Environmental Permit Application

VPI Immingham Energy Park A
Appendix E: Air Quality Assessment

VPI Immingham Energy Park A Limited

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Delivering a better world

Quality information

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Revision History

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1. Introduction

This Air Quality Assessment Appendix supports the Environmental Permit application for the VPI Immingham Energy Park A Peaking Plant, located near Immingham, North Lincolnshire (hereafter referred to as the 'VPI Immingham Energy Park A' or 'the Installation') and describes the dispersion modelling of the point source emissions from the Installation.

The purpose of this Appendix is to detail the Air Impact Assessment that has been carried out for the Installation and to demonstrate that the emissions from the Installation would not lead to the exceedance of any Air Quality Standards objectives, Environmental Assessment Levels, Critical Levels and Critical Loads, as appropriate. It is also to demonstrate that the stack heights proposed are appropriate.

2. Assessment Criteria

2.1 Air Quality Legislation

The principal air quality legislation within the United Kingdom is the Air Quality Standards Regulations 2010[1], which transposes the requirements of the European Ambient Air Quality Directive 2008[2] and the 2004 fourth Air Quality Daughter Directive[3]. The Regulations set air quality limits for a number of major air pollutants that have the potential to impact public health, such as nitrogen dioxide (NO_2) and carbon monoxide (CO).

The Environment Act 1995[4] requires the UK Government to produce a national air quality strategy (NAQS)[5], last reviewed in 2007), containing air quality objectives and timescales to meet those objectives. These objectives apply to outdoor locations where people are regularly present and do not apply to occupational, indoor or in-vehicle exposure. It requires local authorities to undertake an assessment of local air quality to establish whether the objectives are being achieved, and to designate air quality management areas (AQMA) if improvements are necessary to meet the objectives. Where an AQMA has been designated, the local authority must draw up an air quality action plan (AQAP) describing the measures that will be put in place to assist in achieving the objectives. Defra has responsibility for coordinating assessments and AQAPs for the UK as a whole.

The current objectives and assessment criteria applicable in this assessment for the protection of human health are presented in Table 2.1. Concentrations are expressed in micrograms per cubic metre ($\mu g/m^3$).

[1] The Air Quality Standards Regulations 2010 (SI 2010/1001). London: The Stationery Office.

[2] Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe' (2008) *Official Journal* L152, P.1

[3] 'Directive 2004/107/EC of the European Parliament and of the Council of 15 December 2004 relating to arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air' (2004) *Official Journal* L23, P.3

[4] The Environment Act 1995 (c. 25). London: The Stationery Office.

[5] Department for Environment, Food and Rural Affairs (2007). The Air Quality Strategy for England, Scotland, Wales and Northern Ireland. London: The Stationery Office.

Table 2.1: National Air Quality Strategy (NAQS) Objectives - Protection of Human Health

Pollutant	Objective ($\mu g/m^3$)	Averaging Period	Percentile (to be met by date)
Nitrogen dioxide (NO_2)	200	1-hour mean	99.79th or not to be exceeded more than 18 times/ year (31 Dec 2005)
	40	Annual mean	(31 Dec 2005)
Carbon monoxide (CO)	10,000	8-hour, daily running mean	(31 Dec 2003)

For the protection of vegetation and ecosystems, a number of Critical Levels have been developed; Critical Levels are defined as "concentrations of pollutants in the atmosphere above which direct adverse effects on...plants [and] ecosystems...may occur according to present knowledge"[6]. The Critical Levels applicable to this assessment are shown in Table 2.2.

Table 2.2: Critical Levels - Protection of Vegetation and Ecosystems

Pollutant	Objective ($\mu g/m^3$)	Averaging Period	Percentile (to be met by date)
Oxides of nitrogen (NOx)	75	Daily mean	-
	30*	Annual mean	-

* denotes objective set in Air Quality Standards Regulations 2010

In addition to the above Critical Levels set in the legislation, there are non-legislative limits, called Critical Loads that have been derived for different habitats covering the deposition of nitrogen and acidifying species; Critical Loads are defined as "a quantitative estimate of exposure to one or more pollutant below which significant harmful effects on specified elements of the environment do not occur according to present knowledge" (APIS). These are discussed further in Section 7.3 and habitat-specific Critical Loads are presented in the tabulated results towards the end of this Appendix.

2.2 Environmental Permitting Regulations

The Environmental Permitting (England and Wales) Regulations 2016 ('the EP Regulations') apply to all new installations and transpose the requirements of the EU Industrial Emissions Directive (IED)[7] into UK legislation. Under the IED and EP Regulations, the operator of an installation covered by the IED is required to employ Best Available Techniques (BAT) for the prevention or minimisation of emissions to the environment, to ensure a high level of protection of the environment as a whole. Generating stations exceeding 50MW thermal input ratings (50MWth) (such as the Installation) are covered by the IED and the EP Regulations.

Where legislative ambient air quality limits or objectives are not specified for the pollutant species potentially released from the Installation, Environmental Assessment Levels (EALs), published in the Environment Agency's (EA) Risk Assessments for Specific Activities: Environmental Permits guidance[8] can be used to assess potential health effects on the general population. The EALs applicable in this assessment for the protection of human health from pollutants that could be emitted from the Installation are presented in Table 2.3.

[6] APIS (2016). Centre for Ecology and Hydrology – www.apis.ac.uk

[7] 'Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control) Text with EEA relevance' (2010). *Official Journal* L334, P.17.

[8] Air emissions risk assessment for your environmental permit - GOV.UK (www.gov.uk)

Table 2.3: Environmental Assessment Levels (EALs) - Protection of Human Health

Pollutant	Objective (µg/m^3)	Averaging Period	Percentile (to be met by date)
Carbon monoxide (CO)	30,000	1-hour mean	-

For the purpose of assessment, the NAQS objectives, Critical Levels and Environmental Assessment Levels are here on in on referred to as 'Environmental Standards'.

2.3 Industrial Emissions Directive/ Medium Combustion Plant Directive

The IED provides operational limits and controls to which plant must comply, including BAT-Achievable Emission Limits (BAT-AELs) for pollutant releases to air defined in the Large Combustion Plant BAT Reference document[9] and BAT Conclusions documents. However, it should be noted that although the proposed combustion activity falls under Section 1.1 Part A(1)(a): Burning of any fuel in an appliance with a rated thermal input of 50MW or more of the EP Regulations, by virtue of the overall thermal input to the engines (circa 108MWth), the engines do not comprise a Large Combustion Plant under IED, as the gross thermal input to each engine is less than 15MW.

As such, the individual engines are not required to comply with the BAT-Achievable Emission Levels (BAT-AELs) implemented by the Large Combustion Plant BAT Conclusions (LCP BATc). As the thermal input for individual engines is >15MW, the gas engines are defined as medium combustion plants, and the emissions from the engines are required to comply with the emission limit values (ELVs) provided in Schedule 25B of the EP Regulations.

3. Assessment Methodology

Emissions from the Installation have been assessed using the EA Risk Assessment methodology in order to identify where emissions can be screened as having an insignificant impact. The H1 screening tool, did not screen emissions from the Installation as insignificant, and hence detailed dispersion modelling has been carried out.

Detailed dispersion modelling using the atmospheric dispersion model ADMS 5.2 has been used to calculate the concentrations of pollutants at identified receptors. These concentrations have been compared with the air quality assessment criteria for each pollutant species. Dispersion modelling calculates the predicted concentrations arising from the emissions to atmosphere, based on Gaussian approximation techniques. The model employed has been developed for UK regulatory use.

The assessment has been based on the operational design parameters for the Installation, based on technology information provided by Clarke Energy, who are to supply 11 gas engines to be installed at the Installation.

The assessment of worst-case long-term and short-term emissions of NOx and CO resulting from operation of the Installation has been undertaken by comparison of the maximum process contributions (PC) with the Environmental Standards and Critical Loads for ecological receptors, taking into consideration the baseline air quality, in accordance with EA risk assessment methodology, and factoring the medium- to long-term impacts for annual operating hours, which are expected to not exceed a maximum of 2,250 hours in a single year (based on 1,500 hours as a 5-year rolling average).

An assessment of nutrient nitrogen enrichment has been undertaken by applying published deposition velocities to the predicted annual average NO_2 concentrations at the identified statutory habitat sites, determined through dispersion modelling, to calculate nitrogen deposition rates. These deposition rates have then been compared to the Critical Loads for nitrogen published by UK Air Pollution Information

[9] European Commission (2017) *Best available techniques Reference document for Large Combustion Plants.* [Online]. [Accessed 04 February 2020]. Available from: https://eippcb.jrc.ec.europa.eu/sites/default/files/2019-11/JRC_107769_LCPBref_2017.pdf

System (APIS, Centre for Ecology and Hydrology) for the species present at each habitat site, taking into consideration the baseline air quality.

Increases in acidity from deposition contributions of NO_2 from the process contribution have also been considered. In this assessment, the nitrogen kilo equivalent (K_{eq}/ha/yr), which are the units in which acidity Critical Loads are described, have been derived from nitrogen deposition modelling values using standard conversion factors. The acidity deposition rates and baseline deposition rates have been used within the Critical Load Function Tool (APIS) to determine whether the contribution would result in exceedance of the defined acidity Critical Loads for the most sensitive feature. Process contributions of SO_2 to the acidity deposition rate have been assumed to be zero as the SO_2 emissions from the process are negligible.

Consideration of the Black Start diesel engine to be included in the Installation has also been included in the assessment, as has the potential for cumulative impacts from emissions from the adjacent permitted OCGT plant, which has yet to be constructed.

3.1 NOx to NO_2 Conversion – Combustion Plant

Emissions of nitrogen oxides from industrial point sources are typically dominated by nitric oxide (NO), with emissions from combustion sources typically in the ratio of nitric oxide to nitrogen dioxide (NO_2) of 9:1. However, it is NO_2 that has specified Environmental Standard due to its potential impact on human health. In the ambient air, NO is oxidised to NO_2 by the ozone present, and the rate of oxidation is dependent on the relative concentrations of NO and ozone in the ambient air.

For the purposes of detailed modelling, and in accordance with EA technical guidance it is assumed that 70% of emitted nitric oxide is oxidised to nitrogen dioxide in the long term and 35% of the emitted nitric oxide is oxidised to nitrogen dioxide in the local vicinity of the site in the short-term.

3.2 Human Health Significance Criteria

The EA's Risk Assessment for Specific Activities guidance identifies two stages of screening criteria for comparison of the process contribution (PC) with Environmental Standards. The first stage of screening states that an emission may be considered to have an insignificant impact where:

- Short term PC <=10% of the relevant Environmental Standard; and
- Long term PC <=1% of the relevant Environmental Standard.

The second stage of screening considers the PCs in the context of the existing background pollutant concentrations; the predicted environmental concentration (PEC) is considered acceptable where:

- Short term PC <20% of the relevant short term Environmental Standard minus twice the long-term background concentration; and
- Long term PEC (PC + background concentration) <70% of the relevant Environmental Standard.

The EA's Risk Assessment guidance indicates that where Environmental Standards are likely to be breached as a result of contributions from an installation, or where installation releases constitute a major proportion of the standard or objective, such releases are likely to be considered unacceptable.

Where the PEC is not predicted to exceed the Environmental Standard, and the proposed emissions comply with the BAT-AEL (or equivalent requirements) the emissions may be considered acceptable by the EA.

3.3 Ecological Significance Criteria

For European sites (Special Protection Areas (SPA), Special Areas of Conservation (SAC) or Ramsar sites) an assessment is made as to whether the emissions from the installation are "likely to have a significant effect", and whether this could lead to an "adverse effect on site integrity". SPA, SAC and Ramsar sites within 15km have been considered in the assessment and Sites of Special Scientific Interest (SSSIs) within 15km have also been considered.

For local nature sites, the assessment needs to determine whether the emissions are "likely to damage" the site and is applicable to sites within 2km of the Installation.

The EA's Risk Assessment guidance screening criteria for significance of the PC have been applied to the outcome of the dispersion modelling for all identified habitat sites, as described above.

The impact of point source emissions on ecological receptors with statutory designation, through deposition of nutrient nitrogen or acidity, has been evaluated using the EA's guidance insignificance criterion of 1% of the long-term Environmental Standard, as above.

The impact of point source emissions on non-statutory designations (Local Wildlife Sites - LWSs) have been evaluated using the H1 guidance criterion of requiring the PC to comply with the short-term and long-term Environmental Standards for ecological receptors, (i.e., PC<100% of the Critical Level).

4. Baseline Air Quality and Receptors

4.1 Human Health Receptors

Receptors potentially affected by the emissions from the Installation, including local residential and amenity receptors, have been identified through site knowledge and desk study of local mapping. Isopleth figures of pollutant dispersion have been examined to identify the receptors that will receive the highest point source contributions and the assessment of impact has been made at these receptors.

North Lincolnshire Council (NLC) has declared two AQMAs within its administrative area (Scunthorpe and Low Santon, both for PM_{10}), both of which are over 5km from the Installation. The Low Santon AQMA was revoked in March 2018.

The adjacent North East Lincolnshire Council (NELC) has also declared two AQMAs (Immingham (also for PM_{10}) and Grimsby (for NO_2)). The Immingham AQMA was revoked in 2016 and the Grimsby AQMA is located over 10km to the southeast of the Installation. Given the distance of all the AQMAs from the Installation, it is considered that no significant impacts could occur at these locations as a result of the emissions from the VPI Immingham Energy Park A.

Ecological receptors potentially affected by the operation of the Installation have been identified through desk study of Defra Magic mapping. Statutory designated sites (including SPAs, SACs, Ramsar sites and SSSIs) up to 15km have been included in the assessment; and non-statutory designations (LWS) and Sites of Nature Conservation Interest (SNCI) within 2km have been included in the assessment. Identified receptors are detailed in Table 4.1. The receptor locations are shown in Figures 4.1 and 4.2 provided in Annex A.

Table 4.1: Identified Receptors with Potential for Air Quality Impacts from the Installation

ID	Receptor Name	Receptor Type	Grid Reference	Approx. Distance and Direction from Installation Boundary
R1	Hazel Dene	Residential	517330, 417311	0.7km East
R2	Station House	Residential	517333, 418345	1.1km Northeast
R3	Fairfield House, North Garth	Residential	514687, 418769	2.2km Northwest
R4	Old Vicarage, North Garth	Residential	514428, 418197	2.1km Northwest
R5	Manor Farm, North Killingholme	Residential	514515, 417653	1.9km Northwest
R6	Church Lane, North Killingholme	Residential	514763, 417331	1.6km West
R6	Westfield Farm, North Killingholme	Residential	514708, 416785	1.8km West
R8	Staple Road, South Killingholme	Residential	515115, 416417	1.7km Southwest
R9	Humber Road, South Killingholme	Residential	515516, 416120	1.4km Southwest

ID	Receptor Name	Receptor Type	Grid Reference	Approx. Distance and Direction from Installation Boundary
R10	South Killingholme Primary School	School	514880, 416120	1.9km Southwest
R11	East End Farm	Residential	515935, 415730	1.3km Southwest
R12	Immingham	Residential	517765,415255	2.2km South
R13	Allerton Primary School	School	518016, 414882	2.km Southeast
E1	Humber Estuary – worst case location	SAC, SPA, Ramsar	517500, 418900	1.9 km Northeast
E1a	Humber Estuary (Rich Fens habitat)	SAC, SPA, Ramsar	516851, 419535	2.0 km North
E1b	Humber Estuary (Saltmarsh habitat)	SAC, SPA, Ramsar	516990, 419690	2.0km North
E1c	Humber Estuary (Hay Meadows habitat)	SAC, SPA, Ramsar	513431, 423906	7.0km Northwest
E2	North Killingholme Haven Pits	SSSI	516851, 419535	2.0km North
E3	Swallow Wold	SSSI	516950, 404990	11.9km South
E4	Wrawby Moor	SSSI	503350, 411120	14.2km Southwest
E5	Eastfield Road Railway Embankment	LWS	515313, 417108	1.2km Southwest
E6	Burkinshaws Covert	LWS	516432, 417874	0.5km North
E7	Rosper Road Pools	LWS	517224, 416937	07km Southeast
E8	Chase Hill Wood	LWS	515702, 418875	1.6km Northwest
E9	Mayflower Wood Meadow	LWS	516000, 415920	1.4km Southwest
E10	Homestead Park Pond	LWS/SINC	517935, 415625	2.0km Southeast
E11	Eastfield Road Pit	SINC	515350, 417040	1.1km Southwest

It is understood that the Station Road Fields LWS that was located 500m east of the Installation, has been removed by the Able Marine Energy Park (AMEP) development and therefore has not been include in the assessment.

4.2 Existing Air Quality

Existing air quality conditions in the vicinity of the Installation have been evaluated through a review of local authority air quality management reports, Defra published data and other sources. As described, the key pollutants of concern resulting from operation of the Installation are NOx, NO_2 and CO, therefore the assessment of baseline conditions considers these pollutants only.

4.2.1 Human Health Receptors Background Concentrations

Under the requirements of Part IV of the Environment Act, NLC and NELC have a duty to undertake the periodic review and assessment of local air quality within their administrative areas. There are no AQMAs declared for NO_2 within 10km of the Installation, and therefore it is considered unlikely that the Installation will result in significant impact at any AQMA.

The 2018 Annual Management Report available from NLC stated that during 2017 there were no recorded exceedances of the relevant air quality objectives for NO_2 or CO within the area. The review and assessment process has not identified any air quality issues in the vicinity of the Installation, nor the air quality study area surrounding it.

Automatic monitoring for NO_2 is undertaken by NLC at four locations within the borough, with two of the monitoring sites located within 2km of the Installation (Killingholme School monitoring site located in South Killingholme and Killingholme Roadside). Typically, annual mean concentrations of NO_2 at the automatic monitoring sites within the vicinity of the Installation have shown a reduction in NO_2 concentrations since 2014. Summary monitoring data from 2014 - 2021 is presented in Table 4.2.

Table 4.2: NLC Automatic Monitoring Data for NO_2

Monitoring Site	2014 (µg/m^3)	2015 (µg/m^3)	2016 (µg/m^3)	2017 (µg/m^3)	2018 (µg/m^3)	2019 (µg/m^3)	2020 (µg/m^3)	2021 (µg/m^3)
CM6 Killingholme School	22.1	20.4	17.0	17.0	18.0	15.0	13.0	14.0
CM10 Killingholme Roadside	28.5	24.6	23.0	ND	ND	ND	ND	ND

NLC also operates a number of NO_2 diffusion tubes within the borough including background, roadside and kerbside locations. The closest tubes to the Installation are located within South Killingholme. Summary monitoring data for 2019 is presented in Table 4.3.

Table 4.3: NLC Annual Mean NO_2 Diffusion Tube Monitoring Data (2019)

Monitoring Site	Distance to Site (km)	NO_2 Concentration 2019 µg/m^3	Monitor Type
DT13 Ulceby Road, Killingholme	2.5	17	Roadside
DT14 Killingholme NOx Analyser	2.3	29	Roadside
DT15 Humber Road, Chip Shop	1.7	18	Urban Background
DT16 Humber Road, LP 695	1.8	25	Roadside

Background data has also been obtained from Defra published maps for the locations of likely maximum impact from point source emissions from the Installation, and at identified sensitive receptor locations. Background mapping data for 2018 (based on 2018 background maps) is conservatively assumed to be representative of the background concentrations when the Installation becomes operational (assumed to be mid 2023); as general trends are showing a reduction in both NO_2 and PM_{10} concentrations over time this is considered to be a conservative assumption. Background data assumed for the maximum impact location from the point source emissions is provided in Table 4.4 and indicates NO_2 and CO concentrations within the vicinity of the Installation are consistently well below the NAQS annual mean objectives.

Table 4.4: Defra Background Air Quality Data (Annual Mean) (1km^2 grid average)

Location	Pollutant	2018 (µg/m^3) Assumed for and Future Opening Year
Maximum Impact Location (down-wind of the Installation Site at 517500, 418500)	NO_2	14.4
	CO[1]	113.1
Killingholme School Automatic Monitor (514500, 416500)	NO_2	11.4

[1] The Defra year adjustment factor for CO has been applied for 2018 baseline.

It can be seen from Table 4.2 and Table 4.4 that the Defra NO_2 background mapping data for the Killingholme School location is lower than the automatic monitoring data in the same location.

The 2018 Defra background maps have also been consulted for each identified human health receptor location, with NO_2 concentrations ranging from 11.2 – 14.4µg/m^3, therefore in order to carry out a conservative assessment, the concentrations measured during 2019 at the Killingholme School automatic monitoring station (15µg/m^3) have been assumed to be representative of all human health receptors in the immediate vicinity of the Installation. The data from 2020 and 2021 is not going to be used due to the temporary impact of COVID-19 on NO_2 concentrations, and thus might not be representative of air quality trends.

Short-term (hourly) background concentrations have been calculated by multiplying the selected annual mean background concentration by a factor of two, in accordance with the Environment Agency Risk Assessment methodology.

4.2.2 Ecological Receptors Background Concentrations

The background concentrations for ecological receptors have been obtained from the APIS website and are shown in Table 4.5 and Table 4.6.

Table 4.5: Baseline Data for Ecological Receptors (APIS Background)

Receptor I.D.	Ecology Site	NOx (µg/m^3)
E1	Humber Estuary – worst case location	18.4
E1a	Humber Estuary (Rich Fens habitat)	20.1
E1b	Humber Estuary (Saltmarsh habitat)	20.1
E1c	Humber Estuary (Hay Meadows habitat)	13.9
E2	North Killingholme Haven Pits	20.1
E3	Swallow Wold	11.3
E4	Wrawby Moor	12.4
E5	Eastfield Road Railway Embankment	15.7
E6	Burkinshaws Covert	16.2
E7	Rosper Road Pools	17.5
E8	Chase Hill Wood	17.2
E9	Mayflower Wood Meadow	14.6
E10	Homestead Park Pond	15.9
E11	Eastfield Road Pit	15.7

Short-term (daily) background concentrations have been calculated by multiplying the selected annual mean background concentration by a factor of 1.5, as advised by the EA on previous projects.

Table 4.6: Baseline Deposition Data (APIS Background)

Receptor I.D.	Ecology Site	Habitat Type and Location	Grid Reference x, y	N-Deposition (kg N/Ha/Yr)	Acid Deposition	
					Keq N/Ha/Yr)	Keq S/Ha/Yr)
E1a	Humber Estuary	Northern wet heath – North Killinholme Pits	516851, 419535	20.4	1.48	0.31
E1b		Pioneer, low, mid upper saltmarshes	516990, 419690	20.4	1.48	0.31
E1c		Low and medium altitude hay meadows	513431, 423906	20.3	1.49	0.22
E2	North Killingholme Haven Pits	Pioneer, low, mid upper saltmarshes	516851, 419535	20.4	1.48	0.31
E3	Swallow Wold	Sub-atlantic semi-dry calcareous grassland	516950, 404990	22.3	1.58	0.17
E4a	Wrawby Moor	Non-mediterranean dry acid and neutral closed grassland	503305, 410990	24.9	1.78	0.19
E4b		Meso- and eutrophic Quercus woodland	503280, 411180	42.6	3.04	0.23
E5	Eastfield Road Railway Embankment	Neutral grassland	515313, 417108	20.4	1.46	0.38
E6	Burkinshaws Covert	Broadleaved woodland	516432, 417874	34.2	2.44	0.45
E7	Rosper Road Pools	Wetland and reedbeds	517224, 416937	20.4	1.46	0.38
E8	Chase Hill Wood	Broadleaved woodland	515702, 418875	34.2	2.44	0.45
E9	Mayflower Wood Meadow	Neutral grassland	516000, 415920	20.4	1.46	0.38
E10	Homestead Park Pond	Standing open water and neutral grassland	517935, 415625	20.4	1.46	0.38
E11	Eastfield Road Pit	Calcareous grassland	515350, 417040	20.4	1.46	0.38

5. Point Source Emissions

5.1 Emissions Inventory

The Installation will consist of 11 x 4.5MWe Gas Engines and an approximately 200kW Black Start Engine.

Emissions data for the Gas Engines has been determined from information supplied by Clarke Energy Ltd, the supplier of the J624 gas engines. Conservative assumptions have been made with regard to the operational parameters for the gas engines, to determine the maximum potential effects of the operation of the Installation on sensitive receptors. These assumptions include:

- Worst case MCPD NOx emissions limits (NOx 95mg/m^3 as a daily average);
- The assessment of annual average emissions for the maximum of 2,250 hours operation in one year; and

- The assessment of hourly average impacts assuming continuous operation throughout the year, to ensure that the worst-case meteorological conditions are taken into account.

The actual hours of operation of the Installation will be subject to the national demand for electricity and the economic viability of gas-fired generation. The likely operation of the plant would be to meet short-term peak demand, and therefore the plant would be likely to operate for periods of only a few hours at a time.

Stack emissions for the Black Start Engine have been estimated from the type of products available on the market and scaled to 200kW, emissions are assumed to be compliant with USEPA tier 2 criteria for Nonroad Compression-Ignition Engines[10] (NO_X 6.4 g/kW.hr and CO 3.5 g/kW.hr). Use of tier 2 emissions standards is a conservative approach, as it is likely that a more modern diesel engine will be installed at the Installation. Although the black start engine is for emergency use only, it has been assumed that testing will be carried out for up to 1 hour per month, to ensure that the engine remains fit for purpose.

The in-combination impacts of the VPI Immingham Energy Park A plant together with the adjacent planned VPI-B OCGT Peaking Plant have also been assessed. This assessment also includes a number of worst-case assumptions, namely:

- Assessment of short-term impacts from the OCGT at IED limits, over the whole year to ensure meteorological conditions that lead to the worst-case impacts are taken into consideration; and;
- Assessment of annual average impacts from the OCGT assuming operation of 2,250 hours per year, as the maximum annual operation taking into consideration an average of 1,500 hours operation over a 5 year rolling average.

It is considered that the assumptions outlined above will provide a conservative assessment of the effect on local air quality from the operation of the Installation. The modelled emission parameters are summarised in Table 5.1.

Table 5.1: Modelled Combustion Plant Air Emission Parameters

Assumed Parameter	11 x 4.5 MWe Gas Engines (each)	OCGT Unit	Black Start Engine
Maximum volumetric flow (Am^3/s)	12.0	1,695	0.9
Oxygen content (%)	9.4	12.1	15.1
Moisture content (%)	10.1	5.5	4.6
Temperature (°C)	351	600	200
Maximum volumetric flow at reference conditions (Nm^3/hr)[1]	33,031	2,601,880	1,480
Approx. flue diameter (m)	0.7	7.8	0.5
Average efflux velocity (m/s)	31.1	35.5	4.5
NO_x Emission Standard	95 (mg/Nm^3)	50 (mg/Nm^3)	6.6 (g/kW.hr)
NOx release rate (g/s)	0.87	36.1	0.37
CO ELV Emission Standard	390 (mg/Nm^3)	100 (mg/Nm^3)	3.5 (g/kW.hr)
CO release rate (g/s)	3.58	72.3	0.19
Stack height (m) (above finished ground level)	15	45	9.6

[10] USEPA, 2016. *Nonroad Compression-Ignition Engines: Exhaust Emission Standards.* [Online]. [Accessed 15 September 2022]. Available from: https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100OA05.pdf

Assumed maximum operating hours/ year	2,250	2,250	12

6. Dispersion Model Parameters

The emissions inventory modelled for the assessment of impacts from the operational Installation is detailed in Table 5.1, and the additional model input parameters are provided in the sections below.

6.1 Medium/ Long Term Process Contributions

The annual mean process contributions of NOx and NO_2 have been factored to take account of the maximum proposed 2,250 operating hours per year for the gas engines. This is based on the maximum number of hours in any one year, based on a 5-year rolling average of 1,500 hours per year.

The emissions have been modelled as a continuous source to account for the worst-case meteorological conditions to assess a robust worst-case and the PC factored for 2,250 / 8,760 hours per year to give the long-term mean result. As actual hours of operation for the Installation are not known, it is considered that this is more appropriate than modelling a time varying emission.

The Black Start diesel engine is assumed to be tested for 12 hours per year (1 hour per month) and therefore the emission have been factored and modelled as described for the gas engines.

6.2 Short Term Process Contributions

The hourly mean process contributions of NO_2 and CO have been assumed to occur continuously throughout the year, in order to ensure meteorological conditions that lead to the worst-case impacts are taken into consideration.

This approach has also been applied to the daily NOx impacts in the first instance, and is considered to be very much worst case, as the Installation is only likely to operate for 4 – 6 hours in any one a day. The potential for the site to operate continuously for 24 hours is highly unlikely.

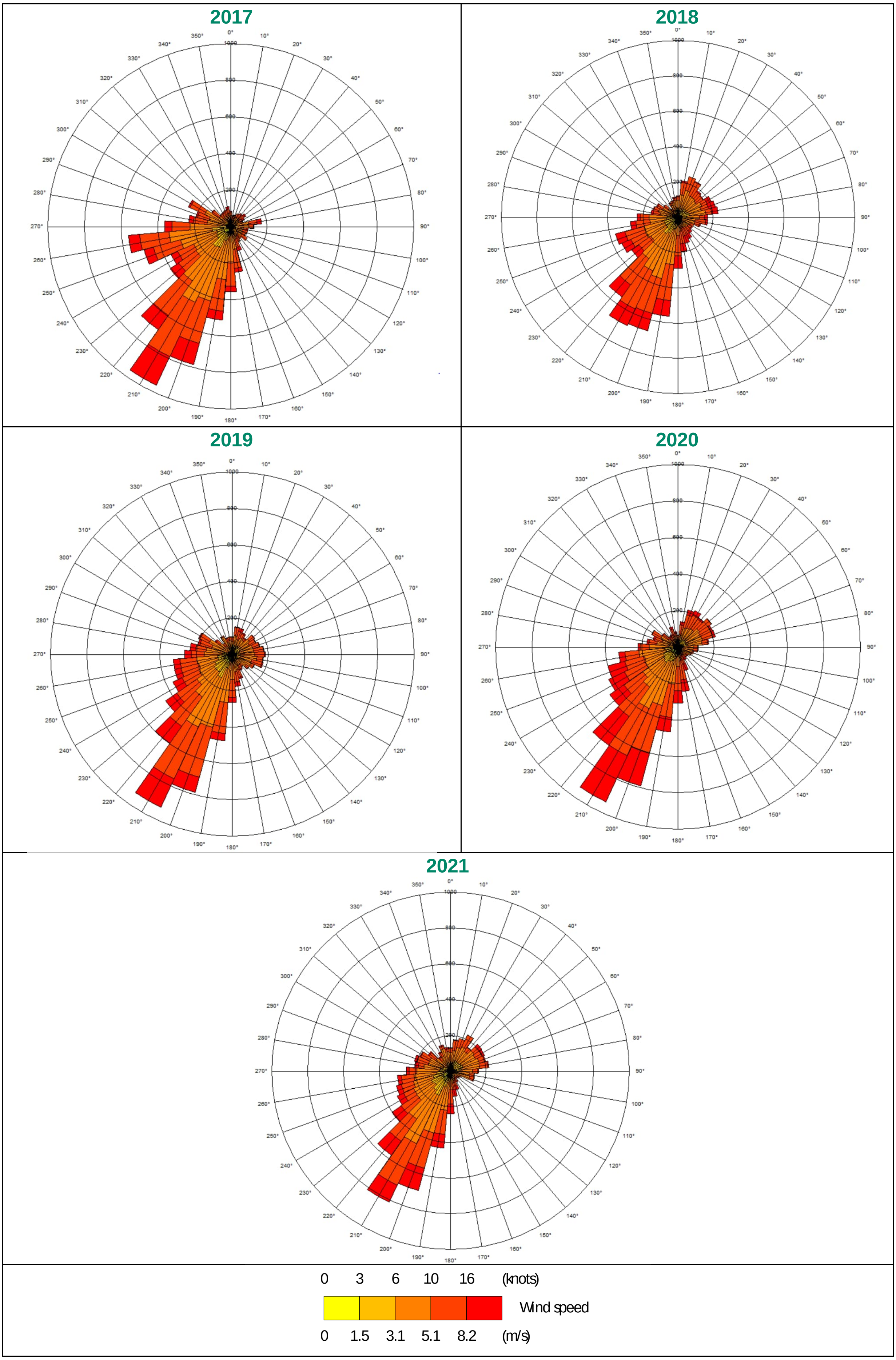
6.3 Meteorological Data

Actual measured hourly-sequential meteorological data is available for input into dispersion models, and it is important to select data as representative as possible for the site that is modelled. This is usually achieved by selecting a meteorological station as close to the site as possible, although other stations may be used if the local terrain and conditions vary considerably, or if the station does not provide sufficient data.

The meteorological site that was selected for the assessment is Humberside Airport, located approximately 9.5km south-west of the Installation, at a flat airfield in a principally agricultural area, and therefore a surface roughness of 0.2m (representative of minimum agricultural areas) has been selected for the meteorological site.

The modelling for this assessment has utilised five years of meteorological data for the period 2017 - 2021, and the worst-case impacts from all years modelled has been used in the assessment. The sensitivity of the results to different years' data is discussed in Section 8. The wind roses for Humberside Airport for 2017 to 2021 are provided in Table 6.1.

Table 6.1: Wind Rose, Humberside Airport 2017 - 2021



6.4 Buildings and Terrain

The presence of buildings or structures near to the emission points can have a significant effect on the dispersion of emissions. The wind field can become entrained into the wake of buildings, which causes the wind to be directed to ground level more rapidly than in the absence of a building. If an emission is entrained into this deviated wind field, this can give rise to elevated ground-level concentrations. Building effects are typically considered where a structure of height greater than 40% of the stack height is situated within 8 - 10 stack heights of the emissions source.

Buildings associated with the Installation (and the surrounding area) that are considered to be of sufficient height and volume to potentially impact on the dispersion of emissions from the engine stacks have been included in the dispersion model.

The sensitivity of the model results to the building dimensions is provided in Section 8.

Parameters representing the buildings included in the model are shown in Table 6.2 and are illustrated in Figure 6.2.

Table 6.2: Buildings Incorporated into the Modelling Assessment

Building	Height (m)[1]	Length (m)	Width (m)	Angle[2]
Generator Housings	4.75	65.6	30.6	60
Control Room	12	28	10	60
Cooling Units	5.7	31.5	10	60
Water Tank	12	10	10	0
Transformer Area	10	10	9	60
Other Tanks	7	33	8	60
VPI CHP Site	22	130	35	60
VPI-B OCGT	30	45	45	60

The local area upwind and downwind of the installation is flat, and predominantly industrial to the west, and agricultural to the north, south and east. A surface roughness of 0.5m, corresponding to Parkland and Open Suburbia, has therefore been selected to represent the local terrain. The sensitivity of the model results to surface roughness is provided in Section 8.

Site-specific terrain data has not been used in the model, as typically terrain data will only have a marked effect on predicted concentrations where hills with gradient of more than 1 in 10 are present in the vicinity of the source, which is not the case at the Installation.

6.5 Modelled Domain and Receptors

The main model results have been based on a nested grid extending 1km from the point sources with a grid resolution of 50m, 1km-2km at 100m and 2-4km at 200m. The nearest sensitive receptor to the source is located approximately 350m from the source, therefore this resolution is considered appropriate. Discrete receptor locations, including residential properties and ecological receptors up to 15km from the Installation, have also been included in the model. These discrete receptors are not affected by the grid resolution selected in the model. Modelled receptor locations are shown in Figures 4.1 and 4.2 (Annex A).

7. Results and Conclusions

The PCs of pollutants from dispersion modelling of the worst-case operational scenario for human health impacts, and for impacts at designated statutory and non-statutory ecological receptors, are shown in the following tables, together with baseline concentrations and the appropriate percentage of the Environmental Standard, as per EA's guidance.

Isopleth figures showing the maximum predicted annual mean and short-term process contributions of NO_2 and NOx are provided in Figures 7.1 - 7.4 (presented in Annex A).

The dispersion modelling includes a number of conservative assumptions in combination, including:

- Use of the worst-case year of meteorological data modelled;
- Maximum annual operation for the plant (2,250 hours);
- Operation of the plant at appropriate emission limit values; and
- Conservative estimates of background concentrations at the receptor locations.

The following abbreviations are used in Table 7.1 to Table 7.8:

- ES: Environmental Standard (NAQS, EAL, Critical Level);
- PC: this is the Process Contribution and represents the change caused by the Installation;
- Headroom: this is the short-term PC as a percentage of the available headroom between the baseline (ambient) concentration (AC) and the Environmental Standard; and
- PEC: this is the Predicted Environmental Concentration and is PC plus baseline (ambient) concentration (AC). It is the concentration expected at a particular receptor once the effect of the installation is taken into account.

7.1 Human Health Impacts

The modelling results for the Installation are presented in Table 7.1. The in-combination results, together with the planned VPI-B OCGT Peaking Plant are presented in Table 7.2.

Table 7.1: Predicted Ground Level Concentrations – VPI-A Gas Engines and Black Start Only

Pollutant	ES ($\mu g/m^3$)	Impact Location	PC ($\mu g/m^3$)	PC/ NAQS	PC < Insignificance Threshold?	PEC ($\mu g/m^3$)	PEC/ ES
NO_2 (1-hour mean, 99.79th %ile)	200	Max off-site	84.4	42%	**No**	114.4	57%
		Max residential receptor	18.6	9%	Yes	-	-
NO_2 (Annual mean)	40	Max off-site	6.4	16%	**No**	21.4	53%
		Max residential receptor	0.6	2%	**No**	15.6	39%
CO (1-hour mean)	30,000	Max off-site	977	3%	Yes	-	-
CO (8-hour, daily running mean)	10,000	Max off-site	791	8%	Yes	-	-

The maximum hourly mean process contribution of NO_2 at any off-site location beyond the Installation boundary represents 42% of the Environmental Standard, and is therefore not considered to be insignificant (i.e. results are greater than 10% of the Environmental Standard). As can be seen in Figure 7.1 (Annex A), the maximum impacts occur very close to the Installation Boundary and within the VPI-B Installation Boundary and therefore not in an area where the general public can access. Predicted impacts at the worst-case human health receptor are considerably less than this, with a PC at the worst-case receptor (R1 Hazel Dean) predicted to represent 9% of the Environmental Standard, and therefore considered to be insignificant at the first stage of screening. It is therefore considered that the short-term impacts from the VPI Immingham Energy Park A will be very unlikely to result in any exceedance of the hourly NO_2 Environmental Standard at any human health receptor. It should also be noted that this assessment includes the operation of the Black Start diesel engine, which will only be operated for very short periods for testing purposes, estimated to be up to 12 hours per year.

The maximum long-term process contribution of NO_2 at any off-site location beyond the Installation boundary results in a PC of 16% of the annual mean Environmental Standard, and therefore cannot be screened as insignificant at the first stage of screening. At the maximum human health receptor (R1 Hazel Dene) the maximum long-term PC is considerably reduced and represents 2% of the Environmental Standard. The second stage of assessment allows the PEC to be compared to the Environmental Standard. The annual average PEC at the worst-case receptor is 15.6µg/m^3, which represents 39% of the annual NO_2 Environmental Standard, and therefore is well below the Environmental Standard and therefore it is considered that the long-term impacts from the VPI Immingham Energy Park A will be very unlikely to result in any exceedance of the annual average NO_2 Environmental Standard at any human health receptor. Figure 7.2 (Annex A), shows the isopleths of the predicted annual average Process Contributions.

The maximum 1-hour and 8-hour mean process contributions of CO at maximum off-site impact locations are below the threshold for insignificance for short-term impacts, with worst-case PC of 3% of the 1-hour mean and 8% of the hourly mean Environmental Standard.

Table 7.2: Predicted Ground Level Concentrations – VPI-A Gas Engines, Black Start and VPI-B OCGT In-combination

Pollutant	ES (µg/m^3)	Impact Location	PC (µg/m^3)	PC/ NAQS	PC < Insignificance Threshold?	PEC (µg/m^3)	PC < Insignificance Threshold?
NO_2 (1-hour mean, 99.79th %ile)	200	Max off-site	84.4	42%	**No**	114.4	**No**
		Max residential receptor	18.6	9%	Yes	-	Yes
NO_2 (Annual mean)	40	Max off-site	6.4	16%	**No**	21.4	**No**
		Max residential receptor	0.7	2%	**No**	15.7	**No**
CO (1-hour mean)	30,000	Max off-site	977	3%	Yes	-	Yes
CO (8-hour, daily running mean)	10,000	Max off-site	800	8%	Yes	-	Yes

It can be seen in Table 7.2 that the results for the in-combination impacts with the OCGT are comparable with those to the VPI Immingham Energy Park A Installation on its own. This is due to the lower stack height of the gas engines resulting in ground level impacts occurring closer to the emission sources than for the OCGT. Again, although at the maximum human health receptor (R2 Station House) the maximum long-term PC represents 2% of the Environmental Standard and therefore cannot be screened as insignificant at the first stage of screening, the PEC is still only 15.7µg/m^3, which still represents 39% of the annual NO_2 Environmental Standard, and therefore is well below the Environmental Standard.

7.2 NOx Impacts at Ecological Receptors

The ecological modelling results for the VPI Immingham Energy Park A plant are presented in Table 7.3. The in-combination results, together with the planned VPI-B OCGT Peaking Plant are presented in Table 7.4.

Table 7.3: Predicted Ground Level Concentrations of NOx – VPI-A Gas Engines and Black Start Only

Receptor ID	Annual Average Impacts						24-hour Average Impacts					
	AQAL	PC (µg/m³)	PC/ AQAL %	BC (µg/m³)	PEC (µg/m³)	PEC/ AQAL %	AQAL	PC (µg/m³)	PC/ AQAL %	BC (µg/m³)	PEC (µg/m³)	PEC/ AQAL %
E1 – Worst-case location	30	0.58	1.9%	18.4	19.0	63%	75	11.4	15%	27.6	39.0	52%
E1 – Rich Fens		0.29	1.0%	20.1	20.4	68%		8.2	11%	30.2	38.4	51%
E1 – Saltmarsh		0.29	1.0%	20.1	20.2	68%		6.9	9%	30.2	37.1	49%
E1 – Hay Meadow		0.01	<0.1%	13.9	13.9	46%		1.1	1%	20.8	21.9	29%
E2		0.29	1.0%	20.1	20.4	68%		8.2	11%	30.2	38.4	51%
E3		0.01	<0.1%	11.3	11.3	38%		0.8	1%	16.9	17.7	24%
E4		0.01	<0.1%	12.4	12.4	41%		1.4	2%	18.6	20.0	27%
E5		0.23	0.8%	15.7	16.0	53%		25.7	34%	23.6	49.3	66%
E6		0.91	3.0%	16.2	17.1	57%		39.9	53%	24.3	64.2	86%
E7		0.53	1.8%	17.5	18.0	60%		28.7	38%	26.2	54.9	73%
E8		0.10	0.3%	17.2	17.3	58%		7.7	10%	25.7	33.4	45%
E9		0.22	0.7%	14.6	14.8	49%		11.6	15%	21.9	33.5	45%
E10		0.07	0.2%	15.9	15.9	53%		5.4	7%	23.8	29.2	39%
E11		0.24	0.8%	15.7	16.0	53%		20.3	27%	23.6	44.0	59%

Table 7.4: Predicted Ground Level Concentrations of NOx – VPI-A Gas Engines, Black Start and VPI-B OCGT In-combination

Receptor ID	Annual Average Impacts						24-hour Average Impacts					
	AQAL	PC (µg/m³)	PC/ AQAL %	BC (µg/m³)	PEC (µg/m³)	PEC/ AQAL %	AQAL	PC (µg/m³)	PC/ AQAL %	BC (µg/m³)	PEC (µg/m³)	PEC/ AQAL %
E1 – Worst-case location	30	0.68	2.3%	18.4	19.1	64%	75	12.8	17%	27.6	40.4	54%
E1 – Rich Fens		0.33	1.1%	20.1	20.5	68%		8.4	11%	30.2	38.6	51%
E1 – Saltmarsh		0.32	1.1%	20.1	20.5	68%		7.4	10%	30.2	37.6	50%
E1 – Hay Meadow		0.02	<0.1%	13.9	13.9	46%		1.4	2%	20.8	22.2	30%
E2		0.33	1.1%	20.1	20.5	68%		8.4	11%	30.2	38.6	51%
E3		0.01	<0.1%	11.3	11.3	38%		1.1	1%	16.9	18.0	24%
E4		0.02	<0.1%	12.4	12.4	41%		1.6	2%	18.6	20.2	27%
E5		0.26	0.9%	15.7	16.0	53%		25.7	34%	23.6	49.3	66%
E6		0.92	3.1%	16.2	17.1	57%		40.1	54%	24.3	64.4	86%
E7		0.54	1.8%	17.5	18.0	60%		29.2	39%	26.2	55.4	74%
E8		0.12	0.4%	17.2	17.3	58%		9.4	13%	25.7	35.2	47%
E9		0.23	0.8%	14.6	14.8	49%		13.8	18%	21.9	35.6	48%
E10		0.07	0.3%	15.9	16.0	53%		6.0	8%	23.8	29.8	40%
E11		0.27	0.9%	15.7	16.0	53%		20.4	27%	23.6	44.0	59%

The predicted annual average NOx concentrations are below the 1% screening threshold to demonstrate insignificance at all receptors except at E1 and the E6, E7 and E8 Local Wildlife Sites. As the PECs are well below the Environmental Standard at all of these sites (68%, 57, 58% and 60% respectively) for both the operation of the Installation and both the Installation and the VPI-B OCGT sites in-combination the impacts are considered to be acceptable when compared to the EA's screening methodology. Figures 7.3 and 7.4 (Annex A) show the NOx isopleths for the annual average and daily impacts respectively.

7.3 Deposition Impacts and Effects on Ecological Receptors

Predicted nitrogen deposition and acid deposition concentrations are presented in Tables 7.5 – 7.8. Critical loads for nitrogen deposition were obtained from APIS[6], as referred to previously in this report. Data on APIS is only pertinent to statutory ecological sites, however advise from ecologists has provided the lowest appropriate critical load for the non-statutory sites included in the assessment (E5 - E11). There are no equivalent values for acid deposition, therefore acid deposition data presented in this report is limited to statutory ecological sites only.

Table 7.5: Nitrogen Deposition - VPI-A Gas Engines and Black Start Only

Receptor ID	Most Stringent Critical Load Class for the Site	Background Nitrogen Deposition (kg N/ha/yr)	Lower value of Critical Load Range	PC (kg N/ha/yr)	PC% Critical Load	PEC (kg N/ha/yr)	PEC% Critical Load
E1a	Northern wet heath	20.44	10	0.042	0.41%	20.48	205%
E1b	Pioneer, low, mid upper saltmarshes	20.44	20	0.041	0.21%	20.48	102%
E1c	Low and medium altitude hay meadows	20.30	20	0.002	0.01%	20.30	102%
E2	Pioneer, low, mid upper saltmarshes	20.44	20	0.042	0.21%	20.48	102%
E3	Sub-atlantic semi-dry calcareous grassland	22.26	15	0.001	0.01%	22.26	148%
E4a	Non-mediterranean dry acid and neutral closed grassland	24.92	10	0.001	0.01%	24.92	249%
E4b	Meso- and eutrophic Quercus woodland	42.60	15	0.003	0.02%	42.60	284%
E5	Neutral grassland	20.40	10	0.033	0.33%	20.43	204%
E6	Broadleaved woodland	34.2	10	0.262	2.6%	20.66	345%
E7	Wetland and reedbeds	20.40	10	0.154	1.5%	20.55	206%
E8	Broadleaved woodland	34.20	10	0.015	0.15%	34.21	342%
E9	Neutral grassland	20.40	10	0.031	0.31%	20.43	204%
E10	Standing open water and neutral grassland	20.40	10	0.010	0.10%	20.41	204%
E11	Calcareous grassland	20.40	15	0.034	0.23%	20.43	136%

Table 7.6: Acid Deposition - VPI-A Gas Engines Only

Receptor ID	Most Stringent Critical Load Class for the Site	Background Deposition (keq ha/yr)	Relevant Critical Load (keq ha/yr)	Background % of Critical Load	PC (keq N/ha/yr)	PC% Critical Load	PEC% Critical Load
E1b	Acid grassland	N: 1.42 S: 0.18	MinNMinN: 0.223 MinCLMaxS: 0.42 MinCLMaxN: 0.643	248.8%	N: 0.003	0.5%	249.3%
E1b	Calcareous grassland	N: 1.42 S: 0.18	MinNMinN: 0.856 MinCLMaxS: 4.00 MinCLMaxN: 4.856	32.9%	N: 0.003	0.1%	33.0%
OE1d	Dwarf shrub heath	N: 1.48 S: 0.31	MinNMinN: 0.499 MinCLMaxS: 0.42 MinCLMaxN: 1.312	136.4%	N: 0.0001	0.0%	136.4%
OE2	No critical load assigned in APIS						
OE3	Calcareous grassland	N: 1.58 S:0.17	MinNMinN: 0.856 MinCLMaxS: 4.00 MinCLMaxN: 4.856	36.0%	N: 0.0001	0.0%	36.0%
OE4a	Unmanaged Broadleafed/ Coniferous woodland	N: 3.04 S: 0.23	MinNMinN: 0.285 MinCLMaxS: 0.748 MinCLMaxN: 1.033	316.6%	N: 0.0001	0.0%	316.6%
OE4b	Acid grassland	N: 1.78 S: 0.19	MinNMinN: 0.366 MinCLMaxS: 0.17 MinCLMaxN: 0.536	367.5%	N: 0.0002	0.0%	367.5%

Table 7.7: Nitrogen Deposition - VPI-A Gas Engines, Black Start and VPI-B OCGT In-combination

Receptor ID	Most Stringent Critical Load Class for the Site	Background Nitrogen Deposition (kg N/ha/yr)	Lower value of Critical Load Range	PC (kg N/ha/yr)	PC% Critical Load	PEC (kg N/ha/yr)	PEC% Critical Load
E1a	Northern wet heath	20.44	10	0.047	0.47%	20.49	205%
E1b	Pioneer, low, mid upper saltmarshes	20.44	20	0.047	0.23%	20.49	102%
E1c	Low and medium altitude hay meadows	20.30	20	0.003	0.01%	20.30	102%
E2	Pioneer, low, mid upper saltmarshes	20.44	20	0.047	0.24%	20.49	102%
E3	Sub-atlantic semi-dry calcareous grassland	22.26	15	0.002	0.01%	22.26	148%
E4a	Non-mediterranean dry acid and neutral closed grassland	24.92	10	0.003	0.03%	24.92	249%
E4b	Meso- and eutrophic Quercus woodland	42.60	15	0.005	0.03%	42.61	284%
E5	Neutral grassland	20.40	10	0.037	0.37%	20.44	204%
E6	Broadleaved woodland	34.20	10	0.264	2.6%	20.66	345%
E7	Wetland and reedbed	20.40	10	0.157	1.6%	20.56	206%
E8	Broadleaved woodland	34.20	10	0.017	0.17%	34.22	342%
E9	Neutral grassland	20.40	10	0.033	0.33%	20.43	204%
E10	Standing open water and neutral grassland	20.40	10	0.011	0.11%	20.41	204%
E11	Calcareous grassland	20.40	15	0.039	0.26%	20.44	136%

Table 7.8: Acid Deposition - VPI-A Gas Engines, Black Start and VPI-B OCGT In-combination

Receptor ID	Most Stringent Critical Load Class for the Site	Background Deposition (keq ha/yr)	Relevant Critical Load (keq ha/yr)	Background % of Critical Load	PC (keq N/ha/yr)	PC% Critical Load	PEC% Critical Load
E1b	Acid grassland	N: 1.42 S: 0.18	MinNMinN: 0.223 MinCLMaxS: 0.42 MinCLMaxN: 0.643	248.8%	N: 0.003	0.5%	249.3%
E1b	Calcareous grassland	N: 1.42 S: 0.18	MinNMinN: 0.856 MinCLMaxS: 4.00 MinCLMaxN: 4.856	32.9%	N: 0.003	0.1%	33.0%
OE1d	Dwarf shrub heath	N: 1.48 S: 0.31	MinNMinN: 0.499 MinCLMaxS: 0.42 MinCLMaxN: 1.312	136.4%	N: 0.0002	0.0%	136.4%
OE2	No critical load assigned in APIS						
OE3	Calcareous grassland	N: 1.58 S:0.17	MinNMinN: 0.856 MinCLMaxS: 4.00 MinCLMaxN: 4.856	36.0%	N: 0.0001	0.0%	36.0%
OE4a	Unmanaged Broadleafed/ Coniferous woodland	N: 3.04 S: 0.23	MinNMinN: 0.285 MinCLMaxS: 0.748 MinCLMaxN: 1.033	316.6%	N: 0.0002	0.0%	316.6%
OE4b	Acid grassland	N: 1.78 S: 0.19	MinNMinN: 0.366 MinCLMaxS: 0.17 MinCLMaxN: 0.536	367.5%	N: 0.0004	0.1%	367.6%

The predicted deposition of nutrient nitrogen and acidity concentrations presented are below the 1% screening threshold at all statutory habitat receptors for the Installation on its own, and when operational with the VPI-B OCGT. The impacts at statutory sites can therefore be considered to be insignificant.

At non-statutory habitat receptors (E6 (Burkinshaws Covert) and E7 (Station Road Fields)), the impacts are slightly over the 1% threshold to demonstrate insignificance, however these are LWS and not statutory sites. Given the conservative nature of the assessment carried out, it is anticipated that the actual impacts from the Installation will be lower than those presented in this assessment. In addition, the background deposition at both these sites is well in excess of the relevant Critical Load, that the relatively small additional contribution predicted by the operation of the Installation is considered unlikely to cause adverse effects at these sites.

8. Sensitivity Analysis

The assessment has taken into consideration the sensitivity of predicted results to dispersion model input variables, to identify the realistic worst-case process contributions at sensitive receptor locations. These variables include:

- Meteorological data, for which five years' recent data from a representative meteorological station (Humberside airport) have been used;
- Buildings, structures and local topography that could affect dispersion from the source; and
- Surface roughness.

Specifically, sensitivity to meteorological data has been examined by running models under met conditions for 5 meteorological years (2017 - 2021). The highest concentrations predicted by the model in any of these years was then subjected to sensitivity testing by rotating modelled buildings through 90°, separately rotating the engine sources through 90°, altering the surface roughness at site to 0.3m and 1.0m.

The maximum predicted concentration of NO_2 at the worst-affected human health receptors and NOx at the worst-affected statutory designated ecological receptor, associated with the variable input parameters, are presented in Table 8.1 as the percentage of maximum reported values used in the main assessment.

Table 8.1: Point Source Dispersion Model Sensitivity Analysis – Worst-case Results NO_2/ NO_x

Model Input Variable	Human Health Receptor		Statutory Ecological Receptor	
	Short-term	Long-term	Short-term	Long-term
Meteorological data	92-100%	76-100%	83-100%	78-100%
Building orientations	100%	100%	100%	100%
Stack orientations	100%	100%	101%	100%
Surface roughness	94 – 104%	99 – 102%	96-104%	94-111%

The main uncertainty associated with the model is considered to be meteorological data, with the lowest PCs representing 76% of the maximum reported annual mean NO_2 PC at human health receptors; this is equivalent to an overall uncertainty associated with the annual mean PC at the worst-affected receptor of -0.15µg/m^3 (or -0.4% of the annual average Environmental Standard).

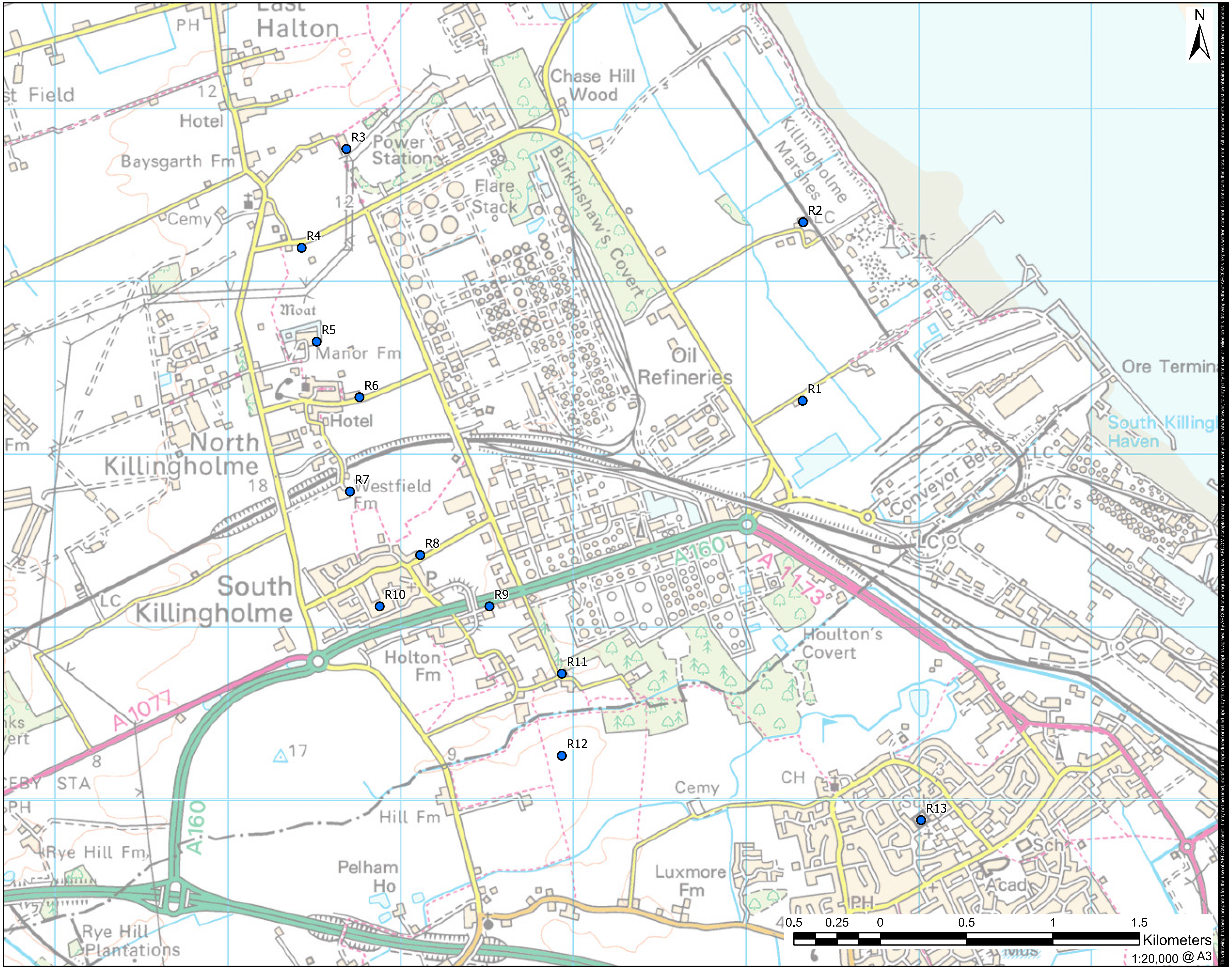
The effect of representation of buildings and stack orientation within the dispersion model has been assessed, with very little variation in short-term and long-term PCs at the worst-affected receptors determined for the alternative layouts, or a change in the stack orientation.

Surface roughness representation within the model has been assessed with higher surface roughness leading to a reduction in the predicted concentrations, and the lower surface roughness leading to a marginal increase in the predicted concentrations.

The overall worst-case input parameters have been used to generate the PCs used in the main assessment. Application of the above sensitivity results to PCs does not adversely alter the predicted effects significance assessment.

Annex A - Figures

Revision: Rev No. Drawn: AB Checked: HW Approved: HW Date: 16/09/2022



AECOM

PROJECT

VPI-A Gas Engine Peaking Plant

CLIENT

VPI Immingham Energy Park A Limited

CONSULTANT

AECOM Limited
12 Regan Way
Chetwynd Business Park
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Nottingham, NG9 6RZ
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LEGEND

Human Receptors

NOTES

ISSUE PURPOSE

DRAFT/FINAL

PROJECT NUMBER

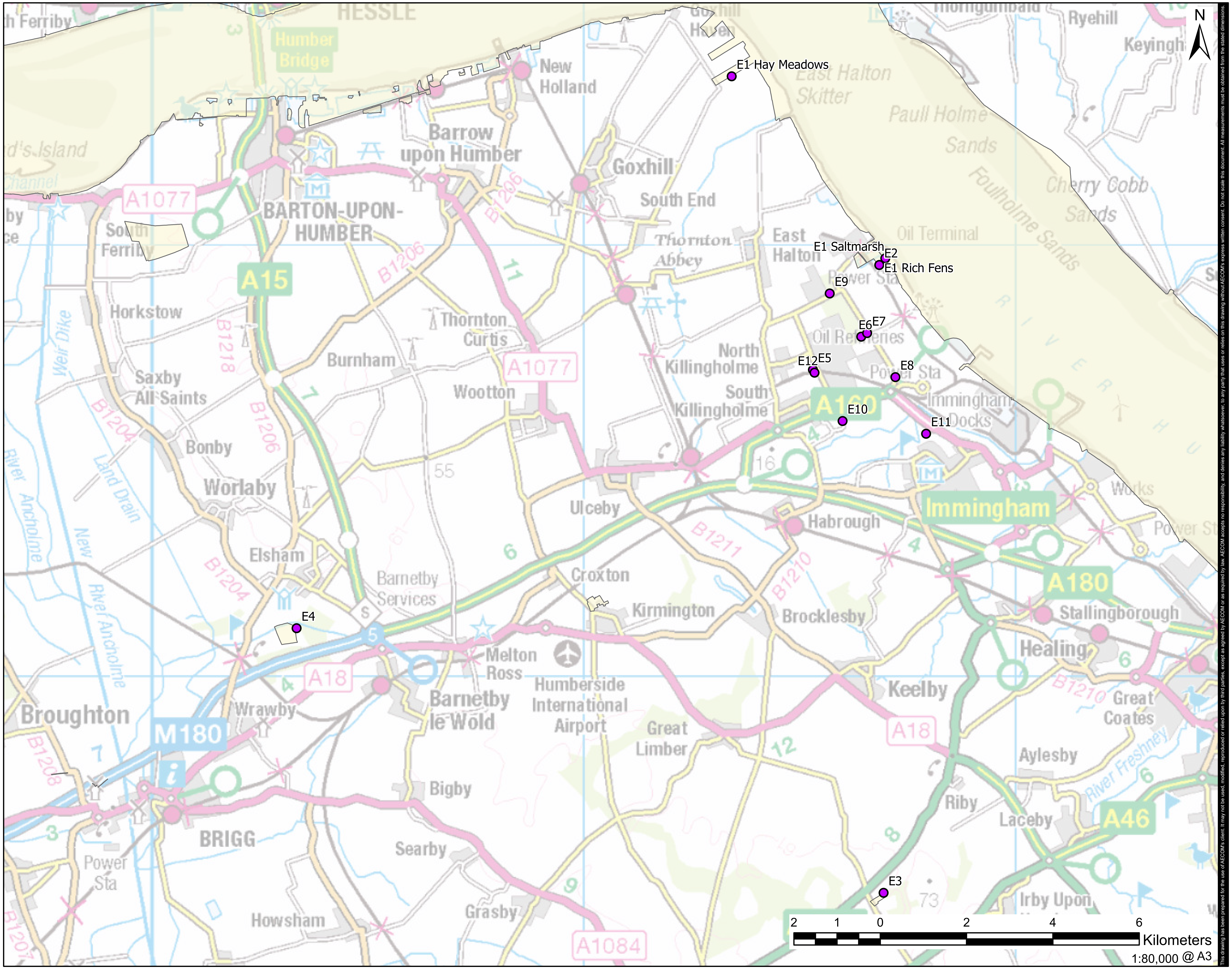
60684052

SHEET TITLE

Human Receptor Locations

SHEET NUMBER

Figure 4.1



Revision: Rev No. Drawn: AB Checked: HW Approved: HW Date: 16/09/2022

AECOM

PROJECT

VPI-A Gas Engine Peaking Plant

CLIENT

VPI Immingham Energy Park A Limited

CONSULTANT

AECOM Limited
12 Regan Way
Chetwynd Business Park
Chilwell
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www.aecom.com

LEGEND

- Ecological Receptors
- RAMSAR/SAC/SPA/SSSI Site

NOTES

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ISSUE PURPOSE

FINAL

PROJECT NUMBER

60684052

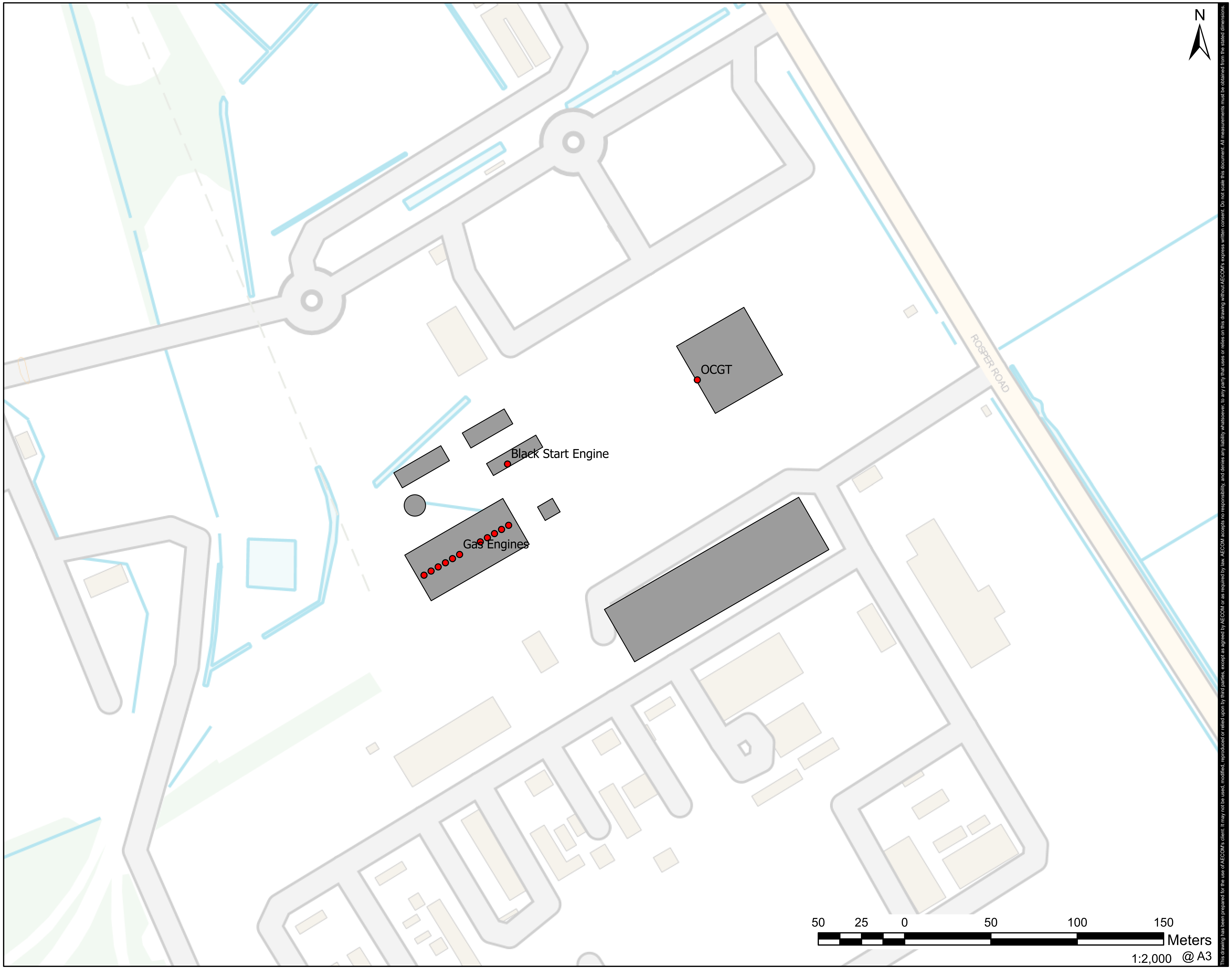
SHEET TITLE

Ecological Receptor Locations

SHEET NUMBER

Figure 4.2

Revision: Rev No. Drawn: AB Checked: HW Approved: HW Date: 16/09/2022



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PROJECT

VPI-A Gas Engine Peaking Plant

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LEGEND

- Modelled Sources
- Modelled Buildings

NOTES

ISSUE PURPOSE

FINAL

PROJECT NUMBER

60684052

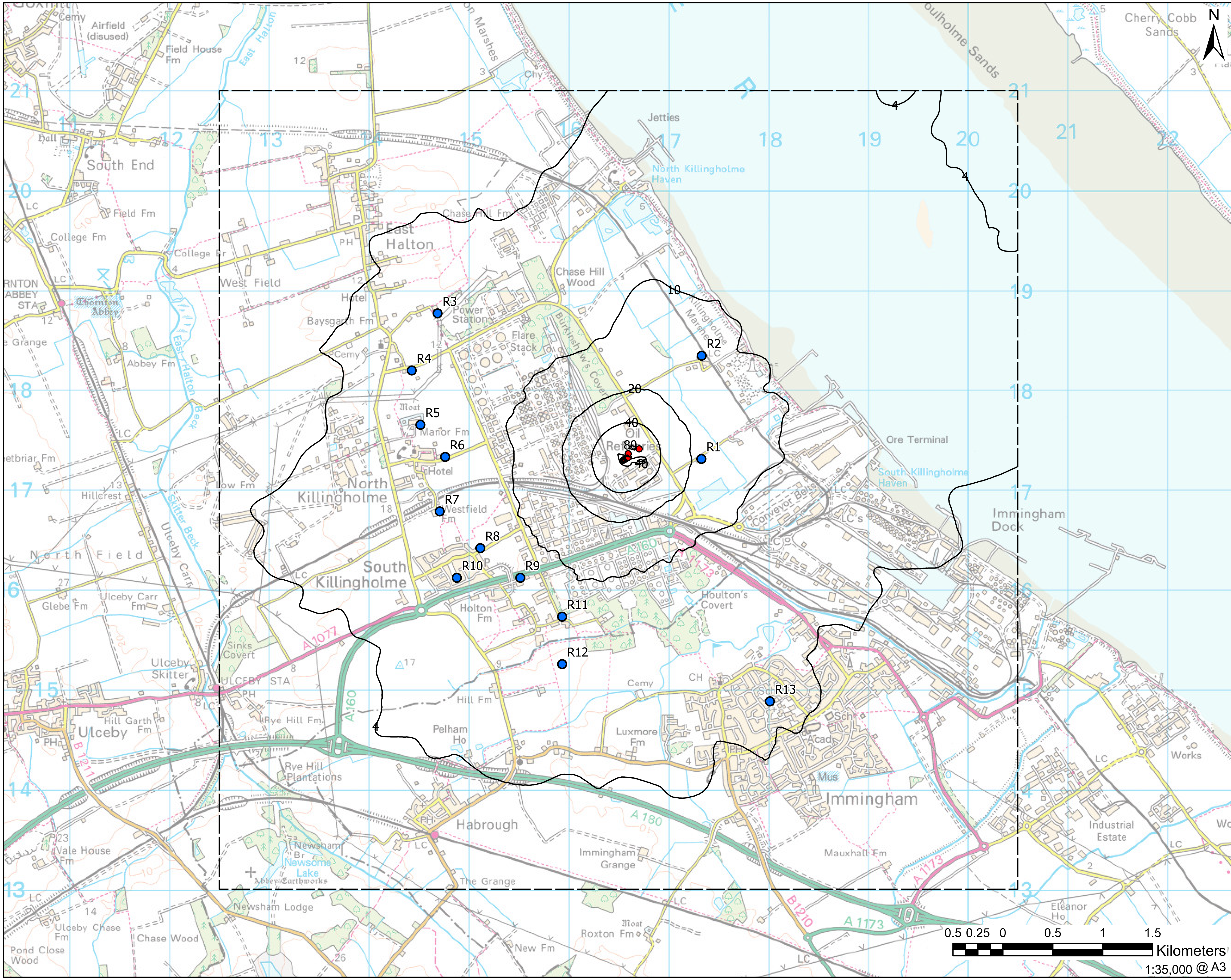
SHEET TITLE

Modelled Sources and Buildings

SHEET NUMBER

Figure 6.2

Revision: Rev No. Drawn: AB Checked: HW Approved: HW Date: 16/09/2022



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LEGEND

- Human Receptors
- Sources
- 99.79th %ile 1-hour NO_2
- Model Domain

NOTES

ISSUE PURPOSE

FINAL

PROJECT NUMBER

60684052

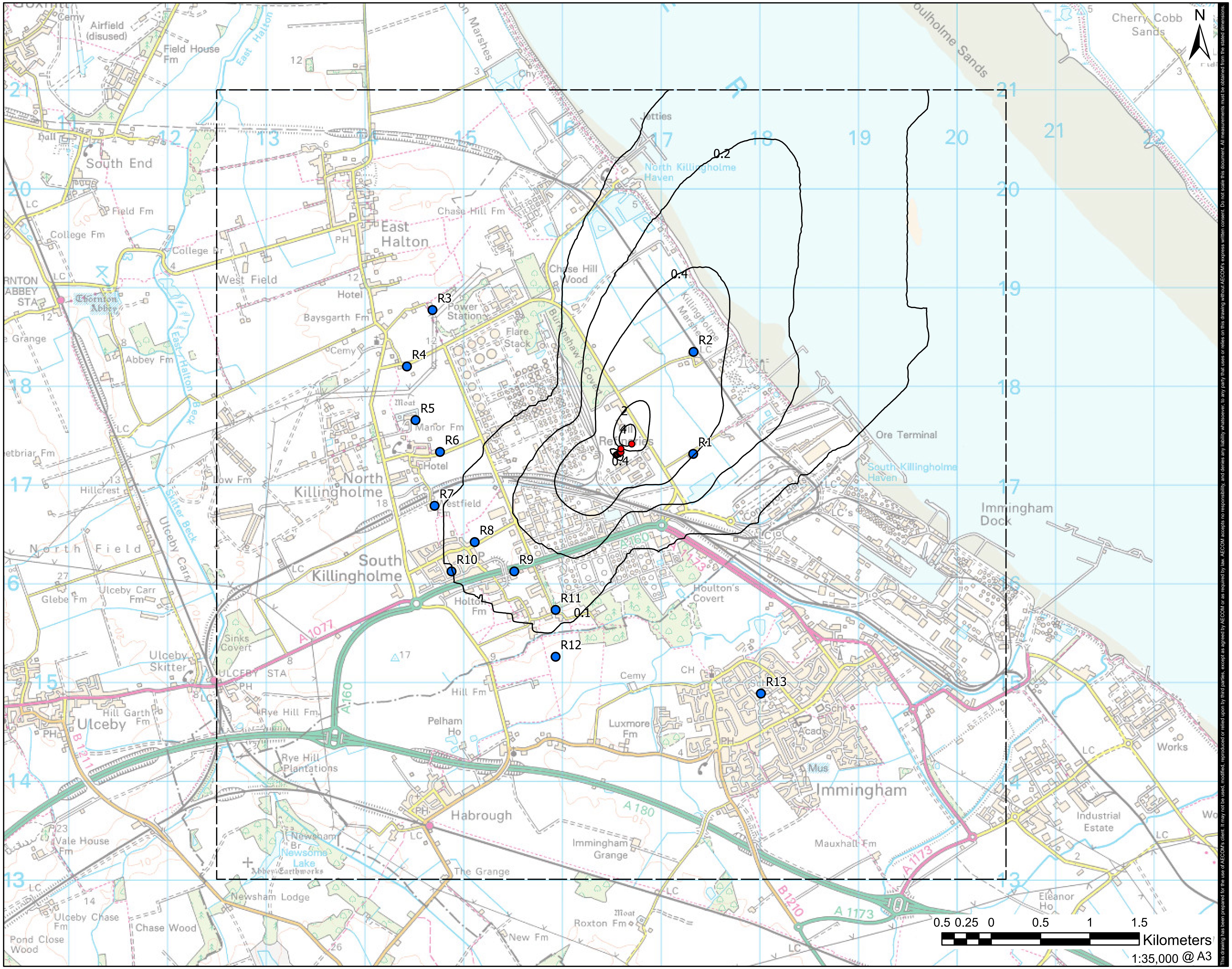
SHEET TITLE

Isopleth Plot Showing PC to 99.79th %ile NO_2 ($\mu g/m^3$)

SHEET NUMBER

Figure 7.1

Revision: Rev No. Drawn: AB Checked: HW Approved: HW Date: 16/09/2022



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LEGEND

- Human Receptors
- Sources
- Annual Mean NO_2
- Model Domain

NOTES

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ISSUE PURPOSE

FINAL

PROJECT NUMBER

60684052

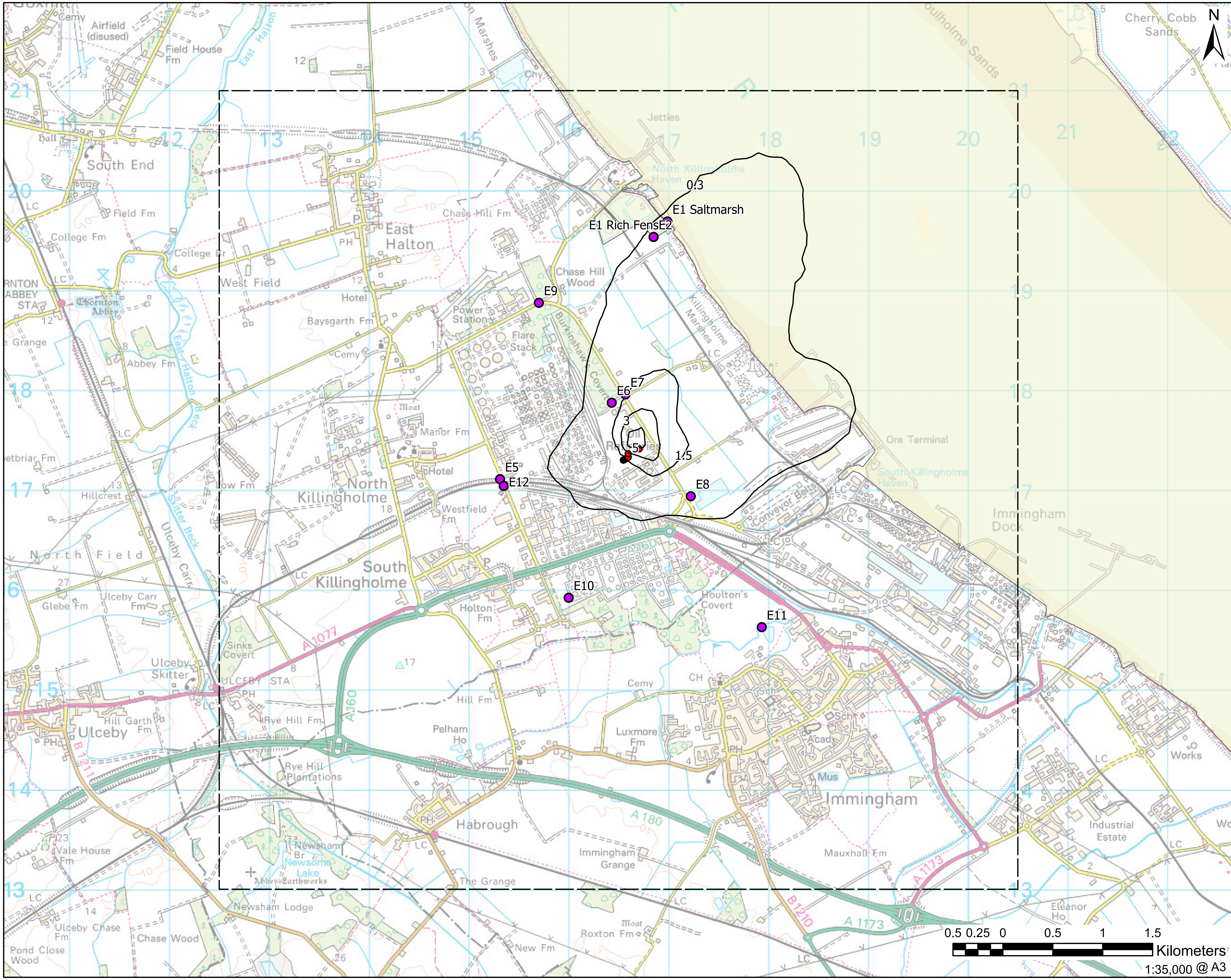
SHEET TITLE

Isopleth Plot Showing PC to Annual Mean NO_2 ($\mu g/m^3$)

SHEET NUMBER

Figure 7.2

Revision: Rev No. Drawn: AB Checked: HW Approved: HW Date: 16/09/2022



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LEGEND

- Ecological Receptors
- Sources
- Annual Mean NO_X
- Model Domain
- RAMSAR/SAC/SPA/SSSI Site

NOTES

ISSUE PURPOSE

FINAL

PROJECT NUMBER

60684052

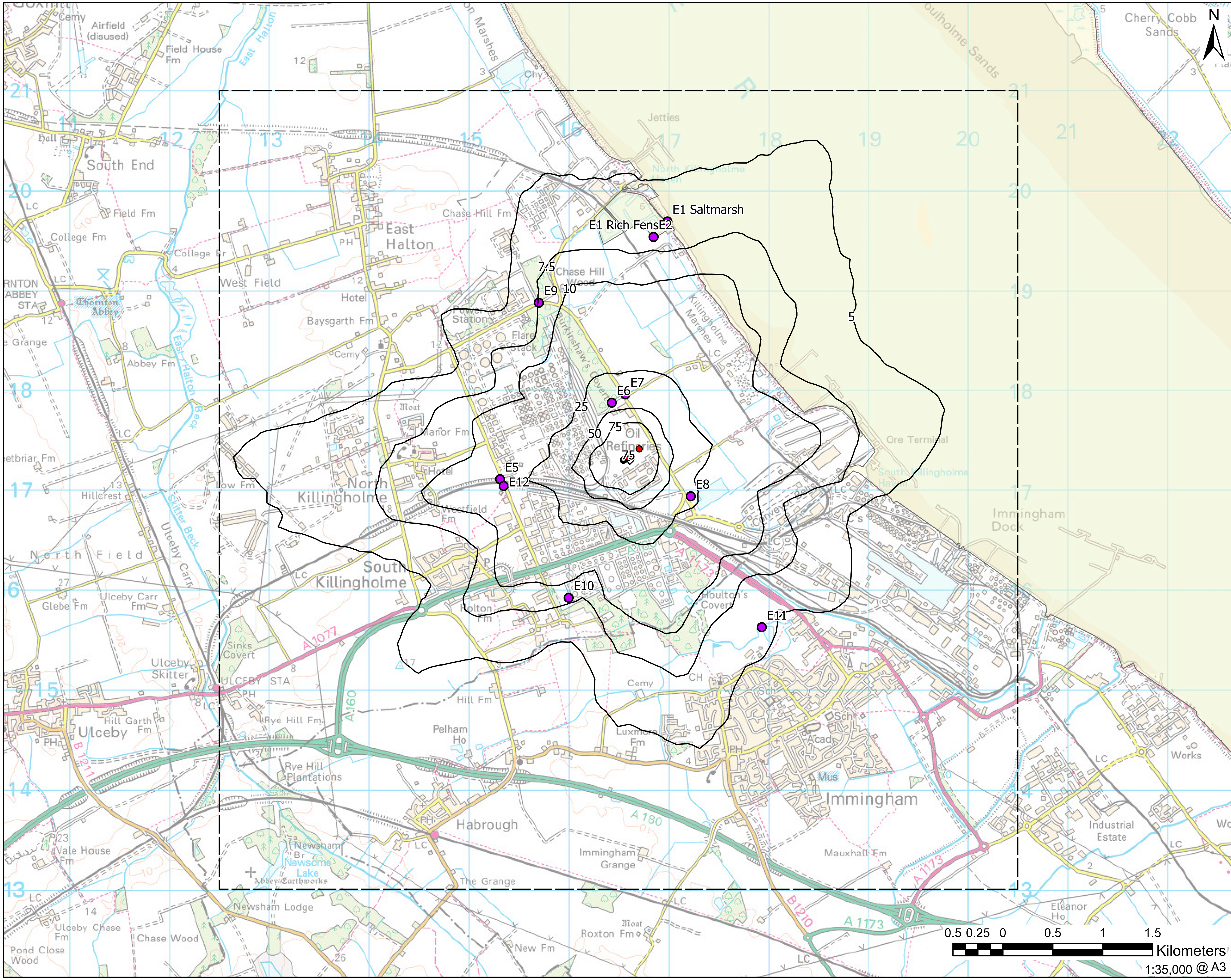
SHEET TITLE

Isopleth Plot Showing PC to Annual Mean NO_X (μg/m3)

SHEET NUMBER

Figure 7.3

Revision: Rev No. Drawn: AB Checked: HW Approved: HW Date: 16/09/2022



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LEGEND

- Ecological Receptors
- Sources
- Maximum 24-hour Mean NO_x
- Model Domain
- RAMSAR/SAC/SPA/SSSI Site

NOTES

ISSUE PURPOSE

FINAL

PROJECT NUMBER

60684052

SHEET TITLE

Isopleth Plot Showing PC to Maximum 24-hour NO_X ($\mu g/m^3$)

SHEET NUMBER

Figure 7.4

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