CRESTWOOD ENVIRONMENTAL LTD

www.crestwoodenvironmental.co.uk

Tel: 01902 229 563

TRITON POWER

Permit Variation Application Report

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Produced by Crestwood Environmental Ltd.

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Crestwood Environmental Limited

Registered Office:
Science, Technology and Prototyping Centre, UoWSP, Glaisher Drive, Wolverhampton, WV10 9RU, UK

Company Reg. no. 06544898
(Registered in England & Wales)

Tel: +44 (0)1902 229 563

Email: info@crestwoodenvironmental.co.uk

Web: www.crestwoodenvironmental.co.uk

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1 INTRODUCTION

1.1 Confidentiality

1.1.1 The contents of this application (in particular Section 4 and the Cost-Benefit Analysis (CBA) in Appendix 2) contain commercially sensitive information. It is requested that this application is treated as commercially confidential and not placed on the public register.

1.2 Background

1.2.1 Crestwood Environmental Ltd ('Crestwood'), were commissioned by Saltend Cogeneration Company Limited (**the Operator**) (trading as Triton Power) to prepare and submit an application to vary their Environmental Permit.

1.2.2 The Operator operates a power station at Saltend Power Station, Saltend Chemicals Park, Hedon Road, Hull, HU12 8GA (**the Site**).

1.2.3 The Site is operated in accordance with Environmental Permit reference EPR/QP3539LE (**the Permit**).

1.2.4 A recent variation of the Permit (EPR/QP3539LE/V010) was issued in February 2024 to remove a boiler which is not in operation and increase the operating hours of a back-up boiler.

1.3 Variation purpose

1.3.1 The purpose of this permit variation application is to seek a temporary increase to the Site's annual average Emission Limit Value (ELV) for oxides of nitrogen (NOx) to match the daily and monthly ELVs of 50mg/m3 until such time as the Site can be upgraded to reduce the overall NOx emissions to meet the annual average ELV.

1.3.2 Part C3, Table 1a of the variation application requires a list of the activities being varied. This is produced below in Table 1.

Table 1 List of activities being varied

Name	Installation Schedule 1 ref	Description of installation activity	Description of activity change	Proposed changes reference document
Saltend Power Station	Section 1.1, A(1)(a)	Gas turbine(s)	Temporary (3.5 year) increase of annual average NOx limit to 50mg/m3	CE-SE-2319-RP02

1.4 Pre-application advice

1.4.1 Pre-application discussions were undertaken between the Operator and the Environment Agency (reference EPR/QP3539LE/V010).

1.4.2 The pre-application advice covered a number of proposals including the increase in operating hours of LCP298, however this application relates to the items in Section 1.3.1 of the pre-application advice only.

1.4.3 The pre-application advice relating to this application is summarised in 1.4.3 below.

Table 2 Pre-application advice

	Pre-app discussion point	Environment Agency advice
1	Temporarily increase the annual average Emission Limit Value (ELV) for oxides of	A derogation request can be included within the overall variation application which will be a substantial variation. The operator can request a derogation with specified time limits, e.g.: if improvements need to be carried out during a major plan maintenance shutdown, or if plant id due to

	Pre-app discussion point	Environment Agency advice
	nitrogen (NOx) to match the daily and monthly ELVs of 50mg/m3 until the plant can be upgraded to reduce overall emissions NOx derogation	close in a few years' time. Article 15(4) IED allows for derogation, and it is noted that this only applies where it needed because of technical characteristic which would lead to a disproportionate high cost to the operator should it not be granted. Therefore, the operator must provide robust evidence to show this. A cost-benefit analysis covering different scenarios is one of the documents needed for this. If the Environment Agency accepts the justifications meet the criteria for a technical characteristic and disproportionate cost, then the process moves on to assessing environmental impact of such a derogation. Here, the operator must show that if a derogation were to be agreed, it will not have a detrimental impact on the environment. It must be noted that the environmental assessment side of the derogation process will not happen if we do not agree with that the operator has met the technical characteristic and disproportionate cost bar first. The Environment Agency asked whether the operator could make a smaller nomination to the grid to achieve the annual NOx limit, and the operator responded that they have other contractual obligations to provide heat and steam to other customers so this is not an option. This information should be included in any such derogation application. DEFRA Part A guidance (s4.37-s4.47) provides some examples of the types of technical characteristics which could potentially be considered during a derogation assessment, such as: • The recent history of pollution control investment in the installation in respect of the pollutant(s) for which the derogation is sought; • The general investment cycle for a particular type of installation; • The configuration of the plant on the site, making it more technically difficult and costly to comply; • The practicability (particularly bearing in mind Health and Safety and other relevant legal obligations) of interrupting the activity so as to install improved emission control upon the pollutant(s); • The effect of reducing the excess emission(s) upon other pollutant emissions, the energy efficiency, water use or waste arisings from the installation as a whole; and • The intended remaining operational lifetime of the installation as a whole or of the part of it giving rise to the emission of the pollutant(s), where the operator is prepared to commit to a timetable for closure. Other examples are: • The installation is part of a large integrated facility and compliance with the BAT-AEL would involve additional modifications to other parts of the facility; • Delaying the improvements to achieve the BAT-AEL until the installation has its next major shut down for routine maintenance e.g. a blast furnace relining or an oil refinery turnaround; • Not carrying out the improvements to achieve compliance with the BAT-AEL because the installation will close down before the next BREF review.

1.4.4 Pre-application advice (1.4.3) obtained from the Environment Agency outlined the need to complete a Cost-Benefit Analysis (CBA). A CBA has been prepared and is presented in see Appendix 2.

1.4.5 The tool models the following three scenarios:

- Business As Usual (BAU) scenario – combined inefficient and prolonged running of the turbines to achieve the existing annual average NOx limit of 40mg/m3.
- Proposed derogation scenario – demonstrating the additional costs and emissions (or savings/ avoidance of emissions) if the annual average NOx limit can be increased from 40mg/m3 to 50mg/m3.
- BAT-AEL scenario – demonstrating the additional costs to be incurred over the BAU scenario to achieve the existing annual average NOX limit.

1.4.6 The output of the tool shows that for the anticipated 3.5 years that the BAT-AEL may be required to be complied with, costs total a disproportionate 39,000,000 million pounds.

1.4.7 Following the modelling referenced above using the CBA tool, an Air Quality Risk Assessment was prepared to concluding "…*that the impact of increasing the NOx ELV does* <u>*not*</u> *amount to significant pollution…*", should the limit be temporarily increased.

1.4.8 There is no proposed change to the monitoring requirements of the Site.

1.5 Application information

1.5.1 The pre-application advice stated that the variation in full (comprising 7 items in total) would constitute a substantial variation. As this application relates only to one of those seven items for which the pre-application advice was sought however, it is considered that this variation application comprises a **minor technical variation**.

1.5.2 Generic pre-application advice for Combustion activities stated that:

"Where there are distinct activities such as separate Large Combustion Plants (LCP) then they should be treated as separate "application activities" with regards to the charging scheme. If there are multiple activities the applicant pays the full fee for the first activity, the fee then reduces by 90% for subsequent activities which fall in the same activity description in the table.

Examples of multiple activities on an Installation: There is more than one large combustion plant (LCP) on site. These will each be counted as an activity e.g. if you have 3 open cycle gas turbines on a site each >50MWth they will be charged 100% of the fee for the first, 10% for the second and 10% for the third."

1.5.3 It is considered that as the variation applies to a change in the annual average limit for the aggregated combustion activities, the variation charge would be a singular charge. Consequently, the application fee for a **minor technical variation** (£5,731) and the habitats assessment fee (£779) totalling **£6,510**, has been processed under Payment reference **PSCAPPSALTE002 on the 06/06/24**.

1.5.4 This application report is accompanied by the relevant application forms, Part A, Part C2, Part C3, and Part F1.

1.5.5 In accordance with Part C2, question 3d, a summary of the Site's EMS is requested. The EMS summary is enclosed as Appendix 1.

1.5.6 The Site operates in accordance with a written EMS which is accredited to ISO 14001 and which has been considered as part of the original permit application. There will be minimal change to the existing EMS. The Management of Change procedure within the existing EMS will be implemented following the Permit variation to reflect the change. Anticipated procedures which will be updated will include the monitoring procedure, Site and equipment maintenance, Contingency plan, Action on receipt of NOx or CO alarms.

1.5.7 Part C2, questions 6 – the environmental risk associated with the proposed emission limits change is considered in Appendix 3 – Air Quality Assessment**Error! Reference source not found.**.

1.5.8 Part C3 Section 6 requires consideration of resource, efficiency and climate change.

- 6a Describe the basic measures for improving how energy efficient your activities are
  - A: The Operator complies with BAT in relation to energy efficiency in so far as is possible. This application serves to request an abatement so that the site may be operated more efficiently, more of the time.
- 6b Provide a breakdown of any changes to the energy your activities use up and create
  - A: The workings shown in Section 4 (Technical considerations) serve to highlight the opportunities to operate the site's turbines in a more energy efficient manner.
- 6d Explain and justify the raw and other materials, other substances and water that you will use
  - A: There is no overarching change to the raw materials used within the site. The Operator seeks to reduce the energy input to the site to improve efficiency.

2 Non-Technical Summary

2.1.1 In order to deliver the contractually-obligated steam demands of the Saltend Chemicals Park, the Operator is having to run the gas turbines in an inefficient manner and for longer periods (or times which they would otherwise be off) to meet the annual average NOx limit of 40mg/m3. This has a threefold impact:

- The financial cost of longer and sub-optimal operation poses a significant and direct business cost
- The impact of longer run-times means greater overall emissions than are necessary for the day to day operations of the Site outwith the requirement to meet the annual average ELV
- The Operator is required to operate the turbines in an energy inefficient manner for longer periods than necessary for the Site outwith the requirement to meet the annual average ELV.

2.1.2 More detail is provided in Section 4 – Technical considerations.

2.1.3 A Cost-Benefit Analysis associated with increasing the annual average NOx emission limit for the Site have been considered in the CBA, (Appendix 2). The CBA concluded that meeting the required standards would present an undue financial burden on the Operator.

2.1.4 Subsequently, the potential impact of the increased NOx concentrations was assessed in an Air Quality Assessment, see Appendix 3.

3 Proposed change

3.1 Purpose

3.1.1 The reader is referred to sections 1.3 and 1.4 of this Report above. As stated therein, the Site will continue to comply with their existing daily and monthly NOx limits. For reference, these are set out in 3.1.1 below, including a comparison of current limits as against the limits proposed to be applied with the variation sought.

Table 3 NOx limits – Current and proposed

LCP-298 – Start-up Boiler							
Emission Point ref.	**Parameter**	**Source**	**Current Limit**	**Proposed limit**	**Reference period**	**Monitoring frequency**	**Monitoring standard or method**
A1, A2, A3	Oxides of nitrogen (NO and NO2 expressed as NO2)	LCP 300, LCP 301, LCP 302 gas turbine fired on natural gas	40 mg/m3 When DLN is effective to baseload	**50 mg/m3 When DLN is effective to baseload**	Yearly average	Continuous	BS EN 14181
A1, A2, A3	Oxides of nitrogen (NO and NO2 expressed as NO2)	LCP 300, LCP 301, LCP 302 gas turbine fired on natural gas	50 mg/m3 When DLN is effective to baseload	**No change**	Monthly mean of validated hourly averages	Continuous	BS EN 14181
A1, A2, A3	Oxides of nitrogen (NO and NO2 expressed as NO2)	LCP 300, LCP 301, LCP 302 gas turbine fired on natural gas	50 mg/m3 When DLN is effective to baseload 50 mg/m3 MSUL/MSDL to base load	**No change**	Daily mean of validated hourly averages	Continuous	BS EN 14181
A1, A2, A3	Oxides of nitrogen (NO and NO2 expressed as NO2)	LCP 300, LCP 301, LCP 302 gas turbine fired on natural gas	60 mg/m3 When DLN is effective to baseload	**No change**	95% of validated hourly averages within a calendar year	Continuous	BS EN 14181

3.2 Derogation rationale

3.2.1 Article 15(3) of the Industrial Emissions Directive (IED) states:

"The competent authority shall set emission limit values that ensure that, under normal

operating conditions, emissions do not exceed the emission levels associated with the best available techniques as laid down in the decisions on BAT conclusions referred to in Article 13(5) through either of the following:

(a)setting emission limit values that do not exceed the emission levels associated with the best available techniques. Those emission limit values shall be expressed for the same or shorter periods of time and under the same reference conditions as those emission levels associated with the best available techniques; or

(b)setting different emission limit values than those referred to under point (a) in terms of values, periods of time and reference conditions.

Where point (b) is applied, the competent authority shall, at least annually, assess the results of emission monitoring in order to ensure that emissions under normal operating conditions have not exceeded the emission levels associated with the best available techniques."

3.2.2 Subsequently Article 15(4) of the IED allows for a derogation to Article 15(3) if:

"By way of derogation from paragraph 3, and without prejudice to Article 18, the competent authority may, in specific cases, set less strict emission limit values. Such a derogation may apply only where an assessment shows that the achievement of emission levels associated with the best available techniques as described in BAT conclusions would lead to disproportionately higher costs compared to the environmental benefits due to:

(a)the geographical location or the local environmental conditions of the installation concerned; or

(b)the technical characteristics of the installation concerned.

The competent authority shall document in an annex to the permit conditions the reasons for the application of the first subparagraph including the result of the assessment and the justification for the conditions imposed.

The emission limit values set in accordance with the first subparagraph shall, however, not exceed the emission limit values set out in the Annexes to this Directive, where applicable.

The competent authority shall in any case ensure that no significant pollution is caused and that a high level of protection of the environment as a whole is achieved.

On the basis of information provided by Member States in accordance with Article 72(1), in particular concerning the application of this paragraph, the Commission may, where necessary, assess and further clarify, through guidance, the criteria to be taken into account for the application of this paragraph.

The competent authority shall re-assess the application of the first subparagraph as part of each reconsideration of the permit conditions pursuant to Article 21."

3.2.3 This application is being made in respect of **Article 15(4) b)** of the IED.

4 Technical considerations

4.1.1 The pre-application advice references a query raised by the Environment Agency during the preliminary discussions, namely whether the Operator could make lower nominations to the Grid in order to achieve the Annual NOx Limit. Whilst this question has been asked and answered as part of the pre-application advice being sought, the information set out in this section is intended to provide additional technical detail on the operating constraints of the Site due to its design (including the impact of the contractual commitments it has), in support of the Operator's response to this enquiry.

4.1.2 The Site operates to generate power and steam using 3 Mitsubishi 701F Gas Turbines (the GTs) which were originally installed in 1997. The GTs have been diligently operated and maintained since that time in line with the design of the Site and industry guidelines/manufacturers' instructions.

4.1.3 The Site currently operates to provide:

- secure on demand power and process steam to the various occupiers of the Saltend Chemicals Park, which include top tier numerous COMAH assets and customers (Site Partners), under a long term (+10 years) power purchase agreement, a steam supply agreement and other associated agreements (those agreements together being referred to as the **Chemicals Park Contracts** for the purpose of this Report); and

- critical energy security services to the National Grid Energy System Operator (the ESO) in the event of a grid network failure, further details of which the Operator is restricted from sharing without consent from the DESNZ Electricity Resilience and State Threats Team.

4.1.4 The Environment Agency will be aware, that the latest ELVs were introduced in August 2021 (the 2021 ELVs). The timing of these being implemented fell between the Site's major inspection outages. Notwithstanding this, as an interim measure, specifically in response to the 2021 ELVs, the following modifications were made to the Site in 2021 to ensure the Site could effectively operate within and monitor emission levels required by the new regulatory requirements:

- combustion tuning of all 3 GTs; and

- the creation of new alarms and calculators/predictors.

4.1.5 Given the timing of the 2021 ELVs coming into effect, the Site having already undergone its major inspections on all 3 of the GTs and those GTs not then being due for their next major inspection outage until 2026/2027, the Operator reasonably considers it would not have been feasible to undertake any more material or substantive alterations to the GTs at the time.

4.1.6 The Operator reasonably believed, at the time of the 2021 ELVs being announced, that it would be able to meet the requirements of these by operating reduced load periods in times where the steam demand of its Site Partners was low (typically overnight). It was however difficult to determine at that time, the full impact of the 2021 ELVs and the proposed operating solution for the Site as these measures were introduced part way through the year and the situation required monitoring across all four seasons. Additionally, the Site Partners demand was expected to be lower than current.

4.1.7 At the time the 2021 ELVs were announced and ahead of these coming into effect, the Operator was typically supplying c.40-60 tonnes p/hr of steam to its Site Partners. One of those Site Partners; Vivergo (an AB Sugar company, being one of Europe's biggest manufacturers of bioethanol and the UK's largest single source supplier of animal feed), unexpectedly returned their operations to service in the summer of 2021 (their facility/operations having been previously mothballed for some years), c.1 month prior to the 2021 ELVs being introduced. The return to service of Vivergo following the Government's announcement to pass legislation providing for the sale of E10 petroleum in Great Britain production in the summer of 2021 led to a 200-300% increase in steam demand required to be fulfilled by the Site (as per the Operator's obligations in the Chemicals Park Contracts); an increase from c.40-60 tonnes p/hr to c.120 tonnes p/hr. Since that time, the Site is more often than not required to generate and export process steam at a rate of c.120 tonnes p/hr. For awareness, the maximum steam provision of a single GT is 120 tonnes p/hr.

4.1.8 the Site Partners may request that the Operator utilise the Site to supply process steam to them up to a maximum of 240 t/hr as per the terms of the Chemicals Park Contracts which run to May 2030. Discussions are currently ongoing however, to potentially extend these out to at least May 2040.

4.1.9 In line with the design of the Site and the manufacturer's instructions, each of the GTs can operate to produce an electrical output between its stable export limit (SEL) of 160MW and its maximum export limit (MEL) of 400MW. The lower the electrical export load, the lower the Site's NOx emissions. The export of process steam however impacts this range such that for each 40 tonnes p/hr of process steam produced and exported, electrical output is reduced by 9 MW. Generating and exporting 120 tonnes p/hr of process steam reduces the Site's MEL per GT by 27MW, from 400 MW to 373MW. Ambient conditions during the summer months also has an impact such that the Site can lose around 30MW of electrical output from each of the GTs, thus reducing the MEL per GT to ~343MW in such circumstances (i.e. where process steam demand is at 120 tonnes p/hr).

4.1.10 In short, where the Site's electrical load is too low (i.e. constrained to meet the NOx emissions 2021 ELVs as per the requirements of its Permit), there is insufficient heat to generate the process steam requirements of the Chemicals Park Contracts and so is not a viable option for the Operator or the Site. The Operator therefore has to take an assumed SEL position of 220MW + 120 tonnes p/hr process steam rather than the

160MW design SEL and so cannot make reduced nominations to Grid/reduce its electrical output to reduce the Site's NOx emissions.

4.1.11 Appendix 4 contains diagrams and graphs designed to act as a visual aid for the technical detail described above. These are aimed at assisting the Environment Agency further in its understanding of the impact on the Site's NOx emissions in different operational scenarios (including typical ambient temperature impact comparisons).

4.2 Technical summary

4.2.1 To summarise the technical considerations:

- where the Site is providing process steam to the Site Partners and/or the ambient temperature is high, the technical characteristics of the Site are such that it operates at, or marginally below, the 2021 ELVs daily and monthly limits; and
- the higher the volume steam demand from the Site Partners the Site is required to fulfil, and/or the higher the ambient temperature, the harder the GTs have to fire/work to produce and supply this demand. In terms of the impact this then has on the Site's emissions levels: the greater the steam demand and/or ambient temperature, the higher the NOx and CO2 emissions.

4.2.2 To be able to bring the overall annual NOx emissions to within the Annual NOx Limit, two options are identified:

- Run when not necessary (resulting in emissions and consumption that would not otherwise occur) or
- Run inefficiently at times when steam demands allow (may not be possible for large periods of the year).

4.2.3 If the Operator were to stop supplying the process steam demanded by the Site Partners in accordance with the Chemicals Park Contracts:

- this triggers significant financial penalties for the Operator and could ultimately be deemed a persistent/material breach of the Chemicals Park Contracts, likely resulting in the termination of the Chemicals Park Contracts and/or the Operator being required to reimburse the Site Partners for significant losses they incur as a result;
- as the Chemicals Park Contracts are one of the two key rationales ultimately underpinning the operating purpose of the Site, these being terminated as a result of a failure to supply steam would trigger a right of determination of the Operator's lease and if exercised, ultimately lead to the Site being demolished, thus ultimately jeopardising the future operations of the Site; and
- the Site Partners would potentially be unable to operate their respective businesses, such that the same would be at risk of closure, impacting not only the chemical production industry in the region Committed Investment in Long Term Solution.

4.2.4 The Operator's Board of Directors have sanctioned (in Nov 2023) the significant multimillion pound investment in and overall plan for carrying out upgrades and modifications to all 3 of the GTs at the Site. These modifications and upgrades, as advised by the OEM (Mitsubishi):

- comprise retrofitting dry-low-NOx (DLN) FMK-08 pre-mix combustors to each of the GTs. It is understood that there is no other known viable alternative for retrofit onto the types of machines installed at the Site (i.e. Mitsubishi 701Fs); and
- these dry-low-NOx (DLN) FMK-08 pre-mix combustors are:
  - already in operation in more than 60 units of the same design/type as the Site's GTs; and
  - have already been successfully retrofitted on seven 501F gas turbine machines operated in Taiwan.

4.2.5 Mitsubishi has informed the Operator that the retrofitting of the FMK-08 combustor technology will reduce NOx levels to c.30-40mg/m3 across the varying fuel specifications for the Site.

4.2.6 The FMK-08 retrofit involves the design, supply and installation of new combustors, combustor casings, FG piping and a net-mation control system. These works can only be performed at the time of the next planned major inspection outages for the GTs expected to occur in 2028. The viability of this has been confirmed by Mitsubishi; they having informed the Operator that there is a 4-6 month time period required by their operations in Japan to produce the necessary standards and codes for these purposes and there is a ~3 year lead time for the delivery of the key component parts of the FMK-08 equipment.

4.2.7 The FMK-08 retrofit not only addresses the issues faced by the Operator in ensuring the Site meets the NOx Annual Limit but also, amongst other green benefits, assists in making the Site "hydrogen ready"; ultimately allowing for a 30% blend of hydrogen for firing purposes. A Sustainability Action Plan has been prepared by the Operator. This concludes that the implementation of the FMK-08 retrofit modification and upgrade works will result in the reduction of emissions from the Site per MW of electricity produced and has a positive impact on the environment (compared with current operations and emissions); furthering the Government's aims and objectives to achieve net zero by 2030, whilst preserving national energy security measures.

4.3 Cost benefit

4.3.1 The Operator appreciates that for the Environment Agency to grant a derogation pursuant to Article 15(4) of the IED, a thorough and detailed cost benefit analysis (CBA) must be undertaken and provided.

4.3.2 The CBA tool (Appendix 2) demonstrates that the combined financial and environmental impacts to comply with the BAT-AEL of 40mg/m3 is disproportionally burdensome.

4.3.3 As a simplification of the CBA tool the table below outlines the financial impacts of meeting the BAT-AEL limit in 2023.

Table 4 Impact of maintaining NOx annual limit - 2023

Cost of efficiency reduction	£	2,254,606
Cost of forgone and forced sales	£	4,062,146
Cost of additional running	£	4,230,928
Total cost	£	10,647,928
Additional NOx emitted	Kg	161,176
Additional CO2 emitted	Tonnes	106,092

5 Concluding remarks

5.1.1 It is considered that maintaining the existing NOx annual average limit is unsustainable due to:

- the current technical characteristics of the Site;
- the contractual (steam) demands the Operator is required to satisfy; and
- sub-optimal running of the Site, causing more overall emissions than would otherwise be necessary.

5.1.2 The Operator is committed to making the necessary significant multi-million-pound financial investment required to modify and upgrade the Site at the time of the next planned major inspection and outage of each of the 3 GTs to permanently reduce the emissions of the Site overall at or below the NOx Annual Limit. This is the earliest opportunity in which this upgrade can happen.

5.1.3 The Operator seeks a derogation from the Agency, to allow for the Annual NOx Limit to be increased to align with the current daily and monthly limits for the Site (being 50mg/m3).

5.1.4 It is acknowledged that the Environment Agency's powers to grant a derogation are limited to issuing the same for a period of up to 9 months. The Operator would require such derogation to be in place for the period between the granting of the derogation and the date upon which the FMK-08 modification works are completed (reasonably expected to be concluded by 2028). In the interests of transparency therefore, should the Agency grant an initial derogation of up to 9 months, the Operator would wish to seek further extensions to the same in due course.

APPENDICES:

APPENDIX 1 EMS SUMMARY

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APPENDIX 2 COST-BENEFIT ANALYSIS (MS EXCEL MACRO DOCUMENT ENCLOSED)

APPENDIX 3 AIR QUALITY ASSESSMENT

Mabbett
Planning | Design | Environment | Engineering | Safety

See a Difference.

Project No: 315528

Air Quality Assessment

For the Site located at:

Saltend Power Station
Hull
HU12 8GA

Prepared for:

Saltend Cogeneration Company Limited

Saltend Cogeneration Plant
Saltend Power Station
Hedon Road
Hull
HU12 8GA

Contents Amendment Record

This report has been issued and amended as follows:

Revision	Description	Date	Signed
1.0	First Issue	11 June 2024	S Carson

Acknowledgement

This report has been prepared for the sole and exclusive use of Saltend Cogeneration Company Limited in accordance with the scope of the Crestwood Environmental Ltd (Crestwood Environmental) Letter Agreement (ref: Q5945), dated 13 July 2023. Crestwood Environmental Ltd is now part of Mabbett & Associates Ltd (Mabbett). This report is based on information and data collected by Mabbett. Should any of the information be incorrect, incomplete or subject to change, Mabbett may wish to revise the report accordingly.

This report has been prepared by the following Mabbett personnel:

MABBETT & ASSOCIATES LTD

Stephen Carson, BSc, MIAQM, CEnv
Senior Environmental Consultant

This report has been reviewed and approved by the following Mabbett personnel:

MABBETT & ASSOCIATES LTD

Joshua Jones, BSc, MSc, MIAQM
Senior Environmental Consultant

Table of Contents

Section 1.0: Introduction

1.1 Background

Saltend Cogeneration Company Limited is submitting an Environmental Permit Variation Application for the Saltend Power Station, Hull (hereafter referred to as 'the site').

The site operates three gas turbines fired on natural gas with a capacity of 400MW each. The gas turbines currently have an annual average Emissions Limit Value (ELV) for oxides of nitrogen (NO_x) of 40mg/m^3. The permit variation seeks to temporarily increase the annual average ELV for NO_x to 50mg/m^3 until the plant can be upgraded to reduce overall emissions.

Pre-application discussions with the Environmental Agency (EA) have indicated that a detailed air quality dispersion modelling assessment is required to support the application. The results of the detailed air quality dispersion modelling are presented in this report.

1.2 Site

The site is located in an industrial estate in Salt End, Hull. The site is bounded by industrial developments to the north, east and west and by the River Humber to the south. The Saltend Power Station is a Combined Heat and Power (CHP) and Combined Cycle Gas Turnbine (CCGT) cogeneration plant. The site includes the following emission to air sources that have been considered in this assessment (i.e. normal operation):

- Three gas turbines;
- One start-up boiler.

A Site location plan is show in Figure 1.1.

Figure 1.1: Site Location

Contains Open Street Map Data © 2024

Section 2.0: Environmental Standards

2.1 Ambient Air Directive (AAD) Limit Values

Table 2.1 summarises the relevant AAD limit values[1] which have been used in this assessment. Emissions from the site must not lead to an exceedance of these legally binding limit values.

Table 2.1: AAD Limit Values

Pollutant	Limit Value	Reference Period	Additional Information
Nitrogen Dioxide (NO_2)	200 µg/m^3	1-Hour Mean	Not to be exceeded more than 35 times a year (99.79th percentile)
	40 µg/m^3	Annual Mean	-
Nitrogen Oxides (NO_x as NO_2)	30 µg/m^3	Annual Mean	Objective for the protection of vegetation and ecosystems

These limits apply at relevant receptors. See Appendix A for example receptors.

2.2 Environmental Assessment Levels (EALs)

EALs are used to help regulators assess the acceptability of an operator's emissions to air and their relative contribution to the environment. They represent a pollutant concentration in ambient air at which no significant risks to public health are expected. Relevant EALs are summarised below.

The Environment Agency (EA) also provides a short term EAL for NO_x, which is shown in Table 2.2 below.

Table 2.2: EALs

Pollutant	EAL	Reference Period	Additional Information
NO_x as NO_2	75 µg/m^3	24-Hour Mean	Objective for the protection of vegetation and ecosystems

2.3 Guidance

A summary of some of the key guidance documents referred to in the undertaking of this assessment is provided below. Others which have been used are referenced throughout the report, as appropriate.

2.3.1 Local Air Quality Management Review and Assessment Technical Guidance

Defra has published technical guidance for use by local authorities in their review and assessment work. This guidance, referred to in this document as LAQM.TG22, has been used where appropriate in the assessment presented herein.

2.3.2 Air Emissions Risk Assessment for your Environmental Permit

The EA's Air Emissions Risk Assessment (AERA) Guidance for Environmental Permitting provides guidance on determining the impacts of emissions to air and the standards that are required to be met. The AERA guidance provides information on EALs against which the impacts of emissions to air can be assessed to evaluate whether the impacts represent 'significant pollution'.

[1] https://uk-air.defra.gov.uk/assets/documents/Air_Quality_Objectives_Update.pdf

Section 3.0: Baseline Air Quality at Sensitive Receptors

3.1 Introduction

The existing air quality in the vicinity of the site was reviewed in order to provide a baseline for the air quality assessment. The findings are summarised below.

3.2 Air Quality Management Areas

Where a local authority identifies an area of non-compliance with the limit values set out in Table 2.1, and there is relevant public exposure, there remains a statutory need for the authority to declare the geographic extent of non-compliance as an Air Quality Management Area (AQMA) and to draw up an air quality action plan (AQAP) detailing remedial measures to address the problem.

The closest AQMA to the site is Hull AQMA No.1 which is located approximately 5.7km west of the site within the boundaries of the Kingston-Upon-Hull City Council (KHCC). The AQMA was declared in 2005 for exceedances of the annual mean NO_2 objective and covers an area encompassing Hull City Centre. Given the distance between the site and the AQMA, the likely impacts are considered negligible and have been scoped out of further assessment.

3.3 Sensitive Receptors (Human Health)

A review of the surrounding area was undertaken to identify potentially sensitive receptors. This focused on identifying the high sensitivity receptors nearest to the site in all directions. All of the averaging periods set out in LAQM.TG22 apply at high sensitivity receptors (reproduced in Appendix A).

In accordance with LAQM.TG22, there are other sensitive receptors in the vicinity of the site where the annual average environmental standards do not apply. These include the gardens and garages of residential properties as well as the site itself where workers could be exposed to unacceptable air quality conditions. In order to adequately assess these receptors, a grid was included in the dispersion modelling assessment.

The modelled grid domain was from easting 511005 – 422854 and northing 521005 – 432854, with a grid spacing of 10 m. The grid was modelled at a breathable height of 1.5m. The extent of the grid is shown in Figure 3.1.

In addition to the modelled gird, discrete receptors were included in the model. Two Air Quality Assessments, which included dispersion modelling, have been completed for previous permitting application in 2005[2] and variation in 2019[3]. For consistency, the discrete human receptors from this assessment, have been retained. This allows direct comparison between the results of this assessment and the 2005 permit application.

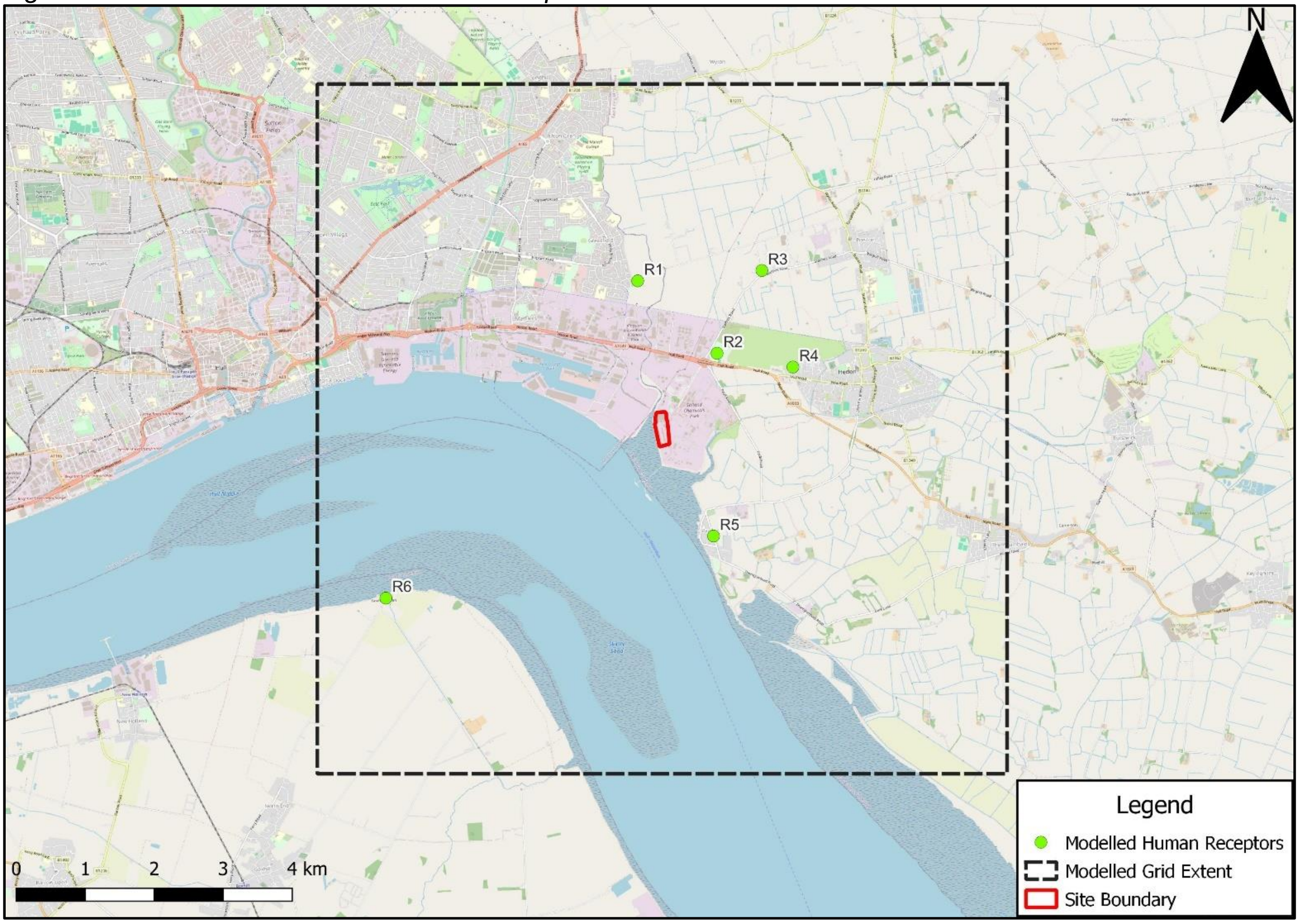
Table 3.1 and Figure 3.1 summarises the discrete sensitive receptors which were modelled. All receptors were modelled at a breathable height of 1.5m (ground floor).

Table 3.1: Modelled Human Health Sensitive Receptors

Ref.	Receptor	X Coordinate (m)	Y Coordinate (m)	Z Coordinate (m)
R1	Hull	515650	430000	1.5
R2	Saltend	516800	428950	1.5
R3	West End	517450	430150	1.5
R4	Hedon	517900	428750	1.5
R5	Paull	516750	426300	1.5
R6	Goxhill Haven	512000	425400	1.5

[2] Gair Consulting. Air Quality Assessment To Support Ppc Permitting Of The Congeneration Plant, Saltend Power Station. 2005
[3] RAS Environmental Permit Variation Detailed Dispersion Modelling. Triton Power, Saltend Power Station. 2019

Figure 3.1: Modelled Sensitive Human Receptors



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3.4 Background Air Quality (Human Health Receptors)

Background concentration data was initially considered from three sources: local monitoring stations, Defra background concentration maps, and local diffusion tubes. It was identified that background concentration maps provide the most representative data for the site and have thus been utilised for modelling background pollutant concentrations.

Data for NO_2 are presented below.

3.4.1 NO_2

Defra background concentration data was obtained for the human health sensitive receptors as identified in Table 3.1. The highest background concentration from these receptors was selected for use within the modelled grid as a conservative approach. The annual mean data is provided (and presented below) in Table 3.2.

Table 3.2: NO_2 Background Concentration Data for Discrete Receptors

Receptor	Year	NO_2 (µg/m^3) Annual Mean
R1	2018	15.1
R2		21.5
R3		13.1
R4		14.3
R5		13.8
R6		11.4

The year-on-year data provided by the background maps is based on a modelling assessment with 2018 as the reference year, and this predicted a decreasing trend in concentration. However, this decrease is not always apparent in reality. Therefore, 2018 data have been used within this assessment as a conservative assumption.

3.4.2 Summary

The background concentrations considered within this assessment for the modelled gird and discrete receptors are summarised in Table 3.3 below. The short-term background concentrations are taken as twice the annual mean concentrations as per modelling good practice. As a conservative approach, worst-case background has been applied to modelled grid results.

Table 3.3: Summary of NO_2 Background Concentrations for Human Health Receptors

Receptor	Background Concentration (µg/m^3)	
	Long Term	Short Term
R1	15.1	30.2
R2	21.5	43
R3	13.1	26.2
R4	14.3	28.6
R5	13.8	27.6
R6	11.4	22.8
Modelled Grid	21.5	43

3.5 Sensitive Receptors (Ecological)

An assessment of impacts on designated ecological receptors was carried out as part of the previous permit variation[3]. Following a receptor review and at the request of the EA, the following receptors were identified for inclusion within the 2019 air quality assessment:

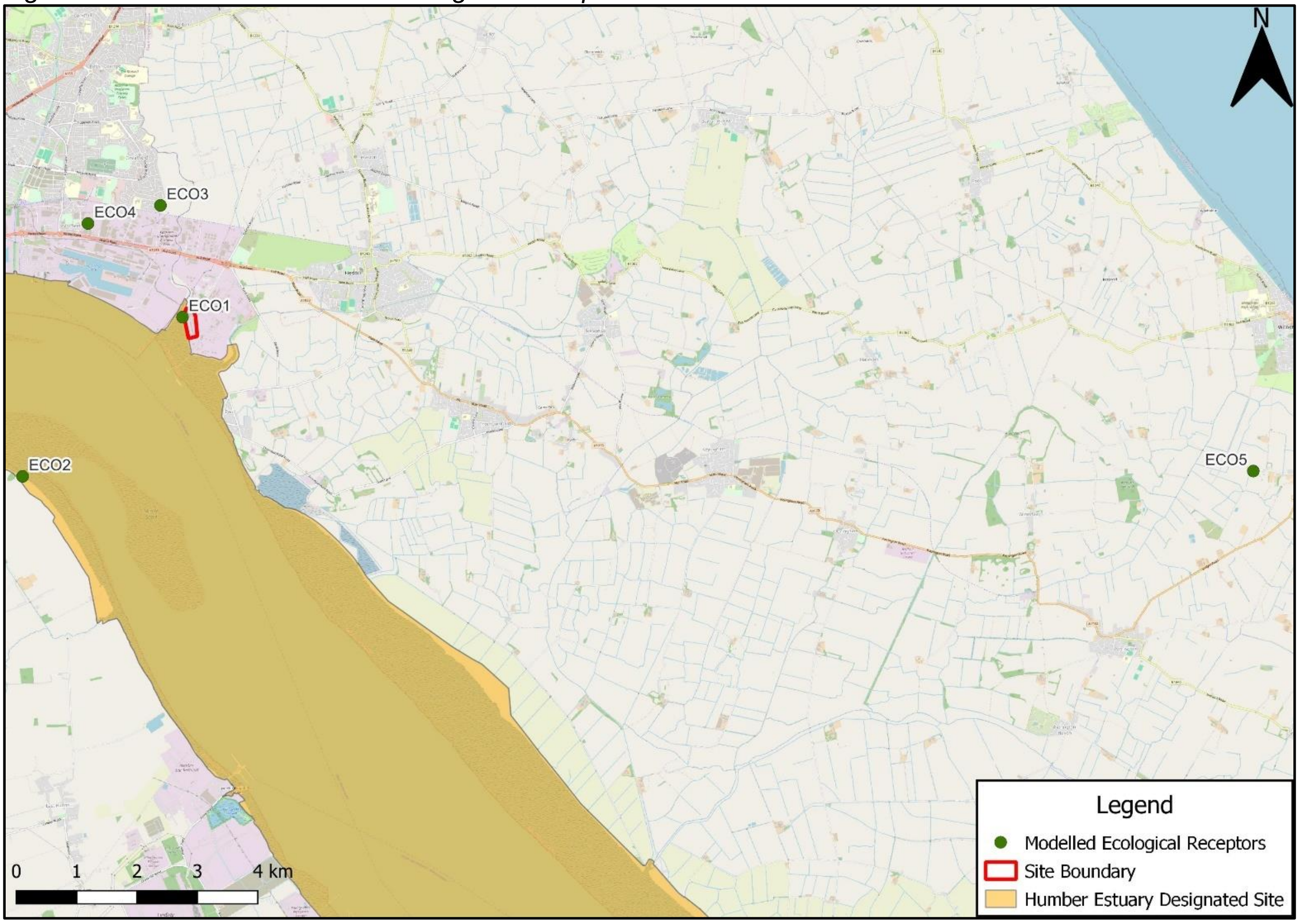
- Humber Estuary Site of Special Scientific Interest (SSSI)/Special Area of Conservation (SAC)/Special Protection Area/Ramsar;
- Land East of Falkland Road Local Wildlife Site (LWS);
- St Giles Bural Ground LWS; and
- Former Withernsea Railway Line LWS.

For consistency, the discrete receptors identified within the 2019 assessment have been retained for this modelling assessment. The modelled ecological receptors are summarised in Table 3.4 and are shown in Figure 3.2. All ecological receptors were modelled at a height of 0m.

Table 3.4: Modelled Ecological Sensitive Receptors

Ref.	Receptor	X Coordinate (m)	Y Coordinate (m)	Z Coordinate (m)
ECO1	Humber Estuary SSSI/SAC/SPA/Ramsar - 1	515865	427950	0
ECO2	Humber Estuary SSSI/SAC/SPA/Ramsar – 2	513217	425311	0
ECO3	Land East of Falkland Road LWS	515500	429800	0
ECO4	St Giles Bural Ground LWS	514300	429500	0
ECO5	Former Withernsea Railway Line LWS	533600	425400	0

Figure 3.2: Modelled Sensitive Ecological Receptors



Contains Open Street Map Data © 2024

3.6 Background Air Quality & Deposition (Ecological Receptors)

Air Pollution Information System (APIS) is a support tool for assessment of potential effects of air pollutants on habitats and species developed in partnership by the UK conservation agencies and regulatory agencies and the Centre for Ecology and Hydrology.

Ambient background concentrations for annual mean NO_x and deposition rates and critical loads for nitrogen deposition and acid deposition were sourced from APIS and are provided in Table 3.5 and Table 3.6 below.

For the Humber Estuary, backgrounds, deposition rates and critical loads were derived using the 'Site Relevant Critical Loads' page on the APIS website to provide specific data for the designated site. Where multiple critical load classes were identified in the same area, the lowest critical load range was selected for inclusion in the assessment, this is considered to be a conservative approach.

APIS does not have any site-specific data for LWS. As such, backgrounds, deposition rates and critical load ranges for the three LWS were derived using the 'Location Search' on the APIS website. The Living England Habitat map was used to identify the closest appropriate habitat for each LWS. As a conservative approach, the lowest critical load range was applied when multiple classes were available.

Table 3.5: APIS Nitrogen Deposition Rates and Critical Loads

Ref.	APIS Nitrogen Critical Load Class	APIS Annual Mean NO_x ($\mu g/m^3$)	Nitrogen Deposition (kg/N/ha/yr)	
			Deposition Rate	Critical Load Range
ECO1	Coastal Dune Grasslands – Acid Type	22.6	16.7	5-10

Ref.	APIS Nitrogen Critical Load Class	APIS Annual Mean NO_x ($\mu g/m^3$)	Nitrogen Deposition (kg/N/ha/yr)	
			Deposition Rate	Critical Load Range
ECO2		13.1	16.9	5-10
ECO3	Valley Mires, Poor Fens and Transition Mires	25.9	17.0	5-15
ECO4		35.4	17.1	5-15
ECO5		10.0	14.5	5-15

Table 3.6: APIS Acid Deposition Rates and Critical Loads

Ref.	APIS Acid Critical Load Class	Acid Deposition (kg_{eq}/ha/yr)		
		Deposition Rate	Critical Load Range	
			CLMinN	CLmaxN
ECO1	Dwarf Shrub Heath	1.2	0.499	1.312
ECO2	Dwarf Shrub Heath	1.2	0.499	1.312
ECO3	Habitat not sensitive to acidity			
ECO4	Broadleaved/Coniferous Unmanaged Woodland	1.2	0.357	8.69
ECO5	Habitat not sensitive to acidity			

Section 4.0: Methodology

4.1 Dispersion Model

ADMS 6.0, the model used to undertake this exercise, is a new generation Gaussian plume air dispersion model, which means that the atmospheric boundary layer properties are characterised by two parameters (the boundary layer depth and the Monin-Obukhov length) rather than in terms of the single parameter Pasquill-Gifford class. Dispersion under convective meteorological conditions uses a skewed Gaussian concentration distribution (shown by validation studies to be a better representation than a symmetrical Gaussian expression).

4.2 Emission Parameters

The assessment has focussed on the three gas turbines and the start-up boiler. It is understood that emergency diesel generators are used as an emergency plant to facilitate start-up of the gas turbines. As these are not likely to run concurrently with the gas turbines for a substantial duration of the year, they have not been included in the modelling assessment.

As a worst-case approach, we have assumed that all three gas turbines will be running concurrently for 100% of the year. As the start-up boiler will only be used for short time periods, it was deemed that emissions from the boiler should only be included for assessment against short-term objectives. The plant emissions considered in the assessment are detailed below:

- Long-term (e.g. annual mean) objectives: three gas turbines running 100% of the time.
- Short-term (e.g. 1-hour mean) objectives: three gas turbines and one start-up boiler.

The modelled emission parameters for the plant is summarised in Table 4.1 and Table 4.2. Modelling was undertaken for two scenarios: existing (40mg/m^3 limit value) and proposed (50mg/m^3 limit value).

For the gas turbines, stack temperature and normalised volume flow rate data were provided by Saltend Cogeneration Company Limited. This enabled derivation of actual volume flow rate data (via temperature correction of normalised flow rate), efflux velocity and NO_x emission rate. The derived data was compared with modelled data for the 2005 air quality assessment for Saltend Power Station. The flow rate data used in this assessment is higher than the 2005 air quality assessment (527 Nm^3/s). The stack temperature is also higher than the 2005 air quality assessment (108 °C). The NO_x concentration used in the 2005 air quality assessment was 46 mg/Nm^3 compared to the existing and proposed ELVs used in this assessment. The stack velocity used in this assessment (30.5 m/s) is marginally higher than that used in the 2005 assessment (28 m/s).

For the start-up boiler, data from the 2005 air quality assessment has been utilised in this assessment.

Table 4.1: Modelled Emission Parameters – Existing Scenario

Parameter	A1 – Gas Turbine	A2 – Gas Turbine	A3 – Gas Turbine	A4 – Start-up Boiler
Stack Location X(m), Y(m)	515953, 427981	515992, 427983	516033, 427983	515961, 427938
Stack Height (m)	65	65	65	45
Stack Diameter (m)	6	6	6	1.5
Exit Temperature (°C)	120	120	120	175
Efflux Velocity - actual (m/s)	30.5	30.5	30.5	8
Volumetric Flow Rate - actual (m^3/hour)	863.7	863.7	863.7	14
Volumetric Flow Rate - normalised (m^3/hour)	600	600	600	8.6
Existing NO_x ELV (mg/Nm^3), yearly average		40		-
NO_x Emission Concentration (mg/Nm^3)		-		69
NO_x Emission Rate (g/s)	24.0	24.0	24.0	0.593

Table 4.2: Modelled Emission Parameters – Proposed Scenario

Parameter	A1 – Gas Turbine	A2 – Gas Turbine	A3 – Gas Turbine	A4 – Start-up Boiler
Stack Location X(m), Y(m)	515953, 427981	515992, 427983	516033, 427983	515961, 427938
Stack Height (m)	65	65	65	45
Stack Diameter (m)	6	6	6	1.5
Exit Temperature (°C)	120	120	120	175
Efflux Velocity - actual (m/s)	30.5	30.5	30.5	8
Volumetric Flow Rate - actual (m^3/hour)	863.7	863.7	863.7	14
Volumetric Flow Rate - normalised (m^3/hour)	600	600	600	8.6
Proposed NO_x ELV (mg/Nm^3), yearly average		50		-
NO_x Emission Concentration (mg/Nm^3)		-		69
NO_x Emission Rate (g/s)	30.0	30.0	30.0	0.593

4.3 Modelled Buildings

Turbulence can be induced by nearby buildings and structures, causing pollutants emitted from an elevated source to be displaced and dispersed rapidly towards the ground, resulting in elevated ground level concentrations.

The on-site buildings deemed to have the biggest potential to impact on emissions were reviewed and included in the dispersion model. The parameters for the selected modelling buildings are detailed in Table 4.3 below. Building heights lengths and widths were derived from the previous air quality assessments at the site[2,3].

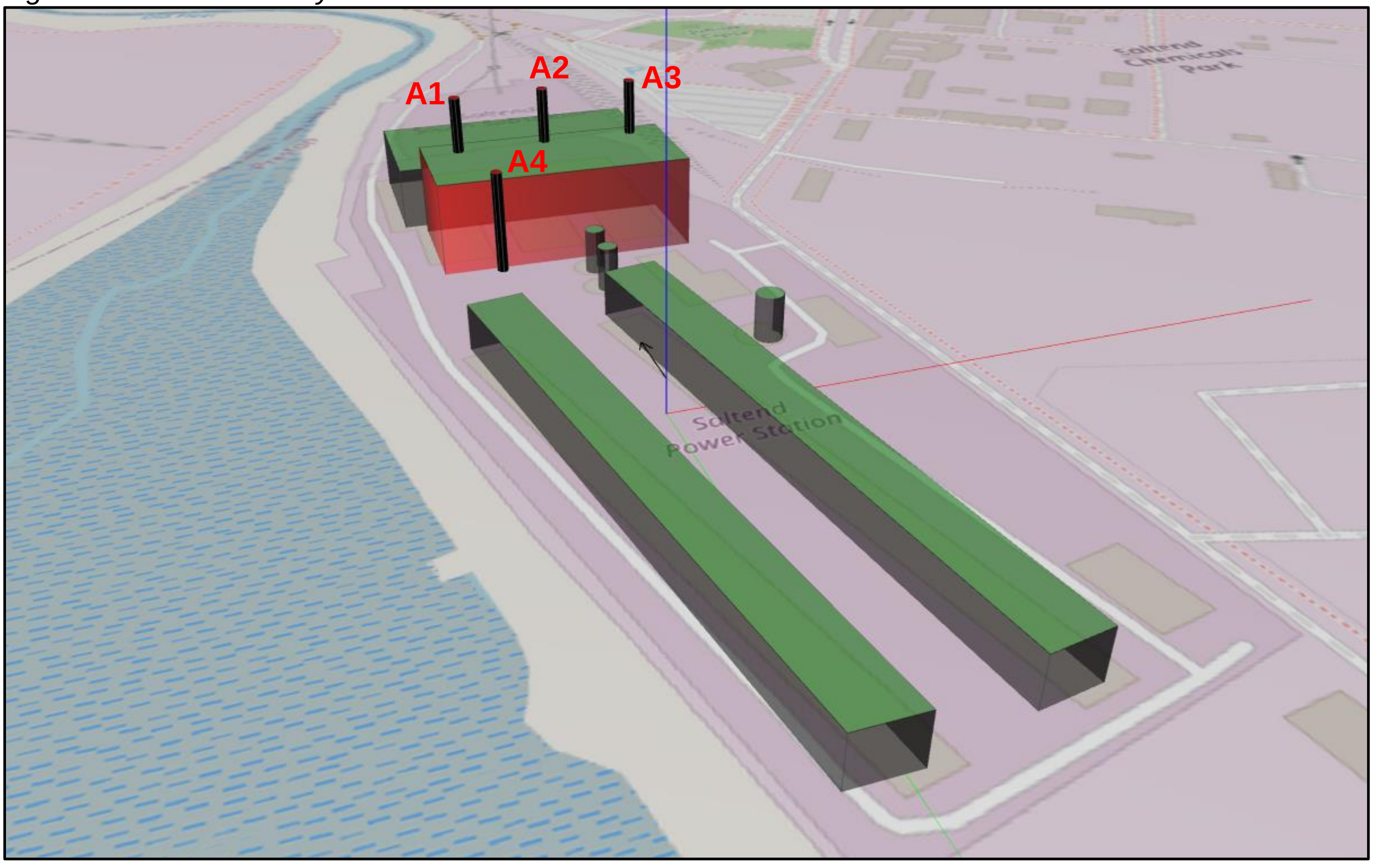
For the purpose of the dispersion modelling assessment, the buildings have been simplified. This results in a set up as shown in Figure 4.1.

Table 4.3: Modelled Buildings

Building ID	Building Centre		Modelled Height (m)	Length (m)	Width (m)
	X Coordinate (m)	Y Coordinate (m)			
HRSG 3[1]	515992	427966	40.5	110	50
Turbine Hall	515989	428029	27.7	120	60
Cooling Tower West	515964	427749	19.1	22	250
Cooling Tower East	516021	427761	19.1	22	250
Demineralisation Tank - 1	515999	427926	19	8	-
Demineralisation Tank - 2	515999	427907	19	8	-
Raw Water Tank	516045	427844	19	11	-

Note: [1] Considered most likely to impact the dispersion of the pollutants based on its proximity to the stacks. Thus, it was entered into the model as the 'main' building.

Figure 4.1: 3D Model Layout



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4.4 Modelled Terrain

The site is located in an area of relatively flat terrain and therefore dispersion is unlikely to be influenced by terrain. As such, no terrain file has been included in the dispersion model. This is consistent with the approach taken in the previous modelling assessments at Saltend Power Station[2,3].

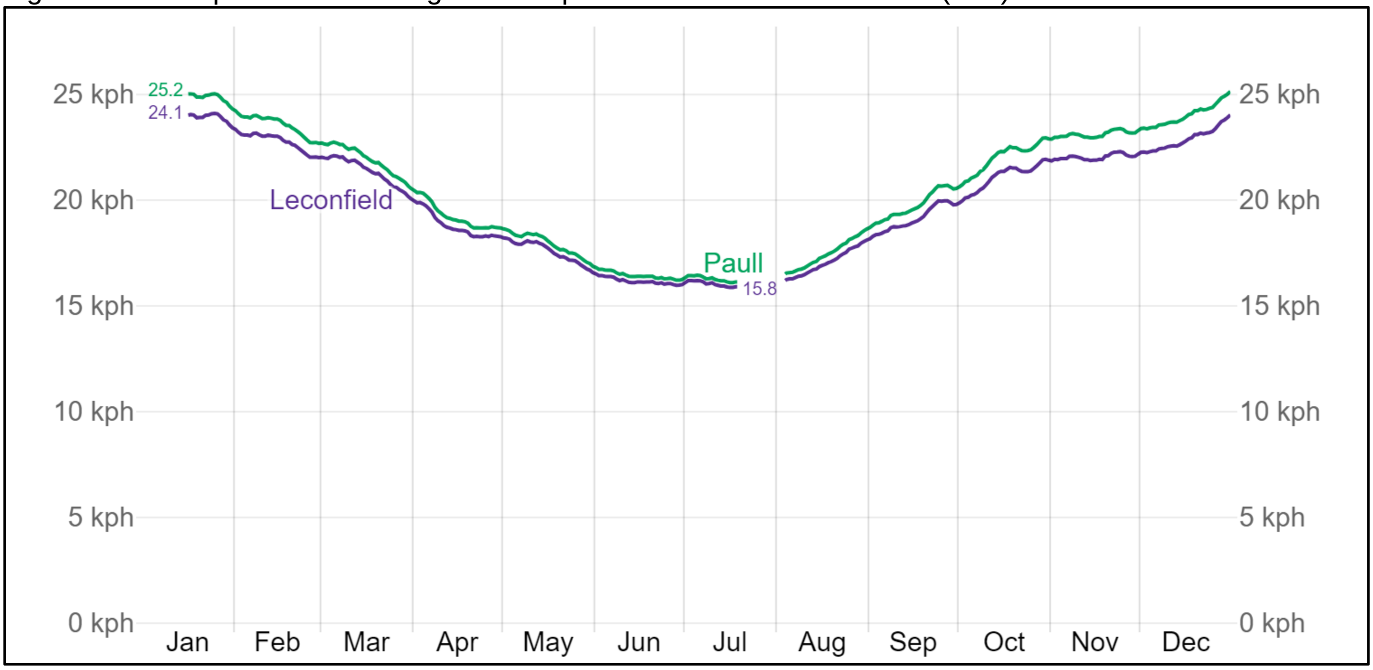
4.5 Meteorology

Leconfield weather station (around 19 km to the north-west of the site) was used to provide hourly sequential meteorological data for the dispersion model. The choice of met data site is consistent with the approach taken in the previous modelling assessments at Saltend Power Station[2,3].

A study by the UK Atmospheric Dispersion Modelling Liaison Committee (ADMLC) into the portability of weather data for dispersion calculations[4] found that the most important factor in the selection of a meteorological station was the annual mean wind speed. A desk study was undertaken to compare the wind speeds from Leconfield with the closest estimate for the site (Paull) as shown in Figure 4.2. The results showed that average wind speeds are very similar. As such, data from Leconfield weather station are considered to be appropriate for use in this assessment.

Five full years of Leconfield meteorological data from years 2019 - 2023 were used in the dispersion modelling; the wind rose for each year is shown in Figure 4.3. The model results presented in Section 5.0 represented the maximum predicted concentrations from these five modelled years.

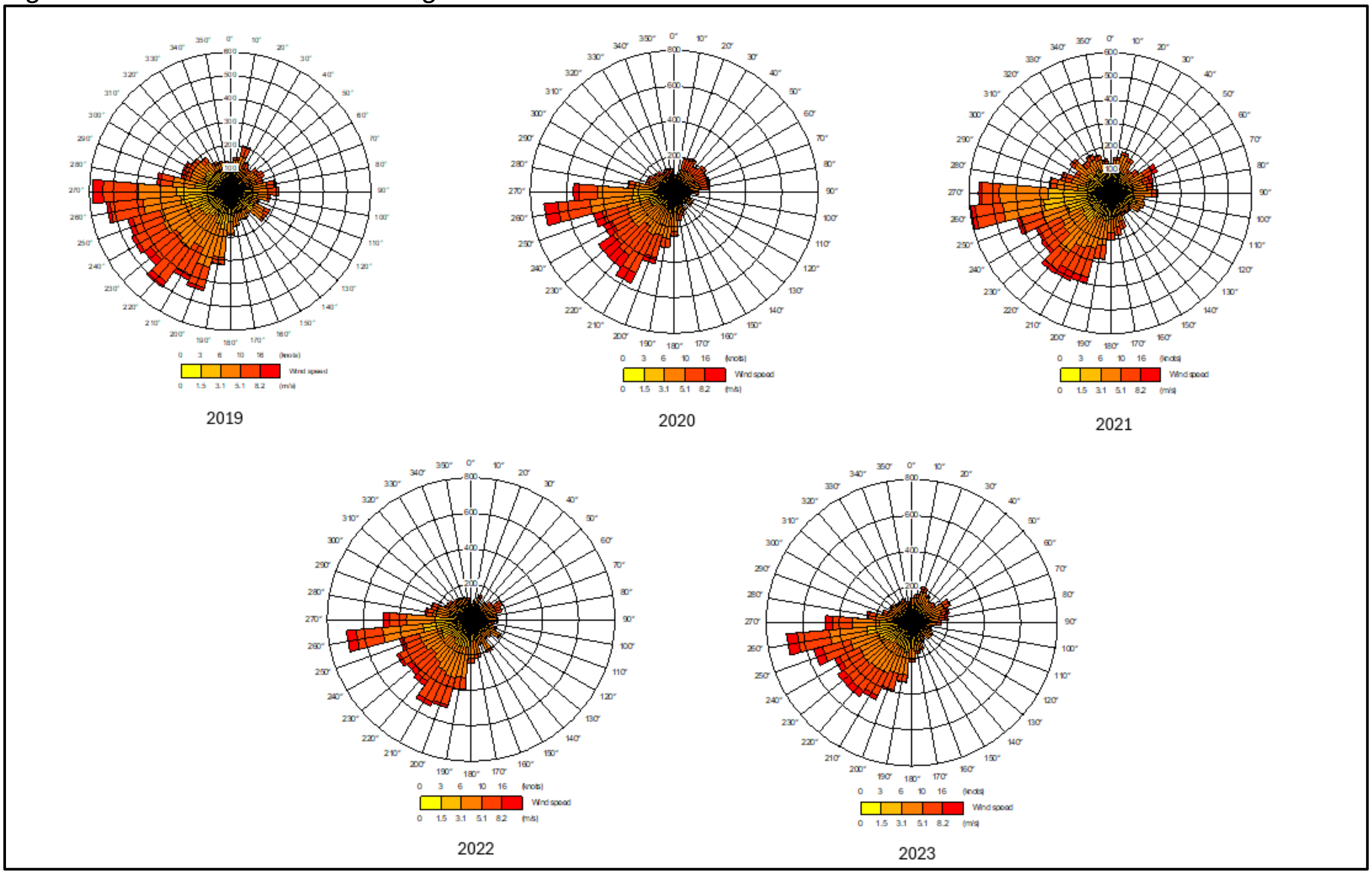
Figure 4.2: Comparison of Average Wind Speed at Leconfield and Paull (Site)



Contains Weatherspark.com Data © 2024

4 https://admlc.files.wordpress.com/2014/09/r316.pdf

Figure 4.3: Leconfield Meteorological Station 2019 - 2023 Wind Rose Data



4.6 Surface Characteristics

A surface roughness length is used to characterise the texture of land as this can impact dispersion of pollutants. With respect to the modelled domain, a length of 1.0 m (cities, woodlands) has been used for the site and 0.3 m (Agricultural areas, max) for the weather station.

4.7 Minimum Monin-Obukhov Length

A minimum Monin-Obukhov length of 30 m (mixed urban/industrial) was used at the development site and a length of 10m (small towns) for the meteorological site to account for the effects of buoyancy on turbulent flows.

4.8 Special Treatments

No special treatment (such as: dry or wet deposition; short-term releases; fluctuations; or chemistry) were deemed appropriate for use within the dispersion model.

4.9 Modelling Uncertainty

There are a variety of factors which can lead to potential uncertainty in dispersion modelling predictions. In the model results, potential uncertainties were minimised as far as is considered practicable and worst-case inputs used to provide a robust assessment. This included:

- The atmospheric dispersion model ADMS-6 has been verified by CERC through a number of studies to ensure predictions are suitably robust;
- Background pollutant concentrations and loads were obtained from Defra as an estimate of baseline conditions at human receptors;
- To account for inter-year variability in meteorological conditions, five years of meteorological data was used in the assessment; and,
- Surface roughness and the Monin-Obukhov length for the dispersion site and meteorological site were evaluated based on the land use guidance provided by CERC.

4.10 Model Output

Predicted pollutant concentrations were summarised in the following formats:

- Process contribution (PC) - Predicted pollutant level due to emissions from the facility only.
- Predicted environmental concentration (PEC) - Total predicted pollutant level due to emissions from the facility and existing baseline conditions.
- Net PC – net change to pollutant level associated with the change in ELV proposed at this facility.

Given the nature of this permit variation, assessment has reviewed the net PC.

4.11 NO_X to NO_2 Conversion

Emissions of NO_x arising from combustion processes are mainly in the form of nitric oxide (NO) at the point of release. NO_2 forms where the NO is oxidised due to excess oxygen in the combustion gases or other atmospheric reactions. In accordance with EA guidance, the NO_x to NO_2 conversions (at the point of impact) were assumed to be 70% for long-term average concentrations and 35% for short-term average concentrations.

4.12 Calculation of Contribution to Critical Loads

Deposition rates were calculated using empirical methods recommended by the EA AQTAG06. Dry deposition flux was calculated using the following equation:

Dry deposition flux (μg/m^2/s) = ground level concentration (μg/m^3) x deposition velocity (m/s)

Wet deposition occurs via the incorporation of the pollutant into water droplets which are then removed in rain or snow and is not considered significant over short distances (AQTAG06) compared with dry deposition and therefore for the purposes of this assessment, wet deposition has not been considered consistent with AQTAG06. The applied deposition velocities are as shown in Table 4.4.

Table 4.4: Deposition Velocities

Pollutant	Deposition Velocity (m/s)	
NO_2	Grassland	0.0015
	Woodland	0.0030

The predicted deposition rates were converted from μg/m^2/s to units of nitrogen deposition and acid equivalent deposition as detailed in Table 4.5.

Table 4.5: Applied Deposition Conversion Factors

Pollutant	Conversion	Factor
NO_2 to Nitrogen Deposition	μg/m^2/s to kg/ha/year	95.9
NO_2 to Acid Deposition	μg/m^2/s to kg_{eq}/ha/year	6.84

4.13 Calculation of PC as a percentage of Acid C_{Lo} Function

The calculation of the process contribution of N to the acid C_{Lo} function has been carried out according to the guidance on APIS, which is as follows:

The potential impacts of additional sulphur and/or nitrogen deposition from a source are partly determined by PEC, because only if PEC of nitrogen deposition is greater than CLminN will the additional nitrogen deposition from the source contribute to acidity. Consequently, if PEC is less that CLminN only the acidifying affects of sulphur from the process need to be considered:

Where PEC N Deposition < CLminN

*PC as % CL function = (PC S deposition/CLmaxS)*100*

Where PEC is greater than CLminN (the majority of cases), the combined inputs of sulphur and nitrogen need to be considered. In such cases, the total acidity input should be calculated as a proportion of the CLmaxN.

Where PEC N Deposition > CLminN

*PC as %CL function = ((PC of S+N deposition)/CLmaxN)*100*

4.14 Assessment Significance

4.14.1 Human Receptors

In accordance with the EA's AERA guidance, a PC for any substance can be considered 'insignificant' if the PC meets the following criteria:

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

Initially, the maximum predicted PC across the modelled grid has been assessed against these criteria. If the above criteria are achieved at the point of maximum impact, then it can be concluded that impacts are 'insignificant' at all locations and that no further assessment is required.

If these criteria are exceeded, the predicted environmental concentration (PEC - defined as the PC plus the background concentration) is then calculated and consideration given to predicted impacts at discrete receptor locations.

Further action is not required, and impacts are considered to be acceptable and not to constitute 'significant pollution', if both of the following criteria are met:

- The proposed emissions comply with Best Available Techniques Associated Emission Levels (BAT AEL) or equivalent where there is no BAT AEL; and
- The resulting PECs are predicted not to exceed environmental standards.

4.14.2 Ecological Receptors

In addition to the AERA guidance, the EA's Operational Instruction 66_12 specifically details how the air quality impacts on ecological sites can be assessed. This guidance provides risk-based screening criteria to determine whether impacts will have 'no likely significant effects (alone and in-combination)' for European sites, 'no likely damage' for SSSIs, as follows:

- PC <1% long-term critical level and/or critical load for European sites and SSSIs.
- PC <10% short-term critical level for NO_x and hydrogen fluoride (if applicable) for European sites and SSSIs.
- PC <100% long-term critical level and/or critical load other conservation sites.
- PC <100% short-term critical level for NO_x for other conservation sites.

Where impacts cannot be classified as resulting in 'no likely significant effect', more detailed assessment may be required depending on the sensitivity of the feature in accordance with EAs Operational Instruction 67_12. This can require the consideration of the potential for in-combination effects, the actual distribution of sensitive features within the site and local factors (such as the water table).

The guidance provides the following further criteria:

- If the PEC<100% of the appropriate critical level and/or critical load it can be assumed there will be no adverse effect.
- If the background is below the critical level and/or critical load, but a small PC leads to an exceedance – decision based on local considerations.
- If the background is currently above the critical level and/or critical load and the additional PC will cause a small increase – decision based on local considerations.
- If the background is below the critical level and/or critical load, but a significant PC leads to an exceedance – cannot conclude no adverse effect.
- If the background is currently above the critical level and/or critical load and the additional PC is large - cannot conclude no adverse effect.

Section 5.0: Results

5.1 Introduction

Table 5.1 summarises the various impact assessments which were undertaken.

Table 5.1: Impact Assessment Summary

Assessment Type	Section	Relevant Tables/Figures	Comment
Prediction of maximum concentrations (µg/m^3) across modelled grid[5]	5.2	Tables 5.2 – 5.3	Assessment of pollutant impact relative to the environmental standards outlined in Section 2.0 and Section 3.6
Prediction of maximum concentrations (µg/m^3) at discrete sensitive human receptors	5.3	Tables 5.4 – 5.5	
Prediction of maximum concentrations (µg/m^3) at discrete sensitive ecological receptors	5.4	Tables 5.6 – 5.9	

In each instance a screening exercise using only the PC value relative to the applicable environmental standard was undertaken i.e. not considering background concentrations. Where screening occurs, the associated impact is considered negligible. The screening criteria are as follows:

- For long term (i.e. annual mean) assessment, screening occurred where the PC value was <1% of the relevant environmental standard, and
- For short term (i.e. 1-hour mean) assessment, screening occurred where the PC value was <10% of the relevant environmental standard.

5.2 Gridded Human Receptors

As summarised in Section 4.5, five years of weather data have been run to help account for the variation in weather conditions which will be experienced at site. Initial model runs indicated that meteorological data from 2020 produced the highest concentrations at discrete receptor locations. As such, grid models have been run using a meteorological year of 2020. Contour plots for long and short-term NO_2 are included in Appendix B.

5.2.1 Annual Mean NO_2

As shown in Table 5.2, the annual mean NO_2 PCs are above 1% of the limit value at worst case locations across the modelled grid in both the existing and proposed scenario. This is highlighted in Figure B.1 and B.2 which shows that exceedances of the 1% limit value are predicted across a large area, predominately to the north-east of the site. This area of exceedance encompasses several sensitive receptors located north-east of the site in the town of Hedon and village of Preston. The increasing of the limit value to 50 mg/m^3 results in a maximum net PC increase of 0.6 µg/m^3 at the worst-case grid location, which corresponds to 1.5% of the limit value.

The corresponding NO_2 PECs are below the 40 µg/m^3 limit value across the modelled grid in both modelled scenarios. A maximum PEC of 24.5 µg/m^3 is predicted across the grid (proposed scenario) which is 39% below the limit value. As such, it is considered that the impact of increasing the NO_x ELV does not amount to significant pollution with regard to annual mean NO_2 concentrations.

5.2.2 1-Hour Mean NO_2

As shown in Table 5.3 the 1-hour mean NO_2 PCs are above 10% of the limit value at worst case locations across the modelled grid in both the existing and proposed scenario. This is highlighted in Figure B.3 and B.4 which shows that exceedances of the 10% significance threshold are predicted, however this is largely

[5] The grid is modelled at 1.5m representative of human breathing height at ground level but the point of maximum impact which is reported will, where applicable, include any sensitive receptors which have been modelled at height

constrained to a small area north-east of the site boundary. This area is not a location where members of the public are reasonably expected to spend up to 1 hour. Concentrations are expected to drop below 10% of the limit value approximately 1km form the site boundary. The increasing of the limit value to 50 mg/m^3 results in a maximum net PC increase of 8.0 µg/m^3 at the worst-case grid location, which corresponds to 4% of the limit value.

The corresponding NO_2 PECs are below the 40 µg/m^3 limit value across the modelled grid in both modelled scenarios. A maximum PEC of 83.3 µg/m^3 is predicted across the grid (proposed scenario) which is 58% below the limit value. As such, it is considered that the impact of increasing the NO_x ELV does not amount to significant pollution with regard to 1-hour mean NO_2 concentrations.

Table 5.2: 2020 Maximum Predicted Concentration of Annual Mean NO_2 Across Modelled Grid (Long Term)

Scenario	Reference Period	Limit Value (µg/m³)	PC (µg/m³)	PC: % of Limit	BC (µg/m³)	PEC (µg/m³)	PEC: % of Limit	Location (x, y, z)			Net PC Change Between Scenarios	Net PC Change as % of Limit
Existing	Annual Mean	40	**2.4**	**6%**	21.5	23.9	60%	516405	428454	1.5	+0.6	1.5%
Proposed			**3.0**	**8%**		24.5	61%	516405	428454	1.5		

Table 5.3: 2020 Maximum Predicted Concentration of 1-Hour Mean NO_2 Across Modelled Grid (Short Term)

Scenario	Reference Period	Limit Value (µg/m³)	PC (µg/m³)	PC: % of Limit	BC (µg/m³)	PEC (µg/m³)	PEC: % of Limit	Location (x, y, z)			Net PC Change Between Scenarios	Net PC Change as % of Limit
Existing	1 Hour (99.79th percentile)	200	**32.3**	**16%**	43.0	75.3	38%	516405	428454	1.5	+8	4%
Proposed			**40.3**	**20%**		83.3	42%	516405	428454	1.5		

5.3 Discrete Human Receptors

5.3.1 Annual Mean NO_2

The maximum predicted annual mean NO_2 concentrations at the human receptor locations are summarised in Table 5.4.

Table 5.4: Maximum Predicted Annual Mean NO_2 Impacts at Discrete Human Receptors

Receptor	PC (µg/m³)	PC % of Limit	PEC	PEC % of Limit
Existing Scenario				
R1	0.2	<1%	SCREENED	
R2	**1.7**	**4%**	23.2	58%
R3	**0.8**	**2%**	13.9	35%
R4	**0.9**	**2%**	15.2	38%
R5	0.2	<1%	SCREENED	
R6	0.2	<1%	SCREENED	
Proposed Scenario				
R1	0.2	<1%	SCREENED	
R2	**2.1**	**5%**	23.6	59%
R3	**1.0**	**3%**	14.1	35%
R4	**1.1**	**3%**	15.4	39%
R5	0.2	<1%	SCREENED	
R6	0.2	<1%	SCREENED	
Limit Value (µg/m³)	**40**			

*Exceedances of screening criteria, where applicable, are highlighted in **bold**.

The annual mean NO_2 PCs are above 1% of the limit value at three of the six modelled receptors in both the existing and proposed scenario. A maximum PC of 2.1 µg/m³ is predicted at receptor R2 (proposed scenario) which is located approximately 1km north of the site. This corresponds to 5% of the limit value. The increasing of the limit value to 50 mg/m³ results in a maximum net PC increase of 0.4 µg/m³ at the modelled discrete sensitive human receptors, which corresponds to 1% of the limit value.

The corresponding NO_2 PECs are well below the 40 µg/m³ limit value at all modelled receptors, in both modelled scenarios. A maximum PEC of 23.6 µg/m³ is predicted at receptor R2, which is below the limit value by 41%. As such, it is considered that the impact of increasing the NO_x ELV does not amount to significant pollution with regard to annual mean NO_2 concentrations at modelled discrete sensitive human receptors.

5.3.2 1-Hour Mean NO_2

The maximum predicted 99.79th percentile 1-hour mean NO_2 concentrations at the receptor locations are summarised in Table 5.5.

Table 5.5: Maximum Predicted 99.79th Percentile 1-hour Mean NO_2 Impacts at Discrete Human Receptors

Receptor	PC (µg/m³)	PC % of Limit	PEC	PEC % of Limit
Existing Scenario				
R1	6.1	3%	SCREENED	
R2	14.5	7%	SCREENED	
R3	6.3	3%	SCREENED	
R4	7.9	4%	SCREENED	
R5	7.7	4%	SCREENED	
R6	4.9	2%	SCREENED	
Proposed Scenario				

Receptor	PC (µg/m³)	PC % of Limit	PEC	PEC % of Limit
R1	7.6	4%	SCREENED	
R2	18.1	9%	SCREENED	
R3	7.8	4%	SCREENED	
R4	9.9	5%	SCREENED	
R5	9.6	5%	SCREENED	
R6	6.1	3%	SCREENED	
Limit Value (µg/m³)	**200**			

The 99.79th percentile 1-hour mean PCs are below 10% of the limit value at all modelled receptors in both the existing and proposed scenario. A maximum PC of 18.1 µg/m³ is predicted at receptor R2 (proposed scenario) which corresponds to 9% of the limit value. The increasing of the limit value to 50 mg/m³ results in a maximum net PC increase of 3.6 µg/m³ at discrete sensitive human receptors which corresponds to 1.8% of the limit value.

Furthermore, the corresponding NO_2 PECs are well below the 200 µg/m³ limit value at all modelled receptors, in both modelled scenarios. A maximum PEC of 48.3 µg/m³ is predicted at receptor R2, which is below the limit value by 76%. As such, it is considered that the impact of increasing the NO_x ELV does not amount to significant pollution with regard to 1-hour mean NO_2 concentrations at modelled discrete sensitive human receptors.

5.4 Discrete Ecological Receptors

5.4.1 Annual Mean NO_x

The maximum predicted annual mean NO_x concentrations at the discrete ecological receptor locations are summarised in Table 5.6.

Table 5.6: Maximum Predicted Annual Mean NO_x Impacts at Discrete Ecological Receptors

Receptor	PC (µg/m³)	PC % of Limit	PEC	PEC % of Limit
Existing Scenario				
ECO1	<0.1	<1%	SCREENED	
ECO2	0.3	<1%	SCREENED	
ECO3	0.2	<100%	SCREENED	
ECO4	0.2	<100%	SCREENED	
ECO5	0.2	<100%	SCREENED	
Proposed Scenario				
ECO1	<0.1	<1%	SCREENED	
ECO2	**0.4**	**1%**	13.5	45%
ECO3	0.3	<100%	SCREENED	
ECO4	0.2	<100%	SCREENED	
ECO5	0.2	<100%	SCREENED	
Limit Value (µg/m³)	**30**			

*Exceedances of screening criteria, where applicable, are highlighted in **bold**.

The annual mean NO_X impacts at modelled receptors ECO1 and ECO3-5 are screened below their respective criteria for both existing and proposed scenarios such that 'no likely significant effects (alone and in-combination)' for European sites and 'no likely damage' for LWS sites is determined.

A maximum PC of 0.4 µg/m³ is predicted at receptor ECO2 (proposed scenario) which is located approximately 3.6km south-west of the site on the banks of the Humber Estuary. This corresponds to 1% of the limit value. The increasing of the limit value to 50 mg/m³ results in a maximum net PC increase of 0.1 µg/m³ at discrete sensitive ecological receptors, which corresponds to 0.3% of the limit value.

The corresponding NO_x PEC at ECO2 is well below the 30 µg/m^3 limit value. A PEC of 13.5 µg/m^3 is predicted at receptor ECO2, which is below the limit value by 55%. The EA's Operational Instruction 67_12 states that if the PEC<100% of the appropriate critical level and/or critical load it can be assumed there will be no adverse effect. No adverse effect is therefore determined for ECO2.

5.4.2 24-Hour Mean NO_x

The maximum predicted 24-hour mean NO_x concentrations at the discrete ecological receptor locations are summarised in Table 5.7.

Table 5.7: Maximum Predicted 24-Hour Mean NO_x Impacts at Discrete Ecological Receptors

Receptor	PC (µg/m^3)	PC % of Limit	PEC	PEC % of Limit
Existing Scenario				
ECO1	6.4	<10%	SCREENED	
ECO2	5.2	<10%	SCREENED	
ECO3	5.5	<100%	SCREENED	
ECO4	6.2	<100%	SCREENED	
ECO5	1.6	<100%	SCREENED	
Proposed Scenario				
ECO1	6.6	<10%	SCREENED	
ECO2	6.4	<10%	SCREENED	
ECO3	6.9	<100%	SCREENED	
ECO4	7.7	<100%	SCREENED	
ECO5	2.0	<100%	SCREENED	
Limit Value (µg/m^3)	**75**			

*Exceedances of screening criteria, where applicable, are highlighted in **bold**.

The daily mean NO_X impacts at modelled receptors ECO1-2 and ECO3-5 are screened below their respective criteria for both existing and proposed scenarios such that 'no likely significant effects (alone and in-combination)' for European sites and 'no likely damage' for LWS is determined.

5.5 Nitrogen Deposition

The predicted annual nitrogen deposition rates at the receptor locations are summarised in Table 5.8.

Table 5.8: Maximum Predicted Annual Mean Nitrogen Deposition Rates at Discrete Ecological Receptors

Receptor	PC (kgN/ha/yr)	PC % of Lower Critical Load	PC % of Upper Critical Load	PEC (kgN/ha/yr)	PEC % of Lower Critical Load	PEC % of Upper Critical Load
Existing Scenario						
ECO1	0.005	<0.1%	<0.1%	SCREENED		
ECO2	**0.085**	**1.7%**	0.9%	**16.9**	**340%**	**170%**
ECO3	0.065	<100%	<100%	SCREENED		
ECO4	0.056	<100%	<100%	SCREENED		
ECO5	0.046	<100%	<100%	SCREENED		
Proposed Scenario						
ECO1	0.006	0.1%	<0.1%	SCREENED		
ECO2	0.107	**2.1%**	**1.1%**	**17.0**	**340%**	**170%**
ECO3	0.081	<100%	<100%	**SCREENED**		
ECO4	0.069	<100%	<100%	**SCREENED**		
ECO5	0.058	<100%	<100%	**SCREENED**		

*Exceedances of screening criteria, where applicable, are highlighted in **bold**.

The annual mean nitrogen deposition PC is above 1% of the lower critical loads at ECO2 in the existing scenario and the proposed scenario. The PC is below 1% of the upper critical loads at ECO2 in the existing scenario and above 1% in the proposed scenario.

As highlighted in Table 3.5, the existing nitrogen deposition rates at receptor ECO2 far exceed the lower and upper critical loads. The PEC from Table 5.8 confirms that lower critical loads are exceeded at ECO2, in both the existing and proposed scenario.

The actual contribution of the site to nitrogen deposition (PC) is imperceptible with a maximum concentration of 0.1 N/ha/yr predicted at receptor ECO2 in the proposed scenario. The increasing of the limit value to 50 mg/m^3 results in a PC increase of 0.02 kgN/ha/yr at receptor ECO2, which corresponds to 0.4% of the lower critical load.

As stated in the EA's Operational Instruction 67_12, where the background is currently above the limit and the additional PC will cause a small increase, decisions on significance can based on local considerations. Considering that existing deposition rates are high in comparison to lower and upper critical loads and given the nitrogen deposition PC is imperceptible (max of 0.1 N/ha/yr at discrete receptors), the effects of nitrogen deposition on sensitive ecological receptors are considered acceptable.

5.6 Acid Deposition

The predicted annual acid deposition rates at the receptor locations are summarised in Table 5.9.

Table 5.9: Maximum Predicted Annual Mean Acid Deposition Rates at Discrete Ecological Receptors

Receptor	Nitrogen PC (keq/ha/yr)	CLmaxN (keq/ha/yr)	PC % of CLmaxN	Nitrogen PEC (keq/ha/yr)	PEC: % of CLmaxN
Existing Scenario					
ECO1	<0.001	1.312	<0.1%	SCREENED	
ECO2	0.003	1.312	0.2%	SCREENED	
ECO4	0.004	8.69	<100%	SCREENED	
Proposed Scenario					
ECO1	<0.001	1.312	<0.1%	SCREENED	
ECO2	0.004	1.312	0.3%	SCREENED	
ECO4	0.005	8.69	<100%	SCREENED	

The annual mean acid deposition PCs are below the relevant screening criteria for ClmaxN at all modelled receptors in both modelled scenarios. The actual contribution of the site (PC) to acid deposition is imperceptible with a maximum predicted concentration of 0.005 kgeq/ha/year. The increasing of the limit value to 50 mg/m^3 results in a maximum PC increase of 0.001 kgeq/ha/year at discrete sensitive ecological receptors, which corresponds to 0.1% of the minimum CLmaxN.

Considering the above, and with reference to the EA's Operational Instruction 67_12, the effects of acid deposition on sensitive ecological receptors are considered acceptable.

Section 6.0: Conclusions

Crestwood Environmental, now part of Mabbett, was appointed by Saltend Cogeneration Company Limited to undertake a detailed air quality dispersion modelling assessment assessing the impacts of increasing the Emissions Limit Value (ELV) at three gas turbines at the Saltend Power Station, Hull.

Dispersion modelling was undertaken using ADMS-6. For the purposes of assessing impacts on sensitive human and ecological receptors, NO_x and NO_2 were including in the dispersion modelling.

The dispersion model results were compared against the relevant limits, as summarised below:

- The annual mean NO_2 PCs are above 1% of the limit value at three of the six discrete modelled receptors and at hypothetical receptor locations in the modelled grid area, in both the existing and proposed scenarios. However, the corresponding NO_2 PECs are below the 40 µg/m^3 limit value at all modelled receptors and grid locations. As such, it is considered that the impact of increasing the NO_x ELV does not amount to significant pollution with regard to annual mean NO_2 concentrations..
- The 1-hour mean NO_2 PCs are below 10% of the limit value at all discrete modelled receptors but above 10% of the limit value at hypothetical receptor locations in the modelled grid area, in both the existing and proposed scenarios. Furthermore, the corresponding NO_2 PECs are below the 200 µg/m^3 limit value at all modelled receptors and grid locations. As such, it is considered that the impact of increasing the NO_x ELV does not amount to significant pollution with regard to 1-hour mean NO_2 concentrations..
- The annual mean NO_x PCs are above their respective screening criteria at one of the five discrete modelled ecological receptors in the proposed scenario only. The maximum PC change, as a result of increasing the ELV, is 0.1 µg/m^3 which corresponds to 0.3% of the limit value. As such, it is considered that the impact of increasing the NO_x ELV does not amount to significant pollution with regard to annual mean NO_x concentrations at sensitive ecological receptors..
- The 24-hour mean NO_x PCs are below their respective screening criteria at all discrete modelled ecological receptors. As such, it is considered that the impact of increasing the NO_x ELV does not amount to significant pollution with regard to 24-hour mean NO_x concentrations at sensitive ecological receptors..
- The annual mean nitrogen deposition PCs are above their respective screening criteria at one receptor in the existing and proposed scenario. This exceedances is predicted at receptor ECO2 where the PC exceeds 1% of the lower and upper critical loads. The maximum PC change at receptor ECO2, as a result of increasing the ELV, is 0.02 kgN/ha/yr which corresponds to 0.4% of the limit value. Considering that existing deposition rates are high in comparison to lower and upper critical loads and given the nitrogen deposition PC from the site is imperceptible, it is considered that the impact of increasing the NO_x ELV does not amount to significant pollution with regard to nitrogen deposition at sensitive ecological receptors.
- The annual mean acid deposition PCs are below their respective screening criteria at all modelled receptors. As such, it is considered that the impact of increasing the NO_x ELV does not amount to significant pollution with regard to acid deposition at sensitive ecological receptors.

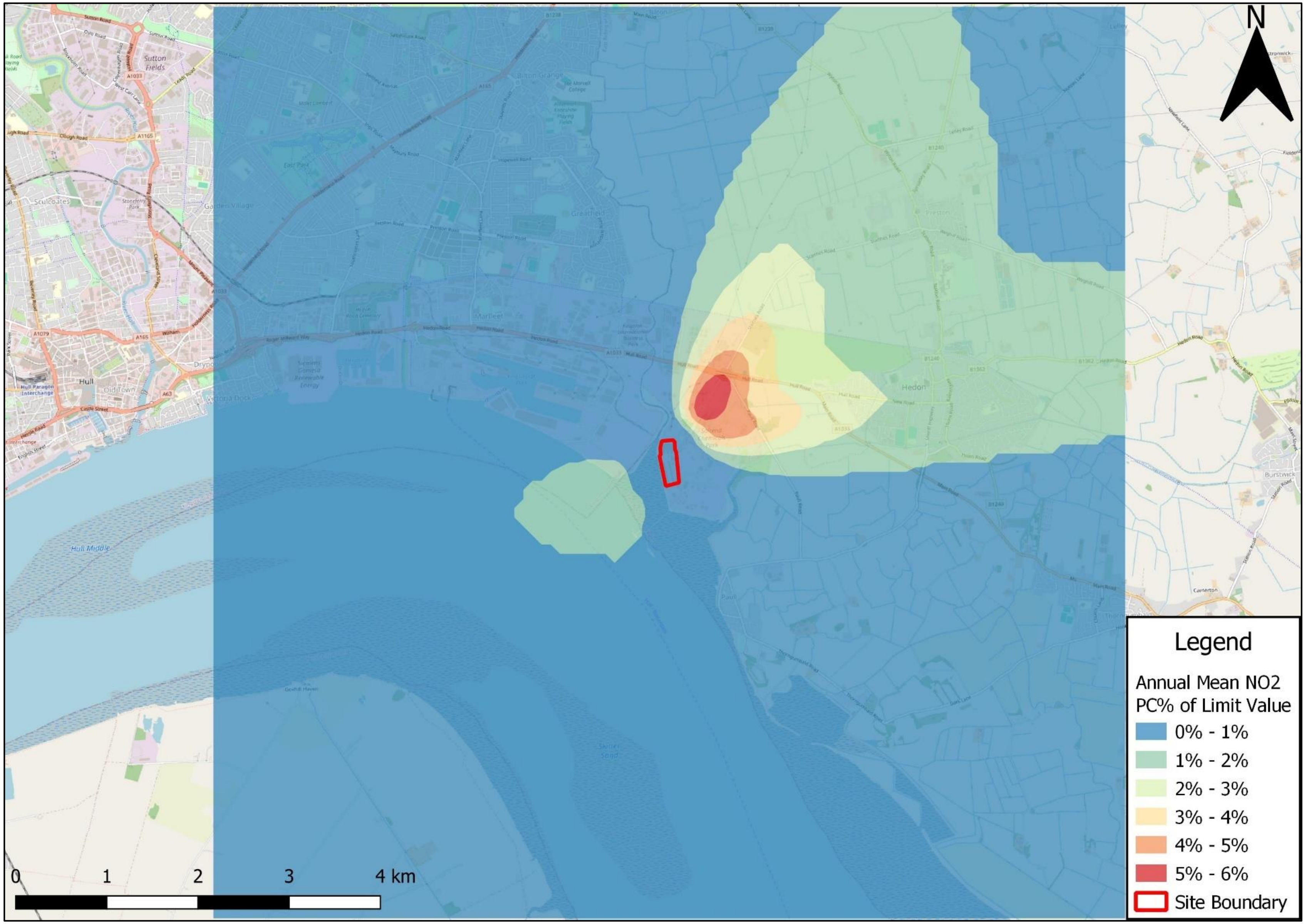
The overall impacts of emissions, from increasing the ELV, on existing sensitive human and ecological receptors are considered to be insignificant.

Appendix A: Examples of Where Environmental Standards Apply

Averaging Period	Objectives should apply at:	Objectives should generally not apply at:
Annual Mean	▪ All locations where members of the public might be regularly exposed. ▪ Building façades of residential properties, schools, hospitals, care homes, etc.	▪ Building façades of offices or other places of work where members of the public do not have regular access. ▪ Hotels, unless people live there as their permanent residence. ▪ Gardens of residential properties. ▪ Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short term.
24 Hour Mean	▪ All locations where the annual mean objectives would apply, together with hotels. ▪ Gardens of residential properties.	▪ Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short term.
1 Hour Mean	▪ All locations where the annual mean and 24 and 8 hour mean objectives would apply. ▪ Kerbside sites (e.g. pavements of busy shopping streets). ▪ Those parts of car parks, bus stations and railway stations, etc. which are not fully enclosed, where the public might reasonably be expected to spend one hour or more. ▪ Any outdoor locations at which the public may be expected to spend on hour or longer.	▪ Kerbside sites where the public would not be expected to have regular access.
15 Minute Mean	▪ All locations where members of the public might reasonably be expected to spend a period of 15 minutes or longer.	

Appendix B: Contour Plots

Figure B.1 2020 Annual Mean NO_2 Process Contribution as Percentage of the Limit Value (Limit Value 40 µg/m^3) – Existing



Contains Open Street Map Data © 2024

Figure B.2 2020 Annual Mean NO_2 Process Contribution as Percentage of the Limit Value (Limit Value 40 µg/m³) – Proposed

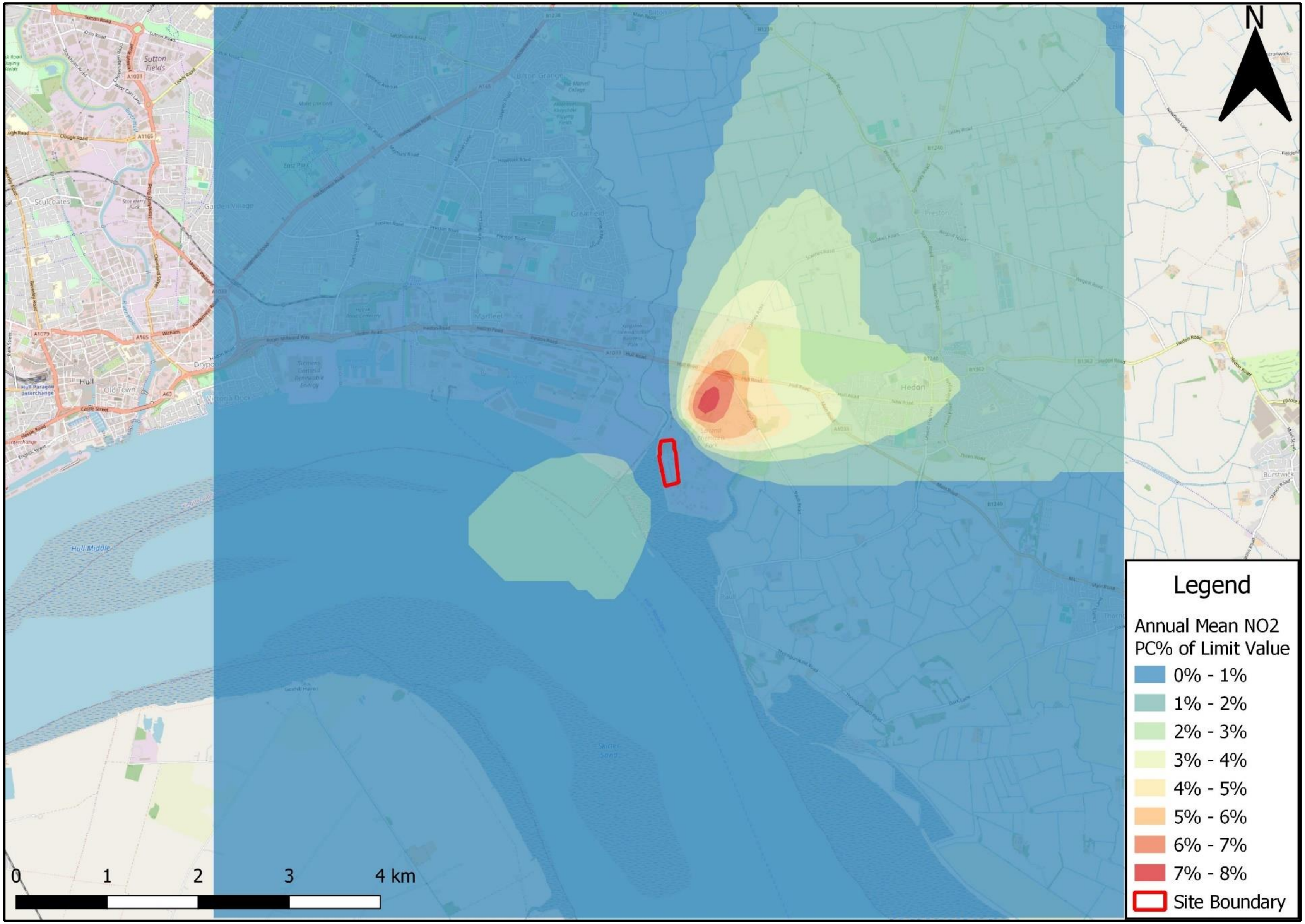


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Figure B.3 2020 1-Hour Mean NO_2 Process Contribution as Percentage of the Limit Value (Limit Value 200 µg/m^3) – Existing

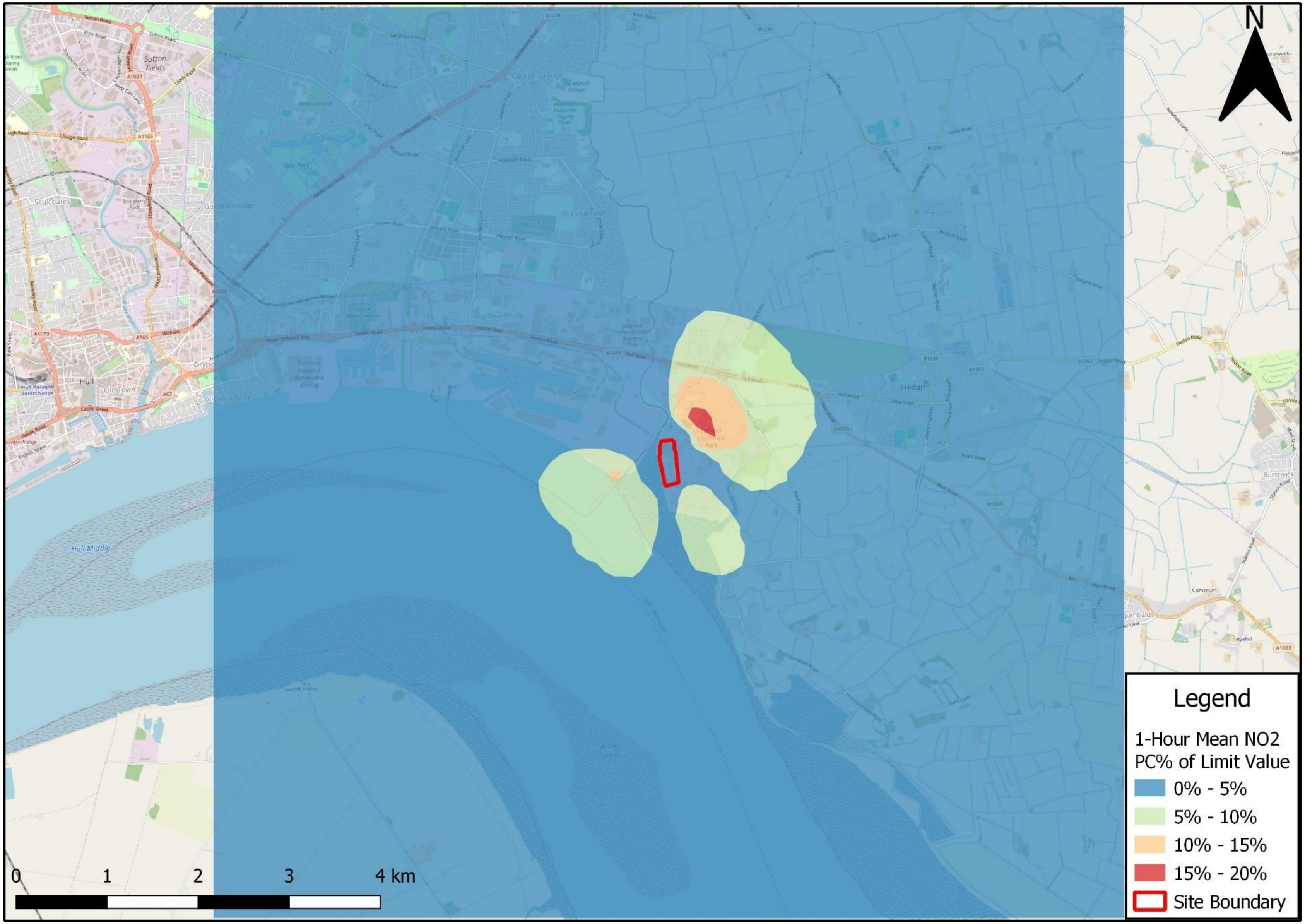

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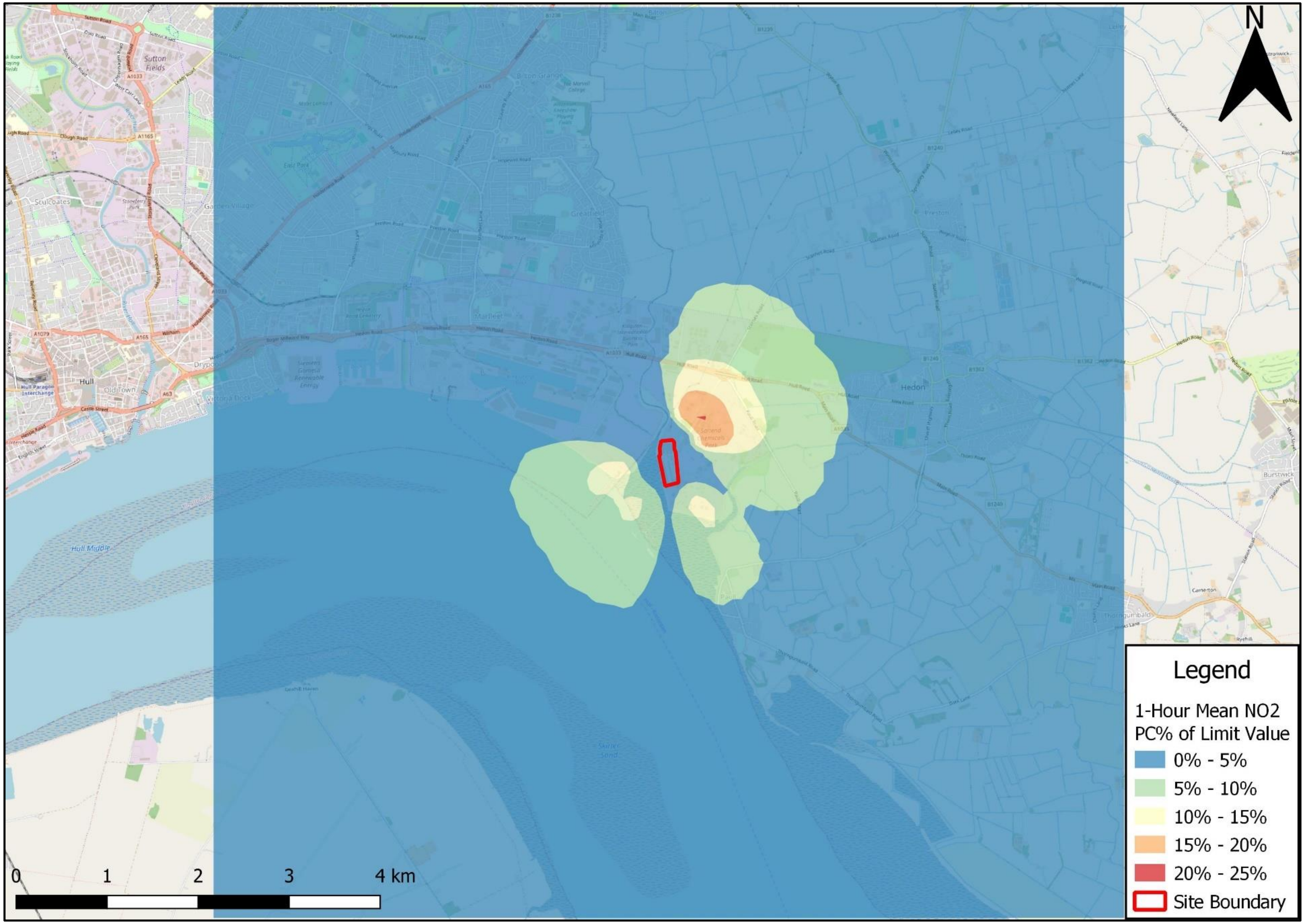
Figure B.4 2020 1-Hour Mean NO_2 Process Contribution as Percentage of the Limit Value (Limit Value 200 µg/m^3) – Existing



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APPENDIX 4 Technical characteristics of the Site as impacted by steam demand and ambient temperatures

Diagram 1 : NOx emission levels to meet steam demand of 120t/hr process steam (single GT in operation), no ambient temperature impact included

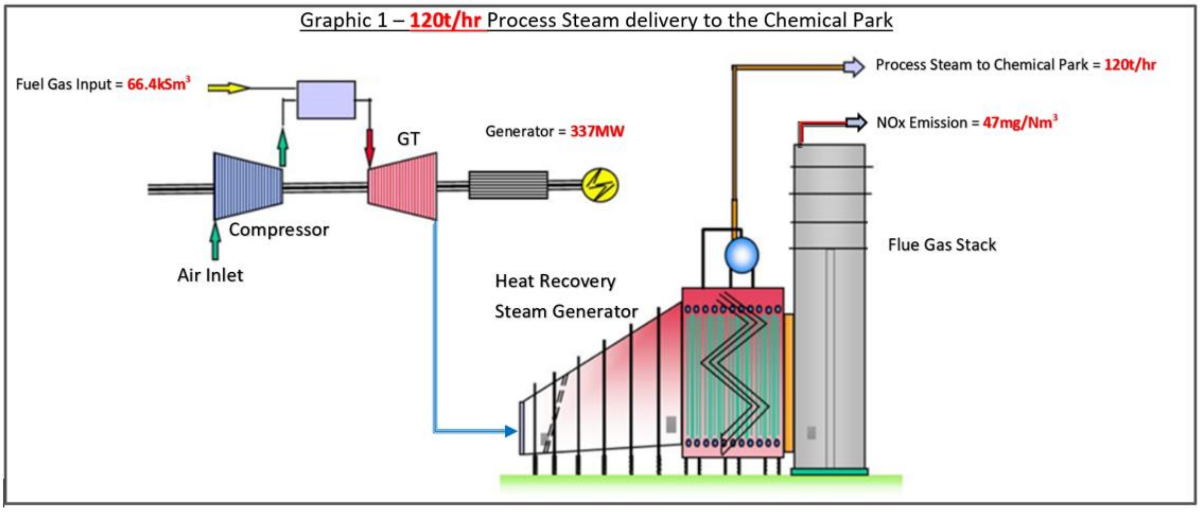
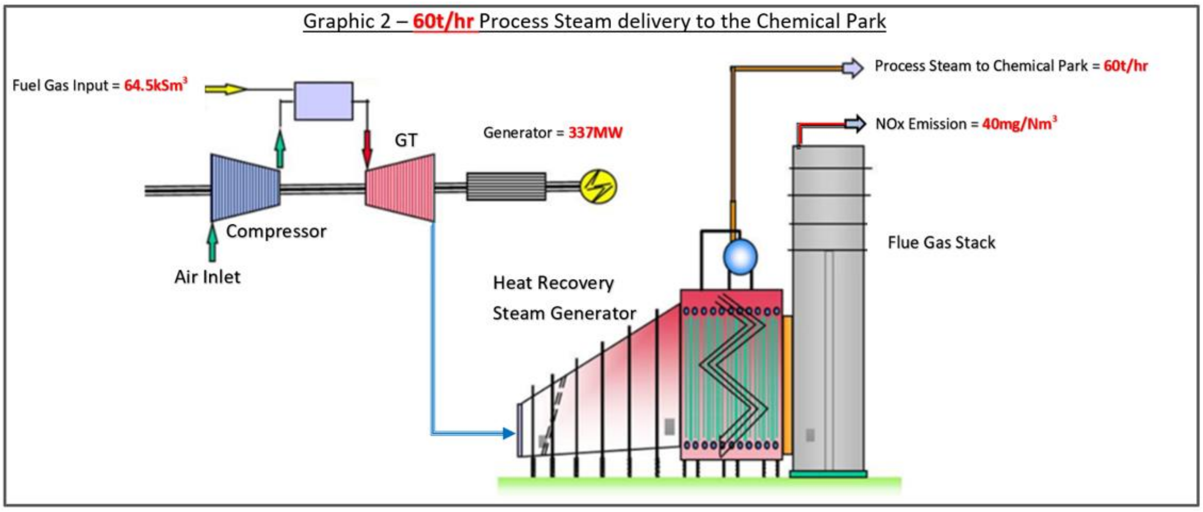


Diagram 2 : Constrained operation to meet NOx limit of 40mg/m3



Diagrams 3 and 4 below demonstrate the impact of ambient temperature on the NOx emissions.

Diagram 3 : NOx emission levels to meet steam demand of 120t/hr process steam (single GT in operation), where the ambient temperature is 24°C

5.1.5

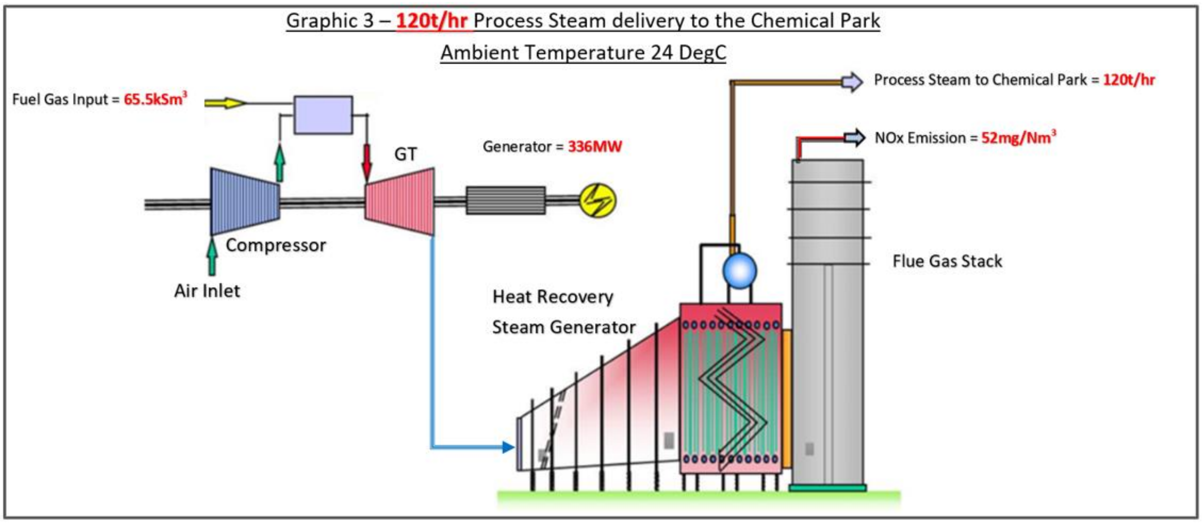
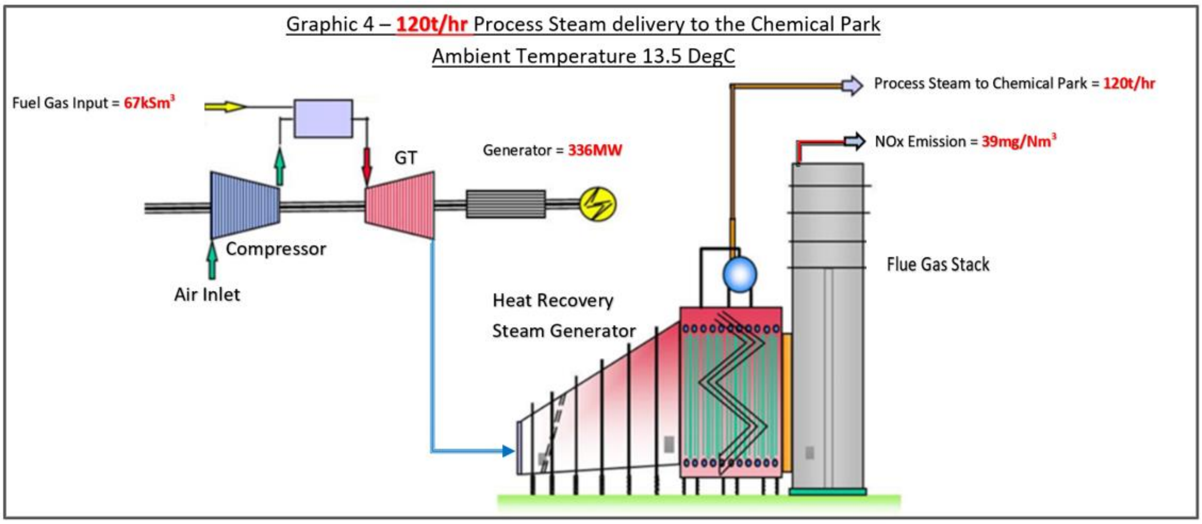
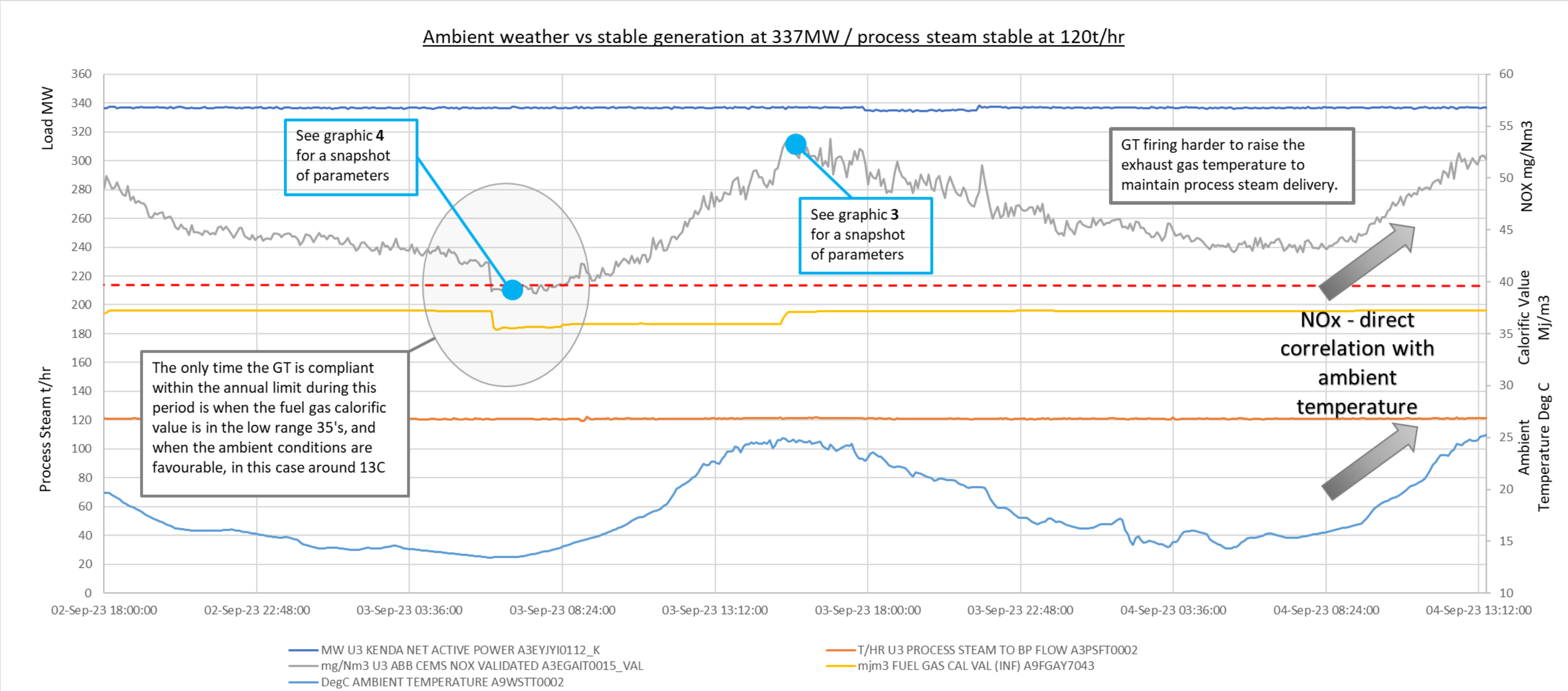


Diagram 4 : NOx emission levels to meet steam demand of 120t/hr process steam (single GT in operation), where the ambient temperature is 13.5°C

5.1.6

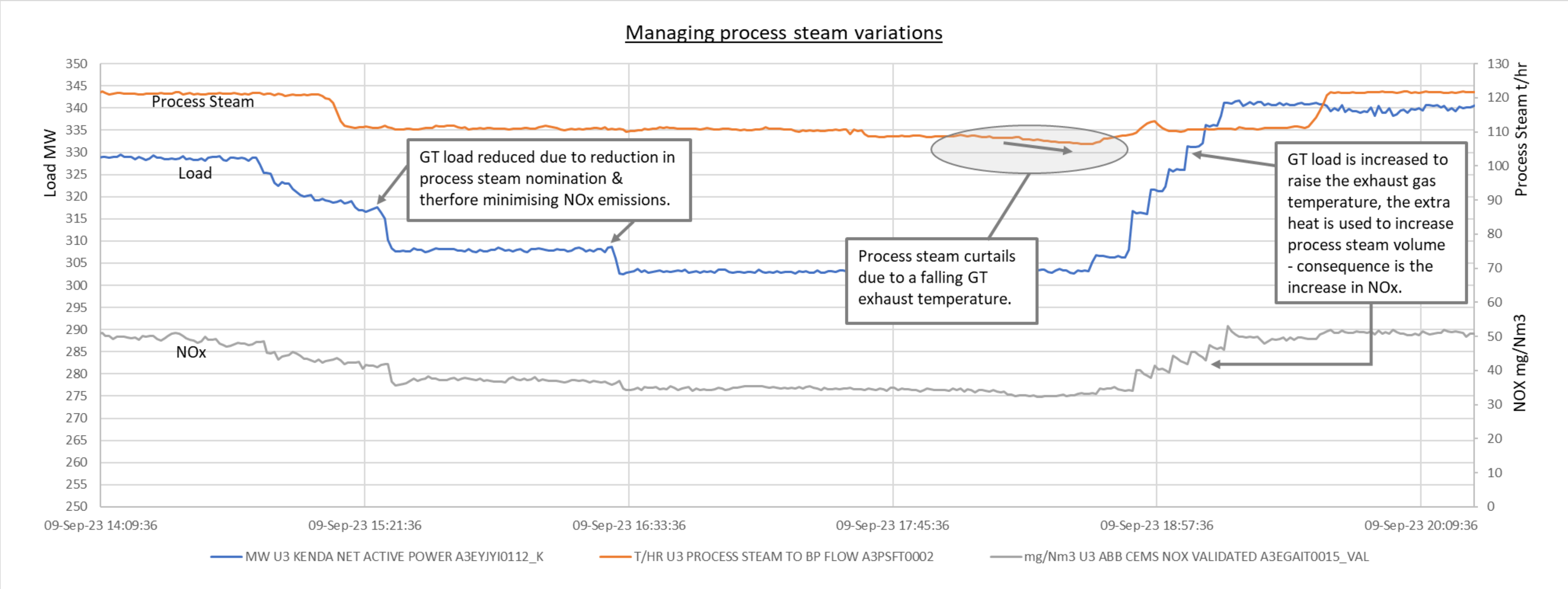


Graph 1:



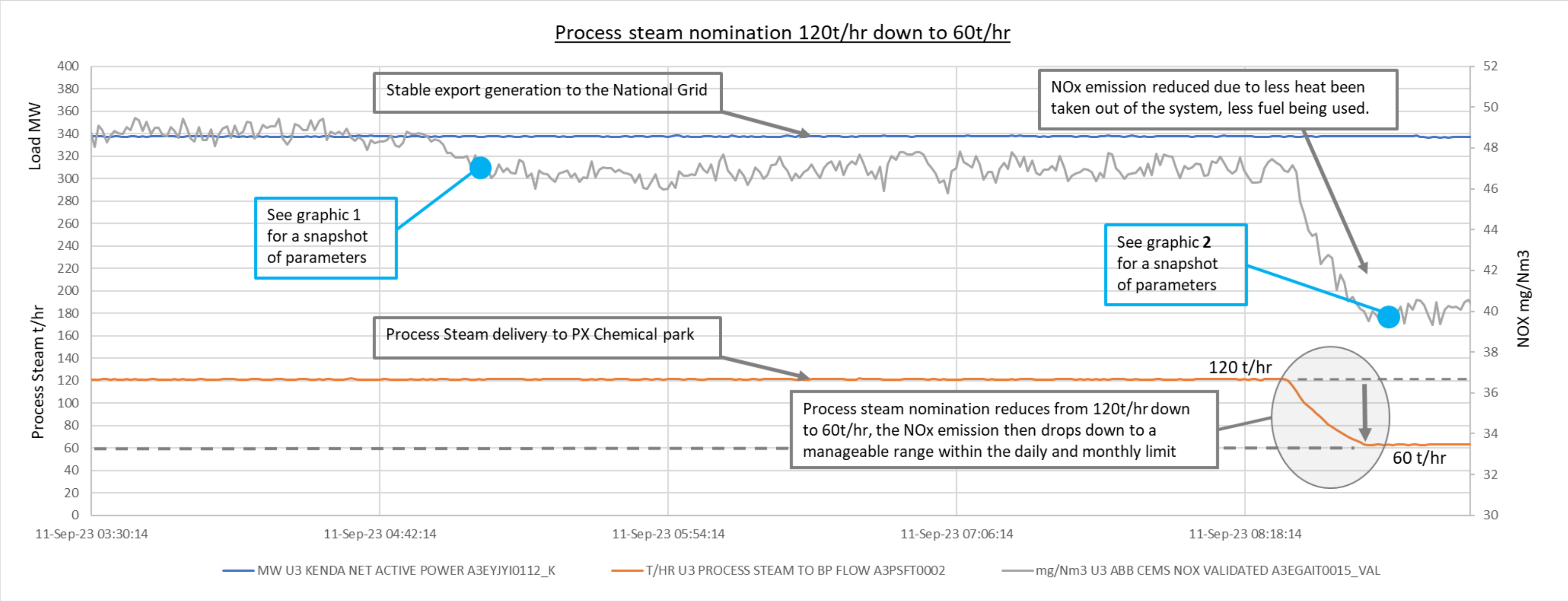
In the graph above, the NOx emissions mirror the ambient temperature. The GTs are fixed volume machines, when the ambient air is cooler it becomes denser, there's then a greater mass of air in the same volume, a higher mass of air flowing through the GTs produces more power. Compressor efficiency is also improved with a lower ambient temperature and therefore more power is sent to the Generator, overall, the GTs don't have to fire as hard for the same MW output and the GT exhaust temperature is lower creating less NOx. The opposite occurs when the ambient temperature is higher, less mass air flowing through the GTs, the GTs must then fire harder, which raises the exhaust gas temperature and creates more NOx.

Graph 2:



This graph shows a GT operating at a stable load of ~330MW electrical output which is being exported to the Grid. Due to a reduction in process steam nomination, the GT unit load is lowered to reduce the average NOx mg/Nm³ value. This is done on a couple of occasions as marked on the graph. After a few hours, the process steam delivery flow starts to tail off (*a change in ambient temperature affects the GT exhaust gas temperature and not enough heat is being generated*). The GT's unit load is increased in stages to try and find the right balance between NOx and exhaust gas temperature. During this period the Site Partners increase their steam nomination which results in the GT being driven harder to meet the delivery needs. The impact here is the NOx emissions are now back to the Annual NOx Limit.

Graph 3:



This graph shows a GT (Unit 3 – LCP 302) operating at a stable load of ~340MW which is being exported to the Grid. The units steam system is delivering 120t/hr to the Site Partners. This 120te of process steam could be converted to an electrical output equivalent of 27MW. When the process steam nomination drops to 60t/hr, you can see the NOx emissions drop to around or close to the Site's Annual NOx Limit. This is due to the GT's exhaust gas temperature dropping. The reduction in steam production means less is being extracted from the combined cycle (Gas & Steam Turbine). As less steam is being extracted from the system, the GT isn't firing as hard to generate extra heat in the Heat Recovery Steam Generator (HRSG).

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