Immingham Green Energy Terminal Green Hydrogen Production Facility

Environmental Permit Application Duly Making Response
Application Reference: EPR/VP3425SV/A001

Air Dispersion Modelling Report

Air Products BR Limited

23 September 2024

Delivering a better world

Quality information

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1. Introduction

This air dispersion modelling report has been prepared by AECOM Limited (AECOM) on behalf of Air Products (BR) Limited (AP), in support of the Environmental Permit (EP) application for the proposed Green Hydrogen (H_2) Production Facility ('proposed installation') which forms part of the wider Immingham Green Energy Terminal (IGET).

Emissions to air consist of both point source releases and fugitive emissions. The main point source emissions will be from the flue gas stack reformers, Hydrogen Production Unit (HPU) flares and pilots and the ammonia storage flares and pilot. The main pollutant from the onshore HPU's is the oxides of nitrogen (NO_X) emissions from the combustion of natural gas. These emissions will be reduced by the use of Selective Catalytic Reduction (SCR) technology. There will be ammonia (NH_3) emissions associated with the SCR process and both NO_X and NH_3 can be harmful to nature conservation sites. When NO_X is converted to nitrogen dioxide (NO_2) following the release into ambient air it can be harmful to human health. NO_2 and NH_3 also contribute to nitrogen deposition. Flares will be a source of combustion emissions but will be operating in pilot mode for the majority of the time and flaring mode only in the event of an emergency.

The assessment also considers emissions from vessels when docked at the proposed installation's jetty. Vessel emissions to air relate to combustion emissions from auxiliary engine and boiler operation. The main pollutants from this source include NO_X associated with combustion marine gas oil and NH_3 associated with the SCR technology in use in some vessels.

Odour is not expected to be an issue at the installation due to the nature of the process, however an Odour Management Plan has been included as part of the application (Appendix I) to manage the risk of fugitive emissions from potential leaks and/or accidents. The main fugitive emission will be NH_3 from potential leaks and controlled emissions from flare stacks, however these emissions are expected to be minimal. Risks associated with fugitive emissions to air have been summarised in the Qualitative Environmental Risk Assessment (Appendix J).

The assessment includes mitigation measures that are inherent within the design of the proposed installation, including the use of SCR technology on the onshore HPU's and the incorporation of a suitable stack emissions release height. Such measures are required to reduce impacts on air quality receptors to 'insignificant' and have been determined through an air quality impact assessment, undertaken in accordance with EA guidance. The assessment includes dispersion modelling of minimum stack heights and the worst case layout of the installation in relation to receptors.

2. Regulatory Framework

The regulatory framework relevant to this assessment is summarised in Table 2-1.

Table 2-1: Relevant legislation, policy and guidance regarding air quality

Legislation/ Policy/Guidance	Summary
Clean Air for Europe	The Clean Air for Europe ("CAFÉ") programme consolidated and replaced (with the exception of the 4th Daughter Directive) preceding directives with a single legal act, the Ambient Air Quality and Cleaner Air for Europe Directive 2008/50/EC (1.1.1.1.1.1a.Ref 3) (hereafter referred to as the 'EU Air Quality Framework Directive').
Air Quality Standards Regulations	Directive 2008/50/EC is transcribed into UK legislation by the Air Quality Standards Regulations 2010, which came into force on 11 June 2010. The 2010 Regulations (1.1.1.1.1.1a.Ref 14) were amended by the Air Quality Standards Regulations 2016 (1.1.1.1.1.1a.Ref 15), which came into force on 31 December 2016. The limit values defined therein are legally-binding and are considered to apply everywhere (with the exception of the carriageway and central reservation of roads and any locations where the public do not have access). EU limit values were published in these regulations for 7 pollutants, as well as target values for an additional 5 pollutants.
UK Air Quality Strategy	Part IV of the Environment Act (2021) (1.1.1.1.1.1a.Ref 16) requires the Government to produce a national Air Quality Strategy ("AQS") which contains standards, Air Quality Objectives (AQOs) and measures for improving ambient air quality. Defra's Clean Air Strategy is the current revision of the Strategy (1.1.1.1.1.1a.Ref 6). The AQS outlines proposals to tackle emissions from a range of sources. This includes providing clear and effective guidance on how Air Quality Management Areas ("AQMAs"), Clean Air Zones ("CAZ") and Smoke Control Areas interrelate and how they can be used by local government to tackle pollution. New legislation will seek to shift the focus towards prevention of exceedances rather than tackling pollution when limits have been surpassed. The AQS sets out air quality objectives that are maximum ambient pollutant concentrations that are not to be exceeded either without exception or with a permitted number of exceedances over a specified timescale. Air quality objectives, as defined by the Air Quality Strategy, are generally in line with the EU limit values, although they have different dates for compliance, and a different legal status as follows: EU limit values (as transcribed into UK legislation) are legally binding in the UK. National government compliance at the agglomeration scale is mandatory. UK air quality objectives are for the purposes of LAQM and there is no legal obligation for local authorities to achieve them. They do have a responsibility to work towards achieving them. The EU limit values and air quality objectives for the remaining pollutants are displayed in Table 2-2.
UK Clean Air Quality Strategy	In 2019, the UK adopted the Clean Air Strategy 2019 (1.1.1.1.1.1a.Ref 6), setting out targets and the policies for how it will tackle all sources of air pollution, complementing three other UK government strategies: the Industrial Strategy, the Clean Growth Strategy and the 25 Year Environment Plan. It sets out the Government's long-term target to reduce people's exposure to $PM_{2.5}$, to 10 µg/m^3 in line with the World Health Organisation's (WHO) current guidelines. It sets out how the Government will reduce $PM_{2.5}$ concentrations across the UK, so that the number of people living in locations above the WHO guideline level of 10 µg/m^3 is reduced by 50% by 2025.
Environment Act 2021	The Environment Act 2021 (1.1.1.1.1.1a.Ref 16) is the UK's primary piece of environmental legislation post-Brexit for environmental protection and the delivery of the Government's 25-year environment plan It includes provisions to establish a post-Brexit set of statutory environmental principles and ensure environmental governance through an environmental watchdog, the Office for Environmental Protection ("OEP"). Part IV of the Environment Act (2021) requires the Government to produce a national AQS which contains standards, objectives and measures for improving ambient air quality. The AQS proposes for the Secretary of State to publish a report reviewing the AQS every five years (as a minimum and with yearly updates to Parliament). The Act also requires the Government to set two targets by October 2022: the first on the amount of $PM_{2.5}$ pollutant in the ambient air and a second long-term target set at least 15 years ahead to encourage stakeholder investment. Those Targets are set by the Environmental Improvement Plan (1.1.1.1.1.1a.Ref 17).
Environmental Permitting Regulations 2016	The Environmental Permitting (England and Wales) Regulations 2016 streamlined the legislative system for industrial and waste installations into a single permitting structure for those activities that have the potential to cause harm to human health or the environment. The permitting system aims to protect the environment, encourage best practice in the operation of regulated facilities, minimise the regulatory administrative burden to operators while fully implementing the requirements of EU legislation. This application is for new bespoke environmental permit for a new Green H_2 Production Facility. The application is made under the Environmental Permitting (England and Wales) Regulations 2016, as amended and has been prepared as a bespoke application. The Operator has completed an enhanced pre-application consultation process with the Environment Agency which has confirmed BAT standards and related guidance to be followed.

Air emissions risk assessment for your environmental permit	Published by the Environment Agency (1.1.1.1.1.1a.Ref 12), this guidance provides a methodology for assessment of point source emissions impacts on human health and nature conservations sites. It also included Environmental Assessment Levels (EALs) for pollutants that are not included in the Air Quality Standards Regulations.

The AQO values and EALs relevant to this assessment are displayed in Table 2-2. In addition to the AQO values and EALs, Critical Loads for nitrogen deposition have been determined by the UNECE Convention on Long Range Transboundary Air Pollution. These represent (according to current knowledge) the exposure below which there should be no significant harmful effects on sensitive elements of those habitats. Critical Loads are set for different types of habitats based on their respective sensitivity to nutrient nitrogen and have been obtained for the designated sites with the potential to be affected by the Project.

Objectives, EALs and Critical Loads are expressed in one of two ways: as long-term (annual mean) concentrations which are not to be exceeded without exception, due to their chronic effects; or as shorter term (daily or hourly) mean concentrations for which only a specified number of exceedances are allowed within a specified time frame, due to their acute effects.

Table 2-2: Air Quality Objectives, Environmental Assessment Levels and Critical Loads

Pollutant	Averaging Period	Concentration	Maximum Permitted Exceedances	Target Date (AQO)	Target Data (EULV)
AQOs for the Protection of Human Health					
Nitrogen Dioxide (NO_2)	Annual mean	40µg/m^3	None	31 Dec 2005	1 Jan 2010
	1 hour mean	200µg/m^3	18 times per year	31 Dec 2005	1 Jan 2010
Particulate matter with an aerodynamic diameter of 10 microns or less (PM_{10})	Annual mean	40µg/m^3	None	31 Dec 2004	1 Jan 2005
	24 hour mean	50µg/m^3	35 times per year	31 Dec 2004	1 Jan 2005
Particulate matter with an aerodynamic diameter of 2.5 microns or less ($PM_{2.5}$)	Annual mean	20 µg/m^3	None	1 Jan 2020	1 Jan 2010
Sulphur Dioxide (SO_2)	24 hour mean	125 µg/m^3	3 times per year	31 Dec 2004	1 Jan 2005
	1 hour mean	350 µg/m^3	24 times per year	31 Dec 2004	1 Jan 2005
AQOs for the Protection of Vegetation and Ecosystems					
Nitrogen oxides (NO_X)	Annual mean	30 µg/m^3	None	31 Dec 2000	19 Jul 2001
Sulphur dioxide (SO_2)	Annual mean	20 µg/m^3	None	31 Dec 2000	19 Jul 2001
EAL for the Protection of Vegetation and Ecosystems					
Ammonia (NH_3)	Annual mean	3 µg/m$^{3(1)}$	None	N/A	N/A
Critical Loads for the Protection of Vegetation and Ecosystems					

Nutrient nitrogen deposition	Annual mean	Salt marsh: 10-20 kg N/ha/yr Woodland: 10-20 kg N/ha/yr Grassland: 10-20 kg N/ha/yr	None	N/A	N/A

[1] 1 μg/m^3 where lichens or bryophytes (including mosses, liverworts and hornwarts) are present, 3 μg/m^3 where they are not present. Bryophytes are not considered present at the habitats considered in this assessment.

3. Assessment Methodology

The assessment of air quality impacts has been undertaken with reference to the industry standard guidance documents listed in Table 2-2. The assessment of impacts assumes that embedded and standard mitigation (see Section 0) is already in place. As such, no unmitigated scenario is assessed because such a scenario will never occur.

It has been assumed for the purpose of this assessment, that the Project will be fully operational in the year of opening (2028). In reality, not all of the Project is likely to be operational until 2036. The assumption that all Project sources are operational in 2028 is precautionary, as it assumes all those sources will combine with the baseline conditions of 2028. Due to the anticipated year-on-year improvement in background air quality and the year-on-year evolution of emissions technology, baseline air quality conditions are likely to better in 2036. As such, the total pollutant concentrations reported for 2028, based on full operation, are precautionary.

Detailed dispersion modelling using the atmospheric dispersion model ADMS 6 has been used to calculate the concentrations of pollutants at identified receptors. These concentrations have been compared with the relevant AQOs, EALs and Critical Loads for each pollutant species associated with emissions released from the proposed installation. 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.

Emissions of SO_2 and PM_{10} from gas fired plant are at such low levels relative to the AQOs, EALs and Critical Loads that they are considered negligible. Emissions of SO_2 and PM_{10} from vessel emissions are controlled by the requirements of International Convention for the Prevention of Pollution from Ships (“MARPOL”) Regulation 14 (1.1.1.1.1.1a.Ref 20) and are also considered negligible. As such, SO_2 and PM_{10} emissions associated with these sources have not been included in the assessment.

An assessment of nutrient nitrogen enrichment has been undertaken by applying published deposition velocities to the predicted annual average NO_2 and NH_3 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 System (1.1.1.1.1.1a.Ref 2) for the species present at each habitat site, taking into consideration the baseline air quality.

Increases in acidity from deposition contributions of NO_2 and NH_3 from the process contribution have not been considered. This is because there are no acidity sensitive habitats within 10km of the proposed installation.

3.1 Emissions Data

The assessment of operational site and vessel emissions follows a hybrid approach, based on the perceived risk of sources contributing to a significant effect on air quality. Site emissions consist of those from a number of onshore hydrogen production units and flares, and offshore vessel combustion plant emissions. A quantitative assessment of those sources that are considered to represent a risk of contributing to a significant effect has been undertaken.

3.1.1.1 Site Emissions

Landside emissions sources include combustion and process emissions associated with a number of converter plant and combustion emissions associated with a number of flares running on pilot mode. All modelled landside sources are assumed to be operational for 8760 hours per year (8784 hours on a leap-year).

The onshore hydrogen production units will be fuelled initially by natural gas. The main pollutant of concern from this is the NO_X emissions from the combustion of the gas. The hydrogen production units will have SCR technology installed to reduce the amount of NO_X released. The presence of SCR technology will also mean that another pollutant of concern will be NH_3 emissions associated with the SCR process.

NO_X and NH_3 at elevated concentrations are harmful to nature conservations sites and, when NO_X is converted to NO_2 following release into the ambient air, also harmful to human health. NO_2 and NH_3 also contribute to nitrogen deposition, which is harmful to nature conservation sites. It is considered that emissions from hydrogen production units have the potential to contribute to a significant effect on air quality and these sources are included in the detailed assessment.

Flares will also be a source of combustion emissions. The flares will operate for most of the time on pilot mode. They will only operate on flare mode in the event of an emergency or during plant start-up, to burn off the release of any uncontrolled NH_3. Such an event is not expected to occur for more than a few hours per year. Emissions data for these sources are summarised in Table 3-1. The location of the modelled landside stacks is shown on Figure 1 of Appendix A.

Table 3-1 Landside Source Emissions Data

Parameter	Reformer Box Top/Flue Gas Stacks		Hydrogen Production Unit (HPU) Flare Pilot		Ammonia Storage Flare Pilot	Unit/Notes
Coordinates	520910, 415277	520906, 415305	502952, 415363	520887, 41539`1	520801, 415200	x,y
	520841, 415333	519771, 414475	520823, 415419	519687, 414505		
	519757, 414401	520009, 414578	519839, 414372	520092, 414549		
Profile	8760		8760		8760	Hours/Year
Height[1]	30.5		37		55	m
Diameter	0.45		0.15		0.6	m
Temperature	144		1700		1700	°C
Mass flow	6.296		-[3]		-[3]	kg/s
A.Vol Flow	-[3]		0.005		0.009	Am^3/s
N.Vol Flow	4.65		0.001		0.001	Nm^3/s
Emissions Concentration for NOx	94.1		-[3]		-[3]	mg/Nm_3
Emissions Concentration for NH_3[2]	3.5		-[3]		-[3]	mg/Nm_3
Mass Emission Rate for NO_X	0.437		0.002		0.002	g/s
Mass Emission Rate for NH_3[2]	0.016		-[3]		-[3]	g/s
Mass Emission Rate for CO	-[3]		0.014		0.014	g/s
Mass Emission Rate for SO_2	-[3]		0.00003		0.00003	g/s
Mass Emission Rate for VOCs	-[3]		0.001		0.001	g/s

Notes:

[1] Design not fixed, but 30.5m considered the minimum height envelope and therefore worst-case.

[2] Emissions due to NH_3 slip, provided as 5 ppm.

[3] Data not provided. Data that was provided sufficient to model emissions source.

General: The indicated numbers are preliminary and worst-case assumptions used for the modelling, it would be tuned based on actual available information during detailed engineering, if required.

3.1.1.2 Vessel Emissions

Exhaust emissions from vessels during operation have the potential to impact on air quality, particularly when they are in dock. At such time, the vessel emissions source is static and, given the anticipated frequency of vessels in dock, operational for approximately 80% of the year. This means that docked vessel emissions will impact on the same locations consistently throughout the year, subject to meteorological conditions. When vessels are in motion, travelling at c.10 knots (19kph) when manoeuvring and c.20 knots (37kph) when up to speed, emissions from each vessel movement will be transient and the impact on a location will be for a period of minutes per day, not hours. Docked vessel emission impacts on local air quality have been quantified in this assessment.

Vessel emissions have the potential to impact on sensitive receptors by increasing exposure to the pollutants most commonly associated with combustion emissions, namely NO_X, a precursor for NO_2 and nitrogen deposition.

Vessels using the proposed installation will need to comply with relevant MARPOL NO_X and SO_2 emission standards (1.1.1.1.1.1a.Ref 19, 1.1.1.1.1.1a.Ref 20), noting that proposed Installation is within the North Sea Emissions Control Area ("ECA").

MARPOL Regulation 13 (1.1.1.1.1.1a.Ref 19) requires that vessel engines comply with tiered NO_X emissions standard based on the age of a vessel's engines. For vessel engine plant installed before 1 January 2021 or new vessels constructed before that same date, NO_X emissions need to be limited to 44n-0.23 g/kWh (MARPOL Regulation 13 Tier II), where n is the engine's rated speed as Revolutions per Minute ("RPM"). For vessel engine plant or new vessels constructed on or after that date, NO_X emissions will need to be limited to 9n-0.2 g/kWh (MARPOL Regulation 13 Tier III). It is likely that vessel engines will require SCR technology to meet the Tier III NO_X standard, the use of which will induce some NH_3 slip. Marine vessel NH_3 slip is typically below 10ppm (1.1.1.1.1.1a.Ref 13), subject to the efficiency of the SCR system.

MARPOL Regulation 14 (1.1.1.1.1.1a.Ref 20) is not tiered and applies to all vessels operating within an ECA. To reduce emissions of SO_2 and fine particulates (PM_{10} and $PM_{2.5}$), vessel engines must operate using MGO with a sulphur content of no more than 0.10 %m/m when travelling through the North Sea ECA, or by means of technological intervention, such as an SO_2 scrubber (subject to approvals with the relevant administration). SO_2 and PM emissions from vessels are therefore likely to be negligible and are not considered further in this assessment.

With regards to vessel emissions when docked, energy is required to facilitate the discharge of cargo and provide amenity use for the crew. Typically, the energy demand for the discharge of cargo is provided by a vessel's auxiliary engine. At this stage it has not been possible to identify the specific vessels that will use the proposed installation when in operation. In the absence of such information, the assessment has referred to marine auxiliary vessel engine emissions data published by Wärtsilä (1.1.1.1.1.1a.Ref 25), as a proxy to represent the auxiliary engines of the actual vessels. The specific engine referred to for the assessment was selected to meet the typical energy demand of a docked vessel when discharging a liquified gas (1.1.1.1.1.1a.Ref 25).

Wartsila publish emissions data for all their marine vessel engines. To meet the energy demand of 7.5 MW required when a vessel is in dock and discharging cargo, emissions data for a Wartsila 14V31 engine has been used. The Wartsila 14V31 engine generates 8.26 MW at 100% load. The auxiliary engine emissions data used in the assessment is provided in Table 3-2. The location of the docked vessel auxiliary engine stack is shown on Figure 1 of Appendix A. NO_X emission rate data is provided for both compliance with the Tier II and Tier III MARPOL Regulation 13 emissions standards.

Table 3-2 Vessel Auxiliary Engine Emissions Data

Parameter	Wärtsilä 14V31 (MGO)[1]		Unit/Notes
	MARPOL NOx Tier II	MARPOL NOx Tier III	
Capacity	8,260		kW per engine
Fuel	Marine Gas Oil		MGO or LNG
Operating Load	100		%
Operating profile	7,002		Hours/year
Release point location	522292,416119		x,y
Emission release height	45		Assumed m above ground level
Internal diameter of release point	0.903[2]		m
Temperature of emissions	268		°C
Mass flow of emissions	14.7		kg/s
Engine speed	720		RPM
MARPOL emission standard	$44n^{-0.23}$ (3)	$9n^{-0.2}$ (3)	Tier II NO_X emission standard: 44·n(-0.23), where n = RPM
NO_X emission rates	9.7	2.4	g/kWh
	80,029	19,941	g/h
	22.2	5.5	g/s
Factored NO_X emission rate	17.8	4.4	g/s based on 7,002 hrs/yr
Ammonia slip concentration	n/a	10	ppm
Ammonia slip emission rate	n/a	0.063	g/s

[1] Emissions standard for SO_2: Inside an Emission Control Area, including North Sea area, established to limit SOx emissions 1.50% m/m prior to 1 July 2010; 1.00% m/m on and after 1 July 2010; 0.10% m/m on and after 1 January 2015.

[2] Recommended by Wärtsilä to maintain an exit velocity of 35 m/s

[3] Where *n* is the engine speed as RPM

The energy demand to facilitate crew amenity is typically provided by a marine boiler. As with the auxiliary engine, the exact type of marine boiler on vessels that will use the facility is unknown. In the absence of such data, a 'typical' marine boiler has been used as a proxy to represent the boiler of the actual vessels. In this instance, the boiler assumed as representative is the Aalborg Industries UNEX BH boiler unit, the emissions data for which is provided in Table 3-3**Error! Reference source not found.**. The location of the docked vessel auxiliary engine stack is shown on Figure 1 of Appendix A.

Table 3-3 Vessel Boiler Emissions Data

Parameter	Marine Boiler	Unit/Notes
Capacity	7	Barg
Operating Load	100	%
Operating profile	7,002	Hours/year
Release point location	522291,416119	x,y
Emission release height	45	Assumed m above ground level
Internal diameter of release point	0.4	m
Temperature of emissions	350	°C
Mass flow of emissions	0.756	kg/s
NO_X emission rates	456	g/h
	0.127	g/s
Factored NO_X emission rate	0.101	g/s based on 7,002 hrs/yr

3.2 Meteorological Data

Wind rose plots for six years of hourly sequential meteorological data from Humberside Airport are provided in Plate 1.

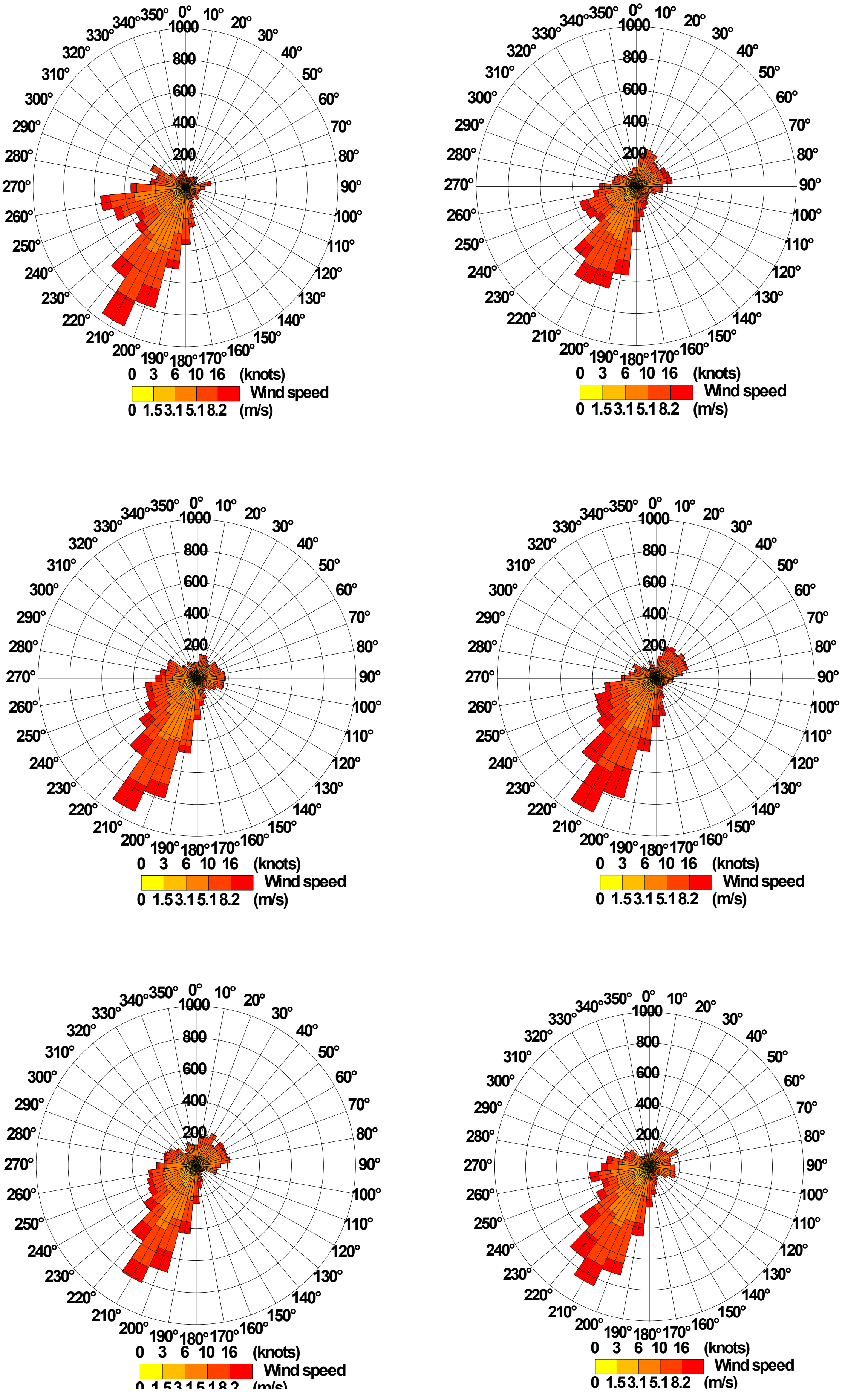
Five of the six years shown of hourly sequential meteorological data from Humberside Airport (2018 to 2022) has been used to inform the assessment. Humberside Airport is approximately 10km to the southwest of the Project site and conditions experienced there are considered representative of conditions experienced in the air quality study area.

For the modelling of point source emissions, it is standard practice to use five years sequential meteorological data for modelling purposes. This is to account for interannual variation with the highest impact over the five-year period at each receptor being reported in the assessment.

Plate 1 shows how consistent wind speed and direction have been over the six years shown, with the clear prevalence of south-westerlies.

Meteorological data is crucial for the dispersion modelling of emissions from point sources. It is therefore important to use data that is representative of the assessment study area.

Plate 1: Wind Rose Plots – Humberside Airport 2017 – 2022



3.3 Building Downwash

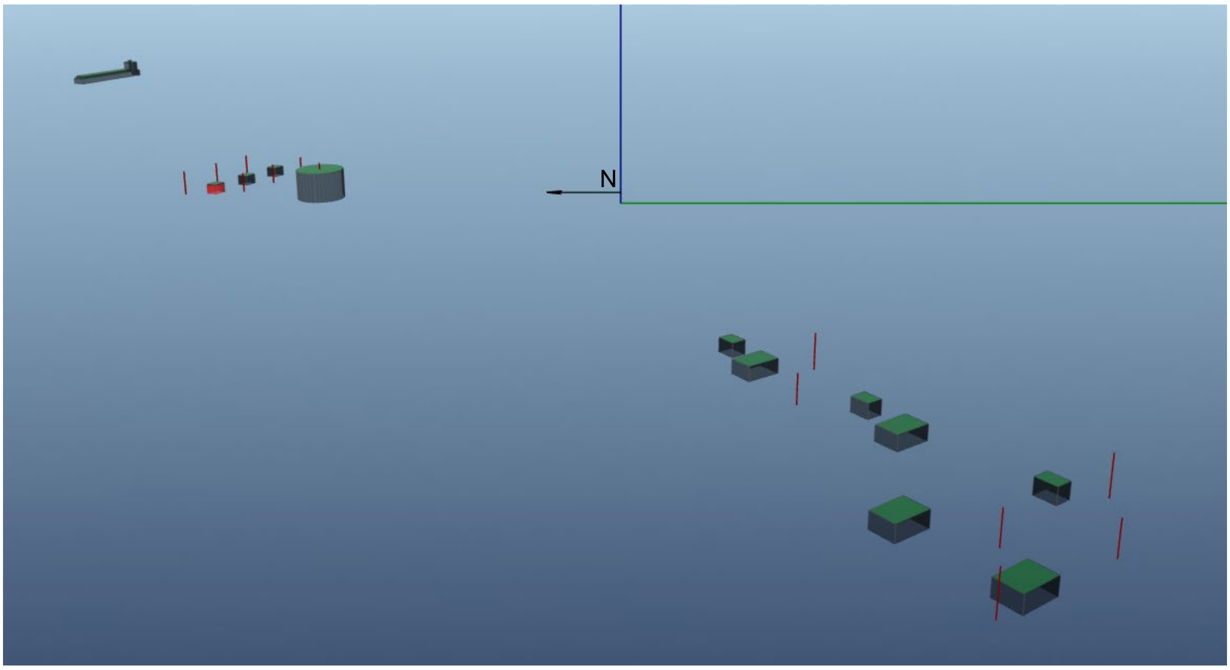
Buildings and structures that make up the Project have the potential to affect the dispersion of emissions from the modelled emission points, depending on their physical dimensions and proximity to the emission sources. This is because of building downwash, which is caused by the creation of a cavity of recirculating winds in the area near to buildings, which often leads to elevated concentrations downwind of affected point sources.

The ADMS 6 buildings effect module has therefore been used to incorporate building downwash effects as part of the modelling procedure. Site buildings or structures have been included in the model where they are as high as 40% of the stack height and the building or structure's proximity to a stack is less than five times the lesser of its height or width. The building and structures included in the model are listed in Table 3-4 and illustrated in Plate 2.

Table 3-4: Building Downwash Data

Building Description	Shape	Height (m)	Length/ Diameter (m)	Width (m)
Reformer plant	Rectangular	15	20	15.92
	Rectangular	15	19.85	15.98
	Rectangular	15	20.06	16.07
	Rectangular	15	16.08	20.11
	Rectangular	15	24.11	36.16
	Rectangular	15	20.01	16.17
	Rectangular	15	24.27	26.11
	Rectangular	15	15.89	20.01
	Rectangular	15	23.8	35.93
	Rectangular	15	24.13	35.85
Ammonia Tank	Circular	45	70.2	-
Docked Vessel	Rectangular	15	29.99	204.86
	Rectangular	15	25.39	170.29
	Rectangular	20	28.46	16
	Rectangular	38	5.71	5.2

Plate 2: Illustration of Modelled Buildings (looking east)



3.4 Terrain Data and Surface Roughness

Due to the proximity of the Project to the Humber Estuary, the land in the vicinity of the Project and across the Immingham area is relatively flat with limited variation in height above sea level. The limited variation in height that does occur is not to the extent that it will influence the dispersion of emissions to air from Project sources, nor how those emissions will impact on sensitive receptors. The dispersion model of site emissions has been set up on the basis that the model domain is flat.

With regards to surface roughness, the dispersion model has been set up on the basis that all land areas have a surface roughness of 0.75m and all surface water areas have a surface roughness of 0.0001m. The higher value represents built-up urban areas and woodland and will overestimate the influence of surface roughness on areas of open space, such as grassland. The lower surface roughness value accounts for the limited influence of surface water to disrupt dispersion.

3.5 Air Quality Sensitive Receptors

The air quality receptors selected for this assessment are those that are considered sensitive to air quality effects and most likely to experience worst-case impacts from the impact pathways considered, because of the proposed installation's operation. Each selected receptor can be considered representative of other sensitive locations in their vicinity.

Receptor selection therefore takes account of the study area of each impact pathway and the location of sensitive receptors relative to the proposed installation's emission sources. Effectively, receptor selection demonstrates the worst-case impact of the proposed installation in each direction from the source. The receptors considered in the assessment are described in Table 3-5 and shown on Figure 1 of Appendix A.

Table 3-5 Operational Phase Human Health Sensitive Receptors

Receptor ID	X	Y	Description
O_R1	519388	414955	Residential Property on Kings Road A1173 approximately 0.4km from West Site
O_R2	519228	414998	Residential Property on Chestnut Avenue approximately 0.5km from West Site
O_R3	519015	414537	Residential Property on Talbot Road approximately 0.7km from West Site
O_R4	519141	414353	Residential Property on Somerton Road approximately 0.5km from West Site
O_R5	519223	414220	Residential Property on Somerton Road approximately 0.5km from West Site
O_R6	518477	414778	Residential Property on Pelham Road approximately 1.3km from West Site
O_R7	518237	414294	Residential Property on Margaret Street approximately 1.5km from West Site
O_R8	519203	413222	Residential Property on Mauxhall Farm/Immingham Road approximately 1.1km from West Site
O_R9	521279	413116	Residential Property on North Moss Lane approximately 1.9km from West Site
O_R10	520827	412115	Residential Property on South Marsh Road approximately 2.4km from West Site
O_R11	519552	411773	Residential Property on Church Lane approximately 2.6km from West Site
O_R12	527773	410446	Residential Property on Cleethorpe Road approximately 8km from the East Site
O_R13	523712	418883	Residential Property on Stone Creek approximately 3.1km from the vessel berth
O_R14	525590	417457	Residential Property on Stone Creek approximately 3.7km from the vessel berth
O_R15	525030	418688	Residential Property on South Farm Road approximately 3.6km from the vessel berth
O_R16	524551	418946	Stone Creek Farm approximately 3.6km from the vessel berth
O_R17	523456	420121	Salthaugh Sands Estate approximately 4.2km from the vessel berth

The assessment of operational phase emissions has also focused on air quality sensitive nature conservation receptors within 10km of the proposed installation, with the intention of identifying worst-case impacts in each direction of the modelled sources. The focus is on habitats that are specifically sensitive to the effects of air pollution, specifically airborne NO_X and NH_3, and nitrogen deposition. Habitats were identified using the online MAGIC resource (1.1.1.1.1.1a.Ref 5). The nature conservation receptors of relevance to this assessment are summarised in Table 3-6 and illustrated in Figure 1 of Appendix A.

Table 3-6: Operational Phase Nature Conservation Sensitive Receptors

Receptor ID	X	Y	Description
O_E1	523254	418899	Saltmarsh habitat within the Humber Estuary SAC, approximately 2.7km from Vessel Berth
O_E2	523857	418287	Saltmarsh habitat within the Humber Estuary SAC, approximately 2.9km from Vessel Berth
O_E3	526249	416864	Saltmarsh habitat within the Humber Estuary SAC, approximately 4.1km from Vessel Berth
O_E4	527141	416671	Saltmarsh habitat within the Humber Estuary SAC, approximately 5km from Vessel Berth
O_E5	523790	413174	Saltmarsh habitat within the Humber Estuary SAC, approximately 3.5km from East Site
O_E6	518347	417802	Saltmarsh habitat within the Humber Estuary SAC, approximately 3.4km from East Site
O_E7	529069	416859	Saltmarsh habitat within the Humber Estuary SAC, approximately 6.9km from Vessel Berth
O_E8	525956	411375	Saltmarsh habitat within the Humber Estuary SAC, approximately 6km from Vessel Berth
O_E9	526333	411086	Saltmarsh habitat within the Humber Estuary SAC, approximately 6.4km from Vessel Berth
O_E10	527136	410868	Saltmarsh habitat within the Humber Estuary SAC, approximately 7.2km from Vessel Berth
O_E11	517001	419691	Saltmarsh habitat within the North Killingholme Haven Pitts SSSI, approximately 5.7km from East Site
O_E12	516492	420321	Saltmarsh habitat within the Humber Estuary SAC, approximately 6.5km from East Site
O_E13	519830	421761	Saltmarsh habitat within the Humber Estuary SAC, approximately 6km from Vessel Berth
O_E14	514553	422884	Saltmarsh habitat within the Humber Estuary SAC, approximately 9.7km from East Site
O_E15	514550	422998	Saltmarsh habitat within the Humber Estuary SAC, approximately 9.7km from East Site
O_E16	521516	415056	Grassland habitat within a LWS, approximately 0.1km from East Site
O_E17	518057	415529	Woodland and freshwater habitat within a LWS, approximately 1.8km from West Site
O_E18	521300	412583	Woodland and freshwater habitat within a LWS, approximately 2.3km from West Site
O_E19	522057	412228	Grassland habitat within a LWS, approximately 3km from East Site and West Site

3.6 Background Pollutant Concentration Data

The dispersion model predicts the contribution of pollutants from modelled emission sources at the selected air quality sensitive receptors. To report total pollutant concentrations that can be compared to the relevant AQOs, EALs and Critical Loads at those receptors, this contribution needs to be added onto the background (or ambient) pollutant concentrations that are representative of those locations. Background pollutant data used in the assessment is summarised in Table 3-7 and Table 3-8**Error! Reference source not found.**.

For human health receptors, background NO_2 concentration data has been sourced from Defra's background pollutant concentration maps from the dataset with a base year of 2018 (1.1.1.1.1.1a.Ref 4).

For nature conservation receptors, background NO_X data has also been sourced from Defra's 2018 base year maps. SO_2, NH_3 and nitrogen deposition rate data has been sourced from the Air Pollution Information System ("APIS") (1.1.1.1.1.1a.Ref 1). APIS reports background concentration data as a 3-year average and current background maps cover the period 2018-2020.

Background pollutant concentrations are anticipated to reduce year on year going forward, due to improving emissions technology and the evolution of the UK vehicle fleet. Defra provide versions of their background maps projected forward into the future, as far as 2030. The NO_X, NO_2, PM_{10} and $PM_{2.5}$ data used in the assessment of operational phase impacts has used the background map published by Defra for those specific assessment years.

The APIS does not provide background concentrations or deposition rates projected forward. The SO_2 and NH_3 data used in this assessment is based on the 2018-2020 background maps for all assessment years. The nitrogen deposition data obtained for APIS has been projected forward to represent conditions in future years, based on the Nitrogen Futures project (1.1.1.1.1.1a.Ref 21) assumption that nitrogen deposition rates are on course to fall year on year by at least 0.07 kg/ha/yr.

Table 3-7 Background Pollutant Data – Human Health Receptors (2022 & 2028)

Rec. ID	Interest Feature	Annual Mean NO_2 Concentration (µg/m^3)	
		2022	2028
O_R1	Operational receptor on Kings Road	15.2	13.8
O_R2	Operational receptor on Chestnut Avenue	15.2	13.8
O_R3	Operational receptor on Talbot Road	15.2	13.8
O_R4	Operational receptor on Somerton Road	15.2	13.8
O_R5	Operational receptor on Kendal Road	15.2	13.8
O_R6	Operational receptor on Pelham Road	12.5	11.1
O_R7	Operational receptor on Margaret Street	12.5	11.1
O_R8	Operational receptor – Mauxhall Farm	11.2	9.9
O_R9	Operational receptor on North Moss Lane	11.3	10.1
O_R10	Operational receptor on South Marsh Road	11.6	9.9
O_R11	Operational receptor on Church Lane	9.6	8.5
O_R12	Operational receptor within Grimsby AQMA	19.6	17.5
O_R13	Operational receptor on Stone Creek	12.3	11.3
O_R14	Operational receptor on Stone Creek	11.7	10.6
O_R15	Operational receptor on South Farm Road	11.0	10.0
O_R16	Operational receptor at Stone Creek Farm	11.6	10.6
O_R17	Operational receptor at Salthaugh Sands Estate	10.7	9.7
AQO Level		**40**	

Notes:

[1] 2028 background precautionarily used to represent background conditions in 2036

Table 3-8: Background Pollutant Data – Nature Conservation Receptors (2022 & 2028)

Rec. ID	Interest Feature	Annual Mean Conc. (µg/m^3)			Nitrogen Deposition Rate (kg/ha/yr)[1,2,3]	Annual Mean Conc. (µg/m^3)			Nitrogen Deposition Rate (kg/ha/yr)[1,2,3]
		NO_X	SO_2	NH_3		NO_X	SO_2	NH_3	
		2022				2028			
O_E1	Saltmarsh (SAC)	16.7	2.1	1.5	15.0	15.1	2.1	1.5	14.6
O_E2	Saltmarsh (SAC)	16.7	2.1	1.5	15.0	15.1	2.1	1.5	14.6
O_E3	Saltmarsh (SAC)	16.5	1.8	1.6	14.3	14.9	1.8	1.6	13.9
O_E4	Saltmarsh (SAC)	15.3	1.7	1.6	14.3	13.8	1.7	1.6	13.9
O_E5	Saltmarsh (SAC)	18.4	3.9	1.5	15.1	16.6	3.9	1.5	14.7
O_E6	Saltmarsh (SAC)	21.0	3.4	1.6	16.4	19.1	3.4	1.6	16.0
O_E7	Saltmarsh (SAC)	14.0	1.6	1.6	14.3	12.6	1.6	1.6	13.9
O_E8	Saltmarsh (SAC)	16.6	2.2	1.5	15.1	14.6	2.2	1.5	14.7
O_E9	Saltmarsh (SAC)	17.7	1.9	1.5	15.1	15.8	1.9	1.5	14.7
O_E10	Saltmarsh (SAC)	28.7	2.8	1.6	13.9	25.1	2.8	1.6	13.5
O_E11	Saltmarsh (SSSI)	23.0	3.4	1.6	16.4	21.1	3.4	1.6	16.0
O_E12	Saltmarsh (SAC)	37.9	3	1.6	16.4	36.5	3.0	1.6	16.0
O_E13	Saltmarsh (SAC)	15.0	2	1.5	15.0	13.6	2.0	1.5	14.6
O_E14	Saltmarsh (SAC)	13.0	1.7	2.1	16.6	11.6	1.7	2.1	16.1
O_E15	Saltmarsh (SAC)	13.0	1.7	2.1	16.6	11.6	1.7	2.1	16.1
O_E16	Grassland (LWS)	20.6	3.2	1.5	15.1	18.4	3.2	1.5	14.7

O_E17	Woodland (LWS)	18.2	3.53	1.6	26.5	16.2	3.5	1.6	25.5
O_E18	Woodland (LWS)	15.4	1.75	1.5	25.4	13.1	1.8	1.5	26.0
O_E19	Grassland (LWS)	14.8	2.22	1.5	15.1	13.0	2.2	1.5	14.7
AQO levels, EAL and Critical Load		**30**	**20**	**3**	**10**	**30**	**20**	**3**	**10**

[1] Short vegetation, such as grassland and marsh, has a lower deposition velocity then tall vegetation, hence lower background deposition rates.

[2] Tall vegetation, such as woodland, has a higher deposition velocity than short vegetation, hence higher background deposition rates.

[3] 2028 background precautionarily used to represent background conditions in 2036

For short-term background pollutant concentrations, it has been assumed in this assessment that these are represented by double the long-term background concentration, in line with Environment Agency guidance.

3.7 Pollutant Conversion

3.7.1.1 NO_X to NO_2

Emissions of nitrogen oxides from combustion sources are typically dominated by nitric oxide (NO), typically in the ratio of NO to NO_2 of 9:1. However, it is NO_2 that has specified environmental standards due to its potential impact on human health and indirect impacts on sensitive habitat.

In the ambient air, nitric oxide is oxidised to nitrogen dioxide by the ozone present, and the rate of oxidation is dependent on the relative concentrations of nitric oxide and ozone in the ambient air.

For the point source emissions modelled, a NO_X to NO_2 conversion rate of 70% has been assumed over an annual mean averaging period and a conversion rate of 35% has been assumed for an hourly mean averaging period, in line with Environment Agency

- Deposition flux (as $\mu g/m^2/s$) is calculated by applying deposition velocity factors of:
  - 0.0015 m/s to the annual mean NO_2 contribution (as $\mu g/m^3$) at habitats with short vegetation (non-woodland) and a deposition velocity factor of 0.003 m/s to annual mean NO_2 (as $\mu g/m^3$) contribution at habitats with tall vegetation (woodland).
  - 0.020 m/s to the annual mean NH_3 contribution (as $\mu g/m^3$) at habitats with short vegetation (non-woodland) and a deposition velocity factor of 0.030 m/s to annual mean NH_3 (as $\mu g/m^3$) contribution at habitats with tall vegetation (woodland);
- Deposition rate (as kgN/ha/yr) is then calculated by applying unit conversion factors of:
  - 95.9 to the calculated deposition flux for NO_2 (as $\mu g/m^2/s$).
  - 260 to the calculated deposition flux for NH_3 (as $\mu g/m^2/s$).

Total nitrogen deposition is then the sum of the deposition rate calculated from NO_2 and NH_3 concentrations at any specific location.

3.8 Assessment of Significance Criteria

3.8.1.1 Human Health Sensitive Receptors

According to Environment Agency guidance, the pollutant impact (Process Contribution (PC)) of the proposed installation can be screened as insignificant where in meets both of the following criteria:

- the short-term PC is less than 10% of the short-term environmental standard
- the long-term PC is less than 1% of the long-term environmental standard

If the impact of a pollutant meets both of these criteria, there is no need to do any further assessment of that pollutant.

If the criteria are not met, a second stage of screening is required, to determine the impact of the total pollutant concentration (Predicted Environmental Concentration (PEC)), which is the PC plus the ambient/background concentration.

If the second stage of screening is required, the proposed installation can be screened as insignificant where in meets both of the following criteria:

- the short-term PC is less than 20% of the short-term environmental standards minus twice the long term background concentration
- the long-term PEC is less than 70% of the long-term environmental standards

Should either of these criteria not be met, then further assessment is required to demonstrate that the emissions from the proposed installation will not be significant.

3.8.1.2 Nature Conservation Sensitive Receptors

Where proposed installation pollutant emissions impact on Special Protection Areas (SPA), Special Areas of Conservation (SAC), Ramsar sites or Sites of Special Scientific Interest (SSSI), they can be screened as insignificant where in meets both of the following criteria:

- the short-term PC is less than 10% of the short-term environmental standard for protected conservation areas
- the long-term PC is less than 1% of the long-term environmental standard for protected conservation areas

If the short-term criteria is not met, then further assessment is required to demonstrate that the emissions from the proposed installation will not be significant.

If the long term criteria is not met, the following second stage of screening is required, to determine the impact of the total pollutant concentration (Predicted Environmental Concentration (PEC)), which is the PC plus the ambient/background concentration.

If the second stage of screening is required, the proposed installation can be screened as insignificant where in meets both of the following criteria:

- the long-term PC is ess than 70% of the long-term environmental standard for protected conservation areas.

If your PEC is greater than 70% of the long-term environmental standard, then further assessment is required to demonstrate that the emissions from the proposed installation will not be significant.

Where proposed installation pollutant emissions impact on Ancient Woodlands (AW), Local Wildlife Sites (LWS) and Nature Reserves (NR), they can be screened as insignificant where in meets both of the following criteria:

- the short-term PC is less than 100% of the short-term environmental standard for protected conservation areas
- the long-term PC is less than 100% of the long-term environmental standard for protected conservation areas

If your PC exceeds either of the screening criteria, then further assessment is required to demonstrate that the emissions from the proposed installation will not be significant.

3.9 Limitations and Assumptions

The air quality assessment has been informed by onsite emissions source characteristics and data provided by the proposed installation design team, including the location, height and internal diameter of stack emission points, and the temperature, rate, and mass by pollutant of emissions released. Where there remains intended flexibility in design, assumptions made have been precautionary where practical. For example, where there is a possible range of flare stack heights from which emissions may be released, the lowest of the possible heights has been assumed. This is because a lower release height will result in higher ground level contributions.

Assumptions made to inform the modelling of onsite plant emissions are as follows:

- Combustion and process emissions associated with the landside hydrogen production units will be operational up to 8760 hours per year.
- Hydrogen plant will be fitted with SCR technology to reduce emissions of NO_X. It is anticipated that this will cause NH_3 slip and a reasonable worst case of 5ppm has been considered.

The air quality assessment includes the assessment of vessel emissions. At this stage, the actual vessels that will call at the facility are unknown. In the absence of this information, a number of assumptions have been made to inform the modelling of vessel emissions. The assessment is based on the following key assumptions:

- Two hundred and ninety-two vessel calls to the facility each year, which equates to 0.8 vessel calls as a daily average (this is considered to be a theoretical maximum, or worst case)
- There will be a single vessel docked at the facility at any one time for 7,008 hours (80%) of the year, based on 292 vessel calls assumed per year.
- When in dock, vessel energy demand will be met by marine auxiliary engines based on a peak demand of around 8MW, to load and discharge cargo;
- All vessels calling at the facility will have this same energy demand when in dock, irrespective of size.
- The Wärtsilä 14V31 (8,260 kWe) marine auxiliary engine has been assumed to be representative of the engines required to meet this energy demand.
- The auxiliary engine will operate at full load for every hour a vessel is in dock.
- The Humber Estuary is part of the North Sea ECA for SO_X and PM_{10}. The assumed implication of the ECA for SO_X and PM_{10} is that vessel emissions of SO_2 and PM_{10} will be negligible, either due to ultra-low sulphur fuel or the operation of a scrubber, following MARPOL Regulation 14.
- The Humber Estuary is now also an ECA for NO_X. The implication of the ECA for NO_X is that vessels with engines installed prior to 2021 have to comply with the MARPOL Regulation 13 Tier II NO_X emissions standard. Engines installed on or after 1 January 2021 have to comply with the Regulation 13 Tier III emissions standard.
- Vessels will need to use SCR technology to meet the NOX Regulation 13 Tier III emissions standard. NH_3 slip from vessel engine SCR use is reported to range from 2ppm to 10ppm. For the purpose of this assessment an NH_3 slip of 10ppm has been assumed from vessel engine emissions.

Combustion emissions associated with flares will be operational on pilot mode for 8760 hours per year. The controlled flaring of NH_3 emissions will only occur in the event of an emergency, or when plant requires start-up.

Meteorological data used in the air quality assessment has been sourced from the nearest and most representative meteorological monitoring site, Humberside Airport, which is approximately 13km southwest of the Site. This data is considered the most representative data available close to the Site. Due to the inter-annual variation in meteorological conditions, five years of data have been used in the modelling of point source emissions to account for that variability, in accordance with Environment Agency guidance.

Defra background data (1.1.1.1.1.1a.Ref 8) and APIS background data (1.1.1.1.1.1a.Ref 1) has been used to represent background pollutant concentration data in the study area. These background concentrations have not had any sources removed and are therefore considered to include emissions associated with the existing neighbours of the Site, including nearby industry and the Port of Immingham. Such an approach is considered proportionate and robust, and is in line with industry standard guidance (1.1.1.1.1.1a.Ref 10, and 1.1.1.1.1.1a.Ref 22).

4. Baseline Conditions

4.1 Existing Baseline

A desk-based study has been undertaken to inform the baseline characterisation on which the impact assessment has been based. This has included review of the following key data sources:

- NELC Local Air Quality Management Data (1.1.1.1.1.1a.Ref 23).
- North Lincolnshire Council Local Air Quality Management Data (1.1.1.1.1.1a.Ref 24).
- A baseline nitrogen dioxide diffusion tube survey.
- Defra's Pollution Climate Mapping ("PCM") Model Compliance Link Outputs (1.1.1.1.1.1a.Ref 7).
- Defra's Background Pollutant Concentration Maps (1.1.1.1.1.1a.Ref 4).
- APIS Background Pollutant Concentration Maps (1.1.1.1.1.1a.Ref 1).

4.1.1.1 Local Air Quality Management Data

NELC undertake monitoring of air quality in their administrative area as part of their LAQM duties (1.1.1.1.1.1a.Ref 23). This includes the monitoring of nitrogen dioxide (NO_2) at two automatic monitoring sites and 30 passive monitoring sites. Of those monitoring sites, four are located at Immingham, including one of the automatic monitoring sites. In 2019, when conditions were not affected by the Covid-19 pandemic, concentrations ranged from 16.5 µg/m3 to 24.5 µg/m^3 at roadside locations in the town and 13.5 µg/m^3 at an urban background location. Concentrations had generally returned to pre-pandemic levels in 2021. These data are summarised in Table 4-1 and demonstrate concentrations below the air quality objective and below the value to suggest any risk of the one-hour NO_2 objective being exceeded.

North Lincolnshire Council also undertake monitoring of air quality within their administrative area using passive and automatic monitoring (1.1.1.1.1.1a.Ref 24), including at locations in South Killingholme and adjacent to the A160. These data are summarised in Table 4-2 and also demonstrate concentrations below the air quality objective and below the value to suggest any risk of the one-hour NO_2 objective being exceeded.

Both councils have current AQMAs declared. NELC have an AQMA located adjacent to the A180 through Grimsby (designated due to elevated NO_2 concentrations). The location of this AQMA is shown on Figure 1. NLC have a more distant AQMA located at Scunthorpe (designated due to elevated concentrations of particulate matter (PM_{10})). Immingham itself has historically had an AQMA close to the Port of Immingham on Kings Road, due to elevated concentrations of PM_{10}. However, this AQMA was revoked in 2016, to reflect PM_{10} concentrations that are now well below the relevant air quality objectives.

Table 4-1: Recorded NO_2 Concentrations in Immingham and Grimsby from North East Lincolnshire Air Quality Monitoring Network.

Site ID	Grid Reference		Site Type	NO_2 Annual Mean Concentration (µg/m^3)[1,2]						
	X	Y		2015	2016	2017	2018	2019	2021	2022
Immingham										
AURN[3]	518277	415116	Background	-	-	16.9	13.9	13.5	12.1	11.7
NEL 23[4]	519193	415279	Roadside	30.0	33.3	28.5	26.5	24.5	25.3	21.7
NEL 24[4]	517543	414312	Kerbside	-	-	-	-	16.5	15.0	14.6
NEL 25[4]	518108	414533	Kerbside	-	-	-	-	19.1	18.2	17.6
Cleethorpe Road AQMA, Grimsby										
Cleethorpe Road[2]	527761	410425	Roadside	46.5	41.6	35.9	-	32.0	33.4	29.6
NEL 11/12/13[5]	527761	410425	Roadside	42.7	45.2	47.3	38.0	37.8	39.1	36.7
NEL 14[4]	527754	410445	Kerbside	34.7	37.3	34.7	33.3	31.6	34.2	31.5
NEL 15[4]	527789	410438	Kerbside	30.8	35.7	37.3	32.9	31.0	35.8	31.3

[1] Values in Bold signify an exceedance of the annual mean NO_2 air quality objective

[2] Values for 2020 not reported due to the influence of Covid-19 lockdowns on emissions

[3] Continuous monitoring station with reference monitor

[4] Diffusion tube

[5] Triplicate diffusion tubes and average reported

Table 4-2: Recorded NO_2 concentrations in South Killingholme from North Lincolnshire Air Quality Monitoring Network

Site ID	Grid Ref.		Site Type	Annual Mean Conc. (µg/m^3)[1,2]						
	X	Y		2015	2016	2017	2018	2019	2021	2022
CM6[3]	514880	416133	Other	20	17	17	18	15	14	14
DT13[4]	514573	415901	Roadside	26	31	20	17	17	17.4	16.8
DT14[4]	514782	415971	Roadside	34	31	27	28	29	28.4	27.1
DT15[4]	515452	416107	Background	19	21	19	20	18	17.9	16.7
DT16[4]	515279	416085	Roadside	27	26	25	26	25	22.0	23.8

[1] North Lincolnshire report concentrations as whole numbers

[2] Values for 2020 not reported due to the influence of Covid-19 lockdowns on emissions

[3] Continuous monitoring station with reference monitor

[4] Diffusion tube

4.1.1.2 Baseline Survey Data

To supplement the existing NO_2 monitoring data gathered by the Local Authorities in the study area, a project specific NO_2 survey was undertaken from January 2023 to April 2023. The data gathered during the survey has been annualised and adjusted for diffusion tube bias in line with Defra's LAQM TG (22) guidance (1.1.1.1.1.1a.Ref 10), to represent annual mean concentrations for 2022.

These results are summarised in Table 4-3 and demonstrate concentrations below the air quality objective and below the value to suggest any risk of the one-hour NO_2 objective being exceeded. The locations of the diffusion tube monitoring sites are illustrated in Figure 1 of Appendix A.

Table 4-3: Baseline NO_2 survey results, annualisation and bias-adjustment

Diffusion Tube ID	Period Mean Concentration (µg/m³)			Annualised Mean (2022)[1]	Bias-adjusted mean (2022)[2]
	Period 1 (31/01/23 – 28/02/23)	Period 2 (28/02/23 – 28/03/23)	Period 3 (28/03/23 – 26/04/23)		
DT1	25.4	20.2	23.4	23.6	19.9
DT2	20.0	18.7	16.6	18.9	15.9
DT3	19.4	20.3	16.5	19.3	16.2
DT4	26.8	26.2	23.9	26.3	22.1

[1] Annualisation factor of 1.03 calculated by comparison of period mean and 2022 annual mean concentrations from the following automatic monitoring stations on the Automatic Urban and Rural Network: Immingham Woodlands Avenue (1.00), York Bootham (1.04) and Scunthorpe Town (1.03), and the North Lincolnshire Council monitoring site: South Killingholme School (1.03). The monitoring station Hull Freetown has not been used due to poor data capture during the sampling period.

[2] A bias-adjustment factor of 0.84 sourced from Defra's National Bias Adjustment Spreadsheet (1.1.1.1.1.1a.Ref 9) which calculated from a number of co-location studies undertaken by the laboratory that prepared and analysed the diffusion tubes used in the survey.

4.1.1.3 Human Health Relative Background Data

Defra has produced publicly available maps of background pollutant concentrations covering the whole of the UK, for the purpose of LAQM (1.1.1.1.1.1a.Ref 10). These maps provide a useful resource for locations where background monitoring data is limited. The maps give background pollutant concentrations for each 1km x 1km grid square within the UK for all years between 2018 and 2030 for NO_2, PM_{10} and $PM_{2.5}$.

Table 3-7 outlines the 2022 and 2028 background concentrations of NO_2 within the grid squares where the human health sensitive receptors are located. The background concentration values account for existing sources of emissions to air within each and neighbouring grid squares and none of these sources have been removed from the values reported. Total background concentrations within these grid squares are well below the respective air quality objectives.

4.1.1.4 Nature Conservation Relative Background Data

With regard to pollutants of importance to nature conservation, Defra also publish 1km x 1km grid square data for NO_X for all years between 2018 and 2030. For other pollutants, the APIS make publicly available maps of background pollutant data across the UK for SO_2, NH_3 and nitrogen deposition rates (1.1.1.1.1.1a.Ref 1). The background concentrations for SO_2 are based on 1km x 1km grid squares whilst concentrations of NH_3 and nitrogen deposition rates are based on 5km x 5km grid squares across the UK. Each square includes for the contribution of existing sources of emissions to air within them and from other grid squares around them.

Table 3-8 provides 2019 background pollutant data (based on a three-year average of 2018 – 2020 inclusive) for SO_2 and NH_3. These 2019 values are used to represent conditions in the existing baseline year of 2022, because there is no published means by which to account for any year-on-year improvements in these pollutants. The table provides 2022 background pollutant data for NO_X and nitrogen deposition. The 2022 nitrogen deposition rate background is the 2019 value provided by the APIS and the application of a yearly reduction in deposition rate of 0.07 kg/ha/yr, as published by the Joint Nature Conservation Committee's Nitrogen Futures Project (1.1.1.1.1.1a.Ref 21).

Background concentrations of SO_2 and NH_3 in 2022 are well below their respective Critical Levels. Background concentrations of NO_X are well below the Critical Level for that pollutant at most locations. There is an existing exceedance at grid square at one receptor location (O_E12), adjacent to the Humber Sea Terminal, and an elevated concentration at receptor O_E10, which includes the Port of Grimsby and North East Lincolnshire's Grimsby AQMA. Background nitrogen deposition rate date for both short vegetation and tall vegetation exceed the lower Critical Load for saltmarsh habitat, which was confirmed by the APIS as 10 kg/ha/yr on 25 May 2023. However, nitrogen deposition rates to short vegetation do not exceed the upper Critical Load value of 20 kg/ha/yr.

4.2 Future Baseline

The future baseline scenario provides the air quality conditions against which the impact of Project emissions is considered. Future baseline air quality differs from existing baseline air quality for several reasons. These include:

- Increased vehicle movements on the local road network and Strategic Road Network, due to traffic growth.
- Reduced emissions per vehicle movement, due to improving vehicle emissions standards and the evolution of the UK vehicle fleet.
- An overall trend of decreasing background pollutant concentrations over future years.

5. Predicted Impacts

This section contains an assessment of the potential impacts to air quality as a result of the proposed installation. The assessment has quantified the PC and PEC from the proposed installation. For ease of interpretation of the paragraphs below and subsequent tables please refer to the following points:

- PC represents the Process Contribution from modelled site emissions only;
- AC represents the Ambient Concentration (background);
- PEC represents total Predicted Environmental Concentration of a pollutant (PEC = PC + AC);
- PC/AQS represent the PC as a percentage of the AQO, EAL and Critical Load; and
- PEC/AQS represent the PEC as a percentage of the AQO, EAL and Critical Load.

The site boundary represents likely worst-case conditions, with the contribution of emissions modelled to pollutant concentrations falling with increasing distance from the source. However, it should be noted that the site boundary itself does not represent sensitive exposure to pollutants with an averaging period of more than 1-hour, as it is unreasonable to presume members of the public would be present there for a period of time comparable to averaging periods of more than 1-hour, as defined by the AQSs and EALs.

5.1 Human Health Impacts

The results of the dispersion model are presented in Table 5-1 and Table 5-2**Error! Reference source not found.** for human health sensitive receptors and the combined impact of site and vessel emissions sources. Impacts are provided for two scenarios: one that assumes all vessels calling at the proposed installation will comply with MARPOL Regulation 13 Tier II; and one that assumes all vessels calling at the proposed installation will comply with MARPOL Regulation 13 Tier III. Drawings illustrating the impact of proposed installation emissions for the key pollutants of concern are provided in Figure 2 of Appendix A.

Table 5-1 Operational NO_2 concentrations at nearest human health sensitive receptors – Assuming MARPOL Tier II Emissions Standard (without SCR)

Receptor ID	Averaging Period	AQS ($\mu g/m^3$)	PC ($\mu g/m^3$)	PC/AQS	AC ($\mu g/m^3$)	PEC ($\mu g/m^3$)	PEC/AQS
O_R1	Annual	40	0.4	1%	13.8	14.3	36%
	Hourly	200	6.2	3%	27.7	33.9	17%
O_R2	Annual	40	0.4	1%	13.8	14.2	36%
	Hourly	200	5.9	3%	27.7	33.6	17%
O_R3	Annual	40	0.4	1%	13.8	14.2	36%
	Hourly	200	5.8	3%	27.7	33.5	17%
O_R4	Annual	40	0.4	1%	13.8	14.3	36%
	Hourly	200	6.1	3%	27.7	33.8	17%
O_R5	Annual	40	0.5	1%	13.8	14.3	36%
	Hourly	200	7.0	3%	27.7	34.6	17%
O_R6	Annual	40	0.3	1%	11.1	11.4	29%
	Hourly	200	4.7	2%	22.2	26.9	13%
O_R7	Annual	40	0.2	1%	11.1	11.3	28%
	Hourly	200	4.6	2%	22.2	26.8	13%
O_R8	Annual	40	0.3	1%	9.9	10.1	25%
	Hourly	200	4.4	2%	19.7	24.1	12%
O_R9	Annual	40	0.3	1%	10.1	10.4	26%
	Hourly	200	4.7	2%	20.2	24.9	12%

O_R10	Annual	40	0.2	1%	9.9	10.1	25%
	Hourly	200	3.4	2%	19.8	23.2	12%
O_R11	Annual	40	0.2	1%	8.5	8.7	22%
	Hourly	200	3.0	1%	17.0	19.9	10%
O_R12	Annual	40	0.1	<1%	17.5	17.5	44%
	Hourly	200	1.7	1%	34.9	36.6	18%
O_R13	Annual	40	1	3%	11.3	12.3	31%
	Hourly	200	7.9	4%	22.5	30.4	15%
O_R14	Annual	40	0.4	1%	10.6	11.1	28%
	Hourly	200	8.5	4%	21.3	29.8	15%
O_R15	Annual	40	0.5	1%	10	10.6	27%
	Hourly	200	7.3	4%	20.1	27.4	14%
O_R16	Annual	40	0.7	2%	10.6	11.3	28%
	Hourly	200	7.2	4%	21.1	28.4	14%
O_R17	Annual	40	0.6	2%	9.7	10.3	26%
	Hourly	200	5.3	3%	19.5	24.7	12%

Table 5-2 Operational NO_2 concentrations at nearest human health sensitive receptors – Assuming MARPOL Tier III Emissions Standard (with SCR)

Receptor ID	Averaging Period	AQS (µg/m^3)	PC (µg/m^3)	PC/AQS	AC (µg/m^3)	PEC (µg/m^3)	PEC/AQS
O_R1	Annual	40	0.3	1%	13.8	14.1	35%
	Hourly	200	2.2	1%	27.7	29.9	15%
O_R2	Annual	40	0.2	1%	13.8	14.1	35%
	Hourly	200	1.9	1%	27.7	29.6	15%
O_R3	Annual	40	0.2	1%	13.8	14.1	35%
	Hourly	200	2.2	1%	27.7	29.9	15%
O_R4	Annual	40	0.3	1%	13.8	14.1	35%
	Hourly	200	2.6	1%	27.7	30.3	15%
O_R5	Annual	40	0.3	1%	13.8	14.2	36%
	Hourly	200	3.6	2%	27.7	31.3	16%
O_R6	Annual	40	0.1	<1%	11.1	11.2	28%
	Hourly	200	1.6	1%	22.2	23.7	12%
O_R7	Annual	40	0.1	<1%	11.1	11.2	28%
	Hourly	200	1.8	1%	22.2	24.0	12%
O_R8	Annual	40	0.2	1%	9.9	10.0	25%
	Hourly	200	1.7	1%	19.7	21.5	11%
O_R9	Annual	40	0.1	0%	10.1	10.2	26%
	Hourly	200	1.2	1%	20.2	21.4	11%
O_R10	Annual	40	0.1	<1%	9.9	10.0	25%

	Hourly	200	0.9	<1%	19.8	20.7	10%
O_R11	Annual	40	0.1	<1%	8.5	8.6	22%
	Hourly	200	1.0	<1%	17.0	17.9	9%
O_R12	Annual	40	<0.1	<1%	17.5	17.5	44%
	Hourly	200	0.6	<1%	34.9	35.6	18%
O_R13	Annual	40	0.3	1%	11.3	11.6	29%
	Hourly	200	2.3	1%	22.5	24.8	12%
O_R14	Annual	40	0.1	<1%	10.6	10.8	27%
	Hourly	200	2.7	1%	21.3	24.0	12%
O_R15	Annual	40	0.2	1%	10	10.2	26%
	Hourly	200	2.4	1%	20.1	22.4	11%
O_R16	Annual	40	0.2	1%	10.6	10.8	27%
	Hourly	200	2.3	1%	21.1	23.4	12%
O_R17	Annual	40	0.2	1%	9.7	9.9	25%
	Hourly	200	1.5	1%	19.5	20.9	10%

5.1.1.1 Annual Mean NO_2

Without SCR technology applied to vessel emissions (Table 5-1), the maximum annual mean NO_2 PC of 1 µg/m^3 occurs at O_R13, which accounts for 3% of the AQO level and exceeds the Environment Agency screening criteria. With the addition of the AC, the PEC at this locations is 12.3 µg/m^3, which accounts for 31% of the AQS. As the PEC is less than 70% of the AQO value, the impact is screened as insignificant. The same is also the case for receptors O_R16 and O_R17.

With SCR technology applied to vessel emissions (Table 5-2), the maximum annual mean NO_2 PC of 0.3 µg/m^3 occurs at receptors O_R1 O_R4, O_R5 and O_R13, which accounts for around 1% (after rounding up) of the AQO value. With the addition of the AC, the PEC at these locations peaks at 14.2 µg/m^3, which accounts for 34% of the AQS. As the PEC is less than 70% of the AQO value, the impact is screened as insignificant.

5.1.1.2 Hourly Mean NO_2

Without SCR technology applied to vessel emissions (Table 5-1), the maximum hourly mean NO_2 PC of 8.5 µg/m^3 occurs at O_R14, which accounts for 4% of the AQO level and therefore does not exceed the Environment Agency screening criteria of 10%. As the PC is less than 10% of the AQO value, the impact is screened as insignificant.

With SCR technology applied to vessel emissions (Table 5-2), the maximum hourly mean NO_2 PC of 3.6 µg/m^3 occurs at O_R5, which accounts for 2% of the AQO level and therefore does not exceed the Environment Agency screening criteria of 10%. As the PC is less than 10% of the AQO value, the impact is screened as insignificant.

5.1.1.3 Source Apportionment

Table 5-4 provides the source apportionment of the PC reported in Table 5-3 for the human health receptors, split between site emissions and vessel emissions.

Table 5-3 Operational NO_2 Impact Source Apportionment

Receptor ID	MARPOL Tier II Emissions Standard (without SCR)				MARPOL Tier III Emissions Standard (with SCR)			
	Annual Mean NO_2		Hourly Mean NO_2		Annual Mean NO_2		Hourly Mean NO_2	
	Site Emissions	Vessel Emissions	Site Emissions	Vessel Emissions	Site Emissions	Vessel Emissions	Site Emissions	Vessel Emissions
O_R1	44%	56%	23%	77%	76%	24%	54%	46%
O_R2	40%	60%	27%	73%	72%	28%	59%	41%

O_R3	47%	53%	30%	70%	78%	22%	63%	37%
O_R4	53%	47%	30%	70%	82%	18%	63%	37%
O_R5	57%	43%	37%	63%	84%	16%	69%	31%
O_R6	36%	64%	22%	78%	69%	31%	53%	47%
O_R7	36%	64%	25%	75%	68%	32%	56%	44%
O_R8	42%	58%	29%	71%	74%	26%	61%	39%
O_R9	20%	80%	18%	82%	50%	50%	46%	54%
O_R10	21%	79%	17%	83%	50%	50%	45%	55%
O_R11	30%	70%	22%	78%	62%	38%	52%	48%
O_R12	23%	77%	24%	76%	54%	46%	55%	45%
O_R13	10%	90%	18%	82%	30%	70%	47%	53%
O_R14	13%	87%	17%	83%	37%	63%	44%	56%
O_R15	12%	88%	14%	86%	34%	66%	40%	60%
O_R16	10%	90%	17%	83%	31%	69%	44%	56%
O_R17	14%	86%	36%	64%	38%	62%	69%	31%

5.2 Nature Conservation Impacts

The results of the dispersion model are presented in Table 5-4 to Table 5-10**Error! Reference source not found.** for nature conservation sensitive receptors and the combined impact of site and vessel emissions sources. Again, the impacts are provided for two scenarios: one that assumes all vessels calling at the proposed installation will comply with MARPOL Regulation 13 Tier II; and one that assumes all vessels calling at the proposed installation will comply with MARPOL Regulation 13 Tier III. Drawings illustrating the impact of proposed installation emissions for the key pollutants of concern are provided in Figure 2 of Appendix A.

Table 5-4 Operational NOx concentrations at selected nature conservation sensitive receptors – Assuming MARPOL Tier II Emissions Standard (without SCR)

Receptor ID	Averaging Period	AQS (µg/m^3)	PC (µg/m^3)	PC/AQS	AC (µg/m^3)	PEC (µg/m^3)	PEC/AQS
O_E1	Annual	30	1.5	**5%**	15.1	16.6	55%
	Daily	75	7.7	**10%**	22.7	30.4	41%
O_E2	Annual	30	1.6	**5%**	15.1	16.8	56%
	Daily	75	11.6	16%	22.7	34.4	46%
O_E3	Annual	30	0.6	**2%**	14.9	15.5	52%
	Daily	75	5.8	8%	22.3	28.2	38%
O_E4	Annual	30	0.4	**1%**	13.8	14.2	47%
	Daily	75	4.7	6%	20.7	25.4	34
O_E5	Annual	30	0.3	**1%**	16.6	16.9	56%
	Daily	75	4.4	6%	24.9	29.3	39%
O_E6	Annual	30	0.2	1%	19.1	19.4	65%
	Daily	75	3.9	5%	28.7	32.6	44%
O_E7	Annual	30	0.3	**1%**	12.6	12.9	43%
	Daily	75	3.2	4%	18.9	22.1	29%
O_E8	Annual	30	0.1	0%	14.6	14.7	49%

	Daily	75	2.3	3%	21.9	24.2	32%
O_E9	Annual	30	0.1	0%	15.8	15.9	53%
	Daily	75	2.2	3%	23.7	25.9	35%
O_E10	Annual	30	0.1	0%	25.1	25.2	84%
	Daily	75	2.2	3%	37.7	39.9	53%
O_E11	Annual	30	0.1	0%	21.1	21.2	71%
	Daily	75	3.3	4%	37.7	34.9	47%
O_E12	Annual	30	0.1	0%	36.5	36.6	122%
	Daily	75	3.0	4%	31.7	57.7	77%
O_E13	Annual	30	0.1	0%	13.6	13.7	46%
	Daily	75	2.6	3%	54.7	23.0	31%
O_E14	Annual	30	0.1	0%	11.6	11.7	39%
	Daily	75	1.9	3%	20.4	19.4	26%
O_E15	Annual	30	0.1	0%	11.6	11.7	39%
	Daily	75	1.9	3%	17.4	19.3	26%
O_E16	Annual	30	1.5	**5%**	18.4	19.9	66%
	Daily	75	15.4	**21%**	17.4	43.0	57%
O_E17	Annual	30	0.3	**1%**	18.4	18.7	62%
	Daily	75	4.4	6%	27.6	32.0	43%
O_E18	Annual	30	0.3	**1%**	18.4	18.8	63%
	Daily	75	4.2	6%	27.6	31.8	42%
O_E19	Annual	30	0.2	1%	18.4	18.6	62%
	Daily	75	3.4	5%	27.6	31.0	41%

Table 5-5 Operational NOx concentrations at selected nature conservation sensitive receptors – Assuming MARPOL Tier II Emissions Standard (with SCR)

Receptor ID	Averaging Period	AQS (µg/m^3)	PC (µg/m^3)	PC/AQS	AC (µg/m^3)	PEC (µg/m^3)	PEC/AQS
O_E1	Annual	30	0.5	**2%**	15.1	15.6	52%
	Daily	75	2.2	3%	22.7	24.9	33%
O_E2	Annual	30	0.5	**2%**	15.1	15.7	52%
	Daily	75	3.6	5%	22.7	26.3	35%
O_E3	Annual	30	0.2	1%	14.9	15.1	50%
	Daily	75	2.2	3%	22.3	24.6	33%
O_E4	Annual	30	0.2	1%	13.8	13.9	46%
	Daily	75	1.8	2%	20.7	22.4	30%
O_E5	Annual	30	0.1	<1%	16.6	16.7	56%
	Daily	75	1.6	2%	24.9	26.4	35%
O_E6	Annual	30	0.1	<1%	19.1	19.2	64%
	Daily	75	1.4	2%	28.7	30.1	40%

O_E7	Annual	30	0.1	<1%	12.6	12.7	42%
	Daily	75	1.2	2%	18.9	20.1	27%
O_E8	Annual	30	<0.1	<1%	14.6	14.6	49%
	Daily	75	0.8	1%	21.9	22.7	30%
O_E9	Annual	30	<0.1	<1%	15.8	15.8	53%
	Daily	75	0.8	1%	23.7	24.4	33%
O_E10	Annual	30	<0.1	<1%	25.1	25.2	84%
	Daily	75	0.7	1%	37.7	38.4	51%
O_E11	Annual	30	<0.1	<1%	21.1	21.2	71%
	Daily	75	1.1	1%	37.7	32.8	44%
O_E12	Annual	30	<0.1	<1%	36.5	36.5	122%
	Daily	75	1.0	1%	31.7	55.7	74%
O_E13	Annual	30	0.1	<1%	13.6	13.7	46%
	Daily	75	0.8	1%	54.7	21.2	28%
O_E14	Annual	30	<0.1	<1%	11.6	11.7	39%
	Daily	75	0.6	1%	20.4	18.1	24%
O_E15	Annual	30	<0.1	<1%	11.6	11.7	39%
	Daily	75	0.6	1%	17.4	18.0	24%
O_E16	Annual	30	0.8	**3%**	18.4	19.2	64%
	Daily	75	4.2	6%	17.4	31.8	42%
O_E17	Annual	30	0.1	<1%	18.4	18.5	62%
	Daily	75	1.5	2%	27.6	29.1	39%
O_E18	Annual	30	0.1	<1%	18.4	18.5	62%
	Daily	75	1.1	2%	27.6	28.8	38%
O_E19	Annual	30	0.1	<1%	18.4	18.5	62%
	Daily	75	1.0	1%	27.6	28.7	38%

Table 5-6 Operational SO_2 concentrations at selected nature conservation sensitive receptors

Receptor ID	Averaging Period	AQS ($\mu g/m^3$)	PC ($\mu g/m^3$)	PC/AQS	AC ($\mu g/m^3$)	PEC ($\mu g/m^3$)	PEC/AQS
O_E1	Annual	20	<0.1	<1%	2.1	2.1	11%
O_E2	Annual	20	<0.1	<1%	2.1	2.1	11%
O_E3	Annual	20	<0.1	<1%	1.8	1.8	9%
O_E4	Annual	20	<0.1	<1%	1.7	1.7	9%
O_E5	Annual	20	<0.1	<1%	3.9	3.9	20%
O_E6	Annual	20	<0.1	<1%	3.4	3.4	17%
O_E7	Annual	20	<0.1	<1%	1.6	1.6	8%
O_E8	Annual	20	<0.1	<1%	2.2	2.2	11%
O_E9	Annual	20	<0.1	<1%	1.9	1.9	10%
O_E10	Annual	20	<0.1	<1%	2.8	2.8	14%
O_E11	Annual	20	<0.1	<1%	3.4	3.4	17%

O_E12	Annual	20	<0.1	<1%	3.0	3.0	15%
O_E13	Annual	20	<0.1	<1%	2.0	2.0	10%
O_E14	Annual	20	<0.1	<1%	1.7	1.7	9%
O_E15	Annual	20	<0.1	<1%	1.7	1.7	9%
O_E16	Annual	20	<0.1	<1%	3.2	3.2	16%
O_E17	Annual	20	<0.1	<1%	3.5	3.5	18%
O_E18	Annual	20	<0.1	<1%	1.8	1.8	9%
O_E19	Annual	20	<0.1	<1%	2.2	2.2	11%

Table 5-7 Operational NH_3 concentrations at selected nature conservation sensitive receptors – Assuming MARPOL Tier II Emissions Standard (without SCR)

Receptor ID	Averaging Period	AQS (µg/m^3)	PC (µg/m^3)	PC/AQS	AC (µg/m^3)	PEC (µg/m^3)	PEC/AQS
O_E1	Annual	3	0.01	<1%	1.5	1.55	52%
O_E2	Annual	3	0.01	<1%	1.5	1.55	52%
O_E3	Annual	3	<0.01	<1%	1.6	1.57	52%
O_E4	Annual	3	<0.01	<1%	1.6	1.57	52%
O_E5	Annual	3	<0.01	<1%	1.5	1.53	51%
O_E6	Annual	3	<0.01	<1%	1.6	1.61	54%
O_E7	Annual	3	<0.01	<1%	1.6	1.57	52%
O_E8	Annual	3	<0.01	<1%	1.5	1.53	51%
O_E9	Annual	3	<0.01	<1%	1.5	1.53	51%
O_E10	Annual	3	<0.01	<1%	1.6	1.56	52%
O_E11	Annual	3	<0.01	<1%	1.6	1.61	54%
O_E12	Annual	3	<0.01	<1%	1.6	1.61	54%
O_E13	Annual	3	<0.01	<1%	1.5	1.54	51%
O_E14	Annual	3	<0.01	<1%	2.1	2.09	70%
O_E15	Annual	3	<0.01	<1%	2.1	2.09	70%
O_E16	Annual	3	0.02	<1%	1.5	1.55	52%
O_E17	Annual	3	<0.01	<1%	1.6	1.56	52%
O_E18	Annual	3	<0.01	<1%	1.5	1.53	51%
O_E19	Annual	3	<0.01	<1%	1.5	1.53	51%

Table 5-8 Operational NH_3 concentrations at selected nature conservation sensitive receptors – Assuming MARPOL Tier II Emissions Standard (with SCR)

Receptor ID	Averaging Period	AQS (µg/m^3)	PC (µg/m^3)	PC/AQS	AC (µg/m^3)	PEC (µg/m^3)	PEC/AQS
O_E1	Annual	3	0.01	<1%	1.5	1.55	53%
O_E2	Annual	3	0.01	<1%	1.5	1.55	53%
O_E3	Annual	3	<0.01	<1%	1.6	1.57	53%
O_E4	Annual	3	<0.01	<1%	1.6	1.57	53%
O_E5	Annual	3	<0.01	<1%	1.5	1.53	50%
O_E6	Annual	3	<0.01	<1%	1.6	1.61	53%
O_E7	Annual	3	<0.01	<1%	1.6	1.57	53%
O_E8	Annual	3	<0.01	<1%	1.5	1.53	50%

O_E9	Annual	3	<0.01	<1%	1.5	1.53	50%
O_E10	Annual	3	<0.01	<1%	1.6	1.56	53%
O_E11	Annual	3	<0.01	<1%	1.6	1.61	53%
O_E12	Annual	3	<0.01	<1%	1.6	1.61	53%
O_E13	Annual	3	<0.01	<1%	1.5	1.54	50%
O_E14	Annual	3	<0.01	<1%	2.1	2.09	70%
O_E15	Annual	3	<0.01	<1%	2.1	2.09	70%
O_E16	Annual	3	0.02	1%	1.5	1.55	53%
O_E17	Annual	3	<0.01	<1%	1.6	1.56	53%
O_E18	Annual	3	<0.01	<1%	1.5	1.53	50%
O_E19	Annual	3	<0.01	<1%	1.5	1.53	50%

Table 5-9 Operational NDep concentrations at selected nature conservation sensitive receptors – Assuming MARPOL Tier II Emissions Standard (without SCR)

Receptor ID	Averaging Period	AQS (kgN/ha/yr)	PC (kgN/ha/yr)	PC/AQS	AC (kgN/ha/yr)	PEC (kgN/ha/yr)	PEC/AQS
O_E1	Annual	10 / 20	0.17	**2%** / <1%	14.6	14.76	**148%** / 74%
O_E2	Annual	10 / 20	0.19	**2%** / <1%	14.6	14.78	**148%** / 74%
O_E3	Annual	10 / 20	0.07	<1% / <1%	13.9	13.96	140% / 70%
O_E4	Annual	10 / 20	0.05	<1% / <1%	13.9	13.94	140% / 70%
O_E5	Annual	10 / 20	0.04	<1% / <1%	14.7	14.72	147% / 74%
O_E6	Annual	10 / 20	0.03	<1% / <1%	16	15.98	160% / 80%
O_E7	Annual	10 / 20	0.04	<1% / <1%	13.9	13.93	139% / 70%
O_E8	Annual	10 / 20	0.02	<1% / <1%	14.7	14.70	147% / 74%
O_E9	Annual	10 / 20	0.01	<1% / <1%	14.7	14.69	147% / 74%
O_E10	Annual	10 / 20	0.01	<1% / <1%	13.5	13.47	135% / 68%
O_E11	Annual	10 / 20	0.02	<1% / <1%	16	15.97	160% / 80%
O_E12	Annual	10 / 20	0.01	<1% / <1%	16	15.96	160% / 80%
O_E13	Annual	10 / 20	0.02	<1% / <1%	14.6	14.61	146% / 73%
O_E14	Annual	10 / 20	0.01	<1% / <1%	16.1	16.14	161% / 81%
O_E15	Annual	10 / 20	0.01	<1% / <1%	16.1	16.14	161% / 81%
O_E16	Annual	10 / 20	0.25	**2%** / 1%	14.7	14.93	**149%** / 75%
O_E17	Annual	10 / 20	0.04	<1% / <1%	25.5	25.54	255% / 128%
O_E18	Annual	10 / 20	0.05	<1% / <1%	26	26.09	261% / 131%
O_E19	Annual	10 / 20	0.03	<1% / <1%	14.7	14.72	147% / 74%

Table 5-10 Operational NDep concentrations at selected nature conservation sensitive receptors – Assuming MARPOL Tier II Emissions Standard (with SCR)

Receptor ID	Averaging Period	AQS (kgN/ha/yr)	PC (kgN/ha/yr)	PC/AQS	AC (kgN/ha/yr)	PEC (kgN/ha/yr)	PEC/AQS
O_E1	Annual	10 / 20	0.10	**1%** / <1%	14.6	14.69	**147%** / **74%**
O_E2	Annual	10 / 20	0.11	**1%** / <1%	14.6	14.70	**147%** / **74%**
O_E3	Annual	10 / 20	0.04	<1% / <1%	13.9	13.93	139% / 70%
O_E4	Annual	10 / 20	0.03	<1% / <1%	13.9	13.92	139% / 70%
O_E5	Annual	10 / 20	0.03	<1% / <1%	14.7	14.71	147% / 74%
O_E6	Annual	10 / 20	0.02	<1% / <1%	16	15.97	160% / 80%
O_E7	Annual	10 / 20	0.02	<1% / <1%	13.9	13.91	139% / 70%
O_E8	Annual	10 / 20	0.01	<1% / <1%	14.7	14.69	147% / 74%
O_E9	Annual	10 / 20	0.01	<1% / <1%	14.7	14.69	147% / 74%
O_E10	Annual	10 / 20	0.01	<1% / <1%	13.5	13.47	135% / 68%
O_E11	Annual	10 / 20	0.01	<1% / <1%	16	15.96	160% / 80%
O_E12	Annual	10 / 20	0.01	<1% / <1%	16	15.96	160% / 80%
O_E13	Annual	10 / 20	0.01	<1% / <1%	14.6	14.60	146% / 73%
O_E14	Annual	10 / 20	0.01	<1% / <1%	16.1	16.14	161% / 81%
O_E15	Annual	10 / 20	0.01	<1% / <1%	16.1	16.14	161% / 81%
O_E16	Annual	10 / 20	0.2	**2% / 1%**	14.7	14.88	**149% / 75%**
O_E17	Annual	10 / 20	0.03	<1% / <1%	25.5	25.53	255% / 128%
O_E18	Annual	10 / 20	0.03	<1% / <1%	26	26.07	261% / 131%
O_E19	Annual	10 / 20	0.02	<1% / <1%	14.7	14.71	147% / 74%

5.2.1.1 Annual Mean NOx

Without SCR technology, the maximum annual mean NO_X PC of 1.6 µg/m^3 occurs at O_E2 (Humber Estuary SAC), which accounts for 5% of the AQO value. With the addition of the AC, the PEC at this location is 16.8 µg/m^3, which accounts for 56% of the AQO value. As the PEC is less than 70% of the AQO value, the impact is screened as insignificant. The same is also the case for SAC receptors O_E1, O_E3 and O_E4.

Receptor O_E16 is a LWS with a PC of 1.5 µg/m^3. This is less than 100% of the AQO value. In line with Environment Agency guidance, this impact can be screeded as insignificant at local nature conservation site designations.

With SCR technology, the maximum annual mean NO_X PC within the SAC is 0.5 µg/m^3 at receptors O_E1 and O_E2 (Humber Estuary SAC), which accounts for under 2% of the AQO value. With the addition of the AC, the maximum PEC at these locations is 15.7 µg/m^3, which accounts for 52% of the AQO value. As the PEC is less than 70% of the AQO value, the impact is screened as insignificant. No other SAC receptors experience a PC of more than 1%.

With SCR technology, the maximum annual mean NO_X PC of 0.8 µg/m^3 occurs at O_E16 (Grassland habitat within a LWS), which accounts for less than 100% of the AQS (Critical Level). Again, in line with Environment Agency guidance, this impact can be screeded as insignificant at local nature conservation site designations.

5.2.1.2 Daily Mean NOx

Without SCR technology, a maximum daily NO_X PC of 11.6 µg/m^3 occurs at receptor O_E2, within the SAC, which accounts for 16% of the EAL. With the addition of the AC, the PEC at this location is 34.4 µg/m^3, which accounts for 46% of the EAL. Because this short-term PC is more than 10% of the EAL, further analysis is required before the impact can be determined as insignificant.

In 2020, the Institute of Air Quality Management (IAQM) published guidance on the assessment of air quality impacts on designated nature conservation sites (1.1.1.1.1.1a.Ref 18). This guidance was informed by expert opinions in the fields of air quality and ecology. Within that guidance, it is suggested that the EAL for daily mean NO_X should only apply where there are high concentrations of SO_2 and ozone (O_3), which is not generally the current situation in the UK. The guidance also stresses the relative importance of the long term mean NO_X concentrations when compared to the short term mean, citing several studies which state that the 'UNECE Working Group on Effects strongly recommended the use of the annual mean value, as the long term effects of NOx are thought to be more significant than the short term effects'. The IAQM guidance recommends that only the annual mean NOx concentration is used in assessments unless specifically required by a regulator; for instance, as part of an industrial permit application where high, short term peaks in emissions, and consequent ambient concentrations, may occur.

In light of the guidance published by the IAQM, the low SO_2 and O_3 concentrations in the area and the limited periods of peak emissions, it is considered that the impact on daily mean NO_X concentrations is insignificant.

5.2.1.3 Annual Mean SO_2

The PC is less than 1% of the AQO values and therefore the impact on annual mean SO_2 can be screened as insignificant.

5.2.1.4 Annual Mean NH_3

The PC is less than 1% of the AQO values and therefore the impact on annual mean NH_3 can be screened as insignificant.

5.2.1.5 Nitrogen Deposition

Without SCR technology on the marine vessels, the maximum annual nitrogen deposition rate PC within the SAC is 0.19 kgN/ha/yr, which occurs at receptor O_E2 and accounts for just under 2% of the Critical Load. With the addition of the AC, the PEC at this location is 14.8 kgN/ha/yr, which accounts for 148% of the lower Critical Load threshold EAL and 74.5% of the upper Critical Load threshold EAL. With a PC of more than 1% of the Critical Load, further analysis is required before the impact can be determined as insignificant.

With SCR technology on the marine vessels, the maximum annual nitrogen deposition rate PC within the SAC is 0.11 kgN/ha/yr, which occurs at receptor O_E2 and accounts for just around 1% of the Critical Load. With the addition of the AC, the PEC at this location is 14.7 kgN/ha/yr, which accounts for 147% of the lower Critical Load threshold EAL and 75% of the upper Critical Load threshold EAL. With a PC of 1% of the Critical Load, further analysis is required before the impact can be determined as insignificant.

The highest nitrogen deposition rate PC both with and without SCR on the marine vessels, occurs at receptor O_E16, a LWS. The PC at this location is less than 100% of the Critical Load and is therefore screened as insignificant.

For the further analysis required at the SAC receptors, reference is made to the air quality and marine ecology chapters of the Environmental Statement (ES) for the proposed installation (1.1.1.1.1.1a.Ref 1), which made the following points with regards to the air quality impact of nitrogen deposition:

> *a. For saltmarsh, the APIS provides a Critical Load range of 10-20 kg/ha/yr and nitrogen inputs have been experimentally demonstrated to have an effect on overall species composition of saltmarsh. However, the Critical Loads on APIS are relatively generic for each habitat type and cover a wide range of deposition rates. They do not (and are not intended to) take other influences (to which the habitat on a given site may be exposed) into consideration.*
>
> *b. Moreover, it is important to note from APIS that the experimental studies which underlie conclusions regarding the sensitivity of saltmarsh have "…neither used very realistic N doses nor input methods i.e. they have relied on a single large application more representative of agricultural discharge", which is far in excess of anything that would be deposited from atmosphere. Therefore, APIS indicates that determining which part of the critical load range to use for saltmarsh requires expert judgement. Overall, there is good reason to believe the upper*

part of the critical load range (20 kgN/ha/yr) may be more appropriate than the lower part (10 kgN/ha/yr) for upper saltmarsh.

c. Generally, nitrogen inputs from the air are not as important to plants as nitrogen from other sources. Effects of nitrogen deposition from atmosphere are likely to be dominated by much greater impacts from marine or agricultural sources. This is reflected on APIS itself, which states regarding saltmarsh that 'Overall, N deposition [from atmosphere] is likely to be of low importance for these systems as the inputs are probably significantly below the large nutrient loadings from river and tidal inputs'. Another mitigating factor is that the nature of intertidal saltmarsh in the Humber estuary means that there is daily flushing from tidal incursion. This is likely to further reduce the role of nitrogen from atmosphere in controlling botanical composition.

In Chapter 9 of the ES: Nature Conservation (Marine Ecology), it is determined that the additional predicted contribution from nitrogen emissions from the Project does not result in any exceedance of the Critical Load range for saltmarsh, as the highest deposition rate reported is less than 20 kg N/ha/yr. The operation of the Project does not cause an exceedance of the Critical Load and it therefore concluded that there will be a neutral impact on the Humber Estuary designated site, which gives rise to a neutral effect that is insignificant.

5.2.1.6 Source Apportionment

Source apportionment of the PC is reported in Table 5-11 and Table 5-12 for the nature conservation receptors, split between site emissions and vessel emissions. This demonstrates that of the pollutant impacts described above, site emissions alone would be screened as insignificant following the criteria given in Environment Agency guidance.

Table 5-11 Operational NO_X Impact Source Apportionment

Receptor ID	MARPOL Tier II Emissions Standard (without SCR)				MARPOL Tier III Emissions Standard (with SCR)			
	Annual Mean NO_X		Daily Mean NO_X		Annual Mean NO_X		Hourly Mean NO_X	
	Site Emissions	Vessel Emissions	Site Emissions	Vessel Emissions	Site Emissions	Vessel Emissions	Site Emissions	Vessel Emissions
O_E1	11%	89%	12%	88%	32%	68%	36%	64%
O_E2	9%	91%	12%	88%	28%	72%	35%	65%
O_E3	14%	86%	18%	82%	38%	62%	45%	55%
O_E4	16%	84%	20%	80%	42%	58%	50%	50%
O_E5	20%	80%	14%	86%	49%	51%	38%	62%
O_E6	20%	80%	16%	84%	50%	50%	44%	56%
O_E7	18%	82%	20%	80%	46%	54%	50%	50%
O_E8	23%	77%	15%	85%	54%	46%	40%	60%
O_E9	23%	77%	14%	86%	54%	46%	40%	60%
O_E10	24%	76%	13%	87%	55%	45%	36%	64%
O_E11	19%	81%	15%	85%	47%	53%	41%	59%
O_E12	19%	81%	14%	86%	47%	53%	39%	61%
O_E13	28%	72%	16%	84%	59%	41%	43%	57%
O_E14	20%	80%	13%	87%	48%	52%	38%	62%
O_E15	20%	80%	14%	86%	48%	52%	39%	61%
O_E16	37%	63%	21%	79%	70%	30%	52%	48%
O_E17	29%	71%	22%	78%	61%	39%	52%	48%
O_E18	18%	82%	16%	84%	47%	53%	43%	57%
O_E19	20%	80%	19%	81%	50%	50%	48%	52%

Table 5-12 Operational NH_3 and Nitrogen Deposition Impact Source Apportionment

Receptor ID	MARPOL Tier II Emissions Standard (without SCR)				MARPOL Tier III Emissions Standard (with SCR)			
	Annual Mean NH_3		Nitrogen Deposition		Annual Mean NH_3		Nitrogen Deposition	
	Site Emissions	Vessel Emissions	Site Emissions	Vessel Emissions	Site Emissions	Vessel Emissions	Site Emissions	Vessel Emissions
O_E1	100%	0%	26%	74%	56%	44%	45%	55%
O_E2	100%	0%	22%	78%	50%	50%	39%	61%
O_E3	100%	0%	32%	68%	62%	38%	51%	49%
O_E4	100%	0%	36%	64%	66%	34%	55%	45%
O_E5	100%	0%	42%	58%	72%	28%	62%	38%
O_E6	100%	0%	43%	57%	73%	27%	63%	37%
O_E7	100%	0%	39%	61%	70%	30%	59%	41%
O_E8	100%	0%	47%	53%	76%	24%	66%	34%
O_E9	100%	0%	47%	53%	76%	24%	66%	34%
O_E10	100%	0%	48%	52%	76%	24%	67%	33%
O_E11	100%	0%	41%	59%	71%	29%	61%	39%
O_E12	100%	0%	40%	60%	71%	29%	60%	40%
O_E13	100%	0%	53%	47%	80%	20%	71%	29%
O_E14	100%	0%	42%	58%	72%	28%	61%	39%
O_E15	100%	0%	42%	58%	72%	28%	62%	38%
O_E16	100%	0%	63%	37%	86%	14%	80%	20%
O_E17	100%	0%	54%	46%	81%	19%	73%	27%
O_E18	100%	0%	40%	60%	70%	30%	60%	40%
O_E19	100%	0%	43%	57%	73%	27%	63%	37%

6. Mitigation and Enhancement Measures

This section sets out measures by which emissions to air are controlled by embedded design methods, or by standard practice methods. The assessment of air quality impacts set out in Section 5 assumes that these measures are already in place, as there is no such scenario where they would not be.

It should be noted that some elements of the Project design remain flexible subject to the evolution of the Project design. To account for this flexibility, the air quality assessment is based on precautionary assumptions, such as modelling the lowest emissions release heights of those possible within the flexible design.

6.1.1.1 Embedded Measures

The Project has been designed, as far as possible, to avoid and minimise impacts and effects to population and health through the process of design development, and by embedding mitigation measures into the design.

Emissions to air and potential impacts at sensitive locations are mitigated by direct and indirect control measures including those which will be embedded within the Project design or which will be required to obtain or secure compliance with the environmental permit which must be obtained for the operation of the hydrogen production facility ("Environmental Permit"). These measures include, but are not limited to:

- Proposed installation layout design and the locating of defined works and associated onsite sources set out in Schedule 1 of the DCO application within the relevant work areas shown on the Work Plans, which has given consideration to nearby air quality sensitive receptors, including the position of the jetty and docked vessels;
- Closed system for ammonia and hydrogen handling with leak detection management system, which will be a requirement of the Environmental Permit;
- Emergency flares to burn off NH_3 or hydrogen emissions should the need arise; hydrogen flares will also be used in plant start up and shut down, which will be a requirement of the Environmental Permit and necessary to ensure compliance with COMAH regulations (ALARP);
- Emissions release heights to encourage optimal dispersion – assuming the lowest emission release height of the flexible design parameters as set out in Requirement 4(4) of the DCO;
- Demonstration of the application of best available techniques in plant design and operation as will be required to obtain the Environmental Permit, which the hydrogen production facility will need to comply with throughout its operational life; and
- The enforcement of relevant emissions standards including those set by MARPOL for Marine Vessels, with the Humber Estuary being part of the North Sea ECA for SO_X and NO_X, as enforced by the UK Maritime and Coastguard Agency.

6.1.1.2 Operational Phase

As stated previously, it is best practice to mitigate emissions to air. Measures to reduce operational phase sources include:

- Implementation of an Odour Management Plan to control odour emissions, to be a requirement of the Environmental Permit.
- Operational process and management control and monitoring of emissions to be a requirement of the Environmental Permit.

7. In-combination Effects

The In-combination effects are reported in Appendix 25.C of the ES. The main other development with the potential to contribute to in-combination effects in the neighbouring Immingham Eastern Ro-Ro Terminal (IERRT), which is still waiting on determination from the Secretary of State.

During the operational phase, assuming that the vessels calling at the facility will comply with MARPOL Regulation 13 Tier III standards (with SCR), the proposed installation contributes 1.7% of the Critical Level for annual mean NO_X, 1% of the Critical Load for nitrogen deposition, and less than 1% of the Critical Levels for annual mean SO_2 and NH_3, at the worst affect nature conservation receptor within the SAC (O_E2). With the contribution of emissions from the IERRT project, the combined impact within the SAC contributes 2.7% of the Critical Level for annual mean NO_X (receptor O_E1), 1% of the Critical Load for nitrogen deposition (receptors O_E1 and O_E2) and less than 1% of the Critical Levels for annual mean SO_2 and NH_3 (all receptors). With the background contribution, total annual mean NO_X concentrations account for less than 54% of the Critical Level at the location of worst impacts in the SAC (receptors O_E1 and O_E2) and noting that higher total NO_X concentrations are predicted where the combined impact of the Project and IERRT project account for less than 1% of the Critical Level. Total nitrogen deposition rates within the SAC account for over 100% of the Critical Load at all receptors, predominantly due to the background contribution, which accounts for up to 146% of the lower Critical Load threshold at receptors E_O1 and E_O2. Total SO_2 concentrations account for 11% of the Critical Level and Total NH_3 concentrations less than 50% of the Critical Level (again noting that higher total SO_2 and NH_3 concentrations are predicted where the combined impact of the Project and IERRT project account for a lesser proportion of those Critical Levels).

During the operational phase, assuming that the vessels calling at the facility will comply with MARPOL Regulation 13 Tier II standards (without SCR), the proposed installation contributes 5% of the Critical Level for annual mean NO_X, 2% of the Critical Load for nitrogen deposition, and less than 1% of the Critical Levels for annual mean SO_2 and NH_3, at the worst affect nature conservation receptor within the SAC (O_E2). With the contribution of emissions from the IERRT project, the combined impact contributes 6% of the Critical Level for annual mean NO_X, 2% of the Critical Load for nitrogen deposition and less than 1% of the Critical Levels for annual mean SO_2 and NH_3, at receptor O_E2. With the background contribution, total annual mean NO_X concentrations account for less than 57% of the Critical level at the location of worst impacts. It is also noted that higher total NO_X concentrations are predicted at other locations where the combined impact of the Project and IERRT project account for 1% or less of the Critical Level. Total nitrogen deposition rates account for over 100% of the Critical Load at all receptors, predominantly due to the background contribution at receptors E_O1 and E_O2. Total SO_2 concentrations account for 11% of the Critical Level and Total NH_3 concentrations around 50% of the Critical Level (again noting that higher total SO_2 and NH_3 concentrations are predicted where the combined impact of the proposed installation and IERRT project account for a lesser proportion of the Critical Levels).

It is impossible to estimate the proportion of Tier II and Tier III vessels that may use the facility in 2028 or 2036. Therefore, the actual impact at the receptors is likely to be somewhere between the two sets of values predicted for Tier III and Tier III vessels (as reported in Section 5). The proportion of Tier II vessels using the facility will reduce year on year and Tier III vessels will increase year on year, as older vessels or vessel engines are replaced or retrofitted with new technology.

In summary, combined emissions from the Project and the IERRT project will cause a cumulative impact on annual mean NO_X concentrations of more than 1% of the AQO value at a limited area of Saltmarsh habitat on the northern shore of the Humber Estuary. At these and other locations considered in the assessment, the combined impact does not cause an exceedance of the AQO for NO_X, nor put the AQO at risk of an exceedance. At locations where total NO_X concentrations are more elevated, combined impacts are 1% or less of the AQO.

The combined emissions of the Project and IERRT project will cause a cumulative impact on nitrogen deposition of more than 1% of the Critical Load at the same limited area of Saltmarsh habitat on the northern shore of the Humber Estuary, when assuming vessel emissions will comply with MARPOL Regulation 13 Tier II standards. At these and other locations, the deposition rate is over 100% of the Critical Load, although that is predominantly due to the background, which accounts for at least 99% of the total deposition rates reported. With MARPOL Regulation 13 Tier III standards, the combined effect of the proposed installation and IERRT project will cause a cumulative effect on nitrogen deposition of 1% or less of the Critical Load. In reality, there will be a mix of Tier II and Tier III standard compliant vessels using the facility, with the proportion of Tier III compliant vessels increasing year by year.

The significance of the cumulative effect on nature conservation receptors, in terms of planning policy, was described in the Nature Conservation (Marine Ecology) assessment of cumulative effects, reported in Appendix 25.C of the Environmental Statement. It concluded that the in-combination effect of the proposed installation with other development sources of emissions to air would not have a significant effect.

Over the course of the DCO examination, correspondence with Natural England including the Statement of Common Ground also concluded that Natural England were satisfied with the conclusion that in-combination air quality effects were not significant.

8. Conclusion

An air dispersion modelling assessment has been undertaken to quantify emissions to air associated with the proposed installation. Emissions from onsite sources and offshore vessel emissions have been considered and the impact on human health sensitive receptors and nature conservation receptors reported.

The assessment demonstrates that a large proportion of the impact from emissions generated by the operation of the proposed installation are from the vessels when docked at the facility.

The air dispersion modelling assessment has demonstrated that the proposed installation will not have a significant effect on air quality with reference to Environment Agency permitting guidance.

The effect of in-combination emissions is reported with reference to the Environmental Statement prepared for the proposed installations DCO examination, the conclusions of that assessment were that in-combination effects were not significant and this was substantiated by consultation with Natural England.

9. References

Ref 1. Air Products (BR) Limited (AP) (2023). Immingham Green Energy Terminal Development Consent Order 2023.

Ref 2. Air Pollution Information System (2023) APIS

Ref 3. Council of the European Union (2008), Directive 2008/50/EC on ambient air quality and cleaner air for Europe.

Ref 4. Department for Environment, Food and Rural Affairs UK Air (2023), Background Mapping data for local authorities.

Ref 5. Department for Environment, Food and Rural Affairs. (2024), MAGIC. Available at: www.magic.defra.gov.uk.

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Ref 7. Department for Environment, Food and Rural Affairs. (2022). 2020 NO_2 and PM projections data (2018 reference year).

Ref 8. Department for Environment, Food and Rural Affairs. (2022). Modelled background pollution data.

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Ref 10. Department for Food, Environment and Rural Affairs (2022), Local Air Quality Management Technical Guidance (TG22)

Ref 11. Environment Agency (2014) AQTAG06 – Technical Guidance on detailed modelling approach for an appropriate assessment for emissions to air.

Ref 12. Environment Agency (2016), Air emissions risk assessment for your environmental permit – Updated March 2023.

Ref 13. Environmental Protection Agency (2019), Selective Catalytic Reduction

Ref 14. H.M. Government (2010) The Air Quality Standards Regulations 2010.

Ref 15. H.M. Government (2016) The Air Quality Standards (Amendment) Regulations 2016.

Ref 16. H.M. Government (2021), The Environment Act.

Ref 17. H.M. Government (2023), Environmental Improvement Plan 2023.

Ref 18. Holman et al. (2020), A guide to the assessment of air quality impacts on designated nature conservation sites. Version 1.1.

Ref 19. International Convention for the Prevention of Pollution from Ships (MARPOL) (1997), Annex VI: Regulations for the Prevention of Air Pollution from Ships – NOX emission standards, Ref 20. International Convention for the Prevention of Pollution from Ships (MARPOL) (1997), Annex VI: Regulations for the Prevention of Air Pollution from Ships – SOX emission standards,

Ref 21. Joint Nature Conservation Committee (2020), Nitrogen Futures Project.

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Ref 23. North East Lincolnshire Council. (2020). 2023 Air Quality Annual Status Report (ASR).

Ref 24. North Lincolnshire Council. (2020). 2023 Air Quality Annual Status Report (ASR).

Ref 25. Wärtsilä (2023), Online engine configurator.

Revision: 1 Drawn: EB Checked: DF Approved: GH Date: 2023-08-16

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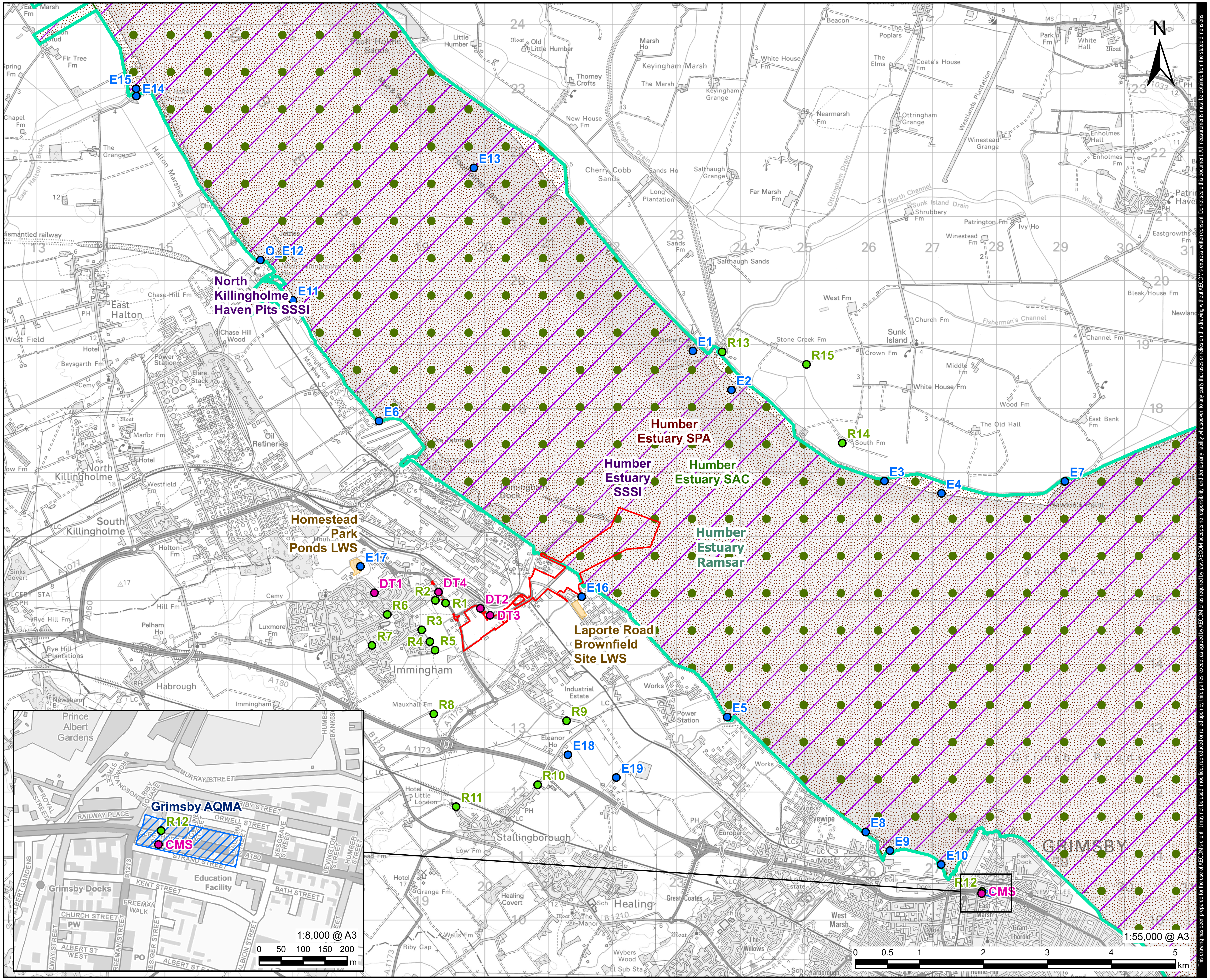

AECOM

PROJECT

Immingham Green Energy Terminal

CLIENT

Associated British Ports

CONSULTANT

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LEGEND

- Site Boundary
- Nature Conservation Receptors
- Human Health Receptors
- Air Quality Monitoring Locations
- Air Quality Management Area (AQMA)
- Local Wildlife Sites (LWS)
- Special Area of Conservation (SAC)
- Special Protection Area (SPA)
- Site of Scientic Interest (SSSI)
- Ramsar

NOTES

ISSUE PURPOSE

Environmental Statement

PROJECT NUMBER

60673509

DEVELOPMENT CONSENT ORDER NO

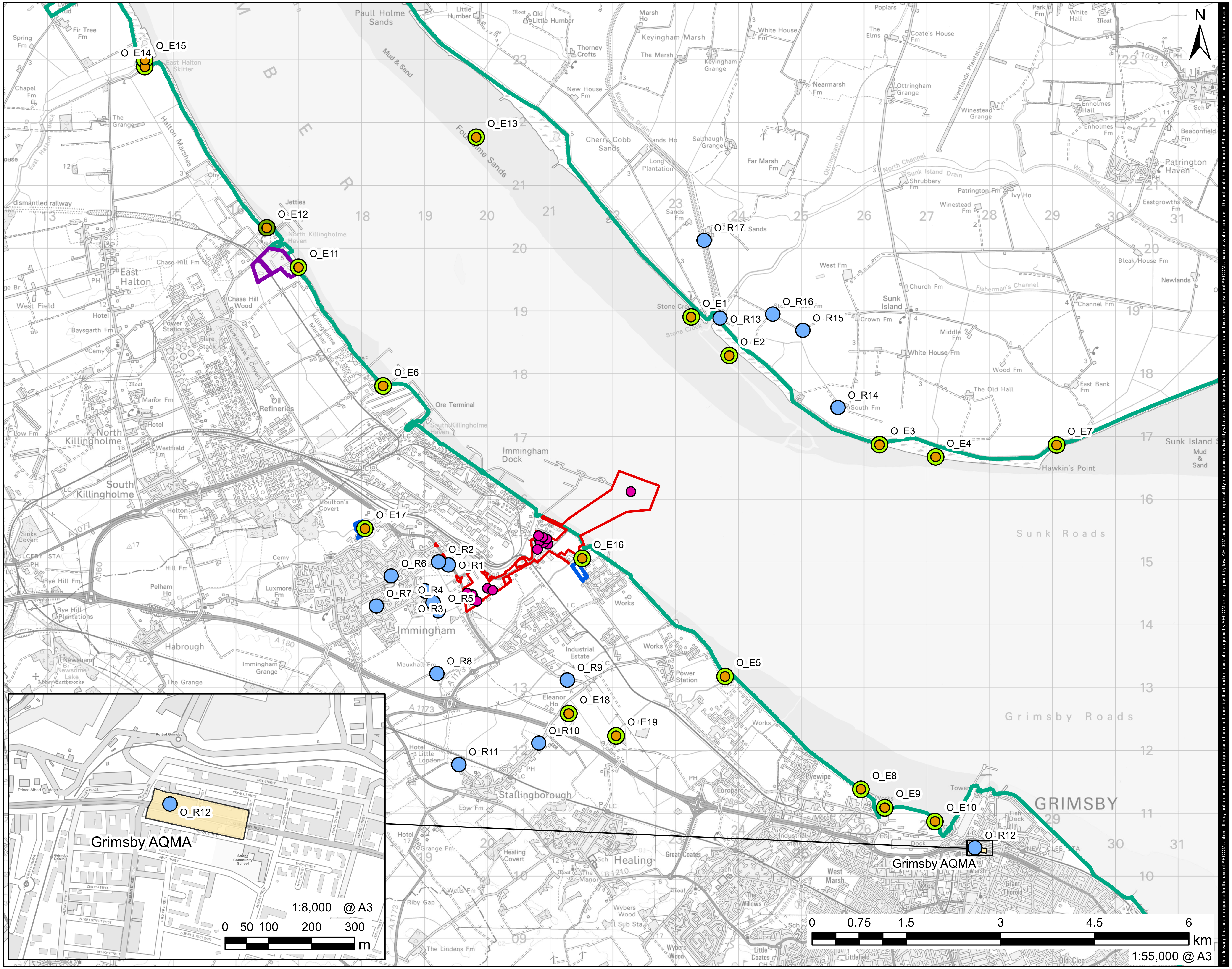
TR030008

FIGURE TITLE

Air Quality Study Area

FIGURE NUMBER

Figure 1



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PROJECT

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LEGEND

- Modelled IGET Emission Sources
- Site of Special Scientific Interest (SSSI)
- Humber Estuary EMS
- Air Quality Management Area (AQMA)
- Site Boundary
- Local Wildlife Sites (LWS)

Human Health Receptors

- Nitrogen Dioxide Concentrations <75% of the Air Quality Objective
- Nitrogen Dioxide Concentrations ≥75% of the Air Quality Objective

Nature Conservation Receptors

- Nitrogen Oxide Concentrations <100% of the Critical Level
- Nitrogen Oxide Concentrations ≥100% of the Critical Level
- Nitrogen Deposition Rates ≤100% of the Critical Load
- Nitrogen Deposition Rates >100% of the Critical Load

NOTES

ISSUE PURPOSE

ENVIRONMENTAL STATEMENT

PROJECT NUMBER

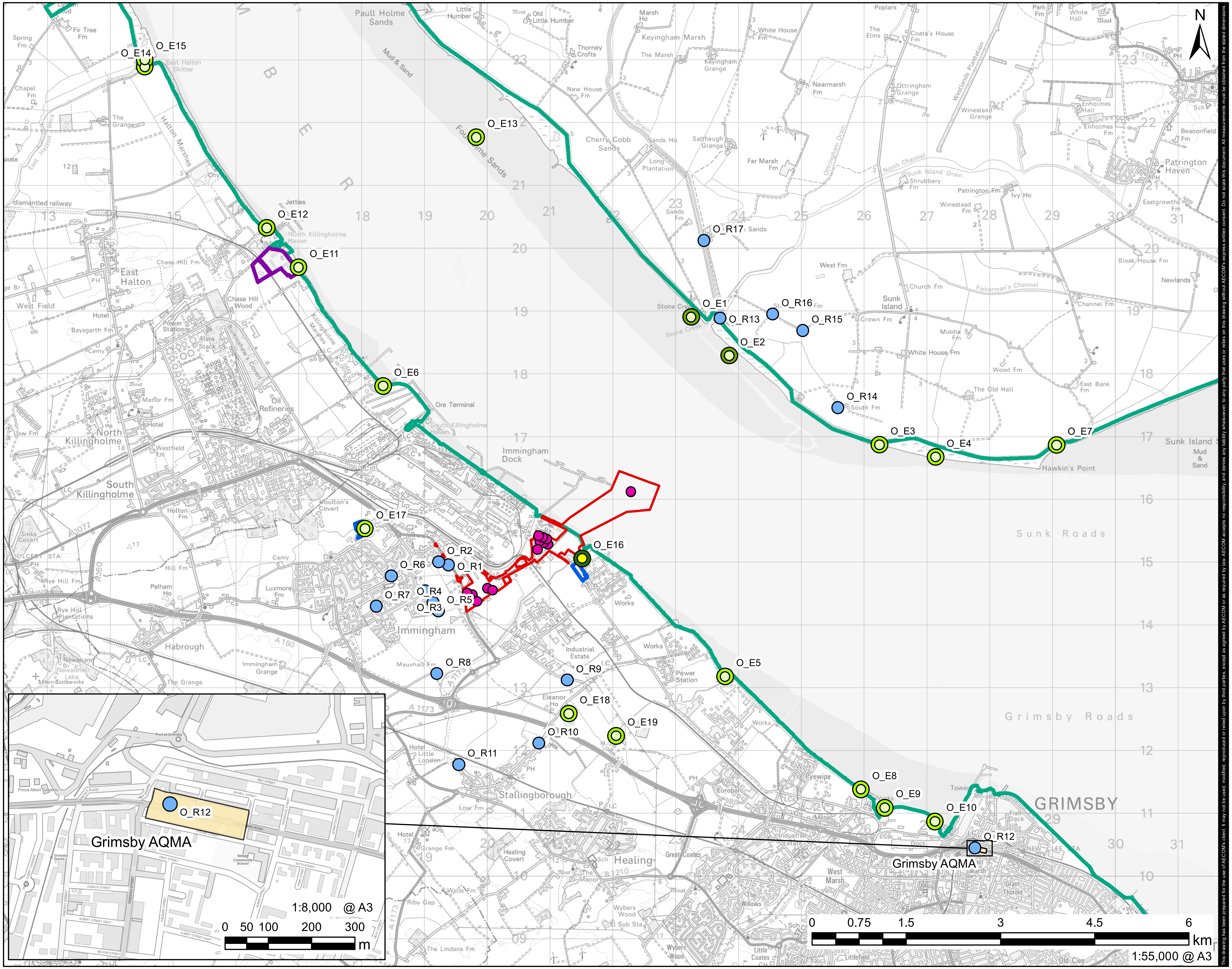
60673509

SHEET TITLE

A1: Operational Phase Air Quality Assessment Concentrations and Deposition Rates (MARPOL Tier III)

SHEET NUMBER

Figure 6.2



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Drawn: IR Checked: GH Approved: TS Date: 31/08/2023
Revision: 1

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PROJECT

Immingham Green Energy Terminal

CLIENT

Associated British Ports

CONSULTANT

AECOM Limited
2 City Walk
Leeds
LS11 9AR
www.aecom.com

LEGEND

- Modelled IGET Emission Sources
- Site of Special Scientific Interest (SSSI)
- Humber Estuary EMS
- Air Quality Management Area (AQMA)
- Site Boundary
- Local Wildlife Sites (LWS)

Human Health Receptors

- Nitrogen Dioxide impacts ≤1% of the Air Quality Objective
- Nitrogen Dioxide impacts >1% of the Air Quality Objective

Nature Conservation Receptors

- Nitrogen Oxide Impacts ≤1% of the Critical Level
- Nitrogen Oxide Impacts >1≤2% of the Critical Level
- Nitrogen Dioxide Impacts <3% of the Critical Level
- Nitrogen Deposition Impacts ≤1% of the Critical Load
- Nitrogen Deposition impacts >1≤2% of the Critical Load

NOTES

ISSUE PURPOSE

ENVIRONMENTAL STATEMENT

PROJECT NUMBER

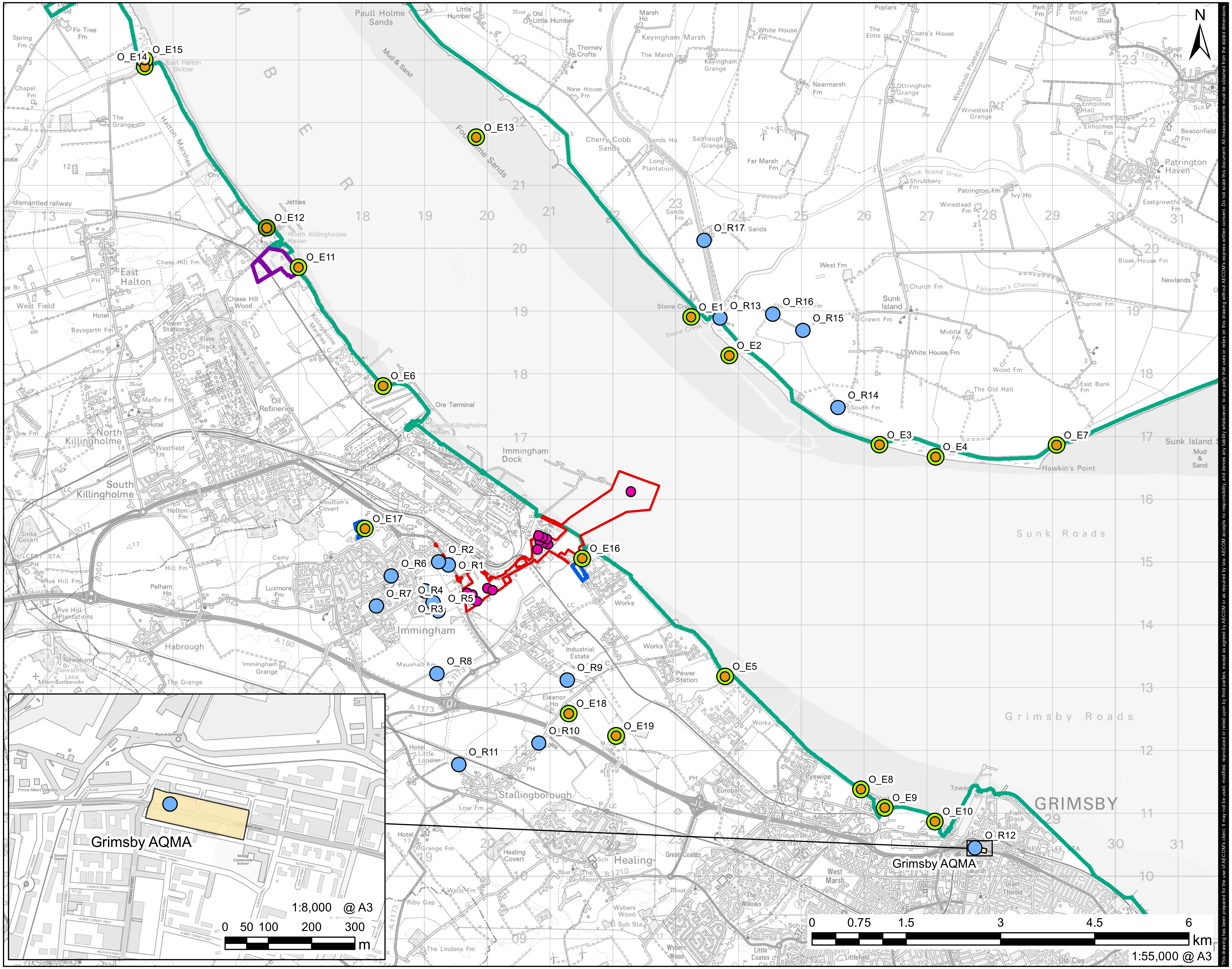
60673509

SHEET TITLE

A2: Operational Phase Air Quality Assessment Impacts (MARPOL Tier III)

SHEET NUMBER

Figure 6.2



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LEGEND
- Modelled IGET Emission Sources
- Site of Special Scientific Interest (SSSI)
- Humber Estuary EMS
- Air Quality Management Area (AQMA)
- Site Boundary
- Local Wildlife Sites (LWS)

Human Health Receptors
- Nitrogen Dioxide Concentrations <75% of the Air Quality Objective
- Nitrogen Dioxide Concentrations ≥75% of the Air Quality Objective

Nature Conservation Receptors
- Nitrogen Oxide Concentrations <100% of the Critical Level
- Nitrogen Oxide Concentrations ≥100% of the Critical Level
- Nitrogen Deposition Rates ≤100% of the Critical Load
- Nitrogen Deposition Rates >100% of the Critical Load

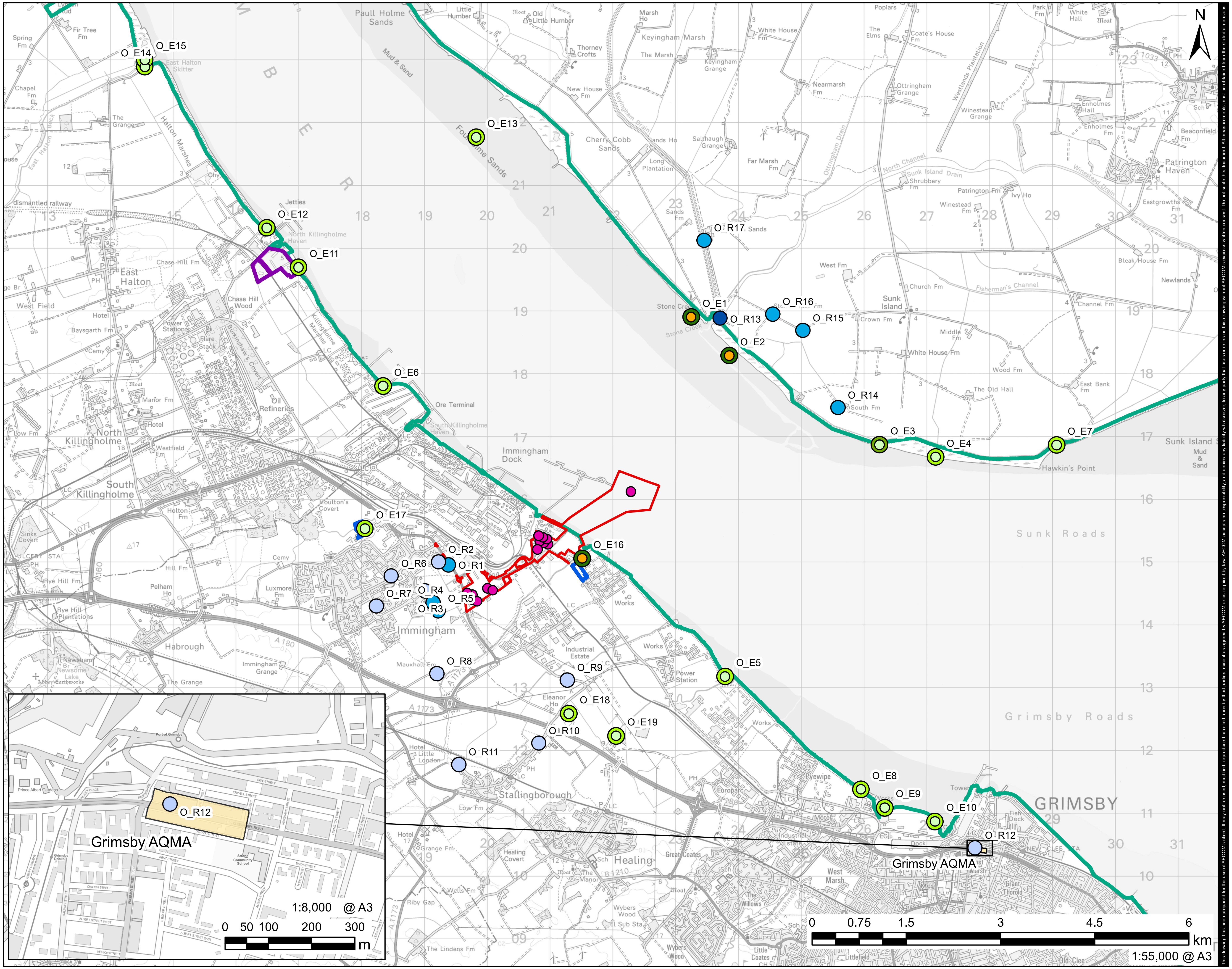
NOTES

ISSUE PURPOSE
ENVIRONMENTAL STATEMENT

PROJECT NUMBER
60673509

SHEET TITLE
B1: Operational Phase Air Quality Assessment Concentrations and Deposition Rates (MARPOL Tier II)

SHEET NUMBER
Figure 6.2



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LEGEND

- Modelled IGET Emission Sources
- Site of Special Scientific Interest (SSSI)
- Humber Estuary EMS
- Air Quality Management Area (AQMA)
- Site Boundary
- Local Wildlife Sites (LWS)

Human Health Receptors

- Nitrogen Dioxide impacts ≤1% of the Air Quality Objective
- Nitrogen Oxide Impacts >1≤2% of the Air Quality Objective
- Nitrogen Dioxide impacts >2≤3% of the Air Quality Objective

Nature Conservation Receptors

- Nitrogen Oxide Impacts ≤1% of the Critical Level
- Nitrogen Oxide Impacts >1≤2% of the Critical Level
- Nitrogen Oxide Impacts >2≤5% of the Critical Level
- Nitrogen Deposition Impacts ≤1% of the Critical Load
- Nitrogen Deposition Impacts >1≤2% of the Critical Load
- Nitrogen Deposition impacts >2≤3% of the Critical Load

NOTES

ISSUE PURPOSE

ENVIRONMENTAL STATEMENT

PROJECT NUMBER

60673509

SHEET TITLE

B2: Operational Phase Air Quality Assessment Impacts (MARPOL Tier II)

SHEET NUMBER

Figure 6.2

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