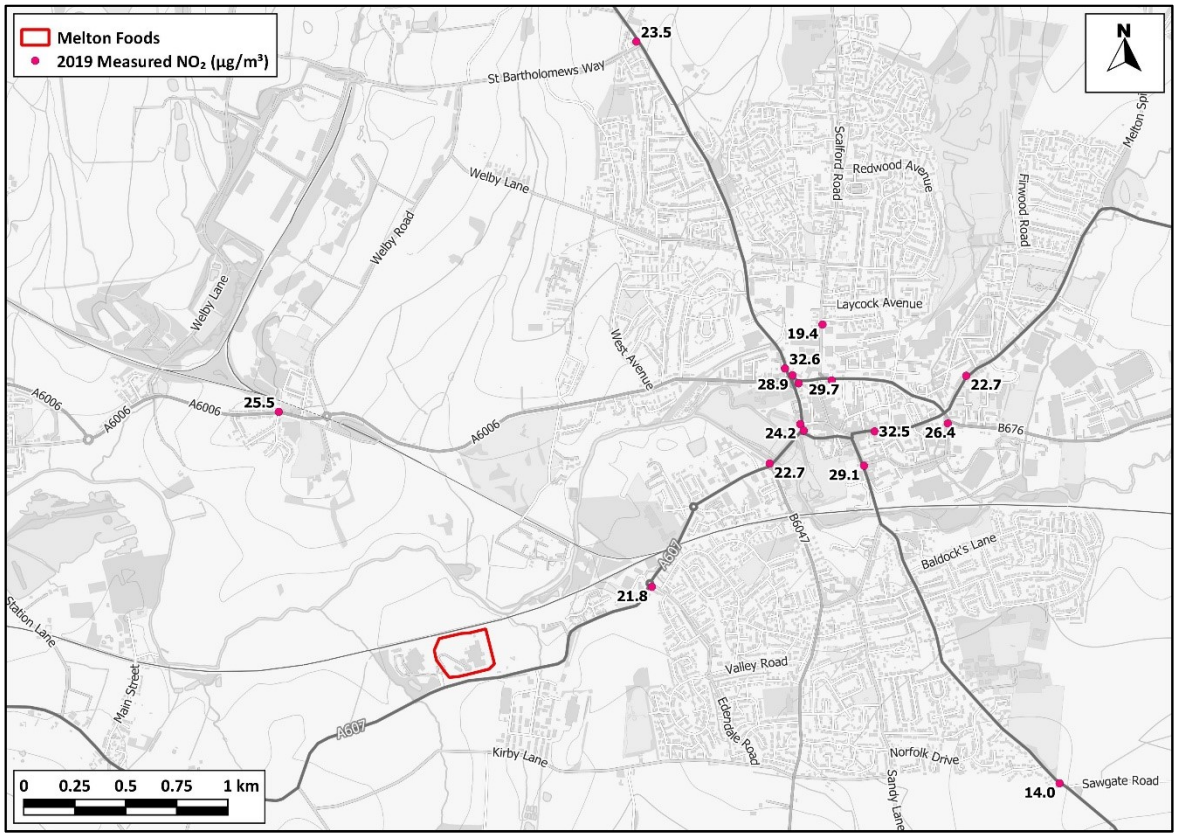


Figure 6: Measured 2019 Annual Mean NO_2 Concentrations in the Area Surrounding the Site (µg/m³)

Table 8: Summary of NO_2 Monitoring [a, b]

Site ID	Site Type	Location	2016	2017	2018	2019	2020
DT1	Urban Centre	Wilton Road	30.3	25.4	26.6	24.2	20.2
DT2	Suburban	Leicester Road	24.3	22.8	23.8	21.8	17.9
DT3	Suburban	Brook Street	-	-	24.6	26.4	19.6
DT4	Suburban	Thorpe Road	29.6	28.7	25.3	22.7	-
DT5	Suburban	Scalford Road / Elgin Drive Junction	-	-	-	19.4	-
DT6	Suburban	Burton Road (MMDR)	-	-	-	14.0	10.8
DT7	Urban Centre	Nottingham Road / Norman Way Junction	-	-	-	28.9	24.6
DT8	Suburban	St Bartholomew's Way / Nottingham Rd Junction	-	-	23.0	23.5	17.2
DT9	Rural	Melton Road	28.5	26.6	23.3	25.5	19.0

Site ID	Site Type	Location	2016	2017	2018	2019	2020
DT10	Urban Centre	Norman Way (Court House)	-	-	29.4	29.7	23.4
DT11	Urban Centre	Norman Way / Wilton Road Junction	-	27.4	26.5	24.1	20.3
DT12	Suburban	Dalby Road / Leicester Road Junction	24.8	25.7	24.7	22.7	19.6
DT13	Urban Centre	Leicester Street / Wilton Road Junction	28.8	24.6	33.0	34.5	25.6
DT14	Urban Centre	Sherrard Street	34.7	34.0	31.2	32.5	24.2
DT15	Suburban	Nottingham Road	40.2	39.4	26.5	32.6	24.3
DT16	Suburban	Burton Street	32.9	30.0	27.8	29.1	22.2
Objective			**40**				

[a] Data downloaded from the Melton Borough Council Annual Status Report (Melton Borough Council, 2022).

[b] Diffusion tubes prepared and analysed by SOCOTEC (using the 50% TEA in acetone method) and adjusted for bias by the Council.

Summary of Baseline NO_2 Concentrations

5.4 Table 9 sets out the baseline NO_2 concentrations used in this assessment for human health receptors. Since both Kettleby Foods and Melton Foods have been operational for a number of years, these baseline data do include an undefined contribution from both facilities, and the specific modelling of the emission sources means that their impact has been double-counted.

Table 9: Baseline NO_2 Concentrations Used in Assessment

Location	Value (µg/m^3)	Derivation
Annual Mean Concentrations		
All Receptors within Melton Mowbray Town Centre	34.5	Highest concentration across all of the urban centre measurements in 2019 (DT13)
All Receptors Outside of Melton Mowbray Town Centre	25.5	Highest concentration across any of the monitoring sites outside of the town centre (DT9)
All Receptors Away from Roads	12.6	Highest concentration across all of the mapped background concentrations in the study area
1-hour Mean Concentrations		
All Receptors within Melton Mowbray Town Centre	69.0	2 x the annual mean
All Receptors Outside of Melton Mowbray Town Centre	51.0	
All Receptors Away from Roads	25.2	

Designated Ecological Sites

5.5 The estimated annual mean background NOx concentrations at the designated ecological sites have been derived using Defra's background maps (Defra, 2024a). The baseline nutrient nitrogen and acid deposition fluxes have been defined using APIS (2024) and are 1 km x 1 km grid square averages based on the three-year mean between 2019 and 2021.

5.6 The derived values are presented in Table 10. The NOx concentrations are well below the critical level of 30 µg/m^3. Baseline nutrient and acid nitrogen deposition fluxes at all sites are above the critical loads, which is the case for many designated ecological sites across the UK.

Table 10: Background NOx Concentrations and Deposition Fluxes at Designated Ecological Sites

Designated Habitat	NOx (µg/m^3)	Nutrient Nitrogen Deposition (kgN/ha/yr)	Acid Deposition (keq/ha/yr)
Asfordby Hill LWS	9.9	18.8	1.34
Bull Field LWS	10.3 – 12.2	18.0 – 18.4	1.27 – 1.31
Eye Ash LWS	9.9	32.7	2.35
Leicester Road Grassland LWS	10.3	18.1	1.28
Melton Mowbray Railway Sidings LWS	10.3 – 12.2	31–4 - 31.6	2.–4 - 2.26
Critical Level / Load	**30**	**3**	**0.489**

5.7 Table 11 sets out the baseline values used in this assessment for the ecological receptors; as set out in Paragraph 5.4, these data will include an undefined contribution from both facilities, given that they have been operational for a number of years.

Table 11: Baseline NOx Concentrations and Deposition Fluxes Used in Assessment

Pollutant and Averaging Period	Value	Derivation
Asfordby Hill LWS		
Annual Mean NOx (µg/m^3)	9.9	Table 10
Maximum 24-hour Mean NOx (µg/m^3)	19.8	2 x the annual mean
Nutrient Nitrogen Deposition (kgN/ha/yr)	18.8	Table 10
Acid Deposition (keq/ha/yr)	1.34	Table 10
Bull Field LWS		
Annual Mean NOx (µg/m^3)	12.2	Maximum from Table 10
Maximum 24-hour Mean NOx (µg/m^3)	24.4	2 x the annual mean
Nutrient Nitrogen Deposition (kgN/ha/yr)	18.4	Maximum from Table 10
Acid Deposition (keq/ha/yr)	1.31	Maximum from Table 10

Pollutant and Averaging Period	Value	Derivation
Eye Ash LWS		
Annual Mean NOx (µg/m^3)	9.9	Table 10
Maximum 24-hour Mean NOx (µg/m^3)	19.8	2 x the annual mean
Nutrient Nitrogen Deposition (kgN/ha/yr)	32.7	Table 10
Acid Deposition (keq/ha/yr)	2.35	Table 10
Leicester Road Grassland LWS		
Annual Mean NOx (µg/m^3)	10.3	Table 10
Maximum 24-hour Mean NOx (µg/m^3)	20.6	2 x the annual mean
Nutrient Nitrogen Deposition (kgN/ha/yr)	18.1	Table 10
Acid Deposition (keq/ha/yr)	1.28	Table 10
Melton Mowbray Railway Sidings LWS		
Annual Mean NOx (µg/m^3)	12.2	Maximum from Table 10
Maximum 24-hour Mean NOx (µg/m^3)	24.4	2 x the annual mean
Nutrient Nitrogen Deposition (kgN/ha/yr)	31.6	Maximum from Table 10
Acid Deposition (keq/ha/yr)	2.26	Maximum from Table 10

6 Modelling Methodology

6.1 Modelling has been carried out in line with EA documents:

- Air emissions risk assessment for your environmental permit (EA, 2024); and
- Environmental permitting: air dispersion modelling reports (EA, 2019).

Dispersion Model

6.2 There are two primary dispersion models which are used extensively throughout the UK for assessments of this nature and accepted as appropriate air quality modelling tools by the Regulators and local planning authorities alike:

- The ADMS model, developed in the UK by Cambridge Environmental Research Consultants (CERC) in collaboration with the Met Office, National Power and the University of Surrey; and
- The AERMOD model, developed in the United States by the American Meteorological Society (AMS)/United States Environmental Protection Agency (EPA) Regulatory Model Improvement Committee (AERMIC).

6.3 Both models are termed 'new generation' Gaussian plume models, parameterising stability and turbulence in the planetary boundary layer (PBL) by the Monin-Obukhov length and the boundary layer depth. This approach allows the vertical structure of the PBL to be more accurately defined than by the stability classification methods of earlier dispersion models. Like these earlier models, ADMS and AERMOD adopt a symmetrical Gaussian profile of the concentration distribution in the vertical and crosswind directions in neutral and stable conditions. However, unlike earlier models, the ADMS and AERMOD vertical concentration profile in convective conditions adopts a skewed Gaussian distribution to take account of the heterogeneous nature of the vertical velocity distribution in the Convective Boundary Layer (CBL).

6.4 Numerous model inter-comparison studies have demonstrated little difference between the output of ADMS and AERMOD, except in certain scenarios, such as in areas of complex terrain (Carruthers et al., 2011). For the purposes of this particular study, the use of the ADMS model (version 6.0) is adopted. ADMS is widely used for assessments of this type and has been extensively validated (CERC, 2024). Consequently, it is considered suitable for the current assessment.

Emission Parameters

New Plant

6.5 Operational parameters for the new plant, such as stack diameter and stack height have been provided by Melton Foods.

6.6 The combustion parameters for TP6 have been taken from the MCerts emissions testing report completed by Envirocare in June 2021. In the absence of detailed technical information for the tray wash and oven, it has been assumed that the combustion parameters, with the exception of the oven exhaust temperature which has been extracted from the product datasheet, are the same as those measured for TP5 and TP3, respectively. The plant parameters are shown in Table 12.

Table 12: Plant Specifications, Emissions and Release Conditions for New Plant

Parameter	Value		
	TP6	Tray Wash	Oven
Actual Exhaust O_2 Content (%)	16.6	16.2	11.1
Actual Exhaust H_2O Content (%)	6.3	3.3	1.6
Exhaust Flow (m^3/hr) for Actual Flow [a]	3,548	1,366	545
Exhaust Flow (m^3/s) for Actual Flow [a]	0.99	0.38	0.15
Exhaust Flow (Nm^3/hr) for Normalised Flow	506 [b]	920 [c]	362 [c]
Exhaust Flow (Nm^3/s) for Normalised Flow	0.14 [b]	0.26 [c]	0.10 [c]
Flue Internal Diameter (m)	0.30	0.18	0.18
Exhaust Velocity (m/s) for Actual [a] Flow	13.9	14.9	5.9
Exhaust Temperature (ºC)	168	135	70
NOx Emission Concentration (mg/Nm^3) [d]	64 [b]	37 [c]	51 [c]
NOx Emission Rate (g/hr) [d]	33	34	19
NOx Emission Rate (g/s) [d]	0.009	0.010	0.005

[a] Actual flow conditions in the exhaust at the stated exhaust O_2 and H_2O contents.

[b] Normalised conditions (N) are at 0 ºC, 101.325 kPa, 3% oxygen, dry.

[c] Normalised conditions (N) are at 0 ºC, 101.325 kPa, wet.

[d] Values have been rounded.

6.7 The physical parameters for the three flues associated with the new plant included in the modelling are outlined in Table 13. The new point sources have been modelled as three individual, vertical point sources.

Table 13: Modelled Physical Release Emission Parameters for the New Plant

Parameter	Modelled Release Emission Parameters		
	TP6	Tray Wash	Oven
Source Type	Point		
X-Coordinate	473450.4	473467.2	473408.6
Y-Coordinate	317969.8	318012.7	318033.7
Height above Ground (m)	5.8	11.8	11.8

Existing Melton Food Sources

6.8 Operational parameters for the existing emission sources at Melton Foods facility, such as stack diameter and stack height have been provided by Melton Foods.

6.9 The combustion parameters have been taken from the annual MCerts emissions testing results, completed by Envirocare in March 2021, for each existing emission source. The plant parameters are shown in Table 14.

Table 14: Emissions and Release Conditions for Existing Melton Foods Emission Sources

Parameter	TP1 [a]	TP2 [a]	TP3 [b]	TP4 [b]	TP5 [b]
Actual Exhaust O_2 Content (%)	17.3	13.8	11.1	19.9	16.2
Actual Exhaust H_2O Content (%)	10.0	7.3	1.6	2.2	3.3
Molecular Mass (g/mol) for Actual Flow [c]	28.7	28.9	28.8	29.1	28.8
Exhaust Flow (m^3/hr) for Actual Flow [c]	1,228	4,375	545	824	1,366
Exhaust Flow (m^3/s) for Actual Flow [c]	0.34	1.22	0.15	0.23	0.38
Exhaust Flow (Nm^3/hr) for Normalised Flow	184	1,266	362	672	920
Exhaust Flow (Nm^3/s) for Normalised Flow	0.05	0.35	0.10	0.19	0.26
Flue Internal Diameter (m)	0.35	0.35	0.30	0.30	0.18
Exhaust Velocity (m/s) for Actual Flow	3.5	12.6	2.1	3.2	14.9
Exhaust Temperature (ºC)	65	80	140	64	135
NOx Emission Concentration (mg/Nm^3) [d]	51	108	51	4	37
NOx Emission Rate (g/hr) [d]	9	136	19	2	34
NOx Emission Rate (g/s) [d]	0.003	0.038	0.005	0.001	0.010

[a] Normalised conditions (N) are at 0 ºC, 101.325 kPa, 3% oxygen, dry.

[b] Normalised conditions (N) are at 0 ºC, 101.325 kPa, wet.

[c] Actual flow conditions in the exhaust at the stated exhaust O_2 and H_2O contents.

[d] Values have been rounded.

6.10 The physical parameters for the sources included in the modelling are outlined in Table 15. The existing point sources have been modelled as five individual, vertical point sources.

Table 15: Modelled Physical Release Emission Parameters for the Melton Foods Emission Sources

Parameter	Modelled Release Emission Parameters				
	TP1	TP2	TP3	TP4	TP5
Source Type	Point				
X-Coordinate	473412	473409	473463	473440	473426
Y-Coordinate	318073	318073	317982	317974	318003
Height above Ground (m)	12.7	12.7	12.0	12.0	10.3

Receptors and Study Area

6.11 Human health impacts have been predicted over a 10 km x 10 km model domain, with the Melton Foods site at the centre. Concentrations have been predicted over this area using nested Cartesian grids (see Figure 7). These grids have a spacing of:

- 5 m x 5 m within 200 m of the facility;
- 25 m x 25 m within 400 m of the facility;
- 50 m x 50 m within 1,000 m of the facility;
- 250 m x 250 m within 2,000 m of the facility; and
- 500 m x 500 m within 5,000 m of the facility.

6.12 This grid is considered to provide a sufficiently high resolution to enable the identification of worst-case impacts throughout the study area. The receptor grid has been modelled at a height of 1.5 m above ground level.

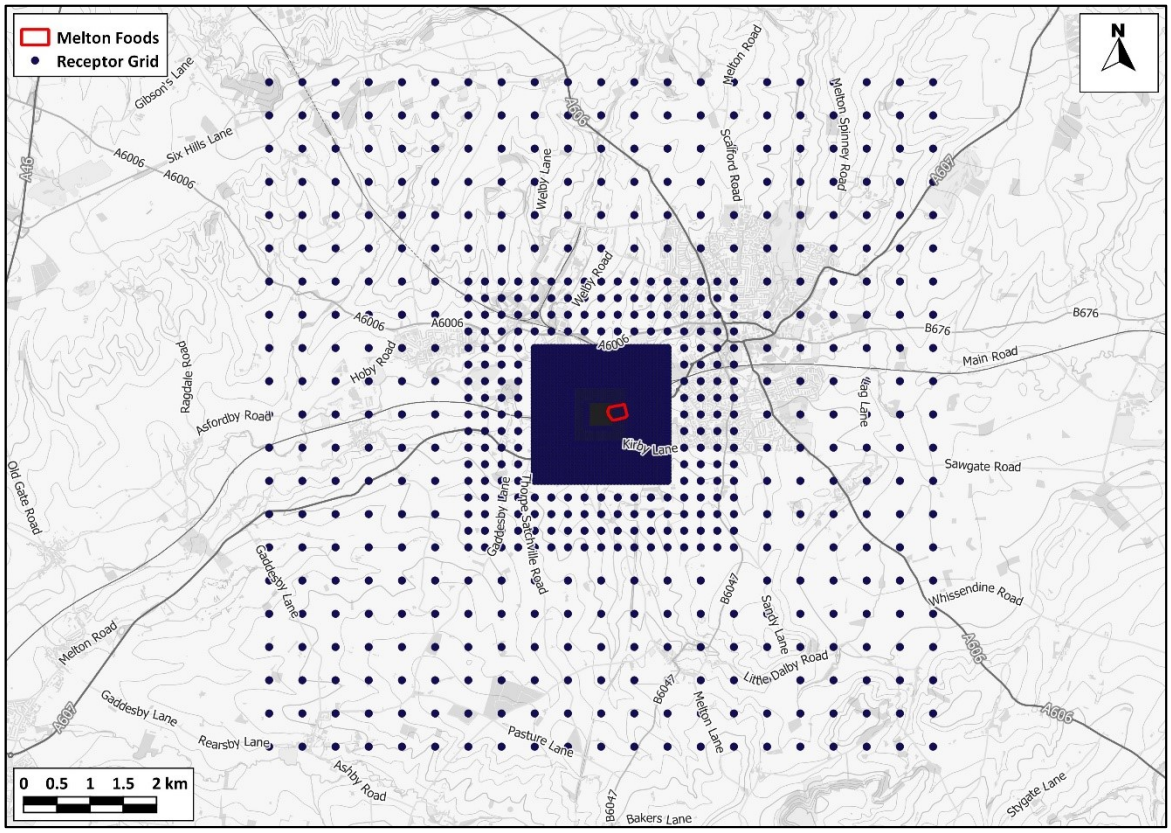


Figure 7: Nested Grid of Modelled Receptors

6.13 Specific receptors have also been selected to determine impacts at locations where the AQS for human health apply. The specific receptors identified are detailed in Table 16 and shown in Figure 8. Table 16 also identifies the setting (background, within Melton Mowbray or outside Melton Mowbray) of each receptor.

Table 16: Specific Human Health Receptor Coordinates

Receptor ID	Description	Setting	X Coordinate	Y Coordinate
H1	2 White House Farm Cottages	Background	473544.3	317950.5
H2	White House Farm	Background	473620.6	318018.8
H3	44 Badger Avenue	Background	473723.7	318214.1
H4	40 Badger Avenue	Background	473732.9	318193.5
H5	45 Badger Avenue	Outside Melton Mowbray	473924.4	318175.4
H6	4 Bailey Crescent	Background	473993.8	318097.3

Receptor ID	Description	Setting	X Coordinate	Y Coordinate
H7	8 Dobney Close	Background	473934.7	318036.2
H8	20 Gilbey Close	Background	473905.6	317881.4
H9	55 Main Street	Background	474026.5	317856.9
H10	42 Residential Street	Background	474000.9	317713.4
H11	13 Managed Lane	Background	473966.2	317515.7
H12	6 Asfordby Road	Within Melton Mowbray	474954.3	319393.8

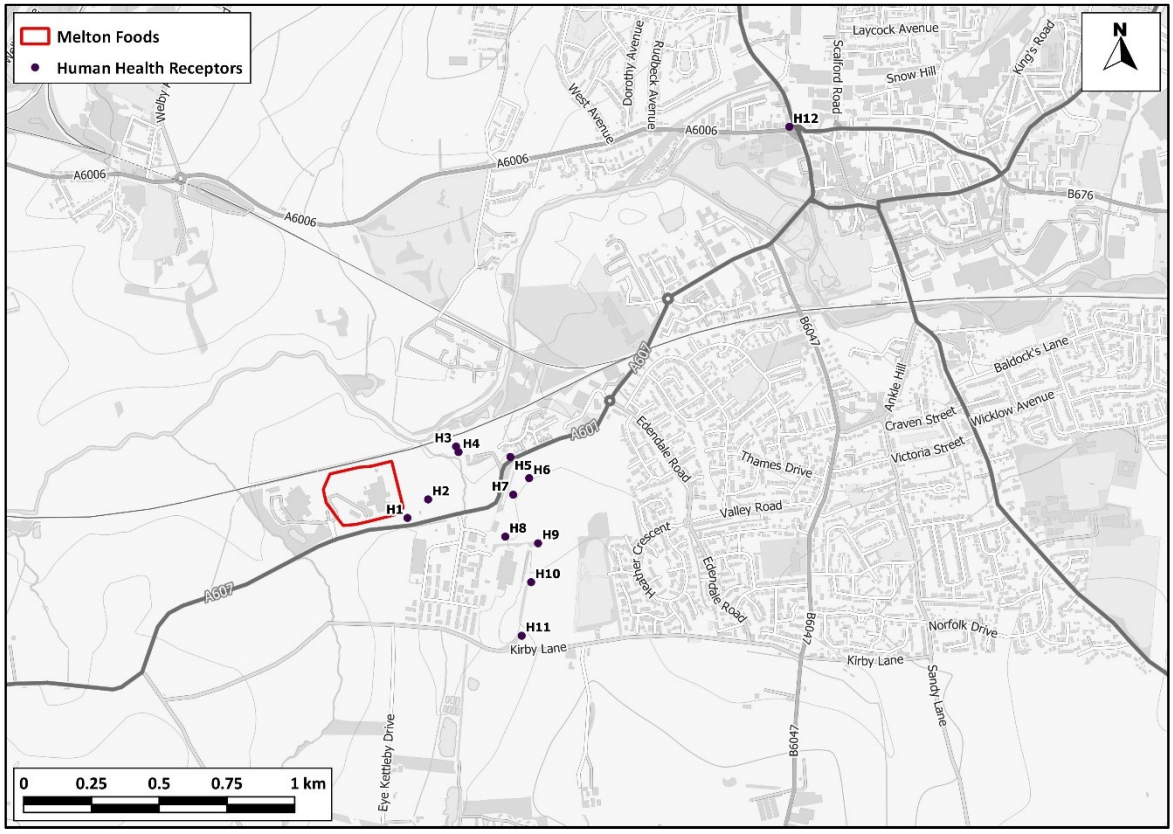


Figure 8: Modelled Discrete Receptors

6.14 Specific receptors have also been modelled at the boundaries of the designated ecological sites closest to the facility. Receptors have been modelled at 1.5 m above ground level to be consistent with Defra's national modelling of ecosystem impacts. The locations of these specific locations are shown in Figure 9 and the grid references are presented in Table 17.

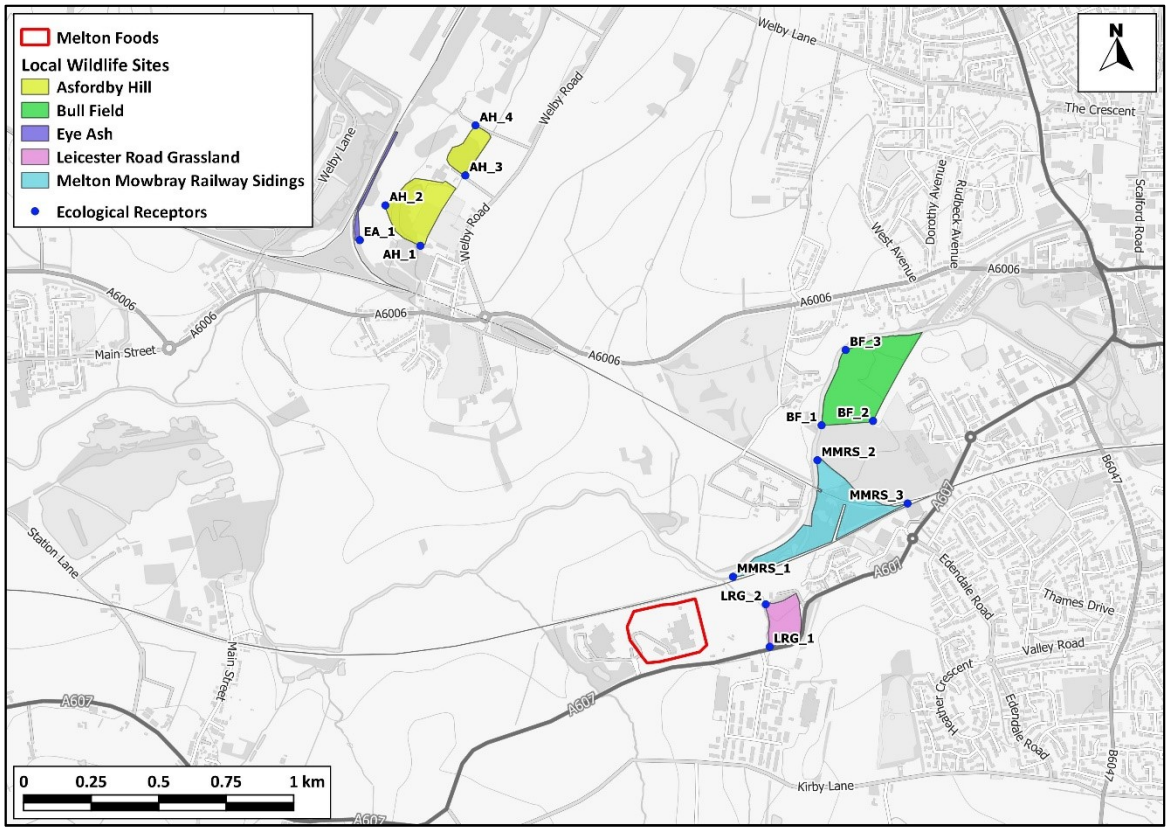


Figure 9: Modelled Ecological Receptors

Table 17: Specific Ecological Receptor Coordinates

Receptor ID	Designated Ecological Site	X Coordinate	Y Coordinate
LRG_1	Leicester Road Grassland LWS	473761.9	317981.9
LRG_2		473747.2	318139.3
MMRS_1	Melton Mowbray Railway Sidings LWS	473625.8	318241.2
MMRS_2		473938.5	318673.1
MMRS_3		474272.7	318512.7
BF_1	Bull Field LWS	473954.1	318802.3
BF_2		474144.7	318818.4
BF_3		474043.3	319081.1
AH_1	Asfordby Hill LWS	472467.9	319467.2
AH_2		472338.3	319616.8
AH_3		472634.5	319727.7
AH_4		472672.3	319913.2
EA_1	Eye Ash LWS	472243.6	319488.0

Meteorological Data

6.15 In order to allow for uncertainties in local and future-year conditions, the dispersion model has been run five times, with each run using a different full year of hour-by-hour meteorological data from the nearest appropriate meteorological site.

6.16 Hourly sequential meteorological data from Sutton Bonington have been used for the years 2016-2020 inclusive. The Sutton Bonington meteorological monitoring station is located approximately 24 km to the west of the site. It is deemed to be the nearest monitoring station representative of meteorological conditions at the site. The Sutton Bonington meteorological station is operated by the UK Meteorological Office. Raw data were provided by the Met Office, and processed by AQC for use in ADMS.

6.17 The meteorological parameters entered into the model are shown in Table 18. Wind roses for each year are presented in Appendix A4.

Table 18: Meteorological Parameters Entered into the ADMS Model

Parameter	Modelled Receptors	Meteorological Site
Surface Roughness	Variable Surface Roughness File	0.1 m
Minimum MO Length	10 m	1 m
Surface Albedo	0.23 [a]	0.23 [a]
Priestly-Taylor Parameter	1 [a]	1 [a]

[a] Model default value

Variable Surface Roughness File

6.18 The study area encompasses a range of land types. A variable surface roughness file has been used to represent the spatial variation of the surface roughness over each land type as shown in Figure 10. The following parameters have been used regarding surface roughness and land type:

- forest – 1.0 m;
- built-up area – 0.5 m;
- grassland – 0.2 m; and
- water – 0.0001 m.

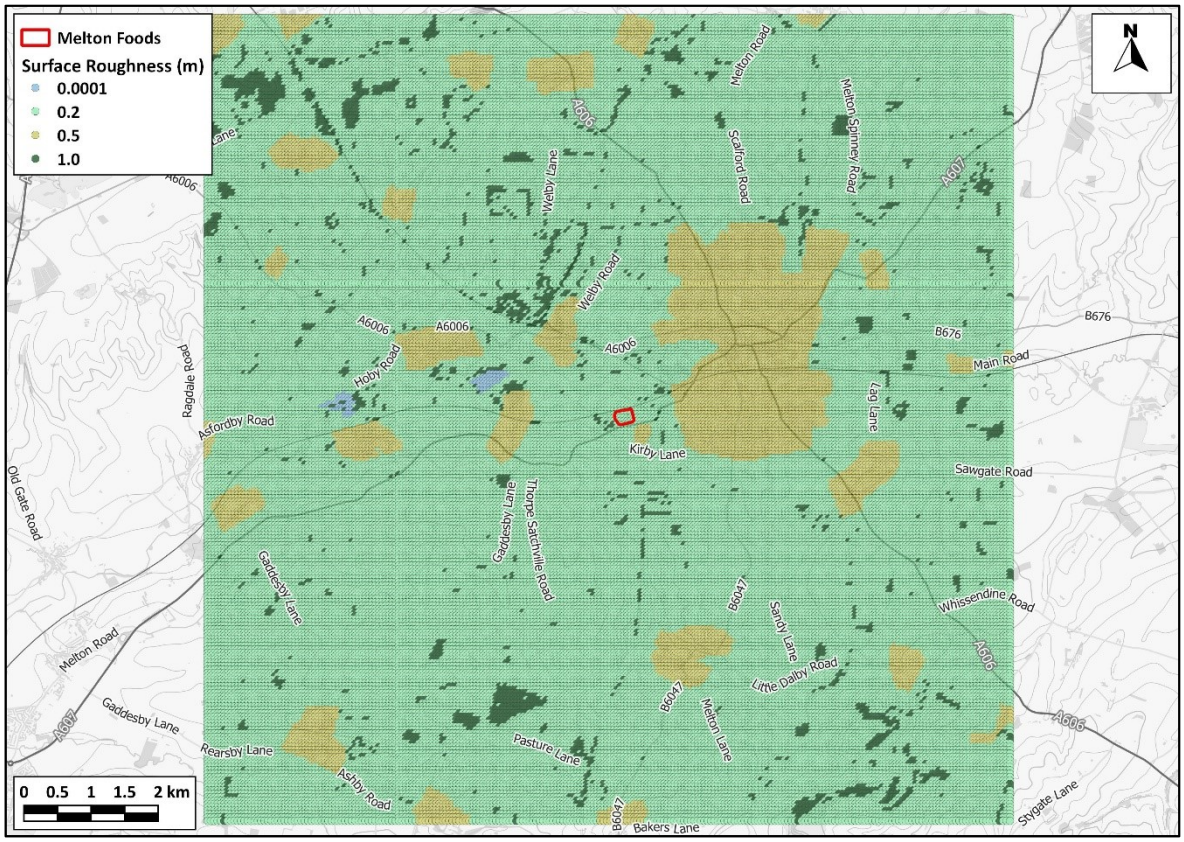


Figure 10: Surface Roughness across Modelled Area

Buildings

6.19 Where buildings are a significant height relative to the stack height, building downwash effects may occur. The downwash effects should be accounted for within modelling where the stack is less than 2.5 times the height of the buildings within a distance which is five times the minimum of the stack height and the maximum projected width of the building.

6.20 The ADMS model combines each of the modelled buildings in to a single, 'effective' building. As such, the main Melton Foods building has been defined as the 'main building' within the dispersion model due to its height, projected width and proximity to the exhaust flues for all sources associated with Melton Foods, including for the new plant. The main Melton Foods building was chosen as the 'main building' since it is considered to have the greatest influence on building downwash.

6.21 The model has been run once with the adjacent buildings included, and once without, for each meteorological year. Modelled buildings at the Melton Foods site are shown in Figure 11, and the dimensions of all buildings are given in Table 19.

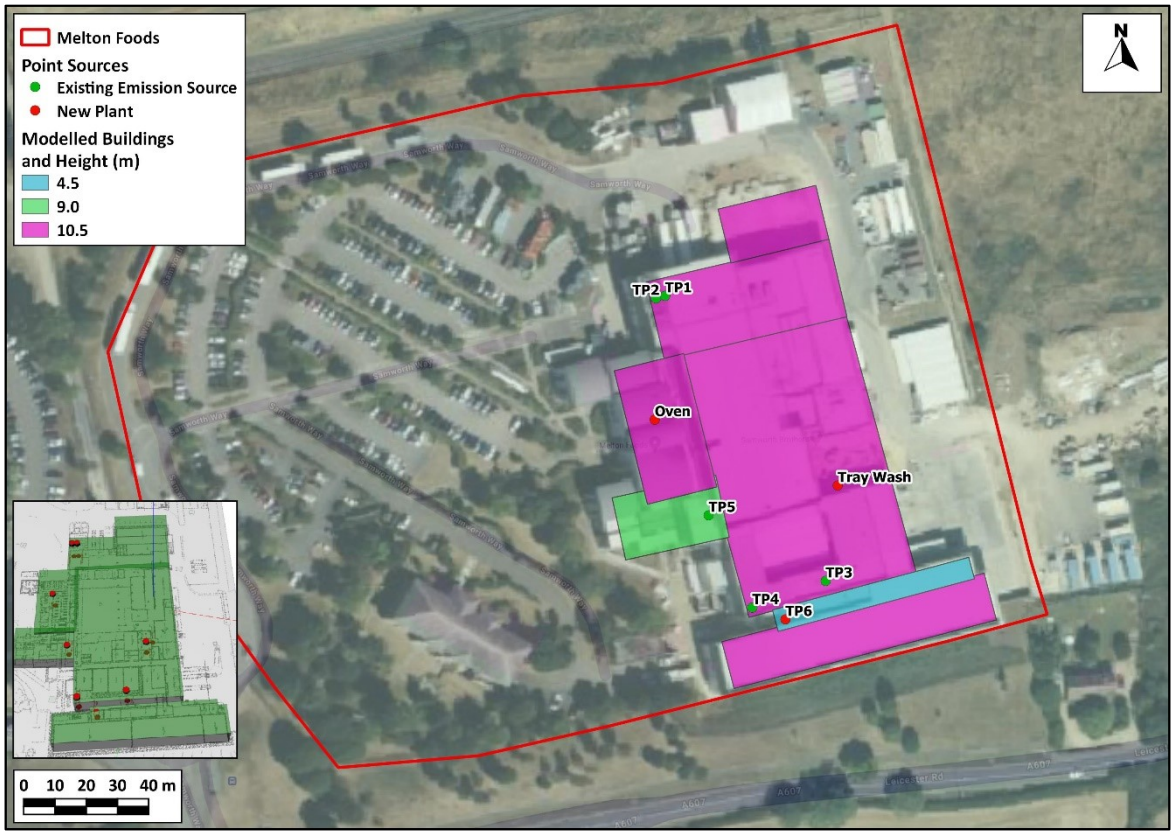


Figure 11: Buildings Included in the Model. Inset Shows 3D Image.

Imagery ©2024 Google, Imagery ©2024 Bluesky, CNES / Airbus, Getmapping plc, Infoterra Ltd & Bluesky, Maxar Technologies.

Table 19: Melton Modelled Building Dimensions

Building	Height (m)	Length (m)	Width (m)	Rotation (°)
Melton 1	10.5	88.3	55.4	164.7
Melton 2	10.5	25.5	60.1	166.8
Melton 3	9.0	33.9	20.3	257.6
Melton 4	10.5	22.9	44.0	256.0
Melton 5	10.5	32.2	17.7	256.4
Melton 6	10.5	15.5	86.8	165.4
Melton 7	4.5	7.1	65.0	345.0

Terrain Effects

6.22 Local terrain has been included within the model based on OS Terrain 50 data, as shown in Figure 3.

NO_X to NO_2 Conversion

6.23 NOx emissions will be in the form of nitric oxide (NO) and primary NO_2. The primary NO_2 from natural gas-fuelled plant is likely to be in the region of 5-12% of the total NOx. Over time, the NO emissions will react with available ozone (O_3) to form NO_2. In close proximity to the source, the ratio will be similar to the primary NO_2 proportion; with increasing distance from the source the ratio will increase, depending on the availability of O_3.

6.24 The EA (2024) recommends that, as a conservative approach:

- 70% of the NOx emitted from the plant converts to NO_2 for the annual mean average concentrations; and
- 35% of the 1-hour mean NOx emitted from the plant converts to NO_2 for the 1-hour mean average concentrations.

6.25 The EA guidance (EA, 2019) states: "*For combustion processes where no more than 10% of nitrogen oxides are emitted as nitrogen dioxide, you can assume worst case conversion ratios to nitrogen dioxide of 35% for short-term average concentrations and 70% for long-term average concentrations.*"

6.26 Given the size of the plant and their fuel, it is likely that the primary NO_2:NOx ratio will be 10% or less; therefore, the 70% (long-term) and 35% (short-term) conversion ratios used represent a conservative approach.

Model Post-Processing

6.27 The maximum predicted concentrations from either building scenario, and any meteorological year, have been determined and presented for each receptor point.

Annual Mean PCs

6.28 The model has been run assuming constant operation; no adjustments have therefore been necessary to the raw model outputs.

Short-term PCs

6.29 The AQS for 1-hour mean NO_2 is based on the number of hours (18) that a threshold concentration (200 µg/m^3) can be exceeded in a year. The 1-hour mean AQS has been assessed by assuming constant operation, and considering the 99.79th percentile of 1-hour mean concentrations, which represents the 19th highest hour from a full year (8,760 hours).

Deposition

6.30 Deposition of NO_2 has not been included within the dispersion model because NO_2 has been calculated from NOx outside of the model. Instead, deposition has been calculated from the modelled process contributions using the deposition velocity set out in Table 20. This means that depletion effects are ignored, resulting in a worst-case assessment. Deposition velocities refer to a height above ground, typically 1 or 2 m, although in practice the precise height makes little difference, and here they have been applied to concentrations predicted at a height of 1.5 m above ground, which is the average height of the monitors which underpin the Concentration Based Estimated Deposition (CBED) model which generates predictions used by UK Government. The velocities are applied simply by multiplying a concentration ($\mu g/m^3$) by the velocity (m/s) to predict a deposition flux ($\mu g/m^2/s$). Subsequent calculations required to present the data as kg/ha/yr of nitrogen as keq/ha/yr for acidity follow basic chemical and mathematical rules[2].

Table 20: Deposition Velocities Used in This Assessment

Pollutant	Deposition Velocity (m/s)	Reference
Nitrogen Dioxide	0.0015 m/s (Grassland)	AQTAG06 (2011)
	0.003 m/s (Forest)	AQTAG06 (2011)

6.31 Wet deposition of emissions from the facility has been discounted. Wet deposition of the emitted pollutants this close to the emission source will be restricted to wash-out, or below cloud scavenging. For this to occur, rain droplets must come into contact with the gas molecules before they hit the ground. Falling raindrops displace the air around them, effectively pushing gases away. The low solubility of NO_2 means that any scavenging of this gas will be a negligible factor.

Uncertainty

6.32 The point source dispersion model used in the assessment is dependent upon emission rates, flow rates, exhaust temperatures and other parameters for each source, all of which are both variable and uncertain. There are then additional uncertainties, as models are required to simplify real-world conditions into a series of algorithms. These uncertainties cannot be easily quantified and it is not possible to verify the point-source model outputs. Where these parameters have been estimated the approach has been to use reasonable worst-case assumptions.

6.33 On balance, when taking into account the assumed number of operating hours; the approach taken to meteorological conditions and the sensitivity testing for building downwash, the assessment can be expected to over-predict the impacts of the facility. The approach has been designed to provide a robust and conservative assessment.

[2] i.e. 1 kg N/ha/yr = 0.071 keq/ha/yr

7 Assessment Approach

7.1 The Environment Agency's *air emissions risk assessment for your environmental permit* (previously Horizontal Guidance Note H1) provides methods for quantifying the environmental impacts of emissions to air. This compares predicted process contributions (PC) and predicted environmental concentrations (PEC, i.e., PC in addition to background) to both long- and short-term environmental standards. These standards primarily include guideline EALs and statutory AQS.

7.2 Air emission risk assessments for environmental permits require a three-tiered approach to assessing the significance of emissions to atmosphere. The first stage is to 'screen out' insignificant emissions to air using the H1 screening tool; these are emissions which are emitted in such small quantities that they are unlikely to cause a significant impact on ground level concentrations. The Environment Agency's guidance suggests that emissions are insignificant where PCs are less than:

- 1% of a long-term environmental standard; or
- 10% of a short-term environmental standard

7.3 This is the case regardless of the total concentration or deposition flux (i.e. the PC + the local baseline, or the Predicted Environmental Concentration 'PEC').

7.4 For local nature conservation sites and ancient woodlands, the EA (2024) states that PCs are insignificant where they are less than 100% of either a long-term or short-term standard.

7.5 For those emissions that cannot be screened out as insignificant, the guidance indicates that further modelling of emissions may be appropriate for long term effects where the PEC is greater than 70% of the long-term environmental benchmark. For short-term effects, further modelling of emissions is required where the PC is more than 20% of the difference between twice the (long term) background concentration and the relevant short term environmental benchmark (i.e., more than 20% of the model 'headroom').

7.6 In any resultant modelling assessment, the EA guidance explains no further action is required where the assessment shows that both of the following apply:

- Emissions comply with Best Available Technique Associated Emission Levels (BAT-AELs) or the equivalent requirements where there is no BAT-AEL; and
- The resulting PECs will not exceed environmental standards.

7.7 For human health receptors, the approach has been to provide contour plots which highlight the area within which PCs cannot be considered insignificant using the criteria outlined in Paragraph 7.2. Consideration is also given to the maximum PCs at locations with relevant exposure to the AQS, and to the PECs. A judgement of significance has then reached based on the potential for the facility to cause an exceedance of the AQS.

7.8 For the designated ecological sites, the assessment has focused on the maximum PCs within the designated sites.

7.9 To ensure a robust assessment of the PECs, the PCs associated with the Kettleby Food facility has also been explicitly modelled. In the case of annual mean PECs, the PEC is calculated by summing the process contributions from both facilities with the baseline concentration. For the short-term PECs, in the first instance, the assessment has considered the Melton PCs in isolation. Where the PCs from Melton alone exceed the screening criterion, since it is not appropriate to add short-term PCs, the assessment has assumed continuous operation of both facilities simultaneously. The short-term PC from both sites operating concurrently has then been added to the short-term baseline concentration. This approach is conservative, since both facilities have been operational for a number of years, and therefore will already contribute to existing baseline concentrations.

8 Results

Human Health Receptors

Annual Mean

8.1 The predicted annual mean PCs and PECs at the specific receptors identified in Figure 8 and Table 16 are set out in Table 21. Table 21 also sets out the maximum PCs and PECs across the entire modelled grid. The PECs at each specific receptor are determined based on the contributions from the following sources:

- New Plant Only – the PC from TP6, the oven and tray wash at Melton Foods;
- Existing Plant – the PC from the existing plant at the Melton Foods facility, assuming continuous operation of all plant;
- Background – the assumed concentration in the atmosphere at each receptor location in the absence of any point source emissions, using the values in Table 9. As set out in Paragraph 5.4, since Melton Foods and Kettleby Foods have been operational for a number of years, these background concentrations do include an undefined contribution from both facilities; and
- Kettleby Foods – the PC from the plant at Kettleby Foods facility, assuming continuous operation of all plant. Whilst the Kettleby Foods facility does not form part of the permit variation, its inclusion ensures a robust assessment of the PECs, as set out in Paragraph 7.9.

Table 21: Annual Mean PCs and PECs at Specific Receptors

Receptor ID	Melton Foods (µg/m^3)		Total PC (µg/m^3)	% of AQS [a]	Baseline (µg/m^3)		PEC	
	New Plant PC	Existing Plant PC			Background [b]	Kettleby Foods PC	Total PEC (µg/m^3)	% of AQS [a]
Max on Grid	2.27	0.79 [c]	3.05	7.6	12.6	2.15 [c]	17.80	44.5
H1	0.46	0.38	0.84	2.1	12.6	1.59	15.03	37.6
H2	0.38	0.49	0.86	2.2	12.6	1.81	15.27	38.2
H3	0.15	0.28	0.43	1.1	12.6	1.29	14.32	35.8
H4	0.15	0.29	0.43	1.1	12.6	1.32	14.36	35.9
H5	0.08	0.18	0.26	0.6	25.5	1.01	26.77	66.9
H6	0.08	0.16	0.24	0.6	12.6	0.95	13.78	34.5
H7	0.10	0.18	0.27	0.7	12.6	1.00	13.88	34.7
H8	0.07	0.11	0.17	0.4	12.6	0.74	13.52	33.8
H9	0.05	0.08	0.13	0.3	12.6	0.62	13.34	33.4
H10	0.02	0.04	0.06	0.2	12.6	0.42	13.08	32.7

H11	0.01	0.02	0.03	0.1	12.6	0.25	12.88	32.2
H12	0.01	0.02	0.03	0.1	34.5	0.22	34.75	86.9

[a] Based on unrounded numbers.

[b] As defined in Table 9.

[c] These concentrations correspond to the PCs at the location of the maximum PC from the new plant.

8.2 Figure 12 presents the area where the annual mean PC from the new plant (TP6, tray wash and oven) is greater than 0.4 µg/m^3 (1% of the AQS). This covers an area which extends up to approximately 85 m from the site boundary and encompasses two residential properties.

8.3 Figure 13 presents the area where the annual mean PC from all of the Melton plant (new and existing plant) is greater than 0.4 µg/m^3 (1% of the AQS). This covers an area which extends up to approximately 295 m from the site boundary and encompasses approximately six residential properties.

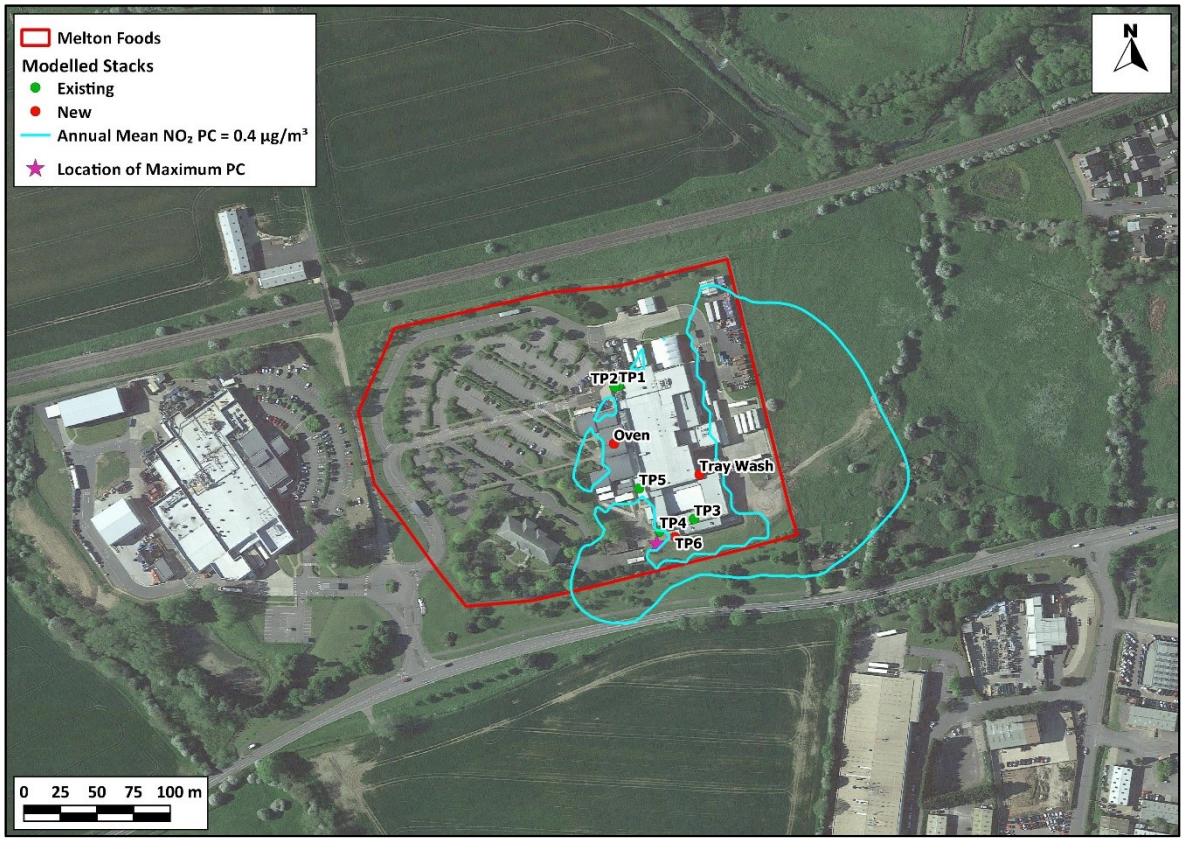


Figure 12: Contour Plot of Annual Mean NO_2 PCs from New Plant in Isolation

Imagery ©2024 Google, Imagery ©2024 Bluesky, CNES / Airbus, Getmapping plc, Infoterra Ltd & Bluesky, Maxar Technologies.

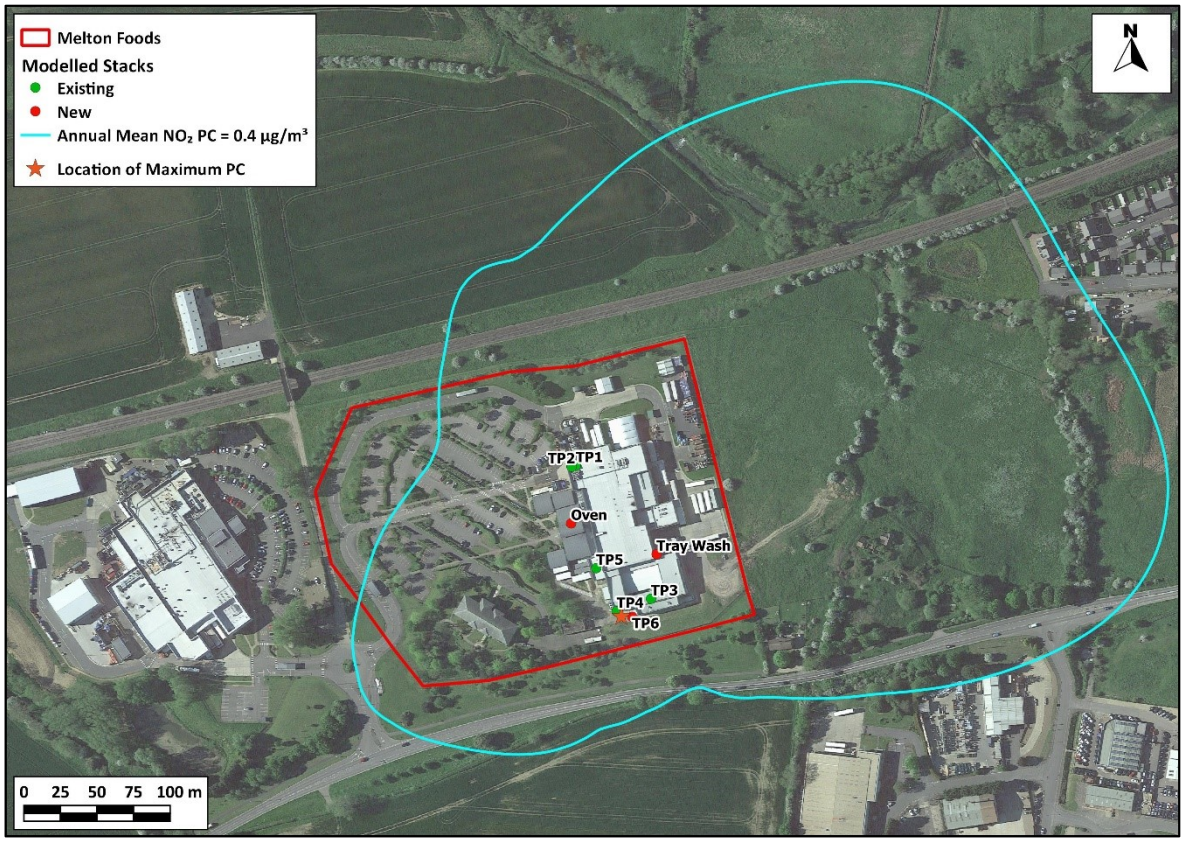


Figure 13: Contour Plot of Annual Mean NO_2 PCs from All Melton Emission Points (New and Existing Plant)

Imagery ©2024 Google, Imagery ©2024 Bluesky, CNES / Airbus, Getmapping plc, Infoterra Ltd & Bluesky, Maxar Technologies.

1-hour Mean

8.4 The predicted 99.79th percentile of 1-hour mean PCs at the specific receptors identified in Figure 8 and Table 16 are set out in Table 22, for the Melton Foods facility (existing and new plant). Table 22 also sets out the maximum PC across the entire modelled grid.

Table 22: 1-hour Mean PCs at Specific Receptors

Receptor ID	PC (µg/m^3)	% of AQS [a]
Max on Grid	14.08	7.0
H1	2.95	1.5
H2	2.73	1.4
H3	2.76	1.4
H4	1.03	0.5
H5	1.27	0.6
H6	0.90	0.5
H7	1.08	0.5
H8	0.70	0.4

Receptor ID	PC (µg/m^3)	% of AQS [a]
H9	0.31	0.2
H10	0.36	0.2
H11	0.35	0.2
H12	0.39	0.2

[a] Based on unrounded numbers.

8.5 As presented in Table 22, the PCs from the Melton Foods facility in isolation do not exceed 10% of the AQS; it is not, therefore, necessary to provide contours. Consideration of the combined effect with Kettleby Foods is provided in Appendix A1.

Designated Ecological Sites

8.6 Table 23 presents the maximum PCs at each of the receptors within the designated ecological sites. Since the PCs are well below the EA's recommended screening criterion of 100% for local wildlife sites, the operation of the Melton installation is insignificant, irrespective of the PECs.

Table 23: Maximum PCs at Designated Ecological Sites

Receptor	Habitat	New Plant PC	Existing Plant PC	Total PC	% of AQS [a]
Annual Mean NOx – 30 µg/m^3					
LRG_1	Leicester Road Grassland LWS	0.26	0.37	0.63	2.1
LRG_2		0.22	0.44	0.66	2.2
MMRS_1	Melton Mowbray Railway Sidings LWS	0.28	0.51	0.80	2.7
MMRS_2		0.06	0.12	0.18	0.6
MMRS_3		0.04	0.09	0.14	0.5
BF_1	Bull Field LWS	0.05	0.10	0.15	0.5
BF_2		0.04	0.09	0.13	0.4
BF_3		0.03	0.06	0.09	0.3
AH_1	Asfordby Hill LWS	0.01	0.02	0.02	0.1
AH_2		0.01	0.02	0.02	0.1
AH_3		0.01	0.02	0.03	0.1
AH_4		0.01	0.02	0.02	0.1
EA_1	Eye Ash LWS	0.01	0.01	0.02	0.1
24-hour Mean NOx – 75 µg/m^3 [b]					
LRG_1	Leicester Road Grassland LWS	4.36			5.8
LRG_2		3.56			4.7
MMRS_1		4.45			5.9
MMRS_2		0.97			1.3

Receptor	Habitat	New Plant PC	Existing Plant PC	Total PC	% of AQS [a]
MMRS_3	Melton Mowbray Railway Sidings LWS	1.54			2.1
BF_1	Bull Field LWS	1.03			1.4
BF_2		1.23			1.6
BF_3		0.68			0.9
AH_1	Asfordby Hill LWS	0.25			0.3
AH_2		0.29			0.4
AH_3		0.33			0.4
AH_4		0.38			0.5
EA_1	Eye Ash LWS	0.39			0.5
Nutrient Nitrogen - 3 kgN/ha/yr					
LRG_1	Leicester Road Grassland LWS	0.03	0.04	0.06	2.1
LRG_2		0.02	0.04	0.07	2.2
MMRS_1	Melton Mowbray Railway Sidings LWS	0.06	0.10	0.16	5.3
MMRS_2		0.01	0.03	0.04	1.2
MMRS_3		0.01	0.02	0.03	0.9
BF_1	Bull Field LWS	<0.01	0.01	0.01	0.5
BF_2		<0.01	0.01	0.01	0.4
BF_3		<0.01	0.01	0.01	0.3
AH_1	Asfordby Hill LWS	<0.01	<0.01	<0.01	0.1
AH_2		<0.01	<0.01	<0.01	0.1
AH_3		<0.01	<0.01	<0.01	0.1
AH_4		<0.01	<0.01	<0.01	0.1
EA_1	Eye Ash LWS	<0.01	<0.01	<0.01	0.1
Acid Nitrogen - 0.489 keq/ha/yr					
LRG_1	Leicester Road Grassland LWS	<0.01	<0.01	<0.01	0.9
LRG_2		<0.01	<0.01	<0.01	1.0
MMRS_1	Melton Mowbray Railway Sidings LWS	<0.01	0.01	0.01	2.3
MMRS_2		<0.01	<0.01	<0.01	0.5
MMRS_3		<0.01	<0.01	<0.01	0.4
BF_1	Bull Field LWS	<0.01	<0.01	<0.01	0.2
BF_2		<0.01	<0.01	<0.01	0.2
BF_3		<0.01	<0.01	<0.01	0.1
AH_1		<0.01	<0.01	<0.01	<0.1

Receptor	Habitat	New Plant PC	Existing Plant PC	Total PC	% of AQS [a]
AH_2	**Asfordby Hill LWS**	<0.01	<0.01	<0.01	<0.1
AH_3		<0.01	<0.01	<0.01	<0.1
AH_4		<0.01	<0.01	<0.01	<0.1
EA_1	**Eye Ash LWS**	<0.01	<0.01	<0.01	0.1

[a] Based on unrounded numbers.

[b] Includes the contribution from the existing Melton sources and the new plant operating simultaneously. It is not technically correct to add maximum short-term process contributions from different source groups since these will often occur under different temporal scales. The modelled PC presents the “All sources” source group output.

9 Discussion

Human Health Receptors

Annual Mean AQS

9.1 Table 21 shows that the PC from the new plant exceeds 1% of the long-term AQS at the worst-case location and at Receptor H1; the combined PCs from the existing Melton Foods emissions sources exceed 1% of the long-term AQS at a number of the receptors (H1 to H4).

9.2 However, at all locations, including the worst-case location on the modelled grid, the maximum PEC is below the AQS. At all but one specific receptor, the PECs are below 70% of the long-term AQS. At Receptor H12, where the PEC exceeds 70% of the AQS, the PC is less than 1% thus the effects are insignificant.

9.3 There is therefore a negligible risk that the AQS will be exceeded as a result of emissions from the facility.

1-hour Mean AQS

9.4 Table 22 shows that the PC from the Melton Foods facility does not exceed 10% of the short-term AQS at any location, including the worst-case location across the modelled grid. The effects are, therefore, insignificant.

9.5 There is therefore a negligible risk that the AQS will be exceeded as a result of the facility.

Designated Ecological Sites

9.6 Table 23 shows that the maximum PCs are less than 100% of the long-term and short-term AQS. The EA guidance is thus that these PCs are insignificant regardless of the PEC.

10 Conclusions

10.1 There is negligible risk that the annual mean and 1-hour mean NO_2 AQS will be exceeded as a result of the new plant at the facility, or as a result of the operation of existing plant at the Melton Foods facility. There is also considered to be negligible risk when taking the operation of the neighbouring Kettleby Foods facility into account. On this basis, the effects are judged to be not significant.

10.2 The PCs at designated ecological sites are predicted to be less than 100% of the AQS. The EA guidance is thus that these PCs are insignificant.

10.3 The assessment is based on continuous operation of all plant (new and existing) throughout the year and includes a number of conservative assumptions. It also takes account of the maximum predicted impacts across several sensitivity tests. In particular:

- the assessment of short-term impacts assumes constant operation of all plant;
- the results presented are the maxima from modelling with five separate years of meteorological data;
- the results presented are the maxima from modelling both with and without including surrounding buildings within the dispersion model;
- depletion has not been included in the model. This will cause a tendency for impacts to be over-predicted;
- a conservative approach has been taken to calculating NO_2 concentrations from modelled NOx concentrations; and
- the annual mean PECs include the contribution from the adjacent Kettleby Foods facility so as not to underpredict the total concentrations.

10.4 It is thus concluded that the air quality effects will be not significant.

Table 24: EA Checklist for Dispersion Modelling Report for Installations

Item	Included	Comment
Location map	✓	See Figure 1 and Figure 2
Site plan	✓	See Figure 4
List of emissions modelled	✓	See Paragraphs 1.4 and 1.6
Details of modelled scenarios	✓	See Table 2 and Section 6
Details of relevant ambient concentrations used	✓	See Section 5
Model description and justification	✓	See Paragraph 6.2
Special model treatments used	✓	See Section 6
Table of emission parameters used	✓	See Table 13 and Table 15
Details of modelled domain receptors	✓	Paragraphs 6.11 to 6.14
Details of meteorological data used (including origin) and justification	✓	See Paragraphs 6.15 to 6.17
Details of terrain treatment	✓	See Paragraph 6.22
Details of building treatment	✓	See Paragraphs 6.19 and 6.21
Sensitivity analysis	✓	See Table 2 and Section 6
Assessment of impacts	✓	See Sections 8 and 9
Model input files	✓	Sent electronically

11 References

APIS (2024) *APIS*, Available: http://www.apis.ac.uk/.

AQC (2016) *Relationship between the UK Air Quality Objectives and Occupational Air Quality Standards*, Available: http://www.aqconsultants.co.uk/AQC/media/Reports/Relationship-between-the-UK-Air-Quality-Objectives-and-Occupational-Air-Quality-Standards.pdf.

AQTAG (2011) *AQTAG06 - Technical guidance on detailed modelling approach for an appropriate assessment for emissions to air*.

Carruthers, D.J., Seaton, M.D., McHugh, C.A., Sheng, X., Solazzo, E. and Vanwyve, E. (2011) 'Comparison of the complex terrain algorithms incorporated into two commonly used local-scale air pollution dispersion models (ADMS and AERMOD) using a hybrid model', *Journal of Air and Waste Management Association*, pp. 61(11): 1227-1235.

CERC (2024) *Model Validation*, [Online], Available: https://www.cerc.co.uk/environmental-software/model-validation.html.

Defra (2022) *Review & Assessment: Technical Guidance LAQM.TG22 August 2022 Version*, Defra, Available: https://laqm.defra.gov.uk/documents/LAQM-TG16-February-18-v1.pdf.

Defra (2024a) *Background Mapping data for local authorities*, Available: https://uk-air.defra.gov.uk/data/laqm-background-home.

Defra (2024b) *UK-Air*, [Online], Available: https://uk-air.defra.gov.uk/interactive-map.

EA (2019) *Environmental permitting: air dispersion modelling reports*, Available: https://www.gov.uk/guidance/environmental-permitting-air-dispersion-modelling-reports?utm_source=4101c1a1-65a0-4299-99f3-d50dc8cd5823&utm_medium=email&utm_campaign=govuk-notifications&utm_content=immediate.

EA (2024) *Air emissions risk assessment for your environmental permit*, Available: https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit.

Melton Borough Council (2022) *2021 Air Quality Annual Status Report*.

The Air Quality (England) (Amendment) Regulations 2002, Statutory Instrument 3043 (2002), HMSO, Available: https://www.legislation.gov.uk/uksi/2002/3043/contents/made.

The Air Quality (England) Regulations 2000 Statutory Instrument 928 (2000), HMSO, Available: http://www.legislation.gov.uk/uksi/2000/928/contents/made.

The European Parliament and the Council of the European Union (2008) *Directive 2008/50/EC of the European Parliament and of the Council*, Available: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32008L0050.

12 Appendices

A1 Kettleby Foods

A1.1 The neighbouring Kettleby Foods facility comprises a number of combustion sources operating on natural gas, the emissions from which exhaust from vertical flues at varying heights above ground level. The plant are all anticipated to operate continuously throughout the year. The locations of the emission points relative to Melton Foods are shown on Figure A1.1, and basic operating details are provided in Table A1.1.

Table A1.1: Existing Emission Sources Information – Kettleby Foods

Emission Point	Process	X, Y Coordinate	Operational Hours per Year	Stack Height above Ground (m)	Flue Diameter at Point of Release (m)
A1	Gas boiler	473132.7, 318046.9	Continuous	9.0	0.45
A2	Gas boiler	473128.9, 318045.2	Continuous	9.1	0.45
A3	Gas boiler	473141.2, 318058.0	Continuous	10.8	0.60
A4	Travelling Oven	473139.2, 318019.6	Continuous	11.5	0.40
A5b	Travelling Oven	473134.2, 318021.3	Continuous	11.5	0.29
A6	Double D Rack Oven	473121.8,318003.8	Continuous	9.3	0.20
A7	Double D Rack Oven	473121.0,318004.4	Continuous	9.3	0.20
CHP	CHP Unit	473139.7, 318073.4	Continuous	9.9	0.40
Oven Stack 111	Travelling Oven	473137.8,318024.0	Continuous	11.2	0.30
Oven Stack 112	Travelling Oven	473140.8, 318019.8	Continuous	11.2	0.30

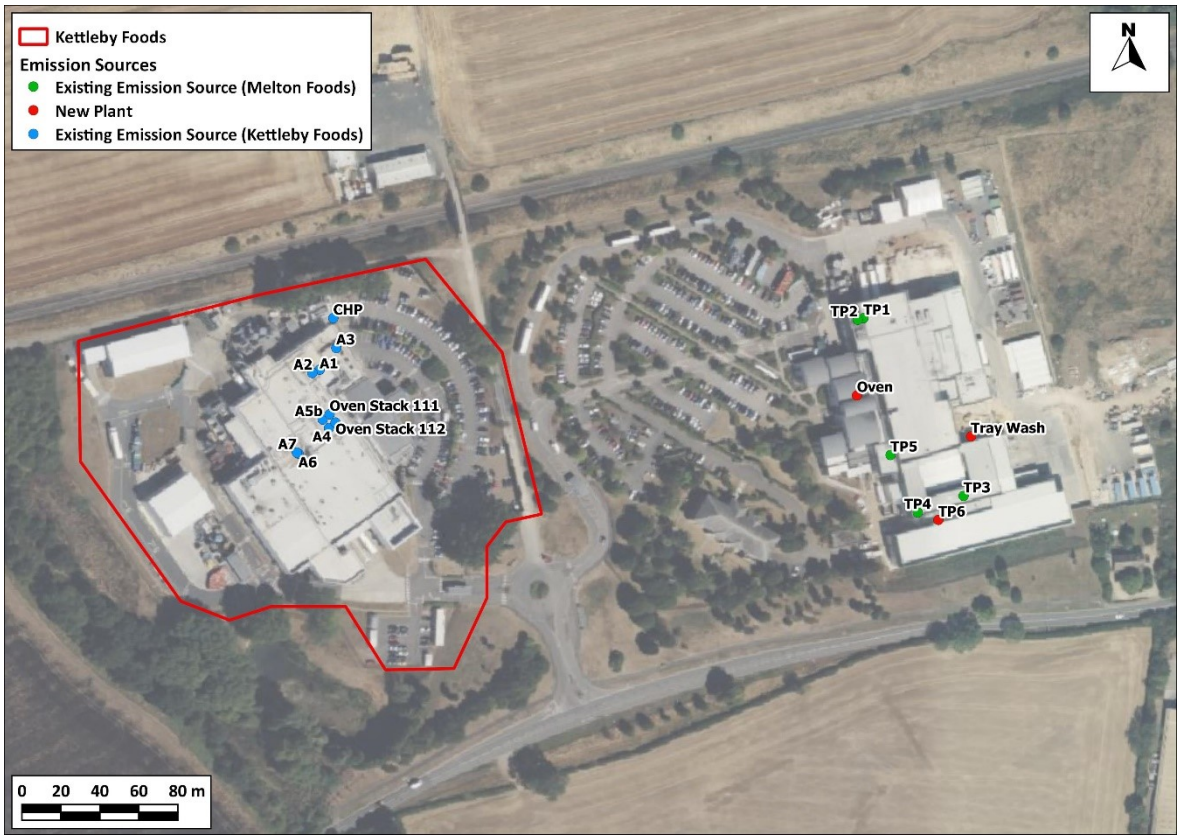


Figure A1.1: Melton Foods and Kettleby Foods Emission Sources

Imagery ©2024 Google, Imagery ©2024 Bluesky, CNES / Airbus, Getmapping plc, Infoterra Ltd & Bluesky, Maxar Technologies.

Operational Parameters

A1.2 Operational parameters for the existing emission sources at Kettleby Foods facility, such as stack diameter and stack height have been provided by Kettleby Foods.

A1.3 The combustion parameters for Sources A1 – A3 and A6 – A7 have been taken from the annual MCerts emissions testing results for each existing emission source, completed by Envirocare in March 2021. The combustion parameters for Sources A4 and A5b, and Oven Stack 111 and 112 have been taken from the MCerts emissions testing report completed by Element in June 2023. The combustion parameters for the CHP unit have been taken from the air quality assessment that accompanied the permit variation. The plant parameters are shown in Table A1.2.

Table A1.2: Emissions and Release Conditions for Melton Foods Emission Sources

Parameter	A1 [a]	A2 [a]	A3 [a]	A4 [b]	A5b [b]	A6 [b]	A7 [b]	CHP [c]	Stack 111	Stack 112
Actual Exhaust O_2 Content (%)	3.3	4.5	4.3	13.5	13.5	13.8	12.8	8.4	20.8	20.8
Actual Exhaust H_2O Content (%)	8.7	1.4	22.2	1.0	1.0	11.9	7.1	11.8	0.5	0.5
Molecular Mass (g/mol) for Actual Flow	27.3	28.0	25.9	29.0	29.0	27.3	27.8	28.2	29.0	29.0
Exhaust Flow (m^3/hr) for Actual Flow [d]	5,624	2,741	15,703	515	515	859	1,346	11,266	525	525
Exhaust Flow (m^3/s) for Actual Flow [d]	1.56	0.76	4.36	0.14	0.14	0.24	0.37	3.13	0.15	0.15
Exhaust Flow (Nm^3/hr) for Normalised Flow	2,633	1,648	8,229	446	446	592	845	11,467	484	484
Exhaust Flow (Nm^3/s) for Normalised Flow	0.73	0.46	2.29	0.12	0.12	0.16	0.23	3.19	0.13	0.13
Flue Internal Diameter (m)	0.45	0.45	0.60	0.30	0.30	0.20	0.20	0.40	0.30	0.30
Exhaust Velocity (m/s) for Actual Flow	9.8	4.8	15.4	0.01 [e]	0.01 [e]	7.6	11.9	24.9	0.01 [e]	0.01 [e]
Exhaust Temperature (ºC)	258	144	109	41	41	129	169	180	22	22
NOx Emission Concentration (mg/Nm^3) [f]	164	155	150	28	28	33	42	95	0.4	0.4
NOx Emission Rate (g/hr) [f]	431	255	1,235	12	12	19	36	1,089	0.2	0.2
NOx Emission Rate (g/s) [f]	0.12	0.10 [g]	0.34	<0.01	<0.01	0.01	0.01	0.30	<0.01	<0.01

[a] Normalised conditions (N) are at 0 ºC, 101.325 kPa, 3% oxygen, dry.

[b] Normalised conditions (N) are at 0 ºC, 101.325 kPa, wet.

[c] Normalised conditions (N) are at 0 ºC, 101.325 kPa, 15% oxygen, dry.

[d] Actual flow conditions in the exhaust at the stated exhaust O_2 and H_2O contents.

[e] Velocity reduced to 0.01 m/s due to the rain cowl on the flue.

[f] Values have been rounded.

[g] The A2 emission source was operating at 75% load during testing, thus emissions have been uplifted to represent operation at 100% load, which is considered typical.

A1.4 The physical parameters for the sources included in the modelling are outlined in Table A1.3. The existing point sources have been modelled as seven individual, vertical point sources. The locations of the Kettleby Foods existing emission points relative to the Melton Foods site are shown in Figure A1.1.

Table A1.3: Modelled Physical Release Emission Parameters for Existing Emission Points at Kettleby Foods

Parameter	Modelled Release Emission Parameters									
	A1	A2	A3	A4	A5b	A6	A7	CHP	Stack 111	Stack 112
Source Type	Point									
X-Coordinate	473133	473129	473141	473137	473134	473122	473121	473140	473138	473141
Y-Coordinate	318047	318045	318058	318017	318021	318004	318004	318073	318024	318020
Height above Ground (m)	9.0	9.1	10.8	11.2	11.2	9.3	9.3	9.9	11.2	11.2

Buildings

A1.5 Emissions from Kettleby Foods will also be affected by building downwash. The model has been run once with the adjacent buildings included, and once without, for each meteorological year. The maximum predicted concentrations from either buildings scenario, and any meteorological year, have then been determined and presented. The dimensions of all buildings are given in Table A1.4, and the modelled buildings at the Kettleby Foods site are shown in Figure A1.2.

Table A1.4: Kettleby Modelled Building Dimensions

Building	Height (m)	Length (m)	Width (m)	Rotation (º)
Kettleby 1	8.0	55.2	49.8	145.3
Kettleby 2	8.0	37.9	21.3	144.0
Kettleby 3	8.0	20.6	58.0	322.5
Kettleby 4	8.0	8.7	49.2	144.0
Kettleby 5	7.7	62.8	12.5	55.0
Kettleby 6	8.0	7.8	13.4	324.6
Kettleby 7	8.0	10.6	11.6	61.7
Kettleby 8	8.0	21.6	53.3	144.0
Kettleby 9	8.0	14.0	11.1	55.0
Kettleby 10	7.7	16.4	11.0	233.9
Kettleby 11	8.0	40.5	16.7	145.0
CHP Building	4.5	3.5	11.4	158.0
CHP Container	4.5	3.5	12.2	156.5

Figure A1.2: Kettleby Buildings Included in the Model. Inset Shows 3D Image.

Imagery ©2023 Google, Imagery ©2023 Bluesky, CNES / Airbus, Getmapping plc, Infoterra Ltd & Bluesky, Maxar Technologies. Contains imagery provided by Melton Foods.

Combined 1-hour mean PCs and PECs from Melton and Kettleby

A1.6 The predicted 99.79th percentile of 1-hour mean PCs and PECs at the specific receptors identified in Figure 8 and Table 16 are set out in Table A1.5, taking account of the existing plant within the neighbouring Kettleby Foods facility and those currently within Melton Foods. Table A1.5 also sets out the maximum PCs and PECs across the entire modelled grid. The PECs at each specific receptor are determined following the same approach set out in Paragraph 8.1.

Table A1.5: 1-hour Mean PCs and PECs at Specific Receptors

Receptor ID	PC [a]		Background ($\mu g/m^3$) [c]	PEC	
	PC ($\mu g/m^3$)	% of AQS [b]		Total PEC ($\mu g/m^3$)	% of AQS [b]
Max on Grid	62.7	31.4	25.2	87.92	44.0
H1	13.4	6.7	25.2	38.60	19.3
H2	15.3	7.7	25.2	40.55	20.3
H3	9.6	4.8	25.2	34.80	17.4
H4	10.0	5.0	51.0	35.16	17.6
H5	9.2	4.6	25.2	60.15	30.1
H6	9.4	4.7	25.2	34.56	17.3
H7	10.1	5.0	25.2	35.26	17.6
H8	9.0	4.5	25.2	34.23	17.1
H9	8.0	4.0	25.2	33.18	16.6
H10	7.7	3.9	25.2	32.93	16.5
H11	6.4	3.2	25.2	31.58	15.8
H12	2.6	1.3	69.0	71.61	35.8

[a] Includes the contribution from the new and existing Melton plant and Kettleby Foods plant modelled simultaneously.

[b] Based on unrounded numbers.

[c] As defined in Table 9.

A1.7 Figure A1.3 presents the area where the PC to the 99.79th percentile of 1-hour mean NO_2 concentrations from both manufacturing facilities (i.e. Melton Foods and Kettleby Foods) is greater than 20 $\mu g/m^3$ (10% of the AQS). This covers an area which extends up to approximately 265 m from the site boundary and encompasses the Kettleby Foods, the Melton Foods car park, agricultural fields and buildings and highways.

Figure A1.3: Contour Plot of the 99.79th Percentile of 1-hour Mean NO_2 PCs

Imagery ©2024 Google, Imagery ©2024 Bluesky, CNES / Airbus, Getmapping plc, Infoterra Ltd & Bluesky, Maxar Technologies.

A2 Carbon Monoxide

Air Quality Standards

A2.1 The relevant AQS for carbon monoxide are set out in Table A2.1 (EA, 2024).

Table A2.1: AQS for Human Health

Pollutant	Averaging Period	AQS (µg/m^3)	Acceptable Exceedance Criteria
CO	Daily 8-hour Mean	10,000	Maximum running daily 8-hour mean

A2.2 The 8-hour mean CO objective is assumed to apply in the same locations as the annual mean NO_2 objective, as described in Paragraph 4.3.

CO Monitoring

A2.3 The nearest monitoring site measuring concentrations of carbon monoxide is located in Leeds city centre, approximately 125 km northwest of Melton Foods. The monitoring site is described as an urban background site and is located approximately 30 m from a busy four-lane inner-city road. Concentrations of CO may be higher than in the area surrounding Melton Mowbray. Use of measured concentrations from this site therefore represent a worst-case baseline concentration at locations immediately surrounding the Melton Foods facility; results for 2018 to 2022 are presented in Table A2.2. There was no exceedance of the 8-hour rolling mean objective in any year.

Table A2.2: Carbon Monoxide Rolling 8-hour Mean Monitoring Results [a]

Site ID	Site Type	Location	2018	2019	2020	2021	2022
UKA00217	Urban Background	Leeds Centre	991	997	855	875	634
Objective			**10,000**				

[a] Data have been downloaded from the UK-Air website (Defra, 2024b).

CO Emission Rates

A2.4 CO emission rates used in the modelling are provided in Table A2.3 for existing plant at Melton Foods and Table A2.4 for the new plant.

Table A2.3: CO Emission Rates for Existing Melton Foods Emission Sources [a]

Parameter	TP1	TP2	TP3	TP4	TP5
CO Emission Rate (g/hr)	59.9	246.0	0.7	46.7	80.6
CO Emission Rate (g/s)	0.016	0.068	<0.01	0.013	0.022

[a] Values have been rounded.

Table A2.4: CO Emission Rates for New Plant [a]

Parameter	TP6	Tray Wash	Oven
CO Emission Rate (g/hr)	34.0	80.6	0.7
CO Emission Rate (g/s)	0.009	0.022	<0.01

[a] Values have been rounded.

CO Results

A2.5 The predicted 8-hour rolling mean PCs at the specific receptors identified in Figure 8 and Table 16, as a result of the operation of plant at Melton Foods, including the new plant, are set out in Table A2.5. Table A2.5 also sets out the maximum PCs across the entire modelled grid. The PCs are well below 10% of the AQS for CO, thus the effect of the scheme is insignificant, irrespective of consideration of the PECs.

Table A2.5: 8-hour Rolling Mean PCs at Specific Receptors from Melton Facility

Receptor ID	All Melton Plant PC (µg/m^3)	% of AQS [a]
Max on Grid	35.6	0.36
H1	23.1	0.23
H2	14.1	0.14
H3	12.8	0.13
H4	12.7	0.13
H5	9.0	0.09
H6	8.0	0.08
H7	9.0	0.09
H8	9.2	0.09
H9	7.1	0.07
H10	5.3	0.05
H11	3.7	0.04
H12	1.4	0.01

[a] Based on unrounded numbers.

A3 New Plant Datasheets

TP6 – Steam Boiler

Monitoring Results

where MU = Measurement Uncertainty associated with the result (95% Confidence)

Substance		Concentration Limit (mg/m³)	Concentration Result (mg/m³)	Concentration Measurement Uncertainty (MU) +/-	Reference Conditions	Mass Emission Limit (g/hr)	Mass Emission Result (g/hr)	Mass Emission Measurement Uncertainty (MU) +/-	Sampling Date	Sampling Times
Water Vapour	R1	-	6.3%	-	273K, 101.3kPa	-	-	-	20/05/2021	14:00-15:00
Carbon Monoxide	R1	-	67.3	9.2	273k, 101.3kPa, Dry Gas, 3% O2.	-	34.0	4.9	20/05/2021	10:55-12:55
Oxides of Nitrogen (as NO_2)	R1	-	64.2	6.6	273k, 101.3kPa, Dry Gas, 3% O2.	-	32.5	3.7	20/05/2021	10:55-12:55
Oxygen	R1	-	16.6%	0.18	273k, 101.3kPa, Dry Gas	-	-	-	20/05/2021	10:55-12:55
Volumetric Flow	R1	-	506 m³/h	23.6	273k, 101.3kPa, Dry Gas, 3% O2.	-	-	-	20/05/2021	10:20-10:25

Reference conditions (REF) are: 273k, 101.3kPa, dry gas, 3% oxygen.

Operating Information

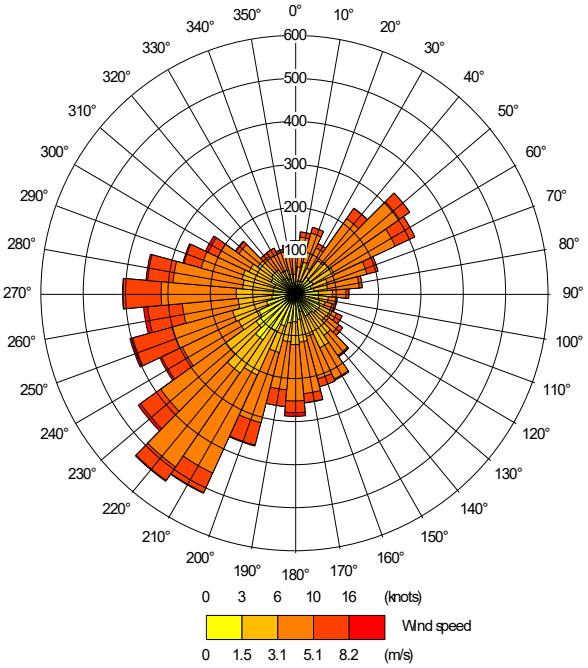
Parameter	Process Details
Process Type	Boiler
Continuous or Batch Process	Batch
Operating Status	Normal operation
Feedstock	N/A
Normal Load, Throughput or Continuous Rating	100%
Abatement System	N/A
Abatement System Status	N/A
Process Fuel	Natural Gas
Plume Appearance	Steam Plume visible

Oven

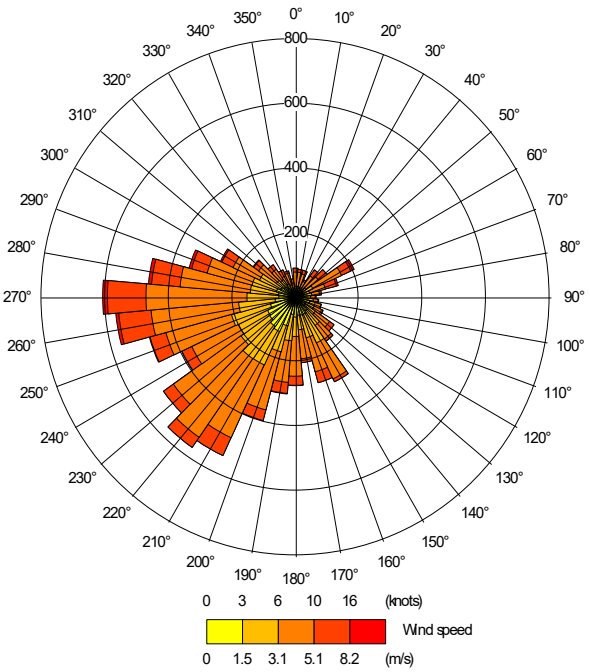
Model HEM-NVx				10-3	15-4	18-5	25-5	30-6	40-8	50-6	60-7	75-9	100-12	110-13	125-15	150-18	175-21
Output	Max	kW		9.6	14.5	17.7	23.6	27.4	36.0	44.8	54.2	67.6	91.9	98.0	112.0	134.9	154.4
	Min.	kW		5.0	9.8	11.9	15.7	18.2	23.2	29.0	36.4	49.6	62.5	66.0	76.5	78.8	112.8
Temp	Rise		Δt °C						35								
	Air Off	Max	°C						70								
Airflow	Min. Airflow		m³/s	0.34	0.44	0.58	0.71	0.86	1.01	1.55	1.94	2.28	2.78	2.99	3.39	4.14	4.67
	Min. Airflow ΔP		Pa	43	26	45	32	47	31	59	67	59	54	43	43	47	45

A4 Wind Roses for Sutton Bonington

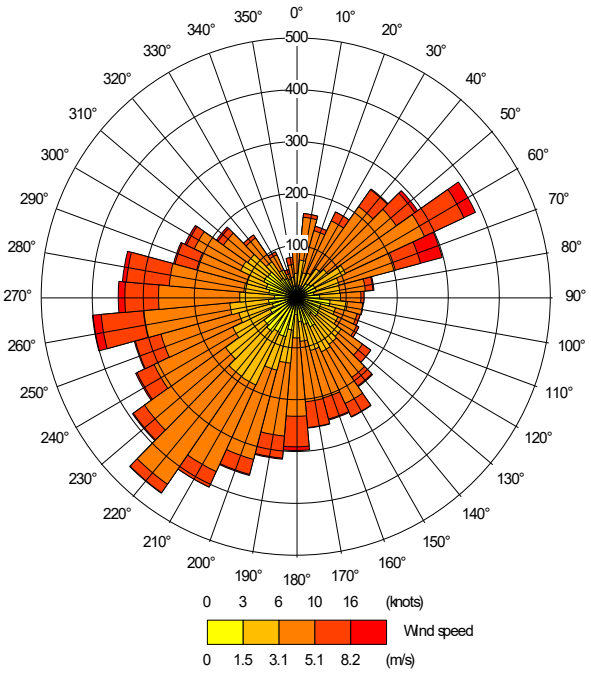
2016



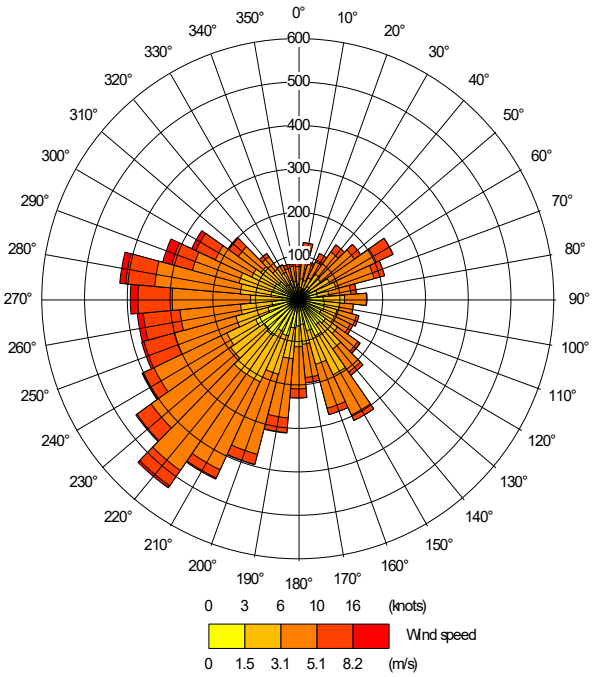
2017



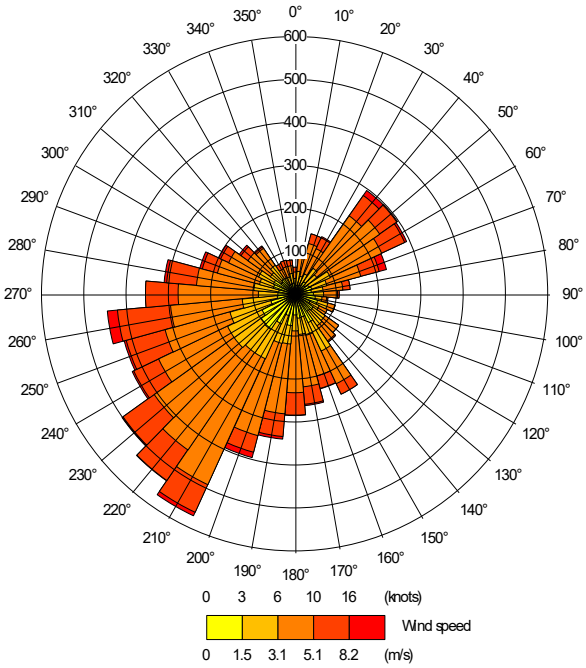
2018


0°
10°
20°
30°
40°
50°
60°
70°
80°
90°
100°
110°
120°
130°
140°
150°
160°
170°
180°
190°
200°
210°
220°
230°
240°
250°
260°
270°
280°
290°
300°
310°
320°
330°
340°
350°
500
400
300
200
100
0 3 6 10 16 (knots)
Wind speed
0 1.5 3.1 5.1 8.2 (m/s)

2019


0°
10°
20°
30°
40°
50°
60°
70°
80°
90°
100°
110°
120°
130°
140°
150°
160°
170°
180°
190°
200°
210°
220°
230°
240°
250°
260°
270°
280°
290°
300°
310°
320°
330°
340°
350°
600
500
400
300
200
100
0 3 6 10 16 (knots)
Wind speed
0 1.5 3.1 5.1 8.2 (m/s)

2020


0°
10°
20°
30°
40°
50°
60°
70°
80°
90°
100°
110°
120°
130°
140°
150°
160°
170°
180°
190°
200°
210°
220°
230°
240°
250°
260°
270°
280°
290°
300°
310°
320°
330°
340°
350°
600
500
400
300
200
100
0 3 6 10 16 (knots)
Wind speed
0 1.5 3.1 5.1 8.2 (m/s)

A5 100th Percentile of 1-hour Mean PCs

A5.1 Table A5.1 presents the maximum 100th percentile of 1-hour mean NO_2 PCs, assuming continuous operation of the new and existing Melton plant, at the specific receptors identified in Table 16 and Figure 8. Table A5.1 also sets out the maximum PCs across the entire modelled grid.

A5.2 As presented in Table A5.1, the PCs from the Melton Foods facility in isolation do not exceed 10% of the AQS; it is not, therefore, necessary to present contours.

A5.3 The AQS for 1-hour mean NO_2 concentrations allows 18 exceedances of 200 µg/m^3 in each calendar year. The 100th percentile of 1-hour means (i.e. the maximum in any hour of the year) is thus not directly comparable with the AQS. Results are provided here for information only.

Table A5.1: Maximum 100th Percentile of 1-hour Mean NO_2 PCs

Receptor ID	PC (µg/m^3) [a]	PC (% of AQS)
Max on Grid	20.0	10.0
H1	9.5	4.7
H2	3.2	1.6
H3	3.0	1.5
H4	3.0	1.5
H5	2.1	1.1
H6	2.0	1.0
H7	2.1	1.0
H8	2.3	1.2
H9	1.8	0.9
H10	1.7	0.8
H11	1.6	0.8
H12	0.4	0.2

[a] Includes the contribution from the new and existing Melton plant operating simultaneously.