Prepared for
Alpha HPA Limited
ABN: 79 106 879 690

AECOM

Changed Development Approval - Material Change of Use for a Special Industry & Linear Infrastructure Facility

Alpha HPA Processing Plant

13-Jun-2024
ALPHA HPA
Doc No. 60617664

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Changed Development Approval - Material Change of Use for a Special Industry & Linear Infrastructure Facility

Alpha HPA Processing Plant

Applicant: Alpha HPA Limited

ABN: 79 106 879 690

Prepared by

AECOM Australia Pty Ltd
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13-Jun-2024

Job No.: 60617664

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Quality Information

Document	Changed Development Approval - Material Change of Use for a Special Industry & Linear Infrastructure Facility
Ref	60617664
Date	13-Jun-2024
Originator	Renee Weightman
Checker/s	Chris Harris
Verifier/s	Rouven Lau

Revision History

Rev	Revision Date	Details	Approved	
			Name/Position	Signature
0	31-May-2024	Draft for Client Review	Rouven Lau Project Manager	
A	13-Jun-2024	For Lodgement	Rouven Lau Project Manager	

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1.0 Introduction

AECOM Australia Pty Ltd (AECOM) has prepared this Change Application for an SDA Approval pursuant to Schedule 2, Section 4, Item 1b of the Gladstone State Development Area Development Scheme 2022 (GSDA Development Scheme) on behalf of Alpha HPA Limited (Alpha HPA) (the Applicant).

The Approval relates to the High Purity Alumina (HPA) Processing Plant and Linear Infrastructure Facility (the Project) at 53-55 Reid Road, Yarwun. The Project was approved on 25 January 2021 (AP2020/001) and a subsequent change was approved on 26 October 2021 (APC2021/012).

Since the originating Approval, the Project has substantially started with the construction and full operation of Stage 1 Precursor Production Facility (PPF). Stage 2 is yet to commence construction and is in detailed design phase.

Stage 2, located adjacent to the Stage 1 PPF, will produce commercial volumes of HPA and related premium aluminium based materials through proprietary solvent extraction (SX) and refining technology. Stage 2 will leverage the established Stage 1 PPF, and the latest in process control systems and automation to produce ~10,400 tonnes of HPA products per year.

As the Project has progressed, changes have been identified to Stages 1 and 2 which have required updated assessment of the Projects environmental impacts and associated technical reports. As a result, the changes have triggered Changes to the Conditions of the SDA Development Approval and Environmental Authority (EA).

It is noted that proposed change is not:

- changing the approved Environmentally Relevant Activities (ERAs) (chemical manufacturing or crushing, milling, grinding or screening)
- including additional ERAs as a result of the change
- increasing approved Environmental Protection Regulation 2019 Schedule 2 thresholds conditioned in the EA.

The proposed change will however include a new product being produced on site, and a result of this, the Project has undergone the following key changes:

- site layout change
  - including change of internal driveways
  - car parking locations
  - orientation of buildings
  - location of equipment
  - additional equipment.
- amended landscape plan
- inclusion of temporary construction buildings and vehicular access from Reid Road
- Updated site water management.

These proposed additions and amendments have resulted in the reassessment of the approved Site Water Management Plan, Air Quality Impact Assessment, Preliminary Noise Impact Assessment and Plume Rise Assessment.

In summary, the updated technical reports have concluded the following:

<u>Noise:</u>

- Predicated to exceed day time and nighttime criteria by 2dba and 7bda without noise treatment
- Increase is day and increase in nighttime proposed since the original approval

- Noise treatment recommendations are the same as originally proposed.

Air Quality:

- No changes to the key findings have been noted since the original assessment
- Compliance is expected to be achieved with the relevant air quality objectives.

Plume Rise:

- Modelling has indicated that it is unlikely to present a hazard to local aircraft
- Referral to CASA is recommended for the proposed emergency flare
- No changes with exception of the referral to CASA since the original assessment.

Site Water Management:

- Dry weather release volumes will exceed EA conditions
- Trade waste releases are expected to exceed EA concentration limits
- Trade waste releases are expected to meet mass load limits
- Stormwater system still achieve ERA guideline Pollutant reduction targets.

No other changes are proposed to technical reporting supplied as part of the originating application material.

Stage 2 site establishment and construction activities are expected to commence in July 2024 and continue through to late 2026.

Figure 1 provides a 3D rendering of the Project viewed from Reid Road.

Figure 1 3D Render of Project – Stage 1 and Stage 2

1.1 Application Details

This Planning Report has been prepared to present and evaluate the proposed Change Application for an SDA Approval against the requirements of the GSDA Development Scheme, and other relevant Queensland legislative and policy requirements, for the consideration of the Office of the Coordinator-General (OCG) and relevant Referral Entities. Key application details are provided in Table 1 and Table 2. The Project site is shown on Figure 2.

A separate Amendment Application for the approved Site Specific EA application will be submitted to the Department of Environment, Science and Innovation (DESI) and it is expected that the timing of the applications will be somewhat concurrent and is discussed in Section 2.2.

Table 1 Summary of Application Details

Application Details	
Proponent Name and Address	Alpha HPA Limited Level 2, 66 Hunter Street Sydney NSW 2000
Lot/Plan	Lot 12 on SP239343
Site Area	9.2 ha
Registered Owner	Solindo Pty Ltd
Local Government Area	Gladstone Regional Council
Assessment Manager	Office of the Coordinator General – Gladstone State Development Area
Planning Instrument	Gladstone State Development Area Development Scheme 2022
Existing Use	Stage 1 PPF has been constructed and operational – Special Industry
Approved Land Use	Special Industry (HPA Processing Plant) and Linear Infrastructure Facility
Precinct	Port Related Industry Precinct
Use Definitions	***Special Industry*** *means land used for industrial activities that include the manufacturing, producing, processing, repairing, altering, recycling, storing, distributing, transferring or treating of products and have one or more of the following attributes:* *(a) potential for extreme impacts on sensitive land uses due to offsite emissions including aerosol fume, particle, smoke, odour and noise* *(b) potential for extreme offsite impacts in the event of fire, explosion or toxic release* *(c) onsite controls are required for emissions and dangerous goods risks (d) the use generally involves night time and outdoor activities* *(e) the use may involve the storage and handling of large volumes of dangerous goods and* *(f) requires significant separation from non-industrial uses.* ***Linear Infrastructure Facility*** *means land used for a pipeline or conveyor to transport materials including gas, bulk materials, liquid, slurry or any other mineral.*

Figure 2 Project Site Location (Queensland Globe)

The Project is located within the GSDA, declared by the OCG under the *State Development and Public Works Organisation Act 1971*. Pursuant to Schedule 2, Part 4 of the GSDA Development Scheme, the changed approval will require referral to State referrals that would typically be required under the Planning Regulation 2017. Table 2 lists the applicable referrals, which were also referrals for the originating Development Application.

Table 2 Applicable Referral Agencies

Applicable Referral Agencies Under Planning Regulations 2017				
Part	**Division**	**Table**	**Referral Trigger**	**Referral Agency**
5	4	2	Environmentally Relevant Activity	Department of Environment, Science and Innovation
7	3	1	Hazardous Chemical Facilities	Work Safe Queensland
9	4	1	Transport Related Activities	Department of Transport and Main Roads

1.2 Pre-lodgement

A Pre-lodgement meeting was undertaken with the CG to discuss the proposed changes on 24 May 2024. The OCG provided the following to be addressed in the application package:

- Current version of the GSDA Development Scheme May 2022 is to be used as the assessment benchmarks.
- OCG accept that the Site Water Management Plan will be submitted post lodgement.

- OCG aware that the Operational Works (OPW) for Stage 2 will be lodged with Gladstone Regional Council (GRC) at the same time as the SDA Change Approval, and OCG said they can provide update to GRC to allow for the assessment of the OPW despite the site plans not currently aligning.

1.3 Supporting Information

The following technical reports and documentation are included in support of this Change Application for an SDA Approval:

- Owners' Consent (Appendix A)
- Properly Made Checklist (Appendix B)
- Development Plans (Appendix C)
- Gladstone State Development Area Preferred Development Intent Assessment (Appendix D)
- State Planning Policy Assessment (Appendix E)
- State Development Assessment Codes (Appendix F)
- Air Quality Impact Assessment (Appendix G)
- Plume Rise Assessment (Appendix H)
- Preliminary Noise Impact Assessment (Appendix I)
- Site Water Management Plan (Appendix J).

1.4 Contact

The Applicant contact for this SDA Application is:

Renee Weightman
Principal Planner
AECOM Australia Pty Ltd
Ph: 0431 824 446
Email: renee.weightman@aecom.com

2.0 Project Background

2.1 Overview of Existing SDA Approval

Alpha HPA has obtained an Approval over the Project site (Figure 3) under the *State Development and Public Works Organisations Act 1971* for Development Permit for a Material Change of Use for a Special Industry (HPA Processing Plant) and Linear Infrastructure Facility (APC2021/012) dated 26 October 2021 (the Approval) (Figure 3).

Stage 1 of the site has been constructed and fully operational (Figure 2) and a Development Permit for Operational Works approval was obtained from GRC in 2021 for Stage 1.

The balance of the HPA processing plant will be constructed as Stage 2 of the Project (yet to be constructed) and the subject of this application. Both stages will operate concurrently once Stage 2 is constructed.

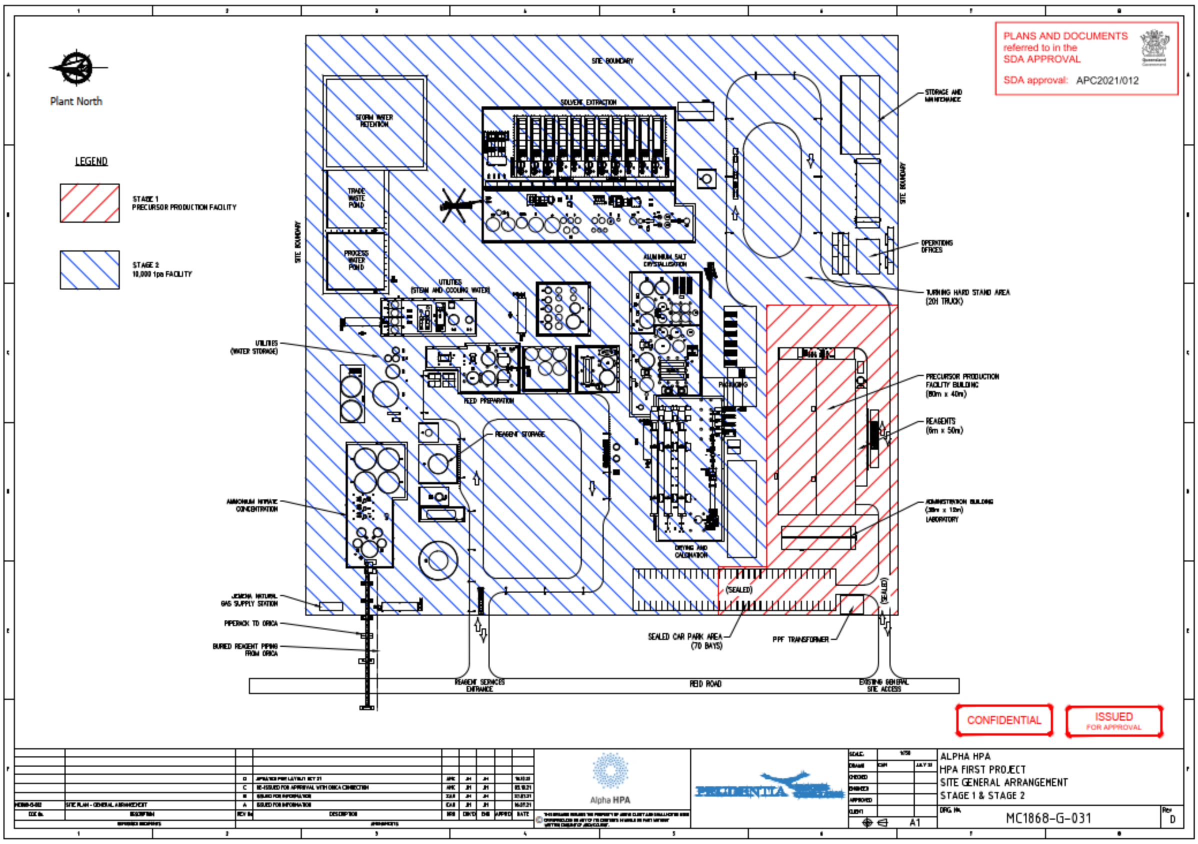

Figure 3 **Approved Site Layout**

2.2 Sequence of Applications

As discussed herein, the Project will require a number of amended Approvals and a new Development Permit to undertake the final changes and allow for the construction of Stage 2. The following provides for an overview of the sequence of the applications:

1. Change Application for an SDA Approval (subject application) lodged beginning of June 2024.
2. To facilitate on site works, an OPW Stage 2 is required to be prepared and submitted to GRC. The OPW allocation will be lodged at the same time as the subject application. This is required to allow for works to commence on site in August / September 2024 for Stage 2.
3. An Amendment to the existing EA is required to be prepared and submitted to the DESI. The EA amendment will be lodged in late June early July 2024.

3.0 Changed Development Approval

3.1 Proposed Changes

This application seeks changes to conditions the approved Special Industry and Linear Infrastructure Facility (APC2021/012).

Since the originating Approvals, the Project has substantially started with the construction and full operation of Stage 1 PPF. Stage 2 is yet to commence construction and is in detailed design phase.

Stage 2, located adjacent to the Stage 1 PPF, will produce commercial volumes of HPA and related premium aluminium based materials through proprietary SX and refining technology. Stage 2 will leverage the established Stage 1 PPF, and the latest in process control systems and automation to produce ~10400 tonnes of HPA products per year.

As the Project has progressed, changes have been identified to Stages 1 and 2 which have required updated assessment of the Projects environmental impacts and associated technical reports. As a result, the changes have triggered Changes to the Conditions of the SDA Development Approval and EA.

It is noted that proposed change is not:

- changing the approved ERAs (chemical manufacturing or crushing, milling, grinding or screening)
- including additional ERAs as a result of the change
- increasing approved Environmental Protection Regulation 2019 Schedule 2 thresholds conditioned in the EA.

The proposed change will however include a new product being produced on site, and a result of this, the Project has undergone the following key changes:

- site layout change
    - including change of internal driveways
    - car parking locations
    - orientation of buildings
    - location of equipment
    - additional equipment.
- amended landscape plan
- inclusion of temporary construction buildings and vehicular access from Reid Road
- updated site water management.

These proposed additions and amendments have resulted in the reassessment of the approved Site Water Management Plan, Air Quality Impact Assessment, Preliminary Noise Impact Assessment and Plume Rise Assessment.

The following provides a background Stage 1 and Stage 2 operations, followed by the proposed condition changes.

3.1.1 Stage 1 – Constructed and Operational

The PPF is an advanced stage of the Project thereby allowing the production of between 10-20 Metric Tonnes (MT) per month of Ultra High Purity alumina, alumina salt products and sapphire crystal.

Stage 1 has been constructed and is currently operational. As constructed plans can be provided upon request. The PPF is fully contained within an industrial shed with any external storage areas being fully covered and appropriately bunded.

Figure 4 demonstrates Stage 1 manufacturing process flow chart:

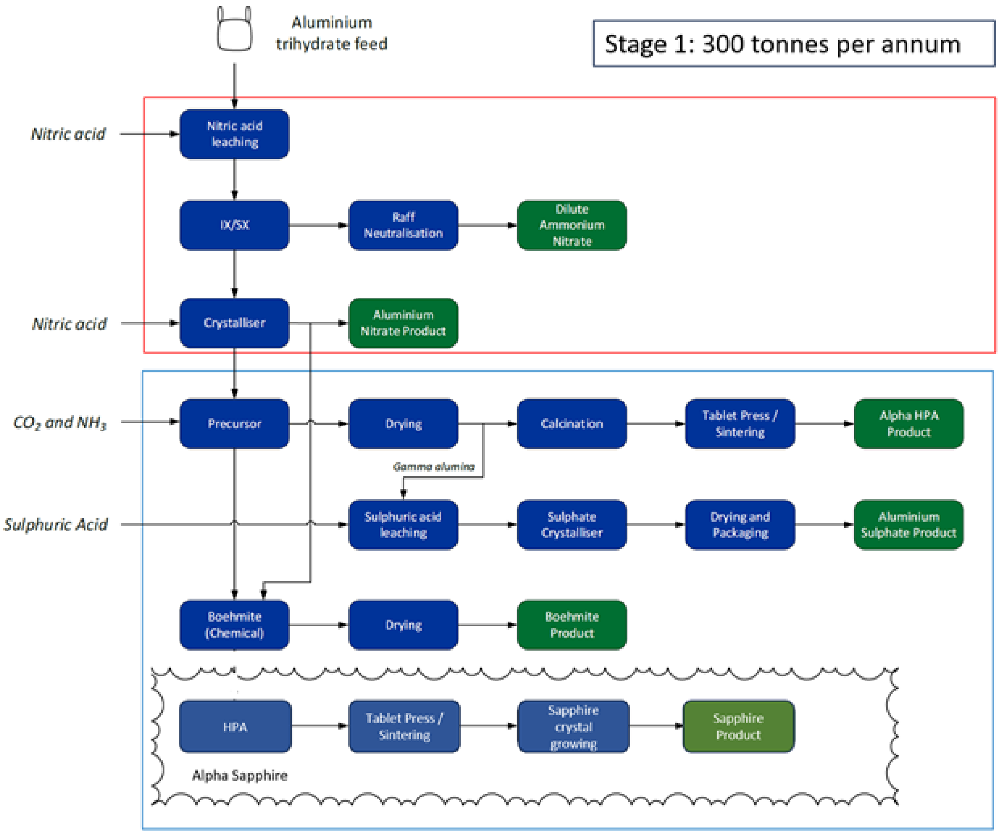

Figure 4 Stage 1 Manufacturing Process Flow Chart

3.1.1.1 PPF Built Form

The PPF generally consists of the following built form.

- general site access
- PPF facility
- PPF Laboratory and administration building
- associated car parking for 40 car parking spaces.

3.1.2 Stage 2 – Yet to be Constructed

The balance of the HPA processing plant will be constructed as Stage 2 of the Project (yet to be constructed). Both stages will operate concurrently once Stage 2 is constructed.

The Project will process an aluminium based feedstock into a >99.99% pure HPA and will manufacture 10,400tpa of HPA and 136,000tpa of Ammonium Nitrate using the following associated processes:

- Feed Preparation
- Aluminium solvent extraction
- Aluminium salt crystallisation
- Product precipitation
- Drying and calcination
- Ammonium nitrate concentration
- HPA product milling and bagging.

The process used by Alpha HPA has been developed specifically for the Project and licensed by Alpha HPA. It has a number of benefits over alternative processing methods and has a low environmental signature.

The Project feedstock is a refined aluminium bearing feedstock sourced locally. The neighbouring Orica operation supplies reagents (nitric acid and ammonia) via separate underground or overhead pipelines and receives the Ammonium Nitrate by-product via an overhead pipeline across Reid Road at a height of approximately 12m.

Stormwater will be treated on site via swales, humeceptors and bioretention basin before being discharged in accordance with Stormwater Guideline: Environmentally Relevant Activities (DES 2014). Boiler blow down and cooling tower blow down will be directed to the Gladstone Regional Council Trade Waste system which discharges via a diffuser at Fisherman's Landing. Runoff from production areas will be collected as first flush and taken off site for disposal. During periods of significant and extended rainfall, secondary runoff from the production areas will be directed to onsite ponds for testing before also discharging to the trade waste system.

Figure 5 demonstrates Stage 2 manufacturing process flow chart:

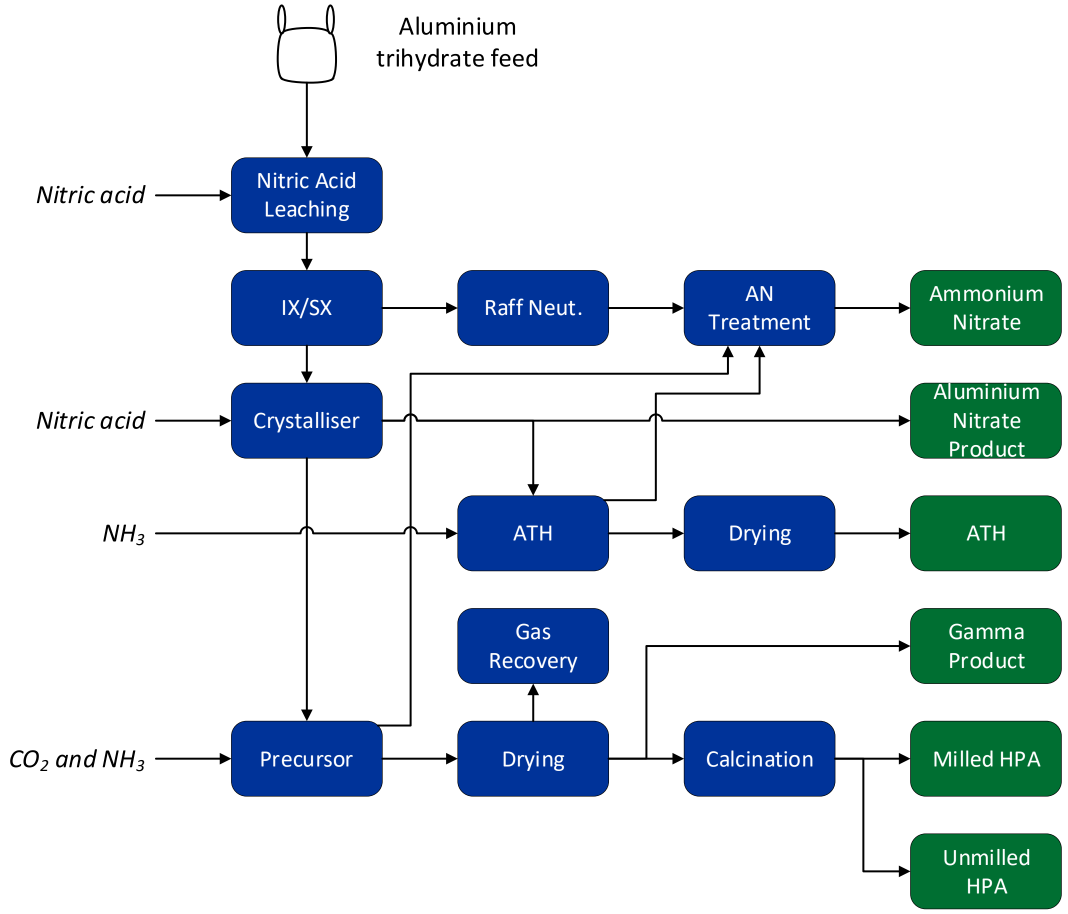

Figure 5 Stage 2 Manufacturing Process Flow Chart

The manufacturing process for Stage 1 and Stage 2 are largely the same, the key differences being that the production capacity for Stage 2 will be significantly higher, and the full suite of products produced in Stage 1 will not all be produced in the larger Stage 2 facility.

For example, the sapphire crystal machines that have been installed as part of Stage 1 will not be replicated on a larger scale for Stage 2. The Stage 2 facility will include a couple of additional treatment steps that are not included in Stage 1, these include additional purification and evaporation of the ammonium nitrate solution, additional treatment of the waste from the IX circuit and additional gas scrubbing steps for recovery of CO2 and NH3 from offgas from the dryers.

This Request to Change an SDA Approval has sought a change in the site layout, inclusion of production of sapphire crystal and additional machinery. It is noted that no change is proposed to the approved chemical manufacturing thresholds approved in the EA as a result of this change or changes to approved land uses.

3.1.2.1 HPA Processing Plant Built Form (Stage 2)

The HPA processing plant will be provided with the following built form.

- feed storage silo sufficient for storage of 3 days of material
- product shed sufficient for storage of 2 days material
- control room
- laboratory
- store and maintenance building
- organic storage shed
- reagent storage tanks (atmospheric tanks or liquid vessels)
- AN storage and concentrator.
- AN preparation shed
- aluminium solvent extraction infrastructure
- aluminium salt crystallisation infrastructure
- production areas
- HPA calcination and bagging infrastructure
- by-product storage tanks
- ammonia and nitric acid will be supplied to the Project via an underground or overhead pipeline from Orica. Ammonium Nitrate Solution will be pumped back to Orica via an over the road pipe-rack at a height of approximately 12 m with a minimum traffic envelope of 10 m x 10 m within the Reid Road reserve as per current approval conditions
- the site will be secured with chain mesh security fencing and security gate/turnstile
- administration building
- associated car parking for an additional 40 car parking spaces
- temporary construction buildings.

3.2 Proposed Condition Changes

3.2.1 Site Layout

Figure 6 and Figure 7 demonstrates the Approved Site Layout in comparison to the Proposed Site Layout. The comparison demonstrates the rearrangement of the equipment on site allowing for the sites optimisation, improved function and site operations.

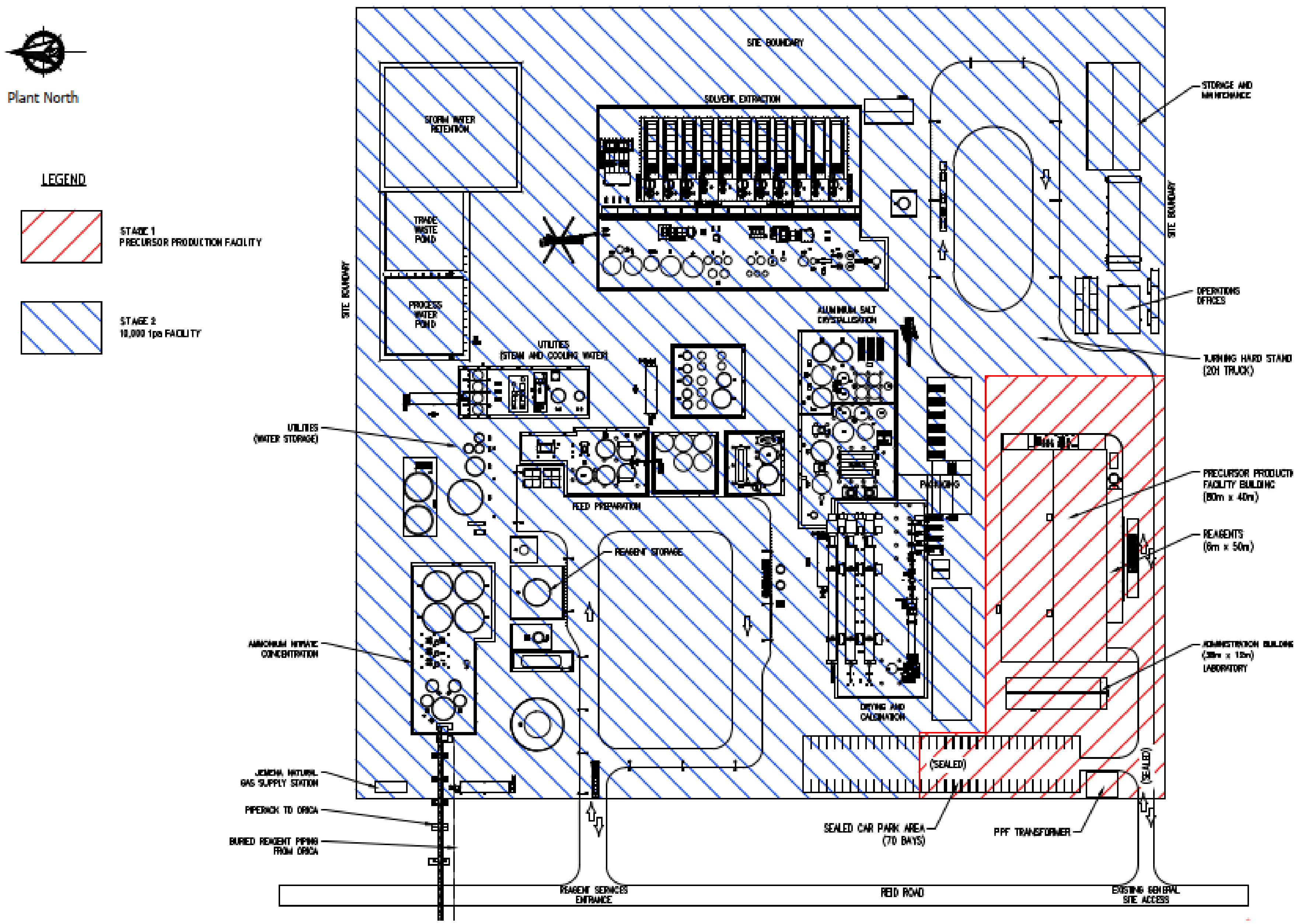

Figure 6 Approved Site Layout

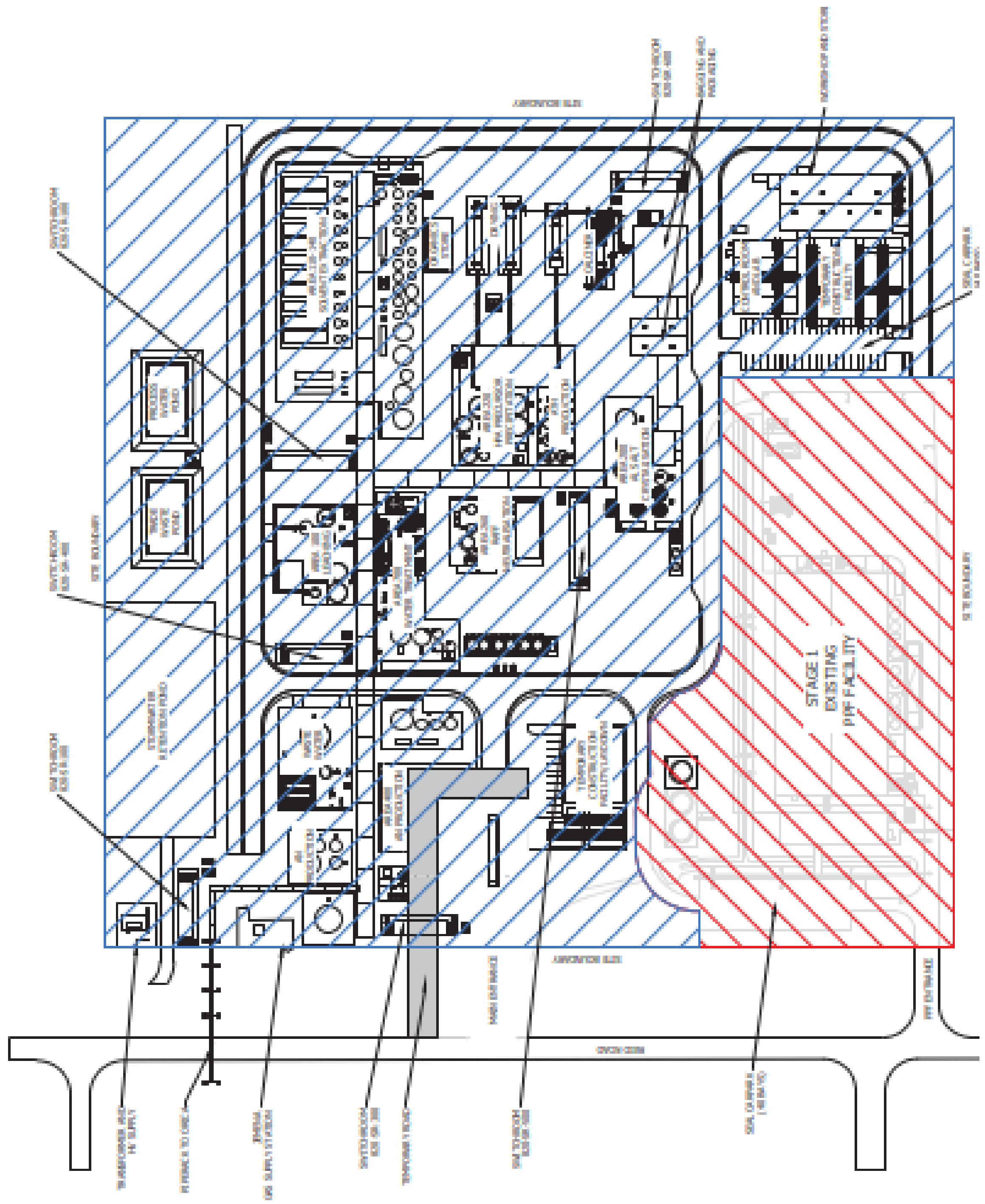

Figure 7 Proposed Site Layout

Table 3 discusses the key changes in the site layout and with the corresponding environmental value.

Table 3 Proposed Changes

Environmental Value	Proposed Changes	Summary of Amended Technical Report Outcome
Air Quality and Plume Rise	• Locations for approved emissions to air have changed. • Additional emission sources are proposed, including emergency flare for ammonia storage and ATH dryer. • Changes to emission concentrations of some existing sources and proposed sources.	An Amended Air Quality Impact Assessment (Appendix G) has been prepared to accompany the request, the technical report concluded the following: • No changes to the key findings have been noted since the original assessment. • Compliance is expected to be achieved with the relevant air quality objectives. An Amended Plume Rise Assessment (Appendix H) has been prepared to accompany the request, the technical report has concluded the following: • Modelling has indicated that it is unlikely to present a hazard to local aircraft. • Referral to CASA is recommended for the proposed emergency flare. • No changes with exception of the referral to CASA since the original assessment.
Noise	• Locations of approved noise emissions have changed. • Additional equipment has been proposed. • Vendor supplied noise estimates have changed.	An Amended Preliminary Noise Impact Assessment (Appendix I) has been prepared to accompany the request, the technical report has concluded the following: • Predicated to exceed day time and nighttime criteria by 2dba and 7bda – increase since originating approval. • Noise treatment recommendations are the same as originally proposed.
Site Water Management	• Changes to drainage layout, e.g some drains buried rather than open and grassed • Pond locations changed e.g stormwater pond moved closer to the western boundary • Trade waste for stage 1 PPF will be included into trade waste discharge, previously trucked.	An Amended Site Water Management Plan (Appendix J) has been prepared to accompany the request, the technical report has concluded the following: • Dry weather release volumes will exceed EA conditions • Trade waste releases are expected to exceed EA concentration limits • Trade waste releases are expected to meet mass load limits • Stormwater system still achieve ERA guideline Pollutant reduction targets.
Traffic / carparking / access arrangement changes	• Site layout has been amended with respect to internal roads layout and carpark added to southeast corner of site adjacent to control room and warehouse. • Access from Reid Road remains as	No changes are required to the approved Traffic Impact Assessment, whilst it is acknowledged that the plans referenced in the assessment have been amended, no changes are proposed that will impact the conditions of the SDA Development

Environmental Value	Proposed Changes	Summary of Amended Technical Report Outcome
	approved two site access locations, with the inclusion of a temporary site access. • No changes are proposed to the Traffic Impact Assessment.	Approval or recommendations of the assessment.
Other site layout changes	• Amended landscape plan. • Changes to warehouse capacity and locations. • Temporary construction facilities have been included eg. site office buildings, laydown yards, temporary fencing, temporary site access road for a minimum period of 2 years.	Landscape plans and amended site plans have been included in Appendix C. It is considered that proposed changes are not introducing a new use or increasing the scale or intensity of the use.

3.2.2 Requested Condition Changes

Table 4 discusses the proposed condition changes sought as part of this request.

Table 4 Requested Condition Changes

<table>
<tr><th>No</th><th>Conditions of the SDA Approval</th><th>Timing</th><th>Condition Change</th></tr>
<tr><td colspan="4">Condition 1 – Approved plans and documents</td></tr>
<tr><td>1.1</td><td>Carry out the approved development generally in accordance with the approved plans and documents as referenced in Table 1 (including any amendments marked in red), except insofar as modified by any of the conditions of this approval.
<table>
<tr><th>Title</th><th>Prepared By</th><th>Document No</th><th>Date</th></tr>
<tr><td>Alpha HPA – HPA First Project Overall Site with background</td><td>PRUDENTIA Process consulting</td><td>MC1868-G-004 Rev: J</td><td>15/10/2021</td></tr>
<tr><td>Alpha HPA – HPA First Project Site General Arrangement – Stage 1 – Precursor Production Plant</td><td>PRUDENTIA Process consulting</td><td>MC1868-G-030 Rev: E</td><td>19/10/2021</td></tr>
<tr><td>Alpha HPA – HPA First Project Site General Arrangement –Stage 1 & Stage 2</td><td>PRUDENTIA Process consulting</td><td>MC1868-G-031 Rev: D</td><td>15/10/2021</td></tr>
<tr><td>Precursor Production Facility – General Site Wide – Stage 1 – Landscaping Plan – General Details</td><td>PRUDENTIA Process consulting</td><td>MC21023-1810-C-DRG-020 Rev: B</td><td>19/10/2021</td></tr>
<tr><td>Alpha HPA – HPA First Project Site General Details Landscaping Plan</td><td>PRUDENTIA Process consulting</td><td>MC1868-G-001 Rev: D</td><td>15/10/2021</td></tr>
</table></td><td>To be maintained at all times</td><td>Condition 1.1 is requested to be amended to reference the revised set of drawings provided in Appendix C and technical reports including:
• Air Quality (Appendix G)
• Plume Rise (Appendix H)
• Preliminary Noise Impact Assessment (Attachment I)
• Site Water Management Plan (Attachment J).</td></tr>
</table>

<table>
<tr><th>No</th><th>Conditions of the SDA Approval</th><th>Timing</th><th>Condition Change</th></tr>
<tr><td></td><td>
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<tr><td>Air Quality Impact Assessment – HPA Processing Plant</td><td>AECOM Australia Pty Ltd</td><td>Ref: 60617664
Rev: D</td><td>19/10/2021</td></tr>
<tr><td>Plume Rise Assessment – HPA Processing Plant</td><td>AECOM Australia Pty Ltd</td><td>Ref: 60617664
Rev: C</td><td>03/08/2021</td></tr>
<tr><td>Preliminary Operational Noise Impact Assessment – HPA Processing Plant</td><td>AECOM Australia Pty Ltd</td><td>Ref: 60617664
Rev: B</td><td>27/05/2021</td></tr>
<tr><td>Conceptual Site Water Management Plan – Gladstone High Purity Alumina Site</td><td>AECOM Australia Pty Ltd</td><td>Ref: 60617664
Rev: D</td><td>21/10/2021</td></tr>
<tr><td>Site Based Management Plan – HPA Processing Plant</td><td>AECOM Australia Pty Ltd</td><td>Ref: 60617664
Rev: D</td><td>19/10/2021</td></tr>
<tr><td>Alpha HPA Project, Yarwun
Traffic Impact Assessment</td><td>Access Traffic Consulting</td><td>APL0121-002
Rev: C</td><td>19/10/2021</td></tr>
<tr><td>Ecological Assessment Report – HPA Processing
Plant</td><td>AECOM Australia Pty Ltd</td><td>Ref: 60617664
Rev: A</td><td>30/09/2020</td></tr>
</table>
</td><td></td><td></td></tr>
<tr><td colspan="4">Condition 2 – Commencement of the development</td></tr>
<tr><td>2.1</td><td>Notify the Coordinator-General in writing of the date of commencement of construction and commencement of the use for stage 1 and stage 2.</td><td>Within 30 days of commencement of
each stage</td><td>No change proposed</td></tr>
</table>

No	Conditions of the SDA Approval	Timing	Condition Change
Condition 3 – ‘As constructed’ plans			
3.1	Prepare and submit to the Coordinator-General, ‘As constructed’ plans certified by RPEQ or other independent suitably qualified person. The plans must show that the development has been constructed generally in accordance with the plans referenced in Table 1 of Condition 1. Plans must be submitted in electronic pdf and shape files.	Within 30 business days of the commencement of the use of each stage	**No change proposed**
Condition 4 – Staged development			
4.1	The development is to occur in accordance with the sequence of staging indicated in the approved plans and documents and commencement dates outlined in Condition 2.	As indicated	**No change proposed**
4.2	Stage 2 of the development must commence within 4 years of the commencement of the use of stage 1.	As indicated	**No change proposed**
Condition 5 – Auditing			
5.1	Prepare and submit audit reports to the Coordinator-General. The audit report must be prepared by an independent suitably qualified person to determine whether the conditions of this approval have been complied with. Audit reports are required within 30 business days of the following: (a) commencement of construction for stage 1 (b) commencement of the use for stage 1 (c) commencement of construction for stage 2 (d) commencement of the use for stage 2 confirming all conditions of this approval have been complied with. An audit report will contain detail consistent with the information provided in **Enclosure 1**.	As indicated	**No change proposed**
Condition 6 – Inspection			
6.1	Permit the Coordinator-General, or any person authorised by the Coordinator-General, to inspect any aspect of the development.	At all times	**No change proposed**

No	Conditions of the SDA Approval	Timing	Condition Change
Condition 7 – Waste management			
7.1	Reuse, recycle or lawfully dispose of all waste (other than treated waste-water released to land) generated by the development.	At all times	**No change proposed**
7.2	Waste storage area/s must be: (a) sufficient in size to house all waste collection containers including recycling waste containers (b) suitably enclosed and imperviously paved, with a hose cock and hose fitted in close proximity to the enclosure to ensure the area can be easily and effectively cleaned.	Prior to commencement of use of each stage and ongoing	**No change proposed**
7.3	Open storage areas shall be adequately screened so as not to detract from the visual amenity of the area.	Prior to commencement of use of each stage and ongoing	**No change proposed**
Condition 8 – Hazardous materials			
8.1	All flammable and combustible liquids (including hazardous waste materials) must be contained within an on-site containment system, controlled in a manner that prevents environmental harm and must be maintained in accordance with the current edition of *Australian Standard AS1940 - Storage and Handling of Flammable and Combustible Liquids*.	At all times	**No change proposed**
8.2	All containers must be secured to prevent movement during a flood event.	At all times	**No change proposed**
Condition 9 – Complaints			
9.1	Record all complaints received relating to the development in a register that includes, as a minimum: (a) date and time when complaint was received; (b) details including name and contact information; (c) reasons for the complaint;	At all times	**No change proposed**

No	Conditions of the SDA Approval	Timing	Condition Change
	(d) investigations undertaken and conclusions formed; (e) actions taken to resolve this complaint, including the time taken to implement these actions; (f) include a notation in the register as to the satisfaction (or dissatisfaction) of the complainant with the outcome. Prepare and provide a response to the complainant within 48 hours of receipt of the complaint. Provide an up to date copy of the register to the Coordinator-General with each audit report required under Condition 5 Auditing.	As indicated As indicated	
Condition 10 – Services and utilities			
10.1	Provide and maintain appropriate connection for all required services and utilities (power, potable water, sewer, gas, wastewater, communications etc) for both construction and operation.	Prior to commencement of site works of each stage	**No change proposed**
Condition 11 – Traffic management and access			
11.1	Undertake all works in accordance with the Traffic Management Plan titled “Alpha HPA Project, Yarwun Traffic Impact Assessment” prepared by Access Traffic Consulting dated 19/10/2021 in Table 1.	At all times	**No change proposed**
11.2	Ensure adequate and safe access for firefighting/other emergency vehicles and for safe evacuation, in accordance with any relevant guidelines and Australian Standards.	At all times	**No change proposed**
11.3	A 9 metre wide at the kerb and 6 metre wide internal Type B2 Commercial Driveway is to be constructed for Stage 1 as shown on plan “Alpha HPA - HPA First Project Site General Arrangement – Stage 1 – Precursor Production Plant” prepared by PRUDENTIA Process consulting dated 19/10/2021 in Table 1.	Prior to the commencement of the use of stage 1	Condition 11.3 is requested to be amended to reference the revised set of drawings provided in Appendix C.

No	Conditions of the SDA Approval	Timing	Condition Change
	The Type B2 Commercials Driveway is to be constructed in accordance with Gladstone Regional Council's Standard Drawing Urban Commercial/Industrial Driveway (CMDG-R-042A). Note: Gladstone Regional Council's standard drawing is located within the Capricorn Municipal Development Guidelines - Drawings and Specifications at http://www.cmdg.com.au/index.html.		
11.4	A 9 metre wide at the kerb and 6 metre wide internal Type B2 Commercial Driveway is to be constructed for Stage 2 as shown on plan "Alpha HPA – HPA First Project Site General Arrangement – Stage 1 & Stage 2" prepared by PRUDENTIA Process consulting dated 15/10/2021 in Table 1. The Type B2 Commercials Driveway is to be constructed in accordance with Gladstone Regional Council's Standard Drawing Urban Commercial/Industrial Driveway (CMDG-R-042A). Note: Gladstone Regional Council's standard drawing is located within the Capricorn Municipal Development Guidelines - Drawings and Specifications at http://www.cmdg.com.au/index.html.	Prior to the commencement of the use of stage 2	Condition 11.4 is requested to be amended to reference the revised set of drawings provided in Appendix C.
11.5	Manholes located on the driveways are to be covered with Class D Covers to *Australian Standard – AS3996 Access, Covers and Grates Requirements*, and are to be maintained at finished surface levels and remain accessible at all times.	Prior to the commencement of the use of each stage and to be maintained	**No change proposed**
11.6	Any damage to the driveway crossing and kerb and channel shall be repaired at the owner's expense and to Gladstone Regional Council's Standard Drawing Urban Commercial/Industrial Driveway. Note: Gladstone Regional Council's standard drawing is located within the Capricorn Municipal Development Guidelines - Drawings and Specifications at http://www.cmdg.com.au/index.html.	Prior to the commencement of the use of each stage	**No change proposed**

No	Conditions of the SDA Approval	Timing	Condition Change
11.7	Grassed footpath areas disturbed by the development are to be top dressed and turfed following completion of construction of each stage.	Prior to the commencement of the use of each stage	**No change proposed**
Condition 12 – Vehicle parking			
12.1	All parking is to occur on site unless otherwise agreed to in writing by the Office of the Coordinator General.	At all times	**No change proposed**
12.2	Design and construct vehicle access, parking, internal roadways and manoeuvring for vehicles on site in accordance with *Australian Standard AS2890.1: 2004 Parking facilities: Part 1* and *Australian Standard AS2890.2:2002: Part 2* to include the following: (a) parking on site for a minimum of 40 cars for stage 1, including designated disabled car parking spaces, and for the loading and unloading of vehicles within the site (b) parking on site for a minimum of 70 cars for the overall development (stage 1 and 2), including designated disabled car parking spaces, and for the loading and unloading of vehicles within the site (c) manoeuvring on site for heavy vehicles and for the loading and unloading of the vehicles.	Prior to commencement of the use of each stage and to be maintained	**No change proposed** It is noted that the Project has provided 80 on site car parking spaces.
12.3	Parking spaces and all vehicle movement areas are to be constructed, sealed, line marked, provided with wheel stops and maintained in accordance with the Engineering Design Planning Scheme Policy under the Our Place Our Plan Gladstone Regional Council Planning Scheme and *Australian Standard AS2890 Parking facilities*, unless otherwise shown on the approved plans referenced in Condition 1.1.	Prior to commencement of the use of each stage and to be maintained	**No change proposed**
Condition 13 – External details			
13.1	Construct and/or paint external details of buildings and structures to reduce visual impact and negate excessive glare in accordance with current best practise.	Prior to commencement of the use of each stage and to be maintained	**No change proposed**

No	Conditions of the SDA Approval	Timing	Condition Change
Condition 14 – Pipe-rack			
14.1	Design and construct the ammonia and nitric acid pipeline in the overhead pipe to include the following requirements: (a) The design and location of the structure must comply with Gladstone Regional Council's Building over or Adjacent to Council Infrastructure Policy. (b) The structure must be suitably engineered taking into account Gladstone Regional Council's existing infrastructure and technical requirements outlined in the Department of Transport and Main Roads design criteria for Bridges and other structures. (c) The structure must provide a minimum traffic envelope of 10 metre x 10 metre within the Reid Road reserve to accommodate oversize and overmass vehicle movements.	Prior to commencement of the use of stage 2 and to be maintained	**No change proposed**
14.2	Construction and maintenance of the ammonia and nitric acid pipeline and pipe rack must be in accordance with *Australian Standard/New Zealand Standard AS/NZS2022:2003: Anhydrous ammonia - Storage and handling*.	At all times	**No change proposed**
Condition 15 – Landscaping			
15.1	Provide landscaping for stage 1 in accordance with plan "Precursor Production Facility – General Site Wide – Stage 1 – Landscaping Plan – General Details" prepared by PRUDENTIA Process consulting dated 19/10/2021 in Table 1, unless otherwise agreed to in writing by the Office of the Coordinator General.	Prior to commencement of the use of stage 1 and to be maintained until the commencement of construction of stage 2	Condition 15.1 is required to be amended to reference the revised set of landscaping drawings provided in Appendix C.

No	Conditions of the SDA Approval	Timing	Condition Change
15.2	Provide landscaping for stage 2 in accordance with plan "Alpha HPA – HPA First Project Site General Details –Landscaping Plan" prepared by PRUDENTIA Process consulting dated 15/10/2021 in Table 1, unless otherwise agreed to in writing by the Office of the Coordinator General.	Prior to commencement of the use of stage 2 and to be maintained	Condition 15.2 is required to be amended to reference the revised set of landscaping drawings provided in Appendix C.
15.3	Maintain landscaping and replace any failed or failing trees or shrubs.	At all times	**No change proposed**
15.4	All landscaping areas are to be constructed with an irrigation system that optimises water and energy efficiency and responds appropriately to local conditions by maintaining infiltration to subsurface soil.	Prior to commencement of the use of each stage and to be maintained	**No change proposed**
Condition 16 – Fencing			
16.1	Install a fence made from chain wire to a height of 1.8 metres around the perimeter of the site as shown on plan "Alpha HPA – HPA First Project Site General Arrangement – Stage 1 – Precursor Production Plant" prepared by PRUDENTIA Process consulting dated 19/10/2021 in Table 1.	Prior to commencement of use for stage 1 and to be maintained until the commencement of construction of stage 2	Condition 16.1 is required to be amended to reference the revised set of drawings provided in Appendix C.
16.2	Install a fence made from chain wire to a height of 1.8 metres around the perimeter of the site as shown on plan "Alpha HPA – HPA First Project Site General Arrangement – Stage 1 & Stage 2" prepared by PRUDENTIA Process consulting dated 15/10/2021 in Table 1.	Prior to commencement of use for stage 2 and to be maintained	Condition 16.2 is required to be amended to reference the revised set of drawings provided in Appendix C.

No	Conditions of the SDA Approval	Timing	Condition Change
Condition 17 – Noise			
17.1	Undertake all works in accordance with the recommended noise treatments of the operational noise impact assessment titled “Preliminary Operational Noise Impact Assessment – HPA Processing Plant” prepared by AECOM Australia Pty Ltd dated 27/05/2021 in Table 1.	At all times	Condition 17.1 is required to be amended to reference the revised Preliminary Noise Impact Assessment located in Appendix I.
Condition 18 – Site-based management plan			
18.1	Undertake all works in accordance with the site-based management p Site Based Management Plan HPA Processing Plant prepared by AECOM Australia Pty Ltd dated 19/10/2021 in Table 1 which must be current and available on site at all times.	At all times	**No change proposed**
Condition 19 – Construction management plan			
19.1	Prepare a construction management plan (by a suitably qualified person in accordance with current best practice) that includes the following: (a) detail on construction parking, access and laydown areas etc. (b) management of noise and dust generated from the site during and outside construction work hours; (c) management of stormwater flows and quality around and through the site without increasing the concentration of total suspended solids or prescribed water contaminants (as defined in the *Environmental Protection Act 1994*), causing erosion, creating any ponding and causing any actionable nuisance to upstream or downstream properties; (d) management of contaminated soils (if required) including removal, treatment and replacement; (e) site remediation plans; (f) a monitoring program to identify issues of non-compliance, actions for correcting any non-compliance and who is responsible for undertaking those actions; (g) a timetable and process for review of the construction management plan to assess its effectiveness and to implement amendments as required. Undertake all works generally in accordance with the construction management plan which must be current and available on site at all times during the construction period.	Prior to commencement of site works of stage 1 At all times during construction for each stage	**No change proposed**

No	Conditions of the SDA Approval	Timing	Condition Change
Condition 20 – Stormwater management			
20.1	Implement the stormwater management plan titled “Conceptual Site Water Management Plan – Gladstone High Purity Alumina Site” prepared by AECOM Australia Pty Ltd dated 21/10/2021 in Table 1.	At all times	Condition 20.1 is required to be amended to reference the revised Site Water Management Plan Assessment in Appendix J.
20.2	Connect the development to a lawful point of discharge with ‘no-worsening’ to upstream or downstream properties for storm events up to 1% Annual Exceedance Probability in accordance with Gladstone Regional Council’s current adopted standards.	Prior to commencement of the use of each stage	**No change proposed**
20.3	Drainage from the development works/building shall not adversely impact upon adjacent properties. No ponding, concentration or redirection of stormwater not outlined in the approved stormwater management plan shall occur on adjoining land.	At all times	**No change proposed**
20.4	Drainage works shall be designed and constructed in accordance with the Queensland Urban Drainage Manual 2017.	Prior to commencement of the use of each stage	**No change proposed**
Condition 21 – Repair of damage			
21.1	Repair any, roads, service infrastructure and re-instate existing signage and pavement markings that have been removed or damaged during any works carried out in association with the approved development.	Prior to commencement of the use of each stage	**No change proposed**
Condition 22 – Lighting			
22.1	Ensure outdoor lighting installed within the development minimises light spill in the adjacent properties and sensitive receptors in accordance with *Australian Standard AS4282:1997 Control of obtrusive effects of outdoor lighting*.	To be maintained	**No change proposed**

No	Conditions of the SDA Approval	Timing	Condition Change
22.2	Lighting at ground level and associated with illuminating ground level areas must be focused downwards and be provided with hoods, shades or other permanent devices to direct illumination downwards and not allow upward lighting to adversely affect uses adjoining the site.	Prior to commencement of the use of each stage	**No change proposed**

The following sections discuss the construction and operational phases that will be undertaken as part of Stage 2 works noting that Stage 1 has been constructed and is operational. No significant changes have been made since the originating approval.

3.3 Construction Phase

3.3.1 Construction Activities

Stage 2 construction will consist of the following activities:

- site earthworks
- civil works
- laydown areas
- temporary site offices
- structural mechanical piping (SMP)
- electrical and instrumentation (E&I)
- site commissioning.

Commissioning will be staged from construction, with water commissioning performed prior to introduction of chemical reagents.

3.3.2 Construction Timeframe

Stage 2 will commence approximately August 2024 and will be completed late 2026.

3.3.3 Construction Workforce

Stage 2 total site direct manhours are anticipated to be 400,000 hrs. Peak site construction workforce is expected to be 300 people at peak construction periods.

3.3.4 Construction Traffic & Car Parking

During construction of Stage 2, anticipated traffic for the Project will consist of the following:

- Earthworks materials will be imported to the site from the local quarry west of the Project (Quarry Road) and will be transferred to the site via trucks and 4 axle dog configurations via Gladstone-Mount Larcom Road (Hanson Road).
- Construction staff will be commuting from Gladstone via private vehicles (light vehicles and 4WD's).
- All other construction materials, equipment, componentry, and plant for the facility will be delivered to the site via road from Gladstone which will utilise Gladstone-Mount Larcom Road (Hanson Road) and Reid Road.

During construction phase, all associated construction traffic including car parking and deliveries will be located wholly on site within a nominated area. The area will be identified during detailed design phases and demonstrated within the post approval construction management plans.

3.4 Operation Phase

3.4.1 Site Access

The Project's site access location and internal circulation configuration of the Project has been demonstrated in Appendix C.

The Project will be accessed from Reid Road (local road). Reid Road has direct connection to Gladstone-Mount Larcom Road (Hanson Road) to the north (State Controlled Road).

The Project has two (2) vehicular crossovers directly from Reid Road. Stage 1 access has been constructed, with Stage 2 site access yet to be constructed.

Temporary vehicular crossovers are proposed to allow for construction traffic.

3.4.2 Traffic

During operations phase for Stage 2, anticipated traffic for the Project will consist of the following:

- Workforce commuting from Gladstone consisting of 120 staff which are split over four separate shifts. With teams of approximately 20 people and a daytime work force of 38 people.
- Daily heavy vehicle movements are expected to consist of the following:
  - feed (raw materials) delivery – 3 x 20t truck deliveries per day
  - product export – 3 x 15t containers per day
  - waste removal – 1 x refuse collection truck (heavy rigid vehicle – HRV) per day
  - miscellaneous deliveries – 1 HRV per day.

3.4.3 Car Parking

Formal car parking has been proposed which will accommodate 80 spaces across the Stage 1 and Stage 2. 40 car parking spaces have already been provided for Stage 1.

Refer to Appendix C for proposal plans.

3.4.4 Staffing

The Stage 1 has employed approximately 50 people.

Stage 2 is expected to be approximately 130 staff with four (4) teams of 20 people, and a daytime workforce of approximately 40 staff.

At any given time one shift team will be present on site, with approximately 60 total staff on site at any one time at the completion of Stage 2.

3.4.5 Hours of Operation

The Stage 1 and Stage 2 will operate 24 hours per day/7 days per week. The majority of the process plant operates continuously and is monitored and controlled from a central control room. Staff will be operational 24 hours per day with daytime staff working from approximately 7.30am to 5.00pm.

3.4.6 Waste

The process has been developed to recycle the majority of reagents and limit wastes. The key waste from the process plant are:

Stage 1

- Solid waste 1-2 x 10 t trucks per year
- Aqueous waste 1-2 x 20 t per month
- General waste and recycling – 2 trucks per week with varying truck size.

Stage 2

- feed processing waste residue (approx. 7 t per day)
- solvent Extraction Waste Solids (approx. 0.5 tonnes per week)
- cooling Tower and Boiler Blowdown wastewater (approx. 6m^3/hr).

A by-product fertilizer will be sold to a 3rd party locally based in Gladstone.

Waste disposal from the facility is likely to create up to 1.5 tonnes of solid waste residue per day.

3.4.7 Utilities

Stage 1 is already connected to utilities.

Stage 2 will be connected to the following utilities:

- Electricity - Ergon will install a 66kV transmission lines to site that will be connected to an onsite substation for reticulation around the site. This will power plant and equipment on site.

- Telecommunications - the Project will be connected to telecommunications within the Reid Road reserve.
- Potable Water - will be sourced from Gladstone Area Waterboard with flow nominally 5 m^3/hr.
- Raw/Process water - will be sourced from Gladstone Area Waterboard with flow nominally 50 m^3/hr
- Sewer - the Project will be connected to the existing sewer line within the Reid Road Reserve
- Gas - the Project will be connected to the Jemena Gas Pipeline located within the Reid Road reserve.

3.5 Impact Assessments

3.5.1 Air Quality Impact Assessment

An updated Air Quality Impact Assessment has been prepared and included within Appendix G.

The Air Quality Impact Assessment report has been amended to include the proposed changes discussed in Section 3.0, and has sought to address the Project pollutant concentration at sensitive receptors and sensitive zone. The assessment concludes that at the completion of Stage 2, the Project will contribute to only minor amounts of pollutant at these receptors and the emissions are unlikely to contribute to exceedances of the relevant air quality objectives.

It is noted that no changes in key findings have been identified since the originating assessment.

3.5.2 Venting to Air Impact Assessment

An updated Plume Rise Assessment has been prepared and included within Appendix H.

The processing facility requires combustion engines and processes which will require venting to air within the Obstacle Limitation Surface (OLS) of the Gladstone Airport. The Gladstone Airport is located approximately 5.5 km to the south-east of the eastern boundary of the Project area.

The Plume Rise Assessment has been amended to include the proposed changes discussed in Section 3.0, and has concluded that the Project is unlikely to present a hazard to local aircraft and referral to CASA is recommended for the proposed emergency flare.

It is noted that no changes have been identified with the exception of the referral to CASA since the originating assessment.

3.5.3 Noise Impact Assessment

An updated Preliminary Operational Noise Impact Assessment has been prepared and included within Appendix I.

The Noise Impact Assessment has been amended to include the proposed changes discussed in Section 3.0, and has sought to assess the preliminary operational noise impacts from the Project to nearby sensitive receptors which are located to the south and west of the Project area approximately 4.5 km away.

The assessment concluded that noise treatments can be practicably applied to the Project area to ensure compliance with the nominated criteria within the GSDA Development Scheme and the Environmental Protection (Noise) Policy 2019.

The treatments discussed in the report (Appendix I) are considered to be “indicative” and have not been proposed as part of this Development Application. Final noise treatments (if required) will be refined as the Project progresses into detailed design and the equipment selection has been finalised.

It is noted that no changes in key findings have been identified since the originating assessment.

3.6 Environmental Management

3.6.1 Site Water Management

An amended Site Water Management Plan (SWMP) has been included within Appendix J.

The SWMP has been amended to include the proposed changes discussed in Section 3.0 and seeks to demonstrate how stormwater and process affected water will be managed to mitigate impacts on the surrounding environment.

To manage site water, two (2) water management systems have been proposed being:

- Stormwater Management System, which covers the management and treatment of stormwater on the site from areas with a lower risk of contamination.
- Production Area Water Management System, which covers blow down water from the operation of the plant and stormwater within the bunded production areas with a higher risk of contamination.

The two (2) system approach seeks to achieve the following site outcomes:

- Prevent contaminated water being discharged to the downstream receiving environment.
- Prevent process water from the operation of the plant contaminating stormwater.
- Use Water Sensitive Urban Design (WSUD) techniques to treat stormwater before it is released into the downstream receiving environment.
- Optimise the storage capacity of the on-site storages.

The assessment has proposed operational protocols for each system to minimise the likelihood contaminated water is released from the site due to prolonged and extreme weather events. These operational protocols are discussed in Appendix J.

4.0 Legislative and Policy Framework

4.1 Overview

The following sections discuss the relevant legislative policy framework applicable to the Project.

4.2 Making a Change Application

Pursuant to Schedule 2 of the *State Development and Public Works Organisation Act 1971*, a Minor Change means a change application for a minor change to a development approval as defined under the *Planning Act 2016*.

For a change to be considered a 'minor change', the proposed change must comply with Schedule 2 of the Planning Act, which defines a minor change for a development approval as:

i. *Would not result in substantially different development; and*

ii. *If a development application for the development, including the change, were made when the change application is made would not cause –*

- *A.* *the inclusion of prohibited development in the application; or*
- *B.* *referral to a referral agency, other than to the chief executive, if there were no referral agencies for the development application; or*
- *C.* *referral to extra referral agencies, other than to the chief executive; or*
- *D.* *a referral agency to assess the application against, or have regard to, matters prescribed by the regulation under section 55(2), other than matters the referral agency must have assessed the application against, or have had regard to, when the application was made; or*
- *E.* *public notification if public notification was not required for the development application.*

The following assessment has determined that the Project is not considered to be a minor change as the amendments has resulted in minor increases to known impacts.

4.2.1 Substantially Different Development

Schedule 1 of the Development Assessment Rules is intended to assist applicants and assessment managers to determine if a proposed change to a development approval is considered to result in substantially different development. An assessment the individual elements/tests is provided in Table 5.

Table 5 Compliance with substantially different development criteria

A change may be considered to result in a substantially different development if any of the following apply to the proposed change:	Compliance
Involves a new use	**Complies** The proposed change will not introduce or facilitate a new use.
Results in the application applying to a new parcel of land	**Complies** The proposed change does not result in the application applying to a new parcel of land.
Dramatically changes the built form in terms of scale, bulk and appearance	**Complies** The proposed change does not dramatically change the built form in terms of scale, bulk and appearance. Whilst it is acknowledged that the appearance may change as a result of the buildings being arranged and additional temporary buildings being proposed, it is not considered to dramatically change the scale, bulk and appearance within the industrial precinct.

A change may be considered to result in a substantially different development if any of the following apply to the proposed change:	Compliance
Changes the ability of the proposed development to operate as intended	**Complies** The proposed change will not alter the ability of the Project to operate as intended.
Removes a component that is integral to the operation of the development	**Complies** The proposed change does not remove a component of the Project that is integral to the operation of the development.
Significantly impacts on traffic flow and the transport network, such as increasing traffic to the site	**Complies** The proposed change will not increase impacts on traffic flow or the transport network compared to what was assessed and considered as part of the original development application.
Introduces new impacts or increases the severity of known impacts	**Alternative Proposed** The amended technical reports including the proposed change has concluded that only minor increases in known impacts have been identified. The majority of mitigation measures have remained unchanged since the originating approval.
Removes an incentive or offset component that would have balanced a negative impact of the development	**Complies** The proposed change does not remove an incentive or offset component that would have balanced a negative impact of the Project.
Impacts on infrastructure provisions	**Complies** The proposed change will not impact the provision, location or demand on infrastructure.

4.2.2 Remaining Planning Act Criteria

An assessment of the proposed changes against part (b)(ii) of the minor change definition in Schedule 2 of the Planning Act has been undertaken in Table 6.

i. *If a development application for the development, including the change, were made when the change application is made would not cause –*

Table 6 Compliance with the remaining Planning Act criteria

If a development application for the development, including the change, were made when the change application is made would not cause:	Compliance
A. The inclusion of prohibited development in the application; or	**Complies** The proposed change does not result in the inclusion of any prohibited development.
B. Referral to a referral agency, other than to the chief executive, if there were no referral agencies for the development application; or	**Complies** The original development application did trigger referral to referral agencies and the Changed Approval will not result in any additional referral agencies.
C. Referral to extra referral agencies, other than to the chief executive; or	
D. A referral agency to assess the application against, or have regard to, matters prescribed by the regulation under section 55(2), other than matters the referral agency must have assessed the application against, or have had regard to, when the application was made; or	

If a development application for the development, including the change, were made when the change application is made would not cause:	Compliance
E. Public notification if public notification was not required for the development application.	**Not Applicable** The original development application did not require public notification. The proposed change will not alter the level of assessment.

4.3 Gladstone State Development Area Development Scheme 2022

The Project site is located within the GSDA (Figure 8). The GSDA was declared in 1993 as a State Development Area under the *State Development and Public Works Organisation Act 1971*.

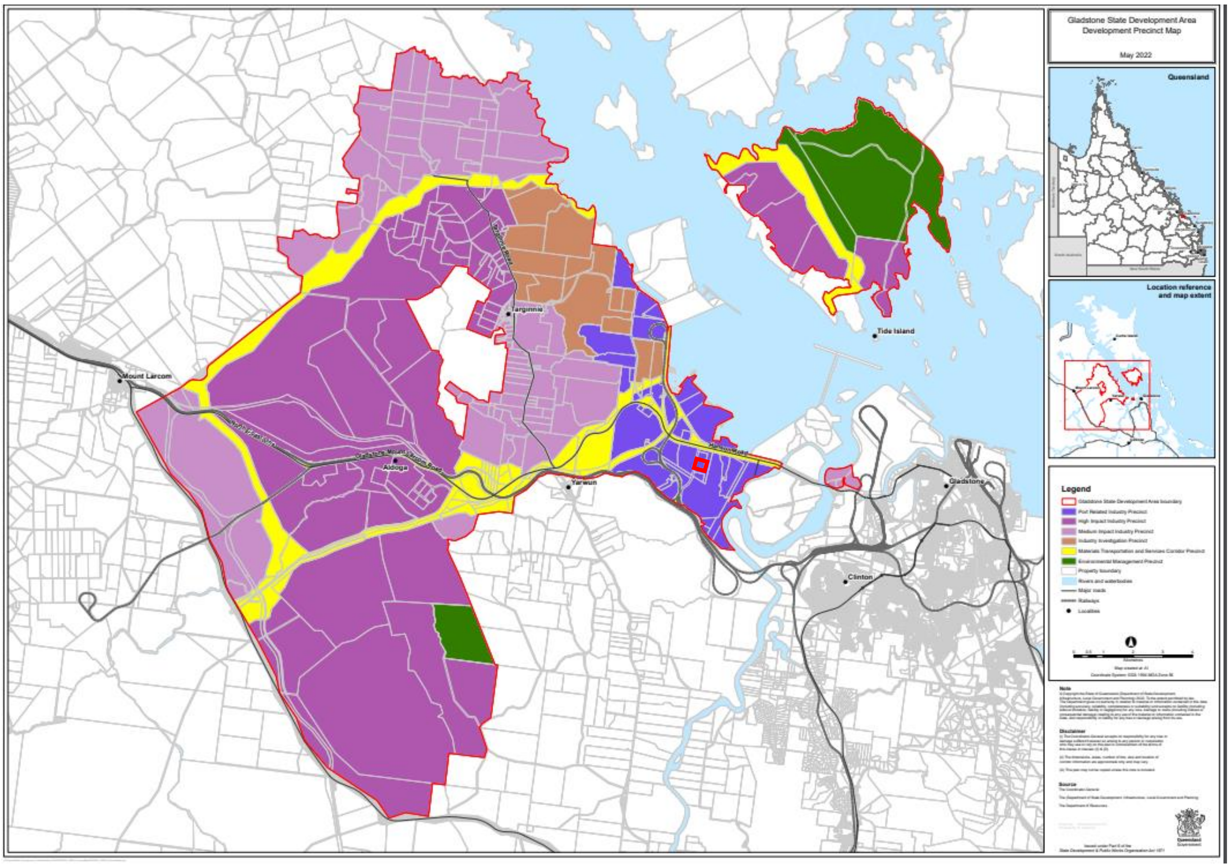


Figure 8 Gladstone State Development Area Precinct Map (GSDA Development Scheme, 2022)

At the time of the originating approval, the Project site was located in the Medium-High Impact Precinct. Since this originating approval an amendment to the GSDA Development Scheme has been undertaken and has been rezoned to the designed Port Related Industry Precinct in Many 2022 (Figure 8).

On this basis, an assessment of the change has been undertaken against the Port Related Industry Precinct has been provided in Appendix E. The assessment has determined that the changes maintain the intent of the new Precinct.

Under the GSDA Development Scheme Schedule 1, Section 2 the Project is defined as 'Special Industry' and 'Linear Infrastructure Facility'. The applicable definition has been discussed above in Section 1.1 above. No changes are proposed to the approved defined land uses.

4.3.1 Strategic Vision

The strategic vision of the GSDA Development Scheme is:

(1) The vision for the Gladstone SDA is to:

> *(a) be Central Queensland's economic powerhouse, with an efficient concentration of large-scale industry of national, State and regional significance that benefit from the SDA's strategic location near the Port of Gladstone and major road and rail networks*
>
> *(b) support development that aligns with the Queensland Government's strategic priorities for the region, particularly related to the hydrogen industry*
>
> *(c) maintain environmental, cultural heritage and community values where possible to support wider ecological processes and provide community benefits.*

(2) The strategic vision is supported by the overall objectives for development and preferred development intents of development precincts within the Gladstone SDA.

Assessment of the Project changes against the Strategic Vision has been included within Table 7.

4.3.2 Overall Objective

Commentary on how the Project supports the overall objectives for the GSDA Development Scheme is provided in Table 7. The change has sought to ensure compliance with the overall objectives of the GSDA Development Scheme.

4.3.3 SDA Development Precincts

The GSDA comprises of 6 precincts. Section 2.4 of the GSDA Development Scheme describes the preferred intent and level of assessment for each precinct. The following subsections of the Planning Report outline the preferred development intent for the relevant precinct associated with the Project and provide commentary on the degree to which the Project reflects this intent.

The Special Industry (HPA Processing Plant) and Linear Infrastructure Facility is considered to meet intent of the Port Related Industry Precinct. Commentary on how the Project supports the Port Related Industry Precinct for the GSDA Development Scheme is provided in Appendix E. The inclusion of amendment sought to ensure that the Project maintains the intent of the SDA Precinct and no conflicts have been identified.

4.3.4 SDA Wide Assessment Criteria

The Project is generally consistent with the SDA Wide Assessment Criteria. An assessment of the SDA Wide Assessment Criteria has been included within Appendix E. The change has sought to ensure that the Project maintains the intent of the SDA Wide Assessment Criteria and no conflicts have been identified.

4.3.5 Referrals

The GSDA Development Scheme identifies that where referrals would typically be required under the Planning Regulation 2017 for development, the same referrals apply under the GSDA Development Scheme. Under Schedule 2, Section 2.2 (a) of the GSDA Development Scheme, the OCG must give a copy of the application to any referral entities.

Review of the State Assessment Referral Agency (SARA) Development Assessment Mapping System (DAMS) identified the following in relation to the site:

- Native vegetation:
  - Category B regulated vegetation
  - Category R regulated vegetation
  - Category X
  - Essential Habitat
- Water resource – water resources planning area boundary.

Schedule 10 of the Planning Regulation 2017 has been utilised to identify matters which the OCG may consider relevant for referral. The following referral triggers have been identified:

- Environmentally Relevant Activity - Part 5, Division 4, Table 2 – Environmentally Relevant Activity.
- Transport thresholds - Part 9, Division 4, Subdivision 1, Table 1 – Transport Related Activities.
- Hazardous Chemical Facility (MHF) - Part 7, Division 3, table 1 – Hazardous Chemical Facilities.

We note no changes are proposed as part of this application with respect to increasing chemical storage or production on site. However, further discussions are required with Work Safe Queensland regarding the potential for the Project to be defined as a Major Hazard Facility (MHF).

Pursuant to Schedule 21, Part 1, (1)(a) of the Planning Regulation 2017 the clearing of vegetation is exempt under a development approval in which referral was undertaken for vegetation clearing. Confirmation was received at the time of the originating approval from the OCG that referral for vegetation clearing is not required, however was referred to then Department of Natural Resources Mines and Energy (DNRME) as a third party referral was undertaken.

It is also noted that the originating application was exempt from Native Vegetation Clearing under Schedule 21 Part 2 as the Project is for a for an urban purpose in an urban area.

It is noted that the majority of vegetation clearing has been undertaken on site as part of Stage 1 works.

The Project has been assessed against the applicable State Development Assessment Provision Codes (SDAP Codes 6, 8 and State Code 22) and have been included within Appendix F.

The proposed amendments has not altered the assessment of the Project against the relevant State Codes.

4.3.6 Public Consultation

In accordance with Schedule 2 of the GSDA Development Scheme, public consultation applies unless the OCG gives notice during the application stage that public consultation does not apply. The originating Development Application did not require public consultation.

We consider that public consultation is not required as the defined use for a Special Industry and Linear Infrastructure Facility is a preferred development intent of the Port Related Industry Precinct (refer Section 2.4.1 (2)(d) and 2.4.1 (3)(c) of the GSDA Development Scheme.

Table 7 Assessment of Project against GSDA Overall Objectives

Objective	Commentary
(1) Development within the GSDA will:	
a) capitalise on Gladstone SDA's strategic location and support the role and function of the Port of Gladstone	**Complies – no change** The Project is defined as a "Special Industry and Linear Infrastructure Facility" under Schedule 2 of the GSDA Development Scheme. The proposed amendment has not resulted in the inclusion of an additional land use definition and will fall within the definition of Special Industry and Linear Infrastructure Facility. The use and operations are consistent with the purpose of the Strategic Vision on the following basis: • The Project has sought an industrial related development of regional, State and National Significance. • The Project area is considered to be the preferred site location for an operation of this nature and is complementary to the adjoining Orica site. • A local Gladstone workforce will be utilised for all phases and stages of the Project including construction and operation. • The materials produced support industries who utilise sapphire glass wafers for LED lighting and HPA for the production of Electric Vehicles. The product HPA will be packaged and transported for export via Brisbane. • Gladstone Port is currently not able to support the proposed operations, however, once this is available at Gladstone Port, the Project will seek to utilise the Port. • The Project has sought to ensure access is provided to the site via a local road (Reid Road) which connects to Gladstone-Mount Larcom Road (Hanson Road). All access and egresses have sought to ensure no conflicts are present between the Project area and the existing Orica development. • The Project has sought to ensure that water management has been a top priority of the Project to ensure no adverse impacts on the surrounding natural environment. • The Project will ensure that it will positively impact the local economy during construction and operation phases.
b) identify and implement opportunities for synergies and co-location between other uses, services and infrastructure to minimise waste and inefficiencies	**Complies – no change** The Project area is considered to be the preferred site location for an operation of this nature and is complementary to the adjoining Orica site.
c) use land and infrastructure efficiently and be adequately serviced by infrastructure	**Complies – no change** The use and operations are consistent with the purpose of the Precinct on the following basis: • The Project is defined as Special Industry and Linear Infrastructure Facility to which the precinct seeks to

Objective	Commentary
	accommodate and encourage. • The Project is for the purposes of refining and processing chemicals. • The Project requires storage of hazardous materials. • The site is sufficiently separated from all sensitive receptors. • The use and impacts are comparable with adjoining land uses within the precinct.
d) ensure the integrity and functionality of the Gladstone SDA, including infrastructure corridors and future development opportunities, is maintained and protected from incompatible land uses	**Complies – no change** The Project is considered to be a supported land use and satisfies the intent of the Port related Industry Precinct of the GSDA Development Scheme.
e) ensure new lots are appropriately sized to accommodate preferred development	**N/A** Subdivision is not being proposed
f) be designed, constructed, and operated to a high quality consistent with best practice	**Complies – no change**
g) avoid impacts on environmental, cultural heritage, and community values (including sensitive land uses), or minimise or mitigate impacts where they cannot be avoided and offset any residual impacts	**Complies – no change** Environmental: The Project has sought to recognise the site's environmental values through the undertaking of an ecological desktop analysis and field survey of the Project area. The results and recommendations of the assessment have been compiled within the Ecology Assessment Report previously submitted in the originating application. It is noted that the proposed amendment has not resulted in any changes to the assessment as the Project area previously assessed. The Ecology Assessment concluded the following: • The Project was assessed against the significant impact assessment criteria in accordance with the *Environment Protection Biodiversity and Conservation Act 1999 (*EPBC Act*) Policy Statement 1.1 Significant Impact Guidelines: Matters of National Environmental Significance* which concluded that the Project is unlikely to result in a significant impact to threatened and migratory species. • Several potential impacts to flora and fauna may occur as a result of the Project. Impacts include removal of remnant vegetation that provides suitable habitat for threatened fauna and migratory species and animal breeding place. • Direct and indirect impacts are expected to be low. Mitigation and management measures have been recommended to ensure the potential impact on ecological values are minimised or avoided.

Objective	Commentary
	<u>Cultural:</u> Alpha HPA have notified the First Nations Bailai, Gurang Gooreng Gooreng, Taribelang Bunda Registered Native Title Body Corporation regarding Stage 2 (Stage 1 was also previously notified prior to site works). Some objects or sites of cultural heritage were identified during a cultural heritage inspection and any relocatable artefacts were relocated at the time to a Temporary Relocation Area. The assessment provided a number of recommendations including on going consultation, cultural heritage finds are to be uploaded to the Queensland State Development of Seniors, Disability Services and Aboriginal and Torres Strait Islander Partnerships Cultural Heritage Database and the coordinates of the Temporary Relocation area are to be recorded for the database. <u>Community values:</u> The Project has sought to consider the operational impacts on sensitive receptors. Technical reporting has been undertaken with respect to noise, plume rise, traffic, noise and risk. The reports have concluded that the Project will have minimal impacts on sensitive receptors. Mitigation measures have been considered where necessary and are included in each technical assessment.
h) not adversely impact on the outstanding universal values of the Great Barrier Reef World Heritage Area	**Complies** The Project has considered the impacts on the Great Barrier Reef World Heritage Area thought the updating of the Dispersion Modelling Assessment for the Project proposed discharge into Fisherman's Landing. The results have concluded: • The revised Alpha HPA release concentrations do not result in any significant changes to the outcomes of the original assessment. • This is due to the relatively small contribution of Alpha HPA to the overall change when combined with Orica. Refer to the Site Based Water Assessment in Appendix J.
i) manage the risks associated with the projected impacts of climate change and natural hazards to protect people and property	**Complies** A Climate Change Risk Assessment has been undertaken for the Project to assess the potential critical risks associated with climate variability and extremes. A copy can be provided upon request.
j) manage impacts of air quality on the capacity of the Gladstone airshed.	**Complies – no change** <u>Air Quality</u>: An updated Air Quality Impact Assessment has been prepared and included within Appendix G. The updated Air Quality Impact Assessment report has been amended to include the proposed changes discussed in

Objective	Commentary
	Section 3.0, and has sought to address the Project pollutant concentration at sensitive receptors and sensitive zone. The assessment concludes that at the completion of Stage 2, the Project will contribute to only minor amounts of pollutant at these receptors and the emissions are unlikely to contribute to exceedances of the relevant air quality objectives. It is noted that no changes in key findings have been identified since the originating assessment. <u>Plume Rise:</u> An updated Plume Rise Assessment has been prepared and included within Appendix H. The processing facility requires combustion engines and processes which will require venting to air within the Obstacle Limitation Surface (OLS) of the Gladstone Airport. The Gladstone Airport is located approximately 5.5 km to the south-east of the eastern boundary of the Project area. The amended Plume Rise Assessment has been amended to include the proposed changes discussed in Section 3.0, and has concluded that the Project is unlikely to present a hazard to local aircraft and referral to CASA is recommended for the proposed emergency flare. It is noted that no changes have been identified with the exception of the referral to CASA since the originating assessment.

4.4 Central Queensland Regional Plan

The Project area is located within the Gladstone Regional Local Government Area which is under the Central Queensland Regional Plan 2013 (Regional Plan). The GSDA Development Scheme Wide Assessment Criteria identified the need to identify the consistency of the Project with applicable regional plans.

The purpose of the Regional Plan is to identify the State's interests in land use planning for the region. A key driver for the preparation of the plan included the identification of infrastructure outcomes that support economic growth.

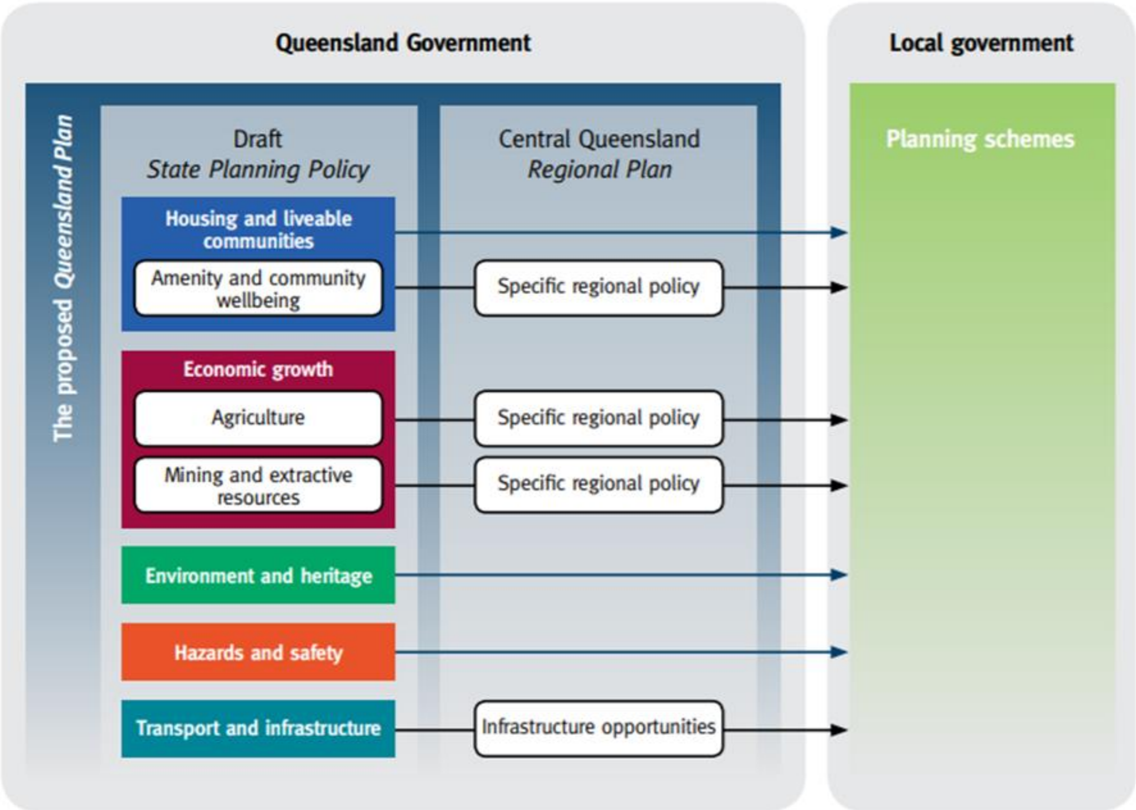


Figure 9 **Relationship between instruments of the Queensland planning framework. Source: Central Queensland Regional Plan 2013, Department of State Development, Infrastructure Local Government and Planning**

While the Regional Plan comments on State interests it identifies where external planning instruments (i.e. local planning schemes, SPP, etc.) are better placed to deliver these interests. The Regional Plan focuses on amenity and community wellbeing, agriculture, mining and extractive resources, and transport and infrastructure (refer to Figure 9).

A priority outcome for economic growth for the development and construction industry for the region is to supply land for a variety of industrial purposes.

The Project remains consistent with this aspect of the Regional Plan as the proposed Special Industry and Linear Infrastructure Facility will be located within the GSDA which is considered within the Regional Plan as an industrial hub for large scale heavy industry.

4.5 State Planning Policy 2017

The SPP commenced on 3 July 2017 and identifies 17 State and regional planning interests that are critical to responsible land-use planning and development across Queensland. The SPP has effect throughout Queensland and sits above regional plans and planning schemes.

Section 2.5.13 of the GSDA Development Scheme identifies the need to demonstrate the consistency of the development with the SPP. Review of the SPP mapping indicates that the site (Lot 12 on SP239343) is affected by the following overlays.

- Development and Construction:
  - State Development Area
- Biodiversity:
  - Matters of State Environmental Significance (MSES) – Wildlife habitat (endangered or vulnerable)
  - MSES – Wildlife habitat (special least concern animal)
  - MSES – Regulated vegetation (category R)
  - MSES – Regulated vegetation (essential habitat)
  - MSES – Regulated vegetation (intersecting a watercourse)
- Coastal Environment
  - Coastal Management District
- Natural Hazards, Risk and Resilience:
  - Flood hazard area – Flood hazard area – Level 1 – Queensland floodplain assessment overlay and Local Government Flood mapping area
  - Bushfire Prone Area
- Strategic airports and aviation facilities:
  - Obstacle Limitation Surface Area
  - Obstacle Limitation Surface Contours
  - Wildlife hazard buffer zone.

Appendix E contains a full assessment of the Project against the range of State interests contained within the SPP. The Project is compliant with the intent of the SPP, noting the following.

- **Housing supply and diversity** – the Project is non-residential in nature and is located on land identified for industrial purposes in the GSDA Development Scheme.
- **Liveable communities** – the Project is non-residential in nature and is located on land identified for industrial purposes in the GSDA Development Scheme. The Project area is also located away from land zoned for residential purposes where the objectives of this interest apply.
- **Agriculture** – the Project is not located in Agricultural Land (class A or B) or stock route. The Project is not rural in nature and will not limit the use of rural zoned land in the surrounding locality.
- **Development and construction** – the Project represents the appropriate delivery of large scale infrastructure within an SDA. The development is consistent with the intent and purpose of the GSDA and precincts.
- **Mining and extractive resources** – the Project is not within a Key Resource Area (KRA) or associated separation areas and transport routes. The Project will not affect the operation of KRAs in the surrounding region.
- **Tourism** – the Project is located within the GSDA which has been long-recognised as an area for large scale industrial and infrastructure development.
- **Biodiversity** – the Project will involve the clearing of native vegetation which is exempt development. A Significant Impact Assessment has been undertaken under the EPBC Act *Policy Statement 1.2 Significant Impact Guidelines: Matters of National Environmental Significance* which concluded that the project is unlikely to result in a significant impact to threatened and migratory species.

- **Coastal environment** – the Project is not located within the Coastal Management District (CMD).
- **Cultural heritage** – the Project is located away from listed National and State heritage places. In order to meet Duty of Care requirements under the *Aboriginal Cultural Heritage Act 2003* Alpha HPA has engaged with the Traditional Owners.
- **Water quality** – a SWMP has been and included within Appendix J and addresses the State Planning Policy Water Quality objectives.
- **Emissions and hazardous activities** – an Air Quality Impact Assessment has been undertaken to address the Projects pollutant concentration at sensitive receptors and sensitive zone. The assessment concludes that the Project will contribute to only minor amounts of pollutant at these receptors.

  As the Project is located within the OLS for Gladstone Airport, a plume rise assessment has been undertaken. The assessment concluded that the Project is considered unlikely to present a hazard to local aircraft operations. Referral to CASA has been recommended on the basis of the proposed emergency flare.
- **Natural hazards, risk and resilience** – the Project is located within a medium potential bushfire intensity and potential impact buffer designation. The development footprint has sought to ensure the minimisation of risks to life and property thought the inclusion of adequate setbacks from adjoining vegetation and adequate bushfire buffers.
- **Energy and water supply** – the Project will be connected to electricity and water supply.
- **Infrastructure integration** – the Project represents the appropriate siting. The Project will utilise existing infrastructure within the road reserve, integrates with Orica and Jemena Gas Pipeline.
- **Transport infrastructure** – construction traffic associated with the Project has been discussed within Section 3.4.2 and has been assessed within the Traffic Impact Assessment (which formed part of the originating Development Application). The Traffic Impact Assessment determined that no works are required on the Gladstone-Mount Larcom Road (Hanson Road)/Reid Road intersection or road upgrades.
- **Strategic airports and aviation facilities** – the Project will not affect the ongoing safe operation of Gladstone Airport. A Plume Rise Assessment (Appendix H) has been prepared for the Project which has concluded that the exhaust velocities are unlikely to present a hazard to the local aircraft operations. Referral to CASA has been recommended on the basis of the proposed emergency flare.
- **Strategic ports** – the Project will not affect the ongoing operation of the Gladstone Port.

4.6 Gladstone Regional Council Planning Scheme 2017

The Gladstone Regional Council Planning Scheme 2017 identifies the Project area zoned as Special Purpose Zone. Under the Section 5.8, Table 5.8.1 Operational Work associated with a MCU and involving earthworks, including filling or excavating land is accepted development where in the SDA within the Special Purpose Zone.

Building permits will be sought from Gladstone Regional Council or a private building certifier where necessary for Project buildings such as the administration building.

4.7 Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act is administered by the Commonwealth Department of Climate Change Energy, the Environment and Water (DCCEEW). If a Project will or is likely to cause a significant impact to a Matter of National Environmental Significance (MNES) a Referral is must be lodged to the DCCEEW.

A self-assessment was undertaken (submitted as part of the originating Development Application) to determine if the Project has the potential to result in a significant residual impact on a MNES. The self-assessment concluded that the Project is unlikely to result in a significant impact to threatened and migratory species.

The proposed changes will not result in any changes to the self-assessment.

4.8 Nature Conservation Act 1992

The *Nature Conservation Act 1992* (NCA 1992) and the Nature Conservation (Wildlife Regulation) 2006 lists species that are classed as threatened or near threatened in Queensland.

The site has been identified as having essential habitat species pursuant to schedule 2 and 3 of the Nature Conservation (Wildlife Regulation) 2006.

No threatened fauna species were recorded within the Project area during the field survey. A detailed assessment was submitted as part of the originating Development Application.

4.9 Environmental Protection Act 1994

The objective of the EP Act is to protect Queensland’s environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological process on which life depends (ecologically sustainable development).

The EP Act provides the key legislative framework for the protection of the environment in Queensland. The EP Act imposes a ‘general environmental duty’ which specifies that a person must not undertake any activity that may harm the environment without taking reasonable and practical measures to prevent or minimise harm.

Pursuant to the EP Act and EP Regulations, the Project will be conducting ERAs with the operational thresholds triggered the requirement for an EA.

The following ERA activities will be undertaken:

- ERA 7 (4)(a) - Chemical Manufacturing (manufacturing, in a year, 200 tonnes - 5,000 tonnes of fertiliser).
- ERA 7 (6) (d) - Chemical Manufacturing (Manufacturing more than 100,000 tonnes of inorganic chemicals in a year).
- ERA 33 – Crushing, milling, grinding or screening (crushing, milling, grinding or screening more than 5,000 tonnes of material in a year).

An Amendment EA Application will be submitted to DESI to reflect the proposed changes discussed herein.

4.10 Biosecurity Act 2014

The *Biosecurity Act 2014* is administered by the Department of Agriculture and Fisheries (DAF). The Act provides management measures to protect agricultural and tourism industries and the environment from pests, diseases and contaminants.

Under the Act, invasive plants and animals are categorised as either a ‘Prohibited Matter’ or a ‘Restricted Matter’ and replace the ‘Declared’ status under the superseded *Land Protection (Pest and Stock Route Management) Act 2002*. The *Biosecurity Act 2014* also requires every local government in Queensland to develop a biosecurity plan for their area.

No introduced fauna species listed under the *Biosecurity Act 1994* were recorded during the field study.

4.11 Fisheries Act 1994

The *Fisheries Act 1994* (Fisheries Act) and the Fisheries Regulation 1994 govern both commercial and recreational fishing activities and provide for the management, use, development and protection of fisheries resources and fish habitats, and the management of aquaculture activities. The Fisheries Act holds provisions for the following:

- removal, damage or disturbance to marine plants, including mangroves
- works in a declared fish habitat
- waterway barrier works.

There are no mapped waterways on the Queensland waterways for barrier works mapping within the Project area.

4.12 Environmental Offsets Act 2014

The environmental offsets framework in Queensland includes the *Environmental Offsets Act 2014* (EO Act), the Environmental Offsets Regulation 2014 (EO Regulation) and the Queensland Environmental Offsets Policy (EO Policy).

MSES are a component of the biodiversity State interest that is defined under the SPP and defined under the EO Regulation. MSES are defined as:

- regulated vegetation
- connectivity areas (non-urban areas)
- wetlands and watercourses
- designated precincts in Strategic Environmental Areas
- protected wildlife habitat
- protected areas (national parks, regional parks; and nature refuges)
- declared fish habitat areas and highly protected zones of State Marine Parks
- waterways providing for fish passage
- marine plants
- legally secured offsets areas.

A significant impact assessment was undertaken in accordance with the EPBC Act *Policy Statement 1.1 Significant Impact Guidelines: Matters of National Environmental Significance* which concluded that the Project is unlikely to result in a significant impact to threatened and migratory species. The Significant Impact Assessment was provided within the originating Development Application and no changes to this assessment is proposed.

The Significant Impact Guidelines under the EPBC Act have the same impact criteria as the Significant Residual Impact Guidelines under the EO Act, therefore it can be concluded that the Project will not result in a Significant Residual Impact on MSES.

4.13 Work Health and Safety Act 2011

The Project may exceed the thresholds identified within Schedule 15 of the *Work Health and Safety Act 2011* and therefore a potential Major Hazard Facility. Safe Work Australia will be consulted to discuss the next steps for Notification of a Major Hazard Facility.

5.0 Conclusion

This Application proposes a Change to an Existing Approval for a MCU on land within the GSDA.

The changes to the Project have been assessed against the relevant State and Local assessment criteria, including the GSDA Development Scheme, SPP and other relevant Strategic Plans and Policies.

The changes to the approved development is considered to be consistent with the intent of these planning instruments and no conflicts have been identified.

Appendix A

Owners Consent

Owner's consent for making an SDA application or request under Part 6 of the *State Development and Public Works Organisation Act 1971*

PART 1: Company owner's consent

I,

Rimas Kairaitis

Managing Director of the company mentioned below

and I, Richard James Edwards, Company Secretary of the company mentioned below

[*Insert name in full*

[*Insert position in full—i.e. another director, or a company secretary*]

Of Solindo Pty Ltd (ACN 158 170 506)

as owner of the premises identified as follows:

53 Reid Road, Yarwun, Queensland, 4680

Also known as Lot 12 on SP239343

consent to the making of an SDA application or request under Part 6 of the *State Development and Public Works Organisation Act 1971* by:

Alpha HPA Ltd

on the premises described above for:

Amendment to State Development Area (SDA) Approval (AP2020/001 & AP2021/2012) for a Material Change of Use to establish a Special Industry (HPA Processing Plant) and Linear Infrastructure Facility (the Project) for the purposes of a High Purity Alumina (HPA) processing plant.

The *State Development and Public Works Organisation Act 1971* is administered by the Department of State Development, Infrastructure, Local Government and Planning, Queensland Government.

Company name and ACN: Solindo Pty Ltd (ACN 158 170 506)	
.... Signature of Director 18/03/2024 .... Date	.... Signature of Director/Secretary 18/03/2024 .... Date

Appendix B

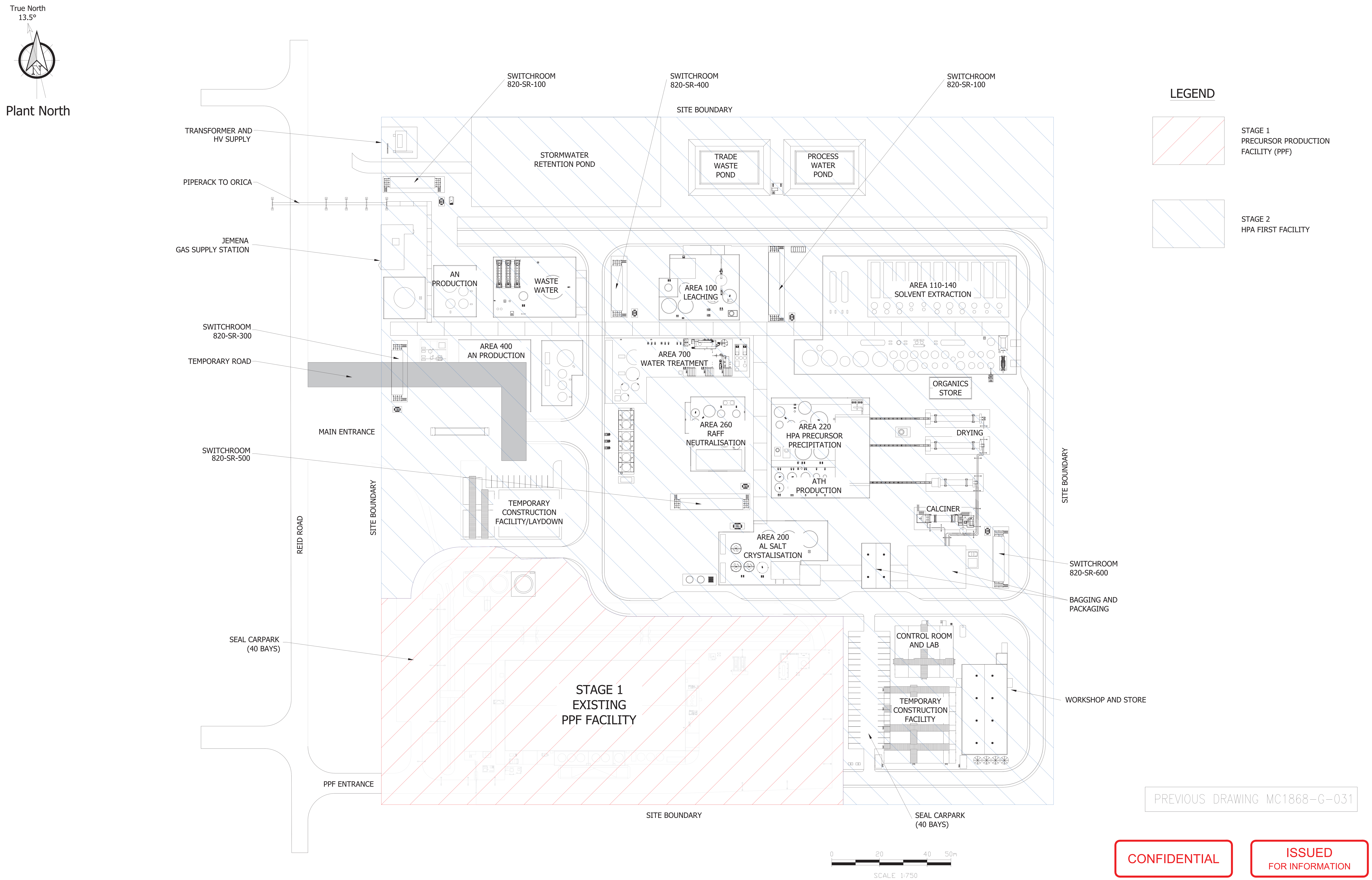
SDA Properly Made Checklist

SDA Properly Made Checklist

Items		Location
Be made to the Coordinator-General in the approved form including:		
a.	A clear and accurate description of the land subject to the application.	Refer Section 1.1, Table 1
a.	The proponent's name, address and contact details.	Refer Section 1.1, Table 1
b.	Identify the development for which approval is being sought.	Refer Section 1.1, Table 1
c.	The written consent of the owner of the land.	Refer Appendix A
d.	State the referral triggers under the Planning Act (and referral entities if known) for the application.	Refer Section 1.1 Table 2
e.	If the application is part of a larger development, include a description of the larger development and details of how the application relates to the larger development.	Not Applicable
f.	Include a statement on whether the development has been, is or will be subject to an EIS or IAR.	Not Applicable The development will not be subject to an EIS or IAR.
Be accompanied by:		
g.	A planning report.	Refer herein
h.	If one has been prepared, an EIS or IAR relevant to the application including an EIS or IAR evaluation report.	Not Applicable
i.	Payment of the relevant fee, if prescribed by regulation.	Application fee will be paid prior to lodgement.

Appendix C

Development Plans



CONFIDENTIAL

ISSUED
FOR INFORMATION

		E	24.04.24	SITE LAYOUT REVISED	AMC	JH	JH		TC
		D	29.04.24	SITE LAYOUT UPDATED	AMC	JH	JH		TC
		C	11.04.24	SITE LAYOUT REVISED - IN PROGRESS	AMC	JH	JH		TC
		B	19.02.24	LAYOUT UPDATED, TEMPORARY CONSTRUCTION FACILITIES ADDED	AMC	WB	WB		TC
		A	11.11.23	ISSUED FOR INFORMATION	AS	JH	JH		TC
NUMBER	REFERENCE DRAWINGS	REV	DATE	REVISION DESCRIPTION	DRN	CHK	ENG	REG No.	APP

Anthony McCredden Jason Hepburn

Alpha HPA

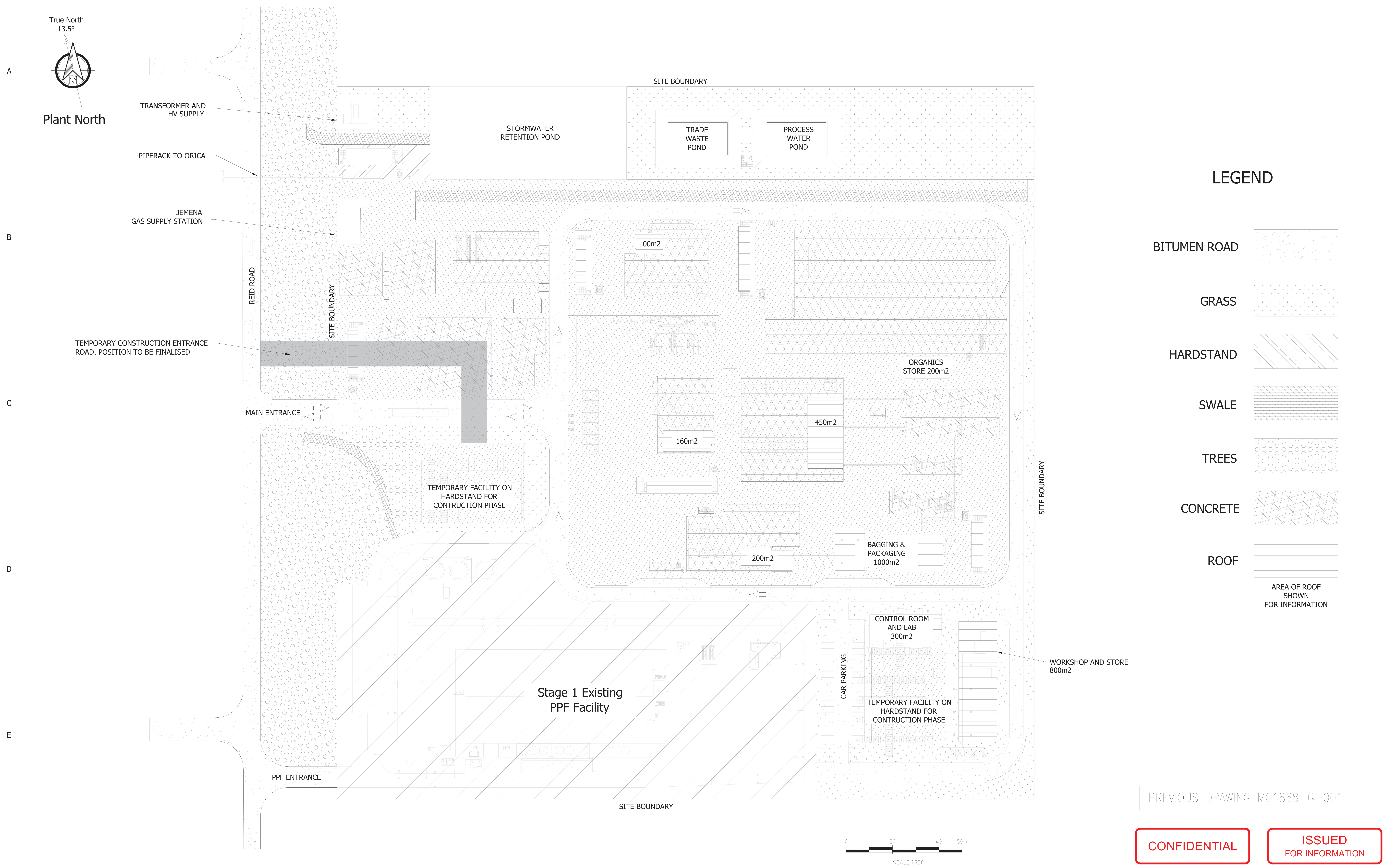
Prudentia ENGINEERING

SCALE	1:750	
DRAWN	A. SHAW	08.11.23
CHECKED	J. HEPBURN	19.02.24
ENGINEER	J. HEPBURN	19.02.24
APPROVED	T. CHOW	19.02.24
CLIENT		
		A1

ALPHA HPA
HPA FIRST PROJECT
OVERALL SITE PLAN
GENERAL LAYOUT STAGE 1 & 2

DRG. No. MC23050-000-Z-GAR-00001

REV E



CONFIDENTIAL

ISSUED
FOR INFORMATION

NUMBER	REFERENCE DRAWINGS	REV	DATE	REVISION DESCRIPTION	DRN	CHK	ENG	REG No.	APP
					Anthony McCredden	Jason Hepburn			
		C	24.05.24	SITE LAYOUT UPDATED	AMC	JH	JH		TC
		B	29.04.24	SITE LAYOUT UPDATED	AMC	JH	JH		TC
MC23050-000-Z-GAR-001	GENERAL LAYOUT STAGE 1 & 2	A	19.02.24	ISSUED FOR INFORMATION	AMC	JH	JH		TC

Alpha HPA

Prudentia ENGINEERING

SCALE	1:750	
DRAWN	A.MCCREDDEN	08.11.23
CHECKED	J. HEPBURN	19.02.24
ENGINEER	J. HEPBURN	19.02.24
APPROVED	T. CHOW	19.02.24
CLIENT		
		A1

ALPHA HPA
HPA FIRST PROJECT
OVERALL SITE PLAN
LANDSCAPING DETAILS

DRG. No. MC23050-000-Z-GAR-00004

REV C

True North
13.5°

Plant North

LEGEND

STAGE 1
PRECURSOR PRODUCTION FACILITY (PPF)

STAGE 2
HPA FIRST FACILITY

PREVIOUS DRAWING MC1868-G-004

0 20 40 50m
SCALE 1:750

CONFIDENTIAL

ISSUED
FOR INFORMATION

NUMBER	REFERENCE DRAWINGS	REV	DATE	REVISION DESCRIPTION	DRN	CHK	ENG	REG No.	APP
		B	24.05.24	SITE LAYOUT UPDATED	AMC	JH	JH		TC
		A	29.04.24	ISSUED FOR INFORMATION	AMC	JH	JH		TC

Anthony McCredden | Jason Hepburn | Digitally signed by Jason Hepburn Date: 2024.05.27 19:50:50 +10'00'

Alpha HPA

Prudentia ENGINEERING

SCALE	1:750	
DRAWN	A. MCCREDDEN	29.04.24
CHECKED	J. HEPBURN	29.04.24
ENGINEER	J. HEPBURN	29.04.24
APPROVED	T. CHOW	29.04.24
CLIENT		
		A1

ALPHA HPA
HPA FIRST PROJECT
OVERALL SITE PLAN
GENERAL LAYOUT STAGE 1 & 2 - SATELLITE OVERLAY

DRG. No. MC23050-000-Z-GAR-00005

REV B

Appendix D

Gladstone State Development Area Assessment

SDA Wide Assessment Criteria

Criteria	Response
2.5.1 Infrastructure &Services	
1. Development: a) is designed to maximise efficiency and minimise the cost for infrastructure and services	**Complies – no change** The Project has sought to ensure an effective and efficient design. The site will be connected to: • telecommunications • transport with direct access to Reid Road (Local) which provides direct access to Gladstone-Mount Larcom Road (Hanson Road) (State Controlled Road) • water • wastewater • recycled water is not available to the subject site • electricity. Connection to each service will correlate to the relevant built form within Stage 2.
b) plans for and manages its impacts on existing and planned infrastructure and services	**Complies – no change** The Project has considered impacts on transport, water, wastewater and energy networks. Technical reporting has been prepared and submitted herein demonstrating compliance.
c) is adequately serviced by the infrastructure and services necessary to meet the demand generated by the development	**Complies – no change** Refer above, the development will be adequately serviced.
d) integrates with existing and planned infrastructure and services where possible. Note: infrastructure and services include telecommunications, transport (including corridors and operations), water, wastewater, recycled water and energy networks, and state or local government infrastructure and services.	**Complies – no change** Refer above, the development will be adequately serviced and will integrate with existing services where possible.
2.5.2 Transport	
1. Increased traffic arising from the development is either able to be accommodated within existing road networks, or works are undertaken to minimise adverse impacts on existing and future uses and road networks.	**Complies – no change** The originating Development Application material had included a Traffic Impact Assessment (TIA). The TIA has discussed the Projects impacts both phases being construction and operation. The

Criteria	Response
2. Road networks in the Gladstone SDA are designed to accommodate the proposed vehicle type and predicted traffic volumes associated with the development and the precinct/s. 3. Development is designed to facilitate safe and efficient vehicular ingress and egress and does not unduly impact on the safe and efficient operation of transport infrastructure, including corridors. 4. Adequate onsite parking for the number and nature of vehicles expected is provided.	assessment concluded that the Project will have minimal impacts on the State Controlled Road and Local Road intersections and networks from a capacity perspective. However, the results did indicate that the additional construction traffic will lead to increases in the pavement loadings on Reid Road during construction only and will result in negligible increase in pavement loadings on the State Controlled Road. The TIA determined that no road works or intersection upgrades are required to facilitate the Project, therefore it can be considered that the Local Road and State Road network is sufficiently designed to accommodate the proposed vehicle type and predicted traffic volumes. The Project will be accessed from Reid Road (Local Road). Reid Road has direct connection to Gladstone-Mount Larcom Road (Hanson Road) to the north (State Controlled Road). The Project will have two (2) permanent vehicular crossovers via Reid Road. The TIA has determined the access configurations are adequate to cater for the expected volume and configuration of vehicles during both phases of the Project. An additional temporary access has been proposed for construction purposes. This temporary access is not considered to result in the amendment of this TIA. In addition, additional car parking has been proposed to accommodate construction vehicles, it is not considered that the TIA is required to be updated as the Project is proposing additional on site car parking and has not resulted in any decreases. Reference is made to Appendix C containing the proposal plans. The plans have identified adequate car parking for both staff and visitors during both phases of the Project ensuring that all vehicles are wholly located within the site boundaries. The TIA has not been updated to include the temporary access. It is considered based on the above results that the inclusion will only impact on State Controlled Road during construction only and will not cause additional impacts post construction.
2.5.3 Environmental Nuisance	
1. Development is located, designed, and operated to avoid, minimise or manage: a) adverse impacts from air, noise and other emissions that will affect the environment and/or health and safety, wellbeing, and amenity of communities and individuals b) conflicts with sensitive uses arising from (but not limited to) spray drift, odour, noise, light spill, dust, smoke, or ash emissions.	**Complies – no change** The Project has been designed to minimise potential impacts to health and safety, wellbeing and amenity through the following considerations: • Noise – a Preliminary Operational Noise Impact Assessment has been prepared and included within Appendix I. The preliminary report concluded recommendations to ensure compliance is achieved with the GSDA Development Scheme and the EPP (Noise) 2019. • Air – an Air Quality Impact Assessment has been included within Appendix G. • Emissions – a Plume Rise Assessment has been included within Appendix H.

Criteria	Response
	• Chemicals – A Quantitative Risk Assessment was included in the originating application material and was not updated as a result of the Changed Approval. • Land - a Site Based Management Plan was included in the originating application material and was not required to be updated as a result of the Changed Approval.
2. The location, design and operation of development achieves the relevant acoustic objectives of the Environmental Protection (Noise) Policy 2019 and achieves the relevant air quality objectives of the Environmental Protection (Air) Policy 2019.	**Complies – no change** Noise: The Preliminary Operational Noise Impact Assessment has been updated and included within Appendix I. The updated reporting and assessment has identified that the Project with the proposed will have negligible impacts on sensitive receptors and has demonstrated compliance can be achieved with the applicable acoustic requirements provided within the GSDA Development Scheme and the EPP (Noise) 2019 though the inclusion of mitigation measures to be implemented if required within the detailed design phases once all equipment has been finalised. Air: The Air Quality Impact Assessment has been updated and included within Appendix G. The Air Quality Impact Assessment report has sought to address the Project pollutant concentration at sensitive receptors and sensitive zone in accordance with the EPP (Air) 2019. The assessment concludes that the Project will comply with relevant air quality objectives.
3. Development: a) avoids adverse impacts on the cumulative air quality of the Gladstone airshed or b) where impacts cannot be avoided, conducts air shed modelling in accordance with current best practice to demonstrate compliance with air quality standards.	**Complies – no change** The Plume Rise Assessment has been updated and included within Appendix H. The Project is located within the Obstacle Limitation Surface (OLS) of the Gladstone Airport, which is located approximately 5.5 km to the south-east of the eastern boundary of the Project area. The processing facility requires combustion engines and processes which will require venting to air. The updated assessment has concluded that based on the location of the Project area and the emission sources proposed as part of the Project, is unlikely to present a hazard to local aircraft, however, a recommendation to refer to CASA for the proposed emergency flare is required. No additional changes are proposed to recommendations with the exception of the referral to CASA.
2.5.4 Contaminated Land	
1. Development on land likely to be contaminated or recorded on the Environmental Management Register or Contaminated Land Register does not adversely impact on human health or the environment by exposure,	**Complies – no change** The site is identified on the Environmental Management Register (EMR) for the following notifiable activities related to the historic use of the site:

Criteria	Response
management, or movement of contaminants. Note: Refer to Department of Environment and Science (DES) if a site is subject to a per-and poly-fluoroalkyl substances site investigation.	• Chemical Storage (other than petroleum products or oil) – storing more than 10 tonne of chemicals (other than compressed or liquefied gases) that are dangerous good under the dangerous goods code. • Foundry Operations – Commercial production of metal products by injecting or pouring molten metal into moulds and associated activities in works having a design capacity of more than 10 tonne per year. • Mineral Processing – chemically or physically extracting or processing metalliferous ores. GHD were commissioned at the time of the decommissioning of the Australian Magnesium Corporations (AMC) Gladstone Demonstration Plant to prepare an assessment identifying any potential contaminations issues of the subject site (included in originating Development Application material). The report concluded that there were a few areas of environmental concern, however no concern was raised whilst the site continues to be used for industrial purpose. No remediation measures were prescribed within the report. Should earthworks require the removal, treatment or disposal of contaminated soil from site, a soil disposal permit will be sought with the Department of Environment Science and Innovation.
2. Where required, develop a strategy to manage any existing contamination and the potential for additional contamination, so that human health and the environment are not adversely affected.	**Complies – no change** Refer above
2.5.5 Natural hazards	
1. Development, in accordance with current best practice: a) identifies relevant natural hazards that may impact upon the project b) appropriately manages risk associated with identified hazards c) avoids increasing the severity of natural hazards d) avoids adverse impacts from natural hazards to protect people and property and enhances the community's resilience to natural hazards, or where adverse impacts cannot be avoided, impacts are minimised, mitigated, or offset e) avoids directly or indirectly increasing the severity of coastal erosion either on or off the site	**Complies – no change** A bushfire hazard assessment has not been prepared. However, mitigation measures have been included within the Site Based Management Plan that was submitted as part of the originating Development Application. No changes are proposed with respect to the Site Based Management Plan as a result of the amendments.

Criteria	Response
2. Development, in accordance with current best practice, achieves an appropriate level of flood immunity and: a) does not adversely affect existing flow rates, flood heights, or cause or contribute to other flooding impacts on upstream, downstream, and adjacent properties, or the state transport network (including potential impacts from changes to stormwater flows and local flooding).	**Complies – no change** An updated Site Water Management Plan has been undertaken to include the proposed amendments (Appendix J). The assessment was undertaken to understand the potential impacts of stormwater discharge from the Project on the receiving environment surface water quality and quantity. The potential impacts associated with the construction and operation can be appropriately managed through implementation of a range of suitable mitigation measures discussed within Appendix J.
2.5.6 Climate Change	
1. Development: a) avoids or, if avoidance cannot be achieved, minimises net increases in the emission of greenhouse gases b) can adapt to current and future impacts of a changing climate. Note: projected climate change conditions include potential impacts from sea level rises, increased maximum cyclone intensity, increased rainfall intensity or increased likelihood and intensity of bushfires.	**Complies** Climate change risk assessment has been undertaken for the Project and can be provided upon request. The assessment concluded that the Project meets the specified criteria.
2.5.7 Acid sulfate soils	
1. Development, in accordance with current best practice, is to: i. avoid the disturbance of acid sulfate soils (ASS) or ii. ensure that the disturbance of ASS avoids or minimises the mobilisation and release of acid and metal contaminants.	**Complies – no change** Australian Soil Resource Information (ASRIS) mapping has identified that the Project area as having Extremely Low Probability of Occurrence. The Project is therefore not considered to impact on ASS, however if they are encountered minimising of release through site based operations will be undertaken during construction.
2.5.8 Water quality	
1. Consistent with the Environmental Protection (Water and Wetland Biodiversity) Policy 2019, development avoids or, if avoidance cannot be achieved, minimises, mitigates or offsets adverse impacts on the environmental values and water quality objectives of	**Complies – no change** An updated Site Water Management Plan has been undertaken to include the proposed amendments (Appendix J). The assessment was undertaken to understand the potential impacts of stormwater discharge from the Project on the receiving environment surface water quality and quantity. The potential impacts associated with the construction and operation can be

Criteria	Response
receiving waters and wetlands arising from: a) altered stormwater quality and/or flow b) wastewater (other than contaminated stormwater and sewage) c) the creation or expansion of regulated structures or non-tidal artificial waterways d) the release and mobilisation of nutrients and sediments.	appropriately managed through implementation of a range of suitable mitigation measures discussed within Appendix J.
2. Development encourages a precinct-wide stormwater management approach that achieves an improved water quality outcome.	**Complies – no change** An updated Site Water Management Plan has been undertaken to include the proposed amendments (Appendix J). The assessment was undertaken to understand the potential impacts of stormwater discharge from the Project on the receiving environment surface water quality and quantity. The potential impacts associated with the construction and operation can be appropriately managed through implementation of a range of suitable mitigation measures discussed within Appendix J.
3. Development protects the ecological and hydraulic function of waterway corridors in and adjacent to the Gladstone SDA, with particular regard to the Great Barrier Reef World Heritage Area, fish passage and marine plants.	**Complies – no change** An updated Site Water Management Plan has been undertaken to include the proposed amendments (Appendix J). The assessment was undertaken to understand the potential impacts of stormwater discharge from the Project on the receiving environment surface water quality and quantity. The potential impacts associated with the construction and operation can be appropriately managed through implementation of a range of suitable mitigation measures discussed within Appendix J.
2.5.9 Risk Management - Activities	
1. (1) Development is located, designed, and operated to: a) minimise the health and safety risks to communities and individuals b) avoid any potential adverse impacts from emissions and hazardous activities, or where adverse impacts cannot be avoided, impacts are minimised or mitigated c) protect high pressure gas pipelines from encroachment that would compromise the ability of the pipelines to function safely and	**Complies – no change** A Quantitative Risk Assessment was prepared and submitted as part of the originated Development Application. No changes are proposed as part of this application.

Criteria	Response
effectively.	
2. Activities involving the use, storage, and disposal of hazardous materials and prescribed hazardous chemicals, dangerous goods, and flammable or combustible substances are located and managed to minimise the health and safety risks to communities and individuals.	**Complies – no change** A Quantitative Risk Assessment was prepared and submitted as part of the originated Development Application. No changes are proposed as part of this application.
3. Development provides adequate protection from the harmful effects of noxious and hazardous materials and chemicals manufactured or stored in bulk during natural hazard events.	**Complies – no change** A Quantitative Risk Assessment was prepared and submitted as part of the originated Development Application. No changes are proposed as part of this application.
2.5.10 Cultural heritage and community	
1. Indigenous and non-Indigenous cultural heritage values, and community values of the premises on which the development is undertaken, and immediate surrounds, are identified and managed, consistent with current best practice. Note: Duty of Care under Section 23 of the Aboriginal Cultural Heritage Act 2003 should be considered a minimum requirement of all development.2	**Complies – no change** The Project has sought to consider the sites environmental, cultural heritage and community values though the assessment considerations within the submitted Ecology Assessment Report, updated Preliminary Operational Noise Impact Assessment, updated Air Quality Assessment and through compliance with the cultural heritage Duty of Care. A range of mitigation measures will be implemented to minimise and manage any potential impacts for the Project and have been discussed within the Site Based Management Plan which was included as part of the originating Development Application.
2. Development is located, designed and operated to avoid adverse impacts on cultural heritage and community values, or where adverse impacts cannot be avoided, impacts are minimised, mitigated, or offset.	**Complies – no change** Refer above, no change proposed.
3. Development recognises and protects the cultural heritage values associated with: (a) the Euroa Homestead on Lot 200 on SP239672 (b) the Mount Larcombe Station Original Homestead Site on Lot 73 on SP272417 and Lot 20 on SP272417 (c) the Targinnie Cemetery on Lot 95 on DS287	**Not Applicable** The Project site is not located on these allotments.
4. Where development requires a buffer to mitigate the adverse amenity impacts of the development, including, but not limited to, visual and acoustic impacts, that	**Not Applicable** The Project is located within an industrial precinct and is not adjoining sensitive receptors.

Criteria	Response
buffer is accommodated within the development site.	
2.5.11 Environment	
1. Environmental values of the premises on which the development is undertaken, and immediate surrounds are identified and managed, consistent with current best practice.	**Complies – no change** The originating application material included an Ecological Assessment Report which has assessed the ecological values of the site. The Project area has identified that no areas of essential habitat areas for threatened flora, however, the mapping has identified essential habitat within the Project area for: • Wallum froglet (crinia tinnula)(Vulnerable under the NC Act). • Greater glider (Petauroides Volans)(Vulnerable under the NC Act). • Lesser sand plover (Charadrius mongolus) (Endangered under the NC Act). During the ecological field study, no species records were found within 2km of the Project area, however, the field study has identified the following habitat within the Project area: • Does not meet the definition of essential habitat for the wallum froglet. • Does meet the definition of essential habitat for the greater glider. However the study has identified that the Project area is not considered suitable to support a resident population of greater gliders. • Does not met the definition for essential habitat for the lesser sand plover. Mitigation measures have been proposed within Section 7 of the Ecological Assessment to ensure that potential impacts during construction are minimised. Based on the prepared ecological assessment, the proposal has sought to minimise impacts on known species of important fauna.
2. Development is located, designed, and operated to: a) avoid adverse impacts on environmental values including matters of local, state, and national environmental significance or where adverse impacts cannot be avoided, impacts are minimised, mitigated, or offset b) maintain ecological connectivity and processes c) maintain the outstanding universal value (OUV) of the Great Barrier Reef World Heritage Area including the local attributes of the OUV identified in the Master plan for the Priority Port of Gladstone	**Complies – no change** The Project has been sited in an industrial area, impacts on environmental values has been assessed and considered as part of the originating application. No changes are proposed.

Criteria	Response
and Port overlay d) retain, to the greatest extent possible, tidal fish habitat and marine plants	
3. Any residual significant adverse impacts are offset in accordance with the relevant Commonwealth or Queensland environmental offset framework.	**Complies – no change** The Project has been sited in an industrial area, impacts on environmental values has been assessed and considered as part of the originating application. No changes are proposed.
4. Lighting associated with the construction and operation of development is designed to limit the impacts on aquatic wildlife, including turtles and migratory species.	**Complies – no change** The Project will seek to comply with lighting requirements during construction and operation.
5. Where development requires a buffer to mitigate the impacts of the development, that buffer must be accommodated within the development site.	**Complies – no change** The Project has been sited in an industrial area, impacts on environmental values has been assessed and considered as part of the originating application. No changes are proposed.
6. Development avoids native vegetation clearing, or where avoidance is not reasonably possible, minimises clearing to: a) conserve vegetation b) avoid land degradation c) avoid fragmentation and conserve connectivity.	**Complies – no change** The Project is located within a coastal area, however the Project area is not located within the Coastal Management District (CMD). The Project will not impact on the coastal resources of the Project area.
2.5.12 Engineering and design standards	
1. Development is to be designed and constructed in accordance with the relevant engineering and design standards (and any subsequent revisions to the relevant standards) stated in Table 7 below. Alternative and innovative solutions that demonstrate compliance with the relevant standards are encouraged.	**Complies – no change** The Project will comply with all relevant engineering standards where required.

Criteria	Response

Table 7 Relevant engineering and design standards

Acid sulfate soils	• Queensland Acid Sulfate Soil Technical Manual – Soil Management Guideline v4.0 • National Acid Sulfate Soils Guidance – Guidance for the dewatering of acid sulfate soils in shallow groundwater environments – June 2018
Car parking	• Relevant local government standards
Clearing native vegetation	• State code 16: Native vegetation clearing
Environment	• Sea Turtle Sensitive Area Code • Pathways to a climate resilient Queensland – Queensland Climate Adaptation Strategy 2017-2030
Filling	• *AS3798 – Guidelines on Earthworks for Commercial and Residential Developments*
Footpaths and cycle paths	• Relevant local government standards • AustRoads, Guide to Road Design - Part 6A: Pedestrian and Cyclist Paths
Natural hazards - flooding	• Relevant local government standards
Rail	• Department of Transport and Main Roads (DTMR) Guide to Development in a Transport Environment - Rail
Risk management	• *AS2885 – Pipelines – Gas and liquid petroleum* • *AS/NZS ISO 31000:2009 – Risk management* • *AS/NZS 2022-2003: Anhydrous ammonia – Storage and handling* • State code 21: Hazardous chemical facilities
Roads (major)	• DTMR Road Planning and Design Manual • DTMR Pavement Design Manual • DTMR Pavement Design Supplement • DTMR Bridge Design Manual • Queensland Urban Drainage Manual • DTMR Road drainage manual • Manual of Uniform Traffic Control Devices • DTMR Traffic and Road Use Management manual, Volume 3 – Signing and Pavement Making • *AS1158 - Lighting for roads and public spaces* • Institute of Public Works Engineering Australasia, Complete Streets: Guidelines for Urban Street Design - Section 17: Industrial Streets
Roads (minor)	• Relevant local government standards

Criteria	Response

Site access	• Relevant local government standards
Soil erosion	• International Erosion Control Association (IECA) – Best Practice Erosion and Sediment Control
Stormwater quality	• Water sensitive urban design: Design objectives for urban stormwater management • Health Land and Water, Construction and Establishment Guidelines: Swales, Bioretention Systems and Wetlands: Version 1.1 • Concept Design Guidelines for Water Sensitive Urban Design • Standard Drawings for Water Sensitive Urban Design • Curtis Island, Calliope River and Boyne River Basins - Environmental Values and Water Quality Objectives • Great Barrier Reef River Basins—End-of-Basin Load Water Quality Objectives • Water quality guidelines for the Great Barrier Reef Marine Park • State code 9: Great Barrier Reef wetland protection areas • State Planning Policy 2017 State Interest Water Quality Supplementary Implementation Guidelines February 2021
Stormwater quantity	• Queensland Urban Drainage Manual • Australian Rainfall and Runoff
Utilities (e.g. sewer, water, telecommunications, electricity supply)	• Relevant service provider standards (e.g. Gladstone Regional Council)

Note: Where any inconsistencies arise between relevant engineering and design standards listed in Table 7, the relevant local government constructions standards prevail.

2.5.13 Other Government matters

Criteria	Response
1. Development is to demonstrate consistency with any other relevant legislative requirements that may be necessary for the development to proceed and to the extent practicable, be consistent with regional plans, the State Planning Policy, the Port Overlay for the priority Port of Gladstone, and the State Development Assessment Provisions, where the State interests articulated by these instruments are likely to be affected by the development. 4	**Complies – no change** The application documentation has provided an assessment of the Project against the applicable legislative provisions contained within the: • Central Queensland Regional Plan 2013. • State Planning Policy 2017. • State Development Assessment Provisions. The Project is considered to demonstrate consistency with all relevant legislative requirements and the assessments have been included herein.
2. Development recognises and protects the long-term availability of the extractive resource and access related to the Targinnie Key Resource Area (Number 119).	**Complies – no change** The Project has sought to minimise adverse impacts on existing state and local government infrastructure including but not limited to traffic impacts relating to the local and State controlled roads and local infrastructure within the road reserve. Assessments have been included within the Planning Report and supporting documentation herein.
3. Development does not compromise existing or future port facilities and operation on Strategic Port Land.	**Complies – no change** The Project does not compromise existing or future port operation on Strategic Port Land.

Criteria	Response
2.5.14 Energy and water efficiency	
1. Building, site design, and layout maximises energy efficiency having regard to: (a) building orientation and passive solar design (b) maximising opportunities for cross ventilation (c) appropriate shade treatments (d) landscaping treatments to the western side of the building.	**Complies – no change** The site layout has been designed to optimise the industrial operations of the site to ensure that the layout is efficient and optimises site performance.
2. Water efficiency is optimised with alternative water supply sources, including: a) rainwater harvesting systems b) recycled water source.	**Complies – no change** The site layout has been designed to optimise the industrial operations of the site to ensure that the layout is efficient and optimises site performance.
3. Where practicable, development should be consistent with the Queensland government's renewable energy policies.	**Complies – no change** The site layout has been designed to optimise the industrial operations of the site to ensure that the layout is efficient and optimises site performance.
2.5.14 Visual Impact	
1. Visual impacts of buildings, retaining structures, or other development are minimised through building design, landscaping, and use of appropriate materials when viewed from a publicly accessible viewpoint such as major roads and the Mount Larcom landform.	**Complies – no change** The site layout has been designed to optimise the industrial operations of the site to ensure that the layout is efficient and optimises site performance. Landscaping has been proposed to enhance the visual amenity of the land use.
2. Development maintains and enhances significant vegetation where possible and provides landscaping that: a) minimises the visual impacts of the development b) incorporates at least 50 per cent local species c) is low maintenance.	**Complies – no change** The site layout has been designed to optimise the industrial operations of the site to ensure that the layout is efficient and optimises site performance. Landscaping has been proposed to enhance the visual amenity of the land use. No change has been proposed with respect to vegetation clearing on site.

Objective	Commentary
The preferred development intent for the Port Related Industry Precinct is described below	
(1) The preferred development intent for the Port Related Industry Precinct is described below. (a) This precinct is to accommodate industrial development that: (i) has links to the Port of Gladstone through the import and export of material (ii) benefits from close proximity to port related infrastructure and services (iii) is difficult to locate and requires separation from sensitive land uses. (b) This precinct may also accommodate industrial development that requires co-location with uses that support the preferred development intent.	**Complies** The Project is considered to comply through the following considerations: • The Project is defined as Special Industry and Linear Infrastructure Facility to which the precinct seeks to accommodate. • The Project is for the purposes of refining and processing chemicals. • The Project requires storage of hazardous materials. • The site is sufficiently separated from all sensitive receptors. • The use and impacts are comparable with adjoining land uses within the precinct. • The Project is collocated with Orica. • Stage 1 of the Project has been constructed and is operational. Whilst the Project is not anticipated to utilise the port for import or export at this time, as materials will be transported to Brisbane for export. At this time, the Port does not have the facilities to allow containers or export or import. Once this operation changes, the Project will seek to use the Port where possible. The Project has sought to support Gladstone and the regional economy with the workforce during construction and operation being from Gladstone. The Project will source local materials including: • site and earthworks from the nearby quarry • chemicals for production being sourced directly from Orica. Therefore, despite not utilising the Port facilities, the Project has sought to support the local economy through the above considerations.
(2) Defined uses that support the preferred development intent are: (a) high impact industry (b) medium impact industry (c) port facilities (d) special industry.	**Complies** The Project is considered to comply through the following considerations: • The Project is defined as Special Industry and Linear Infrastructure Facility to which the precinct seeks to accommodate.
(3) Defined uses that may be considered where the use does not compromise the preferred development intent include:	**Complies** The Project is defined as a Special Industry and Linear Infrastructure Facility for the purposes of a of a HPA Processing Plant. The Linear Infrastructure Facility is for the transportation of materials to Orica.

Objective	Commentary
(a) extractive industry (where required for port functions and activities) (b) freight terminal (c) linear infrastructure facility (d) research and technology industry (e) substation (f) utility installation (g) warehouse.	

Appendix E

State Planning Policy Assessment

State Planning Policy and Assessment Benchmarks

The State Planning Policy (Part E) discusses the State Interest Policies and Assessment Benchmarks. The following contains an assessment of the Project against the range of State interests contained within the SPP. The Project is compliant with the intent of the State Planning Policy, noting the following:

Table E1 - SPP Assessment

Policy	Mapping	Policy Applicability	Assessment Benchmarks Applicability
Planning for liveable communities and housing			
Housing supply and diversity.	No mapping associated with this interest.	**No Conflict** The development is non-residential in nature and is located on land identified for industrial purposes in the GSDA Development Scheme.	**Not Applicable** No assessment benchmarks associated with this interest.
Liveable communities.	No mapping associated with this interest.	**No Conflict** The development is non-residential in nature and is located on land identified for industrial purposes in the GSDA Development Scheme. The site is also located away from land zoned for residential purposes where the objectives of this interest apply.	**Not Applicable** Assessment benchmarks are not applicable as the Project does not involve a premises accessed via a common private title.
Planning for economic growth			
Agriculture.	The site is not within any of the following: • Important agricultural area (IAA). • Agricultural land classification (ALC) – class A and B. • Stock route network.	**No Conflict** The development is not located in an IAA, ALC (class A or B) or stock route. The proposed development is not rural in nature however will not limit the use of rural zoned land in the surrounding locality in accordance with the objectives of the state interest.	**Not Applicable** No assessment benchmarks associated with this interest.
Development and construction.	The site is within a State Development Area.	**Applicable** The Project represents the appropriate delivery of large scale industrial infrastructure within an SDA. The development is consistent with the intent and purpose of the GSDA and precincts,	**Not Applicable** No assessment benchmarks associated with this interest.

Policy	Mapping	Policy Applicability	Assessment Benchmarks Applicability
		in particular the function to accommodate the proposed HPA Processing Plant within the Port Related Industry Precinct.	
Mining and extractive resources.	The site is not within a key resource area (KRA) – resource/processing area, separation area, transport route, transport route separation area.	**No Conflict** The development is not within a KRA or associated separation areas and transport routes. The development will not affect the operation of KRAs in the surrounding region.	**Not Applicable** Assessment benchmarks are not applicable as the site is not within a KRA or associated separation areas and transport routes.
Tourism.	No mapping associated with this interest.	**No Conflict** The development is located within the GSDA which has been long-recognised as an area for large scale industrial and infrastructure development.	**Not Applicable** No assessment benchmarks associated with this interest.
Planning for the environment and heritage			
Biodiversity	The site is subject to the following: • MSES – Wildlife habitat (endangered or vulnerable) • MSES – Wildlife habitat (special least concern animal) • MSES – Regulated vegetation (category R) • MSES – Regulated vegetation (essential habitat) • MSES – Regulated vegetation (intersecting a watercourse)	**Applicable** The Project will involve the clearing of native vegetation which is exempt development pursuant to Schedule 21 of the Planning Regulation 2017.	**Not Applicable** No assessment benchmarks associated with this interest.

Policy	Mapping	Policy Applicability	Assessment Benchmarks Applicability
Coastal environment.	The site is not subject to the Coastal Management District.	**No Conflict** – The site is not subject to the Coastal Management District.	**Not Applicable** No assessment benchmarks associated with this interest.
Cultural heritage.	The site is not within a national heritage place or state heritage place.	**Applicable** The Project is located away from listed national and state heritage places. In order to meet Duty of Care requirements under the *Aboriginal Cultural Heritage Act 2003*, all activities on the site will be conducted in accordance with the relevant Cultural Heritage arrangements for the site.	**Not Applicable** No assessment benchmarks associated with this interest.
Water quality.	The site is within a water resource catchment.	**Applicable** An updated Site Water Management Plan has been prepared and included within Appendix K.	**Applicable** Assessment benchmarks are applicable – refer to Table E2 for further detail.
Planning for safety and resilience to hazards			
Emissions and hazardous activities.	The Project is located within the OLS for Gladstone Airport	**Applicable** An updated Plume Rise Assessment has been prepared and included within Appendix J. A Quantitative Risk Assessment was prepared and included within the originating Development Application material.	**Not Applicable** No assessment benchmarks associated with this interest.
Natural hazards, risk and resilience.	The site is within the following: • Flood hazard area (Queensland floodplain assessment overlay). • Flood hazard area (local government flood mapping area). • Bushfire prone area (medium potential	**Applicable** A bushfire hazard assessment has not been prepared. However, mitigation measures have been included within the development to ensure that adequate bushfire separation has been proposed. The site has not been included within the Planning Schemes Flood Hazard Overlay.	**Applicable** Assessment benchmarks are applicable – refer to Table E3 for further detail.

Policy	Mapping	Policy Applicability	Assessment Benchmarks Applicability
	intensity and potential impact buffer).		
Planning for infrastructure			
Energy and water supply.	No mapping associated with this interest.	**Not Applicable** The site has not been identified within the Mapping.	**Not Applicable** No assessment benchmarks associated with this interest.
Infrastructure integration.	No mapping associated with this interest.	**No Conflict** The site has not been identified as having conflicts with relevant infrastructure.	**Not Applicable** No assessment benchmarks associated with this interest.
Transport infrastructure.	The site is not within an existing or future state controlled road or railway. The site is however located to the south of Gladstone-Mount Larcom Road (Hanson Road) and north of a railway corridor.	**No Conflict** The proposed development will not require direct access to the State Controlled Road (Gladstone-Mount Larcom Road (Hanson Road)). All access (permanent and temporary) is from a local road (Reid Road).	**Not Applicable** No assessment benchmarks associated with this interest.
Strategic airports and aviation facilities.	The site is subject to the following: • Obstacle limitation surface area. • Obstacle limitation surface contours. • Wildlife hazard buffer zone.	**No Conflict** The development will not affect the ongoing safe operation of Gladstone Airport. An updated Plume Rise Assessment has been prepared and included within Appendix H. The assessment concluded that the Project is considered unlikely to present a hazard to local aircraft operations. Referral to CASA is recommended.	**Not Applicable** Assessment benchmarks are not applicable – none of the works or infrastructure associated with the proposed use will intrude into the OLS contour for the Gladstone Airport.
Strategic ports.	The site is not within a strategic port and is located with a priority port.	**No Conflict** The development will not affect the ongoing operation of the Gladstone Port.	**Not Applicable** No assessment benchmarks associated with this interest.

Table E2 Assessment benchmarks – water quality

Assessment Benchmark	Commentary
1. Development is located, designed, constructed and operated to avoid or minimise adverse impacts on environmental values arising from: a. altered stormwater quality and hydrology b. waste water c. the creation or expansion of non-tidal artificial waterways d. the release and mobilisation of nutrients and sediments.	**Complies – no change** An updated Site Water Management Plan has been undertaken to include the proposed amendments and is provided in Appendix J. The assessment was undertaken to understand the potential impacts of stormwater discharge from the Project on the receiving environment surface water quality and quantity. The potential impacts associated with the construction and operation can be appropriately managed through implementation of a range of suitable mitigation measures discussed within Appendix J.
2. Development achieves the applicable stormwater management design objectives outlined in tables A and B (appendix 2).	**Complies – no change** An updated Site Water Management Plan has been undertaken to include the proposed amendments and is provided in Appendix J. The assessment was undertaken to understand the potential impacts of stormwater discharge from the Project on the receiving environment surface water quality and quantity. The potential impacts associated with the construction and operation can be appropriately managed through implementation of a range of suitable mitigation measures discussed within Appendix J.
3. Development in a water supply buffer area avoids adverse impacts on drinking water supply environmental values.	**Not Applicable**

Table E3 Assessment benchmarks – natural hazards, risk and resilience

Assessment Benchmark	Commentary
Bushfire, flood, landslide, storm tide inundation, and erosion prone areas outside the coastal management district:	
1. Development other than that assessed against (1) above, avoids natural hazard areas, or where it is not possible to avoid the natural hazard area, development mitigates the risks to people and property to an acceptable or tolerable level.	**Complies – no change** The Project will not hinder disaster management response or recovery capacity and capability by virtue of increasing the severity of existing hazards or significantly increasing the workforce within the hazard area.
All natural hazard areas	
2. Development supports and does not hinder disaster management response or recovery capacity and capabilities.	**Complies – no change**

Assessment Benchmark	Commentary
	The Project will not hinder disaster management response or recovery capacity and capability by virtue of increasing the severity of existing hazards or significantly increasing the workforce within the hazard area.
3. Development directly, indirectly and cumulatively avoids an increase in the severity of the natural hazard and the potential for damage on the site or to other properties.	**Complies – no change** The Project will reduce the severity of bushfire hazard on the site though the implementation of buffers, and hydraulic modelling has been undertaken to ensure no off site worsening of flood characteristics.
4. Risks to public safety and the environment from the location of hazardous materials and the release of these materials as a result of a natural hazard are avoided.	**Complies – no change** A Quantitative Risk Assessment was prepared and included within the originating Development Application material demonstrating compliance will be achieved. The QRA was not updated as part of the proposed changes discussed herein.
5. The natural processes and the protective function of landforms and the vegetation that can mitigate risks associated with the natural hazard are maintained or enhanced.	**Complies – no change** The development has been designed to largely retain the natural landform to ensure no worsening of off-site flooding.

Appendix F

State Development Assessment Provision Codes

State code 22: Environmentally relevant activities

Guideline – SDAP State code 22: Environmentally Relevant Activities provides direction on how to address this code.

Table 22.1: All development

Performance outcomes	Acceptable outcomes	Response
All ERAs		
PO1 Development is suitably located and designed to avoid or mitigate **environmental harm** to the acoustic **environment**.	**AO1.1** Development meets the acoustic quality objectives for sensitive receptors identified in the Environmental Protection (Noise) Policy 2019.	**Complies - no change** The Project has been designed to avoid and mitigate environmental harm to the acoustic environment. Specifically, a Preliminary Operational Noise Impact Assessment has been prepared and updated to include the proposed changes (Appendix I). The report sought to assess the preliminary operational noise impacts from the Project to nearby sensitive receptors which are located to the South and west of the Project area approximately 4.5km away. This assessment concluded that noise treatments can be practicably applied to the Project site to ensure compliance with the nominated criteria within the GSDA Development Scheme and the EPP (Noise) Policy 2019. The treatments discussed in the report (Appendix I) are considered to be “indicative” and have not been proposed as part of this Development Application. Final noise treatments (if required) will be refined as the Project progresses into Detailed Design and the equipment selection has been finalised. It is expected that a condition of approval will be provided as part of the Environmental

Performance outcomes	Acceptable outcomes	Response
		Authority (EA) demonstrating compliance is achieved.
PO2 Development is suitably located and designed to avoid or mitigate **environmental harm** to the air **environment**.	**AO2.1** Development meets the air quality objectives of the Environmental Protection (Air) Policy 2019.	**Complies - no change** An Air Quality Impact Assessment has been prepared and updated to include the proposed changes (Appendix G). The Air Quality Impact Assessment report has sought to address the Project pollutant concentration at sensitive receptors and sensitive zone pursuant to the EPP (Air) Policy. The assessment concludes that the Project will contribute to only minor amounts of pollutant at these receptors.
PO3 Development (other than **intensive animal industry** for **poultry farming**), is suitably located and designed to avoid or mitigate **environmental harm** on adjacent **sensitive land uses** caused by odour.	No acceptable outcome is prescribed.	Refer above
PO4 Development is suitably located and designed to avoid or mitigate **environmental harm** to the receiving waters **environment**.	**AO4.1** Development meets the management intent, water quality guidelines and objectives of the Environmental Protection (Water and Wetland Biodiversity) Policy 2019.	**Complies - no change** A Site Water Management Plan has been undertaken and updated to include the proposed changes (Appendix J). The assessment was undertaken to understand the potential impacts of stormwater discharge from the Project on the receiving environment surface water quality and quantity. The potential impacts associated with the construction and operation can be appropriately managed through implementation of a range of suitable mitigation measures discussed within Appendix J.
PO5 Development is designed to include elements which: 1. prevent or minimise the production of **hazardous contaminants** and **waste** as by-products; or 2. contain and treat **hazardous contaminants** on-site rather than releasing them into the **environment**; and	No acceptable outcome is prescribed.	**Complies - no change** A Site Water Management Plan has been undertaken and updated to include the proposed changes (Appendix J). The assessment was undertaken to understand the potential impacts of stormwater discharge from the Project on the receiving environment

Performance outcomes	Acceptable outcomes	Response
3. provide secondary containment to prevent the accidental release of **hazardous contaminants** to the **environment** from spillage or leaks.		surface water quality and quantity. The potential impacts associated with the construction and operation can be appropriately managed through implementation of a range of suitable mitigation measures discussed within Appendix J.
PO6 Environmentally hazardous materials located on-site are stored to avoid or minimise their release into the **environment** due to inundation during flood events.	No acceptable outcome is prescribed.	**Complies - no change** A Site Water Management Plan has been undertaken and updated to include the proposed changes (Appendix J). The assessment was undertaken to understand the potential impacts of stormwater discharge from the Project on the receiving environment surface water quality and quantity. The potential impacts associated with the construction and operation can be appropriately managed through implementation of a range of suitable mitigation measures discussed within Appendix J.
All development – matters of state environmental significance		
PO7 Development is designed and sited to: 1. avoid impacts on **matters of state environmental significance**; or 2. minimise and mitigate impacts on **matters of state environmental significance** after demonstrating avoidance is not reasonably possible; and 3. provide an **offset** if, after demonstrating all reasonable avoidance, minimisation and mitigation measures are undertaken, the development results in an acceptable **significant residual impact** on a **matter of state environmental significance**. Statutory note: For Brisbane core port land, an offset may only be applied to development on land identified as E1 Conservation/Buffer, E2 Open Space or Buffer/Investigation in the Brisbane Port LUP precinct plan.	No acceptable outcome is prescribed.	**Not Applicable – no change** A self-assessment using the Queensland Significant Residual Impact Guideline is not considered to be required for the proposed updates in this instance due to the following considerations: • The Project area is located within the GSDA. The GSDA was declared in 1993 as a State Development Area under the SDPOW Act. The SDPW Act is not a prescribed Act under the EO Act, and therefore offsets under the Act are not applicable for this application. • The Project will be assessed against the Queensland Significant Residual Impact Guideline as part of the Environmental

Performance outcomes	Acceptable outcomes	Response
		Authority Application (pursuant to the EP Act – submitted under separate cover), as the EP Act is prescribed under the EO Act. • A significant impact assessment was undertaken in accordance with the EPBC Act *Policy Statement 1.1 Significant Impact Guidelines: Matters of National Environmental Significance* which concluded that the Project is unlikely to result in a significant impact to threatened and migratory species. • The Significant Impact Guidelines under the EPBC Act have the same impact criteria as the Significant Residual Impact Guidelines under the EO Act, therefore it can be concluded that the Project will not result in a Significant Residual Impact on Matters of State Environmental Significance.
Intensive animal industry – poultry farming (ERA 4(2))		
PO8 Poultry farming development (where farming more than 200,000 birds) is suitably located and designed to avoid or mitigate **environmental harm** on adjacent **sensitive land uses**, caused by odour.	**AO8.1** For poultry farming involving 300,000 birds or less, development meets the separation distances as determined using the S-factor methodology to: 1. a **sensitive land use** in a rural zone; and 2. boundary of a non-rural zone. OR **AO8.2** Development meets the separation distances as determined by odour modelling using the following criteria: 1. 2.5 **odour units**, 99.5 percent, 1 hour average for a **sensitive land use** in a rural zone; or 2. 1.0 **odour units**, 99.5 percent, 1 hour average for the boundary of a non-rural zone.	**Not Applicable – no change** The proposed Development Application is not for the purposes of an Intensive Animal Industry.

Table 6.2 Development in general

Performance outcomes	Acceptable outcomes	Response
Network impacts		
PO1 Development does not compromise the safety of users of the **state-controlled road** network.	No acceptable outcome is prescribed.	**Project complies with PO1.** This is demonstrated through the road safety assessment undertaken as part of the Traffic Impact Assessment which identified that the proposed Special Industry and Linear Infrastructure Facility would not result in a worsening of the safety of a state-controlled road.
PO2 Development does not adversely impact the structural integrity or physical condition of a **state-controlled road** or **road transport infrastructure**.	No acceptable outcome is prescribed.	**Project complies with PO2.** This is demonstrated through the traffic and pavement impact assessments undertaken as part of the Traffic Impact Assessment which identified that the proposed Special Industry and Linear Infrastructure Facility would not result in a worsening of the infrastructure condition of a state-controlled road or road transport infrastructure).
PO3 Development ensures **no net worsening** of the operating performance the **state-controlled road** network.	No acceptable outcome is prescribed.	**Project complies with PO3.** This is demonstrated through the traffic and pavement impact assessments undertaken as part of the Traffic Impact Assessment which identified that the proposed Special Industry and Linear Infrastructure Facility would not result in a worsening of the infrastructure condition of a state-controlled road or road transport infrastructure).
PO4 Traffic movements are not directed onto a **state-controlled road** where they can be accommodated on the **local road** network.	No acceptable outcome is prescribed.	**Project complies with PO4.** The proposed layout and design of the development only utilises accesses from a local road, while the proposed transport routes for the

Performance outcomes	Acceptable outcomes	Response
		Project only utilise the state-controlled road network where no alternative local road is available.
PO5 Development involving haulage exceeding 10,000 tonnes per year does not damage the pavement of a **state-controlled road**.	No acceptable outcome is prescribed.	**Project complies with PO5.** This is demonstrated through the pavement impact assessments undertaken as part of the Traffic Impact Assessment which identified that the proposed Special Industry and Linear Infrastructure Facility would not result in significant damage (>5% increase in pavement traffic loadings) to road pavements of a state-controlled road.
PO6 Development does not require a new **railway** level crossing.	No acceptable outcome is prescribed.	**N/A** No railway crossings are proposed to be utilised as part of the proposed Special Industry and Linear Infrastructure Facility.
PO7 Development does not adversely impact the operating performance of an existing **railway crossing**.	No acceptable outcome is prescribed.	**N/A** No railway crossings are proposed to be utilised as part of the proposed Special Industry and Linear Infrastructure Facility.
PO8 Development does not adversely impact on the safety of an existing **railway crossing**.	No acceptable outcome is prescribed.	**N/A** No railway crossings are proposed to be utilised as part of the proposed Special Industry and Linear Infrastructure Facility.
PO9 Development is designed and constructed to allow for on-site circulation to ensure vehicles do not queue in a **railway crossing**.	No acceptable outcome is prescribed.	**N/A** No railway crossings are proposed to be utilised as part of the proposed Special Industry and Linear Infrastructure Facility.
PO10 Development does not create a safety hazard within the **railway corridor**.	No acceptable outcome is prescribed.	**N/A** No railway crossings are proposed to be utilised as part of the proposed Special Industry and Linear Infrastructure Facility.

Performance outcomes	Acceptable outcomes	Response
PO11 Development does not adversely impact the operating performance of the **railway corridor**.	No acceptable outcome is prescribed.	**N/A** No railway crossings are proposed to be utilised as part of the proposed Special Industry and Linear Infrastructure Facility.
PO12 Development does not interfere with or obstruct the **railway transport infrastructure** or **other rail infrastructure**.	No acceptable outcome is prescribed.	**N/A** No railway crossings are proposed to be utilised as part of the proposed Special Industry and Linear Infrastructure Facility.
PO13 Development does not adversely impact the structural integrity or physical condition of a **railway corridor** or **rail transport infrastructure**.	No acceptable outcome is prescribed.	**N/A** No railway crossings are proposed to be utilised as part of the proposed Special Industry and Linear Infrastructure Facility.
Stormwater and overland flow		
PO14 Stormwater run-off or overland flow from the development site does not create or exacerbate a safety hazard for users of a **state transport corridor** or **state transport infrastructure**.	No acceptable outcome is prescribed.	**Complies with PO14** A Site Water Management Plan has been prepared and included within Appendix J.
PO15 Stormwater run-off or overland flow from the development site does not result in a material worsening of operating performance of a **state transport corridor** or **state transport infrastructure**.	No acceptable outcome is prescribed.	**Complies with PO15** A Site Water Management Plan has been prepared and included within Appendix J.
PO16 Stormwater run-off or overland flow from the development site does not interfere with the structural integrity or physical condition of the **state transport corridor** or **state transport infrastructure**.	No acceptable outcome is prescribed.	**Complies with PO16** A Site Water Management Plan has been prepared and included within Appendix J.
PO17 Development associated with a **state-controlled road** or **road transport infrastructure** ensures that stormwater is lawfully discharged.	**AO17.1** Development does not create any new points of discharge to a **state transport corridor** or **state transport infrastructure**. AND **AO17.2** Development does not concentrate flows to a **state transport corridor**.	**Complies With PO17** A Site Water Management Plan has been prepared and included within Appendix J.

Performance outcomes	Acceptable outcomes	Response
	AND **AO17.3** Stormwater run-off is discharged to a **lawful point of discharge**. AND **AO17.4** Development does not worsen the condition of an existing **lawful point of discharge** to a **state transport corridor** or **state transport infrastructure**.	
Flooding		
PO18 Development does not result in a material worsening of flooding impacts within a **state transport corridor** or **state transport infrastructure**	*For a **state-controlled road** or **road transport infrastructure**, all of the following apply:* **AO18.1** For all flood events up to 1% **annual exceedance probability**, development ensures there are negligible impacts (within +/- 10mm) to existing flood levels within a **state transport corridor**. AND **AO18.2** For all flood events up to 1% **annual exceedance probability**, development ensures there are negligible impacts (up to a 10% increase) to existing peak velocities within a **state transport corridor**. AND **AO18.3** For all flood events up to 1% annual exceedance probability, development ensures there are negligible impacts (up to a 10% increase) to existing time of submergence of a **state transport corridor**. *No acceptable outcome is prescribed for a **railway corridor** or **rail transport infrastructure**.*	**Complies with PO18** A Site Water Management Plan has been prepared and included within Appendix J.

Performance outcomes	Acceptable outcomes	Response
Drainage infrastructure		
PO19 Drainage infrastructure does not create a safety hazard in a **state transport corridor**.	*For a **state-controlled road** environment, both of the following apply:* **AO19.1** Drainage infrastructure associated with, or in a **state-controlled road** is wholly contained within the development site, except at the **lawful point of discharge**. AND **AO19.2** Drainage infrastructure can be maintained without requiring access to a **state transport corridor**. *For a **railway** environment both of the following apply:* **AO19.3** Drainage infrastructure associated with a **railway corridor** or **rail transport infrastructure** is wholly contained within the development site. AND **AO19.4** Drainage infrastructure can be maintained without requiring access to a **state transport corridor**.	**Complies with PO19** A Site Water Management Plan has been prepared and included within Appendix J.
PO20 Drainage infrastructure associated with, or in a **state-controlled road** or **road transport infrastructure** is constructed and designed to ensure the structural integrity and physical condition of existing drainage infrastructure and the surrounding drainage network is maintained.	No acceptable outcome is prescribed.	**Complies with PO20** A Site Water Management Plan has been prepared and included within Appendix J.
Planned upgrades		
PO21 Development does not impede delivery of **planned upgrades** of **state transport infrastructure**.	No acceptable outcome is prescribed.	**Complies with PO21.**

Performance outcomes	Acceptable outcomes	Response
		Development is not located on land identified by TMR as land required for the planned upgrade of state transport infrastructure.

Table 6.3 Public passenger transport infrastructure and active transport

Performance outcomes	Acceptable outcomes	Response
PO22 Development does not damage or interfere with **public passenger transport infrastructure**, **active transport infrastructure** or **public passenger services**.	No acceptable outcome is prescribed.	**Complies with PO22.** As identified within the Traffic Impact Assessment for the Project the proposed vehicular access to the development site is not within 5m of public passenger transport infrastructure.
PO23 Development does not compromise the safety of **public passenger transport infrastructure**, **public passenger services** and **active transport infrastructure**.	No acceptable outcome is prescribed.	**Complies with PO23.** As identified within the Traffic Impact Assessment for the Project the proposed vehicular access to the development site is not within 5m of public passenger transport infrastructure.
PO24 Development does not adversely impact the operating performance of **public passenger transport infrastructure, public passenger services** and **active transport infrastructure**.	No acceptable outcome is prescribed.	**Complies with PO24.** As identified within the Traffic Impact Assessment for the Project the proposed vehicular access to the development site is not within 5m of public passenger transport infrastructure.
PO25 Development does not adversely impact the structural integrity or physical condition of **public passenger transport infrastructure** and **active transport infrastructure**.	No acceptable outcome is prescribed.	**Complies with PO25.** As identified within the Traffic Impact Assessment for the Project the proposed vehicular access to the development site is not within 5m of public passenger transport infrastructure.

Performance outcomes	Acceptable outcomes	Response
PO26 Upgraded or new **public passenger transport infrastructure** and **active transport infrastructure** is provided to accommodate the demand for **public passenger transport** and **active transport** generated by the development.	No acceptable outcome is prescribed.	**N/A** No upgraded or new public passenger transport infrastructure was identified as being required for the proposed Special Industry and Linear Infrastructure Facility.
PO27 Development is designed to ensure the location of **public passenger transport infrastructure** prioritises and enables efficient **public passenger services**.	No acceptable outcome is prescribed.	**N/A** No upgraded or new public passenger transport infrastructure was identified as being required for the proposed Special Industry and Linear Infrastructure Facility.
PO28 Development enables the provision or extension of **public passenger services**, **public passenger transport infrastructure** and **active transport infrastructure** to the development and avoids creating indirect or inefficient routes for **public passenger services**.	No acceptable outcome is prescribed.	**N/A** No upgraded or new public passenger transport infrastructure was identified as being required for the proposed Special Industry and Linear Infrastructure Facility.
PO29 New or modified road networks are designed to enable development to be serviced by **public passenger services**.	**AO29.1** Roads catering for buses are arterial or **sub-arterial roads**, collector or their equivalent. AND **AO29.2** Roads intended to accommodate buses are designed and constructed in accordance with: 1. Road Planning and Design Manual, 2nd Edition, Volume 3 – Guide to Road Design; Department of Transport and Main Roads; 2. Supplement to Austroads Guide to Road Design (Parts 3, 4-4C and 6), Department of Transport and Main Roads; 3. Austroads Guide to Road Design (Parts 3, 4-4C and 6); 4. Austroads Design Vehicles and Turning Path Templates; 5. Queensland Manual of Uniform Traffic Control Devices, Part 13: Local Area Traffic Management and AS 1742.13-2009 Manual	**N/A** No upgraded or new public passenger transport infrastructure was identified as being required for the proposed Special Industry and Linear Infrastructure Facility.

Performance outcomes	Acceptable outcomes	Response
	of Uniform Traffic Control Devices – Local Area Traffic Management; AND **AO29.3** Traffic calming devices are not installed on roads used for buses in accordance with section 2.3.2 Bus Route Infrastructure, Public Transport Infrastructure Manual, Department of Transport and Main Roads, 2015.	
PO30 Development provides safe, direct and convenient access to existing and future **public passenger transport infrastructure** and **active transport infrastructure**.	No acceptable outcome is prescribed.	**N/A** No upgraded or new public passenger transport infrastructure was identified as being required for the proposed Special Industry and Linear Infrastructure Facility.
PO31 On-site vehicular circulation ensures the safety of both **public passenger transport services** and pedestrians.	No acceptable outcome is prescribed.	**N/A** No upgraded or new public passenger transport infrastructure was identified as being required for the proposed Special Industry and Linear Infrastructure Facility.
PO32 Taxi facilities are provided to accommodate the demand generated by the development.	No acceptable outcome is prescribed.	**N/A** No taxi facilities were identified as being required for the proposed Special Industry and Linear Infrastructure Facility. Notwithstanding this, the layout of the proposed development provides suitable areas that could be used for taxi setdown / dropoff if required.
PO33 Facilities are provided to accommodate the demand generated by the development for community transport services, courtesy transport services, and **booked hire services** other than taxis.	No acceptable outcome is prescribed.	**N/A** No taxi facilities were identified as being required for the proposed Special Industry and Linear Infrastructure Facility. Notwithstanding this, the layout of the proposed development provides suitable areas that could be used for taxi setdown / dropoff if required.

Performance outcomes	Acceptable outcomes	Response
PO34 Taxi facilities are located and designed to provide convenient, safe and equitable access for passengers.	**AO34.1** A **taxi facility** is provided parallel to the kerb and adjacent to the main entrance. AND **AO34.2 Taxi facilities** are designed in accordance with: 1. AS2890.5–1993 Parking facilities – on-street parking and AS1428.1–2009 Design for access and mobility – general requirements for access – new building work; 2. AS1742.11–1999 Parking controls – manual of uniform traffic control devices 3. AS/NZS 2890.6–2009 Parking facilities –off street parking for people with disabilities; 4. Disability standards for accessible public 5. transport 2002 made under section 31(1) of the Disability Discrimination Act 1992; 6. AS/NZS 1158.3.1 – Lighting for roads and public spaces, Part 3.1: Pedestrian area (category P) lighting – Performance and design requirements; 7. Chapter 7 Taxi Facilities, Public Transport Infrastructure Manual, Department of Transport and Main Roads, 2015.	**N/A** No taxi facilities were identified as being required for the proposed Special Industry and Linear Infrastructure Facility. Notwithstanding this, the layout of the proposed development provides suitable areas that could be used for taxi setdown / dropoff if required.
PO35 Educational establishments are designed to ensure the safe and efficient operation of **public passenger services**, pedestrian and cyclist access and **active transport infrastructure**.	**AO35.1** Educational establishments are designed in accordance with the provisions of the Planning for Safe Transport Infrastructure at Schools, Department of Transport and Main Roads, 2011.	**N/A** Project is for the purposes of an industrial development.

State code 21: Hazardous chemical facilities

Planning guideline – State code 21: Hazardous chemical facilities provides direction on how to address this code.

Table 21.1: Material change of use

Performance outcomes	Response
Off-site impacts—vulnerable land use or land zoned for a vulnerable land use	
PO1 The **hazardous chemical facility** does not create a **dangerous dose to human health**.	**Complies** A Quantitative Risk Assessment (QRA) was prepared and submitted as part of the originating Development Application Material. The QRA has not been updated as part of the changes proposed. The report assessed the Projects risk to the sensitivity of the surrounding land uses and concluded compliance.
Off-site impacts—sensitive land use or land zoned for a sensitive land use	
PO2 The **hazardous chemical facility** does not create a **dangerous dose to human health**.	**Complies** A QRA was prepared and submitted as part of the originating Development Application Material. The QRA has not been updated as part of the changes proposed. The report assessed the Projects risk to the sensitivity of the surrounding land uses and concluded compliance.
Off-site impacts—commercial or community activity land use or land zoned for a commercial or community activity land use	
PO3 The **hazardous chemical facility** does not create a **dangerous dose to human health**.	**Complies** A Quantitative Risk Assessment (QRA) was prepared and submitted as part of the originating Development Application Material. The QRA has not been updated as part of the changes proposed. The report assessed the Projects risk to the sensitivity of the surrounding land uses and concluded compliance.
Off-site impacts—open space land use or land zoned for an open space land use	

PO4 The **hazardous chemical facility**, does not create: a. a **dangerous dose to human health**; or b. where (a) cannot be achieved, an **individual fatality risk level** of 10 x 10^{-6}/year and the societal risk criteria in figure 21.1.	**Complies** A Quantitative Risk Assessment (QRA) was prepared and submitted as part of the originating Development Application Material. The QRA has not been updated as part of the changes proposed. The report assessed the Projects risk to the sensitivity of the surrounding land uses and concluded compliance.
Off-site impacts—industrial land use or land zoned for an industrial land use	
PO5 The **hazardous chemical facility**, does not create either of the following: a. a **dangerous dose to the built environment**; and b. an **individual fatality risk level** of 50 x 10^{-6}/year.	**Complies** A Quantitative Risk Assessment (QRA) was prepared and submitted as part of the originating Development Application Material. The QRA has not been updated as part of the changes proposed. The report assessed the Projects risk to the sensitivity of the surrounding land uses and concluded compliance.
Storage and handling areas	
PO6 Storage and handling areas for **fire risk hazardous chemicals** are provided with a 24-hour monitored fire detection system that has the ability to detect a fire in its early stages and notify an **emergency responder** at all times.	**Will Comply** Storage and handling areas for fire risk hazardous chemicals will be provided with a 24 hour monitored fire detection system that has the ability to detect a fire in its early stages. Compliance will be demonstrated during detail design phases of the Project and consider that a condition can demonstrate compliance with PO6.
PO7 Storage and handling areas for **packages** of liquid or solid **fire risk hazardous chemicals** are provided with a spill containment system with a working volume capable of containing a minimum of 100 percent of all **packages** (**prescribed hazardous chemicals** and/or non-hazardous chemicals) within the area plus the output of any **fixed firefighting system** provided for the area over a minimum of 90 minutes.	**Will Comply** Storage and handling areas for packages of liquids or solid fire risk hazardous chemicals will be provided with a spill containment system. Compliance will be demonstrated during detail design phases of the Project and consider that a condition can demonstrate compliance with PO7.
PO8 Storage and handling areas for liquid or solid **fire risk hazardous chemicals** in **tanks** are provided with a spill containment system with a working volume capable of containing a minimum of: a. 110 percent of the largest **tank** within a spill compound or 25 percent of the aggregate where multiple **tanks** are located within a spill compound, whichever is the greater; and b. the output of any **fixed firefighting system** provided for any bulk **tank** within a spill compound over a minimum of 90 minutes.	**Will Comply** Storage and handling areas for packages of liquids or solid fire risk hazardous chemicals will be provided with a spill containment system. Compliance will be demonstrated during detail design phases of the Project and consider that a condition can demonstrate compliance with PO8.

PO9 Storage and handling areas for **prescribed hazardous chemicals** that, if in contact with each other, may react to produce a fire, explosion or other harmful reaction, or a flammable, toxic or corrosive vapour are designed to prevent contact between the **prescribed hazardous chemicals**.	**Will Comply** Storage and handling areas for packages of liquids or solid fir risk hazardous chemicals will be provided with a spill containment system. Compliance will be demonstrated during detail design phases of the Project and consider that a condition can demonstrate compliance with PO9.
PO10 Development is designed and sited to mitigate impacts on **storage and handling areas** from **natural hazard** including, but not limited to: a. flood; b. bushfire; c. erosion; d. storm tide inundation; e. landslide; f. earthquake; g. **wind action**.	**Complies** The Project complies with PO10 though the following considerations: • Flooding - reference is made to the planning report which demonstrates flood mitigation measures to ensure compliance is achieved. • Bushfire Prone Area - reference is made to the previously submitted Site Based Management Plan which demonstrates mitigation measures to ensure compliance is achieved. • Erosion Prone Area/Storm Tide Inundation Area - the Project area is not impacted by erosion prone area or storm tide inundation mapping. • Landslide Hazard Area – the Project area is not mapped as a landslide hazard area.
All development	
PO11 Development is designed and sited to mitigate the risks from **hazard scenarios** occurring at existing **hazardous chemical facilities**.	**Complies** A Quantitative Risk Assessment (QRA) was prepared and submitted as part of the originating Development Application Material. The QRA has not been updated as part of the changes proposed. The report assessed the Projects risk to the sensitivity of the surrounding land uses and concluded compliance.

Appendix G

Air Quality Impact Assessment

Alpha HPA
Alpha HPA Limited
29-May-2024

Air Quality Impact Assessment

HPA Processing Plant

Air Quality Impact Assessment

HPA Processing Plant

Client: Alpha HPA Limited

ABN: 79 106 879 690

Prepared by

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29-May-2024

Job No.: 60617664

AECOM in Australia and New Zealand is certified to ISO9001, ISO14001 and ISO45001.

Quality Information

Document	Air Quality Impact Assessment
Ref	60617664 \\na.aecomnet.com\lfs\apac\newcastle-auntl1\legacy\projects\60617664\400_tech\432_gladstone\5. air quality\03 revised aqia\07_report\05 final issue\60617664 alpha hpa aqia_ rev 2a_final_issue.docx
Date	29-May-2024
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Reviewed by	Mitch Ryan

Revision History

Rev	Revision Date	Details	Authorised	
			Name/Position	Signature
0	14-Sep-2020	Draft Issue	Rouven Lau Project Manager	
A	30-Sep-2020	Final Issue	Rouven Lau Project Manager	Original previously signed
B	28-May-2021	Updated issue for response to DESI comments	Rouven Lau Project Manager	Original previously signed
C	03-Aug-2021	Final for Issue	Rouven Lau Project Manager	Original previously signed
D	19-Oct-2021	Final for Issue (Updated Appendix A)	Rouven Lau Project Manager	Original previously signed
1	29-April-2024	Draft Revision	Rouven Lau Project Manager	Original previously signed
1A	29-May-2024	Final Revision	Rouven Lau Project Manager	

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Executive Summary

AECOM Australia Pty Ltd (AECOM) was commissioned by Alpha HPA Limited to assess the potential impacts of the proposed High Purity Alumina (HPA) processing plant (the Project) on air quality environmental values. An air quality impact assessment (AQIA) was undertaken to support the necessary environmental approval process for the Project and is set out in this report.

This AQIA was originally undertaken for the Project in October 2021 based on the most accurate information available at the time. The Project has since progressed and additional information is available that better reflects the expected operation of the Project. As a result, this AQIA has been revised to reflect the recent available information. The updated impact assessment, using the latest project inputs, concluded that the environmental effects remain materially unchanged. Therefore, the current mitigation strategies are still suitable and do not need further mitigation measures.

The AQIA has been undertaken with reference to the following guidelines:

- 'Application requirements for activities with impacts to air', guideline document under the *Environmental Protection* Act 1994 to support applications for activities with impacts to air (DESI, 2024).
- 'Approved methods for the modelling and assessment of air pollutants in New South Wales', which provides statutory methods for modelling and assessing emissions of air pollutants in NSW (NSW EPA, 2022).
- 'Generic guidance and optimum model settings for the CALPUFF modelling system for inclusion into the "Approved methods for the modelling and assessments of air pollutants in NSW, Australia"' (Barclay & Scire, 2011).
- *'Odour Impact Assessment from Developments'*, guideline document under the *Environmental Protection Act 1994* to provide information on odour impact assessment from developments (DEHP, 2014).

The existing environment in the Study Area was defined in terms of its meteorology and climate, pollutant concentrations and the location of sensitive receptors and sensitive receptor zones. An air quality model was developed to predict the potential impacts on the nearby sensitive locations. An airshed model of the Gladstone airshed was developed for the existing emission sources in the region, with background NO_x modelled. The ARM2 method endorsed by the US EPA was used for the chemical transformation between modelled NO_x and estimated NO_2. A single operational scenario was developed for the assessment which was based on estimated emissions from the Project.

A single exceedance of the 1-hour NO_2 criterion was predicted for the sensitive receptor zone SZ2 (Gladstone). However, this exceedance included negligible (0.03%) contribution from the Project and was predominately the result of the modelled cumulative background emissions sources. For all other pollutants, predicted air pollutant cumulative concentrations resulted in no exceedances of the adopted air quality objectives for all pollutants of concern at all sensitive receptor locations or sensitive receptor zones (including ecological sensitive areas).

The Project should implement the following mitigation measures:

- If required to maintain compliance with the pollutant emission rates relied upon in this AQIA, appropriate air pollutant control systems should be installed for stack emission sources. This may include the following air pollutant control systems:
  - a wet scrubber system installed on the ammonia and nitric acid scrubber vent, and
  - baghouse filtration systems to locations in the process that may have significant particulate emissions.
- Installed air pollutant control systems should be maintained and used as per manufacturer specifications to ensure operational uptime and maximise pollutant removal efficiencies.
- A fume extraction system should be installed to capture fugitive emissions from the solvent extraction tanks.

- Natural gas fired boilers and burners should be maintained and used as per manufacturers specifications.

Overall, predicted pollutant concentrations for the cumulative and Project only scenarios showed that the Project will contribute only minor amounts to pollutant concentrations at sensitive receptors and sensitive zones. Based on the results, the assimilative capacity of the Gladstone airshed appears sufficient such that Project emissions are unlikely to contribute to exceedances of the relevant adopted air quality objectives.

It is likely that upon commencement of the Project, actual air quality impacts to sensitive locations would generally reflect the outcome of the assessment. The Project is therefore considered viable from an air quality perspective.

1.0 Introduction

Alpha HPA Limited (the Applicant) seeks to establish a Special Industry (HPA Processing Plant) and Linear Infrastructure Facility for the purposes of a High Purity Alumina (HPA) processing plant (the Project) at 53 Reid Road, Yarwun, formally described as Lot 12 on SP239343. The key objective of the Project is to supply HPA and related high purity aluminium chemicals into the rapidly expanding HPA LED lighting and lithium-ion battery markets.

The proposed site location in Gladstone is presented in Figure 1.

AECOM Australia Pty Ltd (AECOM) has been engaged by the Applicant to prepare and undertake an amended air quality impact assessment (AQIA) for the Project demonstrating changes resulting from the Stage 1 Precursor Production Facility (PPF) being fully operational (constructed) and changes necessary to State 2 (yet to be constructed). The results of this AQIA will provide technical reporting to accompany the necessary changes to existing Development Permit and Environmental Authority for the Project. This assessment documents both Stage 1 and 2 operating concurrently.

The AQIA seeks to determine whether proposed activities expected as part of the Project are predicted to comply with relevant ambient air quality standards and goals. This report outlines the current regulatory system relevant to air quality management, the baseline air quality in the region around the Project, meteorological conditions occurring within the Gladstone airshed and the methodology used to carry out an assessment of potential air quality impacts. Air quality mitigation measures and strategies are also provided where relevant.

For the purposes of the AQIA, the following definitions have been used:

- "Study Area" refers to the airshed environment and footprint of specific identified sensitive receptor locations or zones adjacent to the Project.
- "Gladstone airshed" refers to the wider airshed environment of the Gladstone region including any identified cumulative heavy industry emission sources, which may also impact the identified sensitive receptor locations or zones.
- "Air quality objectives" refers to adopted ambient air quality criteria sourced from relevant air quality legislation or other guidance documentation.

Figure 1 Location of the Project

1. Coordinate system GDA Zone 56 in metres
2. Red star denotes the location of the Project

1.1 Assessment revision

This AQIA was originally undertaken for the Project in October 2021 by AECOM based on the most accurate information available at the time. The Project has since progressed and additional information is available that better reflects the expected operation of the Project. As a result, this AQIA has been revised to reflect the recent available information.

Table 1 outlines the key changes made in reference to the original AQIA.

It is noted that although elements of the Project and inputs to the AQIA have been updated, the overall outcome of the assessment and mitigation measures required for the Project are unchanged from the outcomes of the AQIA originally undertaken in October 2021. Therefore, despite changes to the Project, the impact of the Project on air quality is unchanged.

Table 1 Assessment revision items

Change	Comment
Updated Project site layout (Figure 2).	Site layout has changed since the original Project AQIA was undertaken.
Inclusion of PPF (Stage 1) emission sources in dispersion model.	PPF (Stage 1) air emissions sources included to assess Project air quality impacts cumulatively.
Updated Stage 2 emission sources, including additional sources, revised source locations, revised source release parameters and revised source emission rates in dispersion model.	Stage 2 emissions source details have changed since the original Project AQIA was undertaken.
Updated discrete receptor heights in dispersion model.	More accurate terrain date is available for the Study Area.
Updated tabulated model results (Table 38,Table 39,Table 40).	Model results have changed as a result of revised emissions source inputs.
Updated concentration contours (Figure 54 to Figure 59).	
Minor updates to cumulative impact assessment (Section 11.0).	
Minor updates to conclusion and recommendations (Section 12.0).	

1.2 Scope

The scope of the AQIA for the Project included the following:

- An analysis of the expected operational activities for the Project and Study Area from an air quality perspective.
- Selection of appropriate ambient air quality objectives for the Project.
- Discussion and analysis of existing air quality monitoring data sourced from the Queensland Department of Environment, Science and Innovation (DESI).
- Analysis of local meteorology and climatic conditions using data collected by the Bureau of Meteorology (BoM) and DESI.
- Identification and of key existing background emission sources to be included in the assessment using the National Pollutant Inventory (NPI) database.
- A qualitative assessment of odour impacts from the site.
- Meteorology modelling for the Study Area and Gladstone airshed and validation of produced modelling data using BoM and DESI monitoring data.
- Gladstone airshed model of NO_x dispersion from identified background emissions sources with predictions compared against DESI monitoring data.

- Computational Gladstone airshed dispersion modelling and impact assessment of operational emissions associated with the Project, and Study Area.
- Where appropriate, recommendations for mitigation and management measures to minimise air quality impacts within the Study Area.

The AQIA has been undertaken with reference to the following guidelines:

- 'Application requirements for activities with impacts to air', guideline document under the Environmental Protection Act 1994 to support applications for activities with impacts to air (DESI, 2024).
- 'Approved methods for the modelling and assessment of air pollutants in New South Wales', which provides statutory methods for modelling and assessing emissions of air pollutants in NSW (NSW EPA, 2022).
- 'Generic guidance and optimum model settings for the CALPUFF modelling system for inclusion into the "Approved methods for the modelling and assessments of air pollutants in NSW, Australia"' (Barclay & Scire, 2011).
- 'Odour Impact Assessment from Developments', guideline document under the *Environmental Protection Act 1994* to provide information on odour impact assessment from developments (DEHP, 2014).

1.3 Report structure

The structure of this AQIA technical report is presented as below in Table 2.

Table 2 Report structure

Content	Reference
Introduction	Section 1
Project description	Section 2
Relevant legislation and policy	Section 3
Existing environment	Section 4
Emissions inventory	Section 5
Qualitative odour impact assessment	Section 6
Modelling methodology	Section 7
Meteorology modelling	Section 8
Dispersion modelling	Section 9
Limitations of assessment	Section 10
Cumulative impact assessment	Section 11
Conclusions and recommendations	Section 12
Detailed site layout	Appendix A
Generator specifications	Appendix B
Additional wind roses	Appendix C

2.0 Project description

Alpha HPA is proposing to construct a High Purity Alumina (HPA) processing plant at a site at Reid Road within the Gladstone State Development Area (the Project). The site has obtained approval under the *State Development and Public Works Organisation Act 197*1 for the purpose of a Special Industry and Linear Infrastructure Facility. HPA and related high purity aluminium chemicals are key materials in the production of LED lighting and Lithium Ion batteries in the electric vehicle market. These industries are experiencing significant growth as part of the global de-carbonisation effort.

Stage 1 PPF is an advanced stage of the Project thereby allowing the production of between 10-20 Metric Tonnes (MT) per month of Ultra High Purity alumina, alumina salt products and sapphire crystal. Stage 1 has been constructed and is currently operational. The PPF is fully contained within an industrial shed with any external storage areas being fully covered and appropriately bunded.

The balance of the HPA processing plant will be constructed as Stage 2 of the Project (yet to be constructed). Both stages will operate concurrently once Stage 2 is constructed.

The Project will process an aluminium based feedstock into a >99.99% pure HPA and will manufacture 10,000tpa of HPA and 136,000tpa of Ammonium Nitrate using the following associated processes:

- Feed preparation
- Aluminium solvent extraction
- Aluminium salt crystallisation
- Product precipitation
- Drying and calcination
- Ammonium nitrate concentration
- HPA product milling and bagging.

The process used by Alpha HPA has been developed specifically for the Project and licensed by Alpha HPA. It has a number of benefits over alternative processing methods and has a low environmental signature.

The Project feedstock is a refined aluminium bearing feedstock sourced locally. The neighbouring Orica operation supplies reagents (nitric acid and ammonia) via separate underground pipelines and receives the Ammonium Nitrate by-product via an overhead pipeline across Reid Road at a height of approximately 12m.

The Project is expected to operate 24 hours per day, 7 days per week. The site is expected to have approximately 25 air emissions sources of varying release height, efflux velocities and temperatures. However, five of those air emissions sources have negligible pollutant emissions and have not been considered further in this assessment.

The Project site layout is presented below in Figure 2.

Figure 2 The Project site layout

2.1 Pollutants of concern

Based upon the identified emissions sources outlined in Section 2.0 it is expected that the key emissions to air from the Project would include the following:

- Ammonia, nitrogen oxides (NO_x), and nitric acid from the process, which would be treated and recovered prior to release from the ammonia and nitric acid scrubber.
- Natural gas combustion emissions from the boiler, dryer, and calciner.
- Alumina particulate emissions from product bin vents.
- Fugitive emissions of volatile organic compounds (VOCs) from the naturally ventilated solvent extraction tanks (using an industrial solvent similar in chemical structure to naphtha).

2.1.1 Ammonia

Ammonia (NH_3) is a highly reactive, toxic gas. Sources of ammonia are both natural and anthropogenic, with a major proportion coming from agriculture. Ammonia is also emitted from a range of anthropogenic sources such as catalytic converters in cars, landfill and sewage works, and heavy industry applications. Ammonia can negatively impact semi-natural ecosystems by soil acidification and toxic damage to leaves, as well as react with other chemicals to form photochemical smog or secondary pollutants that can create human health impacts.

2.1.2 Carbon monoxide

Carbon monoxide (CO) is a colourless, odourless gas produced by the incomplete combustion of fuels containing carbon (e.g. oil, gas, coal and wood). Carbon monoxide is absorbed through the lungs of humans, where it reacts to reduce the blood's oxygen-carrying capacity. In urban areas, motor vehicles account for up to 90 % of all CO emissions.

2.1.3 Nitrogen oxides and nitric acid

Nitrogen dioxide (NO_2) is a brownish gas with a pungent odour. It exists in the atmosphere in equilibrium with nitric oxide (NO). The mixture of these two gases (and some other minor Nitrogen and Oxygen gas mixtures) is commonly referred to as Nitrogen Oxides (NO_x). Nitrogen oxides are a product of combustion processes. In urban areas, motor vehicles and industrial combustion processes are the major sources of ambient nitrogen oxides. Nitrogen dioxide can cause damage to the human respiratory tract, increasing a person's susceptibility to respiratory infections and asthma. Sensitive populations, such as the elderly, children, and people with pre-existing health conditions are most susceptible to the adverse effects of NO_2 exposure. NO_2 can also cause damage to plants, especially in the present of other pollutants such as ozone and SO_2. Nitrogen oxides are also primary ingredients in the reactions that lead to photochemical smog formation.

Nitric acid (HNO_3) can exist in as a gas, vapour, mist, fume, or aerosol. High levels of exposure to gaseous HNO_3 can cause immediate irritation to the respiratory tract and also cause pain and dyspnoea. Asthmatics or allergy sufferers can be sensitive to lower concentrations of HNO_3 exposure. Emissions of HNO_3 can also dissolve within rain clouds, which together with SO_2 can cause acid rain that has potential to cause environmental harm. However, it is expected that emissions of HNO_3 will not be significant from the site due to treatment of emission sources using air pollutant control technologies, such as wet scrubbers, which are highly effective at removing gaseous HNO_3. Thus, HNO_3 emissions have not been considered further in this AQIA.

2.1.4 Ozone

Ozone is a highly reactive, colourless gas with a distinctive odour, that is naturally formed by electrical discharge (such as lightning) in the upper atmosphere (the ozone layer), which protects earth from harmful ultraviolet radiation. At ground level, ozone is produced by continuous chemical reactions between sunlight, nitrogen oxides and certain volatile organic compounds (VOCs), which react to form a brownish photochemical smog. Bushfires, motor vehicle engines and power stations are the biggest sources of the pollutants that form ozone. Elevated concentrations of ground-level ozone can cause adverse health effects, such impact to the cardiac system or irritation of the respiratory tract. Elevated concentrations can also cause environmental impacts such as reduced vegetation growth, damage to materials such as fabric, paint and masonry, and reduction in visibility due to photochemical smog.

However, ozone is currently not an issue within the Gladstone airshed with no recorded exceedances by DES from monitoring completed at the Memorial Park station. As such, ozone has not been considered further in this assessment.

2.1.5 Particulate matter

Airborne particles are commonly differentiated according to size based on their equivalent aerodynamic diameter. TSP refer to airborne particles, generally up to 100 micrometres (µm) in diameter. TSP is primarily associated with aesthetic impacts associated with coarse particles settling on surfaces, which also causes soiling and discolouration. These large particles can, however, cause some irritation of mucosal membranes, which pose a greater risk to health when ingested if they are contaminated. Particles with diameters less than or equal to 10 µm (known as PM_{10}) can be created through crushing and grinding of rocks and soil, and typically comprise soot, dirt, mould and pollen. These particles tend to remain suspended in the air for longer periods than larger particles (minutes or hours) and can penetrate into human lungs. Fine particulates (those with diameters less than or equal to 2.5 µm, known as $PM_{2.5}$) are typically generated from vehicle exhaust, bushfires, and some industrial activities and can remain suspended in the air for days or weeks. As these fine particulates can travel further into human lungs than the larger particulates and are often made up of heavy metals and carcinogens, fine particulates are considered to pose a greater risk to health.

Exposure to particulate matter has been linked to a variety of adverse health effects, such as respiratory problems (for example coughing, aggravated asthma, chronic bronchitis), lung damage and non-fatal heart attacks. Furthermore, if the particles contain toxic materials (such as lead, cadmium, zinc) or live organisms (such as bacteria or fungi), toxic effects or infection can occur from inhalation of the dust.

2.1.6 Sulfur dioxide

Sulfur dioxide (SO_2) is a colourless gas with a sharp, irritating odour. It is formed in combustion processes through burning fossil fuels containing sulfur. SO_2 may be oxidised in the atmosphere to form sulfuric acid, which contributes to acid rain. SO_2 is also an irritant gas that can cause respiratory tract infections. People with pre-existing respiratory conditions such as asthma are most sensitive to SO_2 exposure. The simultaneous presence of airborne particulate matter can compound these effects. SO_2 and its aerosols can also damage vegetation and some materials.

2.1.7 Volatile organic compounds

Organic compounds with a vapour pressure at 20°C exceeding 0.13 kilopascals are referred to as VOCs. VOCs can be a major precursor in the production of photochemical smog, which causes atmospheric haze, eye irritation, and respiratory problems. VOCs are commonly emitted from vehicle exhausts. Three primary VOCs (benzene, toluene and xylenes) are components of petroleum and diesel fuel and are typically the focus for assessments of engine combustion emissions. However, significant emissions of these pollutants can also originate from other sources such as industrial processes.

Benzene

Benzene is an airborne substance that is a precursor to photochemical smog. Benzene exposure commonly occurs through inhalation of air containing the substance. It can also enter the body through the skin, although it is poorly absorbed this way. Low levels of benzene exposure result from car exhaust. Benzene is considered to be a toxic health hazard and a carcinogen. It has high acute toxic effects on aquatic life and long-term effects on marine life and agricultural crops. Human exposure to very high levels for even brief periods of time can potentially result in death, while lower level exposure can cause skin and eye irritation, drowsiness, dizziness, headaches and vomiting, damage to the immune system, leukaemia and birth defects.

Toluene

Toluene (methylbenzene) is a highly volatile chemical that quickly evaporates to a gas if released as a liquid. Due to relatively fast degradation, toluene emissions are usually confined to the local area in which it is emitted. Human exposure typically occurs through breathing contaminated air, but toluene can also be ingested or absorbed through the skin (in liquid form). Toluene usually leaves the body within twelve hours.

Short-term exposure to high levels of toluene can cause dizziness, sleepiness, unconsciousness and sometimes death. Long-term exposure can cause kidney damage and permanent brain damage that can lead to speech, vision and hearing problems, as well as loss of muscle and memory functions. The substance can cause membrane damage in plant leaves and is moderately toxic to aquatic life with long-term exposure.

Xylenes

Xylenes are flammable liquids that are moderately soluble in water. They are quickly degraded by sunlight when released to air, and rapidly evaporate when released to soil or water. They are used as solvents and in petrol and chemical manufacturing.

Xylenes can enter the body through inhalation or skin absorption (liquid form), and can cause irritation of the eyes and nose, stomach problems, memory and concentration problems, nausea and dizziness. High-level exposure can cause death. The substances have high acute and chronic toxicity to aquatic life and can adversely affect crops.

3.0 Relevant legislation and policy

The relevant legislation and policy instruments considered in the assessment of air quality are:

- *Environmental Protection Act 1994* (QLD) (EP Act);
- Environment Protection Regulation 2019 (QLD) (EP Regulation);
- Environmental Protection (Air) Policy 2019 (QLD) (EPP Air);
- National Environment Protection (Ambient Air Quality) Measure (Cth) (Air Quality NEPM);
- National Environment Protection (Air Toxics) Measure (Cth) (Air Quality NEPM).

3.1 Environmental Protection Act 1994 and Environment Protection Regulation 2019

The *Environmental Protection Act 1994* (EP Act) is intended to protect Queensland's environment while allowing for development that improves total quality of life, now and in the future, by encouraging ecologically sustainable development. The EP Act regulates environmentally relevant activities (ERA) under the EP Regulation and some of these activities will require a permit. There are several policies published under the Act that govern the requirement for management of some environmental issues such as noise, air, and water.

These policies determine objectives to be achieved in various environments with reference to sensitive receptors. One of these, the EPP Air must be considered for the AQIA.

3.2 Environmental Protection (Air) Policy 2019

The EPP Air was prepared by the Queensland Government to enhance or protect the atmospheric environment in Queensland by providing air quality objectives. It does not apply to workplaces and the air quality objectives set out in the EPP Air are intended to be progressively achieved over the long term.

The EPP Air recommends different strategies to control emissions for different types of activities, including:

- identifying environmental values to be enhanced or protected;
- stating indicators and air quality objectives for enhancing or protecting the environmental values;
- providing a framework for making consistent, equitable and informed decisions about the air environment.

The environmental values to be enhanced or protected under the EPP Air are:

- The qualities of the air environment that are conducive to protecting the **health and biodiversity of ecosystems**; and
- The qualities of the air environment that are conducive to **human health and wellbeing**; and
- The qualities of the air environment that are conducive to protecting the **aesthetics of the environment**, including the appearance of buildings, structures and other property; and
- The qualities of the air environment that are conducive to **protecting agricultural use** of the environment.

Air quality objectives discussed in Section 3.4 have been used to identify if an environmental value of the air environment is enhanced or protected in an area or place.

3.3 National Environment Protection Measures

National Environment Protection Measures (NEPM) are broad framework-setting statutory instruments that outline agreed national objectives for protecting or managing particular aspects of the environment.

The air quality of an environment is protected nationally by the Ambient Air Quality NEPM as amended (2021) and the Air Toxics NEPM as amended (2011).

3.3.1 Ambient Air Quality NEPM

The Ambient Air Quality NEPM provides guidance relating to air in the external environment and does not include air inside buildings or structures. The Ambient Air Quality NEPM outlines monitoring, assessment and reporting procedures for the following pollutants:

- Nitrogen oxides;
- Sulfur dioxide;
- Carbon monoxide;
- Particulates (PM_{10} and $PM_{2.5}$);
- VOCs (e.g. benzene, toluene, and xylenes).

The goal of the Air Quality NEPM is to achieve the recommended standards with the allowable exceedances, as assessed in accordance with the associated monitoring protocol. The standards are set at a level intended to adequately protect human health and wellbeing. However, it is noted that the Air Quality NEPM standards are intended to be applied to air quality experienced by the general population in a region and not to air quality in areas in the region affected by localised air emissions, such as individual industrial sources or Projects.

The standards for pollutants as presented in the Ambient Air Quality NEPM are generally in accordance with the air quality objectives prescribed by the EPP (Air) 2019 with the exception of SO_2 and NO_2. As the EPP (Air) 2019 air quality objectives are intended for the assessment of localise air emission sources, the EPP (Air) 2019 air quality objectives for SO_2 and NO_2 have been adopted for the assessment.

3.3.2 Air Toxics NEPM

The Air Toxics NEPM provides information on levels of toxic air pollutants at sites where significantly elevated concentrations are expected to occur, or where significant population exposure is expected to occur. The Air Toxics NEPM does not include air inside buildings or structures. The Air Toxics NEPM outlines monitoring, assessment and reporting procedures for the following Project-relevant pollutants:

- Benzene;
- Toluene;
- Xylenes.

The Air Toxics NEPM standards are intended to be applied to air quality experienced by the general population in a region and not to air quality in areas in the region affected by localised air emissions, such as individual industrial sources.

The Air Toxics NEPM includes monitoring investigation levels for use in assessing the significance of monitored levels of air toxics with respect to human health. The monitoring investigation levels are levels of air pollution below which lifetime exposure, or exposure for a given averaging time, does not constitute a significant health risk. If these limits are exceeded in the short term, it does not mean that adverse health effects automatically occur; rather some form of further investigation by the relevant jurisdiction of the cause of the exceedance is required.

The goal of the Air Toxics NEPM is to achieve recommended standards as assessed in accordance with associated monitoring and investigation protocol. The standards were set at a level intended to adequately protect human health and wellbeing. The standards presented in Air Toxics NEPM relevant to the proposal correspond to the EPP Air objectives protecting the health and wellbeing environmental values. The Air Quality NEPM standards relevant to the proposal are consequently addressed in the air quality objectives in the EPP Air.

The standards in the Air Toxics NEPM relevant to the Project correspond to the EPP Air objectives protecting the health and wellbeing environmental values, consequently addressed by the EPP Air with the exception of benzene, for which the EPP Air objective is more stringent.

3.4 Adopted air quality objectives

The referenced air quality criteria and guidelines values shown below in Table 3 have been adopted as the air quality objectives for the Project. As per the DESI Guideline Application requirements for activities with impacts to air (DESI, 2024) other recognised criteria has been used for pollutants not listed within the EPP Air, Air Quality NEPM or Air Toxics NEPM.

Table 3 Adopted air quality objectives

Pollutant	Air quality objective	Averaging period	Allowable Exceedances	Environmental value	Source
Ammonia	330	1 hour	-	Air toxic	NSW EPA (2022)
Benzene	5.4	Annual	-	Health and wellbeing	EPP (Air) 2019
	10.5	Annual	-	Air toxic	NEPM (Air Toxics) 2011
Carbon monoxide	11,000	8 hours	1 day / year	Health and wellbeing	EPP (Air) 2019
Sulfur Dioxide	570	1 hour	1 day / year	Health and wellbeing	EPP (Air) 2019
	229	24 hours	1 day / year	Health and wellbeing	EPP (Air) 2019
	57	Annual	-	Health and wellbeing	EPP (Air) 2019
	31	Annual	-	Protecting agriculture	EPP (Air) 2019
	21	Annual	-	Health and biodiversity of ecosystems (forests and natural vegetation)	EPP (Air) 2019
Nitrogen dioxide	250	1 hour	1 day / year	Health and wellbeing	EPP (Air) 2019
	62	Annual	-	Health and wellbeing	EPP (Air) 2019
	33	Annual	-	Health and biodiversity of ecosystems	EPP (Air) 2019
Particulate matter (as PM_{10})	50	24 hours	-	Health and wellbeing	EPP (Air) 2019
	25	Annual	-	Health and wellbeing	EPP (Air) 2019
Particulate matter (as $PM_{2.5}$)	25	24 hours	-	Health and wellbeing	EPP (Air) 2019
	8	Annual	-	Health and wellbeing	EPP (Air) 2019
Toluene	4,100	24 hours	-	Health and wellbeing	EPP (Air) 2019
	400	Annual	-	Health and wellbeing	EPP (Air) 2019
	1,100	30 minutes	-	Protecting aesthetic environment	EPP (Air) 2019

Pollutant	Air quality objective	Averaging period	Allowable Exceedances	Environmental value	Source
Xylene	1,200	24 hours	-	Health and wellbeing	EPP (Air) 2019
	950	Annual	-	Health and wellbeing	EPP (Air) 2019

4.0 Existing environment

The following sections describe the existing environment the Gladstone region. Aspects of the existing environment that are relevant to this assessment are discussed in the following sections, which include the following:

- Local climate and meteorological conditions.
- Existing air quality due to regional and local sources of air pollution (natural and anthropogenic) that emit similar air pollutants as those being assessed.
- Summary of major regional emission sources.
- Nearby sensitive receptor locations.
- Land use and terrain.

The BoM operates a network of meteorological monitoring stations around Australia that have long-term climatic data available for analysis. Also, DESI has an ambient air quality monitoring network across Queensland that monitors for controlled pollutants in areas with large population bases or heavy industry adjacent to residential areas. For the purposes of describing the existing environment within the Gladstone region the monitoring stations detailed below Table 4 were used.

Table 4 Locations of meteorological and air quality monitoring stations

Operator	Name	Station type	Latitude and Longitude	Distance from the Project (km)	Direction from the Project
BoM	Gladstone Airport (039326)	Meteorological	-23.87, 151.22	7.3	SW
	Gladstone Radar (039123)	Meteorological	-23.86, 151.26	9.5	ESE
DESI	Aldoga	Meteorological only	-23.84, 151.06	11	W
	Auckland Point	Neighbourhood	-23.83, 151.25	8.5	ENE
	Boat Creek	Neighbourhood	-23.82, 151.15	2.7	NW
	Boyne Island	Neighbourhood	-23.94, 151.35	22	SE
	Targinie	Background	-23.77, 151.10	9.7	NW
	Clinton	Neighbourhood	-23.87, 151.22	6.3	SE
	Fisherman's Landing	Peak (Industry)	-23.79, 151.16	5.1	NNW
	Memorial Park	Neighbourhood	-23.84, 151.25	8.3	ESE
	South Gladstone	Neighbourhood	-23.86, 151.27	10.6	ESE

The stations listed in the table above are presented in Figure 3 for geographical context to the Project.

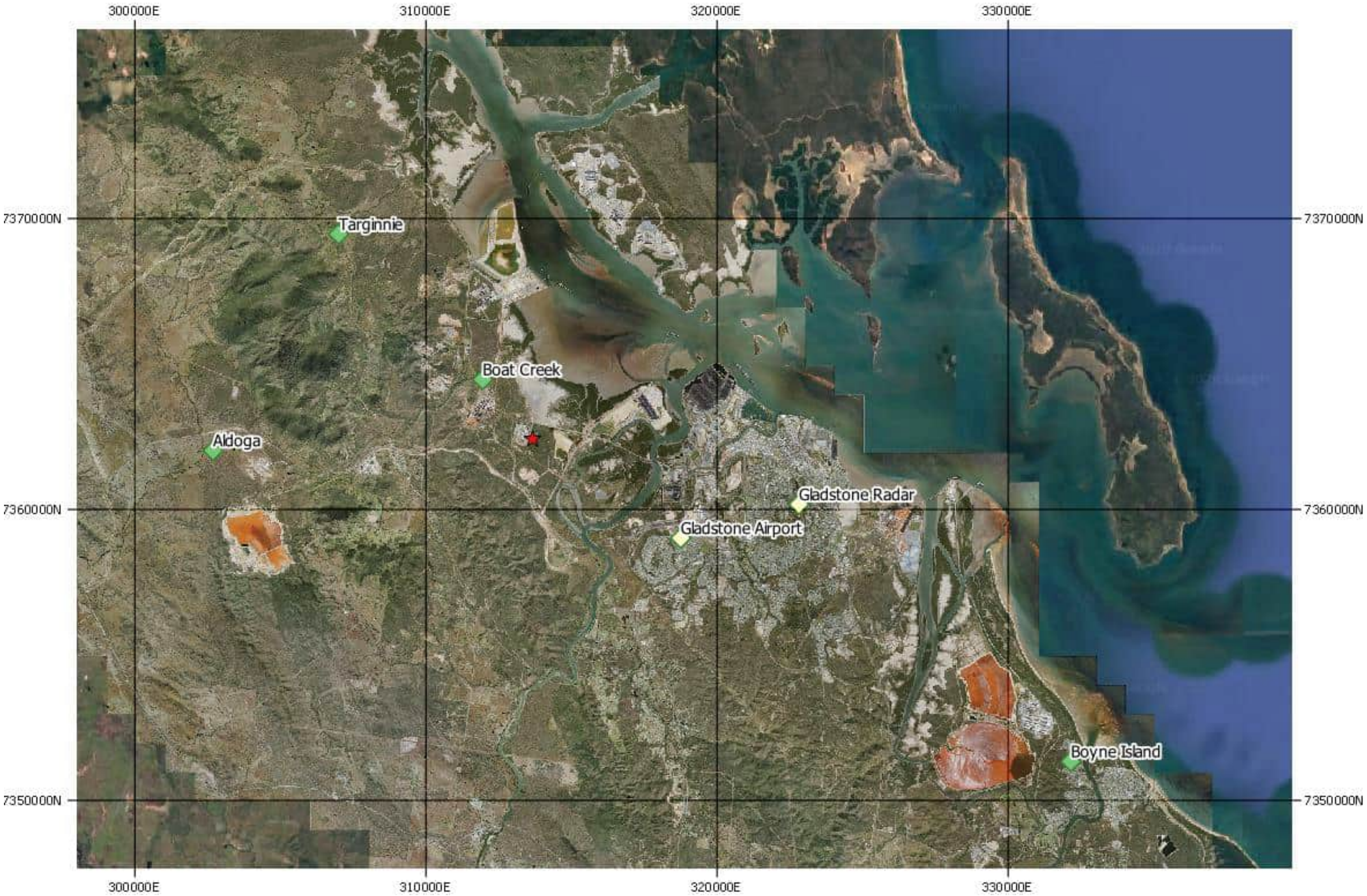

Figure 3 Location of BoM and DESI monitoring stations

1. Coordinate system GDA Zone 56 in metres
2. Red star denotes the location of the Project
3. Green diamond locations represent DESI monitoring sites, yellow diamond locations represent BoM monitoring sites

4.1 Climate and meteorology

The following sections describe the temperature, rainfall, and wind speed and direction characteristics as measured by the Gladstone Airport, Gladstone Radar, and Boat Creek meteorology monitoring stations. Additionally, a multiyear analysis of El Niño-Southern Oscillation (ENSO) indices is presented.

Table 5 below presents information on relevant DESI and BoM meteorological monitoring stations in the area.

Table 5 Meteorological monitoring stations

Station name	Station Operator	Parameters monitored	Period of Available Data (1-minute resolution)
Gladstone Airport (039326)	BoM	Winds, temperature, rainfall, relative humidity, pressure	2003 to 2019
Gladstone Radar (039123)	BoM	Winds, temperature, rainfall, relative humidity, pressure	2003 to 2019
Boat Creek	DESI	Winds, temperature, relative humidity	2010 to 2019

The long-term statistics presented for temperature and rainfall are based upon hourly measurement data that precede the collection of 1-minute resolution data, which the wind direction and speed analysis is based upon.

4.1.1 Wind speed and direction

Long-term annual wind speed and direction data was requested from BoM for the Gladstone Airport and Gladstone Radar stations. Data from the DESI Boat Creek station was sourced through the Queensland Government open data portal (Qld Government, 2020).

Wind roses for each of these stations for the years 2017, 2018, and 2019 (as per Table 5) are presented in Figure 4, Figure 5, and Figure 6.

Figure 4 shows that the predominant wind directions at for the BoM Gladstone and Gladstone Radar stations are easterly to south-easterly with moderate wind speeds, consistent with a coastal location and showing easterly ocean breezes. The Gladstone BoM stations both show relatively low amounts of calms, ranging from between 0.3 and 1.8 per cent of the time. The DESI Boat Creek station shows an overall lower average wind speed, with a greater proportion of wind speeds under 2 m/s. The percentage calms experienced at the Boat Creek station is also higher, with calms measured 5.9 per cent of the time. The wind direction includes significant proportions from the east (likely due to ocean breeze) but also large amounts of winds from the west. This is likely due to katabatic and drainage winds from the neighbouring mountain ranges.

The seasonal variation in winds experienced at the three monitoring locations is presented in Figure 5. All stations recorded higher wind speeds during the summer months, ranging between 2.4 to 4.8 m/s and lower wind speeds during the winter months, ranging between 2.0 to 3.9 m/s. Percentage calms experiences were also the greatest during the winter months, with the stations recording between 0.5 and 6.4 per cent calms. Most seasons had significant proportions of winds from the east for each of the monitoring stations. However, during the winter months, winds were measured from the west and south west. It is likely that this is due to higher occurrences of katabatic and drainage winds down the nearby steep terrain from the cooler winter month temperatures.

The daytime and night-time variation in winds are presented in Figure 6 for the three monitoring locations. Overall lower wind speeds and higher percentage calms are experienced during the night-time hours, ranging from 0.4 to 8.6 per cent and 1.8 to 2.9 m/s. The daylight hours winds originate predominately from the east, consistent with the coastal location of each of the stations.

Overall, analysis of the annual wind roses shows that the wind speed and directions at each station do vary; in particular, the Gladstone BoM stations when compared with the DESI Boat Creek station. This variation is likely due to the influence of terrain, elevation and land use on local scale winds, which is discussed further in Section 4.5.

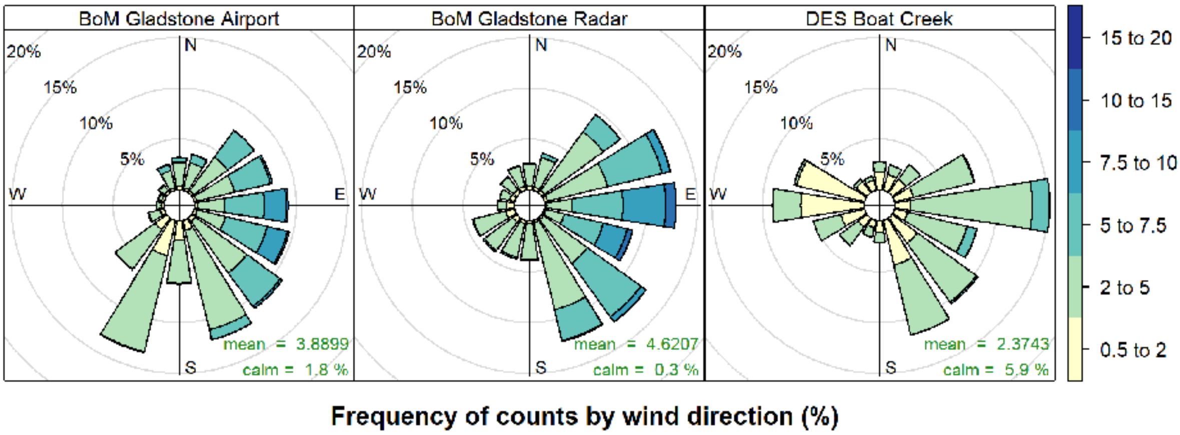

Figure 4 Long term wind roses for the BoM Gladstone Airport, BoM Gladstone Radar, and DESI Boat Creek monitoring stations

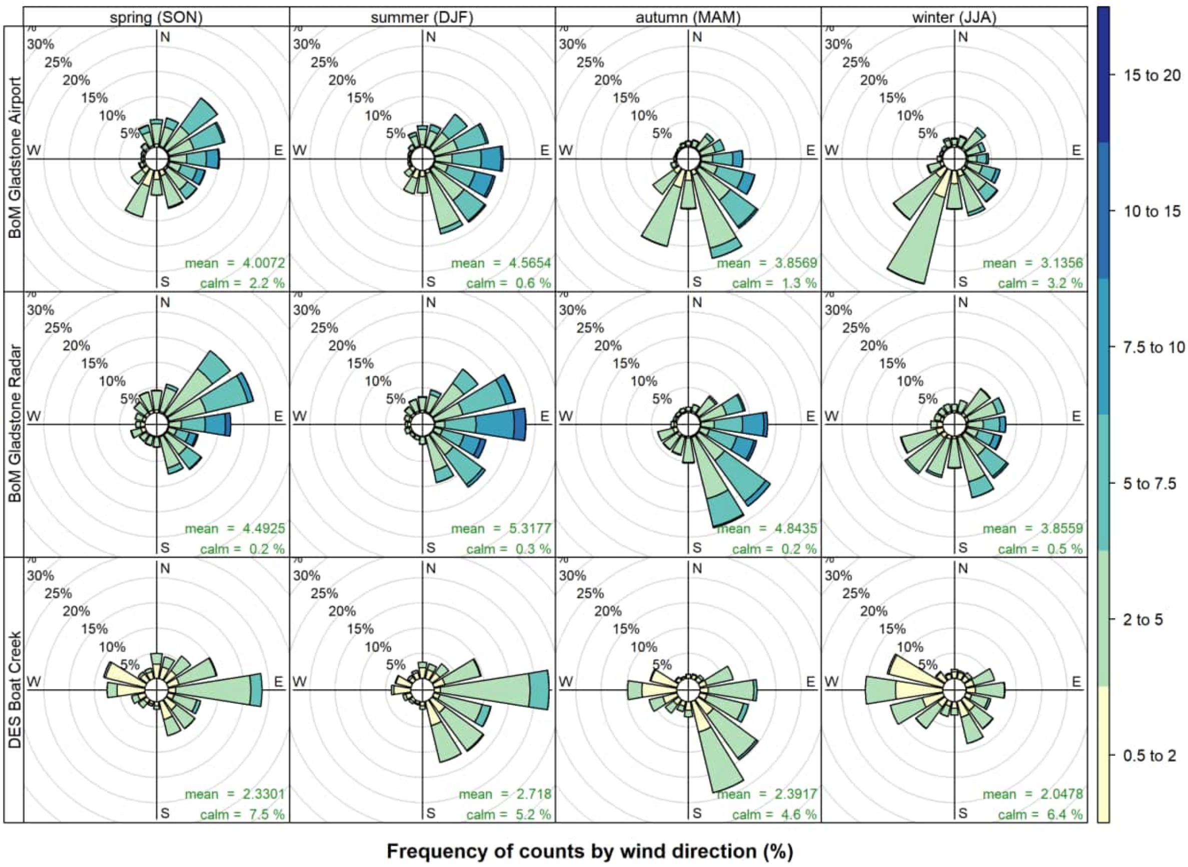

Figure 5 Seasonal wind roses for the BoM Gladstone Airport, BoM Gladstone Radar, and DESI Boat Creek monitoring stations

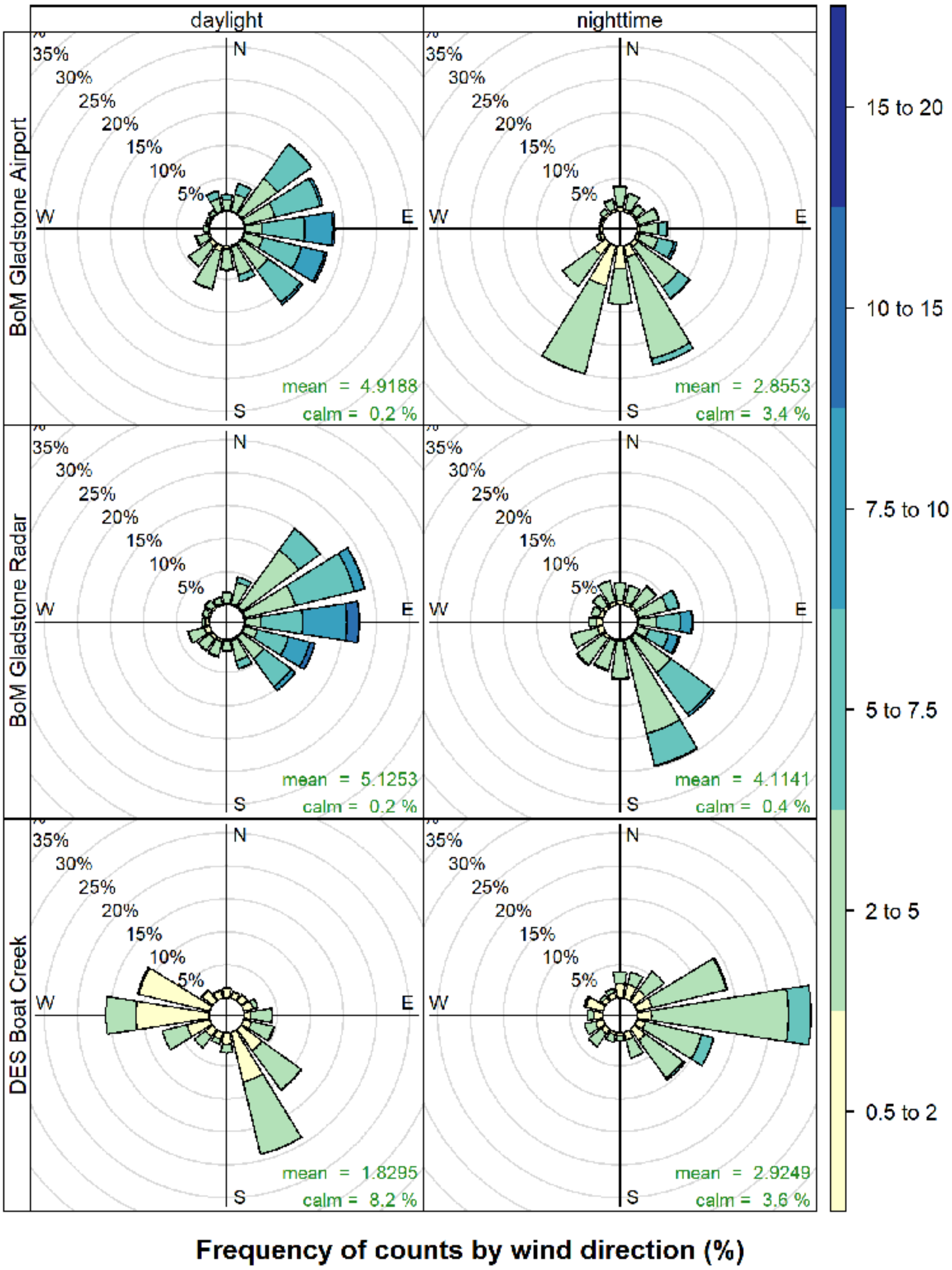

Figure 6 **Daylight and night-time hours wind roses for the BoM Gladstone Airport, BoM Gladstone Radar, and DESI Boat Creek monitoring stations**

4.1.2 Temperature

Long term mean, minimum and maximum temperatures have been collected from the Gladstone Airport and Gladstone Radar BoM stations and are displayed in Table 6.

The monitoring data shows that the average maximum temperatures for Gladstone Airport and Gladstone Radar are similar. The maximum temperatures experienced at each station occur during the summer months, peaking for the month of January. The coldest recorded temperatures occur in in the winter months, with the lowest average recorded temperatures in July.

Table 6 Mean minimum (blue) and maximum (red) monthly temperatures at the BoM monitoring stations relevant to the Project

Station	Mean minimum and mean maximum temperatures (°C)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
Gladstone Airport[1.]	30.8	30.7	29.9	28.2	25.7	23.5	23.2	24.0	26.2	27.6	29.0	30.2	27.4
	23.1	23.0	21.9	19.1	15.6	13.4	12.0	12.6	15.6	18.5	20.5	22.2	18.1
Gladstone Radar[2.]	31.4	31.1	30.2	28.4	25.7	23.3	23.0	24.3	26.6	28.5	30.1	31.1	27.8
	22.6	22.5	21.6	19.7	17.0	14.4	13.5	14.3	16.5	18.7	20.6	21.9	18.6

Table notes:

1. Mean maximum and minimum temperature values have been calculated based on 27 years of data (1993 to 2019)
2. Mean maximum and minimum temperature values have been calculated based on 62 years of data (1957 to 2020)

4.1.3 Rainfall

Mean rainfall values have been collected from the Gladstone Airport and Gladstone Radar stations and are presented in Table 7. The data shows that distinct wet (summer) and dry (winter) seasons are experienced at the monitoring locations annually. Of the two stations, Gladstone Airport receives the highest amount of rainfall annually (176 mm) in February, with the Gladstone Radar station receiving its peak rainfall in January (147.9 mm). The driest periods occur mostly in winter and spring months, with September on average receiving the lowest rainfall with approximately 26 mm experienced at each monitoring location.

Table 7 Mean monthly rainfall at the BoM monitoring stations relevant to the Project

Station	Monthly mean rainfall (mm)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
Gladstone Airport[1.]	143.3	176	111.7	40.6	34.4	37.5	28.5	31.0	26.4	59.1	55.7	104.9	857.1
Gladstone Radar[2]	147.9	138	105.8	46.9	54.6	36.6	34.0	30.7	26.1	60.8	66.8	124.3	886.5

Table notes:

1. Mean maximum and minimum temperature values have been calculated based on 25 years of data (1994 to 2019)
2. Mean maximum and minimum temperature values have been calculated based on 57 years of data (1957 to 2020)

4.1.4 El Niño-Southern Oscillation

For the eastern side of Australia, the ENSO has the strongest effect on year to year climate variability, mostly affecting rainfall and temperature. El Niño incidences represent periods of unusually warm Pacific Ocean conditions along the western coast of South America, which frequently presents as high rainfall events in South America and drought conditions for Australia. Conversely, La Niña periods represent cooler ocean surface temperatures along the western coast of South America and increase the likelihood of drought conditions locally and high rainfall periods in Australia.

The Southern Oscillation Index (SOI), Oceanic Niño Index (ONI), and Multivariate ENSO Index (MEI) are measures that indicate episodes of El Niño and La Niña. Due to differences in methodology each of these indices can have slightly differing results. In order to provide a robust investigation of ENSO periods, monthly results from each of these measures have been analysed.

Figure 7 presents the monthly SOI, ONI, and MEI values for the period of 2008 to 2020.

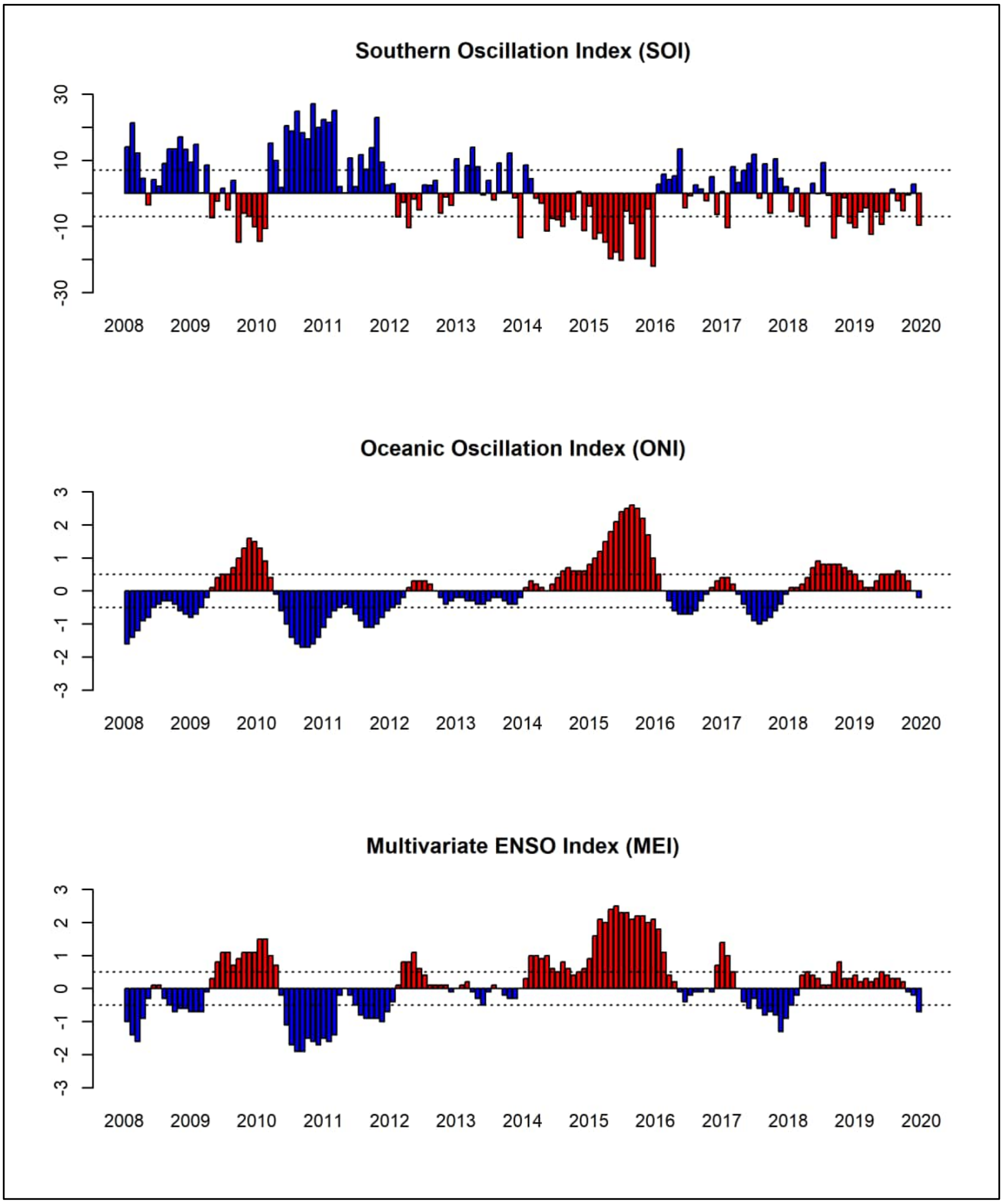

Figure 7 Comparison of Monthly SOI, ONI, and MEI for 2008 to 2020 (red values greater than the reference thresholds indicate periods of El Niño conditions, and blue values greater than the reference thresholds indicate periods of La Niña conditions)

Data from the analysed ENSO indices show mostly neutral conditions for the three years used in the assessment dispersion modelling (2017-2019).

4.2 Background air environment

In order to establish a background air quality level, data was gathered from several Queensland DESI monitoring stations within the Gladstone area over a monitoring period from January 2010 to December 2019. Information on the DESI stations selected is presented in Table 4 and Figure 3, as previously stated in Section 4.0. Pollutants monitored include NO_x, SO_2, CO, particulates (as PM_{10} and $PM_{2.5}$), and VOCs.

Ammonia monitoring is not currently completed within the Gladstone region. Typically, ammonia is a very localised pollutant with specific sources, which are often industrial in nature. As such, existing ammonia within the Gladstone area is considered through cumulative modelling of nearby ammonia sources, as discussed in Section 5.1.

4.2.1 Data analysis and availability

The DESI datasets from monitoring locations reviewed below were sourced as validated datasets; however, there are gaps within the dataset that are either missing monitoring data or have been subsequently invalidated by DESI. The data is considered representative of actual pollutant concentrations in the air at the time of monitoring. The datasets consist of hourly averages that have been summarised and analysed for the required averaging periods. Where there was less than 75 per cent available valid data for an averaging period, then that averaging period was not calculated. Annual averages were considered valid when at least three of the year's quarterly periods had a data availability threshold of at least 75 per cent, as per guidance from Technical Paper No. 5 – Data Collection and Handling (NEPC, 2001).

Pollutant concentrations for PM_{10} and $PM_{2.5}$ have been recorded in micrograms per metre cubed (µg/m³). Concentrations for NO_x, SO_2, CO, O_3 and VOCs have been recorded in parts per million (ppm) and converted to µg/m³ for the purposes of this AQIA. For averaging periods of less than one year, the 70th percentile has been used for data analysis.

Data analysis of NO_x monitoring has been included purely to inform the reader of the typical ambient monitoring statistics for NO_x present in the Gladstone airshed. For the AQIA the ARM2 methodology using the hourly NO and NO_2 data from the seven stations within the Gladstone region that measure NO and NO_2 has been employed to determine cumulative NO_2 impacts from the Project (see Section 7.4).

4.2.2 Summary of stations

Table 8 below presents an overview of relevant DESI monitoring stations in the Gladstone area, pollutants available from each station, period of data monitored at each station, and the percentage of available data.

Table 8 DESI air quality monitoring stations

Station name	Pollutants monitored	Period of available data	Percentage of available data
Auckland Point	PM_{10}	Jan 2019 to Dec 2019	97 %
Boat Creek	NO_x, SO_2, PM_{10}, $PM_{2.5}$	Jan 2010 to Dec 2019	88 %
Boyne Island	NO_x, SO_2, CO, PM_{10}, $PM_{2.5}$	Jan 2010 to Dec 2019	93 %
Clinton	NO_x, SO_2, PM_{10}, $PM_{2.5}$	Jan 2010 to Dec 2019	92 %
Fisherman's Landing	NO_x, SO_2, PM_{10}, $PM_{2.5}$	Jan 2016 to Dec 2019	89 %
Memorial Park	NO_x, SO_2, O_3, benzene, formaldehyde, toluene, xylene	Jan 2010 to Dec 2019	71 %
South Gladstone	NO_x, SO_2, PM_{10}, $PM_{2.5}$	Jan 2010 to Dec 2019	93 %
Targinie	NO_x, SO_2, PM_{10}, $PM_{2.5}$	Jan 2010 to Dec 2019	90 %

4.2.3 Monitoring of pollutants

As shown in Table 8, particulate matter is measured at seven out of eight of the identified stations. All DESI monitoring stations are located within a 22 km radius of the Project (as per Table 4). The Boat Creek monitoring station is located closest to the Study Area. The Fisherman's Landing monitoring station is also located nearby; however, this station is identified as a peak industry monitoring station for the Curtis Island LNG Plants and therefore may not be representative of background conditions experienced at the Project site. As such, the Boat Creek station is considered the most accurate representation of background air quality for the Study Area.

Carbon monoxide is only monitored by the Boyne Island monitoring station, approximately 22 km away. VOCs such as benzene, formaldehyde, toluene and xylene are monitored at Memorial Park within the city of Gladstone, approximately 8.3 km away.

4.2.3.1 PM_{10}

Available PM_{10} concentration data have been analysed from the DESI stations located at Auckland Point, Boat Creek, Boyne Island, Clinton, Fisherman's Landing, and South Gladstone, and Targinie from the period of 2010 to 2019.

Daily and annual average PM_{10} concentrations are presented in Table 9 and Table 10 and compared against the EPP (Air) Policy criteria.

Table 9 24-hour PM_{10} concentrations (µg/m^3) for DESI stations in the Gladstone area

Monitoring Station	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	ALL
Maximum 24-hour average concentration											**Max**
Auckland Point	-	-	-	-	-	-	-	-	-	**166**	166
Boat Creek	37.4	**<u>324</u>**	**61.5**	**50.5**	38.6	**<u>60.1</u>**	30.6	**<u>141</u>**	**142**	**143**	324
Boyne Island	32.3	**183**	**<u>82.2</u>**	41.2	29.4	27.6	42.7	28.3	**60.7**	**121**	183
Clinton	<u>40.7</u>	**102**	46.6	47.0	**<u>69.1</u>**	34.8	28.0	44.6	**107**	**183**	183
Fisherman's Landing	-	**-**	-	-	-	-	**<u>117</u>**	**131**	**<u>497</u>**	**<u>241</u>**	497
South Gladstone	39.6	**137**	**63.0**	37.6	49.3	31.5	32.1	40.2	**80.3**	**130**	137
Targinie	30.0	**124**	**59.4**	**<u>84.1</u>**	**68.1**	**55.5**	25.9	45.0	**180**	**135**	180
Number of exceedances											**Sum**
Auckland Point	-	-	-	-	-	-	-	-	-	12	12
Boat Creek	0	12	1	1	0	1	0	1	8	15	39
Boyne Island	0	7	2	0	0	0	0	0	4	10	23
Clinton	0	8	0	0	1	0	0	0	7	15	31
Fisherman's Landing	-	-	-	-	-	-	18	44	31	59	152
South Gladstone	0	3	1	0	0	0	0	0	5	10	19
Targinie	0	4	6	4	6	3	0	0	10	12	45
70th Percentile 24-hour average concentration											**Avg.**
Auckland Point	-	-	-	-	-	-	-	-	-	21.3	21.3
Boat Creek	19.3	25.6	21.2	18.4	17.6	14.8	16.0	14.6	15.3	21.3	18.4
Boyne Island	15.0	16.0	12.6	15.3	13.2	13.0	15.3	12.0	13.9	16.9	14.3
Clinton	16.2	19.4	18.9	19.7	14.2	13.3	14.3	12.9	16.5	21.4	16.7
Fisherman's Landing	-	-	-	-	-	-	31.5	36.8	32.0	35.4	33.9
South Gladstone	19.2	15.8	16.6	19.0	18.5	15.0	16.7	15.6	15.5	16.9	16.9
Targinie	12.7	14.8	19.7	22.2	17.6	13.6	13.7	15.0	14.0	18.6	16.2
EPP (Air) Policy Criterion – Health and wellbeing											**50**

Table note:
Highest monitored concentrations for the year are <u>underlined</u>, with exceedances of assessment criterion presented in **bold.**

From review of the analysed data, several exceedances of the PM_{10} daily criterion (50 µg/m³) were observed for each monitoring stations. These exceedances were recorded from 2011 to 2019, with the highest recorded concentrations for each year as follows:

- 40.7 µg/m³ at Clinton in 2010;
- 324 µg/m³ at Boat Creek in 2011;
- 82.2 µg/m³ at Boyne Island in 2012;
- 84.1 µg/m³ at Targinie in 2013;
- 69.1 µg/m³ at Clinton in 2014;
- 60.1 µg/m³ at Boat Creek in 2015;
- 117 µg/m³ at Fisherman's Landing in 2016;
- 141 µg/m³ at Boat Creek in 2017;
- 497 µg/m³ at Fisherman's Landing in 2018;
- 241 µg/m³ at Fisherman's Landing at 2019.

Annual average PM_{10} concentrations for the period of between 2010 and 2019 are presented below in Table 10. Averages from the years 2017 to 2019 were also provided to more easily compare to results from years used in meteorological modelling.

Table 10 Annual PM_{10} averages (µg/m³) for DESI stations in the Gladstone area

Monitoring station	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Average 2017-2019
Auckland Point	-	-	-	-	-	-	-	-	-	21.0	21.0
Boat Creek	<u>17.1</u>	<u>24.3</u>	<u>18.9</u>	16.7	15.4	<u>13.2</u>	14.0	13.7	15.2	21.7	16.9
Boyne Island	13.5	15.8	11.4	12.9	11.5	11.2	13.0	10.1	12.8	15.2	12.7
Clinton	14.1	18.1	16.7	17.6	12.6	12.0	12.5	11.4	16.1	21.6	16.4
Fisherman's Landing	-	-	-	-	-	-	**<u>26.9</u>**	**<u>32.2</u>**	**<u>29.7</u>**	**<u>35.2</u>**	32.4
South Gladstone	16.5	14.0	14.6	16.8	16.2	12.9	14.5	13.9	13.9	15.9	14.6
Targinie	11.1	14.3	18.5	<u>19.4</u>	<u>17.1</u>	13.1	11.8	13.3	14.6	18.0	15.3
EPP (Air) Criterion - Health and wellbeing											25

Table note:
Highest monitored concentrations for the year are <u>underlined</u>, with exceedances of assessment criterion presented in **bold.**

There were four exceedances of the EPP Air PM_{10} annual objective (25 µg/m³) recorded from 2016 to 2019, all at the Fisherman's Landing monitoring station. The highest concentrations for each year are listed below:

- 17.1 µg/m³ at Boat Creek in 2010;
- 24.3 µg/m³ at Boat Creek in 2011;
- 18.9 µg/m³ at Boat Creek in 2012;
- 19.4 µg/m³ at Targinie in 2013;
- 17.1 µg/m³ at Targinie in 2014;
- 13.2 µg/m³ at Boat Creek in 2015;
- 26.9 µg/m³ at Fisherman's Landing in 2016;

- 32.2 µg/m^3 at Fisherman’s Landing in 2017;
- 29.7 µg/m^3 at Fisherman’s Landing in 2018;
- 35.2 µg/m^3 at Fisherman’s Landing in 2019.

According to annual NEPM Queensland air monitoring reports (*Department of Environment and Science, 2010 to 2019*) and monthly DESI Air Quality bulletins (*Department of Environment and Science, 2019, multiple volumes*) smoke from nearby vegetation fires in the Gladstone region, as well as local sources attributed to exceedances in PM_{10} in 2011, 2012, 2018 and 2019.

Based upon the close proximity of the Boat Creek monitoring station to the Project area and proximity of nearby Fisherman's Landing monitoring station to similar heavy industry sites in comparison to remaining monitoring stations, PM_{10} concentrations from these sites are likely more representative of the PM_{10} concentrations expected within the Project location.

4.2.3.2 $PM_{2.5}$

Monitoring data for $PM_{2.5}$ from Boat Creek, Boyne Island, Clinton, Fisherman’s Landing, South Gladstone, and Targinie for 2010 to 2019 have been analysed, where available.

Daily and annual average PM_{10} concentrations are presented in Table 11 and Table 12 and are compared to the EPP (Air) Policy criteria.

Table 11 24-hour $PM_{2.5}$ concentrations (µg/m³) for DESI stations in the Gladstone area

Monitoring station	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	ALL
Maximum 24-hour average concentration											**Max**
Boat Creek	15.3	**277**	**39.0**	19.9	14.8	**50.6**	13.2	**122**	**116**	**79.6**	79.6
Boyne Island	11.0	**173**	**66.6**	**30.5**	23.7	13.6	**32.2**	24.5	**33.1**	**47.4**	32.2
Clinton	18.7	**96.7**	**31.1**	23.5	**64.8**	17.2	16.8	22	**60.2**	**63.8**	64.8
Fisherman's Landing	-	-	-	-	-	-	13.0	**50.2**	**76.6**	**77.8**	77.8
South Gladstone	17.5	**127**	**49.6**	18.3	**44.0**	13.8	15.9	**28.6**	**55.0**	-	127
Targinie	12.4	**116**	21.0	**25.2**	23.2	**41.2**	11.7	**31.5**	**158**	**52.6**	158
Number of exceedances											**Sum**
Boat Creek	0	10	1	0	0	1	0	2	7	12	33
Boyne Island	0	11	3	3	0	0	1	0	1	6	25
Clinton	0	14	1	0	1	0	0	0	10	12	38
Fisherman's Landing	-	-	-	-	-	-	0	3	8	14	25
South Gladstone	0	9	1	0	1	0	0	1	7	0	19
Targinie	0	4	0	1	0	4	0	2	16	10	37
70th Percentile 24-hour average concentration											**Avg.**
Boat Creek	7.5	7.0	6.0	5.3	4.8	5.5	5.0	5.0	4.9	7.2	6.2
Boyne Island	3.9	5.4	4.6	7.1	5.0	4.3	4.9	4.6	5.2	5.8	5.2
Clinton	5.6	10.0	7.5	8.6	5.6	4.9	5.3	4.7	7.1	8.1	6.9
Fisherman's Landing	-	-	-	-	-	-	4.9	6.8	6.8	7.4	6.7
South Gladstone	6.7	6.6	5.4	6.0	7.1	5.0	6.3	6.2	5.4	5.9	6.2
Targinie	4.0	4.5	5.3	6.2	4.5	3.7	5.1	4.7	5.5	6.5	5.3
EPP (Air) Criterion - Health and wellbeing											**25**

Table notes:
Highest monitored concentrations for the year are underlined, with exceedances of assessment criterion presented in **bold.**

From review of the analysed data, several exceedances of the $PM_{2.5}$ daily criterion (25 µg/m³) were observed for each monitoring stations. These exceedances were also recorded in 2011 to 2019, with the highest recorded concentrations for each year as follows

- 18.7 µg/m³ at Clinton in 2010;
- 278 µg/m³ at Boat Creek in 2011;
- 66.6 µg/m³ at Boyne Island in 2012;
- 30.5 µg/m³ at Boyne Island in 2013;
- 64.8 µg/m³ at Clinton in 2014;

- 50.6 µg/m³ at Boat Creek in 2015;
- 32.2 µg/m³ at Boyne Island in 2016;
- 122 µg/m³ at Boat Creek in 2017;
- 158 µg/m³ at Targinie in 2018; and
- 79.6 µg/m³ at Boat Creek in 2019.

Annual average $PM_{2.5}$ concentrations for the period of between 2010 and 2019 are presented below in Table 12. Averages from the years 2017 to 2019 were also provided to more easily compare to results from years used in meteorological modelling.

Table 12 Annual $PM_{2.5}$ averages (µg/m³) for DESI stations in the Gladstone area

Monitoring station	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Average 2017-2019
Boat Creek	<u>6.6</u>	**<u>10.0</u>**	6.0	4.7	4.2	<u>5.1</u>	4.6	4.9	5.6	**8.1**	6.2
Boyne Island	3.2	7.0	4.5	5.7	4.6	3.8	4.5	4.3	5.0	6.0	5.1
Clinton	5.1	**9.9**	<u>7.1</u>	<u>7.9</u>	5.5	4.3	4.8	4.1	<u>7.8</u>	**<u>8.9</u>**	6.9
Fisherman's Landing	-	-	-	-	-	-	4.7	<u>6.3</u>	6.8	**8.2**	7.1
South Gladstone	6.2	7.6	5.2	5.6	<u>6.0</u>	4.3	<u>5.7</u>	5.6	5.5	6.4	5.8
Targinie	3.6	5.6	4.9	5.7	4.4	4.0	4.5	4.6	7.1	7.1	6.3
EPP (Air) Criterion - Health and wellbeing											**8**

Table note:

Highest monitored concentrations for the year are <u>underlined,</u> with exceedances of assessment criterion presented in **bold.**

There were several exceedances of the EPP Air annual $PM_{2.5}$ (25 µg/m³) objective in 2011 and 2019 at Boat Creek, Fisherman's Landing and Clinton. Highest concentrations of each year are listed below:

- 6.6 µg/m³ at Boat Creek in 2010;
- 10.0 µg/m³ at Boat Creek in 2011;
- 7.1 µg/m³ at Clinton in 2012;
- 7.9 µg/m³ at Clinton in 2013;
- 6.0 µg/m³ at South Gladstone in 2014;
- 5.1 µg/m³ at Boat Creek in 2015;
- 5.7 µg/m³ at South Gladstone in 2016;
- 6.3 µg/m³ at Fisherman's Landing in 2017;
- 7.8 µg/m³ at Clinton in 2018;
- 8.9 µg/m³ at Clinton in 2019.

According to annual NEPM Queensland air monitoring reports and monthly DESI Air Quality bulletins smoke from nearby vegetation fires in the Gladstone region, as well as local sources attributed to elevated concentrations and exceedances in $PM_{2.5}$ in 2011 to 2014, and 2018 to 2019 (DESI, 2019).

Based upon the close proximity of the Boat Creek monitoring station to the Project area and proximity of nearby Fisherman's Landing monitoring station to similar heavy industry sites in comparison to remaining monitoring stations, $PM_{2.5}$ concentrations from it is likely more representative of the $PM_{2.5}$ concentrations expected within the Study Area.

4.2.3.3 NO_2

NO_2 concentration data from Boat Creek, Boyne Island, Clinton, Fisherman's Landing, Memorial Park, South Gladstone, and Targinie from the period of 2010 to 2019 has been analysed, where available. Maximum 1-hour and annual average NO_2 concentrations for the relevant monitoring stations from the period of 2010 to 2019 are presented in Table 13 and Table 14.

Data presented below has not been directly used to determine cumulative NO_2 concentrations from the Project, and only presented to inform the reader of the NO_2 present in the Gladstone airshed. For the AQIA the ARM2 methodology using the hourly NO and NO_2 data from the seven stations within the Gladstone region that measure NO and NO_2 has been employed to determine cumulative NO_2 impacts from the Project (see Section 7.4).

Table 13 1-hour NO_2 maximum concentrations (µg/m^3) for DESI stations in the Gladstone area

Monitoring station	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	ALL
Maximum 1-hour average concentration											**Max**
Boat Creek	69.8	<u>189</u>	78.0	69.8	80.1	80.1	67.8	119	71.9	134	189
Boyne Island	45.2	69.8	67.8	59.6	57.5	47.2	55.4	49.3	67.8	82.1	82.0
Clinton	67.8	65.7	69.8	69.8	69.8	67.8	61.6	65.7	78.0	84.2	84.0
Fisherman's Landing	-	-	-	-	-	-	65.7	59.6	65.7	117	117
Memorial Park	76.0	14	<u>127</u>	<u>113</u>	<u>203</u>	<u>90.4</u>	<u>187</u>	121	<u>162</u>	<u>160</u>	203
South Gladstone	65.7	71.9	86.3	84.2	94.5	88.3	76.0	<u>152</u>	69.8	73.9	152
Targinie	<u>78.0</u>	78.0	71.9	67.8	71.9	78.0	88.3	92.4	113	78.0	113
70th Percentile 1-hour average concentration											**Avg.**
Boat Creek	<u>14.4</u>	<u>14.4</u>	14.4	<u>16.4</u>	<u>16.4</u>	<u>12.3</u>	<u>12.3</u>	<u>12.3</u>	<u>14.4</u>	<u>14.4</u>	14.2
Boyne Island	2.1	2.1	4.1	2.1	2.1	2.1	2.1	2.1	4.1	4.1	2.7
Clinton	8.2	8.2	10.3	10.3	10.3	8.2	8.2	8.2	10.3	10.3	9.2
Fisherman's Landing	-	-	-	-	-	-	8.2	6.2	8.2	8.2	3.1
Memorial Park	<u>14.4</u>	6.2	6.2	6.2	4.1	4.1	6.2	4.1	12.3	8.2	7.7
South Gladstone	12.3	<u>14.4</u>	<u>16.4</u>	14.4	12.3	<u>12.3</u>	<u>12.3</u>	10.3	12.3	12.3	12.9
Targinie	6.2	6.2	8.2	8.2	6.2	6.2	8.2	8.2	8.2	6.2	7.2
EPP (Air) Criterion - Health and wellbeing											**250**

Table note:
Highest monitored concentrations for the year are <u>underlined</u>, with exceedances of assessment criterion presented in **bold**.
Concentrations have been converted from parts per million (ppm)

There were no exceedances of the 1-hour EPP Air criteria for NO_2 (250 µg/m³) for any of the monitoring stations. Highest recorded concentrations for each year are as follows

- 78.0 µg/m³ at Targinie in 2010;
- 189 µg/m³ at Boat Creek in 2011;
- 127 µg/m³ at Memorial Park in 2012;
- 113 µg/m³ at Memorial Park in 2013;
- 203 µg/m³ at Memorial Park in 2014;
- 90.4 µg/m³ at Memorial Park in 2015;

- 187 µg/m³ at Memorial Park in 2016;
- 152 µg/m³ at South Gladstone in 2017;
- 162 µg/m³ at Memorial Park in 2018;
- 160 µg/m³ at Memorial Park in 2019.

Annual average NO_2 concentrations for the period of between 2010 and 2019 are presented below in Table 14.

Table 14 Annual NO_2 average concentrations (µg/m³) for DESI stations in the Gladstone area

Monitoring station	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Average 2017-2019
Boat Creek	10.8	11.0	12.0	<u>13.0</u>	<u>12.3</u>	9.8	10.4	<u>9.9</u>	11.0	<u>10.8</u>	10.6
Boyne Island	1.5	2.8	3.6	3.1	2.5	2.4	2.1	2.2	3.9	3.6	3.2
Clinton	6.8	8.3	10.0	9.3	8.9	7.1	7.5	6.9	9.2	8.2	8.1
Fisherman's Landing	-	-	-	-	-	-	6.9	5.9	7.4	7.4	6.9
Memorial Park	<u>11.6</u>	6.1	6.0	5.5	5.6	5.2	6.2	4.5	<u>11.4</u>	7.6	7.8
South Gladstone	9.9	<u>12.1</u>	<u>14.5</u>	11.8	11.1	<u>10.4</u>	<u>11.2</u>	9.6	10.1	10.1	9.9
Targinie	6.3	6.8	7.9	8.1	7.2	7.0	7.9	7.4	7.9	7.3	7.6
EPP (Air) Criterion - Health and wellbeing											**62**
EPP (Air) Criterion - Health and biodiversity of ecosystems											**33**

Table note:
Highest monitored concentrations for the year are <u>underlined</u>, with exceedances of assessment criterion presented in **bold.**
Concentrations have been converted from parts per million (ppm).

There were no exceedances of any of the EPP (Air) NO_2 annual average criteria at any of the monitoring stations during the monitoring period from 2010 to 2019. Highest concentrations for each year are as follows:

- 11.6 µg/m³ in Memorial Park in 2010;
- 12.1 µg/m³ in South Gladstone in 2011;
- 14.5 µg/m³ in South Gladstone in 2012;
- 13.0 µg/m³ in Boat Creek in 2013;
- 12.3 µg/m³ in Boat Creek in 2014;
- 10.4 µg/m³ in South Gladstone in 2015;
- 11.2 µg/m³ in South Gladstone in 2016;
- 9.9 µg/m³ in Boat Creek in 2017;
- 11.4 µg/m³ in Memorial Park in 2018;
- 10.8 µg/m³ in Boat Creek in 2019.

4.2.3.4 SO_2

SO_2 concentration data from Boat Creek, Boyne Island, Clinton, Fisherman's Landing, Memorial Park, South Gladstone, and Targinie from the period of 2010 to 2019 has been analysed, where available. Maximum 1-hour, daily, and annual average SO_2 concentrations for the relevant monitoring stations from the period of 2010 to 2019 are presented in Table 15, Table 16, and Table 17.

Table 15 1-hour SO_2 maximum concentrations (µg/m³) for DESI stations in the Gladstone area

Monitoring station	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	ALL
Maximum 1-hour average concentration											Max
Boat Creek	229	249	237	191	226	314	171	157	177	249	314
Boyne Island	160	154	154	260	194	263	249	263	197	120	263
Clinton	143	154	129	97	140	151	149	129	191	294	294
Fisherman's Landing	-	-	-	-	-	-	131	280	34.3	20.0	280
Memorial Park	197	131	91.4	129	126	94.3	91.4	97.1	111	94.3	197
South Gladstone	149	260	169	191	194	220	174	209	166	203	260
Targinie	126	91.4	194	126	129	100	206	134	194	91.4	206
70th Percentile 1-hour average concentration											Average
Boat Creek	2.9	2.9	2.9	5.7	2.9	2.9	2.9	2.9	2.9	2.9	3.1
Boyne Island	-	5.7	2.9	2.9	2.9	2.9	-	-	2.9	2.9	2.3
Clinton	2.9	2.9	5.7	2.9	2.9	2.9	2.9	2.9	2.9	2.9	3.1
Fisherman's Landing	-	-	-	-	-	-	2.9	-	-	-	0.7
Memorial Park	5.7	22.9	20	20	14.3	14.3	14.3	14.3	14.3	11.4	15.1
South Gladstone	2.9	5.7	5.7	2.9	2.9	5.7	2.9	2.9	2.9	5.7	4.0
Targinie	2.9	2.9	2.9	5.7	2.9	2.9	2.9	-	5.7	2.9	3.1
EPP (Air) Criterion- Health and wellbeing											570

Table note:
Highest monitored concentrations for the year are underlined, with exceedances of assessment criterion presented in **bold**.
Concentrations have been converted from parts per million (ppm).

There were no exceedances of the 1-hour EPP Air criteria for SO_2 (570 µg/m³) for any of the monitoring stations. Highest recorded concentrations for each year are as follows:

- 229 µg/m³ at Boat Creek in 2010;
- 260 µg/m³ at South Gladstone in 2011;
- 237 µg/m³ at Boat Creek in 2012;
- 260 µg/m³ at Boyne Island in 2013;
- 226 µg/m³ at Boat Creek in 2014;
- 314 µg/m³ at Boat Creek in 2015;
- 249 µg/m³ at Boyne Island in 2016;
- 280 µg/m³ at Fisherman's Landing in 2017;

- 197 µg/m³ at Boyne Island 2018;
- 294 µg/m³ at Clinton in 2019.

Maximum recorded daily average SO_2 concentrations for the period from 2010 to 2019 are presented below in Table 16.

Table 16 24-hour SO_2 maximum concentrations (µg/m³) for DESI stations in the Gladstone area

Monitoring station	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	ALL
Maximum 24-hour average concentration											Max
Boat Creek	20.2	14.7	18.2	25.9	29.8	20.3	27.9	29.5	19.6	16.4	29.8
Boyne Island	15.4	16.7	18.6	56.3	26.8	23.9	28.7	35.4	22.3	15.1	56.3
Clinton	22.3	11.7	4.0	26.6	11.7	11.1	13.9	12.3	18.2	19.6	26.6
Fisherman's Landing	-	-	-	-	-	-	15.1	17.1	4.7	4.1	17.1
Memorial Park	19.8	40.2	25.8	39.0	26.8	26.9	29.3	25.3	27.2	32.4	40.2
South Gladstone	20.9	22.8	21.3	26.3	29.7	26.9	24.6	22	20.4	26.3	29.7
Targinie	20.6	16.0	15.4	17.3	21.7	15.2	25.1	21.3	22.6	17.8	25.1
70th Percentile 24-hour average concentration											Avg.
Boat Creek	4.9	5.0	3.9	4.8	4.5	4.4	5.0	4.5	5.1	4.1	4.6
Boyne Island	1.1	3.8	3.0	1.3	2.2	1.1	1.2	0.6	2.0	2.2	1.9
Clinton	2.5	2.1	3.9	2.6	3.3	3.1	3.1	2.9	2.3	2.3	2.8
Fisherman's Landing	-	-	-	-	-	-	2.9	1.9	0.2	0.7	0.6
Memorial Park	6.2	16.9	13.8	15.7	10.9	9.8	11.2	10.9	12.2	8.7	11.6
South Gladstone	4.1	6.4	5.2	4.0	4.2	5.0	4.9	4.2	5.0	5.5	4.8
Targinie	5.7	4.0	4.8	5.4	4.3	4.7	6.3	1.8	6.4	5.5	4.9
EPP (Air) Criterion- Health and wellbeing											229

Table note:
Highest monitored concentrations for the year are underlined, with exceedances of assessment criterion presented in **bold.**
Concentrations have been converted from parts per million (ppm).

There were no exceedances of the 24-hour EPP Air criteria for SO_2 (229 µg/m³) for any of the monitoring stations. Highest recorded concentrations for each year are as follows:

- 22.3 µg/m³ at Clinton in 2010;
- 40.2 µg/m³ at Memorial Park in 2011;
- 25.8 µg/m³ at Memorial Park in 2012;
- 56.3 µg/m³ at Boyne Island in 2013;
- 29.8 µg/m³ at Boat Creek in 2014;
- 26.9 µg/m³ at Memorial Park and South Gladstone in 2015;
- 29.3 µg/m³ at Memorial Park in 2016;

- 35.4 µg/m³ at Boyne Island in 2017;
- 27.2 µg/m³ at Memorial Park in 2018;
- 32.4 µg/m³ at Memorial Park in 2019.

Annual average SO_2 concentrations for the period between 2010 and 2019 are presented below in Table 17.

Table 17 Annual SO_2 average concentrations (µg/m³) for DESI stations in the Gladstone area

Monitoring station	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Average 2017-2019
Boat Creek	5.3	5.7	4.4	5.5	5.3	4.8	5.8	5.2	5.9	4.9	5.3
Boyne Island	1.6	4.3	3.9	2.6	3.7	1.4	2.0	1.6	2.2	2.5	2.1
Clinton	3.1	2.4	4.6	2.9	3.7	3.5	3.5	3.2	2.6	2.7	2.8
Fisherman's Landing	-	-	-	-	-	-	3.3	2.0	0.4	0.8	1.1
Memorial Park	6.8	19.5	17.9	19.1	12.5	11.9	13.2	12.2	14.5	11.5	12.7
South Gladstone	4.8	7.7	6.1	5.0	5.7	6.6	6.4	5.0	6.1	7.0	6.0
Targinie	5.9	4.3	5.4	6.1	4.7	4.3	6.8	2.7	6.7	5.5	4.9
EPP (Air) Criterion - Health and wellbeing											**57**
EPP (Air) Criterion - Agriculture											**31**
EPP (Air) Criterion - Health and biodiversity of ecosystems											**21**

Table note:
Highest monitored concentrations for the year are underlined, with exceedances of assessment criterion presented in **bold.**
Concentrations have been converted from parts per million (ppm).

There were no exceedances of any of the EPP (Air) annual SO_2 objectives at any of the monitoring stations during the monitoring period from 2010 to 2019. Highest recorded concentrations for each year were consistently recorded at Memorial Park, and are as follows:

- 6.8 µg/m³ in 2010;
- 19.5 µg/m³ in 2011;
- 17.9 µg/m³ in 2012;
- 19.2 µg/m³ in 2013;
- 12.5 µg/m³ in 2014;
- 11.9 µg/m³ in 2015;
- 13.2 µg/m³ in 2016;
- 12.2 µg/m³ in 2017;
- 14.5 µg/m³ in 2018;
- 11.5 µg/m³ in 2019.

4.2.3.5 CO

CO concentration data was only recorded at Boyne Island from the period of 2010 to 2019, and has been analysed, where available. Concentrations for 8-hour rolling averages at Boyne Island monitoring station for the period of 2010 to 2019 are presented in Table 18.

Table 18 8-hour CO maximum concentrations (µg/m^3) for DESI stations in the Gladstone area

Monitoring Station	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	ALL
Maximum 8-hour average concentration											Max
Boyne Island	1,234	3,446	1,589	625	1,125	464	1,359	297	554	703	3,446
70th Percentile 8-hour average concentration											Avg.
Boyne Island	69.6	125	53.6	78.1	125	125	125	-	-	78.1	77.9
EPP (Air) Criterion - Health and wellbeing											11,000

Table note:
Highest monitored concentrations are underlined, with exceedances of assessment criterion presented in **bold**. Concentrations have been converted from parts per million (ppm).

There were no exceedances of the 8-hour EPP Air criteria for CO (11 mg/m³) for any of the monitoring stations. Highest recorded concentration was 3,446 µg/m³ in 2011.

4.2.3.6 VOCs

Benzene, toluene, and xylene are only recorded at Memorial Park. Table 19, Table 20, and Table 21 present the measured concentrations for toluene, xylenes, and benzene at the Memorial Park DESI monitoring station for the period of 2010 to 2019.

Maximum 1-hour concentrations for toluene from Memorial Park monitoring station for the period of 2010 to 2019 are presented below in Table 20.

Table 19 1-hour toluene concentrations (µg/m^3) for Memorial Park DESI monitoring station

Monitoring station	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	All
Maximum 1-hour concentrations											Max
Memorial Park	16.0	45.6	38.2	50.1	92.8	36.1	53.4	57.9	45.6	138.0	138
70th Percentile 1-hour concentrations											Avg.
Memorial Park	4.9	5.8	7.4	8.6	7.8	9.4	5.3	9.9	10.7	9.4	7.9
EPP (Air) Criterion (Toluene) - Protecting aesthetic environment (30 minutes)											1,100

Table note:
Highest monitoring concentrations are underlined, with exceedances of assessment criterion are presented in **bold**. Concentrations have been converted from parts per million (ppm)

There were no exceedances of the EPP Air 30-minute objective (1.1 mg/m^3) for toluene. Highest concentration for toluene was 138 µg/m³ in 2019. 24-hour concentrations for toluene and xylene from Memorial Park monitoring station for the monitoring period of 2010 to 2019 are presented below in Table 20.

Table 20 24-hour toluene and xylene concentrations (µg/m³) for Memorial Park DESI monitoring station

Pollutant	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	ALL
Maximum 24-hour concentrations											Max
Toluene	8.8	8.4	11.9	17.5	16.6	11.7	11.8	17.1	17.0	<u>26.8</u>	26.8
Xylene	34.1	66.8	62.9	<u>125</u>	104	86.8	93.1	49.2	57.5	124	125
70th Percentile 24-hour concentrations											Avg.
Toluene	2.9	5.1	-	7.8	7.0	8.5	5.2	9.5	<u>9.7</u>	7.7	6.3
Xylene	13	30.5	-	44.8	49.0	<u>50.8</u>	39.8	31.1	24.1	36.3	31.9
EPP (Air) Criterion (Toluene) - Health and wellbeing											4,100
EPP (Air) Criterion (Xylene) - Health and wellbeing											1,200

Table notes:
Highest monitored concentrations for the year are <u>underlined</u>, with exceedances of assessment criterion presented in bold.
Concentrations have been converted from parts per million (ppm).

There were no exceedances for 24 hour concentrations for toluene or xylene. Highest concentration for toluene is 26.8 µg/m³ in 2019. Highest concentration for xylene is 125 µg/m³ in 2013.

Annual average concentrations for benzene, toluene and xylene from Memorial Park monitoring station for the period of 2010 to 2019 are presented below in Table 21.

Table 21 Annual average benzene, toluene and xylene concentrations (µg/m³) for Memorial Park DESI monitoring station

Pollutant	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Average 2017-2019
Benzene	4.2	4.7	4	4.4	4.3	<u>5.1</u>	3.6	4.3	<u>5.1</u>	4.5	4.6
Toluene	4.0	4.8	6.2	7.5	6.6	7.8	4.7	7.9	<u>8.9</u>	8.1	8.3
Xylenes	19.5	28.7	36	41	44.2	<u>47.7</u>	35.7	24.5	22.1	36.3	27.6
EPP (Air) Criterion (Benzene) - Health and wellbeing											5.4
NEPM Air Toxics (Benzene) - Health and wellbeing											10.5
EPP (Air) Criterion (Toluene) - Health and wellbeing											400
EPP (Air) Criterion (Xylene) - Health and wellbeing											950

Table notes:
Highest monitored concentrations for the year are <u>underlined</u>, with exceedances of assessment criterion presented in **bold.**
Concentrations have been converted from parts per million (ppm).

No exceedances of the annual benzene EPP (Air) (5.4 µg/m³) or NEPM Air Toxic criterion (10.5 µg/m³) were recorded, with the highest concentrations recorded as 5.1 µg/m³ in 2015 and 2018. No exceedances of the annual toluene EPP (Air) objective (400 µg/m³) were recorded, with the highest concentration recorded as 8.9 µg/m³ in 2018. No exceedances of the annual xylene EPP (Air) objective (950 µg/m³) were recorded, with the highest concentration recorded as 44.2 µg/m³ in 2014.

4.2.4 Summary of background air environment

Table 22 below summarises the existing environment background concentrations adopted for the air quality assessment. The average 70th percentile concentration was selected as the adopted background concentration from determinate sites for assessment of the 1-hour average, 4-hour average, 8-hour average, 24-hour average goals, for all pollutants. Adopted annual averages were calculated from years 2017-2019 as to coincide with the years used in the meteorological modelling and AQIA. Additionally, the assimilative capacity of the receiving air environment has been estimated through the percentage remaining between the adopted background concentration and the Project air quality objective and is presented below in Table 22.

Background pollutant concentrations were adopted from locations other than the DESI Boat Creek site where monitoring data was only available at that site (i.e. in the case of the Memorial Park and Boyne Island monitoring stations for VOCs or CO).

Presented NO_2 concentrations have been presented only to inform the reader of the quantities present in the Gladstone airshed, and not to calculate cumulative NO_2 concentrations from the Project. For the AQIA the ARM2 methodology using the hourly NO and NO_2 data from the seven stations within the Gladstone region that measure NO and NO_2 has been employed to determine cumulative NO_2 impacts from the Project (see Section 7.4).

Table 22 Summary of adopted existing pollutant concentrations compared to adopted air quality goals

Pollutant	Averaging time and statistic	Adopted air quality goal (µg/m^3)	Adopted background concentration (µg/m^3)	Assimilative capacity (%)	Monitoring location
Benzene	Annual average (2017-2019)	5.4	4.6	14.8%	Memorial Park
CO	8 hours, 70th percentile	11,000	77.9	99.3%	Boyne Island
NO_2	1 hour, 70th percentile	250	14.2	94.3%	Boat Creek
	Annual average (2017- 2019)	62	10.6	82.9%	
PM_{10}	24 hours, 70th percentile	50	18.4	63.2%	Boat Creek
	Annual average (2017-2019)	25	16.9	32.4%	
$PM_{2.5}$	24 hours, 70th percentile	25	6.2	75.2%	Boat Creek
	Annual average (2017-2019)	8	6.2	22.5%	Boat Creek
SO_2	1 hour, 70th percentile	570	3.1	99.5%	Boat Creek
	24 hours, 70th percentile	229	4.6	98.0%	
	Annual average (2017-2019)	57	5.3	90.7%	
Toluene	1 hour, 70th percentile	1,100	7.9	99.3%	Memorial Park
	24 hours, 70th percentile	4,100	6.3	99.8%	
	Annual average (2017-2019)	400	8.3	97.9%	

Pollutant	Averaging time and statistic	Adopted air quality goal (µg/m^3)	Adopted background concentration (µg/m^3)	Assimilative capacity (%)	Monitoring location
Xylene	24 hours, 70th percentile	1,200	31.9	97.3%	Memorial Park
	Annual average (2017-2019)	950	27.6	97.1%	

The above data shows that the assimilative capacity has been depleted for PM_{10} daily average concentrations and $PM_{2.5}$ annual concentrations. Relevant Air quality bulletins (DESI, 2019) state that there were widespread bushfires and dust events in the Gladstone and Central Queensland region at this time (2017-2019), which may have attributed to the elevated concentrations over this time and resulting in the low assimilative capacities of PM_{10} and $PM_{2.5}$ in the Gladstone airshed. It is also noted that the assimilative capacity of annual average benzene concentration is relatively low.

DESI background monitoring within the Gladstone airshed indicates that all other analysed pollutants have an assimilative capacity of 75% or higher.

4.3 Existing emission sources

The Gladstone region has several significant heavy industrial sites, many of which take advantage of the local port and transport infrastructure and relative proximity to energy supplies and mineral export facilities (DERM, 2011). These industrial sources are significant emitters of air pollutants within the Gladstone airshed. The NPI was used as the primary tool to identify these emission sources and determine the significant emitters of air pollutants in the Gladstone region.

The NPI is regulated by the Australian Government and is tasked with tracking pollution across Australia, ensuring that the community has access to information about the emission and transfer of toxic substances which may affect them locally. All major polluters are required by the Australian Government to submit annual reports of their emissions to air. The NPI has emission estimates for 93 toxic substances and the source and location of these emissions. These substances have been identified as important due to their possible effect on human health and the environment. The data comes from facilities like mines, power stations, and factories, as well as other sources.

An NPI search conducted for the Study Area and Gladstone airshed shows 14 main facilities that report annual NO_x emissions. A description of each existing emission source is identified and its approximate distance from the Project Study area is described in Table 23. The location of these nearby facilities is indicated in Figure 8.

As NO_x emissions will be the only pollutant that will be modelled at a regional scale, the NPI emissions shown are limited to this pollutant. Of the emitters mentioned in Table 23, 10 facilities make up 99.9 % of the NO_x emissions reported to the NPI for the previous three annual reporting periods. The total amount of reported NO_x emissions to air during the three annual reporting periods ranged from 50 to 64 thousand tonnes. The largest emitter of NO_x emissions was the Gladstone Power Station, which averaged 62 % of the total emissions released in the Gladstone airshed. Other significant emitters of NO_x included the Rio Tinto Yarwun Alumina Refinery, Queensland Alumina Refinery, Cement Australia Fisherman's Landing Cement Manufacturing facility, and the three LNG facilities located on Curtis Island. The closest facility to the Project (Orica Yarwun), was responsible for less than 1 % of the total NO_x emissions in the Gladstone region, according to reported NPI emissions.

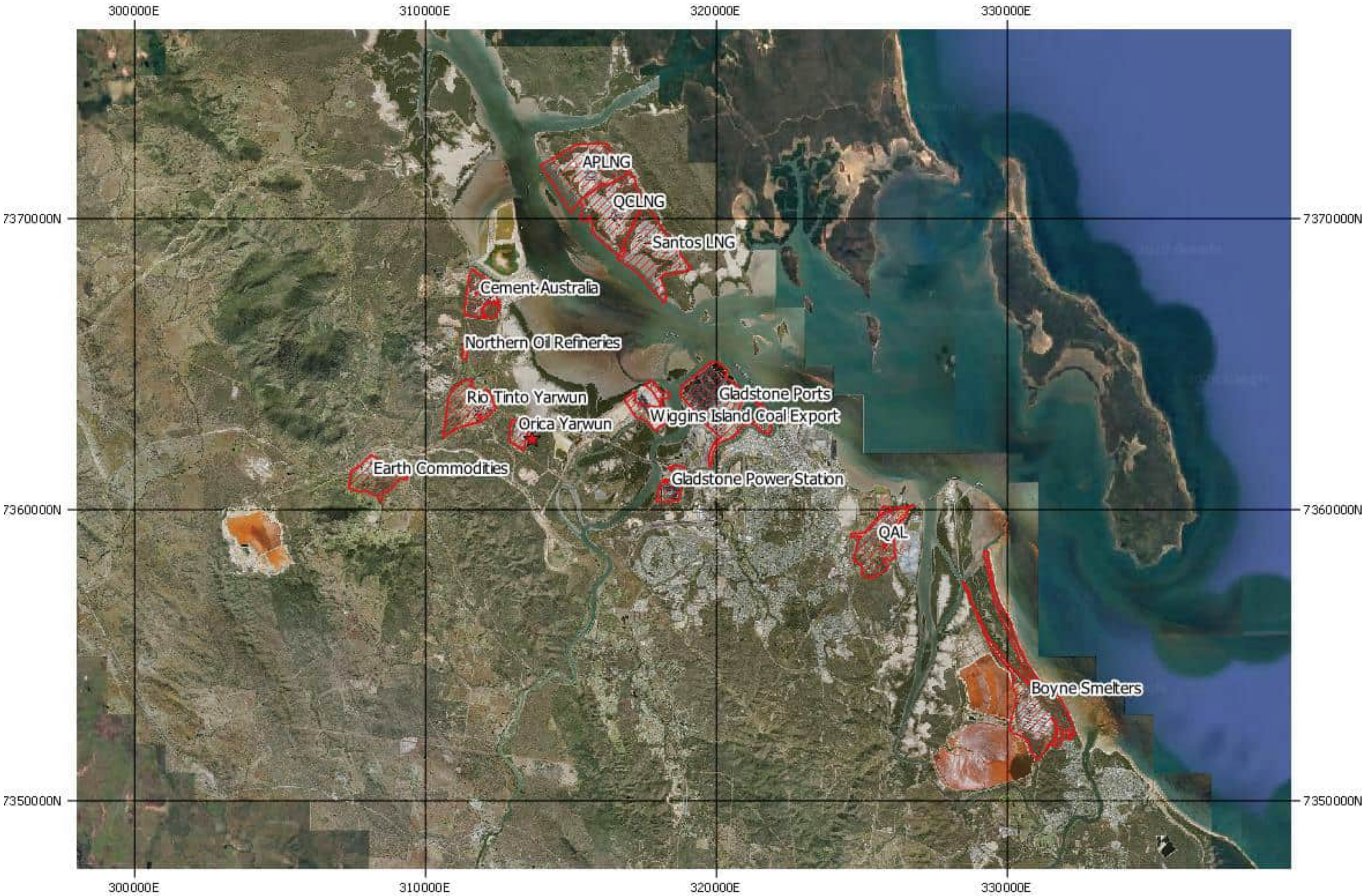

Figure 8 Identified NPI existing emissions sources

Figure notes:

1. Coordinate system GDA Zone 56 in metres
2. Red star denotes the location of the Project

Table 23 Local existing emission sources

Facility name	Industry	Lat/Lon	NPI Total Reported NO_x emissions (kg)			Distance from the Project	Direction from the Project
			2016/2017	2017/2018	2018/2019	km	
Gladstone Power Station	Coal power generation	-23.856, 151.219	28,800,845	41,101,940	34,901,400	5	ESE
Rio Tinto Alumina Yarwun	Alumina refinery	-23.827, 151.154	2,456,821	2,446,160	2,539,649	2	WNW
Cement Australia Fisherman's Landing	Cement manufacture	-23.793, 151.155	3,162,760	2,552,459	2,487,547	5	NNW
Queensland Alumina Limited	Alumina refinery	-23.866, 151.290	7,367,200	8,995,400	7,009,200	12	ESE
QCLNG	LNG plant	-23.769, 151.199	917,504	800,190	697,629	8	NNE
APLNG	LNG plant	-23.755, 151.190	1,120,438	1,120,539	1,080,479	9	N
Santos LNG	LNG plant	-23.782, 151.213	4,960,629	5,810,916	5,337,906	8	NE
Boyne Smelters	Aluminium smelter	-23.924, 151.338	577,000	577,000	581,000	20	SW
Gladstone Ports	Port facility	-23.827, 151.235	390,050	360,050	384,014	6	NE
Orica Australia	Chemical manufacture	-23.836, 151.167	236,010	302,898	341,579	< 1	E
Wiggins Island Coal Export	Coal export terminal	-23.835, 151.203	22,416	18,828	23,151	3	E
Northern Oil Refineries	Used oil recycling	-23.810, 151.148	20,456	17,059	17,984	4	NW
Earth Commodities	Quarry	-23.845, 151.116	12,833	11,863	14,226	6	W
Jemena Queensland Gas Pipeline	Gas pipeline	-23.823, 151.155	879	-[a.]	-[a.]	2	NW

Table notes:

a. No reported emissions for the NPI reporting period

4.4 Sensitive receptors

Sensitive air quality receptors in the broader study area were identified as per the DESI Guideline Application requirements for activities with impacts to air (DESI, 2024). As per the DESI guideline, a sensitive receptor can include the following:

- a dwelling, residential allotment, mobile home or caravan park, residential marina or other residential premises;
- a motel, hotel or hostel;
- a kindergarten, school, university or other educational institution;
- a medical centre or hospital;
- a protected area under the Nature Conservation Act 1992, the Marine Parks Act 2004 or a World Heritage Area;
- a public park or garden;
- a place used as a workplace including an office for business or commercial purposes.

The Project site is located within the Gladstone SDA within a Medium-High Impact and Port Related Industry Precinct. As such, few residential sensitive receptors exist within a close proximity to the Project. The nearest discrete sensitive receptor locations that have been identified close to the Project are rural dwellings, which range from 4.5 to 6.5 kilometres from the Project. Other sensitive areas have also been considered for the Gladstone airshed area. These have been assessed using sensitive receptor zones that represent localities within the Gladstone airshed. The highest modelled result from the 250 metre resolution grid receptors within the sensitive receptor zones was then used to assess the impacts from air emissions from the Project. In addition to the identified residential sensitive receptors, several protected areas as defined under the federal Nature Conservation Act 1992 have been included as sensitive receptor zones and assessed as above.

The locations of the identified nearby sensitive receptors and sensitive receptor zones are presented below in Table 24 and displayed in Figure 9.

Table 24 Locations of identified sensitive receptors

Sensitive receptor ID	Receptor type	Distance to the Project (km)	Coordinates (GDA94, zone 56)	
			X (m)	Y (m)
SR1	Residential	4.5	309,143	7,361,521
SR2	Residential	4.5	310,305	7,359,791
SR3	Residential	4	316,072	7,359,087
SR4	Residential	6	311,528	7,356,800
SR5	Residential	6	315,929	7,356,700
SR6	Residential	6.5	317,221	7,356,803
SR7	Residential	5.5	317,189	7,358,005
ER1	State Forest (Mount Stowe SF)	1.5	311,593	7,360,953
ER2	Conservation Park (Calliope CP)	2.5	312,412	7,358,854
ER3	State Forest (Beecher SF)	8	316,298	7,351,205
ER4	State Forest (Mount Maurice SF)	8	319,600	7,354,562
ER5	State Forest (Targinie SF)	5	309,942	7,367,797

Sensitive receptor ID	Receptor type	Distance to the Project (km)	Coordinates (GDA94, zone 56)	
			X (m)	Y (m)
ER6	Conservation Park (Garden Island CP)	9	321,031	7,367,962
ER7	Conservation Park (Curtis Island CP)	12	323,563	7,373,768
SZ1	Residential Region (Yarwun)	4	308,153	7,362,432
SZ2	Residential Region (Gladstone)	5	322,462	7,361,056

Figure 9 Identified sensitive receptors and sensitive receptor zones

Figure notes:

1. Yellow bounded areas denote sensitive receptor zones, green bounded areas denote ecological sensitive zones.
2. Yellow points indicate identified discrete sensitive receptor locations
3. Orange points indicate modelled grid receptor locations at 250 metre resolution

4.5 Terrain and land use

Terrain features and land use can influence meteorological conditions on both a local and regional scale. The Gladstone airshed and Study Area have significant terrain features and varying land use types, which are shown in Figure 10 and Figure 11.

The Gladstone greater area has several large terrain features, including mountains, ranges, and valleys. The tallest mountain in the region is Mount Larcom at 633 m above sea level, which is to the west of Gladstone and the Project and forms part of the Larcom Range. To the north of the Larcom Range is the Rundle Range, which spans north from the Larcom Range toward Balaclava Island. To the west of the Study Area exists Mount Sugarloaf (316 m). Together with the Larcom Range, and peaks that exist in the Mount Stowe State Forest and Calliope Conservation Park, complex meteorology can develop, such as anabatic and katabatic winds. To the south of Gladstone are the smaller peaks of Mount Stowe (239 m) and Mount Beecher (156 m) with the Calliope Conservation Park and Beecher State Forest. To the east of these peaks is Maurice Hill (225 m), which is the highest peak along the O'Connell Ridges. The Gladstone metropolitan area near the coast is mostly flat in comparison to the surrounding terrain. Overall, the Gladstone region consists of mostly complex topography where weather patterns are influenced by terrain features.

Land use in the Gladstone region is largely dominated by large areas of agricultural land. However, significant areas of forest and bushland, urban areas, and industrial sites also exist. The forested locations include several State Forests, Conservation Parks, and National Parks on the mainland and Curtis Island. The main urban areas are Gladstone itself but with smaller regions of urban land to both the north and south (Targinie and Tannum Sands). Several industrial areas are located in the region, with most beyond the outskirts of the urban areas.

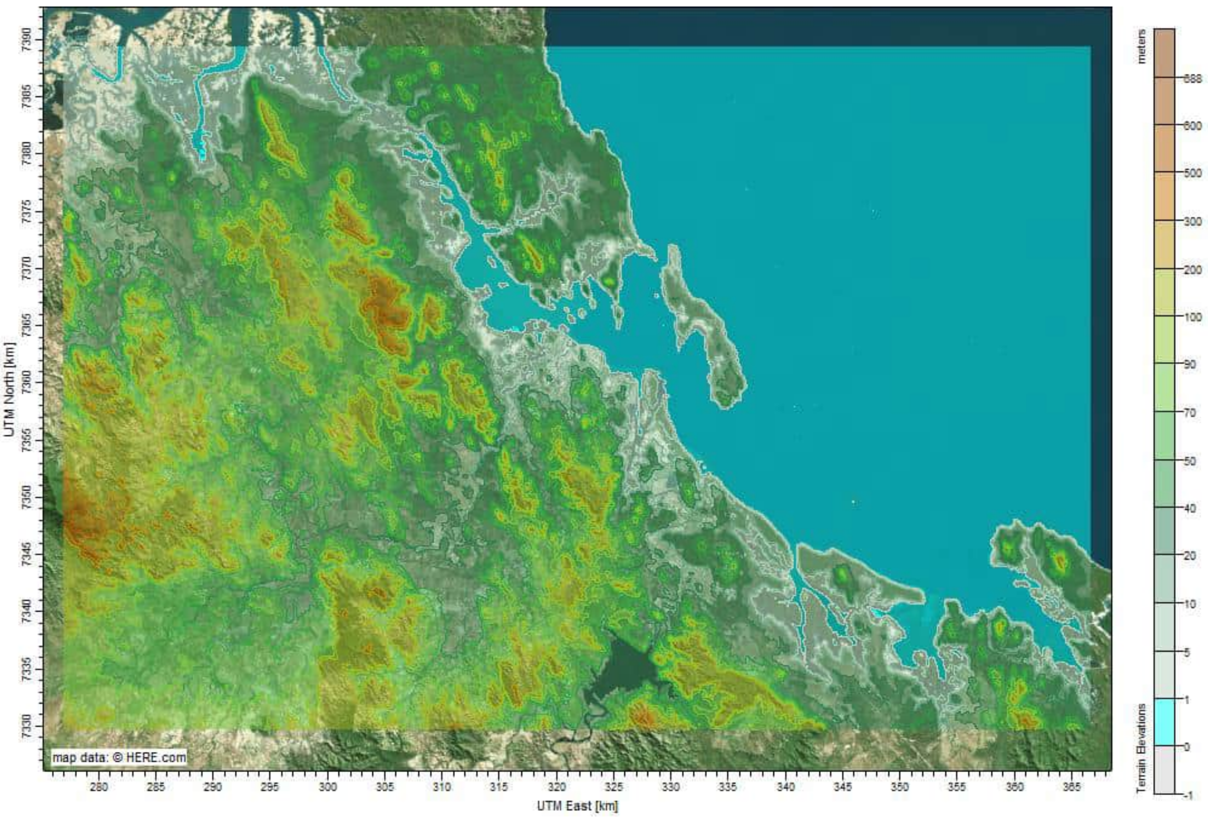

Figure 10 Terrain surrounding the Project in the Gladstone region

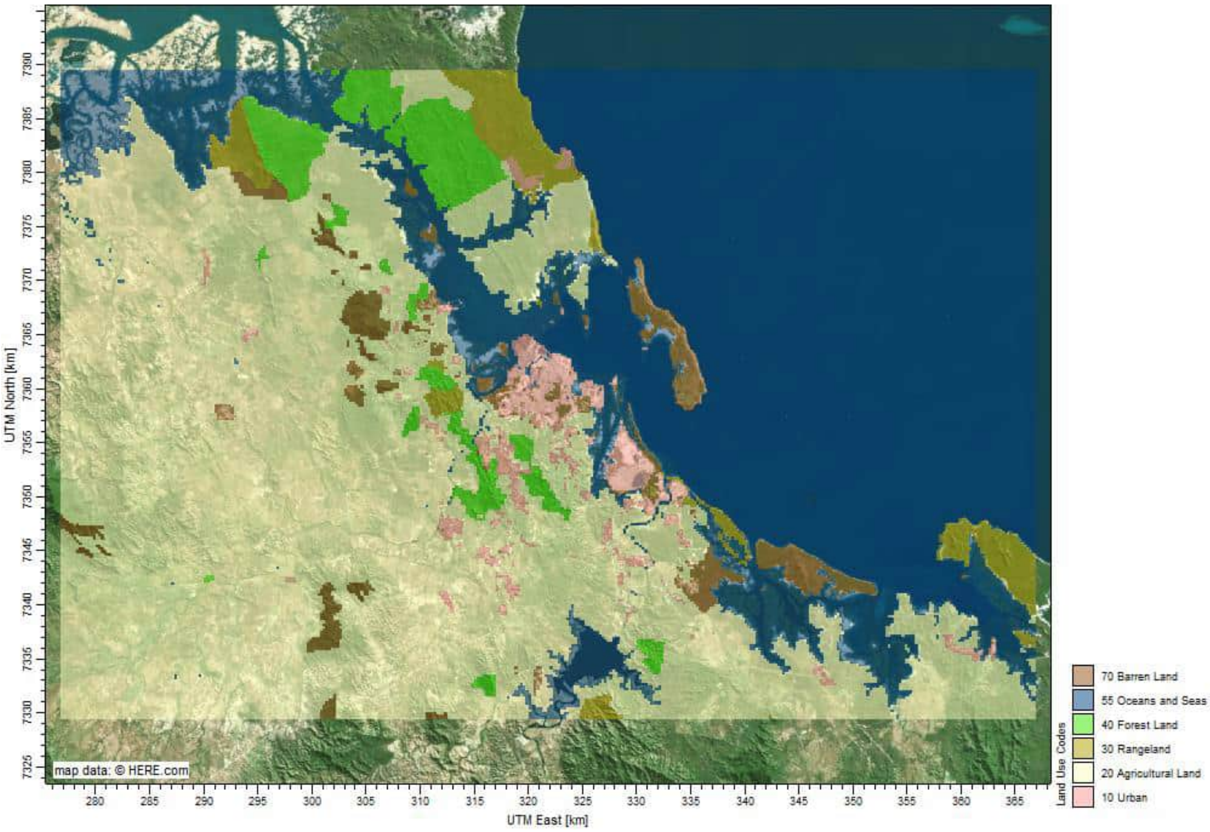

Figure 11 Land-use surrounding the Project in the Gladstone region

5.0 Emissions inventory

This section outlines the methodologies and emissions factors used to develop the emissions inventories for the Project and cumulative emissions sources in the Gladstone airshed.

5.1 Existing emission sources

Emissions from existing background sources within the Gladstone airshed utilised the following methodologies, in order of preference:

- Site specific data sourced from industry, including emissions testing and continuous monitoring data.
- Environmental Authority emissions limits for identified existing emission sources to calculate modelled pollutant emission rates.
- NPI reported emissions data to calculate overall existing background source emissions.

Table 25 presents the existing emission sources and annual totals of NO_x and ammonia modelled, with their corresponding emission inventory methodology or information source. Figure 12 presents the location of all existing emission points included in the cumulative Gladstone airshed model.

Table 25 Summary of modelled cumulative emissions from existing sources in the Gladstone region

Existing Emission Source	Total Estimated Modelled Emissions Annually		Emissions Inventory Methodology
	NO_x (kg)	Ammonia (kg)	
Gladstone Power Station	34,900,000	0	NPI 2018/2019
Rio Tinto Alumina Yarwun	3,014,099	0	Environmental Authority emissions limits
Cement Australia Fisherman's Landing	2,481,918	0	NPI 2018/2019
Queensland Alumina	6,940,000	0	NPI 2018/2019
APLNG	4,701,387[a.]	0	Environmental Authority emissions limits
QCLNG	1,892,160	0	Environmental Authority emissions limits
Santos LNG	1,756,871	0	Environmental Authority emissions limits
Boyne Smelters	476,000	0	NPI 2018/2019
Gladstone Ports	384,000	0	NPI 2018/2019
Orica Yarwun	305,584	4,793	Industry supplied data

Table notes:

a. Estimated emissions from the APLNG site, include emission sources currently approved for but not currently operational at the time of completing the AQIA.

From the estimated emission rates of NO_x from the Project (as per Section 5.2) annual emissions are estimated to be 150,584 kg per year. This is approximately half the amount from the smallest cumulative emission source modelled (Orica Yarwun) and 0.26% of the total NO_x emissions stated in Table 25.

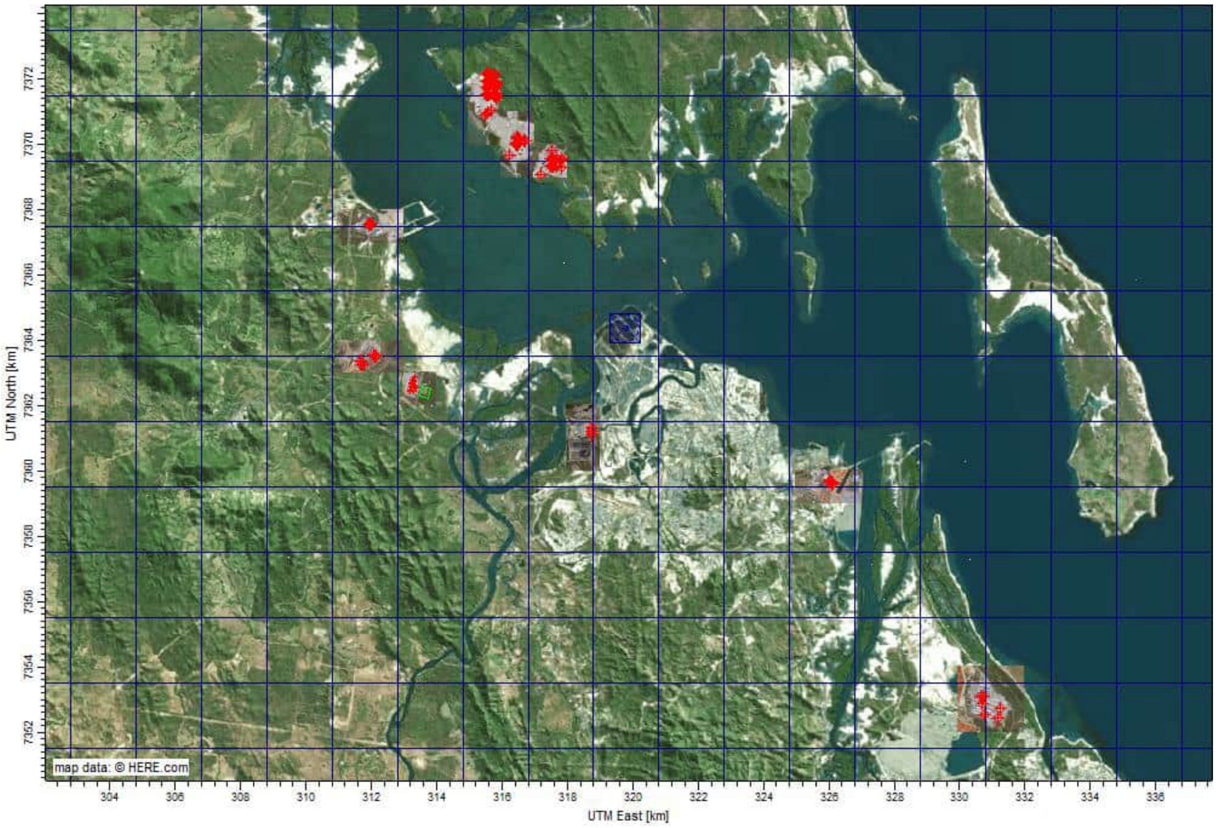

Figure 12 Modelled cumulative emission sources

Figure notes:

1. Coordinate system GDA Zone 56 in kilometres
2. Green boundary denotes the location of the Project
3. Red crosses denote modelled cumulative source emission points, and shaded blue boundary denotes a cumulative volume emission source

5.2 The Project

Emissions from the Project were calculated using data provided by the Applicant for process operations for Stage 1 (PPF) and Stage 2. Specifically, stack pollutant exhaust concentration data and emissions source characteristics were provided by the Applicant and were used to calculate mass emission rates for the Project emission sources.

It is expected that no significant emissions of heavy metals would occur from the Project site. This is expected due to the proposed alumina feedstock quality being 99.3 % purity. As such, the majority of hazardous heavy metals that would generally be associated with the alumina refinery process have already been extracted prior to the feedstock entering the facility.

In addition to the sources presented in the following sections, the Project also includes solvent extraction tanks. The solvent extraction tanks will include an overhead fume extraction system that will aim to capture any fugitive emissions of VOCs that are released. Additionally, due to low height of the emission release points for the solvent extraction tanks and the long distance between the site and the sensitive receptor locations (over 4 km), any fugitive emissions from these tanks are not considered likely to have any material effect on sensitive locations. Thus, fugitive tank emissions of VOCs from solvent extraction were not considered a significant emission source and were not included as part of the emissions inventory and modelling assessment.

5.2.1 Stage 1

The following section details the emissions estimations developed for input into the dispersion modelling assessment for Stage 1 of the Project.

Table 26 presents the modelled pollutant emission rates for Stage 1 emission sources. All the Stage 1 sources are stack sources. Table 27 presents the emission concentrations as modelled for each of the sources, referenced to standard reference conditions.

The emission source characteristics for each of the sources (e.g. stack height, stack diameter, exhaust temperature, etc) are presented in Section 9.2.

Table 26 Modelled Project pollutant emission rates

Stack Emission Source ID	Source Description	Modelled emission rate (g/s)						
		CO	NO_x	PM_{10}	$PM_{2.5}$ [a]	SO_2	NH_3	TVOCs
PPF-E1	Hot oil stack	0.007	0.01	0.001	0.001	0.00002	0.0002	0.001
PPF-E2	Gas scrubber vent	0.008	0.08	0.08	0.08	0.008	0.2	0.1
PPF-E3	Spray dryer vent	0.003	0.003	0.03	0.03	0.003	0.003	0.003
PPF-E4	Flash dryer vent	0.0007	0.0007	0.003	0.003	0.007	0.0007	0.001
PPF-E5	Dust collector vent	0.008	0.008	0.08	0.08	0.008	0.008	0.008

Table notes:
a. Due to the nature of the processes involved all PM is assumed to be in the $PM_{2.5}$ size range and therefore $PM_{2.5}$ and PM_{10} emissions are the same.

Table 27 Modelled Project pollutant emission concentrations

Stack Emission Source ID	Source Description	Modelled emission concentrations (mg/Nm^3)[a.]						
		CO	NO_x	PM_{10}	$PM_{2.5}$	SO_2	NH_3	TVOCs
PPF-E1	Hot oil stack	54.4	101.1	6.2	6.2	0.2	1.6	6.2
PPF-E2	Gas scrubber vent	6.5	65.0	65.0	65.0	6.5	130.0	80.6
PPF-E3	Spray dryer vent	7.9	7.9	78.7	78.7	7.9	7.9	7.9
PPF-E4	Flash dryer vent	7.8	7.8	31.3	31.3	78.4	7.8	7.8
PPF-E5	Dust collector vent	6.8	6.8	68.2	68.2	6.8	6.8	6.8

Table notes:
a. Reference conditions - dry, 273 K, 101.3 kPa

5.2.2 Stage 2

The following section details the emissions estimations developed for input into the dispersion modelling assessment for Stage 2 of the Project.

Table 28 below presents the modelled emission rates for Stage 2 emission sources. All the Stage 2 sources are stack sources. Table 29 presents the emission concentrations as modelled for each of the sources, referenced to standard referenced conditions.

It is noted that the flare source (E17) is included in the Project as an emergency measure and is expected to operate only intermittently and for short periods of time, as required in response to emergency situations. As the periods when the flare will operate are unknown, a conservative approach has been taken for modelling with flare emissions being modelling as occurring continuously for all hours of the meteorological period modelled. This approach has been taken in accordance with the DESI (2024) requirement to consider ‘worst case’ emissions.

The emission source characteristics for each of the sources (e.g. stack height, stack diameter, exhaust temperature, etc) are presented in Section 9.2.

Table 28 Modelled Project pollutant emission rates

Stack Emission Source ID	Source Description	Modelled emission rate (g/s)						
		CO	NO_x	PM_{10}	$PM_{2.5}$ [a]	SO_2	NH_3	TVOCs
E2	Leech scrubber	0.05	0.02	0.05	0.05	0.05	0.09	0.009
E3	Feed silo filter vent	-	-	0.007	0.007	-	-	-
E4	Fume scrubber	0.4	1.0	0.4	0.4	0.4	0.9	0.4
E5	ATH dryer stack	0.01	0.02	-	-	0.002	0.002	0.002
E6-A	Precursor dryer stack	0.06	0.1	-	-	0.01	0.01	0.01
E6-B		0.06	0.1	-		0.01	0.01	0.01
E7	Rotary kiln combustion stack	0.01	0.03	-	-	0.003	0.003	0.003
E8-A	Boiler combustion stack	0.1	0.3	-	-	0.03	0.03	0.03
E8-B		0.1	0.3	-	-	0.03	0.03	0.03
E8-C		0.1	0.3	-	-	0.03	0.03	0.03
E9	Miscellaneous bin vent	-	-	0.01	0.01	-	-	-
E11	General dust collector vent	-	-	0.3	0.3	-	-	-
E13A	Microniser vent	-	-	0.1	0.1	-	-	-
E13B				0.1	0.1		-	-
E17	Flare	0.4	0.1	-	-	0.06	0.01	-

Table notes:

a. Due to the nature of the processes involved all PM is assumed to be in the $PM_{2.5}$ size range and therefore $PM_{2.5}$ and PM_{10} emissions are the same.

Table 29 Modelled Project pollutant emission concentrations

Stack Emission Source ID	Stack Emission Source Description	Modelled emission concentrations (mg/Nm^3)[a.]						
		CO	NO_x	PM_{10}	$PM_{2.5}$	SO_2	NH_3	TVOCs
E2	Leech scrubber	50	20	50	50	50	100	10
E3	Feed silo filter vent	-	-	50	50	-	-	-
E4	Fume scrubber	50	120	50	50	50	100	50
E5	ATH dryer stack	50	100	-	-	10	10	10
E6-A	Precursor dryer stack	50	100	-	-	10	10	10
E6-B		50	100	-	-	10	10	10
E7	Rotary kiln combustion stack	50	100	-	-	10	10	10
E8-A	Boiler combustion stack	50	100	-	-	10	10	10
E8-B		50	100	-	-	10	10	10
E8-C		50	100	-	-	10	10	10

Stack Emission Source ID	Stack Emission Source Description	Modelled emission concentrations (mg/Nm^3)[a.]						
		CO	NO_x	PM_{10}	$PM_{2.5}$	SO_2	NH_3	TVOCs
E9	Miscellaneous bin vent	-	-	50	50	-	-	-
E11	General dust collector vent	-	-	50	50	-	-	-
E13A	Microniser vent	-	-	50	50	-	-	-
E13B				50	50		-	-
E17	Flare	400	100	-	-	10	10	-

Table notes:
a. Reference conditions - dry, 273 K, 101.3 kPa

5.2.3 NSW EPA's POEO Clean Air Regulations (2010) emissions comparison

To provide a comparison to the modelled emission concentrations, standard emissions limits sourced from the NSW EPA's POEO *Clean Air Regulations* (2010) were sourced. These are presented below in Table 30.

Pollutant concentrations for the Project emission sources are generally equal to or below the NSW EPA's POEO *Clean Air Regulations* (2010) standard emissions limits. Exceptions include pollutant concentrations for the gas scrubber vent (PM, TVOCs), spray dryer vent (PM), dust collector vent (PM), fume scrubber (TVOCs) and the flare (CO).

Table 30 Standard emission limits sourced from the NSW POEO Clean Air Regulation

Emission Source Type	Standard Emissions Limits (mg/Nm^3)[a.]					
	CO	NO_x	TSP	SO_2	NH_3	TVOCs
Aluminium: primary production	125	300	50	-[b.]	-[b.]	40
Aluminium: secondary production	125	300	50	-[b.]	-[b.]	40
General activities and plant	125	350	50	-[b.]	-[b.]	40

Table notes:
a. Reference conditions – dry, 273 K, 101.3 kPa
b. No applicable standard emission limits available within the NSW POEO Clean Air Regulation

6.0 Qualitative odour impact assessment

There are components of the industrial process proposed which include the potential for odorous compounds to be released into the Gladstone airshed. The key odour emissions sources are likely to include the following:

- Aluminium solvent extraction;
- Emissions from combustion of natural gas (i.e. boiler operation, drying and calcination).

The DESI *Guidelines for Odour Impact Assessment from Developments* (2014) details the methodology to be adopted for odour assessment. Where no complaint history is present, and best practice odour controls and recommended buffer distances are adopted, no further odour impact assessment is required. From review of recommended set-back distances recommended by state environmental protection agencies, no jurisdiction provides distances for high-purity alumina facilities. As such, industry types that are considered as similar as possible were selected for representative buffer distances.

Table 31 presents the recommended set-back distances for industry that were as similar as possible to the proposed facility. The closest sensitive receptors to the Project site were over 4 km away. Reviewing the adopted buffer distances as per the Environment Protection Authority Victoria (EPA Vic) (2013) guidance buffer distances it is evident that the facility easily meets the required set-back. Further, it is expected due to the relatively small scale of the Project that odour emissions will be significantly lower than the industry types described in Table 31. Therefore, odour emissions from the site are considered unlikely to cause significant nuisance impacts at sensitive receptor locations.

Table 31 Recommended separation distance for industry

Industry type	Industry description	Recommended separation distance (m)	Reference
Non-ferrous metal production	Aluminium by electrolysis	2,000	EPA Vic (2013)
Other organic and inorganic chemical production	>2,000 tonnes per year	2,000	

7.0 Modelling methodology

The following sections provide an overview of the meteorology and dispersion modelling methods adopted for the AQIA.

7.1 Model selection

For regulatory assessments in Australia and New Zealand, there are two general types of dispersion models that can be used, these include:

- Steady-state models (e.g. Gaussian plume models such as AERMOD or AUSPLUME).
- Non steady-state models (e.g. Lagrangian or Eulerian models such as CALPUFF or TAPM).

Gaussian plume models such as AERMOD provide simplified representations of air dispersion and assume spatially uniform meteorology. However, these models do not perform well under many circumstances, which can include the following:

- Where significant long-range transport of pollutants is present.
- Complex and steep terrain.
- Meteorology that varies significantly either spatially or vertically.
- Where there are significant periods of stable night-time stagnation (i.e. calms).
- Coastal areas where coastal fumigation may occur.

The Study Area and the Gladstone airshed includes all the above elements. As such, a non-steady-state model such as CALPUFF or TAPM is required in order to consider the complex nature of the Gladstone airshed. This AQIA used a combination of these two models to complete the assessment.

7.2 Meteorology modelling

The regional meteorology modelling of the Gladstone airshed was completed using the TAPM and CALMET models.

7.2.1 TAPM

TAPM predicts three-dimensional meteorology, including terrain-induced circulations. TAPM is a PC-based interface that is connected to databases of terrain, vegetation and soil type, leaf area index, sea-surface temperature, and synoptic-scale meteorological analyses for various regions around the world. TAPM is used to predict meteorological parameters at both ground level and at heights of up to 8,000 m above the surface; these data are required by the CALPUFF model.

7.2.2 CALMET meteorological model

CALMET is a diagnostic meteorological model that produces three-dimensional wind fields based on parameterised treatments of terrain effects such as slope flows and terrain blocking effects.

Meteorological observations are used to determine the wind field in areas of the model domain within which the observations are representative. Fine scale terrain effects are determined by the diagnostic wind module.

The CALMET model consists of a diagnostic wind field module and micro-meteorological modules for over-water and over-land boundary layers. The diagnostic wind field module uses a two-step approach to the computation of the wind fields. In the first step, an initial-guess wind field is adjusted for kinematic effects of terrain, slope flows, and terrain blocking effects to produce a Step 1 wind field. The second step consists of an objective analysis procedure to introduce observational data into the Step 1 wind field to produce a final wind field. The following sections describe the setup to the winds fields in further detail.

Step 1 wind field

Kinematic effects on terrain: CALMET uses the approach of Liu and Yocke (1980) to evaluate kinematic terrain effects. The domain-scale winds are used to compute a terrain-forced vertical velocity, subject to an exponential stability-dependent decay function. The kinematic effects of terrain on the horizontal wind components are evaluated by applying a divergence-minimisation scheme to the initial guess wind field. The divergence minimisation scheme is applied iteratively until the three-dimensional divergence is less than a threshold value.

Slope flows: Slope flows are computed based on the shooting flow parameterisation of Mahrt (1982). Shooting flows are buoyancy-driven flows, balanced by advection of weaker momentum, surface drag and entrainment at the top of the slope flow layer. The slope flow is parameterised in terms of the terrain slope, distance to the crest and local sensible heat flux. The thickness of the slope flow layer varies with the elevation drop from the crest.

Blocking effects: The thermodynamic blocking effects of terrain on the wind flow are parameterised in terms of the local Froude number (Allwine & Whiteman, 1985). If the Froude number at a particular grid point is less than a critical value and the wind has an uphill component, the wind direction is adjusted to be tangential to the terrain.

Step 2 wind field

The second step of the procedure involves the introduction of observational data into the Step 1 wind field through an objective analysis procedure. An inverse-distance squared interpolation scheme is used, which weighs observational data heavily in the vicinity of the observational station, while the Step 1 wind field dominates the interpolated wind field in regions with no observational data. The resulting wind field is subject to smoothing, an optional adjustment of vertical velocities based on the method by O'Brien (1970) and divergence minimisation to produce the final Step 2 wind fields.

The model domains are shown in Figure 16 and a detailed list of the setup parameters is provided in Section 8.1.

7.2.3 Assimilation of data

The following sections describe the assimilation of data from surface meteorology monitoring and upper air data generated by TAPM.

7.2.3.1 Surface observations

No data assimilation was used for the TAPM modelling of the Study Area and was driven entirely by global input synoptic data. Surface meteorology monitoring data from the BoM and DESI locations (see Table 4) were included in the CALMET model.

7.2.3.2 Upper air

The closest upper air station to the Study Area is located at the BoM Rockhampton station, which is approximately 85 km from the Project. This station is likely too far to be deemed representative of the upper air meteorology for the Project and the Gladstone airshed. As such, upper air data was generated using the prognostic meteorology model TAPM.

The NSW EPA has released guidance documentation by Barclay and Scire (2011), which includes recommended settings for the use of the CALPUFF modelling system. One modelling approach provided in the document is the use of a 'Hybrid Mode' whereby numerical prognostic three-dimensional meteorological model data, in a 3D.DAT file, along with surface observation data gained from a representative nearby surface monitoring station, are combined.

In most instances, as recommended by the CALPUFF User Guidelines (Barclay & Scire, 2011), prognostic data (e.g. TAPM data) is best used as a 3-D input field in CALMET as an initial guess field rather than as pseudo-stations. This is because the 3-D input file allows the spatial variability in the prognostic model to be utilised by the CALMET model and the initial guess wind field allows for smaller-scale terrain adjustments to be made by the CALMET diagnostic algorithms.

Where a domain contains a representative surface observation station located close to the area of assessment (such as in the case of the DESI Boat Creek monitoring station), the 'Observations only' mode can be used to provide more weighting to the representative surface monitoring station. Vertical extrapolation of pseudo upper air stations (as up.dat files) from 3-D prognostic data generated by TAPM developed for CALPUFF allows the surface station to carry greater weight extending horizontally and vertically out toward the surface station. This approach prevents the creation of assimilation boundaries when using the CALMET hybrid mode (i.e. distinct areas of conflicting wind fields as shown in the study by Hanna and Chang (2012)) and allows the appropriate weighting of monitoring station data.

A preliminary comparison of the winds as generated by TAPM at the Project location and monitoring data from the DESI Boat Creek is presented below in Figure 13. The TAPM output does not well reflect the measured winds both in terms of wind speed and wind direction. Further, the TAPM predicted percentage calms are significantly lower at 1% calms compared with the DESI measured 6% calms. Due to the inconsistencies between the two datasets it is important that the DESI surface monitoring data be used to drive dispersion from the Project site to consider actual meteorological conditions.

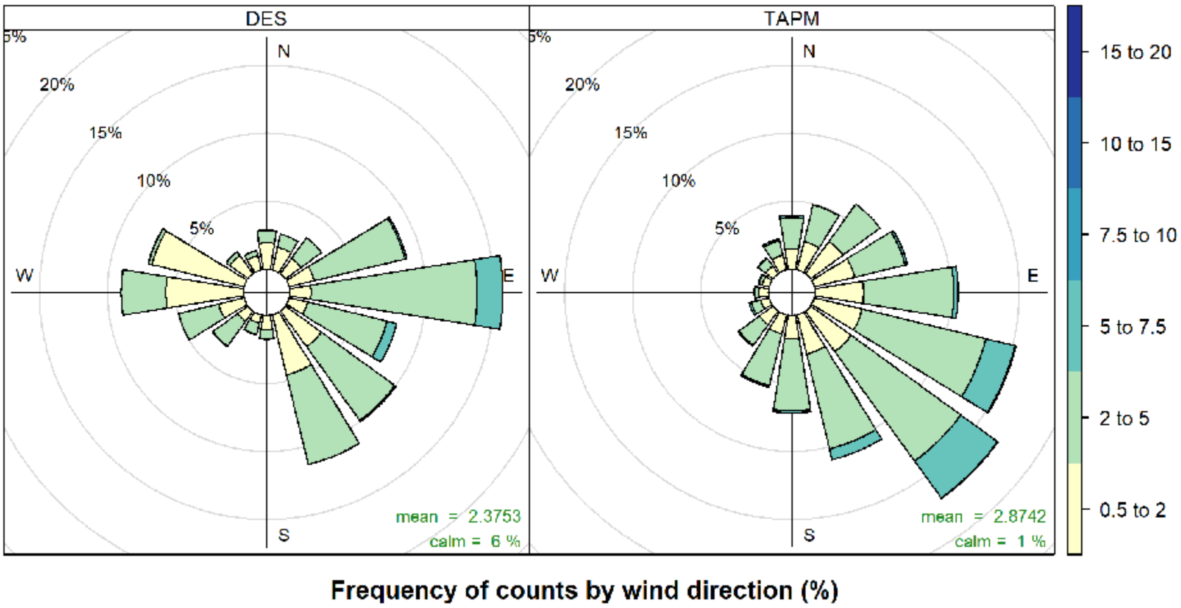

Figure 13 Comparison of TAPM generated winds at the Project site and the DESI Boat Creek station

As previously discussed, it is important when using the CALMET hybrid mode that the surface monitoring winds show good agreement between the prognostic proposed to be used. In this case, the TAPM prognostic predictions do not show good agreement and differ considerably from the measured meteorology. The model developers recommend that the CALMET hybrid option not be used in this situation. Further, if good surface monitoring data is available then an observation only run can be used with pseudo upper air stations generated from the available prognostic data. This allows the representative surface meteorology monitoring data to drive the dispersion in CALPUFF and also provide the best available upper air data to the model. As such, an observation only CALMET methodology was adopted so that the DESI Boat Creek meteorology data would drive the dispersion emissions from the Project site.

Four pseudo upper air stations were used within the CALMET modelling domain and located in areas of uniform terrain and land use to ensure the upper air profiles are correctly representative of the area. Barclay and Scirie (2011) recommend that upper air stations need to be within 10-50km to be representative of the upper air environment. As such, a single upper air station centred over the Project site within the inner CALMET domain (8 x 6km) was considered sufficient to represent local upper air profiles at the site.

7.3 Dispersion modelling

The CALPUFF modelling system consists of three main components and a set of pre-processing and post-processing programs. The main components of the modelling system are CALMET (a diagnostic three-dimensional meteorological model), CALPUFF (an air quality dispersion model), and CALPOST (a post-processing package). The main CALPUFF related software package programs are described in the following sections.

7.3.1 CALPUFF

CALPUFF is a non-steady-state puff dispersion model. It accounts for spatial changes in the meteorological fields, variability in surface conditions (such as elevation, surface roughness, vegetation type, etc), chemical transformation, wet removal due to rain and snow, dry deposition and terrain influences on plume interaction with the surface.

CALPUFF simulates the effects of time- and space-varying meteorological conditions on pollutant transport, transformation and removal, and contains algorithms for near-source effects, such as building downwash, transitional plume rise, partial plume penetration, sub-grid scale terrain interactions, as well as longer range effects, such as pollutant removal (wet scavenging and dry deposition), chemical transformation, vertical wind shear, over-water transport and coastal interaction effects.

A detailed list of the model settings and source emission parameters is provided in 8.2.3.

7.3.2 CALPOST

The CALPOST program is used to process the outputs of the CALPUFF program into a format defined by the user. Results can be tabulated for selected options including percentiles, selected days, gridded results or discrete locations, and can be adjusted to account for chemical transformation and background values.

The program default settings were used for the CALPOST program, ensuring that the correct averaging periods, percentiles and receptors were selected to meet the EPP air ambient pollutant criteria assessed.

7.4 NO_X to NO_2 conversion

One of the challenges of modelling NO_x emissions is determining the amount of NO_2 at a receiver, due to uncertainties in the conversion rates. Early studies by Hegg *et al.* (1977) showed that the rate of oxidation is controlled by the rate of plume mixing rather than by gas reaction kinetics. Ozone is usually the chemical that is responsible for most of the oxidation, but other reactive atmospheric gases (e.g. VOCs) can also oxidise NO to NO_2.

Several methods are available for evaluating the amount of NO_2 that is formed from NO_X. The most commonly used methods include the following:

- Total conversion (i.e. 100% conversion).
- The Ambient Ratio Method (ARM) (0.75 is the US default value) when no measured nearby NO_X/NO_2 ratios are available.
- The Ambient Ration Method 2 (ARM2), based upon observed hourly NO_2/NO_x concentration ratios.
- Ozone Limiting Method (OLM).
- Jansenn's equations (which assume approximately 10 per cent of all NO_x is NO_2) – used in Australia and New Zealand.
- Plume Volume Molar Ratio method (PVMRM).

Atmospheric chemistry modules available in TAPM or CALPUFF (e.g. RIVAD/ARM3, MESOPUFF, ISOROPIA) would also be good candidates for estimating NO_x to NO_2 conversion. However, due to the data requirements (e.g. background ammonia concentration and ammonia vertical profile data) to model the atmospheric chemistry with TAPM or CALPUFF, these chemistry modules were not used.

The Gladstone region has a relatively large air quality monitoring network, with 7 stations that measure NO and NO_2 hourly with data for the period of 2010 to 2019. Based upon the NO_x monitoring dataset available for the Gladstone region, the ARM2 methodology was implemented. This allowed the generation of a ARM2 NO_x to NO_2 conversion scheme that is specific to the Gladstone airshed.

Figure 14 displays a plot of all hourly NO_x measurements against NO_2/NO_x ratio from all available DESI monitoring data from the Gladstone region.

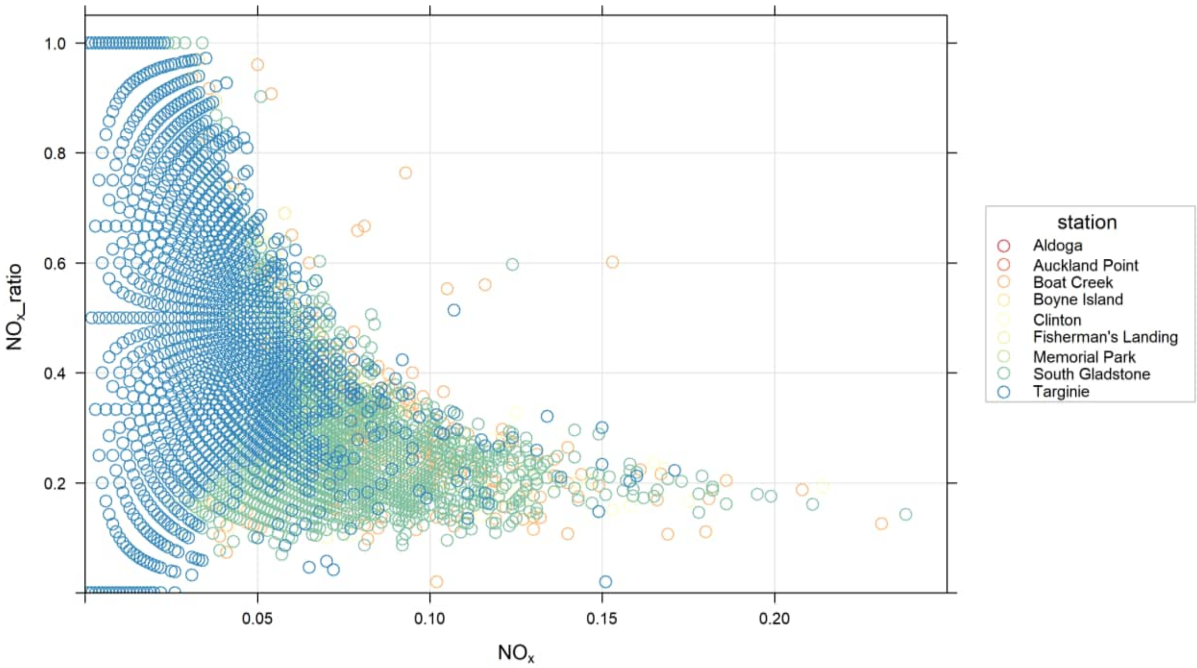

Figure 14 Hourly NO_x measurements against NO_2/NO_x ratios for all available data from DESI monitoring stations for the period 2010-2019

As per the methodology endorsed by the US EPA by RTP (2013) the calculated NO_2/NO_x ratios were sorted into NO_x concentration bins of 10 ppb (0.010 ppm).

The 99th percentile of each NOx bin was then taken to develop a polynomial regression of NO_x concentration to NO_2/NO_x ratio. RTP (2013) recommended taking the 98th percentile to develop this relationship. However, a sensitivity analysis showed that using the 99th percentile produced the most conservative estimates of NO_2 concentrations when compared with background monitoring data.

Figure 15 presents the developed polynomial equation used to estimate the NO_2/NO_x conversion ratios. Table 32 presents the 14 adopted NO_2/NO_x conversion ratios used in CALPOST to determine modelled NO_2 concentrations. The maximum and minimum NO_x to NO_2 conversion ratios recommended by RTP (2013) are 0.9 and 0.2, respectively. The ARM2 estimated NO_x conversion ratio for the highest concentrations was 0.17. However, as the ARM2 recommends using a default minimum ratio of 0.2 to correctly predict concentrations at these higher NO_x concentrations, a ratio of 0.2 was used for the highest bin.

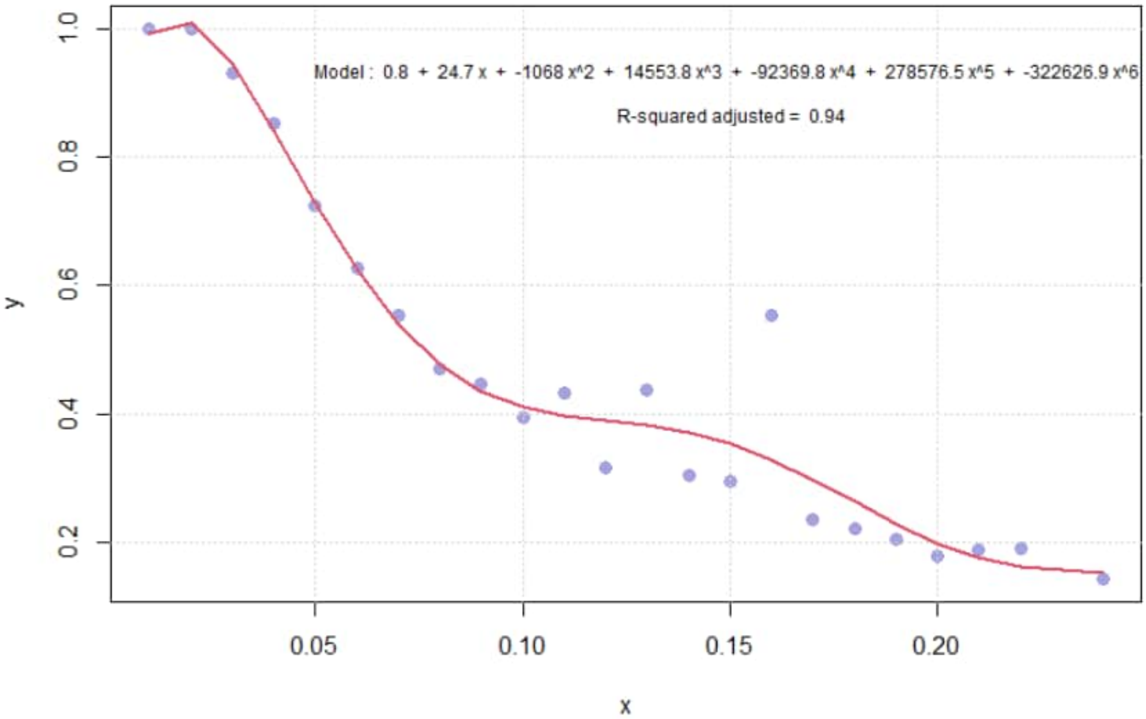

Figure 15 99th percentile ambient ratios and ARM2 equation for all Gladstone DESI NO_x monitoring stations

Table 32 Estimated ARM2 NO_2/NO_x conversion ratios used in CALPOST

NO_x concentration		Adopted NO_2 to NO_x ratio1.
ppm	µg/m^3	-
0.030	62	0.90
0.042	87	0.78
0.055	113	0.64
0.068	139	0.52
0.081	166	0.43
0.094	192	0.38
0.106	219	0.36
0.119	245	0.35
0.132	271	0.34
0.145	298	0.32
0.158	324	0.29
0.171	351	0.25
0.184	377	0.21
0.196	403	0.20

Table notes:

1. NO_x concentrations predicted by CALPUFF between the listed concentrations are linearly interpolated NO_2/NO_x between estimated conversion ratios.

7.5 Building downwash

Building height data for many of the existing identified emission sources in the Gladstone airshed was not readily available for the assessment. As such, as a conservative assumption, it is assumed that all background emissions sources identified are not affected by building downwash. This assumes that a greater proportion of regional emissions travels throughout the Gladstone airshed with their emissions impacting a wider area. This method is consistent with the typical approach of air quality assessments to investigate worst case conditions as required by DESI (2024).

For the modelling of the Project emissions, building heights were taken from preliminary site design drawings. Downwash impacts were estimated using the BPIP-PRIME algorithm prior to the running of CALPUFF.

7.6 Modelling of other pollutants

With the exception of NO_2 and ammonia, all modelled pollutants used background monitoring data (see Section 4.2.3.5) to determine predicted cumulative concentrations. The Project is not expected to emit the other considered pollutants at a scale that is significant to the Gladstone airshed. As such, adopting appropriate background concentrations is expected to adequately assess the impacts of the other modelled pollutants.

In addition to above, photochemical modelling to determine ozone impacts has not been completed for the AQIA. This type of airshed modelling requires detailed emissions inventory data (e.g. detailed industrial and traffic emissions data for ozone precursors NO_x, VOCs, and SO_2) and background air quality monitoring (e.g. vertical ammonia profiles, secondary organic aerosol (SOA) data). This data is not currently available for the Gladstone airshed and the emissions from the Project represent less than 0.3 percent contribution of NO_x to the Gladstone air shed. Also, ozone pollution is currently not a problem within the Gladstone airshed with no recorded exceedances by DESI of ozone criteria. Thus, photochemical airshed modelling has not been completed as part of this AQIA of the Project.

8.0 Meteorology modelling

The following sections detail the modelling completed with TAPM and CALMET, including:

- Meteorology data used;
- Model settings;
- Analysis of the generated meteorology data.

Three years of meteorology were modelled to provide a robust meteorology dataset to drive the CALPUFF dispersion model. A nested domain modelling approach was used in CALMET, with three domains adopted with increasing resolution for each inner domain. This allowed the inclusion of regional meteorology due to varying terrain and land use in the Gladstone airshed while minimising computational modelling requirements. Monitoring data was sourced from local and regional DESI and BoM monitoring stations (as per Table 4). No upper air data is available from BoM for the Gladstone area, as such, pseudo upper stations generated from TAPM output data were used. The pseudo upper stations were placed in areas of flat terrain and uniform land use as to be representative of the local area.

The location of the CALMET domains, surface monitoring stations, and the TAPM generated pseudo upper air stations is shown in Figure 16.

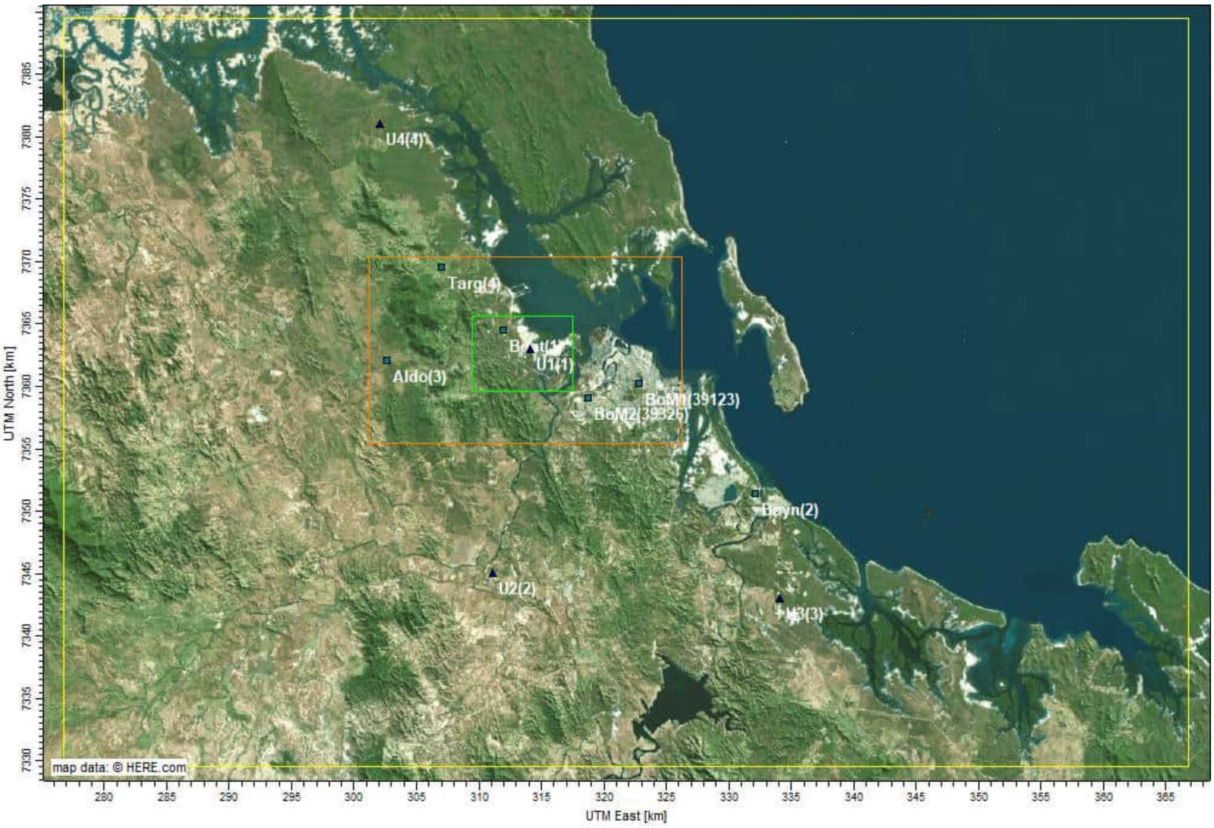

Figure 16 CALMET modelling domains, assimilated surface monitoring stations, and TAPM generated pseudo upper air stations

Figure notes:

1. Coordinate system GDA Zone 56 in kilometres
2. Green boundary denotes the inner grid, orange boundary denotes the middle grid, and yellow boundary denotes the outer grid

8.1 Model settings

A summary of the data and parameters used as inputs to TAPM and CALMET is shown in Table 33. The CALMET settings have been chosen in accordance with the following documents:

- *Generic Guidance and Optimum Model Settings for the CALPUFF Modelling System for Inclusion into the Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (Barclay & Scire, 2011).
- *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (NSW EPA, 2022).

Table 33 Summary of model input parameters

Parameter	Input
TAPM (v4.0.4)	
TAPM Version	v4.04
Number of grids (spacing)	4 (30 km, 10 km, 3 km, 1km)
Number of grid points	25 x 25 x 50
Simulation period	31 December 2016 to – 1 January 2020
Terrain information	AUSLIG 9 second (horizontal resolution 9”)
Centre of analysis	314,118 m E; 7,363,029 m S
Local data assimilation	No data assimilation
CALMET (v6.42)	
Meteorological grid domain	90 km x 60 km (outer domain) 25 km x 15 km (middle domain) 8 km x 6 km (inner domain)
Meteorological grid resolution	2000 m resolution, 45 x 30 grid cells (outer domain) 500 m resolution, 50 x 30 grid cells (middle domain) 200 m resolution, 40 x 30 grid cells (inner domain)
Reference grid coordinate (centre)	321,800 m E, 7,359,500 m S (outer domain) 313,734 m E, 7,362,922 m S (middle domain) 313,503 m E, 7,362,484 m S (inner domain)
Cell face heights in vertical grid	0, 20, 40, 80, 160, 320, 640, 1200, 2000, 3000 and 4000 m
Simulation length	2017 to 2019
Surface meteorological stations[1.]	BoM Gladstone Radar (39123) BoM Gladstone Airport (39326) DESI Adolga DESI Boat Creek DESI Boyne Island DESI Targinie
Upper air meteorological stations	No upper air stations. The 3-dimensional gridded prognostic data from TAPM (M3D) were used to develop 4 pseudo upper air stations for CALMET.
Terrain data	SRTM Version 3.0 Global DEM (1 arc second)
Land use data	Catchment Scale Land Use (CLUM) of Australia 2003-2018
TERRAD (Terrain radius of influence)	10 km

Parameter	Input
R1 (Distance from an observational station at which the observation and first guess field are equally weighted) – Surface RMAX1 (Radius of influence of meteorological stations: Surface)	1.4 km 2.6 km
R2 (Distance from an observational station at which the observation and first guess field are equally weighted) - Upper air RMAX2 (Radius of influence of meteorological stations: Upper)	3.0 km 5.0 km
IEXTRP (Vertical extrapolation of surface wind observation)	-4 (extrapolate using similarity theory, exclude upper air observations from layer 1)
BIAS (Relative weight of extrapolated observations versus upper air soundings in the computation of the initial guess field)	-1.0 (10 m) -0.989 (30 m) -0.971 (60 m) -0.937 (120 m) -0.868 (240 m) -0.731 (480 m) -0.479 (920 m) -0.089 (1600 m) 0.427 (2500 m) 1.0 (3500 m)

Table notes:

1. The DESI Fisherman’s Landing meteorology monitoring data was omitted from the modelling as to allow the DESI Boat Creek data to drive the meteorology dataset (due to its closer proximity) developed for the surrounding area and the Project site.

8.2 Analysis of modelled meteorology

The following sections detail the analysis of the modelled meteorology used to complete the dispersion modelling for the AQIA, which include analysis of the modelled winds, temperatures, stability classes, and mixing heights.

8.2.1 Winds

Figure 17 through Figure 23 compare the CALMET generated wind roses displaying frequency counts by wind direction. Overall, wind direction frequencies of each of the BoM and DESI monitoring locations show good agreement with the monitoring data, with wind direction patterns well represented by the CALMET meteorological data.

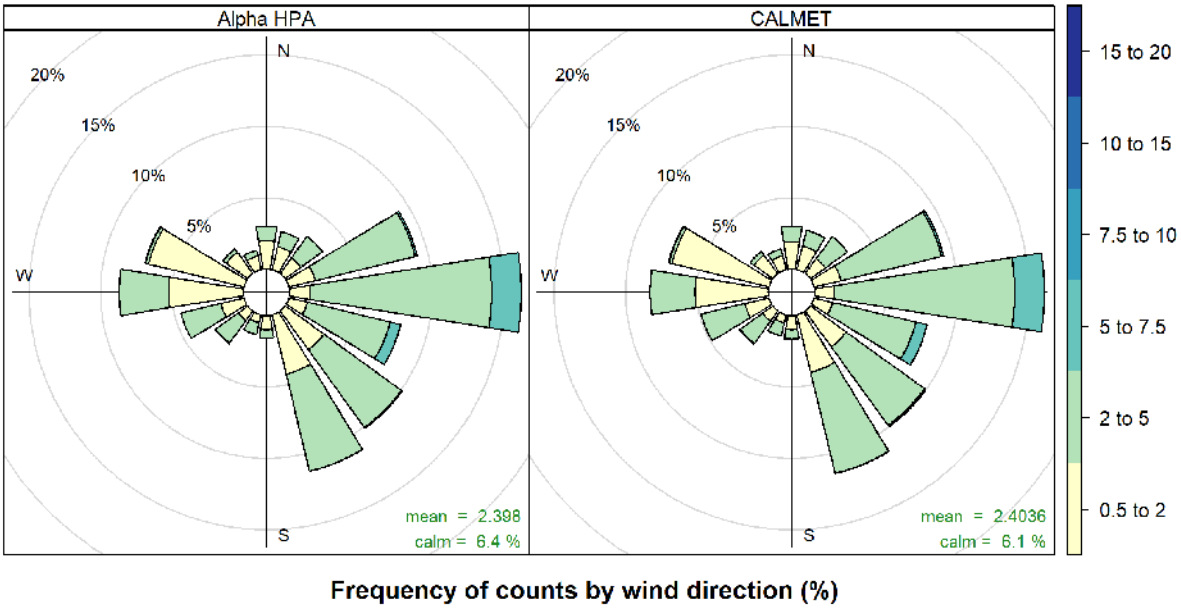

Figure 17 CALMET generated data wind roses compared to monitoring data – The Project site compared with DESI Boat Creek

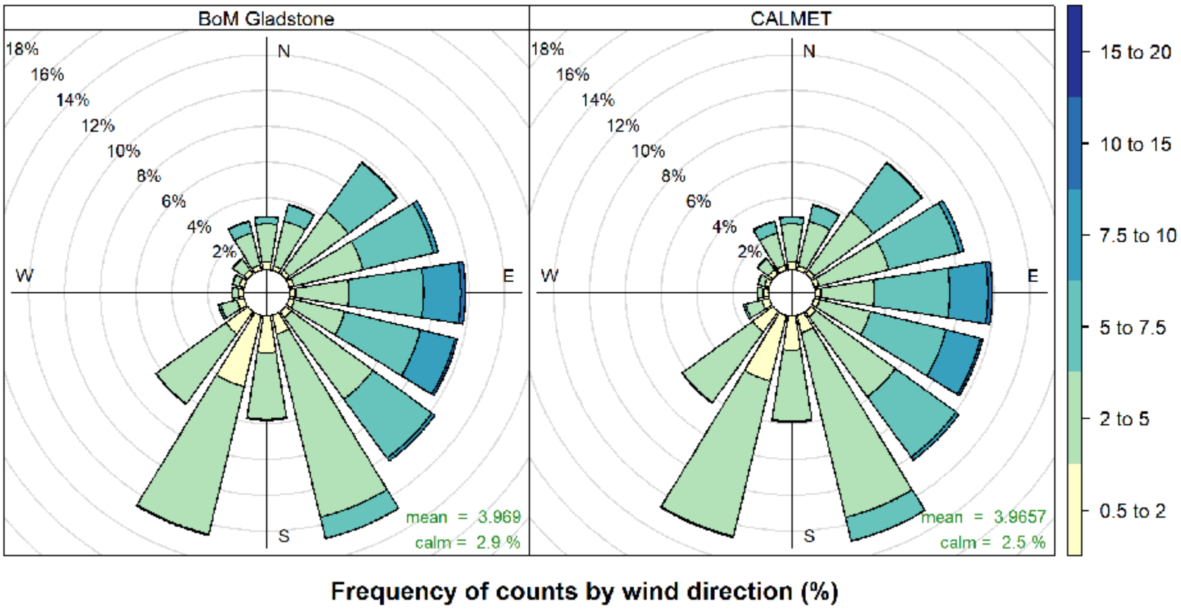

Figure 18 CALMET generated data wind roses compared to monitoring data – BoM Gladstone Airport

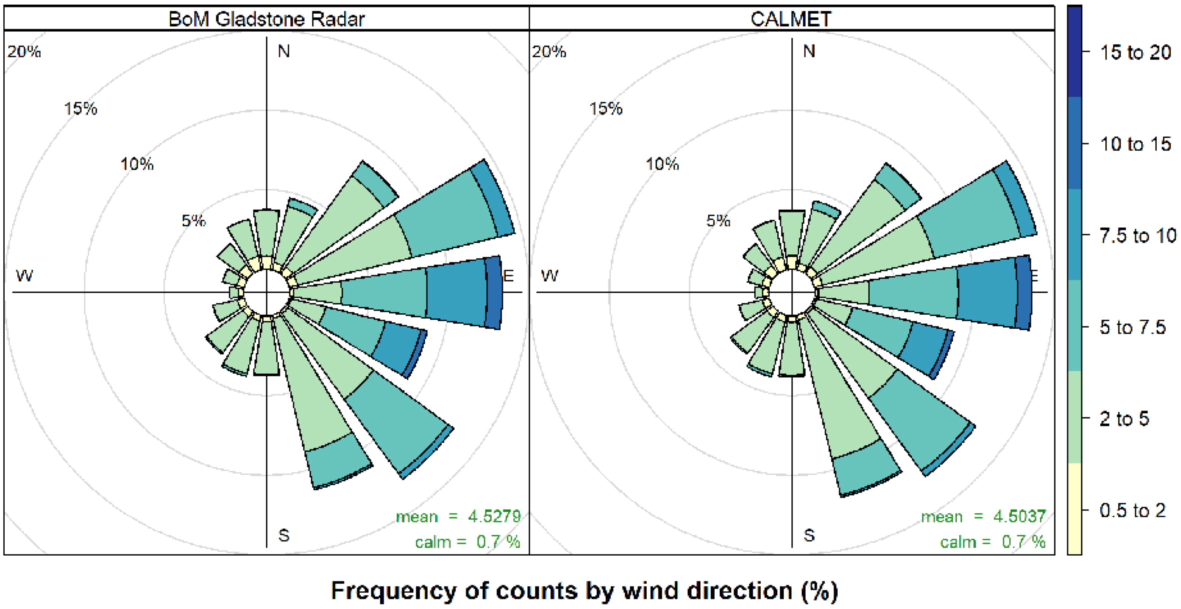

Figure 19 CALMET generated data wind roses compared to monitoring data – BoM Gladstone Radar

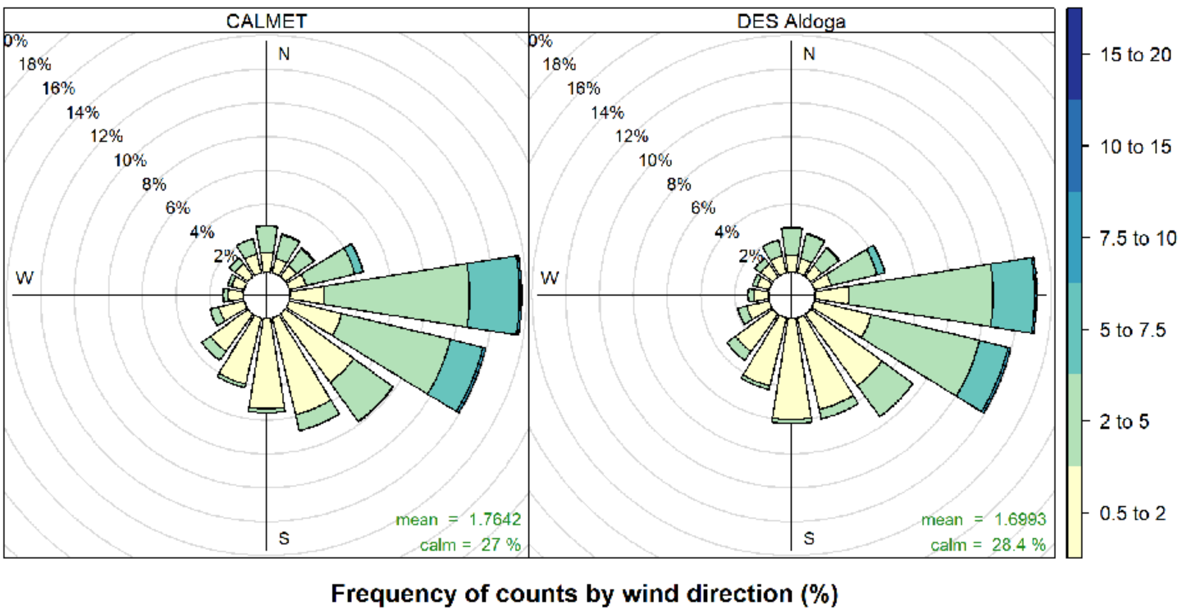

Figure 20 CALMET generated data wind roses compared to monitoring data – DESI Aldoga

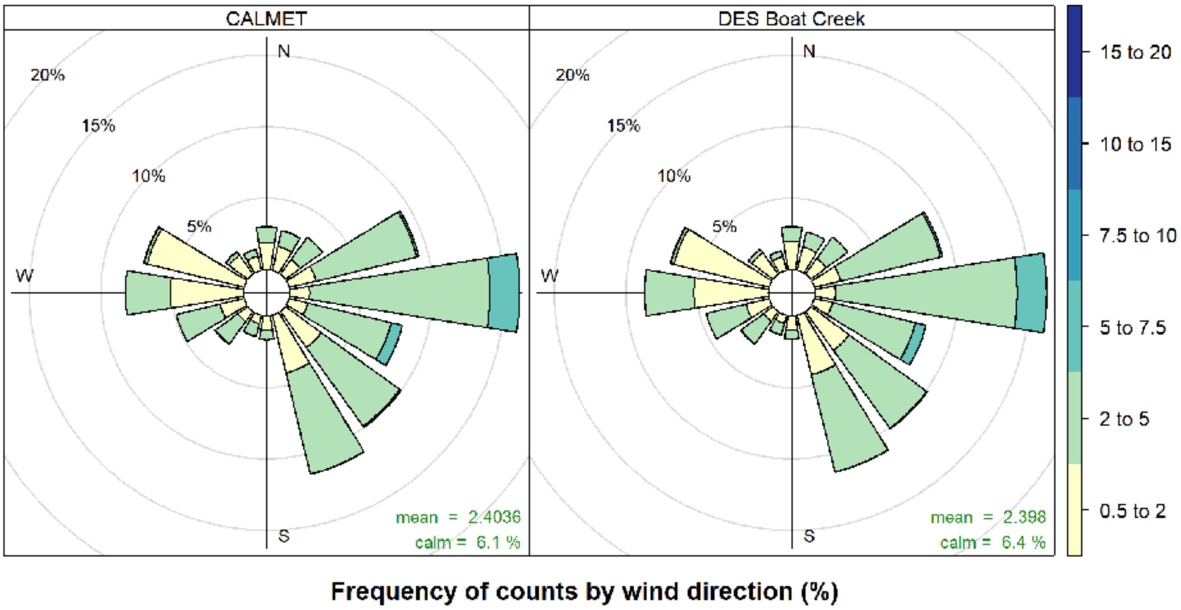

Figure 21 CALMET generated data wind roses compared to monitoring data – DESI Boat Creek

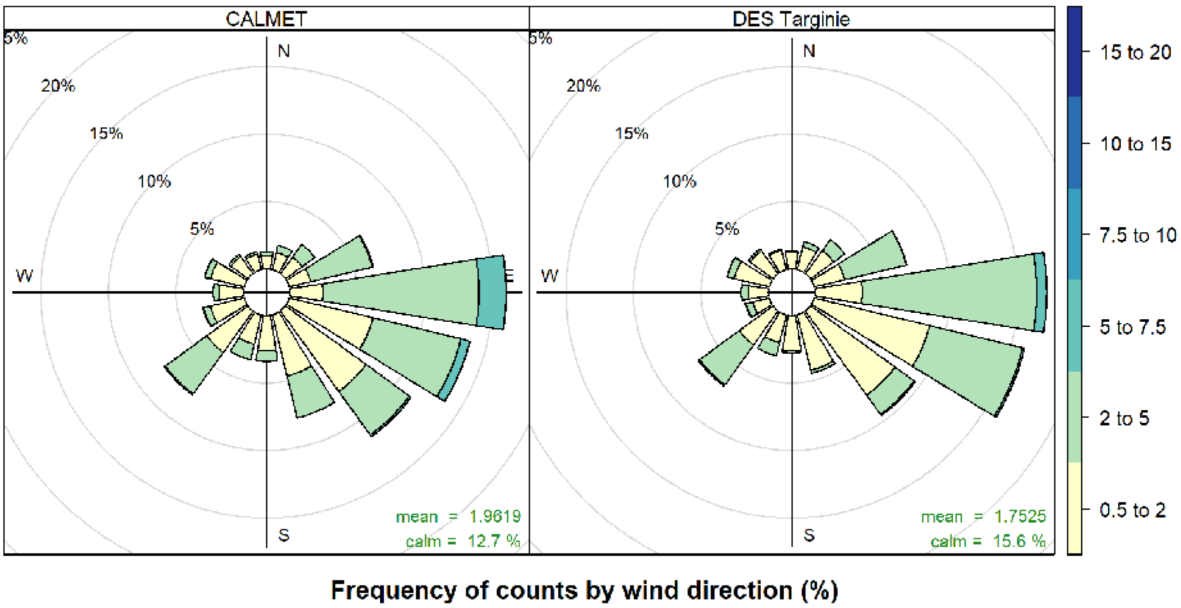

Figure 22 CALMET generated data wind roses compared to monitoring data – DESI Targinie

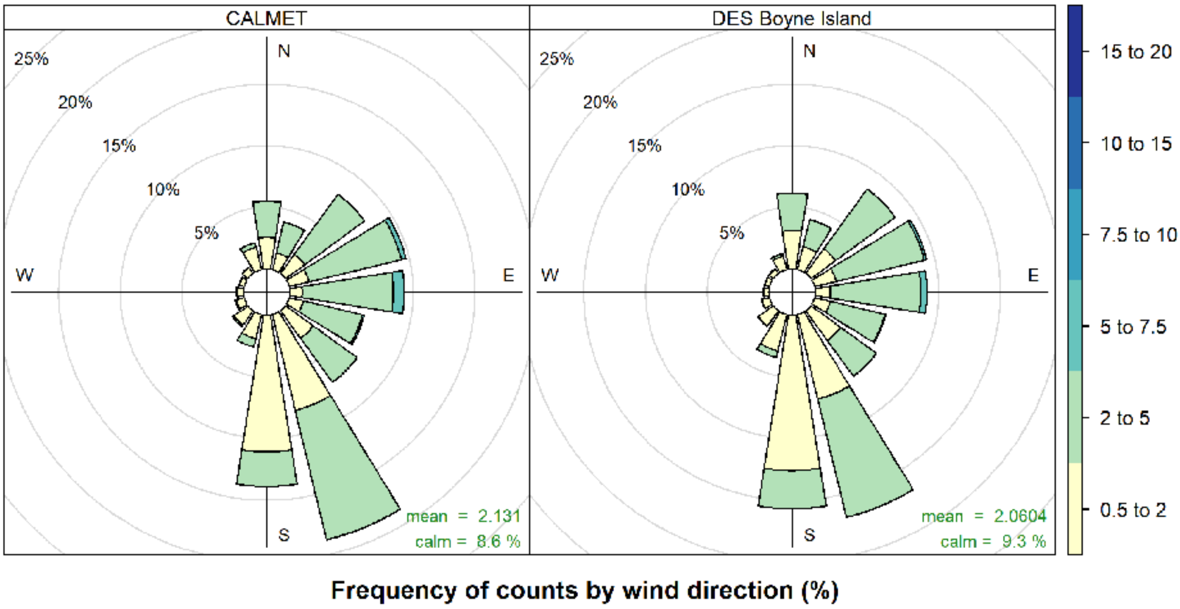

Figure 23 CALMET generated data wind roses compared to monitoring data – DESI Boyne Island

Table 34 presents a summary of wind speed statistics for the Project site, BoM and DESI monitoring stations. Modelled wind speeds are shown to be in good agreement with monitoring data for each of the locations, with little variance between the two data sets. Percentage calms were shown to under predict at all monitoring locations, with the DESI Targinie station showing the highest discrepancy between modelled and monitoring data, with a prediction of 12.7 per cent calms compared to 15.6 per cent measured. Other monitoring locations showed smaller differences in model predictions, which ranged from 0.3 to 1.4 differences in percentage calm occurrences. The occurrence of calm conditions can lead to poorer dispersion and stagnation of air pollutants. However, the difference in predicted calm conditions is not considered significant to cause erroneous predictions from the model.

Table 34 Summary of wind speed statistics for CALMET modelled locations

Station	Period of modelled meteorological data[1.]			
	2017	2018	2019	All modelled years
The Project site[2.]				
Average Wind Speed (m/s)	2.2 (2.2)	2.4 (2.4)	2.6 (2.6)	2.4 (2.4)
Percentage Calms (%)	7.6 (7.2)	6.1 (5.8)	5.5 (5.3)	6.1 (6.4)
BoM Gladstone Airport				
Average Wind Speed (m/s)	3.7 (3.7)	4.0 (4.0)	4.2 (4.2)	4.0 (4.0)
Percentage Calms (%)	3.1 (3.1)	2.2 (3.2)	2.2 (2.3)	2.5 (2.9)
BoM Gladstone Radar				
Average Wind Speed (m/s)	4.3 (4.3)	4.4 (4.4)	4.8 (4.8)	4.5 (4.5)
Percentage Calms (%)	0.8 (0.8)	0.8 (0.9)	0.5 (0.6)	0.7 (0.7)
DESI Boat Creek				
Average Wind Speed (m/s)	2.2 (2.2)	2.4 (2.4)	2.6 (2.6)	2.4 (2.4)
Percentage Calms (%)	7.2 (7.6)	5.8 (6.1)	5.3 (5.5)	6.1 (6.4)

Station	Period of modelled meteorological data[1.]			
	2017	2018	2019	All modelled years
DESI Aldoga				
Average Wind Speed (m/s)	1.5 (1.5)	1.8 (1.7)	2.0 (1.9)	1.8 (1.7)
Percentage Calms (%)	30.5 (31.6)	25.3 (26.7)	25.1 (26.9)	27.0 (28.4)
DESI Targinie				
Average Wind Speed (m/s)	1.8 (1.6)	2.1 (2.0)	2.0 (1.6)	2.0 (1.8)
Percentage Calms (%)	16.3 (23.1)	6.1 (6.8)	15.8 (20.4)	12.7 (15.6)
DESI Boyne Island				
Average Wind Speed (m/s)	2.0 (2.0)	2.0 (2.0)	2.3 (2.2)	2.1 (2.1)
Percentage Calms (%)	9.1 (9.7)	9.6 (10.3)	7.1 (7.9)	8.6 (9.3)

Table notes:

1. Bracketed values are the monitored results from the corresponding BoM or DESI monitoring location for the defined period.
2. The Project Site CALMET results are compared with monitoring data from the DESI Boat Creek monitoring station.

8.2.2 Temperature

Figure 24 through Figure 30 display the predicted hourly temperature compared to their associated BoM or DESI monitoring station. Modelled temperatures are on average between 10 and 35 degrees Celsius, which is consistent with the sub-tropical climate of the Gladstone area. During periods of missing data for assimilated monitoring station, CALMET shows consistency with the overall trend of warmer temperatures in the summer months and cooler temperatures during the winter months. Overall, CALMET predictions shows good agreement with the monitoring data incorporated in the model.

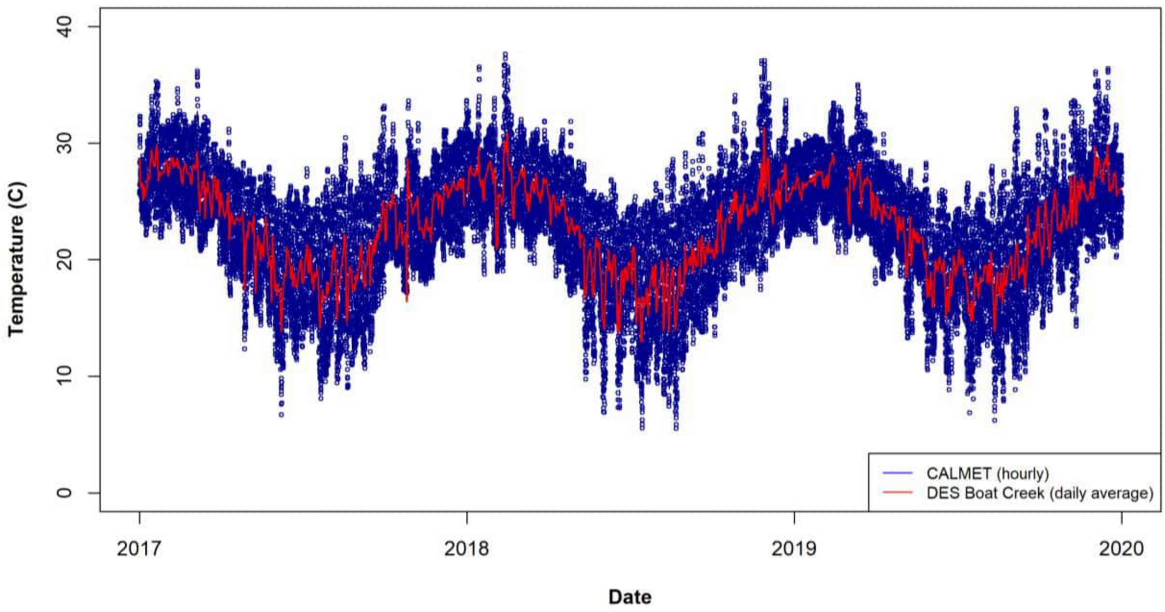

Figure 24 CALMET modelled hourly temperature compared to average daily measured temperature – The Project site compared with DESI Boat Creek

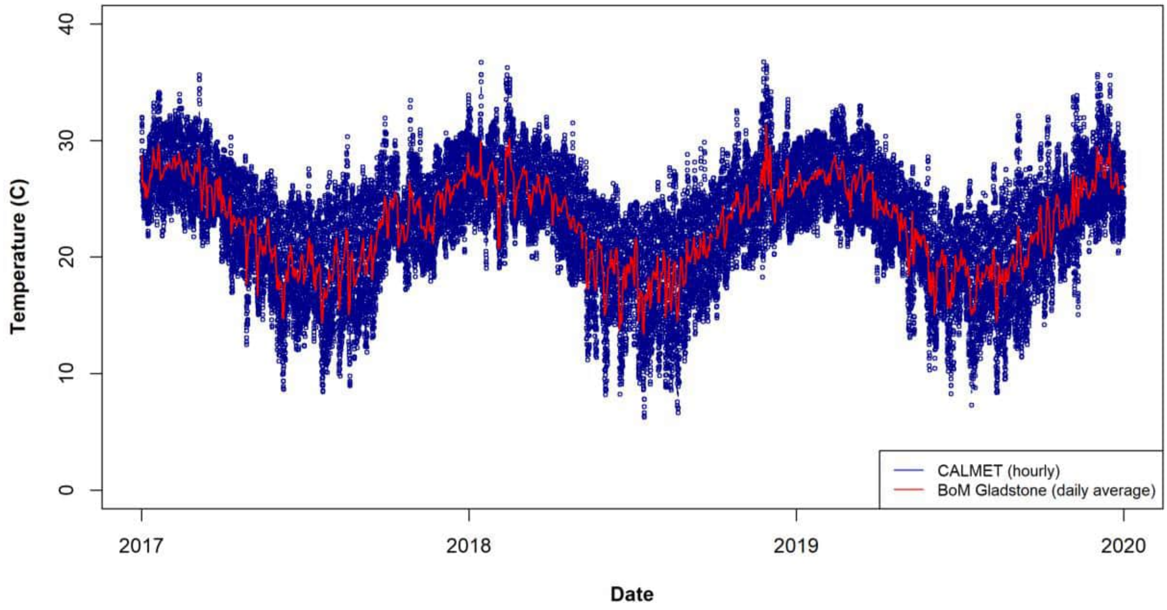

Figure 25 CALMET modelled hourly temperature compared to average daily measured temperature – BoM Gladstone Airport

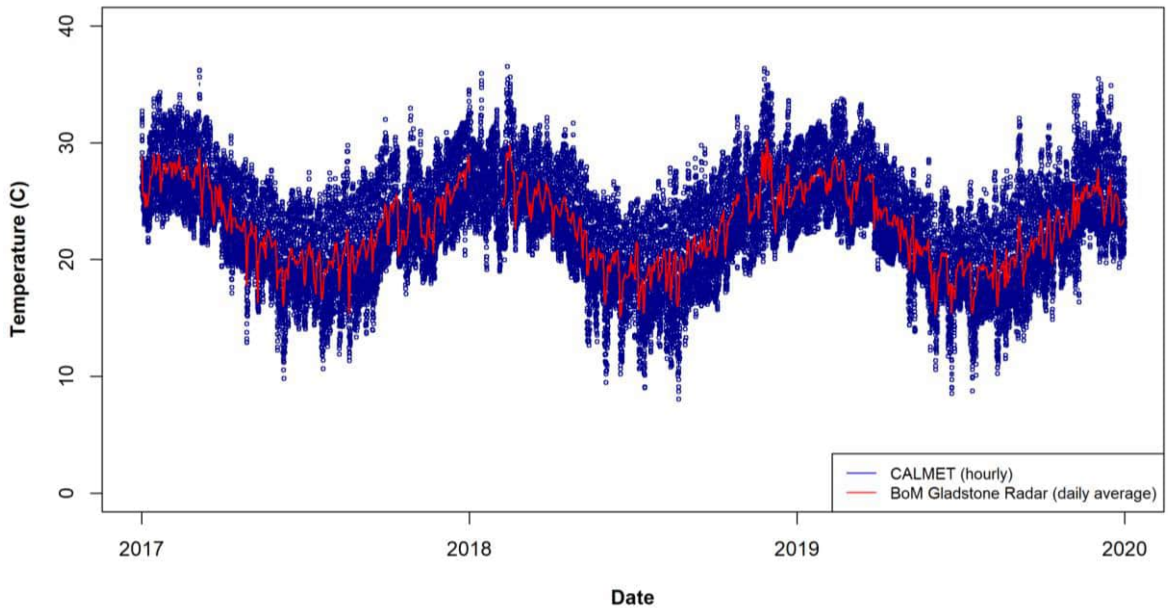

Figure 26 CALMET modelled hourly temperature compared to average daily measured temperature – BoM Gladstone Radar

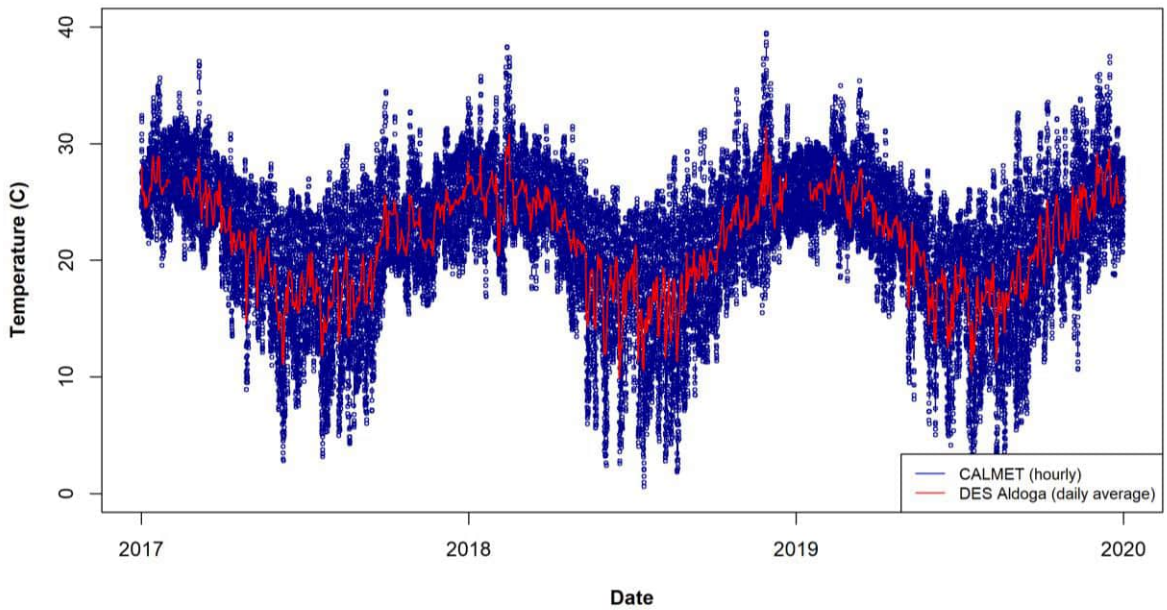

Figure 27 CALMET modelled hourly temperature compared to average daily measured temperature – DESI Aldoga

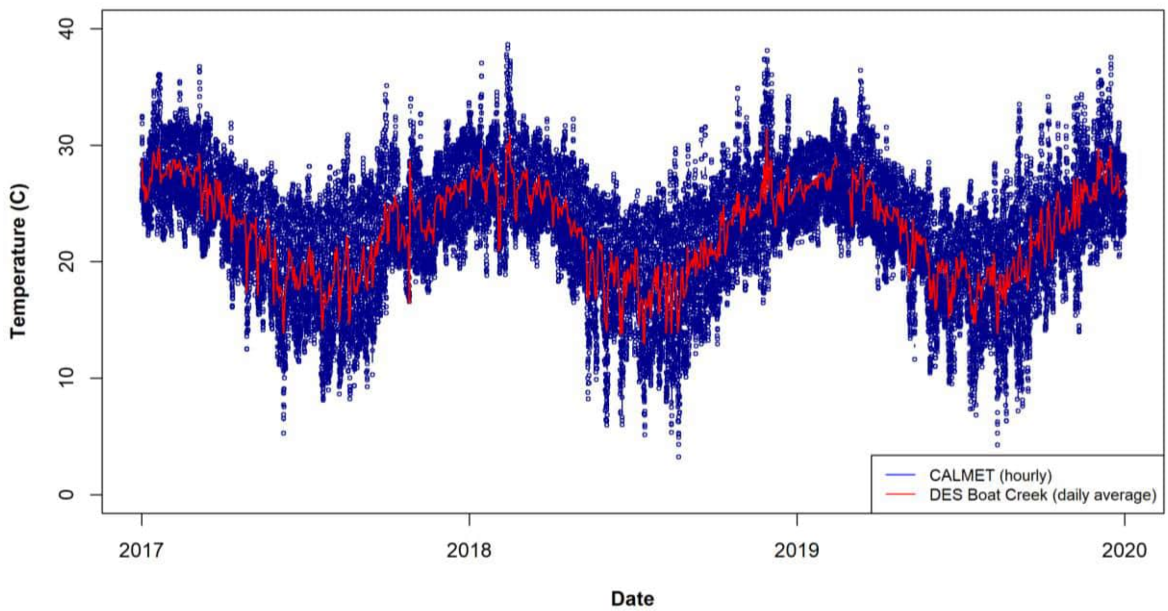

Figure 28 CALMET modelled hourly temperature compared to average daily measured temperature – DESI Boat Creek

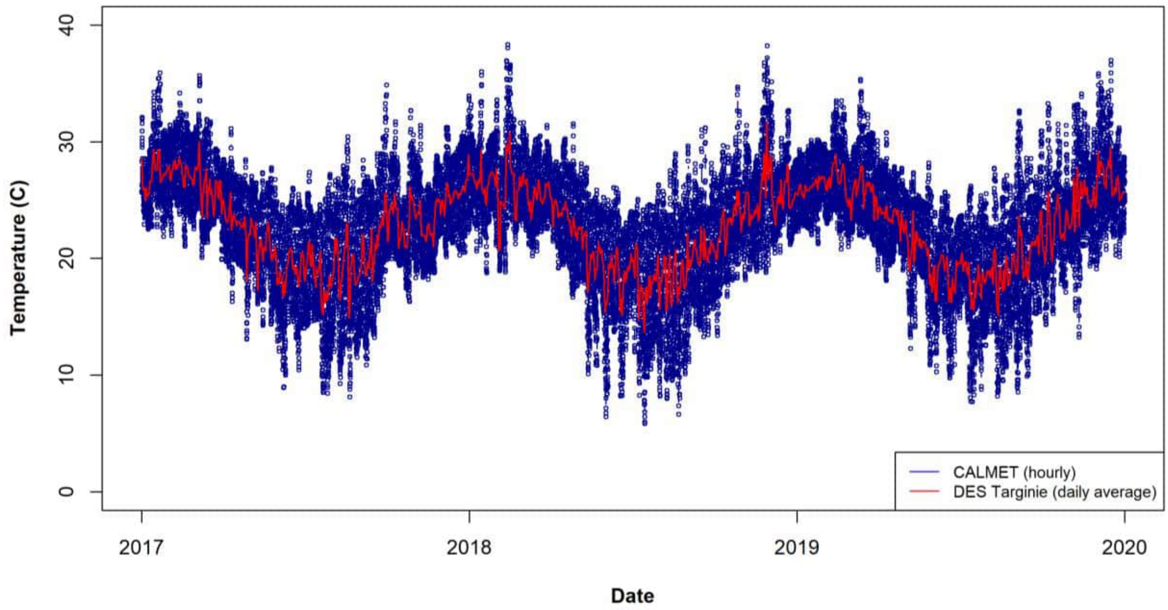

Figure 29 CALMET modelled hourly temperature compared to average daily measured temperature – DESI Targinie

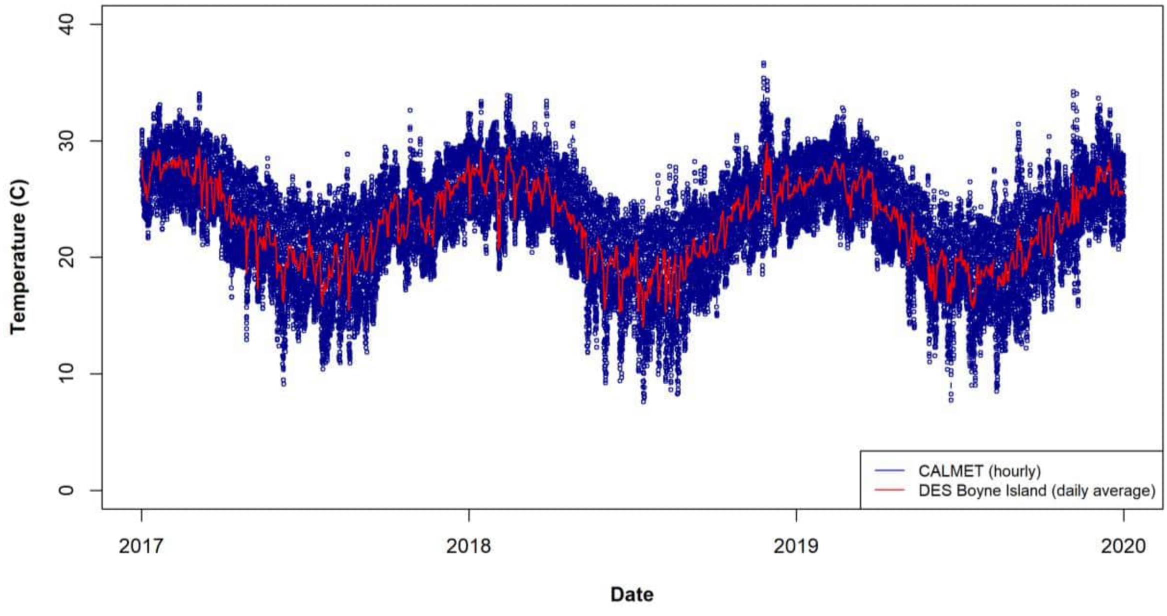

Figure 30 CALMET modelled hourly temperature compared to average daily measured temperature – DESI Boyne Island

8.2.3 Atmospheric stability

Stability class is used as an indicator of atmospheric turbulence for use in meteorological models. The class of atmospheric stability generally used in these types of assessments is based on the Pasquill-Gifford-Turner (PG) scheme where six categories are used (A to F) which represent atmospheric stability from extremely unstable to moderately stable conditions respectively. The stability class of the atmosphere is based on three main characteristics, these being:

- Static stability (vertical temperature profile/structure);
- Convective turbulence (caused by radiative heating of the ground);
- Mechanical turbulence (caused by surface roughness).

Whilst CALPUFF centrally uses Monin-Obukhov (MO) similarity theory to characterise the stability of the surface layer, conversions are made within the model to calculate the PG class based on Golders method (Golder, 1972) as a function of both MO length and surface roughness height.

Stability class data extracted from the CALMET files for locations representing the Project site, BoM meteorological stations, and DESI air quality monitoring stations are shown in Figure 31 through to Figure 44. Predicted stability class categories are displayed by hour of day and total frequency count.

Many of the monitoring stations and the Project site are dominated by stability class F, which is shown to occur in very high proportions during the night-time hours. These stations also experience the higher proportions of calms, which is consistent with stable night-time stagnation and the very low night-time mixing heights (shown in Section 8.2.4). The BoM Gladstone Airport and Gladstone Radar stations have more of a range of night-time stability classes, with significant periods of stability classes D, E, and F. This indicates more vertical mixing occurs during night-time hours at these stations, which is consistent with higher mixing heights experienced in urban areas due to increased surface roughness and surface heating such as those occur from the “urban heat island effect” (Baklanov & Kuchin, 2004). Overall, on average more unstable conditions occurred during the day and stable conditions occurred during the night. This is consistent with normal atmospheric conditions expected in an urban and rural areas that exist within the Gladstone region.

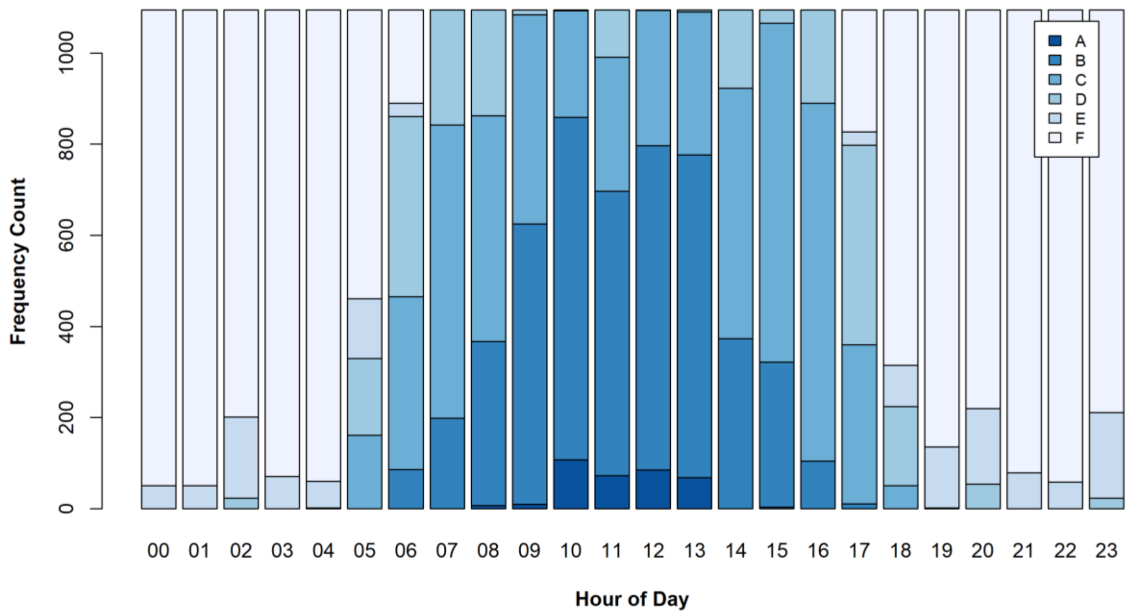

Figure 31 CALMET predicted stability class count by hour of day – The Project site

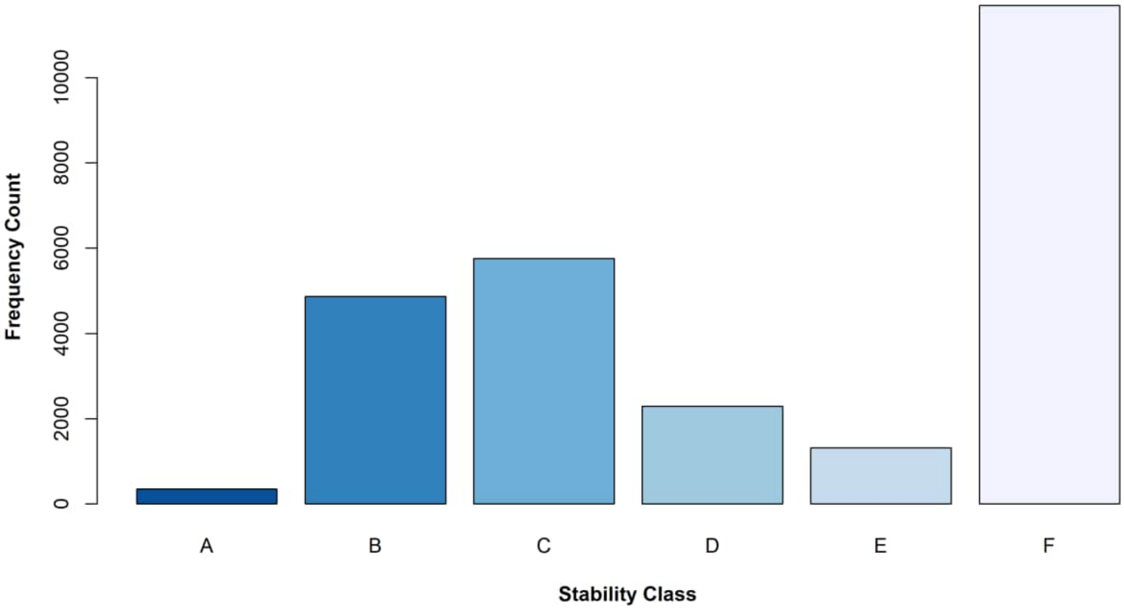

Figure 32 CALMET predicted stability class total frequency count – The Project site

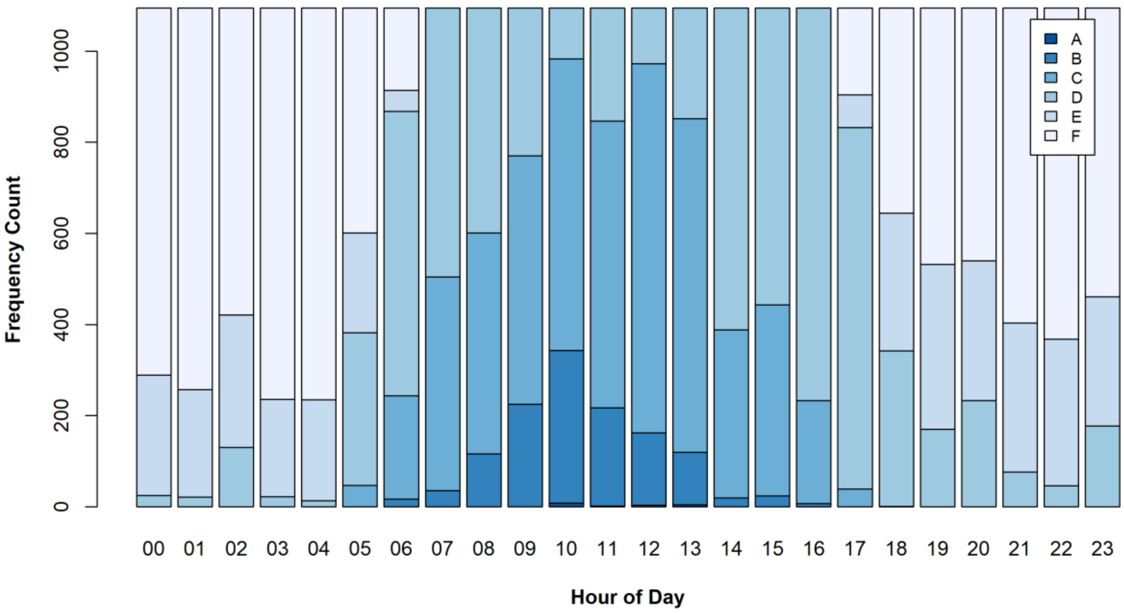

Figure 33 CALMET predicted stability class count by hour of day – BoM Gladstone Airport

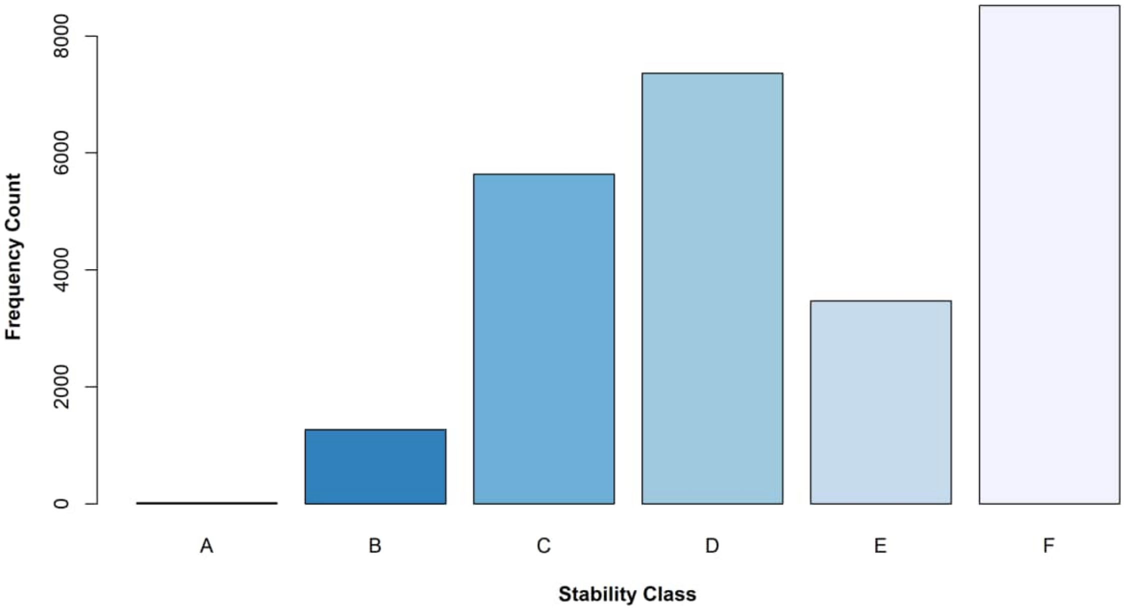

Figure 34 CALMET predicted stability class total frequency count – BoM Gladstone Airport

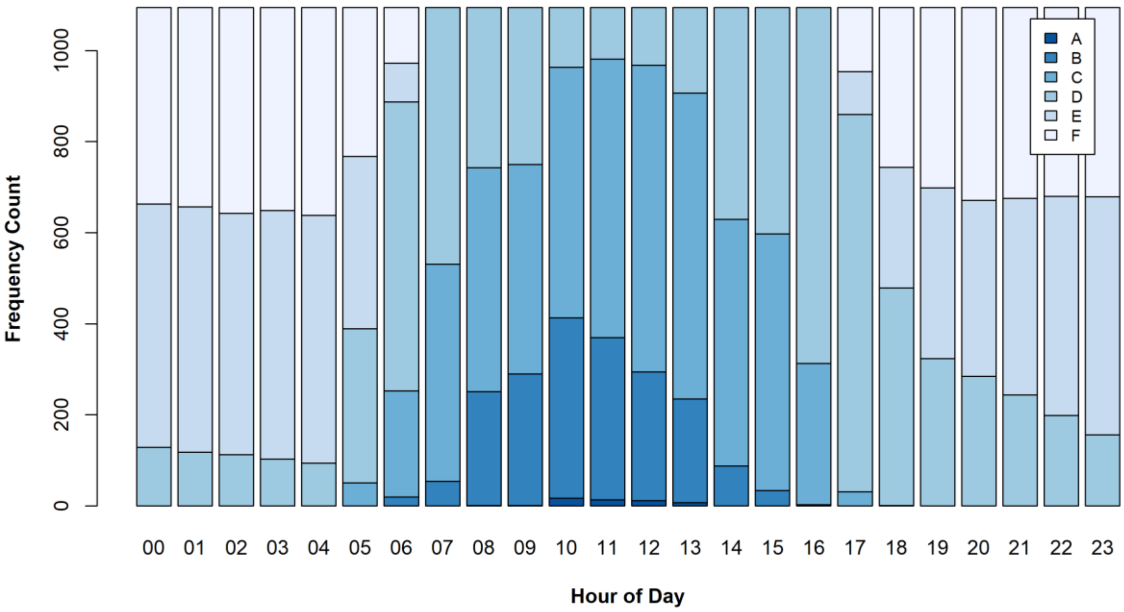

Figure 35 CALMET predicted stability class count by hour of day – BoM Gladstone Radar

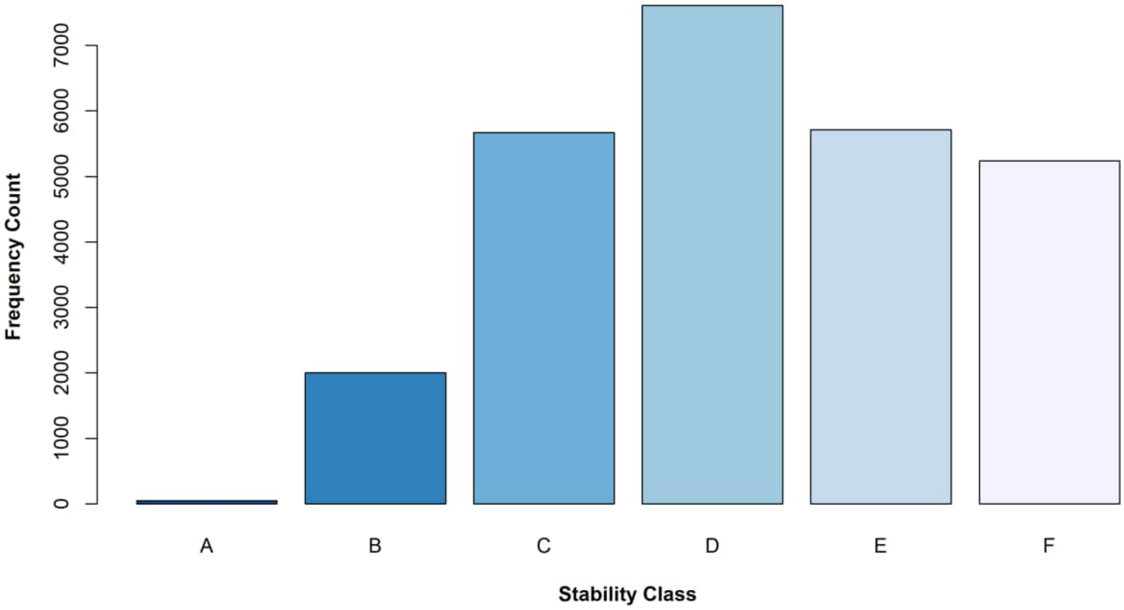

Figure 36 CALMET predicted stability class total frequency count – BoM Gladstone Radar

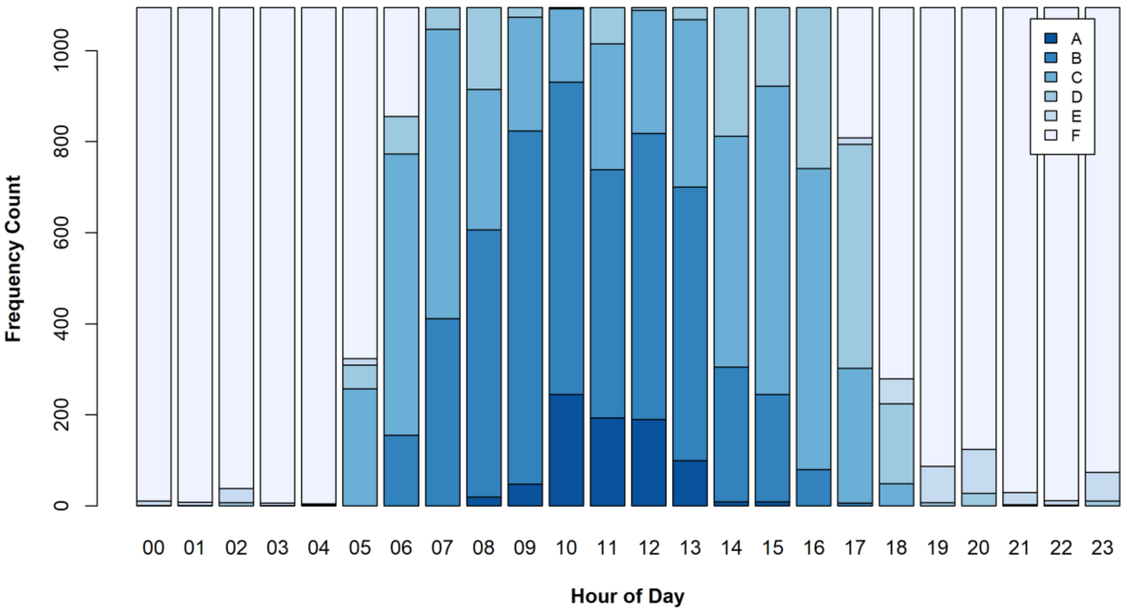

Figure 37 CALMET predicted stability class count by hour of day – DESI Aldoga

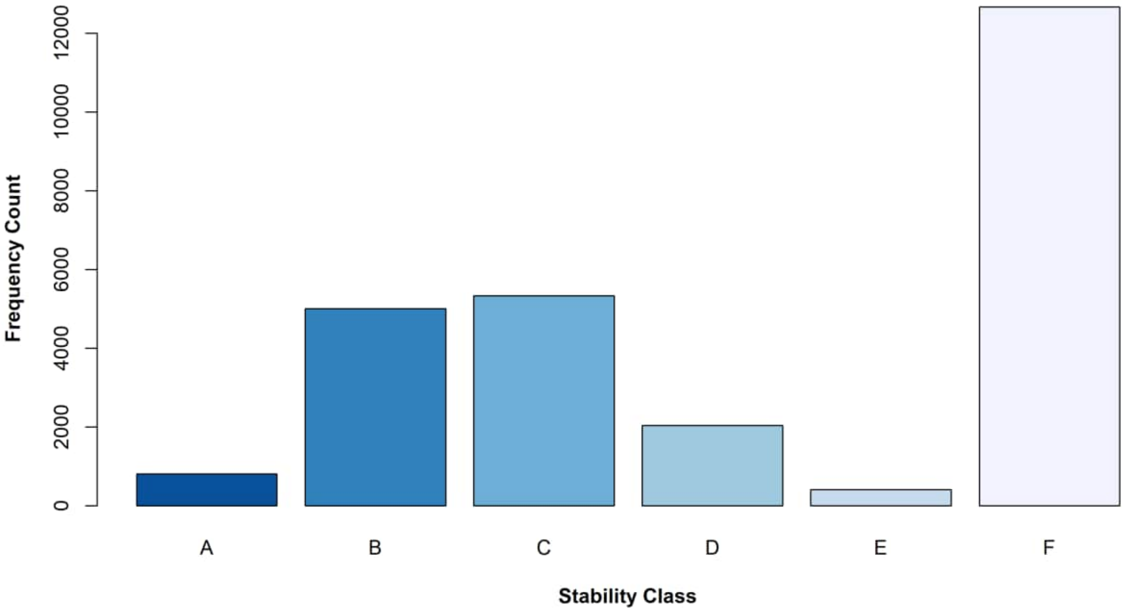

Figure 38 CALMET predicted stability class total frequency count – DESI Aldoga

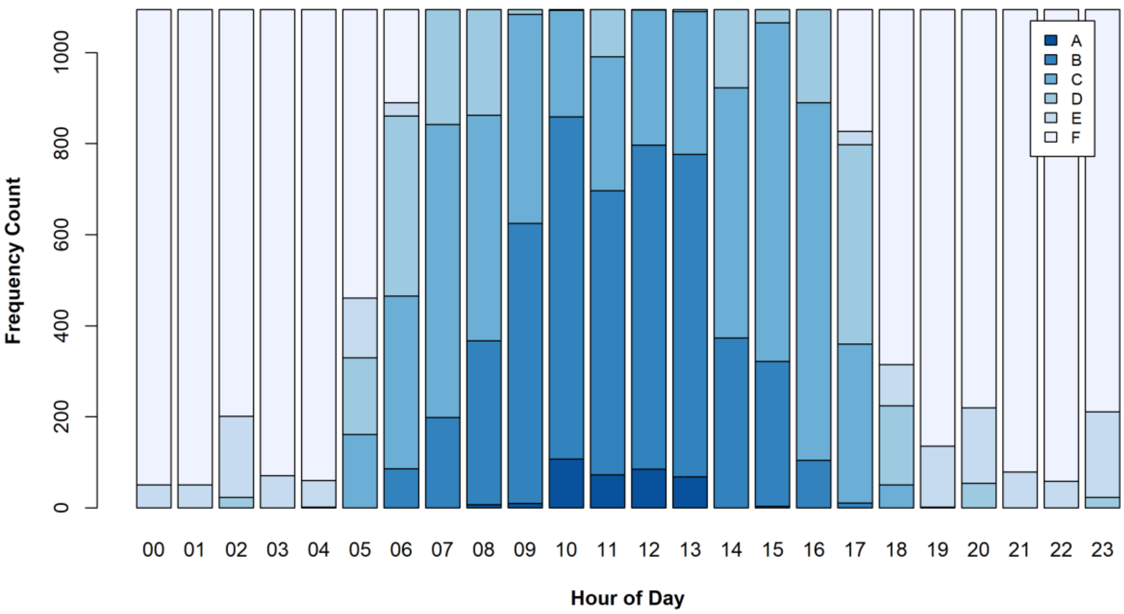

Figure 39 CALMET predicted stability class count by hour of day – DESI Boat Creek

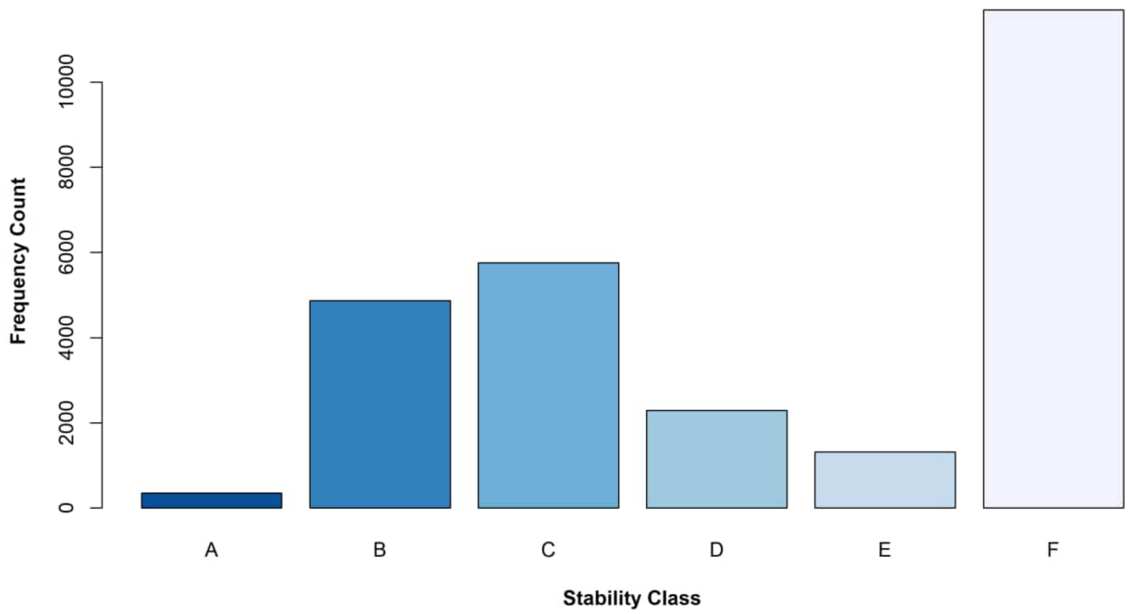

Figure 40 CALMET predicted stability class total frequency count – DESI Boat Creek

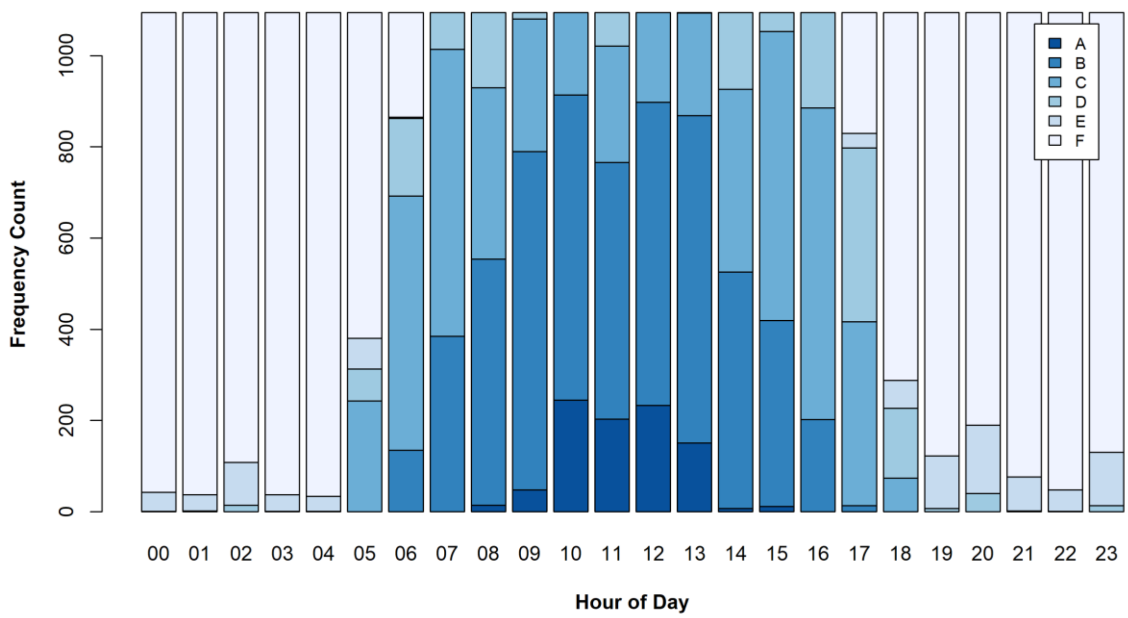

Figure 41 CALMET predicted stability class count by hour of day – DESI Targinie

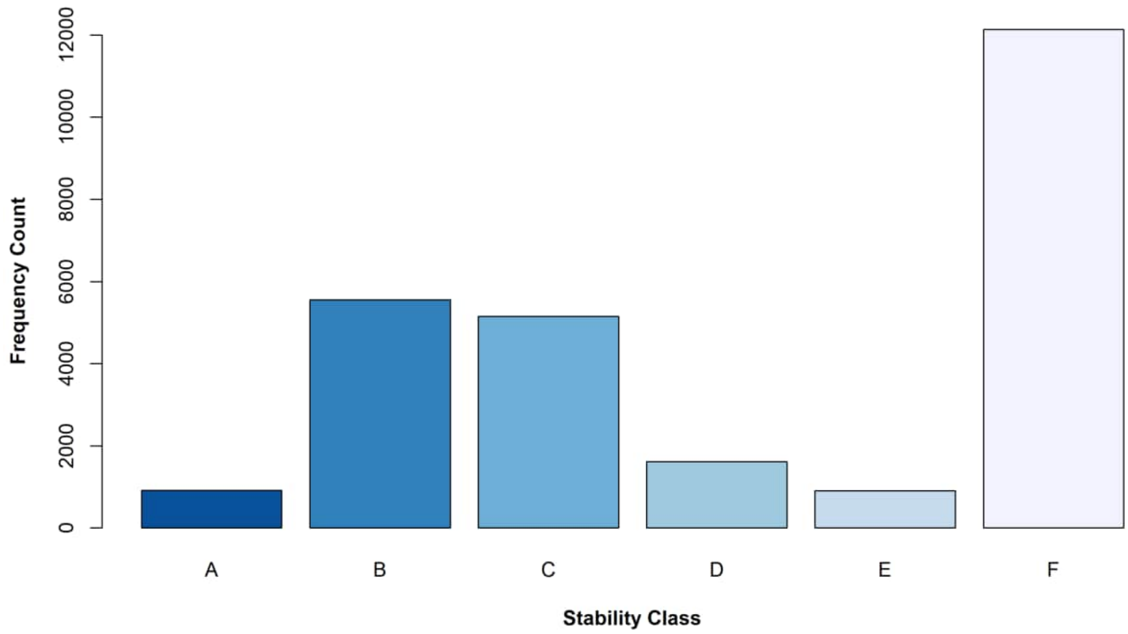

Figure 42 CALMET predicted stability class total frequency count – DESI Targinie

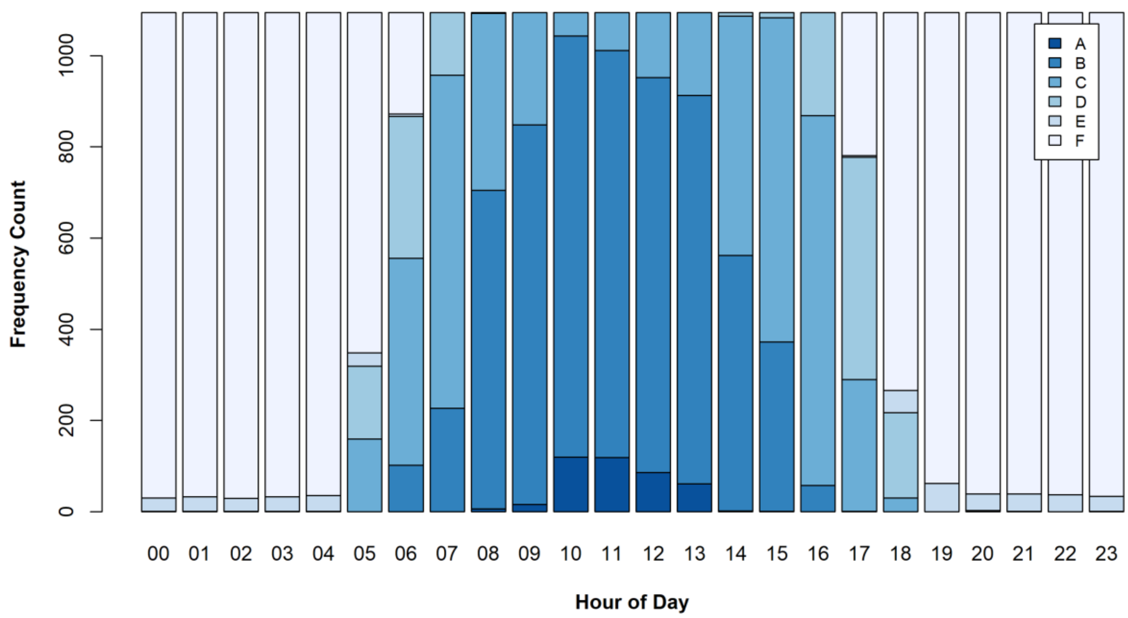

Figure 43 CALMET predicted stability class count by hour of day – DESI Boyne Island

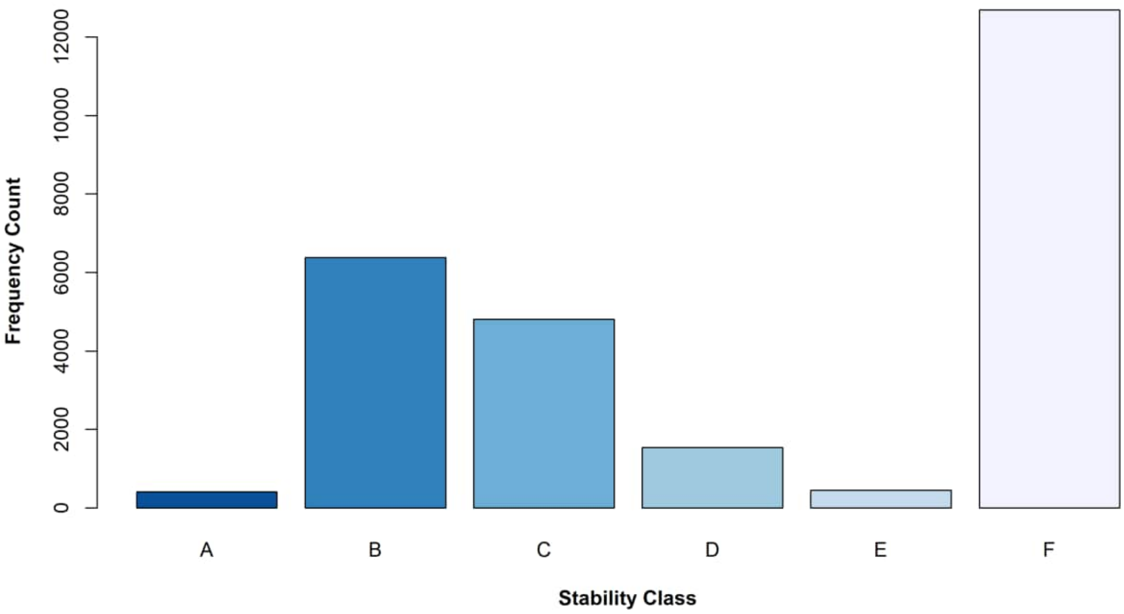

Figure 44 CALMET predicted stability class total frequency count – DESI Boyne Island

8.2.4 Mixing height

Mixing height or mixed layer height is an important meteorological parameter to air quality as it determines the vertical diffusion of atmospheric pollutants in the boundary layer (Aron (1983); Stull (1988); Tang *et al*. (2016)). Mixing height is estimated within CALMET for stable and convective conditions (respectively), with a minimum mixing height of 50 m.

Figure 45 to Figure 51 present mixing height statistics by hour of day across the meteorological dataset (2017-2019) as generated by CALMET for locations representing the Project site, DESI stations, and BoM stations. The BoM monitoring stations predict higher night-time mixing heights when compared to the other modelled monitoring locations. This is consistent with mixing heights above urban areas, which tend to be higher due to larger surface roughness values (from urban structures of varying height and size) and increased surface heating (Baklanov & Kuchin, 2004). Overall, these results are consistent with general atmospheric processes that show increased vertical mixing with the progression of the day, as well as lower mixing heights during night-time. In addition, peak mixing heights are consistent with typical ranges.

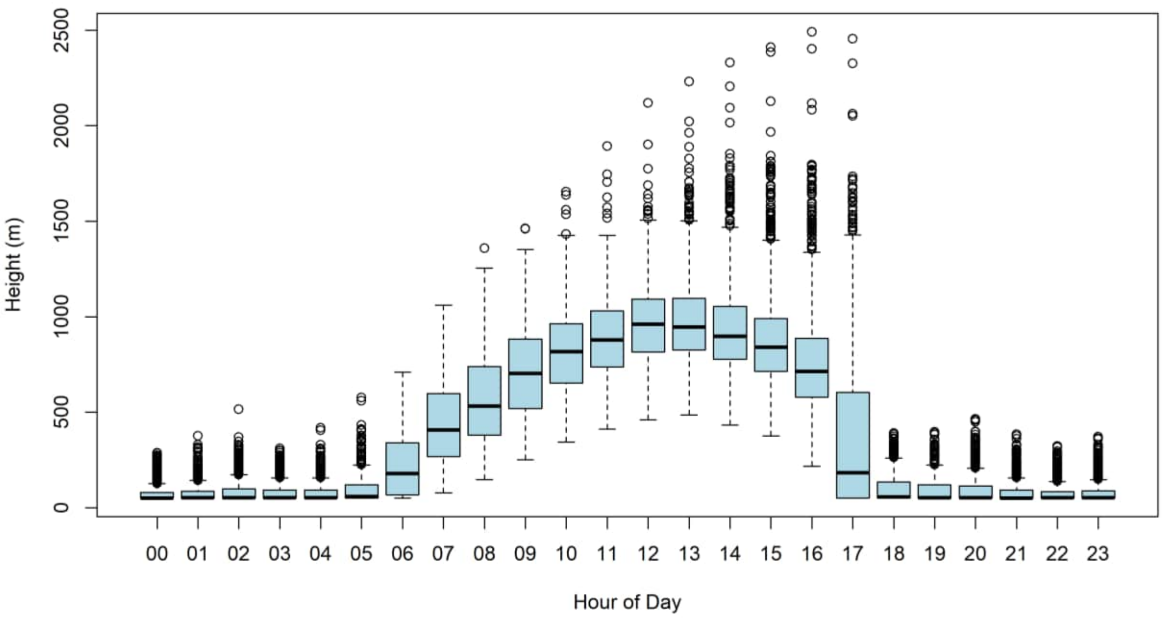

Figure 45 CALMET predicted mixing height box and whisker plot – The Project site

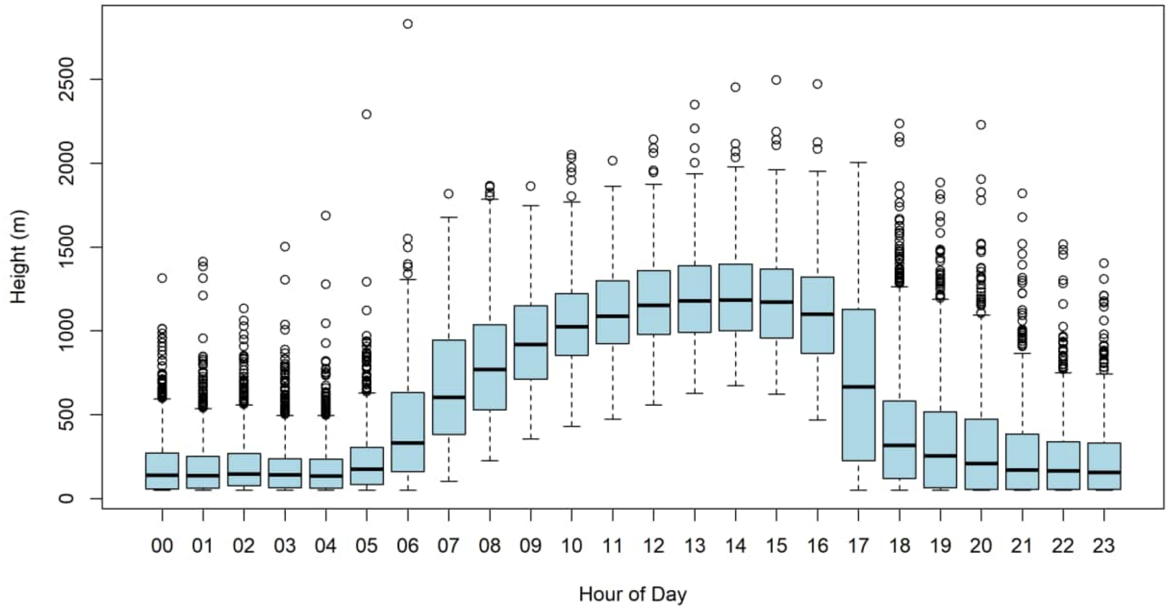

Figure 46 CALMET predicted mixing height box and whisker plot – BoM Gladstone Airport

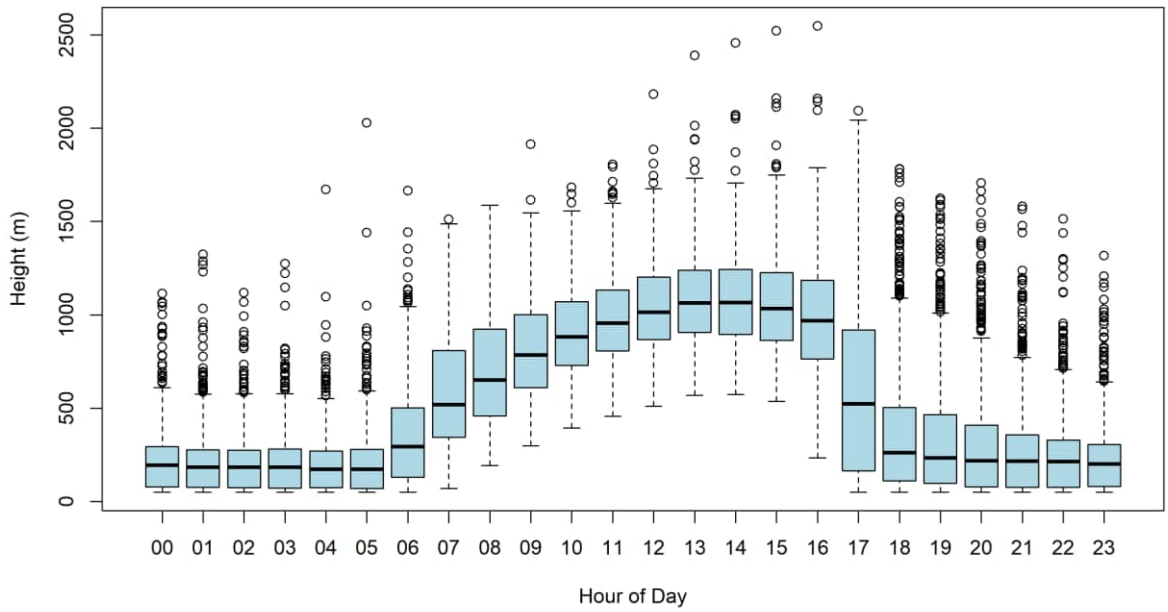

Figure 47 CALMET predicted mixing height box and whisker plot – BoM Gladstone Radar

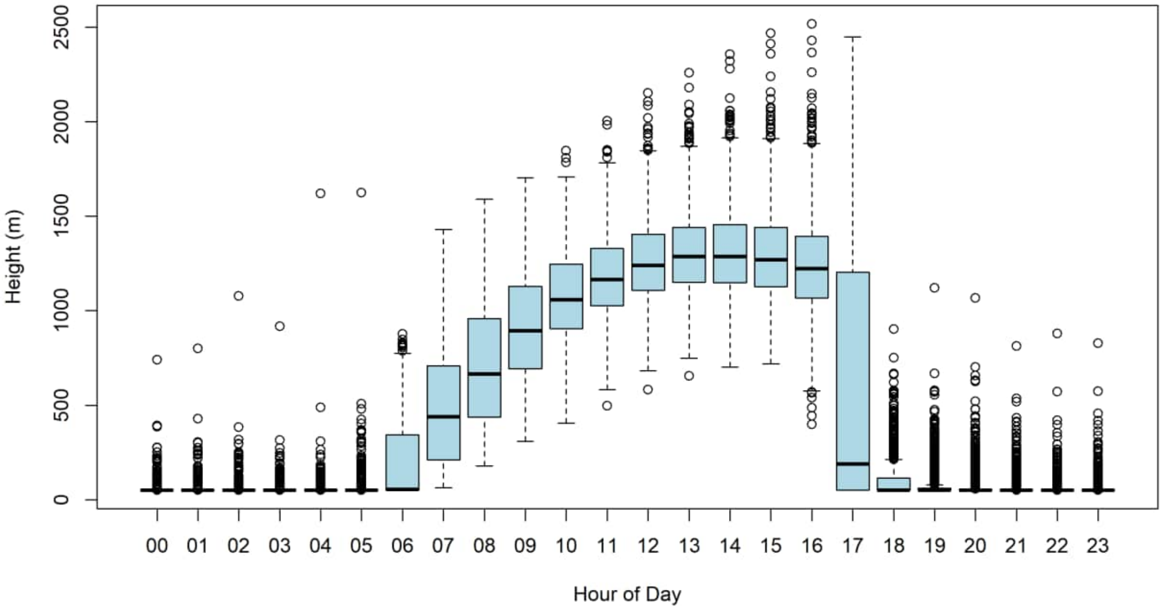

Figure 48 CALMET predicted mixing height box and whisker plot – DESI Aldoga

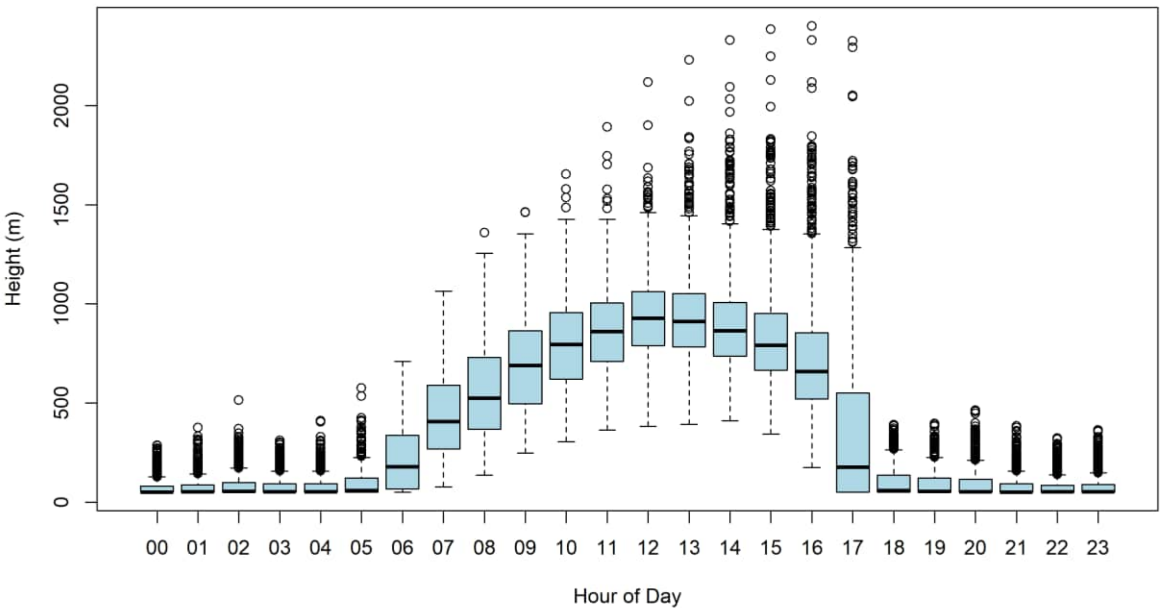

Figure 49 CALMET predicted mixing height box and whisker plot – DESI Boat Creek

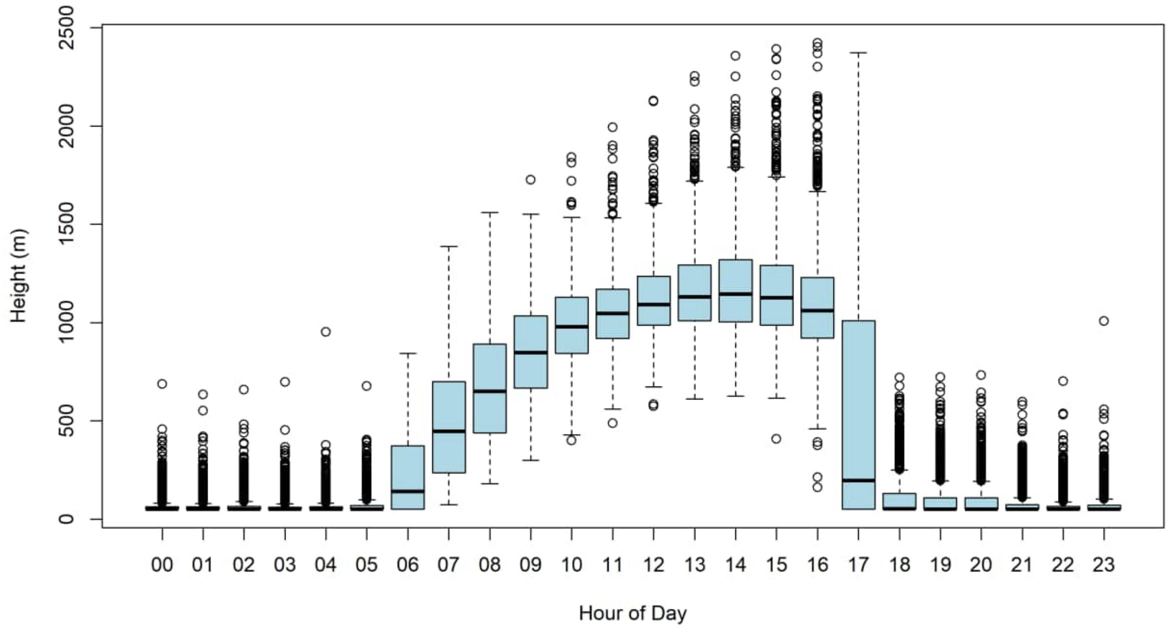

Figure 50 CALMET predicted mixing height box and whisker plot – DESI Targinie

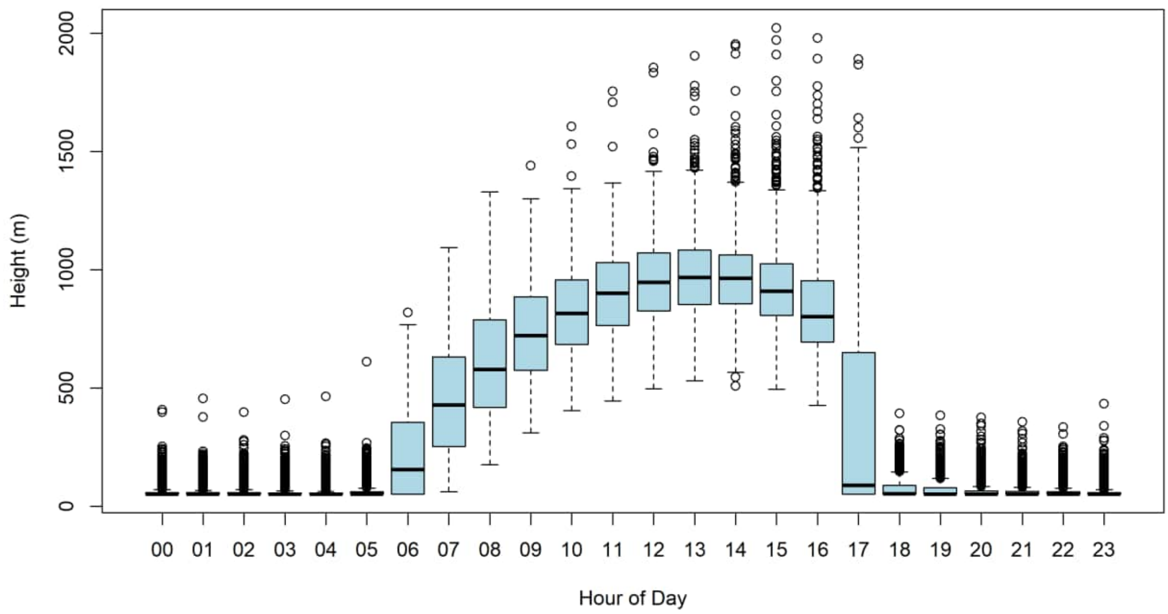

Figure 51 CALMET predicted mixing height box and whisker plot – DESI Boyne Island

8.2.5 Suitability of developed meteorology

A three year meteorological dataset for the period of 2017-2019 has been prepared for the Study Area and Gladstone airshed using a combination of local observations and prognostic meteorological modelling. Data has been evaluated using hourly monitoring data extracted at DESI and BoM monitoring stations. The findings of the data analysis show that the CALMET model is performing well, with predicted meteorology at BoM and DESI monitoring station locations showing good agreement with the measured meteorology. The following key points were noted about the accuracy of the developed 3-year meteorology dataset:

- Wind direction flow patterns are well represented in the CALMET meteorology data, showing good agreement with the monitoring data.
- Modelled wind speeds correlated well with the monitoring data showing minimal variance between the two datasets.
- Percentage calms on a whole were slightly under predicted by CALMET; however, the differences in predictions are not considered significant enough to produce erroneous results from the model.
- On average more unstable conditions occurred during the day and stable conditions occurred during the night. This is consistent with typical atmospheric processes expected in an urban and rural area such as the Gladstone region.
- Predicted mixing heights showed increased vertical mixing with the progression of the day, as well as lower mixing heights during night-time.

As a result of the above findings, the predicted meteorology is considered fit for purpose and acceptable for use in modelling of emissions from the Project and within the Gladstone airshed model.

9.0 Dispersion modelling

The following sections describe the Project related dispersion modelling as well as the Gladstone airshed modelling of NO_x completed. This section describes the CALPUFF model settings used, source emission parameters, and an analysis of model performance by way of comparing measured NO_2 concentrations from existing Gladstone airshed sources with measured DESI monitoring stations.

9.1 Model settings

Table 35 summarises the key CALPUFF model settings used to model background NO_x emissions from the existing emission sources within the Gladstone airshed.

Table 35 CALPUFF model settings

Parameter	Input
CALPUFF version	7.2.1
Sampling grid resolution	250 m
Dispersion algorithm	Turbulence computed from micrometeorology and PDF method
Meteorological data period	1 January 2017 – 31 December 2019
Stack tip downwash	Active

9.2 Emission source parameters

Table 36 presents the model parameters and location coordinates for each of the modelled stack emission sources for the Project.

Table 36 Project source parameters

Emission Source	Coordinates (GDA, zone 56)		Stack Height	Stack Diameter	Efflux Velocity	Efflux Temperature	Oxygen content
-	X (m)	Y (m)	m	m	m/s	°K	% v/v
Stage 1							
PPF-E1	313,627	7,362,315	11.7	0.15	10.0	353	14.0
PPF-E2	313,627	7,362,303	9.8	0.30	19.0	298	-
PPF-E3	313,568	7,362,304	9.8	0.15	31.0	353	-
PPF-E4	313,559	7,362,312	10.0	0.10	15.0	363	-
PPF-E5	313,557	7,362,297	7.0	0.31	19.0	313	-
Stage 2							
E2	313,683	7,362,470	15.0	0.35	10.0	323	-
E3	313,680	7,362,487	15.0	0.15	7.0	298	20.0
E4	313,689	7,362,406	15.0	1.00	10.0	313	-
E5	313,771	7,362,372	20.0	0.15	10.0	373	1.7
E6-A	313,744	7,362,402	20.0	0.40	10.0	423	1.7
E6-B	313,744	7,362,403	20.0	0.40	10.0	423	1.7
E7	313,763	7,362,356	20.0	0.20	10.0	423	1.7

Emission Source	Coordinates (GDA, zone 56)		Stack Height	Stack Diameter	Efflux Velocity	Efflux Temperature	Oxygen content
E8-A	313,674	7,362,449	20.0	0.60	10.0	423	1.7
E8-B	313,674	7,362,450	20.0	0.60	10.0	423	1.7
E8-C	313,674	7,362,451	20.0	0.60	10.0	423	1.7
E9	313,744	7,362,343	15.0	0.30	5.0	353	-
E11	313,754	7,362,341	10.0	0.60	15.0	323	-
E13A	313,747	7,362,339	20.0	0.50	10.0	403	-
E13B	313,747	7,362,340	20.0	0.50	10.0	403	-
E17	313,598	7,362,515	26.25	1.27	18.3	1,273	-

Emission parameters were retrieved for 153 existing emission sources from publicly available environment authorities, which included release limit data for the following identified cumulative emissions sources (as per Section 5.1):

- Cement Australia (EPPR00846713);
- Rio Tinto Alcan Yarwun (EPPR00926513);
- Orica Australia Yarwun (EPPR00872013);
- NRG Gladstone (EPPR00973013);
- Australia Pacific LNG (EPPG00715613);
- Queensland Curtis LNG (EPPG00711513);
- Santos LNG (EPPG00712213).

Insufficient information was able to be sourced for the Boyne Smelters and QAL industrial sites to precisely represent source emissions from each of these industrial sites. As such, pseudo source emission points were used to represent the emissions from these locations coupled with reported NPI emissions. Due to the separation distance from the Project and identified sensitive receptor locations the impacts from these two sites to the Project specific sensitive areas is likely to be low. Therefore, for this AQIA it was considered an appropriate approach in lieu of site-specific emission parameters from these two industrial sites.

9.3 Analysis of modelled existing emission sources

Figure 52 and Figure 53 present the results of the background NO_2 airshed modelling for existing emission sources in the Gladstone airshed. The predicted results have been converted from modelled NO_x results using the ARM2 methodology developed from DESI Gladstone NO_x monitoring data as per Section 7.4.

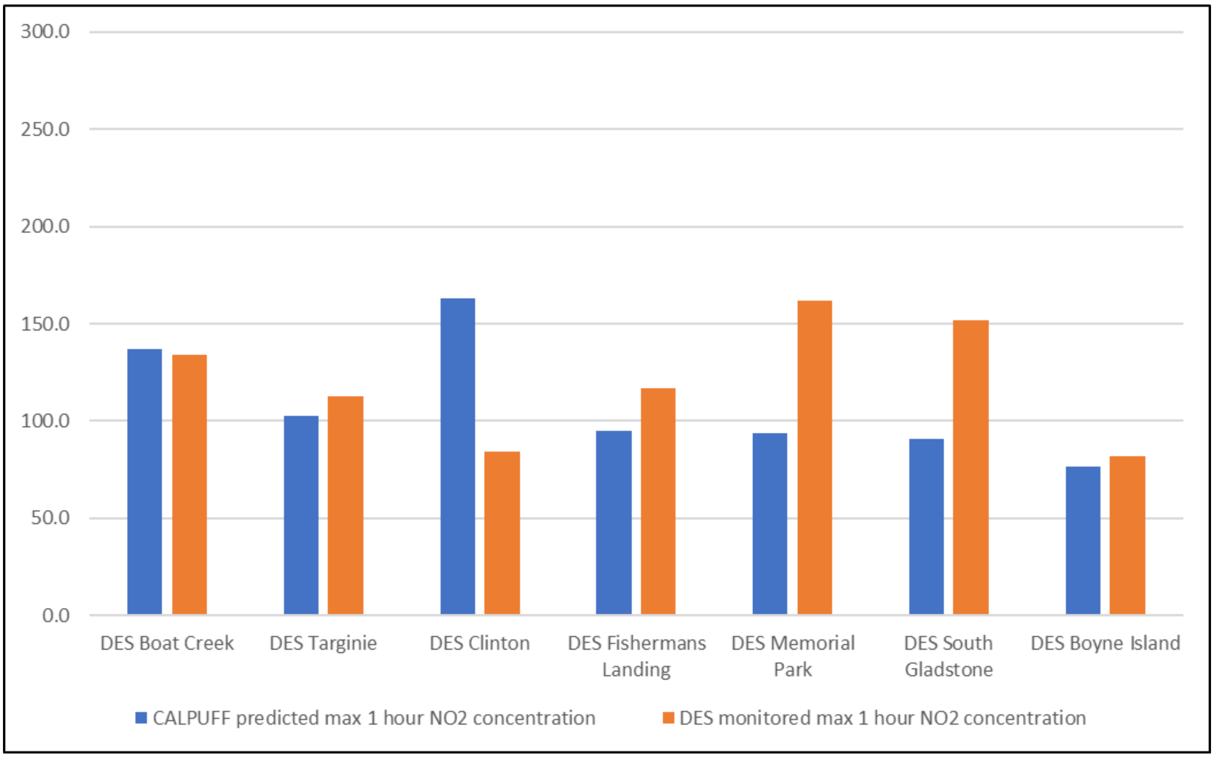

Figure 52 Predicted maximum 1-hour NO_2 concentrations compared with DESI monitoring data (2017-2019)

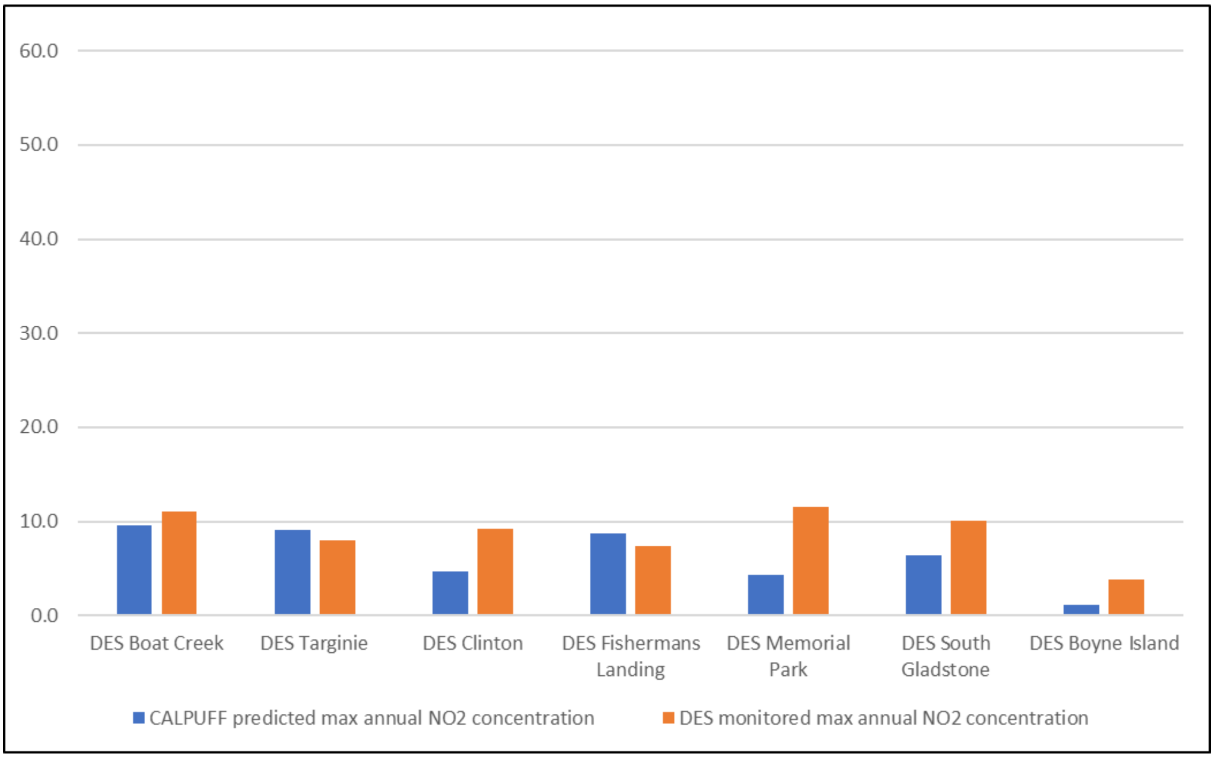

Figure 53 Predicted maximum annual NO_2 concentration compared with DESI monitoring data (2017-2019)

The CALPUFF model coupled with the ARM2 NO_x conversion methodology underpredicts NO_2 concentrations at all locations, with the exception of the Boat Creek and Clinton DESI stations. Overall, the CALPUFF predicted results show good agreement with the measured NO_2 data from the DESI monitoring stations, with most stations within a factor of 2 between the predicted and measured concentrations for both the maximum 1 hour and annual average predictions. The Boat Creek and Targinie DESI monitoring stations showed the best predicted results, with a factor of accuracy of between 0.9 and 1.1 for the maximum 1 hour and annual averaged NO_2 concentrations. This indicates a good representation of emissions sources, meteorology, land-use, and terrain for areas within close proximity to the Project site.

Guidance from Barclay and Scire (2011) states that CALPUFF model uncertainty is expected to be in the range of a factor of 2, which is consistent with the predicted results from the Gladstone NO_2 airshed model. Exceptions to this include the annual predictions at the DESI Memorial Park and Boyne Island monitoring stations, where predictions differ by a factor of 2.6 and 3.4, respectively. Generally, dispersion models are more reliable for estimating longer time averaged concentrations than short-term concentrations at specific locations. As such, it is likely the emissions source information near these stations is not represented well. The discrepancies in the CALPUFF predicted NO_2 results could be due to numerous factors such as the complexity of the atmosphere and emissions. However, it is thought they differ mainly due to the following reasons:

- Uncertainty in the modelled emissions data, that is based upon reported NPI data and site Environmental Authority emissions release limits, which does not account for day to day variability in emissions.
- Uncertainty in the emissions parameters used for the QAL and Boyne Island Smelter emission sources, which was not readily available for use in the AQIA.
- Omission of small-scale cumulative sources and other diffuse emissions sources (e.g. road and rail traffic emissions) in the CALPUFF model from the Gladstone area. This reason is likely a primary contributing factor for the CALPUFF underpredictions for the Memorial Park and South Gladstone DESI monitoring stations.

Overall, the Gladstone airshed CALPUFF model and ARM2 NO_x conversion shows good agreement with the measured NO_2 at most of the DESI monitoring sites. Where some discrepancies between measured and modelled are present, they are a significant distance from the Project and beyond the likely region of impacts from the Project. As such, the background CALPUFF airshed modelling of NO_2 in the Gladstone airshed is considered suitable for use to determine the cumulative impacts from the Project. However, in order to incorporate the variance in the modelled background concentrations to the DESI monitoring data, results will be factored to take into account the potential model inaccuracy.

Table 37 below presents each of the identified sensitive receptors, and the nearest DESI monitoring station and its applicable adjustment factor for predicted NO_2 results.

Table 37 NO_2 background adjustment factors

Sensitive receptor ID	Receptor type	Nearest DESI Monitoring Station	Adjustment Factor	
			1 hour	Annual
SR1	Residential	Boat Creek	1.0	1.1
SR2	Residential	Boat Creek	1.0	0.9
SR3	Residential	Clinton	0.5	2.0
SR4	Residential	Clinton	0.5	2.0
SR5	Residential	Clinton	0.5	2.0
SR6	Residential	Clinton	0.5	2.0
SR7	Residential	Clinton	0.5	2.0
ER1	State Forest (Mount Stowe SF)	Clinton	0.5	2.0
ER2	Conservation Park (Calliope CP)	Clinton	0.5	2.0
ER3	State Forest (Beecher SF)	Clinton	0.5	2.0
ER4	State Forest (Mount Maurice SF)	Clinton	0.5	2.0
ER5	State Forest (Targinie SF)	Targinie	1.1	0.9
ER6	Conservation Park (Garden Island CP)	Fisherman's Island	1.2	0.8
ER7	Conservation Park (Curtis Island CP)	Fisherman's Island	1.2	0.8
SZ1	Residential Region (Yarwun)	Boat Creek	1.0	1.1
SZ2	Residential Region (Gladstone)	Clinton, South Gladstone, and Memorial Park	1.3[a.]	1.3[a.]

Table notes:

a. The average factor between all the Clinton, South Gladstone and Memorial Park monitoring stations located within the sensitive receptor zone SZ2 was used to determine the used adjustment factors.

10.0 Limitations of assessment

The atmosphere is a complex, physical system, and the movement of air in a given location is dependent on a number of variables, including temperature, topography and land use, as well as larger-scale synoptic processes. Dispersion modelling is a method of simulating the movement of air pollutants in the atmosphere using mathematical equations. The model equations necessarily involve some level of simplification of these very complex processes based on an understanding of the processes involved and their interactions, available input data, processing time and data storage limitations.

These simplifications come at the expense of accuracy, which particularly affects model predictions during certain meteorological conditions and source emission types. For example, the prediction of pollutant dispersion under low wind speed conditions (typically defined as those less than 1 m/s) or for low-level, non-buoyant sources, is problematic for most dispersion models. To accommodate these known deficiencies, the model outputs tend to provide conservative estimates of pollutant concentrations at particular locations.

While the models contain a large number of variables that can be modified to increase the accuracy of the predictions under any given circumstance, the constraints of model use in a commercial setting, as well as the lack of data against which to compare the results in most instances, typically precludes extensive testing of the impacts of modification of these variables. With this in mind, model developers typically specify a range of default values for model variables that are applicable under most modelling circumstances.

The results of dispersion modelling; therefore, provide an indication of the likely level of pollutants within the modelling domain. While the models, when used appropriately and with high quality input data, can provide very good indications of the scale of pollutant concentrations and the likely locations of the maximum concentrations occurring, their outputs should not be considered to be representative of exact pollutant concentrations at any given location or point in time.

In relation to this assessment, there are a number of limitations and assumptions in the modelling methodology which add varying degrees of uncertainty to the results, including the following:

- Inaccuracies and uncertainty are inherent in the NPI emission factors used to estimate some Project emissions. The published factors are the best currently available estimates of emissions from mining activities but may or may not provide a realistic estimation of actual site-specific emission rates. Each published emission factor, including those used in this assessment, comes with an associated Emission Factor Rating, which range from excellent (low uncertainty) to poor (very high uncertainty). The published emission factors, and consequently the Project emission rates, should therefore be viewed with a degree of caution.
- Emission rates were modelled as a constant rate for the duration of the modelled year. Realistically, emission rates are likely to show some variability. This means that during worst-case meteorological conditions, which usually occur at night, the model is assuming the same constant emission rate as all other times. In reality, the likelihood of a high emission event occurring concurrently with worst-case meteorological conditions is low.

Based on these limitations in the modelling methodology, all predictions made in this assessment can be considered conservative in nature.

11.0 Cumulative impact assessment

11.1 Model results

The predicted cumulative ground level concentrations have been compared against the adopted air quality objectives for the identified pollutants and are presented below in Table 38, Table 39 and Table 40. The results are presented in the following categories:

- "Project", presenting the Project contribution for the highest predicted cumulative result.
- "Background", presenting the adopted background concentrations, or in the case of NO_2 and NH_3 the cumulative concentrations due to the existing sources in the Gladstone airshed.
- "Factored background", presenting the modelled NO_2 cumulative concentration due to existing sources factored as per Table 37 in Section 9.3.
- "Cumulative", presenting the total of Project and background concentrations.
- "Factored cumulative", presenting the total of Project and factored background concentrations.

Predicted contour plots for the maximum predicted Project only concentrations and maximum predicted cumulative concentrations for maximum 1-hour and annual concentrations of NO_2 are presented in Figure 54 and Figure 57.

Table 38 Maximum predicted pollutant concentrations

Pollutant	Averaging Period	Maximum predicted pollutant concentration at an identified sensitive receptor or zone (µg/m³)			Adopted objective (µg/m³)	Environmental Value	Sensitive Receptor of Maximum Predicted Concentration
		Project	Background	Cumulative			
Ammonia	1 hour	15.4	4.2[a]	19.6	330	Air toxic	SZ1
CO	8 hours	5.6	77.9	83.5	11,000	Health and wellbeing	SZ1
SO_2	1 hour	7.3	3.1	10.4	570		SZ1
	24 hours	1.7	4.6	6.3	229		SZ1
	Annual	0.1	5.3	5.4	57		SZ1
	Annual	0.4		5.7	21	Health and biodiversity of ecosystems (forests and natural vegetation)	ER2
PM_{10}	24 hours	3.6	18.4	22.0	50	Health and wellbeing	SR2
	Annual	0.2	16.9	17.1	25		SZ1
$PM_{2.5}$	24 hours	3.6	6.2	9.8	25		SR2
	Annual	0.2	6.2	6.4	8		SZ1
Benzene	Annual	0.11	4.6	4.7	5.4		SZ1
Toluene	30 minutes	8.0	7.9	15.9	1,100	Protecting aesthetic environment	SZ1
	24 hours	1.8	6.3	8.1	4,100	Health and wellbeing	SR2
	Annual	0.1	8.3	8.4	400		SZ1
Xylenes	24 hours	1.8	31.9	33.7	1,200		SZ1
	Annual	0.1	27.6	27.7	950		SZ1

Table notes:

a. The background concentration for ammonia was determined by modelling emissions from the Orica Yarwun facility, with the total cumulative concentration being the combined total for ammonia emissions from the Project and Orica Yarwun.

Table 39 Maximum predicted 1-hour NO_2 average concentrations

Sensitive Receptor	Sensitive Receptor Details	Predicted maximum 1-hour NO_2 concentration (µg/m³)					Adopted objective	Environmental Value
		Project	Background	Factored background	Cumulative	Factored cumulative		
SR1	Residential	0.9	95.3	95.3	96.3	96.3	250	Health and wellbeing
SR2	Residential	5.8	94.7	94.7	100.5	100.5		
SR3	Residential	0.1	78.1	39.0	78.2	39.1		
SR4	Residential	0.4	95.1	47.6	95.6	48.0		
SR5	Residential	0.1	86.0	43.0	86.1	43.1		
SR6	Residential	0.2	81.0	40.5	81.3	40.8		
SR7	Residential	0.2	94.7	47.4	95.0	47.6		
SZ1	Residential Region (Yarwun)	0.4	226.2	226.2	226.6	226.6		
SZ2	Residential Region (Gladstone)	0.1	225.1	292.6	225.2	**292.7**		
Table note: Predicted cumulative concentrations which exceed the air quality objective are presented in **bold**								

Table 40 Maximum predicted annual average NO_2 concentrations

Sensitive Receptor	Sensitive Receptor Details	Predicted maximum annual NO_2 concentration (µg/m^3)					Adopted objective	Environmental Value
		Project	Background	Factored Background	Cumulative	Factored Cumulative		
SR1	Residential	0.2	11.2	12.3	11.4	12.5	62	Health and wellbeing
SR2	Residential	0.3	10.6	9.6	10.9	9.9		
SR3	Residential	0.1	5.9	11.7	6.0	11.8		
SR4	Residential	0.2	7.5	14.9	7.6	15.1		
SR5	Residential	0.1	6.2	12.5	6.3	12.6		
SR6	Residential	0.1	4.7	9.4	4.8	9.4		
SR7	Residential	0.1	6.4	12.9	6.5	13.0		
ER1	State Forest (Mount Stowe SF)	1.1	13.5	26.9	14.6	28.0	33	Health and biodiversity of ecosystems (forests and natural vegetation)
ER2	Conservation Park (Calliope CP)	0.6	12.7	25.4	13.4	26.1		
ER3	State Forest (Beecher SF)	0.1	5.6	11.1	5.6	11.2		
ER4	State Forest (Mount Maurice SF)	0.1	4.3	8.6	4.3	8.6		
ER5	State Forest (Targinie SF)	0.4	18.0	16.2	18.4	16.6		
ER6	Conservation Park (Garden Island CP)	0.2	3.2	2.5	3.4	2.7		
ER7	Conservation Park (Curtis Island CP)	0.1	2.6	2.1	2.7	2.2		
SZ1	Residential Region (Yarwun)	0.3	14.2	15.6	14.5	15.9	62	Health and wellbeing
SZ2	Residential Region (Gladstone)	<0.1	10.4	13.5	10.4	13.6		

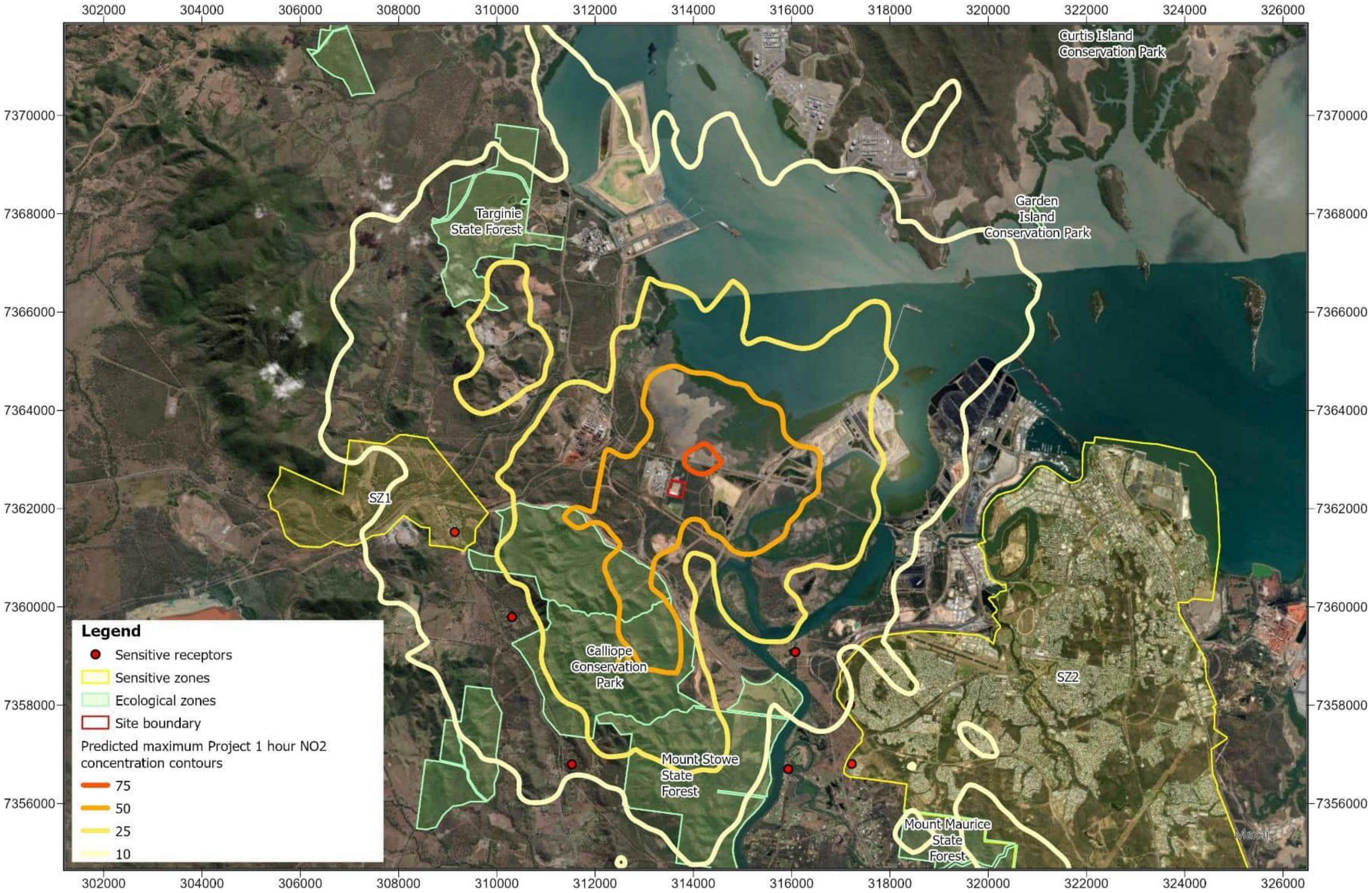

Figure 54 Maximum predicted Project only 1-hour average NO_2 concentrations (µg/m^3)

Figure notes:

1. Adopted 1-hour average NO_2 objective is 250 µg/m³
2. Coordinate system GDA Zone 56 in kilometres

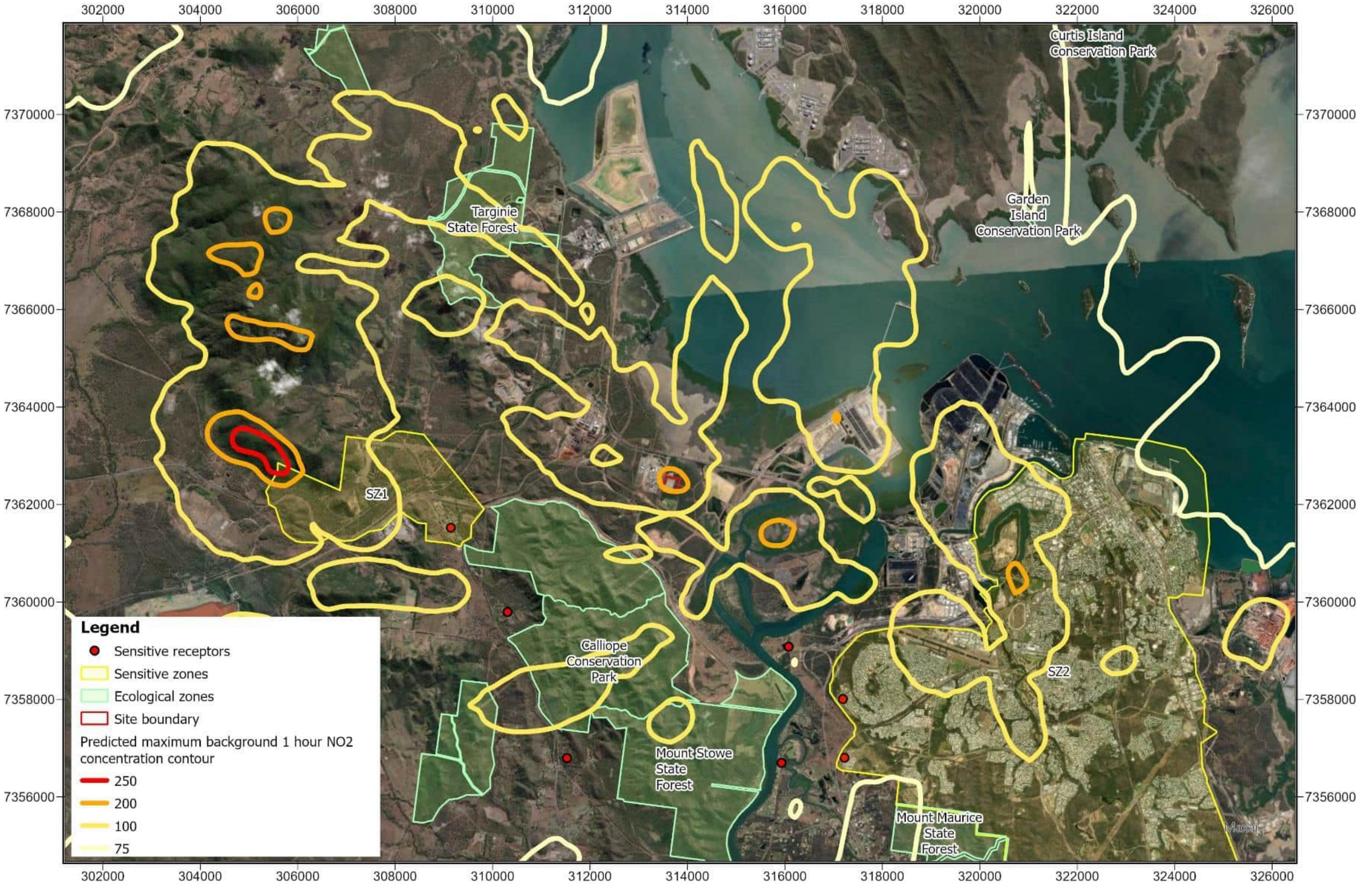

Figure 55 Maximum predicted Background 1-hour average NO_2 concentrations (µg/m³)

Figure notes:

1. Adopted 1-hour average NO_2 objective is 250 µg/m³
2. Coordinate system GDA Zone 56 in kilometres

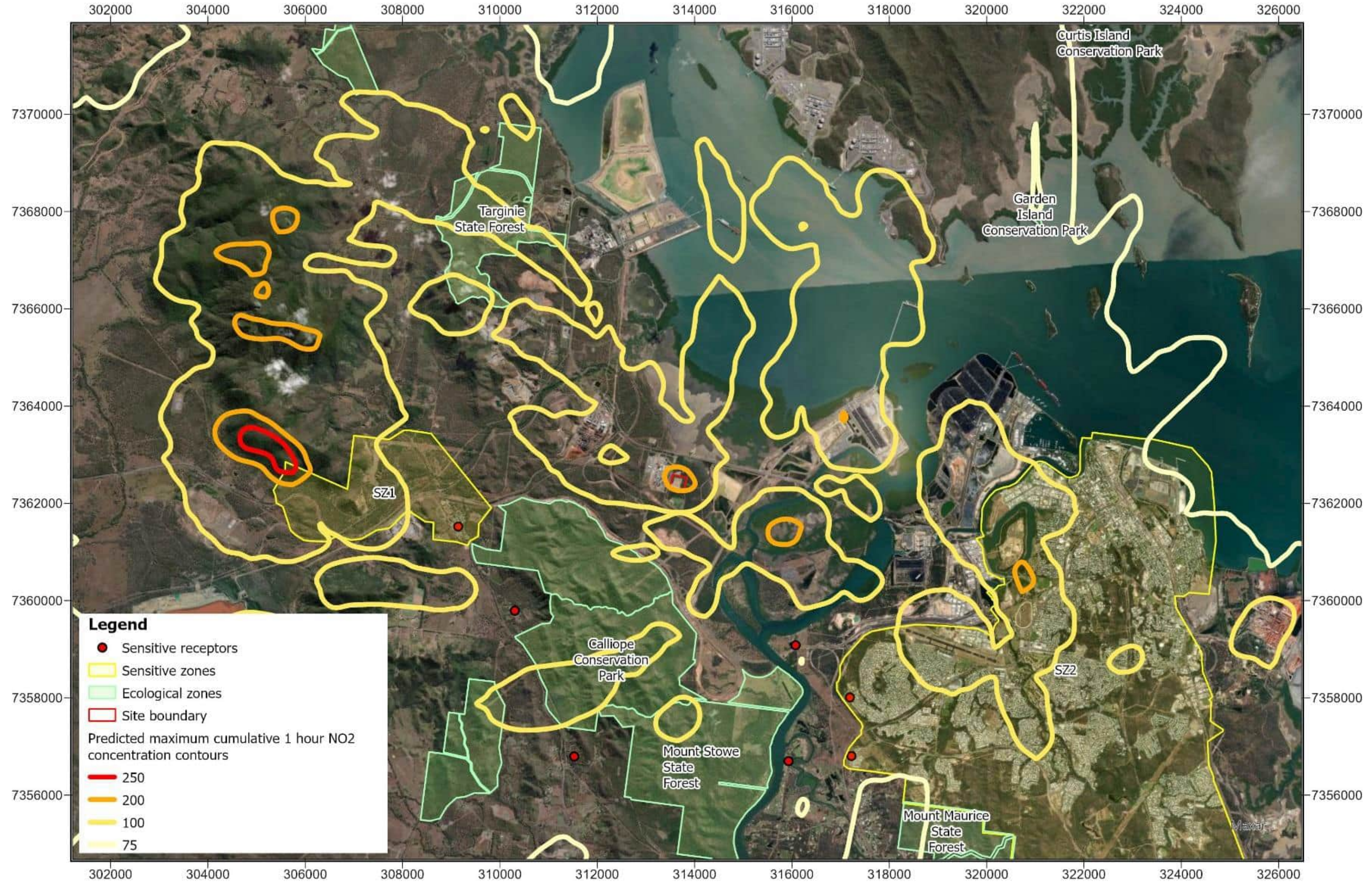

Figure 56 Maximum predicted Cumulative 1-hour average NO_2 concentrations (µg/m³)

Figure notes:

1. Adopted 1-hour average NO_2 objective is 250 µg/m³
2. Coordinate system GDA Zone 56 in kilometres

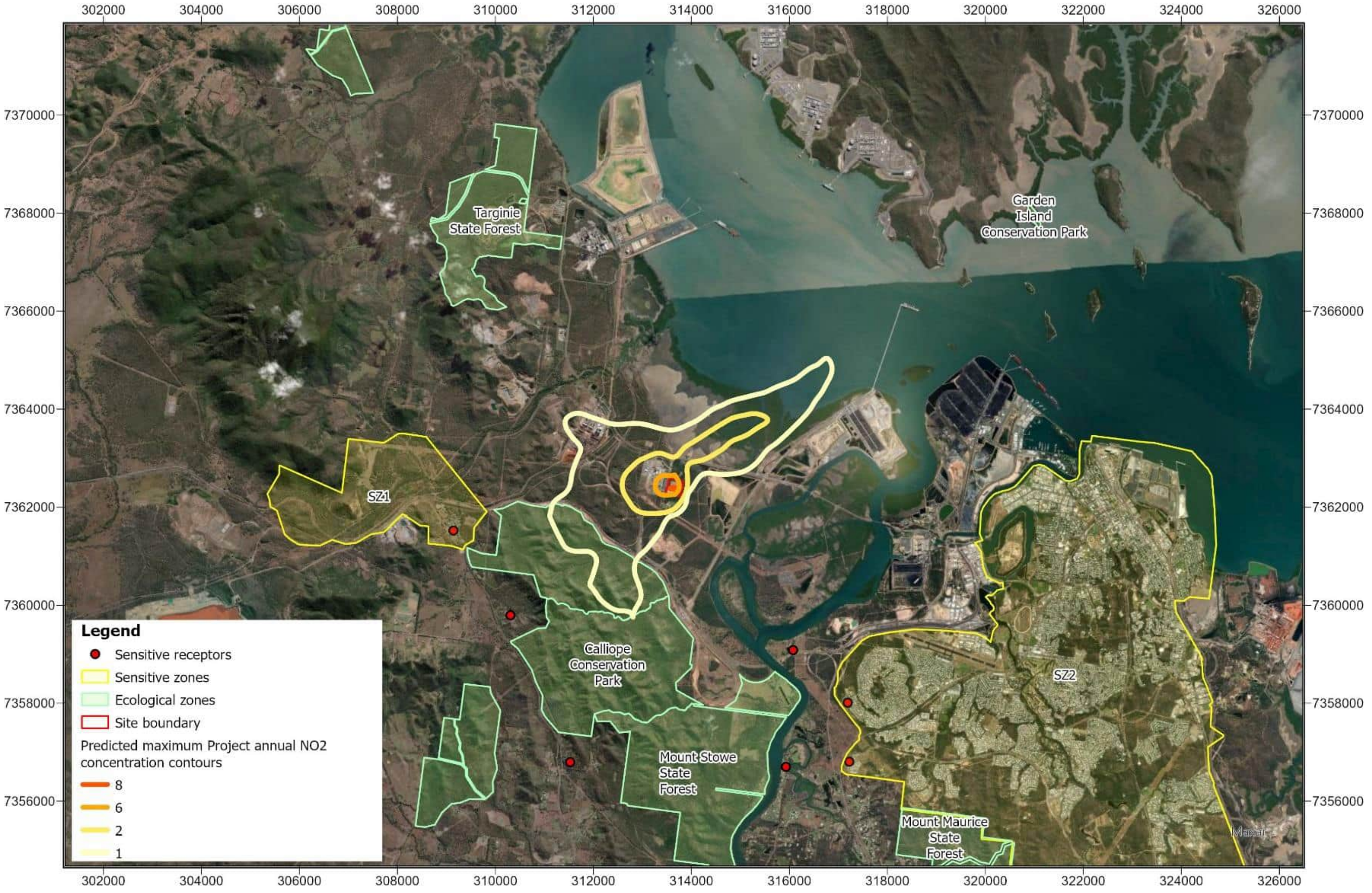

Figure 57 Maximum predicted Project only annual average NO_2 concentrations (µg/m³)

Figure notes:

1. Adopted annul average NO_2 objective is 62 µg/m³ for residential receptors and 33 µg/m³ for protected areas
2. Coordinate system GDA Zone 56 in kilometres

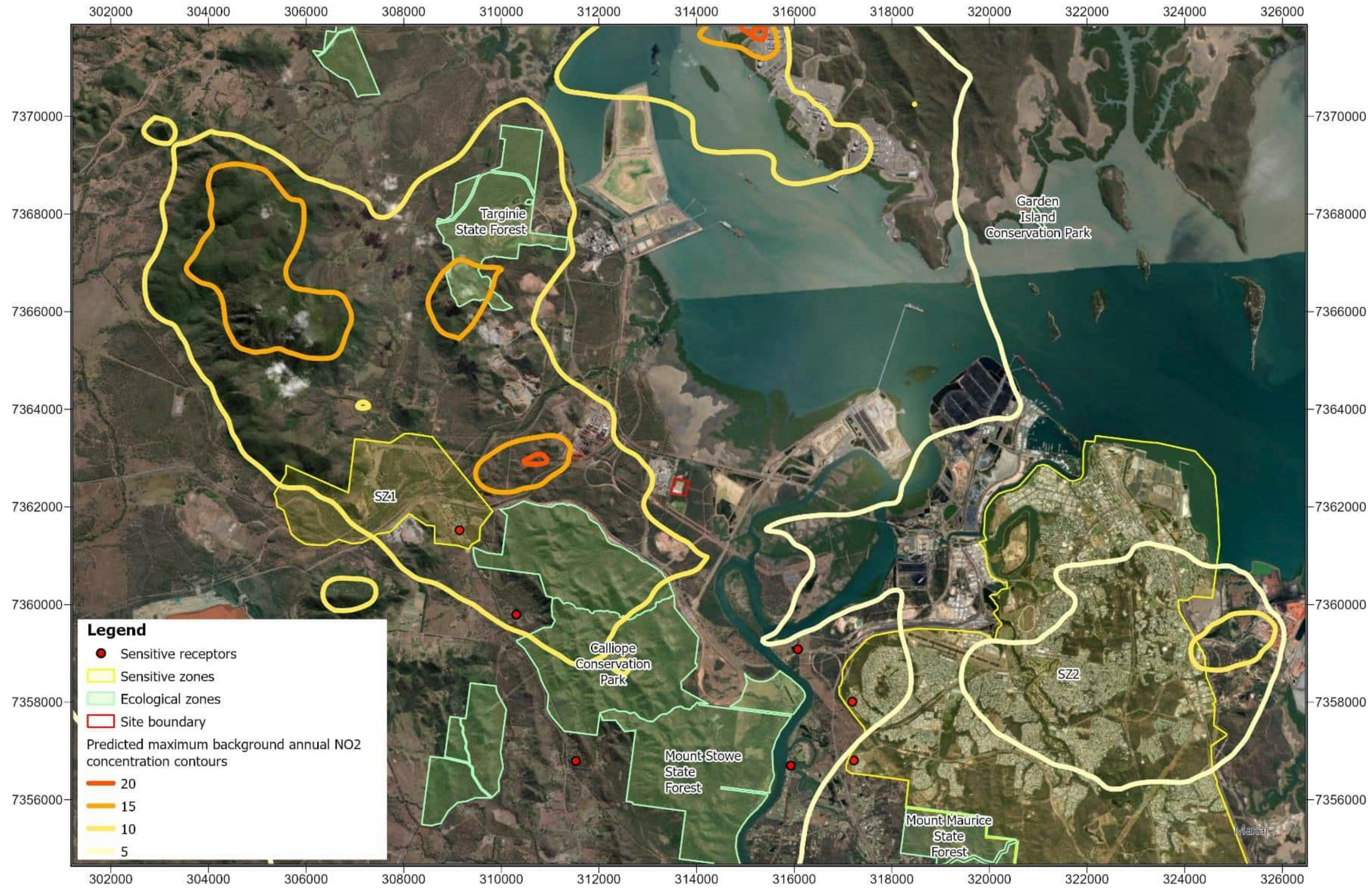

Figure 58 Maximum predicted Background annual average NO_2 concentrations (µg/m^3)

Figure notes:

1. Adopted annul average NO_2 objective is 62 µg/m³ for residential receptors and 33 µg/m³ for protected areas
2. Coordinate system GDA Zone 56 in kilometres

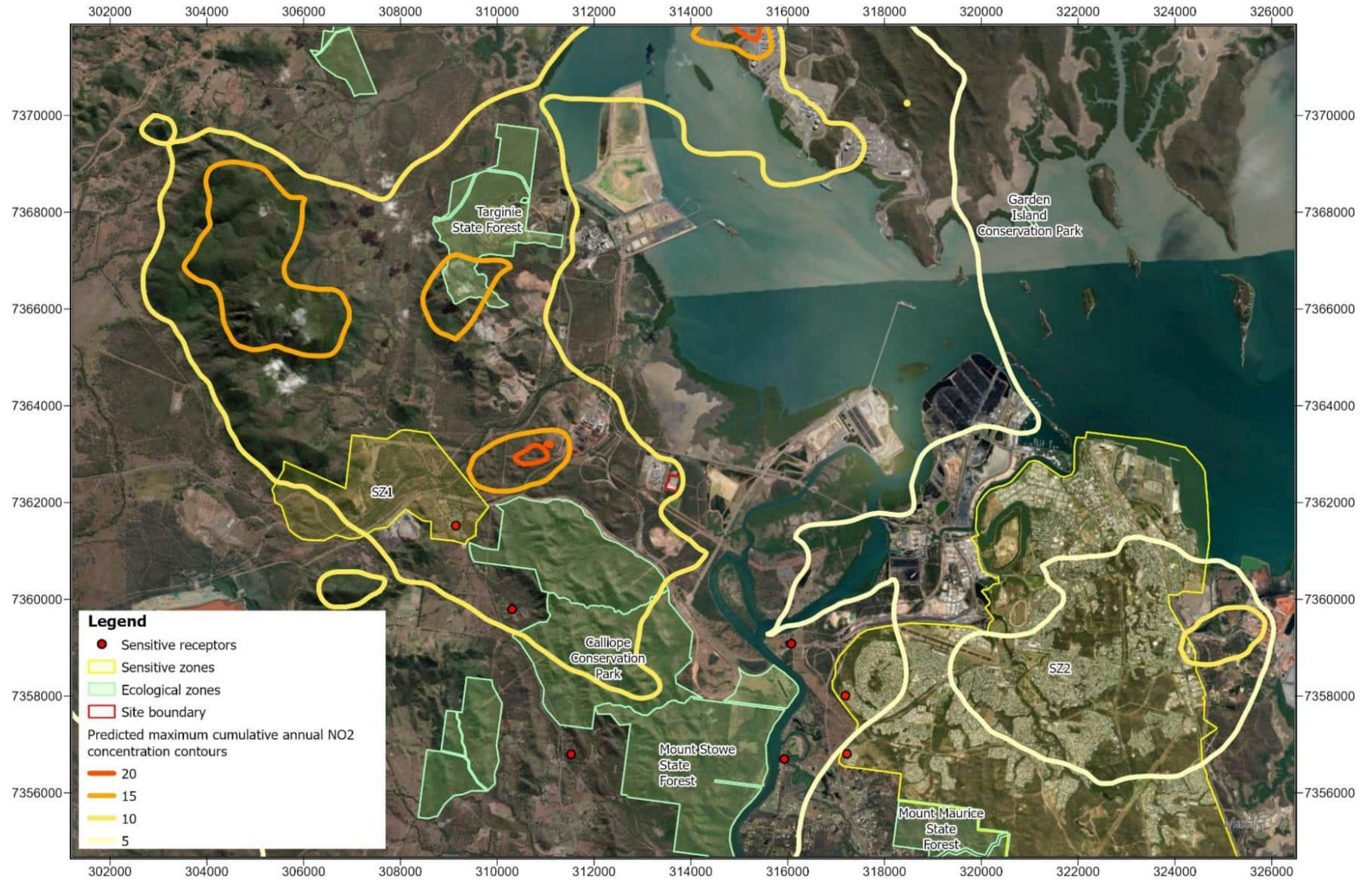

Figure 59 Maximum predicted Cumulative annual average NO_2 concentration (µg/m³)

Figure notes:

1. Adopted annul average NO_2 objective is 62 µg/m³ for residential receptors and 33 µg/m³ for protected areas
2. Coordinate system GDA Zone 56 in kilometres

11.2 Discussion

The results of the AQIA are summarised as follows:

- A single exceedance of the 1-hour NO_2 objective was predicted at sensitive receptor zone SZ2 (Gladstone) with a predicted concentration of 293 µg/m^3. However, this prediction included only a minor contribution (0.1 µg/m^3, or 0.03%) from the Project and therefore the impact of the Project is considered negligible. All other modelled sensitive receptors and zones were compliant with the 1 hour NO_2 objective.
- There were no exceedances of the NO_2 annual average objective at any of the modelled sensitive receptors or zones.
- The Project only NO_2 contributions to the cumulative maximums include the following:
  - For the 1-hour average: 5.8 µg/m^3 at SR2, with an estimated cumulative NO_2 concentration of 100.5 µg/m^3. Higher cumulative concentrations of NO_2 were predicted at sensitive receptor zones SZ1 (Yarwun) and SZ2 (Gladstone); however, the Project only contributions for 1-hour average concentrations were only a minor contribution with the majority of these peak concentrations caused by modelled cumulative emission sources.
  - For the annual average at sensitive receptor or zone: 0.3 µg/m^3 at SR2, with an estimated cumulative NO_2 concentration of 9.6 µg/m^3.
  - For the annual average at ecological receptors: 1.1 µg/m^3 at ER1 (Mount Stowe SF), with an estimated cumulative NO_2 concentration 26.9 µg/m^3.
- There were no predicted exceedances of the 24-hour or annual average PM_{10} or $PM_{2.5}$ objectives at any of the modelled sensitive receptors or zones for Project only or cumulative predictions. The highest predicted Project only contribution for both PM_{10} and $PM_{2.5}$ was 3.6 µg/m^3 (14% of the $PM_{2.5}$ 24 hour objective and 7% of the 24-hour PM_{10} objective) at SR2.
- There were no predicted exceedances of the 8-hour average CO objective at any of the modelled sensitive receptors or zones for Project only or cumulative predictions. The highest Project only contribution was 5.6 µg/m^3 (0.05% of the objective) at SZ1 (Yarwun).
- There were no predicted exceedances of the 1-hour, 24 hour or annual average SO_2 criteria at any of the modelled sensitive receptors or zones for Project only or cumulative predictions. The highest Project only contribution was 7.3 µg/m^3 (1.3% of the 1-hour objective) at SZ1 (Yarwun).
- There were no predicted exceedances of the 1-hour ammonia objective at any of the modelled sensitive receptors for Project only or cumulative predictions. The highest Project only contribution was 15.4 µg/m^3 (4.7% of the 1-hour objective) at SZ1 (Yarwun).
- Modelling of cumulative TVOCs predicted no exceedances for any adopted air quality objectives of benzene, toluene, and xylenes. The highest Project only contribution for annual average benzene was 0.11 µg/m^3 (2.0% of the objective) at SZ1 (Yarwun).

Overall, the modelling assessment has determined that cumulative pollutant concentrations are generally expected to be compliant with relevant air quality objectives and that the Project will not contribute significantly to pollutant concentrations at sensitive receptors and sensitive zones. Based on the results of the assessment, emissions from the Project are considered to present low risk of causing significant impacts to air quality.

12.0 Mitigation measures

The Project should implement the following mitigation measures:

- If required to maintain compliance with the pollutant emission rates relied upon in this AQIA, appropriate air pollutant control systems should be installed for stack emission sources. This may include the following air pollutant control systems:
    - a wet scrubber system installed on the ammonia and nitric acid scrubber vent, and
    - baghouse filtration systems to locations in the process that may have significant particulate emissions.
- Installed air pollutant control systems should be maintained and used as per manufacturer specifications to ensure operational uptime and maximise pollutant removal efficiencies.
- A fume extraction system should be installed to capture fugitive emissions from the solvent extraction tanks.
- Natural gas fired boilers and burners should be maintained and used as per manufacturers specifications.

13.0 Conclusions

An AQIA was conducted to assess the potential for offsite impacts due to emissions from the industrial processes associated with the Project. Cumulative emissions of NO_2 were considered through airshed modelling of existing emission sources within the Gladstone airshed. Other pollutants of concern were assessed cumulatively through the adoption of static background concentrations based on analysis of DESI monitoring data for the Gladstone region.

The key findings of the assessment are summarised as follows:

- The closest sensitive receptors to the Project site have a separation distance of greater than 4 km. Based on the buffer distances prescribed by EPA Vic (2013) (maximum buffer distance requirement of 2 km), the separation distance to sensitive receptors is considered sufficient to mitigate the risk of odour impacts. Therefore, odour emissions from the site are considered unlikely to cause significant nuisance impacts at sensitive receptor locations.
- Predicted cumulative 1-hour and annual average NO_2 concentrations were below the adopted air quality objectives at all receptors, except for an exceedance predicted for sensitive receptor zone SZ2 (Gladstone). However, this prediction included only a minor contribution (0.1 µg/m^3, or 0.03%) from the Project and therefore the influence of the Project on this predicted exceedance is considered negligible.
- Predicted cumulative concentrations for all other pollutant species of concern were below the adopted air quality objectives for all averaging periods at all sensitive receptors considered in the assessment.

Overall, the assessment has determined that cumulative pollutant concentrations are generally expected to be compliant with relevant air quality objectives and that the Project will not contribute significantly to pollutant concentrations at sensitive receptors and sensitive zones. Based on the results of the assessment, emissions from the Project are considered to present low risk of causing significant impacts to air quality.

The predictions made in this assessment may differ from the ground level concentrations that could be experienced during actual operation of the Project. This is due to the inherent uncertainty of air dispersion modelling. Continued monitoring and appropriate management of air emissions according to the mitigation processes outlined in the assessment (refer Section 12.0) will ensure that air quality impacts are kept to acceptable levels.

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Appendix A

Detailed Site Layout

Appendix B

Additional Wind Roses

Appendix B Additional Wind Roses

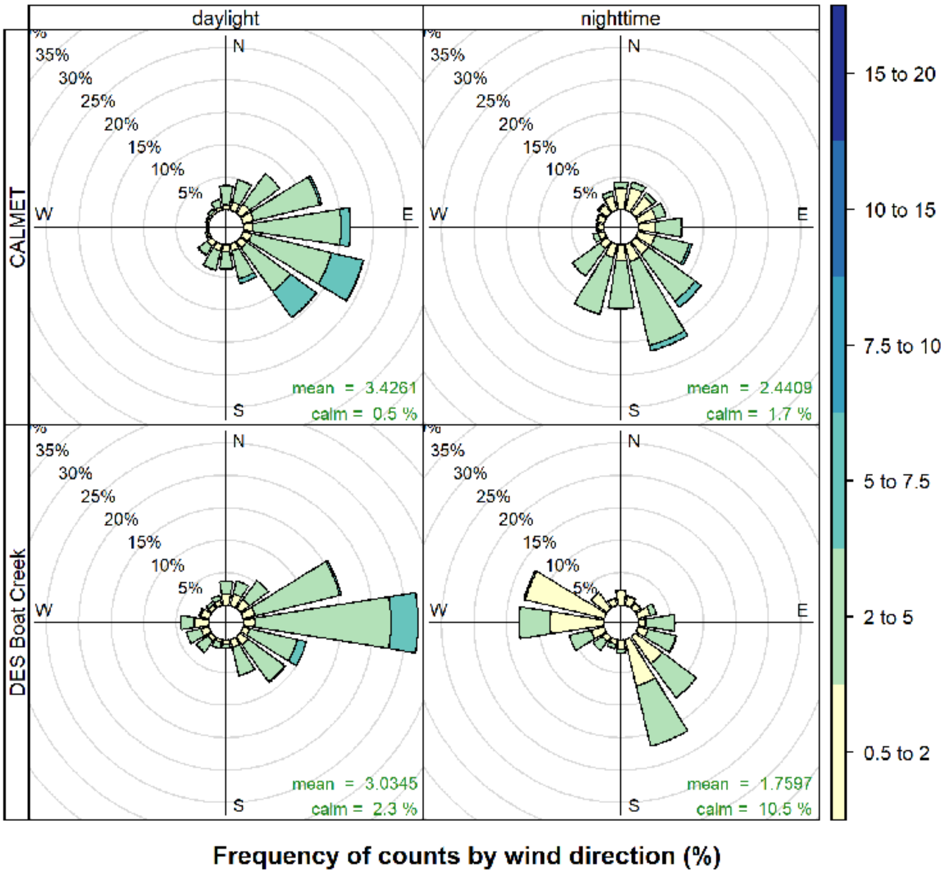

Figure 60 CALMET generated data daylight and night-time wind roses compared with monitoring data – The Project site compared with DESI Boat Creek

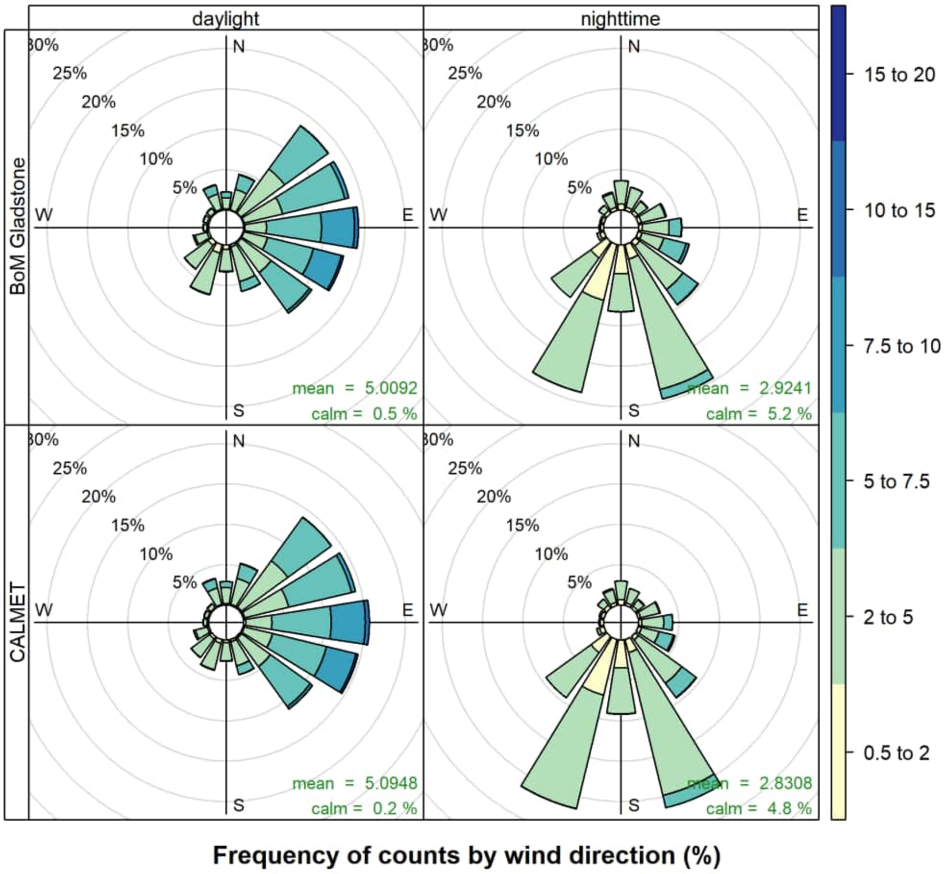

Figure 61 CALMET generated data daylight and night-time wind roses compared with monitoring data – BoM Gladstone Airport

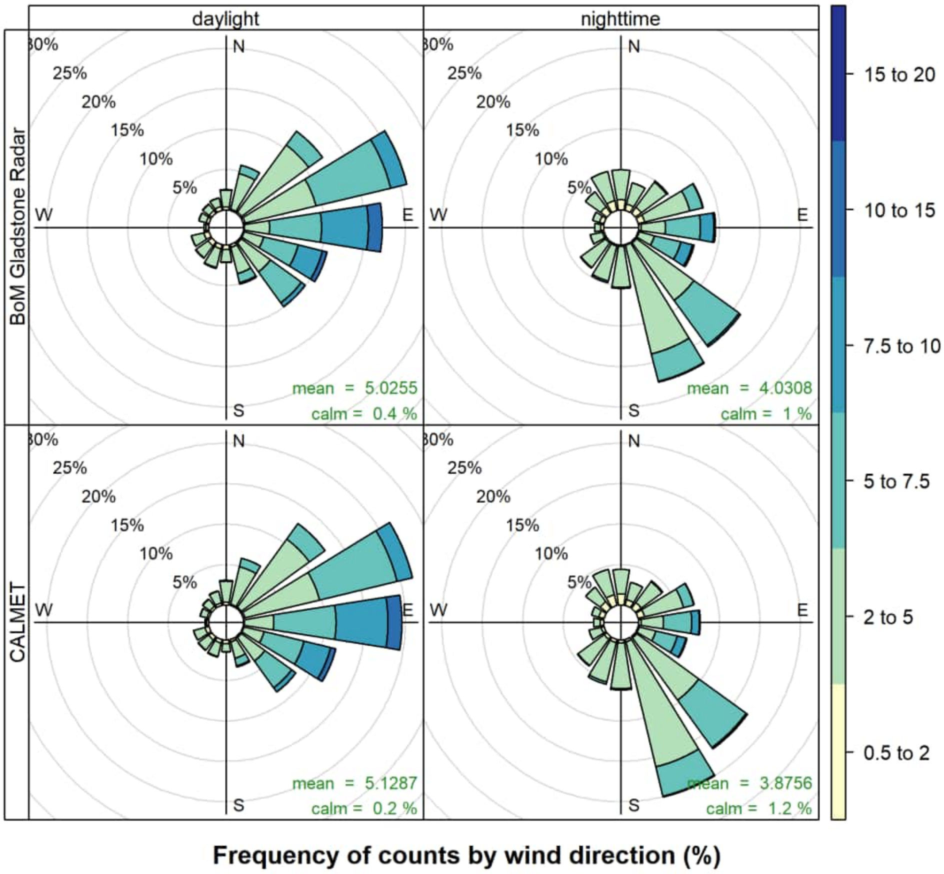

Figure 62 CALMET generated data daylight and night-time wind roses compared with monitoring data – BoM Gladstone Radar

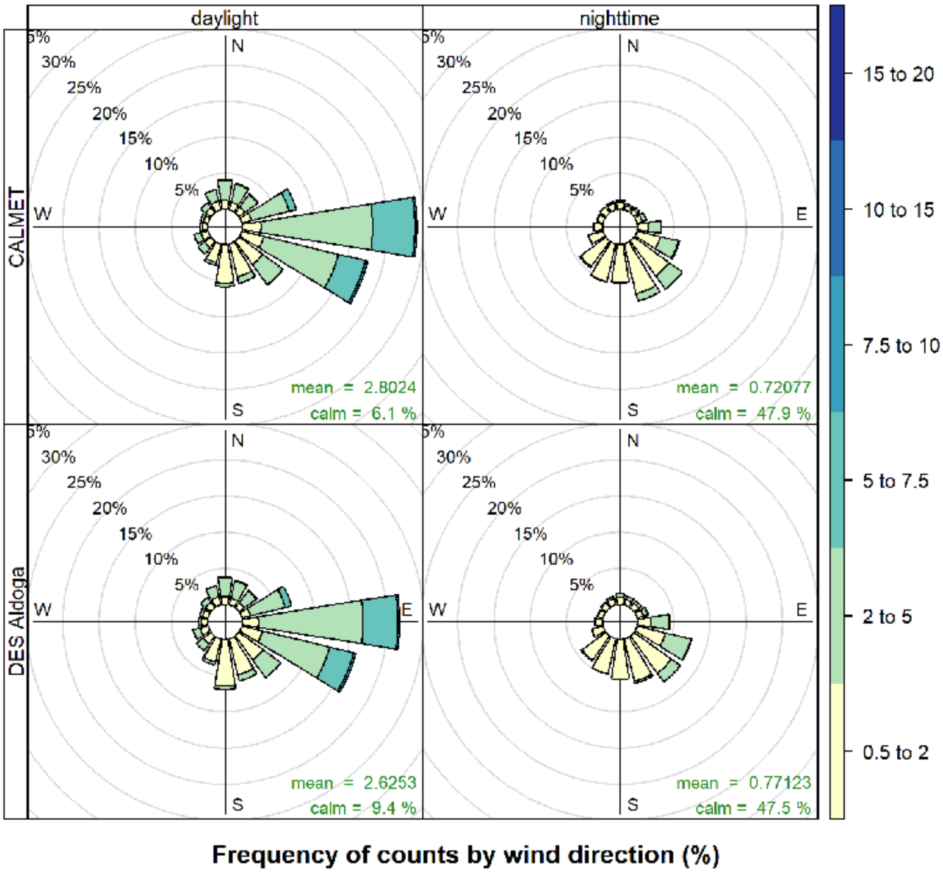

Figure 63 CALMET generated data daylight and night-time wind roses compared with monitoring data – DESI Aldoga

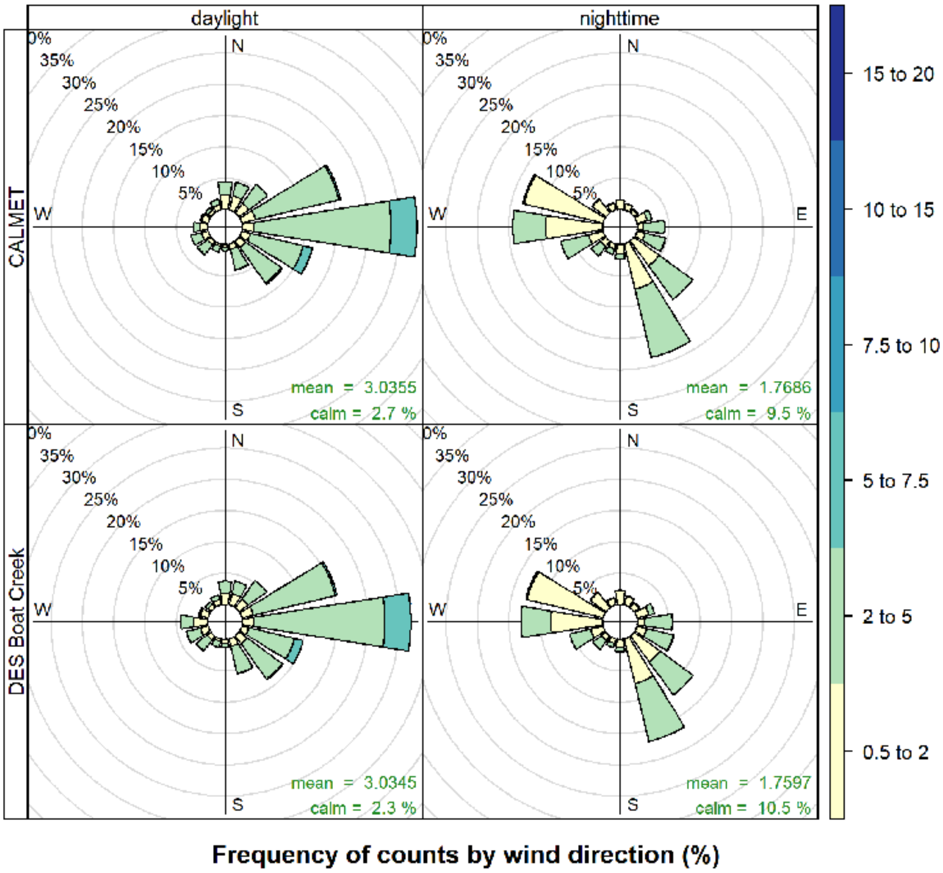

Figure 64 CALMET generated data daylight and night-time wind roses compared with monitoring data – DESI Boat Creek

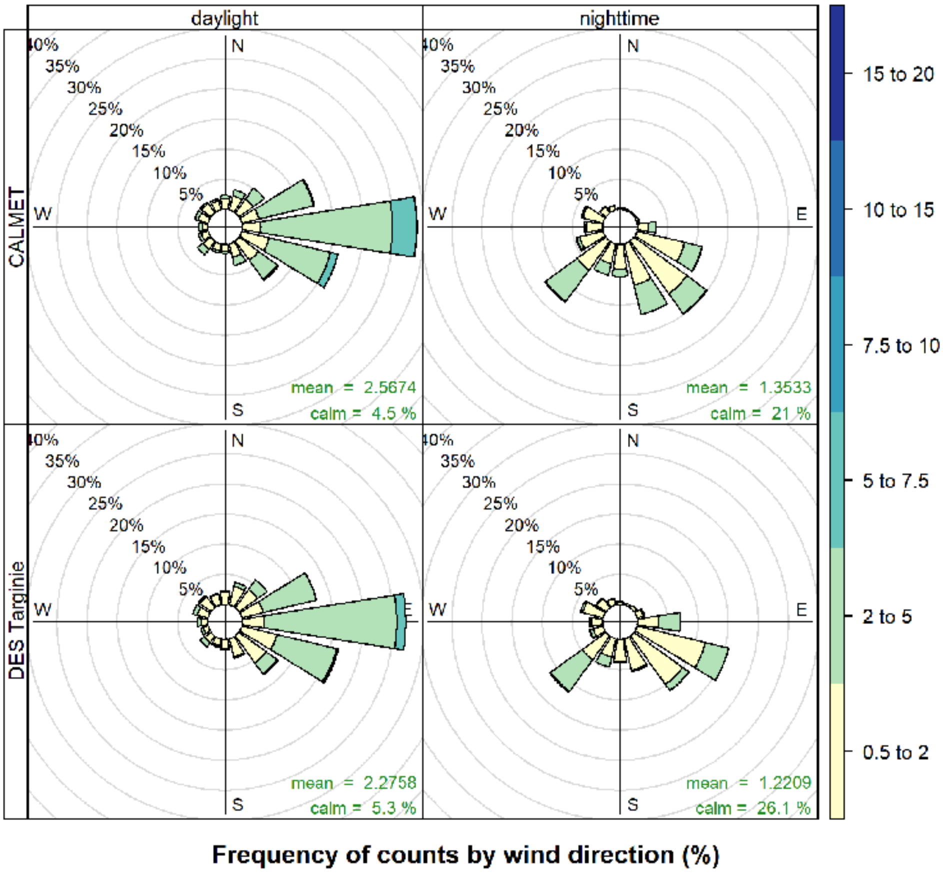

Figure 65 CALMET generated data daylight and night-time wind roses compared with monitoring data – DESI Targinie

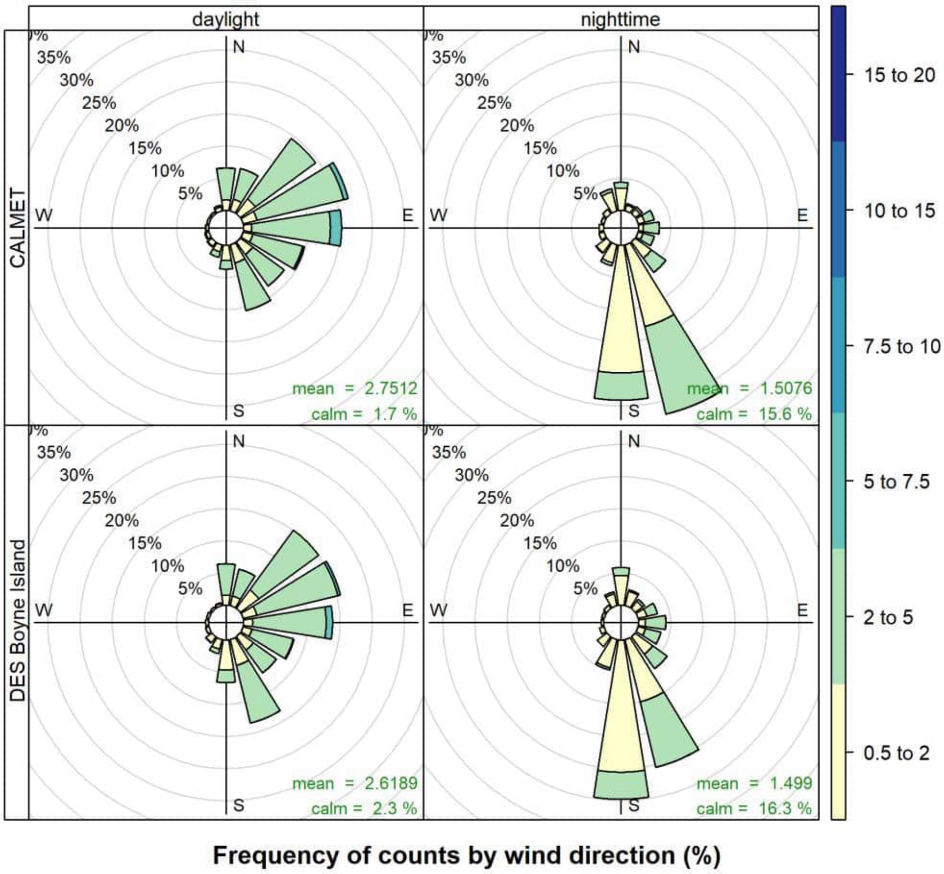

Figure 66 CALMET generated data daylight and night-time wind roses compared with monitoring data – DESI Boyne Island

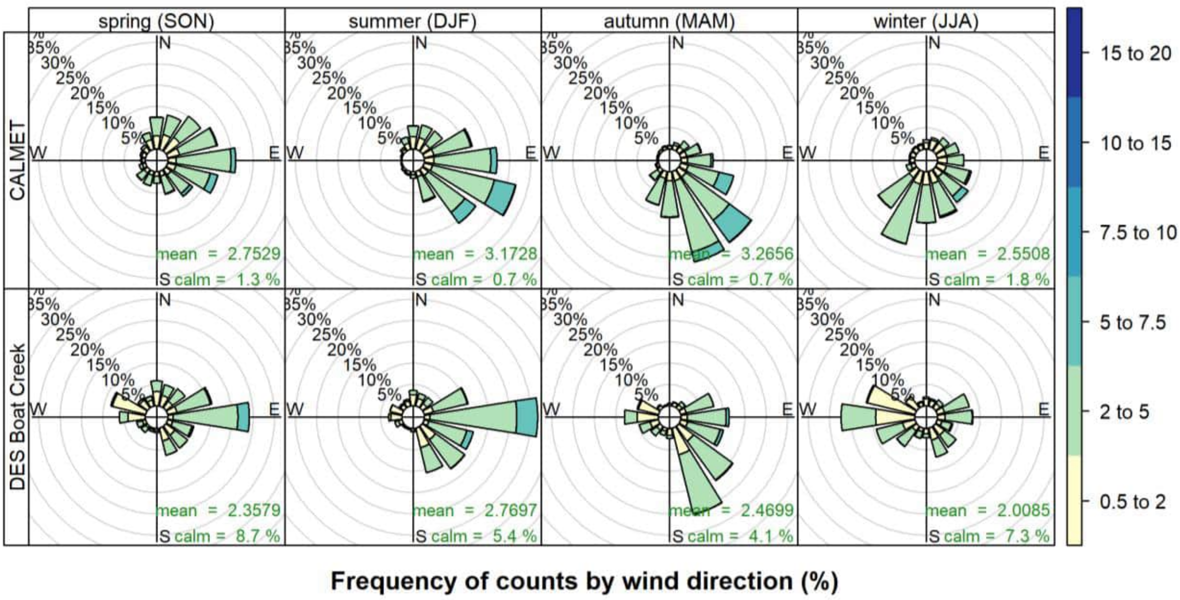

Figure 67 CALMET generated data seasonal wind roses compared with monitoring data – The Project site compared with DESI Boat Creek

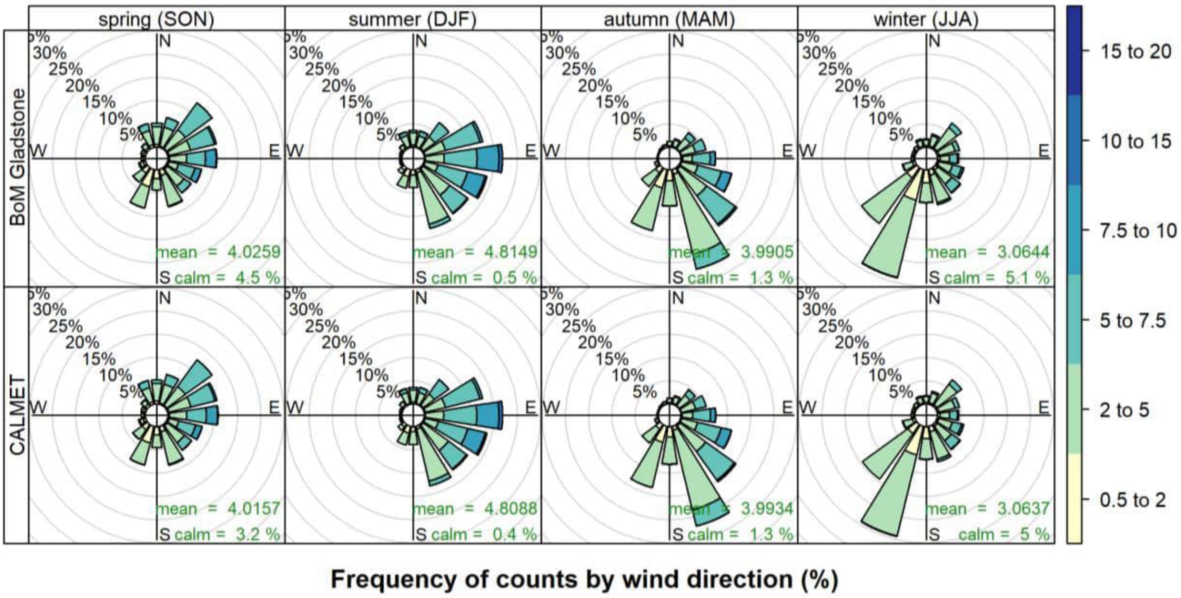

Figure 68 CALMET generated data seasonal wind roses compared with monitoring data – BoM Gladstone Airport

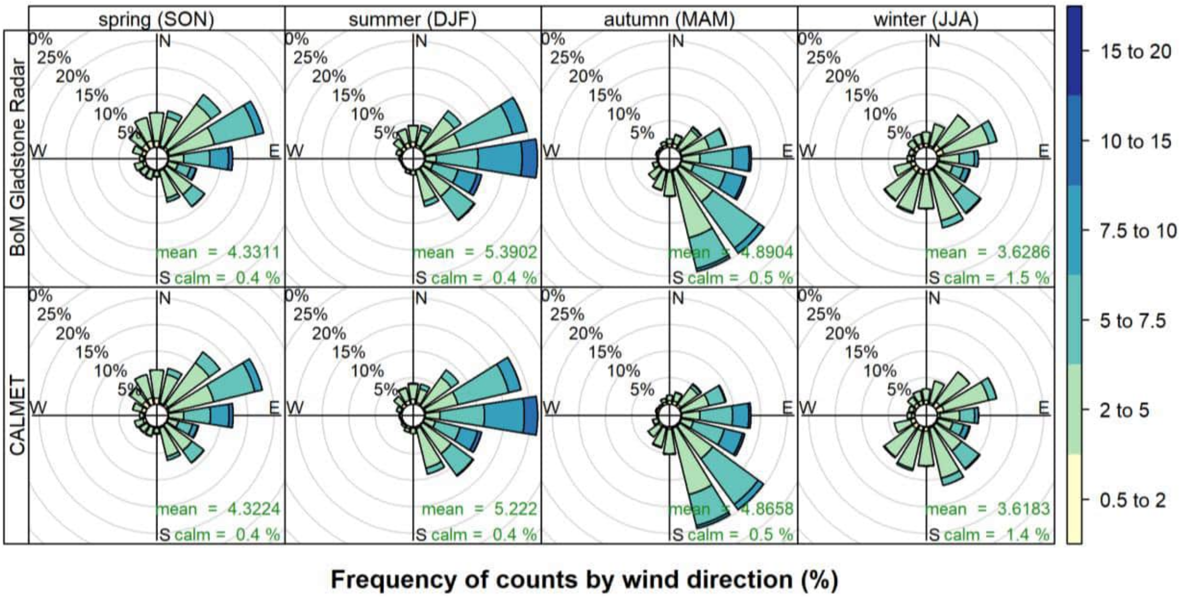

Figure 69 CALMET generated data seasonal wind roses compared with monitoring data – BoM Gladstone Radar

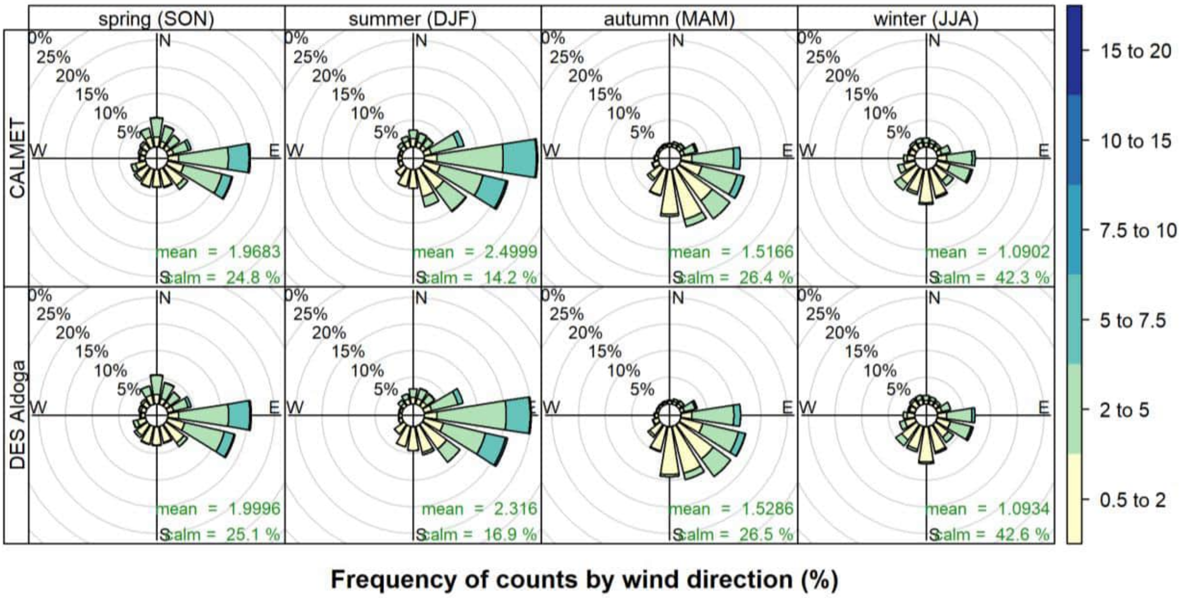

Figure 70 CALMET generated data seasonal wind roses compared with monitoring data – DESI Aldoga

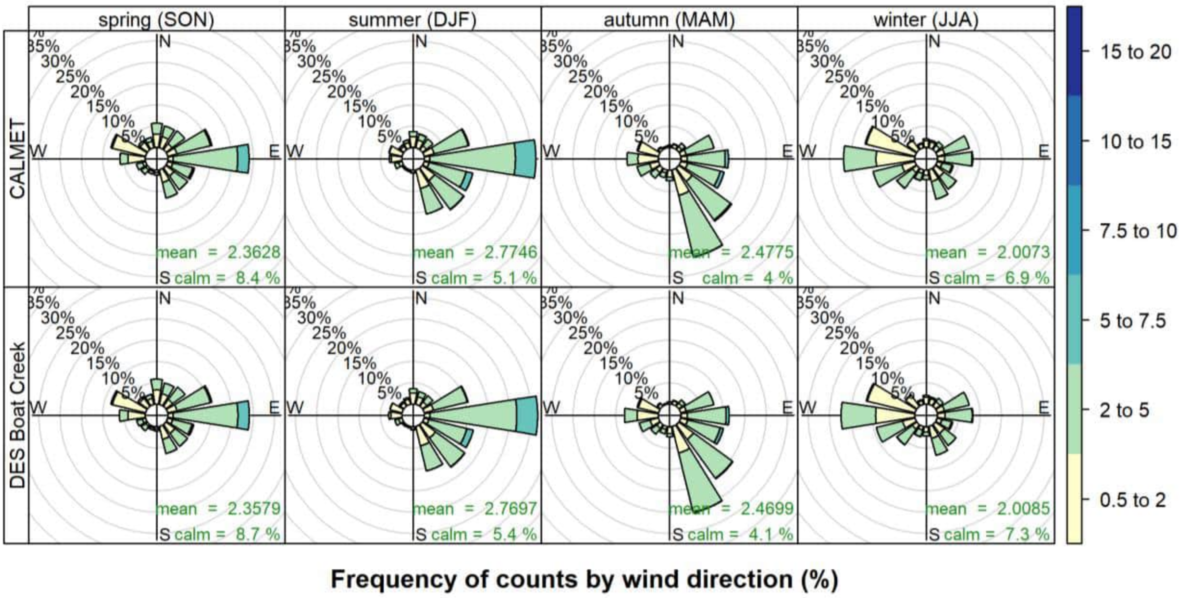

Figure 71 CALMET generated data seasonal wind roses compared with monitoring data – DESI Boat Creek

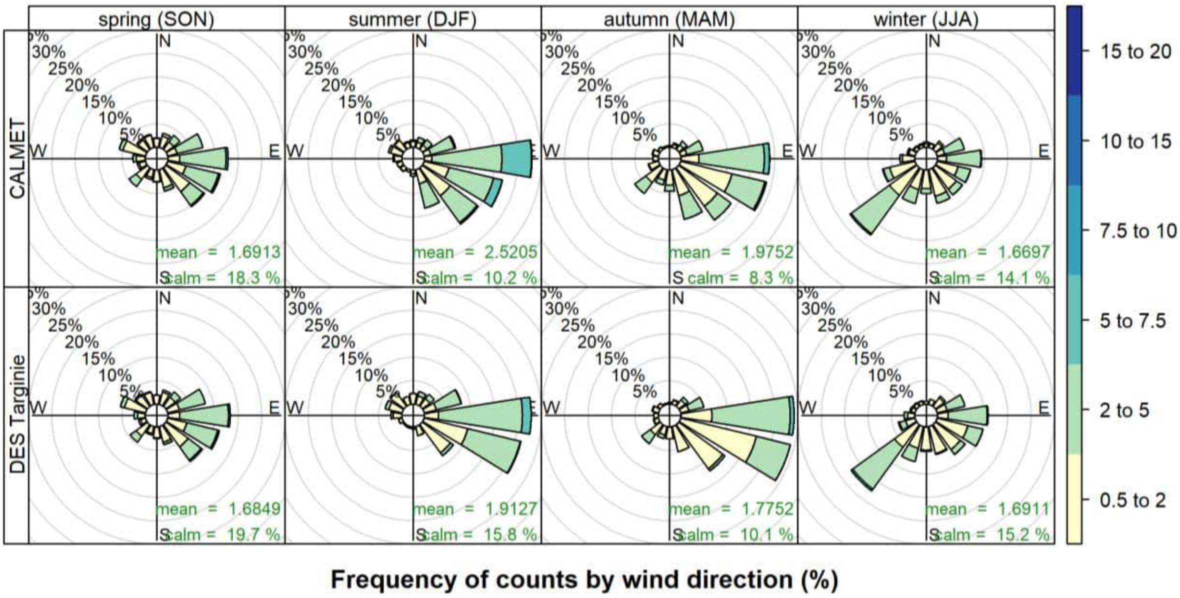

Figure 72 CALMET generated data seasonal wind roses compared with monitoring data – DESI Targinie

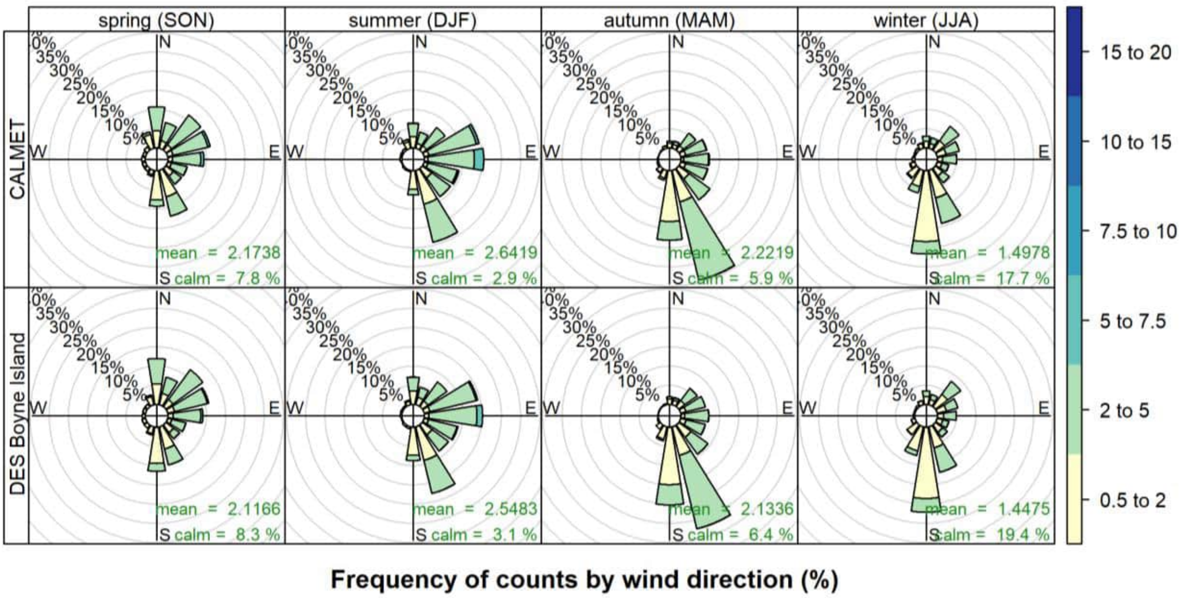

Figure 73 CALMET generated data seasonal wind roses compared with monitoring data – DESI Boyne Island

Appendix H

Plume Rise Assessment

Alpha HPA
Alpha HPA Limited
09-May-2024

Plume Rise Assessment

HPA Processing Plant

Plume Rise Assessment

HPA Processing Plant

Client: Alpha HPA Limited

ABN: 79 106 879 690

Prepared by

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09-May-2024

Job No.: 60617664

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Quality Information

Document	Plume Rise Assessment
	60617664
Ref	\\na.aecomnet.com\lfs\apac\newcastle-auntl1\legacy\projects\60617664\400_tech\432_gladstone\5. air quality\04 revised plume rise assessment\07_report\04 final issue\60617664 alpha hpa plume rise rev 1c 20240529.docx
Date	09-May-2024
Prepared by	Mitch Ryan, Michael Burchill
Reviewed by	Kristen Clarke, Mitch Ryan

Revision History

Rev	Revision Date	Details	Authorised	
			Name/Position	Signature
0	14-Sep-2020	Draft Issue	Rouven Lau Project Manager	
A	30-Sep-2020	Final Issue	Rouven Lau Project Manager	
B	28-May-2021	Final Issue	Rouven Lau Project Manager	
C	03-Aug-2021	Final Issue	Rouven Lau Project Manager	
D	20-Oct-2023	Draft Issue	Rouven Lau Project Manager	
1	12-Apr-2024	Draft Issue	Rouven Lau Project Manager	
1B	09-May-2024	Final Issue	Rouven Lau Project Manager	
1C	29-May-2024	Final Issue	Rouven Lau Project Manager	

Table of Contents

Glossary

Term / Acronym	Description
AGL	Height above ground level
ASL	Height above sea level
BoM	Australian Bureau of Meteorology
Plume rise enhancement or buoyancy enhancement	Describes a situation in which multiple vertical exhaust plumes in close proximity can merge to alter the plume characteristics.
CASA	Civil Aviation Safety Authority
critical plume velocity (CPV)	A critical plume velocity of 6.1 m/s is the velocity at which a vertical plume rise can affect the handling characteristics of an aircraft in flight and requires assessment by CASA.
DESI	Queensland Government Department of Environment, Science and Innovation
HPA	high purity alumina
km	kilometres
kg	kilogram
kg/m^3	kilograms per metres cubed
m	metres
m^3/s	metres cubed per second
obstacle limitation surface (OLS)	A series of planes associated with each runway at an aerodrome that defines the desirable limits to which objects may project into the airspace around the aerodrome so that aircraft operations may be conducted safely.
TAPM	The Air Pollution Model, developed by CSIRO

Executive Summary

Alpha HPA Limited (the Applicant) seeks to establish a Special Industry (HPA Processing Plant) and Linear Infrastructure Facility for the purposes of High Purity Alumina (HPA) processing plant (the Project) at 53 Reid Road, Yarwun, formally described as Lot 12 on SP239343 (the Site). The key objective of the Project is to supply HPA and related high purity aluminium chemicals into the rapidly expanding HPA LED lighting and lithium-ion battery markets.

The Project is proposed to be located in the Gladstone State Development Area (SDA).

The Site is located within the Obstacle Limitation Surface (OLS) of the Gladstone Airport, which is located approximately 5.5 km to the south-east of the eastern boundary of the Site. The processing plant requires a flare, combustion engines and other processes which will require venting to air. Exhaust plumes with a vertical velocity of greater than 4.3 metres per second (m/s) may impact aircraft operations due to momentary loss of control of the aircraft or damage to the aircraft airframe due to travel through the plume. As the Site is located within the OLS for Gladstone Airport, a plume rise assessment is required to be undertaken.

This plume rise assessment was originally undertaken for the Project in August 2021 based on the most accurate information available at the time. The Project has since progressed and additional information is available that better reflects the expected operation of the Project. As a result, this plume rise assessment has been revised to reflect the recent available information.

Current Civil Aviation Safety Authority (CASA) guidance mandates that assessment of potential plume rise impacts are made independently by CASA. However, plume rise assessments can be undertaken by technical consultants to inform CASA and aviation facilities such as Gladstone Airport. The Applicant has requested and commissioned AECOM to undertake a plume rise assessment to support the development of the Project and assess the potential for plume rise impacts.

The plume rise assessment has been undertaken using The Air Pollution Model (TAPM) in accordance with the CASA assessment methodology requirements outlined in AC 139-5(0) (2004) but has considered critical plume velocities (CPVs) of 4.3, 6.1 and 10.6 m/s in accordance with more recent CASA guidance. Meteorological data from 2015 to 2019 measured at the BoM Gladstone Airport station and the DES Boat Creek station has been assimilated into the TAPM model for the assessment.

A total of 16 emission sources have been modelled for the Project. Air emission sources such as bin vents and condenser vents have not been modelled due to the exhaust temperature (ambient temperature) and as emissions from these sources will be passive (e.g. via air displacement) rather than mechanical, and as such will have low exhaust velocities. Emissions have been modelled as occurring 24 hours per day, every day of the year for the duration of the five year modelling period. This is consistent with the proposed continuous operation of the Project, with the exception of the flare, which is an emergency flare and will therefore operate only rarely.

Analysis of the plume rise output data from TAPM was undertaken to determine the maximum, minimum and average heights at which the plume vertical velocity falls below the CPVs of 4.3, 6.1 and 10.6 m/s. This analysis determines the height where the CPV may be exceeded, for assessment against the height of the OLS for Gladstone Airport.

Based on the location of the Site and the emission sources proposed as part of the Project, TAPM modelling results indicate that normal operations emission sources would not produce vertical velocities greater than 4.3 m/s at altitudes above the OLS for Gladstone Airport. The analysis indicates that there is the potential for the flare, when operating, to produce vertical velocities greater than 4.3 m/s, but less than 6.1 m/s, at altitudes above the OLS.

The Project is considered unlikely to present a hazard to local aircraft operations, however a referral to CASA for the flare is required.

1.0 Introduction

Alpha HPA Limited (the Applicant) seeks to establish a Special Industry (HPA Processing Plant) and Linear Infrastructure Facility for the purposes of a High Purity Alumina (HPA) processing plant (the Project) at 53 Reid Road, Yarwun, formally described as Lot 12 on SP239343 (the Site). The key objective of the Project is to supply HPA and related high purity aluminium chemicals into the rapidly expanding HPA LED lighting and lithium-ion battery markets.

AECOM Australia Pty Ltd (AECOM) has been engaged by the Applicant to prepare and undertake an amended plume rise assessment for the Project demonstrating changes resulting from Stage 1 being fully operational (constructed) and changes necessary to State 2 (yet to be constructed). The results of this assessment will provide technical reporting to accompany the necessary changes to existing Development Permit and Environmental Authority for the Project. This assessment documents both Stage 1 and 2 operating concurrently.

The Site is located opposite the existing Orica Yarwun facility, also located on Reid Road, Yarwun. The location of the Site is presented in Figure 1.

The Site is within the Obstacle Limitation Surface (OLS) of the Gladstone Airport, which is located approximately 5.5 km to the south-east of the eastern boundary of the Site. The processing plant requires a flare, combustion engines and other processes which will require venting to air. Exhaust plumes with a vertical velocity of greater than 4.3 metres per second (m/s) may impact aircraft operations due to momentary loss of control of the aircraft or damage to the aircraft airframe due to travel through the plume. As the Site is located within the OLS for Gladstone Airport, a plume rise assessment is required to be undertaken.

Under current guidelines (CASA, 2023) the assessment (and approval) of potential plume rise impacts is made independently by the Civil Aviation Safety Authority (CASA). However, the Applicant has commissioned AECOM to prepare a plume rise assessment to identify potential hazards to aircraft operations. This report presents the results of a screening assessment of plume rise for the Project, conducted using the CSIRO model The Air Pollution Model (TAPM). The use of TAPM is appropriate for a screening level assessment as it forms the basis of the screening tool used by CASA for preliminary assessments.

1.1 Assessment revision

This plume rise assessment was originally undertaken for the Project in August 2021 by AECOM based on the most accurate information available at the time. The Project has since progressed and additional information is available that better reflects the expected operation of the Project. As a result, this plume rise assessment has been revised to reflect the recent available information.

Table 1 outlines the key changes made in reference to the original plume rise assessment.

Table 1 Assessment revision items

Change	Comment
Updated Project site layout (Figure 2).	Site layout has changed since the original Project plume rise assessment was undertaken.
Inclusion of Stage 1 PPF emissions sources in the plume rise model.	Stage 1 PPF emission sources included to quantitatively assess plume rise from all sources.
All sources have updated velocities, based on conservative estimates of volume flows.	Stage 2 emission source details have changed since the original Project plume rise assessment was undertaken.
Inclusion of additional Stage 2 sources in the plume rise model.	The following additional sources have been assessed as part of Stage 2: • Feed silo filter vent (S2-E2) • Precursor dryer (S2-E5) • Bin vents (S2-E8)

Change	Comment
	• General dust collector vent (S2-E9) • Emergency flare (S2-E11)
Updated model results (Section 5.0)	Model results have changed as a result of revised inputs.

1.2 Scope

The scope of work for the plume rise assessment consisted of the following:

- Review of the Project and identification of emission sources
- Review of CASA plume rise assessment criteria and the Gladstone Airport OLS
- Plume rise modelling
- Analysis of modelling results and discussion of potential plume rise impacts.

Figure 1 Location of the Project

2.0 Project description

Alpha HPA is proposing to construct a HPA processing plant at a site at Reid Road within the Gladstone State Development Area (the Project). The site has approval under the *State Development and Public Works Organisation Act 197*1 for the purpose of a Special Industry and Linear Infrastructure Facility. HPA and related high purity aluminium chemicals are key materials in the production of LED lighting and Lithium Ion batteries in the electric vehicle market. These industries are experiencing significant growth as part of the global de-carbonisation effort.

Stage 1 Precursor Production Facility (PPF) is an advanced stage of the Project thereby allowing the production of between 10-20 Metric Tonnes (MT) per month of Ultra High Purity alumina, alumina salt products and sapphire crystal. Stage 1 has been constructed and is currently operational. The PPF is fully contained within an industrial shed with any external storage areas being fully covered and appropriately bunded.

The balance of the HPA processing plant will be constructed as Stage 2 of the Project (yet to be constructed). Both stages will operate concurrently once Stage 2 is constructed.

The Project will process an aluminium based feedstock into a >99.99% pure HPA and will manufacture 10,000tpa of HPA and 136,000tpa of Ammonium Nitrate using the following associated processes:

- Feed Preparation
- Aluminium solvent extraction
- Aluminium salt crystallisation
- Product precipitation
- Drying and calcination
- Ammonium nitrate concentration
- HPA product milling and bagging.

The process used by Alpha HPA has been developed specifically for the Project and licensed by Alpha HPA. It has a number of benefits over alternative processing methods and has a low environmental signature.

The Project feedstock is a refined aluminium bearing feedstock sourced locally. The neighbouring Orica operation supplies reagents (nitric acid and ammonia) via separate underground pipelines and receives the Ammonium Nitrate by-product via an overhead pipeline across Reid Road at a height of approximately 12m.

The processing plant is expected to operate continuously, that is 24 hours per day, 7 days per week. In total the site is expected to have 21 air emissions sources of varying release height, temperature and velocity. However, not all sources are required to be considered in the plume rise assessment due to their characteristics as discussed in Section 4.3.

The Project site layout is presented below in Figure 2. The location of identified exhaust stacks included in the plume rise assessment are shown in Figure 6.

Figure 2 Alpha HPA Site layout

The Site is within the OLS of the Gladstone Airport, which is located approximately 5.5 km to the south-east of the eastern boundary of the Site.

OLS areas are designed to protect aircraft flying in close proximity to airports. The OLS defines a volume of airspace above a set of surfaces that are primarily modelled upon the layout and configuration of airport runways. The OLS components consist of a series of sloping and horizontal surfaces. In the case of Gladstone Airport, the surface of the OLS extends outward and upward, from ground level at the location of the proposed runways, to a distance of 15 kilometres from the airport.

Heights of the OLS are given above mean sea level (ASL) using the Australian Height Datum (AHD) elevation. The height of the OLS for Gladstone Airport at the boundaries of the Site are as follows:

- Eastern boundary (closest to the airport): 130 m ASL, approximately 122 m above ground level (AGL)
- Western boundary: 148 m ASL, approximately 140 m AGL.

3.0 Plume rise assessment criteria

3.1 Advisory Circular AC 139-5(0) Guidelines for Conducting Plume Rise Assessments (2004)

In June 2004, CASA released *Advisory Circular (AC) 139-5(0) Guidelines for Conducting Plume Rise Assessments* (AC 139-5(0)), which was the first guidance published by CASA with respect to plume rise assessments.

The purpose of the AC was to provide guidance to aerodrome operators and persons involved in the design, construction and operation of facilities with exhaust plumes with the information required to assess the potential hazard from a plume rise to aircraft operations.

AC 139-5(0) identified the roles of the parties involved (CASA, the proponent, etc) and prescribes the recommended method for the assessment of plume rise impacts using TAPM. Attachment A in AC 139-5(0) describes the recommended model inputs and requirements for data analysis and presentation. Key requirements for plume rise assessments from AC 139-5(0) are summarised as follows:

- Modelling to be undertaken using TAPM version 2.0 or higher
- At least 5 years of continuous meteorological data modelled
- Horizontal displacement of the plume centreline evaluated as a function of height
- Plume spread about the centreline evaluated as a function of height
- Consideration of average and peak vertical plume rise velocities for each height
- Wind speed evaluated as a function of height
- Probability of vertical velocity exceeding 4.3 m/s.

3.2 Advisory Circular AC 139-5(1) Plume Rise Assessments (2012)

In November 2012, CASA released *AC 139-5(1) Plume Rise Assessments* (AC 139-5(1)) superseding AC 139-5(0) issued in June 2004. AC 139-5(1) provided further clarification regarding plume rise assessments. AC 139-5(1) also introduced the Screening Tool, which is a computer generated method of plume rise analysis used by CASA's Office of Airspace Regulation (OAR) to derive the height at which the plume reduces to a trigger velocity of 4.3m/s or 10.6m/s.

The Advisory Circular states that the critical plume velocity (CPV) to be scrutinised (either 4.3 m/s or 10.6 m/s, which was introduced in AC 139-5(1)) would be determined based on the type of operations at the location and any associated risks identified by CASA. Following determination of the CPV, CASA would determine the Critical Plume Height (CPH) for the CPV using the Screening Tool, which is based on the TAPM methodology designed by the CSIRO, incorporating a buoyancy enhancement factor for multiple plumes if required.

AC 139-5(1) mandated that CASA was responsible for undertaking the assessment of potential plume rise impacts on an aviation facility.

3.3 Advisory Circular AC 139-05 v3.0 Plume Rise Assessments (2019)

AC 139-05 v3.0 Plume Rise Assessments (AC 139-05 v3.0) (CASA, 2019) was released in January 2019 and superseded AC 139-5(1). AC 139-05 v3.0 replaced the previous CPV value of 4.3 m/s, with a new value of 6.1 m/s as the default value for analysis of plume rise impacts, a less conservative approach than specified by the former AC*139-5(1).*

Referencing the Manual of Aviation Meteorology (BoM, 2003), the classifications of turbulence intensity are defined in AC 139-05 v3.0 as:

- Light (1.5 - 6.1 m/s) which can cause momentary changes in altitude and attitude
- Moderate (> 6.1 - 10.6 m/s) which can cause appreciable changes in altitude and attitude

- Severe (>10.6 m/s - 15.2 m/s) which can cause large abrupt changes in altitude and attitude and momentary loss of control
- Extreme (> 15.2 m/s) where it can be practically impossible to control the aircraft, and which can cause structural damage.

AC 139-05 v3.0 states that an exhaust plume of moderate or higher turbulence intensity has the potential to affect the safety of aircraft operations, such as aircraft in critical stages of flight (periods of high pilot workload) and low-level flying operations.

3.4 Advisory Circular AC 139.E-02 v1.0 Plume Rise Assessments (2023)

AC 139.E-02 v1.0 Plume Rise Assessments (AC 139.E-02 v1.0) (CASA, 2023) was released in March 2023 and superseded AC 139-05 v3.0. It is the current version at the time of this report. AC 139.E-02 v1.0 incorporates the use of the MITRE Exhaust Plume Analyzer (EPA), used by CASA to conduct detailed plume rise assessments.

CASA will conduct a preliminary assessment of plume rise using the CASA screening tool. According to AC 139.E-02 v1.0, “if the outputs of the screening tool indicate that the plume velocity will infringe a flight protection surface at a vertical velocity exceeding 4.3 m/s, CASA will use the information provided to conduct a detailed assessment of the impact of the plume rise proposal using the [MITRE] EPA”.

3.5 Adopted assessment criteria

Current CASA guidance mandates that assessment of potential plume rise impacts are considered independently by CASA. However, plume rise assessments can be undertaken by technical consultants to inform CASA and aviation facilities such as Gladstone Airport. The Applicant has engaged AECOM to undertake a plume rise assessment to support the necessary development applications for the Project. This plume rise assessment report will be provided to Gladstone Airport.

The plume rise assessment undertaken for the Project and documented in this report follows the assessment methodology requirements outlined in AC 139-5(0) (2004), but has considered CPVs of 4.3, 6.1 and 10.6 m/s in the assessment of plume rise modelling results in accordance with more recent CASA guidance.

The plume rise assessment has been undertaken using the CSIRO model TAPM. The use of TAPM is appropriate for a screening level assessment as it forms the basis of the screening tool used by CASA for preliminary assessments. If the outcome of the screening assessment shows the potential for a plume with vertical velocity exceeding 4.3 m/s at flight protection surface, CASA will conduct a detailed assessment of plume rise using the MITRE EPA model, as per AC 139.E-02 v1.0 (2023).

4.0 Methodology

4.1 TAPM setup

TAPM is a prognostic model with capability to generate meteorological data for any location in Australia using synoptic information determined from the 6-hour Limited Area Prediction System (LAPS). TAPM is described in more detail in the model's user manual (Hurley, 2008).

Key inputs for the TAPM modelling undertaken for the assessment are presented in Table 2.

Table 2 TAPM inputs for plume rise assessment

Modelling parameter	Input
TAPM version	v4.0.4
Number of grids (spacing)	4 (30 km, 10 km, 3 km, 1 km)
Number of grid points	25 (X direction) x 25 (Y direction) x 30 (vertical levels)
5-year simulation period	2015 to 2019 inclusive
Terrain information	AUSLIG 9 second (horizontal resolution 9")
Centre of analysis	UTM MGA Z56 X: 313,270 Y: 7,362,864
Local data assimilation	Bureau of Metrology (BoM) station at Gladstone Airport, 2015 to 2019 UTM MGA Z56 X: 318,895 Y: 7,359061 Department of Environment and Science (DES) station at Boat Creek, 2015 to 2019 UTM MGA Z56 X: 311,949 Y: 7,364,478
Mode	Meteorology and pollution mode

4.2 Assimilation of local meteorological data

Meteorological data from 2015 to 2019 measured at the BoM Gladstone Airport station and the DESI Boat Creek station has been assimilated into the TAPM model for the assessment. The five years of hourly wind speed and wind direction data from the stations have been used to nudge the TAPM prognostic data towards the recorded observational datasets. The locations of the monitoring stations are shown in Figure 3.

Wind roses for the meteorological station data for 2015 to 2019 are shown in Figure 4 and Figure 5. The wind roses for BoM Gladstone Airport show that the predominant wind direction is from the south-east, with south-westerly winds also prevalent. The wind roses for DESI Boat Creek show that the predominant wind direction is easterly and south-easterly, with westerly winds also prevalent. The wind roses for both stations show the influence of the topography to the west of both stations and the presence of the eastern coastline of Queensland.

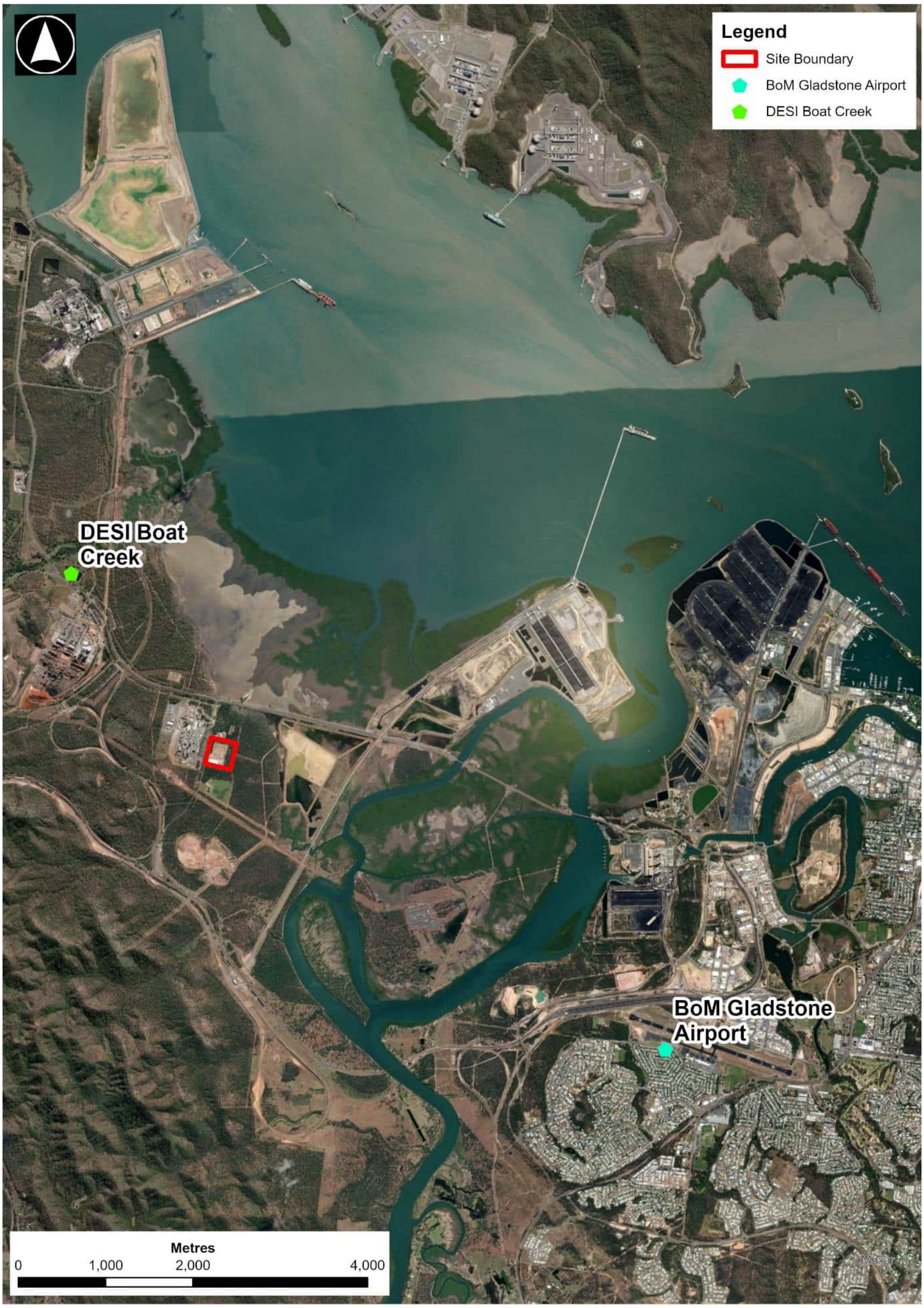


Figure 3 Location of BoM Gladstone Airport and DESI Boat Creek stations

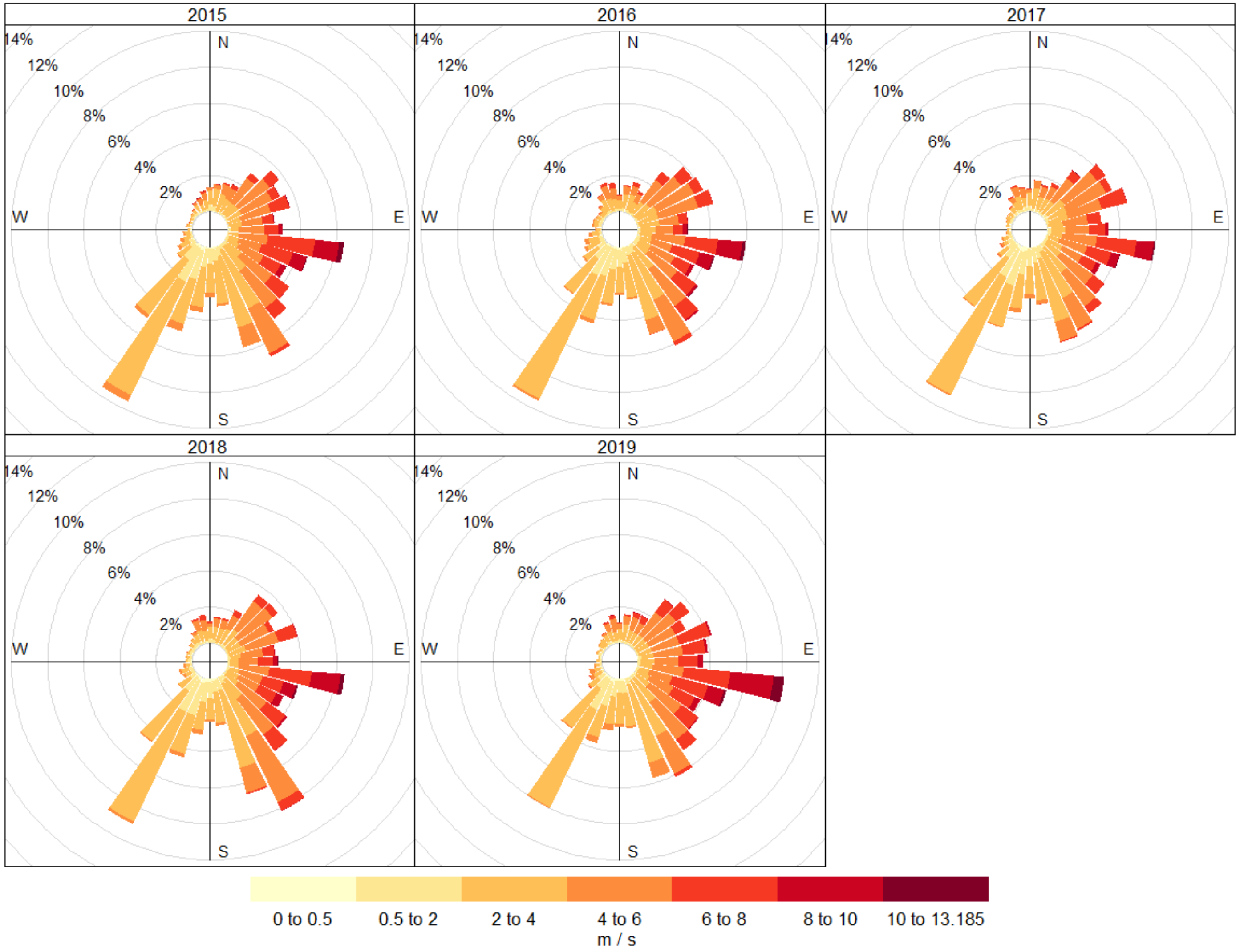


Figure 4 **Wind roses for BoM Gladstone Airport (2015 to 2019) (wind speed in m/s)**

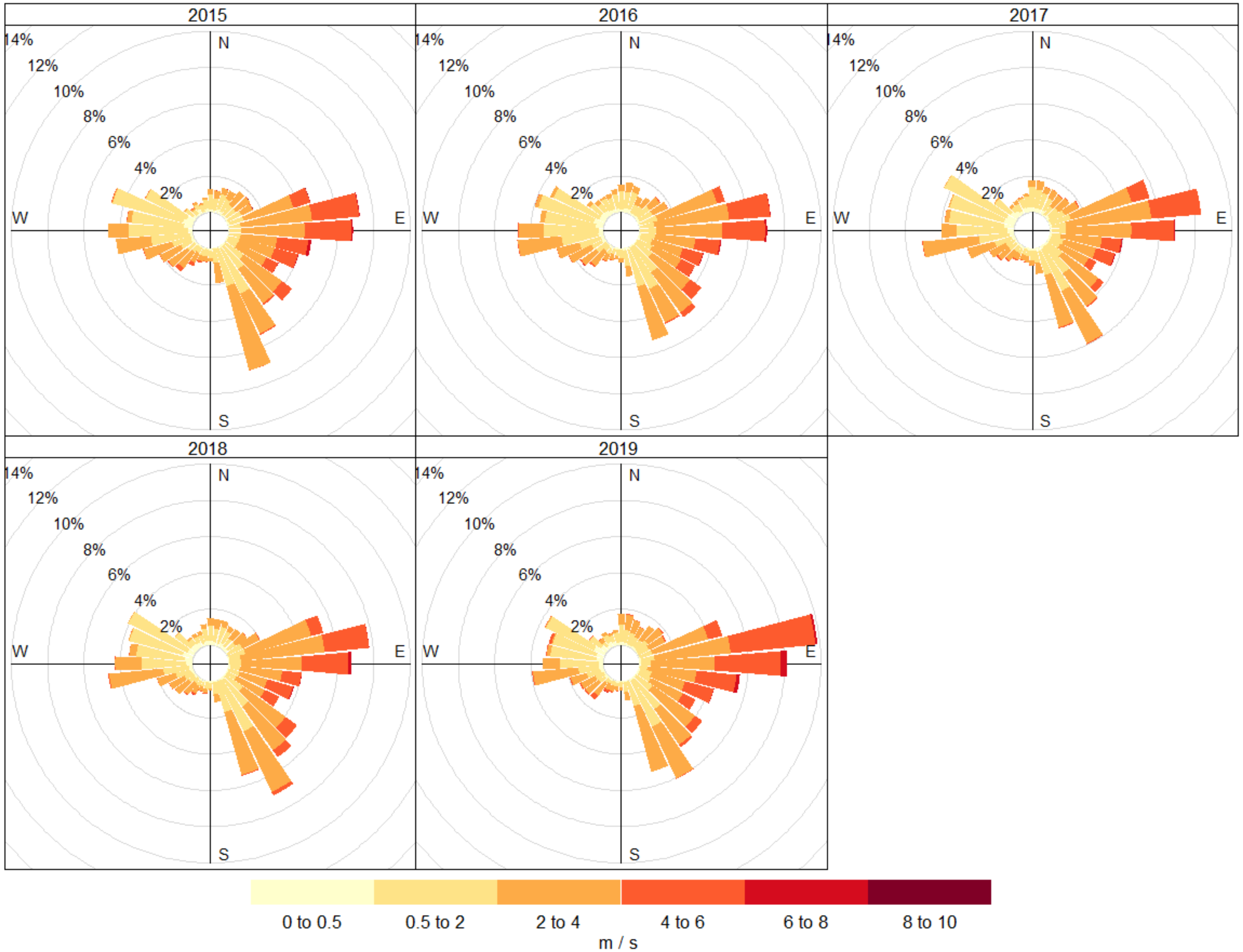


Figure 5 Wind roses for DESI Boat Creek (2015 to 2019) (wind speed in m/s)

4.3 Emission Sources

The following sections describe the expected emissions sources during the two stages (Stage 1 PPF and Stage 2) of the Project.

The emission sources in Stage 1 PPF and Stage 2 will operate concurrently.

4.3.1 Stage 1 sources

The Stage 1 PPF sources are listed in Table 3, along with their emission parameters. The locations of the sources are shown in Figure 6.

The modelled exit velocities and flow rates shown in Table 3 are conservative estimates for the purposes of the assessment and are above the values anticipated to be observed in practice.

Consistent with the proposed operation of the Project, emissions have been modelled as occurring 24 hours per day, every day of the year for the duration of the five year modelling period.

Table 3 Stage 1 emission sources

ID	Source	Source coordinates (UTM MGA Zone 56)		Release height (m)	Stack diameter (m)	Exhaust Conditions		
		Easting	Northing			Temperature (ºC)	Velocity (m/s)	Flow rate (Am^3/s)[a]
PPF-E1	Hot oil stack	313,624	7,362,312	11.7	0.15	80	15	0.27
PPF-E2	Gas scrubber vent	313,621	7,362,297	9.8	0.30	25	20	1.41
PPF-E3	Spray dryer vent	313,568	7,362,304	9.8	0.15	80	35	0.62
PPF-E4	Flash dryer vent	313,559	7,362,312	10.0	0.10	90	20	0.16
PPF-E5	Dust collector vent	313,557	7,362,297	7.0	0.31[b]	40	20	1.51

Table Note:
a Flow rate at actual exhaust conditions
b Effective diameter for square vent
Source ID used to show location of sources in Figure 6

4.3.2 Stage 2 sources

The emission sources which have been included in the plume rise assessment for Stage 2 are presented in Table 4. The modelled exit velocities and flow rates shown in Table 4 are conservative estimates for the purposes of the assessment and are above the values anticipated to be observed in practice. The locations of the emission sources are shown in Figure 6.

A total of 11 emission sources have been modelled. Air emission sources such as bin vents and condenser vents have not been modelled due to the exhaust temperature (ambient temperature) and as emissions from these sources would be passive (e.g. via air displacement) rather than mechanical, and as such would have low exhaust velocities. Sources with lower initial exhaust velocities are unlikely to present an aviation safety hazard and have not been assessed.

The following sources may have their exhaust configured into multiple smaller stacks following detailed design, however, for the purpose of the assessment they have each been conservatively modelled as a single stack to assess worst case plume rise potential:

- Precursor dryer stack
- Boiler combustion stack

- Microniser gas vent.

Consistent with the proposed operation of the Project, emissions have been modelled as occurring 24 hours per day, every day of the year for the duration of the five year modelling period. This includes the emergency flare, which has been conservatively modelled as operating continuously. As an emergency measure, the flare is expected to operate only intermittently and for short periods of time, as required in response to emergency situations. Conservative modelling of the flare (emissions occurring continuously) has been undertaken to investigate the risk of plume rise impacts when the flare does operate.

Table 4 Stage 2 emission sources included in plume rise assessment

ID	Source	Source coordinates (UTM MGA Zone 56)		Release height (m)	Stack diameter (m)	Exhaust Conditions		
		Easting	Northing			Temperature (ºC)	Velocity (m/s)	Flow rate (Am^3/s)[a]
S2-E1	Leach scrubber	313,683	7,362,470	15	0.35	50.0	15.0	1.4
S2-E2	Feed silo filter vent	313,680	7,362,487	15	0.15	25.0	10.0	0.2
S2-E3	Fume scrubber	313,689	7,362,406	15	1.00	40.0	15.0	11.8
S2-E4	Dryer	313,771	7,362,372	20	0.15	100.0	25.0	0.4
S2-E5	Precursor dryer	313,744	7,362,402	20	0.40	150.0	40.0	5.0
S2-E6	Rotary Kiln	313,763	7,362,356	20	0.20	150.0	15.0	0.5
S2-E7	Boiler (10 MW)	313,674	7,362,449	20	0.60	150.0	55.0	15.6
S2-E8	Bin vents	313,744	7,362,343	15	0.30	80.0	10.0	0.7
S2-E9	General dust collector vent	313,754	7,362,341	10	0.60	50.0	25.0	7.1
S2-E10	Microniser vent	313,747	7,362,339	20	0.50	130.0	35.0	6.9
S2-E11	Emergency flare	313,598	7,362,515	20[b]	0.30[c]	1,000.0	20.0	25.3

Table Note:
a Flow rate at actual exhaust conditions
b Actual release height. Modelled release height of 26.25 m, see Section 4.3.3
c Actual stack diameter. Modelled stack diameter of 1.27 m, see Section 4.3.3
Source ID used to show location of sources in Figure 6

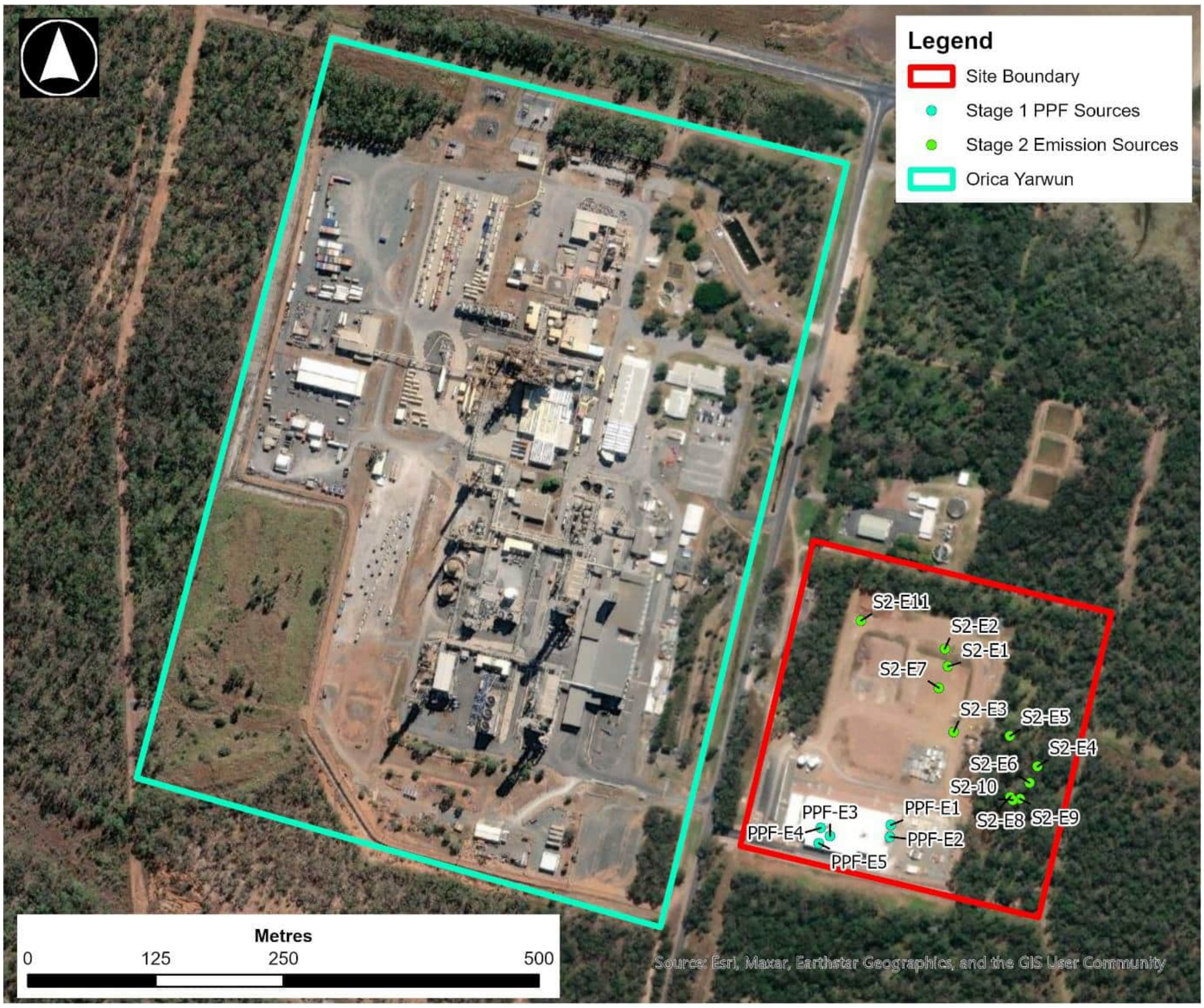


Figure 6 **Location of emission sources**

4.3.3 Flare effective parameters

The emergency flare model inputs shown in Table 4 are the effective stack parameters for the flare calculated by the Lakes Environmental software (Lakes Calpuff View, v9.0.1, November 2021) based on information provided by Alpha as shown in Table 5.

The effective release height dialog within CALPUFF View allows for the calculation of effective flare release height above ground for flare sources. The dialog follows the procedures presented in the "Workbook of Screening Techniques for Assessing Impacts of Toxic Air Pollutants" (US EPA, 1992) for calculating the effective release height above ground and to calculate total heat release rate. Approximately 45% of the total heat release is assumed to be radiated as sensible heat. The effective release height above ground is determined by adding the flare height to the stack height as presented in US EPA, 1992.

Table 5 Flare parameters

Parameter	Units	Value
NH_3 flow rate	Tonnes per hour (tph)	5
	m^3/s	1.07
Velocity	Feet per second (ft/s)	60
Temperature	°C	1000
Density of NH_3	kg/m^3	0.771
Heating value of NH_3	Megajoule per kilogram (MJ/kg)	18.8

4.4 Plume rise enhancement

4.4.1 Theory and calculation method

In situations where emissions are vented from multiple stacks there is the possibility that merged, overlapping hot plumes may interact with one another, resulting in a single, higher buoyancy plume. This process is referred to as buoyancy enhancement or plume rise enhancement.

For a number of stacks with the same emission geometries and exit conditions, the buoyancy enhancement factor is defined as (e.g. Manins et al, 1992):

$$N_E = \left[\frac{n+S}{1+S}\right],$$

where n is the number of stacks and S is a dimensionless separation factor, given by,

$$S = 6 \times \left[\frac{(n-1).\Delta s}{n^{\frac{1}{3}}.\Delta z}\right]^{\frac{3}{2}},$$

where Δs is the stack separation and Δz is the rise of the individual plume.

Once calculated, the buoyancy enhancement factor (N_E) can be specified as an input parameter for each modelled source in TAPM.

It is noted that this buoyancy enhancement estimation technique can only be applied to stack emissions of similar physical and emission characteristics. For example, it is applicable for power stations or other facilities where there a multiple emission sources with the same emission characteristics, oriented side-by-side or adjacent to each other.

4.4.2 Application to the Project

Details for the emission sources that have been included in the plume rise assessment are presented in Table 3 and Table 4. It is evident from these tables that the characteristics of the 16 emission sources considered in the assessment are not similar.

Further, the distance between the Stage 1 and Stage 2 sources, and the low thermal buoyancy of the Stage 1 sources means that they are unlikely to lead to any plume enhancement.

In addition to the emission sources included in the Project, existing emission sources are located within the Orica Yarwun facility, located to the west of the Site across Reid Road as shown in Figure 6.

For the purpose of the plume rise assessment and air quality impact assessment (reported separately) undertaken by AECOM for the Project, Orica provided relevant emissions data pertaining to existing emissions sources at the Yarwun facility. The emissions source data provided by Orica was reviewed to determine the likelihood of buoyancy enhancement as a result of mixing of plumes from the Orica

Yarwun facility and plumes from the Project. The Orica emissions source data is not the intellectual property of AECOM and therefore cannot be included within this report.

Based on review of the emissions data provided by Orica for the Yarwun facility, the existing Orica emission sources are not considered to have similar characteristics to the emission sources associated with the Project. It is also noted that the Orica emission sources are located on a separate site to the west of Project, with the nearest Project emission source (source ID 3), located approximately 100 m to the east of the eastern boundary of the Orica Yarwun facility.

Based on the dissimilarity between the characteristics of the Project emission sources, the distance and general low buoyancy of the different sources, and the distance and dissimilarity between the Project sources and the existing Orica Yarwun emission sources, it is not considered appropriate to calculate or apply a buoyancy enhancement factor for the assessment of plume rise for the Project. For the purpose of the assessment, no buoyancy enhancement factor has been adopted.

5.0 Results

The results of plume rise modelling for the Project are presented and discussed in the following subsections.

5.1 Plume rise height and critical velocity

Statistics on the final rise (vertical velocity of 0 m/s) of individual plumes from each of the modelled sources are shown in Table 6. Table 6 shows that the maximum final plume rise height for normal operations sources is 487 m AGL (495 m ASL) for Stage 2 source 7 (boiler), and 713 m AGL (721 m ASL) for the emergency flare. These heights are above the OLS height of 130 m ASL at the eastern boundary of the Site.

Table 6 Final rise for individual plumes

Project stage	Source ID	Statistics for final rise of individual plumes (m AGL)		
		Min	Max	Average
Stage 1 PPF	PPF-E1	15	97	21
	PPF-E 2	15	73	22
	PPF-E 3	17	129	26
	PPF-E 4	14	82	18
	PPF-E 5	13	121	22
Stage 2	S2-E1	19	141	31
	S2-E2	17	41	19
	S2-E3	24	229	50
	S2-E4	25	130	35
	S2-E5	33	320	75
	S2-E6	23	147	36
	S2-E7	43	487	119
	S2-E8	17	137	29
	S2-E9	20	223	45
	S2-E10	33	344	80
Emergency flare	S2-E11	63	713	218

Analysis of the plume rise output data from TAPM was undertaken to determine the maximum, minimum and average heights at which the plume vertical velocity falls below the CPVs of 4.3, 6.1 and 10.6 m/s. This analysis determines the height where the CPV may be exceeded, for assessment against the height of the OLS for Gladstone Airport.

The results for CPVs of 4.3 and 6.1 m/s are provided in Table 7 and Table 8 respectively. Table 7 and Table 8 also present the OLS height (m ASL) for the eastern boundary of the Site, which is located closest to Gladstone Airport.

Table 7 shows that:

- for normal operational sources, the maximum height where the plume velocity falls below 4.3 m/s is predicted to be 63 m ASL from Stage 2 source 7 (boiler). This maximum height is well below the OLS height of 130 m ASL.

- For the flare, the maximum height where the plume velocity falls below 4.3 m/s is predicted to be 138 m ASL, which is above the OLS height of 130 m ASL at the eastern boundary, but below the OLS height of 148 m ASL at the western boundary.

Table 8 shows that the maximum height where the plume velocity falls below 6.1 m/s is predicted to be well below the OLS height of 130 m ASL for all sources, including the emergency flare.

Based on the results for CPVs of 4.3 m/s and 6.1 m/s, analysis for a CPV of 10.6 m/s has not been presented as the maximum heights are lower than those reported in Table 7 and Table 8, and well below the height of the OLS.

Table 7 Summary of heights where plume vertical velocity falls below 4.3 m/s

Project stage	Source ID	Height where plume velocity falls below 4.3 m/s (m AGL)			OLS height (m ASL)[1]	Site base height (m ASL)	Max height where plume velocity falls below 4.3 m/s (m ASL)
		Min	Max	Average			
Stage 1 PPF	PPF-E1	15	17	15	130	8	25
	PPF-E2	15	18	15			26
	PPF-E3	17	22	18			30
	PPF-E4	14	17	14			25
	PPF-E5	12	15	13			23
Stage 2	S2-E1	19	22	19			30
	S2-E2	17	19	17			27
	S2-E3	20	28	21			36
	S2-E4	25	29	26			37
	S2-E5	29	36	31			44
	S2-E6	23	26	24			34
	S2-E7	33	55	37			63
	S2-E8	17	20	18			28
	S2-E9	17	26	18			34
	S2-E10	28	38	30			46
Emergency flare	S2-E11	32	130	37			138

Table Note:
1. OLS height at eastern boundary of the Site, which is closest to Gladstone Airport. The OLS height at the western boundary of the site is 148 m ASL.

Table 8 Summary of heights where plume vertical velocity falls below 6.1 m/s

Project stage	Source ID	Height where plume velocity falls below 6.1 m/s (m AGL)			OLS height (m ASL)[1]	Site base height (m ASL)	Max height where plume velocity falls below 6.1 m/s (m ASL)
		Min	Max	Average			
Stage 1 PPF	PPF-E1	15	17	15	130	8	25
	PPF-E 2	15	18	15			26
	PPF-E 3	17	22	18			30
	PPF-E 4	14	17	14			25
	PPF-E 5	12	15	13			23
Stage 2	S2-E1	19	22	19			30
	S2-E2	17	19	17			27
	S2-E3	20	23	21			31
	S2-E4	25	29	26			37
	S2-E5	29	36	31			44
	S2-E6	23	26	24			34
	S2-E7	33	41	35			49
	S2-E8	17	20	18			28
	S2-E9	17	21	18			29
	S2-E10	28	34	30			42
Emergency flare	S2-E11	32	55	38			46

Table Note:
1. OLS height at eastern boundary of the Site, which is closest to Gladstone Airport. The OLS height at the western boundary of the site is 148 m ASL.

The plume rise modelling indicates that there is the potential for the plume generated by the emergency flare to exceed that CPV of 4.3 m/s at the OLS of 130 m ASL. However, the risk of this occurrence is low based on the following mitigating factors:

- As it is included as an emergency measure, the flare will rarely operate
- Based on the modelling undertaken, only five hours of the modelled dataset of five years of meteorology (total of 43,870 hours) were above the CPV of 4.3 m/s at the OLS of 130 m ASL.

5.2 Plume velocity and wind speed

Hourly wind speed data at nine heights between ground level and 160m above ground level (approximately 168m ASL) were extracted from the TAPM generated profile data. The heights analysed from the TAPM model are as follows:

- 25 m, 30 m, 40 m, 60 m, 80 m and 100 m AGL – between ground level and the OLS
- 120 m AGL (128 m ASL) – approximately the height of the OLS (130 m ASL) at the eastern boundary of the Site
- 140 m AGL (148 m ASL) – approximately the height of the OLS at the western boundary of the Site
- 160 m AGL (168 m ASL) – within the OLS.

The percentage of time of calm wind speeds (below 0.5 m/s) for each of the analysed heights is presented in Table 9 as required by AC 139-5(0).

Table 9 Percentage of the time of calm wind speeds (below 0.5 m/s)

Height (m AGL)	Percentage of time below wind speed (%)				
	0.1 m/s	0.2 m/s	0.3 m/s	0.4 m/s	0.5 m/s
25	0.13	0.29	0.52	0.82	1.17
30	0.01	0.17	0.52	1.27	2.27
40	0.00	0.06	0.19	0.59	1.34
60	0.02	0.12	0.43	0.96	1.49
80	0.05	0.16	0.34	0.67	1.09
100	0.09	0.21	0.31	0.49	0.77
120	<0.01	0.03	0.09	0.19	0.39
140	<0.01	0.05	0.12	0.23	0.37
160	<0.01	0.05	0.13	0.20	0.34

The modelled plume vertical velocities for the emergency flare (the source with the highest height at which exceedance of the CPV of 4.3 m/s is predicted) and Stage 2 source 7 (boiler), the business as usual source with the highest plume rise, have also been extracted from TAPM for each of the vertical levels in Table 9, from 40 m and higher.

Figure 7 to Figure 15 provide histograms of wind speed and vertical plume velocity for the nine heights above ground as required by AC 139-5(0). The graphs in Figure 9 to Figure 15 show the frequencies of occurrence of all wind speeds and plume vertical velocities for Stage 2 source 7 (boiler) and the emergency flare.

It can be seen in Figure 13 (120 m AGL, 128 m ASL) and Figure 14 (140 m AGL, 148 m ASL) that the plume vertical velocities are well below the CPVs of 6.1 m/s and 10.6 m/s at the height of the OLS over the Site, and velocities above the CPV of 4.3 m/s due to operation of the emergency flare are rare.

Wind Speed

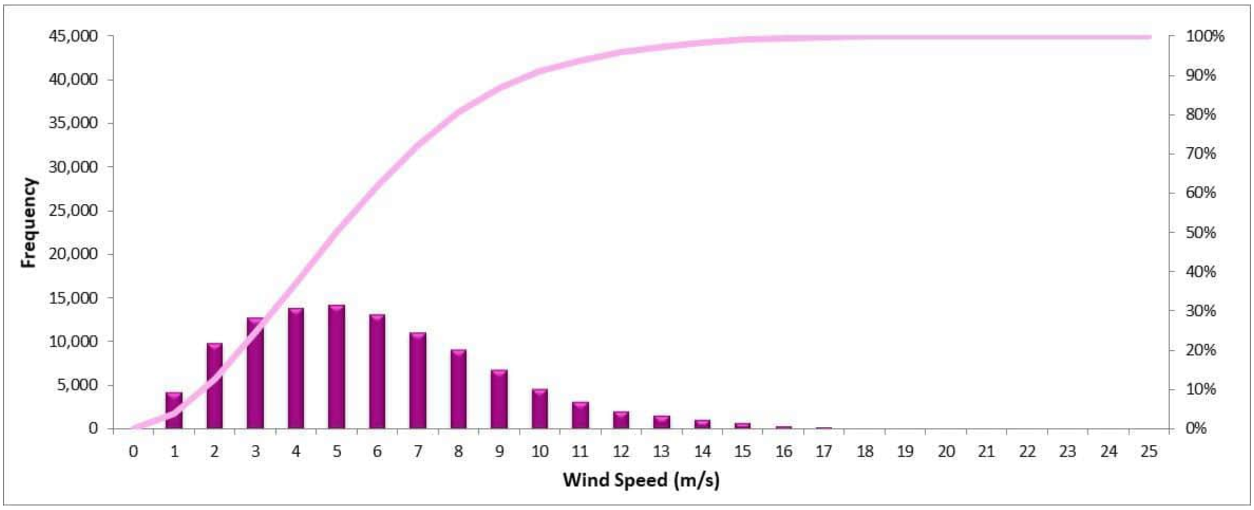


Figure 7 Cumulative frequency charts for wind analysis for 25m above ground level (33m ASL)

Wind Speed

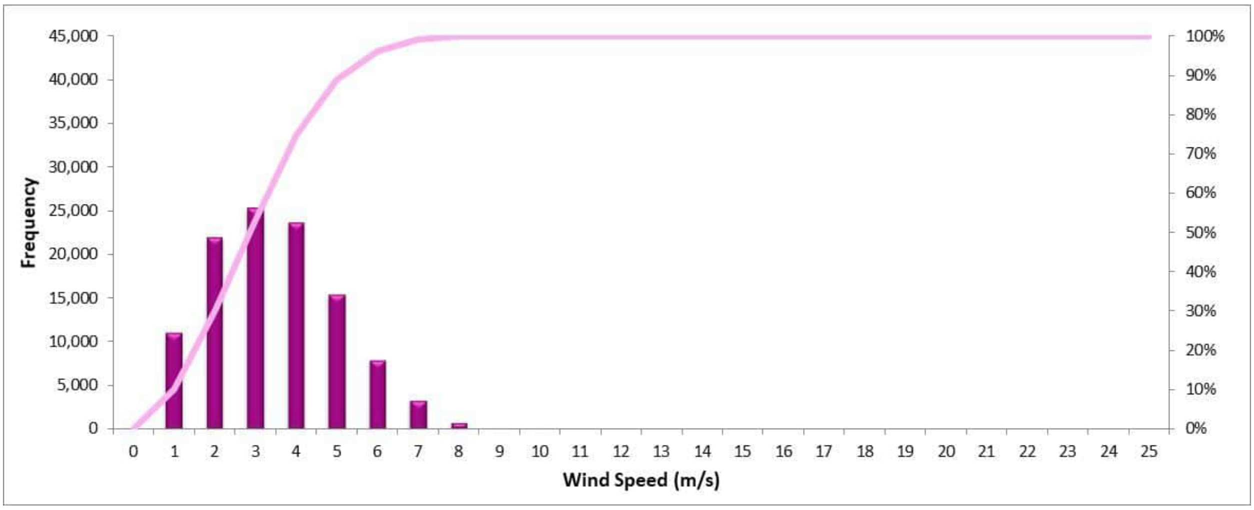
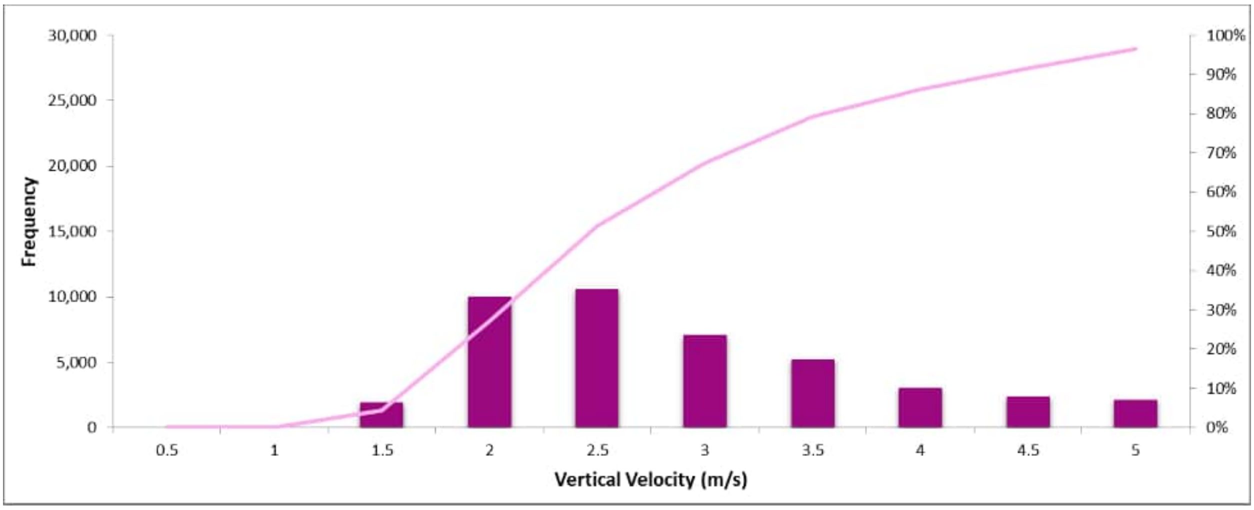
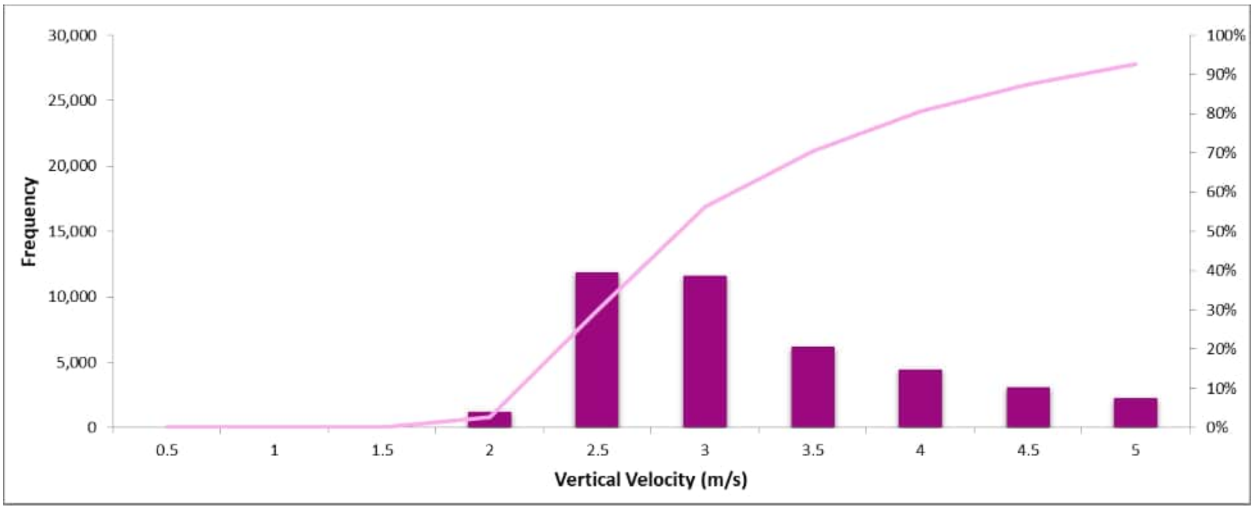


Figure 8 Cumulative frequency charts for wind analysis for 30m above ground level (38m ASL)

Plume Vertical Velocity (Stage 2 source 7)



Plume Vertical Velocity (Emergency flare)



Wind Speed

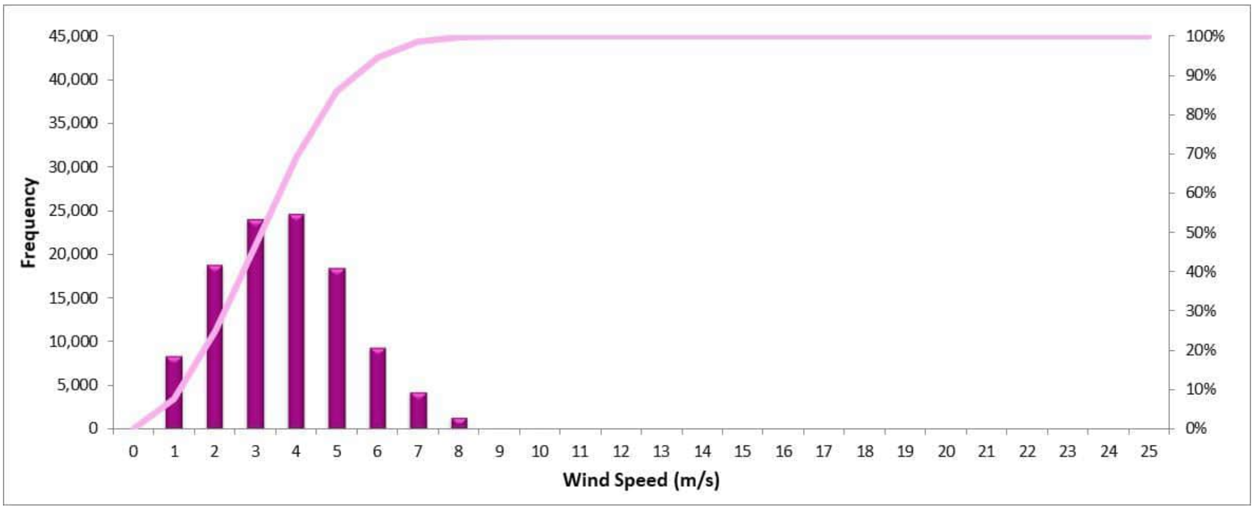
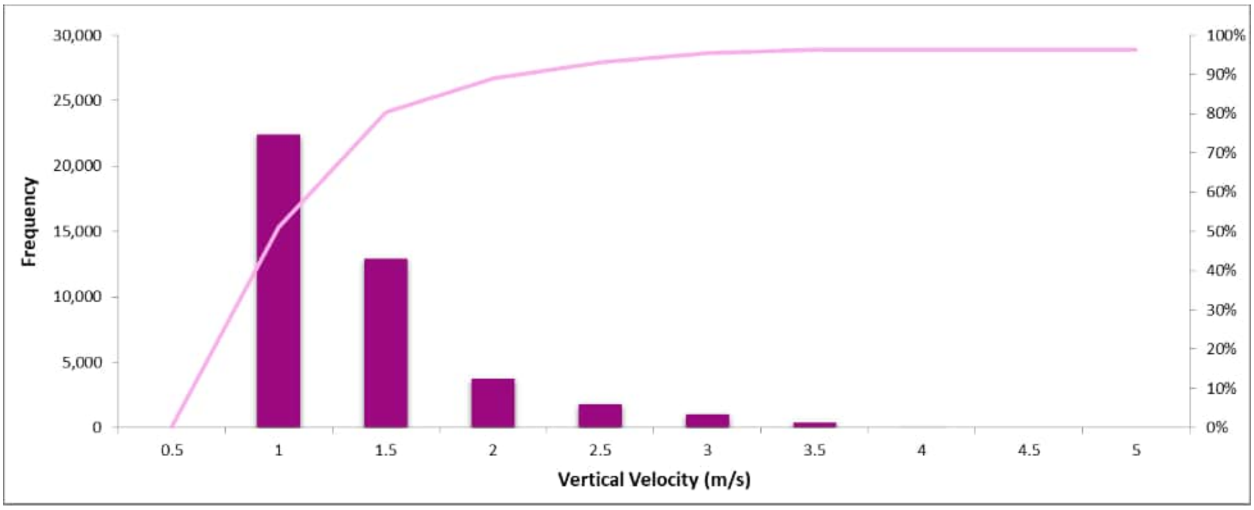
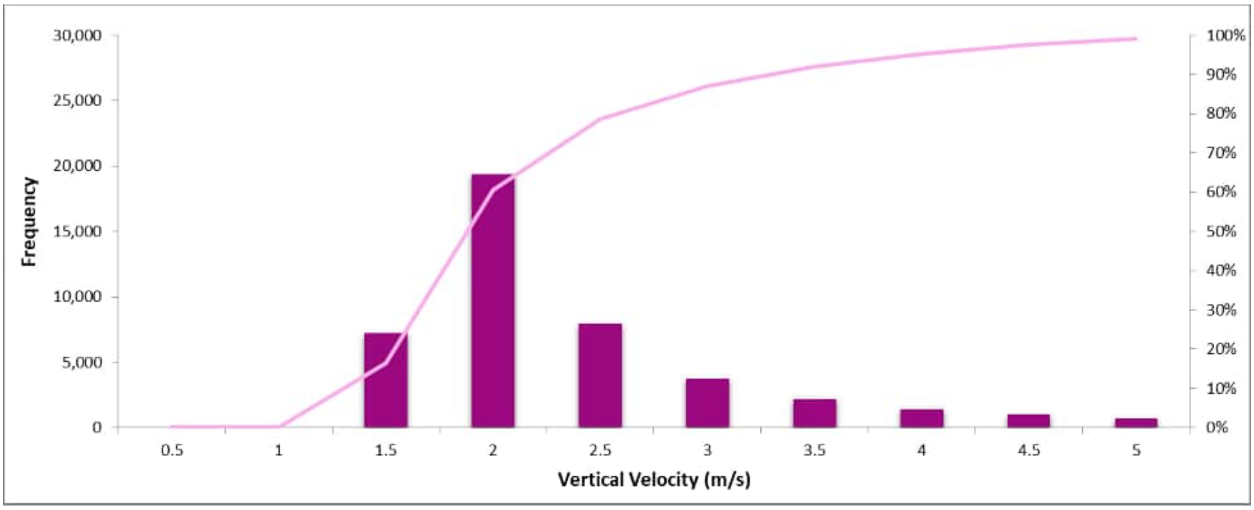


Figure 9 Cumulative frequency charts for plume and wind analysis for 40m above ground level (48m ASL)

Plume Vertical Velocity (Stage 2 source 7)



Plume Vertical Velocity (Emergency flare)



Wind Speed

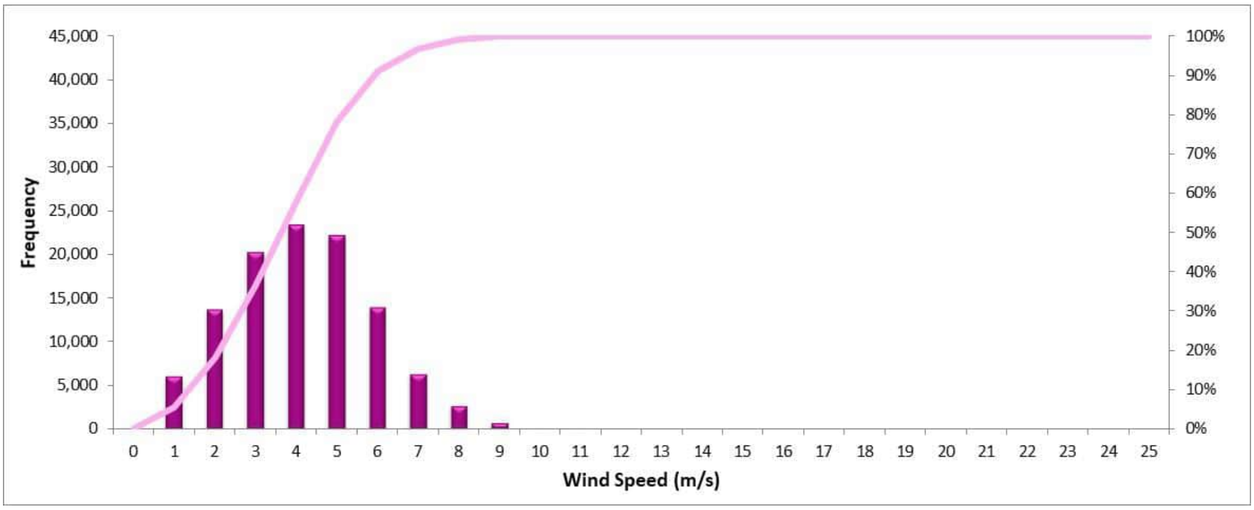
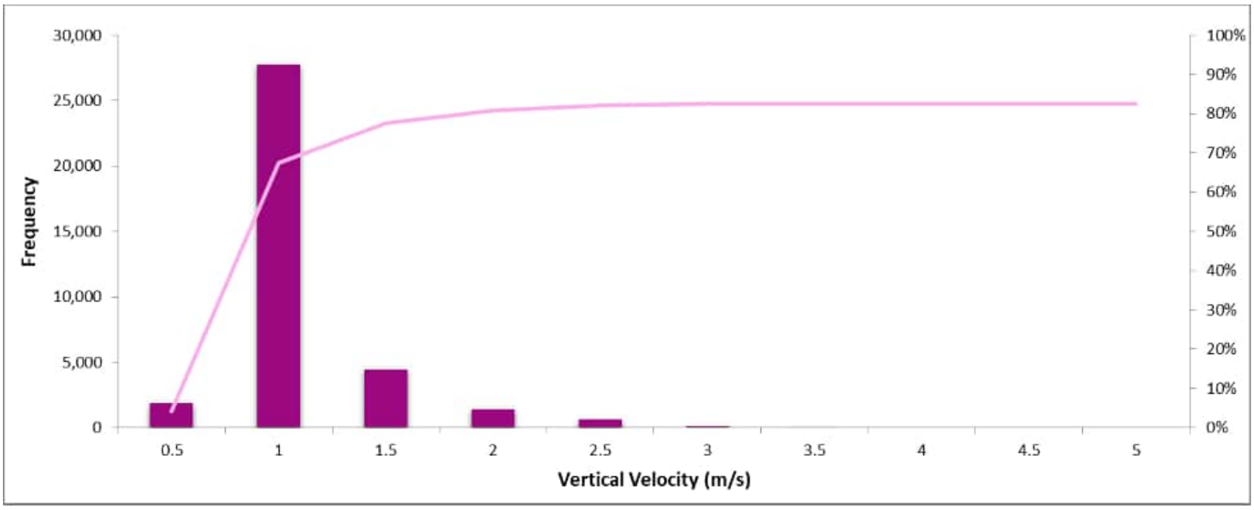
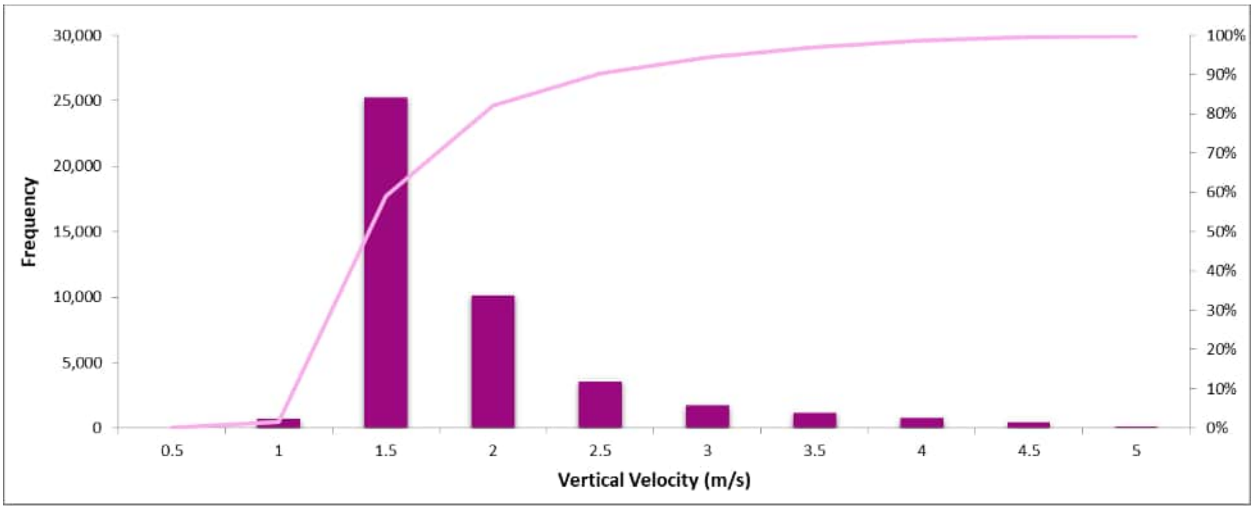


Figure 10 Cumulative frequency charts for plume and wind analysis for 60m above ground level (68m ASL)

Plume Vertical Velocity (Stage 2 source 7)



Plume Vertical Velocity (Emergency flare)



Wind Speed

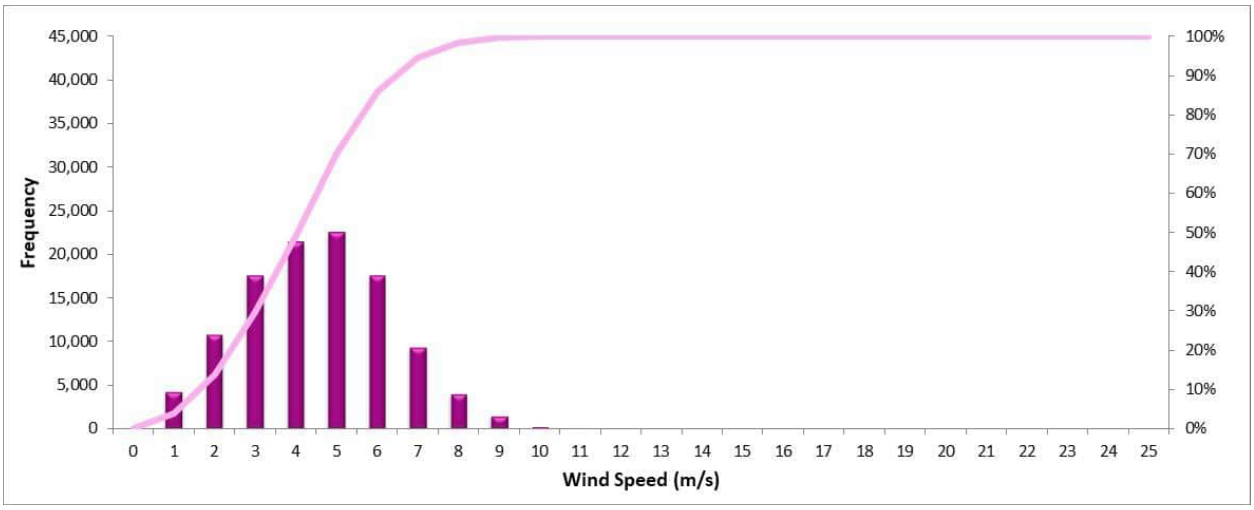
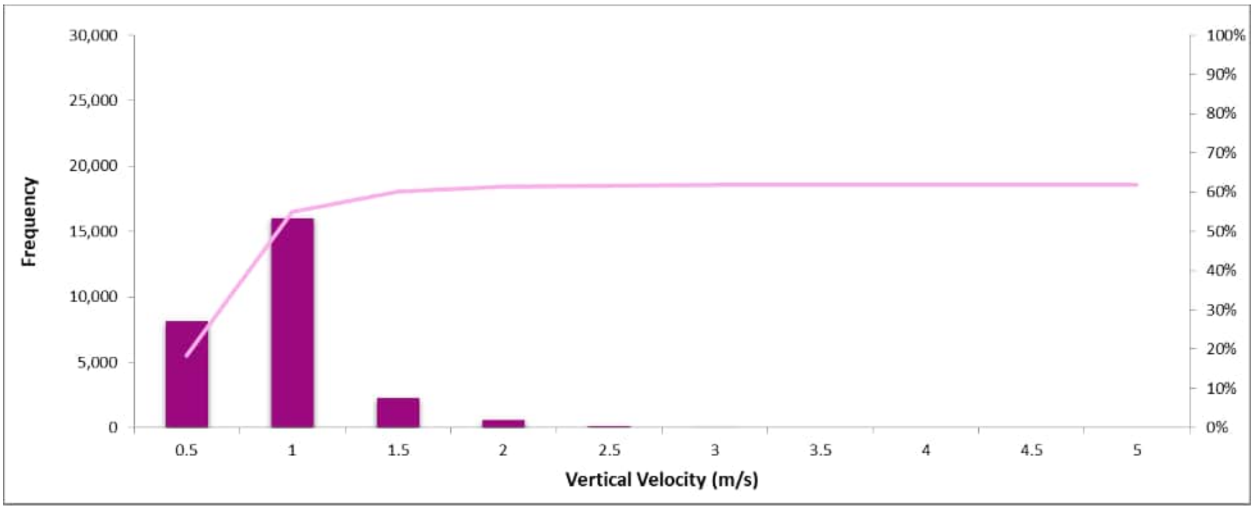
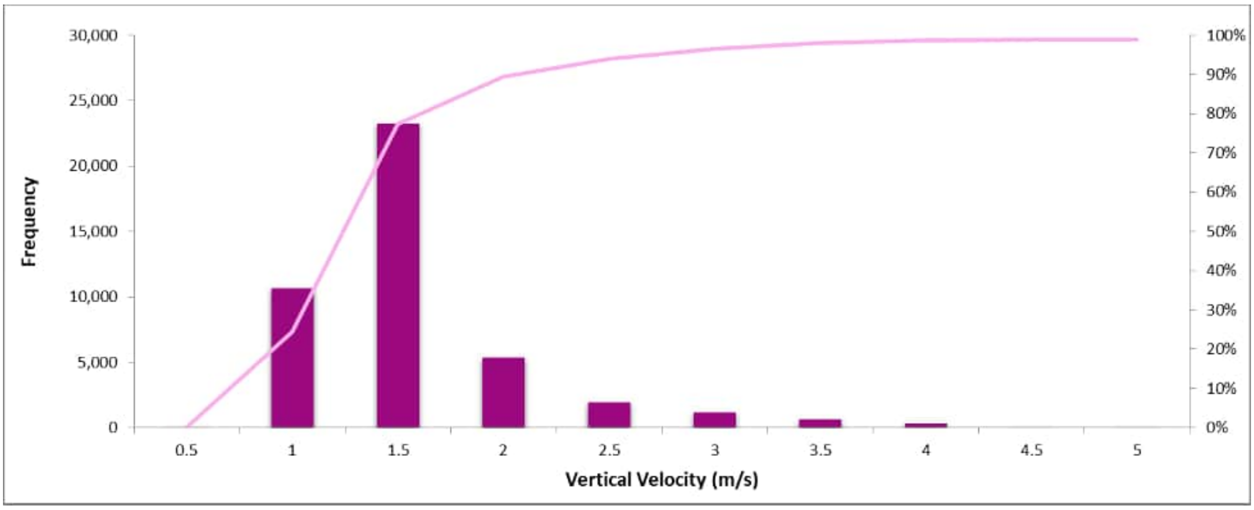


Figure 11 Cumulative frequency charts for plume and wind analysis for 80m above ground level (88m ASL)

Plume Vertical Velocity (Stage 2 source 7)



Plume Vertical Velocity (Emergency flare)



Wind Speed

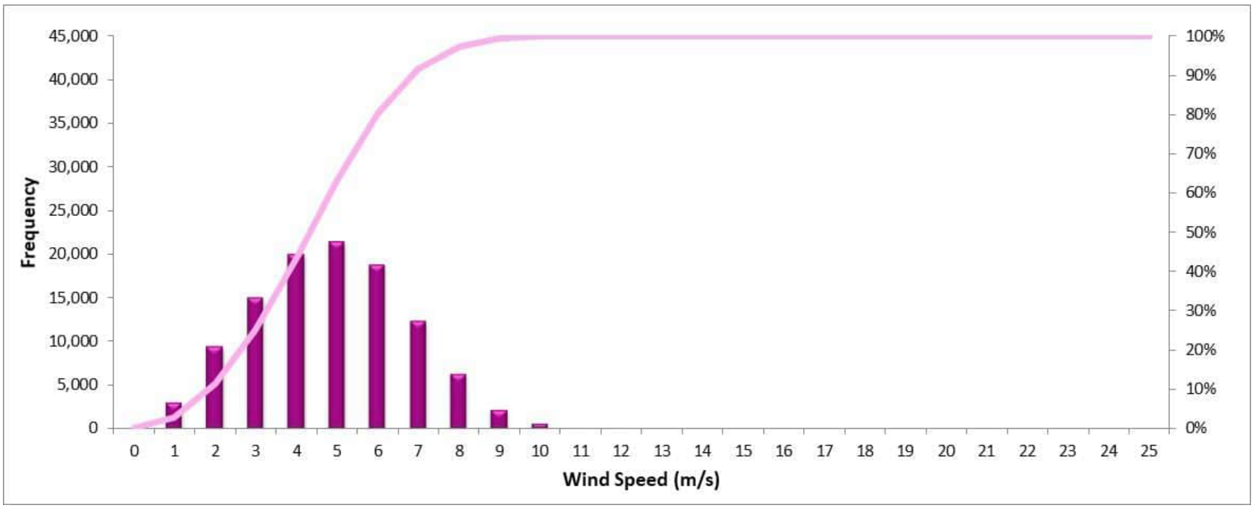
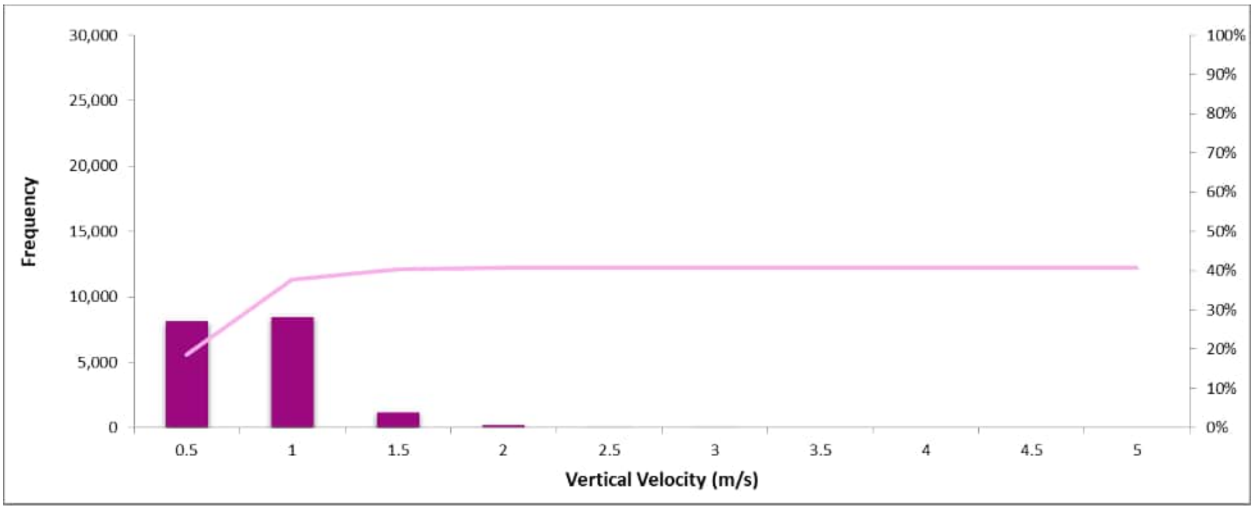
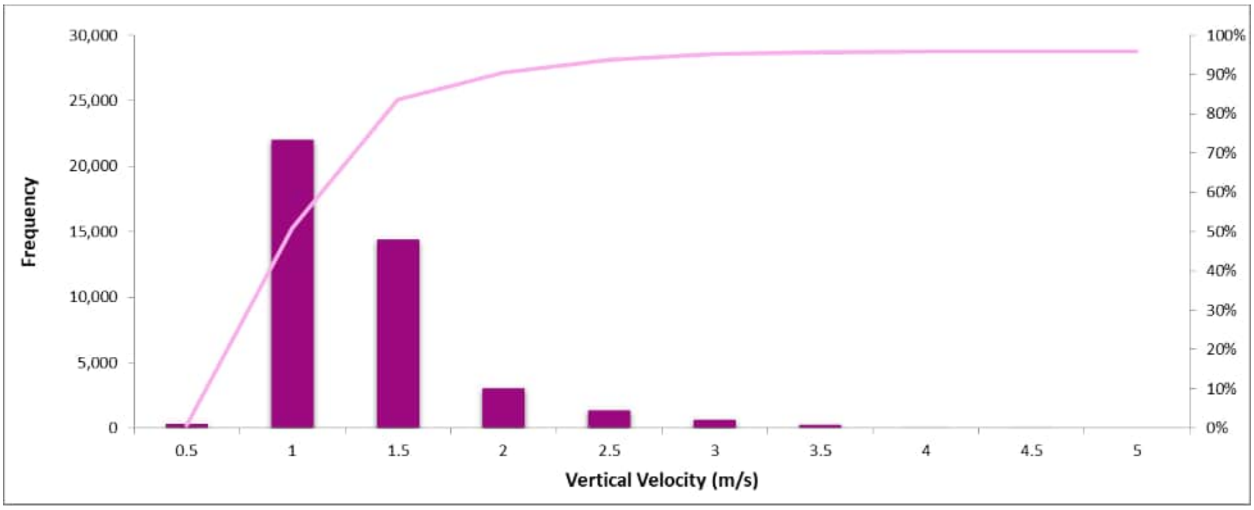


Figure 12 Cumulative frequency charts for plume and wind analysis for 100m above ground level (108m ASL)

Plume Vertical Velocity (Stage 2 source 7)



Plume Vertical Velocity (Emergency flare)



Wind Speed

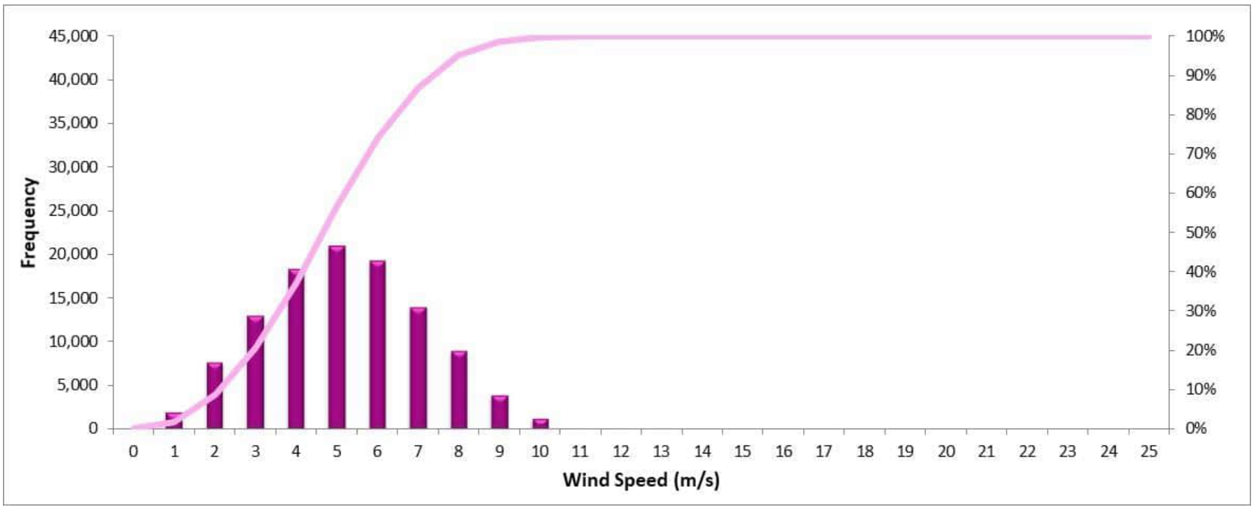
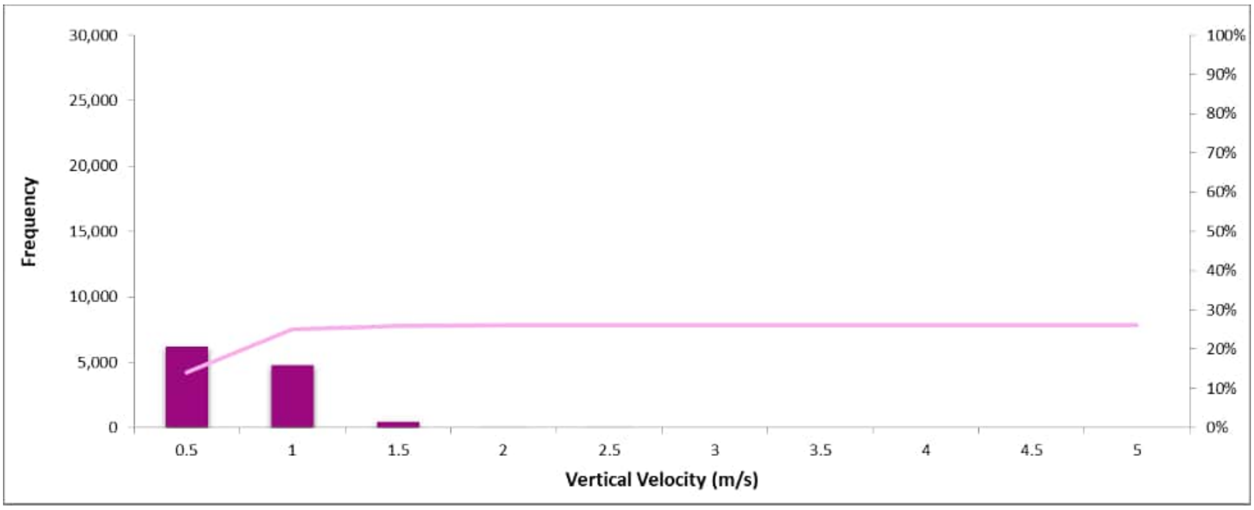
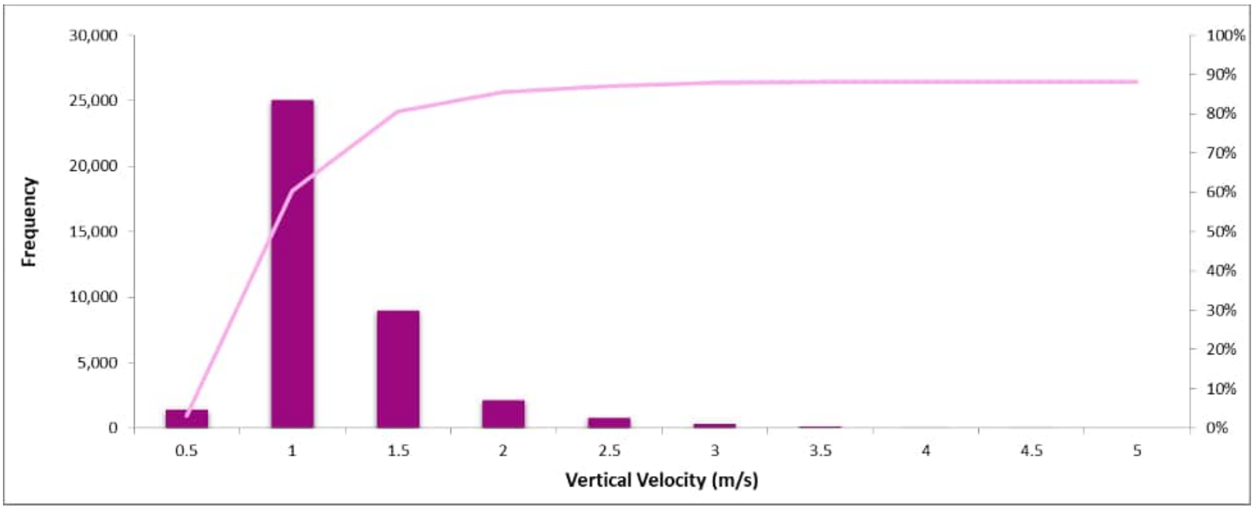


Figure 13 Cumulative frequency charts for plume and wind analysis for 120m above ground level (128m ASL) (approximate height of the OLS at the eastern boundary of the Site)

Plume Vertical Velocity (Stage 2 source 7)



Plume Vertical Velocity (Emergency flare)



Wind Speed

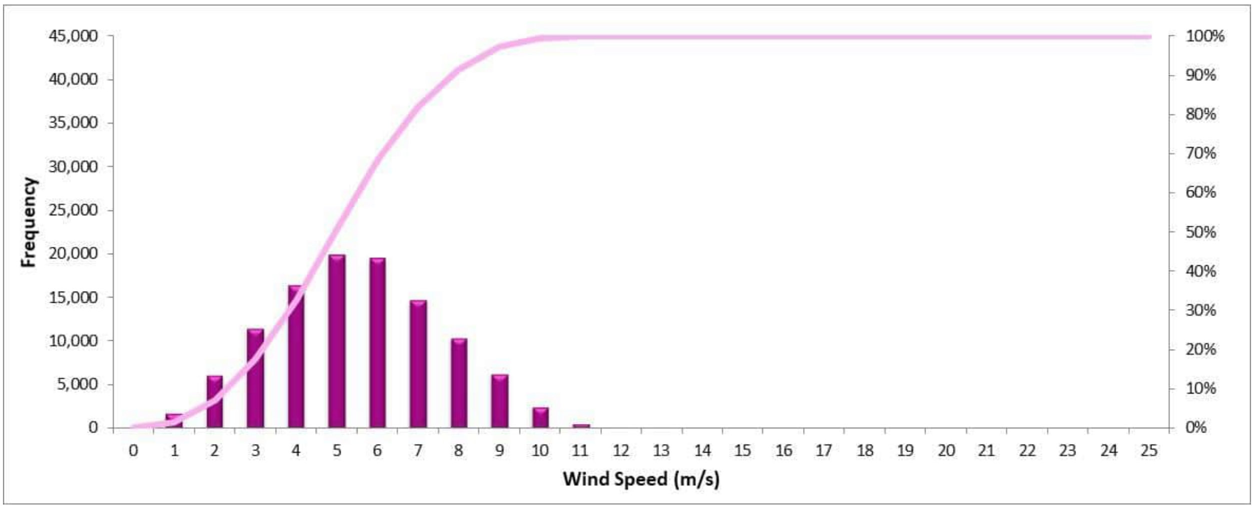
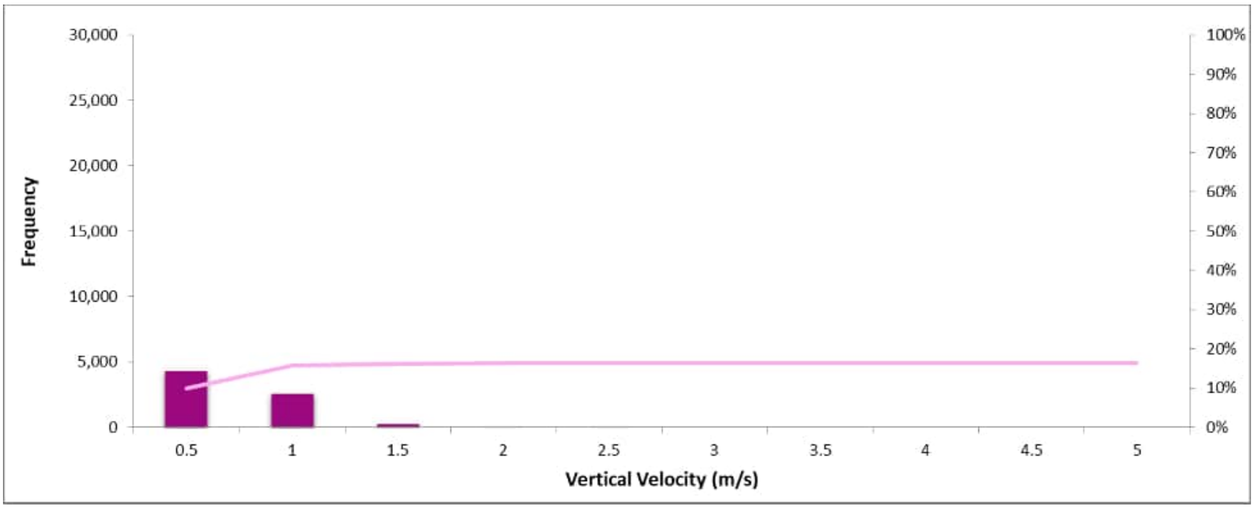
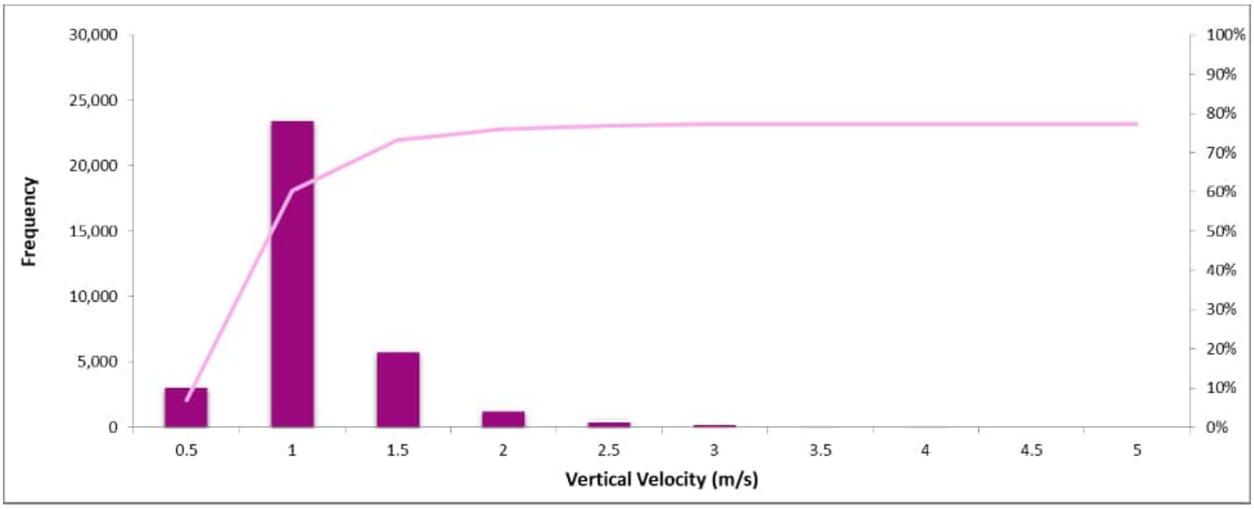


Figure 14 Cumulative frequency charts for plume and wind analysis for 140m above ground level (148m ASL) (approximate height of the OLS at the western boundary of the Site)

Plume Vertical Velocity (Stage 2 source 7)



Plume Vertical Velocity (Emergency flare)



Wind Speed

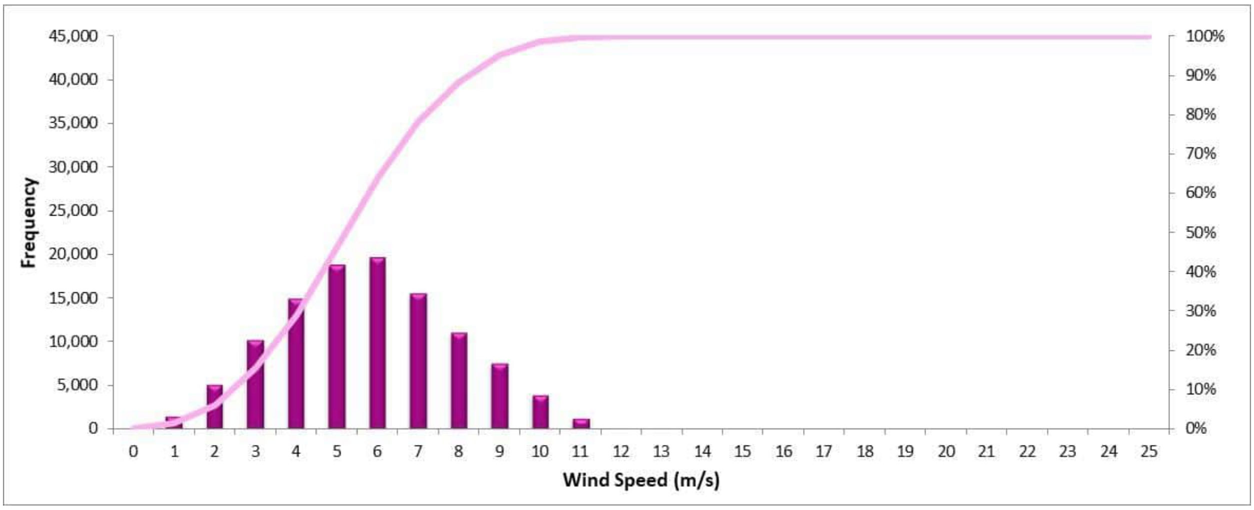


Figure 15 Cumulative frequency charts for plume and wind analysis for 160m above ground level (168m ASL)

5.3 Plume centreline displacement

Plume displacement has been investigated for the emergency flare to illustrate the displacement of the centreline of the plume as required by AC 139-5(0).

Table 10 shows the plume centreline displacement for the emergency flare as extracted from the TAPM model for vertical heights of 80 m and 120 m AGL. Table 10 shows the average plume vertical velocity for hours in which the CPV of 4.3 m/s is exceeded, and the average horizontal displacement. Table 10 also shows the maximum vertical velocity at each elevation and the maximum horizontal displacement.

It is evident from Table 10 that the horizontal displacement of the plume is minimal when the vertical velocity is high, with the average displacement at 120 m AGL predicted to be 15.8 m from the flare while vertical velocity is greater than 4.3 m/s. This is further demonstrated in Figure 16, which shows the relationship between the plume's vertical velocity and horizontal displacement at 120 m AGL. Significant horizontal displacement of the plume does not occur while the plume has a high vertical velocity.

Plume centreline displacement for CPV's of 6.1 m/s and 10.6 m/s will be less than the values presented for 4.3 m/s and therefore have not been presented.

Table 10 Horizontal plume centreline displacement for the emergency flare

Vertical height AGL (height ASL in brackets)	Average of hours where vertical velocity > 4.3 m/s		Maximum	
	Average vertical velocity (m/s)	Average horizontal displacement (m)	Maximum vertical velocity (m/s)	Maximum horizontal displacement (m)
80 m (88 m ASL)	4.6	13.4	5.3	437
120 m (128 m ASL)	4.4	15.8	4.5	968

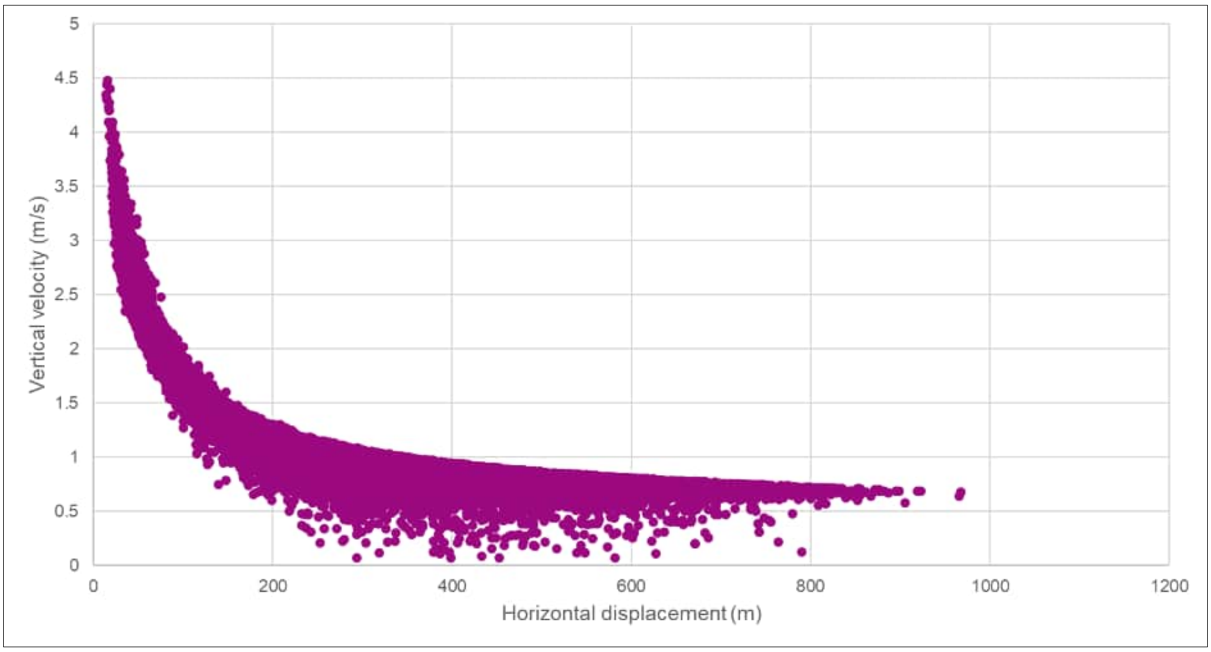


Figure 16 Emergency flare plume characteristics at 120 m AGL (128 m ASL)

6.0 Conclusion

This report provides results for the plume rise assessment for the Alpha HPA processing plant proposed to be located at 53 Reid Road, Yarwun, formally described as Lot 12 on SP239343.

Current CASA guidance mandates that assessment of potential plume rise impacts are considered independently by CASA. However, plume rise assessments can be undertaken by technical consultants to inform CASA and aviation facilities such as Gladstone Airport. This assessment has been undertaken to support the Project and assess the likelihood of plume rise impacts. The plume rise assessment has been undertaken in accordance with the CASA assessment methodology requirements outlined in AC 139-5(0) (2004), but has considered CPVs of 4.3, 6.1 and 10.6 m/s in accordance with more recent CASA guidance.

The TAPM modelling results indicate that from normal operations of the Alpha HPA processing plant the maximum height at which plume vertical velocity falls below the CPV of 4.3 m/s was found to be 63 m ASL. This maximum height is well below the height of the OLS for Gladstone Airport, which is 130 m ASL at its lowest height over the Site.

The modelling results do indicate that the operation of the emergency flare has the potential to generate a plume with a vertical velocity above the CPV of 4.3 m/s at the lowest height of the OLS over the Site (130 m ASL). However, the risk of plume rise impacts occurring from the emergency flare is considered low as the flare will only operate in emergency situations and the modelling indicates that exceedance above the CPV of 4.3 m/s is rare.

As a result of this assessment, while Project operation is considered unlikely to present a hazard to local aircraft operations, a referral to CASA for the flare is required.

7.0 References

BoM (2003) Manual of Aviation Meteorology, Airservices Australia, 2003

CASA (2004) Advisory Circular AC 139-5(0) Guidelines for Conducting Plume Rise Assessments, Civil Aviation Safety Authority, Australian Government, June 2004

CASA (2012) Advisory Circular AC 139-5(1) Plume Rise Assessments, Civil Aviation Safety Authority, Australian Government, November 2012

CASA (2019) Advisory Circular AC 139-05 v3.0 Plume Rise Assessments, Civil Aviation Safety Authority, Australian Government, January 2019

CASA (2023) Advisory Circular AC 139.E-02 v1.0 Plume Rise Assessments, Civil Aviation Safety Authority, Australian Government, March 2023

Hurley, P., *TAPM v.4. User Manual*. CSIRO Marine and Atmospheric Research Internal Report No. 5, October 2008.

Manins, P, C., Carras, J, N,. and Williams, D, L., (1992) Plume Rise from Multiple Stacks, Clean Air (Australia), May 1992, Vol 26 Part 2, pp 65–68

Appendix I

Preliminary Noise Impact Assessment

Prepared for
Alpha HPA Limited
ABN: 79 106 879 690

AECOM

Preliminary Operational Noise Impact Assessment

HPA Processing Plant

29-May-2024
Alpha HPA

Preliminary Operational Noise Impact Assessment

HPA Processing Plant

Client: Alpha HPA Limited

ABN: 79 106 879 690

Prepared by

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Job No.: 60617664

AECOM in Australia and New Zealand is certified to ISO9001, ISO14001 and ISO45001.

Quality Information

Document	Preliminary Operational Noise Impact Assessment
Ref	60617664
Date	29-May-2024
Originator	Omar Al-Busaidi
Verifier	Aloysius Chang

Revision History

Rev	Revision Date	Details	Approved	
			Name/Position	Signature
0	12-Aug-2020	Revision – for client's comments	Rouven Lau Environment Group Lead - NQNT	Original previously signed
A	29-Sep-2020	For Issue	Rouven Lau Environment Group Lead - NQNT	Original previously signed
B	27-May-2021	For Issue - Includes PPF	Rouven Lau Environment Group Lead - NQNT	Original previously signed
C	12-April-2024	For Issue - For client's comments	Rouven Lau Environment Group Lead - NQNT	Original previously signed
D	29-May-2024	For Issue - Final Issue	Rouven Lau Environmental Group Lead NQNT	

Table of Contents

1.0 Introduction

1.1 Overview

Alpha HPA Limited (the Applicant) seeks to establish a Special Industry (High Purity Alumina (HPA) processing plant) and Linear Infrastructure Facility for the purposes of the approved HPA processing plant (the Project). The key objective of the Project is to supply HPA and related alumina, alumina salt products and sapphire crystals.

AECOM Australia Pty Ltd (AECOM) was commissioned by the Applicant to assess potential operational noise emission from the plant located at 53 Reid Road, Yarwun, impacting nearby sensitive receptors.

Nomenclature of terms used in this report is provided in Appendix A.

1.2 Project Overview

A Site Specific EA (P-EA-100167564) for Environmentally Relevant Activities was originally approved in March 2022 and a Minor Amendment was Approved in 2024. The Project is approved to be staged into two stages to allow Alpha HPA to respond to urgent market demand. The following provides for a description of each stage.

Stage 1

The Precursor Production Facility (PPF) is an advanced stage of the Project thereby allowing the production of between 10-20 Metric Tonnes (MT) per month of Ultra HPA, alumina salt products and sapphire crystal.

Stage 1 has been constructed and is currently operational. The PPF is fully contained within an industrial shed with any external storage areas being fully covered and appropriately bunded.

Figure 1 demonstrates Stage 1 manufacturing process flow chart:

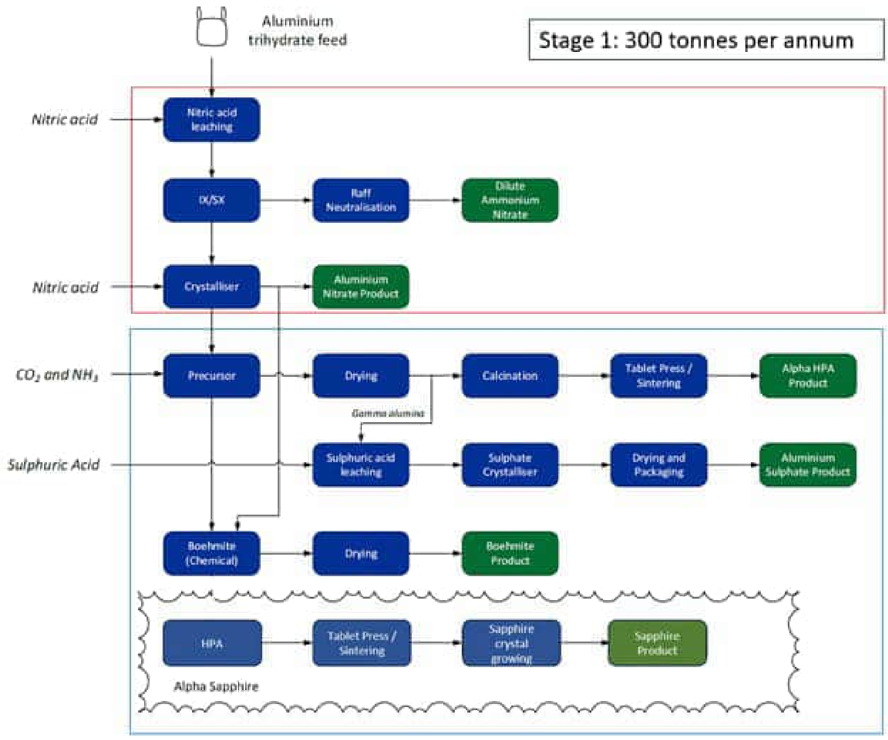


Figure 1 Stage 1 Manufacturing Process Flow Chart

Stage 2

The balance of the HPA processing plant will be constructed as Stage 2 of the Project (yet to be constructed). Both stages will operate concurrently once Stage 2 is constructed.

The Project will process an aluminium based feedstock into a >99.99% pure HPA and will manufacture 10,000tpa of HPA and 136,000tpa of Ammonium Nitrate using the following associated processes:

- Feed Preparation
- Aluminium solvent extraction
- Aluminium salt crystallisation
- Product precipitation
- Drying and calcination
- Ammonium nitrate concentration
- HPA product milling and bagging.

The process used by Alpha HPA has been developed specifically for the Project and licensed by Alpha HPA. It has a number of benefits over alternative processing methods and has a low environmental signature.

The Project feedstock is a refined aluminium bearing feedstock sourced locally. The neighbouring Orica operation supplies reagents (nitric acid and ammonia) via separate underground pipelines and receives the Ammonium Nitrate by-product via an overhead pipeline across Reid Road at a height of approximately 12m.

The following demonstrates Stage 2 manufacturing process flow chart:

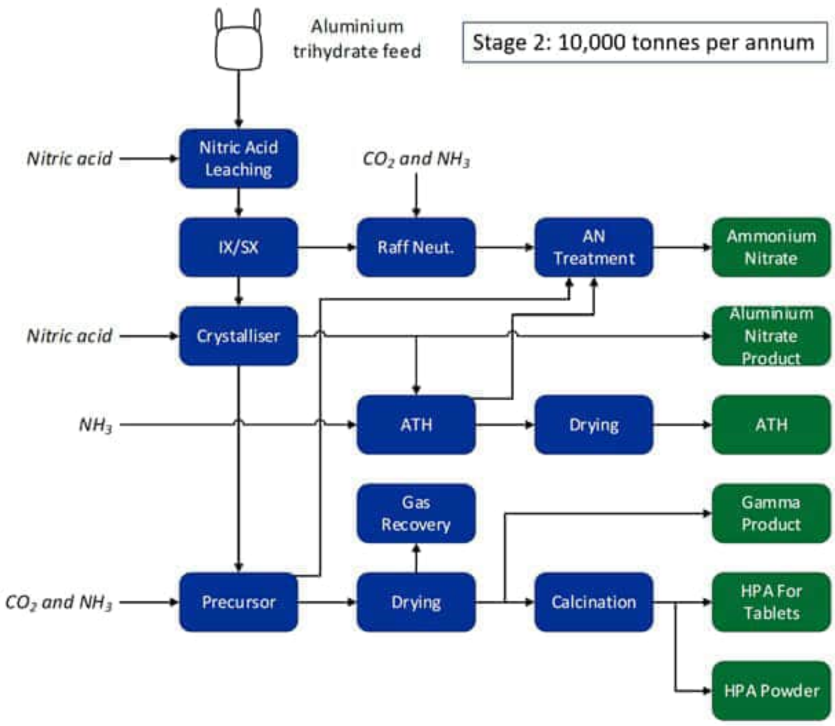


Figure 2 Stage 2 Manufacturing Process Flow Chart

The manufacturing process for Stage 1 and Stage 2 are largely the same, the key differences being that the production capacity for Stage 2 will be significantly higher, and the full suite of products produced in

Stage 1 (high purity alumina, alumina salt products and sapphire crystal) will not all be produced in the larger Stage 2 facility (aluminium nitrate, high purity alumina products and Ammonium Nitrate solution).

For example, the sapphire crystal machines that have been installed as part of Stage 1 will not be replicated on a larger scale for Stage 2. The Stage 2 facility will include a couple of additional treatment steps that are not included in Stage 1, these include additional purification and evaporation of the ammonium nitrate solution, additional treatment of the waste from the IX circuit and additional gas scrubbing steps for recovery of CO2 and NH3 from offgas from the dryers.

Stormwater will be treated on site via swales, humeceptors and bioretention basin before being discharged in accordance with Stormwater Guideline: Environmentally Relevant Activities (DES 2014). Boiler blow down and cooling tower blow down will be directed to the Gladstone Regional Council Trade Waste system which discharges via a diffuser at Fisherman's Landing. Runoff from production areas will be collected as first flush and taken off site for disposal. During periods of significant and extended rainfall, secondary runoff from the production areas will be directed to onsite ponds for testing before also discharging to the trade waste system.

1.3 Report Purpose

This report comprises a preliminary assessment of operational noise impacts from the HPA processing plant to nearby sensitive receptors. This preliminary assessment is intended to demonstrate that noise treatments can be practicably applied to the Project site to allow compliance with the nominated criteria. This has been done by:

- Review Environmental Authority P-EA-100167564 dated 27 March 2024 and determine the relevant noise conditions.
- Identifying nearby sensitive receptors based on the requirements of the EPP (Noise) 2019.
- Determining indicative sound power levels as part of the plant.
- Assessing the environment noise impact of the HPA processing plant to sensitive receptors under typical worst case-meteorological conditions.
- Identifying any predicted exceedances of the nominated noise criteria.
- Recommending indicative noise treatments intended to achieve the noise criteria where exceedances are predicted.

Final noise treatments will need to be refined as the project progresses into Detailed Design and the equipment selection has been finalised. As such, the discussion of noise treatments in this assessment should be considered as "indicative" only.

This assessment comprises an update to the Rev B assessment dated 24 May 2021 to incorporate the following:

- Updated Stage 1 and Stage 2 equipment lists and site layouts provided by Alpha HPA in their emails dated 23 December 2023 and 1 March 2024.
- Elevations obtained as 1m contours from Queensland Spatial Catalogue.

1.4 Assessment Scope and Limitations

The limitations of this report are as follows:

- The findings of this report are based on the information provided to date, and may change as the project progresses to Detailed Design phase. Should the final conditions/activities differ from that discussed in this report, the impact to nearby receptors may differ from the findings presented in this report.
- The findings of this report are considered preliminary in the absence of vendor-provided, final Sound Power Levels of acoustically significant equipment, and detailed noise modelling incorporating shielding effects from buildings, and terrain, etc.
- Measurements of noise from other existing facilities located within the Gladstone State Development Area (GSDA), and background noise levels at nearby sensitive receptors, have not been undertaken, as the nominated criteria are not dependent on these pre-existing background noise levels.
- Only operational noise emission from the HPA processing plant to existing dwellings has been assessed. Operational vibration, and construction-related noise and vibration emissions, are excluded from the current report and discussion.

The advice contained herein is specifically related to acoustic issues. AECOM recommends that additional advice be sought regarding structural performance, build-ability, seismic restraint, wind-loading and other non-acoustical issues associated with this project.

2.0 Description of Site and Surrounds

2.1 Location

The proposed Alpha HPA Project is located at 53 Reid Road, Yarwun, formally known as Lot 12 SP239343 (the Project Site), within the GSDA. The Project Site is located along Reid Road opposite ORICA's Ammonium Nitrate Facility in Yarwun and is shown in Figure 3 .

Figure 3 Site Location

An extract from the GSDA Development Scheme showing the boundary and development precincts of the GSDA is provided in Figure 4 overleaf. The Project Site is located in the Port Related Industry Precinct. The surrounding land extending from the Project Site to Calliope River is currently vegetated.

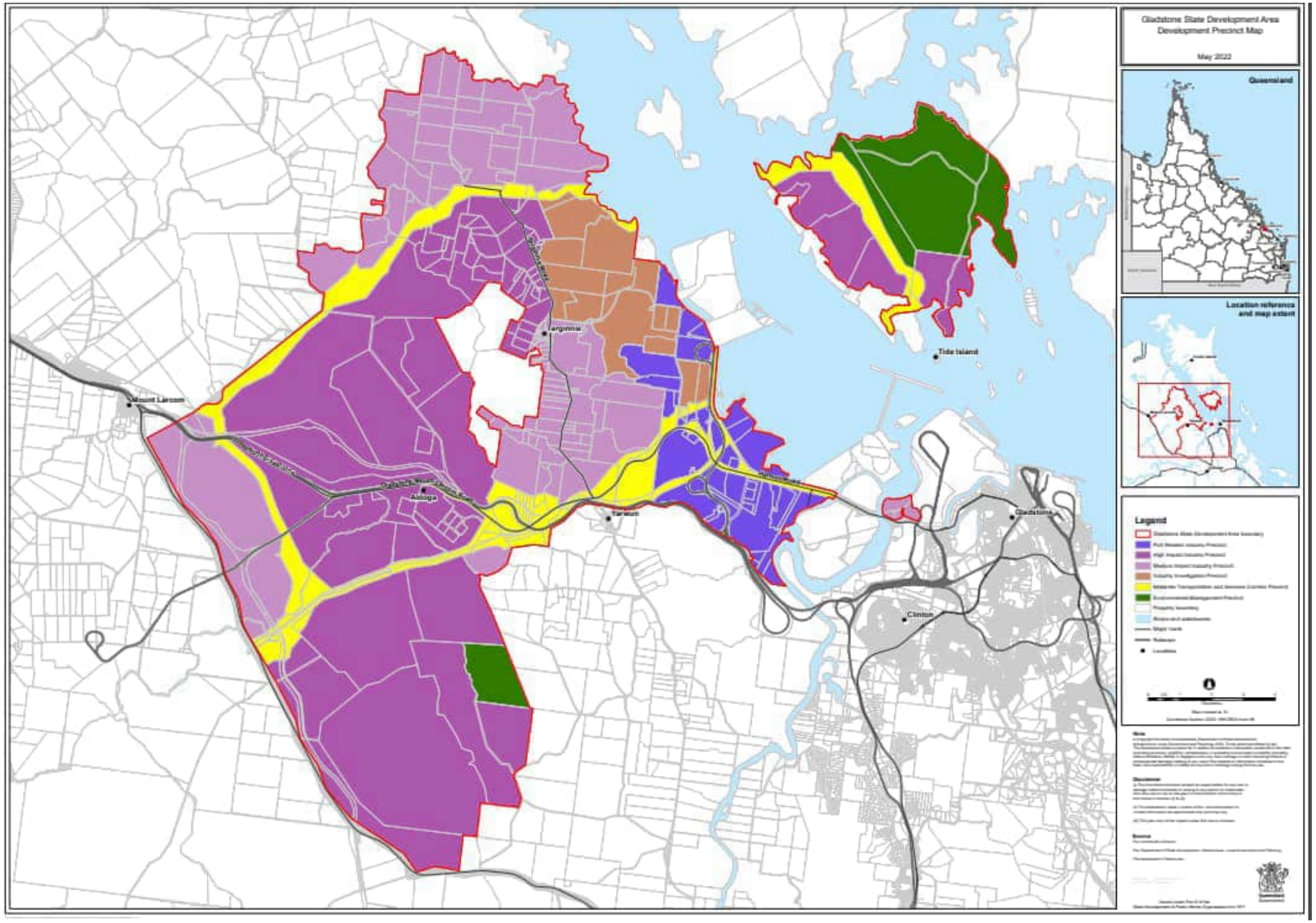


Figure 4 Gladstone State Development Area Precinct Map (GSDA Development Scheme, 2022)

2.2 Typical Operation

The plant (Stages 1 & 2) is envisaged to operate continuously 24 hours a day, 7 days a week.

An equipment list for Stage 2 was provided by Alpha HPA via email dated 1 March 2024. Acoustically-significant equipment were identified from this list, and Sound Power Levels were estimated for these equipment. The estimation of Sound Power Levels is discussed in Section 4.2.

The equipment list for Stage 1 was subsequently provided by Prudentia Process Consulting Pty Ltd in their email dated 19 May 2021 and by Alpha HPA in their email dated 23 December 2023.

A list of acoustically-significant equipment and their sound power levels including both Stage 01 and Stage 02 equipment, is provided in Appendix B.

2.3 Sensitive Receptors

Sensitive receptors are described in Schedule 2 of the EPP (Noise) 2019. This schedule has been used to identify sensitive receptors in proximity to the Project Site.

Using aerial imagery, nearby sensitive receptors were found to comprise dwellings. The coordinates of these sensitive receptors are summarised in Table 1 and shown in Figure 5 overleaf. The highest density of receptors comprises dwellings within the suburb of Clinton, approximately 5 km to the SE of the Project site (farther to the southeast past Receptor R03).

Table 1 Sensitive Receptor List

Sensitive Receptor ID	Type of Sensitive Receptor	Easting*	Northing*	Approximate Distance to Project Site (km)	Direction from Project Site
R01	Dwelling	309143	7361520	4.5	West
R02	Dwelling	310304	7359790	4.5	Southwest
R03	Dwelling	316072	7359087	4	Southeast
R04	Dwelling	311528	7356800	6	Southwest
R05	Dwelling	315929	7356699	6	Southeast
R06	Dwelling	317221	7356802	6.5	Southeast
R07	Dwelling	317188	7358004	5.5	Southeast

*Based on GDA94 MGA Zone 56 coordinate system

Receptor R03 is located closest to the Project site than other sensitive receptors tabulated in Table 1 above. Additionally, this receptor is located partway between the Project site and receptors in the suburb of Clinton.

Accordingly, noise impact from the HPA processing plant to Receptor R03 is predicted to be louder than the impact to receptors farther away, and it is envisaged that compliance with the nominated noise criterion at Receptor R03 will allow compliance at these other receptors. Therefore, the predicted noise impact to Receptor R03 comprises the focus for the remainder of this preliminary assessment.

AECOM

0 2 km

Sensitive Receptor

Project Site

Alpha HPA Project

Figure 5 Sensitive Receptor Locations

3.0 Noise Criteria

3.1 Environmental Authority P-EA-100167564

The site has a relevant Environmental Authority, EA P-EA-100167564 dated 27 March 2024. The noise schedule in the EA is as provided below.

Schedule: Noise

N1 Other than as permitted within this environmental authority, noise generated by the activity must not cause environmental nuisance to any sensitive place or commercial place.

N2 Noise from the activity must not include substantial low frequency noise components and must not exceed the levels identified in Table N1 – Noise limits and the associated requirements at any nuisance sensitive place or commercial place.

Table 2 EA P-EA-100167564 Table N1 - Noise limits

Noise level measured in dB(A)	Monday to Saturday			Sunday and public holidays		
	Day	Evening	Night	Day	Evening	Night
	7am to 6pm	6pm to 10pm	10pm to 7am	9am to 6pm	6pm to 10pm	10pm to 9am
	Noise measured outdoors at the nearest sensitive place			Noise measured outdoors at the nearest sensitive place		
$L_{Aeq, adj, 1hr}$	50	42	37	42	37	37
$L_{Amax\ 1hr}$	NA	NA	49	NA	NA	49
	Noise measured outdoors at a commercial place (when the activity is open for business)			Noise measured outdoors at a commercial place (when the activity is open for business)		
$L_{Aeq\ adj,\ 1hr}$	52			52		

Notes:
LAeq, adj,1hr means an A-weighted sound pressure level of a continuous stead sound, adjusted for tonal character and impulsiveness of the sound, that within a 1 hour period has the same mean square sound pressure of a sound that varies with time.
LAmax,1hr means the maximum A-weighted sound pressure level measured over a time period of 1 hour.

N3 The method of measurement and reporting of noise level must comply with the latest edition of the administering authority's noise measurement manual

N4 When requested by the administering authority, noise monitoring must be undertaken by an appropriately qualified person(s), to investigate any complaint of noise nuisance, and the results notified withing 14 days to the administering authority. Monitoring must include:

a) LAeq, adj, T; and
b) Background noise (Background) as LA 90, adj, T; and
c) MaxLpA,T; and
d) The level and frequency of occurrence of any impulsive or tonal noise; and
e) Atmospheric conditions including wind speed and direction; and
f) Effects dues to extraneous factors such as traffic noise; and
g) Location, date and time of recording.

3.2 Assessment Noise Criteria

As noise from the Project Site is quasi-steady in nature due to the presence of continuously operating equipment, the L_{Aeq} noise descriptor is considered to be appropriate to describe noise emission from the site. Given the type of site activities assessed, the L_{Amax} noise levels are predicted to be no more than 10 dB(A) higher than the L_{Aeq} noise levels. Since the L_{Amax} noise criterion, 49 dB(A), is 12 dB(A) higher than the Evening/Night L_{Aeq} limit of 37 dB(A), the limiting noise level in the assessment is the L_{Aeq} descriptor. For brevity, this noise descriptor, has been used for the remainder of this assessment as compliance with the L_{Aeq} descriptor is envisaged to allow compliance with the L_{Amax} descriptor.

Noise Schedule N2 specifies that no substantial low frequency noise, however, no noise limit for this requirement has been specified in the EA. The Department of Environment, Science and Innovation Document ESR/2015/1828 Version 12.02 effective 1 July 2019 specified an overall sound pressure level noise limit of 55 dB(Z). For the purposes of this assessment, to determine compliance with the substantial low frequency noise criterion, this noise limit has been applied at the sensitive receptors.

The assessment criteria for the Project is detailed in Table 3 below. The noise criterion is applied in the free-field i.e. more than 3.5 metres away from a vertical reflective surface such as dwelling facades.

Table 3 External Free-Field Assessment Noise Criteria

Sensitive Receptor Type	Time Period	External Noise Criteria
Dwelling	Day	42 $L_{Aeq,adj,1hr}$ dB(A)
		55 $L_{eq,\ adj,\ 1hr}$ dB(Z)
	Evening and Night	37 $L_{Aeq,adj,1hr}$ dB(A)
		55 $L_{eq,\ adj,\ 1hr}$ dB(Z)

It is noted that all the sensitive receptors assessed are dwellings, hence the commercial noise criterion have not been included in Table 3 above.

4.0 Methodology

4.1 Modelling

SoundPLAN (version 8.2) noise modelling software package was used to predict the free-field, external noise impacts from the Project Site to nearby sensitive receptors. The CONCAWE prediction method was used to model environmental noise emissions from the Project site. CONCAWE is the generally accepted method used to predict operational noise emission from industrial sites in Queensland. Modelled parameters representing the weather conditions above are presented in Table 4.

Table 4 Meteorological Noise Modelling Parameters

Scenario	Scenario Description	Temperature	Relative Humidity	Wind Speed and direction	Pasquil Stability Class
1	Neutral (A)	25 °C	70%	0 m/s (calm)	D
2	Neutral (B)	25 °C	70%	3 m/s, adverse (from source to receptor)	D
3	Adverse (A)	10 °C	60%	0 m/s (calm)	F
4	Adverse (B)	10 °C	60%	3 m/s, adverse (from source to receptor)	F

There are six distinct atmospheric classes typically used to represent atmospheric stability. These range from Class A to Class F. Each of these classes represents a differing ability of sound to propagate across terrain. For the purposes of a screening assessment, Class D and Class F conditions are considered to represent the typical conditions on site, and have been adopted for the remainder of this assessment.

- Class D is considered neutral to the propagation of sound and can occur under a range of conditions including little or no wind and no temperature inversion.
- Class F conditions are characterised by a temperature inversion during the night time period (typically winter months), which can assist the propagation of noise and increase the noise impact in areas surrounding a site.
- Noise propagation is also affected by the type of ground cover between the source and receptor. Most standards use a 'ground absorption factor' to evaluate the ground effect. The ground absorption factor ranges from 0 (which is applied to acoustically "hard" surfaces such as asphalt and water) to 1 (which is applied to acoustically "soft" surfaces such as fields and grass). Around the site, the ground coverage is predominantly wetlands which are reflective. It is also understood that the GSDA may be built out in future and can become fully hard ground. As such, a ground absorption factor of 0 was used as a conservative approach.

4.2 Input and Assumptions

The equipment list was provided by Alpha HPA in their email dated 1 March 2024. This list comprises a description and the predicted power rating of equipment (in kW) anticipated to be used on the Project Site.

For the preliminary assessment, the following assumptions have been adopted. These are considered to be conservative:

- Stage 1 and 2 operating concurrently.
- All equipment operating simultaneously.
- All equipment and equipment have been conservatively assumed to be operating outdoors.
- Sound power levels generally estimated based on formulas provided in *Engineering Noise Control*, third edition, 1996 (Bies, D.A and Hansen, C.H). Where several variables/formulas are applicable, the variable/formula giving rise to the highest Sound Power Level have has been adopted, as a conservative approach.
- All equipment is free from tonal, impulsive or other annoying characteristics.
- The equipment is located at the heights listed in the equipment register provided by Alpha HPA, with the following heights above the terrain assumed:
  - Where the equipment is at ground level, 4m.
  - Where the equipment is described to be at 5m to 10m above terrain, 10m.
- Digital ground model based on 1m contours obtained from Queensland Spatial Catalogue.
- No intervening structures e.g. shielding from other buildings onsite.
- Receptor height of 4.6 m above ground level; representing the upper floor of a double storey dwelling.

The loudest 40 Stage 2 items of equipment were predicted to have the greatest effect on noise emissions from the site, and were thus included in the noise assessment as separate point sources. Conversely, the remaining Stage 2 items of equipment (ranked 41 and lower) were combined into three point receptors based on the equipment height. Stage 1 items of equipment were predicted to have a minor effect on the noise emissions from the site and were included as individual and grouped point sources. A list of acoustically-significant equipment is provided in Appendix B.

5.0 Predicted Operational Noise Impacts

5.1 Predicted Impact Without Treatment

The predicted typical worst-case noise levels at each sensitive receptor have been presented in Table 5 based on the methodology discussed in Section 4.0. For brevity, the highest predicted noise level across the four meteorological scenarios in Table 4 have been presented in Table 5 below. Refer to Appendix D for predicted noise levels of all four meteorological scenarios, and Appendix C for noise contour map corresponding to the loudest case scenario.

Table 5 Predicted worst-case external noise levels without additional treatment

Sensitive Receptor ID	Criteria		Predicted External Noise Level $L_{Aeq,adj,1hr}$ dB(A)	Predicted to comply with criteria?	
	Day $L_{Aeq,adj,1hr}$ dB(A)	Evening/Night $L_{Aeq,adj,1hr}$ dB(A)		Day	Evening/Night
R01	42	37	26	Yes	Yes
R02	42	37	23	Yes	Yes
R03	42	37	44	No	No
R04	42	37	19	Yes	Yes
R05	42	37	38	Yes	No
R06	42	37	37	Yes	Yes
R07	42	37	40	Yes	No

The operational noise impact at Receptor R03 is predicted to exceed the Day and Evening/Night criteria by 2 dBA and 7 dBA respectively. A slight exceedance, 1 dBA and 3 dBA, of the Evening/Night criterion is predicted at Receptors R05 and R07, respectively. However, compliance with the noise criteria is predicted at all other receptors. As discussed in Section 4.0, these predicted levels are considered to be conservative.

A discussion of indicative noise treatments, intended to demonstrate that noise treatments can be practicably applied to the Project site to allow compliance with the nominated criteria, are discussed in Section 5.2. The predicted component noise level from the top 40 individual loudest item types of Stage 2 equipment, combined noise sources of the remaining Stage 2 equipment, and all Stage 1 equipment, with and without these indicative noise treatments, are shown in Table 8.

The predicted typical worst-case low frequency overall noise levels at each sensitive receptor have been presented in Table 6. Refer to Appendix D for predicted noise levels of all four meteorological scenarios.

Table 6 Predicted worst-case low frequency overall noise levels without additional treatment

Sensitive Receptor ID	Criteria		Predicted External Noise Level $L_{eq,adj,1hr}$ dB(Z)	Predicted to comply with criteria?	
	Day $L_{Aeq,adj,1hr}$ dB(Z)	Evening/Night $L_{Aeq,adj,1hr}$ dB(Z)		Day	Evening/Night
R01	55	55	40	Yes	Yes
R02	55	55	34	Yes	Yes
R03	55	55	54	Yes	Yes
R04	55	55	32	Yes	Yes
R05	55	55	49	Yes	Yes

Sensitive Receptor ID	Criteria		Predicted External Noise Level $L_{eq,adj,1hr}$ dB(Z)	Predicted to comply with criteria?	
	Day $L_{Aeq,adj,1hr}$ dB(Z)	Evening/Night $L_{Aeq,adj,1hr}$ dB(Z)		Day	Evening/Night
R06	55	55	48	Yes	Yes
R07	55	55	50	Yes	Yes

Based on the noise levels above, compliance with the substantial low frequency noise criteria is predicted at all the sensitive receptors.

5.2 Indicative Noise Treatments

Section 8 of the EPP (Noise) 2019 details the management hierarchy for noise and has been reproduced below.

> *To the extent it is reasonable to do so, noise must be dealt with in the following order of preference—*
>
> a. *firstly—avoid the noise;*
>
> *Example for paragraph (a)— locating an industrial activity in an area that is not near a sensitive receptor*
>
> b. *secondly—minimise the noise, in the following order—*
>
> i. *firstly—orientate an activity to minimise the noise;*
>
> *Example for subparagraph (i)— facing a part of an activity that makes noise away from a sensitive receptor*
>
> ii. *secondly—use best available technology to minimise the noise;*
>
> c. *thirdly—manage the noise.*
>
> *Example for paragraph (c)— using heavy machinery only during business hours*

Option a) is not applicable for this project as the site and receptors have been established.

Option c) is not applicable for this project as the project site is required to operate 24 hours per day due to operational viability requirements, which are consistent with the types of land use intended for the GSDA.

In this instance, noise treatments are guided by Option b), and comprise both:

1. Procuring equipment with lower noise levels, and/or those with low-noise options, quiet kits, mufflers, etc. Procuring equipment without tonal, impulsive, or other annoying characteristics.
2. In-situ acoustic treatments, such as the provision of noise barriers and noise acoustic enclosures. For the purposes of this assessment, three levels of indicative, in-situ acoustic treatments are considered. These are summarised in Table 7 below.

Table 7 Indicative, In-situ Acoustic Treatment Levels

Level	Minimum Acoustic Treatment	Predicted Noise Reduction dB(A)
A	Noise barrier (breaks line-of-sight) • Located between the equipment and the receptor(s). • Located as close to equipment as practicable. • At least 0.5m taller, and 1m wider, than the equipment being shielded. Barrier material has a minimum sound reduction index of Rw 25.	5

Level	Minimum Acoustic Treatment	Predicted Noise Reduction dB(A)
B	Noise barrier • Located between the equipment and the receptor(s). • As close to equipment as practicable. • At least 2m taller, and 4m wider, than the equipment being shielded equipment. • Alternatively, a “U” shaped barrier around the equipment may be required; noting the above minimum height requirement. • Barrier material has a minimum sound reduction index of Rw 25. • May require NRC 0.7 insulation on side of barrier facing equipment.	15
C	Acoustic enclosure/building • Masonry walls and roof and ceiling with minimum weighted sound reduction index (Rw) of 48. • No acoustically-untreated penetrations in the skin of building. • Minimum NRC 0.9 acoustic absorption applied to 100% of the ceiling soffit.	25

The highest component noise contributions for the worst affected sensitive receptor, R03, have been included in Table 8. It is noted that some equipment with lower noise contributions have been grouped into three point sources based on the equipment height.

The indicative noise treatment to be applied to each individual equipment, is displayed in Table 8. The equipment list has been ordered in descending noise contribution to Receptor R03 i.e. loudest, untreated equipment at the top. The overall noise impacts with and without the indicative treatments nominated in Table 7 are summarised at the bottom of Table 8. Refer to Appendix E for list of acoustically significant equipment that have been assessed as a grouped noise sources.

With the implementation of indicative noise treatments, the nominated evening/night time criterion of 37 dB(A) $L_{Aeq,\ 1hr}$ is predicted to be achievable at the nearest receptor.

Discussion

Vendor-provided sound power levels for some equipment were received by the Client at the time of this report revision. Whilst unfinalised, these vendor-provided sound power levels were at least 7 dB(A) quieter than the levels assumed in Section 4.1 for some acoustically-significant equipment such as the Cooling Water Package (730-VP-001). This indicates that predicted untreated noise impacts discussed in Section 5.1 may be conservatively loud.

Procuring equipment with quieter sound power levels is consistent with the “minimise the noise” step of the management hierarchy of noise discussed in this section. Additionally, doing so can reduce the severity of the indicative noise treatments discussed in Table 8.

Accordingly, this preliminary assessment is intended to demonstrate that noise treatments can be practicably applied to the Project site to allow compliance with the nominated criteria. Final noise treatments will need to be refined as the project progresses into Detailed Design and the equipment selection has been finalised. As such, the above discussion of noise treatments should be considered as “indicative” only.

Table 8 Predicted Free-field External Noise Contribution from Loudest 15 items of Equipment, and Indicative Noise Treatment, at Receptor R03

Equipment Name	Equipment Number	Predicted Component Noise Level (without treatment) $L_{Aeq,1hr}$ (dBA)	Indictive Level of Treatment (refer to Table 7)	Indicative Noise Reduction $L_{Aeq,1hr}$ (dBA) (refer to Table 7)	Predicted Component Noise Level (with Treatment) $L_{Aeq,1hr}$ (dBA)
Cooling Water Package	730-VP-001	38	B	15	23
HPA Bagging Package	250-VP-002	35	B	15	20
Water Chiller Package	730-VP-002	35	B	15	20
ATH Dryer Package	236-VP-001	33	B	15	18
Precursor Dryer Package	240-VP-001	33	B	15	18
Calciner Package	240-VP-002	33	B	15	18
Stage 02 combined equipment ranked 41 and lower (height 10m)	Refer to table for list of Stage 02 combined equipment (height 10m)	32	Non	0	32
Ammonium Nitrate Evaporator Package	400-VP-001	28	B	15	13
Stage 02 combined equipment ranked 41 and lower (height 4m)	Refer to table for list of Stage 02 combined equipment (height 4m)	28	Non	0	28
Storage HVAC Package	250-VP-005	27	B	15	12
HVAC System - Precursor Room	230-VP-004	27	B	15	12
Stage 02 combined equipment ranked 41 and lower (height 5m)	Refer to table for list of Stage 02 combined equipment (height 5m)	27	Non	0	27
Compressed Air and Nitrogen Package	750-VP-001	26	B	15	11
HPA Pre-cursor Filter 1 & 2	230-FL-001/2	25	A	5	20
Reagent 1 Absorber Package	220-VP-001	25	A	5	20
Aqueous Ammonia Make-Up Scrubber	610-VP-001	21	A	5	16
Precursor Tube Conveyor 1	230-CV-003	21	Non	0	21
Precursor Tube Conveyor 2	230-CV-004	21	Non	0	21
Overall Noise Level without Treatment dB(A)		**44**	**Overall Noise Level with Indicative Treatment dB(A)**		**37**

Note
(1) Equipment with lower sound power levels have been grouped together and assessed as single noise sources based on their height. Refer to Appendix E for a full list of each source group.
(2) No treatments have been recommended for this equipment as this will entail wide scale treatments across the entire plant. However, lower noise levels should be considered during the procurement process.

5.3 Predicted Impact with Indicative Treatment

The predicted with treatment worst-case noise levels at each sensitive receptor have been presented in Table 9 based on the indicative noise treatments recommended in Section 5.2. For brevity, the highest predicted noise level across the four meteorological scenarios in Table 4 have been presented in Table 9 below. The corresponding noise contour map is provided in Appendix C.

Table 9 Predicted worst-case external noise levels with indicative treatment

Sensitive Receptor ID	Criteria		Predicted External Noise Level $L_{Aeq,adj,1hr}$ dB(A) with Indicative Treatment	Predicted to comply with criteria?	
	Day $L_{Aeq,adj,1hr}$ dB(A)	Evening/Night $L_{Aeq,adj,1hr}$ dB(A)		Day	Evening/Night
R01	42	37	20	Yes	Yes
R02	42	37	17	Yes	Yes
R03	42	37	37	Yes	Yes
R04	42	37	12	Yes	Yes
R05	42	37	32	Yes	Yes
R06	42	37	31	Yes	Yes
R07	42	37	33	Yes	Yes

Based on the with treatment noise levels presented in Table 9, compliance is predicted at all the sensitive receptors.

6.0 Conclusion

AECOM has carried out a preliminary operational noise impact assessment of the proposed Alpha HPA Project Stages 1 and 2 to nearby sensitive receptors. This assessment is intended to demonstrate that noise treatments can be practicably applied to the Project site to allow compliance with the nominated noise criteria.

The assessment was guided by the noise nuisance requirements and criteria in Environmental Authority, EA P-EA-100167564 dated 27 March 2024. Operational noise emission from the Project site to nearby sensitive receptors (all dwellings) were assessed under typical operating conditions of the equipment and typical adverse meteorological conditions.

Based on the results of the noise assessment, noise emissions from the site during operation are predicted to exceed the day and evening/night criteria by 2 dBA and 7 dBA respectively.

Indicative noise treatments are discussed in the report and comprise:

1. Procuring equipment
    a. with lower noise levels, and/or those with low-noise options, quiet kits, mufflers, etc.
    b. without tonal, impulsive, or other annoying characteristics.
2. In-situ acoustic treatments. Minimum indicative treatments considered in this assessment comprise two different noise barriers options, and an acoustic enclosure/building.

With the implementation of the aforementioned indicative noise treatments, the nominated evening/night criterion is predicted to be achievable at the worst affected receptor, R03.

This preliminary assessment is intended to demonstrate that noise treatments can be practicably applied to the Project site to allow compliance with the nominated criteria.

Final noise treatments will need to be refined as the project progresses into Detailed Design and the equipment selection has been finalised. As such, the above discussion of noise treatments should be considered as “indicative” only.

Appendix A

Acoustic Glossary

Appendix A Acoustic Glossary

The following is a brief description of the acoustic terminology used in this report.

'A' Weighted	Frequency filter applied to measured noise levels to represent how humans hear sounds.
dB(A)	'A' Weighted overall sound pressure / power level.
dB(Z)	Linear unweighted overall sound pressure / power level.
Decibel (dB)	The measurement unit of sound.
Frequency [f]	The repetition rate of the cycle measured in Hertz (Hz). The frequency corresponds to the pitch of the sound. A high frequency corresponds to a high-pitched sound and a low frequency to a low-pitched sound.
Impulsiveness	Noise that comprises distinct impulses in the noise (bangs, clicks, clatters, or thumps) etc.
L_{Aeq}	The constant 'A' weighted sound level which, when occurring over the same period of time, would result in the receptor experiencing the same amount of sound energy.
$L_{Aeq, 1hour}$	The energy-averaged level of the total noise measured without adjustment for the character of the noise (e.g. tonal or impulsive), over a period of 1 hour.
Steady/Quasi-Steady Noise	Continuous noise that has a steady sound pressure level is typically referred to as continuous or steady noise. Where a noise level is from a continuous source but has some fluctuation in levels, particularly due to meteorological effects, this is referred to as quasi-steady noise. For the purposes of assessment, quasi-steady noise is assessed the same as steady noise.
Tonality	A prominent tonal component which may be detected in one-third octave spectra.

Appendix B

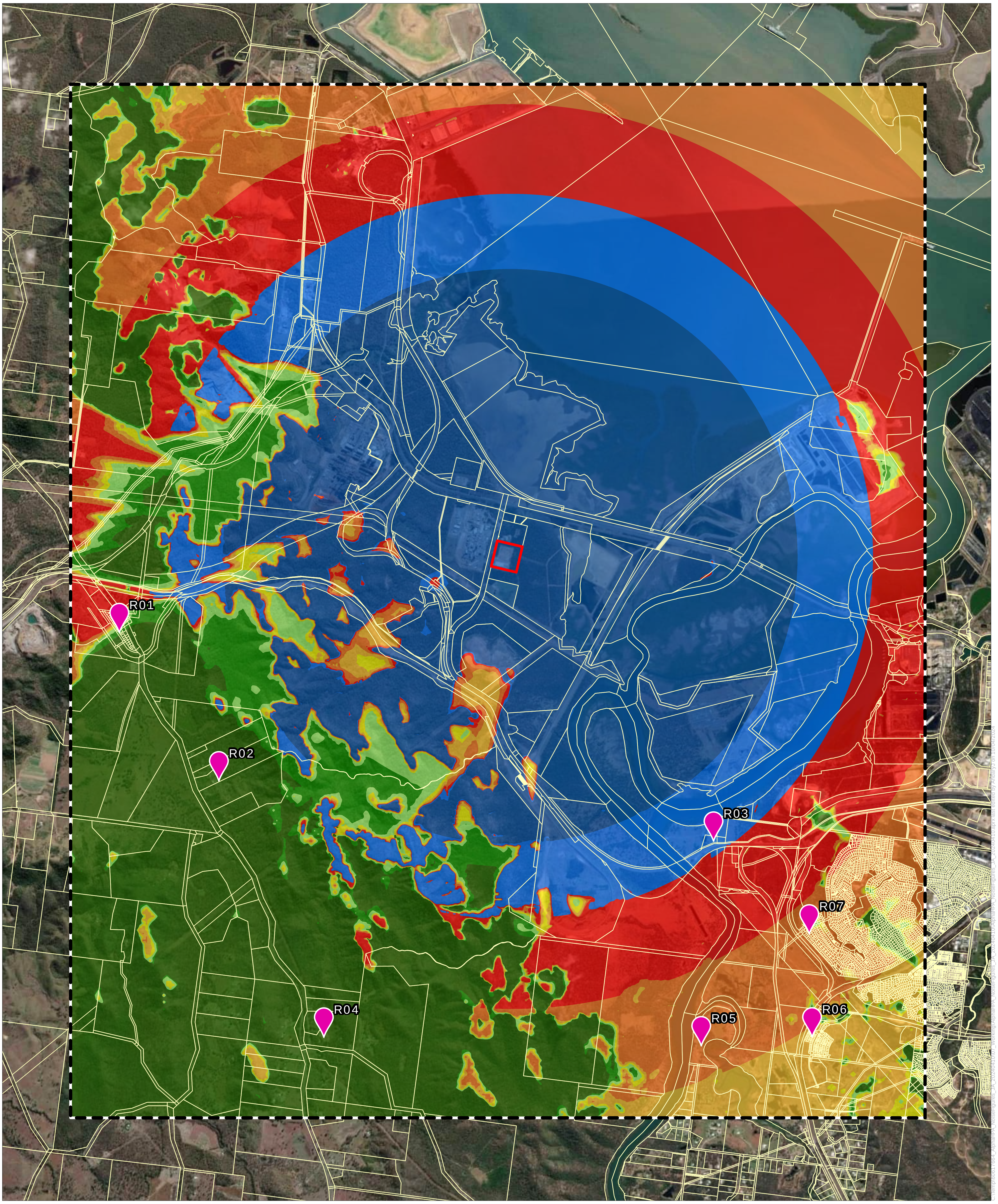
Estimated Sound Power Levels

No.	Equipment No.	Equipment Name	Motor kW	Duty Drives	Assumed No. of Equipment	Overall Sound Power Level dBA	Sound Power Level dbZ per Octave Band (Hz)								
							31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
1	100-AG-001	Leach Tank 1 Agitator	30	1	1	97	93	93	95	95	96	93	90	84	75
2	100-AG-002	Leach Tank 2 Agitator	30	1	1	97	93	93	95	95	96	93	90	84	75
3	100-AG-003	Leach Filter Feed Tank Agitator	37	1	1	99	94	94	96	96	97	94	91	85	76
5	100-CH-001	Aluminium Hydroxide Feed Tank 1 Chute	0	0	1	101	96	96	98	98	99	96	93	87	78
6	100-CH-002	Aluminium Hydroxide Feed Tank 2 Chute	0	0	1	101	96	96	98	98	99	96	93	87	78
7	100-CH-003	Aluminium Hydroxide Silo Chute	0	0	1	101	96	96	98	98	99	96	93	87	78
8	100-CV-001	Aluminium Hydroxide Feed Conveyor	11	1	1	91	86	86	88	88	89	86	83	77	68
9	100-CV-002	Aluminium Hydroxide Bucket Elevator 1	15	1	1	93	88	88	90	90	91	88	85	79	70
10	100-CV-004	Aluminium Hydroxide Bucket Elevator 2	15	1	1	93	88	88	90	90	91	88	85	79	70
11	100-DV-001	Aluminium Hydroxide Diverter Chute	0	0	1	101	96	96	98	98	99	96	93	87	78
12	100-FD-003	Aluminium Hydroxide Feeder	11	1	1	91	86	86	88	88	89	86	83	77	68
13	100-FL-001	Leach Filter Press	45	3	3	96	91	91	93	93	94	91	88	82	73
21	100-PP-001A/B	Leach Slurry Transfer Pumps	15	1	1	93	82	83	84	86	86	89	86	82	76
22	100-PP-003A/B	Leach Filter Feed Pumps	22	1	1	94	84	85	86	88	88	91	88	84	78
23	100-PP-004A/B	PLS Pumps	5.5	1	1	88	78	79	80	82	82	85	82	78	72
24	100-PP-005	Leach Wick Liquor Pump	0	0	1	93	82	83	84	86	86	89	86	82	76
32	100-VP-002	Feed Solids Transfer Package	0	0	1	101	96	96	98	98	99	96	93	87	78
33	100-VP-003	Leach off-gas scrubber package	75	2	2	108	98	94	99	98	96	99	104	101	94
35	105-AG-011	IX Strip Liquor Neutralisation Tank Agitator	1.1	1	1	73	68	68	70	70	71	68	65	59	50
36	105-AG-012	Impurity Precipitation Tank Agitator	1.5	1	1	75	70	70	72	72	73	70	67	61	52
37	105-AG-015	SOW Wash Feed Make-Up Tank Agitator	2.2	1	1	78	73	73	75	75	76	73	70	64	55
39	105-FL-001	Impurity Precipitation Filter	15	3	3	88	83	83	85	85	86	83	80	74	65
41	105-PP-001	PLS IX Strip Liquor Pump	2.2	1	1	84	74	75	76	78	78	81	78	74	68
42	105-PP-004	PLS IX Weak Acid Wash Liquor Pump	2.2	1	1	84	74	75	76	78	78	81	78	74	68
43	105-PP-008	PLS IX Spent Post Elution Wash Pump	0.37	1	1	77	66	67	68	70	70	73	70	66	60
44	105-PP-009A/B	PLS IX Eluate Pumps	5.5	1	1	88	78	79	80	82	82	85	82	78	72
45	105-PP-011	IX Neutralised Strip Liquor Pump	1.5	1	1	83	72	73	74	76	76	79	76	72	66
46	105-PP-012	Impurity Precipitation Slurry Pump	5.5	1	1	88	78	79	80	82	82	85	82	78	72
47	105-PP-013	Impurity Precipitation Filtrate Pump	1.5	1	1	83	72	73	74	76	76	79	76	72	66
48	105-PP-015	SOW Wash Feed Pump	0.75	1	1	80	69	70	71	73	73	76	73	69	63
62	105-VP-001	PLS Ion Exchange Columns	3	1	1	86	75	76	77	79	79	82	79	75	69
64	110-AG-002	Al SX E1 Primary Mixing Tank Agitator	18.5	1	1	94	89	89	91	91	92	89	86	80	71
65	110-AG-003	Al SX E1 Secondary Mixing Tank Agitator	18.5	1	1	94	89	89	91	91	92	89	86	80	71
66	110-AG-005	Al SX E2 Primary Mixing Tank Agitator	18.5	1	1	94	89	89	91	91	92	89	86	80	71
67	110-AG-006	Al SX E2 Secondary Mixing Tank Agitator	18.5	1	1	94	89	89	91	91	92	89	86	80	71
68	110-AG-008	Al SX E3 Primary Mixing Tank Agitator	18.5	1	1	94	89	89	91	91	92	89	86	80	71
69	110-AG-009	Al SX E3 Secondary Mixing Tank Agitator	18.5	1	1	94	89	89	91	91	92	89	86	80	71
71	110-MX-003	E3 Inline Mixer	0	0	1	100	95	95	97	97	98	95	92	86	77
73	110-PP-001A/B	Loaded Organic Pump	55	2	2	98	88	89	90	92	92	95	92	88	82
74	110-PP-003	Raffinate Recovered Organic Pump	0	0	1	93	82	83	84	86	86	89	86	82	76
75	110-PP-010	Organic Coalescer Aqueous Pump	0	0	1	93	82	83	84	86	86	89	86	82	76
76	110-PP-011A/B	Raffinate Carbon Column Feed Pump	5.5	1	1	88	78	79	80	82	82	85	82	78	72
77	110-PP-012	Raffinate Bypass Pump	0	0	1	93	82	83	84	86	86	89	86	82	76
78	110-PP-015A/B	Raffinate Transfer Pump	37	1	1	97	86	87	88	90	90	93	90	86	80
92	120-AG-001	Al SX W1 Primary Mixing Tank Agitator	18.5	1	1	94	89	89	91	91	92	89	86	80	71
93	120-AG-002	Al SX W1 Secondary Mixing Tank Agitator	18.5	1	1	94	89	89	91	91	92	89	86	80	71
94	120-AG-004	Al SX W2 Secondary Mixing Tank Agitator	18.5	1	1	94	89	89	91	91	92	89	86	80	71
95	120-AG-005	Al SX W2 Primary Mixing Tank Agitator	18.5	1	1	94	89	89	91	91	92	89	86	80	71
96	120-AG-007	Al SX W3 Secondary Mixing Tank Agitator	18.5	1	1	94	89	89	91	91	92	89	86	80	71
97	120-AG-008	Al SX W3 Primary Mixing Tank Agitator	18.5	1	1	94	89	89	91	91	92	89	86	80	71
98	120-PP-001	Spent Wash After Settler Transfer Pump	5.5	1	1	88	78	79	80	82	82	85	82	78	72
99	120-PP-002	Spent Wash Recovered Organic Pump	0	0	1	93	82	83	84	86	86	89	86	82	76
100	120-PP-010A/B	Spent Wash Transfer Pump	5.5	1	1	88	78	79	80	82	82	85	82	78	72
113	130-AG-001	Al SX S1 Primary Mixing Tank Agitator	18.5	1	1	94	89	89	91	91	92	89	86	80	71
114	130-AG-002	Al SX S1 Secondary Mixing Tank Agitator	18.5	1	1	94	89	89	91	91	92	89	86	80	71
115	130-AG-004	Al SX S2 Primary Mixing Tank Agitator	18.5	1	1	94	89	89	91	91	92	89	86	80	71
116	130-AG-005	Al SX S2 Secondary Mixing Tank Agitator	18.5	1	1	94	89	89	91	91	92	89	86	80	71
117	130-AG-007	Al SX S3 Primary Mixing Tank Agitator	18.5	1	1	94	89	89	91	91	92	89	86	80	71
118	130-AG-008	Al SX S3 Secondary Mixing Tank Agitator	18.5	1	1	94	89	89	91	91	92	89	86	80	71
121	130-PP-002A/B	Advanced Electrolyte Transfer Pump	30	1	1	96	85	86	87	89	89	92	89	85	79
122	130-PP-003	Advanced Electrolye Recovered Organic Pur	1.5	1	1	83	72	73	74	76	76	79	76	72	66
123	130-PP-004A to H	Crud Pump	0	0	1	93	82	83	84	86	86	89	86	82	76
133	140-AG-005	Iron Removal S1 Primary Mixing Tank Agitato	18.5	1	1	94	89	89	91	91	92	89	86	80	71
134	140-AG-006	Iron Removal S1 Secondary Mixing Tank Agi	18.5	1	1	94	89	89	91	91	92	89	86	80	71
135	140-PP-002	Diluent Unloading Pump	7.5	1	1	90	79	80	81	83	83	86	83	79	73
136	140-PP-004	Extractant 1 Transfer Pump	0	0	1	93	82	83	84	86	86	89	86	82	76
137	140-PP-005	Extractant 2 Transfer Pump	0	0	1	93	82	83	84	86	86	89	86	82	76
138	140-PP-011	Iron Strip Solution Pump	5.5	1	1	88	78	79	80	82	82	85	82	78	72
139	140-PP-012	Diluent Supply Pump	0	0	1	93	82	83	84	86	86	89	86	82	76
140	140-PP-013	SX Drain Pump	0	0	1	93	82	83	84	86	86	89	86	82	76
147	145-AG-001	TOC Removal Primary Mixing Tank Agitator	18.5	1	1	94	89	89	91	91	92	89	86	80	71
148	145-AG-002	TOC Removal Secondary Mixing Tank Agitat	18.5	1	1	94	89	89	91	91	92	89	86	80	71
149	145-PP-004	TOC Spent Wash Transfer pump	1.1	1	1	81	71	72	73	75	75	78	75	71	65
154	150-AG-001	Organic Recovery Tank 1 Agitator	2.2	1	1	78	73	73	75	75	76	73	70	64	55
155	150-AG-003	Organic Recovery Tank 2 Agitator	2.2	1	1	78	73	73	75	75	76	73	70	64	55
156	150-CH-001	DE Feed Chute	0	0	1	101	96	96	98	98	99	96	93	87	78
157	150-FL-001	Crud Filter Package	15	3	3	88	83	83	85	85	86	83	80	74	65
158	150-PP-001	Crud Pump 1	0	0	1	93	82	83	84	86	86	89	86	82	76
159	150-PP-002	Recovered Aqueous Pump	0	0	1	93	82	83	84	86	86	89	86	82	76
160	150-PP-003	Crud Pump 2	0	0	1	93	82	83	84	86	86	89	86	82	76
161	150-PP-004	Recovered Organic Pump	0	0	1	93	82	83	84	86	86	89	86	82	76
166	150-VP-002	Deiatomaceous Earth Bulka Bag Dosing Pac	15	1	1	93	88	88	90	90	91	88	85	79	70
167	200-AG-003	Crystalliser Tank 1 Agitator	22	1	1	95	90	90	92	92	93	90	87	81	72
168	200-AG-004	Crystalliser Tank 2 Agitator	22	1	1	95	90	90	92	92	93	90	87	81	72
169	200-AG-005	Crystalliser Tank 3 Agitator	22	1	1	95	90	90	92	92	93	90	87	81	72
170	200-AG-006	Crystalliser Tank 4 Agitator	22	1	1	95	90	90	92	92	93	90	87	81	72
171	200-CF-001A/B	Aluminium Salt Centrifuge	75	2	2	97	89	89	88	86	86	88	92	91	87
172	200-CV-001A/B	Aluminium Salt Centrifuge Conveyor	15	2	2	93	88	88	90	90	91	88	85	79	70
173	200-CV-003	Crystal Distribution Conveyor	15	1	1	93	88	88	90	90	91	88	85	79	70
177	200-PP-001A/B	Crystalliser Feed Pump	15	1	1	93	82	83	84	86	86	89	86	82	76
178	200-PP-003A/B	Crystal Slurry Pump	90	1	1	100	89	90	91	93	93	96	93	89	83
179	200-PP-007A/B	Crystal Thickener Underflow Pumps	11	1	1	91	81	82	83	85	85	88	85	81	75
180	200-PP-008	Spent Electrolyte Pump	15	1	1	93	82	83	84	86	86	89	86	82	76
182	200-TH-007	Crystal Slurry Thickener	15	1	1	93	82	83	84	86	86	89	86	82	76
190	200-VP-002	Advanced Electrolyte Polishing Filter Packag	0	0	1	96	91	91	93	93	94	91	88	82	73
191	205-CV-001	Aluminium Salt Feed Conveyor 1	15	1	1	93	88	88	90	90	91	88	85	79	70
192	205-CV-002	Aluminium Salt Feed Conveyor 2	15	1	1	93	88	88	90	90	91	88	85	79	70
193	205-VP-001	Aluminium Salt Bagging Package	15	10	10	90	82	82	81	79	79	81	85	84	80
194	210-AG-001	Precursor Crystal Dissolution Tank Agitator	7.5	1	1	87	82	82	84	84	85	82	79	73	64
196	210-PP-001A/B	Precursor Aluminium Solution Transfer Pump	11	1	1	91	81	82	83	85	85	88	85	81	75
197	210-PP-003	Precursor Aluminium Solution Feed Pump	11	1	1	91	81	82	83	85	85	88	85	81	75
200	210-VP-001	Precursor Aluminium Solution Polishing Filter	0	0	1	96	91	91	93	93	94	91	88	82	73
201	220-AG-001	HPA Pre-cursor Precipitation Tank 1 Agitator	11	1	1	90	85	85	87	87	88	85	82	76	67
202	220-AG-002	HPA Pre-cursor Precipitation Tank 2 Agitator	11	1	1	90	85	85	87	87	88	85	82	76	67
204	220-PP-001A/B	HPA Pre-cursor Slurry Pump	11	1	1	91	81	82	83	85	85	88	85	81	75
205	220-PP-005A/B	Reagent 1 Feed Pump	11	1	1	91	81	82	83	85	85	88	85	81	75
206	220-PP-007	Warm Water Recirculation Pump	37	1	1	97	86	87	88	90	90	93	90	86	80
210	220-VP-001	Reagent 1 Absorber Package	132	3	3	110	100	96	101	100	98	101	106	103	96
211	220-VP-003	Fume Scrubber	75	2	2	108	98	94	99	98	96	99	104	101	94
212	230-AG-001	HPA Pre-cursor Filter Feed Tank Agitator	30	1	1	97	93	93	95	95	96	93	90	84	75
213	230-CV-001	Precursor Conveyor 1	37	1	1	100	95	95	97	97	98	95	92	86	77
214	230-CV-002	Precursor Conveyor 2	37	1	1	100	95	95	97	97	98	95	92	86	77
215	230-CV-003	Precursor Tube Conveyor 1	75	1	1	103	98	98	100	100	101	98	95	89	80
216	230-CV-004	Precursor Tube Conveyor 2	75	1	1	103	98	98	100	100	101	98	95	89	80
219	230-FL-001/2	HPA Pre-cursor Filter 1 & 2	90	6	6	99	94	94	96	96	97	94	91	85	76
220	230-PP-001	HPA Pre-cursor Filter Feed Pump 1	75	1	1	100	89	90	91	93	93	96	93	89	83
221	230-PP-002	HPA Pre-cursor Filter Feed Pump 2	75	1	1	100	89	90	91	93	93	96	93	89	83

No.	Equipment No.	Equipment Name	Motor kW	Duty Drives	Assumed No. of Equipment	Overall Sound Power Level dBA	Sound Power Level dbZ per Octave Band (Hz)								
							31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
222	230-PP-004A/B	Precursor Filtrate Pump	18.5	1	1	94	83	84	85	87	87	90	87	83	77
223	230-PP-006	Precursor Filtrate Wick Pump	0	0	1	93	82	83	84	86	86	89	86	82	76
228	230-VP-004	HVAC System - Precursor Room	110	1	1	108	108	111	111	108	105	101	98	95	87
229	235-AG-001	ATH Crystal Dissolution Tank Agitator	2.2	1	1	78	73	73	75	75	76	73	70	64	55
230	235-AG-003	ATH Reactor Tank Agitator	7.5	1	1	87	82	82	84	84	85	82	79	73	64
231	235-AG-004	ATH NH3 Solution Tank Agitator	5.5	1	1	85	80	80	82	82	83	80	77	71	62
232	235-AG-010A/B	ATH Repulp Tank Agitator	3	2	2	80	76	76	78	78	79	76	73	67	58
233	235-AG-013	ATH Filter 1 Feed Tank Agitator	11	1	1	90	85	85	87	87	88	85	82	76	67
234	235-AG-014	ATH Filter 2 Feed Tank Agitator	5.5	1	1	85	80	80	82	82	83	80	77	71	62
235	235-CV-001	ATH Conveyor 1	30	1	1	98	94	94	96	96	97	94	91	85	76
236	235-CV-002	ATH Conveyor 2	30	1	1	98	94	94	96	96	97	94	91	85	76
238	235-FL-001	ATH Filter 1	37	3	3	95	90	90	92	92	93	90	87	81	72
239	235-FL-002	ATH Filter 2	37	3	3	95	90	90	92	92	93	90	87	81	72
241	235-MX-001	ATH Static Mixer	0	0	1	100	95	95	97	97	98	95	92	86	77
242	235-PP-001A/B	ATH Aluminium Solution Transfer Pump	0.37	1	1	77	66	67	68	70	70	73	70	66	60
243	235-PP-002A/B	ATH Aluminium Solution Feed Pump	0.75	1	1	80	69	70	71	73	73	76	73	69	63
244	235-PP-003A/B	ATH Reactor Transfer Pump	7.5	1	1	90	79	80	81	83	83	86	83	79	73
245	235-PP-004A/B	ATH NH3 Solution Transfer Pump	0.75	1	1	80	69	70	71	73	73	76	73	69	63
246	235-PP-005	ATH Filter 1 Spent Wash 2 Pump	0.37	1	1	77	66	67	68	70	70	73	70	66	60
247	235-PP-006	ATH Filter 1 Filtrate and Spent Wash Pump	1.5	1	1	83	72	73	74	76	76	79	76	72	66
248	235-PP-010A/B	ATH Repulp Transfer Pump	7.5	1	1	90	79	80	81	83	83	86	83	79	73
249	235-PP-012	ATH Filter 2 Filtrate & Spent Wash Pump	0.75	1	1	80	69	70	71	73	73	76	73	69	63
250	235-PP-013A/B	ATH Filter 1 Feed Pump	18.5	1	1	94	83	84	85	87	87	90	87	83	77
251	235-PP-014A/B	ATH Filter 2 Feed Pump	7.5	1	1	90	79	80	81	83	83	86	83	79	73
252	235-PP-016	ATH Filter 1 Wick Pump	0	0	1	93	82	83	84	86	86	89	86	82	76
253	235-PP-015	ATH Filter 2 Wick Pump	0	0	1	93	82	83	84	86	86	89	86	82	76
268	235-VP-001	ATH Aluminium Solution Polishing Filter	0	0	1	96	91	91	93	93	94	91	88	82	73
269	235-VP-002	ATH Filter 2 Filtrate Polishing Filter	0	0	1	96	91	91	93	93	94	91	88	82	73
270	236-CV-001	ATH Dryer Feed Conveyor 1	30	1	1	98	94	94	96	96	97	94	91	85	76
272	236-VP-001	ATH Dryer Package	75	15	15	103	98	98	100	100	101	98	95	89	80
275	237-VP-001	ATH Bagging Package	15	10	10	90	82	82	81	79	79	81	85	84	80
283	240-VP-001	Precursor Dryer Package	75	15	15	103	98	98	100	100	101	98	95	89	80
284	240-VP-002	Calciner Package	75	15	15	103	98	98	100	100	101	98	95	89	80
285	240-VP-003	Dryer Scrubber Package	45	2	2	64	80	80	76	67	56	46	41	34	28
290	245-VP-001	Gamma Bagging Package	15	10	10	90	82	82	81	79	79	81	85	84	80
298	250-VP-001	Microniser Package	15	3	3	93	88	88	90	90	91	88	85	79	70
299	250-VP-002	HPA Bagging Package	15	10	10	111	100	101	102	104	104	107	104	100	94
301	250-VP-005	Storage HVAC Package	110	1	1	108	108	111	111	108	105	101	98	95	87
302	250-VP-007	Alumina Dust Collector	45	3	3	78	95	95	91	82	71	61	56	49	43
303	250-VP-010	Jet Mill Air Compressor Package	1600	1	1	110	102	102	101	99	99	101	105	104	100
304	260-AG-001	AN Neutralisation Tank Agitator	2.2	1	1	78	73	73	75	75	76	73	70	64	55
305	260-AG-004	Raffinate Neutralisation Tank 1 Agitator	11	1	1	90	85	85	87	87	88	85	82	76	67
306	260-AG-005	Raffinate Neutralisation Tank 2 Agitator	11	1	1	90	85	85	87	87	88	85	82	76	67
307	260-AG-006	Neutralised Raffinate Solids Repulp Tank Ag	3	1	1	80	76	76	78	78	79	76	73	67	58
308	260-AG-008	Neutralised Raffinate Filter Feed Tank Agitat	15	1	1	92	87	87	89	89	90	87	84	78	69
310	260-CH-001	Neutralised Raffinate Solids Chute	0	0	1	101	96	96	98	98	99	96	93	87	78
311	260-CV-001	Neutralised Raffinate Solids Cake Conveyor	22	1	1	96	91	91	93	93	94	91	88	82	73
312	260-CV-002	Neutralised Raffinate Solids Conveyor	22	1	1	96	91	91	93	93	94	91	88	82	73
314	260-FL-001	Neutralised Raffinate Filter Press	45	1	1	96	91	91	93	93	94	91	88	82	73
316	260-PP-004A/B	Neutralised Raffinate Slurry Transfer Pump	11	1	1	91	81	82	83	85	85	88	85	81	75
317	260-PP-006	Repulped Raffinate Slurry Transfer Pump	7.5	1	1	90	79	80	81	83	83	86	83	79	73
318	260-PP-008	Neutralised Raffinate Filter Feed Pump	75	1	1	100	89	90	91	93	93	96	93	89	83
319	260-PP-009	Carbon Column Wash Liquor Feed Pump	7.5	1	1	90	79	80	81	83	83	86	83	79	73
320	260-PP-010	Raffinate Neutralisation Feed Pump	7.5	1	1	90	79	80	81	83	83	86	83	79	73
321	260-PP-011	Carbon Column Spent Wash Transfer Pump	7.5	1	1	90	79	80	81	83	83	86	83	79	73
322	260-PP-012	Neutralised Raffinate Filtrate Wick Pump	0	0	1	93	82	83	84	86	86	89	86	82	76
337	265-PP-001	Dilute AN Carbon Column Feed Pump	7.5	1	1	90	79	80	81	83	83	86	83	79	73
338	265-PP-002	Dilute AN IX Feed Pump	11	1	1	91	81	82	83	85	85	88	85	81	75
339	265-PP-003	AN IX Strip Liquor Pump	0.37	1	1	77	66	67	68	70	70	73	70	66	60
340	265-PP-007	AN IX Post Elution Wash Pump	0.37	1	1	77	66	67	68	70	70	73	70	66	60
347	265-VP-001	Dilute AN Ion Exchange Column	7.5	1	1	90	79	80	81	83	83	86	83	79	73
348	265-VP-002	Dilute AN Guard Filter	0	0	1	96	91	91	93	93	94	91	88	82	73
350	400-MX-001	Dilute AN Static Mixer	0	0	1	100	95	95	97	97	98	95	92	86	77
351	400-MX-002	Concentrated AN Static Mixer	0	0	1	100	95	95	97	97	98	95	92	86	77
352	400-PP-001A/B/C/D	Dilute AN Tank A/B/C/D pump	5.5	4	4	88	78	79	80	82	82	85	82	78	72
353	400-PP-002A/B/C/D	Concentrated AN Transfer Pump	5.5	4	4	88	78	79	80	82	82	85	82	78	72
354	400-PP-003A/B	Concentrated AN Surge Tank Discharge Pun	3	1	1	86	75	76	77	79	79	82	79	75	69
358	400-VP-001	Ammonium Nitrate Evaporator Package	90	12	12	108	99	95	100	99	97	100	105	102	95
359	600-PP-001A/B	Nitric Acid Supply Pump	15	1	1	93	82	83	84	86	86	89	86	82	76
361	600-VP-001	Nitric Acid Filter	0	0	1	96	91	91	93	93	94	91	88	82	73
362	605-MX-001	Hydrogen Peroxide Inline Mixer	0	0	1	100	95	95	97	97	98	95	92	86	77
363	605-PP-001	Hydrogen Peroxide Transfer Pump	0.37	1	1	77	66	67	68	70	70	73	70	66	60
364	605-PP-002	Hydrogen Peroxide Unloading Pump	0.37	1	1	77	66	67	68	70	70	73	70	66	60
366	610-PP-001A/B	Aqueous Ammonia Pump	1.5	1	1	83	72	73	74	76	76	79	76	72	66
368	610-VP-001	Aqueous Ammonia Make-Up Scrubber	45	4	4	105	96	92	97	96	94	97	102	99	92
372	620-VP-002	Carbon Dioxide Vessel and Evaporator	7.5	1	1	90	79	80	81	83	83	86	83	79	73
373	620-VP-003	Liquid Ammonia Filter	0	0	1	96	91	91	93	93	94	91	88	82	73
374	620-VP-004	Ammonia Gas Filter	0	0	1	96	91	91	93	93	94	91	88	82	73
375	630-VP-001	Ammonia Flare Vendor Package	7.5	1	1	90	79	80	81	83	83	86	83	79	73
376	710-HX-001	Safety Shower Chiller	30	1	1	73	80	80	78	77	70	63	56	51	41
377	710-PP-001A/B	Process Water Pump	30	1	1	96	85	86	87	89	89	92	89	85	79
378	710-PP-002A/B	Clean Water Pump	30	1	1	96	85	86	87	89	89	92	89	85	79
379	710-PP-004A/B	Potable Water Pump	15	1	1	93	82	83	84	86	86	89	86	82	76
380	710-PP-005A/B	Safety Shower Pump	15	1	1	93	82	83	84	86	86	89	86	82	76
407	710-VP-001	RO Water Package	37	1	1	97	86	87	88	90	90	93	90	86	80
408	710-VP-002	Fire Water Pump Package	132	2	2	100	90	91	92	94	94	97	94	90	84
409	710-VP-004	FIRE FOAM SYSTEM PACKAGE	7.5	1	1	90	79	80	81	83	83	86	83	79	73
414	720-PP-001A/B	Trade Waste Pump	0	0	1	93	82	83	84	86	86	89	86	82	76
415	720-PP-003A/B	Process Water Waste Pump	0	0	1	93	82	83	84	86	86	89	86	82	76
416	720-PP-004A/B/C	Area 260 Bund Pump	0	0	1	93	82	83	84	86	86	89	86	82	76
417	720-PP-005	Area 220 and 260 AN Reclaim Pump	0	0	1	93	82	83	84	86	86	89	86	82	76
418	720-PP-006A/B/C/D	Area 220 Bumd Pumps	0	0	1	93	82	83	84	86	86	89	86	82	76
419	720-PP-010A/B/C/D	SX Bund Pumps	0	0	1	93	82	83	84	86	86	89	86	82	76
420	720-PP-013A/B/C	Leach Bund Pumps	0	0	1	93	82	83	84	86	86	89	86	82	76
421	720-PP-015A/B/C/D	Conc AN Bund Pump A	0	0	1	93	82	83	84	86	86	89	86	82	76
422	720-PP-017A/B	AN Concentrator Bund Pumps	0	0	1	93	82	83	84	86	86	89	86	82	76
423	720-PP-019A/B/C	Dilute AN Bund Pumps	0	0	1	93	82	83	84	86	86	89	86	82	76
424	720-PP-021A/B/C	Area 200 Bund Pumps	0	0	1	93	82	83	84	86	86	89	86	82	76
425	720-PP-023A/B	Area 600 Bund Pumps	0	0	1	93	82	83	84	86	86	89	86	82	76
426	720-PP-025A/B/C	Area 720/610 Bund Pump	0	0	1	93	82	83	84	86	86	89	86	82	76
427	720-PP-031	Area 605 Bund Pump	0	0	1	93	82	83	84	86	86	89	86	82	76
428	720-PP-032A/B	Waste AN Pump	0	0	1	93	82	83	84	86	86	89	86	82	76
429	720-PP-033	Area 400 AN Reclaim Pump	0	0	1	93	82	83	84	86	86	89	86	82	76
433	730-PP-001A/B/C	Cooling Water Pump	90	2	2	100	89	90	91	93	93	96	93	89	83
434	730-VP-001	Cooling Water Package	45	6	6	111	111	114	114	111	108	104	101	98	90
435	730-VP-002	Water Chiller Package	2	48	1	123	112	113	114	115	113	118	118	113	107
436	730-VP-003	Cooling Tower Chemical Dosing Package	7.5	1	1	90	79	80	81	83	83	86	83	79	73
438	740-PP-001A/B	Steam Condensate Pump	11	1	1	91	81	82	83	85	85	88	85	81	75
439	740-PP-003A/B	Hot Water Pump	55	1	1	98	88	89	90	92	92	95	92	88	82
442	740-VP-001	Boiler & Boiler Feed Water Package	45	3	3	97	87	88	89	91	91	94	91	87	81
443	740-VP-002	Boiler Chemical Dosing Package	5.5	1	1	88	78	79	80	82	82	85	82	78	72
444	750-VP-001	Compressed Air and Nitrogen Package	350	2	2	114	104	100	105	104	102	105	110	107	100
Stage 01 01	NA	2kW pump	2	NA	30	89	78	79	80	82	82	85	82	78	72
Stage 01 02	NA	1kW pump	1	NA	30	86	75	76	77	79	79	82	79	75	69
Stage 01 03	NA	Compressor	NA	NA	2	92	82	78	83	82	80	83	88	85	78
Stage 01 04	NA	Generator	NA	NA	1	90	101	101	86	78	90	87	82	83	83
Stage 01 05	NA	Dust Collector	NA	NA	1	97	107	107	103	99	93	88	88	83	80

Appendix C

Noise Contour Maps



Alpha HPA Project

$L_{Aeq, adj, 1hr}$ Noise Contour Map Without Treatment

Appendix C - Figure 1

AECOM

0 1 km

Sensitive Receptor

Project Site

Assessment Area

Lot boundaries

$L_{Aeq, adj, 1hr}$ worst case free-field noise levels at height 4.6m above ground without additional treatment

< 25 db(A)

25 - 28 dB(A)

28 - 31 dB(A)

31 - 34 dB(A)

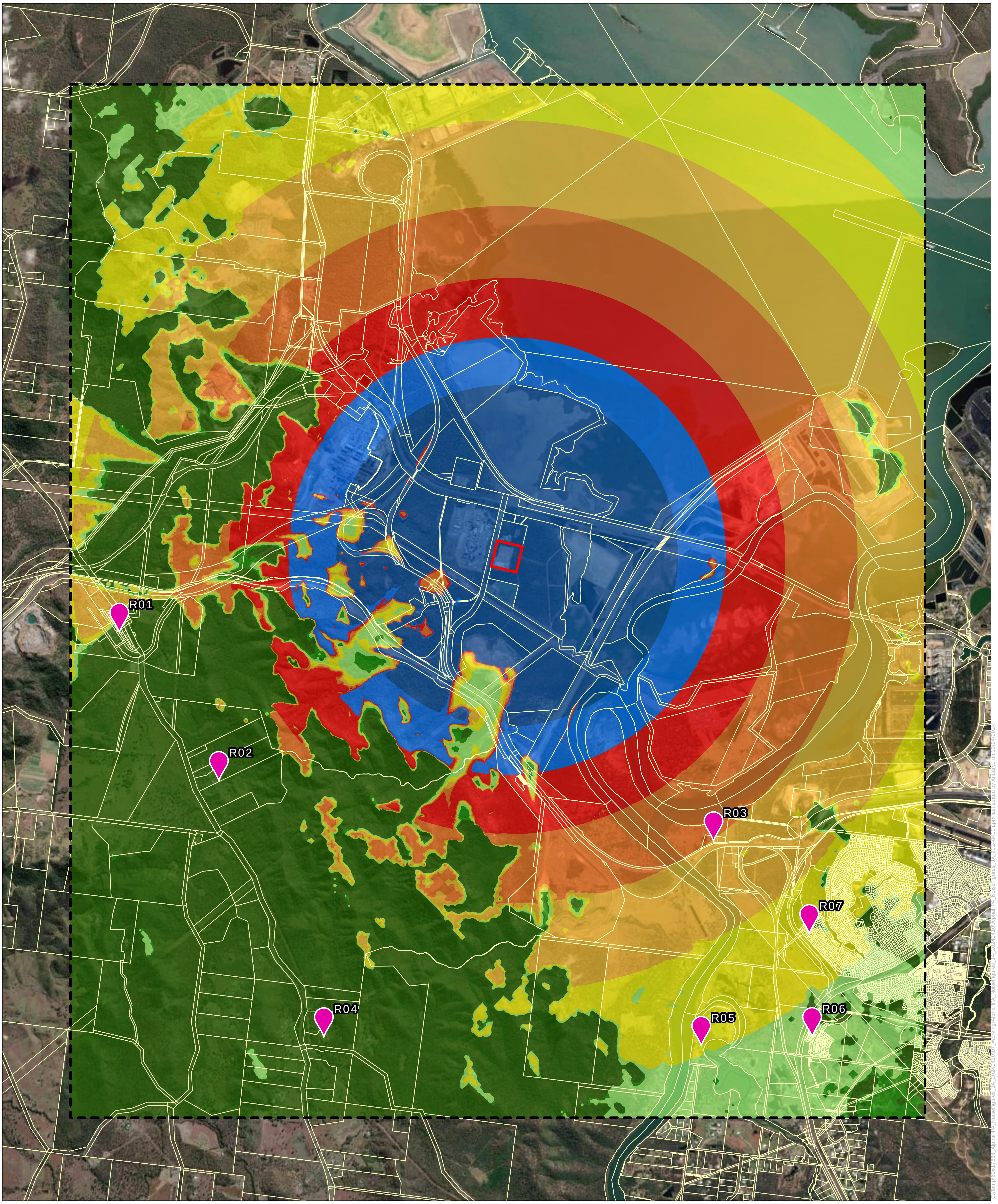
34 - 37 dB(A)

37 - 40 dB(A)

40 - 43 dB(A)

43 - 46 dB(A)

> 46 dB(A)



Alpha HPA Project

$L_{Aeq,\ adj,\ 1hr}$ Noise Contour Map With Treatment

Appendix C - Figure 2

AECOM

km 0 1

- Sensitive Receptor
- Project Site
- Lot boundaries
- Assessment Area

$L_{Aeq,\ adj,\ 1hr}$ worst case free-field noise levels at height 4.6m above ground with additional treatment

- < 25 db(A)
- 25 - 28 dB(A)
- 28 - 31 dB(A)
- 31 - 34 dB(A)
- 34 - 37 dB(A)
- 37 - 40 dB(A)
- 40 - 43 dB(A)
- 43 - 46 dB(A)
- > 46 dB(A)

Appendix D

Tabulated Noise Results

Appendix D Tabulated Noise Results

The predicted noise levels at the receptors for all meteorological conditions are presented in Table 10 to Table 13 below.

Table 10 Predicted noise levels – Meteorological Condition Neutral (A) – without additional treatment

Sensitive Receptor ID	Criteria		Predicted External Noise Level $L_{Aeq,adj,1hr}$ dB(A)	Predicted to comply with criteria?	
	Day $L_{Aeq,adj,1hr}$ dB(A)	Evening/Night $L_{Aeq,adj,1hr}$ dB(A)		Day	Evening/Night
R01	42	37	18	Yes	Yes
R02	42	37	14	Yes	Yes
R03	42	37	35	Yes	Yes
R04	42	37	9	Yes	Yes
R05	42	37	28	Yes	Yes
R06	42	37	27	Yes	Yes
R07	42	37	30	Yes	Yes

Table 11 Predicted noise levels – Meteorological Condition Neutral (B) – without additional treatment

Sensitive Receptor ID	Criteria		Predicted External Noise Level $L_{Aeq,adj,1hr}$ dB(A)	Predicted to comply with criteria?	
	Day $L_{Aeq,adj,1hr}$ dB(A)	Evening/Night $L_{Aeq,adj,1hr}$ dB(A)		Day	Evening/Night
R01	42	37	23	Yes	Yes
R02	42	37	20	Yes	Yes
R03	42	37	41	Yes	No
R04	42	37	14	Yes	Yes
R05	42	37	34	Yes	Yes
R06	42	37	32	Yes	Yes
R07	42	37	35	Yes	Yes

Table 12 Predicted noise levels – Meteorological Condition Adverse (A) – without additional treatment

Sensitive Receptor ID	Criteria		Predicted External Noise Level $L_{Aeq,adj,1hr}$ dB(A)	Predicted to comply with criteria?	
	Day $L_{Aeq,adj,1hr}$ dB(A)	Evening/Night $L_{Aeq,adj,1hr}$ dB(A)		Day	Evening/Night
R01	42	37	26	Yes	Yes
R02	42	37	23	Yes	Yes
R03	42	37	44	No	No
R04	42	37	19	Yes	Yes

Sensitive Receptor ID	Criteria		Predicted External Noise Level $L_{Aeq,adj,1hr}$ dB(A)	Predicted to comply with criteria?	
	Day $L_{Aeq,adj,1hr}$ dB(A)	Evening/Night $L_{Aeq,adj,1hr}$ dB(A)		Day	Evening/Night
R05	42	37	38	Yes	No
R06	42	37	37	Yes	Yes
R07	42	37	40	Yes	No

Table 13 Predicted noise levels – Meteorological Condition Adverse (B) – without additional treatment

Sensitive Receptor ID	Criteria		Predicted External Noise Level $L_{Aeq,adj,1hr}$ dB(A)	Predicted to comply with criteria?	
	Day $L_{Aeq,adj,1hr}$ dB(A)	Evening/Night $L_{Aeq,adj,1hr}$ dB(A)		Day	Evening/Night
R01	42	37	25	Yes	Yes
R02	42	37	22	Yes	Yes
R03	42	37	43	No	No
R04	42	37	17	Yes	Yes
R05	42	37	36	Yes	Yes
R06	42	37	35	Yes	Yes
R07	42	37	38	Yes	No

The predicted low frequency overall noise levels at the receptors for all meteorological conditions are presented in Table 14 to Table 17 below.

Table 14 Predicted low frequency overall noise levels – Meteorological Condition Neutral (A) – without additional treatment

Sensitive Receptor ID	Criteria		Predicted External Noise Level $L_{eq,adj,1hr}$ dB(Z)	Predicted to comply with criteria?	
	Day $L_{eq,adj,1hr}$ dB(Z)	Evening/Night $L_{eq,adj,1hr}$ dB(Z)		Day	Evening/Night
R01	55	55	36	Yes	Yes
R02	55	55	29	Yes	Yes
R03	55	55	48	Yes	Yes
R04	55	55	28	Yes	Yes
R05	55	55	43	Yes	Yes
R06	55	55	43	Yes	Yes
R07	55	55	45	Yes	Yes

Table 15 Predicted low frequency overall noise levels – Meteorological Condition Neutral (B) – without additional treatment

Sensitive Receptor ID	Criteria		Predicted External Noise Level $L_{eq,adj,1hr}$ dB(Z)	Predicted to comply with criteria?	
	Day $L_{eq,adj,1hr}$ dB(Z)	Evening/Night $L_{eq,adj,1hr}$ dB(Z)		Day	Evening/Night
R01	55	55	40	Yes	Yes
R02	55	55	32	Yes	Yes
R03	55	55	52	Yes	Yes
R04	55	55	31	Yes	Yes
R05	55	55	47	Yes	Yes
R06	55	55	47	Yes	Yes
R07	55	55	48	Yes	Yes

Table 16 Predicted low frequency overall noise levels – Meteorological Condition Adverse (A) – without additional treatment

Sensitive Receptor ID	Criteria		Predicted External Noise Level $L_{eq,adj,1hr}$ dB(Z)	Predicted to comply with criteria?	
	Day $L_{eq,adj,1hr}$ dB(Z)	Evening/Night $L_{eq,adj,1hr}$ dB(Z)		Day	Evening/Night
R01	55	55	40	Yes	Yes
R02	55	55	34	Yes	Yes
R03	55	55	54	Yes	Yes
R04	55	55	32	Yes	Yes

Sensitive Receptor ID	Criteria		Predicted External Noise Level $L_{eq,adj,1hr}$ dB(Z)	Predicted to comply with criteria?	
	Day $L_{eq,adj,1hr}$ dB(Z)	Evening/Night $L_{eq,adj,1hr}$ dB(Z)		Day	Evening/Night
R05	55	55	49	Yes	Yes
R06	55	55	48	Yes	Yes
R07	55	55	50	Yes	Yes

Table 17 Predicted low frequency overall noise levels – Meteorological Condition Adverse (B) – without additional treatment

Sensitive Receptor ID	Criteria		Predicted External Noise Level $L_{eq,adj,1hr}$ dB(Z)	Predicted to comply with criteria?	
	Day $L_{eq,adj,1hr}$ dB(Z)	Evening/Night $L_{eq,adj,1hr}$ dB(Z)		Day	Evening/Night
R01	55	55	40	Yes	Yes
R02	55	55	33	Yes	Yes
R03	55	55	53	Yes	Yes
R04	55	55	32	Yes	Yes
R05	55	55	48	Yes	Yes
R06	55	55	48	Yes	Yes
R07	55	55	49	Yes	Yes

Appendix E

Grouped Noise Sources

Equipment No.	Equipment Name	Height above Terrain (m)	SWL dBA
Stage 02 combined equipment ranked 41 and lower (height 4m)			
200-PP-003A/B	Crystal Slurry Pump	4	100
205-VP-001	Aluminium Salt Bagging Package	4	90
237-VP-001	ATH Bagging Package	4	90
245-VP-001	Gamma Bagging Package	4	90
230-PP-001	HPA Pre-cursor Filter Feed Pump 1	4	100
230-PP-002	HPA Pre-cursor Filter Feed Pump 2	4	100
260-PP-008	Neutralised Raffinate Filter Feed Pump	4	100
740-PP-003A/B	Hot Water Pump	4	98
250-VP-001	Microniser Package	4	93
110-PP-015A/B	Raffinate Transfer Pump	4	97
220-PP-007	Warm Water Recirculation Pump	4	97
710-VP-001	RO Water Package	4	97
130-PP-002A/B	Advanced Electrolyte Transfer Pump	4	96
710-PP-001A/B	Process Water Pump	4	96
710-PP-002A/B	Clean Water Pump	4	96
400-PP-001A/B/C/D	Dilute AN Tank A/B/C/D pump	4	88
400-PP-002A/B/C/D	Concentrated AN Transfer Pump	4	88
100-PP-003A/B	Leach Filter Feed Pumps	4	94
230-PP-004A/B	Precursor Filtrate Pump	4	94
235-PP-013A/B	ATH Filter 1 Feed Pump	4	94
100-PP-001A/B	Leach Slurry Transfer Pumps	4	93
100-PP-005	Leach Wick Liquor Pump	4	93
110-PP-003	Raffinate Recovered Organic Pump	4	93
110-PP-010	Organic Coalescer Aqueous Pump	4	93
110-PP-012	Raffinate Bypass Pump	4	93
120-PP-002	Spent Wash Recovered Organic Pump	4	93
130-PP-004A to H	Crud Pump	4	93
140-PP-004	Extractant 1 Transfer Pump	4	93
140-PP-005	Extractant 2 Transfer Pump	4	93
140-PP-012	Diluent Supply Pump	4	93
140-PP-013	SX Drain Pump	4	93
150-PP-001	Crud Pump 1	4	93
150-PP-002	Recovered Aqueous Pump	4	93
150-PP-003	Crud Pump 2	4	93
150-PP-004	Recovered Organic Pump	4	93
200-PP-001A/B	Crystalliser Feed Pump	4	93
200-PP-008	Spent Electrolyte Pump	4	93
200-TH-007	Crystal Slurry Thickener	4	93
230-PP-006	Precursor Filtrate Wick Pump	4	93
235-PP-016	ATH Filter 1 Wick Pump	4	93
235-PP-015	ATH Filter 2 Wick Pump	4	93
260-PP-012	Neutralised Raffinate Filtrate Wick Pump	4	93
600-PP-001A/B	Nitric Acid Supply Pump	4	93
710-PP-004A/B	Potable Water Pump	4	93
710-PP-005A/B	Safety Shower Pump	4	93
720-PP-001A/B	Trade Waste Pump	4	93
720-PP-003A/B	Process Water Waste Pump	4	93
720-PP-004A/B/C	Area 260 Bund Pump	4	93
720-PP-005	Area 220 and 260 AN Reclaim Pump	4	93
720-PP-006A/B/C/D	Area 220 Bumd Pumps	4	93
720-PP-010A/B/C/D	SX Bund Pumps	4	93
720-PP-013A/B/C	Leach Bund Pumps	4	93
720-PP-015A/B/C/D	Conc AN Bund Pump A	4	93
720-PP-017A/B	AN Concentrator Bund Pumps	4	93
720-PP-019A/B/C	Dilute AN Bund Pumps	4	93
720-PP-021A/B/C	Area 200 Bund Pumps	4	93
720-PP-023A/B	Area 600 Bund Pumps	4	93
720-PP-025A/B/C	Area 720/610 Bund Pump	4	93

Equipment No.	Equipment Name	Height above Terrain (m)	SWL dBA
720-PP-031	Area 605 Bund Pump	4	93
720-PP-032A/B	Waste AN Pump	4	93
720-PP-033	Area 400 AN Reclaim Pump	4	93
200-PP-007A/B	Crystal Thickener Underflow Pumps	4	91
210-PP-001A/B	Precursor Aluminium Solution Transfer Pump	4	91
210-PP-003	Precursor Aluminium Solution Feed Pump	4	91
220-PP-001A/B	HPA Pre-cursor Slurry Pump	4	91
220-PP-005A/B	Reagent 1 Feed Pump	4	91
260-PP-004A/B	Neutralised Raffinate Slurry Transfer Pump	4	91
265-PP-002	Dilute AN IX Feed Pump	4	91
740-PP-001A/B	Steam Condensate Pump	4	91
140-PP-002	Diluent Unloading Pump	4	90
235-PP-003A/B	ATH Reactor Transfer Pump	4	90
235-PP-010A/B	ATH Repulp Transfer Pump	4	90
235-PP-014A/B	ATH Filter 2 Feed Pump	4	90
260-PP-006	Repulped Raffinate Slurry Transfer Pump	4	90
260-PP-009	Carbon Column Wash Liquor Feed Pump	4	90
260-PP-010	Raffinate Neutralisation Feed Pump	4	90
260-PP-011	Carbon Column Spent Wash Transfer Pump	4	90
265-PP-001	Dilute AN Carbon Column Feed Pump	4	90
265-VP-001	Dilute AN Ion Exchange Column	4	90
620-VP-002	Carbon Dioxide Vessel and Evaporator	4	90
630-VP-001	Ammonia Flare Vendor Package	4	90
710-VP-004	FIRE FOAM SYSTEM PACKAGE	4	90
730-VP-003	Cooling Tower Chemical Dosing Package	4	90
100-PP-004A/B	PLS Pumps	4	88
105-PP-009A/B	PLS IX Eluate Pumps	4	88
105-PP-012	Impurity Precipitation Slurry Pump	4	88
110-PP-011A/B	Raffinate Carbon Column Feed Pump	4	88
120-PP-001	Spent Wash After Settler Transfer Pump	4	88
120-PP-010A/B	Spent Wash Transfer Pump	4	88
140-PP-011	Iron Strip Solution Pump	4	88
740-VP-002	Boiler Chemical Dosing Package	4	88
105-VP-001	PLS Ion Exchange Columns	4	86
400-PP-003A/B	Concentrated AN Surge Tank Discharge Pump	4	86
105-PP-001	PLS IX Strip Liquor Pump	4	84
105-PP-004	PLS IX Weak Acid Wash Liquor Pump	4	84
250-VP-007	Alumina Dust Collector	4	78
105-PP-011	IX Neutralised Strip Liquor Pump	4	83
105-PP-013	Impurity Precipitation Filtrate Pump	4	83
130-PP-003	Advanced Electrolye Recovered Organic Pump	4	83
235-PP-006	ATH Filter 1 Filtrate and Spent Wash Pump	4	83
610-PP-001A/B	Aqueous Ammonia Pump	4	83
145-PP-004	TOC Spent Wash Transfer pump	4	81
105-PP-015	SOW Wash Feed Pump	4	80
235-PP-002A/B	ATH Aluminium Solution Feed Pump	4	80
235-PP-004A/B	ATH NH3 Solution Transfer Pump	4	80
235-PP-012	ATH Filter 2 Filtrate & Spent Wash Pump	4	80
105-PP-008	PLS IX Spent Post Elution Wash Pump	4	77
235-PP-001A/B	ATH Aluminium Solution Transfer Pump	4	77
235-PP-005	ATH Filter 1 Spent Wash 2 Pump	4	77
265-PP-003	AN IX Strip Liquor Pump	4	77
265-PP-007	AN IX Post Elution Wash Pump	4	77
605-PP-001	Hydrogen Peroxide Transfer Pump	4	77
605-PP-002	Hydrogen Peroxide Unloading Pump	4	77
710-HX-001	Safety Shower Chiller	4	73
240-VP-003	Dryer Scrubber Package	4	64

Equipment No.	Equipment Name	Height above Terrain (m)	SWL dBA
Stage 02 combined equipment ranked 41 and lower (height 5m)			
100-VP-002	Feed Solids Transfer Package	5	101
230-CV-001	Precursor Conveyor 1	5	100
230-CV-002	Precursor Conveyor 2	5	100
235-CV-001	ATH Conveyor 1	5	98
235-CV-002	ATH Conveyor 2	5	98
236-CV-001	ATH Dryer Feed Conveyor 1	5	98
200-CV-001A/B	Aluminium Salt Centrifuge Conveyor	5	93
260-CV-001	Neutralised Raffinate Solids Cake Conveyor	5	96
260-CV-002	Neutralised Raffinate Solids Conveyor	5	96
100-CV-002	Aluminium Hydroxide Bucket Elevator 1	5	93
100-CV-004	Aluminium Hydroxide Bucket Elevator 2	5	93
150-VP-002	Deiatomaceous Earth Bulka Bag Dosing Package	5	93
200-CV-003	Crystal Distribution Conveyor	5	93
205-CV-001	Aluminium Salt Feed Conveyor 1	5	93
205-CV-002	Aluminium Salt Feed Conveyor 2	5	93
100-CV-001	Aluminium Hydroxide Feed Conveyor	5	91
100-FD-003	Aluminium Hydroxide Feeder	5	91

Equipment No.	Equipment Name	Height above Terrain (m)	SWL dBA
Stage 02 combined equipment ranked 41 and lower (height 10m)			
100-DV-001	Aluminium Hydroxide Diverter Chute	10	101
150-CH-001	DE Feed Chute	10	101
260-CH-001	Neutralised Raffinate Solids Chute	10	101
100-FL-001	Leach Filter Press	10	96
110-MX-003	E3 Inline Mixer	10	100
235-MX-001	ATH Static Mixer	10	100
400-MX-001	Dilute AN Static Mixer	10	100
400-MX-002	Concentrated AN Static Mixer	10	100
605-MX-001	Hydrogen Peroxide Inline Mixer	10	100
200-CF-001A/B	Aluminium Salt Centrifuge	10	97
235-FL-001	ATH Filter 1	10	95
235-FL-002	ATH Filter 2	10	95
100-AG-003	Leach Filter Feed Tank Agitator	10	99
100-AG-001	Leach Tank 1 Agitator	10	97
100-AG-002	Leach Tank 2 Agitator	10	97
230-AG-001	HPA Pre-cursor Filter Feed Tank Agitator	10	97
200-VP-002	Advanced Electrolyte Polishing Filter Package	10	96
210-VP-001	Precursor Aluminium Solution Polishing Filter	10	96
235-VP-001	ATH Aluminium Solution Polishing Filter	10	96
235-VP-002	ATH Filter 2 Filtrate Polishing Filter	10	96
260-FL-001	Neutralised Raffinate Filter Press	10	96
265-VP-002	Dilute AN Guard Filter	10	96
600-VP-001	Nitric Acid Filter	10	96
620-VP-003	Liquid Ammonia Filter	10	96
620-VP-004	Ammonia Gas Filter	10	96
200-AG-003	Crystalliser Tank 1 Agitator	10	95
200-AG-004	Crystalliser Tank 2 Agitator	10	95
200-AG-005	Crystalliser Tank 3 Agitator	10	95
200-AG-006	Crystalliser Tank 4 Agitator	10	95
110-AG-002	Al SX E1 Primary Mixing Tank Agitator	10	94
110-AG-003	Al SX E1 Secondary Mixing Tank Agitator	10	94
110-AG-005	Al SX E2 Primary Mixing Tank Agitator	10	94
110-AG-006	Al SX E2 Secondary Mixing Tank Agitator	10	94
110-AG-008	Al SX E3 Primary Mixing Tank Agitator	10	94
110-AG-009	Al SX E3 Secondary Mixing Tank Agitator	10	94
120-AG-001	Al SX W1 Primary Mixing Tank Agitator	10	94
120-AG-002	Al SX W1 Secondary Mixing Tank Agitator	10	94
120-AG-004	Al SX W2 Secondary Mixing Tank Agitator	10	94
120-AG-005	Al SX W2 Primary Mixing Tank Agitator	10	94
120-AG-007	Al SX W3 Secondary Mixing Tank Agitator	10	94
120-AG-008	Al SX W3 Primary Mixing Tank Agitator	10	94
130-AG-001	Al SX S1 Primary Mixing Tank Agitator	10	94
130-AG-002	Al SX S1 Secondary Mixing Tank Agitator	10	94
130-AG-004	Al SX S2 Primary Mixing Tank Agitator	10	94
130-AG-005	Al SX S2 Secondary Mixing Tank Agitator	10	94
130-AG-007	Al SX S3 Primary Mixing Tank Agitator	10	94
130-AG-008	Al SX S3 Secondary Mixing Tank Agitator	10	94
140-AG-005	Iron Removal S1 Primary Mixing Tank Agitator	10	94
140-AG-006	Iron Removal S1 Secondary Mixing Tank Agitator	10	94
145-AG-001	TOC Removal Primary Mixing Tank Agitator	10	94
145-AG-002	TOC Removal Secondary Mixing Tank Agitator	10	94
105-FL-001	Impurity Precipitation Filter	10	88
150-FL-001	Crud Filter Package	10	88
260-AG-008	Neutralised Raffinate Filter Feed Tank Agitator	10	92
220-AG-001	HPA Pre-cursor Precipitation Tank 1 Agitator	10	90
220-AG-002	HPA Pre-cursor Precipitation Tank 2 Agitator	10	90
235-AG-013	ATH Filter 1 Feed Tank Agitator	10	90
260-AG-004	Raffinate Neutralisation Tank 1 Agitator	10	90

Equipment No.	Equipment Name	Height above Terrain (m)	SWL dBA
Stage 02 combined equipment ranked 41 and lower (height 10m)			
260-AG-005	Raffinate Neutralisation Tank 2 Agitator	10	90
210-AG-001	Precursor Crystal Dissolution Tank Agitator	10	87
235-AG-003	ATH Reactor Tank Agitator	10	87
235-AG-004	ATH NH3 Solution Tank Agitator	10	85
235-AG-014	ATH Filter 2 Feed Tank Agitator	10	85
235-AG-010A/B	ATH Repulp Tank Agitator	10	80
260-AG-006	Neutralised Raffinate Solids Repulp Tank Agitator	10	80
105-AG-015	SOW Wash Feed Make-Up Tank Agitator	10	78
150-AG-001	Organic Recovery Tank 1 Agitator	10	78
150-AG-003	Organic Recovery Tank 2 Agitator	10	78
235-AG-001	ATH Crystal Dissolution Tank Agitator	10	78
260-AG-001	AN Neutralisation Tank Agitator	10	78
240-BN-001	Dried Gamma Alumina Silo 1	10	76
240-BN-002	Dried Gamma Alumina Silo 2	10	76
240-CL-001	HPA Cooler	10	76
240-CL-002	Gamma Cooler	10	76
250-HP-001	Rolls Crusher Feed Hopper	10	76
250-HP-004	Crushed HPA Hopper 1	10	76
250-HP-005	Crushed HPA Hopper 2	10	76
105-AG-012	Impurity Precipitation Tank Agitator	10	75
105-AG-011	IX Strip Liquor Neutralisation Tank Agitator	10	73
100-HP-002	Aluminium Hydroxide Silo Hopper	10	71

Appendix J

Site Water Management Plan