Air Quality Impact Assessment

University of Liverpool Energy Centre

Report produced for **University of Liverpool Energy Company Limited**

Provided by Walker Resource Management Ltd (WRM)

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1.0 INTRODUCTION

Walker Resource Management Limited (hereon referred to as 'WRM') were commissioned by the University of Liverpool Energy Company Limited (hereon referred to as 'ULEC') to undertake an Air Quality Impact Assessment for the operation of two Energy Centres that house three natural gas fired boilers and three natural gas fired combined heat and power (CHP) engines. The Energy Centres provide heat and power to nearby University of Liverpool campus buildings and are located at the following address:

University of Liverpool Energy Company Limited
Ashton Street,
Liverpool
L69 7ZX

Site Grid Reference: SJ 35839 90499

The Air Quality Impact Assessment is produced as part of a bespoke Part A installation permit to operate the gas fired boilers and CHP engines. The AQIA clarifies the following details of the development:

- Stack height and impact of buildings on pollutant dispersion; and
- Confirmation of emission pollutants and concentrations from each source.

1.1 Site Location

There are two buildings that make up the site which are located approximately 1km to the east of Liverpool city centre. Access to the site is via Ashton Street which runs in a north-south direction connecting West Derby Street with Brownlow Hill. The facility is situated in a highly urbanised area with hospitals, museums, university buildings and halls of residences surrounding it. Figure 1 indicates the local setting of the site, situated at national grid reference SJ 35839 90499.

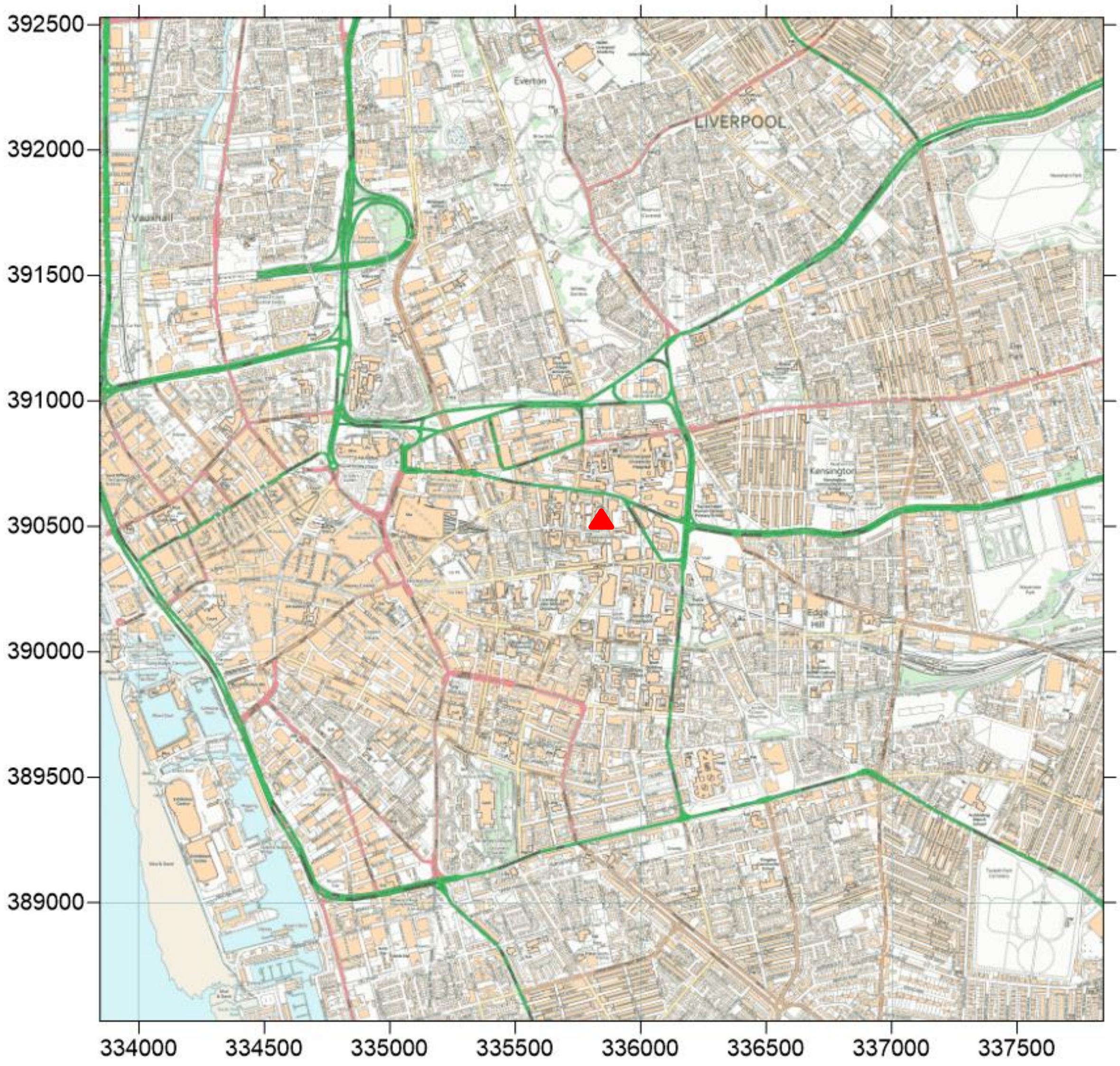

Figure 1 – Site Location on 4km x 4km Georeferenced Base Map

1.2 Proposed Operations

Air quality modelling requires that sources of emissions are defined in terms of dimensions, location and physical characteristics of temperature and velocity. This modelling study has been carried out to assess the potential impact on local air quality due to releases of atmospheric pollutants from the natural gas fed boilers and natural gas fed CHP units.

The CHP and boilers supply heat and electricity to the main campus buildings of the University of Liverpool. The CHP engines produce electricity via the combustion of gas which in turn generates heat as a by-product. This heat will be harnessed and transferred into useable energy for hot water which is then piped across the campus. The operation of the boilers and CHP plant will follow demand to some extent and as such, the CHP plants will be operating at full load in times of high demand e.g. winter and reduced loads in periods of low demand e.g. summer. One of the boilers runs more often than the others, providing additional heat where required. The remaining two boilers are back-up for use in times of plant failure or in the extreme scenario that more heat is demanded than can be provided by the CHP engines and other boiler. Energy Centre 1 (NEC 1) is the most southerly of the two Energy Centres and houses the CHP engine which has a net thermal input rating of 11MW and the three boilers. This Energy Centre is a modern purpose-built building. The CHP engine and boiler plant in this building emit their exhaust gases through individual chimney stacks that are 48m high. Energy Centre 2 (NEC 2) houses the two CHP engines with net thermal input ratings of 4.5MW. This Energy Centre is a former boiler house. Each appliance in this building emits their exhaust gases through individual chimney stacks that are 29m high.

The natural gas which is combusted in the boilers will be piped directly onto site from three gas mains via gas boosters.

1.3 Scoping Assessment

This air quality impact assessment has been prepared by WRM based on a specific design proposed by ULEC.

This assessment considers the impacts of combustion pollutants from the biomass boiler on sensitive receptors adjacent to the proposed development. The main aims are to:

- confirm appropriate assessment criteria for the development;
- quantify the main sources of pollutants;
- consider site specific conditions likely to affect dispersion; and
- assess proposed stack heights taking into consideration downwash effects from buildings.

2.0 REGULATORY SETTING

In order to provide meaningful input parameters to be modelled against a set threshold value, the regulatory background to air quality modelling is provided. The regulatory setting forms the basis for the justification for model input data and the assessment of modelled output data against set values.

2.1 Air Quality Standards

EC Council Directive 96/62/EC on ambient air quality assessment and management (The Air Quality Framework Directive) established a framework through which the European Union will agree limits or target values for air pollutants. The limits within the EC Directive were implemented by The Air Quality Limit Value Regulations. EC Council Directive 2008/50/EC consolidated earlier air quality directives. The Limit Value Regulations set air quality standards for a range of air pollutants. The UK Government has published an Air Quality Strategy[1] which sets out how the Government proposes to fulfil the UK's obligations under the Air Quality Directive. The Air Quality Strategy (AQS) for England, Scotland, Wales and Northern Ireland sets out the policy, targets and objectives for a range of air pollutants.

The Technical Guidance[2] to local authorities for the review and assessment of air quality sets out the methods to be used to determine if the air quality objectives are likely to be achieved. The air quality standards are intended to protect human health and should apply to dwellings and land to which the public has access, irrespective of ownership.

2.2 Air Quality Strategy

The 'Air Quality Strategy for England, Scotland, Wales and Northern Ireland' (AQS) 2007, contains air quality objectives based on the protection of both human health and vegetation (ecosystems). The AQS sets out a framework for reducing hazards to health from air pollution and ensuring that international commitments are met.

These objectives have been set taking into account the Air Quality Standards defined in the Air Quality Standards Regulations 2007 (now superseded by the Air Quality Standards Regulations 2010).

2.3 Air Quality Management

The Environment Act 1995 requires the UK Government and the devolved administrations for Scotland and Wales to produce a national air quality strategy containing standards, objectives and measures for improving ambient air quality and mechanisms to keep these policies under review. In addition, it sets out the responsibilities of local authorities on air quality management.

Part IV of the Environment Act 1995 requires local authorities to periodically review and assess the quality of air within their administrative area. The reviews have to consider the present and future air quality and whether any air quality objectives prescribed in regulations are being achieved or are likely to be achieved in the future.

Where any of the prescribed air quality objectives are not likely to be achieved, the authority concerned must designate an Air Quality Management Area (AQMA). For each AQMA, the local

[1] DEFRA (2007) T*he Air Quality Strategy for England, Scotland, Wales and Northern Ireland Vols 1 & 2*.
[2] DEFRA (2018) Review and Assessment Technical Guidance TG(16).

authority has a duty to draw up an Air Quality Action Plan (AQAP) setting out the measures the authority intends to introduce to deliver improvements in local air quality in pursuit of the air quality objectives.

DEFRA has published technical guidance for use by local authorities in their review and assessment work. This guidance, referred to in this report as LAQM.TG(16), has been used where appropriate in the assessment presented here.

2.4 General Nuisance

Part III of the Environmental Protection Act (EPA) 1990 (as amended by the Noise and Statutory Nuisance Act 1993) contains the main legislation on Statutory Nuisance and allows local authorities and individuals to take action to prevent a statutory nuisance. Section 79 of the EPA defines, amongst other things, smoke, fumes, dust and smells emitted from industrial, trade or business premises so as to be prejudicial to health or a nuisance, as a potential Statutory Nuisance. It also defines accumulation or deposit, which is prejudicial to health as a nuisance.

2.5 Planning Policy Guidance

Policy guidance for local planning authorities regarding local air quality and new development is provided in the National Planning Policy Framework[3] (NPPF) superseding PPS23, which states that the 'existing, and likely future, air quality in the area [of proposed development plans], including any Air Quality Management Areas (AQMA) or other areas where air quality is likely to be poor' should be considered in the preparation of development plan documents and may also be material in the consideration of individual planning applications where pollution considerations arise.

A planning authority must also consider the potential implications of contamination when it is considering applications for planning permission. Specifically, PPS23 states 'Any consideration of the quality of land, air or water and potential impacts arising from development, possibly leading to an impact on health, is capable of being a material planning consideration, in so far as it arises or may arise from any land use'.

The proposed development will not be required to be regulated by the Environment Agency under an Environmental Permit according to the Environmental Permitting (England and Wales) Regulations[4]. The relationship between planning and pollution control is set out in NPPF in which it is stated 'the planning and pollution control systems are separate but complementary. Pollution control is concerned with preventing pollution through the use of measures to prohibit or limit the release of substances to the environment from different sources', whereas 'the planning system should focus on whether the development itself is an acceptable use of the land, and the impacts of those uses, rather than the control of processes or emissions themselves'. Therefore 'planning authorities should work on the assumption that the relevant pollution control regime will be properly applied and enforced. They should act to complement but not seek to duplicate it'.

[3] Department for Communities and Local Government (2012) *National Planning Policy Framework*. 2012.
[4] Environment Agency (2016) *Environmental Permitting (England and Wales) Regulations 2016 (SI 2016 No, 1154)*.

2.6 PPC Guidance

The Environment Agency for England has published Guidance[5] that should be taken into account when determining the level of assessment required for PPC process operations. H1 is general Guidance relating to all process operations that are subject to PPC. H1 provides information about methods for quantifying environmental impacts to soil, water and air. H1 includes a list of Environmental Quality Standards (EQS) and Environmental Assessment Levels (EAL) for air quality.

The air quality criteria used in this assessment are based on the EALs published in H1. This Guidance also sets out benchmarks to assess predicted rates of deposition of pollutants to land.

2.7 Air Quality Objectives

The UK Air Quality Strategy (UKAQS 2007) sets out a framework for the short to medium term, and the roles that Government, the Environment Agency, local government, industry & business, individuals and transport have in protecting and improving air quality.

The UKAQS includes more exacting standards for some pollutants than required by EC legislation. In the majority of cases, standards are carried into the Environmental Permitting regime as short and long term EALs. The Environment Agency's role in relation to Local Air Quality Management is described, with a commitment to ensuring that regulated installations will not contribute significantly to breaches of AQS objectives or EU limit values.

2.8 Sensitive Receptors

Nature conservation sites should be screened against the relevant standards if they occur within specified distance criteria, as detailed below:

- Special Protection Areas (SPAs), Special Areas of Conservation (SACs) or Ramsar sites within 10km of the installation;
- Sites of Special Scientific Interest (SSSIs) within 2 km of the installation; and
- National Nature Reserves (NNRs), Local Nature Reserves (LNRs), local wildlife sites and ancient woodland within 2km of the location of the installation.

According to the Guidance in LAQM-TG(16), air quality objectives should apply to all locations where members of the public may be reasonably likely to be exposed to air pollution for the duration of the relevant objective. Thus, short-term standards such as the 1-hour objective for NO_2 should apply to footpaths at site boundaries and other areas which may be frequented by the public even for a short period of time. Longer term objectives such as the 24-hour or annual mean should apply at houses or other locations which the public can be expected to occupy on a continuous basis. These objectives do not apply to exposure at the workplace. The long-term impacts on human health from exposure to residual process emissions of dioxins, furans and metals are mainly from ingestion, rather than inhalation.

[5] Environment Agency (2011) *Horizontal Guidance Note H1 – Annex f v.2.2*.

3.0 EMISSION INVENTORY AND BASELINE DATA

An emission inventory has been created from technical data for the plant development as outlined in Section 1.2. Information has been provided by ULEC for the build.

3.1 Emission Inventory

WRM has compiled an inventory for the proposed process emissions based on technical data provided by technology providers for the project build. The emission inventory for the process is summarised in Table 1 below. The Energy Centre stacks are assumed to be continuous emission points.

Table 1 – Summary of Emission Source

Location	Source	Frequency	Conditions
NEC 1	CHP 1	Continuous	Elevated Point
	Boiler 1	Continuous	Elevated Point
	Boiler 2	Continuous	Elevated Point
	Boiler 3	Continuous	Elevated Point
NEC 2	CHP 2	Continuous	Elevated Point
	CHP 3	Continuous	Elevated Point

3.2 Background Pollution

Estimates of background pollution have been obtained from the DEFRA sponsored air quality archive[6]. The 2018 updates of the maps were used for NO_2 and PM10, according to DEFRA guidance for new assessments, and incorporate background-based maps for years 2018 to 2030, as such no adjustment factor for year of study was required.

For CO, the reference data for 2001 was applied, then projected forward for 2022 using the DEFRA Year Adjustment Calculator[7]. For SO_2, year adjustment factors are no longer provided because it is considered that SO_2 background levels would change very little, i.e. the factor would be close to one.

The data in Table 2 presents the highest reported estimated background concentration within 2km of the proposed installation, within the study area.

For the purposes of data input to the ADMS model, background units must be converted to ppb. The applied conversion factors for ppb to µg/m^3 is 1.91 (NO_2). The conversion factor from ppm to mg/m^3 for (CO) is 1.16 (please note, the figure for CO needs to be converted to ppb following the initial conversion). A conversion factor was not applied to the PM10 figure as conversion to ppb is not required within the model.

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[6] DEFRA. LAQM data available from http://laqm.defra.gov.uk/?tool=background04.
[7] DEFRA. Adjustment calculator available from http://laqm.defra.gov.uk/tools-monitoring-data/year-adjustment.html

Table 2 – Applied Background Air Quality Concentrations

NO_2		PM10	CO		SO_2	
(µg/m³)	ppb	(µg/m³)	(mg/m³)	ppb	(µg/m³)	ppb
23.98	12.55	14.30	0.52	200.44	32.50	12.22

3.3 Human Receptors

A desk-top study was undertaken in order to identify any sensitive receptor locations in the vicinity of the site that required specific consideration during the assessment. The site is located in an area which is of an urban nature, and the nearest residential property is approximately 230m from the stack emission point of the proposed development. The location of the nearest sensitive receptors and the distances and direction of these receptors from the site are summarised in the table below, and are mapped out in Appendix A.

Table 3 – Human Receptor Locations

Receptor	Distance to Site (m)	Coordinates (x,y)
HR01 – Cedar House	58	335845, 390587
HR02 – Adjacent to centre	38	335847, 390572
HR03 – University of Liverpool Dental School	112	335857, 390641
HR04 – Royal Liverpool and Broadgreen University Hospital	193	335883, 390714
HR05 – Sherrington Building (Lecture Theatres)	65	335880, 390582
HR06 – Clatterbridge Private Hospital	123	335882, 390645
HR07 – Sherrington Building (Medical School)	32	335865, 390535
HR08 – William Duncan Building	131	335956, 390578
HR09 - Sherrington Building (Nuffield Wing)	51	335872, 390499
HR10 - Harold Cohen Library	80	335876, 390459
HR11 - Department of Electrical Engineering and Electronics	150	335885, 390392
HR12 - Ashton Building	107	335836, 390425
HR13 - George Holt Building	67	335840, 390465
HR14 - Victoria Gallery and Museum	150	335855, 390385
HR15 - Johnson Building	70	335815, 390465
HR16 - Victoria Building	84	335790, 390463
HR17 - Harrison Hughes Building	134	335784, 390405

Receptor	Distance to Site (m)	Coordinates (x,y)
HR18 - Thompson Yates Building	115	335746, 390460
HR19 - Waterhouse Building (Block A & F)	25	335814, 390535
HR20 - Waterhouse Building (Block B)	65	335773, 390537
HR21 - Waterhouse Building (Block E)	75	335796, 390587
HR22 - Brownlow Group Practice (Block H)	90	335793, 390608
HR23 - Liverpool University Dental Hospital	122	335808, 390650
HR24 - Duncan Building	204	335816, 390736

3.4 Ecological Receptors

A desk-top study was undertaken in order to identify any ecological receptor locations in the vicinity of the site that required specific consideration during the assessment. In terms of identifying sensitive locations, consideration has been given to sensitive receptors at distances stated within section 2.8.

The location of the sensitive receptors and the distances from the site are summarised in the table below, and are mapped out in Appendix A.

Table 4 – Ecological Receptor Locations

Receptor	Habitat	Distance to Site (m)	Coordinates (x,y)
ER01 – Everton Park and Nature Garden (1)	Wood Pasture and Parkland	668	335697, 391727 (Central grid reference)
ER02 – Everton Park and Nature Garden (2)	Wood Pasture and Parkland	1,548	335223, 392047 (Central grid reference)
ER03 – Mersey Estuary (SPA, Ramsar)	Coastal Saltmarsh	3,856	335631, 387007
ER04 – Mersey Narrows and North Wirral Foreshore (SPA, Ramsar) (1)	Coastal Saltmarsh	3,120	332686, 390584
ER05 – Mersey Narrows and North Wirral Foreshore (SPA, Ramsar) (2)	Coastal Saltmarsh	7,540	331547, 396760
ER06 – Ribble & Alt Estuaries (SPA, Ramsar)	Coastal Saltmarsh	8,192	331121, 397244
ER07 – Dee Estuary (SAC)	Coastal Saltmarsh	5,200	331229, 394285
ER08 – Sefton Coast (SAC)	Coastal Saltmarsh	8,120	331086, 397222

3.5 Critical Loads and Levels

The Air Pollution Information System (APIS[8]) is a support tool for assessment of potential effects of air pollutants on habitats and species developed in partnership by the UK conservation agencies and regulatory agencies and the Centre for Ecology and Hydrology. APIS has been used to provide information on:

- identification of whether the habitats present are sensitive;
- critical levels and current baseline concentrations; and
- critical loads and current N deposition rates.

[8] APIS http://www.apis.ac.uk

4.0 ASSESSMENT METHODOLOGY

The following section outlines the data and model parameters utilised in order to model the emissions from the development at identified sensitive receptors. Identification is provided of data sources, input parameters within the chosen model and acknowledgement of uncertainty inherent with modelling exercises.

4.1 Dispersion Modelling

The transport and transformation of a pollutant in the boundary layer can be predicted with a reasonable degree of confidence using an appropriate mathematical model. The model used for this exercise is ADMS 5.2 which is developed by Cambridge Environmental Research Consultants (CERC) Ltd. ADMS 5 is a short-range dispersion modelling software package that simulates a wide range of buoyant and passive releases to atmosphere. It is a new generation model utilising boundary layer height and Monin-Obukhov length to describe the atmospheric boundary layer and a skewed Gaussian concentration distribution to calculate dispersion under convective conditions. The model utilises meteorological data to define conditions for plume rise, transport and diffusion. It estimates the concentration for each source and receptor combination for each hour of input meteorology and calculates user-selected long-term and short-term averages. The model is routinely used by UK environment agencies.

The principal factors affecting the concentration of a pollutant are:

- source characteristics including source strength, height of discharge, density, and temperature of the release;
- prevailing atmospheric conditions including wind speed, wind direction, cloud cover, precipitation, ambient temperature and the depth of the boundary layer; and
- adjacent buildings, topography and local surface conditions.

These factors can be assigned numerical values and the resultant downwind concentrations of pollutants may be predicted.

4.2 Approach to Model Uncertainty

Uncertainty in dispersion modelling predictions can be associated with a variety of factors, including:

- Model uncertainty - due to model limitations;
- Data uncertainty - due to errors in input data, including emission estimates, land use characteristics and meteorology; and,
- Variability - randomness of measurements used.

Potential uncertainties in model results have been minimised as far as practicable and worst-case inputs used in order to provide a robust assessment. This included the following:

- Choice of model - ADMS 5 is a commonly used atmospheric dispersion model and results have been verified through a number of studies to ensure predictions are as accurate as possible;
- Meteorological data - Modelling was undertaken using three annual meteorological data sets from the closest observation site to the facility, selecting the year in which the worst-case conditions were identified when modelled;

- Operating conditions - Operational parameters were supplied by Myriad and Blackpole Recycling based on proposed design and anticipated operational activities. As such, these are considered to be representative of likely operating conditions;
- Emission rates - Emission rates were derived from process design and are therefore considered to be representative of potential releases during normal operation;
- Receptor locations - Receptor points were included at sensitive locations to provide consideration of impacts on these areas. Emission levels at any point within the assessment extents may be derived from the output model results; and,
- Variability - All model inputs are as accurate as possible and worst-case conditions were considered as necessary in order to ensure a robust assessment of potential pollutant concentrations.

Results were considered in the context of the relevant assessment levels. It is considered that the use of the stated measures to reduce uncertainty and the use of worst-case assumptions when necessary has resulted in model accuracy of an acceptable level.

4.3 Model Parameters

The emission conditions of the identified pollutant sources are based on technical information provided by Myriad. These are summarised in the table below, in accordance with the requirements of H1 and EA Guidelines. There are six combustion processes leading to the emission of pollutants that requires assessment, the CHP and boiler stacks emitting pollutants are identified below for assessment inclusion.

Table 5 – Summary of Modelled Source Conditions

Parameter	CHP1	CHP2	CHP3	Boiler 1	Boiler 2	Boiler 3
Coordinates (x,y)	335827, 390508	335833, 390555	335833, 390553	335827, 390510	335825, 390510	335825, 390508
Exit Diameter (m)	0.796	0.9	0.9	0.85	0.85	0.85
Exit Temperature (°C)	115	115	115	155	155	155
Efflux Velocity (m/s)	18.57	5.94	5.94	7.4	7.4	7.4
Release Height (m)	48	29	29	48	48	48
NO_x Emission Rate (g/s)	0.69	0.28	0.28	0.42	0.42	0.42
SO_2 Emission Rate (g/s)	n/a	n/a	n/a	0.14	0.14	0.14
CO Emission Rate (g/s)	0.92	0.38	0.38	0.42	0.42	0.42
Total Particulate Matter PM10 (g/s)	n/a	n/a	n/a	0.02	0.02	0.02
O2 Emission Content (%)	15	15	15	3	3	3

The assessment considers pollutants based upon the emission limit values in the Industrial Emissions Directive. The stack specific information such as temperature, velocity and oxygen content has been completed using a mixture of data provided by the technology suppliers and where this is absent then calculations for flue gas flow rates based on fuel types[9].

[9] VGB Powertech (2012) *Validated methods for flue gas flow rate calculation with reference to EN 12952-15*

4.3.1 Meteorological Data

Meteorological data used in this assessment was taken from Liverpool John Lennon Airport meteorological station, over the period of January 2019 to December 2021 (inclusive). Liverpool John Lennon Airport meteorological station is located approximately 10km southeast of the proposed development. DEFRA guidance LAQM.TG(16) recommends meteorological stations within 30km of an assessment area as being suitable for detailed modelling. This is the closest meteorological station to the proposed site of development which most represents the land the development is to be situated on. All meteorological data used in the assessment was provided by the Met Office, which is an established distributor of meteorological data within the UK.

The worst-case results vary with the year of hourly sequential meteorological data used to predict dispersion. The worst-case meteorological data for dispersion is for the year 2019and this has been used in all subsequent analysis. Met data for this period is presented as a wind rose in Figure 2 below, with all data in Appendix B.

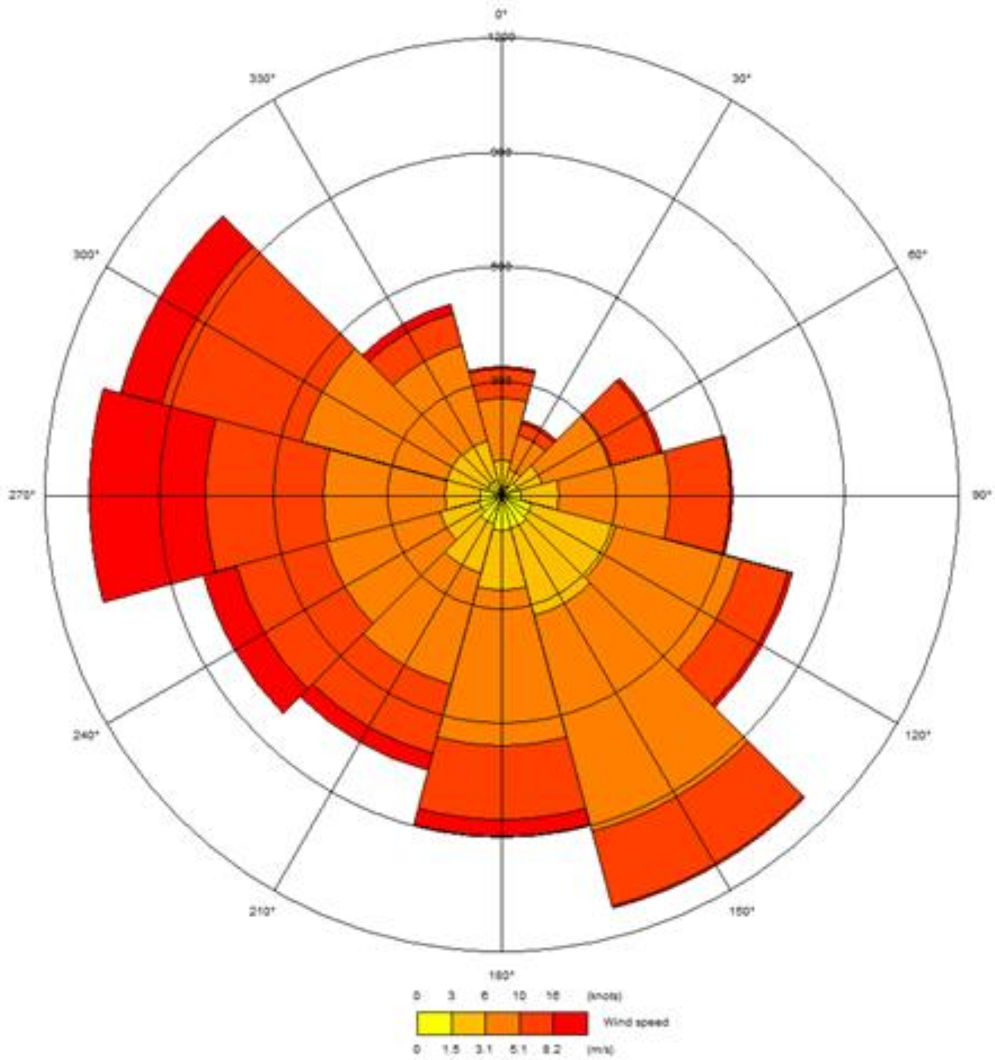


Figure 2 – Wind Rose of Liverpool John Lennon Meteorological Data for 2019

4.3.2 Terrain

The model terrain algorithm should only be used where slopes are >1:10. The proposed site is on level ground where terrain effects are unlikely to affect dispersion and terrain effects have therefore been discounted.

4.3.3 Buildings

The dispersion model used can take account of the effects of recirculating flow or downwash effects caused by buildings near the point of release, although these effects are generally not important where the release is close to the ground. Building effects have been considered for all point source releases. The details of buildings used in the assessment are presented in the table below, and schematically in Figure 3.

Table 6 – Buildings Included within Model Assessment

Building	Coordinates (x,y)	Shape	Height (m)	Length / Radius (m)	Width (m)	Angle (°)
Cedar House	335825, 390605	Rectangular	24	44	33	96
Clatterbridge Hospital	335933, 390650	Rectangular	36	95	55	111
Sherrington Medical School	335876, 390527	Rectangular	20	114	10	175
William Duncan Building	335997, 390532	Rectangular	20	104	36	145
Electrical Engineering	335907, 390380	Rectangular	24	35	22	85
Harold Cohen	335897, 390430	Rectangular	16	57	36	176
Sherrington Nuffield	335908, 390494	Rectangular	24	46	13	86
Sherrington Lecture Theatres	335887, 390584	Rectangular	12	47	35	85
Ashton Building	335849, 390408	Rectangular	16	53	23	175
George Holt	335840, 390451	Rectangular	16	35	40	86
Johnson Building	335812, 390452	Rectangular	16	27	11	175
Thompson Yates	335781, 390442	Rectangular	16	33	53	85
Whelan Building	335746, 390436	Rectangular	16	48	31	175
Waterhouse Block A-F	335807, 390532	Rectangular	8	94	13	184
Waterhouse Block B	335765, 390524	Rectangular	12	60	13	184

Building	Coordinates (x,y)	Shape	Height (m)	Length / Radius (m)	Width (m)	Angle (º)
Brownlow Practice	335770, 390622	Rectangular	20	48	16	97
Waterhouse Block E	335762, 390583	Rectangular	12	45	18	96
Dental Hospital	335803, 390666	Rectangular	24	86	33	96
NEC1	335836, 390509	Rectangular	11	35	14	185
NEC2	335841, 390551	Rectangular	15	18	9	185

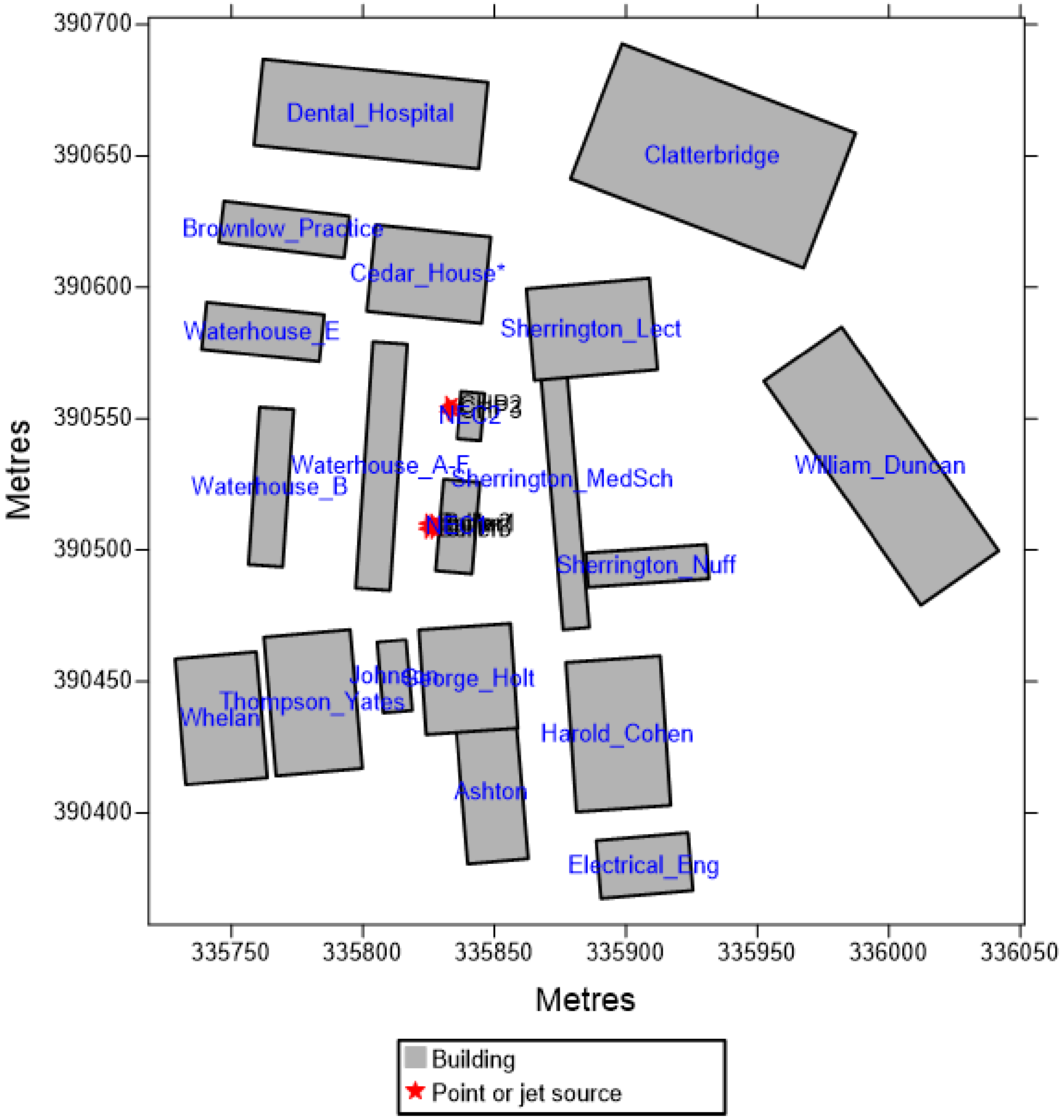


Figure 3 – Building and Point Sources Layout

Note on Building Height
As the existing buildings possess sloped roofs the model cannot accurately work with these dimensions. As this is the case, the height of building Unit A has been set at the height of where the boiler stack exits the associated roof.

4.4 Special Treatment of Model Results

Nitric Oxide to NO2 Conversion
NO_x emitted to atmosphere as a result of combustion will consist largely of nitric oxide (NO), a relatively innocuous substance. Once released into the atmosphere, NO is oxidised to NO_2. The proportion of NO converted to NO_2 depends on a number of factors including wind speed, distance from the source, solar radiation and the availability of oxidants, such as ozone (O_3).

Following the EA Air Quality Modelling and Assessment Unit (AQMAU) guidance on conversion ratio for NO_x and NO_2, a worst-case scenario has been applied in that 35% of NO_x is presented as NO_2 in relation to short-term impacts and 70% of NO_x is present as NO_2 in relation to long-term impacts.

Averaging Periods
Where the short-term environmental standard is measured using a time period other than hourly, conversion factors are applied to model results to present the correct concentrations. Hourly concentrations are therefore multiplied by the appropriate factor identified below:

- 1.34 to convert to a 15-minute average
- 0.7 to convert to an 8-hour average
- 0.59 to convert to a 24-hour average

4.5 Human Receptor Assessment

The Environment Agency publishes a list of pollutants to include within an assessment where released at source. The H1 document includes a list of Environmental Quality Standards (EQS) and Environmental Assessment Levels (EAL) for air quality. The air quality criteria used in this assessment are based on the EALs published in H1. This Guidance also sets out benchmarks to assess predicted rates of deposition of pollutants to land. The environmental assessment levels for human receptors are provided in the table below for the appropriate averaging period and pollutants.

Table 7 – Human Receptor Environment Assessment Levels (EAL)

Pollutant	Averaging Period	EAL (µg/m^3)
Nitrogen Dioxide	1-hour mean ≤18 exceedances	200
	Annual mean	40
Particulates PM10	24-hour mean ≤35 exceedances	50
	Annual mean	40
Carbon Monoxide	Maximum daily running 8-hour mean	10,000
Sulphur Dioxide	15-min mean ≤35 exceedances	266

Pollutant	Averaging Period	EAL (µg/m^3)
	1-hour mean ≤24 exceedances	350
	24-hour mean ≤3 exceedances	125

4.6 Ecological Receptor Assessment

The EA's Operational Instruction details how the air quality impacts on ecological sites should be assessed. This guidance provides risk-based screening criteria to determine whether impacts will:

- have a likely significant effect on a European site;
- be an operation likely to damage (OLD) a Site of Special Scientific Interest (SSSI); or
- result in significant pollution of a National Nature Reserve (NNR), Local Nature Reserve (LNR), Local Wildlife Site (LWS) or ancient woodland (AWL).

The environmental assessment levels for ecological receptors is provided in the table below for the appropriate averaging period and pollutants.

Table 8 - Ecological Receptor Environment Assessment Levels (EAL)

Pollutant	Averaging Period	EAL (µg/m^3)
Nitrogen Oxide (as NO_2)	Annual mean	30
Nitrogen Oxide (as NO_2)	Daily mean	75

4.7 Critical Load Assessment

Designated habitats may contain species, habitats or other receptors which are potentially sensitive to atmospheric pollution for which indicative exposure thresholds for their protection have been defined. These thresholds are known as Critical Levels (for airborne concentrations) and Critical Loads (for deposition rates).

Critical levels are a quantitative estimate of exposure to one or more airborne pollutants in gaseous form, below which significant harmful effects on sensitive elements of the environment do not occur, according to present knowledge. Critical levels for the protection of vegetation and ecosystems are specified within the Air Quality Standards Regulations.

Critical loads are a quantitative estimate of exposure to deposition of one or more pollutants, below which significant harmful effects on sensitive elements of the environment do not occur, according to present knowledge. Critical loads are set for the deposition of various substances to sensitive ecosystems.

Empirical critical loads for eutrophication (derived from a range of experimental studies) are assigned based for different habitats, including grassland ecosystems, mire, bog and fen habitats, freshwaters, heathland ecosystems, coastal and marine habitats, and forest habitats and can be obtained from the UK Air Pollution Information System (APIS).

4.7.1 *Deposition Rates*

Deposition rates for the process contribution (PC), were calculated using empirical methods recommended by the EA (AQTAG06)[10]. If the annual average ground level concentration of a pollutant is Pc (μg/m^3) and the dry deposition velocity for that pollutant is Vd (m/s) then the annual dry deposition rate Dr (kg/ha/yr) is calculated from the following formula:

$$D_r = Vd \times Pc \times Mf \times Cf$$

Where:
Mf = 14/46 for NO_2
32/64 for SO_2
1/17 for NH_3
1/35 for HCl

and converts from nitrogen dioxide to nitrogen, sulphur dioxide to sulphur and hydrogen chloride to hydrogen.

Cf = the conversion factor value (315.36) which converts to kg/ha/yr.

Dry deposition velocities vary depending on the type of land mass and weather conditions such as humidity. The following values have been used for Vd, as presented within the Technical Guidance note.

- NO_2 – 0.0015 m/s
- SO_2 – 0.012 m/s
- NH_3 – 0.02 m/s
- HCl – 0.025 m/s

In order to calculate acid deposition in terms of k_{eq}/ha/yr from deposition data (calculated using the equation above) in terms of kg/ha/yr the following conversion factors are used:

- Nitrogen derived acid deposition: 1kg N/ha/yr is equal to 1/14 keq N/ha/yr
- Sulphur derived acid deposition: 1 kg S/ha/yr is equal to 1/16 keq S/ha/yr

4.8 Significance of Impact

This air quality impact assessment (AQIA) will provide quantitative predictions for a range of pollutants and to help assess their significance. The structure for assessing the significance of air quality impacts is set out in the table below.

Table 9 – Assessment Matrix for Determination of Significance

Predicted Impact	Significance	Justification
Process Contribution + baseline greater than EAL	Major	Exceeding any air quality limit value would be unacceptable in terms of human health, or where the impact would have significant ecological impacts.

[10] Environment Agency AQTAG06 *Technical guidance on detailed modelling approach for an appropriate assessment for emissions to air Status*: Updated version, (Approved March 2014).

Predicted Impact	Significance	Justification
Process Contribution + baseline <100% of EAL	Moderate	Risk based approach advocated by Environment Agency taking account of model headroom and uncertainty. May not be acceptable for sensitive ecological and human receptors.
Process Contribution + baseline <70% of EAL	Minor	Risk based approach advocated by Environment Agency taking account of model headroom and uncertainty.
Process Contribution <10% of EAL	Negligible	Adopted risk-based approach taking into account the factor of 10.
Process Contribution <1% of EAL	Insignificant	The assessment criteria proposed within H1 screening tool which states that process contributions can be considered insignificant if the long-term process contribution is <1% of the long-term environmental standard.

5.0 SENSITIVITY ANALYSIS

This section presents the potential air quality impacts associated with the operational phase of the proposed development, the mitigation measures that will be employed and any residual impacts. Appendix C and D summarise the findings of the potential emissions and the scale and extent of potential impacts. Aspects of the assessment are discussed in more detail below.

It is a requirement of the Royal Meteorological Society Guidelines on Dispersion Modelling[11] and a subsequent review[12] that dispersion modelling studies should include a sensitivity analysis for model inputs, to provide an estimate of the possible errors in the predictions. The potential errors in predictions were outlined in Section 4. The sensitivity analysis conducted for this study considers the likely variability and errors arising from meteorological data, surface roughness and stack heights.

The Environment Agency's method for assessing model uncertainty[13] indicates that the confidence in the model is low. However, the approach to assessment is the method normally accepted by DEFRA, the EA and other regulatory bodies. The main causes of model uncertainties are:

- potential combination of the effects of terrain and buildings on dispersion;
- uncertainties in source estimates for diffuse releases; and
- the low model headroom.

Despite these uncertainties, the modelling provides a useful comparison between the likely impact for the baseline and as proposed Scenarios.

5.1.1 Meteorological Variability

Initially, the model predictions consider the variability of emissions around the site for a range of years (Liverpool John Lennon met station 2019–2021 inclusive). This sensitivity analysis considers the predicted NO_2 for the proposed release conditions. This indicates that for the proposed release conditions, the worst case NO_2 results are displayed in 2019. The worst-case factor taken into account in the assessment is identified in the table below.

Table 10 – PEC NO_2 (Annual Mean) Predictions with Met Data Year Adjustments

Met Data Year	2019	2020	2021
NO_2 (µg/m^3)	28.67	28.50	28.51

5.1.2 Surface Roughness

The land around the site consists of built-up urban areas. The model runs were initially conducted assuming a surface roughness of 1.5m typically associated with large urban areas.

[11] Royal Meteorological Society (1995) *Atmospheric Dispersion Modelling Guidelines on the justification of choice and use of models and the communication and reporting of results.*
[12] Atmospheric Dispersion Modelling Liaison Committee (2004) *Guidelines for the Preparation of Dispersion Modelling Assessments for Compliance with Regulatory Requirements – an Update to the 1995 Royal Meteorological Society Guidance.*
[13] Ji Ping Shi and Betty Ng (2004) *Risk based pragmatic approach to address model uncertainty. Air Quality Modelling and Assessment Unit.* Environment Agency: Cardiff.

The dispersion model has been run using surface roughness values of 0.2m, 0.3m, 0.5m, 1.0m and 1.5m across the domain. These are likely to represent the credible range of worst-case dispersion factors within the study area. The worst case predicted impact occurs at the most affected dwellings when a surface roughness value of 1.5m is assumed (see Table 11 below). This has therefore been adopted throughout to represent worst case scenario modelling.

Table 11 – PEC NO_2 (Annual Mean) Predictions with Surface Roughness Adjustments

Surface Roughness	0.2m	0.3m	0.5m	1.0m	1.5m
NO_2 (µg/m^3)	27.09	27.36	27.75	28.34	28.67

5.1.3 Release Height

The model sensitivity analysis has so far considered the likely impact from the CHP and boiler stack heights (48m in NEC1 and 29m in NEC2). Further analysis is undertaken to determine whether increasing the stack heights of the boilers will significantly improve dispersion.

The effect of increased stack height has been considered for all emissions of NO2 for a range of stack heights between 48m & 29m and 52m & 33m at 1m intervals. Stack heights of 48mm & 29m has been chosen as it provides the most conservative estimate. The results are summarised in Table 12 below.

Table 12 – PEC NO_2 (Annual Mean) Predictions with Amended Stack Heights

Release Heights	48m & 29m	49m & 30m	50m & 31m	51m & 32m	52m & 33m
NO_2 (µg/m^3)	28.67	28.37	28.10	27.84	27.60

6.0 IMPACT ASSESSMENT

This section presents the potential air quality impacts associated with the operational phase of the proposed development, the mitigation measures that will be employed and any residual impacts. Appendix C and D summarise the findings of the potential emissions and the scale and extent of potential impacts. Aspects of the assessment are discussed in more detail below.

6.1 Applied Scenarios

The predicted contours for airborne pollutants are plotted in Appendix C. The predicted concentrations at sensitive receptors are included within Appendix D and summarised in section 6.2. These predictions are based on the worst-case dispersion conditions for surface roughness (1.5m), meteorology (2019), building effects and at the proposed stack height (48m & 29m).

The criteria used to assess the significance of these predictions were presented earlier in Section 4.8. The significance of these predicted concentrations and deposits is summarised in Section 6.2, where the predicted value is expressed as a percentage of the EAL.

6.2 Impact Assessment at Human Receptors

The worst-case air quality impacts are summarised in the following sections for each pollutant and averaging period. The Process Contributions (PCs) and Predicted Environmental Concentrations (PECs) predicted at each sensitive receptor are itemised in Appendix E.

6.2.1 Long Term NO_2

Predicted annual mean maximum NO_2 PCs and PECs are presented within Table 13. Reference should be made to Appendix C for an illustration of the long-term (annual mean) NO_2 contour plot.

Table 13 – Predicted Max Annual Mean NO_2 Concentrations

	CHPs & Boiler				
Emission	EAL (µg/m^3)	PC (µg/m^3)	PC% EAL	PEC (µg/m^3)	PEC% EAL
Annual Mean NO_2	40	3.18	7.95	27.31	68.28
Significance	Negligible (PC<10% EAL)				

6.2.2 Short Term NO_2

Predicted 1-hr mean NO_2 maximum PCs and PECs are presented within Table 14. Reference should be made to Appendix C for an illustration of the short-term (1hr mean) NO_2 contour plot.

Table 14 - Max Predicted NO_2 Short Term Concentrations

	CHPs & Boilers				
Emission	**EAL (µg/m^3)**	**PC (µg/m^3)**	**PC% EAL**	**PEC (µg/m^3)**	**PEC% EAL**
1hr NO_2	200	18.19	9.10	26.63	13.32
Significance	Negligible (PC<10% EAL)				

6.2.3 Long Term PM10

Predicted annual mean maximum PM10 PCs and PECs are presented within Table 15. Reference should be made to Appendix C for an illustration of the long-term (annual mean) PM10 contour plot.

Table 15 – Predicted Max Annual Mean PM10 Concentrations

	CHPs and Boilers				
Emission	**EAL (µg/m^3)**	**PC (µg/m^3)**	**PC% EAL**	**PEC (µg/m^3)**	**PEC% EAL**
Annual Mean PM10	40	0.05	0.13	14.35	35.8
Significance	Insignificant (PC<1% EAL)				

6.2.4 Short Term PM 10

Predicted 24-hr mean PM10 maximum PCs and PECs are presented within Table 16. Reference should be made to Appendix C for an illustration of the short-term (24hr mean) PM10 contour plot.

Table 16 – Max Predicted PM10 Short Term Concentrations

	CHPs and Boilers				
Emission	**EAL (µg/m^3)**	**PC (µg/m^3)**	**PC% EAL**	**PEC (µg/m^3)**	**PEC% EAL**
24hr PM10	50	0.82	1.64	9.26	18.52
Significance	Negligible (PC<10% EAL)				

6.2.5 Short Term SO2

Predicted short term SO_2 maximum PCs and PECs are presented within Table 18. Reference should be made to Appendix C for an illustration of the short-term SO_2 contour plot.

Table 18 – Max Predicted SO2 Short Term Concentrations

	CHPs and Boilers				
Emission	EAL (µg/m3)	PC (µg/m^3)	PC% EAL	PEC (µg/m^3)	PEC% EAL
1hr SO_2	350	9.76	2.79	42.76	12.22
24hr SO_2	125	5.76	4.61	25.23	20.18
15min SO_2	266	13.07	4.91	57.29	21.54
Significance	Negligible (PC <10% of EAL)				

6.2.6 Short Term CO

Predicted 8-hr mean CO maximum PCs and PECs are presented within Table 19. Reference should be made to Appendix C for an illustration of the short-term (8hr mean) CO contour plot.

Table 19 – Max Predicted CO Short Term Concentrations

	CHPs and Boilers				
Emission	EAL (µg/m^3)	PC (µg/m^3)	PC% EAL	PEC (µg/m^3)	PEC% EAL
8hr CO	10,000	42.00	0.42	205.14	2.05
Significance	Insignificant (PC<1% EAL)				

6.2.7 Exceedance Analysis

In addition to UK Air Quality Strategy (AQS) objectives, the modelled pollutant emissions are also considered in context of Ambient Air Directive (AAD) Limit Values for the number of exceedances permitted within a given emission period. The results of this assessment are identified in Table 20 for the emissions resultant from the proposed development. The results identify that no exceedances for any pollutant are modelled under the worst-case exposure scenario.

Table 20 – Summary of Modelled Emission Period Exceedances

Pollutant	Emission Period	Limit	Permitted Exceedances	Modelled Exceedances
NO_2	1hr	200 µg/m^3	≤18	0
NO_2	Annual	40 µg/m^3	0	0
PM10	24hr	50 µg/m3	≤35	0
PM10	Annual	40 µg/m3	0	0
SO_2	15mins	266 µg/m^3	≤35	0
SO_2	1hr	350 µg/m^3	≤24	0
SO_2	24hr	125 µg/m^3	≤3	0

CO	8hr Average in 24hrs	10,000 µg/m³	0	0

6.2.8 Impact Assessment at Ecological Receptors

Modelling of impacts at ecological receptors has been undertaken for the proposed site, to determine impacts on critical loads and critical levels, as presented within the following subsections.

6.2.9 Annual Mean NO_2

Predicted annual mean maximum nitrogen oxide as NO_2 PCs and PECs are presented within Table 21 for each sensitive habitat.

Table 21 - Annual Mean NO_2 Concentrations

	CHPs and Boilers					
Receptor	**EAL (µg/m³)**	**PC (µg/m³)**	**PC% EAL**	**PEC (µg/m³)**	**PEC% EAL**	**Significance**
ER01	30	0.37	1.24	24.51	81.70	Negligible (PC <10% of EAL)
ER02	30	0.27	0.91	24.41	81.37	Insignificant (PC<1% EAL)
ER03	30	0.02	0.07	24.16	80.52	Insignificant (PC<1% EAL)
ER04	30	0.05	0.17	24.19	80.62	Insignificant (PC<1% EAL)
ER05	30	0.03	0.09	24.16	80.54	Insignificant (PC<1% EAL)
ER06	30	0.02	0.08	24.16	80.53	Insignificant (PC<1% EAL)
ER07	30	0.03	0.10	24.17	80.56	Insignificant (PC<1% EAL)
ER08	30	0.02	0.08	24.16	80.53	Insignificant (PC<1% EAL)

6.2.10 Daily Mean NO_2

Predicted daily mean maximum nitrogen oxide as NO_2 PCs and PECs are presented within Table 22 for each sensitive habitat.

Table 22 - Daily Mean NO_2 Concentrations

	CHPs and Boilers					
Receptor	**EAL (µg/m³)**	**PC (µg/m³)**	**PC% EAL**	**PEC (µg/m³)**	**PEC% EAL**	**Significance**
ER01	75	1.78	2.38	6.77	9.02	Negligible (PC <10% of EAL)
ER02	75	1.40	1.86	6.38	8.51	Negligible (PC <10% of EAL)
ER03	75	0.53	0.71	5.51	7.35	Insignificant (PC<1% EAL)
ER04	75	0.79	1.05	5.77	7.70	Negligible (PC <10% of EAL)

	CHPs and Boilers					
Receptor	EAL (µg/m^3)	PC (µg/m^3)	PC% EAL	PEC (µg/m^3)	PEC% EAL	Significance
ER05	75	0.44	0.59	5.43	7.24	Negligible (PC<10% EAL)
ER06	75	0.42	0.56	5.40	7.20	Insignificant (PC<1% EAL)
ER07	75	0.42	0.55	5.40	7.20	Insignificant (PC<1% EAL)
ER08	75	0.43	0.57	5.41	7.21	Insignificant (PC<1% EAL)

6.2.11 Critical Loads

The process contribution to critical loads for nitrogen deposition and acid deposition are presented in Table 23 below with critical load values.

Table 23 – Critical Load Evaluation

Habitat	Nutrient Nitrogen (kg/ha/yr)			Acid Deposition (k_{eq}/ha/yr)		
	Critical Load	PC	PC as % CL	Critical Load	PC	PC as % CL
ER01	10	0.054	0.54	3.2	0.01	0.9
ER02	10	0.039	0.39	3.2	0.0081	<0.01
ER03	20	0.003	0.02	2.09	0.0006	<0.01
ER04	3	0.0072	0.04	2.09	0.0015	<0.01
ER05	3	0.0039	0.02	2.09	0.0008	<0.01
ER06	3	0.0035	0.02	2.09	0.0007	<0.01
ER07	10	0.0045	0.02	2.09	0.0009	<0.01
ER08	3	0.0034	0.02	2.09	0.0007	<0.01

The predicted deposition at the ecologically sensitive habitats within the scope of this study are likely to be insignificant for both acid and nitrogen deposition when compared to critical loads (less than 100% of the critical load).

6.3 Assessment Summary

This assessment indicates that air emissions from the biomass boilers are likely to range from insignificant to minor for all emission sources at both long and short-term exposure scenarios. The assessment includes both human and ecological receptors. Analysis has taken account of the downwash effect of buildings and stack heights.

The short and long-term assessment of the significance of impact from the biomass boiler is summarised in the table below.

Table 24 – Summary of the Assessment of Significance

Receptor Type	Assessment Scenario	Emission	Predicted Significance of Impact
Human	Long Term	NO_2	Negligible (PC<10% EAL)
		PM10	Insignificant (PC<1% EAL)
	Short Term	NO_2	Negligible (PC<10% EAL)
		PM10	Negligible (PC<10% EAL)
		SO_2	Negligible (PC<10% EAL)
		CO	Insignificant (PC<1% EAL)
Environmental	Long Term	See above	
	Short Term		

7.0 PROPOSED MITIGATION MEASURES

The following measures are proposed to prevent or minimise impacts on air pollution:

- The combustion pollutants from the site shall be compliant with the emissions limit values stated in the Industrial Emissions Directive.
- Monitoring in line with permit shall be conducted by independent testing agencies.
- Supervisory staff shall be trained to ensure that the works are operated within specification.
- All process operations shall be subject to routine planned preventative maintenance.

8.0 CONCLUSIONS

The following conclusions are drawn from the modelled output data and justification for model approach discussed throughout.

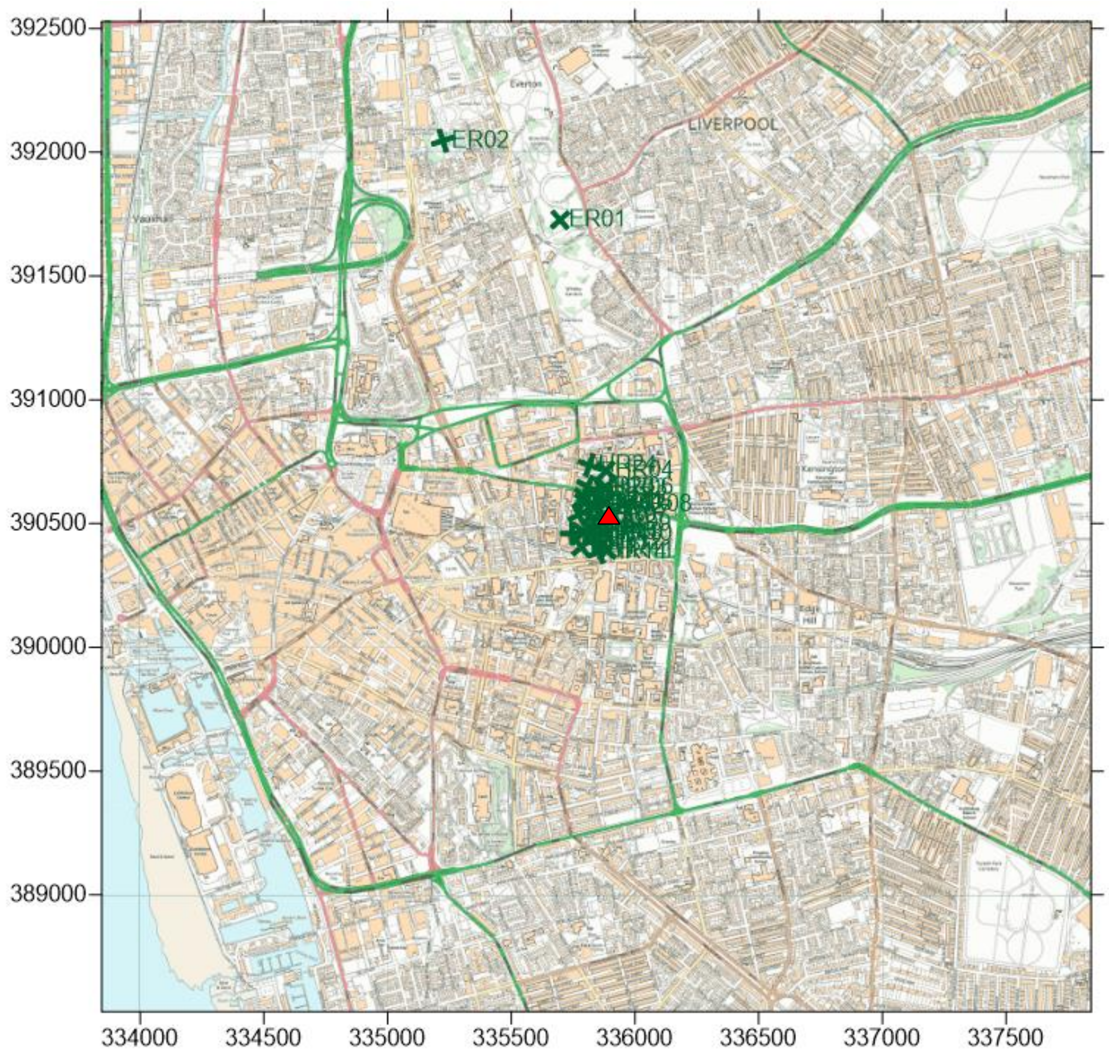
8.1 Human Exposure

- Baseline air quality around the proposed biomass boilers is within European Limit Values and UK objectives.
- The overall confidence in the model predictions is medium. A detailed model sensitivity analysis has been conducted to improve the robustness of the predictions.
- The assessment takes account of the worst-case model predictions, the relevant Environmental Assessment Level (EAL) and the significance criteria as detailed.
- Exposure to the annual mean NO_2 is likely to be **negligible.**
- Exposure to the annual mean PM10 is likely to be **negligible.**
- Short-term exposure to NO_2, PM10, CO and SO_2, is predicted to range from **insignificant to negligible**.
- The emissions from the proposed CHPs and Boilers are unlikely to result in any air quality objective or limit value being exceeded.

8.2 Ecological Exposure

- The critical loads at designated sites within vicinity of the biomass boilers are likely to be **insignificant** for both acid and nitrogen deposition.

APPENDIX A – SENSITIVE RECEPTORS LOCATION MAP



HR RECEPTORS MAP

✚	Sensitive Receptors
▲	Site Location

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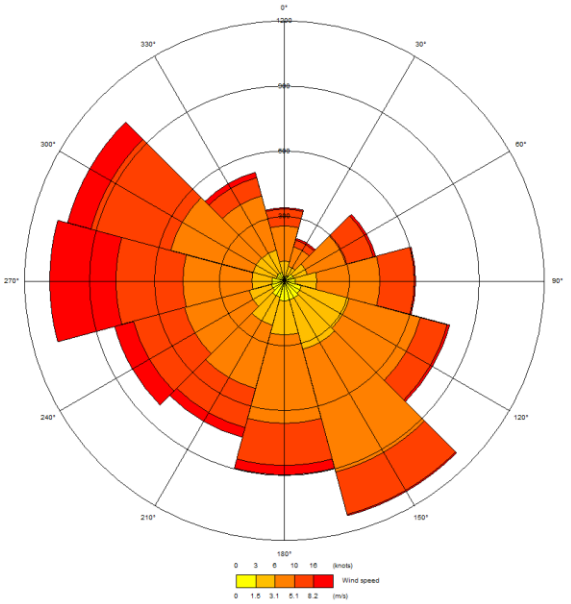
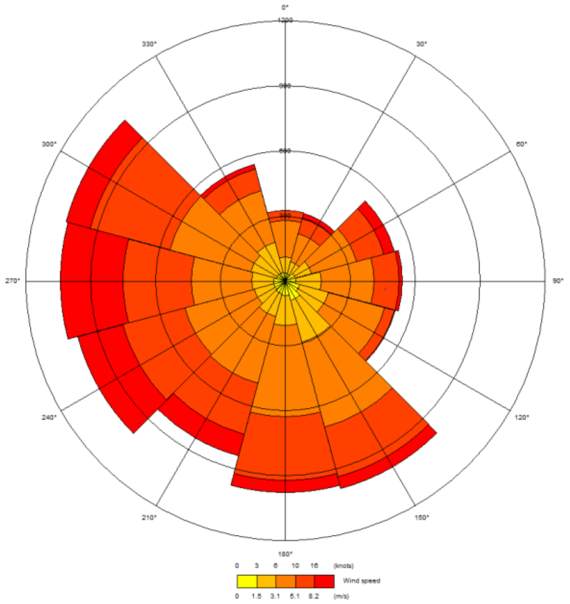
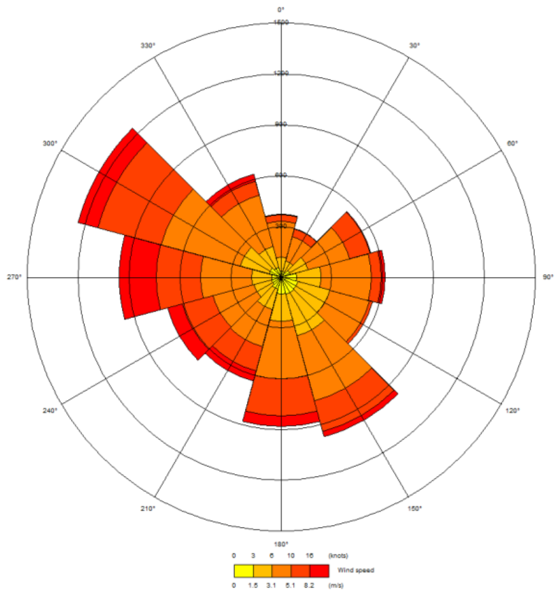
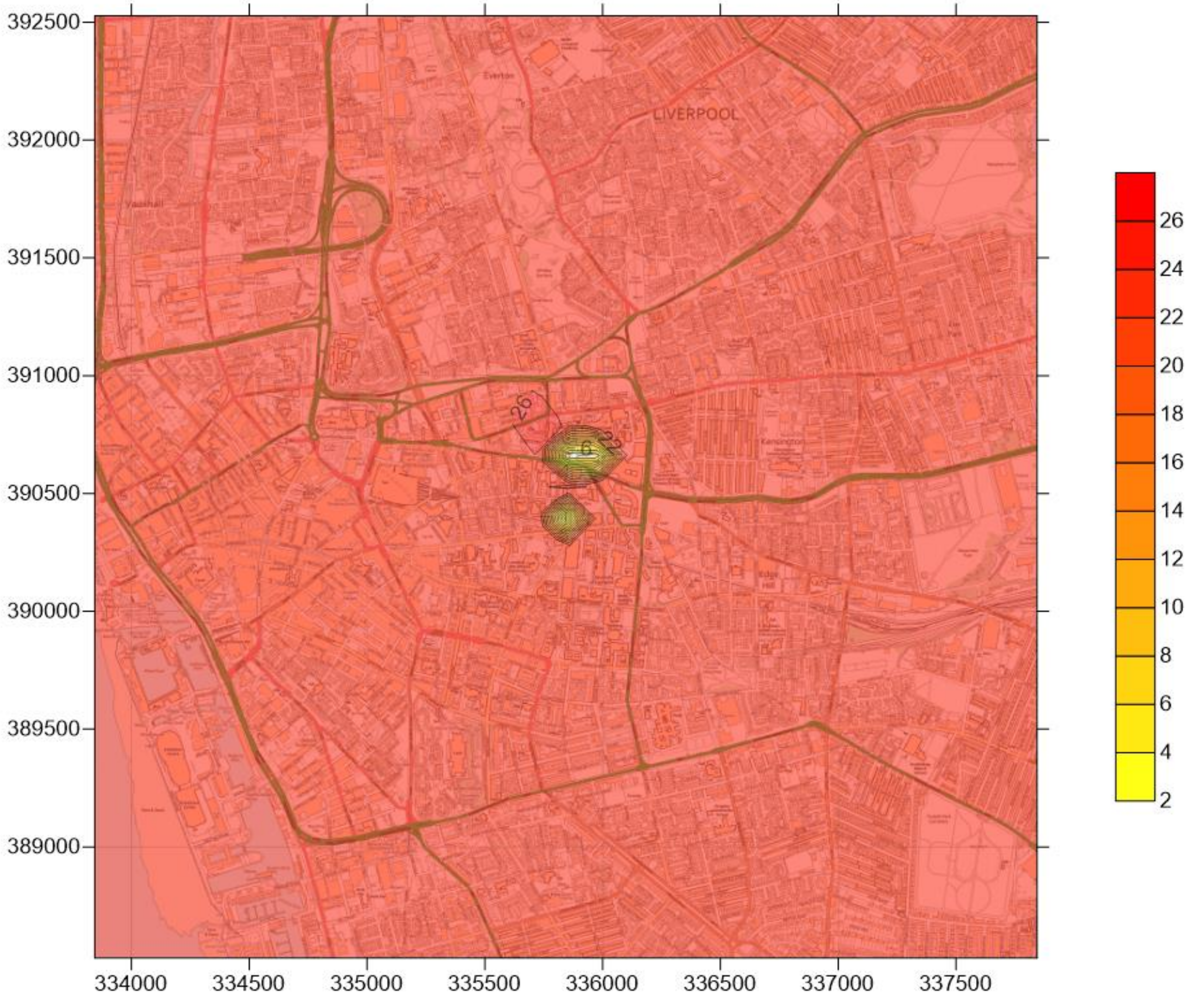
APPENDIX B – WEATHER DATA SETS

	
Liverpool John Lennon Met Data - 2019	Liverpool John Lennon Met Data - 2020
	Met Office
Liverpool John Lennon Met Data - 2021	Data Supplier

APPENDIX C – DISPERSION MODEL PLOTS



Long Term NO_2

Units = μg/m^3

EAL = 40 μg/m^3

SR = 1.5m
SH = 48m & 29m
Met year = 2019

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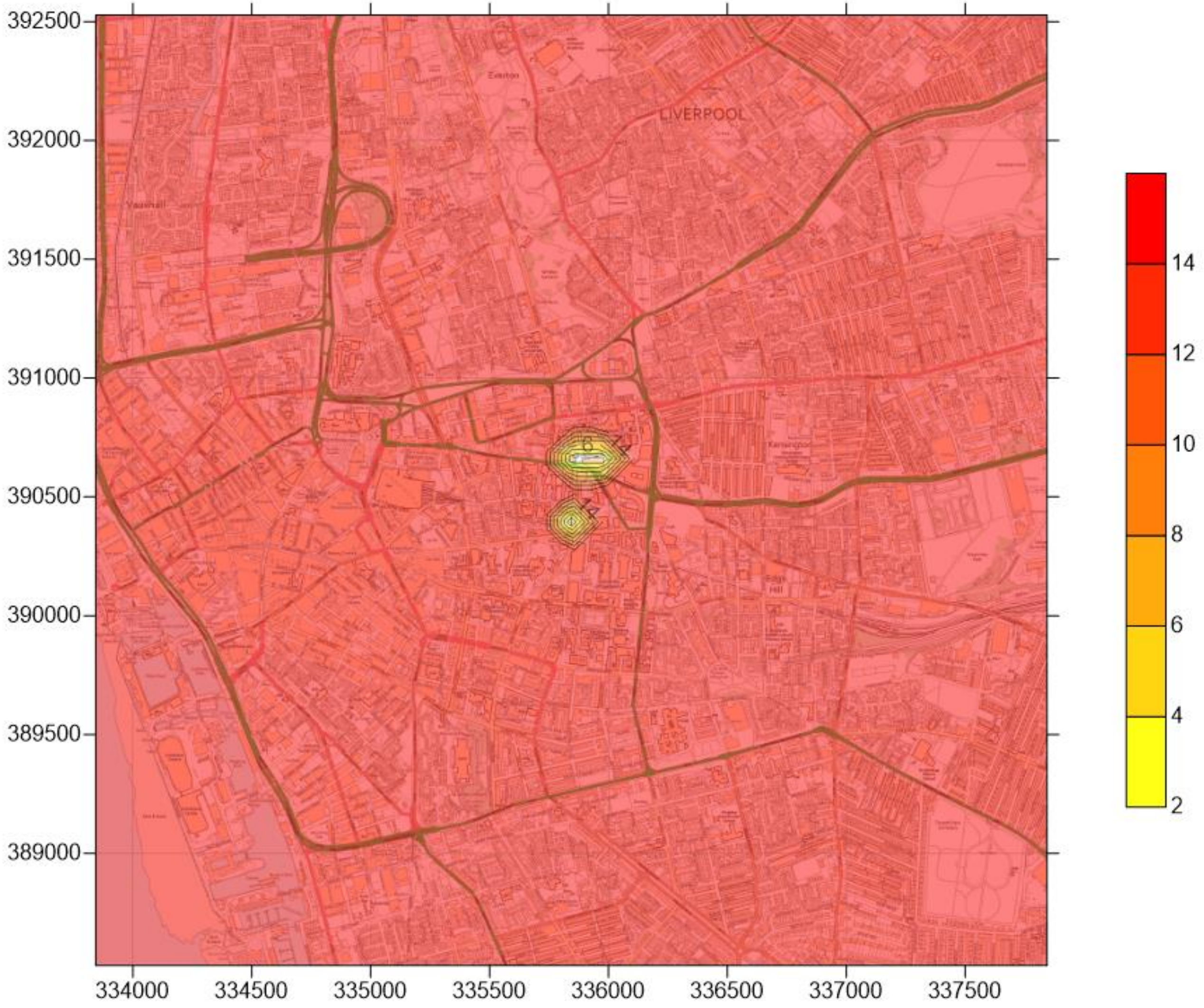

Long Term PM10

Units = μg/m^3

EAL = 40 μg/m^3

SR = 1.5m
SH = 48m & 29m
Met year = 2019

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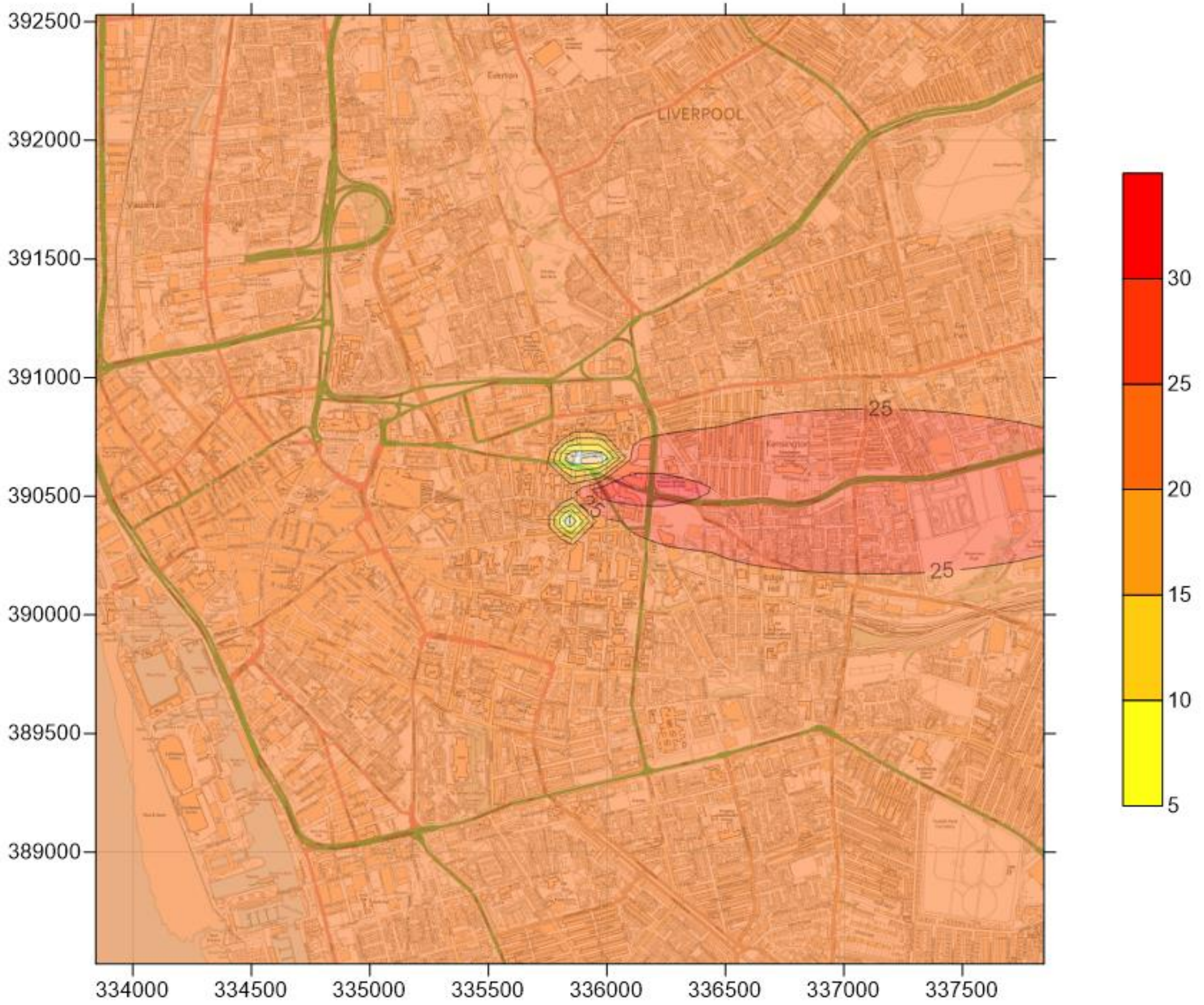

Short Term NO_2

Units = µg/m^3

EAL = 200 µg/m^3

SR = 1.5m
SH = 48m & 29m
Met year = 2019

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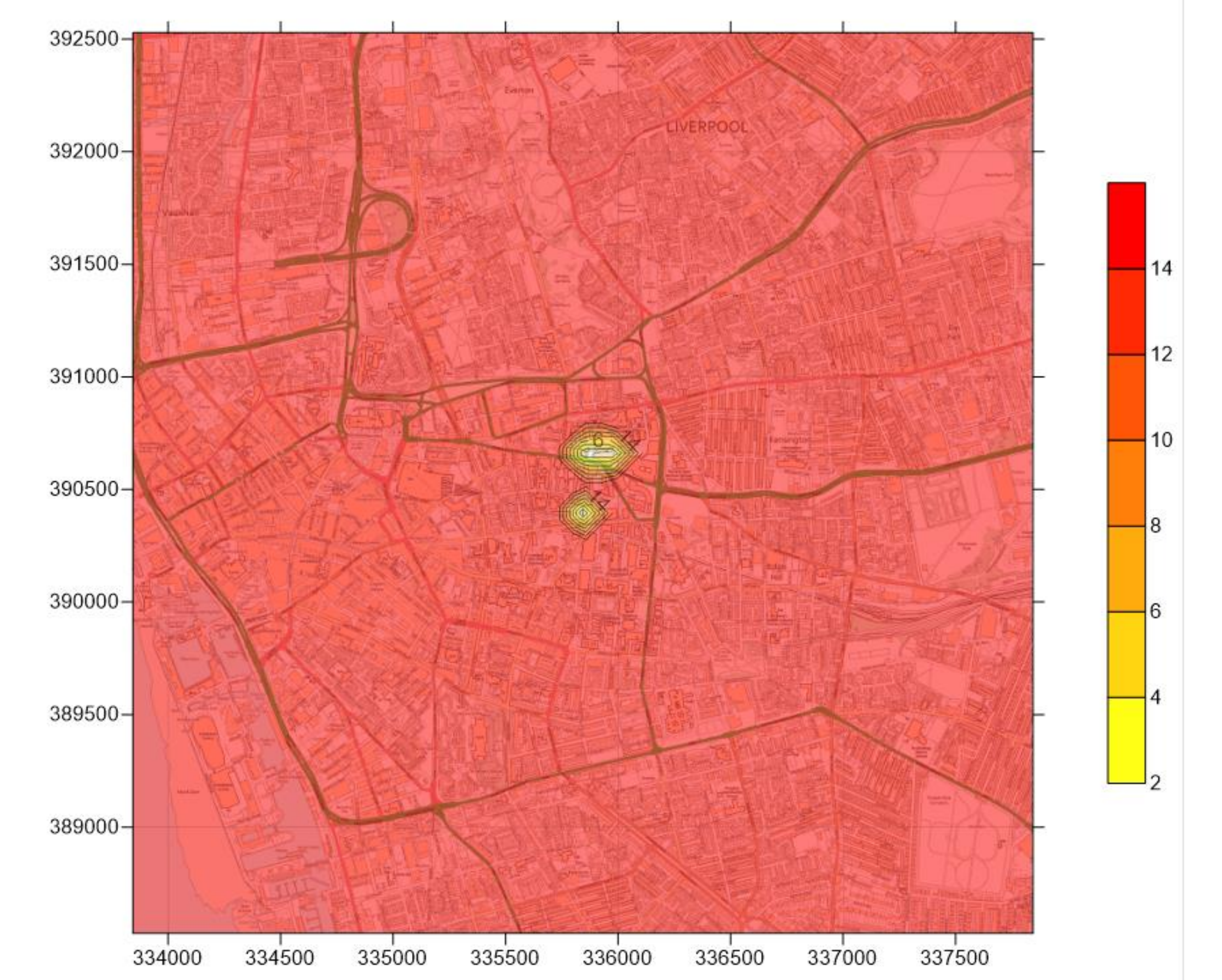

Short Term PM10

Units = μg/m^3

EAL = 50 μg/m^3

SR = 1.5m
SH = 48m & 29m
Met year = 2019

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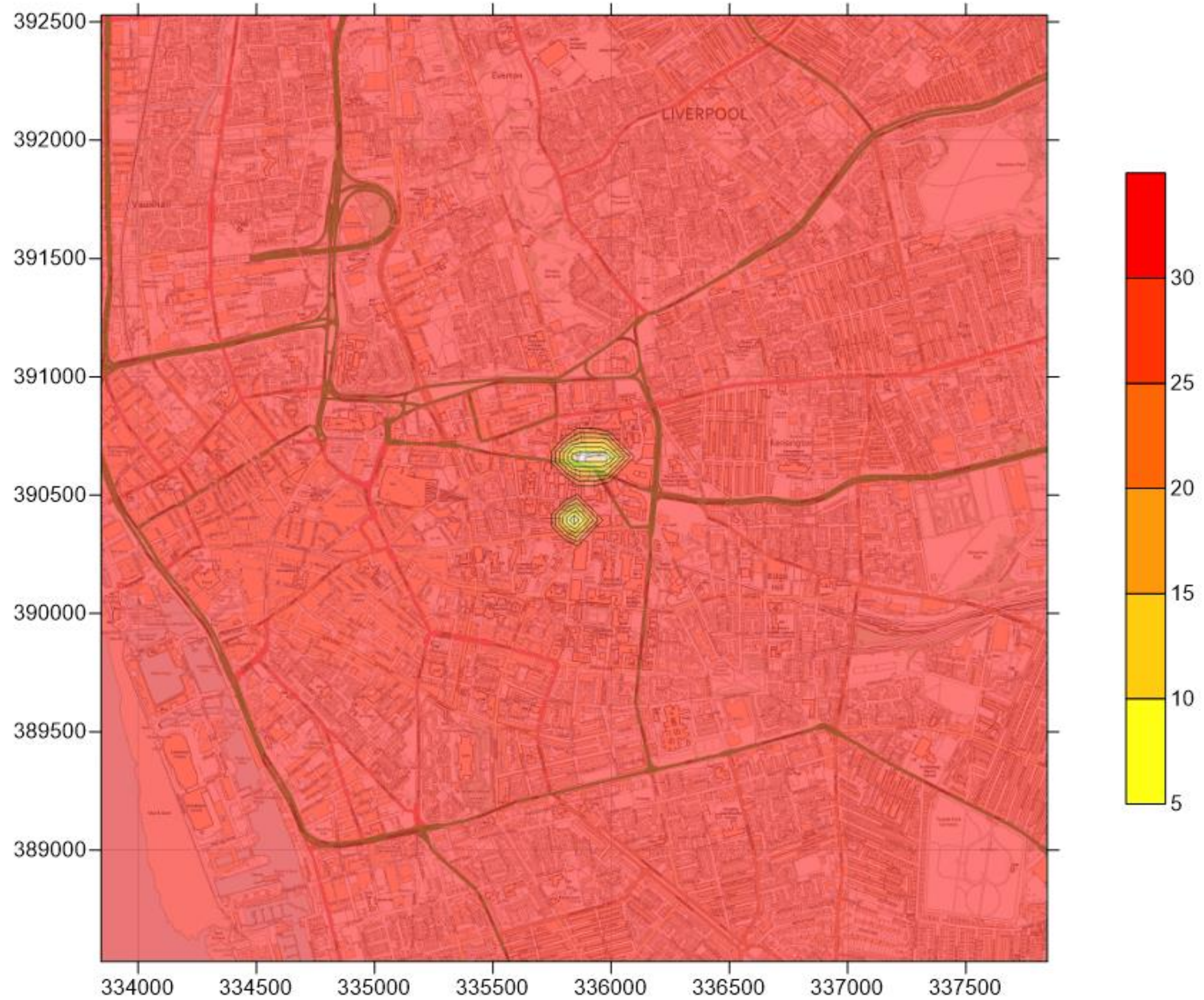

Short Term SO_2

Units = µg/m^3

EAL = 266 µg/m3

SR = 1.5m
SH = 48m & 29m
Met year = 2019

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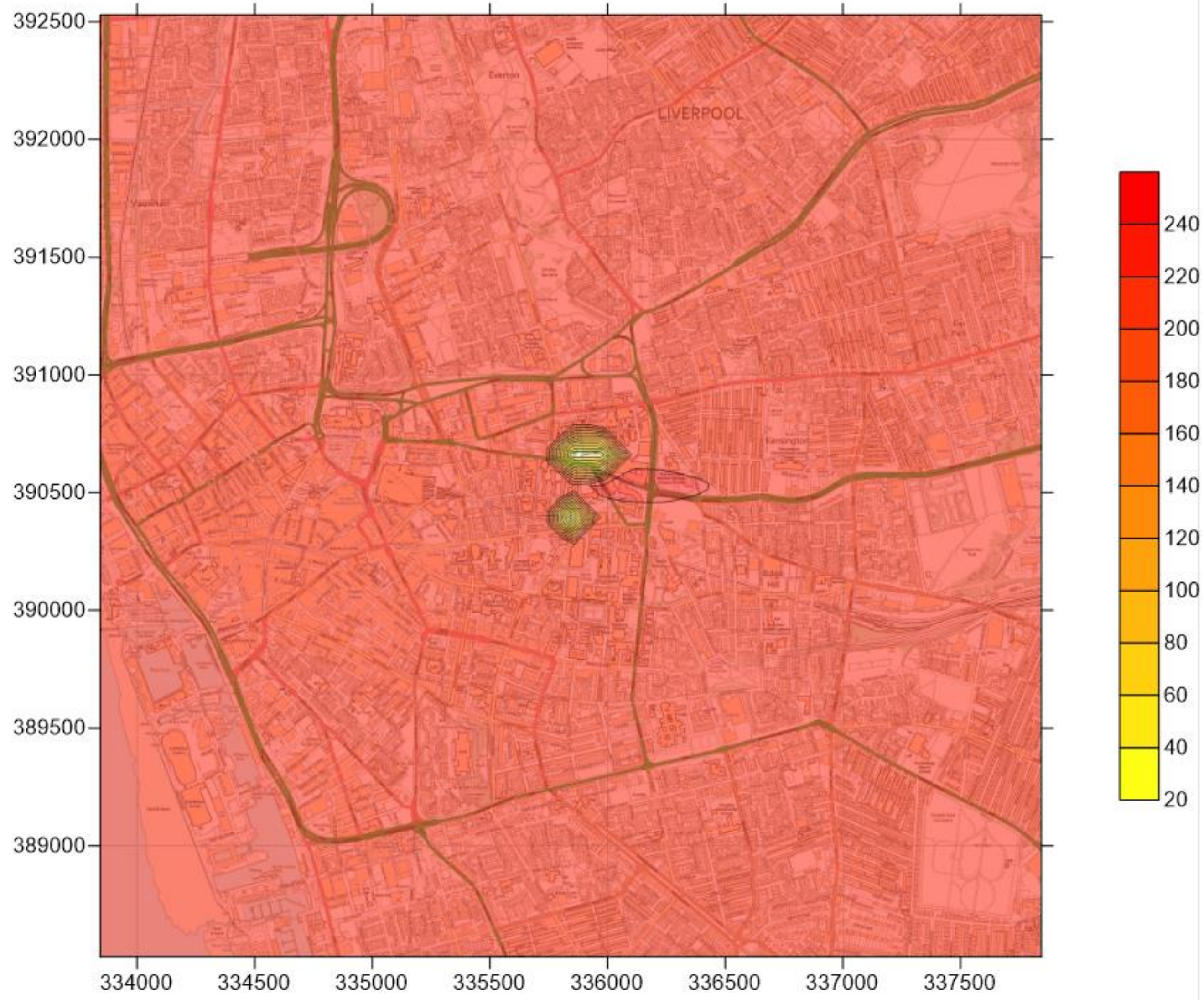

Short Term CO

Units = µg/m³

EAL = 10,000 µg/m³

SR = 1.5m
SH = 48m & 29m
Met year = 2019

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APPENDIX D – MODEL SENSITIVITY ANALYSIS DATA

Receptor name	X(m)	Y(m)	Z(m)	LT PC (ug/m³) NO_2 ALL	LT PEC (ug/m³) NO_2 ALL
HR01	335845	390587		0.00	0
HR02	335847	390572		3.93	28.0629
HR03	335857	390641		0.61	24.7492
HR04	335883	390714		1.14	25.2723
HR05	335880	390582		0.00	0
HR06	335882	390645		0.00	0
HR07	335865	390535		3.10	27.2361
HR08	335956	390578		1.17	25.3035
HR09	335872	390499		2.16	26.2949
HR10	335876	390459		2.00	26.1315
HR11	335885	390392		1.48	25.621
HR12	335836	390425		0.00	0
HR13	335840	390465		0.00	0
HR14	335855	390385		0.00	0
HR15	335815	390465		0.00	0
HR16	335790	390463		0.00	0
HR17	335784	390405		0.61	24.7488
HR18	335746	390460		0.00	0
HR19	335814	390535		2.25	26.3813
HR20	335773	390537		0.07	24.2071
HR21	335796	390587		3.55	27.6824
HR22	335793	390608		4.54	28.6744
HR23	335808	390650		0.00	0
HR24	335816	390736		2.41	26.5412
ER01	335697	391727		0.37	24.5092
ER02	335223	392047		0.27	24.4101
ER03	335631	387007		0.02	24.1569
ER04	332686	390584		0.05	24.1863
ER05	331547	396760		0.03	24.1627
ER06	331121	397244		0.02	24.1599
ER07	331229	394285		0.03	24.1669
ER08	331086	397222		0.02	24.1598
MAX				**4.54**	**28.67**
Surface Roughness		1.5			
Buildings		On			
Stack Height NEC1		48			
Stack Height NEC2		29			
Met Data		2019			
			ULEC		

Receptor name	X(m)	Y(m)	Z(m)	LT PC (ug/m^3) NO_2 ALL	LT PEC (ug/m^3) NO_2 ALL
HR01	335845	390587		0.00	0
HR02	335847	390572		3.84	27.9718
HR03	335857	390641		0.69	24.8226
HR04	335883	390714		1.26	25.3964
HR05	335880	390582		0.00	0
HR06	335882	390645		0.00	0
HR07	335865	390535		2.90	27.0401
HR08	335956	390578		1.23	25.3654
HR09	335872	390499		1.89	26.0268
HR10	335876	390459		1.80	25.9401
HR11	335885	390392		1.56	25.6998
HR12	335836	390425		0.00	0
HR13	335840	390465		0.00	0
HR14	335855	390385		0.00	0
HR15	335815	390465		0.00	0
HR16	335790	390463		0.00	0
HR17	335784	390405		0.70	24.8352
HR18	335746	390460		0.00	0
HR19	335814	390535		2.03	26.1623
HR20	335773	390537		0.08	24.2201
HR21	335796	390587		3.32	27.4527
HR22	335793	390608		4.36	28.4995
HR23	335808	390650		0.00	0
HR24	335816	390736		2.54	26.6793
ER01	335697	391727		0.37	24.5044
ER02	335223	392047		0.25	24.384
ER03	335631	387007		0.02	24.1597
ER04	332686	390584		0.04	24.1811
ER05	331547	396760		0.02	24.1561
ER06	331121	397244		0.02	24.1539
ER07	331229	394285		0.02	24.1571
ER08	331086	397222		0.02	24.1538
MAX				**4.36**	**28.50**
Surface Roughness		1.5			
Buildings		On			
Stack Height NEC1		48			
Stack Height NEC2		29			
Met Data		2020			
			ULEC		

Receptor name	X(m)	Y(m)	Z(m)	LT PC (ug/m³) NO_2 ALL	LT PEC (ug/m³) NO_2 ALL
HR01	335845	390587		0.00	0
HR02	335847	390572		3.76	27.8994
HR03	335857	390641		0.70	24.8373
HR04	335883	390714		1.24	25.3715
HR05	335880	390582		0.00	0
HR06	335882	390645		0.00	0
HR07	335865	390535		3.35	27.4852
HR08	335956	390578		1.14	25.2723
HR09	335872	390499		2.16	26.2989
HR10	335876	390459		2.00	26.1331
HR11	335885	390392		1.64	25.7809
HR12	335836	390425		0.00	0
HR13	335840	390465		0.00	0
HR14	335855	390385		0.00	0
HR15	335815	390465		0.00	0
HR16	335790	390463		0.00	0
HR17	335784	390405		0.81	24.9416
HR18	335746	390460		0.00	0
HR19	335814	390535		2.20	26.3363
HR20	335773	390537		0.07	24.2051
HR21	335796	390587		3.30	27.4369
HR22	335793	390608		4.37	28.5072
HR23	335808	390650		0.00	0
HR24	335816	390736		2.43	26.5659
ER01	335697	391727		0.36	24.4922
ER02	335223	392047		0.25	24.3844
ER03	335631	387007		0.03	24.1622
ER04	332686	390584		0.06	24.1952
ER05	331547	396760		0.02	24.1598
ER06	331121	397244		0.02	24.1573
ER07	331229	394285		0.02	24.1606
ER08	331086	397222		0.02	24.1571
MAX				**4.37**	**28.51**
Surface Roughness		1.5			
Buildings		On			
Stack Height NEC1		48			
Stack Height NEC2		29			
Met Data		2021			
			ULEC		

Receptor name	X(m)	Y(m)	Z(m)	LT PC (ug/m³) NO_2 ALL	LT PEC (ug/m³) NO_2 ALL
HR01	335845	390587		0.00	0
HR02	335847	390572		2.80	26.9369
HR03	335857	390641		0.26	24.3922
HR04	335883	390714		0.56	24.7007
HR05	335880	390582		0.00	0
HR06	335882	390645		0.00	0
HR07	335865	390535		1.80	25.9396
HR08	335956	390578		0.52	24.658
HR09	335872	390499		1.39	25.527
HR10	335876	390459		1.46	25.5933
HR11	335885	390392		0.94	25.0715
HR12	335836	390425		0.00	0
HR13	335840	390465		0.00	0
HR14	335855	390385		0.00	0
HR15	335815	390465		0.00	0
HR16	335790	390463		0.00	0
HR17	335784	390405		0.42	24.5534
HR18	335746	390460		0.00	0
HR19	335814	390535		1.62	25.7548
HR20	335773	390537		0.00	24.1391
HR21	335796	390587		2.38	26.5139
HR22	335793	390608		2.96	27.0931
HR23	335808	390650		0.00	0
HR24	335816	390736		1.39	25.5257
ER01	335697	391727		0.43	24.5655
ER02	335223	392047		0.31	24.4475
ER03	335631	387007		0.03	24.1642
ER04	332686	390584		0.06	24.1983
ER05	331547	396760		0.04	24.1789
ER06	331121	397244		0.04	24.175
ER07	331229	394285		0.04	24.1771
ER08	331086	397222		0.04	24.175
MAX				**2.96**	**27.09**
Surface Roughness		0.2			
Buildings		On			
Stack Height NEC1		48			
Stack Height NEC2		29			
Met Data		2019			
			ULEC		

Receptor name	X(m)	Y(m)	Z(m)	LT PC (ug/m^3) NO_2 ALL	LT PEC (ug/m^3) NO_2 ALL
HR01	335845	390587		0.00	0
HR02	335847	390572		3.03	27.1703
HR03	335857	390641		0.28	24.419
HR04	335883	390714		0.62	24.755
HR05	335880	390582		0.00	0
HR06	335882	390645		0.00	0
HR07	335865	390535		2.00	26.1342
HR08	335956	390578		0.61	24.7503
HR09	335872	390499		1.51	25.642
HR10	335876	390459		1.55	25.6889
HR11	335885	390392		0.99	25.1251
HR12	335836	390425		0.00	0
HR13	335840	390465		0.00	0
HR14	335855	390385		0.00	0
HR15	335815	390465		0.00	0
HR16	335790	390463		0.00	0
HR17	335784	390405		0.43	24.5625
HR18	335746	390460		0.00	0
HR19	335814	390535		1.74	25.8719
HR20	335773	390537		0.00	24.1393
HR21	335796	390587		2.59	26.7275
HR22	335793	390608		3.23	27.3648
HR23	335808	390650		0.00	0
HR24	335816	390736		1.53	25.6707
ER01	335697	391727		0.42	24.5604
ER02	335223	392047		0.31	24.4437
ER03	335631	387007		0.03	24.1631
ER04	332686	390584		0.06	24.1973
ER05	331547	396760		0.04	24.175
ER06	331121	397244		0.04	24.1713
ER07	331229	394285		0.04	24.1754
ER08	331086	397222		0.04	24.1713
MAX				**3.23**	**27.36**
Surface Roughness		0.3			
Buildings		On			
Stack Height NEC1		48			
Stack Height NEC2		29			
Met Data		2019			
			ULEC		

Receptor name	X(m)	Y(m)	Z(m)	LT PC (ug/m^3) NO_2 ALL	LT PEC (ug/m^3) NO_2 ALL
HR01	335845	390587		0.00	0
HR02	335847	390572		3.33	27.467
HR03	335857	390641		0.33	24.4681
HR04	335883	390714		0.72	24.8523
HR05	335880	390582		0.00	0
HR06	335882	390645		0.00	0
HR07	335865	390535		2.28	26.4154
HR08	335956	390578		0.75	24.8874
HR09	335872	390499		1.67	25.803
HR10	335876	390459		1.68	25.8128
HR11	335885	390392		1.08	25.2194
HR12	335836	390425		0.00	0
HR13	335840	390465		0.00	0
HR14	335855	390385		0.00	0
HR15	335815	390465		0.00	0
HR16	335790	390463		0.00	0
HR17	335784	390405		0.45	24.5893
HR18	335746	390460		0.00	0
HR19	335814	390535		1.89	26.0217
HR20	335773	390537		0.01	24.1418
HR21	335796	390587		2.89	27.0234
HR22	335793	390608		3.61	27.7507
HR23	335808	390650		0.00	0
HR24	335816	390736		1.76	25.8945
ER01	335697	391727		0.42	24.555
ER02	335223	392047		0.31	24.4467
ER03	335631	387007		0.03	24.1622
ER04	332686	390584		0.06	24.1954
ER05	331547	396760		0.04	24.1711
ER06	331121	397244		0.03	24.1677
ER07	331229	394285		0.04	24.1745
ER08	331086	397222		0.03	24.1677
MAX				**3.61**	**27.75**
Surface Roughness		0.5			
Buildings		On			
Stack Height NEC1		48			
Stack Height NEC2		29			
Met Data		2019			
			ULEC		

Receptor name	X(m)	Y(m)	Z(m)	LT PC (ug/m^3) NO_2 ALL	LT PEC (ug/m^3) NO_2 ALL
HR01	335845	390587		0.00	0
HR02	335847	390572		3.71	27.8448
HR03	335857	390641		0.47	24.6032
HR04	335883	390714		0.94	25.0717
HR05	335880	390582		0.00	0
HR06	335882	390645		0.00	0
HR07	335865	390535		2.74	26.8745
HR08	335956	390578		0.99	25.1222
HR09	335872	390499		1.93	26.0675
HR10	335876	390459		1.85	25.9887
HR11	335885	390392		1.29	25.4248
HR12	335836	390425		0.00	0
HR13	335840	390465		0.00	0
HR14	335855	390385		0.00	0
HR15	335815	390465		0.00	0
HR16	335790	390463		0.00	0
HR17	335784	390405		0.54	24.6772
HR18	335746	390460		0.00	0
HR19	335814	390535		2.09	26.2252
HR20	335773	390537		0.03	24.164
HR21	335796	390587		3.32	27.4511
HR22	335793	390608		4.20	28.3373
HR23	335808	390650		0.00	0
HR24	335816	390736		2.14	26.278
ER01	335697	391727		0.39	24.5304
ER02	335223	392047		0.29	24.4276
ER03	335631	387007		0.02	24.1596
ER04	332686	390584		0.05	24.1906
ER05	331547	396760		0.03	24.1663
ER06	331121	397244		0.03	24.1631
ER07	331229	394285		0.03	24.1709
ER08	331086	397222		0.03	24.1631
MAX				**4.20**	**28.34**
Surface Roughness		1.0			
Buildings		On			
Stack Height NEC1		48			
Stack Height NEC2		29			
Met Data		2019			
			ULEC		

Receptor name	X(m)	Y(m)	Z(m)	LT PC (ug/m^3) NO_2 ALL	LT PEC (ug/m^3) NO_2 ALL
HR01	335845	390587		0.00	0
HR02	335847	390572		3.93	28.0629
HR03	335857	390641		0.61	24.7492
HR04	335883	390714		1.14	25.2723
HR05	335880	390582		0.00	0
HR06	335882	390645		0.00	0
HR07	335865	390535		3.10	27.2361
HR08	335956	390578		1.17	25.3035
HR09	335872	390499		2.16	26.2949
HR10	335876	390459		2.00	26.1315
HR11	335885	390392		1.48	25.621
HR12	335836	390425		0.00	0
HR13	335840	390465		0.00	0
HR14	335855	390385		0.00	0
HR15	335815	390465		0.00	0
HR16	335790	390463		0.00	0
HR17	335784	390405		0.61	24.7488
HR18	335746	390460		0.00	0
HR19	335814	390535		2.25	26.3813
HR20	335773	390537		0.07	24.2071
HR21	335796	390587		3.55	27.6824
HR22	335793	390608		4.54	28.6744
HR23	335808	390650		0.00	0
HR24	335816	390736		2.41	26.5412
ER01	335697	391727		0.37	24.5092
ER02	335223	392047		0.27	24.4101
ER03	335631	387007		0.02	24.1569
ER04	332686	390584		0.05	24.1863
ER05	331547	396760		0.03	24.1627
ER06	331121	397244		0.02	24.1599
ER07	331229	394285		0.03	24.1669
ER08	331086	397222		0.02	24.1598
MAX				**4.54**	**28.67**
Surface Roughness		1.5			
Buildings		On			
Stack Height NEC1		48			
Stack Height NEC2		29			
Met Data		2019			
			ULEC		

Receptor name	X(m)	Y(m)	Z(m)	LT PC (ug/m^3) NO_2 ALL	LT PEC (ug/m^3) NO_2 ALL
HR01	335845	390587		0.00	0
HR02	335847	390572		3.93	28.0629
HR03	335857	390641		0.61	24.7492
HR04	335883	390714		1.14	25.2723
HR05	335880	390582		0.00	0
HR06	335882	390645		0.00	0
HR07	335865	390535		3.10	27.2361
HR08	335956	390578		1.17	25.3035
HR09	335872	390499		2.16	26.2949
HR10	335876	390459		2.00	26.1315
HR11	335885	390392		1.48	25.621
HR12	335836	390425		0.00	0
HR13	335840	390465		0.00	0
HR14	335855	390385		0.00	0
HR15	335815	390465		0.00	0
HR16	335790	390463		0.00	0
HR17	335784	390405		0.61	24.7488
HR18	335746	390460		0.00	0
HR19	335814	390535		2.25	26.3813
HR20	335773	390537		0.07	24.2071
HR21	335796	390587		3.55	27.6824
HR22	335793	390608		4.54	28.6744
HR23	335808	390650		0.00	0
HR24	335816	390736		2.41	26.5412
ER01	335697	391727		0.37	24.5092
ER02	335223	392047		0.27	24.4101
ER03	335631	387007		0.02	24.1569
ER04	332686	390584		0.05	24.1863
ER05	331547	396760		0.03	24.1627
ER06	331121	397244		0.02	24.1599
ER07	331229	394285		0.03	24.1669
ER08	331086	397222		0.02	24.1598
MAX				**4.54**	**28.67**
Surface Roughness		1.5			
Buildings		On			
Stack Height NEC1		48			
Stack Height NEC2		29			
Met Data		2019			
			ULEC		

Receptor name	X(m)	Y(m)	Z(m)	LT PC (ug/m³) NO_2 ALL	LT PEC (ug/m³) NO_2 ALL
HR01	335845	390587		0.00	0
HR02	335847	390572		3.67	27.8097
HR03	335857	390641		0.53	24.6629
HR04	335883	390714		1.04	25.178
HR05	335880	390582		0.00	0
HR06	335882	390645		0.00	0
HR07	335865	390535		2.86	27.001
HR08	335956	390578		1.04	25.1752
HR09	335872	390499		2.01	26.1427
HR10	335876	390459		1.88	26.0112
HR11	335885	390392		1.37	25.5092
HR12	335836	390425		0.00	0
HR13	335840	390465		0.00	0
HR14	335855	390385		0.00	0
HR15	335815	390465		0.00	0
HR16	335790	390463		0.00	0
HR17	335784	390405		0.55	24.6814
HR18	335746	390460		0.00	0
HR19	335814	390535		2.09	26.2215
HR20	335773	390537		0.04	24.1785
HR21	335796	390587		3.32	27.4579
HR22	335793	390608		4.24	28.3728
HR23	335808	390650		0.00	0
HR24	335816	390736		2.26	26.3913
ER01	335697	391727		0.37	24.5044
ER02	335223	392047		0.27	24.4072
ER03	335631	387007		0.02	24.1568
ER04	332686	390584		0.05	24.1858
ER05	331547	396760		0.03	24.1625
ER06	331121	397244		0.02	24.1597
ER07	331229	394285		0.03	24.1666
ER08	331086	397222		0.02	24.1596
MAX				**4.24**	**28.37**
Surface Roughness		1.5			
Buildings		On			
Stack Height NEC1		49			
Stack Height NEC2		30			
Met Data		2019			
			ULEC		

Receptor name	X(m)	Y(m)	Z(m)	LT PC (ug/m³) NO_2 ALL	LT PEC (ug/m³) NO_2 ALL
HR01	335845	390587		0.00	0
HR02	335847	390572		3.44	27.5796
HR03	335857	390641		0.45	24.5872
HR04	335883	390714		0.95	25.0896
HR05	335880	390582		0.00	0
HR06	335882	390645		0.00	0
HR07	335865	390535		2.65	26.7863
HR08	335956	390578		0.92	25.0582
HR09	335872	390499		1.87	26.0059
HR10	335876	390459		1.76	25.8979
HR11	335885	390392		1.27	25.4029
HR12	335836	390425		0.00	0
HR13	335840	390465		0.00	0
HR14	335855	390385		0.00	0
HR15	335815	390465		0.00	0
HR16	335790	390463		0.00	0
HR17	335784	390405		0.48	24.6206
HR18	335746	390460		0.00	0
HR19	335814	390535		1.95	26.0843
HR20	335773	390537		0.02	24.1607
HR21	335796	390587		3.12	27.2529
HR22	335793	390608		3.96	28.0973
HR23	335808	390650		0.00	0
HR24	335816	390736		2.11	26.2471
ER01	335697	391727		0.36	24.4979
ER02	335223	392047		0.27	24.4038
ER03	335631	387007		0.02	24.1567
ER04	332686	390584		0.05	24.1853
ER05	331547	396760		0.03	24.1623
ER06	331121	397244		0.02	24.1595
ER07	331229	394285		0.03	24.1663
ER08	331086	397222		0.02	24.1594
MAX				**3.96**	**28.10**
Surface Roughness		1.5			
Buildings		On			
Stack Height NEC1		50			
Stack Height NEC2		31			
Met Data		2019			
			ULEC		

Receptor name	X(m)	Y(m)	Z(m)	LT PC (ug/m³) NO_2 ALL	LT PEC (ug/m³) NO_2 ALL
HR01	335845	390587		0.00	0
HR02	335847	390572		3.23	27.3608
HR03	335857	390641		0.39	24.5228
HR04	335883	390714		0.87	25.0073
HR05	335880	390582		0.00	0
HR06	335882	390645		0.00	0
HR07	335865	390535		2.44	26.5746
HR08	335956	390578		0.82	24.9518
HR09	335872	390499		1.74	25.8722
HR10	335876	390459		1.65	25.7831
HR11	335885	390392		1.16	25.2971
HR12	335836	390425		0.00	0
HR13	335840	390465		0.00	0
HR14	335855	390385		0.00	0
HR15	335815	390465		0.00	0
HR16	335790	390463		0.00	0
HR17	335784	390405		0.43	24.5693
HR18	335746	390460		0.00	0
HR19	335814	390535		1.82	25.9573
HR20	335773	390537		0.01	24.15
HR21	335796	390587		2.92	27.0579
HR22	335793	390608		3.70	27.84
HR23	335808	390650		0.00	0
HR24	335816	390736		1.97	26.1087
ER01	335697	391727		0.36	24.4916
ER02	335223	392047		0.26	24.3988
ER03	335631	387007		0.02	24.1565
ER04	332686	390584		0.05	24.1849
ER05	331547	396760		0.03	24.1621
ER06	331121	397244		0.02	24.1593
ER07	331229	394285		0.03	24.1661
ER08	331086	397222		0.02	24.1592
MAX				**3.70**	**27.84**
Surface Roughness		1.5			
Buildings		On			
Stack Height NEC1		51			
Stack Height NEC2		32			
Met Data		2019			
			ULEC		

Receptor name	X(m)	Y(m)	Z(m)	LT PC (ug/m^3) NO_2 ALL	LT PEC (ug/m^3) NO_2 ALL
HR01	335845	390587		0.00	0
HR02	335847	390572		3.01	27.1454
HR03	335857	390641		0.33	24.4675
HR04	335883	390714		0.79	24.9306
HR05	335880	390582		0.00	0
HR06	335882	390645		0.00	0
HR07	335865	390535		2.24	26.3748
HR08	335956	390578		0.72	24.8555
HR09	335872	390499		1.62	25.7549
HR10	335876	390459		1.55	25.6818
HR11	335885	390392		1.07	25.207
HR12	335836	390425		0.00	0
HR13	335840	390465		0.00	0
HR14	335855	390385		0.00	0
HR15	335815	390465		0.00	0
HR16	335790	390463		0.00	0
HR17	335784	390405		0.39	24.5261
HR18	335746	390460		0.00	0
HR19	335814	390535		1.70	25.8319
HR20	335773	390537		0.01	24.1439
HR21	335796	390587		2.74	26.8746
HR22	335793	390608		3.46	27.6008
HR23	335808	390650		0.00	0
HR24	335816	390736		1.84	25.9757
ER01	335697	391727		0.35	24.4874
ER02	335223	392047		0.26	24.3955
ER03	335631	387007		0.02	24.1564
ER04	332686	390584		0.05	24.1844
ER05	331547	396760		0.03	24.1618
ER06	331121	397244		0.02	24.1591
ER07	331229	394285		0.03	24.1658
ER08	331086	397222		0.02	24.159
MAX				**3.46**	**27.60**
Surface Roughness		1.5			
Buildings		On			
Stack Height NEC1		52			
Stack Height NEC2		33			
Met Data		2019			
			ULEC		

APPENDIX E – LT PC/PEC DATA OUTPUT

Receptor name	X(m)	Y(m)	Z(m)	LT PC (ug/m³) NO_2 ALL	LT PEC (ug/m³) NO_2 ALL	LT PC (ug/m³) SO2 ALL	LT PEC (ug/m³) SO2 ALL	LT PC (ug/m³) CO ALL	LT PEC (ug/m³) CO ALL	LT PC (ug/m³) PM ALL	LT PEC (ug/m³) PM ALL
HR01	335845	390587	0	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00
HR02	335847	390572	0	3.93	28.0629	0.01	33.01	5.23	238.30	0.00	14.30
HR03	335857	390641	0	0.61	24.7492	0.04	33.04	0.78	233.85	0.01	14.30
HR04	335883	390714	0	1.14	25.2723	0.09	33.10	1.43	234.49	0.01	14.31
HR05	335880	390582	0	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00
HR06	335882	390645	0	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00
HR07	335865	390535	0	3.10	27.2361	0.01	33.01	4.13	237.19	0.00	14.30
HR08	335956	390578	0	1.17	25.3035	0.03	33.03	1.53	234.59	0.00	14.30
HR09	335872	390499	0	2.16	26.2949	0.00	33.00	2.88	235.94	0.00	14.30
HR10	335876	390459	0	2.00	26.1315	0.01	33.01	2.65	235.72	0.00	14.30
HR11	335885	390392	0	1.48	25.621	0.10	33.10	1.89	234.95	0.01	14.31
HR12	335836	390425	0	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00
HR13	335840	390465	0	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00
HR14	335855	390385	0	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00
HR15	335815	390465	0	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00
HR16	335790	390463	0	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00
HR17	335784	390405	0	0.61	24.7488	0.05	33.05	0.77	233.83	0.01	14.31
HR18	335746	390460	0	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00
HR19	335814	390535	0	2.25	26.3813	0.01	33.01	2.99	236.05	0.00	14.30
HR20	335773	390537	0	0.07	24.2071	0.00	33.00	0.09	233.16	0.00	14.30
HR21	335796	390587	0	3.55	27.6824	0.22	33.22	4.52	237.58	0.03	14.33
HR22	335793	390608	0	4.54	28.6744	0.33	33.33	5.73	238.80	0.05	14.35
HR23	335808	390650	0	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00
HR24	335816	390736	0	2.41	26.5412	0.26	33.26	2.96	236.02	0.04	14.34
ER01	335697	391727	0	0.37	24.5092	0.06	33.06	0.44	233.50	0.01	14.31
ER02	335223	392047	0	0.27	24.4101	0.05	33.05	0.32	233.38	0.01	14.31
ER03	335631	387007	0	0.02	24.1569	0.00	33.00	0.02	233.09	0.00	14.30
ER04	332686	390584	0	0.05	24.1863	0.01	33.01	0.06	233.12	0.00	14.30

ER05	331547	396760	0	0.03	24.1627	0.00	33.01	0.03	233.09	0.00	14.30
ER06	331121	397244	0	0.02	24.1599	0.00	33.01	0.03	233.09	0.00	14.30
ER07	331229	394285	0	0.03	24.1669	0.01	33.01	0.04	233.10	0.00	14.30
ER08	331086	397222	0	0.02	24.1598	0.00	33.01	0.03	233.09	0.00	14.30
MAX				**4.54**	**28.67**	**0.33**	**33.33**	**5.73**	**238.80**	**0.05**	**14.35**
			x0.7	**3.18**							
		Difference in PC		1.36							
	PEC with 70% PC conversion				27.31						
Surface Roughness		1.5									
Buildings		On									
Stack Height NEC1		48									
Stack Height NEC2		29									
Met Data		2019									
ULEC											

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