ARUP

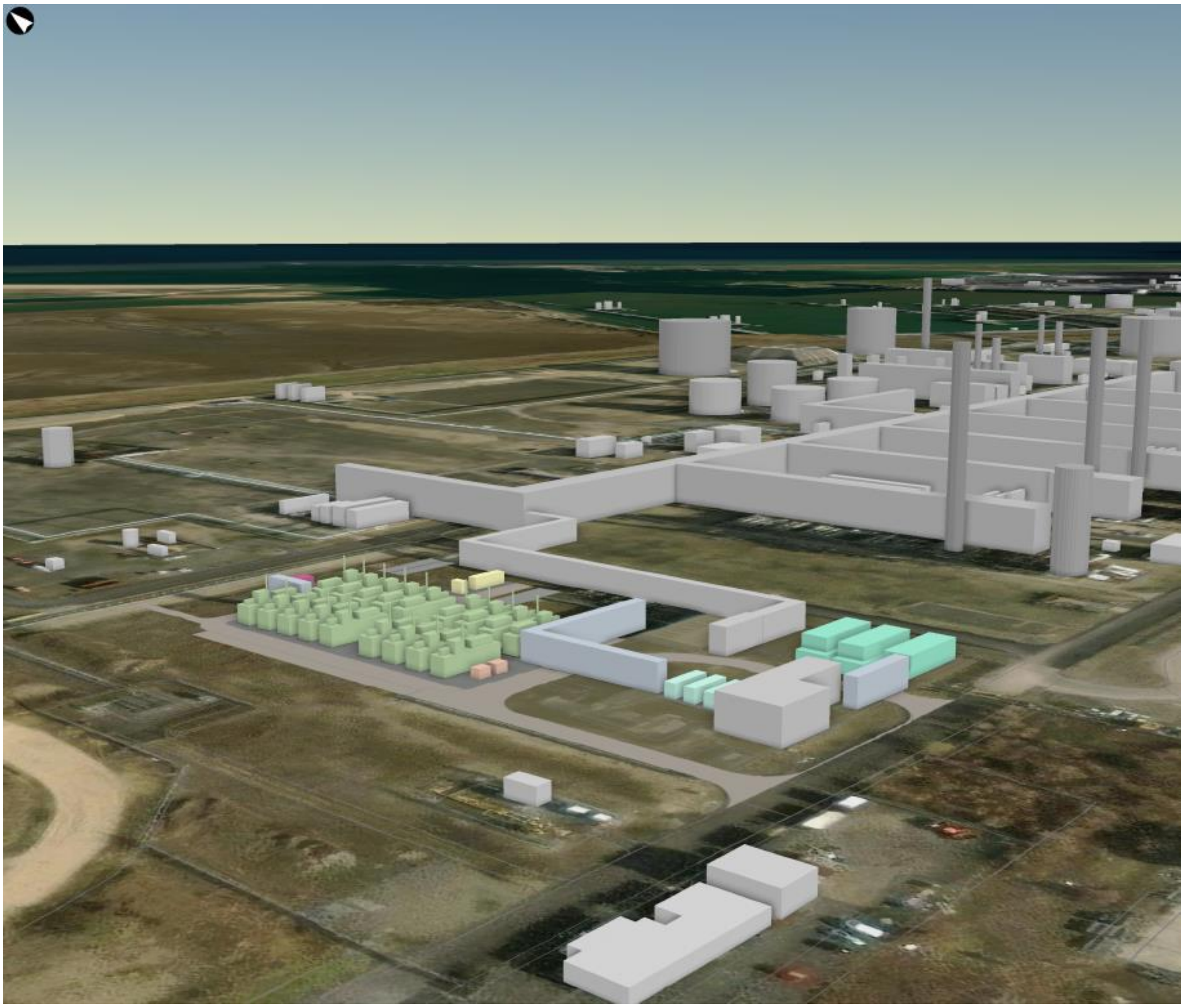
**ConocoPhillips (UK) Teesside Operator Limited**

# Teesside Crude Oil Stabilisation Terminal Environmental Permit Variation

## Appendix E: Air Impact Assessment

Reference: E2P-ARU-ZZ-ZZ-RP-YE-0022

P03 | 30 June 2025





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# List of Abbreviations

| | |
|---|---|
| AADT | Annual Average Daily Traffic |
| ADMS | Atmospheric Dispersion Modelling Assessment |
| APIS | Air Pollution Information System |
| AQAP | Air Quality Action Plan |
| AURN | Automatic Urban and Rural Network |
| CLRTAP | Convention on Long-Range Transboundary Air Pollution |
| AQMA | Air Quality Management Area |
| ASR | Annual Status Report |
| BAT | Best Available Techniques |
| BAT-AELs | Best Available Techniques -Achievable Emission Levels |
| BATc | Best Available Techniques Conclusions document |
| BC | Background Concentration |
| CEMP | Construction Environmental Management Plan |
| CL | Critical Level |
| Defra | Department for Environment, Food and Rural Affairs |
| BS | British Standard |
| CO | Carbon Monoxide |
| DM | Do Minimum |
| DS | Do Something |
| EA | Environment Agency |
| EAL | Environmental Assessment Level |
| ELV | Emission Limit Value |
| EP | Environmental Permitting |
| EPUK | Environmental Protection UK |
| EU | European Union |
| IAQM | Institute of Air Quality Management |
| IED | Industrial Emissions Directive |
| LAQM | Local Air Quality Management |
| LCP | Large Combustion Plant |
| LDV | Light Duty Vehicle |
| LNR | Local Nature Reserve |
| LWS | Local Wildlife Site |
| HDV | Heavy Duty Vehicle |
| MCP | Medium Combustion Plant |
| MWe | Megawatt Electrical |
| MWth | Megawatt Thermal |
| NGL | Natural Gas Liquids |
| NGR | National Grid Reference |
| NNR | Nation Nature Reserve |

| | |
|---|---|
| NO | Nitric Oxide |
| NPPF | National Planning Policy Framework |
| $NO_2$ | Nitrogen Dioxide |
| NOx | Oxides of Nitrogen |
| OS | Ordnance Survey |
| PC | Process Contribution |
| PEC | Predicted Environmental Concentration |
| PM | Particulate Matter |
| PPG | Planning Policy Guidance |
| RCBC | Redcar and Cleveland Borough Council |
| SAC | Special Area of Conservation |
| $SO_2$ | Sulphur Dioxide |
| SPA | Special Protection Area |
| SSSI | Site of Special Scientific Interest |
| STBC | Stockton-on-Tees Borough Council |
| STP | Standard Temperature and Pressure |
| UK | United Kingdom |
| UNECE | United Nations Economic Commission for Europe |
| WHO | World Health Organisation |

# 1. Introduction

Ove Arup & Partners Limited ('Arup') have carried out an Air Quality Impact Assessment to support the Environmental Permit variation application for the ConocoPhillips Ethane 2 Power ('E2P') project. The E2P project would enable ConocoPhillips to develop a power island (the 'E2P Power Island') at their Teesside Crude Oil Stabilisation Terminal (the 'Installation' or 'Teesside Terminal'), at Seal Sands, to utilise their surplus fuel gas comprising ethane/ methane product streams, to produce electrical power for use at the Teesside Terminal, with excess power being exported to the grid. The Teesside Terminal's main function is to stabilize crude oil. The amount of excess gas to burn is a function of the crude oil throughput which is on a continuing declining trend. Consequently, the overall emissions from the existing terminal will continue to decline as the amount of process plant requiring process gas as fuel will also decline. The E2P scheme is essentially a 'flexible outlet' for excess process gas at the Teesside Terminal allowing decarbonization of the existing Teesside Terminal fuel gas consumers and a planned switch to electrification. This will, in the longer term, achieve a further step change reduction in overall emissions from the facility. The E2P scheme is the key enabler for this opportunity, as there will be no other outlet for excess process gas other than to the site flare system.

The E2P Power Island will consist of a maximum of 16 gas engine units with each engine delivering 2.0 MWe. Based on the maximum of 16 x 2.0 MWe engines, the maximum thermal input would be in the region of 77MWth and therefore the E2P Power Island will comprise a listed activity under Environmental Permitting (England and Wales) Regulations 2016 (as amended) (EP Regulations) as a Section 1.1 Part A(1)(a): Burning of any fuel in an appliance with a rated thermal input of 50MW or more.

To support the Environmental Permit variation an air quality assessment has been undertaken to determine the potential impacts from the E2P Power Island, in order to identify whether there are likely to be any adverse impacts predicted at either human health or ecological receptors and particularly whether there is potential for them to lead to an exceedance of any Air Quality Standards (AQS) objectives, Environmental Assessment Levels (EALs), Critical Levels (CLs) and Critical Loads, as appropriate. The pollutants included in the assessment are oxides of nitrogen (NOx), nitrogen dioxide ($NO_2$), carbon monoxide (CO) and sulphur dioxide ($SO_2$).

The assessment considers:

- a summary of the air quality standards and guidance that are applicable;
- existing background air quality data;
- an outline of the assessment methodology;
- a Baseline Assessment of the existing emissions from the Installation; and
- a Future Assessment of the proposed future operation of the Teesside Terminal and the E2P Power Island.

As the design for the E2P Power Island has not yet been finalised, this assessment has been carried out based on the maximum number of engines that could be installed as a conservative worst case. The actual number of engines installed may be lower than the maximum 16 included in the assessment dependent on the final design. In any case, it should also be noted that a number of the installed engines (up to four) will be provided to provide redundancy to ensure that the availability of the E2P Power Island meets target levels, thereby minimising the potential for flaring, as detailed in the Main Supporting Document. Therefore, there would be no envisaged operational scenario that would result in the operation of all installed engines concurrently, however it is recognised that this scenario needs to be assessed for the Permit variation application. A more realistic worst-case scenario of 12 engines operating concurrently has therefore also been modelled to provide a more realistic worst case operational assessment.

In addition, the available fuel gas volumes will decline over time as throughput volumes at the Terminal decrease, and therefore the number of engines needing to operate would reduce correspondingly, such that the number of engines operational remains appropriate for the available fuel gas volume. The maximum number of engines are therefore only likely to be operational and on standby for the first four years of operation of the E2P Power Island, with the number of operational engines reducing rapidly after seven years of operation.

# 2. Assessment Criteria

## 2.1 Air Quality Legislation and Guidance

The principal air quality legislation within the United Kingdom is the Air Quality Standards Regulations 2010, which transposes the requirements of the European Ambient Air Quality Directive 2008 and the 2004 fourth Air Quality Daughter Directive. The Air Quality Standards Regulations 2010 set air quality limits for a number of major air pollutants that have the potential to impact public health, such as $NO_2$, CO and $SO_2$.

The Environment Act 1995 (amended by the Environment Act 2021) requires the UK Government to produce a National Air Quality Strategy (NAQS), last reviewed in 2007, containing air quality objectives and timescales to meet those objectives. The objectives apply to outdoor locations where people are regularly present and do not apply to occupational, indoor or in vehicle exposure.

The relevant pollutants of concern for the Installation are associated with the on-site combustion sources, including boilers, reboilers, flares and gas turbines. These sources, together with the future operation of the E2P Power Island release NOx, CO and $SO_2$ and therefore these species have been included in this assessment. The air quality AQS objectives that are applicable to this assessment are presented in Table 2.1.

**Table 2.1: Air Quality Standard Objectives Applicable to the Assessment**

| Pollutant | Air Quality Standard (µg/m$^3$) | Averaging period |
|---|---|---|
| $NO_2$ | 200 | 1-hour mean (not to be exceeded more than 18 times a year (99.79$^{th}$ percentile)) |
| | 40 | Annual mean |
| CO | 10,000 | Running 8-hour mean |
| $SO_2$ | 266 | 15-minute mean (not to be exceeded more than 35 times a year (99.9$^{th}$ percentile)) |
| | 350 | 1 hour mean (not to be exceeded more than 24 times a year (99.73$^{th}$ percentile)) |
| | 125 | 24 hour mean (not to be exceeded more than 3 times a year (99.18$^{th}$ percentile)) |

The EP Regulations apply to all new installations and transpose the requirements of the IED into UK legislation. Where legislative ambient AQS are not specified for the pollutant species potentially released from an Installation, Environmental Assessment Levels (EALs), published in the EA's Risk Assessments for Specific Activities: Environmental Permits guidance[1] ('EA's Risk Assessment Guidance') can be used to assess potential health effects on the general population.

For this assessment this includes an additional EAL for hourly concentrations of CO from combustion emissions. The EALs relevant to this assessment are provided in Table 2.2.

**Table 2.2: Environmental Assessment Levels Applicable to the Assessment**

| Pollutant | EAL µg/m$^3$ | Averaging period |
|---|---|---|
| CO | 30,000 | 1-hour mean (100$^{th}$ percentile) |

[1] Risk assessments for specific activities: environmental permits - GOV.UK (www.gov.uk)

The impact of emissions from the existing Teesside Terminal and the E2P Power Island on sensitive ecological receptors are quantified within this assessment in two ways:

- as direct impacts arising due to increases in atmospheric pollutant concentrations, assessed against defined 'Critical Levels'; and
- as indirect impacts arising through deposition of acids and nutrient nitrogen to the ground surface, assessed against defined 'Critical Loads'.

Critical Levels for the protection of vegetation and ecosystems have been adopted by, amongst others, the European Union and the United Nations Economic Commission for Europe (UNECE) Convention on Long-range Transboundary Air Pollution (CLRTAP). They are defined as *"concentrations of pollutants in the atmosphere above which direct adverse effects on receptors, such as plants, ecosystems or materials, may occur according to present knowledge"*. In terms of the ecosystem effects, the Critical Level relates to the effects on plants physiology, growth and vitality.

Under the European Ambient Air Quality Directive, assessment of compliance with Critical Levels is strictly only required at locations more than 20 km from towns with more than 250,000 inhabitants or more than 5 km from other built-up areas, industrial installations or motorways. However, in practice, assessment against Critical Levels is frequently undertaken to inform planning and permitting processes across the country, regardless of this definition.

Annual average Critical Levels for NOx and $SO_2$ have been transposed in the Air Quality Standards Regulations 2010. Additional values for daily NOx are also generally used as regulatory standards, although these have not been formally adopted. The applicable Critical Levels are shown in Table 2.3.

**Table 2.3: Critical Levels Applicable to the Assessment**

| Pollutant | Critical Levels $\mu g/m^3$ | Averaging period | Other Information |
|---|---|---|---|
| Oxides of nitrogen (NOx) as $NO_2$ | 75 | 24-hour mean | The critical level is generally considered to be $75\mu g/m^3$, but this only applies where there are high concentrations of $SO_2$ and ozone, which is not generally the current situation in the UK.[2] Given the low UK $SO_2$ concentrations IAQM consider the higher value of 200 $\mu g/m^3$ can be used as a short-term critical load. |
| | 30 | Annual average | - |
| $SO_2$ | 10 | Annual mean | Where lichens or bryophytes are present |
| | 20 | | For the protection of higher plants only |

Critical Loads for the deposition of nutrient nitrogen and acidifying species are dependent on the habitat type and species present at identified ecological receptors and therefore are specific to the location of relevant habitat types. They are based on empirical evidence, mainly observations from experiments and gradient studies.

The relevant Critical Loads for the habitat types present within the ecological receptors considered in this assessment are defined on the Centre for Ecology and Hydrology Air Pollution Information System (APIS) website[3] and are detailed in Section 4.

[2] IAQM (2020). A Guide to the Assessment of Air Quality Impacts on Designated Nature Conservation Sites.

[3] Air Pollution Information System | Air Pollution Information System (apis.ac.uk)

Critical Loads are provided as ranges of kilograms of nitrogen per hectare per year (kg N/ha/yr), which reflect the variation in ecosystem response across Europe. To ensure that a conservative assessment is carried out, it is usual for impacts to be determined against the lower end (i.e. the most stringent) of the Critical Load range.

## 2.2 Human Health Significance Criteria

The EA's Risk Assessment guidance identifies a two-stage process for determining the impact of emissions to air from an Installation. The stage one screening criteria compares the process contribution (PC) (i.e. the modelled ground level pollutant concentration) with the relevant AQS or EAL. The criteria states that an emission may be considered to have an insignificant impact where:

- Short term PC <=10% of the AQS or EAL; and,
- Long term PC <=1% of the AQS or EAL.

If both criteria are met, no further assessment is required, but if they are not met, the second stage of screening is applied.

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

- Short term PC <20% of the short term AQS or EAL minus twice the long-term background concentration (headroom); and
- Long term PEC (PC + background concentration) <70% of the AQS or EAL.

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

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

## 2.3 Ecological Significance Criteria

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

The EA's Risk Assessment guidance states that PCs may be considered to have an insignificant impact at the first stage of screening on these sites where:

- Short term PC <=10% of the Critical Level; and,
- Long term PC <=1% of the Critical Level.

If these requirements are not met for short term impacts, further assessment is required. For long term impacts, the PEC must be calculated and if it is less than 70% of the Critical Level, the impacts are considered insignificant.

For local nature sites, the assessment needs to determine whether the emissions are 'likely to damage' the site and is applicable to sites within 2km of the Installation Boundary. The EA's Risk Assessment guidance screening criteria states that where PCs are less than 100% of the short- or long-term Critical Level, the impact of emissions is insignificant.

For deposition impacts, PCs that are <1% of the relevant Critical Load can be considered to be insignificant. Where PCs are >1% of the relevant Critical Load, results need to be considered in the context of their background concentrations, and whether this is already exceeding the Critical Load and may require a Habitats Risk Assessment to be carried out.

# 3. Methodology

## 3.1 Scope of Assessment

The overall approach to the air quality assessment comprises the following:

- a background assessment to determine existing air quality conditions in the area around the Installation and in the vicinity of the Teesside Terminal;
- identification of human and ecological receptors in the vicinity of the Installation;
- a Baseline Assessment of the impact on air quality from the existing operation of the Teesside Terminal;
- a Future Assessment of the proposed future operation of the Teesside Terminal and the E2P Power Island; and
- conclusions on the significance of any effects on local air quality and at nearby ecological receptors.

The assessment is based on the worst-case operation of the Installation when maximum fuel gas volumes are available, assuming all plant is operational at full load for 8,760 hours per year, where actual operation will be less than this, due to maintenance outages and actual processing rates through the Teesside Terminal.

## 3.2 Existing Background Air Quality

Existing or background ambient air quality refers to the concentrations of relevant substances that are already present in the environment. These are present from various sources, such as industrial processes, commercial and domestic activities, traffic and natural sources.

A desk-based review of the following data sources has been undertaken to determine background conditions of air quality around the Installation:

- Stockton-on-Tees Borough Council Air Quality Annual Status Report 2023 (ASR)[4]
- the Defra Local Air Quality Management website[5];
- the UK Air Information Resource website[6] for details on air quality monitoring and Air Quality Management Areas (AQMAs); and
- the Air Pollution Information System (APIS)[7] website.

## 3.3 Receptors

The following sections provide information of the receptors included in the assessment.

### 3.3.1 Model Grid

The assessment of emissions from the Installation has been predicted on a grid of 7km by 7km, for contour plotting of the results and identification of the point of maximum impact on the modelled grid. The grid area has used the E2P Power Island at the central point and the extent is: National Grid Reference (NGR) (449627, 521535) to (456627, 528535), presented in Figure 1. The modelled height of the grid is at 0m.

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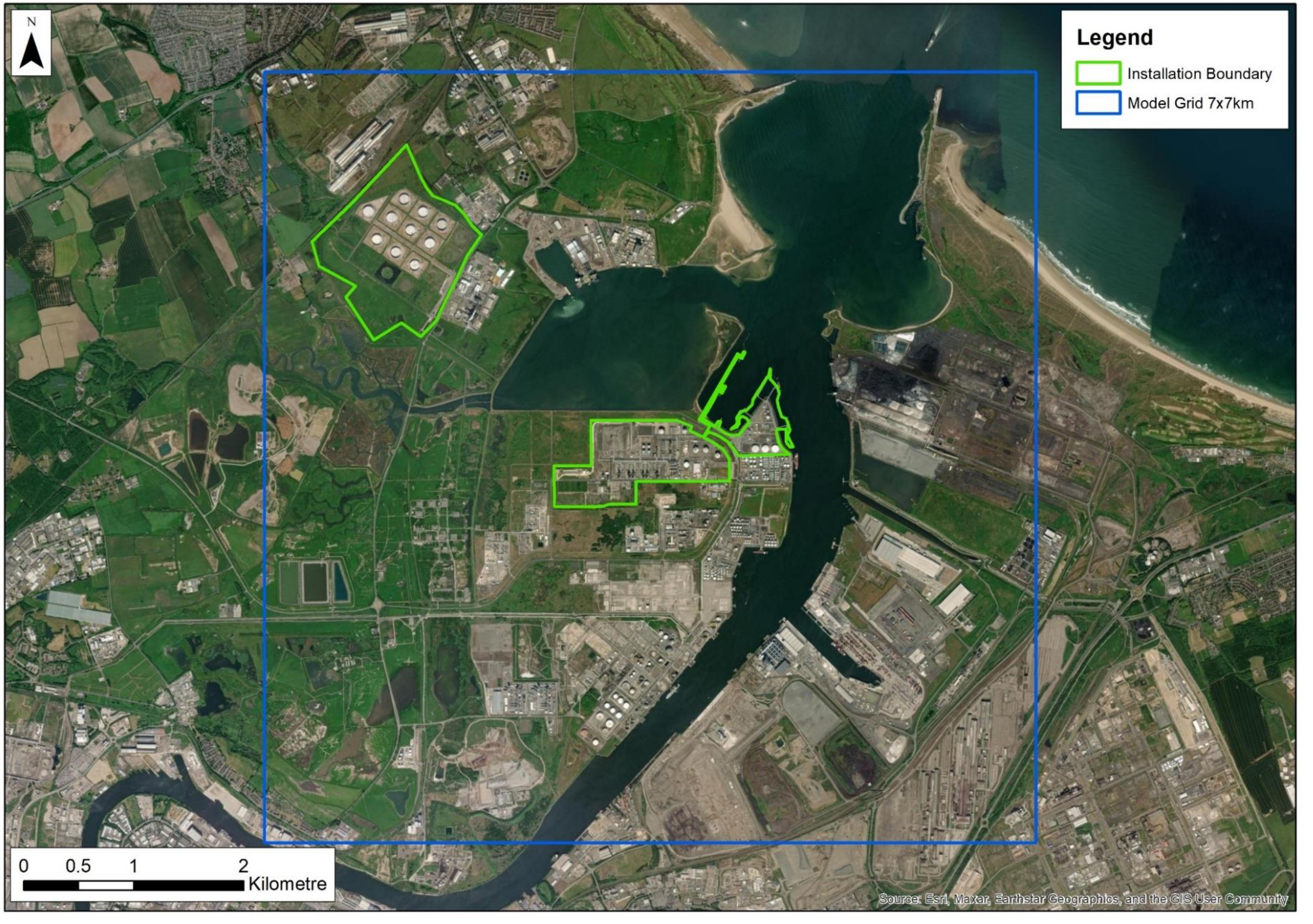
[4] Stockton-on-Tees Borough Council (2023) Air Quality Annual Status Report.
[5] Defra background mapping data. Available at: https://uk-air.defra.gov.uk/data/laqm-background-home [Accessed January 2025]
[6] UK Air Information Resource website: Available at: https://uk-air.defra.gov.uk/aqma/ [Accessed January 2025]
[7] Air Pollution Information System. Available at: https://www.apis.ac.uk/ [Accessed January 2025]

**Figure 1: Modelled Grid**



### 3.3.2 Human Receptors

Human receptors potentially affected by the emissions from the Installation, including local residential and amenity receptors, have been identified through a desk study of local mapping. Due to the industrial nature of the area, there are limited human health receptors within close proximity of the Installation.

For the purpose of identifying potential human receptors, the distance is defined as the shortest distance between the Installation and the closest residential property. These are shown in Table 3.1 and Figure 2.

**Table 3.1: Human Health Receptors in the Vicinity of the Teesside Terminal**

| ID | Receptor name | OS grid reference (m) | | Receptor type | Distance (km) and direction from the Installation |
|---|---|---|---|---|---|
| | | X | Y | | |
| R1 | Greatham | 449625 | 527150 | Residential | 3.7km north-west |
| R2 | Seaton Carew | 452090 | 528910 | Residential | 3.8km north |
| R3 | Dormanston | 458030 | 523805 | Residential | 5.2km east |
| R4 | Port Clarence | 449350 | 522275 | Residential | 4.1km south-west |
| R5 | Billingham | 447265 | 524865 | Residential | 5.3km west |
| R6 | Marsh House Lane | 449803 | 526833 | Residential | 3.1km north-west |
| R7 | Cowpen Bewley | 448280 | 524820 | Residential | 4.2km west |
| Note: Modelled heights for human receptors are at 1.5m. | | | | | |

### 3.3.3 Ecological Receptors

Ecological receptors potentially affected by the Installation have been identified through desk study of Defra Magic mapping[8]. Statutory designated sites (including SPAs, SACs, Ramsar sites and SSSIs) up to 15km have been included in the assessment and non-statutory designations such as natural nature reserves (NNR) and Local Wildlife Sites (LWS) within 2km have been also identified. All ecological receptors included in the assessment are shown in Table 3.2 and shown in Figure 3.

Ecological receptors E1 to E12 have been selected to determine the worst-case impacts at the Teesmouth and Cleveland Coast SPA, Ramsar, SSSI and NNR, the highest predicted concentrations have been used in the Critical Level results. It is also understood that the sensitive habitats of saltmarsh and dunes are present at receptors E1, E11 to E13, E31, E33, E35, E36 and E40 and these locations have been used in the nitrogen deposition and acidity assessment. Further information on the location and sensitivity of these habitats is provided in Section 5.1.2.

The Environment Agency, in their pre-application advice, provided information on a number of LWS in the vicinity of the Installation including:

- Greetham Creek North Bank Saltmarsh;
- Greenabella Marsh;
- Zinc Works Bird Field;
- Power Station Grassland and Wetland;
- Saltern Saltmarsh;
- Seaton Common;
- Phillips Tank Farm Grassland;
- Brenda Road Sewage Works Grassland;
- Brenda Road Brownfield; and

[8] MAGIC (defra.gov.uk)

- Queen's Meadow Wetland.

It is considered that the distance to a number of these sites is greater than the 2km screening distance namely, Brenda Road Sewage Works Grassland, Brenda Road Brownfield and Queen's Meadow Wetland, and therefore these sites have not been included in the assessment. A number of the other LWSs correspond to receptor locations that have been identified as part of the Teesmouth and Cleveland Coast SSSI – this has been indicated in Table 3.2 where relevant.

**Table 3.2: Ecological Receptors in the Vicinity of the Installation (within 15km)**

| ID | Receptor | Designation | OS grid reference (m) | | Distance and Direction from Installation (km) |
|---|---|---|---|---|---|
| | | | X | Y | |
| E1^ | Teesmouth and Cleveland Coast | SPA, Ramsar, SSSI and NNR | 451868 | 525445 | Adjacent north |
| E2 | | | 452076 | 525445 | |
| E3 | | | 452297 | 525445 | |
| E4 | | | 452536 | 525459 | |
| E5 | | | 452796 | 525454 | |
| E6 | | | 453071 | 525459 | |
| E7 | | | 453380 | 525441 | |
| E8 | | | 453681 | 525357 | |
| E9 | | | 453880 | 525163 | |
| E10 | | | 454423 | 524862 | |
| E11* | | | 453561 | 525600 | |
| E12* | | | 451842 | 525379 | |
| E13# | | | 453561 | 526785 | 1.4km north |
| E14 | Northumbria Coast | SPA and Ramsar | 448266 | 537476 | 12.7km north-west |
| E15 | Durham Coast | SAC and SSSI | 448266 | 537476 | 12.7km north-west |
| E16 | North York Moors | SPA, SAC, SSSI | 461229 | 513618 | 13.6km south-east |
| E17 | Lovell Hill Pools | SSSI | 459555 | 519057 | 8km south-east |
| E18 | Hart Bog | SSSI | 445285 | 535391 | 12.4km north-west |
| E19 | Langbaurgh Ridge | SSSI | 455467 | 512389 | 12.5km south |
| E20 | Roseberry Topping | SSSI | 457835 | 512796 | 13km south-east |
| E21 | Saltburn Gill | SSSI | 466990 | 521253 | 13.6km east |
| E22 | Whitton Bridge Pasture | SSSI | 438679 | 522285 | 13.7km west |
| E23 | Briarcroft Pasture | SSSI | 439513 | 519361 | 13.7km south-west |
| E24 | Pike Whin Bog | SSSI | 441514 | 533400 | 13.7km north-west |
| E25 | Cliff Ridge | SSSI | 457266 | 511728 | 13.7km south-east |
| E26 | Hulam Fen | SSSI | 443898 | 537392 | 14.8km north-west |

| ID | Receptor | Designation | OS grid reference (m) | | Distance and Direction from Installation (km) |
|---|---|---|---|---|---|
| | | | X | Y | |
| E27 | Charity Land | SSSI | 437520 | 534526 | 15km north-west |
| E28 | Fishburn Grassland | SSSI | 436462 | 532832 | 15km north-west |
| E29 | Seaton Dunes and Common | LNR | 452549 | 527829 | 2km north |
| E30[%] | Teesmouth and Cleveland Coast | SPA, Ramsar, SSSI and NNR | 451890 | 526152 | 1.2km north-west |
| E31* | | | 450906 | 525494 | 1.5km north-west |
| E32 | | | 450596 | 525178 | 1.6km north-west |
| E33[$] | | | 453055 | 528648 | 3.6km north |
| E34 | | | 452409 | 521998 | 1.6km south-east |
| E35* | | | 450073 | 525858 | 2.3km north-west |
| E36* | | | 451190 | 525282 | 1.1km north-east |
| E37 | Power Station Grasslands | LWS | 452630 | 527290 | 1.8km north |
| E38 | Seaton Common | LWS | 453720 | 527320 | 1.9km north |
| E39 | Phillips Tank Farm | LWS | 451130 | 526345 | 1.7km northwest |
| E40[$] | Teesmouth and Cleveland Coast | SPA, Ramsar, SSSI and NNR | 453555 | 527870 | 2.4km north |

Note: Modelled heights for ecological receptors are at 0m.

* This location is for assessing the species of saltmarsh and E36 specifically is also taken to be representative of Saltern Saltmarsh LWS.

[#] This location is for assessing the species of coastal dune grassland (calcareous)/ Shifting Dunes, and is also taken to be representative of Zinc Works Bird Field LWS.

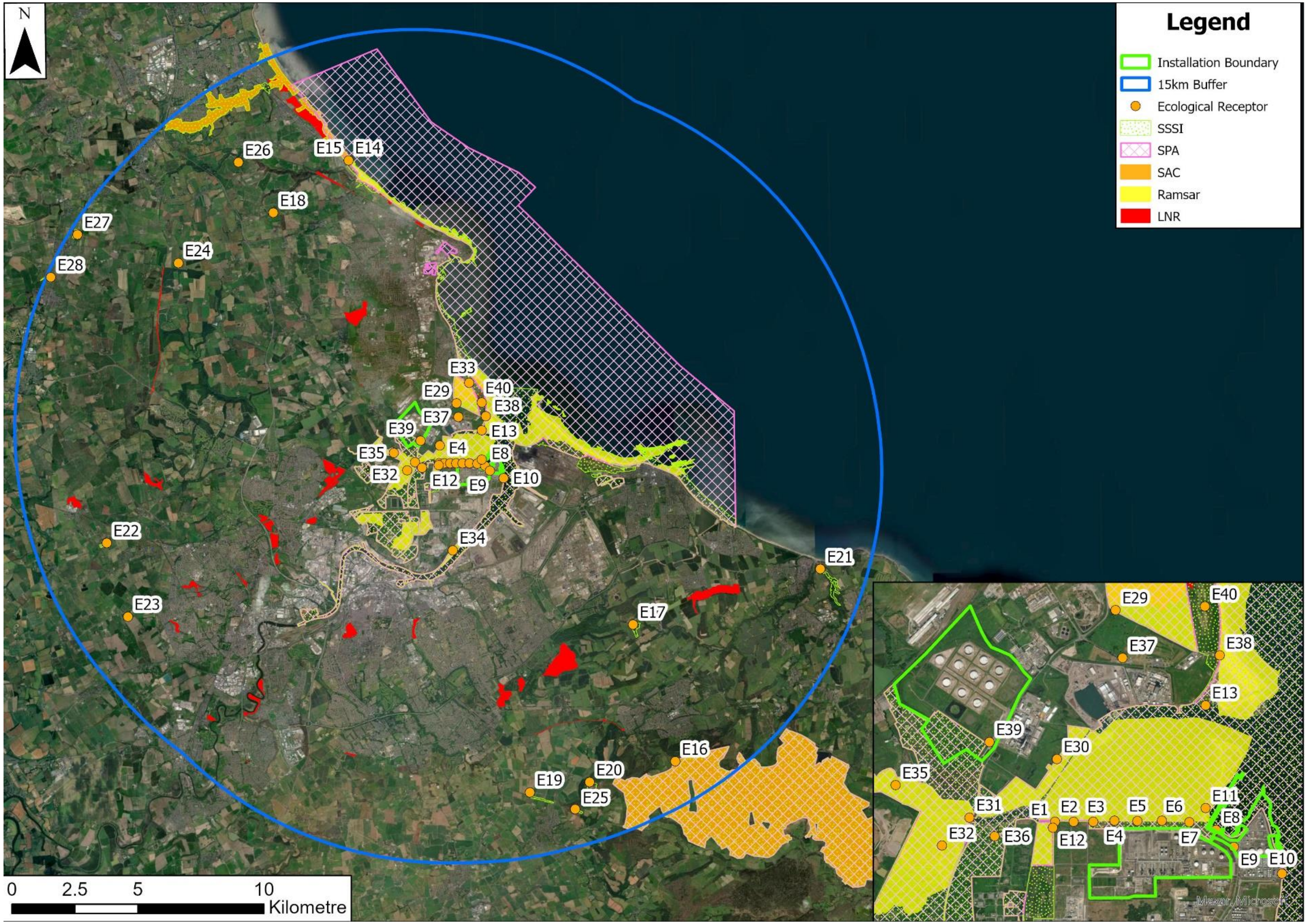
[%] This location is also taken to be representative of Greenabella Marsh LWS

[^] This location is also taken to be representative of Greetham Creek North Bank Saltmarsh LWS

[$] This location is for assessing the species of moist and wet dune slacks

**Figure 2: Human Receptors Included in the Assessment**

Figure 3: Ecological Receptors Included in the Assessment



## 3.4 Assessed Emission Parameters

The assessment has been undertaken using the existing operation of the Teesside Terminal (Baseline Assessment) in order to determine the existing impacts of the Installation's operations. A Future Assessment has then been carried out to include the operation of the existing Teesside Terminal and the E2P Power Island, so that the additional impacts associated with the E2P Power Island can be determined.

The assessment has used the latest ADMS atmospheric dispersion model (version 6). ADMS has been used to predict long-term and short-term concentrations, at discrete receptors and across a gridded domain, and results have been compared with the relevant objectives.

The information of the relevant emission sources and parameters used in both the Baseline and Future Assessment model scenarios are presented in the following sections.

### 3.4.1 Baseline Assessment

There are numerous Emission Points detailed in the existing Environmental Permit for the Teesside Terminal; however not all the existing Emission Points are currently in operation. A review of existing emissions from the Installation has been carried out to ensure that a realistic Baseline Assessment of the current impacts is carried out.

Emission sources that have not been included in the assessment, and their reason for omission is detailed in Table 3.3.

**Table 3.3: Emission Sources Excluded from the Baseline Assessment**

| Emission Point | Description | Reason for not including in the Baseline Assessment |
|---|---|---|
| A2 | Stabiliser train 40MWth Direct Fired Heater Reboiler | Stabilisation Train 2 Reboiler out of service since 2008.<br>No future service foreseen. |
| A4 | Stabiliser train 40MWth Direct Fired Heater Reboiler | Stabilisation Train 4 – reboiler on hot standby |
| A6 | Stabiliser train 40MWth Direct Fired Heater Reboiler | Stabilisation Train 6 – reboiler on hot standby |
| A7 | Stabiliser train 40MWth Direct Fired Heater Reboiler | Stabilisation Train 7 - reboiler on hot standby |
| A11 - 13 | Gas turbine standby stack | No emissions during normal operation. |
| A14 | Cold ground flare stack | NGL tank pressure control - minimal emissions. |
| A17 | 82m elevated flare stack | Only one flare is operational at any one time. The main flare (Emission point A16) is normally operational and has been modelled. |
| A19 | Vapour recovery unit | No combustion emissions from this point source. |
| A20 – A23 | Gas turbines and CHP plant | These Emission Points were included in the Environmental Permit for a CHP plant proposed for a planned Liquified Natural Gas Plant that has never installed and therefore do not exist at the Teesside Terminal. These Emission Points are to be removed from the Environmental Permit. |

Of the stabilisation trains at the Installation, only two of these are in operation at any one time, with trains 3 and 5 being currently operational (Emission Points A3 and A5). This level of operation has been in place for over 18 months and due to the declining volumes going through the Teesside Terminal, it is considered that this is unlikely to change. The reboilers on stabilisation trains 4 and 6 are on warm standby and therefore can be brought online if required, although this has not been the case over the last 18 months and is considered unlikely to be the case in the future. There are minimal emissions from this mode of operation and therefore they have been discounted from the assessment.

The parameters for the Emission Points that have been included in the assessment are shown in Table 3.4. Emission concentrations have been modelled at the Emission Limit Values (ELVs) within the Environmental Permit. Where these are provided for hourly and monthly averaging periods the appropriate ELV has been used for the comparison against the relevant AQS averaging periods.

Although some of the existing emission points have ELVs for particulates, as there are no particulate emissions associated with the E2P Power Island these have not been included in the assessment. Stack flows and temperatures have been based on measured data provided by ConocoPhillips.

Flare emissions have been based on calculated g/s release rates based on tonnages of annual NOx and $SO_2$ released from this source, as reported in the Installation's Pollution Inventory. NOx is calculated as 0.0015 kg NOx per kg of hydrocarbon flared. $SO_2$ is calculated from the volume of acid gas going to the flare from the DEA system, and the onsite labs evaluation of $H_2S$ present in the acid gas (calculated as a monthly average).

The flare flow rates are calculated based on the quantity of hydrocarbons sent to the flare.

Whilst not included in the assessment, the E2P Power Island is a key enabler to allow the electrification of the existing Teesside Terminal fuel gas consumers and ultimate decarbonization of the Terminal's Operation. This will, in the longer term, achieve significant reductions in existing combustion emissions from the Installation, reducing the overall impacts.

**Table 3.4: Emission Parameters and Pollutant Emission Rates for Baseline Assessment**

<table>
<tr><th colspan="2">Parameter</th><th colspan="2">A3</th><th colspan="2">A5</th><th colspan="2">A8</th><th colspan="2">A9</th><th colspan="2">A16</th></tr>
<tr><td colspan="2">Description</td><td colspan="4">40 MWth Direct fired heat reboiler</td><td colspan="4">LCP No.62, including 3 units of gas turbines and 3 units of boilers</td><td colspan="2">Flare</td></tr>
<tr><td colspan="2">Location (NRG)</td><td colspan="2">453099, 524860</td><td colspan="2">452974, 524860</td><td colspan="2">453341, 524862</td><td colspan="2">453362, 524862</td><td colspan="2">452829, 525228</td></tr>
<tr><td colspan="2">Stack height (m) (above finished ground level)</td><td colspan="2">61</td><td colspan="2">61</td><td colspan="2">45.5</td><td colspan="2">45.5</td><td colspan="2">122</td></tr>
<tr><td colspan="2">Approx. flue diameter (m)</td><td colspan="2">1.9</td><td colspan="2">1.9</td><td colspan="2">4.0</td><td colspan="2">4.0</td><td colspan="2">0.9</td></tr>
<tr><td colspan="2">Actual volumetric flow ($Am^3/hr$)</td><td colspan="2">26,481</td><td colspan="2">26,481</td><td colspan="2">142,617</td><td colspan="2">88,937</td><td colspan="2">1,277</td></tr>
<tr><td colspan="2">Average efflux velocity (m/s)</td><td colspan="2">2.6</td><td colspan="2">2.6</td><td colspan="2">3.2</td><td colspan="2">2.0</td><td colspan="2">0.6</td></tr>
<tr><td colspan="2">Oxygen content (%)</td><td colspan="2">7.8</td><td colspan="2">6.0</td><td colspan="2">9.1</td><td colspan="2">9.3</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Moisture content (%)</td><td colspan="2">8.5</td><td colspan="2">8.5</td><td colspan="2">9.4</td><td colspan="2">9.7</td><td colspan="2">N/A</td></tr>
<tr><td colspan="2">Temperature (°C)</td><td colspan="2">145.1</td><td colspan="2">108.2</td><td colspan="2">154.9</td><td colspan="2">136.8</td><td colspan="2">1,000</td></tr>
<tr><td colspan="2">Normalised volumetric flow ($Nm^3/s$)</td><td colspan="2">3.2</td><td colspan="2">4.0</td><td colspan="2">45.9</td><td colspan="2">29.1</td><td colspan="2">0.08</td></tr>
<tr><td colspan="2">Emission Limit Values</td><td>Hourly</td><td>Monthly</td><td>Hourly</td><td>Monthly</td><td>Hourly</td><td>Monthly</td><td>Hourly</td><td>Monthly</td><td>Hourly</td><td>Monthly</td></tr>
<tr><td rowspan="2">NOx</td><td>Concentration ($mg/Nm^3$)</td><td>300</td><td>150</td><td>300</td><td>150</td><td>90</td><td>90</td><td>90</td><td>90</td><td>-</td><td>-</td></tr>
<tr><td>Emission rate (g/s)</td><td>1.0</td><td>0.5</td><td>1.2</td><td>0.6</td><td>4.1</td><td>4.1</td><td>2.6</td><td>2.6</td><td>0.94</td><td>0.94*</td></tr>
<tr><td rowspan="2">CO</td><td>Concentration ($mg/Nm^3$)</td><td>70</td><td>50</td><td>70</td><td>50</td><td>23</td><td>12</td><td>23</td><td>12</td><td>No limit</td><td>No limit</td></tr>
<tr><td>Emission rate (g/s)</td><td>0.2</td><td>0.2</td><td>0.3</td><td>0.2</td><td>1.1</td><td>0.7</td><td>0.4</td><td>0.3</td><td>No limit</td><td>No limit</td></tr>
<tr><td rowspan="2">$SO_2$</td><td>Concentration ($mg/Nm^3$)</td><td>35^</td><td>35</td><td>35^</td><td>35</td><td>17</td><td>12</td><td>17</td><td>12</td><td>-</td><td>-</td></tr>
<tr><td>Emission rate (g/s)</td><td>0.1^</td><td>0.1</td><td>0.1^</td><td>0.1</td><td>0.8</td><td>0.6</td><td>0.5</td><td>0.3</td><td>1.95</td><td>1.95*</td></tr>
<tr><td colspan="12">Note:<br>^Monthly ELV data has been used as a proxy for hourly data.<br>*Hourly data has been used as a proxy as monthly data is not available.</td></tr>
</table>

**Figure 4: Existing Emission Points Included in the Baseline Assessment**

### 3.4.2 Future Assessment

For the Future Assessment, the existing plant has been modelled as detailed in Section 3.4.1. In addition, the E2P Power Island will consist of up to a maximum of 16 gas engine units with each engine having a thermal input of approximately 4.8 MWth. The E2P Power Island design is still undergoing refinement, therefore although the maximum number of engines has been stated in the Environmental Permit variation as 16, it is envisaged that the actual maximum number likely to be operational at any one time will be a maximum of 12. For the purpose of this assessment 16 engines have been modelled, as a very conservative worst-case scenario.

The maximum number of engines allows for some redundancy (up to 4 engines), in order to ensure that sufficient operational engines are always available, in the event that any engines require maintenance, and as such the maximum number of engines that will be operational at any one time will be less than the maximum number installed, and therefore a more realistic worse-case operational scenario of 12 engines operational has also been modelled.

Although timelines are uncertain at this stage, the Teesside Terminal will be expected to operate as long as the last remaining offshore production facility deems it economically viable to produce oil and gas, with the current forecasts indicating that this will be 2048, although this could be longer. Up until the cessation of activities, the volumes of oil through the Teesside Terminal are set to decline, which means that the volume of the fuel gas produced will also decrease and therefore there will be less fuel gas for the E2P Power Island.

Table 3.5 shows the forecast maximum and average available fuel gas production and the corresponding number of operational engines that will be required to combust the available gas, demonstrating that even considering the maximum fuel gas flows, the maximum number of operational engines required to be operational at full load to use the maximum available fuel gas is 11 and 9 engines for the predicted average gas flow, therefore less than the number installed and assessed.

**Table 3.5: Fuel Input Availability and Engine Requirements**

| Year | Based on Maximum Fuel Gas Flows | | | Based on Average Fuel Gas Flows | | |
|---|---|---|---|---|---|---|
| | Fuel Gas (kg/h) | Available Fuel Input (MWth) | No. of Operational Engines (full oad) | Fuel Gas (kg/h) | Available Fuel Input (MWth) | No. of Operational Engines (full load) |
| 2027 | 3,663 | 48.7 | 11 | 3,053 | 40.6 | 9 |
| 2028 | 3,834 | 51.0 | 11 | 3,195 | 42.5 | 9 |
| 2029 | 3,963 | 52.7 | 11 | 3,302 | 43.9 | 9 |
| 2030 | 3,539 | 47.0 | 10 | 2,949 | 39.2 | 9 |
| 2031 | 2,611 | 34.7 | 8 | 2,176 | 28.9 | 6 |
| 2032 | 3,443 | 45.8 | 10 | 2,869 | 38.1 | 8 |
| 2033 | 2,998 | 39.9 | 9 | 2,498 | 33.2 | 7 |
| 2034 | 2,276 | 30.3 | 7 | 1,897 | 25.2 | 6 |
| 2035 | 2,024 | 26.9 | 6 | 1,686 | 22.4 | 5 |
| 2036 | 1,677 | 22.3 | 5 | 1,397 | 18.6 | 4 |
| 2037 | 745 | 9.9 | 2 | 621 | 8.3 | 2 |
| 2038 | 740 | 9.8 | 2 | 617 | 8.2 | 2 |
| 2039 | 445 | 5.9 | 2 | 371 | 4.9 | 1 |
| 2040 | 728 | 9.7 | 2 | 606 | 8.1 | 2 |
| 2041 | 439 | 5.8 | 2 | 366 | 4.9 | 1 |
| 2042 | 436 | 5.8 | 2 | 364 | 4.8 | 1 |
| 2043 | 438 | 5.8 | 2 | 365 | 4.9 | 1 |
| 2044 | 438 | 5.8 | 2 | 365 | 4.9 | 1 |

| Year | Based on Maximum Fuel Gas Flows | | | Based on Average Fuel Gas Flows | | |
|---|---|---|---|---|---|---|
| | Fuel Gas (kg/h) | Available Fuel Input (MWth) | No. of Operational Engines (full oad) | Fuel Gas (kg/h) | Available Fuel Input (MWth) | No. of Operational Engines (full load) |
| 2045 | 150 | 2.0 | 1 | 125 | 1.7 | 1 |
| 2046 | 0 | 0.0 | 0 | 0 | 0.0 | 0 |
| 2047 | 0 | 0.0 | 0 | 0 | 0.0 | 0 |

As shown in Table 3.5, based on the maximum forecast fuel gas volumes, the maximum number of engines that would be required to be operational for the fuel gas available would be 11 at full load and after approximately the first 8 years of operation, the number of engines anticipated to be operational has halved from the number required for the opening year. This has more than halved again after 2 further years.

For the average fuel gas volumes, a maximum of 9 engines at full load would be operational for the peak fuel gas flows and therefore the assumption that the maximum number of engines would be operating continuously for a full year is very conservative as the available fuel gas volumes will fluctuate over the course of a year.

As such, it is considered that the predicted maximum level of impacts will only occur for approximately the first 4 years of operation of the E2P Power Island, with a rapid drop-off in impacts after 7 years of operation.

All operating engines have been assumed to be operational at 100% load, continuously, in the modelling assessment to ensure a worst-case assessment. The modelled emission parameters for each individual engine are shown in Table 3.6.

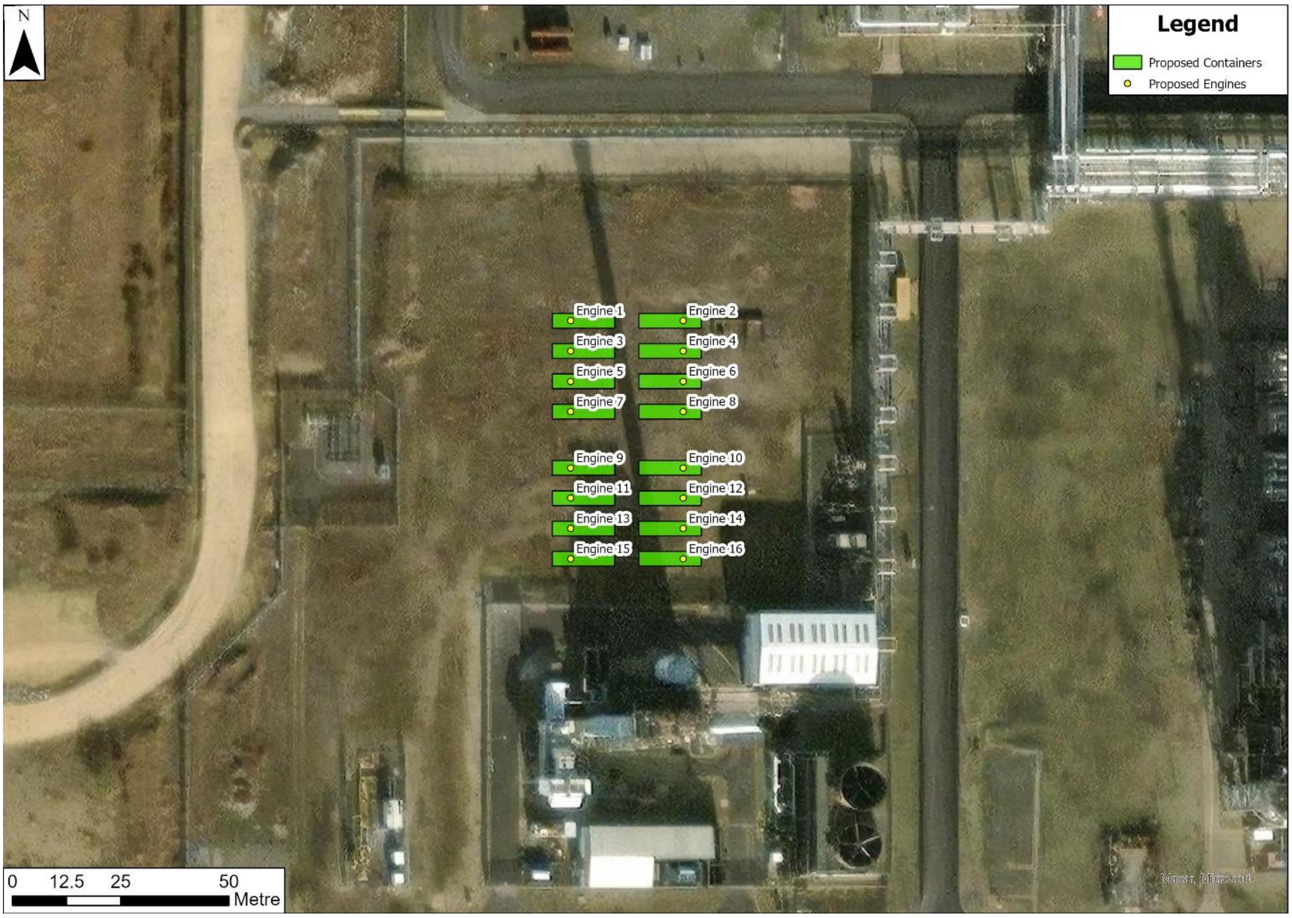
**Table 3.6: Emission Parameters and Pollutant Emission Rates Per Engine**

| Parameter | 2.0MWe Engine (each engine) |
|---|---|
| Stack height (m) (above finished ground level) | 10.4 |
| Approx. flue diameter (m) | 0.5 |
| Actual volumetric flow ($Am^3/s$) | 6.3 |
| Average efflux velocity (m/s) | 32.1 |
| Oxygen content (%) | 9.7 |
| Moisture content (%) | 11.0 |
| Temperature (°C) | 444.0 |
| Normalised volumetric flow ($Nm^3/s$)[1] | 4.1 |
| Proposed NOx Emission ($mg/Nm^3$) | 95 |
| NOx release rate (g/s) | 0.39 |
| Proposed CO emission ($mg/Nm^3$) | 100 |
| CO release rate (g/s) | 0.41 |
| Proposed $SO_2$ ($mg/Nm^3$) | 35 |
| $SO_2$ release rate (g/s) | 0.14 |
| [1] STP at 15% oxygen, dry | |

It should be noted that although emissions of $SO_2$ from the engines has been assumed to be at the Refineries BAT-AEL of 35mg/Nm$^3$, it is anticipated that due to the removal of sulphur from the fuel gas by the DEA scrubber to a specification of <10ppm (as detailed in the Main Supporting Document) actual emissions of $SO_2$ are not anticipated to occur, or anticipated to be at very low concentrations (<5mg/m$^3$ based on calculations carried out) and therefore the assessment of $SO_2$ impacts presented should be viewed as a very much worst-case.

The modelled engine layout is provided in Figure 5.

Figure 5: Locations of the Modelled Emission Sources and Buildings



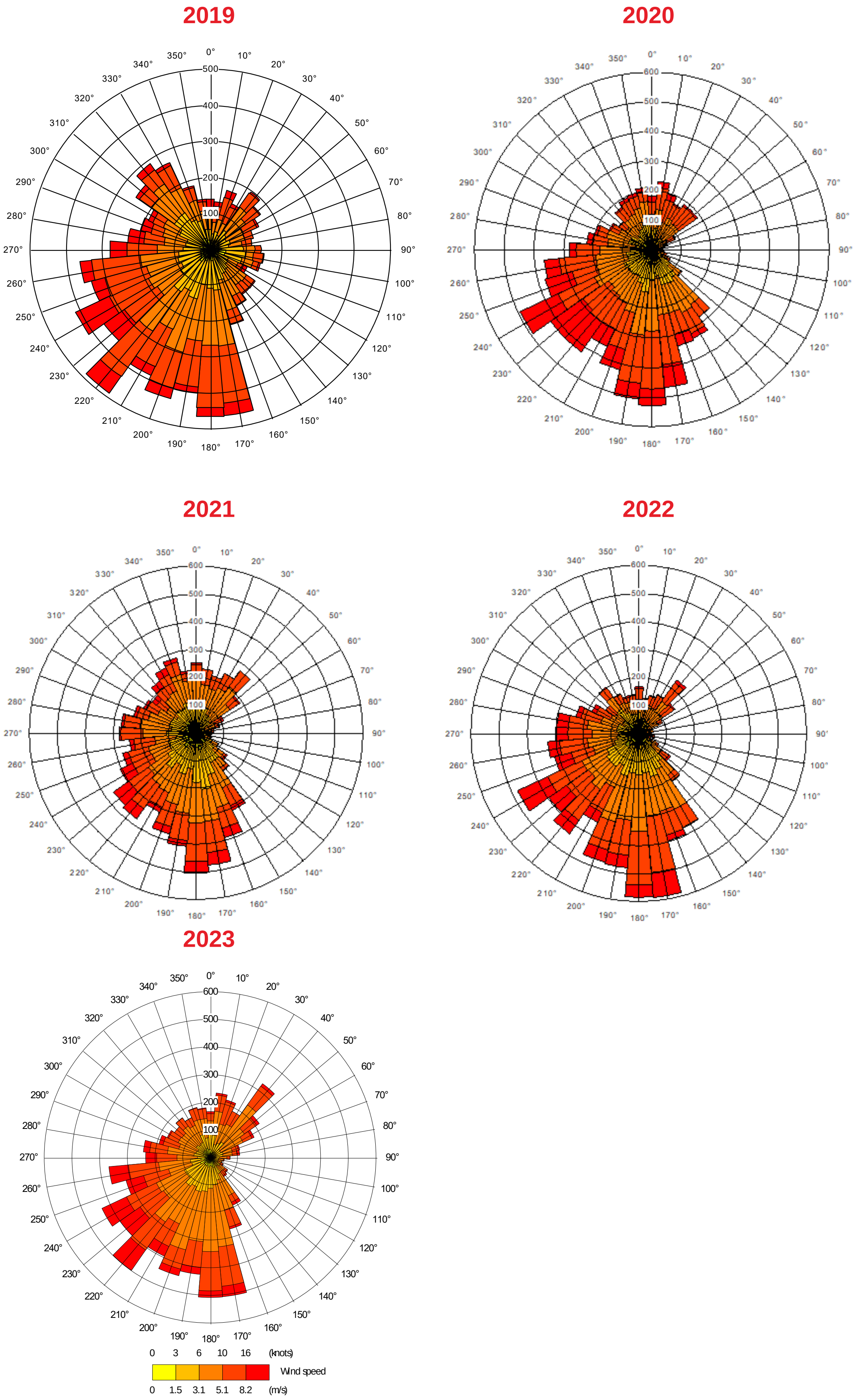

## 3.5 Meteorological Data

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

The meteorological site that was selected for the assessment is Durham Tees Valley Airport, located approximately 19km southwest of the Terminal, at a flat airfield in a principally agricultural area, and therefore a surface roughness of 0.3 m (representative of an agricultural area) has been selected for the meteorological site within the model.

The modelling for this assessment has utilised five years of meteorological data for the period 2019 - 2023, and the worst-case impacts from all years modelled has been presented in the assessment. The wind roses for Durham Tees Valley Airport are provided in Figure 6.

Figure 6: Wind Roses for Durham Tees Valley Airport 2019 - 2023



## 3.6 Buildings

The presence of buildings or structures near to the emission points can have a significant effect on the dispersion of emissions. The wind field can become entrained into the wake of buildings, which causes the wind to be directed to ground level more rapidly than in the absence of a building. If an emission is entrained into this deviated wind field, this can give rise to elevated ground-level concentrations.

Building effects are typically considered where a structure of height greater than 40% of the stack height is situated within 8 - 10 stack heights of the emissions source. For the Baseline scenario, as there are no buildings onsite that are considered would affect the dispersion of the emissions from the existing sources, building effects have not been considered further.

For the Future Assessment, building effects have been included for the individual engine containers, which are 14.4m long, 3.4m wide, 3.8m high.

## 3.7 Grid Terrain

The immediate local area downwind of the Installation is flat and undeveloped land followed by the River Tees Estuary. A surface roughness of 0.3 m, corresponding to the minimum value associated with the terrain type, has been selected to represent the local terrain.

Site-specific terrain data has not been used in the model, as typically terrain data will only have a marked effect on predicted concentrations where hills with gradient of more than 1 in 10 are present in the vicinity of the source. There are no potentially significant changes in gradient within the study area.

## 3.8 Result processing

### 3.8.1 NOx to $NO_2$ Conversion

The assessment models concentrations of NOx, which is a mixture of $NO_2$ and nitric oxide (NO). Both gases react in the atmosphere, particularly with ozone. In general, NOx is mainly emitted as NO and this converts to $NO_2$ in the atmosphere. The AQS has been set for $NO_2$ and therefore it is important that an appropriate conversion rate is used to calculate ambient $NO_2$ concentrations at the receptors that result from the modelled NOx emissions. The EA advice on conversion rates has been used, which recommends a ratio of 35% for short-term (i.e. hourly average) and 70% for long-term (i.e. annual mean) concentrations. In practice, these ratios represent conditions some distance away from a release source. Close to an industrial source, the proportion of $NO_2$ in NOx is typically much lower than this. Applying these ratios will therefore provide a conservative assessment for receptors close to the site.

### 3.8.2 Ecological Assessment – Deposition

With regard to nitrogen and acid deposition, site and habitat specific Critical Loads and existing deposition rates have been taken from the APIS website[3]. Predicted deposition at ecological receptors have been compared against the lowest Critical Loads to provide a worst-case assessment.

The dry deposition flux for each receptor has been calculated based on recommended deposition velocities[9], presented in Table 3.7.

**Table 3.7: Deposition Velocities**

| Parameter | Deposition velocity (m/s) | |
|---|---|---|
| $NO_2$ | Grassland | 0.0015 |
| | Forest | 0.003 |
| $SO_2$ | Grassland | 0.012 |

[9] Institute of Air Quality Management (IAQM) (2020) A guide to the assessment of air quality impacts on designated nature conservation sites

| Parameter | Deposition velocity (m/s) | |
|---|---|---|
| | Forest | 0.024 |

Conversion factors are used to convert dry deposition flux from units of µg/m$^2$/s to kg/ha/yr are shown in Table 3.8.

**Table 3.8: Factors to Convert Deposition to kg/ha/yr**

| Parameter | Conversion factor µg/m$^2$/s of species to kg/ha/yr | |
|---|---|---|
| $NO_2$ | of N: | 96 |
| $SO_2$ | of S: | 157.7 |

To convert kg/ha/yr to keq/ha/yr, the conversion factors shown in Table 3.9 are applied.

**Table 3.9: Conversion Factors to Convert from kg of N or S ha/yr to keq of N or S ha/yr**

| Parameter | Conversion factor kg/ha/yr to keq/ha/yr |
|---|---|
| N | 0.071428 |
| S | 0.0625 |

# 4. Air Quality Background Conditions

Following a review of the Stockton-on-Tees Borough Council 2023 ASR, the nearest background automatic monitoring location is located in Billingham, approximately 6.5km to the west of the Installation, and within an urban centre. As such, this is not considered to be representative of the site location, which is located away from any built-up residential areas. Therefore, Defra background maps have been used to determine the background concentrations for use in this assessment.

Defra publish background maps are available at a 1x1 km resolution for the whole UK. Data taken for the grid square in which the E2P Power Island is located (NGR 452500, 524500) has been taken to be representative of the grid squares where maximum off-site impacts occur. For $NO_2$ and particulates the latest published maps from 2021 have been used, with no correction factor applied, as a worst case. Background maps for CO and $SO_2$ have not been updated since 2001 and therefore Defra advise the use of the latest available Pollution Climate Mapping (PCM) background maps (2010 for CO and 2021 for $SO_2$) in line with the Background Concentrations Maps User Guide[10].

**Table 4.1: Defra Background Air Quality Data for Human Health Receptors (2021)**

| Description | X, Y | Annual Mean Concentrations (μg/m$^3$) | | |
|---|---|---|---|---|
| | | $NO_2$ | $SO_2$ | CO |
| E2P Power Island | 452500, 524500 | 15.5 | 3.6 | 232.1 |
| Receptor locations | 449500, 527500 | 8.8 | 2.4 | 217.7 |
| | 452500, 528500 | 10.2 | 2.5 | 221.4 |
| | 458500, 523500 | 11.6 | 2.8 | 220.8 |
| | 449500, 522500 | 13.7 | 3.1 | 220.0 |
| | 447500, 524500 | 15.7 | 4.1 | 224.4 |
| | 449500, 526500 | 9.2 | 2.0 | 216.3 |
| | 448500, 524500 | 13.0 | 3.0 | 218.2 |

For pollutants with short-term averaging periods, the AQS are given as a permitted annual number of exceedances of a threshold concentration which can be expressed as an equivalent percentile. For instance, the $SO_2$ 15-minute mean limit can be expressed as the 99.9$^{th}$ percentile of the predicted environmental concentration, that is, the sum of the modelled process contribution (PC) and two times of background concentrations.

For NOx and $SO_2$ concentrations at ecological receptors, backgrounds have been taken from the APIS database. Depositional backgrounds for nutrient nitrogen and acid deposition have also been obtained from APIS. The background concentrations for use at each identified ecological receptor are shown in Table 4.2.

[10] Background Maps | LAQM

**Table 4.2: APIS Deposition Backgrounds**

| ID | Receptor | Designation | Distance and Direction from Installation (km) | Background Concentrations | | | |
|---|---|---|---|---|---|---|---|
| | | | | NOx µg/m³ | $SO_2$ µg/m³ | N-Deposition Kg N/ha/yr | Acid Deposition Keq/ha/yr S : N |
| E1 to E12 | Teesmouth and Cleveland Coast | SPA, Ramsar and SSSI | Adjacent north | 15.9 to 37.2 | 2.0 – 3.9 | 13.3 - 13.8 | 0.22 – 0.25<br>0.95 – 0.99 |
| E13 | Teesmouth and Cleveland Coast | SPA, Ramsar and SSSI | 1.4km north | 19.3 | 2.5 | 13.5 | 0.27 : 0.96 |
| E14 | Northumbria Coast | SPA and Ramsar | 12.7km north-west | 6.3 | 1.0 | 10.4 | 0.17 : 0.96 |
| E15 | Durham Coast | SAC and SSSI | 12.7km north-west | 8.7 | 1.5 | 11.6 | 0.17 : 0.96 |
| E16 | North York Moors | SPA, SAC, SSSI | 13.6km south-east | 4.8 | 0.5 | 15.8 | 0.15 : 1.11 |
| E17 | Lovell Hill Pools | SSSI | 8km south-east | 9.2 | 1.3 | No information on Critical Loads applicable to this site. | |
| E18 | Hart Bog | SSSI | 12.4km north-west | 8.1 | 1.1 | 14.8 | 0.16 : 1.06 |
| E19 | Langbaurgh Ridge | SSSI | 12.5km south | 7.2 | 1.1 | No information on Critical Loads applicable to this site. | |
| E20 | Roseberry Topping | SSSI | 13km south-east | 6.6 | 0.9 | No information on Critical Loads applicable to this site. | |
| E21 | Saltburn Gill | SSSI | 13.6km east | 8.2 | 1.3 | 22.1 | 0.17 : 1.55 |
| E22 | Whitton Bridge Pasture | SSSI | 13.7km west | 7.8 | 1.2 | 16.1 | 0.14 : 1.15 |
| E23 | Briarcroft Pasture | SSSI | 13.7km south-west | 8.4 | 1.3 | 16.2 | 0.15 : 1.16 |
| E24 | Pike Whin Bog | SSSI | 13.7km north-west | 7.3 | 1.1 | 15.7 | No relevant Critical Loads for acid deposition |
| E25 | Cliff Ridge | SSSI | 13.7km south-east | 6.6 | 1.0 | No information on critical loads applicable to this site. | |
| E26 | Hulam Fen | SSSI | 14.8km north-west | 7.7 | 1.2 | 14.7 | No relevant Critical Loads for acid deposition |
| E27 | Charity Land | SSSI | 15.0km north-west | 7.0 | 1.4 | 15.5 | 0.13 : 1.11 |
| E28 | Fishburn Grassland | SSSI | 15.0km north-west | 7.4 | 1.5 | 15.6 | 0.13 : 1.11 |
| E29 | Seaton Dunes & Common | LNR | 2km north | 17.4 | 2.7 | 13.5 | 0.25 : 0.99 |
| E30 | Teesmouth and Cleveland Coast | SPA, Ramsar and SSSI | 1.2km north-west | 17.1 | 2.9 | 14.2 | 0.25 : 0.99 |
| E31 | Teesmouth and Cleveland Coast | SPA, Ramsar and SSSI | 1.5km north-west | 14.1 | 1.9 | 14.0 | 0.23 : 1.0 |

| ID | Receptor | Designation | Distance and Direction from Installation (km) | Background Concentrations | | | |
|---|---|---|---|---|---|---|---|
| | | | | NOx µg/m³ | $SO_2$ µg/m³ | N-Deposition Kg N/ha/yr | Acid Deposition Keq/ha/yr S : N |
| E32 | Teesmouth and Cleveland Coast | SPA, Ramsar and SSSI | 1.6km north-west | 14.1 | 1.9 | 14.0 | 0.25 : 0.95 |
| E33 | Teesmouth and Cleveland Coast | SPA, Ramsar and SSSI | 3.6km north | 14.4 | 2.3 | 13.7 | 0.25 : 0.99 |
| E34 | Teesmouth and Cleveland Coast | SPA, Ramsar and SSSI | 1.6km south-east | 17.9 | 3.0 | 13.8 | 0.25 : 0.99 |
| E35 | Teesmouth and Cleveland Coast | SPA, Ramsar and SSSI | 2.3km north-west | 13.4 | 1.8 | 14.0 | 0.23 : 1.0 |
| E36 | Teesmouth and Cleveland Coast | SPA, Ramsar and SSSI | 1.1km north-east | 15.9 | 2.0 | 13.8 | 0.25 : 0.99 |
| E37 | Power Station Grasslands | LWS | 1.8km north | 17.4 | 2.7 | 13.9 | 0.29 : 0.99 |
| E38 | Seaton Common | LWS | 1.9km north | 16.3 | 3.2 | 13.5 | 0.27 : 0.96 |
| E39 | Phillips Tank Farm | LWS | 1.7km northwest | 17.1 | 2.3 | 13.9 | 0.26 : 0.99 |
| E40 | Teesmouth and Cleveland Coast | SPA, Ramsar and SSSI | 2.3km north | 17.5 | 2.5 | 13.5 | 0.29 : 0.82 |

For daily NOx impacts, the background concentrations have been assumed to be 1.5 times the annual average concentration, in-line with EA recommendations on other assessments.

# 5. Assessment Results

The concentrations of pollutants as a result of the Baseline Assessment and Future Assessment have been predicted using five years of meteorological data (2019 – 2023), with the results being reported for the worst-case meteorological year for each operational scenario.

The Baseline Assessment results are presented for comparison purposes only, and it should be noted that there will be some double counting of the PECs as a result. The Future Assessment results have been presented in terms of the increase between the Future and Baseline Assessments.

## 5.1 Baseline Assessment

### 5.1.1 Human Health Receptors

For the maximum impacts at human health receptors, the maximum concentrations beyond the Installation Boundary have been reported. Additionally, the maximum concentration at the identified human receptors has also been reported.

#### Annual mean $NO_2$

The maximum $NO_2$ annual mean concentration predicted to occur beyond the Installation Boundary for the Baseline Assessment is 2.2µg/m$^3$ or 5.6% of the AQS (40µg/m$^3$). The PEC is 17.7µg/m$^3$, or 44% of the AQS, which is well below the second stage of screening to determine insignificance.

The predicted PC for annual mean $NO_2$ at the worst-case receptor (R2 Seaton Carew) is 0.2µg/m$^3$, this represents less than 1% of the AQS. The PEC is predicted to be 10.4µg/m$^3$, this is 26% of the AQS.

#### Hourly mean $NO_2$

The predicted maximum $NO_2$ hourly mean (as the 99.79$^{th}$ percentile) beyond the Installation Boundary for the Baseline Assessment is 15.2µg/m$^3$ or 7.6% of the hourly AQS (200 µg/m$^3$ not to be exceeded more than 18 times a year). The PEC is 46.2µg/m$^3$ which is well below the hourly mean AQS, at 23%.

At the worst case identified human receptor (R6 Marsh House Lane), the PC is predicted to be 3.3µg/m$^3$ or 1.6% of the AQS. The PEC is 23.6µg/m$^3$, this is equivalent to 12% of the AQS.

#### Hourly mean CO

The maximum predicted offsite hourly mean CO PC (as the 100$^{th}$ percentile) is 17.7µg/m$^3$, which is less than 1% of the EAL (30,000µg/m$^3$). The PEC is 481.9 µg/m$^3$, which represents 2% of the EAL.

The predicted PC at the worst-case receptor (R2 Seaton Carew) is 3.4µg/m$^3$, this is well below 1% of the AQS. The PEC is predicted to be 446.2 µg/m$^3$, which represents 2% of the AQS.

#### 8-hour rolling CO

The maximum predicted offsite 8-hour rolling CO PC for the Baseline Assessment is 10.5µg/m$^3$, which less than 1% of the AQS (30,000µg/m$^3$). The PEC is 474.7 this is equivalent to 5% of the AQS.

The predicted PC at the worst-case receptor (R2 Seaton Carew) is 1.7µg/m$^3$, this is at well below 1% of the AQS. When accounting for the background concentration at the receptor location, the PEC is predicted to be 444.5 µg/m$^3$, which is 4% of the AQS.

#### 15-minute mean $SO_2$

The predicted maximum 15-minute $SO_2$ PC beyond the Installation Boundary is 14.0µg/m$^3$, which is 5.3% of the relevant AQS (266µg/m$^3$). When considered with the background concentrations, the PEC is 21.2µg/m$^3$, equivalent to 8% of the AQS.

The highest predicted PC is 4.1µg/m$^3$, at R2 Seaton Carew, this is equivalent 1.6% of the AQS. When background concentration is accounted, the PEC is 9.1µg/m$^3$, this is 3% of the AQS.

### 1-hour mean $SO_2$

The maximum predicted 1-hour $SO_2$ PC beyond the Installation Boundary for the Baseline Assessment scenario is 9.7µg/m$^3$, which is 2.8% of the AQS (350µg/m$^3$). When considered with the background concentration, the PEC is 16.9µg/m$^3$, representing 5% of the AQS.

Among the assessed human health receptor locations, the highest PC is 2.9µg/m$^3$ (predicted at R2 Seaton Carew), this is less than 1% of the AQS. The PEC is 7.9µg/m$^3$, this is equivalent to 2% of the AQS.

### 24-hour mean $SO_2$

The maximum predicted 24-hour $SO_2$ PC beyond the Installation Boundary is 3.6µg/m$^3$, which is 2.9% of the relevant AQS (125µg/m$^3$). When background concentration is accounted, the PEC is 10.8µg/m$^3$, representing 9% of the AQS.

Across the assessed human health receptor locations, the highest predicted PC is 0.7µg/m$^3$ (predicted at R2 Seaton Carew), this is less than 1% of the AQS. When considered with the background concentration at this location, the PEC is 5.7µg/m$^3$, this is equivalent to 5% of the AQS.

**Table 5.1: Baseline Assessment Human Health Receptor Results**

| Pollutant | Measured as | AQS or EAL (µg/m$^3$) | PC (µg/m$^3$) | PC/ AQS or EAL | BC (µg/m$^3$) | PEC (µg/m$^3$) | PEC/ AQS or EAL |
|---|---|---|---|---|---|---|---|
| $NO_2$ | Max off-site annual mean | 40 | 2.2 | 5.6% | 15.5 | 17.7 | 44% |
| | Worst-case receptor annual mean (R2) | | 0.2 | 0.6% | 10.2 | 10.4 | 26% |
| | Max off-site hourly mean (99.8$^{th}$ %ile) | 200 | 15.2 | 7.6% | 31.0 | 46.2 | 23% |
| | Worst-case receptor hourly Mean (99.8$^{th}$ %ile) (R6) | | 3.3 | 1.6% | 20.4 | 23.6 | 12% |
| CO | Max off-site hourly mean | 30,000 | 17.7 | <0.1% | 464.2 | 481.9 | 2% |
| | Worst-case receptor hourly mean (R2) | | 3.4 | <0.1% | 442.8 | 446.2 | 2% |
| | Max off-site 8-hr rolling average | 10,000 | 10.5 | <0.1% | 464.2 | 474.7 | 5% |
| | Worst-case receptor 8-hr rolling average (R2) | | 1.7 | <0.1% | 442.8 | 444.5 | 4% |
| $SO_2$ | Max off-site 15 minute mean (99.9$^{th}$ %ile) | 266 | 14.0 | 5.3% | 7.2 | 21.2 | 8% |
| | Worst-case receptor 15 minute mean (99.9$^{th}$ %ile) (R2) | | 4.1 | 1.6% | 5.0 | 9.1 | 3% |
| | Max off-site 1-hour mean (99.73$^{th}$ %ile) | 350 | 9.7 | 2.8% | 7.2 | 16.9 | 5% |
| | Worst-case receptor 1-hour mean (99.73$^{th}$ %ile) (R2) | | 2.9 | 0.8% | 5.0 | 7.9 | 2% |

| Pollutant | Measured as | AQS or EAL ($\mu g/m^3$) | PC ($\mu g/m^3$) | PC/ AQS or EAL | BC ($\mu g/m^3$) | PEC ($\mu g/m^3$) | PEC/ AQS or EAL |
|---|---|---|---|---|---|---|---|
| | Max off-site 24-hour mean (99.18th %ile) | 125 | 3.6 | 2.9% | 7.2 | 10.8 | 9% |
| | Worst-case receptor 24-hour mean (99.18th %ile) (R2) | | 0.7 | 0.5% | 5.0 | 5.7 | 5% |

### 5.1.2 Ecological Receptors

#### NOx Annual Mean

The annual mean NOx concentrations for the Baseline Assessment at all but the Teesmouth and Cleveland Coast receptors are considered to be insignificant, in that they are either <1% of the first screening threshold or <70% of the second screening threshold. Some of the locations within the Teesmouth and Cleveland Coast receptor have background concentrations that exceed the Critical Level for annual NOx, however it should be noted that the background concentrations already include the contribution from the existing Teesside Terminal and therefore the PECs including double counting of these sources. The modelling shows that the operation of the existing Teesside Terminal is a small component of the reported APIS background concentrations.

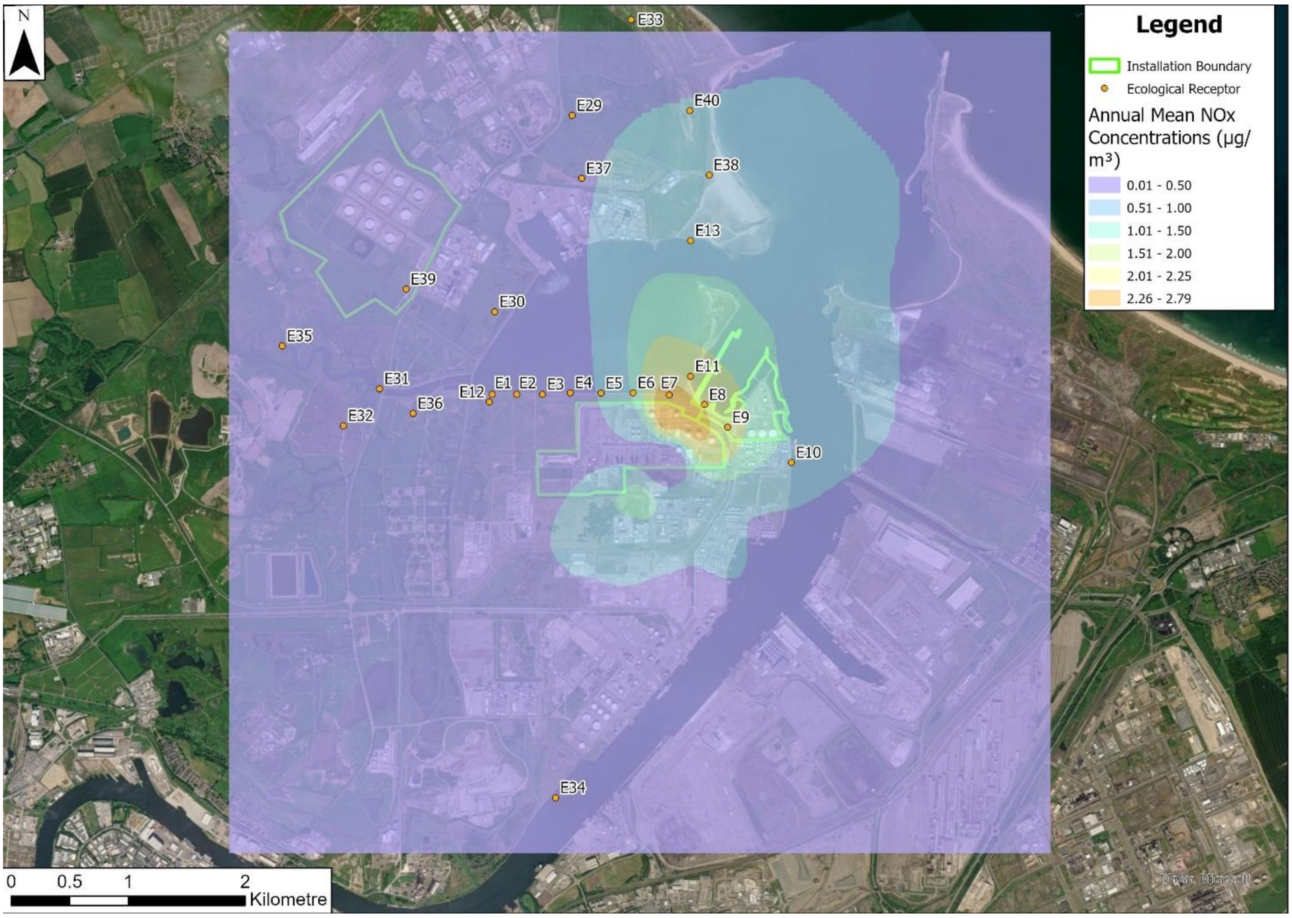
Figure 7 shows the isopleths of the annual mean NOx concentrations from the existing operations.

**Table 5.2: Baseline Assessment NOx Annual Mean Ecological Receptor Results**

| Receptor | CL ($\mu g/m^3$) | PC ($\mu g/m^3$) | PC / CL (%) | BC ($\mu g/m^3$) | PEC ($\mu g/m^3$) | PEC/CL (%) |
|---|---|---|---|---|---|---|
| E1 – E12 | 30 | 0.2 – 2.8 | 0.6% - 9.3% | 15.9 – 37.2 | 16.1 – 38.1 | 54% - 127% |
| E13 | | 0.9 | 2.9% | 19.3 | 20.2 | 67% |
| E14 | | 0.1 | 0.3% | 6.3 | 6.4 | 21% |
| E15 | | 0.1 | 0.3% | 8.7 | 8.8 | 29% |
| E16 | | 0.1 | 0.2% | 4.8 | 4.8 | 16% |
| E17 | | 0.1 | 0.3% | 9.2 | 9.3 | 31% |
| E18 | | 0.1 | 0.2% | 8.1 | 8.2 | 27% |
| E19 | | 0.1 | 0.2% | 7.2 | 7.3 | 24% |
| E20 | | 0.1 | 0.2% | 6.6 | 6.7 | 22% |
| E21 | | 0.1 | 0.2% | 8.2 | 8.3 | 28% |
| E22 | | 0.02 | 0.1% | 7.8 | 7.8 | 26% |
| E23 | | 0.02 | 0.1% | 8.4 | 8.4 | 28% |
| E24 | | 0.03 | 0.1% | 7.3 | 7.3 | 24% |
| E25 | | 0.1 | 0.2% | 6.6 | 6.7 | 22% |
| E26 | | 0.05 | 0.2% | 7.7 | 7.7 | 26% |
| E27 | | 0.02 | 0.1% | 7 | 7.0 | 23% |
| E28 | | 0.01 | <0.1% | 7.4 | 7.4 | 25% |
| E29 | | 0.5 | 1.7% | 17.4 | 17.9 | 60% |

| Receptor | CL (µg/m³) | PC (µg/m³) | PC / CL (%) | BC (µg/m³) | PEC (µg/m³) | PEC/CL (%) |
|---|---|---|---|---|---|---|
| E30 | | 0.3 | 0.9% | 17.1 | 17.4 | 58% |
| E31 | | 0.1 | 0.4% | 14.1 | 14.2 | 47% |
| E32 | | 0.1 | 0.4% | 14.1 | 14.2 | 47% |
| E33 | | 0.4 | 1.4% | 14.4 | 14.8 | 49% |
| E34 | | 0.3 | 0.9% | 17.9 | 18.2 | 61% |
| E35 | | 0.1 | 0.3% | 13.4 | 13.5 | 45% |
| E36 | | 0.1 | 0.4% | 15.9 | 16.0 | 53% |
| E37 | | 0.6 | 2.0% | 17.4 | 18.0 | 60% |
| E38 | | 0.7 | 2.2% | 16.3 | 17.0 | 57% |
| E39 | | 0.1 | 0.5% | 17.1 | 17.2 | 57% |
| E40 | | 0.5 | 1.8% | 17.5 | 18.0 | 60% |

**Figure 7: Baseline Assessment - Isopleths of the Annual NOx PC (µg/m³)**




## NOx Daily Mean

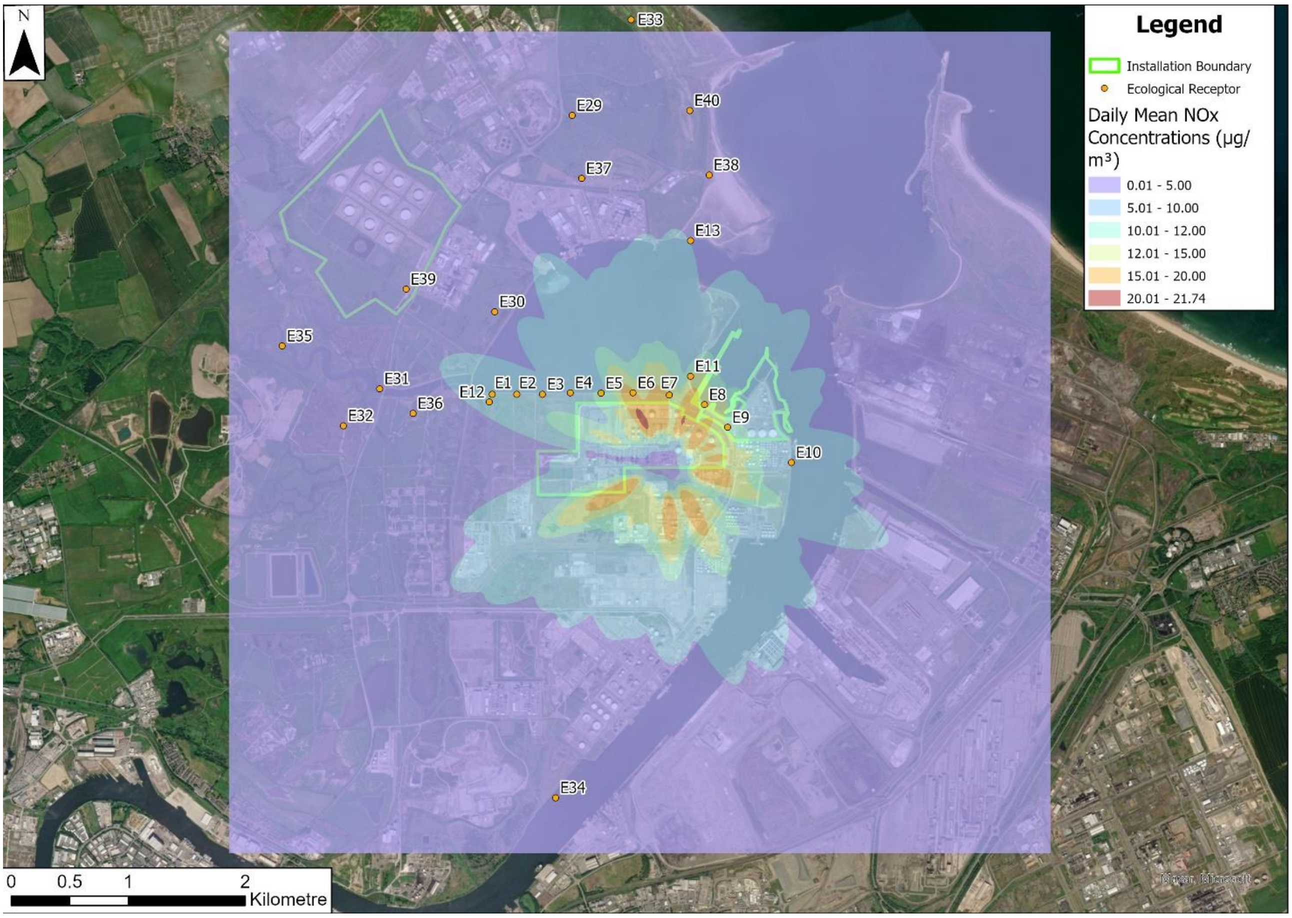
The NOx daily mean concentrations predicted at the assessed ecological receptors for the Baseline Assessment are presented in Table 5.3. Similarly to the above results, the majority of PCs can be considered to be insignificant, however there are some results at the Teesmouth Coast receptor that are over the 10% first screening threshold (based on the conservative Critical Leel of 75µg/m$^3$).

All the PECs however remain below the daily Critical Level, which also includes the double counting of the existing emissions, given that these will already be accounted for in the background concentrations used in the assessment. Figure 8 shows the isopleths of the daily mean NOx concentrations from the existing operations.

**Table 5.3: Baseline Assessment NOx Daily Mean Ecological Receptor Results**

| Receptor | CL (µg/m$^3$) | PC (µg/m$^3$) | PC / CL (%) | BC (µg/m$^3$) | PEC (µg/m$^3$) | PEC/CL (%) |
|---|---|---|---|---|---|---|
| E1 – E12 | 75 | 6.4 – 17.7 | 8.5% - 23.5% | 23.9 – 55.8 | 30.3 – 66.2 | 40% - 88% |
| E13 | | 4.9 | 6.6% | 29.0 | 33.9 | 45% |
| E14 | | 1.0 | 1.3% | 9.5 | 10.4 | 14% |
| E15 | | 1.0 | 1.3% | 13.1 | 14.0 | 19% |
| E16 | | 0.7 | 0.9% | 7.2 | 7.9 | 11% |
| E17 | | 1.4 | 1.9% | 13.8 | 15.2 | 20% |
| E18 | | 0.9 | 1.2% | 12.2 | 13.1 | 17% |
| E19 | | 1.5 | 1.9% | 10.8 | 12.3 | 16% |
| E20 | | 0.9 | 1.2% | 9.9 | 10.8 | 14% |
| E21 | | 0.7 | 0.9% | 12.3 | 13.0 | 17% |
| E22 | | 0.6 | 0.8% | 11.7 | 12.3 | 16% |
| E23 | | 0.7 | 0.9% | 12.6 | 13.3 | 18% |
| E24 | | 0.8 | 1.1% | 11.0 | 11.7 | 16% |
| E25 | | 1.0 | 1.3% | 9.9 | 10.9 | 15% |
| E26 | | 0.8 | 1.0% | 11.6 | 12.3 | 16% |
| E27 | | 0.5 | 0.7% | 10.5 | 11.0 | 15% |
| E28 | | 0.4 | 0.6% | 11.1 | 11.5 | 15% |
| E29 | | 3.5 | 4.7% | 26.1 | 29.6 | 39% |
| E30 | | 5.2 | 7.0% | 25.7 | 30.9 | 41% |
| E31 | | 2.7 | 3.6% | 21.2 | 23.9 | 32% |
| E32 | | 2.5 | 3.3% | 21.2 | 23.6 | 31% |
| E33 | | 2.8 | 3.8% | 21.6 | 24.4 | 33% |
| E34 | | 2.8 | 3.7% | 26.9 | 29.7 | 40% |
| E35 | | 2.0 | 2.7% | 20.1 | 22.1 | 29% |
| E36 | | 3.2 | 4.2% | 23.9 | 27.0 | 36% |
| E37 | | 4.0 | 5.4% | 26.1 | 30.1 | 40% |
| E38 | | 3.7 | 5.0% | 24.5 | 28.2 | 38% |
| E39 | | 3.8 | 5.0% | 25.7 | 29.4 | 39% |
| E40 | | 3.2 | 4.3% | 26.3 | 29.5 | 39% |

**Figure 8: Baseline Assessment - Isopleths of the Daily NOx PC (µg/m³)**




## $SO_2$ Annual Mean

The annual mean $SO_2$ PCs predicted at all ecological receptors for the Baseline Assessment are shown in Table 5.4. The highest predicted PC is 0.4µg/m³, this is 2.2% of the Critical Level. When considering background concentration, the total PEC is 2.5µg/m³, this is equivalent to 12% of the Critical Level.

**Table 5.4: Baseline Assessment $SO_2$ Annual Mean Ecological Receptor Results**

| Receptor | CL (µg/m³) | PC (µg/m³) | PC / CL (%) | BC (µg/m³) | PEC (µg/m³) | PEC/CL (%) |
|---|---|---|---|---|---|---|
| E1 – E12 | 20 | 0.05 – 0.44 | 0.3% - 2.2% | 2.0 – 3.9 | 2.1 – 4.1 | 10% - 20% |
| E13 | | 0.22 | 1.1% | 2.5 | 2.7 | 14% |
| E14 | | 0.03 | 0.1% | 1.0 | 1.0 | 5% |
| E15 | | 0.03 | 0.1% | 1.5 | 1.5 | 8% |
| E16 | | 0.01 | 0.1% | 0.5 | 0.5 | 3% |
| E17 | | 0.02 | 0.1% | 1.3 | 1.3 | 7% |
| E18 | | 0.02 | 0.1% | 1.1 | 1.1 | 6% |
| E19 | | 0.02 | 0.1% | 1.1 | 1.1 | 6% |
| E20 | | 0.02 | 0.1% | 0.9 | 0.9 | 5% |
| E21 | | 0.02 | 0.1% | 1.3 | 1.3 | 7% |
| E22 | | 0.01 | 0.0% | 1.2 | 1.2 | 6% |
| E23 | | 0.01 | 0.0% | 1.3 | 1.3 | 7% |

| Receptor | CL (µg/m³) | PC (µg/m³) | PC / CL (%) | BC (µg/m³) | PEC (µg/m³) | PEC/CL (%) |
|---|---|---|---|---|---|---|
| E24 | | 0.01 | 0.0% | 1.1 | 1.1 | 6% |
| E25 | | 0.02 | 0.1% | 1 | 1.0 | 5% |
| E26 | | 0.02 | 0.1% | 1.2 | 1.2 | 6% |
| E27 | | 0.01 | 0.0% | 1.4 | 1.4 | 7% |
| E28 | | <0.01 | 0.0% | 1.5 | 1.5 | 8% |
| E29 | | 0.2 | 0.8% | 2.7 | 2.9 | 14% |
| E30 | | 0.1 | 0.4% | 2.9 | 3.0 | 15% |
| E31 | | 0.03 | 0.2% | 1.9 | 1.9 | 10% |
| E32 | | 0.03 | 0.2% | 1.9 | 1.9 | 10% |
| E33 | | 0.1 | 0.6% | 2.3 | 2.4 | 12% |
| E34 | | 0.1 | 0.4% | 3.0 | 3.1 | 15% |
| E35 | | 0.03 | 0.1% | 1.8 | 1.8 | 9% |
| E36 | | 0.04 | 0.2% | 2.0 | 2.0 | 10% |
| E37 | | 0.19 | 0.9% | 2.7 | 2.9 | 14% |
| E38 | | 0.18 | 0.9% | 3.2 | 3.4 | 17% |
| E39 | | 0.04 | 0.2% | 2.3 | 2.3 | 12% |
| E40 | | 0.15 | 0.7% | 2.5 | 2.6 | 13% |

### Nitrogen Deposition

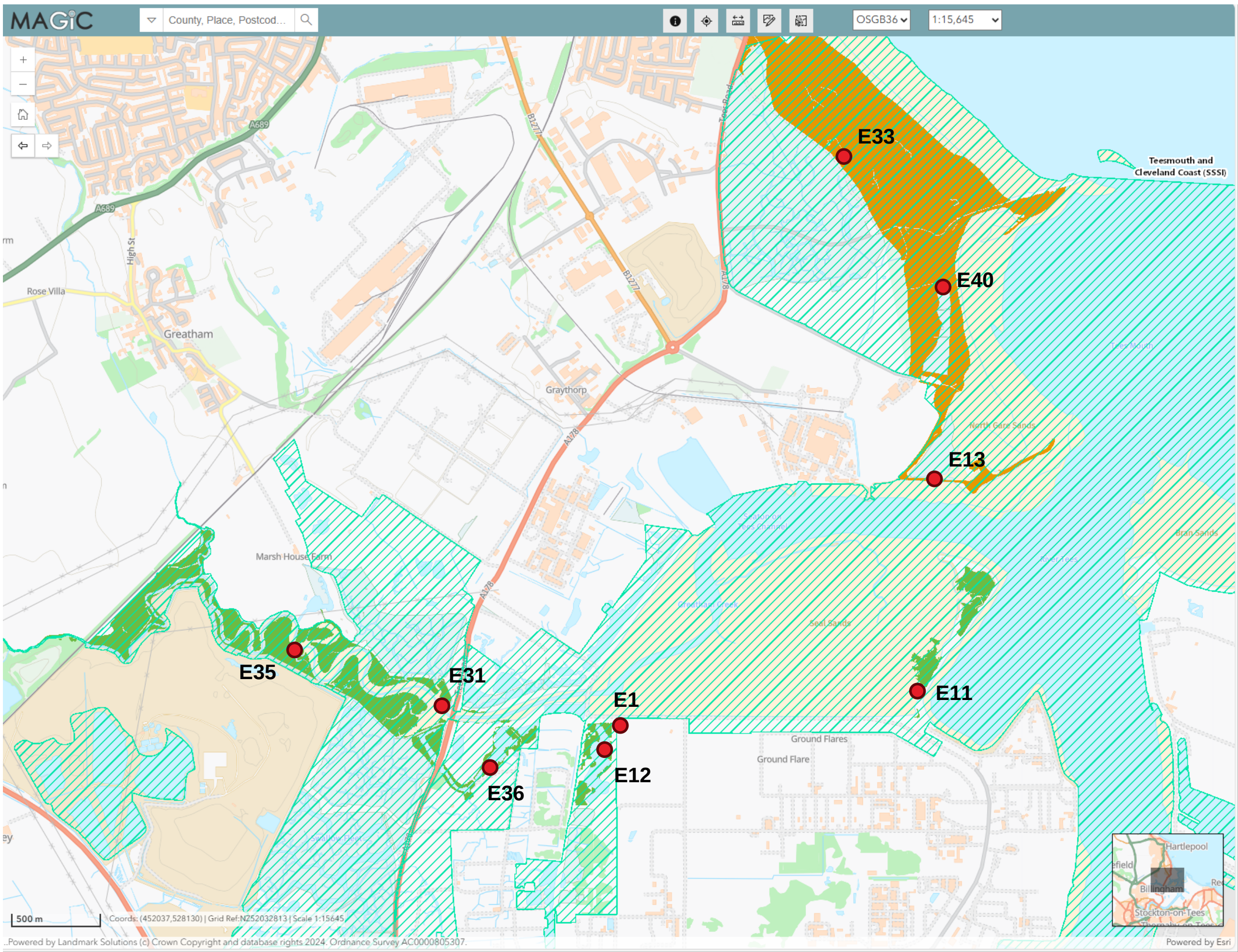
Using the APIS website, ecological sites were reviewed in terms of the locations of relevant habitat features present, and their respective sensitivity to nitrogen was determined. The impacts of nitrogen deposition have been assessed at the locations of the relevant habitat features that occur for the Teesmouth and Cleveland Coast SPA, Ramsar, SSSI and NNR, given that this is the closest receptor to the emission sources and therefore the most impacted.

Section 3.3.3 stated that the sensitive habitats of saltmarsh and dunes are present at a number of the identified ecological receptor locations. This includes:

- Saltmarsh at E1, E11, E12, E31, E35, E36
- Dunes at E13, E33 and E40.

The locations of the relevant habitats are shown on Defra's Magic Map Application (dunes are shaded orange and saltmarsh is shaded green) and the individual receptor locations used in the assessment are shown in Figure 9.

**Figure 9: Location of the Relevant Habitats in the Vicinity of the Installation**



Map produced by MAGIC on 6th June 2025. © Crown Copyright and database rights 2024. Ordnance Survey 100022861.

Whilst for screening assessments it is best practice to apply the lowest Critical Load provided for any habitat type on the APIS website to determine whether there are likely to be any significant effects, it is also important that a realistic assessment of impacts is carried out, in order to not overestimate the potential for impacts to occur.

In terms of Saltmarsh habitats, the APIS listing for the Teesmouth and Cleveland Coast SPA, Ramsar, SSSI and NNR cites "Atlantic upper-mid & mid-low salt marshes" as being present. It further qualifies the citing to state that "*it is recommended that this is the relevant critical load for most of saltmarsh but the lower level of 10 kgN/ha/yr should be applied to the more densely vegetated upper marsh (e.g. EUNIS class MA223, MA224) and to areas of marsh subjected to direct run-off from adjacent catchments (NRW recommendation). For pioneer saltmarsh (MA225) use the higher 20-30 kg N/ha/yr critical load.*"

Based on the receptor locations selected, it would be reasonable to conclude that the saltmarsh present at location E11 (i.e. within the estuary) does not represent "upper marsh" or an area where the marsh would be subjected to direct run-off from adjacent catchments. This is corroborated by the Natural England Unit 9 (corresponding to the E11 receptor location) condition report[11], which states that "*A large portion of the pioneer and lower zones are present in managed realignment areas.*"

Additionally, the Defra Saltmarsh and Zonation mapping[12] shows that at receptor E11, pioneer and mid-low saltmarsh are present, with upper marsh being shown at the other saltmarsh receptor locations selected (i.e. E1, E12, E31, E35 and E36). It is therefore considered appropriate to use the higher Critical Load range of 20-30

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[11] Unit detail

[12] Saltmarsh Extent & Zonation

kg N/ha/yr at the E11 location, and the 10 – 20kg N/ha/yr Critical Load range at all other saltmarsh locations assessed.

The Teesmouth and Cleveland Coast SPA, Ramsar and SSSI comprises an area called Seaton Dunes which stretch from Seaton Carew in the north to the mouth of the River Tees in the south. The closest dunes to the E2P Power Island occur to the south of the North Gare and are much narrower than the dunes between Seaton Carew and the North Gare and are reportedly eroding.[13]

There are a number of dune habitat types reported on the APIS website for the Teesmouth and Cleveland Coast SPA, Ramsar and SSSI, which have different Critical Load ranges depending on their sensitivity to nitrogen deposition, namely;

- Shifting coastal dunes – Critical Load Range 10 – 20kg N/ha/yr
- Moist and wet dune slacks 5 – 15kg N/ha/yr
- Coastal dune grasslands (grey dunes) - calcareous type 10 -15kg N/ha/yr
- Coastal dune grasslands (grey dunes) – acid type 5 – 10kg N/ha/yr
- Coastal dune grasslands (grey dunes) – 5 - 15kg N/ha/yr

The Natural England Supporting Information Report on the Teesmouth and Cleveland SSSI[12] states that Seaton and Coatham Dunes represent the largest dune system with calcareous substrate in the area of the study, this therefore brings into question the appropriateness of applying the Coastal dune grasslands (grey dunes) – acid type Critical Load range for the assessment of potential impacts in this specific location. The Natural England Supporting Information Report also states that the rest of Seaton Dunes comprises fixed dune systems, except towards the south end of the fixed dunes, where a series of wetter depressions occur.

The German Environment Agency, Review of Empirical Critical Loads of Nitrogen for Europe document[14] provides evidence for the reduction of the Critical Load range for Coastal dune grasslands (grey dunes) from the previous value of 8 - 15kg N/ha/yr to 5 - 15 kgN/ha/yr, however states that where phosphorous limitation is a factor, nitrogen deposition may lead to fewer botanical responses in calcareous dunes compared with other dune sites. The higher end of the Critical Load range therefore is more relevant to calcareous rich locations where there is phosphorous limitation. It is not currently known whether Seaton Dunes are phosphorous limited, however it is understood that the Environment Agency together with Natural England are currently looking into this issue for the dunes in the Teesside area.

The location of maximum impact (E13), represents the foredunes, and therefore is most likely to comprise of Shifting coastal dunes and therefore it may be that the most appropriate Critical Load range to apply for assessment would be that for Shifting coastal dunes in that particular location, but at the location where the wetter depressions occur, the Moist and wet dune slacks Critical Load would be more appropriate (i.e. at locations E33 and E40).

Natural England have been consulted on this issue through the Planning process, and there is recognition that there is insufficient information available to say without doubt that the Seaton dunes are calcareous or phosphorous limited, and therefore there is recognition that the information available does not enable assessors to determine the most appropriate Critical Load range to apply for specific locations of dunes in the Teesside area. As such, Natural England advise that a conservative approach of applying the Coastal dune grasslands (grey dunes) Critical Load range of 5 – 15kg N/ha/yr remains appropriate. For the purpose of this assessment, the results have been presented against both the generic Coastal dune grasslands (grey dunes) and the Shifting coastal dunes Critical Load ranges.

All other ecological receptors have been assessed at the closest point to the emission sources.

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[13] SSSI supporting info Blackmore Vale Commons and Moors

[14] Available at: Review and revision of empirical critical loads of nitrogen for Europe

The results for the Baseline Assessment are presented in Table 5.5.

**Table 5.5: Baseline Assessment Nitrogen Deposition**

| Receptor | Critical Load Class | Critical Load (kgN/ha/yr) | Background N-dep (kgN/ha/yr) | Background N-dep / Critical Load Min (kgN/ha/yr) | PC Annual Mean $NO_2$ ($\mu g/m^3$) | PC N Dry Dep (kgN/ha/yr) | PC/ Critical Load Min (%) | PEC N-Dep (kgN/ha/yr) | PEC/ Critical Load Min |
|---|---|---|---|---|---|---|---|---|---|
| E1 | Atlantic upper-mid & mid-low salt marshes | 10 – 20 | 13.8 | 138% | 0.2 | 0.03 | 0.3% | 13.8 | 138% |
| E11 | Pioneer saltmarsh | 20 – 30 | 13.3 | 67% | 1.4 | 0.2 | 1.0% | 13.5 | 67% |
| E12 | Atlantic upper-mid & mid-low salt marshes | 10 – 20 | 13.8 | 138% | 0.1 | 0.02 | 0.2% | 13.8 | 138% |
| E13 Assessed as: | Coastal Shifting Dunes | 10 – 20 | 13.5 | 135% | 0.6 | 0.1 | 0.9% | 13.6 | 136% |
| | Coastal dune grasslands (grey dunes) | 5 - 15 | | 270% | | | 1.7% | | 272% |
| E14 | Coastal dune grasslands (grey dunes) | 5 - 15 | 10.4 | 208% | 0.1 | 0.01 | 0.2% | 10.4 | 208% |
| E15 | Coastal dune grasslands (grey dunes) | 5 - 15 | 11.6 | 232% | 0.1 | 0.01 | 0.2% | 11.6 | 232% |
| E16 | Raised and blanket bogs | 5 - 10 | 15.8 | 316% | 0.03 | 0.005 | 0.1% | 15.8 | 316% |
| E17 | No Critical loads assigned | | | | | | | | |
| E18 | Raised and blanket bogs | 5 - 10 | 14.8 | 296% | 0.04 | 0.01 | 0.1% | 14.8 | 296% |
| E19 | No Critical loads assigned | | | | | | | | |

| Receptor | Critical Load Class | Critical Load (kgN/ha/yr) | Background N-dep (kgN/ha/yr) | Background N-dep / Critical Load Min (kgN/ha/yr) | PC Annual Mean $NO_2$ (µg/m$^3$) | PC N Dry Dep (kgN/ha/yr) | PC/ Critical Load Min (%) | PEC N-Dep (kgN/ha/yr) | PEC/ Critical Load Min |
|---|---|---|---|---|---|---|---|---|---|
| E20 | No Critical loads assigned | | | | | | | | |
| E21 | Carpinus and Quercus mesic deciduous forest | 15 - 20 | 22.1 | 147% | 0.04 | 0.01 | 0.1% | 22.1 | 147% |
| E22 | Low and medium altitude hay meadows | 10 – 20 | 16.1 | 161% | 0.02 | 0.002 | <0.1% | 16.1 | 161% |
| E23 | Low and medium altitude hay meadows | 10 - 20 | 16.2 | 162% | 0.02 | 0.002 | <0.1% | 16.2 | 162% |
| E24 | Valley mires, poor fens and transition mires | 5 - 15 | 15.7 | 314% | 0.02 | 0.003 | 0.1% | 15.7 | 314% |
| E25 | No Critical loads assigned | | | | | | | | |
| E26 | Rich fens | 15 - 25 | 14.7 | 98% | 0.03 | 0.005 | <0.1% | 14.7 | 98% |
| E27 | Low and medium altitude hay meadow | 10 -20 | 15.5 | 155% | 0.01 | 0.002 | <0.1% | 15.5 | 155% |
| E28 | Semi-dry Perennial calcareous grassland (basic meadow steppe) | 10 - 15 | 15.6 | 156% | 0.01 | 0.001 | <0.1% | 15.6 | 156% |
| E29 | No Critical loads assigned | | | | | | | | |
| E30 | No designated features at this location. | | | | | | | | |

| Receptor | Critical Load Class | Critical Load (kgN/ha/yr) | Background N-dep (kgN/ha/yr) | Background N-dep / Critical Load Min (kgN/ha/yr) | PC Annual Mean $NO_2$ (µg/m$^3$) | PC N Dry Dep (kgN/ha/yr) | PC/ Critical Load Min (%) | PEC N-Dep (kgN/ha/yr) | PEC/ Critical Load Min |
|---|---|---|---|---|---|---|---|---|---|
| E31 | Atlantic upper-mid & mid-low salt marshes | 10 – 20 | 14.0 | 140% | 0.08 | 0.01 | 0.1% | 14.0 | 140% |
| E32 | No designated features at this location. | | | | | | | | |
| E33 | Moist and wet dune slacks | 5 - 15 | 13.7 | 274% | 0.3 | 0.04 | 0.9% | 13.7% | 275% |
| E34 | No designated features at this location. | | | | | | | | |
| E35 | Atlantic upper-mid & mid-low salt marshes | 10 – 20 | 14.0 | 140% | 0.06 | 0.01 | 0.1% | 14.0 | 140% |
| E36 | Atlantic upper-mid & mid-low salt marshes | 10 – 20 | 13.8 | 138% | 0.09 | 0.01 | 0.1% | 13.8 | 138% |
| E37 | Low and medium altitude hay meadow | 10 - 20 | 13.9 | 139% | 0.4 | 0.06 | 0.6% | 14.0 | 140% |
| E38 | No designated features at this location. | | | | | | | | |
| E39 | Low and medium altitude hay meadow | 10 - 20 | 13.9 | 13.9% | 0.1 | 0.01 | 0.1% | 13.9 | 139% |
| E40 | Moist and wet dune slacks | 5 - 15 | 13.9 | 270% | 0.4 | 0.05 | 1.1% | 13.6 | 271% |

## Acid Deposition

The results for Baseline Assessment are presented in Table 5.6.

**Table 5.6: Baseline Assessment Acid-Deposition**

| Receptor | Critical Load Class | Background dep (keq/ha/yr) | Relevant Critical Load (keq ha/yr) | Background % Critical Load | PC Annual Mean (keq ha/yr) | PC/ Critical Load % | PEC/ Critical Load % |
|---|---|---|---|---|---|---|---|
| E1 | Calcareous grassland | N: 0.99<br>S: 0.25 | CLminN: 0.856<br>CLMaxS: 4<br>CLMaxN: 4.856 | 25.5% | N: 002<br>S: 0.01 | 0.2% | 25.7% |
| E11 | Calcareous grassland | N: 0.95<br>S: 0.22 | CLminN: 0.856<br>CLMaxS: 4<br>CLMaxN: 4.856 | 24.1% | N: 0.01<br>S: 0.04 | 1.0% | 25.1% |
| E12 | Calcareous grassland | N: 0.99<br>S: 0.25 | CLminN: 0.856<br>CLMaxS: 4<br>CLMaxN: 4.856 | 25.5% | N: 0.001<br>S: 0.01 | 0.2% | 25.7% |
| E13 | Calcareous grassland | N: 0.96<br>S: 0.27 | CLminN: 0.856<br>CLMaxS: 4<br>CLMaxN: 4.856 | 25.3% | N: 0.01<br>S: 0.03 | 0.8% | 26.1% |
| E14 | Calcareous grassland | N: 0.96<br>S: 0.17 | CLminN: 0.856<br>CLMaxS: 4<br>CLMaxN: 4.856 | 23.3% | N: 0.001<br>S: 0.003 | 0.1% | 23.4% |
| E15 | Calcareous grassland | N: 0.96<br>S: 0.17 | CLminN: 0.856<br>CLMaxS: 4<br>CLMaxN: 4.856 | 23.3% | N: 0.001<br>S: 0.003 | 0.1% | 23.4% |
| E16 | Dwarf shrub heath | N: 1.11<br>S: 0.15 | CLminN: 0.321<br>CLMaxS: 0.183<br>CLMaxN: 0.504 | 250% | N: 0.0003<br>S: 0.002 | 0.5% | 250.5% |
| E17 | No Critical loads assigned | | | | | | |
| E18 | Bogs | N: 1.06<br>S: 0.16 | CLminN: 0.321<br>CLMaxS: 0.148<br>CLMaxN: 0.469 | 260.2% | N: 0.0004<br>S: 0.002 | 0.5% | 260.7% |
| E19 | No Critical loads assigned | | | | | | |
| E20 | No Critical loads assigned | | | | | | |
| E21 | Unmanaged broadleafed/ Coniferous woodland | N: 1.55<br>S: 0.17 | CLminN: 0.142<br>CLMaxS: 2.448 | 65.2% | N: 0.001<br>S: 0.004 | 0.2% | 65.4% |

| Receptor | Critical Load Class | Background dep (keq/ha/yr) | Relevant Critical Load (keq ha/yr) | Background % Critical Load | PC Annual Mean (keq ha/yr) | PC/ Critical Load % | PEC/ Critical Load % |
|---|---|---|---|---|---|---|---|
| | | | CLMaxN: 2.639 | | | | |
| E22 | Calcareous grassland | N: 1.15<br>S: 0.14 | CLminN: 1.071<br>CLMaxS: 4<br>CLMaxN: 5.071 | 25.4% | N: 0.0002<br>S: 0.0009 | <0.1% | 25.4% |
| E23 | Calcareous grassland | N: 1.16<br>S: 0.15 | CLminN: 1.071<br>CLMaxS: 4<br>CLMaxN: 5.071 | 25.6% | N: 0.0002<br>S: 0.0009 | <0.1% | 25.6% |
| E24 | No information provided | | | | | | |
| E25 | No information provided | | | | | | |
| E26 | No information provided | | | | | | |
| E27 | Calcareous grassland | N: 1.11<br>S: 0.13 | CLminN: 1.071<br>CLMaxS: 4<br>CLMaxN: 5.071 | 24.5% | N: 0.0001<br>S: 0.001 | <0.1% | 24.5% |
| E28 | Calcareous grassland | N: 1.11<br>S: 0.13 | CLminN: 0.856<br>CLMaxS: 4<br>CLMaxN: 4.856 | 25.5% | N: 0.0001<br>S: 0.001 | <0.1% | 25.5% |
| E29 | No information on Critical Loads applicable to this site. | | | | | | |
| E30 | No designated features at this location. | | | | | | |
| E31 | Calcareous grassland | N: 1.00<br>S: 0.23 | CLminN: 0.856<br>CLMaxS: 4<br>CLMaxN: 4.856 | 25.3% | N: 0.001<br>S: 0.004 | 0.1% | 25.4% |
| E32 | No designated features at this location. | | | | | | |
| E33 | Calcareous grassland | N: 0.95<br>S: 0.25 | CLminN: 1.071<br>CLMaxS: 4<br>CLMaxN: 5.071 | 6.2% | N: 0.003<br>S: 0.015 | 0.4% | 6.6% |
| E34 | No designated features at this location. | | | | | | |
| E35 | Calcareous grassland | N: 1.00<br>S: 0.23 | CLminN: 0.856<br>CLMaxS: 4<br>CLMaxN: 4.856 | 25.3% | N: 0.001<br>S: 0.003 | 0.1% | 25.4% |
| E36 | Calcareous grassland | N: 0.99<br>S: 0.25 | CLminN: 0.856<br>CLMaxS: 4<br>CLMaxN: 4.856 | 25.5% | N: 0.001<br>S: 0.005 | 0.1% | 25.7% |
| E37 | Calcareous grassland | N: 0.99<br>S: 0.29 | CLminN: 1.071<br>CLMaxS: 4 | 7.2% | N: 0.004<br>S: 0.02 | 0.5% | 7.7% |

| Receptor | Critical Load Class | Background dep (keq/ha/yr) | Relevant Critical Load (keq ha/yr) | Background % Critical Load | PC Annual Mean (keq ha/yr) | PC/ Critical Load % | PEC/ Critical Load % |
|---|---|---|---|---|---|---|---|
| | | | CLMaxN: 5.071 | | | | |
| E38 | No designated features at this location. | | | | | | |
| E39 | Calcareous grassland | N: 0.99<br>S:0.26 | CLminN: 1.071<br>CLMaxS: 4<br>CLMaxN: 5.071 | 6.5% | N: 0.001<br>S: 0.005 | 0.1% | 6.6% |
| E40 | Calcareous grassland | N: 0.82<br>S:0.29 | CLminN: 0.856<br>CLMaxS: 4<br>CLMaxN: 4.856 | 25.5% | N: 0.004<br>S: 0.02 | 0.4% | 25.9% |

## 5.2 Future Assessment – Maximum 16 Engines

### 5.2.1 Human Health Receptors

The Future Assessment results show the increases from the Baseline Assessment to the Future Assessment with the existing sources operational together with the operation of the E2P Power Island, assuming that a maximum of 16 engines are installed and are operational concurrently, which is considered to be an operational case that would never occur, based on the volumes of fuel gas available, as previously stated.

#### Annual Mean $NO_2$

The maximum $NO_2$ annual average concentration that is predicted to occur beyond the ConocoPhillips Installation Boundary for the Future Assessment is 5.5µg/m$^3$ or 13.8% of the AQS (40µg/m$^3$). This represents an increase of 8.2% of the AQS over the Baseline Assessment, however the PEC is 21.0µg/m$^3$ or 53% of the AQS, and therefore remains well below the second EA screening threshold of 70% and so can be considered to be insignificant.

Due to the distance to actual human health receptors, the predicted PC at the worst-case receptor (R2 Seaton Carew), is significantly lower at 0.6µg/m$^3$ or 1.4% of the AQS. This represents an increase over the Baseline Assessment of 0.8%, which is less than the first EA screening threshold for determining insignificance.

#### Hourly mean $NO_2$

The maximum $NO_2$ annual average concentration that is predicted to occur beyond the ConocoPhillips Installation Boundary for the Future Assessment is 24.0µg/m$^3$ or 12.0% of the AQS (40µg/m$^3$). This represents an increase of 4.4% of the AQS over the Baseline Assessment and therefore can be considered to be insignificant as is it less than the 10% screening threshold for short term impacts. The PEC is 55.0µg/m$^3$ or 27% of the AQS, which indicates that an exceedance of the standard is unlikely.

At the worst-case human health receptor (R6 Marsh House Lane), the predicted PC is significantly lower at 7.1µg/m$^3$ or 3.5% of the AQS, which is less than the first EA screening threshold for determining insignificance. The increase over the Baseline Assessment is only 2.1%

#### Hourly mean CO

The maximum CO hourly concentration that is predicted to occur beyond the Installation Boundary is 113.1µg/m$^3$ or 0.4% of the EAL (30,000µg/m$^3$). The increase over the Baseline Assessment is 0.4% of the EAL and therefore can be considered to be insignificant. The predicted impacts at the human health receptors are lower and therefore also insignificant.

### 8-hour rolling CO

The maximum CO concentration as an 8 hour rolling average is 59.6µg/m$^3$ or 0.6% of the AQS (10,000µg/m$^3$) and therefore can be considered to be insignificant. The predicted impacts at the human health receptors are lower and also insignificant.

### 15-minute mean $SO_2$

The predicted maximum 15-minute $SO_2$ PC beyond the Installation Boundary is 30.5µg/m$^3$, which is 11.5% of the relevant AQS (266µg/m$^3$). When considered with the background concentrations, the PEC is 37.7µg/m$^3$, representing 14% of the AQS. The increase over the Baseline Assessment is 6.2% of the AQS and therefore can be considered to be insignificant.

At the worst-case human health receptor locations, the PC reduces to 10.2µg/m$^3$, representing 3.8% of the AQS and therefore can be considered to be insignificant. The increase from the Baseline Assessment is 2.5% of the AQS.

### 1-hour mean $SO_2$

The maximum predicted 1-hour $SO_2$ PC beyond the Installation Boundary for the Future Assessment is 24.4µg/m$^3$, which is 7.0% of the relevant AQS (350µg/m$^3$). When considered with the background concentrations, the PEC is 31.6µg/m$^3$, representing 9% of the AQS. The increase over the Baseline Assessment is 4.2% and therefore is lower than the 10% screening threshold for short term impacts and therefore can be considered to be insignificant.

At human health receptor locations, the PC reduces to 6.3µg/m$^3$, representing 1.8% of the AQS and therefore can be considered to be insignificant.

### 24-hour mean $SO_2$

The maximum beyond the Installation Boundary predicted 24-hour $SO_2$ PC is 12.2µg/m$^3$, which is 9.8% of the relevant AQS (125µg/m$^3$). When considered with the background concentrations, the PEC is 19.4µg/m$^3$, representing 16% of the AQS. The increase in the Baseline Assessment is 6.9% of the AQS and therefore is lower than the 10% screening threshold for short term impacts and therefore can be considered to be insignificant.

At human health receptor locations, the PC reduces to 1.6µg/m$^3$, representing 1.3% of the AQS and therefore can be considered to be insignificant, as can the increase from the Baseline Assessment of 0.8% of the AQS.

**Table 5.7: Future Assessment Human Health Receptor Results – 16 Engines**

| Pollutant | Measured as | AQS or EAL (µg/m³) | PC (µg/m³) | PC/ AQS or EAL | BC (µg/m³) | PEC (µg/m³) | PEC/ AQS or EAL | Change in PC over the Baseline |
|---|---|---|---|---|---|---|---|---|
| NOx | Max off-site annual average | 40 | 5.5 | 13.8% | 15.5 | 21.0 | 53% | + 8.2% |
| | Worst-case receptor annual average | | 0.6 | 1.4% | 10.2 | 10.7 | 27% | + 0.8% |
| | Max off-site hourly mean (99.8th %ile) | 200 | 24.0 | 12.0% | 31.0 | 55.0 | 27% | + 4.4% |
| | Worst-case receptor hourly Mean (99.8th %ile) | | 7.1 | 3.5% | 18.4 | 25.4 | 13% | + 2.1% |
| CO | Max off-site hourly mean | 30,000 | 113.1 | 0.4% | 464.2 | 577.3 | 2% | + 0.3% |
| | Worst-case receptor hourly mean | | 23.8 | 0.1% | 432.6 | 456.4 | 2% | + 0.1% |
| | Max off-site 8-hr rolling average | 10,000 | 59.6 | 0.6% | 464.2 | 523.8 | 5% | + 0.5% |
| | Worst-case receptor 8-hr rolling average | | 13.9 | 0.1% | 432.6 | 446.5 | 4% | + <0.1% |
| $SO_2$ | Max off-site 15 minute mean (99.9th %ile) | 350 | 30.5 | 11.5% | 7.2 | 37.7 | 14% | + 6.2% |
| | Worst-case receptor 15 minute mean (99.9th %ile) | | 10.2 | 3.8% | 4.0 | 14.2 | 5% | + 2.5% |
| | Max off-site 1-hour mean (99.73th %ile) | 266 | 24.4 | 7.0% | 7.2 | 31.6 | 9% | + 4.2% |
| | Worst-case receptor 1-hour mean (99.73th %ile) | | 6.3 | 1.8% | 5.0 | 11.3 | 3% | + 1.0% |
| | Max off-site 24-hour mean (99.18th %ile) | 125 | 12.2 | 9.8% | 7.2 | 19.4 | 16% | + 6.9% |
| | Worst-case receptor 24-hour mean (99.18th %ile) | | 1.6 | 1.3% | 5.0 | 6.6 | 5% | + 0.8% |

It is considered that the increase in impacts from the Future Assessment for human health effects are insignificant compared with the relevant AQS and EALs. In addition, the PEC values will include the double counting of the existing emissions from the Teesside Terminal and therefore they can be considered to be very conservative.

### 5.2.2 Ecological Receptors

#### NOx Annual Mean

The Future Assessment results show the increase in PC as a result of the operation of the E2P Power Island, representing the change in concentrations of NOx from the Baseline Assessment as a result of the operation of the maximum 16 engines. Table 5.8 shows that the highest NOx annual mean impacts occur at the Teesmouth and Cleveland Coast receptors (particularly receptors E4 - E6) directly adjacent to the north of the Installation.

The highest PC at the Teesmouth and Cleveland Coast receptor is predicted to be 7.9µg/m³, which occurs at E5, and represent up to 26% of the Critical Level at this location. This level of impact occurs over a very small area of the receptor site as can be seen in Figure 10, with the concentration of NOx rapidly decreasing with distance from the Installation, which is demonstrated by the range of values provided for receptors E1 – E13 and demonstrated in the isopleth figure shown in Figure 10.

With the background concentrations at E5, the PEC is 25.8µg/m$^3$, or 86% of the Critical Level. This is over the second screening criteria threshold, so cannot immediately be screened out, which is also the case for receptors E4, E6 – E11. However, the PEC includes the double counting of the existing emissions, given that these will already be accounted for in the background concentrations used in the assessment. Background concentrations at E6 – E11 are already exceeding the Critical Level, according to the APIS website.

It should be noted that this area of the Teesmouth and Cleveland Coast is defined as mudflats, which are regularly inundated by the tide, and as such there is no vegetation present in the area. Given that Critical Levels are defined for the protection of vegetation, it is therefore considered that the Critical Level is not directly applicable to this location in any case. Furthermore, following discussions with the project Ecologist, mudflats are not a designated feature of the Teesmouth and Cleveland Coast designation and therefore are also not sensitive to NOx. As such, it is considered that the overall effect at this site would be not significant.

With the exception of receptors E4 to E11, the impacts at all other receptor locations are below the screening criteria and are therefore considered to be insignificant for the Future Assessment.

**Table 5.8: Future Assessment - NOx Annual Mean Ecological Receptor Results – 16 Engines**

| Receptor | CL (µg/m$^3$) | PC (µg/m$^3$) | PC / CL (%) | BC (µg/m$^3$) | PEC (µg/m$^3$) | PEC/CL (%) | Change in PC over the Baseline |
|---|---|---|---|---|---|---|---|
| E1 – E12 | 30 | 0.7 – 7.9 | 2.2 – 26.4% | 15.9 37.2 | 16.6 38.9 | 56% - 130% | + 2% - 24% |
| E13 | | 2.3 | 7.5% | 19.3 | 21.6 | 72% | + 4.7% |
| E14 | | 0.1 | 0.5% | 6.3 | 6.4 | 21% | + 0.2% |
| E15 | | 0.1 | 0.5% | 8.7 | 8.8 | 29% | + 0.2% |
| E16 | | 0.1 | 0.3% | 4.8 | 4.9 | 16% | + 0.1% |
| E17 | | 0.1 | 0.5% | 9.2 | 9.3 | 31% | + 0.2% |
| E18 | | 0.1 | 0.4% | 8.1 | 8.2 | 27% | + 0.2% |
| E19 | | 0.1 | 0.4% | 7.2 | 7.3 | 24% | + 0.2% |
| E20 | | 0.1 | 0.4% | 6.6 | 6.7 | 22% | + 0.2% |
| E21 | | 0.1 | 0.3% | 8.2 | 8.3 | 28% | + 0.1% |
| E22 | | 0.04 | 0.1% | 7.8 | 7.8 | 26% | + 0.1% |
| E23 | | 0.04 | 0.1% | 8.4 | 8.4 | 28% | + 0.1% |
| E24 | | 0.1 | 0.2% | 7.3 | 7.4 | 25% | + 0.1% |
| E25 | | 0.1 | 0.4% | 6.6 | 6.7 | 22% | + 0.2% |
| E26 | | 0.1 | 0.3% | 7.7 | 7.8 | 26% | + 0.2% |
| E27 | | 0.03 | 0.1% | 7.0 | 7.0 | 23% | + <0.1% |
| E28 | | 0.02 | 0.1% | 7.4 | 7.4 | 25% | + <0.1% |
| E29 | | 1.2 | 4.1% | 17.4 | 18.6 | 62% | + 2.4% |
| E30 | | 1.5 | 5.0% | 17.1 | 18.6 | 62% | + 4.1% |
| E31 | | 0.4 | 1.2% | 14.1 | 14.5 | 48% | + 0.8% |
| E32 | | 0.3 | 1.1% | 14.1 | 14.4 | 48% | + 0.8% |

| Receptor | CL (µg/m³) | PC (µg/m³) | PC / CL (%) | BC (µg/m³) | PEC (µg/m³) | PEC/CL (%) | Change in PC over the Baseline |
|---|---|---|---|---|---|---|---|
| E33 | | 0.9 | 3.0% | 14.4 | 15.3 | 51% | + 1.6% |
| E34 | | 0.6 | 2.1% | 17.9 | 18.5 | 62% | + 1.3% |
| E35 | | 0.2 | 0.8% | 13.4 | 13.6 | 45% | + 0.5% |
| E36 | | 0.5 | 1.5% | 15.9 | 16.4 | 55% | + 1.1% |
| E37 | | 1.6 | 5.3% | 17.4 | 19.0 | 63% | + 3.3% |
| E38 | | 1.7 | 5.5% | 16.3 | 18.0 | 60% | + 3.3% |
| E39 | | 0.6 | 1.8% | 17.1 | 17.7 | 59% | + 1.4% |
| E40 | | 1.3 | 4.3% | 17.5 | 18.8 | 63% | + 2.5% |

**Figure 10: Future Assessment – Isopleths of Annual Mean NOx PCs (µg/m³)**


## NOx Daily Mean

shows the worst-case daily mean NOx impacts at all receptors. The Teesmouth and Cleveland Coast receptors have the greatest impacts, where the highest PC is reported at receptor E5 as 38.3µg/m3, which represents 51.1% of the conservative daily Critical Level of 75µg/m3. With the background concentrations at receptor E5, the PEC is 65.1µg/m3, or 87% of the Critical Level, however the PEC includes double counting of the impacts of the exiting operational Teesside Terminal. The worst-case impacts occur over a very small area of the Teesmouth and Cleveland Coast site, as shown in Figure 11.

Again, the area of the Teesmouth and Cleveland Coast directly adjacent to the site comprises an area of mudflats that are regularly inundated by the tide (receptors E1 to E13), and as such there is no vegetation present in this area. It is therefore considered that the daily Critical Level is not directly applicable to this location. Receptors E11 and E12 is known to be Saltmarsh, which is sensitive to NOx, however following the advice from the project Ecologist, it is considered that as PEC is less than the Critical Level and the very worst-case nature of the assessment, the overall effect is considered to be not significant. Receptor E30 is a priority habitat known as ‘coastal and floodplain grazing marsh’, which is not known to be sensitive to nitrogen. Since the PEC at this receptor is also below the Critical Level, this is also considered to be not significant.

The impacts at all other ecological receptors are less than 10% of the EA’s screening criteria and the effects at these locations are therefore insignificant

Table 5.9 shows the worst-case daily mean NOx impacts at all receptors. The Teesmouth and Cleveland Coast receptors have the greatest impacts, where the highest PC is reported at receptor E5 as 38.3µg/m$^3$, which represents 51.1% of the conservative daily Critical Level of 75µg/m$^3$. With the background concentrations at receptor E5, the PEC is 65.1µg/m$^3$, or 87% of the Critical Level, however the PEC includes double counting of the impacts of the exiting operational Teesside Terminal. The worst-case impacts occur over a very small area of the Teesmouth and Cleveland Coast site, as shown in Figure 11.

Again, the area of the Teesmouth and Cleveland Coast directly adjacent to the site comprises an area of mudflats that are regularly inundated by the tide (receptors E1 to E13), and as such there is no vegetation present in this area. It is therefore considered that the daily Critical Level is not directly applicable to this location. Receptors E11 and E12 is known to be Saltmarsh, which is sensitive to NOx, however following the advice from the project Ecologist, it is considered that as PEC is less than the Critical Level and the very worst-case nature of the assessment, the overall effect is considered to be not significant. Receptor E30 is a priority habitat known as ‘coastal and floodplain grazing marsh’, which is not known to be sensitive to nitrogen[15]. Since the PEC at this receptor is also below the Critical Level, this is also considered to be not significant.

The impacts at all other ecological receptors are less than 10% of the EA’s screening criteria and the effects at these locations are therefore insignificant

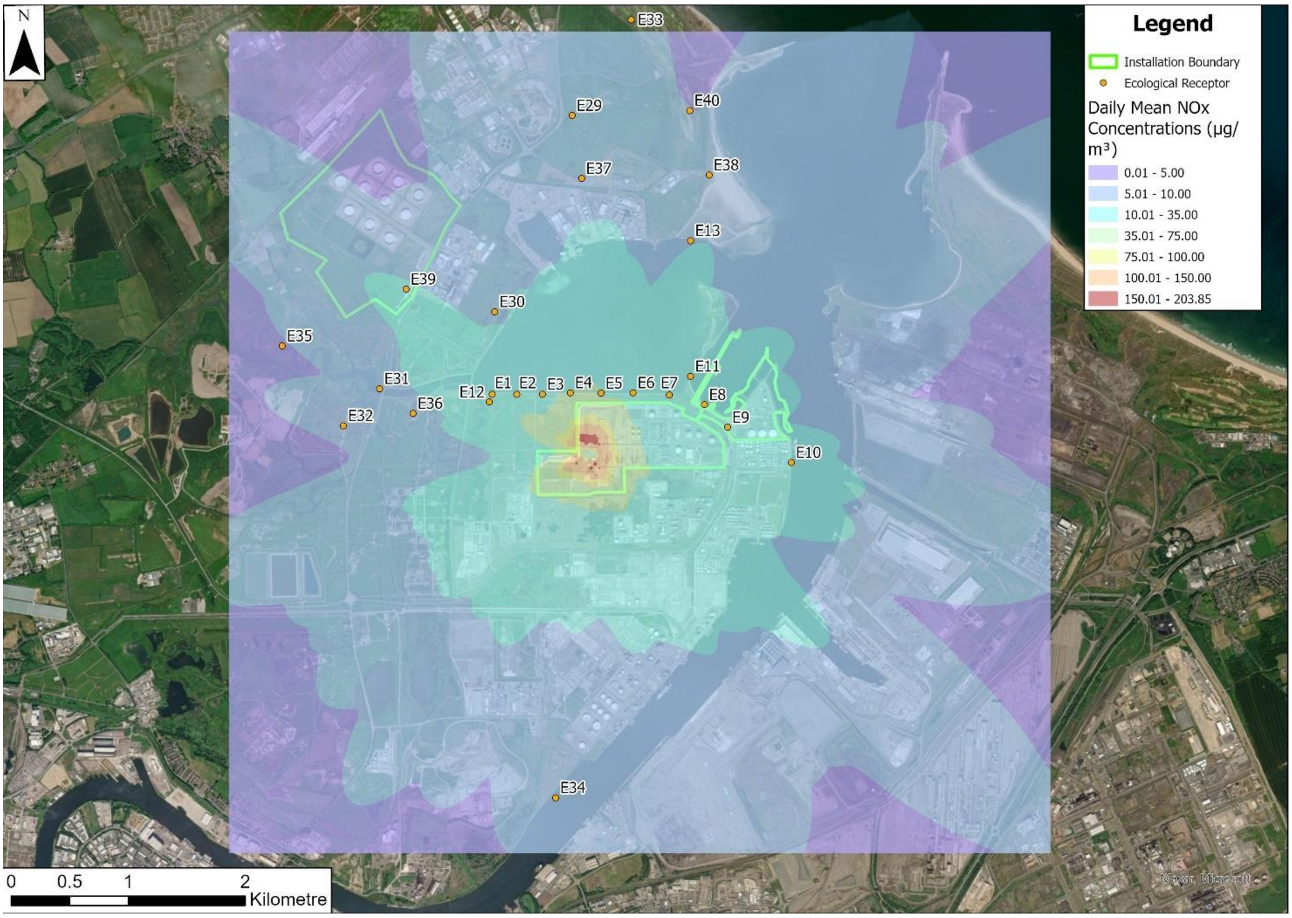
**Table 5.9: Future Assessment NOx 24-Hour Mean Ecological Receptor Results – 16 Engines**

| Receptor | CL (µg/m$^3$) | PC (µg/m$^3$) | PC / CL (%) | BC (µg/m$^3$) | PEC (µg/m$^3$) | PEC/CL (%) | Change in PC over the Baseline |
|---|---|---|---|---|---|---|---|
| E1 – E12 | 75 | 14.4 – 38.3 | 19.2% – 51.1% | 26.9 – 55.8 | 48.0 – 72.7 | 64% - 97% | + 2.7% - 36.8% |
| E13 | | 11.5 | 15.3% | 26.3 | 37.7 | 50% | + 8.7% |
| E14 | | 1.6 | 2.1% | 9.5 | 11.0 | 15% | + 0.8% |
| E15 | | 1.6 | 2.1% | 13.1 | 14.6 | 19% | + 0.8% |
| E16 | | 1.2 | 1.5% | 7.2 | 8.4 | 11% | + 0.6% |
| E17 | | 2.5 | 3.4% | 13.8 | 16.3 | 22% | + 1.4% |
| E18 | | 1.6 | 2.1% | 12.2 | 13.7 | 18% | + 0.9% |
| E19 | | 2.6 | 3.5% | 10.8 | 13.4 | 18% | + 1.6% |
| E20 | | 1.6 | 2.1% | 9.9 | 11.5 | 15% | + 1.0% |
| E21 | | 1.2 | 1.6% | 12.3 | 13.5 | 18% | + 0.7% |
| E22 | | 1.1 | 1.4% | 11.7 | 12.8 | 17% | + 0.6% |
| E23 | | 1.1 | 1.5% | 12.6 | 13.7 | 18% | + 0.6% |

[15] APIS website. Nitrogen Deposition: Coastal and Floodplain Grazing Marsh. Available at https://www.apis.ac.uk/node/967 [Accessed January 2025]

| Receptor | CL (µg/m³) | PC (µg/m³) | PC / CL (%) | BC (µg/m³) | PEC (µg/m³) | PEC/CL (%) | Change in PC over the Baseline |
|---|---|---|---|---|---|---|---|
| E24 | | 1.4 | 1.9% | 11.0 | 12.4 | 16% | + 0.8% |
| E25 | | 1.6 | 2.2% | 9.9 | 11.5 | 15% | + 0.9% |
| E26 | | 1.3 | 1.8% | 11.6 | 12.9 | 17% | + 0.7% |
| E27 | | 0.9 | 1.3% | 10.5 | 11.4 | 15% | + 0.6% |
| E28 | | 0.8 | 1.0% | 11.1 | 11.9 | 16% | + 0.4% |
| E29 | | 7.2 | 9.6% | 26.1 | 33.3 | 44% | + 5.0% |
| E30 | | 14.6 | 19.4% | 25.7 | 40.2 | 54% | + 12.5% |
| E31 | | 6.9 | 9.2% | 21.2 | 28.0 | 37% | + 5.5% |
| E32 | | 7.4 | 9.9% | 21.2 | 28.6 | 38% | + 6.6% |
| E33 | | 5.9 | 7.8% | 21.6 | 27.5 | 37% | + 4.0% |
| E34 | | 5.9 | 7.8% | 26.9 | 32.7 | 44% | + 4.1% |
| E35 | | 4.7 | 6.3% | 20.1 | 24.8 | 33% | + 3.6% |
| E36 | | 8.8 | 11.7% | 23.9 | 32.7 | 44% | + 7.5% |
| E37 | | 8.6 | 11.5% | 26.1 | 34.7 | 46% | + 6.1% |
| E38 | | 8.8 | 11.8% | 24.5 | 33.3 | 44% | + 6.8% |
| E39 | | 10.8 | 14.4% | 25.7 | 36.4 | 49% | + 9.3% |
| E40 | | 7.5 | 10.0 | 26.3 | 33.8 | 45% | + 5.7% |

Figure 11: Future Assessment – Isopleths of Daily Mean NOx PCs (µg/m³)




## $SO_2$ Annual Mean

The annual mean $SO_2$ PCs for all receptors are shown in Table 5.10 for the Future Assessment, assuming that the $SO_2$ emission from the E2P Power Island is at the top of the BAT-AEL range. As stated previously, it is considered that the DEA scrubber will remove sulphur from the fuel gas such that $SO_2$ emissions are very low, and therefore the impacts will significantly?  less than indicated in Table 5.10.

The highest PC was predicted at receptor E5 as 2.7µg/m³ and the percentage of the Critical Level was 13.7%. The highest PEC was 5.7µg/m³, which is 28% of the Critical Level, well below the 70% screening criterion. All other receptors are also below the screening criteria and no exceedances of the Critical Level are predicted. As such, the effect at these receptors is considered to be insignificant.

Table 5.10: Future Assessment $SO_2$ Annual Mean Ecological Receptor Results – 16 Engines

| Receptor | CL (µg/m³) | PC (µg/m³) | PC / CL (%) | BC (µg/m³) | PEC (µg/m³) | PEC/CL (%) | Change in PC over the Baseline |
|---|---|---|---|---|---|---|---|
| E1 – E12 | 20 | 0.3 – 2.7 | 1.3% - 13.7% | 2.0 – 3.9 | 2.3 - 5.7 | 11% - 28% | + 1.0% - 13.1% |
| E13 | | 0.72 | 3.6% | 2.5 | 3.2 | 16% | + 2.5% |
| E14 | | 0.05 | 0.3% | 1 | 1.1 | 5% | + 0.1% |
| E15 | | 0.05 | 0.3% | 1.5 | 1.6 | 8% | + 0.1% |
| E16 | | 0.03 | 0.1% | 0.5 | 0.5 | 3% | + 0.1% |
| E17 | | 0.05 | 0.2% | 1.3 | 1.3 | 7% | + 0.1% |
| E18 | | 0.04 | 0.2% | 1.1 | 1.1 | 6% | + 0.1% |

| Recepto r | CL (µg/m³) | PC (µg/m³) | PC / CL (%) | BC (µg/m³) | PEC (µg/m³) | PEC/CL (%) | Change in PC over the Baseline |
|---|---|---|---|---|---|---|---|
| E19 | | 0.04 | 0.2% | 1.1 | 1.1 | 6% | + 0.1% |
| E20 | | 0.04 | 0.2% | 0.9 | 0.9 | 5% | + 0.1% |
| E21 | | 0.03 | 0.2% | 1.3 | 1.3 | 7% | + 0.1% |
| E22 | | 0.01 | 0.1% | 1.2 | 1.2 | 6% | + <0.1% |
| E23 | | 0.02 | 0.1% | 1.3 | 1.3 | 7% | + <0.1% |
| E24 | | 0.02 | 0.1% | 1.1 | 1.1 | 6% | + <0.1% |
| E25 | | 0.04 | 0.2% | 1 | 1.0 | 5% | + 0.1% |
| E26 | | 0.03 | 0.2% | 1.2 | 1.2 | 6% | + 0.1% |
| E27 | | 0.01 | 0.1% | 1.4 | 1.4 | 7% | + <0.1% |
| E28 | | 0.01 | <0.1% | 1.5 | 1.5 | 8% | + 0.1% |
| E29 | | 0.4 | 2.1% | 2.7 | 3.1 | 16% | + 1.3% |
| E30 | | 0.5 | 2.6% | 2.9 | 3.4 | 17% | + 2.2% |
| E31 | | 0.1 | 0.6% | 1.9 | 2.0 | 10% | + 0.4% |
| E32 | | 0.1 | 0.6% | 1.9 | 2.0 | 10% | + 0.4% |
| E33 | | 0.3 | 1.5% | 2.3 | 2.6 | 13% | + 0.9% |
| E34 | | 0.2 | 1.1% | 3.0 | 3.2 | 16% | + 0.7% |
| E35 | | 0.1 | 0.4% | 1.8 | 1.9 | 9% | + 0.3% |
| E36 | | 0.2 | 0.8% | 2.0 | 2.2 | 11% | + 0.6% |
| E37 | | 0.5 | 2.7% | 2.7 | 3.2 | 16% | + 1.8% |
| E38 | | 0.5 | 2.7% | 3.2 | 3.7 | 19% | + 1.8% |
| E39 | | 0.2 | 0.9% | 2.3 | 2.5 | 12% | + 0.7% |
| E40 | | 0.4 | 2.1% | 2.5 | 2.9 | 15% | + 1.4% |

## Nitrogen Deposition

The impacts of the change in the nitrogen deposition from the Baseline Assessment to the Future Assessment have been assessed at the relevant habitat features that occur for the Teesmouth and Cleveland Coast SPA, Ramsar, SSSI and NNR receptor locations, given that this is the closest receptor to the emission sources and therefore the most impacted. All other receptors have been assessed at the closest point to the emission sources.

The IAQM Air Quality Impacts on Designated Nature Conservation Sites guidance[16] document states that an increment of 1% (or less) of the relevant long term Critical Level or Critical Load alone is considered inconsequential, but that a change of more than 1% does not necessarily indicate that a significant effect (or adverse effect on integrity) will occur; it simply means that the change in concentration or deposition rate cannot in itself be described as numerically inconsequential or imperceptible and therefore requires further consideration. It goes on to state that *"In the IAQM's opinion, the 1% and 10% screening criteria should not be used rigidly and, not to a numerical precision greater than the expression of the criteria themselves. Whilst*

[16] IAQM (2020) A Guide to the Assessment of Air Quality Impacts on Designated Nature Conservation Sies (V1.1)

*it is straightforward to generate model results for the PC to any level of precision required, the accuracy of the result is much less certain and it is unwise to place too much emphasis on whether the PC is 0.9% or 1.1%, for example."*

The nitrogen deposition impacts at all but three of the locations assessed for the Teesmouth and Cleveland Coast SPA, Ramsar, SSSI and NNR ecological receptors are considered to be insignificant in line with the EA's Risk Assessment guidance, with increases at or less than 1% of the lower Critical Load, as shown in Table 5.11.

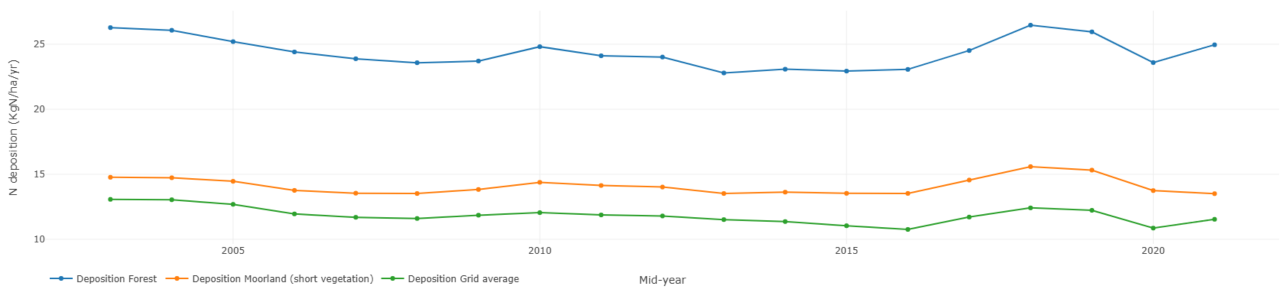
The impacts at Receptors E11, E13 and E40 are over the 1% screening criteria for determining insignificance, with the increase representing 1.1% and 2.8% (or 1.4% based on the application of the Shifting dunes Critical Loads) and 1.5% of the lower Critical Load for saltmarsh and dune habitats respectively. Compared to the upper end of the Critical Load range for the relevant habitats however, the increase in impacts would be insignificant.

It should also be noted that these results are based on the worst-case year of meteorological data, where it is recognised that depositional impacts occur over several years. It is therefore considered that it is more appropriate to consider these impacts over the average of the five years of meteorological data used in the model. When considering this, the increases are reduced to 1.0%, 2.0% (or 1.0% based on the application of the Shifting dunes Critical Loads) and 1.2% for the E1, E13 and E40 receptors respectively. This reduces the impacts to only slightly over 1% and therefore within the range of being considered numerically inconsequential or imperceptible in line with the IAQM Guidance.

Even without considering the average impacts, taking the IAQM Guidance into consideration, the change in the nitrogen deposition impacts at the E11 receptor particularly (+ 1.1%) can be considered to be insignificant against the lower end of the Critical Load range. The PEC at E11 is also below the lower Critical Load, representing 69% of it, and therefore there is no exceedance at this location.

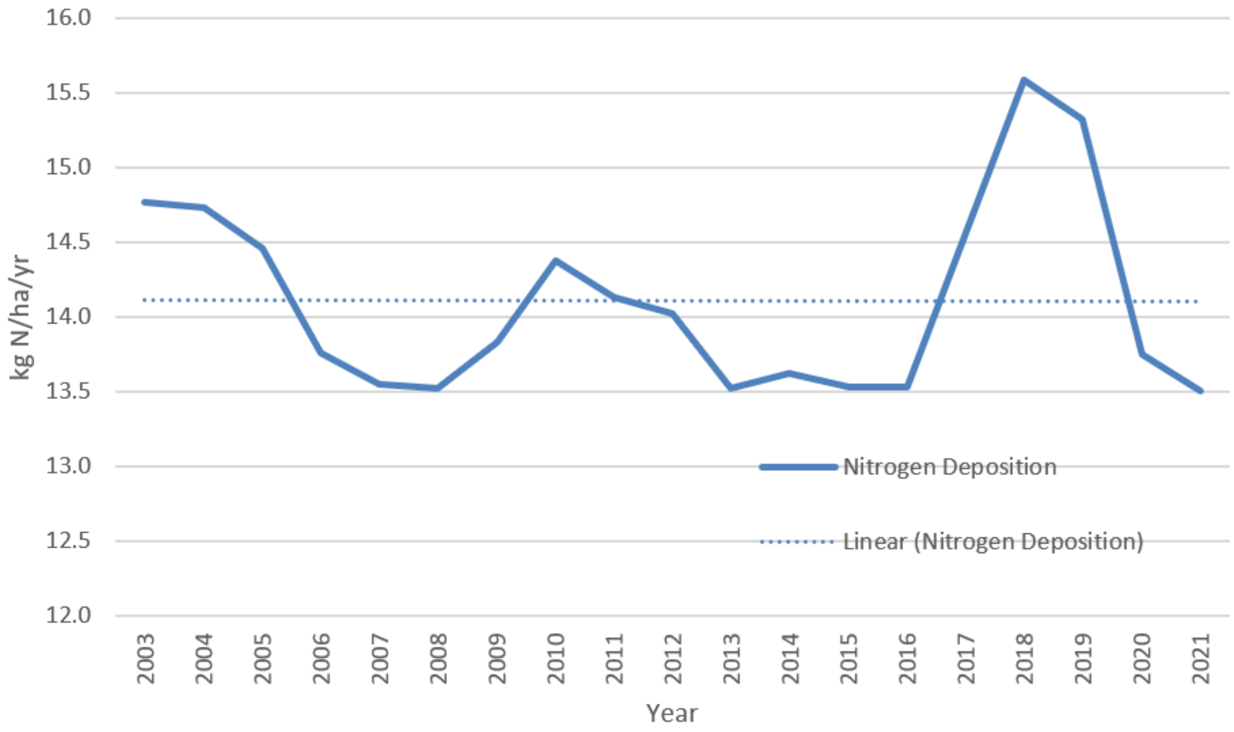
Figure 12 shows the historic nitrogen deposition values present at the Teesmouth and Cleveland Coast SPA, Ramsar, SSSI and NNR in the vicinity of the relevant receptors (E13), as reported by APIS. In 2003, nitrogen deposition for short vegetation (used in the assessment) was 14.8 kgN/ha/yr, and between 2023 and 2021 the values have fluctuated between 13.5 kgN/ha/yr (2021) and 15.6 kgN/ha/yr in 2018. A variance of 2.1 kgN/ha/yr.

**Figure 12: Historic Trend of Nitrogen Deposition for the Installation's Vicinity**




The background deposition values for short vegetation have been further considered in order to determine whether there is a reduction in nitrogen deposition over time, with a trendline added in Figure 13.

Figure 13: Short Vegetation Deposition Showing Trendline




It can be seen in Figure 13 that there is no change in the linear nitrogen deposition (trendline) but that there is considerable interannual variance in the background deposition concentrations. The linear nitrogen deposition (trendline) indicates that, on average, nitrogen deposition is approximately 14.1 kg N/ha/yr for the site.

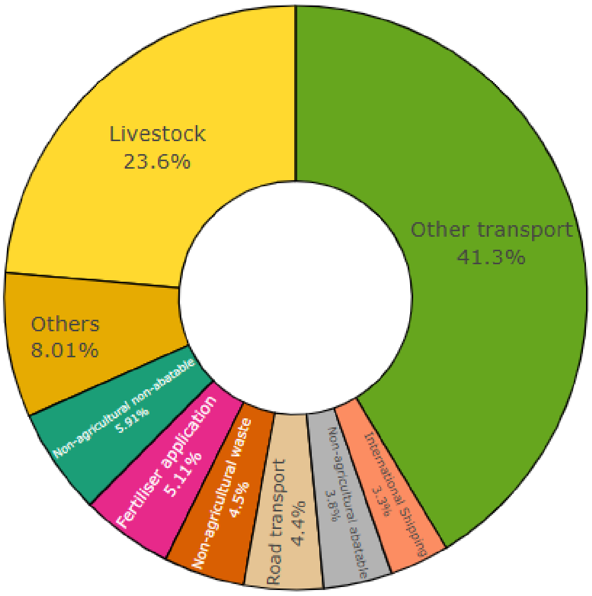
The APIs website states that it is considered that emissions of pollutants change relatively little from year to year, and that the spatial pattern of pollution on an annual basis is mainly driven by meteorological conditions. Significant inter-annual variations in deposition can occur due to the natural variability in annual weather patterns with the circulation of the air, temperature and precipitation all affecting the atmospheric chemistry and transport of pollutants, and therefore it is considered that this is clearly demonstrated by the fluctuation in the background nitrogen deposition at E13, which are shown to vary by up to 2.1 kgN/ha/yr in a two years period.

The change in the nitrogen deposition from the E2P Power Island at the impacted receptors is very low compared to the existing background concentrations, representing 3% of the current background at the maximum location and 1.2% of the current background nitrogen deposition at the E40 receptor location. At E40 the predicted change in nitrogen deposition represents only 5% of the variance that has occurred between 2018 and 2021. It is therefore considered that the operation of the E2P Power Island is unlikely to affect the potential for the nitrogen deposition concentrations at the receptor to reduce to below the lower Critical Load.

As stated previously, Critical Loads are provided as ranges which reflect the variation in ecosystem response across Europe. To ensure that a conservative assessment is carried out, it is usual for impacts to be determined against the lower end (i.e. the most stringent) of the Critical Load range, however it is reasonable to assume that where nitrogen deposition concentrations have been high in the past, a small change in nitrogen deposition that represents only a very small proportion of the current background deposition would be unlikely to result in an adverse response from the ecosystem, especially when the predicted 0.2 kgN/ha/yr at E13, remain well within the natural annual variation of nitrogen deposition demonstrated in Figure 12 and Figure 13.

Figure 14 shows the local contributions to nitrogen deposition in the vicinity of the Installation, as reported by APIS, and it can be seen that the nitrogen deposition is dominated by transport and agricultural sources, which comprise approximately 78% of the background deposition. This again highlights the very small proportion of nitrogen deposition that would be attributable to the Installation.

**Figure 14: Local Contributions to Nitrogen Deposition (kgN/ha/yr) from UK Sources**




Finally, as stated throughout, the assessment has been based on a very conservative worst-case assumption of a maximum of 16 engines being operationally at the same time, continuously. This will never actually occur, as it is considered that the volumes of fuel gas available to the gas engines would not be sufficient to enable this mode of operation. The actual number of engines installed will be dependent on projected volumes of available fuel gas and is expected to be lower than the maximum 16 included in the assessment, being more likely to be in the region of a maximum of 12.

It is envisaged that up to four engines will be installed to provide redundancy in the system, to ensure that there are sufficient operating engines to utilise all the fuel gas available, recognising that there will always be engines undergoing maintenance activities.

Deposition impacts occur over a long period of time (i.e. years), and as the maximum number of operational engines will only operate for the first 4 years of the E2P Power Islands operation, with the number of operating engines then reducing as fuel gas volumes fall, it is therefore considered very unlikely that significant effects on the habitats would occur.

The dispersion model has been run to determine the reduction in the nitrogen deposition, as a result of the more realistic operating scenario of a maximum number of engines of 12 being operational, and the results are shown in Section 5.3.

Figure 15 shows the predicted nitrogen deposition associated with the operation of 16 engines.

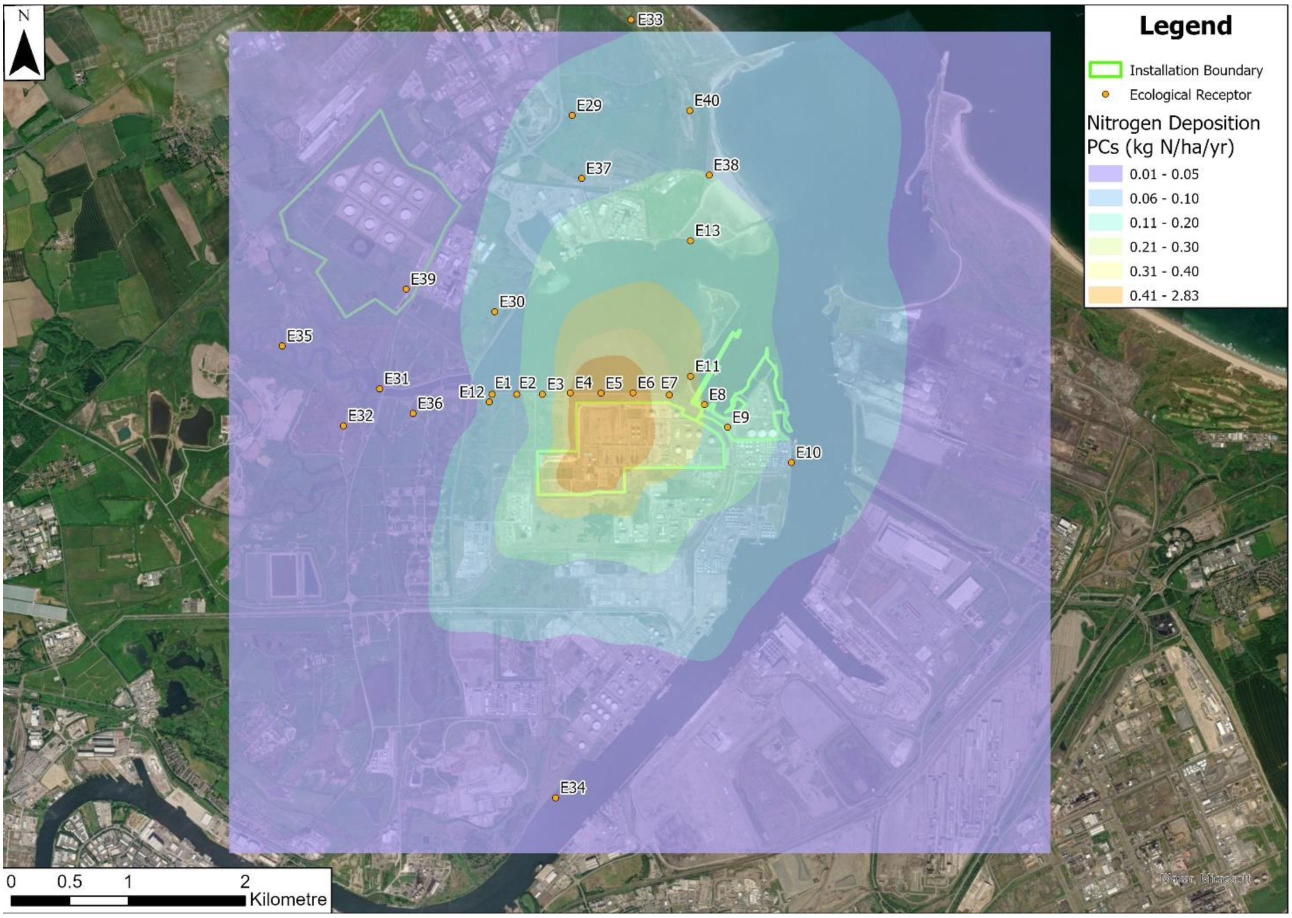
**Table 5.11: Future Assessment Nitrogen Deposition – 16 Engines**

| Receptor | Critical Load Class | Critical Load (kgN/ha/yr) | Background N dep (kgN/ha/yr) | Background N dep / Critical Load Min (kgN/ha/yr) | PC Annual Mean $NO_2$ (µg/m$^3$) | PC N Dry Dep (kgN/ha/yr) | PC/ Critical Load (min)(%) | Total Dep Inc Background (kgN/ha/yr) | PEC/ Critical Load (min) | Change in PC over the Baseline |
|---|---|---|---|---|---|---|---|---|---|---|
| E1 | Atlantic upper-mid & mid-low salt marshes | 10 – 20 | 13.8 | 138% | 0.5 | 0.1 | 0.8% | 13.9 | 139% | + 0.5% |
| E11 | Pioneer saltmarsh | 20 – 30 | 13.3 | 67% | 2.9 | 0.4 | 2.1% | 13.7 | 69% | + 1.1% |
| E12 | Atlantic upper-mid & mid-low salt marshes | 10 – 20 | 13.8 | 138% | 0.5 | 0.1 | 0.7% | 13.7 | 137% | + 0.6% |
| E13 Assessed as: | Coastal Shifting Dunes | 10 – 20 | 13.5 | 135% | 1.6 | 0.2 | 2.3% | 13.7 | 137% | + 1.4% |
| | Coastal dune grasslands (grey dunes) | 5 - 15 | | 270% | | | 4.5% | | 275% | + 2.8% |
| E14 | Coastal dune grasslands (grey dunes) | 5 - 15 | 10.4 | 208% | 0.1 | 0.02 | 0.3% | 10.4 | 208% | + 0.1% |
| E15 | Coastal dune grasslands (grey dunes) | 5 - 15 | 11.6 | 232% | 0.1 | 0.02 | 0.3% | 11.6 | 232% | + 0.1% |
| E16 | Raised and blanket bogs | 5 - 10 | 15.8 | 316% | 0.1 | 0.01 | 0.2% | 15.8 | 316% | + 0.1% |
| E17 | No Critical loads assigned | | | | | | | | | |
| E18 | Raised and blanket bogs | 5 - 10 | 14.8 | 296% | 0.08 | 0.01 | 0.2% | 14.8 | 296% | + 0.1% |

| Receptor | Critical Load Class | Critical Load (kgN/ha/yr) | Background N dep (kgN/ha/yr) | Background N dep / Critical Load Min (kgN/ha/yr) | PC Annual Mean $NO_2$ ($\mu g/m^3$) | PC N Dry Dep (kgN/ha/yr) | PC/ Critical Load (min)(%) | Total Dep Inc Background (kgN/ha/yr) | PEC/ Critical Load (min) | Change in PC over the Baseline |
|---|---|---|---|---|---|---|---|---|---|---|
| E19 | No Critical loads assigned | | | | | | | | | |
| E20 | No Critical loads assigned | | | | | | | | | |
| E21 | Carpinus and Quercus mesic deciduous forest | 15 - 20 | 22.1 | 147% | 0.06 | 0.02 | 0.1% | 22.1 | 147% | + 0.1% |
| E22 | Low and medium altitude hay meadows | 10 – 20 | 16.1 | 161% | 0.03 | 0.004 | 0.04% | 16.1 | 161% | + <0.1% |
| E23 | Low and medium altitude hay meadows | 10 - 20 | 16.2 | 162% | 0.03 | 0.004 | <0.1% | 16.2 | 162% | + <0.1% |
| E24 | Valley mires, poor fens and transition mires | 5 - 15 | 15.7 | 314% | 0.04 | 0.01 | 0.1% | 15.7 | 314% | + <0.1% |
| E25 | No Critical loads assigned | | | | | | | | | |
| E26 | Rich fens | 15 - 25 | 14.7 | 98% | 0.1 | 0.01 | 0.1% | 14.7 | 98% | + <0.1% |
| E27 | Low and medium altitude hay meadow | 10 - 20 | 15.5 | 155% | 0.02 | 0.003 | <0.1% | 15.5 | 155% | + <0.1% |
| E28 | Semi-dry Perennial calcareous grassland (basic meadow steppe) | 10 - 15 | 15.6 | 156% | 0.02 | 0.002 | <0.1% | 15.6 | 156% | + <0.1% |

| Receptor | Critical Load Class | Critical Load (kgN/ha/yr) | Background N dep (kgN/ha/yr) | Background N dep / Critical Load Min (kgN/ha/yr) | PC Annual Mean $NO_2$ (µg/m$^3$) | PC N Dry Dep (kgN/ha/yr) | PC/ Critical Load (min)(%) | Total Dep Inc Background (kgN/ha/yr) | PEC/ Critical Load (min) | Change in PC over the Baseline |
|---|---|---|---|---|---|---|---|---|---|---|
| E29 | No Critical loads assigned | | | | | | | | | |
| E30 | No designated features at this location. | | | | | | | | | |
| E31 | Atlantic upper-mid & mid-low salt marshes | 10 - 20 | 14.0 | 140% | 0.2 | 0.04 | 0.4% | 14.0 | 140% | + 0.2% |
| E32 | No designated features at this location. | | | | | | | | | |
| E33 | Moist and wet dune slacks | 5 - 15 | 13.7 | 274% | 0.6 | 0.09 | 1.8% | 13.8 | 276% | + 1.0% |
| E34 | No designated features at this location. | | | | | | | | | |
| E35 | Atlantic upper-mid & mid-low salt marshes | 10 – 20 | 14.0 | 140% | 0.2 | 0.02 | 0.2% | 14.0 | 140% | + 0.1% |
| E36 | Atlantic upper-mid & mid-low salt marshes | 10 – 20 | 13.8 | 138% | 0.3 | 0.05 | 0.5% | 13.8 | 138% | + 0.3% |
| E37 | Low and medium altitude hay meadow | 10 - 20 | 13.9 | 139% | 1.1 | 0.2 | 1.6% | 14.1 | 141% | + 1.0% |
| E38 | No designated features at this location. | | | | | | | | | |
| E39 | Low and medium altitude hay meadow | 10 - 20 | 13.9 | 139% | 0.4 | 0.06 | 0.6% | 14.0 | 140% | + 0.4% |
| E40 | Moist and wet dune slacks | 5 - 15 | 13.5 | 270% | 0.9 | 0.1 | 2.6% | 13.6 | 273% | + 1.5% |

**Figure 15: Future Assessment – Isopleths of Nitrogen Deposition PCs (kg N/ha/yr) – 16 engines**




## Acid Deposition

The results for Future Assessment are presented in Table 5.12. The impacts at E11, E13 and E37 show an increase of over 1% of the lower Critical Load applied however, as the PECs remain well below the lower Critical Load, it is considered that the impacts would be insignificant.

As previously stated, emissions of $SO_2$ have been assessed at the upper end of the BAT-AEL for Combustion sources in refineries, however it is anticipated that the DEA scrubber will remove the sulphur content from the fuel gas, such that the emissions are at very low levels (<5mg/Nm$^3$). It can be clearly seen in Table 5.12 that the impacts of acid deposition are dominated by the contribution of sulphur, and therefore it is considered that the actual impacts of acid deposition will be significantly lower than those presented.

All other sites have increases in the Critical Load that are less than 1% that can be considered to be insignificant.

**Table 5.12: Future Assessment Acid-Deposition – 16 Engines**

| Receptor | Critical Load Class | Background dep (keq/ha/yr) | Relevant Critical Load (keq ha/yr) | Background % Critical Load | PC Annual Mean (keq ha/yr) | PC/ Critical Load % | PEC/ Critical Load % | Change in PC over the Baseline |
|---|---|---|---|---|---|---|---|---|
| E1 | Calcareous grassland | N: 0.99<br>S: 0.25 | CLminN: 0.856<br>CLMaxS: 4<br>CLMaxN: 4.856 | 25.5% | N: 002<br>S: 0.01 | 0.8% | 26.3% | + 0.6% |
| E11 | Calcareous grassland | N: 0.95<br>S: 0.22 | CLminN: 0.856<br>CLMaxS: 4 | 24.1% | N: 0.03<br>S: 0.1 | 2.5% | 26.6% | + 1.5% |

| Receptor | Critical Load Class | Background dep (keq/ha/yr) | Relevant Critical Load (keq ha/yr) | Background % Critical Load | PC Annual Mean (keq ha/yr) | PC/ Critical Load % | PEC/ Critical Load % | Change in PC over the Baseline |
|---|---|---|---|---|---|---|---|---|
| | | | CLMaxN: 4.856 | | | | | |
| E12 | Calcareous grassland | N: 0.99<br>S: 0.25 | CLminN: 0.856<br>CLMaxS: 4<br>CLMaxN: 4.856 | 25.5% | N: 0.01<br>S: 0.03 | 0.8% | 26.3% | + 0.6% |
| E13 | Calcareous grassland | N: 0.96<br>S: 0.27 | CLminN: 0.856<br>CLMaxS: 4<br>CLMaxN: 4.856 | 25.3% | N: 0.02<br>S: 0.1 | 2.5% | 27.8% | + 1.7% |
| E14 | Calcareous grassland | N: 0.96<br>S: 0.17 | CLminN: 0.856<br>CLMaxS: 4<br>CLMaxN: 4.856 | 23.3% | N: 0.001<br>S: 0.006 | 0.1% | 23.4% | 0 % |
| E15 | Calcareous grassland | N: 0.96<br>S: 0.17 | CLminN: 0.856<br>CLMaxS: 4<br>CLMaxN: 4.856 | 23.3% | N: 0.001<br>S: 0.006 | 0.1% | 23.4% | 0% |
| E16 | Dwarf shrub heath | N: 1.11<br>S: 0.15 | CLminN: 0.321<br>CLMaxS: 0.183<br>CLMaxN: 0.504 | 250% | N: 0.001<br>S: 0.003 | 0.8% | 250.8% | + 0.3% |
| E17 | No Critical loads assigned | | | | | | | |
| E18 | Bogs | N: 1.06<br>S: 0.16 | CLminN: 0.321<br>CLMaxS: 0.148<br>CLMaxN: 0.469 | 260.2% | N: 0.001<br>S: 0.005 | 1.3% | 260.2% | + 0.8% |
| E19 | No Critical loads assigned | | | | | | | |
| E20 | No Critical loads assigned | | | | | | | |
| E21 | Unmanaged broadleafed/ Coniferous woodland | N: 1.55<br>S: 0.17 | CLminN: 0.142<br>CLMaxS: 2.448<br>CLMaxN: 2.639 | 65.2% | N: 0.001<br>S: 0.007 | 0.3% | 65.5% | + 0.1% |
| E22 | Calcareous grassland | N: 1.15<br>S: 0.14 | CLminN: 1.071<br>CLMaxS: 4<br>CLMaxN: 5.071 | 25.4% | N: 0.0003<br>S: 0.002 | <0.1% | 25.4% | < 0.1% |
| E23 | Calcareous grassland | N: 1.16<br>S: 0.15 | CLminN: 1.071<br>CLMaxS: 4<br>CLMaxN: 5.071 | 25.6% | N: 0.0003<br>S: 0.002 | <0.1% | 25.6% | < 0.1% |
| E24 | No information provided | | | | | | | |

| Receptor | Critical Load Class | Background dep (keq/ha/yr) | Relevant Critical Load (keq ha/yr) | Background % Critical Load | PC Annual Mean (keq ha/yr) | PC/ Critical Load % | PEC/ Critical Load % | Change in PC over the Baseline |
|---|---|---|---|---|---|---|---|---|
| E25 | No information provided | | | | | | | |
| E26 | No information provided | | | | | | | |
| E27 | Calcareous grassland | N: 1.11<br>S: 0.13 | CLminN: 1.071<br>CLMaxS: 4<br>CLMaxN: 5.071 | 24.5% | N: 0.0002<br>S: 0.001 | <0.1% | 24.5% | < 0.1% |
| E28 | Calcareous grassland | N: 1.11<br>S: 0.13 | CLminN: 0.856<br>CLMaxS: 4<br>CLMaxN: 4.856 | 25.5% | N: 0.0002<br>S: 0.001 | <0.1% | 25.5% | < 0.1% |
| E29 | No information on Critical Loads applicable to this site. | | | | | | | |
| E30 | No designated features at this location. | | | | | | | |
| E31 | Calcareous grassland | N: 1.00<br>S:0.23 | CLminN: 0.856<br>CLMaxS: 4<br>CLMaxN: 4.856 | 25.3% | N: 0.003<br>S: 0.01 | 0.4% | 25.7% | + 0.3% |
| E32 | No designated features at this location. | | | | | | | |
| E33 | Calcareous grassland | N: 0.95<br>S: 0.25 | CLminN: 1.071<br>CLMaxS: 4<br>CLMaxN: 5.071 | 6.2% | N: 0.007<br>S: 0.036 | 0.9% | 7.1% | + 0.5% |
| E34 | No designated features at this location. | | | | | | | |
| E35 | Calcareous grassland | N: 1.00<br>S:0.23 | CLminN: 0.856<br>CLMaxS: 4<br>CLMaxN: 4.856 | 25.3% | N: 0.002<br>S: 0.001 | 0.2% | 25.6% | + 0.1% |
| E36 | Calcareous grassland | N: 0.99<br>S:0.25 | CLminN: 0.856<br>CLMaxS: 4<br>CLMaxN: 4.856 | 25.5% | N: 0.003<br>S: 0.02 | 0.5% | 26.0% | + 0.4% |
| E37 | Calcareous grassland | N: 0.99<br>S: 0.29 | CLminN: 1.071<br>CLMaxS: 4<br>CLMaxN: 5.071 | 7.2% | N: 0.01<br>S: 0.06 | 1.6% | 8.8% | + 1.1% |
| E38 | No designated features at this location. | | | | | | | |
| E39 | Calcareous grassland | N: 0.99<br>S:0.26 | CLminN: 1.071<br>CLMaxS: 4<br>CLMaxN: 5.071 | 6.5% | N: 0.004<br>S: 0.02 | 0.5% | 7.0% | + 0.4% |
| E40 | Calcareous grassland | N: 0.82<br>S:0.29 | CLminN: 0.856<br>CLMaxS: 4<br>CLMaxN: 4.856 | 25.5% | N: 0.01<br>S: 0.05 | 1.2% | 26.8% | + 0.8% |

## 5.3 Future Assessment – Maximum 12 Engines

As stated previously, the actual number of engines installed will be dependent on projected volumes of available fuel gas and is expected to be lower than the maximum 16 included in the assessment. In any case the number of operational engines are more likely to be in the region of a maximum of 12. It is envisaged that up to four engines will be installed to provide redundancy in the system, to ensure that there are sufficient operating engines to utilise all the fuel gas available, recognising that there will always be engines undergoing maintenance activities. Based on the maximum fuel gas volumes presented in

Table 3.5 it is considered the likely that the maximum number of engines that are actually operated at the same time would be 11, and therefore it is still considered that the assessment of 12 engines represents a conservative assessment.

### 5.3.1 Human Health Impacts

As the Human health impacts for the maximum 16 engine scenario are shown to be insignificant at receptor locations, it thereby follows that the result for the 12 engines case would also be insignificant, and therefore no further assessment of human health impacts has been carried out.

### 5.3.2 Ecological Impacts

#### NOx Annual Mean

The annual mean NOx results for the more realistic operational assessment of a maximum of 12 engines for the Future Assessment are shown in Table 5.13. As the impacts at all but the Teesmouth and Cleveland Coast receptor were considered to be insignificant for the maximum 16 engine scenario, it therefore follows that the impacts would be insignificant for the 12 engine scenario, and therefore only the results at the Teesmouth and Cleveland Coast receptor are presented.

Again, the impacts occur over a very small area of the receptor site, with the concentration of NOx rapidly decreasing with distance from the Installation, which is demonstrated by the range of values provided for receptors E1 – E12. Also, it is not considered that the Critical Level is directly applicable to this location in any case and therefore the effects would be not significant.

**Table 5.13: Future Assessment NOx Annual Mean Ecological Receptor Results – 12 Engines**

| Receptor | CL (µg/m³) | PC (µg/m³) | PC / CL (%) | BC (µg/m³) | PEC (µg/m³) | PEC/CL (%) | Change in PC over the Baseline |
|---|---|---|---|---|---|---|---|
| E1 – E12 | 30 | 0.6 – 6.1 | 1.7 – 20.2% | 15.9 – 37.2 | 16.5 – 38.7 | 55% - 129% | + 1.5% - 17.7% |
| E13 | | 1.9 | 6.3% | 19.3 | 21.2 | 71% | + 3.5% |
| E30 | | 1.2 | 4.0% | 17.1 | 18.3 | 61% | + 3.1% |
| E31 | | 0.3 | 1.0% | 14.1 | 14.4 | 48% | + 0.6% |
| E32 | | 0.3 | 0.9% | 14.1 | 14.4 | 48% | + 0.6% |
| E33 | | 0.8 | 2.6% | 14.4 | 15.2 | 51% | + 1.2% |
| E34 | | 0.5 | 1.8% | 17.9 | 18.4 | 61% | + 1.0% |
| E35 | | 0.2 | 0.6% | 13.4 | 13.6 | 45% | + 0.4% |
| E36 | | 0.4 | 1.2% | 15.9 | 16.3 | 54% | + 0.8% |
| E37 | | 1.3 | 4.5% | 17.4 | 18.7 | 62% | + 2.5% |
| E38 | | 1.4 | 4.7% | 16.3 | 17.7 | 59% | + 2.5% |
| E39 | | 0.4 | 1.5% | 17.1 | 17.5 | 58% | + 1.0% |

| Receptor | CL (µg/m³) | PC (µg/m³) | PC / CL (%) | BC (µg/m³) | PEC (µg/m³) | PEC/CL (%) | Change in PC over the Baseline |
|---|---|---|---|---|---|---|---|
| E40 | | 1.1 | 3.6% | 17.5 | 18.6 | 62% | + 1.9% |

## NOx Daily Mean

Table 5.14 shows the worst-case daily mean NOx impacts at all receptors for the more realistic maximum 12 engine Future Assessment. Again, only the results at the Teesmouth and Cleveland Coast receptors are presented, given that the results at all other sites were insignificant for the 16 engine scenario.

Again, the area of the Teesmouth and Cleveland Coast directly adjacent to the site comprises an area of mudflats that are regularly inundated by the tide (receptors E1 to E13), and as such there is no vegetation present in this area. It is therefore considered that the daily Critical Level is not directly applicable to this location, but the results have been presented to demonstrate the reduction that would occur as a result of the fewer engines. Given that the maximum number of engines that will actually run concurrently is envisaged to be 10, the actual impacts would be less than presented in this assessment.

**Table 5.14: Future Assessment NOx 24-Hour Mean Ecological Receptor Results – 12 Engines**

| Receptor | CL (µg/m³) | PC (µg/m³) | PC / CL (%) | BC (µg/m³) | PEC (µg/m³) | PEC/CL (%) | Change in PC over the Baseline |
|---|---|---|---|---|---|---|---|
| E1 – E12 | 75 | 13.5 – 29.0 | 18.0% – 38.6% | 23.9 – 55.8 | 41.4 – 70.1 | 55% - 93% | + 0% - 24.4% |
| E13 | | 9.0 | 12.0% | 29.0 | 37.9 | 51% | + 5.4% |
| E30 | | 12.2 | 16.3% | 25.7 | 37.9 | 50% | + 9.3% |
| E31 | | 5.8 | 7.7% | 21.2 | 26.9 | 36% | + 4.1% |
| E32 | | 6.2 | 8.2% | 21.2 | 27.3 | 36% | + 4.9% |
| E33 | | 5.09 | 6.6% | 21.6 | 26.6 | 35% | + 2.9% |
| E34 | | 5.18 | 6.8% | 26.9 | 31.9 | 43% | + 3.0% |
| E35 | | 4.0 | 5.4% | 20.1 | 24.1 | 32% | + 2.7% |
| E36 | | 7.1 | 9.5% | 23.9 | 31.0 | 41% | + 5.3% |
| E37 | | 7.4 | 9.8% | 26.1 | 33.5 | 45% | + 4.4% |
| E38 | | 6.9 | 9.3% | 24.5 | 31.4 | 42% | + 4.3% |
| E39 | | 9.0 | 12.0% | 25.7 | 34.7 | 46% | + 7.0% |
| E40 | | 6.3 | 8.4% | 26.3 | 32.5 | 43% | + 4.1% |

## $SO_2$ Annual Mean

As the results for the 16 engine scenario were considered to be insignificant, the same would be true of the 12 engine scenario and therefore the results have not been presented.

## Nitrogen Deposition

As only the Teesmouth and Cleveland Coast receptor had impacts over the screening threshold for the 16 engines scenario, the impacts at this site only have been presented in Table 5.15.

For the 12 engine scenario, the impacts associated with the worst-case meteorological year at Receptors E11 are 0.8% of the Critical Load and therefore can be considered to be insignificant.

The impacts at Receptor E13 are reduced to 2.0% (or 1.1% using the Shifting coastal dunes Critical Load) and 1.1% at E40 of the relevant Critical Loads and therefore within the range of being considered numerically inconsequential or imperceptible in line with the IAQM Guidance.

It should also be noted that these results are based on the worst-case year of meteorological data, where it is recognised that depositional impacts occur over several years. It is therefore considered that it is more appropriate to consider these impacts over the average of the five years of meteorological data used in the model. When considering this, the increases at E13 and E40 are reduced to 1.5% (or 0.8% of the Shifting Coastal dunes Critical Load) and 0.9% respectively and therefore can be considered to be insignificant.

The available fuel gas volumes will decline over time, and therefore the number of engines needing to operate would reduce correspondingly. The maximum number of engines are therefore only likely to be operational for the first 4 years of operation of the E2P Power Island, with operational engines reducing rapidly after this time, as such the nitrogen deposition impacts will also reduce.

Further consideration on the potential for nitrogen deposition to impact the dunes habitat at E13 has been given following review on the SSSI citation which specifically details the main pressures on the dunes as are being recreational from footpaths and increasing cover of scrub/ trees. Although there is some dominance of nutrient loving species noted, the cause of this is not definitive and could be either due to nitrogen deposition or human disturbance – i.e. such species tend to colonise recently disturbed ground as well as nutrient rich soils. Evidence to suggest that the poor condition of the dunes it is not as a result of nitrogen deposition comes from the fact that there are also a number of species present that are associated with nutrient poor soils (e.g. abundant ragwort is present which settles on recently disturbed or open ground and thrives in nutrient poor sandy soils). Additionally, the low occurrence of creeping and spear thistle, which thrive in nutrient rich soils also suggests nitrogen deposition is not influencing the type of plant species present on the dunes.

It is therefore considered that the existing high levels of nitrogen deposition are unlikely to be impacting on the dunes significantly, and therefore the potential impact of the E2P Power Island's operation on the SSSI objectives is also likely to be minimal, especially considering the short duration of the peak impacts (4 years).

Finally, a consideration of how the E2P Power Island could affect the overall trend of nitrogen deposition at the E13 location has been carried out? and whether it could affect any potential decline in background deposition over time.

Figure 13 clearly showed that the background deposition fluctuates significantly, and that the linear nitrogen deposition was static, therefore it is very difficult to predict how the future deposition may actually reduce. That said, a graph has been produced to demonstrate what the downward trend of nitrogen deposition could be, assuming a best case of annual reduction of 0.03 kg N/ha/yr (based on the difference between the 3 year average from 2003 – 2005 and the 3 year average of 2019 – 2021 divided by 18 years (3 year averages are used in APIS to "smooth" out inter annual variations)) and what the impact of the E2P Power Island would be on this. Impacts from the E2P Power Island have taken into account the actual number of engines operational during the lifetime of the project.

**Figure 16: Projected Impact of the E2P Project on Nitrogen Deposition at the E13 Receptor**

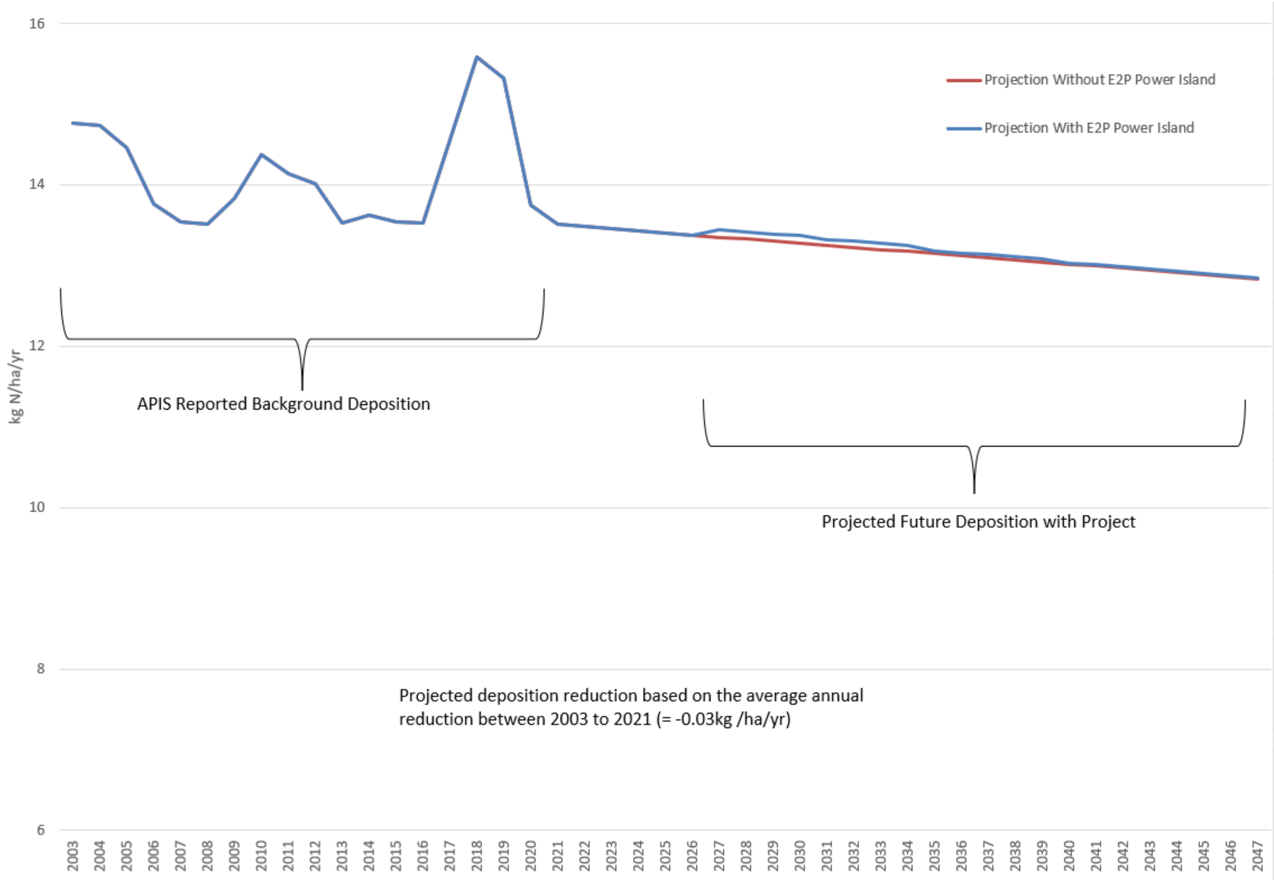



Figure 16 shows that the impacts associated with the E2P Power Island only veers very slightly from the best case downward protectory for the first 8 years of the project, when in excess of 8 engines may be operational concurrently. More importantly the graph also shows that even with the E2P Power Island, nitrogen deposition concentrations would never exceed the average nitrogen deposition reported in 2021 (last year of available data), as a result of the project alone. Additionally, it shows how minimal the impact of the project is compared to the natural inter annual variations as a result of meteorological conditions.

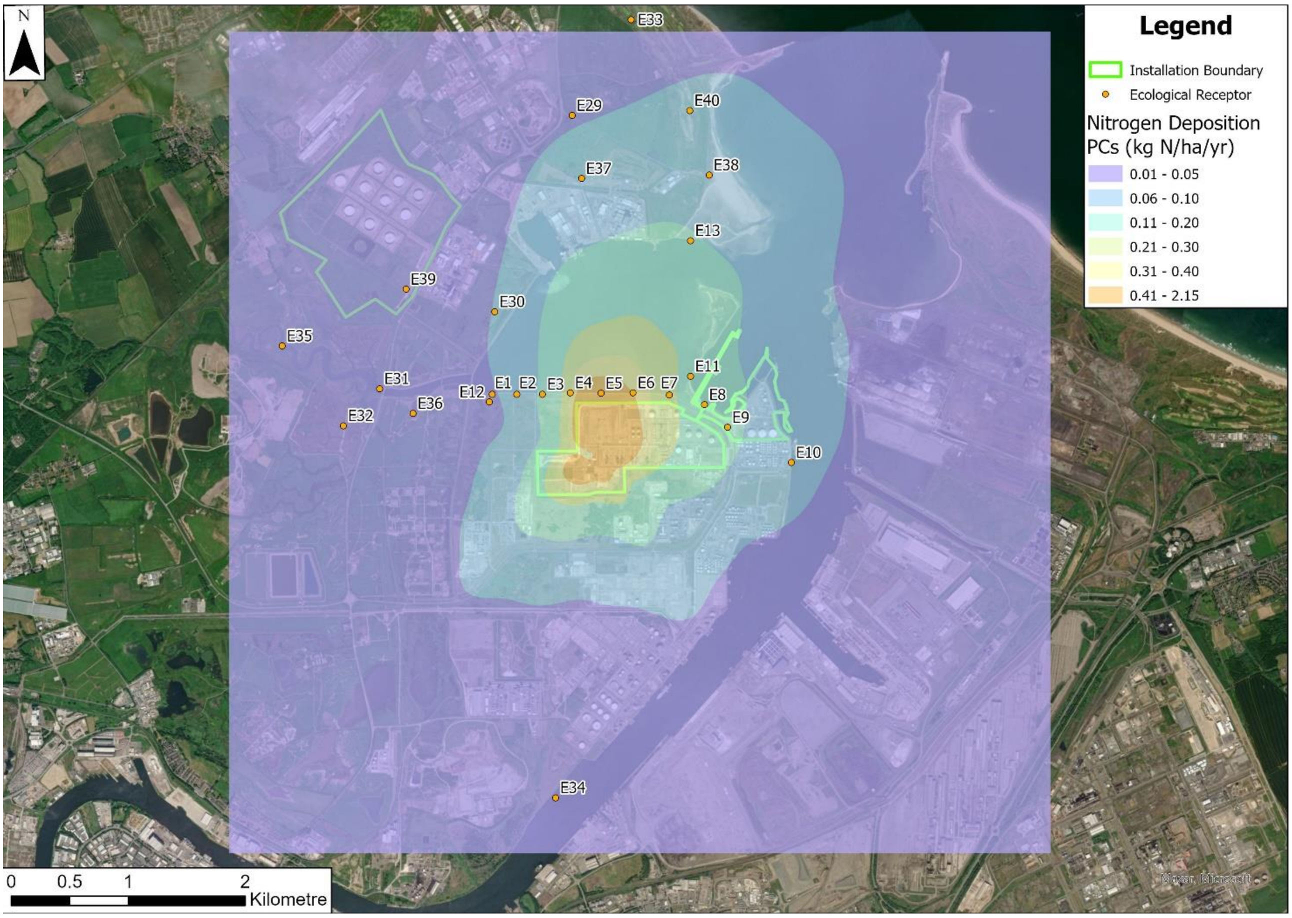
Considering the information available on the historic nitrogen deposition at the E11 and E13 and E40 receptors, that the PCs predicted as a result of the E2P Power Island are very small compared to the current background concentrations at the site, the uncertainty over the appropriate Critical Load range to apply and the uncertainty as to whether nitrogen deposition is actually impacting the SSSI, it is unlikely that the additional nitrogen deposition as a result of the operation of the gas engines will result in any discernible effects at the receptors, which have experienced significantly higher levels of nitrogen deposition in the past. It is therefore considered that the impacts of nitrogen deposition from the E2P Power Island are unlikely to result in a significant impact.

Figure 17 shows the predicted nitrogen deposition associated with the operation of 12 engines.

**Table 5.15: Future Assessment Nitrogen Deposition – 12 Engines**

| Receptor | Critical Load Class | Critical Load (kgN/ha/yr) | Background N dep (kgN/ha/yr) | Background N dep / Critical Load Min (kgN/ha/yr) | PC Annual Mean $NO_2$ (µg/m$^3$) | PC N Dry Dep (kgN/ha/yr) | PC/ Critical Load (%) | Total Dep Inc Background (kgN/ha/yr) | PEC/ Critical Load | Change in PC over the Baseline |
|---|---|---|---|---|---|---|---|---|---|---|
| E11 | Pioneer saltmarsh | 20 – 30 | 13.3 | 67% | 2.5 | 0.4 | 1.8% | 13.7 | 68% | + 0.8% |
| E13<br>Assessed as: | Coastal Shifting Dunes | 10 – 15 | 13.5 | 135% | 1.3 | 0.2 | 1.9% | 13.7 | 137% | + 1.1% |
| | Coastal dune grasslands (grey dunes) | 5 - 15 | | 270% | | | 3.7% | | 274% | + 2.0% |
| E40 | Moist and wet dune slacks | 5 - 15 | 13.5 | 270% | 0.8 | 0.1 | 2.2% | 13.6 | 272% | + 1.1% |

Figure 17: Future Assessment – Isopleths of Nitrogen Deposition PCs (kg N/ha/yr) – 12 Engines




## Acid Deposition

As the results for acid deposition for the 16 engine scenario were considered to be insignificant, especially given the dominance of the impacts of sulphur when $SO_2$ emissions have been modelled at 35mg/Nm$^3$, when actual emissions are anticipated to be very low, the same would be true of the 12 engine scenario and therefore the results have not been presented.

## 5.4 Future Assessment – Selective Catalytic Reduction

BAT 34 in the Refineries BATc details the applicable techniques for preventing or reducing NOx emissions from combustion units and includes secondary or end-of-pipe techniques, such as Selective Catalytic Reduction (SCR).

The gas engines can comply with a proposed emission limit of 95mg/Nm$^3$, which is towards the upper end of the Refineries BATc NOx emissions of 100mg/Nm$^3$ by primary techniques alone, however it is considered that NOx emissions could be reduced to <75mg/Nm$^3$ with the implementation of Selective Catalytic Reduction (SCR). This would reduce the potential for air quality impacts of $NO_2$, which may be particularly relevant where there are human health receptors that could be impacted by the emissions, or where $NO_2$ AQS objectives are close to being exceeded. The nearest human health receptors are >3km from the E2P Power Island however, and the assessment of the maximum number of 16 engines operating concurrently has shown that the impacts at human health receptors can be considered to be insignificant as a result of the operation of the E2P Power Island. It is therefore not considered that there is a particular human health driver to reduce the impacts from NOx emissions of the E2P Power Island.

The application of SCR, introduces an emission of ammonia ($NH_3$), caused by $NH_3$ slip, and this is an important consideration where sensitive habitat receptors are present, such as in the case of the Teesside Terminal. The impacts of nitrogen deposition caused by $NH_3$ are considerably greater than the depositional impacts from

NOx and therefore the reduction in NOx emissions achieved by SCR is countered by the additional nitrogen depositional impacts that result due to an emission of $NH_3$.

To support the case that SCR does not represent BAT for the E2P Power Island, the maximum 16 engine model has been rerun assuming that SCR was employed and an $NH_3$ slip emission of 5mg/Nm$^3$ has been assessed. An arbitrary corresponding reduction in the NOx emission of 50% has also been assumed for the assessment of nitrogen deposition.

Due to the high EALs for human health impacts and the distance to receptors, it is assumed that the impacts of $NH_3$ will be insignificant, however the results against the relevant $NH_3$ Critical Levels at ecological sites are presented in Table 5.16.

On the whole, the $NH_3$ impacts can be considered to be insignificant at the first level of screening, except for the impacts at the E1 – E13 Teesmouth and Cleveland Coast Receptors. However, as with the annual NOx impact discussion, it is considered that the Critical Level for the protection of vegetation is not applicable at this site.

**Table 5.16: Future Assessment $NH_3$ Annual Mean Ecological Receptor Results – 16 Engines with SCR**

| Receptor | CL (µg/m$^3$) | PC (µg/m$^3$) | PC / CL (%) | BC (µg/m$^3$) | PEC (µg/m$^3$) | PEC/CL (%) |
|---|---|---|---|---|---|---|
| E1 – E12 | 1 | 0.03 – 0.38 | 3% – 38% | 1.2 | 1.2 – 1.6 | 123% - 158% |
| E13 | 1 | 0.7 | 7% | 1.2 | 1.3 | 127% |
| E14 | 3 | 0.004 | 0.1% | 1.5 | 1.5 | 50% |
| E15 | 1 | 0.004 | 0.4% | 1.5 | 1.5 | 150% |
| E16 | 1 | 0.002 | 0.2% | 1.0 | 1.0 | 95% |
| E17 | No applicable Critical Level | | | | | |
| E18 | 1 | 0.003 | 0.3% | 1.63 | 1.6 | 163% |
| E19 | 3 | 0.003 | 0.1% | 1.64 | 1.6 | 55% |
| E20 | 3 | 0.003 | 0.1% | 1.41 | 1.4 | 47% |
| E21 | 3 | 0.002 | 0.1% | 1.06 | 1.1 | 35% |
| E22 | 3 | 0.001 | <0.1% | 1.91 | 1.9 | 64% |
| E23 | 3 | 0.001 | <0.1% | 2 | 2.0 | 67% |
| E24 | 1 | 0.001 | 0.1% | 1.5 | 1.5 | 150% |
| E25 | 3 | 0.002 | 0.1% | 1.38 | 1.4 | 46% |
| E26 | 1 | 0.002 | 0.2% | 1.4 | 1.4 | 140% |
| E27 | 3 | 0.001 | <0.1% | 1.54 | 1.5 | 51% |
| E28 | 3 | 0.001 | <0.1% | 1.6 | 1.6 | 53% |
| E29 | 3 | 0.04 | 1% | 1.2 | 1.2 | 41% |
| E30 | 3 | 0.06 | 2% | 1.2 | 1.3 | 42% |
| E31 | 3 | 0.01 | 0.4% | 1.2 | 1.2 | 41% |
| E32 | 3 | 0.01 | 0.4% | 1.2 | 1.2 | 41% |
| E33 | 3 | 0.02 | 1% | 1.2 | 1.2 | 41% |
| E34 | 3 | 0.02 | 1% | 1.2 | 1.2 | 41% |

| Receptor | CL (µg/m$^3$) | PC (µg/m$^3$) | PC / CL (%) | BC (µg/m$^3$) | PEC (µg/m$^3$) | PEC/CL (%) |
|---|---|---|---|---|---|---|
| E35 | 3 | 0.01 | 0.2% | 1.2 | 1.2 | 40% |
| E36 | 3 | 0.02 | 1% | 1.2 | 1.2 | 41% |
| E37 | 3 | 0.05 | 2% | 1.2 | 1.3 | 42% |
| E38 | 3 | 0.05 | 2% | 1.2 | 1.3 | 42% |
| E39 | 3 | 0.02 | 1% | 1.2 | 1.2 | 41% |
| E40 | 3 | 0.04 | 1% | 1.2 | 1.2 | 41% |

The impacts of nitrogen deposition would also be impacted by an additional emission of $NH_3$ and the impacts are shown in Table 5.17.

The increases in nitrogen deposition at the Teesmouth and Cleveland Coast increase significantly as a result of the additional $NH_3$ associated with the application of SCR, with a maximum increase of 5.2% over the non-SCR model results, and an overall increase of 8.0%% over the Baseline Assessment (based on the E13 results assessed against the 5 – 15 kg N/ha/yr Critical Load range). It is therefore considered that the benefits of a slight reduction in the NOx emissions would be outweighed by the additional emission of $NH_3$ associated with SCR and therefore it is not considered that SCR represents BAT for the E2P Power Island.

**Table 5.17: Future Assessment Nitrogen Deposition – 16 Engines with SCR**

| Receptor | Critical Load Class | Critical Load (kgN/ha/yr) | Background N dep (kgN/ha/yr) | Background N dep / Critical Load Min (kgN/ha/yr) | PC Annual Mean $NO_2$ (µg/m³) | PC N Dry Dep (kgN/ha/yr) | PC Annual Mean $NH_3$ (µg/m³) | PC N Dry Dep (kgN/ha/yr) | PC/ Critical Load (min) (%) | Total Dep Inc Background (kgN/ha/yr) | PEC/ Critical Load (min) | Change in PC over non SCR case |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| E1 | Atlantic upper-mid & mid-low salt marshes | 10 – 20 | 13.8 | 138% | 0.3 | 0.04 | 0.03 | 0.2 | 2.0% | 14.0 | 140% | + 1.2% |
| E11 | Pioneer saltmarsh | 20 – 30 | 13.3 | 67% | 1.5 | 0.2 | 0.1 | 0.6 | 4.00% | 14.1 | 70% | + 1.9% |
| E12 | Atlantic upper-mid & mid-low salt marshes | 10 – 20 | 13.8 | 138% | 0.3 | 0.04 | 0.03 | 0.2 | 1.9% | 14.0 | 140% | + 1.1% |
| E13 Assessed as: | Coastal shifting dunes | 10 – 20 | 13.5 | 135% | 0.8 | 0.1 | 0.07 | 0.4 | 4.9% | 14.0 | 140% | + 2.6% |
| | Coastal dune grasslands (grey dunes) calcareous | 5 – 15 | | 270% | | | | | 9.7% | | 280% | + 5.2% |
| E14 | Coastal dune grasslands (grey dunes) calcareous | 5 – 15 | 10.4 | 208% | 0.1 | 0.01 | 0.004 | 0.02 | 0.5% | 10.4 | 209% | + 0.1% |
| E15 | Coastal dune grasslands (grey dunes) calcareous | 5 – 15 | 11.6 | 232% | 0.1 | 0.01 | 0.004 | 0.02 | 0.5% | 11.6 | 233% | + 0.1% |
| E16 | Raised and blanket bogs | 5 - 10 | 15.8 | 316% | 0.03 | 0.004 | 0.002 | 0.01 | 0.3% | 15.8 | 316% | + 0.1% |

| Receptor | Critical Load Class | Critical Load (kgN/ha/yr) | Background N dep (kgN/ha/yr) | Background N dep / Critical Load Min (kgN/ha/yr) | PC Annual Mean $NO_2$ (µg/m$^3$) | PC N Dry Dep (kgN/ha/yr) | PC Annual Mean $NH_3$ (µg/m$^3$) | PC N Dry Dep (kgN/ha/yr) | PC/ Critical Load (min) (%) | Total Dep Inc Background (kgN/ha/yr) | PEC/ Critical Load (min) | Change in PC over non SCR case |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| E17 | No Critical loads assigned | | | | | | | | | | | |
| E18 | Raised and blanket bogs | 5 - 10 | 14.8 | 296% | 0.04 | 0.01 | 0.003 | 0.02 | 0.4% | 14.8 | 296% | + 0.2% |
| E19 | No Critical loads assigned | | | | | | | | | | | |
| E20 | No Critical loads assigned | | | | | | | | | | | |
| E21 | Carpinus and Quercus mesic deciduous forest | 15 - 20 | 22.1 | 147% | 0.03 | 0.01 | 0.002 | 0.01 | 0.1% | 22.1 | 147% | + <0.1% |
| E22 | Low and medium altitude hay meadows | 10 – 20 | 16.1 | 161% | 0.02 | 0.002 | 0.001 | 0.01 | 0.1% | 16.1 | 161% | + 0.1% |
| E23 | Low and medium altitude hay meadows | 10 - 20 | 16.2 | 162% | 0.02 | 0.002 | 0.001 | 0.01 | 0.1% | 16.2 | 162% | + <0.1% |
| E24 | Valley mires, poor fens and transition mires | 5 - 15 | 15.7 | 314% | 0.02 | 0.003 | 0.001 | 0.01 | 0.2% | 15.7 | 314% | + <0.1% |
| E25 | No Critical loads assigned | | | | | | | | | | | |
| E26 | Rich fens | 15 - 25 | 14.7 | 98% | 0.03 | 0.005 | 0.002 | 0.01 | 0.1% | 14.7 | 98% | + <0.1% |
| E27 | Low and medium | 10 -20 | 15.5 | 155% | 0.01 | 0.002 | 0.001 | 0.004 | 0.1% | 15.5 | 155% | + <0.1% |

| Receptor | Critical Load Class | Critical Load (kgN/ha/yr) | Background N dep (kgN/ha/yr) | Background N dep / Critical Load Min (kgN/ha/yr) | PC Annual Mean $NO_2$ (µg/m$^3$) | PC N Dry Dep (kgN/ha/yr) | PC Annual Mean $NH_3$ (µg/m$^3$) | PC N Dry Dep (kgN/ha/yr) | PC/ Critical Load (min) (%) | Total Dep Inc Background (kgN/ha/yr) | PEC/ Critical Load (min) | Change in PC over non SCR case |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | altitude hay meadow | | | | | | | | | | | |
| E28 | Semi-dry Perennial calcareous grassland (basic meadow steppe) | 10 - 15 | 15.6 | 156% | 0.01 | 0.001 | 0.001 | 0.003 | 0.0% | 15.6 | 156% | + <0.1% |
| E29 | No Critical loads assigned | | | | | | | | | | | |
| E30 | No designated features at this location. | | | | | | | | | | | |
| E31 | Atlantic upper-mid & mid-low salt marshes | 10 – 20 | 14.0 | 140% | 0.1 | 0.02 | 0.01 | 0.1 | 0.8% | 14.1 | 141% | + 0.5% |
| E32 | No designated features at this location. | | | | | | | | | | | |
| E33 | Moist and wet dune slacks | 5 - 15 | 13.7 | 274% | 0.3 | 0.05 | 0.03 | 0.1 | 3.5% | 13.9 | 278% | + 1.7% |
| E34 | No designated features at this location. | | | | | | | | | | | |
| E35 | Atlantic upper-mid & mid-low salt marshes | 10 – 20 | 14.0 | 140% | 0.1 | 0.01 | 0.01 | 0.04 | 0.5% | 14.0 | 140% | + 0.3% |
| E36 | Atlantic upper-mid & | 10 – 20 | 13.8 | 138% | 0.2 | 0.02 | 0.02 | 0.1 | 1.1% | 13.9 | 139% | + 0.6% |

| Receptor | Critical Load Class | Critical Load (kgN/ha/yr) | Background N dep (kgN/ha/yr) | Background N dep / Critical Load Min (kgN/ha/yr) | PC Annual Mean $NO_2$ (µg/m$^3$) | PC N Dry Dep (kgN/ha/yr) | PC Annual Mean $NH_3$ (µg/m$^3$) | PC N Dry Dep (kgN/ha/yr) | PC/ Critical Load (min) (%) | Total Dep Inc Background (kgN/ha/yr) | PEC/ Critical Load (min) | Change in PC over non SCR case |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | mid-low salt marshes | | | | | | | | | | | |
| E37 | Low and medium altitude hay meadow | 10 - 20 | 13.9 | 139% | 0.6 | 0.08 | 0.05 | 0.3 | 3.4% | 14.2 | 142% | + 1.8% |
| E38 | No designated features at this location. | | | | | | | | | | | |
| E39 | Low and medium altitude hay meadow | 10 -20 | 13.9 | 139% | 0.2 | 0.03 | 0.02 | 0.1 | 1.4% | 14.0 | 140% | + 0.9% |
| E40 | Moist and wet dune slacks | 5 - 15 | 13.5 | 270% | 0.4 | 0.06 | 0.04 | 0.2 | 5.3% | 13.8 | 275% | + 2.8% |

# 6. Cumulative Impacts

## 6.1 Introduction

Existing sources of pollution in the area are accounted for in the adoption of site-specific background pollutant concentrations, as detailed in Section 4.

It is recognised, however, that there is a potential impact on local air quality from emission sources which have either received or are about to receive planning permission but have yet to come into operation. A review of Proposed Developments that have the potential to have cumulative impacts (i.e. those with combustion emissions) within the vicinity of the E2P Power Island has been carried out and includes:

- The Tees Combined Cycle Power Plant, EN010082 (approximately 5km southeast);
- Net Zero Teesside, EN010103 (approximately 4.5km east);
- Peak Resources Ltd, R/2017/0876/FFM (approximately 5km southeast);
- CBRE anaerobic biogas production facility and combined heat and power plant, R/2016/0484/FFM (approximately 5km southeast);
- Grangetown energy recovery facility (ERF), R/2019/0767/OOM (approximately 4km southeast);
- Tourian Renewables, R/2019/0031/FFM (approximately 5km southeast);
- Redcar Energy Centre (REC), R/2020/0411/FFM (approximately 3km northeast);
- O2N Energy (materials recycling facility and production of energy from waste), 13/2892/EIS (approximately 5km southwest);
- Green Lithium Refining, R/2023/0291/ESM (approximately 3.5km southeast);
- Teesside Green Energy Park, 22/1525/EIS (approximately <1km southeast);
- Greenergy Renewable Fuels and Circular Products Facility, 23/1019/EIS (approximately <1km south);
- Greenergy Biofuels Teesside Carbon Capture and Storage and Utilisation plant, 24/0709/FUL – (approximately <1km south); and
- H2 Teesside EN070009 (approximately 4km east).

The majority of these schemes are >4km from the E2P Power Island and a large number are located to the northeast, east and southeast. Given that the prevailing wind direction is from the southwest, it is considered that the potential for cumulative impacts from these developments are minimal, especially considering the demonstrable low impacts from the E2P Power Island at the majority of human health and ecological receptors, with the exception of the closest ecological sites comprising saltmarsh and dune habitats within the Teesmouth and Cleveland Coast SPA, Ramsar and SSSI (i.e. E11, E13 and E40).

This assumption can be demonstrated by reviewing Figure 8-12 of the H2 Teesside DCO[17], as an example, which shows that the maximum nitrogen deposition impacts from that project occur at Coatham Dunes, directly to the north of the site, and at receptors E11 and E13 for the E2P Power Island, the impacts are less than 0.1% of the 10kg/N ha/yr Critical Load applied.

[17] EN070009-001345-H2T DCO 6.3.26b Figure 8-12 Nitrogen Deposition from Process Contribution Ph1 and 2.pdf

Given their close proximity and direction from the E2P Power Island, the developments that have the most potential therefore to result in cumulative impacts are considered to be:

- Greenergy Renewable Fuels and Circular Products Facility, 23/1019/EIS; and
- Greenergy Biofuels Teesside Carbon Capture and Storage and Utilisation plant, 24/0709/FUL.

The Air Quality Impact assessments that were carried out for the planning applications for these two Proposed Developments have been reviewed and the predicted impacts are summarised for each in turn in the following sections.

## 6.2 Predicted Impacts Associated with Greenergy Renewable Fuels and Circular Products Facility[18]

### 6.2.1 Human Health Receptors

The maximum annual average $NO_2$ PC at any receptor was 0.13µg/m$^3$, or 0.3% of the relevant AQS and therefore insignificant. The maximum hourly average $NO_2$ PC at any receptor was 2.1µg/m$^3$, or 1% of the relevant AQS and therefore also insignificant.

The CO impacts were <1% of the 8-hour rolling mean AQS, as were the $SO_2$ impacts for all averaging periods and therefore CO and $SO_2$ impacts can be considered to be insignificant.

It is therefore considered that there is no potential for cumulative impacts from Greenergy Renewable Fuels and Circular Products Facility with the E2P Power Island for $NO_2$, CO or $SO_2$ at human health receptors.

### 6.2.2 Ecological Receptors

The maximum annual average $NO_x$ concentration within the Teesmouth and Cleaveland Coast SPA, Ramsar and SSSI for the Greenergy Renewable Fuels and Circular Products Facility was 1.4µg/m$^3$ or 4.7% of the Critical Level. This concentration was predicted to occur at their ER3, which corresponds to Receptor E3 in the E2P Power Island assessment. Together with the contribution from the E2P Power Island of 2.1µg/m$^3$ at this location (predicted for the realistic worst-case operating case of 12 engines), the PEC would be 21.4µg/m$^3$ or 71% of the Critical Level. Given that the Critical Level is not considered to be relevant to this location, the cumulative impacts are considered not to be significant.

The maximum daily average $NO_x$ concentration for the Greenergy Renewable Fuels and Circular Products Facility within the Teesmouth and Cleaveland Coast SPA, Ramsar and SSSI was 15.6µg/m$^3$ or 7.8% of the daily Critical Level. This concentration was predicted to occur at ER2, which does not have a corresponding receptor for the E2P Power Island Assessment. At ER3 (the next highest receptor) the PC was 7.3µg/m$^3$ or 3.6%, and together with the 20.1µg/m$^3$ contribution from the E2P Power Island at the corresponding E3 location (predicted for the realistic worst-case operating case of 12 engines), the PEC would be 52.9µg/m$^3$ or 71% of the Critical Level. Given that the Critical Level is not considered to be relevant to this location, the cumulative impacts are considered not to be significant.

The predicted $SO_2$ impacts for the Greenergy Renewable Fuels and Circular Products Facility at all receptors are less than 1% of the Critical Level, and therefore in-combination with the impacts of the E2P Power Island, the highest PEC would still represent only 26% of the Critical Level and therefore would not be significant.

Figures A10.1.18 and A10.1.19 of the Greenergy Renewable Fuels and Circular Products Facility Air Quality Assessment show that the Nitrogen Deposition impacts are <1% of the relevant Critical Loads at the saltmarsh and sand dune habitat location respectively. Receptor ER4 corresponds to E2P Power Island Receptor E11 (i.e. saltmarsh) and the impacts are reportedly 1% of the Critical Load, whereas Receptor ER10 corresponds to E2P Power Island Receptor E13 (i.e. dunes), and the impacts are reportedly 0.9% of the Critical Load. It should be noted that the Critical Load used in the Greenergy Renewable Fuels and Circular Products Facility assessment were 10kg N/ha/yr for receptor ER4 and 8kg N/ha/yr for receptor ER10, whereas for the E2P Power Island

[18] 23_1019_EIS-APPENDIX_10.1_-_AIR_QUALITY_EMISSIONS_ASSESSMENT_FINAL-2450276.pdf

assessment, the use of higher Critical Loads has been justified for the saltmarsh habitat and potentially for the dune habitat locations. With this in mind, the impacts predicted in the Greenergy Renewable Fuels and Circular Products Facility assessment would be lower (i.e. 0.5% at E11 and 0.7% at E13).

The Acid Deposition for the Greenergy Renewable Fuels and Circular Products Facility assessment was reportedly <1% at all receptors assessed.

## 6.3 Predicted Impacts Associated with Greenergy Biofuels Teesside Carbon Capture and Storage and Utilisation plant[19]

The Greenergy Biofuels Teesside Carbon Capture and Storage and Utilisation plant comprises the addition of a carbon capture plant on the already operational biodiesel plant, and therefore the emissions of NOx assessed from the plant do not represent a new emission source, however the changed emission parameters (mainly a reduction in the emission temperature and efflux velocity) of the release from the carbon capture plant, may change the predicted impacts.

### 6.3.1 Human Health Receptors

The increase in the maximum annual average $NO_2$ PC from the Greenergy Biofuels Teesside Carbon Capture and Storage and Utilisation plant at any receptor was 0.01µg/m$^3$, or 0.01% of the relevant AQAL and therefore insignificant. The increase in the maximum hourly average $NO_2$ PC at any receptor was 0.24µg/m$^3$, or 1% of the relevant AQAL and therefore insignificant.

It is therefore considered that there is no potential for in-combination impacts of $NO_2$ at human health receptors with Greenergy Biofuels Teesside Carbon Capture and Storage and Utilisation plant.

### 6.3.2 Ecological Receptors

The maximum annual average $NO_x$ concentration from the Greenergy Biofuels Teesside Carbon Capture and Storage and Utilisation plant within the Teesmouth and Cleaveland Coast SPA, Ramsar and SSSI was 0.2µg/m$^3$ or 0.4% of the Critical Level, however it is not possible to determine where this occurs for receptor comparison. That said, together with the contribution from the E2P Power Island at any location within the receptor, this level of impact would have a minimal effect on the overall PEC and given that the Critical Level is not considered to be relevant to this location, the cumulative impacts are considered not to be significant.

The maximum daily average $NO_x$ concentration within the Teesmouth and Cleaveland Coast SPA, Ramsar and SSSI was 2.6µg/m$^3$ or 3.5% of the daily Critical Level. Again, it is not clear where this impact occurs, however together with the contribution from the E2P Power Island at all locations, the PEC remains within the Critical Level. Given that the Critical Level is not considered to be relevant to this location, the cumulative impacts are considered not to be significant.

The increase in Nitrogen Deposition impacts of the Greenergy Biofuels Teesside Carbon Capture and Storage and Utilisation plant are <1% of the relevant Critical Loads at the saltmarsh and sand dune habitat respectively. It should be noted that the lower Critical Loads used in the Greenergy assessment were 10kg N/ha/yr for receptor saltmarsh and 5kg N/ha/yr for dune habitats, whereas the E2P Power Island assessment justifies the use of higher lower Critical Loads for the saltmarsh and potentially the dune habitat type. The impacts predicted in the Greenergy Biofuels Teesside Carbon Capture and Storage and Utilisation plant assessment would therefore be lower.

No assessment of Acid Deposition was carried out in the Greenergy Biofuels Teesside Carbon Capture and Storage and Utilisation plant, however it is likely that the increase as a result of the change in the emission parameters would be significantly less than 1%.

[19] Document Title

## 6.4 Summary

Whilst the cumulative impacts of the two identified schemes have been detailed above, it should be noted that there is limited understanding of the timescales for the two schemes. Whereas, due to the requirement to find an alternative for the ConocoPhillips fuel gas from 2027, the timescales for the operation of the E2P Power Island are relatively certain by comparison.

The Greenergy Renewable Fuels and Circular Products Facility was planned to start construction in 2025 and be operational by 2027, however construction has not yet commenced, and therefore it is unlikely that operation would commence in 2027.

In terms of the Greenergy Biofuels Carbon Capture Storage and Utilisation scheme, this would not be developed until a carbon gathering network is available to feed into, and therefore it is likely that if this scheme was to proceed, then it would not be operational until 2030 at the earliest, and therefore would only coincide with limited years of the peak operation of the E2P Power Island.

# 7. Conclusions

Dispersion modelling of indicative emissions from the maximum number of engines that could be installed for the E2P Power Island has been carried out and indicates that there is unlikely to be any exceedance of AQS or EALs at identified human health receptors.

Ecological receptors were also considered in detail due to the close proximity of several important designations. The EA two-step screening criteria were used to determine if the impacts could be considered insignificant. The annual and daily mean NOx concentrations at most receptors are considered to be insignificant, although, there were several receptors for each averaging period that could not be immediately screened out. However, there were no exceedances of the relevant Critical Levels for either averaging period. Following discussions with the project Ecologist, it was determined that the affected receptors were mudflats or coastal and floodplain grazing marsh, both of which are not known to be sensitive to NOx.

Furthermore, Critical Levels are defined for the protection of vegetation, and since mudflats undergo regular tidal inundation, no vegetation is present. It is therefore considered that the NOx Critical Levels are not directly applicable to these locations. Given that the predicted concentrations were all below the respective Critical Levels, the professional judgement of the project Ecologist and air quality consultants has concluded that the overall effect on ecological receptors would be not significant.

Ecological receptors were also assessed against the annual mean $SO_2$ Critical Level. Neither of the EA screening criteria were exceeded and nor was the Critical Level. The impacts for all assessed ecological receptors for annual mean $SO_2$ can be considered as insignificant in line with the EA guidance.

The nutrient nitrogen deposition impacts were insignificant at all but 3 of the ecological habitats locations for the 16 engine scenario, however when modelling the more realistic worst case operational scenario of 12 engines and considering average impacts over 5 years of meteorological data rather than the maximum year of impact, the impacts were <1% of the Critical Load for all but one receptor (E13).

Due to the high background concentrations, and the historic trends of nitrogen deposition at the receptor sites, it is considered that the very small proportion of additional nitrogen deposition that would result from the operation of the E2P Power Island would not have a significant effect on the relevant habitats.

In addition, the acid deposition impacts were insignificant at all habitat locations, when considering that the $SO_2$ emissions from the E2P Power Island are likely to be significantly lower than the $35mg/Nm^3$ applied in the assessment.

The assessment carried out assumes the maximum number of engines that could be installed for the E2P power Island are operational, however a number of engines (4) will be installed for redundancy purposes and therefore will not be operational. It is therefore considered that the impact assessment is very conservative.

Additionally, the available fuel gas volumes will decline over time, and therefore the number of engines needing to operate would reduce correspondingly, such that the number of engines operational remains appropriate for the available fuel gas volume. The maximum number of engines are therefore only likely to be operational for the first 4 years of operation of the E2P Power Island, with operational engines reducing rapidly after this time, such that the result impacts will also reduce.

# Appendix A - Model Sensitivity

The maximum predicted concentrations of $NO_2$ off-site and NOx at the worst-affected statutory designated ecological receptor (E5) associated with the variable input parameters, are presented in Table A1 as the percentage of maximum reported values in the main assessment for the Future Assessment (16 engines).

**Table A1: Dispersion Model Sensitivity Analysis – Future Assessment**

| Model Input Variable | Human Health Receptor | | Ecological Receptor | |
|---|---|---|---|---|
| | Short-term | Long-term | Short-term | Long-term |
| **Result Presented in Main Assessment (µg/m$^3$)** | **24.0** | **5.5** | **38.3** | **7.9** |
| Meteorological data (5-year min-max) | 94% | 82% | 80% | 82% |
| Surface roughness representation (0.5m) | 92% | 84% | 93% | 100% |
| Surface roughness representation (0.1m) | 107% | 82% | 112% | 97% |

The main uncertainty associated with the model is considered to be the meteorological data, with the meteorological year with the lowest results predicting a $NO_2$ process contribution that represents 82% of that presented in the main assessment for the annual mean $NO_2$ results; this is equivalent to an overall uncertainty of -1.0 µg/m$^3$ (or -2.5% of the relevant AQAL).

The hourly mean $NO_2$ process contribution for the meteorological year with the lowest results predicted a PC of 94% of that presented in the main assessment, equivalent to an overall uncertainty at the worst-affected receptor of -1.4 µg/m$^3$ (or $< -1\%$ of the relevant AQAL).

The surface roughness representation in the main model has been assessed at 0.3m, representative of the maximum surface roughness for agricultural land, and is considered to be the most appropriate surface roughness to represent the Installation site.

The surface roughness has been varied and it was found that a lower surface roughness (0.1m, representative of root crops), resulted in higher short term impacts, but lower long term impacts at the worst-case receptor for the Installation.

The higher surface roughness of 0.5m (representative of parkland, open suburbia) resulted in generally lower impacts.