Project Aurora

Air Emissions Risk Assessment

Kellogg Company of Great Britain Limited

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Basis of Report

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Table of Contents

Tables in Text

Figures in Text

Appendices

1.0 Introduction

SLR Consulting Limited (SLR) have been commissioned by Kellogg Company of Great Britain Limited (the 'Client') to prepare an Air Emissions Risk Assessment (AERA) in support of an Environmental Permit (EP) variation application for the proposed changes to the existing facility in Wrexham, North Wales (the 'Site').

1.1 Background

1.1.1 The Site

The Site is centred on the approximate National Grid Reference (NGR) x338825, y350510, and located off Bryn Lane, Wrexham Industrial Estate, Wrexham, LL13 9UT. It is situated at the northern edge of Wrexham Industrial Estate approximately 5km east of Wrexham town centre. The Site is within the administrative area of Wrexham County Borough Council (WCBC).

To the south and west the installation is bounded by the industrial estate with a range of commercial and industrial activities. To the north and east the Site is bounded by agricultural land with scattered residential dwellings within 1km.

1.1.2 The Proposed Changes

The requirement for an EP variation application is due to the proposed modifications to production at the Site, which is a consequence of the proposed closure of the Client's Trafford Park, Manchester manufacturing site in 2026.

The proposed changes will impact the configuration and number of emission points at roof level and have therefore resulted in the need for an AERA to support the EP variation.

Further details can be found in the supporting EP variation application, including the Non-Technical Summary (NTS).

1.2 Objective and Scope

The scope of the assessment is limited to consideration of pollutant releases of particulate matter (PM_{10}[1] and $PM_{2.5}$[2]).

Therefore, the objective of the study is to assess, using atmospheric dispersion modelling, the impact of PM_{10} and $PM_{2.5}$ emissions against the relevant Air Quality Standards for the protection of human health.

This report presents the approach, detailed methodology and findings of the AERA.

[1] Particulate matter where particles are less than 10 micrometres in diameter.

[2] Particulate matter where particles are less than 2.5 micrometres in diameter.

2.0 Legislation and Relevant Guidance

2.1 Environmental Permitting Regulations and Guidance

The facility is regulated under the Environmental Permitting (England and Wales) Regulations 2016 (as amended) (EPR).

The assessment has been informed by the Environment Agency (EA) guidance 'Air emissions risk assessment for your environmental permit'[3] (the 'AERA guidance'), as adopted by Natural Resources Wales (NRW).

2.2 Air Quality Legislation and Guidance

2.2.1 Air Quality Standards

The Air Quality Standards (Wales) Regulations 2010 (the AQSR) includes Limit Values, Target Values, Objectives, Critical Levels and Exposure Reduction Targets for the protection of human health and the environment. Following the UK's withdrawal from the EU, the Environment (Miscellaneous Amendments) (Wales) (EU Exit) Regulations 2020[4] was introduced to mirror revisions to supporting EU legislation, including the AQSR.

2.2.2 Air Quality Strategy

In 2020, the Welsh Government published The Clean Air Plan for Wales[5] which sets out the over-arching strategic framework for air quality management in Wales. In 2023, following a review of the Air Quality Strategy (AQS) for England, Scotland, Wales and Northern Ireland, which was published in 2007[6], the Welsh Government formerly adopted The Clean Air Plan for Wales as the National AQS for Wales, to replace the 2007 document.

2.3 Standards for Air Quality

The standards applied in this assessment for the protection of human health are provided in Table 2-1 and are taken from the AQSR and AERA guidance, these are collectively termed Air Quality Assessment Levels (AQALs) throughout this report.

Table 2-1: Applied Air Quality Assessment Levels (AQALs)

Pollutant		Annual AQAL (µg/m^3)	Short Term AQAL (µg/m^3)
Particulate Matter	PM_{10}	40	50 (24-hour mean) not to be exceeded more than 35 times per year
	$PM_{2.5}$	20	-

The Department for Environment, Food and Rural Affairs (Defra) has published technical guidance (LAQM.TG22)[7]. According to LAQM.TG22, air quality standards should only apply to locations where *'members of the public are likely to be regularly present and are likely to be exposed for a period of time appropriate to the averaging period of the objective. Authorities should not consider exceedances of the objectives at any location where relevant*

[3] https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit

[4] The Environment (Miscellaneous Amendments) (Wales) (EU Exit) Regulations 2020, Wales Statutory Instrument No. 1215 (W. 274).

[5] Welsh Government, The Clean Air Plan for Wales: Healthy Air, Healthy Wales, 2020.

[6] Defra, The Air Quality Strategy for England, Scotland, Wales and Northern Ireland, July 2007.

[7] Defra, Local Air Quality Management Review and Assessment Technical Guidance TG22, August 2022.

public exposure would not be realistic'. Longer term standards, such as annual means, should apply at houses or other locations which the public can be expected to occupy on a continuous basis (examples are presented in Table 2-2).

It should be noted that these standards do not apply to exposure at the workplace.

Table 2-2: Relevant Public Exposure

Averaging Period	Relevant Locations	Standards should apply at:	Standards don't apply at:
Annual mean	Where individuals are exposed for a cumulative period of six months in a year	Building facades of residential properties, schools, hospitals etc.	Facades of offices Hotels Gardens of residences Kerbside sites
24-hour mean	Where individuals may be exposed for eight hours or more in a day	As above together with hotels and gardens of residential properties	Kerbside sites where public exposure is expected to be short term

3.0 Assessment Methodology

Detailed atmospheric dispersion modelling has been undertaken with due consideration to the AERA guidance (the dispersion modelling checklist is included in Appendix A). The assessment approach is based upon the following stages:

- Review of emission sources;
- Compilation of the existing air quality baseline and review of Local Air Quality Management (LAQM) status;
- Identification of sensitive receptors;
- Dispersion modelling; and
- Calculation of process contribution to ground level concentrations and evaluation against relevant environmental standards for human receptors only.

3.1 Modelling Scenarios

Three modelled scenarios have been accounted for within the assessment:

- **Scenario 1 (S1)** presents the process contribution (PC) of existing sources being retained only;
- **Scenario 2 (S2)** presents the PC of the proposed sources only; and
- **Scenario 3 (S3)** presents the total PC for all sources at the Site (i.e. existing and proposed sources).

The results of all scenarios are presented in Section 5.0.

3.2 Quantification of Emissions

For existing sources being retained, the emission parameters used in the model have been based on data from a previous H1 assessment completed in 2006[8], as well as the Emission Limit Values (ELVs) specified in the current EP[9]. On review of monitoring data provided by the Client, the application of these emission parameters represents a conservative approach. For the proposed sources, emission parameters have been based on information provided by the Project's Engineers.

At the time of writing, detailed information regarding the specific fraction of $PM_{2.5}$ in the overall particulate matter fraction is not available. Therefore, it has been assumed that the entire particulate matter fraction exists as both PM_{10} and $PM_{2.5}$. This assumption represents a worst-case scenario for the purpose of the assessment.

The emission parameters applied in the modelling are provided in Table 3-1 and Table 3-2.

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[8] Environment H1 Database. Wrexham, Breakfast Cereals – BV8016ID.

[9] BV8016ID-V008 Consolidated Permit.

Table 3-1: Emission Parameters

Source	Pollutant	Stack Location (NGR)		Stack Height (m AGL)	Emission Temperature (ºK)	Moisture Content (%)	Actual Air Flow (Am^3/s)	Emission Velocity (m/s)	Normalised Flow (Nm^3/s)
		x	y						
Existing Emissions Points									
A9	PM_{10} / $PM_{2.5}$	338868	350545	20.0	356	0.4	3.3	12	2.5
A10	PM_{10} / $PM_{2.5}$	338869	350541	20.0	383	0.8	3.1	8	2.2
A11	PM_{10} / $PM_{2.5}$	338837	350545	20.0	367	0.6	3.9	14	2.9
A12	PM_{10} / $PM_{2.5}$	338838	350540	20.0	373	0.1	3.1	8	2.2
A13	PM_{10} / $PM_{2.5}$	338833	350540	20.0	321	1.1	4.7	17	4.0
A14	PM_{10} / $PM_{2.5}$	338799	350524	18.0	318	0.4	2.2	10	1.9
A15	PM_{10} / $PM_{2.5}$	338796	350530	18.0	374	1.3	2.2	5	1.6
A16	PM_{10} / $PM_{2.5}$	338799	350539	18.0	373	1.4	2.2	5	1.6
A23	PM_{10} / $PM_{2.5}$	338792	350541	21.0	303	0	0.04	6	0.04
A24	PM_{10} / $PM_{2.5}$	338867	350610	16.0	306	0	4.8	27	4.3
A26	PM_{10} / $PM_{2.5}$	338869	350596	16.0	306	0	4.8	27	4.3
A27	PM_{10} / $PM_{2.5}$	338870	350529	16.0	338	0	4.0	8	3.2
A28	PM_{10} / $PM_{2.5}$	338870	350575	16.0	346	0	2.6	8	2.0
A29	PM_{10} / $PM_{2.5}$	338870	350492	17.0	304	0	2.3	11	2.1
A30	PM_{10} / $PM_{2.5}$	338862	350610	16.0	323	0	6.7	23	5.6
A31	PM_{10} / $PM_{2.5}$	338834	350580	10.0	298	0	1.3	6	1.2
Proposed Emissions Points									
A32	PM_{10} / $PM_{2.5}$	338858	350419	11	288	0	10.8	22	10.3
A33	PM_{10} / $PM_{2.5}$	338841	350609	11	288	0	13.6	21	12.9
A34	PM_{10} / $PM_{2.5}$	338832	350576	11	288	0	18.1	19	17.1

Source	Pollutant	Stack Location (NGR)		Stack Height (m AGL)	Emission Temperature (°K)	Moisture Content (%)	Actual Air Flow (Am^3/s)	Emission Velocity (m/s)	Normalised Flow (Nm^3/s)
		x	y						
A35	PM_{10} / $PM_{2.5}$	338831	350553	10.5	288	0	2.9	15	2.8
A36	PM_{10} / $PM_{2.5}$	338836	350609	10.5	288	0	1.1	15	1.0
A37	PM_{10} / $PM_{2.5}$	338832	350594	10.5	288	0	0.7	21	0.6
A38	PM_{10} / $PM_{2.5}$	338851	350641	10.5	288	0	0.8	15	0.7
A39(b)	PM_{10} / $PM_{2.5}$	338833	350556	8	288	0	8.7	20	8.2
A40	PM_{10} / $PM_{2.5}$	338839	350527	8	288	0	0.2	9	0.2
A41	PM_{10} / $PM_{2.5}$	338835	350527	15	288	0	0.4	12	0.4
A42(b)	PM_{10} / $PM_{2.5}$	338760	350486	16	323	0	6.1	22	5.2

Table Notes:

(a) Normalised to 273.15k, dry, assuming stack oxygen content 21% (dry) and moisture content as above.

(b) Release geometry – Horizontal.

Table 3-2: Pollutants Emission Rates

Source	Pollutant	Emission Concentration (mg/m^3)	Release Rate (g/s)	Source
Existing Emissions Points				
A9	PM_{10} / $PM_{2.5}$	25	0.06	2006 H1 Assessment[(a)]
A10	PM_{10} / $PM_{2.5}$	25	0.05	2006 H1 Assessment[(a)]
A11	PM_{10} / $PM_{2.5}$	25	0.07	2006 H1 Assessment[(a)]
A12	PM_{10} / $PM_{2.5}$	25	0.06	2006 H1 Assessment[(a)]
A13	PM_{10} / $PM_{2.5}$	25	0.10	2006 H1 Assessment[(a)]
A14	PM_{10} / $PM_{2.5}$	25	0.05	2006 H1 Assessment[(a)]
A15	PM_{10} / $PM_{2.5}$	25	0.04	2006 H1 Assessment[(a)]
A16	PM_{10} / $PM_{2.5}$	25	0.04	2006 H1 Assessment[(a)]
A23	PM_{10} / $PM_{2.5}$	25	0.001	2006 H1 Assessment[(a)]
A24	PM_{10} / $PM_{2.5}$	50	0.22	Permitted value[(b)]
A26	PM_{10} / $PM_{2.5}$	50	0.22	Permitted value[(b)]
A27	PM_{10} / $PM_{2.5}$	50	0.16	Permitted value[(b)]
A28	PM_{10} / $PM_{2.5}$	50	0.10	Permitted value[(b)]
A29	PM_{10} / $PM_{2.5}$	50	0.10	Permitted value[(b)]
A30	PM_{10} / $PM_{2.5}$	50	0.28	Permitted value[(b)]
A31	PM_{10} / $PM_{2.5}$	50	0.06	Permitted value[(b)]
Proposed Emission Points				
A32	PM_{10} / $PM_{2.5}$	10	0.10	Client input[(c)]
A33	PM_{10} / $PM_{2.5}$	10	0.13	Client input[(c)]
A34	PM_{10} / $PM_{2.5}$	10	0.17	Client input[(c)]
A35	PM_{10} / $PM_{2.5}$	10	0.03	Client input[(c)]

Source	Pollutant	Emission Concentration (mg/m^3)	Release Rate (g/s)	Source
A36	PM_{10} / $PM_{2.5}$	10	0.01	Client input(c)
A37	PM_{10} / $PM_{2.5}$	10	0.01	Client input(c)
A38	PM_{10} / $PM_{2.5}$	10	0.01	Client input(c)
A39	PM_{10} / $PM_{2.5}$	10	0.08	Client input(c)
A40	PM_{10} / $PM_{2.5}$	15	0.002	Client input(c)
A41	PM_{10} / $PM_{2.5}$	15	0.01	Client input(c)
A42	PM_{10} / $PM_{2.5}$	10	0.05	Client input(c)

Table Notes:

(a) Document ref: Environment H1 Database. Wrexham, Breakfast Cereals – BV8016ID
(b) Document ref: BV8016ID-V008 Consolidated Permit
(c) Data provided to SLR by the Client.

3.3 Dispersion Model Setup

For this assessment the AERMOD model[10] has been applied; this model is widely used and accepted by the EA for undertaking such assessments and its predictions have been validated against real-time monitoring data by the United States (US) Environmental Protection Agency (EPA). It is therefore considered a suitable model for this assessment.

3.3.1 Model Domain / Receptors

The modelling has been undertaken using a receptor grid across mapping of the study area. Pollutant exposure isopleths have been generated by interpolation between receptor points and superimposed onto the map. This method allows the maximum ground level concentration outside the Site boundary to be assessed. A receptor grid was applied as follows:

- 200m x 200m at 20m grid resolution;
- 500m x 500m at 50m grid resolution;
- 2000m x 2000m at 200m grid resolution; and
- 5000m x 5000m at 500m grid resolution.

In addition, a number of discrete receptor locations at relevant exposure locations surrounding the Site have been modelled, as described in Section 4.1, to facilitate the discussion of results.

3.3.2 Building Downwash

Building downwash occurs when turbulence, induced by nearby structures, causes pollutants emitted from an elevated source to be displaced and dispersed rapidly towards the ground, resulting in elevated ground level concentrations. Building downwash has been considered for buildings that have a maximum height equivalent to at least 40% of the emission height and which are within a distance defined as five times the lesser of the height or maximum projected width of the building.

The integrated Building Profile Input Programme (BPIP) module within AERMOD was used to assess the potential impact of building downwash upon predicted dispersion characteristics. Structures input to the model are represented in Figure 3-1.

[10] Software used: Lakes AERMOD View, (V12.0.0)

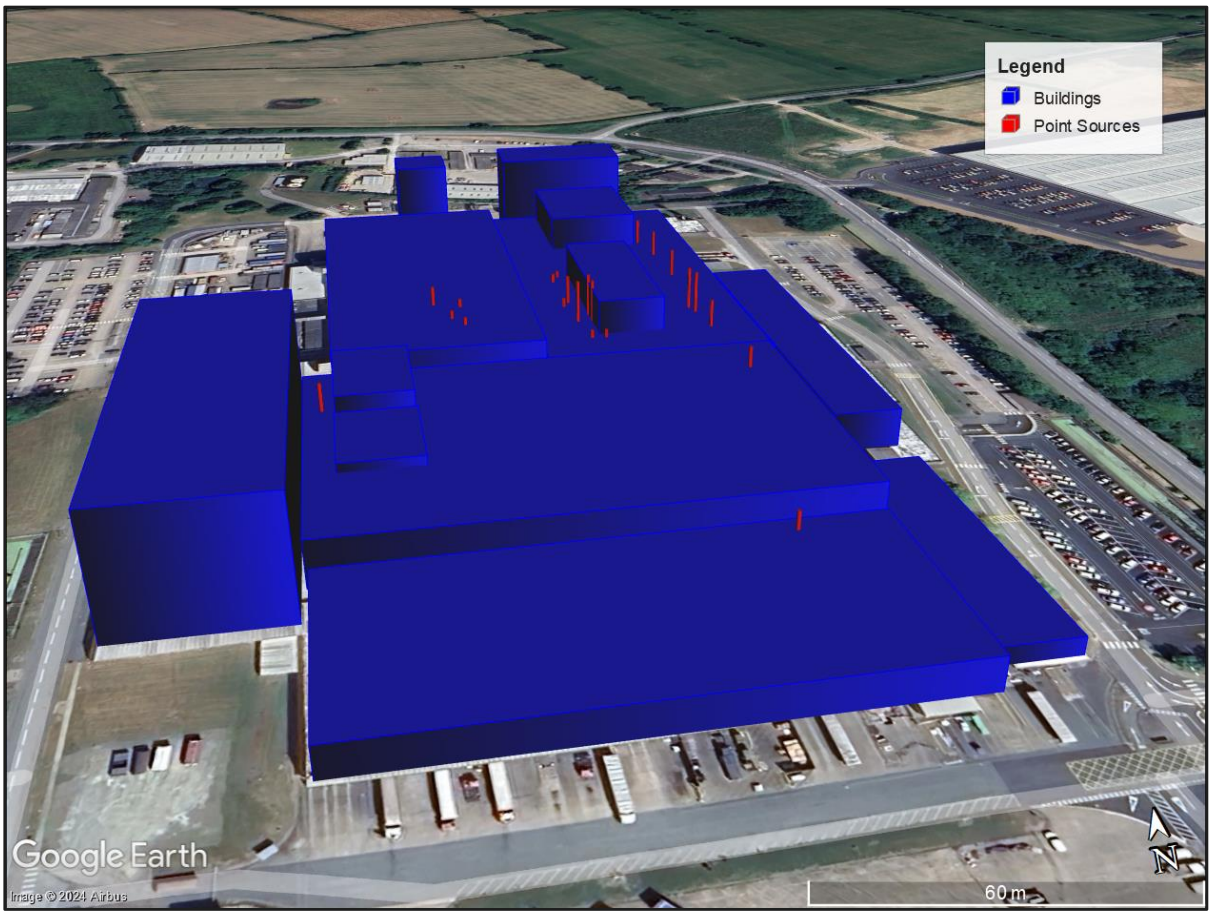


Figure 3-1: Modelled Buildings and Structures

3.3.3 Topography

The presence of elevated terrain can affect the dispersion of pollutants and the resulting ground level concentration in a number of ways. Elevated terrain reduces the distance between the plume centre line and the ground level, thereby increasing ground level concentrations. Elevated terrain can also increase turbulence and, hence, plume mixing with the effect of increasing concentrations near to a source and reducing concentrations further away.

AERMOD utilises digital elevation data to determine the impact of topography on dispersion from a source. Topography was incorporated within the modelling using 30m resolution Shuttle Radar Topography Mission (SRTM) terrain data files. Data was processed by the AERMAP function within AERMOD to calculate terrain heights (see Figure 4-3).

3.3.4 Meteorological Data Preparation

Hawarden meteorological station is the closest station to the Site, located approximately 15km north, and was selected for use in the assessment. The meteorological data (5 years hourly sequential data 2017-2021) was obtained in .met format from the data supplier and converted to the required surface and profile formats for use in AERMOD using the AERMET View meteorological pre-processor. Details specific to the station location were used to define surface roughness, albedo and bowen ratio in the conversion (see Table 3-3). A windrose is presented in Figure 4-2.

Table 3-3: Meteorological Station Surface Characteristics

Zone (Start)	Zone (End)	Albedo	Bowen Ratio	Surface Roughness (m)
0	30	0.18	0.66	0.075
30	67			0.075
67	130			0.075
130	240			0.055
240	300			0.056
300	0			0.060

3.3.5 Dispersion Model Uncertainty

Model validation studies[11] for AERMOD generally suggest that these dispersion models are for the vast majority of cases able to predict maximum short-term high percentiles concentrations well within a factor of two and the latest evaluation studies for AERMOD show the composite (geometric mean) ratio of predicted to observed short-term averages from 'test sites' (where real-time monitoring data is available to validate model performance), to be between 0.96 and 1.2.

3.4 Assessment of Impacts on Air Quality

3.4.1 Operational Envelope

It has been assumed that the emission sources operate for a maximum envelope of 8,760 hours per year. In practice, sources for emissions will be less than assumed.

3.4.2 Treatment of Model Output

The assessment of impacts against the AQALs as defined in Section 2.3 has been undertaken using model output as described in Table 3-4.

Table 3-4: Model Outputs

Criteria	Model Output – Process Contribution (PC)	Predicted Environmental Concentration (PEC)
Annual Mean PM_{10}	Annual Mean	PC + annual mean background
24-hour Mean PM_{10}	24-hour mean 90.4%ile	PC + annual mean background
Annual Mean $PM_{2.5}$	Annual Mean	PC + annual mean background

3.4.3 Assessment of Impact and Significance

To assess the potential impact on air quality the predicted exposure is compared to the AQALs. The results of the dispersion modelling have been presented in the form of:

- Tabulated concentrations at discrete receptor locations to facilitate the discussion of results; and
- Illustrations of the impact as isopleths (contours of concentration) for the criteria selected, enabling determination of impact at any location within the study area.

[11] AERMOD: Latest Features and Evaluation Results, EPA-454/R-03-003, June 2003 (United States Environmental Protection Agency).

In accordance with the AERA guidance, the impact is considered to be insignificant or negligible if:

- The long-term PC is <1% of the long-term standard; and
- The short-term PC is <10% of the short-term standard.

For process contributions that cannot be considered insignificant further assessment has been undertaken and the Predicted Environmental Concentration (PEC: PC + existing background pollutant concentration) determined for comparison as a percentage of the relevant AQAL.

The AERA guidance indicates that no further assessment is required if the resulting PEC is below the AQAL, and the applied emission levels comply with the Best Available Techniques (BAT) requirements.

4.0 Baseline Environment

4.1 Site Setting and Sensitive Receptors

The Site is situated at the northern edge of Wrexham Industrial Estate approximately 5km east of Wrexham town centre.

The nearest residential properties are located approximately 55m to the northeast of the Site, off Bryn Lane. Further information is provided in the following sections.

4.1.1 Human Receptors

The modelled sensitive human receptors selected to inform the risk assessment are presented in Figure 4-1 and Table 4-1. All the selected receptor locations are modelled at a height of 1.5m.

Furthermore, the dispersion modelling has been completed using a receptor grid (see Section 3.3.1) to allow potential short-term exposure to be assessed at all locations surrounding the Site.

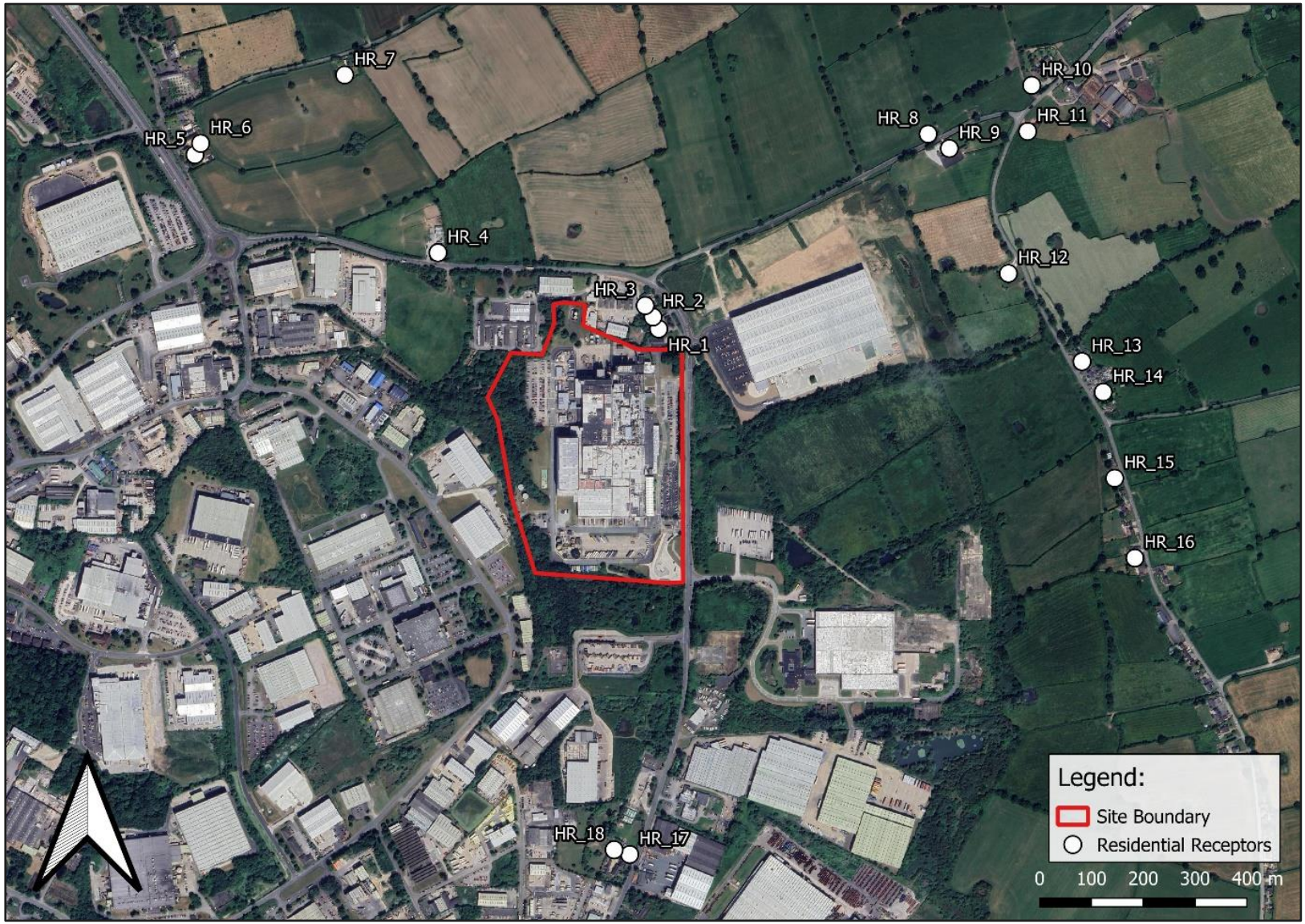


Figure 4-1: Site Setting and Modelled Human Receptors

Table 4-1: Modelled Discrete Receptors – Human Receptors

Ref.	Description	NGR	
		x	y
HR_1	Bryn Lane No.1	338908	350738
HR_2	Bryn Lane No.2	338897	350761
HR_3	Bryn Lane No.3	338882	350783
HR_4	Bryn Lane No.4	338482	350885
HR_5	Hugmore Lane No.1	338013	351074
HR_6	Hugmore Lane No.2	338024	351096
HR_7	Francis Lane No.1	338302	351228
HR_8	Ridley Wood Lane No.1	339428	351114
HR_9	Ridley Wood Lane No.2	339469	351086
HR_10	Holt Road No.1	339628	351208
HR_11	Holt Road No.2	339620	351119
HR_12	Holt Road No.3	339583	350845
HR_13	Holt Road No.4	339725	350675
HR_14	Holt Road No.5	339766	350616
HR_15	Holt Road No.6	339788	350450
HR_16	Holt Road No.7	339827	350296
HR_17	Bryn Lane No.5	338852	349724
HR_18	Bryn Lane No.6	338822	349733

4.2 Ambient Air Quality

Monitoring data collected during the COVID-19 pandemic (i.e. 2020/2021) is expected to be atypical and has therefore not been used to characterise the baseline environment.

4.2.1 Local Air Quality Management

The Site is located within the administrative boundary of WCBC. WCBC are part of the North Wales Authorities Collaborative Project (NWACP) which collectively manage and report on air quality throughout the area in fulfilment of the LAQM regime.

WCBC do not have any declared AQMAs. It is noted that the administrative boundary of Cheshire West and Chester Council (CWCC) is located approximately 2.7km east of the Site. CWCC currently have four declared AQMAs, the closest of which is approximately 15km north of the Site. The declared AQMAs within CWCC have therefore not been considered in the assessment.

4.2.2 Air Quality Monitoring

From review of the NWACP 2023 Air Quality Progress Report[12], there were three automatic monitors within WCBC in 2022. The closest is the Victoria Road monitoring station, which is part of the UK's 'Automatic Urban and Rural Network' (AURN).

The Victoria Road monitoring station (UKA00440) is situated approximately 6km west of the Site. Although the station location is classified as an Urban Traffic[13] setting, contrasting with the Industrial[14] setting of the Site, it has been considered due to the absence of Industrial monitoring stations in proximity to the Site.

The UK Air Information Resource (AIR) has been used to obtain 2023 monitored PM_{10} and $PM_{2.5}$ concentrations from the Victoria Road station, which are presented in Table 4-2 and Table 4-3. The recorded PM_{10} and $PM_{2.5}$ concentrations are below the relevant AQALs.

Table 4-2: Automatic PM_{10} Monitoring Results

Monitoring Station	Monitoring Period	Site Classification	Annual Mean PM_{10} Concentration (µg/m^3)	Data Capture (%)
Victoria Road	01/01/2023 - 31/12/2023	Urban Traffic	10.4	99.9

Table 4-3: Automatic $PM_{2.5}$ Monitoring Results

Monitoring Station	Monitoring Period	Site Classification	Annual Mean $PM_{2.5}$ Concentration (µg/m^3)	Data Capture (%)
Victoria Road	01/01/2023 - 31/12/2023	Urban Traffic	6.2	99.9

4.2.3 Defra Modelled Background Concentrations

Background pollutant concentration data on a 1km x 1km spatial resolution is provided by Defra through the UK AIR website and is routinely used to support LAQM and Air Quality Assessments. Background pollutant concentrations for PM_{10} and $PM_{2.5}$ are based upon a 2018 base year and projected to future years[15].

Table 4-4 presents the 2023 Defra background concentrations of PM_{10} and $PM_{2.5}$ for the grid squares which cover the Site. 2023 has been selected as the base year, to match the latest full year where monitoring data is available.

Table 4-4: Defra Predicted Annual Mean Background Concentrations (2023)

Grid Square NGR (m)		PM_{10} (µg/m^3)	$PM_{2.5}$ (µg/m^3)
x	y		
338500	350500	10.9	6.8
338500	351500	10.0	6.3
339500	351500	9.9	6.3

[12] North Wales Authorities Collaborative Project, 2023 Air Quality Progress Report, September 2023.

[13] Sites in an urban area at least 25 metres from the edge of major junctions and no more than 10 metres from the kerbside.

[14] Site in an urban residential area downwind of specific industrial source.

[15] Background mapping data for local authorities – http://uk-air.defra.gov.uk/data/laqm-background-home. November 2023.

Grid Square NGR (m)		PM_{10} (µg/m^3)	$PM_{2.5}$ (µg/m^3)
x	y		
339500	350500	10.3	6.4
338500	349500	11.1	6.7

4.2.4 Baseline Conditions at Human Receptors

The background concentrations at human receptors applied within this assessment have been based on the most conservative values from the data available. The values are presented within Table 4-5.

Table 4-5: Baseline Conditions at Human Receptors

Pollutant	Averaging Period	Concentration (µg/m^3)	Data Source
PM_{10}	Long-term	11.1	Modelled 2023 Defra background concentration, grid square x338500, y349500.
	Short-term	11.1	1x above as per the method outlined within the AERA guidance
$PM_{2.5}$	Long-term	6.8	Modelled 2023 Defra background concentration, grid square x338500, y350500.

4.3 Meteorological Conditions

A windrose, showing the frequency of wind speed and direction used in the assessment is provided in Figure 4-2 below. The windrose shows that winds from the southeast are most frequent with winds from the northeast least frequent.

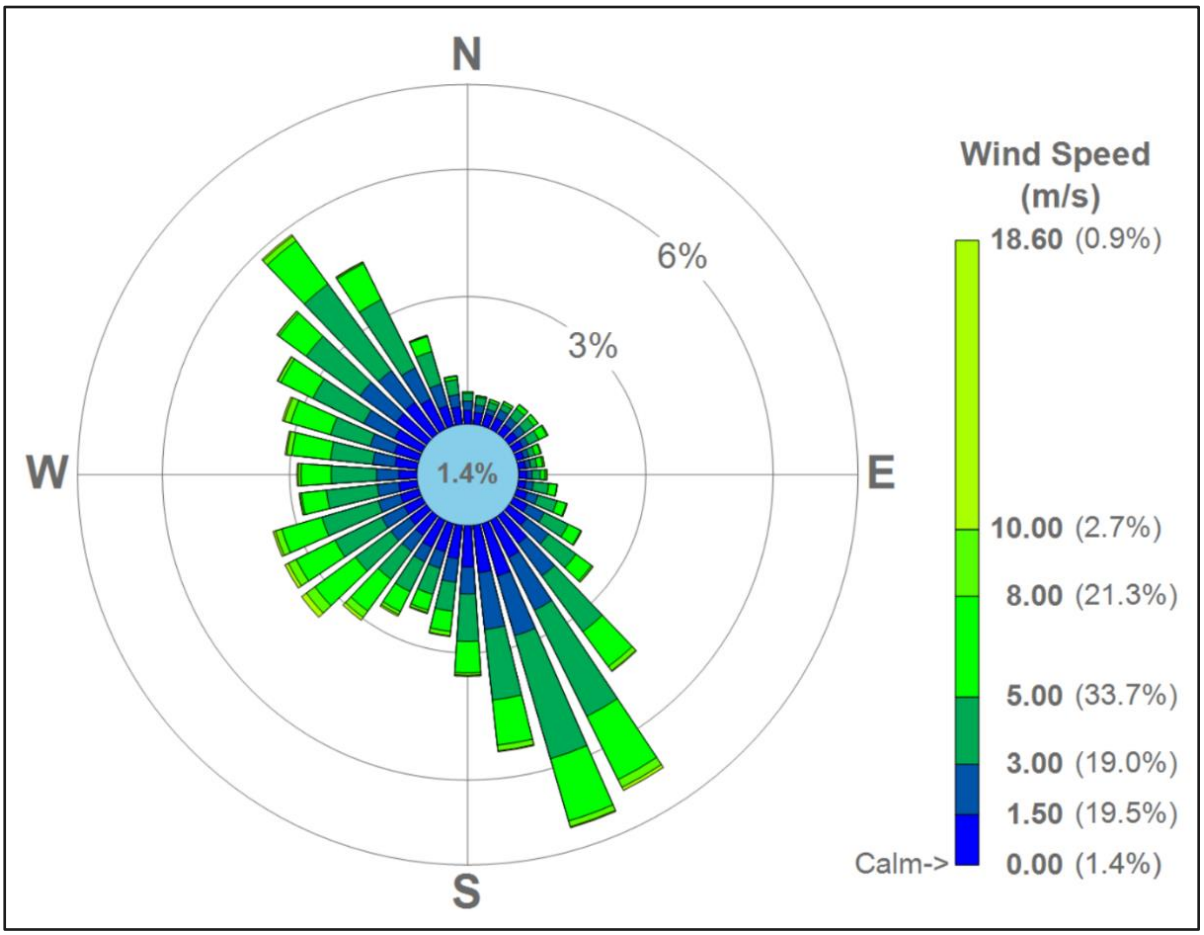


Figure 4-2: Windrose – Hawarden Recording Station (2017-2021)

4.4 Topography

The Sites lies at approximately 38m Above Ordnance Datum (AOD). The immediate surroundings within 1km are relatively flat with more prominent topographical features rising to approximately 75m AOD approximately 4km to the west. The surrounding topography is illustrated in Figure 4-3 below.

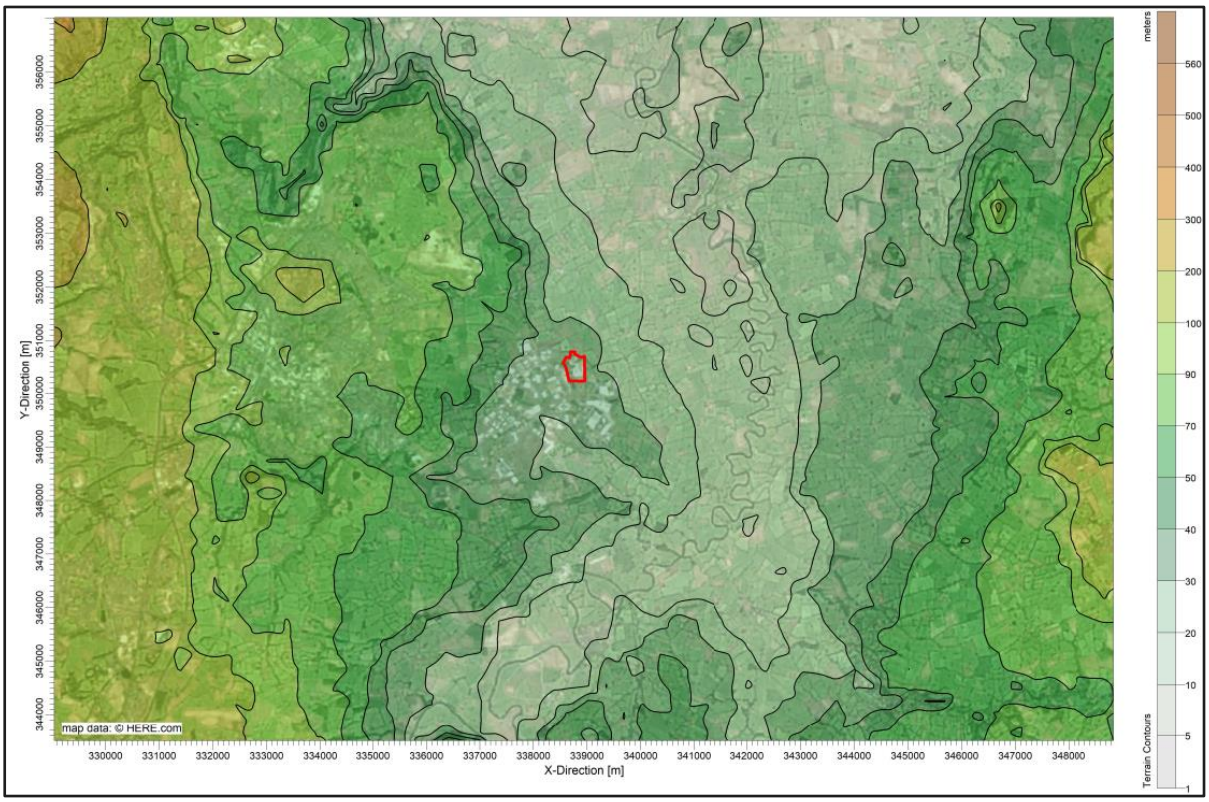


Figure 4-3: Surrounding Topography

5.0 Assessment Results

Within the following sections, the PCs from the three scenarios have been presented:

- **S1** – existing sources being retained only;
- **S2** – proposed sources only; and
- **S3** – all sources (i.e. existing and proposed sources).

Where calculated, the PEC is for all sources i.e. S3.

5.1 Annual Mean PM_{10} Impacts

The maximum predicted annual mean PM_{10} impacts at the modelled receptor locations are summarised in Table 5-1 (an isopleth plot is presented in Appendix A). The AQAL is not exceeded at any of the receptor locations.

Table 5-1: Predicted Annual Mean PM_{10} Impacts

Ref.	PC (µg/m^3)			PC as % of AQAL	PEC (µg/m^3)	PEC as % of AQAL
	S1	S2	S3	S3	S3	S3
HR_1	5.58	4.42	10.00	25.0%	21.10	52.8%
HR_2	6.45	4.21	10.67	26.7%	21.77	54.4%
HR_3	7.61	4.19	11.80	29.5%	22.90	57.3%
HR_4	3.24	1.67	4.88	12.2%	15.98	40.0%
HR_5	0.88	0.47	1.35	3.4%	12.45	31.1%
HR_6	0.94	0.49	1.43	3.6%	12.53	31.3%
HR_7	2.43	1.21	3.63	9.1%	14.73	36.8%
HR_8	1.98	0.93	2.91	7.3%	14.01	35.0%
HR_9	2.05	0.93	2.97	7.4%	14.07	35.2%
HR_10	1.53	0.71	2.24	5.6%	13.34	33.4%
HR_11	1.68	0.77	2.45	6.1%	13.55	33.9%
HR_12	2.15	0.93	3.08	7.7%	14.18	35.5%
HR_13	1.61	0.73	2.33	5.8%	13.43	33.6%
HR_14	1.51	0.72	2.20	5.5%	13.30	33.3%
HR_15	1.46	0.71	2.18	5.4%	13.28	33.2%
HR_16	1.35	0.66	2.01	5.0%	13.11	32.8%
HR_17	0.85	0.48	1.33	3.3%	12.43	31.1%
HR_18	0.80	0.45	1.25	3.1%	12.35	30.9%

5.2 24-hour Mean PM_{10} Impacts

The maximum predicted 24-hour (90.41%iles) mean PM_{10} impacts at the modelled receptor locations are summarised in Table 5-2 (an isopleth plot is presented in Appendix A). The AQAL is not exceeded at any of the receptor locations.

Table 5-2: Predicted 24-hour (90.41%ile) Mean PM_{10} Impacts

Ref.	PC (µg/m³)			PC as % of AQAL	PEC (µg/m³)	PEC as % of AQAL
	S1	S2	S3	S3	S3	S3
HR_1	13.72	10.67	24.47	48.9%	35.57	71.1%
HR_2	16.38	9.94	26.37	52.7%	37.47	74.9%
HR_3	18.40	10.49	28.71	57.4%	39.81	79.6%
HR_4	8.66	4.54	13.28	26.6%	24.38	48.8%
HR_5	3.03	1.49	4.85	9.7%	15.95	31.9%
HR_6	3.12	1.65	4.93	9.9%	16.03	32.1%
HR_7	6.57	3.06	8.94	17.9%	20.04	40.1%
HR_8	6.07	2.79	8.90	17.8%	20.00	40.0%
HR_9	6.45	2.76	8.77	17.5%	19.87	39.7%
HR_10	4.89	2.22	6.82	13.6%	17.92	35.8%
HR_11	5.27	2.34	7.37	14.7%	18.47	36.9%
HR_12	6.40	2.81	9.19	18.4%	20.29	40.6%
HR_13	4.82	2.32	6.85	13.7%	17.95	35.9%
HR_14	4.84	2.29	6.73	13.5%	17.83	35.7%
HR_15	4.66	2.28	6.78	13.6%	17.88	35.8%
HR_16	4.41	2.14	6.45	12.9%	17.55	35.1%
HR_17	3.43	1.55	5.43	10.9%	16.53	33.1%
HR_18	3.14	1.70	5.01	10.0%	16.11	32.2%

5.3 Annual Mean $PM_{2.5}$ Impacts

The maximum predicted annual mean $PM_{2.5}$ impacts at the modelled receptor locations are summarised in Table 5-3 (an isopleth plot is presented in Appendix A). The AQAL is not exceeded at any of the receptor locations.

Table 5-3: Predicted Annual Mean $PM_{2.5}$ Impacts

Ref.	PC (µg/m³)			PC as % of AQAL	PEC (µg/m³)	PEC as % of AQAL
	S1	S2	S3	S3	S3	S3
HR_1	5.58	4.42	10.00	50.0%	16.8	84.0%
HR_2	6.45	4.21	10.67	53.3%	17.5	87.3%
HR_3	7.61	4.19	11.80	59.0%	18.6	93.0%
HR_4	3.24	1.67	4.88	24.4%	11.7	58.4%
HR_5	0.88	0.47	1.35	6.7%	8.1	40.7%
HR_6	0.94	0.49	1.43	7.1%	8.2	41.1%
HR_7	2.43	1.21	3.63	18.2%	10.4	52.2%
HR_8	1.98	0.93	2.91	14.5%	9.7	48.5%
HR_9	2.05	0.93	2.97	14.9%	9.8	48.9%

Ref.	PC (µg/m^3)			PC as % of AQAL	PEC (µg/m^3)	PEC as % of AQAL
	S1	S2	S3	S3	S3	S3
HR_10	1.53	0.71	2.24	11.2%	9.0	45.2%
HR_11	1.68	0.77	2.45	12.2%	9.2	46.2%
HR_12	2.15	0.93	3.08	15.4%	9.9	49.4%
HR_13	1.61	0.73	2.33	11.7%	9.1	45.7%
HR_14	1.51	0.72	2.20	11.0%	9.0	45.0%
HR_15	1.46	0.71	2.18	10.9%	9.0	44.9%
HR_16	1.35	0.66	2.01	10.1%	8.8	44.1%
HR_17	0.85	0.48	1.33	6.6%	8.1	40.6%
HR_18	0.80	0.45	1.25	6.2%	8.0	40.2%

6.0 Summary and Conclusions

This AERA has quantified and assessed the potential air quality impacts associated with the existing and proposed particulate matter sources using NRW approved techniques against published standards for the protection of human health.

The conclusions of the AERA assessment are that the PM_{10} and $PM_{2.5}$ contributions from all sources do not lead to any exceedances of the standards (long-term or short-term) for the protection of human health at any location outside of the Site.

Appendix A Modelling Checklist

Project Aurora

Air Emissions Risk Assessment

Kellogg Company of Great Britain Limited

SLR Project No.: 416.065647.00001

28 October 2024

Table A-1: Modelling Checklist

Item	Yes/No	Details / reason for omission
Location map	Yes	Figure 4-1
Site plan	Yes	Figure 4-1
Pollutants modelled and relevant standards	Yes	Section 2.3
Details of modelled scenarios	Yes	Section 3.1
Details of relevant ambient concentrations	Yes	Section 4.0
Model description and justification	Yes	Section 3.3
Special model treatment used	Yes	Section 3.4.1
Table of emission parameters used	Yes	Table 3-1
Details of modelled domain and receptors	Yes	Section 3.3.1
Details of meteorological data used	Yes	Section 3.3.4
Details of terrain treatment	Yes	Section 3.3.3
Details of building treatment	Yes	Section 3.3.2
Model uncertainty and sensitivity	Yes	Section 3.3.5
Assessment of impacts	Yes	Section 5.0
Contour plots	Yes	Appendix B
Model input files	Yes	Appendix C

Appendix B Contour Plots

Project Aurora

Air Emissions Risk Assessment

Kellogg Company of Great Britain Limited

SLR Project No.: 416.065647.00001

28 October 2024

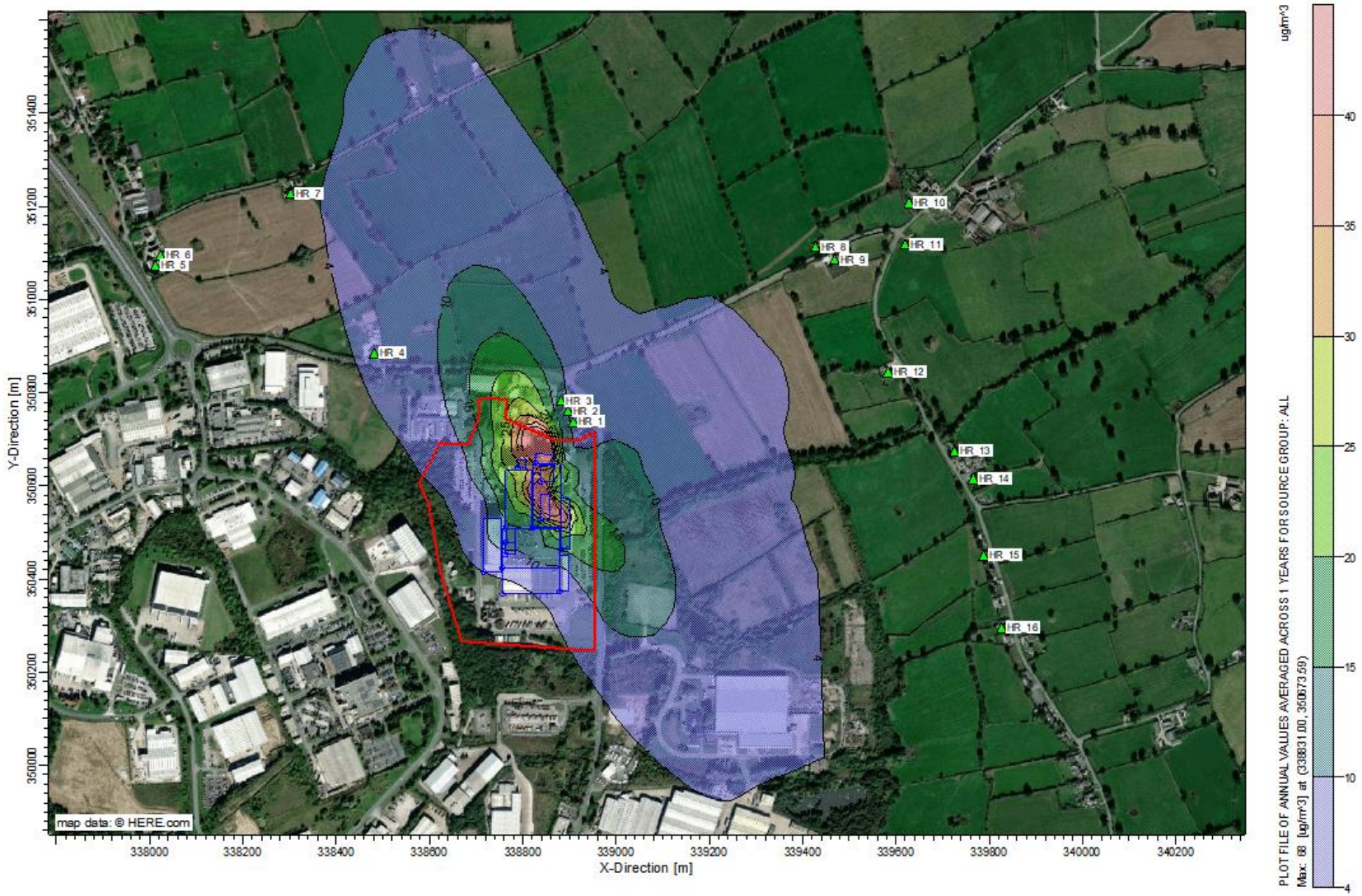


Figure B-1: Annual Mean PM_{10} Process Contribution

Figure B-2: 24-hour Mean (90.41%ile) PM_{10} Process Contribution

Figure B-3: Annual Mean $PM_{2.5}$ Process Contribution

Appendix C Model Input Files

Project Aurora

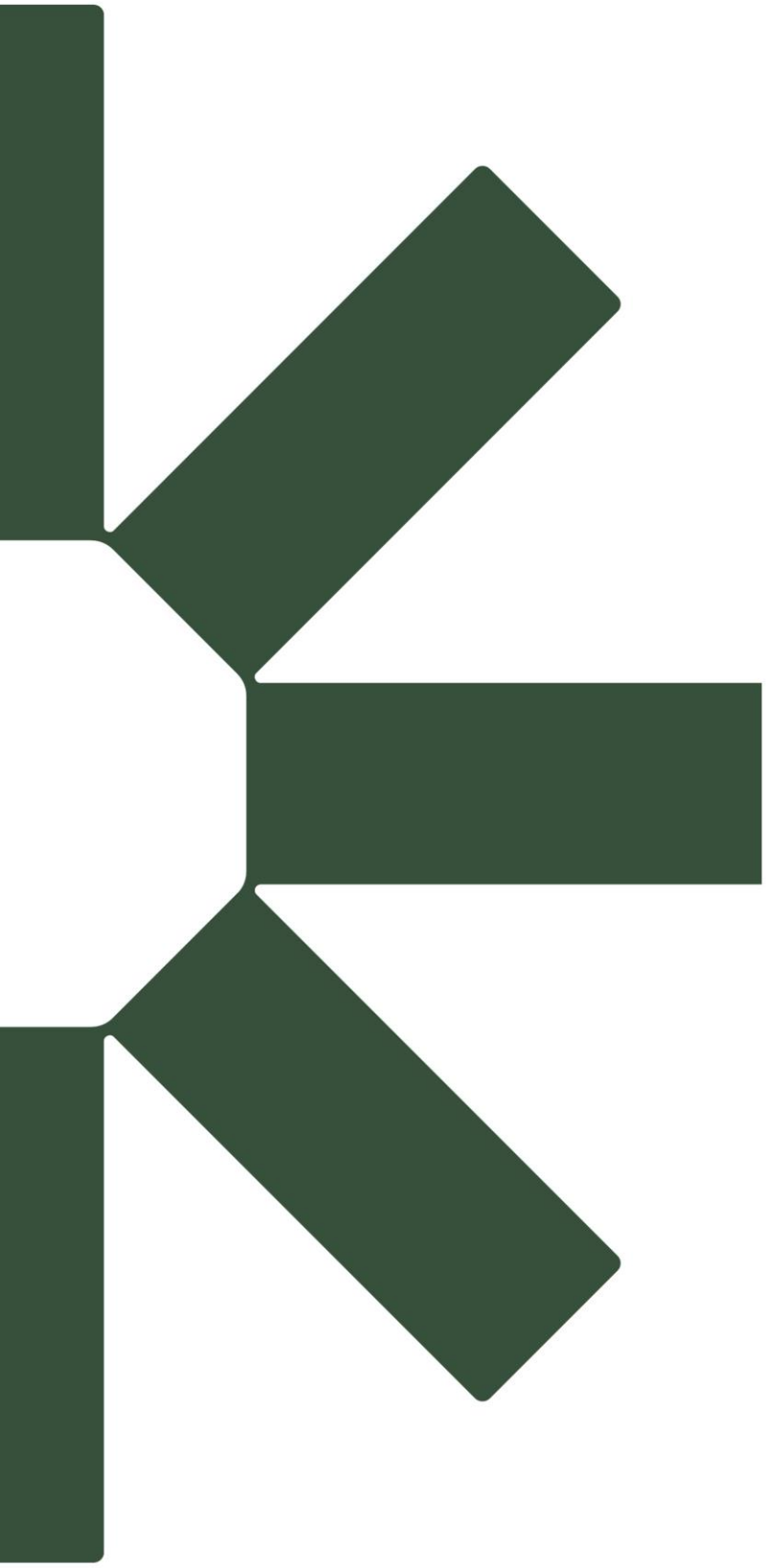
Air Emissions Risk Assessment

Kellogg Company of Great Britain Limited

SLR Project No.: 416.065647.00001

28 October 2024

Provided electronically as compressed (.zip) files



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