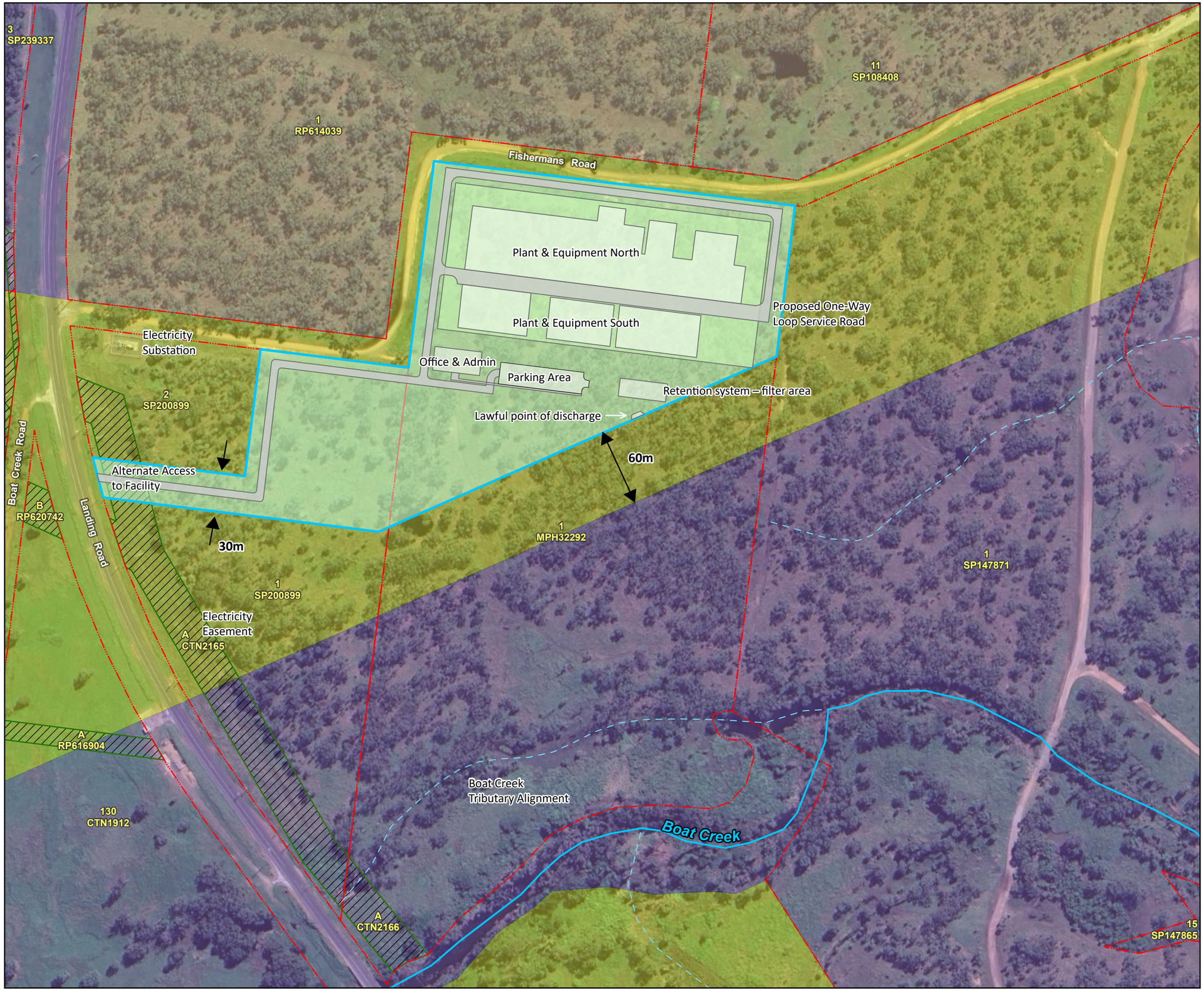


Legend

- Project Area
- Easement
- Lot Type Parcel
- Named Waterways
- Unnamed waterways

Gladstone SDA Precinct

- Port Related Industry Precinct
- Industry Investigation Precinct
- Materials Transportation and Services Corridor Precinct (MTSC)

Disclaimer:
CQG has relied upon data obtained from QSpatial and other public sources, as well as the client (Grenof).
All internal access, manuevering areas, and infrastructure are subject to engineering design

N

Scale 1:2,750 (A3)

0 41 83 124

Metres

Coordinate System: GDA2020 MGA Zone 56

Project Halogen

Conceptual Operations Site Layout (MCU Submission)

PLANS AND DOCUMENTS referred to in the SDA APPROVAL

SDA approval: AP2025/015

GRENOF

Project No: 25054
Map No: 25054-02
Revision: RevA
6 November 2025

Layer Credits- © OpenStreetMap (and) contributors, CC-BY-SA; QSpatial - Roads, Cadastral Boundaries, Gladstone SDA Precinct; CQG; GRENOF

LEGEND

ITEM No.	DESCRIPTION
01	Salt Storage
02	Brine Saturation
03	Brine Precipitation
04	Brine Clarification
05	Brine Filtration
05	Active Carbon Tower
06	Secondary Brine Purification
11	Electrolyser
12	Cell Room Workshop
13	AC/DC Conversion Unit
22	Chlorine Compression
23	Chlorine Liquefaction
24	Chlorine Storage & Filing
26	Waste Gas Dechlorination
27	Sodium Hypochlorite Production
28	Sodium Hypochlorite Storage
32	NaOH Storage
32A	32% NaOH Storage
32B	50% NaOH Storage
51	Hydrochloric Acid Production
52	Hydrochloric Acid Storage
71	Raw Water
73	Demineralised Water
74	Chilled Water
75	Cooling Water Unit
76	Steam Condensate
77	Nitrogen Production
78	Compressed Air
79	Padding Air
80	Sludge Filtration
81	Waste Water Treatment
82	Safety Shower
83	Fire Water
91	Sulphuric Acid
92	LPG Storage
100	Chemical Decanting & Storage
101	Administration Building & Laboratory
102	Parking & Roads
103	Stormwater Systems incl Retention
104	Main Pipe Racks
110	Switchyard & Protection Room
111	MCC/Electrical Switchroom
112	Control Room/DCS

Plant North

Prevailing Wind

PLANS AND DOCUMENTS referred to in the SDA APPROVAL

Queensland Government

SDA approval: AP2025/015

FISHERMANS ROAD

HCL/H2SO4 UNLOADING

NaOH UNLOADING

NaOCl UNLOADING

NaOCl UNLOADING

UNLOADING ANNEX

UNLOADING ANNEX

ENTRY/EXIT

WEIGHBRIDGE

FISHERMANS ROAD

60m EXCLUSION ZONE BOUNDARY

10 0 10 20 30 40m

SCALE 1:500

NOTES:

1. REFERENCE DRG No. 240809-95-BA-1101

Access from Fishermans Road not approved

ISSUED FOR PRELIMINARY DESIGN

NUMBER	REFERENCE DRAWINGS	REV	DATE	REVISION DESCRIPTION	DRN	CHK	ENG	REG No.	APP
		B	28.10.25	ISSUED FOR PRELIMINARY DESIGN	AMC	DB	MA		
		A	13.10.25	PRELIMINARY ISSUE	AMC				

GRENOF

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SEDGMAN Prudentia

SCALE	1:500	
DRAWN	AMC	SEPT 25
CHECKED		
ENGINEER		
APPROVED		
CLIENT		

A1

GRENOF
HALOGEN PROJECT FEED STUDY
SITE LAYOUT
CONCEPTUAL PLAN

DRG. No. OC25008-0000-Z-GAR-001

REV B

TECHNICAL NOTE

Title:	Project Halogen - MTSC Precinct
Client:	Grenof Water Technologies
Project:	Project Halogen
Job:	A0335
Date:	12th September 2025
Doc no_Rev:	A0335-TN01_1
Prepared by:	Glenn Platt, Principal Consultant; Safety Solutions
Reviewed by:	Kim Pullon, Principal Consultant; Safety Solutions
Distribution:	Scott Lucke, Cathee Miller; CQG Luke Sirl, Jason Brooks; Grenof

Background

Grenof's proposed Project Halogen facility is to be located within the Materials Transportation and Services Corridor (MTSC) Precinct adjacent to Fishermans Road at Yarwun as shown in Figure 1

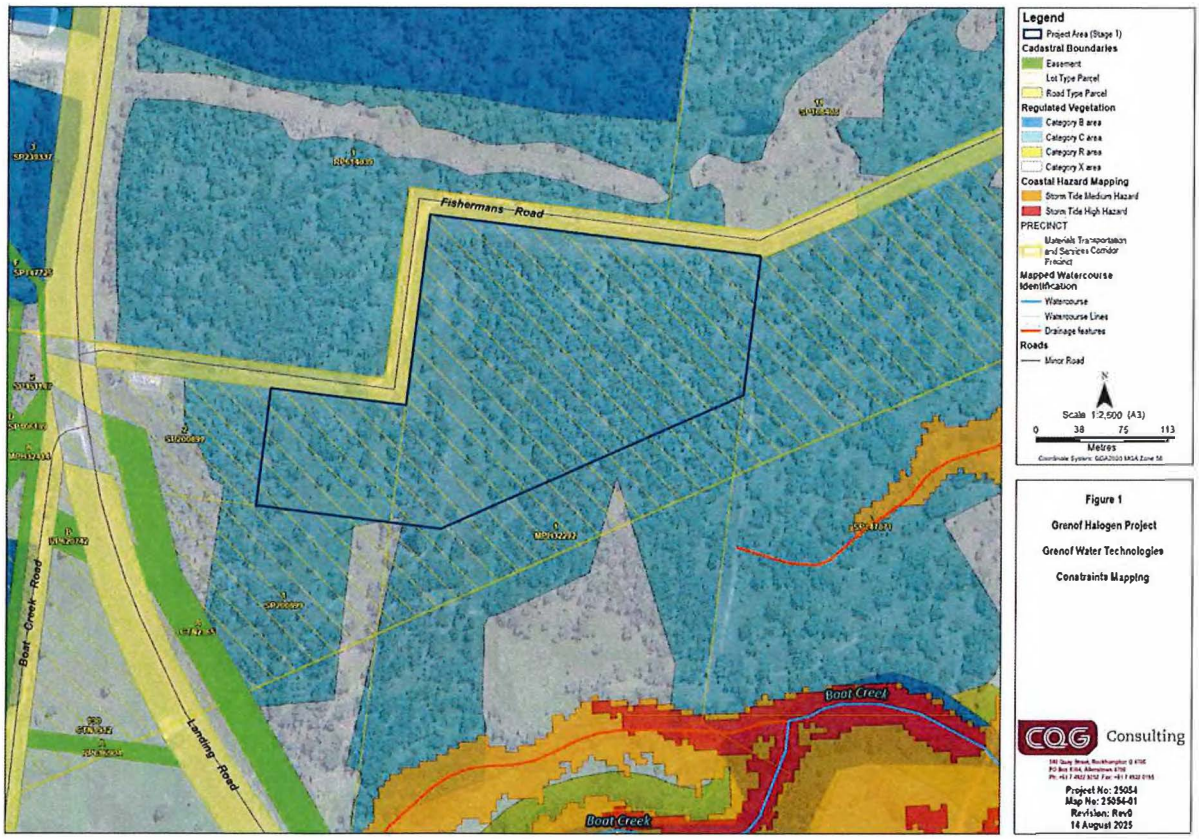


Figure 1 Grenof Halogen Project - Constraints Mapping

The application for the siting of the facility needs to address the suitability of the corridor to the south of the proposed facility for any future underground pipelines to transport hazardous substances such as ammonia and gas, given these are both uses present in the Gladstone State Development Area.

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This Technical Note has been prepared to outline potential issues and provide a response to suitably address any concerns.

Pipeline Corridor

The Grenof Project Halogen facility's proposed site footprint will encroach on the MTSC reducing the effective corridor width to approximately 60m at the southern boundary of the site.

Issue: The construction of new pipelines requires a significant right-of-way (ROW) width to undertake new pipeline construction activities as illustrated in Figure 2.

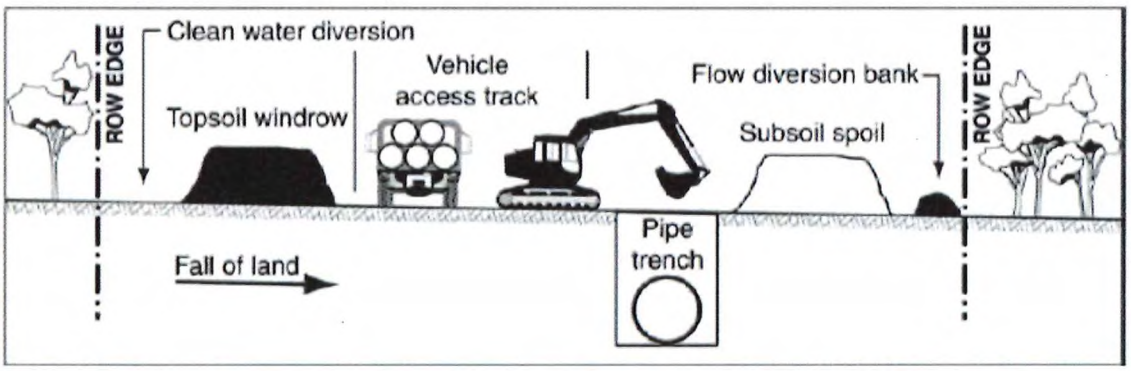


Figure 2 Typical ROW Illustration (IECA 2008 Appendix P: Land-based Pipeline Construction)

Response: Typical requirements for ROW widths for buried pipelines range from 6 to 40m.(ref IECA 2008 Appendix P: Land-based Pipeline Construction). The proposed reduction in MTSC easement width to 60m adjacent to the Grenof facility will meet this requirement.

Accidental Chlorine Releases

Chlorine is classified as a hazardous chemical under Globally Harmonized System (GHS) and as a Toxic Gas (Class 2.3) as well as a Corrosive Hazard (sub Class 8) and an Oxidizer (sub Class 5.1) under the Australian Dangerous Goods (ADG) Code. The proposed Grenof Project Halogen facility will produce chlorine gas for supply to the Australian market.

Issue: An accidental major incident chlorine releases can impact the health of people within the vicinity of such a release. Ongoing inspection and maintenance activities can occur on the buried services within the MTSC.

Response: The Grenof process design limits the possibility of a significant chlorine release. The proposed facility will be classified as a Major Hazard Facility (MHF). Being classified as a MHF ensures a rigorous, legally enforced framework for identifying, controlling, and continuously improving safety measures to prevent catastrophic incidents.

In the very unlikely event of a major chlorine release, there would be a temporary restriction to activities such as corridor inspections and pipeline maintenance on the MTSC services. Such

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activities are infrequent and can be rescheduled. The Grenof facility will have in place comprehensive emergency response plans which will focus on the safety of people on and off site, with appropriate early notification. All MTSC operators would be notified.

There would be little if any impact on a buried pipeline asset, or any above ground associated equipment in the event of a major chlorine release.

Chlorine and Ammonia

The Grenof's Project Halogen facility will produce chlorine gas, and it is noted that a potential use for the MTSC may be to transport anhydrous ammonia by buried pipeline adjacent to the facility.

Issue: Specifically, chlorine gas and anhydrous ammonia are incompatible. Excessive mixing of pure chlorine gas and anhydrous ammonia in air can create nitrogen trichloride, which is explosive, and can release chloramine, a toxic gas that is harmful to the respiratory system.

Response: The Grenof facility's process design and containment systems will maintain minimal, if any chlorine atmospheric releases during normal operation. A significant accidental release of chlorine from the Grenof facility, as discussed earlier, is very unlikely.

Any proposed anhydrous ammonia pipeline will be fully contained (with ongoing integrity validation as a requirement) with any releases also being very unlikely.

Simultaneous failures of the anhydrous ammonia pipeline with a significant ammonia release, and the Grenof facility with a significant chlorine release could be considered not credible.

Acidic / Alkaline run off

The Grenof Project Halogen facility will store and handle corrosive liquids both acid and alkaline materials.

Issue: Any acidic or alkaline contamination of stormwater runoff from the site may impact the pH of the soil and potentially increase the rate of corrosion of buried assets in the MTSC. Any impact on the pipeline integrity would occur over an extended timeframe, with opportunity for early detection by pipeline operator.

Response: The Grenof facility is considering a fully contained water management system with no potentially contaminated discharge to environment. Comprehensive bunding in accordance with AS3780 *The storage and handling of corrosive substances*, will contain corrosive materials in the event of any spill scenario, with subsequent clean up and offsite treatment/disposal. No impact on surrounding soil pH is anticipated.

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SAFETY
SOLUTIONS

Hazard Assessment Report

GRENOF PROJECT HALOGEN FACILITY

Revision 2

A0335-REP-001

PLANS AND DOCUMENTS
referred to in the
SDA APPROVAL

Queensland
Government

SDA approval: AP2025/015

GRENOF

SAFETY SOLUTIONS

Revision Status

Rev	Date	Revision Description	Author	Reviewer	Approver
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2	04/02/2026	Issued for Use	K Pullon	M Mitchell	J Brooks

Change Record

Rev	Description of Change
1	First Issue for use
2	Amendment of sections to address OIR Information requests in response to AP2025/015

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Abbreviation	Definition
ACH	Air Changes per Hour (building air exchange rate)
ADG Code	Australian Dangerous Goods Code for the Transport of Dangerous Goods by Road and Rail
AEGL	Acute Exposure Guideline Levels
Barg	Bar (gauge)
EDQ	Economic Development Queensland
GHS	Globally Harmonized System
GSDA	Gladstone State Development Area
IBC	Intermediate Bulk Container
kg	kilogram
km	kilometres
kPa	Kilo pascals
LPG	Liquefied Petroleum Gas
m	metre
m/s	metres per second
MHF	Major Hazard Facility
mm	Millimetre
NCC	National Construction Code
ºC	Celsius
ppm	Parts per million
SDAP	State Development Assessment Provisions
SFAIRP	So far as is reasonably practicable
SIS	Safety Instrumented System
tpd	Tonnes per day
WHSQ	Workplace Health and Safety Queensland

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1. Summary

This Hazard Assessment Report has been prepared in accordance with the requirements of Queensland State Code 21: Hazardous Chemical Facilities [1], as outlined in the State Planning Policy. The purpose of this report is to identify, evaluate, and mitigate potential risks associated with the proposed development of Grenof Project Halogen facility to be located at Yarwun in the Gladstone Region, Queensland.

This assessment addresses:

- Potential hazards arising from the facility's operations, including processing, storage and handling risks
- Risk control measures to reduce the likelihood and consequences of hazardous events
- Land use compatibility with surrounding sensitive receptors and infrastructure

The findings and recommendations in this report are intended to inform the development application process and to support decision-making by the relevant assessment authorities.

It should be noted that the hazard assessment in this report is based on worst-case unmitigated scenarios (i.e., with no controls in place) as required by State Code 21. This 'worst-case' methodology is adopted to ensure all potential hazards and impacts are comprehensively identified and not overlooked. This process is fundamental to implementing and validating the necessary preventative and mitigative controls, ensuring that risks in both design and operation are reduced to a level that is acceptable so far as is reasonably practicable (SFAIRP).

The proposed Grenof Project Halogen facility will utilise Thyssenkrupp Nucera's advanced Chlor-Alkali Electrolysis membrane-based technologies to produce chlorine, sodium hydroxide, sodium hypochlorite and hydrochloric Acid.

The dominant risk, based on potential severity, that the facility poses to the surrounding land uses is the potential release of chlorine from the processing and storage on site. Chlorine is a dense, toxic gas with physical and chemical properties that make it prone to wide dispersion if released. As chlorine is a heavier-than-air gas, dispersion clouds tend to sink and spread along low-lying areas. Under calm and stable conditions, without good lateral mixing in the air, concentrations dangerous to human health can extend significant distances. Consequence modelling for worst-case release scenarios under the least favourable weather conditions, conducted as part of this hazard assessment, confirmed this, and the relevant performance outcome requirements may not be met under these weather conditions.

Natural gas is the preferred fuel for a steam boiler, required for the process to concentrate sodium hydroxide solution. If the project cannot procure this supply, liquefied petroleum gas (LPG) will be used, with a mounded storage vessel installed at the site. When released, LPG rapidly vaporises into a dense, cold, heavier-than-air flammable gas that can spread along the ground,

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accumulate in low-lying areas, and form an ignitable vapour cloud. Natural gas rapidly disperses as a lighter-than-air, flammable vapour that rises and dilutes quickly in open air but can accumulate and ignite in confined or poorly ventilated spaces. Consequence modelling for the LPG scenario has been conducted, as this represents a worse outcome than with natural gas scenarios. The worst-case release scenarios from piping, modelled under the least favourable weather conditions as part of this hazard assessment, demonstrated that thermal radiation and overpressure effects may extend a marginal distance beyond the facility boundary but neither impacts Landing Road or any identified industrial zone users.

The hydrogen produced in the process will normally be consumed in the synthesis of hydrogen chloride (HCl). Any residual hydrogen that may occur in upset conditions will be vented. Hydrogen is an extremely light, highly diffusive and flammable gas that rises quickly, disperses readily in open air, and burns with a nearly invisible flame if confined or accumulated. The hazard assessment has demonstrated that no off-site impacts from the hydrogen release scenarios occur.

Hydrogen peroxide, used in the brine dichlorination stage can decompose if heated, releasing oxygen and heat, which can intensify fires, cause rapid pressurisation, and strongly support combustion, making it a fire risk chemical despite being non-flammable itself. A small quantity of hydrogen peroxide IBCs will be required at site, and this hazard assessment has demonstrated that no off-site impacts from a hydrogen peroxide decomposition scenario occurs.

Summary of Performance Outcomes attainment:

Performance Outcome	Direct Compliance	Gap	All reasonably practicable controls included?	Intent of the Purpose Statement met?
PO1	Partial	Dangerous dose to human health for vulnerable land user.	Yes	Yes
PO2	Partial	Dangerous dose to human health for sensitive land user.	Yes	Yes
PO3	Partial	Dangerous dose to human health for commercial / community land user.	Yes	Yes
PO4	Partial	Dangerous dose to human health for Open Space land users. Individual fatality risk is not quantified as QRA will occur in the detailed design.	Yes	Yes

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Performance Outcome	Direct Compliance	Gap	All reasonably practicable controls included?	Intent of the Purpose Statement met?
PO5	Partial	Dangerous dose to the built environment for industrial land users. Individual fatality risk is not quantified as QRA will occur in the detailed design.	Yes	Yes
PO6	Yes	Nil	Yes	Yes
PO7	Not applicable			
PO8	Yes	Nil	Yes	Yes
PO9	Yes	Nil	Yes	Yes
PO10	Yes	Nil	Yes	Yes
PO11	Yes	Nil	Yes	Yes

A balanced assessment of the proposed Grenof Project Halogen development confirms its strong alignment with the overarching purpose statement of State Code 21. The project's design and siting are strategically focused on achieving the code's primary intent: ensuring that human health, safety, and the built environment are protected from off-site risks from the chlor-alkali operations. This successful alignment with the code's purpose is considered the key finding of the report.

The key aspects in meeting the intent of the requirements of the code, can be summarised as follows:

- The proposed location for the Grenof Project Halogen facility is within the Gladstone State Development Area (GSDA), a designated industrial zone suitable for a facility such as this. It is compatible with other existing hazardous industries within the area, and suitable separation from vulnerable and residential areas exists. This is an appropriate location for a facility such as Grenof's Project Halogen.
- The proposed Grenof Project Halogen facility will utilise Thyssenkrupp Nucera's advanced technology, recognised globally for high safety performance, energy efficiency, and environmental compatibility. The design utilises advanced engineering, automated controls, and operational discipline to significantly reduce the likelihood and impact of major incidents.

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- The proposed Grenof Project Halogen facility will be a licensed Major Hazard Facility (MHF), subject to strict regulatory requirements, including the implementation of comprehensive safety management systems and detailed safety cases. These measures will require the facility's operations to identify and control major incident hazards, collaborate with emergency services, and engage with local communities.

The selected design, ongoing risk control management and GSDA siting, collectively, satisfy the Purpose Statement SFAIRP by preventing, containing, and neutralising foreseeable hazardous chemical releases and by designing in facility resilience to external hazards.

Through a comprehensive and systematic approach, this report demonstrates the proponent's commitment to safe and responsible industrial development in the GSDA at Yarwun.

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2. Location

2.1. Project Halogen Facility

The Grenof Project Halogen facility is to be located on land managed by Economic Development Queensland (EDQ) in Yarwun, north of Gladstone in Queensland. The Project area is approximately 6.9ha, which includes plant and ancillary facilities

The location is within the Gladstone State Development Area (GSDA) located on land at 56 Fisherman's Road, Yarwun, and 26 Landing Road, Yarwun.

The GSDA is a large, strategically designated industrial zone approximately 10km north of Gladstone. It was established by the Queensland Government to support and attract large-scale, complex industrial projects that are critical to the state's economic development.

The location of the Grenof Project Halogen facility in relation to other industrial facilities within the GSDA and localities is shown in Figure 1.



Figure 1 Project Halogen Facility Location

The extent of the GSDA and the location of the proposed location of the Grenof Project Halogen facility within it are shown in Figure 2 [3].

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The GSDA has several established large-scale industrial sites [4] including:

- Rio Tinto alumina refinery
- Orica chemical manufacturing complex
- Australia Pacific LNG
- Santos Gladstone LNG
- Queensland Curtis LNG
- Transpacific Industries' waste management and recycling facility
- Southern Oil's Northern Oil Refinery
- Alpha HPA alumina production facility

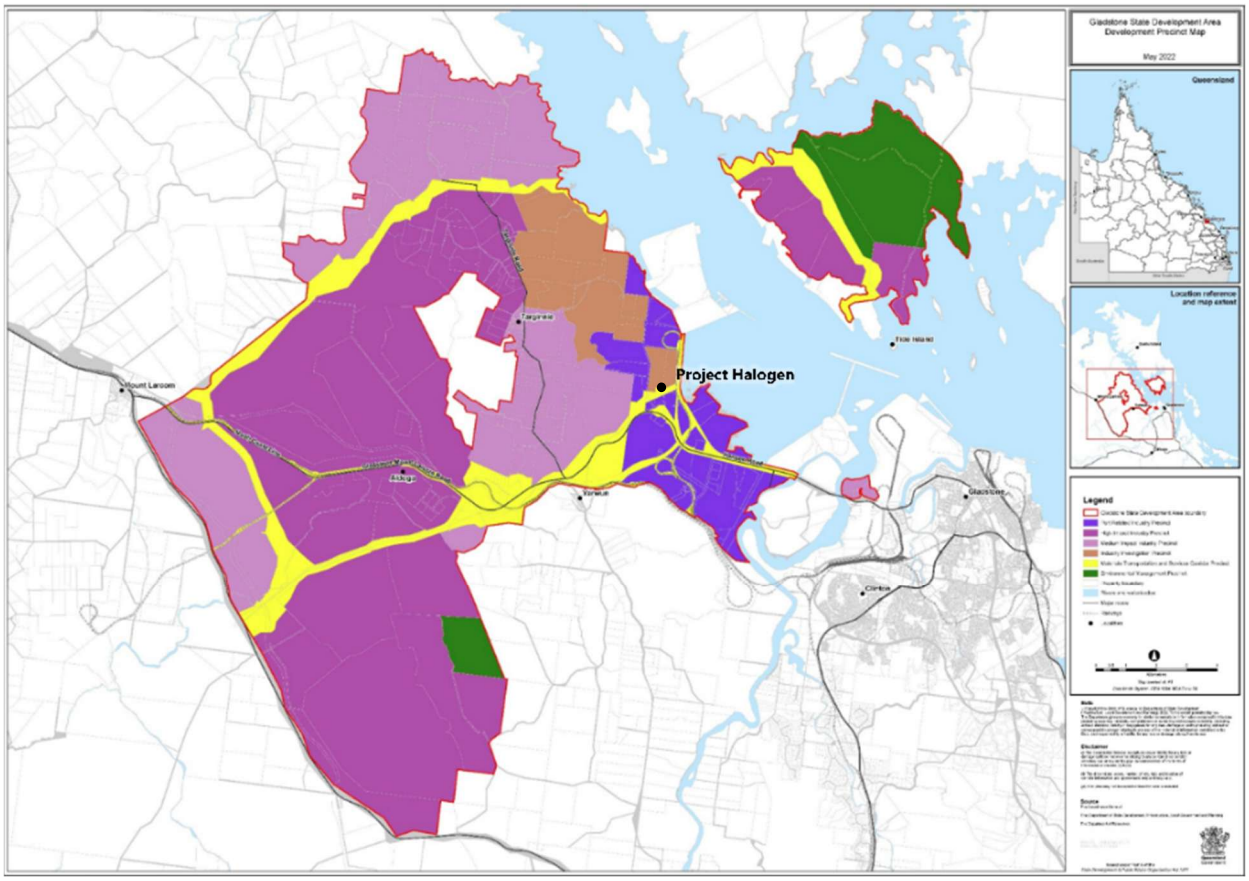


Figure 2 Gladstone State Development Area

As the area hosts major facilities such as those mentioned above, there is potential for synergies with existing chemical operations, a shared emergency response and safety infrastructure, and appropriate separation from vulnerable and residential areas. The GSDA would be an appropriate location for a facility such as Grenof's Project Halogen.

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2.2. Surrounding Land Use

The purpose of State Code 21 is to ensure that hazardous chemical facilities in Queensland are planned, located, and designed in a way that protects public health, safety, and the environment from potential offsite impacts. Central to assessing compliance with the performance outcomes of the code is identifying land use or land zoned for the following land use types:

- vulnerable land use or land zoned for a vulnerable land use
- sensitive land use or land zoned for a sensitive land use
- commercial or community activity land use or land zoned for a commercial or community activity land use
- open space land use or land zoned for an open space land use
- industrial land use or land zoned for an industrial land use

The location of the Grenof Project Halogen facility in relation to surrounding land use is shown in Figure 3.

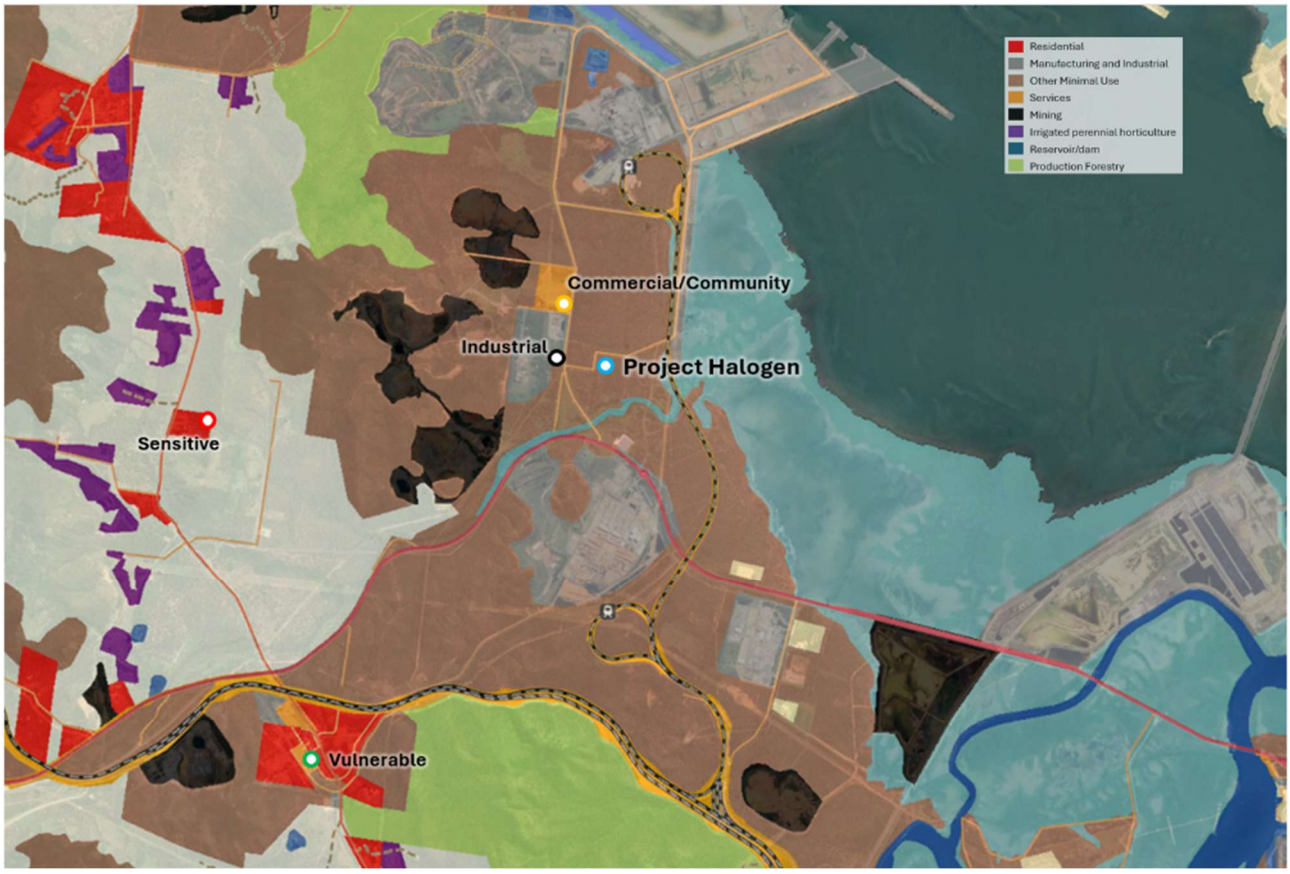


Figure 3 Surrounding Land Use Zones

The nearest land use locations to the proposed Grenof Project Halogen site as shown in Figure 3 are identified in Table 1 with approximate distances and direction from site.

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Table 1 Surrounding Land Use

Land Use Zone	Identification	Distance	Direction
Vulnerable	Yarwun State School	4600 m	SW
Sensitive	Targinnie Rd residences	3600 m	W
Commercial / Community	Gladstone Model Aero Club	600 m	NW
Industrial	Northern Oil Refinery Cleanaway Industrial Waste Services	400 m	W



Figure 4 Orientation of identified nearest land users of each type in Table 1 with respect to the proposed facility location

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3. Site Description

An overview of the proposed site layout is provided in Appendix K Site Layout. Whilst the general location of unit operations and chemical storage is appropriate for the purpose of hazard assessment, the physical size of inventories shown in the drawing are not to be inferred. Inventory size should be read from Table 21: Hazardous Chemicals Stored.

3.1. Technology Selection

The proposed Grenof Project Halogen facility will utilize Thyssenkrupp Nucera's advanced membrane-based chlor-alkali electrolysis technology. These systems are globally recognized for their high safety performance, energy efficiency, and environmental compatibility. The Electrolyzer is designed for low-pressure operation and modular cell construction, the technology offers robust containment, fault isolation, and operational flexibility.

Thyssenkrupp Nucera, has been active in the chlor-alkali sector for more than 60 years. The company has successfully delivered over 600 electrolysis projects across the globe, ranging from small-scale installations to massive industrial complexes. Facilities using these systems are located in key industrial regions including:

- Europe (Germany, Italy)
- North America (USA)
- Asia-Pacific (Japan, India, China)
- Middle East (Saudi Arabia)

The chlorine process within the proposed facility is illustrated in Figure 5.

The process description and technical drawings for the proposed facility[2] provided by Thyssenkrupp Nucera, detailed the Chlor-Alkali Electrolysis and chlorine processes proposed for the Grenof Project Halogen facility. This document not only outlines and describes the various processes and the functions of the process areas but also provides information on the safety measures and controls inherent in the design to minimise the risk of unlikely chlorine releases.

Risks are mitigated through Thyssenkrupp Nucera's integrated safety features, including leak-proof seals, automated shutdown systems, hydrogen venting and dilution mechanisms, and real-time monitoring of membrane integrity and pressure differentials throughout the chlorine processes. The combination of advanced engineering, automated controls, and operational discipline significantly reduces the likelihood and impact of major incidents. The risk control measures are discussed in greater detail in section 8 of this document.

A simplified block flow diagram (**Error! Reference source not found.**) provides a high-level graphical representation of the chlorine processes at the Grenof Project Halogen facility outlining the major process areas and how chlorine and chlorine waste streams flow between them.

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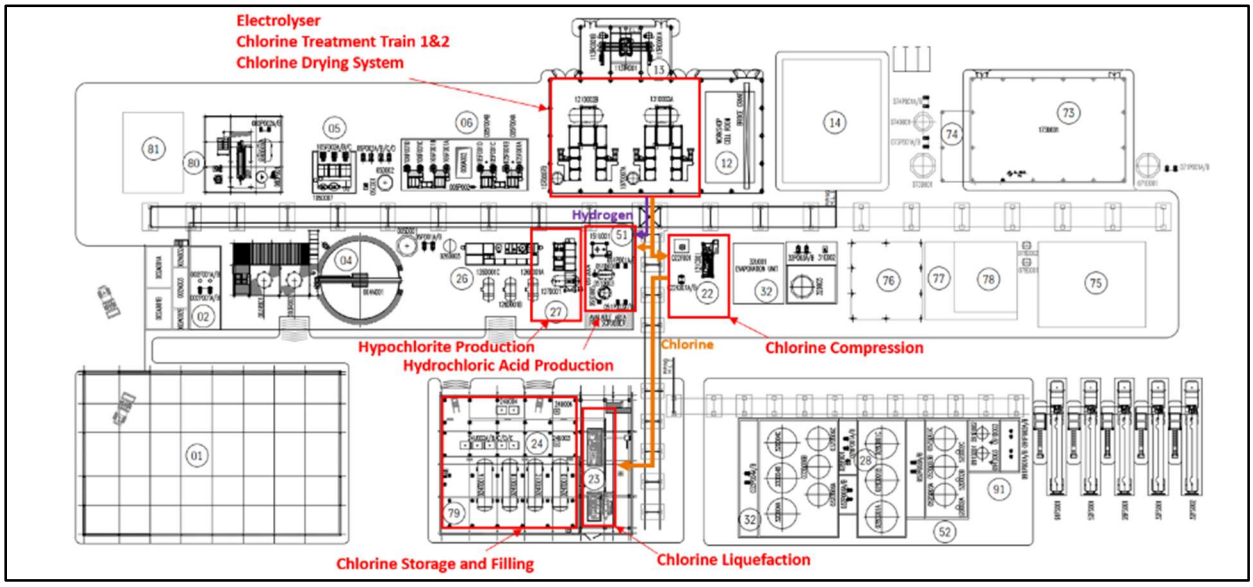


Figure 5 Facility Layout - Chlorine Process Overlay

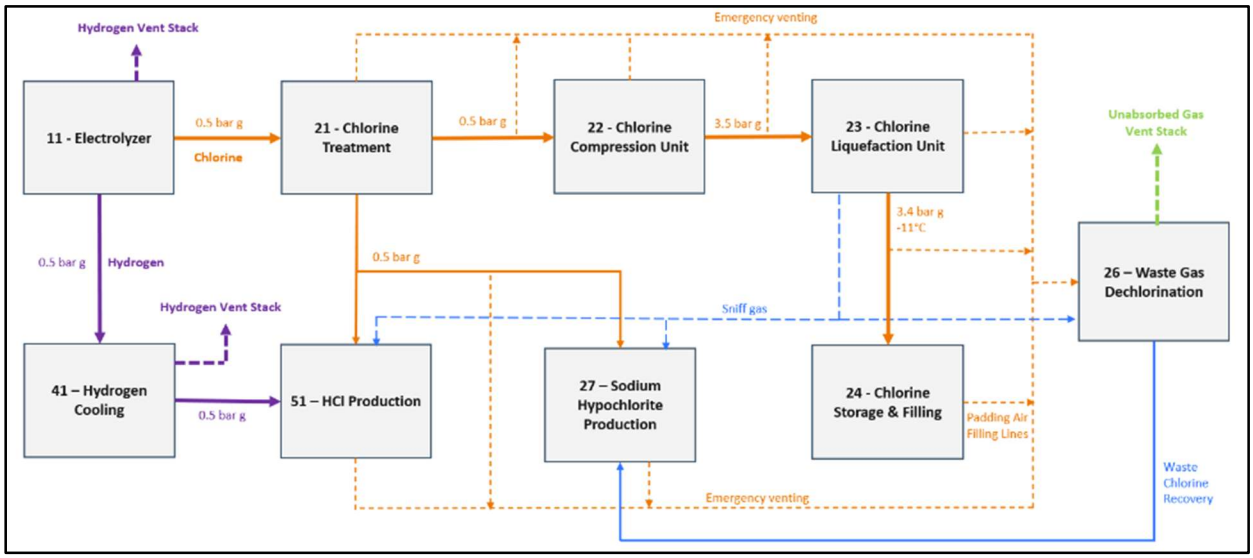


Figure 6 Simplified Chlorine Process Block Flow Diagram

3.2. Site Occupancy

Site occupancy is expected to be 50 persons during the day shift, with 10 on night shift and weekends. At times, specialist contractors and distribution contractors will be required on site.

Chlorine process areas, and specifically enclosed buildings, will be unoccupied during chlorine operations to minimise the risk to personnel from chlorine exposure and to detain and manage any chlorine within the building in the event of an accidental chlorine release from process equipment. The design intent is to remove personnel from the immediate hazard zone, reduce human-initiated escalation, and support rapid, unimpeded emergency response, thereby assisting engineered controls in preventing off-site impacts of hazardous chemicals.

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3.3. Site Security Arrangements

A facility physical security plan will be implemented including perimeter security fencing, lighting, signage, facility access control and management, and surveillance and monitoring. The Grenof Project Halogen operations will be 24/7 with security monitored by the control room. The design intent is to prevent unauthorised access to or interference with hazardous chemical systems, reducing the likelihood of externally initiated releases and off-site hazardous chemical impacts.

A cyber security plan will be implemented to protect against external cyber threats. This will include network segregation, isolating OT systems from IT networks, access management, back-up and recovery and integration of cyber security incident response with emergency response planning. The design intent is to protect process control and safety systems from unauthorised interference, reducing the likelihood of externally initiated releases and off-site hazardous chemical impacts.

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4. Project Stage and Hazard Assessment Activities

4.1. Activities undertaken and planned

Grenof Project Halogen is pre-final investment decision (FID). As such, the design has not yet been through front-end engineering design (FEED). Key design features have been incorporated within the concept design to enhance safety and reduce the identified risks with offsite impacts so far as is reasonably practicable. These are outlined in [insert cross reference]

The following activities have been undertaken to understand off-site risk at this early project stage:

- Review of applicable standards, codes of practice and industry guidelines to ensure their inclusion in the detailed design,
- Facility hazard assessment, based on process flow diagrams and plot schematics,
- Bushfire hazard assessment,
- Preliminary consequence modelling of identified scenarios with potential for offsite risk,
- Creation of qualitative bowtie schematics for an initial understanding of controls, and
- Creation of qualitative fault trees for an initial understanding of incident pathways.

Additional hazard and risk assessment studies will be conducted as the next phases of the project, including, but not limited to:

- Hazard and operability (HAZOP) studies,
- Review of consequence modelling completeness,
- Semi-quantitative bowtie risk assessment with associated layers of protection analysis (LOPA),
- Quantitative Risk Assessment (QRA), and
- SFAIRP assessment of identified risks.

The studies conducted to date are appropriate for the project stage, sufficient to understand the potential for off-site risk, identify the key controls required, and satisfy the intent of State Code 21 early in the project lifecycle.

4.2. MHF Licensing

In Queensland, the Major Hazard Facility (MHF) threshold quantity for chlorine is 25 tonnes as defined under Schedule 15 of the Work Health and Safety Regulation 2011 (Qld). The Grenof Project Halogen facility will exceed this threshold quantity and will be classified as an MHF. Classification and licencing as an MHF will ultimately benefit the ongoing management of risks

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during the project's operational phase, as it imposes a rigorous regulatory framework that enhances safety, accountability, and preparedness.

As an MHF, the Grenof Project Halogen facility is required to develop and maintain a comprehensive Safety Management System that:

- Identifies all major incident hazards
- Establishes control measures to eliminate or minimise risks
- Integrates emergency response, training, and monitoring procedures

This structured approach ensures that risks are systematically managed across all aspects of the facility's operations. The facility will prepare a Safety Case, a detailed document that demonstrates how the facility controls major hazards. This includes:

- Scenario-based hazard identification,
- Consequence analysis,
- Justification of control measures, and
- Ongoing review and improvement mechanisms.

The Safety Case promotes transparency and will require the facility to critically evaluate its risk control measures. MHF status will bring the facility under the oversight of Workplace Health and Safety Queensland (WHSQ), part of the Queensland Office of Industrial Relations. Their role will be to

- Review and approve the Safety Case,
- Conduct regular audits and inspections, and
- Enforce compliance with safety standards.

This external oversight ensures that risk management is actively maintained.

As an MHF, the Grenof Project Halogen facility must develop and test emergency response plans that:

- Coordinate with local emergency services,
- Address offsite impacts and community safety, and
- Include communication protocols for public notification

This will improve preparedness for any potential major incidents.

In summary, to comply with the MHF requirements, the facility will operate with discipline, transparency, and integrity. The result is human health and safety, and the built environment in the Yarwun area are protected, so far as reasonably practicable, from off-site risks resulting from the chemical hazards at the proposed Grenof Project Halogen facility.

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5. Hazardous Chemicals

5.1. Chemicals Stored and Handled

The Grenof Project Halogen facility is a chlor-alkali facility that will produce three primary chemicals—chlorine (Cl_2), hydrogen (H_2), and sodium hydroxide (NaOH) through the electrolysis of brine (saltwater). The produced hydrogen will be used onsite, with excess vented to the atmosphere.

In addition to these primary chemicals, the facility will also produce sodium hypochlorite (NaOCl) solution, and hydrochloric acid (HCl). Hydrogen peroxide (H_2O_2) solution and sulphuric acid (H_2SO_4) will also be used as an in-process chemical.

A summary of the hazards associated with each of these chemicals is provided in Appendix B.

5.2. Chlorine

Of particular interest in assessing the potential for off-site consequences is chlorine. Chlorine is classified as a hazardous substance under the criteria of Safe Work Australia's Globally Harmonized System (GHS) and classified as a Dangerous Good by the criteria of the Australian Dangerous Goods Code for the Transport of Dangerous Goods by Road and Rail (ADG Code).

Chlorine is a greenish-yellow gas at room temperature and has a pungent, irritating odour detectable at concentrations as low as 0.2 ppm. Chlorine is a highly toxic, corrosive gas that poses serious health risks upon inhalation, skin contact, or eye exposure. Inhalation is the most dangerous route. Chlorine gas reacts with moisture in the respiratory tract to form hydrochloric and hypochlorous acids, causing chemical burns.

The health effects of chlorine are as follows:

- Low concentrations (1–3 ppm): Can cause throat irritation, coughing, and chest tightness.
- Moderate concentrations (5–15 ppm): Lead to difficulty breathing, eye irritation, and pulmonary inflammation.
- High concentrations (>30 ppm): May cause acute respiratory distress, pulmonary edema, and potentially fatal outcomes.
- Chronic exposure: Can result in long-term respiratory damage and increased sensitivity to airborne irritants.

Chlorine gas is non-flammable but can cause fire or explosion when in contact with organic substances. It is heavier than air gas and can accumulate in low-lying areas or flow downhill, particularly in still air. Chlorine is highly corrosive to metals, particularly when moisture is present. Chlorine readily absorbs water from the atmosphere.

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5.3. Fuel Storage and Use

The project plans to use piped natural gas to fuel a steam boiler. A small inventory of LPG will be required on site for emergency backup should the natural gas supply be interrupted. If the project cannot secure the natural gas supply, a moderate on-site LPG inventory will be required to support production rates.

Both natural gas and LPG are flammable. Natural gas is lighter than air, while LPG is denser than air. As LPG has wider flammability limits and higher radiant heat if ignited, than natural gas, the hazard assessment has considered the off-site risks associated with a worst-case potential LPG storage requirement.

If LPG is the primary fuel source, then the installed storage vessel will be mounded. This will remove exposure of the inventory to physical impact, fire impingement and credible BLEVE scenarios. This eliminates a high-consequence risk scenario and provides a permanent, passive risk reduction measure.

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6. Process Description

The Grenof Project Halogen facility will utilise Thyssenkrupp Nucera's advanced Chlor-Alkali Electrolysis membrane-based technologies to produce chlorine, hydrogen and sodium hydroxide from brine (a solution of sodium chloride). The process is based on electrochemical decomposition of brine using membrane cell technology, which separates the anode and cathode compartments with an ion-selective membrane.

Pure brine solution prepared on site is fed into the electrolysis cells, consisting of an anode compartment and a cathode compartment separated by a cation-exchange membrane. In the anode compartment, chloride ions (Cl^-) are oxidized to form chlorine gas. In the cathode compartment, water molecules are reduced to produce hydrogen gas (H_2) and hydroxide ions (OH^-). The membrane selectively allows sodium ions (Na^+) to pass from the anode side to the cathode side, where they combine with hydroxide ions to form sodium hydroxide.

Following electrolysis, the products are separated and processed. Chlorine gas is cooled, dried, and compressed for liquefaction, storage and filling into 920kg drums and 70kg cylinders. Hydrogen gas is used as a feedstock for hydrogen chloride (HCl) synthesis. Any excess hydrogen gas is vented safely to the atmosphere.

Sodium hydroxide solution is concentrated, using an evaporator, and stored for distribution or further use at the facility. This evaporator is heated with steam, generated from a gas-fired steam boiler. Additionally, the facility will also produce sodium hypochlorite solution.

The process is designed to minimise environmental impact through closed-loop systems, efficient gas handling, and low emissions. Safety systems are integrated to manage risks associated with chlorine and hydrogen production, including leak detection, emergency shutdown and an emergency waste gas dechlorination systems.

The Grenof Project Halogen facility will operate 24 hours per day, 365 days a year and is proposed to produce the following products:

- **Chlorine gas** - 90 tpd
- **Sodium Hydroxide 50% solution** - 100 tpd
- **Sodium Hypochlorite 12% solution** - 189 tpd
- **Hydrochloric Acid 33% solution** - 93 tpd

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7. Hazard Identification Methods and Hazard Analysis

7.1. Methodology

The hazard assessment methodology with the performance outcomes and acceptable solutions outlined in *State Code 21: Hazardous Chemical Facilities*, part of the State Development Assessment Provisions (SDAP) under the Planning Regulation 2017 (Qld). The purpose is to identify, evaluate, and manage the risks associated with the hazardous chemicals stored, handled, and used at the proposed Grenof Project Halogen Facility.

This approach focused on identifying hazardous scenarios during facility operations and screening for the potential for off-site impacts. The extent of the impacts, with particular focus on human health and safety at offsite locations, was assessed against the performance outcomes of State Code 21 and/or against the code's purpose statement.

It should be noted that this screening and the subsequent consequence modelling are first conducted on an unmitigated basis (i.e., with no controls in place). This conservative 'worst-case' methodology ensures that all potential hazards are identified and not overlooked, forming the basis for implementing controls to minimise risks so far as reasonably practical as part of the project and operations.

7.2. Hazard Assessment

7.2.1. Hazard Identification

The hazard identification process for the Grenof Project Halogen facility was conducted with the primary objective of identifying credible scenarios involving hazardous materials with particular consideration to scenarios that could result in offsite impacts. The emphasis was placed on consequence-based scenario development, particularly those involving the release of chlorine and its potential for effects beyond the facility boundary on surrounding industries and communities.

The methodology adopted was structured and scenario-driven, taking a systematic review of the facility's design, operational parameters, and processes to identify potential initiating events that could lead to a loss of containment. Information relevant to the facility; including process flow diagrams, proposed site layout, and process and control descriptions were reviewed. Particular attention was given to the physical and chemical properties of chlorine, its processing and storage conditions, and the mechanisms by which it could be released into the atmosphere.

7.2.2. Hazard Assessment Workshop

Hazard identification was conducted through a facilitated workshop, with the session encouraging open discussion and brainstorming to explore plausible scenarios, without the proposed controls in place. Each scenario was developed based on the specific process areas, the materials and their process conditions, a defined initiating event and potential causes, such

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as equipment integrity failure, operational issues or external impact. The potential impacts of each risk scenario were identified, along with the planned preventative and mitigative control measures.

The Hazard Assessment Workshop was conducted virtually on 19th September 2025, involving experienced representatives from the Grenof team, with facilitation provided by Safety Solutions. The Grenof team revisited the hazard assessment workshop through virtual correspondence in January 2026, to refine the LPG and bushfire-related scenarios.

The assessment provided a systematic and comprehensive identification of all possible scenarios that could lead to a hazardous incident at the facility, based on:

- Activities at the facility
- Natural events
- Malicious acts
- Hazardous events on neighbouring sites

And documented the following:

- Identified physical and chemical hazards
- Types of incidents that could result from each hazard and their causes
- Possible effects of each incident

The minutes of the workshop are provided in Appendix C.

7.2.3. Workshop Output

The preliminary hazard assessment identified 30 hazardous material scenarios for further screening. These scenarios were derived from a range of potential initiating sources, including activities, potential interactions with neighbouring industrial facilities, exposure to natural hazards such as extreme weather or seismic events, and actions or influences from third parties.

Of the 30 scenarios, 15 specifically involved chlorine and had the potential to cause offsite impacts under certain release conditions. These 15 scenarios were grouped into six top events. These six were selected for detailed consequence modelling to evaluate dispersion characteristics, impact zones, and risk to surrounding land uses in accordance with State Code 21 requirements.

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Several other scenarios were selected for preliminary[1] consequence modelling assessment to understand whether off-site effects could occur or not. These are included in the Top Events list provided in Table 2.

Table 2 Top Events progressed to consequence modelling for assessment of their potential for off-site effects

Top Event	Event Description
Chlorine	
A0335-MI-01	Release of Chlorine from Electrolyzer Building
A0335-MI-03	Release of Chlorine from HCl production unit
A0335-MI-04	Release of Chlorine from Hypochlorite production unit
A0335-MI-05	Release of Chlorine from Chlorine Compressor Building
A0335-MI-06	Release of Chlorine from transfer pipework between Chlorine Compressor Unit and Chlorine Liquefaction Unit
A0335-MI-07	Release of Chlorine from Liquid Chlorine Building (Liquefaction, Storage and Filling)
A0335-MI-23	Release of Chlorine due to external events
Hydrogen	
A0335-MI-02	Release of Hydrogen inside the Electrolyzer Building
A0335-MI-25	Ignition of vented hydrogen from the Hydrogen Vent Stack has been assessed by Prudentia [10] and shown not to have any off-site effect. None of the scenarios modelled reached API thresholds at grade. Consequence modelling not further
Hydrogen Peroxide	
A0335-MI-24	Decomposition of hydrogen peroxide with container overpressure
LPG (If used)	
A0335-MI-14	Release of LPG from bulk storage or connected piping
A0335-MI-22	Uncontrolled combustion event within a gas-fired steam boiler
Medium Pressure Steam	
A0335-MI-26	Boiler overpressure and steam explosion

7.3. Potential Offsite Impact Scenarios

The Top Events identified for worst-case scenario modelling are discussed in greater detail in the following tables.

[1] The consequence models are considered preliminary as they have been developed before detailed design of the project is complete. The models will be reviewed in later project stages and updated where required.

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Table 3 A0335-MI-01 - Release of Chlorine from Electrolyzer Building

Top Event	**A0335-MI-01 - Release of Chlorine from Electrolyzer Building**
Scenarios	**#1** Release of chlorine due to Electrolyzer leaks and/or piping flanges/connection leaks from anode**.** **#3** Release of chlorine due to process units and/or piping flanges/connection leaks. Process units include !21E001 Chlorine Cooler 121E002 Chlorine Chiller, 121F001 Wet Chlorine Filter Mist Eliminator 121C001 Chlorine Drying Tower
Process Area(s)	**11 – Electrolyzer** **21 – Chlorine Treatment** Low pressure dry chlorine gas is produced in the Electrolyzer and is transferred to the Chlorine Treatment for dying at approximately 0.5 barg. The Electrolyzer and Chlorine Treatment units are located within the 'sealed' *Electrolyzer Building* which is continually kept under slight negative by the Waste Gas Dechlorination System exhauster fans. The fans also provide the required suction on the chlorine lines, preventing chlorine to leak to the atmosphere from the plant.
Scenario Description	Potential for chlorine releases from the Electrolyzer and Chlorine Treatment units and/or from associated piping, flanges and connections. Causes may include corrosion, stress corrosion cracking, seal degradation, valve failures, loose fittings or connections, or improper component installation.
Discussion	The credible scenarios for releases from the Electrolyzer and Chlorine Treatment units are likely to be releases from piping, components and fittings
Assumptions	Various hole sizes to be evaluated in the 300mm piping. Isolatable inventory is assumed to be 250kg. (secondary processing stream – conservative assumption) The unit is within the 'sealed' *Electrolyzer Building*. Chlorine will be released from the building based on assumed building air exchange rate of ACH = 0.1 (Appendix D - sealed building assumptions); however consequence modelling not conducted as A0335-MI-03 and A0335-MI-04 will provide worst case results for this specific piping release scenario (i.e. open to the atmosphere)

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Table 4 A0335-MI-03 Release of Chlorine from HCl production unit

Top Event	**A0335-MI-03 Release of Chlorine from HCl production unit**
Scenarios	**#4** Release of chlorine due to process units and/or piping flanges/connection leaks. Process units include 151U001 HCl Synthesis Unit
Process Area	**51 – Hydrochloric Acid Production Unit** Low pressure dry chlorine gas from the Chlorine Drying Tower enters the HCl Synthesis Unit at approximately 0.5 bar g The HCl Synthesis Unit is located open to the atmosphere.
Scenario Description	Potential for chlorine releases from the HCl Synthesis Unit and/or from associated piping, flanges and connections. Causes may include corrosion, stress corrosion cracking, seal degradation, valve failures, loose fittings or connections, or improper component installation.
Discussion	The credible scenarios for releases from the Hydrochloric Acid Production Unit are likely to be releases from piping, components and fittings
Assumptions	Various hole sizes to be evaluated in the 300mm piping. Isolatable inventory is assumed to be 250kg. (secondary processing stream – conservative assumption)

Table 5 A0335-MI-04 Release of Chlorine from Hypochlorite Production Unit

Top Event	**A0335-MI-04 Release of Chlorine from Hypochlorite Production Unit**
Scenarios	**#5** Release of chlorine due to process units and/or piping flanges/connection leaks. Process units include 127F001 Hypochlorite Ejector.
Process Area	**27 – Sodium Hypochlorite Production Unit** Low pressure dry chlorine gas from the Chlorine Drying Tower enters the Hypochlorite Production Unit at approximately 0.5 bar g The process unit is located open to the atmosphere.
Scenario Description	Potential for chlorine releases from the Hypochlorite Production Unit and/or from associated piping, flanges and connections. Causes may include corrosion, stress corrosion cracking, seal degradation, valve failures, loose fittings or connections, or improper component installation.

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Top Event	**A0335-MI-04 Release of Chlorine from Hypochlorite Production Unit**
Discussion	The credible scenarios for releases from the Hypochlorite Production Unit are likely to be releases from piping, components and fittings.
Assumptions	Various hole sizes to be evaluated in the 300mm piping. Isolatable inventory is assumed to be 250kg. (secondary processing stream – conservative assumption)

Table 6 A0335-MI-05 Release of Chlorine from Chlorine Compressor Building

Top Event	**A0335-MI-05 Release of Chlorine from Chlorine Compressor Building**
Scenarios	**#6** Release of chlorine due to equipment integrity Issues leading to process units and/or piping flanges/connection leaks. Process units include 122U001 Chlorine Compression Unit, 022F001 Dry Chlorine Filter Mist Eliminator **# 7** Release of chlorine due to operational issues leading to process units and/or piping flanges/connection leaks. Process units include 122U001 Chlorine Compression Unit, 022F001 Dry Chlorine Filter Mist Eliminator
Process Area	**22 - Chlorine Compression** Low pressure dry chlorine gas from the Chlorine Drying Tower enters the chlorine compression unit for pressurisation to 3.4 bar g (451 kPa a) in preparation for further processing in the Chlorine Liquefaction unit. The chlorine compression unit is located within the 'sealed' *Chlorine Compressor Building* which is continually kept under slight negative by the Waste Gas Dechlorination System exhauster fans. The fans also provide the required suction on the chlorine lines, preventing chlorine to leak to the atmosphere from the plant.
Scenario Discussion	Potential for chlorine releases from the compression units (Chlorine Compression Unit and Dry Chlorine Filter Mist Eliminator) and/or from associated piping, flanges and connections. Causes may include corrosion, stress corrosion cracking, seal degradation, valve failures, loose fittings or connections, worn components, vibration, overheating, over pressurisation or improper component installation.

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Assumptions	The unit is within the 'sealed' *Chlorine Compressor Building,* for the purposes of assessing worst case releases a release at production flow rate into the building (i.e. 90tpd chlorine rate), Chlorine releases from the building are based on assumed building air exchange rate of ACH = 0.1 (Appendix D - sealed building assumptions)

Table 7 A0335-MI-06 Release of Chlorine from transfer pipework

Top Event	**A0335-MI-06 Release of Chlorine from transfer pipework between Chlorine Compressor Unit and Chlorine Liquefaction Unit**
Scenarios	**#8** Release of chlorine due to pipe rupture (vehicle impact) on chlorine piping in pipe bridge between 22 - Chlorine Compression Unit and 23 - Chlorine Liquefaction Unit. Pipe bridge spans central roadway on site. **#9** Release of chlorine due to leak on chlorine piping in pipe bridge between 22 - Chlorine Compression Unit and 23 - Chlorine Liquefaction Unit.
Process Area	**Compressed Chlorine Piping between 22 - Chlorine Compression and 23 Chlorine Liquefaction process areas.** Compressed chlorine is piped from the chlorine compressor to the chlorine liquefaction unit across an internal facility roadway on an elevated pipe bridge. Chlorine gas within the piping is 3.4 bar g (451 kPa a).
Scenario Discussion	Potential releases from this chlorine piping will go directly to the surrounding atmosphere. Causes may include corrosion, stress corrosion cracking, flange and gasket failures, weld defects, improper installation, vibration and impact. The use of approved materials from the technology provider, and limitations of flanges are used for eliminating leaks, along with the operational software and failsafe control features. The pipe bridge is above an internal roadway, with the potential for uncontrolled vehicle movement to impact the pipe bridge structure or the chlorine piping directly. Vehicle movement on this section of the roadway is to be restricted / eliminated
Assumptions	Various hole sizes to be evaluated including 150mm full pipe diameter rupture. Isolatable inventory is assumed to be 1000kg. (15 minutes production)

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Table 8 A0335-MI-07 Release of Chlorine from Liquid Chlorine Building

Top Event	**A0335-MI-07 Release of Chlorine from Liquid Chlorine Building (Liquefaction, Storage and Filling)**
Scenarios	**#10** Release of chlorine due to equipment integrity Issues leading to process units and/or piping flanges/connection leaks. Process units include 123U001 Chlorine Liquefaction Unit **#11** Release of chlorine due to operational issues leading to process units and/or piping flanges/connection leaks. Process units include 123U001 Chlorine Liquefaction Unit **#12** Release of Chlorine from tank, drum and cylinder fill lines due to piping flanges and connections leaks **#13** Release of chlorine from chlorine tank leaks to due to corrosion, vessel integrity issue. **#14** Release of chlorine from chlorine tank leaks due to over-pressurisation or overfill. **#15** Release of chlorine from drum, cylinder leaks or associated piping due to equipment integrity issues. **#16** Release of chlorine from drum, cylinder leaks or associated piping due to operational issues.
Process Areas	**23 Chlorine Liquefaction** The dry and compressed chlorine gas enters the Chlorine Liquefaction Unit where it is liquefied. The chlorine liquefaction unit is located within the 'sealed' *Liquid Chlorine Building* which is continually kept under slight negative by the Waste Gas Dechlorination System exhauster fans. **24 - Chlorine Storage & Filling** Liquid chlorine (approximately at 3.4 bar g and -11°C) flows from the Chlorine Liquefaction Unit to the Liquid Chlorine Storage Tanks. These bulk storage tanks are located within the same 'sealed' *Liquid Chlorine Building,* There are three 20 t capacity bulk tanks in service, as well as an additional emergency 20 t capacity bulk tank which remains empty. Each tank is positioned within a bund to detain any accidental release of liquid chlorine from the storage tanks. Liquid chlorine is filled into 920kg drums or cylinders from the storage tanks. Chlorine gas from these filling stations is sent to Chlorine Absorption System via the liquid chlorine trap. The chlorine drum and cylinder filling operations are undertaken within the same 'sealed' *Liquid Chlorine Building,* which is continually kept under slight negative by the Waste Gas Dechlorination System exhauster fans.

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Top Event	**A0335-MI-07 Release of Chlorine from Liquid Chlorine Building (Liquefaction, Storage and Filling)**
Scenario Discussion	Potential for chlorine releases from the **Chlorine Liquefaction Unit** and/or from associated piping, flanges and connections. Causes may include corrosion, stress corrosion cracking, flange and gasket failures, compressor or pump seal leaks, heat exchanger leaks, valve failures, loose fittings or connections, worn components, ice formation, pressure imbalances, rapid cooling or heating cycles, or improper component installation. Potential for chlorine releases from the **bulk liquid chlorine storage tanks** and/or from associated piping, flanges and connections. Causes may include corrosion of tank walls, stress corrosion cracking, seal and gasket failure, weld defects, overfilling or over-pressuring, or improper component installation. Potential for chlorine releases from the **liquid chlorine storage drums, cylinders** and/or from associated piping, flanges and connections. Causes may include worn or improperly sealed valves, gaskets, or couplings, corroded pipework or fittings, faulty pressure relief valves, damaged containers or overfilling Refer to Table 9 A0335-MI-23 for discussions about BLEVE.
Assumptions	The unit is within the 'sealed' *Liquid Chlorine Building,* for the purposes of assessing worst case releases from all sources will be a 20t chlorine tank instantaneous release into the building (i.e. 90tpd chlorine rate), Chlorine releases from the building are based on assumed building air exchange rate of ACH = 0.1 (Appendix D - sealed building assumptions)

Table 9 A0335-MI-23 Release of Chlorine due to external events

Top Event	**A0335-MI-23 Release of Chlorine due to external events**
Scenarios	**#22** Fire impingement on Chlorine containing equipment leads to toxic release. **#26A** Bushfire in adjacent land use impacting chlorine-containing vessels and pipework
Process Area	All areas where chlorine is in use. **22 - Chlorine Compression** **23 Chlorine Liquefaction** **24 - Chlorine Storage & Filling**

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Top Event	**A0335-MI-23 Release of Chlorine due to external events**
Scenario Discussion	The potential for chlorine releases from the associated piping, flanges, and connections exists if they are exposed to fire. The potential for liquid chlorine drums or cylinders to undergo a BLEVE (boiling liquid expanding vapour explosion) requires an external fire impinging on the vessels for a sustained period. This is considered extremely unlikely given the storage location within an enclosed building, the physical layout and segregation from potential fire sources. As such, Chlorine BLEVE scenarios have been excluded from this assessment. The external transfer piping between units is considered the most credible location for exposure to bushfire radiant heat. It will be elevated from the ground, and beyond the APZ of 10kW/m^2 zone.
Assumptions	Various hole sizes to be evaluated, including 150mm full pipe diameter rupture. Isolatable inventory is assumed to be 1000kg. (15 minutes production)
NOTE	The models required based on these scenarios are equivalent to A0335-MI-06 and are not recreated.

Table 10 A0335-MI-02 Release of Hydrogen within Electrolyzer Building

Top Event	**A0335-MI-02 Release of Hydrogen within the Electrolyzer Building**
Scenarios	**#2** Release of hydrogen due to Electrolyzer leaks and/or piping flanges/connection leaks from cathode.
Process Area	**11 – Electrolyzer** The Electrolyzer is within the 'sealed' Electrolyzer Building which is continually kept under slight negative by the Waste Gas Dechlorination System exhauster fans.
Scenario Discussion	Potential releases from this hydrogen piping will go directly to the surrounding atmosphere, within the Electrolyzer building. Causes may include corrosion, stress corrosion cracking, seal degradation, valve failures, loose fittings or connections, worn components or improper component installation. Ignition may occur within the building and cause internal damage. Delayed ignition may occur within the Waste Gas Dechlorination System, if sufficient hydrogen has been released for a flammable gas concentration to still exist at this point.

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Top Event	**A0335-MI-02 Release of Hydrogen within the Electrolyzer Building**
Assumptions	The building is unmanned. The more credible ignition event within the building was used for modelling purposes.
Assumptions	Various hole sizes to be evaluated including 150mm full pipe diameter rupture. Ignition is assumed to occur within the Electrolyzer Building. Isolatable inventory is assumed to be 1000kg. (15 minutes production)

Table 11 A0335-MI-24 Decomposition of hydrogen peroxide with container overpressure

Top Event	**A0335-MI-24 Decomposition of hydrogen peroxide with container overpressure**
Scenarios	**#22A** Fire impingement on hydrogen peroxide-containing equipment leads to decomposition reaction and fire escalation.
Process Area	**Brine processing**
Scenario Discussion	Fire impingement on hydrogen peroxide IBCs causes rapid exothermic decomposition, oxygen generation, vessel rupture. These IBCs are very unlikely to be exposed to process fire impingement or to radiant heat from bushfires exceeding 10kW/m^2, based on the planned design location and maintained APZ. The failure mode of the IBCs is expected to be rupture, cap ejection, cage failure, seam split. Damage at a distance from the bund from overpressure would require the headspace within the IBCs to significantly pressurise before a failure occurs. The released gas is not flammable itself, but oxygen enrichment can worsen secondary fires.
Assumptions	The quantity of hydrogen peroxide on site will be limited to two IBCs. The information of interest is the extent of oxygen that may arise in such a failure event.

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Table 12 A0335-MI-14 Release of LPG from bulk storage or connected piping

Top Event	**A0335-MI-14 Release of LPG from bulk storage or connected piping**
Scenarios	Note: It is not yet certain that LPG will be stored in bulk on site. **#23A** Release of LPG from bulk storage vessel or connected piping resulting in jet fire and or flash fire. **#23** Fire impingement on LPG storage leads to vessel structural failure, loss of containment of LPG, and fire escalation **#26B** Bushfire in adjacent land use impacting LPG containing vessels and pipework
Process Area	**LPG Storage Area, and pipe rack to steam boiler**
Scenario Discussion	Potential releases from LPG storage tank or connected piping will go directly to the surrounding atmosphere. Causes may include corrosion, stress corrosion cracking, flange and gasket failures, weld defects, improper installation, vibration, overpressure, impact. Potential releases from the LPG road tanker during filling activities will go directly to the surrounding atmosphere. There is no bunding around the LPG tank. Any liquid release would rapidly evaporate on the ground to form LPG vapour. As such, pool fire scenario with risk of vessel BLEVE is deemed not credible. LPG BLEVE from fire impingement from other process fires is deemed not credible on the basis of the bulk storage being mounded
Assumptions	Various hole sizes to be evaluated, including full pipe diameter rupture. A pipe size of DN50 has been assumed. Whilst automated isolation will be included, no credit is taken for it in this worst-case scenario. As such the inventory will assume all available LPG can be released.

Table 13 A0335-MI-22 Uncontrolled combustion event within gas-fired burner

Top Event	**A0335-MI-22 Uncontrolled combustion event within gas-fired burner**
Scenarios	**#31** Uncontrolled combustion event within burner results in internal explosion, structural damage to site, with escalation to fire if gas supply affected.
Process Area	**32 – Caustic Soda** Natural gas or LPG may be used to fuel burner for a steam boiler.

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Scenario Discussion	An uncontrolled combustion event within a gas-fired burner can cause deflagration, severe thermal and mechanical damage, and escalation to fuel supply loss of containment. Initiating events can include loss of air flow, (e.g. fan failure), loss of fuel flow, excess air (e.g. damper failure open), excess fuel flow issues, incomplete purges on start-up, incomplete isolations on shutdown.
Assumptions	The available explosive volume is limited to an estimate of the burner chamber size. This has conservatively been assumed to be approximately equivalent to $7m^3$ LPG fuel has been modelled as the worst case. Natural gas fuel supply is still the preference.

Table 14 A0335-MI-26 Boiler overpressure and steam explosion

Top Event	Boiler overpressure and steam explosion
Scenarios	**#31** Uncontrolled combustion event within burner results in internal explosion, structural damage to site, with escalation to fire if gas supply affected.
Process Area	**32 – Caustic Soda** Evaporator in NaOH concentration is heated by medium pressure steam, supplied by a gas-fired boiler.
Scenario Discussion	Failure of steam pressure control can lead to overpressure and failure of the boiler vessel tubes. The rapid expansion of steam upon release can creates a shockwave capable of fatally harming people and damaging structures. The thermal energy and projectiles released can cause significant harm to those in the vicinity.
Assumptions	A 4MW LHV boiler is assumed. Operating pressure is assumed to be at 10barg for worst case conditions. Vessel dimensions of 3.5m in diameter and 6m in length are assumed.

7.4. Quantitative Assessment of Offsite Consequences

7.4.1. Consequence Modelling

Consequence modelling is the process of predicting and quantifying the physical impacts that might result from a hazardous release. Discharge models are created to estimate the rate of release of hazardous gases, liquids or a mix of both, and the amount released.

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Dispersion models are then used to estimate concentration/time profiles of flammable or toxic gases at various distances downwind from the point of release.

Inputs required are the release characteristics, process conditions (pressure and temperature), weather, and site layout. Outputs provided will be impact distances, which can then be used in risk assessments and emergency response planning.

Vapour cloud behaviour is determined by a variety of factors including:

- the density of the gas relative to air,
- the rate of release over time,
- the amount of air entrainment at source,
- wind speed, and
- weather stability.

7.4.2. Weather Conditions

Yarwun, located on the central coast of Queensland, experiences a warm and humid subtropical climate characterized by hot, wet summers and mild, dry winters. The average annual temperature is approximately 22°C, with summer months (December to February) typically reaching highs of 30–32°C with lows around 21–23°C. In winter months (June to August) the day-time highs average around 22–24°C, with night-time lows of 12–14°C.

The area experiences predominantly easterly winds throughout the year, with average speeds ranging from 2.7 m/s to 5.6 m/s. Easterly winds dominate, especially from September to February, with winds shift slightly toward the southeast and south during winter months (June–August), winds shift slightly toward the southeast and south, though easterlies still prevail.

Rose of wind direction versus wind speed in km/h for the Gladstone area are provided in Appendix E.

7.4.3. Acute Exposure Guideline Levels

Acute Exposure Guideline Levels (AEGLs) are exposure guidelines designed to help responders deal with emergencies involving chemical spills or other catastrophic events where members of the general public are exposed to a hazardous airborne chemical.

AEGLs estimate the concentrations at which most people will begin to experience health effects if they are exposed to a hazardous chemical for a specific length of time (duration). For a given exposure duration, a chemical may have up to three AEGL values, each corresponding to a specific tier of health effects:

- AEGL-1: Notable discomfort, irritation, or certain asymptomatic non-sensory effects. However, the effects are not disabling and are transient and reversible upon cessation of exposure.

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- AEGL-2: Irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape.

1. AEGL-3: Life-threatening health effects or death.

AEGLs estimate how the general public would react to a release of this nature. For the purposes of addressing the State Code 21 requirements, the AEGL-2 value that is considered a dangerous dose to human health.

7.4.4. Thermal Radiation and Explosion Overpressure

The effects of heat radiation from jet, pool, and flash fires and BLEVEs are estimated per the criteria in Table 36: Thermal Radiation Criteria per Table 1, Planning Guideline State Code 21. In estimating heat effects, credit has not been given to active mitigations for example, fire water application or passive mitigations, such as fire-rated elements.

The overpressure effects of vapour cloud explosions, explosive reactions, and BLEVEs are estimated per the criteria in Table 37: Overpressure Criteria per Table 2, Planning Guideline State Code 21 [1]

7.4.5. Consequence Modelling Results

Details of the consequence modelling conducted based on the potential off-site impact scenarios identified in section 7.3, is provided in Appendix D.

Table 15 summarises the extent of the AEGL-2 distances for the worst-case scenario releases under the least favourable weather conditions, i.e. 1.5/F – light wind speed (1.5m/s) and stable atmospheric conditions (Stability Class F).

Table 15 Summary of Consequence Modelling Results – Toxic – where offsite impacts may arise

Ref.	Scenario Description	Material	Consequence Type	Weather Conditions	Extent [km]
MI-01 MI-03 MI-04	Release of Chlorine from HCl production unit/ Electrolyzer	Chlorine	Toxic (AEGL-2)	**1.5/F**	**3.6**
				4.6/C	1.8
MI-05	Release of Chlorine from Chlorine Compressor Building	Chlorine	Toxic (AEGL-2)	**1.5/F**	**3.0**
				4.6/C	0.4
MI-06a MI-06b	Release of Chlorine from Transfer Pipework Between Chlorine	Chlorine	Toxic (AEGL-2)	**1.5/F**	**6.1**

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Ref.	Scenario Description	Material	Consequence Type	Weather Conditions	Extent [km]
MI-23	Compressor Unit and Chlorine Liquefaction Unit			4.6/C	3.7
MI-07	Release of Chlorine from Liquid Chlorine Building (Liquefaction, Storage and Filling)	Chlorine	Toxic (AEGL-2)	**1.5/F**	**9.3**
				4.6/C	0.9

As shown in these results chlorine gas releases can travel long distances because chlorine is heavier than air and capable of forming dense, ground-hugging plumes that spread rapidly under certain atmospheric conditions. Low wind speeds and stable atmospheric layers (e.g., during early morning or evening) can trap chlorine near the ground and promote horizontal spread.

By comparison, the results for the extent of the AEGL-2 distances for the worst-case scenario releases under other weather conditions, i.e., 4.6/C (wind speed of 4.6 m/s and atmospheric stability Class C). This combination represents a moderate dispersion scenario, often used for realistic or average-case modelling rather than worst-case. It reflects a balance between conservative and optimistic assumptions, providing a credible estimate of how a hazardous release might behave under typical daytime conditions.

The consequence modelling overlays provided in Appendix E, demonstrates the significant differences in the distance to the AEGL-2 extend between low wind speeds and stable atmospheric layers (1.5/F) and average wind speeds atmospheric layers (4.6/C).

Table 16 summarises the extent of the thermal radiation and overpressure distances for the worst-case scenario releases under two weather conditions, 1.5/F, and 4.6/C.

Table 16 Summary of Consequence Modelling Results - Thermal Radiation and Overpressure – where offsite impacts marginally extend beyond facility boundary

Ref.	Scenario Description	Material	Thermal Radiation [kW/m^2]	Weather Conditions	Extent [m]
MI-14	Release of LPG from 50mm piping, with subsequent ignition and jet fire	LPG	12.6	1.5/F	104
				4.6/C	88
			4.7	1.5/F	127
				4.6/C	112

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Ref.	Scenario Description	Material	Overpressure [kPa]	Weather Conditions	Extent [m]
MI-14	Release of LPG from 50mm piping with subsequent VCE	LPG	14	1.5/F	230
				4.6/C	261
			7	1.5/F	260
				4.6/C	291

As can be seen by the images in Appendix A, there is a very marginal extent of effect beyond the facility boundary, but with no impacts to the adjacent roadway or nearby industrial zone users.

The following modelled scenarios were determined to have no off-site effect per PO1-PO5:

- MI-14, for releases of LPG from less than 22mm equivalent hole size
- MI-24 Decomposition of hydrogen peroxide with container overpressure
- MI-22 Uncontrolled combustion event in gas-fired burner
- MI-26 Boiler overpressure and steam explosion

7.5. Quantitative Assessment of Offsite Risk

In the initial phases of Grenof Project Halogen facility development, a number of critical design elements such as final process unit design and process configurations (e.g. Chlorine Compression and Liquefaction process units) plant layout, and equipment specifications are still under consideration and subject to change. Undertaking a detailed Quantitative Risk Assessment (QRA) at this stage would therefore require assumptions that may later change materially, potentially giving a false sense of precision.

As such, a qualitative approach that supports the State Code 21 objective of risk-informed land use and siting decisions at the project concept stage, has been taken. By clearly identifying worst-case and representative scenarios, dominant hazards, and escalation mechanisms, the combination of consequence models, bowties (Appendix J) and fault trees (Appendix H) enable informed decisions on separation distances, inventory limits, orientation of hazardous plant, and protection of sensitive receptors. These outcomes are central to the purpose of QRA but do not require numerical risk contours at this stage.

Qualitative fault trees nevertheless meet the intent of a QRA by systematically identifying credible initiating events and combinations of failures that could lead to major incidents. This includes consideration of equipment failures, human errors, loss of utilities, external events, and failures or degradations of safeguards. By analysing combinations of failures rather than relying on single-point assumptions, the fault trees demonstrate that the hazard identification process is systematic and comprehensive, and that the selected scenarios represent realistic and credible events consistent with State Code 21 requirements. Recognising relevant hazard pathways early

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and has enabled the project to eliminate or reduce hazards through inherently safer design choices before they become embedded in the project.

The outputs of the hazard assessment and fault trees have been integrated into bow-tie diagrams (Appendix J) for those scenarios where a potential offset effect may arise, providing a clear representation of intended risk controls. The left-hand side of each bowtie identifies the credible threats that could lead to the loss of containment and the preventive controls in place to prevent the hazardous event. The right-hand side identifies the potential consequence pathways and the mitigation controls that limit escalation and reduce impacts on people, environment, property, and surrounding land uses. This structure aligns directly with State Code 21 expectations for demonstrating both prevention of hazardous events and mitigation of their consequences.

Finally, the use of qualitative bowties and fault trees establishes a transparent and traceable foundation for the subsequent quantitative risk assessment that will occur in detailed design phase. The scenarios, assumptions, and controls identified through this process define the scope and focus of the future QRA, ensuring it is proportionate, targeted, and based on a mature understanding of the facility's hazard profile. In this way, qualitative analyses at the concept stage do not replace QRA; they satisfy its intent early in the project lifecycle while avoiding premature quantification that could undermine both safety and regulatory confidence.

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8. Risk Control Measures

8.1. Identification of Risk Control Measures

Risk control measures have been identified through the hazard assessment process though identification of potential hazardous events associated with the facility's operations, chemical inventory, and external influences. Each scenario was evaluated with particular attention given to those that may result in offsite impacts. Through the analysis, proposed control measures were identified and documented on their ability to eliminate, reduce, or mitigate the identified risks with consideration to the control hierarchy (Figure 7).

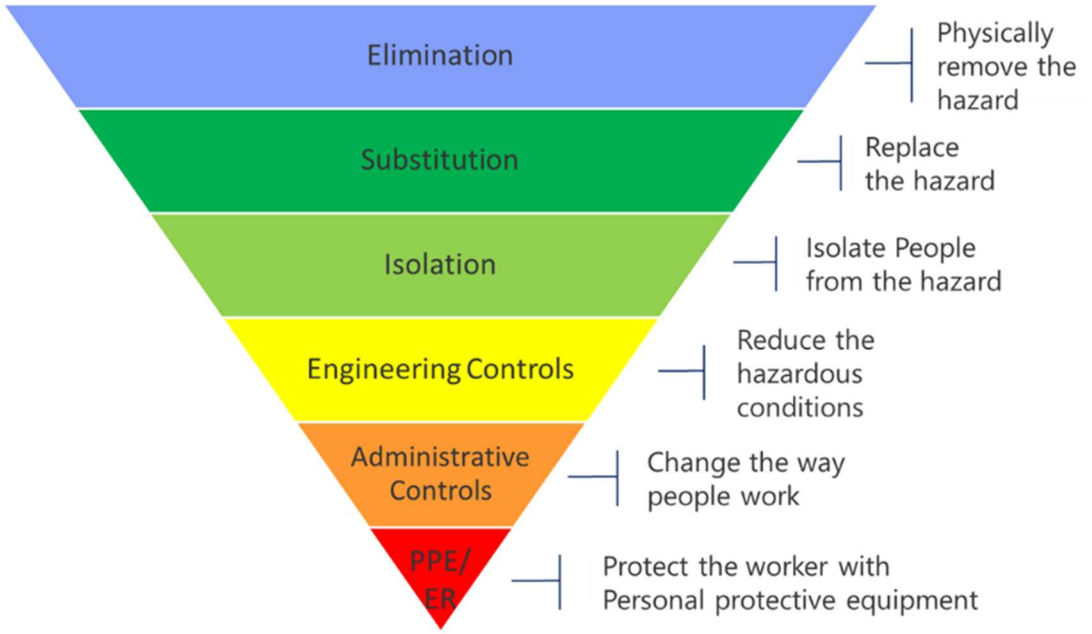


Figure 7 Control Hierarchy

Appendix I provides a detailed list of the risk control measures that will be incorporated into the facility design. The identified risk control measures include engineering solutions such as containment systems, automated shutdowns, and gas detection technologies and dichlorination systems; procedural safeguards such as standard operating procedures, maintenance protocols, and emergency response planning.

These risk control measures are consistent with those that have been successfully implement across over 600 Thyssenkrupp Nucera designed electrolysis projects worldwide, with no significant hazardous releases recorded.

The identified risk control measures and others to be further developed and refined during the Project Halogen implementation, will ensure that the risk of the hazardous release scenarios identified in this report are eliminated so far as is reasonably practicable.

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8.2. Scenario Bow Ties

The Bowtie method is a visual risk management tool that helps organizations understand and mitigate risks by mapping out causes, consequences, and risk controls measures around a central top event. Bow Ties have been developed to provide clarity around the role that the identified risk control measures have in minimising the risk so far reasonably practicable.

The Bow Ties are provided in Appendix J.

8.3. Review of Risk Control Measures

The following details summarise the selected control types and explain how and why they meet the purpose statement. Details about the individual controls is located in Appendix I.

8.3.1. Prevention and reduction of hazardous chemical releases

8.3.1.1. Basic Process Control Systems (BPCS)

POs supported: PO1-PO5

The BPCS maintains key process parameters (pressure, temperature, flow) within defined safe operating limits, preventing abnormal conditions that could lead to loss of containment. By stabilising operations at the source, the system directly supports State Code 21's intent to avoid hazardous chemical incidents rather than relying solely on emergency response.

8.3.1.2. Electrolyzer Design and Leak Detection

POs supported: PO1-PO5

The sealed single-element electrode units with PTFE sealing reduce leak likelihood through inherent design. Continuous pressure-differential monitoring allows immediate identification of pin-hole leaks, enabling rapid intervention before escalation. This aligns with State Code 21's objective to reduce both the likelihood and scale of chlorine and hydrogen releases.

8.3.1.3. Stoichiometric Control in HCl Production

POs supported: PO1-PO5

Maintaining hydrogen at a controlled excess within the HCl Synthesis process ensures full chlorine consumption, preventing free chlorine in vent streams. This control prevents toxic releases under normal and upset conditions, meeting the Code's requirement to minimise toxic gas discharge at the source.

8.3.2. Containment and Controlled Handling of Hazardous Chemicals

8.3.2.1. Enclosed Buildings with Negative Pressure

POs supported: PO1-PO5

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Housing the chlorine-related processes within enclosed, negatively pressurised buildings ensures any fugitive emissions are contained and directed to treatment systems. This approach limits dispersion beyond the site boundary, directly supporting State Code 21's purpose of protecting sensitive receptors and the public.

8.3.2.2. Bulk Storage Design, Bunding, and Segregation

POs supported: PO1-PO5, P06

Chlorine, acids, caustic, hypochlorite, and oxidisers are stored in accordance with relevant Australian Standards, with dedicated bunding and chemical segregation. These measures prevent incompatible reactions and secondary releases. Any moderately sized LPG vessels will be mounded, removing the credibility of scenarios relating to physical impact and BLEVE. These design choices meet State Code 21's expectation for robust containment and consequence reduction.

8.3.3. Detection, Monitoring, and Early Intervention

8.3.3.1. Ambient Chlorine Gas Detection

POs supported: PO1-PO5

Strategically located chlorine detectors provide early warning of releases, automatically alarming and enabling rapid isolation or shutdown via the DCS. Early detection is critical to State Code 21's requirement to promptly mitigate, limiting the duration and magnitude of the release.

8.3.3.2. Automated Process Leak Detection and Venting

POs supported: PO1-PO5

Automated pressure monitoring and interlocked venting systems provide controlled diversion of gases to treatment systems before loss of containment occurs. This reduces reliance on manual response and ensures consistent, reliable mitigation, consistent with the Code's performance-based intent.

8.3.3.3. Instrumented Protection System

POs supported: PO1-PO5

There is a Safety Instrumented System (SIS) to ensure independent operation of trip functionality and emergency shutdowns. This provides an independent layer of protection in the process control, enabling early detection and response to abnormal conditions.

8.3.4. Mitigation and Neutralisation of Releases

8.3.4.1. Waste Gas Dechlorination System

POs supported: PO1-PO5

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The sodium hydroxide scrubbing system provides continuous, duty/standby neutralisation capacity for chlorine-containing gases under both normal and emergency conditions. Routing relief valves, vent stacks, sniff gases, displaced filling gases, and building exhausts to this system ensures toxic releases are treated before discharge, directly fulfilling State Code 21's mitigation objectives.

8.3.4.2. Hydrogen Vent Stacks

POs supported: PO1-PO5

Dedicated hydrogen vent stacks discharge hydrogen to safe locations under controlled conditions, preventing accumulation and ignition risks. This mitigates flammable gas hazards and supports the Code's requirement to manage fire and explosion risks associated with hazardous chemicals.

8.3.5. Emergency Management and Escalation Control

8.3.6. Overpressure Protection and Emergency Storage

POs supported: PO1-PO5

Dual relief devices, rupture disks, expansion vessels, and spare emergency chlorine tanks provide layered protection against overpressure and loss of containment. The ability to transfer chlorine to empty emergency tanks reduces release duration and consequence severity, aligning with State Code 21's emphasis on credible worst-case scenario mitigation.

8.3.7. Structural Design for Natural Hazards

POs supported: PO10

Design to the National Construction Code for flood, cyclone, bushfire, and seismic loads ensures that external events do not compromise hazardous chemical containment. This supports State Code 21's requirement that external hazards are considered in preventing major chemical incidents.

8.3.7.1. Asset Protection Zone of 10kW/m^2

POs supported: PO10

The APZ provides a fuel-reduced, physical separation between the new buildings/structures and bush fire hazards, it is a key element in the suite of bush fire measures and dictates the type of construction necessary to mitigate bushfire attack. In practical terms, the setback of each building/structure will form part of the APZ. This control reduces bushfire radiant heat experienced within the facility and exposure of hazardous chemical infrastructure, maintaining the integrity of safety-critical systems and reducing the likelihood of bushfire-initiated releases that could impact off-site. This supports State Code 21's requirement that external hazards are considered in preventing major chemical incidents.

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8.3.8. Overall Alignment of Risk Control Measures with State Code 21 Purpose

Collectively, these control measures demonstrate a hierarchy-based, integrated risk management approach consistent with State Code 21 by:

- Avoiding releases through inherent design and process control
- Minimising likelihood via monitoring, automation, and redundancy
- Containing hazards within buildings, bunds, and closed systems
- Mitigating consequences through neutralisation, venting, and emergency storage
- Protecting off-site receptors by preventing uncontrolled dispersion

This combination of prevention, detection, containment, and mitigation demonstrates that the development meets the intent and purpose of State Code 21, even in the absence of a fully quantitative risk assessment, by providing credible, layered, and defensible risk reduction measures appropriate to the nature and scale of the hazards

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9. Code Compliance

9.1. Introduction

State Code 21 requires a compliance assessment against each of the performance outcomes (PO). Discussion on each of the performance outcomes compliance is discussed in this section.

In particular PO1- PO3, PO4 and PO5, an evaluation of foreseeable off-site impacts from the worst-case incident scenarios based on a quantitative assessment of the consequences is required. Worst-case scenarios as identified in section 7.3 were evaluated (refer section 7.4) to determine the extent of the potential dangerous dose to human health levels (AEGL-2) from the potential source of release from the proposed facility.

In considering worst-case scenarios as required by State Code 21, no credit is taken for the control measures at the facility to prevent such incidents from occurring or measures in place to mitigate the impacts. Additionally, the releases from these worst-case scenarios are considered for all potential weather conditions (including wind conditions).

9.2. PO1 – PO3 Dangerous dose to human health, vulnerable, sensitive and commercial land use and land use zones

For the purposes of State Code 21 compliance, the dangerous dose to human health is defined as an effect that equals or exceeds:

- AEGL-2 (60 minutes) for a toxic gas. (Chlorine is a toxic gas and has an AEGL-2 (60 minutes) of 2 ppm.)
- 4.7 kW/m^2 thermal radiation, or
- 7 kPa overpressure.

Based on the consequence modelling conducted on the identified worst-case scenarios without the planned controls at the Grenof Project Halogen Facility in this hazard assessment, it was determined that the dangerous dose to human health criteria could be exceeded at Vulnerable, Sensitive and Commercial land use locations as shown in Table 17 for the particular weather conditions indicated, for large chlorine releases.

These weather conditions are 1.5/F – light wind speed (1.5m/s) and stable atmospheric conditions (Stability Class F). As indicated in the relevant rose of wind direction versus wind speed provided in Appendix E, that these conditions are experienced very infrequently in the direction of the Vulnerable (Yarwun State School) and the Sensitive (Residential) land use areas. i.e <0.5% of the time in the afternoon and approximately 2% of the time in the early morning.

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Table 17 Dangerous dose to human health, vulnerable, sensitive and commercial land use and land use zones

Land Use Zone	Location	Top Event Reference	Dose	Weather Conditions
Vulnerable	Yarwun State School	A0335-MI-06/23	AEGL-2	1.5/F
Vulnerable	Yarwun State School	A0335-MI-07	AEGL-2	1.5/F
Sensitive	Targinnie Rd residence	A0335-MI-06/23	AEGL-2	1.5/F
Sensitive	Targinnie Rd residence	A0335-MI-07	AEGL-2	1.5/F
Commercial	Gladstone Model Aero Club	A0335-MI-01/03/04	AEGL-2	All
Commercial	Gladstone Model Aero Club	A0335-MI-05	AEGL-2	1.5/F
Commercial	Gladstone Model Aero Club	A0335-MI-06/23	AEGL-2	All
Commercial	Gladstone Model Aero Club	A0335-MI-07	AEGL-2	All

4.7kW/m^2 thermal radiation and 7kPa overpressure contours modelled do not reach any identified vulnerable, sensitive or commercial land use zone locations.

9.2.1. PO1-PO3 Compliance

The facility is designed such that foreseeable chlorine release scenarios are prevented at source, contained on-site, and neutralised prior to any off-site dispersion. Whilst it has been assessed that the dangerous dose to human health criteria could be exceeded at Vulnerable, Sensitive and Commercial land use locations by a major chlorine release, all reasonably practicable controls have been included in the design to ensure that the potential consequence of any chemical release or major incident is contained within the facility's boundaries. The controls achieve PO1-PO3 through:

- Prevention at source, achieved through inherently safer Electrolyzer design, sealed electrode units, stoichiometric control of hydrogen and chlorine, and continuous process control via the BPCS.
- Continuous process monitoring and automated control, preventing abnormal operating conditions that could lead to uncontrolled releases.
- Early leak detection, provided by pressure-differential leak detection on Electrolyzers and strategically located ambient chlorine gas detectors integrated into the DCS.
- Containment, achieved by enclosing all chlorine process areas within negatively pressurised buildings.

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- Redundant protection systems, including dual relief devices and spare emergency chlorine storage capacity, limiting both the likelihood and duration of release scenarios.
- Mitigation, provided by the Waste Gas Dechlorination System, which continuously neutralises chlorine-bearing gases from vents, relief devices, buildings, filling operations and emergency scenarios.

9.3. PO4 Dangerous dose to human health and individual fatality risk, open space land use and land use zones

For the purposes of State Code 21 compliance, the dangerous dose to human health is defined as an effect that equals or exceeds:

- AEGL-2 (60 minutes) for a toxic gas. (Chlorine is a toxic gas and has an AEGL-2 (60 minutes) of 2 ppm.)
- 4.7 kW/m^2 thermal radiation, or
- 7 kPa overpressure.

Where these cannot be achieved, then an individual fatality risk level of 10 x 10^{-6}/year and the societal risk criteria in Figure 21.1[9] are required to be demonstrated.

Based on the consequence modelling conducted on the identified worst-case scenarios at the Grenof Project Halogen Facility in this hazard assessment, it was determined that the dangerous dose to human health toxic criteria could be exceeded without relevant controls at open space zone locations, as shown in Table 18.

Table 18 Dangerous dose to human health open space land use

Land Use	Location	Top Event Reference	Dose	Weather Conditions
Open Space	Gladstone Model Aero Club	A0335-MI-01/03/04	AEGL-2	All
Open Space	Gladstone Model Aero Club	A0335-MI-05	AEGL-2	1.5/F
Open Space	Gladstone Model Aero Club	A0335-MI-06/23	AEGL-2	All
Open Space	Gladstone Model Aero Club	A0335-MI-07	AEGL-2	All

The Gladstone Model Aero Club is identified as an open space zone as these zones are specifically allocated for recreational and community use.

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4.7kW/m2 thermal radiation and 7kPa overpressure contours modelled do not reach any identified vulnerable, sensitive or commercial land use zone locations.

9.3.1. PO4 Compliance

Whilst it has been assessed that the dangerous dose to human health criteria could be exceeded at open space land use locations by a major chlorine release, all reasonably practicable controls have been included in the design to ensure that the potential consequence of any chemical release or major incident is contained within the facility's boundaries, as outlined for PO1-PO3.

The fatality risk levels have not been assessed at this stage through a Quantitative Risk Assessment, as explained in section 7.5.

At this project concept stage, qualitative bow-tie and fault tree analysis provides a transparent, performance-based demonstration that Performance Outcome PO4 is being addressed by identifying credible hazardous chemical scenarios and the controls that prevent or mitigate off-site impacts, while appropriately deferring quantitative risk assessment to detailed design to ensure it is proportionate, targeted and regulator-robust rather than prematurely quantified.

9.4. PO5 Dangerous dose to the built environment and individual fatality risk, industrial land use and land use zones

For the purposes of State Code 21 compliance, the dangerous dose to human health is defined as an effect that equals or exceeds AEGL-2 (60 minutes) for a toxic gas. Chlorine is a toxic gas and has an AEGL-2 (60 minutes) of 2 ppm.

For the purposes of State Code 21 compliance, the dangerous dose to the built environment is defined as an effect that equals or exceeds:

- 12.6 kW/m^2 thermal radiation, or
- 14 kPa overpressure.

Where these cannot be achieved, then an individual fatality risk level of 50 x 10^{-6}/year is required to be demonstrated.

Based on the consequence modelling conducted on the identified worst-case scenarios at the Grenof Project Halogen Facility in this hazard assessment it was determined that the dangerous dose to human health criteria was exceeded at industrial land use zone locations as shown in Table 19.

Table 19 Dangerous dose to industrial land use

Land Use	Location	Top Event Reference	Dose	Weather Conditions
Industrial	Northern Oil Refinery	A0335-MI-01/03/04	AEGL-2	All
Industrial	Northern Oil Refinery	A0335-MI-05	AEGL-2	1.5/F

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Industrial	Northern Oil Refinery	A0335-MI-06/23	AEGL-2	All
Industrial	Northern Oil Refinery	A0335-MI-07	AEGL-2	All
Industrial	Northern Oil Refinery	A0335-MI-14	14kPa	4.6/C

12kW/m^2 thermal radiation does not extend beyond the facility fencline.

14kPa overpressure may extend marginally beyond the facility fenceline, but does not reach any identified industrial zone location users. The contour does not impact Landing Road,

9.4.1. PO5 compliance

Whilst it has been assessed that the dangerous dose to the built environment could be exceeded at industrial land use locations by a major chlorine release, all reasonably practicable controls have been included in the design to ensure that the potential consequence of any chemical release or major incident is contained within the facility's boundaries, as outlined for PO1-PO3.

The fatality risk levels have not been assessed at this stage through a Quantitative Risk Assessment, as explained in section 7.5.

At this project concept stage, qualitative bow-tie and fault tree analysis provides a transparent, performance-based demonstration that Performance Outcome PO4 is being addressed by identifying credible hazardous chemical scenarios and the controls that prevent or mitigate off-site impacts, while appropriately deferring quantitative risk assessment to detailed design to ensure it is proportionate, targeted and regulator-robust rather than prematurely quantified.

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9.5. PO6 Monitored fire detection

The Grenof Project Halogen Facility will potentially have quantities of several *fire risk hazardous chemicals*[2] as defined by *Work Health and Safety Regulation 2011*, Schedule 19:

- Hydrogen
- LPG
- Hydrogen Peroxide, and
- Chlorine.

9.5.1. Flammable Gas

9.5.1.1. Hydrogen

Hydrogen, a flammable gas, will be produced in the electrolysis process and handled at low pressure (<0.5Bar g), with some used in the downstream process (HCl synthesis) and the excess vented to the atmosphere. Hydrogen in air gas detection will be a consideration during the project as a preference over fire detection for hydrogen.

9.5.1.2. LPG

LPG will be used as a fuel source for a burner within the process for synthesis of hydrochloric acid. It will be stored on site in a quantity no more than 30-tonne, within a mounded 66kL storage vessel, and will be vapourised for use in the downstream burner. The hazard assessment has identified the potential risks associated with LPG releases, including situations where radiant/convective heat from a bushfire is the initiating cause or the degradation mechanism for a critical safety system. The design will be compliant with AS/NZS 1596:2014 *The storage and handling of LP gas*, in particular, the fire detection and protection requirements.

9.5.2. Oxidizer

Hydrogen Peroxide 50% is an oxidizer and will be used for brine dichlorination. The storage and use of hydrogen peroxide will be managed to avoid interaction with incompatible materials and decomposition. As the project progresses, controls such as fire detection and notification systems will be considered to reduce risk so far as is reasonably practicable and maintain compliance with AS 4326:2008 *The storage and handling of oxidizing agents*.

[2] "fire risk hazardous chemical means a hazardous chemical that—
(a)is any of the following— (i) a flammable gas; (ii) a flammable liquid (hazard category 1 to 3); (iii) a flammable solid; (iv) a substance liable to spontaneous combustion; (v) a substance which, in contact with water, emits flammable gases; (vi) an oxidizing substance; (vii) an organic peroxide; and (b) burns readily or supports combustion"

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9.5.3. Chlorine

Although chlorine is not flammable and is not classified as an oxidising substance under the GHS, it is recognised as a fire-risk hazardous chemical because it strongly supports combustion, intensifies fires involving common materials, and presents severe escalation consequences under fire impingement. The hazard assessment has identified the potential risks associated with chlorine releases, including situations where radiant/convective heat from a bushfire is the initiating cause or the degradation mechanism for a critical safety system. The design will be compliant with AS/NZS 2927:2019 *The storage and handling of liquefied chlorine gas*, in particular, the fire detection and protection requirements.

9.5.4. PO6 Compliance

The proposed facility has been assessed as compliant with the requirements of PO6.

9.6. PO7-PO8 Spill containment of fire risk chemicals

It is proposed that no solid fire risk hazardous chemicals will be stored or handled at the Grenof Project Halogen facility.

Hydrogen peroxide quantities will be minimised so far as is reasonably practicable. Hydrogen peroxide will be stored in IBCs, in a bunded area for spill containment purposes. The requirements of AS 4326:2008 *The storage and handling of oxidizing* agents and the minimum requirements of PO8 will be incorporated into the facility design to achieve compliance.

9.6.1. PO7-PO8 Compliance

PO7 is not applicable.

The proposed facility has been assessed as compliant with the requirements of PO8.

9.7. PO9 Prevent mixing of reactive chemicals

The Grenof Project Halogen facility will store and handle incompatible bulk liquids such as sodium hypochlorite, hydrochloric acid, sulphuric acid and sodium hydroxide. The design of the bulk storage areas will be in accordance with AS 3780 *The storage and handling of corrosive substances*, and in particular materials will not share common piping, bunds or bund drains.

9.7.1. PO9 Compliance

The proposed facility has been assessed as compliant with the requirements of PO9.

9.8. PO10: The facility is designed to mitigate the impacts of natural hazards

The Grenof Project Halogen facility is sited and designed to mitigate the impacts of natural hazards including

- Flood – the facility is sited outside identified flood zones,

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- Bushfire – the facility is sited in a medium potential bushfire intensity area, and the design and construction of the facility will address the specific requirements for bushfire management per section 9.8.1 Bushfire.
- Erosion - the facility is sited outside identified erosion zones,
- Storm tide inundation - the facility is sited outside identified storm tide inundation zones,
- Landslide – the facility is sited on flat terrain with landslide impact being non credible,
- Earthquake - in line with the requirements of the National Construction Code (NCC) the design and construction of the facility will address the specific requirements for buildings and structures to resist earthquake hazards applicable to the area,
- Wind action - In line with the requirements of the National Construction Code (NCC) the design and construction of the facility will address the specific requirements for buildings and structures to resist natural hazard events such as cyclones and high winds.

9.8.1. Bushfire

Blackash Bushfire Consulting has assessed bushfire hazards in detail [8], and the results have been considered in this hazard assessment, Appendix C. An asset protection zone (APZ) will be designed to achieve a radiant heat flux level of 10 kW/m^2 or less at all development footprint boundaries. Where this cannot be achieved with firebreaks alone, additional mitigation barriers will be incorporated into the design, for example, non-combustible radiant heat protection barriers or appropriate building design to afford protection of internal facilities. Current design layout shows that 10kW/m^2 is achieved.

9.8.2. PO10 Compliance

The proposed facility has been assessed as compliant with the requirements of PO10.

9.9. PO11: Development is designed and sited to mitigate the risks from hazard scenarios occurring at existing hazardous chemical facilities

The Grenof Project Halogen facility has sufficient separation from existing hazardous chemical facilities in in the region of the facility.

The Northern Oil Refinery approximately 400m to the west, stores and processes combustible liquids (waste oil / reprocessed oil). Heat radiation from a combustible liquid fire at the Northern Oil Refinery would not directly impact the site; however, the smoke plume may impact or potentially cease operations.

Orica has operations to the south (Reid Road) of the Grenof Project Halogen facility producing nitric acid, ammonium nitrate and ammonium nitrate emulsion, as well as sodium cyanide; and ammonia and caustic soda unloading and storage to the north at Fisherman's Landing. Major

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incidents at these facilities would not physically impact the Grenof Project Halogen facility processes and storages; however, toxic releases (ammonia) or incidents may impact or potentially cease operations.

As Project Halogen develops, the facility's operations will co-ordinate with all hazardous chemical facilities in the region on emergency response planning and actions, including joint responses and mutual aid as appropriate.

9.9.1. PO11 Compliance

The proposed facility has been assessed as compliant with the requirements of PO11.

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10. Responses to the State Code 21 - Purpose Statement

State Code 21 – Purpose Statement [9]:

"*The development is designed and sited, so far as reasonably practicable, to ensure:*

1. *Human health and safety, and the built environment are protected from off-site risks resulting from physical or chemical hazards; and*
2. *hazardous chemical facilities are protected from:*
   a) off-site hazard scenarios at existing hazardous chemical facilities;
   b) natural hazards."

Consistent with State Code 21, this hazard assessment screens worst-case, unmitigated scenarios (i.e., no preventative or mitigative controls credited) to avoid overlooking credible hazards and to define the envelope for control selection. Under this conservative basis, large chlorine releases can exceed AEGL-2 at off-site receptors under rare, calm/stable meteorology; therefore, PO1–PO5 are not strictly satisfied in the unmitigated case.

The facility design, however, applies a layered control strategy that meets the Purpose Statement SFAIRP and is intended to prevent, contain, and neutralise foreseeable releases so they do not present unacceptable off-site risks during construction or operations.

For each PO that could not be demonstrated, this section reiterates:

a) why it is not strictly demonstrated under "unmitigated worst-case",
b) the hierarchy of controls and full range of risk controls considered,
c) selected controls and why they are SFAIRP,
d) rejected / not-relied-upon controls and rationale, and
e) how the design and siting meet the Purpose Statement.

10.1. PO1 – Vulnerable land use (dangerous dose to human health)

10.1.1. (a) Unmitigated worst-case screening result (not strictly met).

Consequence modelling of worst-case chlorine scenarios indicates potential to exceed AEGL-2 at the Yarwun State School under 1.5 m/s, Class F stability (rare calm night/early morning), when no controls are credited.

10.1.2. (b) Hierarchy and range of risk controls considered

Reference is made to the detailed lists of controls by hierarchy, in Appendix I, and the discussion in sections 8.3 and 9.2.1.

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10.1.3. (c) Selected controls & SFAIRP rationale.

Primary prevention at source is achieved through sealed single-element electrode units, BPCS, and stoichiometric control minimising the likelihood of any free-chlorine venting and leaks. This provides high risk-reduction per unit cost/complexity.

Containment and neutralisation: Enclosing chlorine units at slight negative pressure and continuously extracting to Waste Gas Dechlorination converts a potential dispersion hazard into a treated, closed-loop stream, directly addressing off-site risk to vulnerable receptors. Mounding the LPG storage eliminates physical impact and BLEVE scenarios that may have offsite impacts were they able to occur.

Designing chlorine buildings to be unoccupied during operations reduces human-initiated escalation and enables rapid, automated mitigation.

Rapid inventory management (spare tank) and automated extraction/scrubbing materially reduce release magnitude/duration, ensuring off-site exposures remain within acceptable bounds for foreseeable scenarios.

10.1.4. (d) Controls rejected / not relied upon, with justification

"Open-air only" layouts for chlorine systems were not selected because enclosed/negative-pressure buildings materially reduce off-site dispersion and enable scrubbing.

Compressed hydrogen storage was rejected (inventory eliminated) to reduce escalation pathways and off-site fire/explosion risk.

Reliance on community-side shelter-in-place alone is not adopted as a primary measure; instead, the design emphasises prevention/containment/neutralisation at source, which is demonstrably more reliable and within the proponent's control.

No credit is taken for active fire-water deluge to mitigate toxic dispersion from chlorine; source control and neutralisation are superior risk controls for this hazard class.

BLEVE-oriented active deluge is not relied upon as a primary safeguard because mounding removes the credible BLEVE mechanism for LPG storage (per AS/NZS 1596 design intent).

10.1.5. (e) How the design/siting meets the Purpose Statement (Vulnerable receptors).

Siting within the Gladstone State Development Area (GSDA) provides large separations to vulnerable land uses; layered controls ensure that foreseeable releases are prevented, contained, and scrubbed, protecting human health at off-site vulnerable receptors so far as is reasonably practicable.

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10.2. PO2 – Sensitive land use (dangerous dose to human health)

10.2.1. (a) Unmitigated worst-case screening result (not strictly met).

Under the same conservative basis (1.5/F, no controls), AEGL-2 can be exceeded at Targinnie Road residences for major chlorine releases.

10.2.2. (b–c) Control hierarchy, range, and selected SFAIRP controls.

As for PO1

10.2.3. (d) Not-relied-upon controls.

As for PO1

10.2.4. (e) Purpose alignment (Sensitive receptors).

Industrial siting within the GSDA and the internal control suite protects nearby sensitive receptors from foreseeable off-site toxic impacts SFAIRP.

10.3. PO3 – Commercial/community activity land use (dangerous dose to human health)

10.3.1. (a) Unmitigated worst-case screening result

For commercial/community locations such as the Gladstone Model Aero Club, the unmitigated worst-case chlorine scenarios exceed AEGL-2 under multiple weather conditions.

10.3.2. (b–c) Control hierarchy, range, and selected SFAIRP controls.

An identical suite to PO1 (prevention at source; enclosure and scrubbing; detection and automation; unoccupied operation) is applied to prevent and neutralise any release before off-site dispersion.

10.3.3. (d) Not-relied-upon controls.

10.3.4. (e) Purpose alignment (Commercial/community).

Containment and scrubbing before discharge, unoccupied operations, and industrial siting collectively protect commercial/community users off-site SFAIRP.

10.4. PO4 – Open space land use (dangerous dose to human health; or individual fatality risk if dose cannot be achieved)

10.4.1. (a) Unmitigated worst-case screening result (not strictly met).

At the Gladstone Model Aero Club (open space), unmitigated worst-case chlorine scenarios exceed AEGL-2; IFR has not been quantified at concept stage and is proposed for detailed design QRA.

10.4.2. (b–c) Control hierarchy, range, and selected SFAIRP controls.

As for PO1

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Reference is made to the detailed lists of controls by hierarchy, in Appendix I, and the discussion in sections 8.3 and 9.4.1.

10.4.3. (d) Not-relied-upon controls

As for PO1.

Full facility-wide QRA is intentionally deferred until detailed design to avoid false precision. Instead, a qualitative bow-tie/fault-tree evidence-base and consequence overlays are used now, with commitment to quantify individual fatality rate during detailed design.

10.4.4. (e) Purpose alignment (Open space)

Through prevention, containment, neutralisation, and external-hazard resilience, the facility design protects open-space users from foreseeable off-site effects of SFAIRP, with the individual fatality rate to be confirmed by QRA during detailed design.

10.5. PO5 – Industrial land use (dangerous dose to the built environment; and IFR 50×10^{-6}/yr)

10.5.1. Unmitigated worst-case screening result

At the Northern Oil Refinery, unmitigated worst-case chlorine scenarios exceed AEGL-2; IFR has not been quantified at concept stage and is proposed for detailed design QRA.

10.5.2. (b–c) Control hierarchy, range, and selected SFAIRP controls.

As for PO1

10.5.3. (d) Controls rejected / not relied upon, with justification

As for PO1

10.5.4. (e) Purpose alignment (Built environment and neighbouring industries)

Containment and scrubbing before discharge, unoccupied operations, and industrial siting collectively protect industrial land users off-site SFAIRP.

Thermal/overpressure criteria are addressed through passive design choices (mounding, segregation, enclosure) and standards-compliant detection/protection, while siting within the GSDA provides separation from adjacent hazardous facilities.

10.6. Purpose Statement Commitments, Residual Actions, and Traceability

The project commits to undertake a QRA in detailed design to quantify individual fatality risk (PO4-5) and societal risk (PO4) once process configuration is fixed, as flagged in the report's methodology and MHF approach.

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The project commits to maintaining control integrity through the MHF SMS. This includes implementing SMS, ERP, CMMS, and competency programs to ensure the selected engineered controls maintain their intended risk-reduction performance throughout the asset's life.

10.7. Purpose Statement Conclusion

While unmitigated, worst-case modelling shows that PO1–PO5 are not strictly satisfied for the no-controls case required by State Code 21 screening, the selected design and GSDA siting, collectively, satisfy the Purpose Statement SFAIRP by preventing, containing, and neutralising foreseeable hazardous chemical releases and by hardening the facility against external hazards.

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11. References

[1] Planning guideline State Code 21 - Hazardous chemical facilities, Ver 3, August 2025
[2] Thyssenkrupp Nucera, Annex 05 Process Description and Technical Drawings, 240809 rev1
[3] Queensland Coordinator-General, Gladstone State Development Area, development Scheme, May 2022
[4] State development, Infrastructure and Planning, Gladstone State Development Area. https://www.statedevelopment.qld.gov.au/coordinator-general/state-development-areas/current/gladstone-state-development-area
[5] Water Corporation, Design Standard DS 70-01 Chlorine Buildings Standard Ver 2 Rev 0 February 2025
[6] Department of Climate Change, Energy, the Environment and Water, Australia's Guide to Environmentally Sustainable Homes. https://www.yourhome.gov.au/passive-design/passive-house
[7] UK HSE, Failure Rate and Event Data for use within Land Use Planning Risk Assessments
[8] Blackash Bushfire Consulting, Bushfire Hazard Assessment Project Halogen: Chlor-Alkali Facility Gladstone State Development Area, January 2025
[9] State Development Assessment Provisions v3.1, State Code 21: Hazardous Chemical Facilities
[10] Prudentia, Project Halogen Report , hydrogen vent stack modelling section 4.3.1

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12. Appendices

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Appendix A. State code 21: Hazardous chemical facilities

Table 20 Material change of use - State Development Assessment Provisions v3.3

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.	**Only under the worst-case (calm) weather conditions, which occur very infrequently. Refer section 9.2**
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.	**Only under the worst-case (calm) weather conditions, which occur very infrequently. Refer section 9.2**
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.	**All of the worst-case release scenarios may exceed the dangerous dose to human health criteria at commercial or community activity land use. Refer section 9.2**
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 dangerous dose to human health; or • 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.	**All of the worst-case release scenarios may exceed the dangerous dose to human health criteria at open space (community activity) land use. Refer section 9.3**

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Performance outcomes	Response
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 dangerous dose to the built environment; and • an individual fatality risk level of 50 x 10^{-6}/year.	**All of the worst-case release scenarios may exceed the dangerous dose to human health criteria at industry land use land use. Refer section 9.4**
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.	**Complies, refer section 9.5**
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.	**Not Applicable.**

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Performance outcomes	Response
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: • 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 • the output of any fixed firefighting system provided for any bulk tank within a spill compound over a minimum of 90 minutes.	**Complies, refer section 9.6**
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.	**Complies, refer section 9.7**

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Performance outcomes	Response
PO10 Development is designed and sited to mitigate impacts on storage and handling areas from natural hazard including, but not limited to: flood; bushfire; erosion; storm tide inundation; landslide; earthquake; wind action.	**Complies, refer section 9.8**
All development	
PO11 Development is designed and sited to mitigate the risks from hazard scenarios occurring at existing hazardous chemical facilities.	**Complies, refer section 9.9**

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Appendix B. Hazardous Chemicals

Table 21: Hazardous Chemicals Stored

Chemical	UN number	GHS Classification	DG Classification	Sch. 15 threshold Qty (t)	Total Qty (t)	Largest container size (t)	Main Process Area
Chlorine	1017	Acute toxicity – category 3 Specific target organ toxicity (single exposure) – category 3 Skin irritation – category 2 Hazardous to the aquatic environment (acute) – category 1 Oxidising gas – category 1 Gases under pressure Eye irritation – category 2A	2.3 sub 5.1,8	25	90	20	24
Hydrochloric Acid 33%	1789	Skin corrosion – category 1B Specific target organ toxicity (single exposure) – category 3	8 PGII	N/A	30	10	52
Hydrogen Peroxide 50%	2014	Oxidising liquid – category 1 Acute toxicity – category 4 Acute toxicity – category 4 Skin corrosion – category 1A Specific target organ toxicity (single exposure) – category 3	5.1 sub 8 PG II	N/A	2	1	07
Liquefied Petroleum Gas	1075	Flammable Gases: Category 1A Gases Under Pressure: Liquefied gas	2.1	200	30	30	41
Sodium Hydroxide 32%	1824	Skin corrosion – category 1A Specific target organ toxicity (single exposure) – category 3	8 PG II	N/A	90	20	32

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Chemical	UN number	GHS Classification	DG Classification	Sch. 15 threshold Qty (t)	Total Qty (t)	Largest container size (t)	Main Process Area
Sodium Hypochlorite 12.5 -15%	1791	Skin corrosion – category 1B Eye damage – category 1 Hazardous to the aquatic environment (acute) – category 1 Hazardous to the aquatic environment (chronic) – category 1 Specific target organ toxicity (single exposure) – category 3	8 PGIII	N/A	60	20	28
Sulphuric Acid 78%	1830	Skin corrosion – category 1A	8 PGII	N/A	15	5	91
Hydrogen[3]	1049	Flammable gases, Category 1A Gases under pressure: Compressed gas	2.1	50	Nil stored per current design.	N/A	41

[3] Although no hydrogen is stored on site, it is produced in the process and is included here for completeness.

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Appendix C. Hazard Assessment Minutes

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Hazard Assessment

Scenario				Assessment					Top Event	Assessment	
Ref #	Activities / locations	Chemical / Hazard	Risk Scenario	Immediate Impact	Causes	Preliminary Consequence Modelling?	Offsite Effect?	Planned Preventative Control Measures / Safeguards / Barriers		Planned Mitigative Control Measures / Safeguards / Barriers	Comments
1	11 - Electrolyzer	Chlorine	Release of chlorine due to electrolyser leaks and/or piping flanges/connection leaks from anode. Pipe diameter: 300mm Pressure: 0.5 Bar g (150 kPa a) Temp: ambient Equiv leak size: Small leak size from seals / flanges. Full piping diameter release not considered credible.	Release of chlorine to immediate process area within the Electrolyser building. Electrolyser building is a "sealed" building to contain potential releases. Air Exchange per Hour (ACH) for this building: 0.1	**Equipment Integrity Issues:** Corrosion, stress corrosion cracking, seal degradation, valve failures, loose fittings or connections, worn components or improper component installation	Yes	**Yes**	Single Element Electrode Unit Enclosed building Electrode Unit leak detection Waste Gas Dechlorination System Ambient air Chlorine gas detectors Basic Process Control Systems CMMS		**A0335-MI-01** Release of Chlorine from Electrolyzer Building	Process areas unoccupied during chlorine operations Emergency Response Plan	
2	11 - Electrolyzer	Hydrogen	Release of hydrogen due to electrolyser leaks and/or piping flanges/connection leaks from cathode. Pipe diameter: 300mm Pressure: 0.5 Bar g (150 kPa a) Temp: ambient Equiv leak size: Small leak size from seals / flanges. Full piping diameter release not considered credible.	Release of hydrogen to immediate process area within the Electrolyser building. Electrolyser building is a "sealed" building to contain potential releases. Air Exchange per Hour (ACH) for this building: 0.1	**Equipment Integrity Issues:** Corrosion, stress corrosion cracking, seal degradation, valve failures, loose fittings or connections, worn components or improper component installation	No	No	Single Element Electrode Unit Enclosed building Electrode Unit leak detection Hydrogen Vent Stack Basic Process Control Systems CMMS		**A0335-MI-02** Release of Hydrogen from Electrolyzer Building	Process areas unoccupied during chlorine operations Emergency Response Plan	Releases of hydrogen within enclosed buildings. Offsite effect not deemed credible
3	21 - Chlorine Treatment	Chlorine	Release of chlorine due to process units and/or piping flanges/connection leaks. Process units include: 121E001 Chlorine Cooler 121E002 Chlorine Chiller 121F001 Wet Chlorine Filter Mist Eliminator 121C001 Chlorine Drying Tower Piping diameter: 300mm Pressure: 0.5 Bar g (150 kPa a) Temp: ambient Equiv leak size: Small leak size from seals / flanges. Full piping diameter release not	Release of chlorine to immediate process area Electrolyser building is a "sealed" building to contain potential releases. Air Exchange per Hour (ACH) for this building: 0.1	**Equipment Integrity Issues:** Corrosion, stress corrosion cracking, seal degradation, valve failures, loose fittings or connections, worn components or improper component installation	Yes	**Yes**	Enclosed building Electrode Unit leak detection Waste Gas Dechlorination System Ambient air Chlorine gas detectors Basic Process Control Systems CMMS		**A0335-MI-01** Release of Chlorine from Electrolyzer Building	Process areas unoccupied during chlorine operations Emergency Response Plan	
4	51 – HCl Production	Chlorine	Release of chlorine due to process units and/or piping flanges/connection leaks. Process units include: 151U001 HCl Synthesis Unit Piping diameter: 300mm Pressure: 0.5 Bar g (150 kPa a) Temp: ambient Equiv leak size: Small leak size from seals / flanges. Full piping diameter release not considered credible.	Release of chlorine to immediate process area within the HCl production area. This processing unit is not within an enclosed building.	**Equipment Integrity Issues:** Corrosion, stress corrosion cracking, seal degradation, valve failures, loose fittings or connections, worn components or improper component installation	Yes	**Yes**	Basic Process Control Systems CMMS		**A0335-MI-03** Release of Chlorine from HCl production unit	Process Leak detection Ambient air Chlorine gas detectors Waste Gas Dechlorination System Emergency Response Plan	
5	27 – Sodium Hypochlorite Production	Chlorine	Release of chlorine due to process units and/or piping flanges/connection leaks. Process units include: 127F001 Hypochlorite Ejector Piping diameter: 300mm Pressure: 0.5 Bar g (150 kPa a) Temp: ambient Equiv leak size: Small leak size from seals / flanges. Full piping diameter release not considered credible.	Release of chlorine to immediate process area within the Hypochlorite production area. This processing unit is not within an enclosed building.	**Equipment Integrity Issues:** Corrosion, stress corrosion cracking, seal degradation, valve failures, loose fittings or connections, worn components or improper component installation	Yes	**Yes**	Basic Process Control Systems CMMS		**A0335-MI-04** Release of Chlorine from hypochlorite production unit	Process Leak detection Ambient air Chlorine gas detectors Waste Gas Dechlorination System Emergency Response Plan	
6	22 - Chlorine Compression Unit	Chlorine	Release of chlorine due to process units and/or piping flanges/connection leaks. Process units include: 122U001 Chlorine Compression Unit 022F001 Dry Chlorine Filter Mist Eliminator Piping diameter: 150mm & 80mm Pressure: 3.5 bar g Temp: Ambient Equiv leak size: Small leak size from seals / flanges and component connections. Full piping diameter release not considered credible.	Release of chlorine to immediate process area. Chlorine compression unit is within a "sealed" building to contain potential releases. Air Exchange per Hour (ACH) for this building: 0.1 Assume isolatable inventory with in the Chlorine Compressor Unit is 2000kg. Release at production flow rate. Potential for release of chlorine beyond site	**Equipment Integrity Issues:** Corrosion, stress corrosion cracking, seal degradation, valve failures, loose fittings or connections, worn components or improper component installation	Yes	**Yes**	Basic Process Control Systems Process Leak detection Ambient air Chlorine gas detectors Waste Gas Dechlorination System Enclosed building CMMS		**A0335-MI-05** Release of Chlorine from Chlorine Compressor Building	Process areas unoccupied during chlorine operations Emergency Response Plan	
7	22 - Chlorine Compression Unit	Chlorine	Release of chlorine due to process units and/or piping flanges/connection leaks. Process units include: 122U001 Chlorine Compression Unit 022F001 Dry Chlorine Filter Mist Eliminator Piping diameter: 150mm & 80mm Pressure: 3.5 bar g Temp: Ambient Equiv leak size: Small leak size from seals / flanges and component connections. Full piping diameter release not considered credible.	Release of chlorine to immediate process area. Chlorine compression unit is within a "sealed" building to contain potential releases. Air Exchange per Hour (ACH) for this building: 0.1 Assume isolatable inventory with in the Chlorine Compressor Unit is 2000kg. Release at production flow rate. Potential for release of chlorine beyond site	**Operational Issues:** Vibration, overheating or over pressurisation	Yes	**Yes**	Basic Process Control Systems Process Leak detection Ambient air Chlorine gas detectors Waste Gas Dechlorination System Enclosed building CMMS		**A0335-MI-05** Release of Chlorine from Chlorine Compressor Building	Process areas unoccupied during chlorine operations Emergency Response Plan	

Hazard Assessment

Scenario				Assessment					Top Event	Assessment	
8	22 - Chlorine Compression Unit	Chlorine	Release of chlorine due to pipe rupture (vehicle impact) on chlorine piping in pipe bridge between 22 - Chlorine Compression Unit and 23 - Chlorine Liquefaction Unit. Pipe bridge spans central roadway on site. Pipe diameter:150mm Pressure: 3.5 bar g Temp: Ambient Equiv leak size: 150mm	Release of chlorine to surrounding atmosphere. Potential for release of chlorine beyond site This scenario is considered not credible with the operational controls in place (exclusion of vehicles in proximity of the pipe bridge)	**Vehicle Impact:** High vehicle impacts with pipework on pipe bridge or vehicle impact with pipe bridge structure, while travelling on internal roadway beneath pipe bridge.	Yes	**Yes**	Exclusion of Vehicles in proximity of pipe bridge	**A0335-MI-06** Release of Chlorine from transfer pipework between Chlorine Compressor Unit and Chlorine Liquefaction Unit	Process Leak detection Ambient air Chlorine gas detectors Waste Gas Dechlorination System Emergency Response Plan	
9	22 - Chlorine Compression Unit	Chlorine	Release of chlorine due to leak on chlorine piping in pipe bridge between 22 - Chlorine Compression Unit and 23 - Chlorine Liquefaction Unit. Pipe bridge spans central roadway on site. Pipe diameter:150mm Pressure: 3.5 bar g Temp: Ambient Equiv leak size: Small leak size from seals / flanges and component connections. Full piping diameter release not considered credible.	Release of chlorine to surrounding atmosphere. Potential for release of chlorine beyond site	**Piping Integrity issues:** Corrosion, stress corrosion cracking, flange and gasket failures, weld defects or improper installation	Yes	**Yes**	Basic Process Control Systems CMMS	**A0335-MI-06** Release of Chlorine from transfer pipework between Chlorine Compressor Unit and Chlorine Liquefaction Unit	Process Leak detection Ambient air Chlorine gas detectors Waste Gas Dechlorination System Emergency Response Plan	
10	23 - Chlorine Liquefaction Unit	Chlorine	Release of chlorine due to process units and/or piping flanges/connection leaks. Process units include: 123U001 Chlorine Liquefaction Unit Pipe diameter:150mm Pressure: 3.4 bar g / Liquid Chlorine Temp: - 11°C Equiv leak size: Small leak size from seals / flanges and component connections. Full piping diameter release not considered credible.	Release of chlorine to immediate process area. Chlorine liquefaction unit is within a "sealed" building (chlorine Storage building) to contain any potential releases. Air Exchange per Hour (ACH) for this building: 0.1 Release of chlorine beyond site	**Equipment Integrity Issues:** Corrosion, stress corrosion cracking, flange and gasket failures, compressor or pump seal leaks, heat exchanger leaks, valve failures, loose fittings or connections, worn components or improper component installation.	Yes	**Yes**	Basic Process Control Systems Process Leak detection Ambient air Chlorine gas detectors Enclosed building Waste Gas Dechlorination System CMMS	**A0335-MI-07** Release of Chlorine from Liquid Chlorine Building (Liquefaction, Storage and Filling)	Process areas unoccupied during chlorine operations Emergency Response Plan	
11	23 - Chlorine Liquefaction Unit	Chlorine	Release of chlorine due to process units and/or piping flanges/connection leaks. Process units include: 123U001 Chlorine Liquefaction Unit Pipe diameter:150mm Pressure: 3.4 bar g / Liquid Chlorine Temp: - 11°C Equiv leak size: Small leak size from seals / flanges and component connections. Full piping diameter release not considered credible.	Release of chlorine to immediate process area. Chlorine liquefaction unit is within a "sealed" building (chlorine Storage building) to contain any potential releases. Air Exchange per Hour (ACH) for this building: 0.1 Release of chlorine beyond site	**Operational Issues:** Ice formation, pressure imbalances, rapid cooling or heating cycles.	Yes	**Yes**	Basic Process Control Systems Process Leak detection Ambient air Chlorine gas detectors Enclosed building Waste Gas Dechlorination System	**A0335-MI-07** Release of Chlorine from Liquid Chlorine Building (Liquefaction, Storage and Filling)	Process areas unoccupied during chlorine operations Emergency Response Plan	
12	24 - Chlorine Storage & Filling	Chlorine	Release of Chlorine from tank, drum and cylinder fill lines due to piping flanges and connections leaks Pipe diameter: 50mm Pressure: 3.4 bar g / liquid chlorine Temp: Ambient	Release of chlorine to immediate storage and filling area. Chlorine storage and filling area is within a "sealed" building (chlorine Storage building) to contain any potential releases. Air Exchange per Hour (ACH) for this building: Release of chlorine beyond site	**Piping Integrity issues:** Corrosion, stress corrosion cracking, flange and gasket failures, weld defects or improper installation	Yes	**Yes**	Basic Process Control Systems CMMS Process Leak detection Ambient air Chlorine gas detectors Enclosed building Waste Gas Dechlorination System Rupture disks releasing to expansion vessels on liquid chlorine fill lines	**A0335-MI-07** Release of Chlorine from Liquid Chlorine Building (Liquefaction, Storage and Filling)	Process areas unoccupied during chlorine operations Emergency Response Plan	
13	24 - Chlorine Storage & Filling	Chlorine	Release of chlorine from chlorine tank leaks to due to corrosion, vessel integrity issue. Catastrophic failure not consider credible; however should be considered for worst case analysis. Pressure: 3.4 bar g / liquid chlorine Temp: Ambient Inventory: 20t Equiv leak diameter: 20mm (consider full inventory release to building)	Release of chlorine to immediate storage and filling area. Chlorine storage and filling area is within a "sealed" building (chlorine Storage building) to contain any potential releases. Air Exchange per Hour (ACH) for this building: 0.1 Release of chlorine beyond site	**Tank Integrity Issues:** Corrosion of tank walls, stress corrosion cracking, seal and gasket failure, weld defects.	Yes	**Yes**	Basic Process Control Systems CMMS Process Leak detection Ambient air Chlorine gas detectors Enclosed building Waste Gas Dechlorination System Chlorine Bulk tank bunding Spare Emergency Chlorine Bulk Tank	**A0335-MI-07** Release of Chlorine from Liquid Chlorine Building (Liquefaction, Storage and Filling)	Process areas unoccupied during chlorine operations Emergency Response Plan	
14	24 - Chlorine Storage & Filling	Chlorine	Release of chlorine from chlorine tank leaks to due to overpressurisation or overfill. Catastrophic failure not consider credible; however should be considered for worst case analysis. Pressure: 3.4 bar g / liquid chlorine Temp: Ambient Inventory: 20t Equiv leak diameter: 20mm (consider full inventory release to building)	Release of chlorine to immediate storage and filling area. Chlorine storage and filling area is within a "sealed" building (chlorine Storage building) to contain any potential releases. Air Exchange per Hour (ACH) for this building: 0.1 Release of chlorine beyond site	**Operational Issues:** Chlorine Storage Tank overpressurisation or overfill	Yes	**Yes**	Basic Process Control Systems Chlorine Bulk tank level control and over fill protection Chlorine Bulk tank over pressure protection Ambient air Chlorine gas detectors Enclosed building Waste Gas Dechlorination System Chlorine Bulk tank bunding Spare Emergency Chlorine Bulk Tank	**A0335-MI-07** Release of Chlorine from Liquid Chlorine Building (Liquefaction, Storage and Filling)	Process areas unoccupied during chlorine operations Emergency Response Plan	

Hazard Assessment

Scenario				Assessment					Top Event	Assessment	
15	**24 - Chlorine Storage & Filling**	**Chlorine**	Release of chlorine from drum, cylinder leaks or associated piping. Pressure: 3.4 bar g / liquid chlorine Temp: Ambient Inventory: 1t & 80kg Equiv leak diameter: 20mm fitting/valve size	Release of chlorine to immediate storage and filling area. Chlorine storage and filling area is within a "sealed" building (chlorine Storage building) to contain any potential releases. Air Exchange per Hour (ACH) for this building: 0.1 Release of chlorine beyond site	**Equipment Integrity Issues:** Worn or improperly sealed valves, gaskets, or couplings, corroded pipework or fittings, faulty pressure relief valves, damaged containers	Yes	**Yes**	Basic Process Control Systems CMMS Process Leak detection Ambient air Chlorine gas detectors Enclosed building Waste Gas Dechlorination System Displaced gas directed to Waste Gas Dechlorination System	**A0335-MI-07** Release of Chlorine from Liquid Chlorine Building (Liquefaction, Storage and Filling)	Process areas unoccupied during chlorine operations Emergency Response Plan	
16	**24 - Chlorine Storage & Filling**	**Chlorine**	Release of chlorine from drum, cylinder leaks or associated piping. Pressure: 3.4 bar g / liquid chlorine Temp: Ambient Inventory: 1t & 80kg Equiv leak diameter: 20mm fitting/valve size	Release of chlorine to immediate storage and filling area. Chlorine storage and filling area is within a "sealed" building (chlorine Storage building) to contain any potential releases. Air Exchange per Hour (ACH) for this building: 0.1 Release of chlorine beyond site	**Operational Issues:** Chlorine drum or cylinder overpressurisation or overfill	Yes	**Yes**	Basic Process Control Systems Rupture disks releasing to expansion vessels on liquid chlorine Process Leak detection Ambient air Chlorine gas detectors Enclosed building Waste Gas Dechlorination System Displaced gas directed to Waste Gas Dechlorination System	**A0335-MI-07** Release of Chlorine from Liquid Chlorine Building (Liquefaction, Storage and Filling)	Process areas unoccupied during chlorine operations Emergency Response Plan	
16	**28 – Sodium Hypochlorite Storage**	**Sodium Hypochlorite 12.5 - 15%**	Release of Sodium Hypochlorite from bulk tank due to: - Overfilling of Sodium Hypochlorite bulk tank - Tank integrity / leak - Fitting pipe leak	Release of Sodium Hypochlorite to surrounding area. Potential stormwater contamination.	**Equipment and Operational issues:** Tank corrosion, seal and gasket deterioration, weld failures or structural fatigue, valve and flange malfunctions, tank overfilling or Improper transfer procedures.	No	No	Hydrochloric Acid Bulk Storage Design CMMS	**A0335-MI-08** Spill / Release of Sodium Hypochlorite at Storage and Load out Area	Emergency Response Plan	
17	**32 - Caustic Soda Storage**	**Sodium Hydroxide 32%**	Release of Sodium Hydroxide from bulk tank due to: - Overfilling of Sodium Hydroxide bulk tank - Tank integrity / leak - Fitting pipe leak	Release of Sodium Hydroxide to surrounding area. Potential stormwater contamination.	**Equipment and Operational issues:** Tank corrosion, seal and gasket deterioration, weld failures or structural fatigue, valve and flange malfunctions, tank overfilling or Improper transfer procedures.	No	No	Caustic Bulk Storage Design CMMS	**A0335-MI-09** Spill / Release of Sodium Hydroxide at Storage and Load out Area	Emergency Response Plan	
18	**52 – HCl Storage**	**Hydrochloric Acid 33%**	Release of Hydrochloric Acid from bulk tank due to: - Overfilling of Hydrochloric Acid bulk tank - Tank integrity / leak - Fitting pipe leak	Release of Hydrochloric Acid to surrounding area. Potential stormwater contamination.	**Equipment and Operational issues:** Tank corrosion, seal and gasket deterioration, weld failures or structural fatigue, valve and flange malfunctions, tank overfilling or Improper transfer procedures.	No	No	Hydrochloric Acid Bulk Storage Design CMMS	**A0335-MI-10** Spill / Release of Hydrochloric Acid at Storage and Load out Area	Emergency Response Plan	
19	**91 - Sulphuric Acid Filling & Storage**	**Sulphuric Acid 78%**	Release of Sulphuric Acid from bulk tank due to: - Overfilling of Sulphuric Acid bulk tank - Tank integrity / leak - Fitting pipe leak	Release of Sulphuric Acid to surrounding area. Potential stormwater contamination.	**Equipment and Operational issues:** Tank corrosion, seal and gasket deterioration, weld failures or structural fatigue, valve and flange malfunctions, tank overfilling or Improper transfer procedures.	No	No	Sulphuric Acid Bulk Storage Design CMMS	**A0335-MI-11** Spill / Release of Sulphuric Acid at Storage and Load out Area	Emergency Response Plan	
20	**Bulk Filling & Storage**	**Sodium Hypochlorite 12.5 - 15%**	Accidental mixing of Sodium Hypochlorite and bulk acids (hydrochloric or sulphuric)	Incompatible mixing resulting in the evolution of chlorine gas due to the reduction in pH	**Operational issues:** Human error during transfer, failure to verify contents, shared piping systems, poor segregation of storage areas or shared containment areas and drains.	No	No	Sulphuric Acid Bulk Storage Design Hydrochloric Acid Bulk Storage Design Hypochlorite Bulk Storage Design	**A0335-MI-12** Chlorine Gas Evolution From Sodium Hypochlorite	Emergency Response Plan	
21	**Bulk Filling & Storage**	**Sodium Hydroxide 32%**	Accidental mixing of Sodium Hydroxide and bulk acids (hydrochloric or sulphuric)	Incompatible mixing resulting in vigorous neutralisation reaction with heat evolution	**Operational issues:** Human error during transfer, failure to verify contents, shared piping systems, poor segregation of storage areas or shared containment areas and drains.	No	No	Sulphuric Acid Bulk Storage Design Hydrochloric Acid Bulk Storage Design Caustic Bulk Storage Design	**A0335-MI-13** Adverse Reaction Mixing of Acids and Bases	Emergency Response Plan	
22	**Site Wide**	**Fire Risk Materials**	Fire impingement on Chlorine containing equipment leads to toxic release	Release of chlorine to immediate area. Chlorine areas are within "sealed" buildings to contain any potential releases. Air Exchange per Hour (ACH) for this building: 0.1 Release of chlorine beyond site The potential impact of fire on safeguards for mitigation of chlorine releases will be reviewed during detailed design to determine safeguard design requirements to ensure required effectiveness achieved.	Process Fire Bushfire - Refer Ref#26A	Yes	**Yes**	Physical layout and segregation Enclosed building Design and maintenance of 10kW/m2 APZ Physical layout and segregation	**A0335-MI-23** Release of Chlorine due to external events	Emergency Response Plan Application of AS/NZS2927, specifically leak and fire detection and protection requirements	Fire risk hazardous chemicals are defined in the Code and the Work Health and Safety Regulation and include oxidisers, spontaneously combustible and water reactive substances, not just flammables. Consideration is given to those hazardous substance for which fire exposure materially worsens public risk. Chlorine areas are in enclosed buildings. The external piping between units is elevated, and afforded some protection from this layout.

Hazard Assessment

Scenario				Assessment					Top Event	Assessment	
22A	Site Wide	Fire Risk Materials	Fire impingement on hydrogen peroxide containing equipment leads to decomposition reaction and fire escalation.	Fire impingement on hydrogen peroxide IBCs causes rapid exothermic decomposition, oxygen generation, vessel rupture, and fire escalation. Hydrogen peroxide can intensify fires as: the released oxygen feeds surrounding flames, the fire temperature increases, and fire may spread to adjacent IBCs.	Process Fire Bushfire - Refer Ref#26	Yes	No	Physical layout and segregation Design and maintenance of 10kW/m2 APZ	**A0335-MI-24** Decomposition of hydrogen peroxide with container overpressure	Emergency Response Plan	Fire risk hazardous chemicals are defined in the Code and the Work Health and Safety Regulation and include oxidisers, spontaneously combustible and water reactive substances, not just flammables. Consideration is given to those hazardous substance for which fire exposure materially worsens public risk. Heat drives an exothermic, oxygen-releasing decomposition that creates overpressure and severe fire-intensification hazards, even though hydrogen peroxide itself is not flammable.
23	LPG Storage	Fire Risk Materials	Fire impingement on LPG piping leads to vessel structural failure, loss of containment of LPG, and fire escalation	Ignited LPG release, either immediate or delayed resulting in localised jet fire and or flash fire. Potential for vapour cloud explosion with delayed ignition.	Process Fire Structural failure of LPG piping due to fire impingement - Refer Bushfire item Ref#26B.	Yes	**Yes, Marginal**	LPG vessel is mounded / buried Physical layout and segregation	**A0335-MI-14** Release of LPG from bulk storage or connected piping resulting in jet fire and or flash fire.	Emergency Response Plan Application of AS/NZS1596, specifically leak and fire detection and protection requirements	There is no bunding around the LPG tank. Any liquid release would rapidly evaporate on the ground to form LPG vapour. As such, pool fire scenario with risk of vessel BLEVE is deemed not credible. LPG BLEVE from fire impingement from other process fires is deemed not credible on the basis of storage location with respect to other flammable and combustible materials
23A	LPG Storage	LPG	Release of LPG from bulk storage vessel or connected piping resulting in jet fire and or flash fire. (Use of LPG as ancillary fuel not yet confirmed. Preference is for natural gas supply)	Ignited LPG release, either immediate or delayed resulting in localised jet fire and or flash fire. Potential for vapour cloud explosion with delayed ignition.	**Equipment issues:** Tank corrosion, seal and gasket deterioration, weld failures or structural fatigue, valve and flange malfunctions, LPG hose integrity defects Overpressure of downstream piping on regulator failure **Operational issues:** Tank overfilling or Improper transfer procedures, including driving away while connected	Yes	**Yes, Marginal**	CMMS Pressure relief valves venting to safe location Task-Specific Operating Procedures Pressure relief valves venting to safe location	**A0335-MI-14** Release of LPG from bulk storage or connected piping resulting in jet fire and or flash fire.	Emergency Response Plan Application of AS/NZS1596, specifically leak and fire detection and protection requirements	
24	Site Wide	Natural Hazard	Earthquake impacting site	Damage to site structures resulting loss of containment of hazardous material such as chlorine. Impact on operations.	**Natural Environment:** Earthquake in Gladstone area. Not a recognised earthquake prone location	No	No	Facility Structural Design CMMS	**A0335-MI-15** Earthquake impacting site	Emergency Response Plan	
25	Site Wide	Natural Hazard	Flooding impacting site	Flood water inundation to site infrastructure and process units resulting in impact on operations.	**Natural Environment:** Flooding of local rivers and creeks in Gladstone area. Not a recognised flood prone location	No	No	Facility Structural Design CMMS	**A0335-MI-16** Flooding impacting site	Emergency Response Plan	
26	Site Wide	Natural Hazard	Bushfire in adjacent land use impacting the site	Bush fire and heat radiation impact to site infrastructure and process units resulting in potential ignition of combustibles on site and impact on operations.	**Natural Environment:** Bushfire in immediate surrounding area. Site is located in Medium Potential Bushfire Intensity zone.	No	No	Facility Structural Design Bush Fire Management Plan CMMS Design and maintenance of 10kW/m^2 APZ	**A0335-MI-17A** Bushfire in adjacent land use impacting the site	Emergency Response Plan	Refer Bushfire Hazard Assessment, prepared by Blackash Bushfire Consulting
26A	24 - Chlorine Storage & Filling	Natural Hazard	Bushfire in adjacent land use impacting chlorine containing vessels and pipework	Bush fire and heat radiation impingement on a chlorine vessel leads to overpressure and loss of primary containment's mechanical integrity, with toxic release.	**Natural Environment:** Bushfire in immediate surrounding area. Site is located in Medium Potential Bushfire Intensity zone.	Yes	**Yes**	Facility Structural Design Bush Fire Management Plan CMMS Design and maintenance of 10kW/m^2 APZ Enclosed building	**A0335-MI-17B** Bushfire in adjacent land use impacting the site	Emergency Response Plan Application of AS/NZS2927, specifically leak and fire detection and protection requirements	Refer Bushfire Hazard Assessment, prepared by Blackash Bushfire Consulting
26B	LPG Storage	Natural Hazard	Bushfire in adjacent land use impacting LPG containing vessels and pipework	Bush fire and heat radiation impingement on a LPG piping leads to overpressure and loss of primary containment's mechanical integrity. BLEVE of vessel is not credible as it will be mounded.	**Natural Environment:** Bushfire in immediate surrounding area. Site is located in Medium Potential Bushfire Intensity zone.	Yes	No	Facility Structural Design Mounded Vessel Bush Fire Management Plan Design and maintenance of 10kW/m^2 APZ CMMS	**A0335-MI-17C** Bushfire in adjacent land use impacting the site	Emergency Response Plan Application of AS/NZS1596, specifically leak and fire detection and protection requirements	Refer Bushfire Hazard Assessment, prepared by Blackash Bushfire Consulting.
27	Site Wide	Natural Hazard	Storm tide inundation impacting the site.	Storm tide water inundation to site infrastructure and process units resulting in impact on operations.	**Natural Environment:** High Storm tide event, particularly during cyclonic storm event	No	No	Facility Structural Design CMMS	**A0335-MI-18** Storm tide inundation impacting the site.	Emergency Response Plan	

Hazard Assessment

Scenario				Assessment					Top Event	Assessment	
28	Site Wide	Natural Hazard	Wind Action from storms and cyclonic weather impacting the site.	Damage to site structures resulting in potential loss of containment of hazardous material such as chlorine. Impact on operations.	**Natural Environment:** High wind event, particularly during cyclonic storm event or localised thunderstorm.	No	No	Facility Structural Design CMMS	**A0335-MI-19** Wind Action from storms and cyclonic weather impacting the site.	Emergency Response Plan	
29	Site Wide	Malicious acts	Security breach - either physical or cyber attack	Damage to site infrastructure or processes. Potential cessation of operations.	**External Interference:** Physical entry or damage by third party Cyber attack on IT network or operational technology (OT) systems	No	No	Facility physical security plans Cyber security plans CMMS	**A0335-MI-20** Security breach - either physical or cyber attack	Emergency Response Plan	
30	Site Wide	Neighbouring Facility	Northern Oil Refinery - 400m West. Release of flammable hydrocarbons. Potential for fire / explosion and associated smoke impacts on Project Halogen site.	Heat radiation from combustible liquid (waste oil / reprocessed oil) fire at the Northern Oil Refinery would not directly impact the site; however the smoke plume may impact or potentially cease operations. Additionally, a fire may initiate local bushfire which may impact Project Halogen site.	**External Site:** Incident at neighbouring Facility	No	No	Emergency Response Plan	**A0335-MI-21** Impact from Neighbouring Facilities	Emergency Response Plan	
31	32 - Caustic Soda Storage	LPG	Uncontrolled combustion event within gas-fired burner of steam boiler results in internal explosion, structural damage to site, with escalation to fire if LPG supply affected.	An uncontrolled combustion event within an LPG burner can cause deflagration, severe thermal and mechanical damage, and escalation to LPG supply loss of containment	**Equipment Issues:** Loss of air flow, (e.g. fan failure), loss of fuel flow, excess air (e.g. damper failure open), excess fuel flow issues, incomplete purges on start-up, incomplete isolations on shutdown	No	No	Burner Management System Instrumented Protection System with inventory isolation	**A0335-MI-22** Uncontrolled combustion event in gas-fired burner	Emergency Response Plan Instrumented Protection System with inventory isolation	Burner Management system design expected to be compliant with AS3814 Fired Appliances, and include flameout detection, air flow detection, fan status, and purge sequence controls. Design will include isolation on LPG supply in event of a burner incident.
32	11 - Electrolyzer	Hydrogen	Ignition of hydrogen venting from Hydrigen Vent Stack	Release of hydrogen from vent stack is ignited by lightning	**Lightning**	No	No	Facility Structural Design Physical layout and segregation Site lightning protection	**A0335-MI-25** Ignition of vented hydrogen	Area is not occupied and at height Emergency Response Plan	Preliminary consequence modelling has been conducted by Prudentia and shown that there is no requirement for exclusions zones at grade to protect from thermal radiation.
32	32 - Caustic Soda Storage	Steam	Boiler overpressure and steam explosion	Uncontrolled overpressure of the boiler, leaking to rupture of the steam drum	**Failure of steam pressure control**	Yes	No	High-pressure trip, independent, hard-wired Pressure relief valves venting to safe location CMMS	**A0335-MI-26** Boiler overpressure and steam explosion	Low occupancy Emergency Response Plan	

Appendix D. Chlorine Consequence Modelling

Results Summary

Table 22 Summary of Chlorine Consequence Modelling Results

Ref.	Scenario Description	Material	Pressure of Release [bar(g)]	Temp. of Release [° C]	Elevation [m]	Consequence Type	Weather Conditions	Extent [km]
MI-01 MI-03 MI-04	Release of Chlorine from HCl production unit/ Electrolyzer	Chlorine	0.5	22.9	1	Toxic (AEGL-2)	1.5/F	3.6
							4.6/C	1.8
MI-05	Release of Chlorine from Chlorine Compressor Building	Chlorine	User defined release rate – 0.1 kg/sec	22.9	1	Toxic (AEGL-2)	1.5/F	3.0
							4.6/C	0.4
MI-06a MI-06b MI-23	Release of Chlorine from Transfer Pipework Between Chlorine Compressor Unit and Chlorine Liquefaction Unit	Chlorine	3.5	22.9	5	Toxic (AEGL-2)	1.5/F	6.1
							4.6/C	3.7
MI-07	Release of Chlorine from Liquid Chlorine Building (Liquefaction, Storage and Filling)	Chlorine	User defined release rate – 0.55 kg/sec	22.9	1	Toxic (AEGL-2)	1.5/F	9.3
							4.6/C	0.9

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Software

DNV Phast 9.11 has been utilised for these dispersion models. Software inputs are provided in Appendix D

Meteorological Conditions

The key parameters when estimating the effects of dispersion are wind speed, temperature, relative humidity, atmospheric (Pasquill) stability class, and surface roughness. Weather conditions such as wind velocity and stability affect the extent of dilution with air, and the cloud velocity.

To determine the maximum downwind impacts for a scenario, several different weather conditions have been considered.

Gladstone Airport (Bureau of Meteorology site number 039326) was used as the closest reference location for the purposes of gathering past weather and climate information. A general summary is provided in Table 23

Table 23 Summary of Gladstone Airport Historical Weather Conditions

	Typical hot summer day	Typical average spring or autumn day	Typical cold winter day	Typical calm night
Wind speed (m/s)	6.7	4.9	4.6	1.5
Pasquill stability	C	B	C	F
Atmospheric Temperature (°C)	30.9	25.8	23.2	12.1
Reference	Jan mean max	May mean max	Jul mean max	Jul mean min
Relative Humidity (%)	60%	51%	46%	65%
Solar radiation (MJ/m^2)	24.7	15.3	13.7	0

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Topographical Assumptions

The dispersion model does not account for the surrounding topography, which can either assist or hinder the dispersion of drifting vapour clouds. As chlorine gas is heavier than air, it tends to gather in valleys and low-lying areas once released into the atmosphere. The resulting footprints modelled assume a flat surface.

Typical surface roughness length criteria that may reasonably be applied for this location is 250mm, representative of a rural landscape with high crops and occasional large obstacles.

Assessment Criteria

- Acute Exposure Guideline Levels (AEGL) thresholds were selected as criteria for determining toxicity of chemical exposure. They define the exposure limits for the general public, including vulnerable people (e.g. elderly) for short-term exposure;
- AEGL-60 values were used – the airborne concentration of a substance above which health effects may occur after 60 minutes of exposure;
- For a transient or slow release, a 60 min. exposure duration is taken as a conservative estimate. The nature of releases considered under this scope of work fit under this category. No instantaneous release scenarios where a more limited exposure duration e.g. a catastrophic vessel rupture where the entire inventory of a given vessel is released at once; and
- AEGL-2 value was used as the threshold for serious harm to a person resulting from toxic exposure.

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Table 24 Toxic Exposure Criteria

Level	Description	Consequence	Value (60 min.) [ppm]
AEGL-1	Airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic non-sensory effects. However, the effects are not disabling and are transient and reversible upon cessation of exposure.	Notable effects	0.5
AEGL-2	Airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape.	Serious Injury	2
AEGL-3	Airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience life threatening health effects or death.	Life Threatening	20

Tool

All scenarios modelled involved chlorine at pressure or as a user defined rate (enclosed building releases). +

- Scenarios were modelled as a leak from pressure vessel using DNV Phast, version 9.11. The tool is designed to simulate LoC events of hazardous chemicals from pressurised equipment. Toxic exposure results to determine the potential impact extents were taken for each applicable scenario.
- Enclosed building releases were modelled as a user defined release rate using DNV Phast, version 9.11. The release rates were calculated based a sealed building air exchange rate of 0.1 per hour.

Assumptions applicable to this model are (unless stated otherwise):

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- The effects of any surrounding structures on the dispersion of toxic material are ignored;
- Effects of enclosure on the dispersion of toxic material are represented on Phast, described for each scenario;
- There is a sufficient quantity of material for continuous discharge up to 3600 seconds;
- Release orientation is horizontal if orientation is unclear;
- The representative hole sizes for leaks covered under the International Association of Oil and Gas Producers' (IOGP) geometric mean approach are realistic to the behaviour of the system; and
- The temperature of the stream remains constant over the duration of the release.

Inputs

Inputs specific to scenarios are shown below.

Table 25 Inputs to Pressure Vessel Model – MI-01/03/04

Refer also to Table 3 A0335-MI-01 - Release of Chlorine from Electrolyzer Building, Table 4 A0335-MI-03 Release of Chlorine from HCl production unit, Table 5 A0335-MI-04 Release of Chlorine from Hypochlorite Production Unit

Parameter	Value	Comment
Stream Temperature [ºC]	22.9	Ambient temperature
Stream Pressure [bar(g)]	0.5	Provided by Grenof
Release Elevation [m]	1.0	Release modelled at 1 m above ground level
Hole Size 1 [mm]	2.0	IOGP Geometric mean approach
Hole Size 2 [mm]	6.0	IOGP Geometric mean approach
Hole Size 3 [mm]	22.0	IOGP Geometric mean approach
Hole Size 4 [mm]	86.0	IOGP Geometric mean approach

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Parameter	Value	Comment
Vessel Inventory [kg]	250	Estimated available based anticipated throughput
Release Location	Outside	Provided by Grenof / site layout

Table 26 Inputs to Equivalent Building Release Model – MI-05

Refer also to Table 6 A0335-MI-05 Release of Chlorine from Chlorine Compressor Building

Parameter	Value	Comment
Stream Temperature [ºC]	22.9	Ambient temperature
User defined release rate [kg/s]	0.1	Anticipated throughput and ACH = 0.1
Release Elevation [m]	1.0	Release modelled at 1 m above ground level
Release Location	Chlorine Compressor Building	Provided by Grenof / site layout

Table 27 Inputs to Pressure Vessel Model – MI-06a/b, MI-23

Refer also to Table 7 A0335-MI-06 Release of Chlorine from transfer pipework, Table 9 A0335-MI-23 Release of Chlorine due to external events

Parameter	Value	Comment
Stream Temperature [ºC]	22.9	Ambient temperature
Stream Pressure [bar(g)]	3.5	Provided by Grenof
Release Elevation [m]	5.0	Release modelled at 1 m above ground level

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Parameter	Value	Comment
Hole Size 1 [mm]	2.0	IOGP Geometric mean approach
Hole Size 2 [mm]	6.0	IOGP Geometric mean approach
Hole Size 3 [mm]	22.0	IOGP Geometric mean approach
Hole Size 4 [mm]	86.0	IOGP Geometric mean approach
Hole Size 5 – Full-Bore Rupture [mm]	150.0	Diameter of largest line
Vessel Inventory [kg]	1000.0	Isolatable inventory based on throughput
Release Location	Outside	Provided by Grenof / site layout

Table 28 Inputs to Equivalent Building Release Model – MI-07

Refer also to Table 8 A0335-MI-07 Release of Chlorine from Liquid Chlorine Building.

Parameter	Value	Comment
Stream Temperature [ºC]	22.9	Ambient temperature
User defined release rate [kg/s]	0.55	20t tank inventory and ACH = 0.1
Release Elevation [m]	1.0	Release modelled at 1 m above ground level
Vessel Inventory [kg]	20000	Provided by Grenof
Release Location	Liquid Chlorine Building	Provided by Grenof / site layout

Building dimensions relevant to release locations are described below.

Assumptions applicable to buildings:

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- Air changes remain constant;
- A small opening is considered for all enclosed buildings as a conservative estimate; and
- Openings on the building are in a circle shape.

Table 29 Chlorine Compressor Building

Parameter	Value	Comment
Length [m]	18	Based on site layout
Width [m]	12	Based on site layout
Height [m]	10	Based on site layout
Air Changes [h^{-1}]	0.1	Sealed building assumption

Table 30 Liquid Chlorine Building

Parameter	Value	Comment
Length [m]	40	Based on site layout
Width [m]	30	Based on site layout
Height [m]	10	Based on site layout
Air Changes [h^{-1}]	0.1	Sealed building assumption

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Results

Table 31 Maximum Impact Radii at Toxic Exposure Thresholds – A0335 – MI-01/03/04

Hole Size	Weather Conditions	Distance to Toxic Exposure Thresholds [m]		
		AEGL-1 [0.5 ppm]	AEGL-2 [2 ppm]	AEGL-3 [20ppm]
2 mm	1.5/F	549.9	**222.0**	36.3
	4.6/C	69.3	33.7	8.9
	4.9/B	46.1	22.7	6.5
	6.7/C	58.2	28.5	7.9
6 mm	1.5/F	2040.9	**875.7**	167.2
	4.6/C	213.8	100.9	28.3
	4.9/B	137.8	67.3	19.6
	6.7/C	176.0	83.6	23.2
22 mm	1.5/F	7502.1	**3593.8**	794.6
	4.6/C	883.3	428.8	131.4
	4.9/B	559.4	273.4	87.4
	6.7/C	718.8	343.3	101.5
86 mm	1.5/F	7015.1	**3536.8**	1041.3
	4.6/C	3511.8	1854.2	564.2
	4.9/B	2420.3	1213.5	387.9
	6.7/C	3226.1	1563.8	472.7

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- 1.5/F (stable, cold night) weather condition produces the largest impact radius for all AEGL levels, for all hole sizes
- Off-site impacts are likely – zones up to 20 km
- Unstable weather significantly reduces spread

Table 32 Maximum Impact Radii at Toxic Exposure Thresholds – A0335–MI-05

Hole Size	Weather Conditions	Distance to Toxic Exposure Thresholds [m]		
		AEGL-1 [0.5 ppm]	AEGL-2 [2 ppm]	AEGL-3 [20 ppm]
User defined release rate	1.5/F	6282.8	**3020.5**	778.1
	4.6/C	753.7	363.3	108.0
	4.9/B	470.1	227.2	69.1
	6.7/C	609.7	291.5	85.5

- Toxic effects of small release are essentially negligible
- Consequence severity does not really increase with hole size above 22 mm – release rate capped

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Table 33 Maximum Impact Radii at Toxic Exposure Thresholds – A0335 – MI-06a/b

Hole Size	Weather Conditions	Distance to Toxic Exposure Thresholds [m]		
		AEGL-1 [0.5 ppm]	AEGL-2 [2 ppm]	AEGL-3 [20 ppm]
2 mm	1.5/F	897.5	**320.7**	Not reached
	4.6/C	105.6	Not reached	Not reached
	4.9/B	68.5	Not reached	Not reached
	6.7/C	84.1	Not reached	Not reached
6 mm	1.5/F	3911.7	**1557.1**	219.3
	4.6/C	381.0	168.7	Not reached
	4.9/B	245.1	110.0	Not reached
	6.7/C	309.7	136.3	Not reached
22 mm	1.5/F	13458.0	**6478.0**	1328.1
	4.6/C	1626.4	759.0	193.2
	4.9/B	1057.0	485.7	127.5
	6.7/C	1363.6	610.4	149.4
86 mm	1.5/F	12527.9	**6148.5**	1719.7
	4.6/C	4636.1	3199.4	1163.1
	4.9/B	3924.6	2324.4	784.4
	6.7/C	5440.1	3051.5	910.5
150 mm	1.5/F	10681.6	**4900.2**	1651.4

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Hole Size	Weather Conditions	Distance to Toxic Exposure Thresholds [m]		
		AEGL-1 [0.5 ppm]	AEGL-2 [2 ppm]	AEGL-3 [20 ppm]
	4.6/C	6453.6	3755.1	1550.1
	4.9/B	4798.6	2847.7	1222.4
	6.7/C	6292.2	3754.8	1515.8

Table 34 Maximum Impact Radii at Toxic Exposure Thresholds – A0335 – MI-07

Hole Size	Weather Conditions	Distance to Toxic Exposure Thresholds [m]		
		AEGL-1 [0.5 ppm]	AEGL-2 [2 ppm]	AEGL-3 [20 ppm]
User defined release rate	1.5/F	19191.5	**9325.0**	2401.8
	4.6/C	1942.5	905.5	265.1
	4.9/B	1206.9	575.6	176.7
	6.7/C	1580.1	744.6	221.3

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Enclosed Building Assumptions

The assumptions outlined in Table 35 have been used in the assessment of offsite impacts for potential chlorine releases within enclosed / sealed chlorine process buildings

Table 35 Enclosed Process Building Assumptions

Assumption	Basis
Sealed building Air Changes per Hour (ACH) = 0.1	The enclosed chlorine process building is designed to well-sealed to detain any potential chlorine leaks. The ACH for these building are expected to be less than conventional chlorine dosing building ACH = 1 [5], and a certified 'Passive House' ACH = 0.6 [6]
Enclosed 'sealed' chlorine process building considered a passive (inherent) control	Potential chlorine gas leaks will be detained within the enclosed 'sealed' chlorine process buildings with leakage rate from the building based on the assumed building air changes per hour (ACH). Note: The Waste Gas Dechlorination System extraction fans which keep the building air space under continual slight negative pressure is considered an additional active control measure.
Releases from enclosed / sealed chlorine process building considered as a calculated equivalent point source release	With reference to the depiction in Figure 8 Equivalent Release from Enclosed Building releases into the enclosed / sealed building will be detained within the building and release to the external atmosphere through passive air exchanges. The following equivalent release rates were used for the following buildings: 1. Chlorine Compression building – maximum release into the building based on facility production rate (90tpd), exchanging with the outside atmosphere at an exchange rate of 0.1 per hour (= 0.1 kg/s) 2. Liquid Chlorine building - maximum release into the building based on maximum isolatable inventory of 20t. exchanging with the outside atmosphere at an exchange rate of 0.1 per hour (= 0.55 kg/s)

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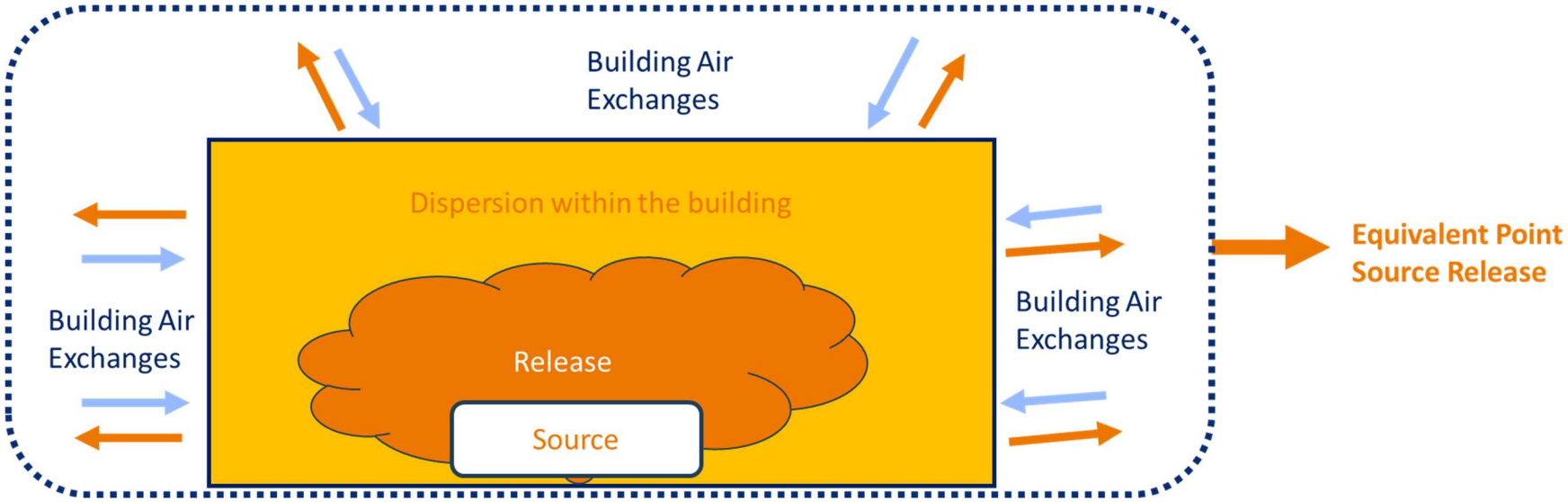


Figure 8 Equivalent Release from Enclosed Building (illustrative)

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Appendix E. Consequence Modelling: Other Hazardous Materials

Meteorological Conditions

As outlined in Appendix D.

Topographical Assumptions

As outlined in Appendix D.

Assessment Criteria

- "Areas outside the facility boundary shall not be exposed to heat radiation exceeding 4.7 kW/m^2, except industrial land use which should not exceed 12.6 kW/m2." [Reference 1, section 4.5.2]

Table 36: Thermal Radiation Criteria per Table 1, Planning Guideline State Code 21

Value [kW m^{-2}]	Description
4.7	**State Code 21 Dangerous dose to human health** Will cause pain in 15-20 seconds and injury after 30 seconds' exposure (at least second-degree burns will occur).
12.6	**State Code 21 Dangerous dose to the built environment** Significant chance of fatality for extended exposure. High chance of injury. Causes the temperature of wood to rise to a point where it can be ignited by a naked flame after long exposure. Thin steel with insulation on the side away from the fire may reach a thermal stress level high enough to cause structural failure.

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- "Areas outside the facility boundary shall not be exposed to an overpressure greater than 7kPa, except industrial land use which shall not exceed 14 kPa. " [Reference 1, section 4.5.3]

Table 37: Overpressure Criteria per Table 2, Planning Guideline State Code 21 [1]

Value [kPa]	Description
7kPa (1psi)	**Dangerous dose to human health** Damage to internal partitions and joinery but can be repaired. Probability of injury is 10 Percent. No fatality.
14 kPa (2 psi)	**Dangerous dose to the built environment** House uninhabitable and badly cracked.

Tool

- LPG Scenarios were modelled as a leak from pressure vessel using DNV Phast, version 9.11.
- Hydrogen - insert
- Hydrogen peroxide - insert

Assumptions applicable to this model are (unless stated otherwise):

- The effects of any surrounding structures on the dispersion of flammable material are ignored;
- There is sufficient quantity of material for continuous discharge up to 3600 seconds;
- Release orientation is horizontal if orientation is unclear;
- The representative hole sizes for leaks covered under the International Association of Oil and Gas Producers' (IOGP) geometric mean approach are realistic to the behaviour of the system; and
- The temperature of the stream remains constant over the duration of the release.

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Inputs

Inputs specific to scenarios are shown below.

Table 38 Inputs to LPG Model – MI-14

Refer also Table 12 A0335-MI-14 Release of LPG from bulk storage or connected piping.

Parameter	Value	Comment
Stream Temperature [ºC]	31	Average outside temperature value used for site
Stream Pressure [kPa(g)]	11barg	Pressure corresponding to storage temp. based on LPG P-T curve
Composition	Propane	Model conservatively assumes material is only propane
Release Elevation [m]	1.0	Release modelled at 1 m above ground level
Hole Size 1 [mm]	2.0	IOGP Geometric mean approach
Hole Size 2 [mm]	6.0	IOGP Geometric mean approach
Hole Size 3 [mm]	22.0	IOGP Geometric mean approach
Hole Size 4 [mm] Full bore rupture	50mm	Assumed maximum pipe diameter
Vessel Inventory [kg]	~33,000	Estimated available based on maximum proposed inventory
Release Location	Outside	Provided by Grenof / site layout
Release Orientation	Horizontal	Assumption

Table 39 Inputs to Hydrogen Peroxide Explosion Model - MI-24

Refer also Table 11 A0335-MI-24 Decomposition of hydrogen peroxide with container overpressure.

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Parameter	Value	Comment
Stream Temperature [ºC]	31	Average outside temperature value used for site
Pressure [bar(g)]	0.34	Calculated
Release Elevation [m]	1.0	Release modelled at 1 m above ground level
Vessel Inventory [kg]	Single IBC of 50% H2O2	Estimated available based on maximum proposed inventory
Oxygen mass inventory [kg]	270	Calculated
Release Location	Outside	Provided by Grenof / site layout
Decomposition can be initiated by light, heat, high pH or contamination with impurities e.g. metals, acids, bases - at very low levels (a few ppm). The exothermic reaction that proceeds, and liberation of heat, can accelerate the decomposition process. Composition of release is assumed to be 100% oxygen.		
Failure mode: plastic bottle rupture, cap ejection, cage failure, seam split, etc		

Table 40 Inputs to Uncontrolled Combustion Model - MI-22

Refer also Table 11 A0335-MI-24 Decomposition of hydrogen peroxide with container overpressure

Parameter	Value	Comment
Stream Temperature [ºC]	31	Ambient outside temperature
Stream Pressure [bar(g)]	850	Atmospheric
Composition	Propane	Model conservatively assumes 100% propane
Release Elevation [m]	1.0	Release modelled at 1 m above ground level

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Parameter	Value	Comment
Flammable volume [m3]	7.1m^3	With consideration of assumed equipment dimensions
Gas Density	1.8kg/m^3	Information from Origin SDS sheet for LPG
Mass propane required in flammable cloud	0.5kg	Stoichiometric calculation considering flammability limit
Phast Model		Standalone – Multi-energy explosion

Table 41 Inputs to Steam Boiler Explosion Models - MI-26

Refer also Table 14 A0335-MI-26 Boiler overpressure and steam explosion

Parameter	Value	Comment
Stream Temperature [ºC]	200degC	Saturated steam at the stream pressure
Stream Pressure [bar(g)]	10	Assumed maximum. Boiler still to be procured
Release Elevation [m]	1.0	Release modelled at 1 m above ground level
Vessel Shape		Cylinder
Vessel length [m]	3.5	Assumed based on averages across this duty of steam boiler available to procure
Vessel diameter [m]	6	
Phast Model		Standalone – BLEVE Blast
Explosion Pressure [bar(g)]	26.5	Calculated, Reference TNO Yellow Book

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Consequence Model Results

Table 42: Thermal Radiation for LPG Jet Fire and Overpressure Impact Radii for LPG VCE – MI-14

Hole Size	Weather Conditions	Jet Fire: Distance to Thermal Radiation Thresholds [m]		VCE: Distance to Overpressure Thresholds [m]	
		4.7 kW m^{-2}	12.6 kW m^{-2}	7 kPa	14 kPa
2 mm	1.5/F	**6.9**	**5.9**	Nil result	Nil result
	4.6/C	6.0	4.9	Nil result	Nil result
	4.9/B	6.0	4.8	Nil result	Nil result
	6.7/C	5.8	4.7	Nil result	Nil result
6 mm	1.5/F	**18.9**	**15.8**	**16.9**	**14.0**
	4.6/C	16.5	13.3	15.9	13.4
	4.9/B	16	13	Nil result	Nil result
	6.7/C	16	13	Nil result	Nil result
22 mm	1.5/F	**61**	**50**	**110**	**97**
	4.6/C	54	42	108	96
	4.9/B	53	42	96	85
	6.7/C	52	41	96	85
50 mm	1.5/F	**127**	**104**	260	230
	4.6/C	112	88	**291**	**261**
	4.9/B	112	88	271	241

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Hole Size	Weather Conditions	Jet Fire: Distance to Thermal Radiation Thresholds [m]		VCE: Distance to Overpressure Thresholds [m]	
		4.7 kW m^{-2}	12.6 kW m^{-2}	7 kPa	14 kPa
	6.7/C	110	85	260	230

Table 43: Oxygen Concentrations from Hydrogen Peroxide Decomposition and IBC rupture – MI-24

Hole Size	Weather Conditions	Distance to concentration of interest [m]	
		40 000ppm Oxygen	
N/A	1.5/F	9	
	4.6/C	13	
	4.9/B	14	
	6.7/C	24	

Table 44: Overpressure from Uncontrolled Combustion Event within gas-fired burner – MI-22

Hole Size	Weather Conditions	Distance to Overpressure Thresholds [m]	
		7 kPa	14 kPa
N/A	1.5/F	24	13
	4.6/C		
	4.9/B		
	6.7/C		

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Table 45: Overpressure from Steam Boiler Explosion – MI-26

Hole Size	Weather Conditions	Distance to Overpressure Thresholds [m]	
		7 kPa	14 kPa
N/A	1.5/F	88	57
	4.6/C		
	4.9/B		
	6.7C		

Table 46: Thermal Radiation for Hydrogen Jet Fire and Overpressure Impact Radii for LPG VCE – MI-02 – Occurring inside enclosed building

Hole Size	Weather Conditions	Jet Fire: Distance to Thermal Radiation Thresholds [m]		VCE: Distance to Overpressure Thresholds [m]	
		4.7 kW m^{-2}	12.6 kW m^{-2}	7 kPa	14 kPa
2 mm	1.5/F	Not reached at height of interest	Not reached at height of interest	Nil result	Nil result
	4.6/C			Nil result	Nil result
	4.9/B			Nil result	Nil result
	6.7/C			Nil result	Nil result
6 mm	1.5/F	1.6	1.4	Nil result	Nil result
	4.6/C			Nil result	Nil result
	4.9/B			Nil result	Nil result
	6.7/C			Nil result	Nil result

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Hole Size	Weather Conditions	Jet Fire: Distance to Thermal Radiation Thresholds [m]		VCE: Distance to Overpressure Thresholds [m]	
		4.7 kW m^{-2}	12.6 kW m^{-2}	7 kPa	14 kPa
22 mm	1.5/F	7	5.6	Nil result	Nil result
	4.6/C			Nil result	Nil result
	4.9/B			Nil result	Nil result
	6.7/C			Nil result	Nil result
86 mm	1.5/F	27	21	35	28
	4.6/C			33	28
	4.9/B			33	27
	6.7/C			32	27

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Appendix F. Rose of Wind direction versus Wind speed

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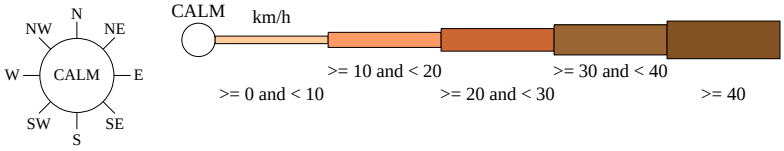
Rose of Wind direction versus Wind speed in km/h (01 Apr 1939 to 31 Jul 2019)

Custom times selected, refer to attached note for details

ROCKHAMPTON AERO Nearest station on BOM supplying annual wind rose.

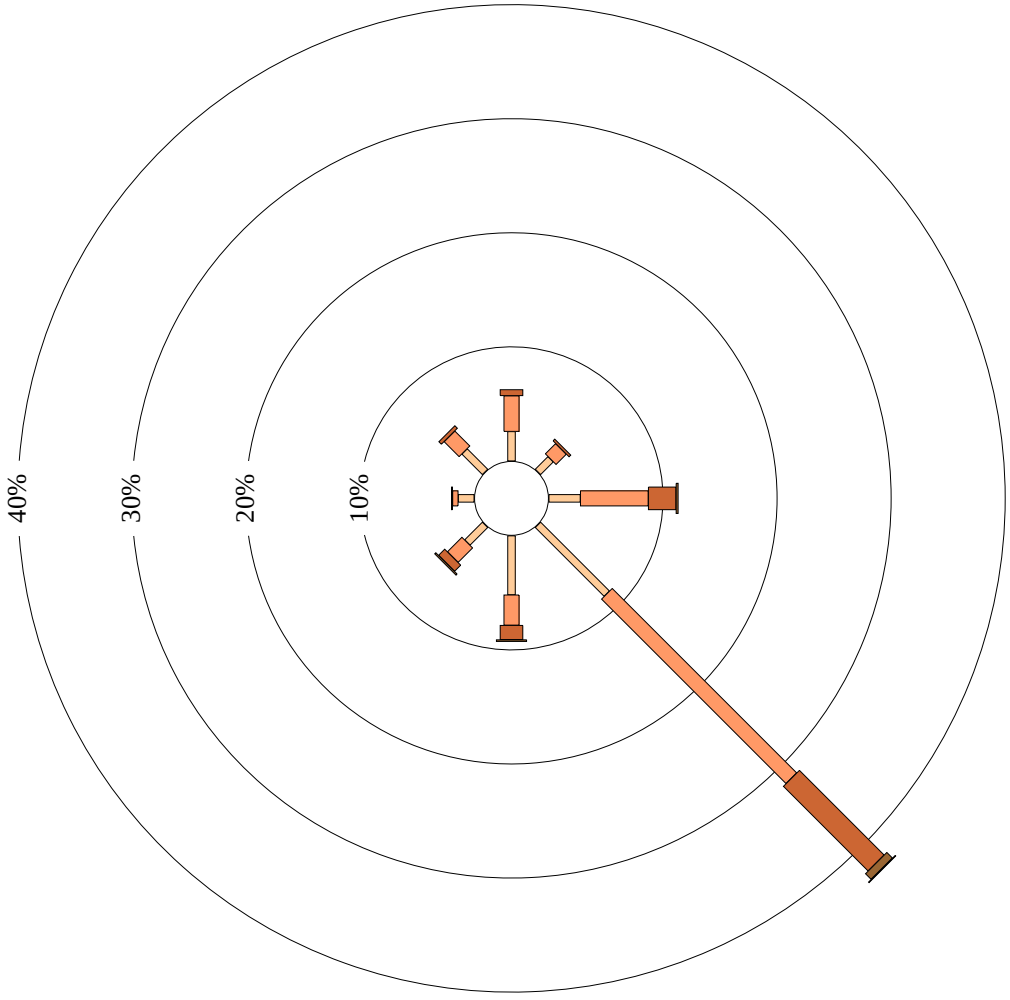
Site No: 039083 • Opened Jan 1939 • Still Open • Latitude: -23.3753° • Longitude: 150.4775° • Elevation 10.m

An asterisk (*) indicates that calm is less than 0.5%.
Other important info about this analysis is available in the accompanying notes.



9 am
29167 Total Observations

Calm 16%



Use for qualitative purposes to understand wind direction trends in relation to off-site dispersion impacts

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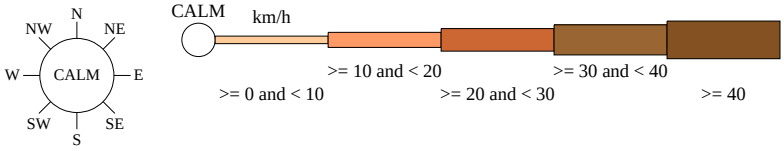
Rose of Wind direction versus Wind speed in km/h (01 Apr 1939 to 31 Jul 2019)

Custom times selected, refer to attached note for details

ROCKHAMPTON AERO Nearest station on BOM supplying annual wind rose.

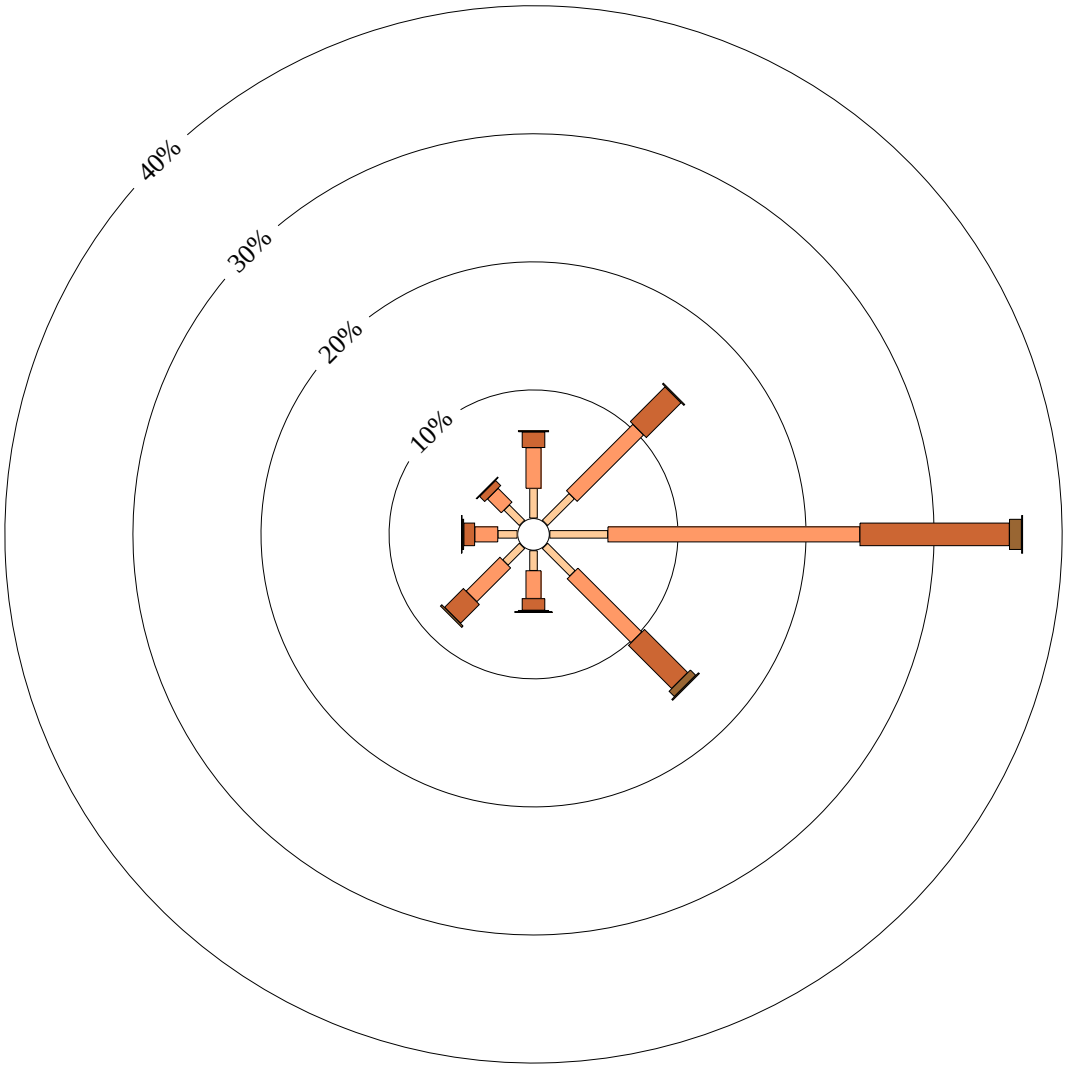
Site No: 039083 • Opened Jan 1939 • Still Open • Latitude: -23.3753° • Longitude: 150.4775° • Elevation 10.m

An asterisk (*) indicates that calm is less than 0.5%.
Other important info about this analysis is available in the accompanying notes.



3 pm
29134 Total Observations

Calm 6%



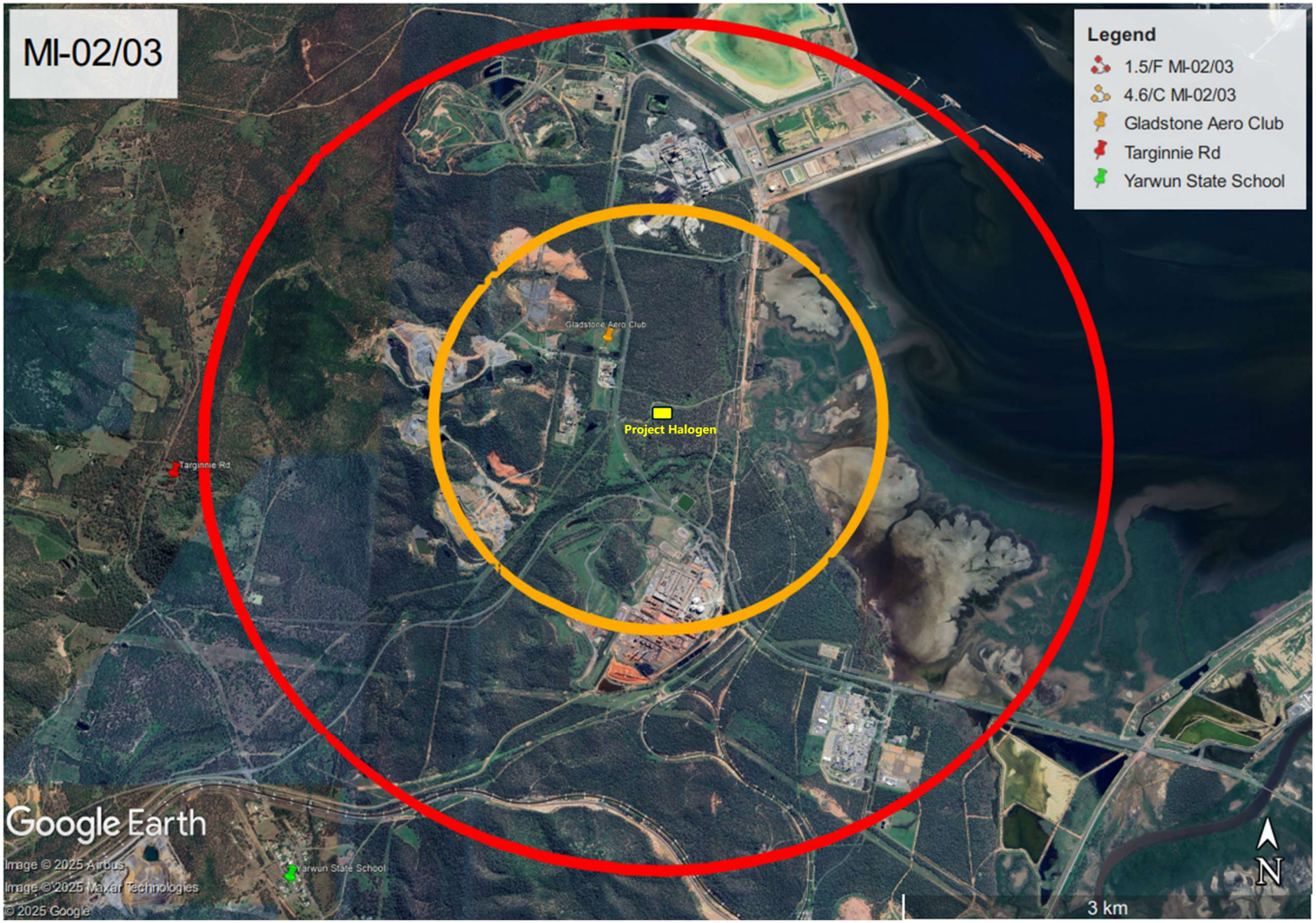
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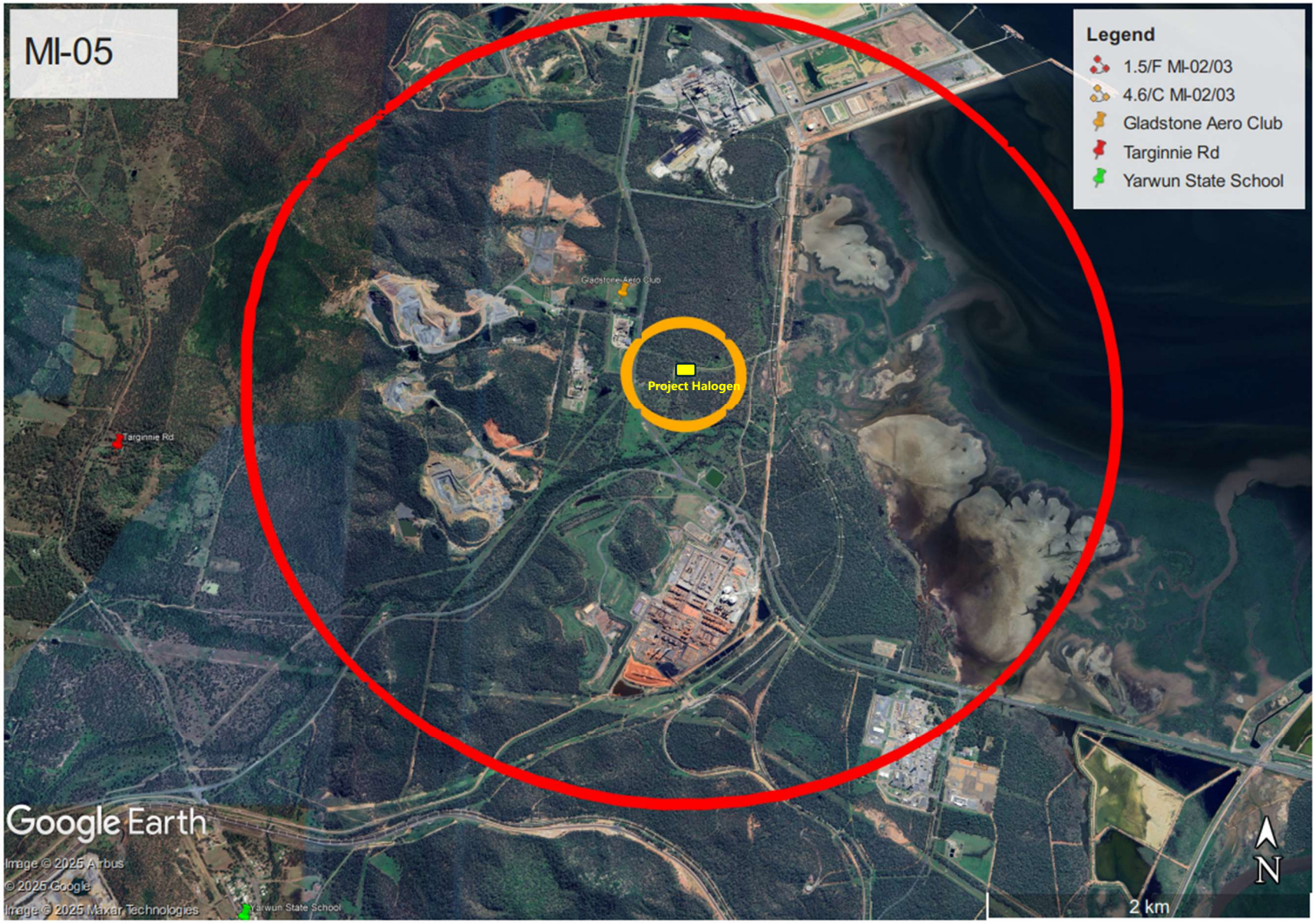
Appendix G. Consequence Contour Overlays where potential for off-site impacts may arise

- MI-02/03 – 1.5/F and 4.6/C Toxic Consequence Contours
- MI-05 - 1.5/F and 4.6/C Toxic Consequence Contours
- MI-06 - 1.5/F and 4.6/C Toxic Consequence Contours
- MI-07 - 1.5/F and 4.6/C Toxic Consequence Contours
- MI-14 – Worst-case Thermal Radiation Consequence Contours
- MI-14 – Worst-case Overpressure Consequence Contours

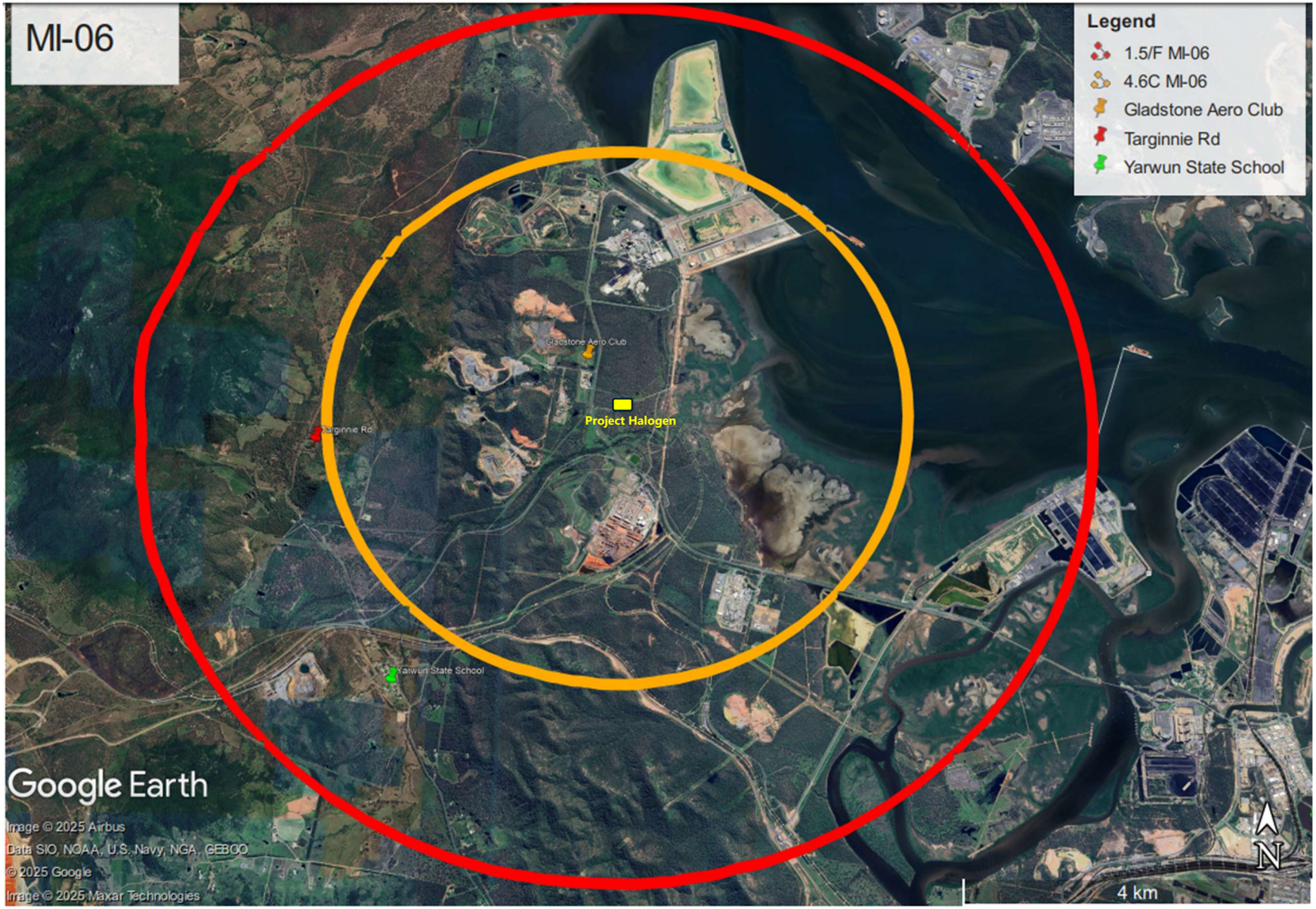
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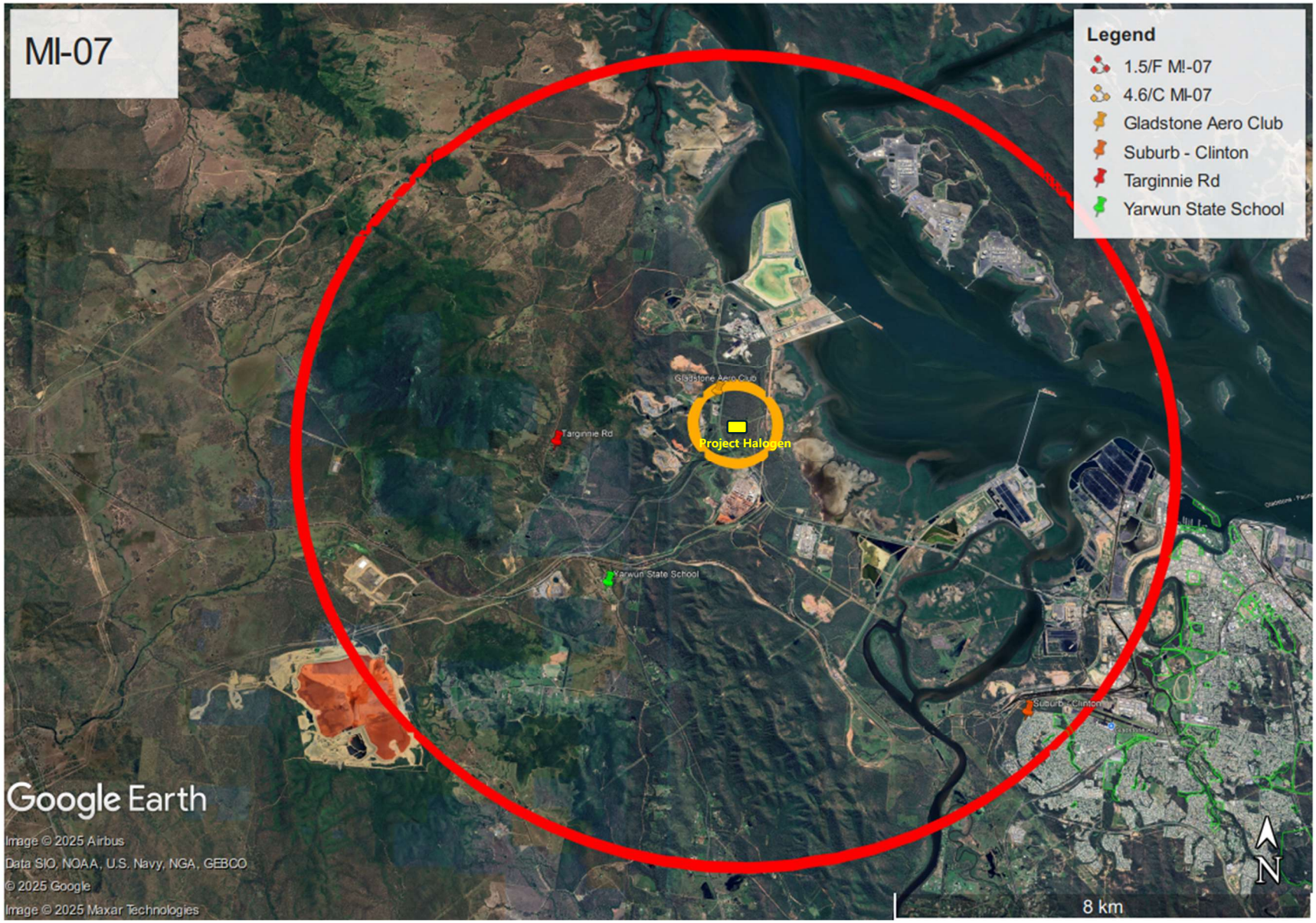
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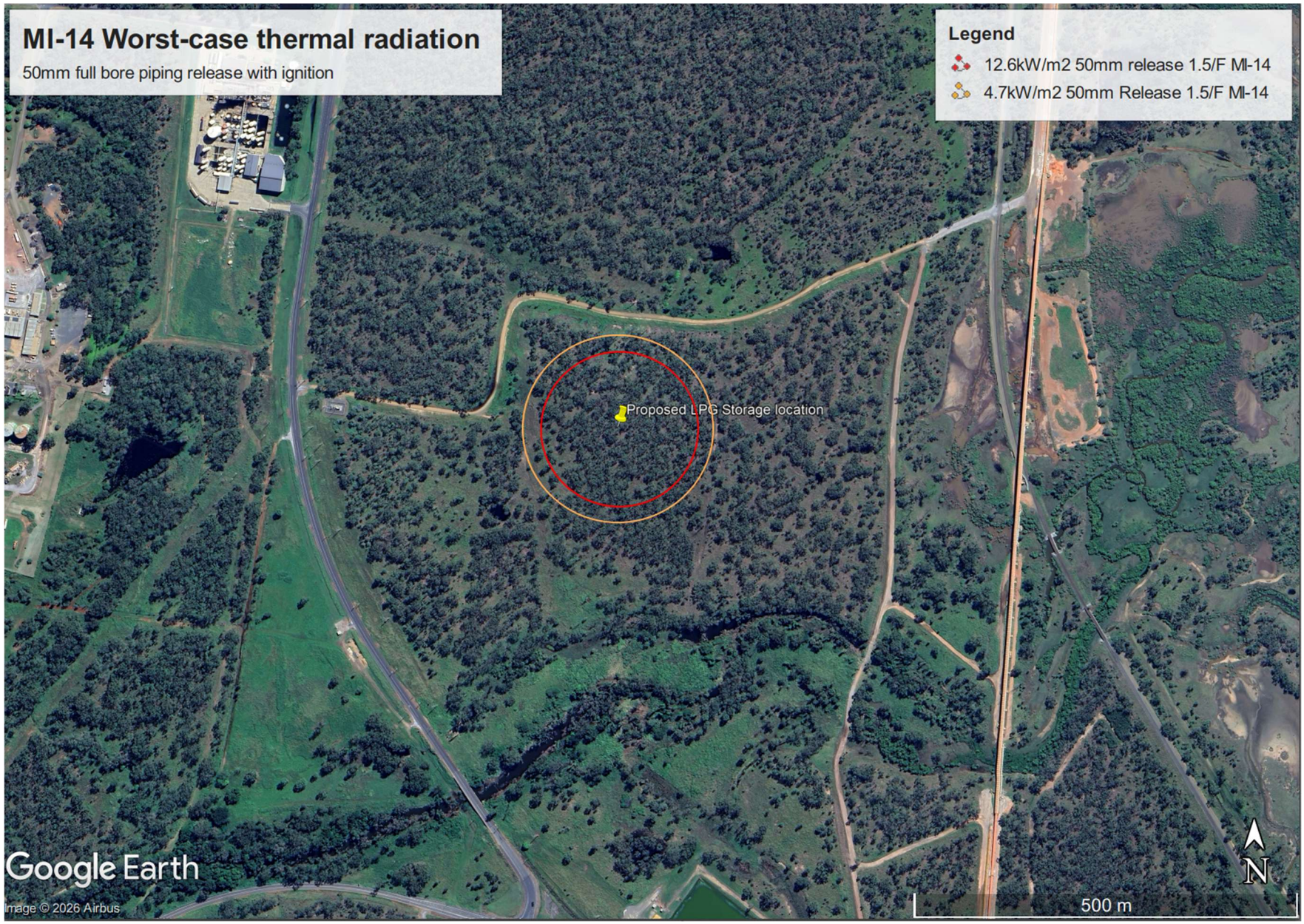
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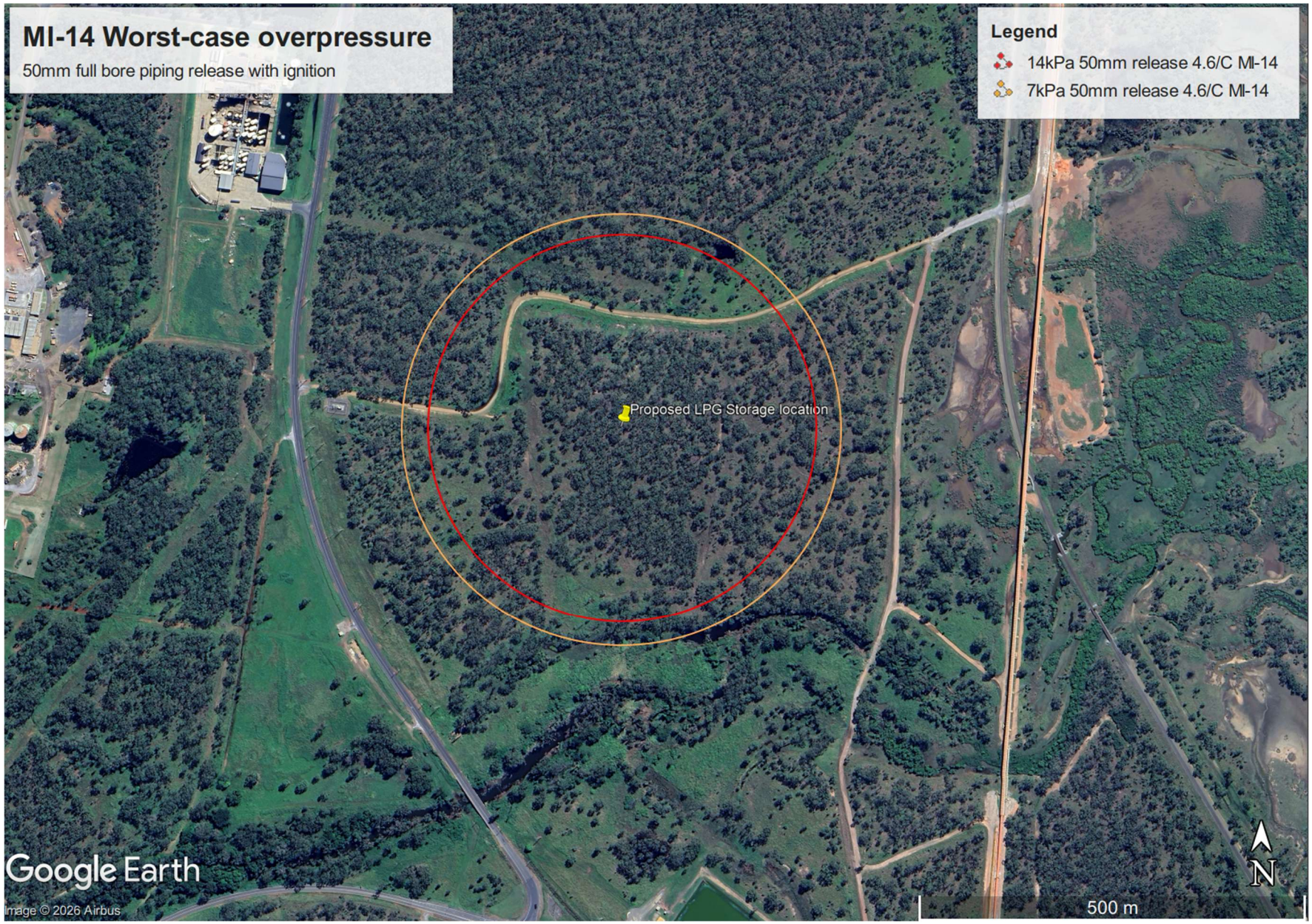


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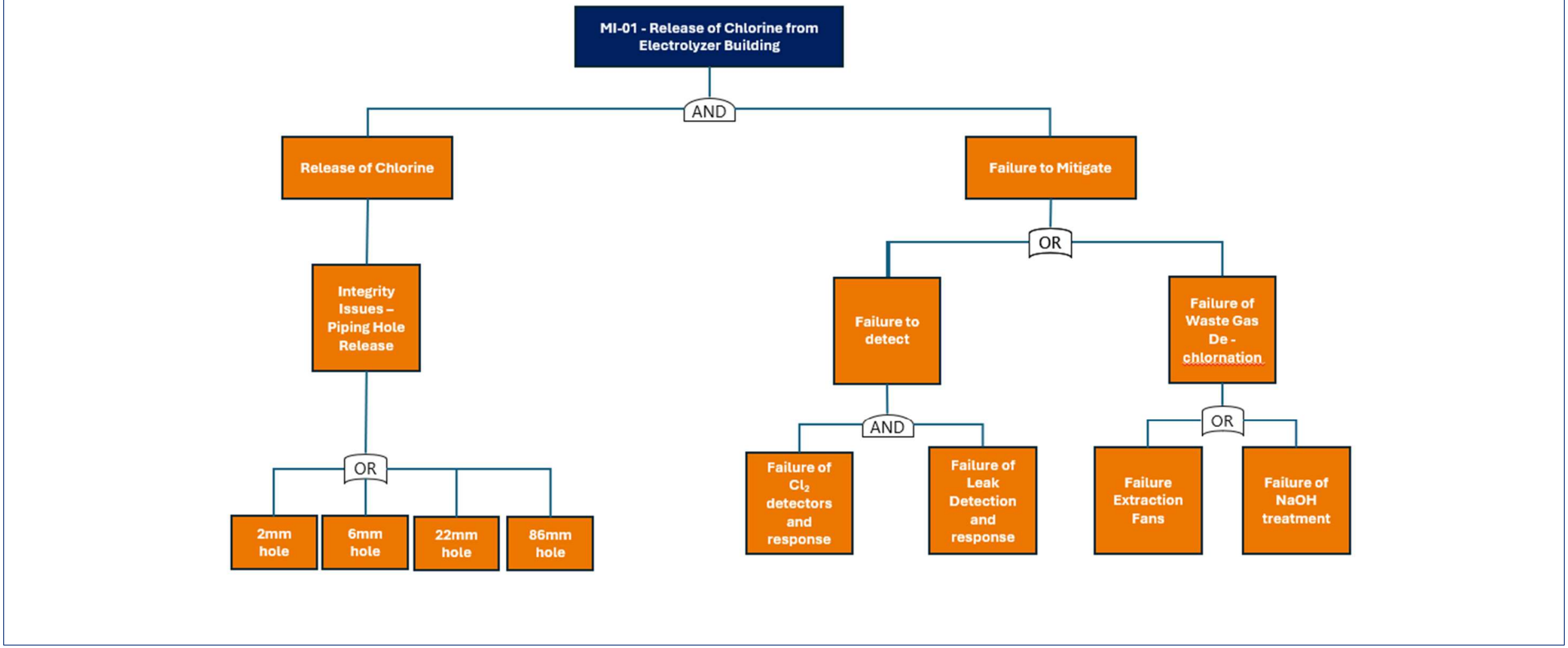
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MI-14 Worst-case thermal radiation
50mm full bore piping release with ignition
Legend
12.6kW/m2 50mm release 1.5/F MI-14
4.7kW/m2 50mm Release 1.5/F MI-14
Proposed LPG Storage location
Google Earth
Image © 2026 Airbus
500 m
N


MI-14 Worst-case overpressure
50mm full bore piping release with ignition
Legend
14kPa 50mm release 4.6/C MI-14
7kPa 50mm release 4.6/C MI-14
Proposed LPG Storage location
Google Earth
Image © 2026 Airbus
500 m
N

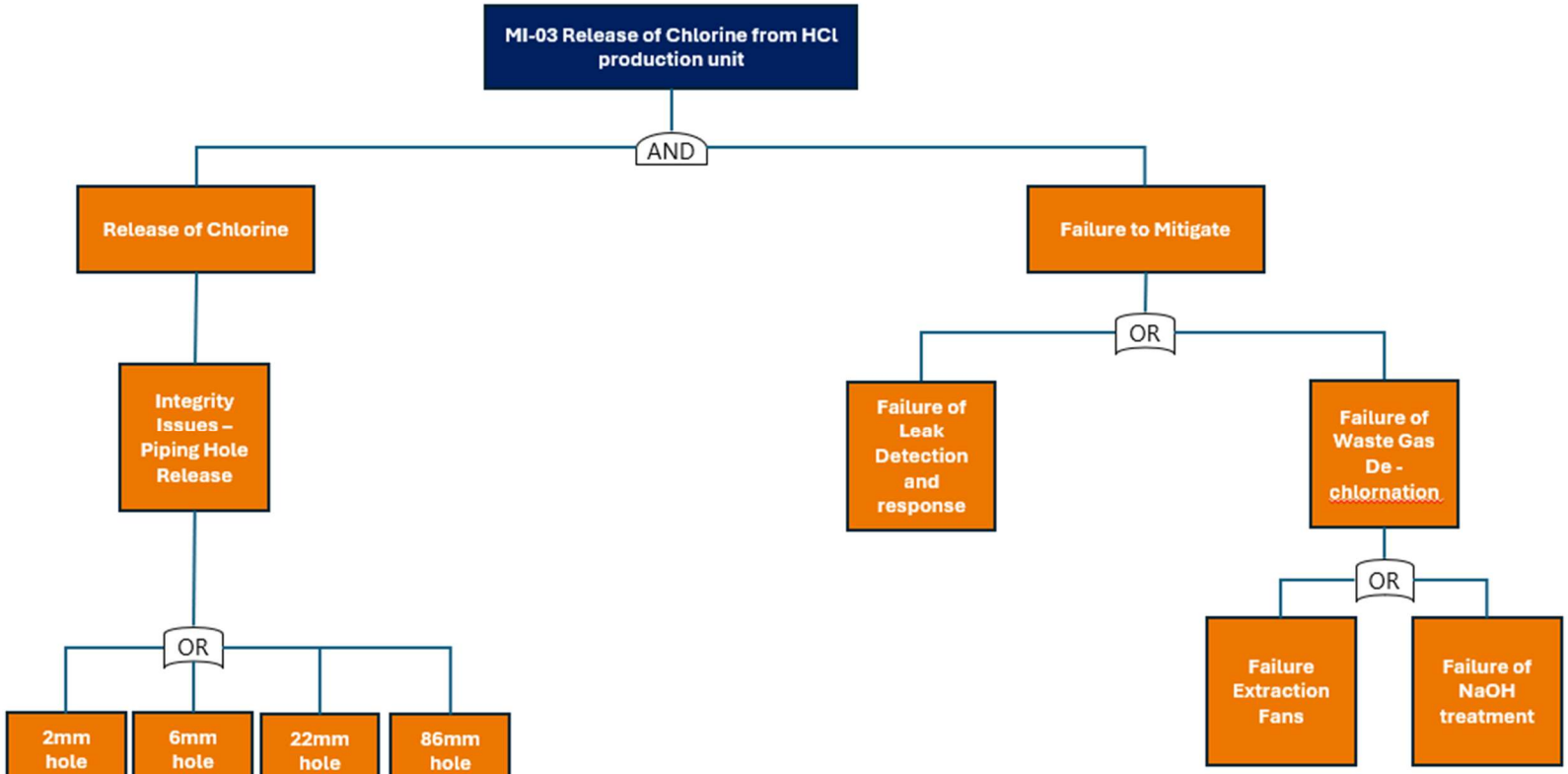
Appendix H. Incident Pathway – Fault Tree Analysis

Fault Tree - MI-01 - Release of Chlorine from Electrolyzer Building



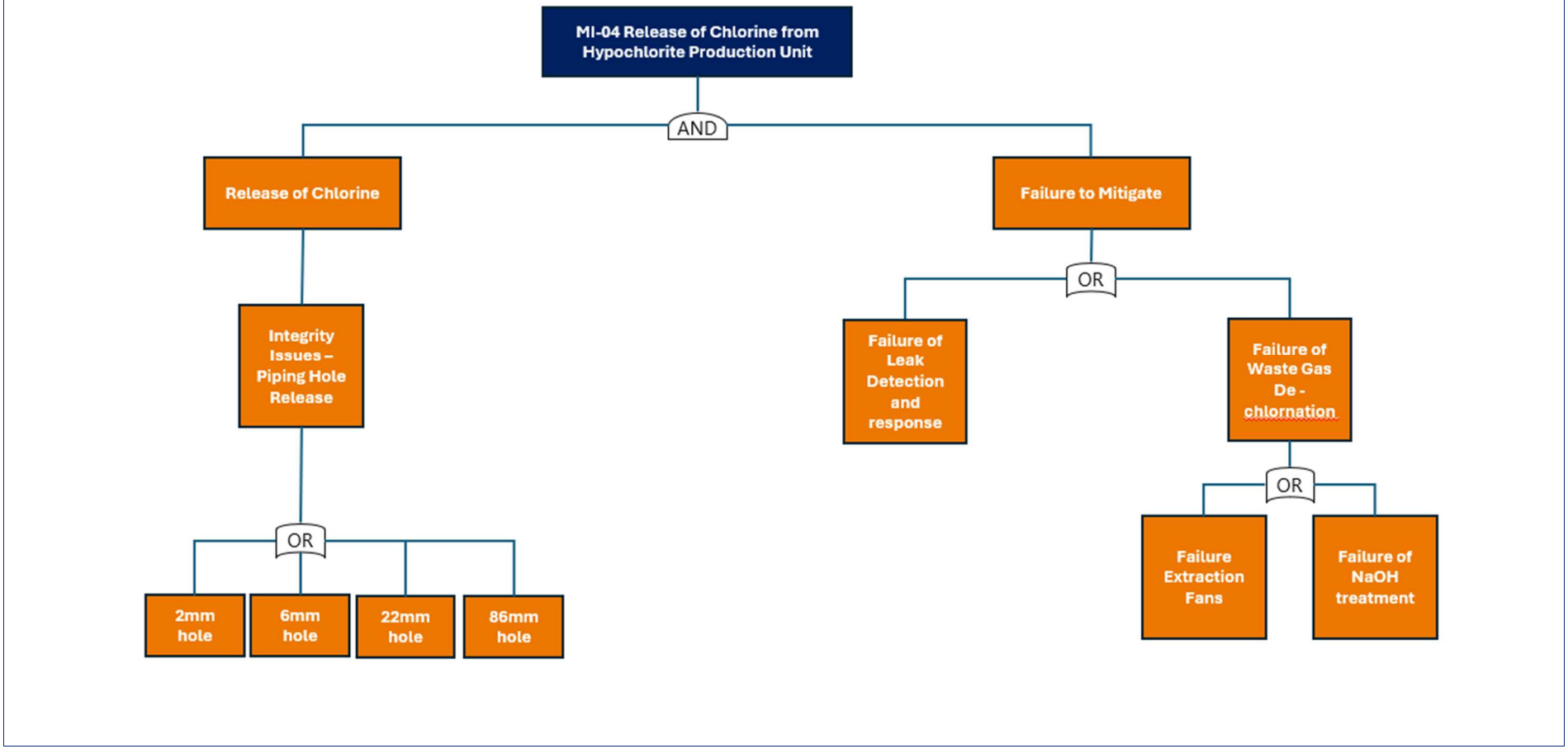
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Fault Tree - MI-03 Release of Chlorine from HCl production unit



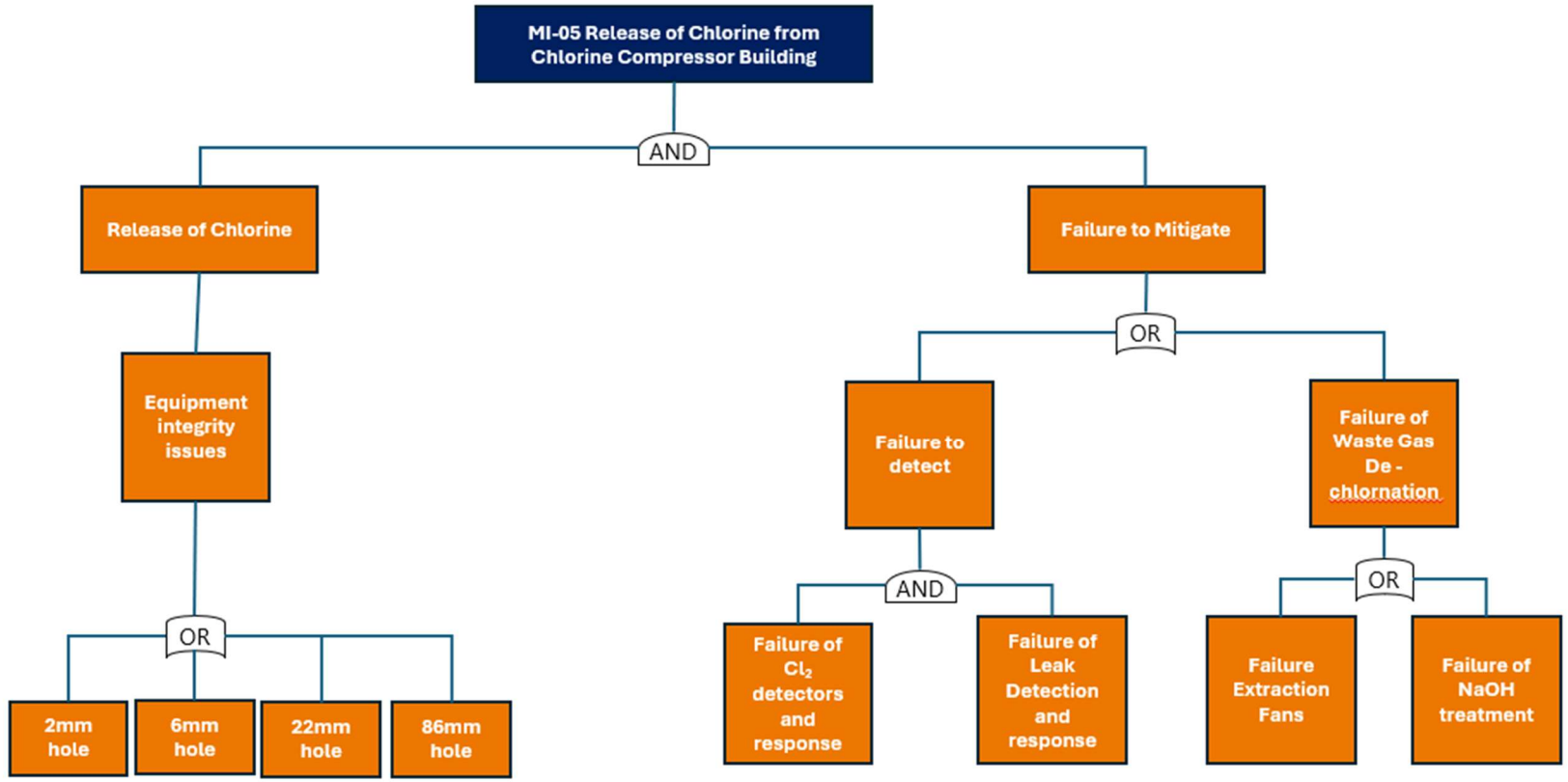
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Fault Tree - MI-04 Release of Chlorine from Hypochlorite Production Unit



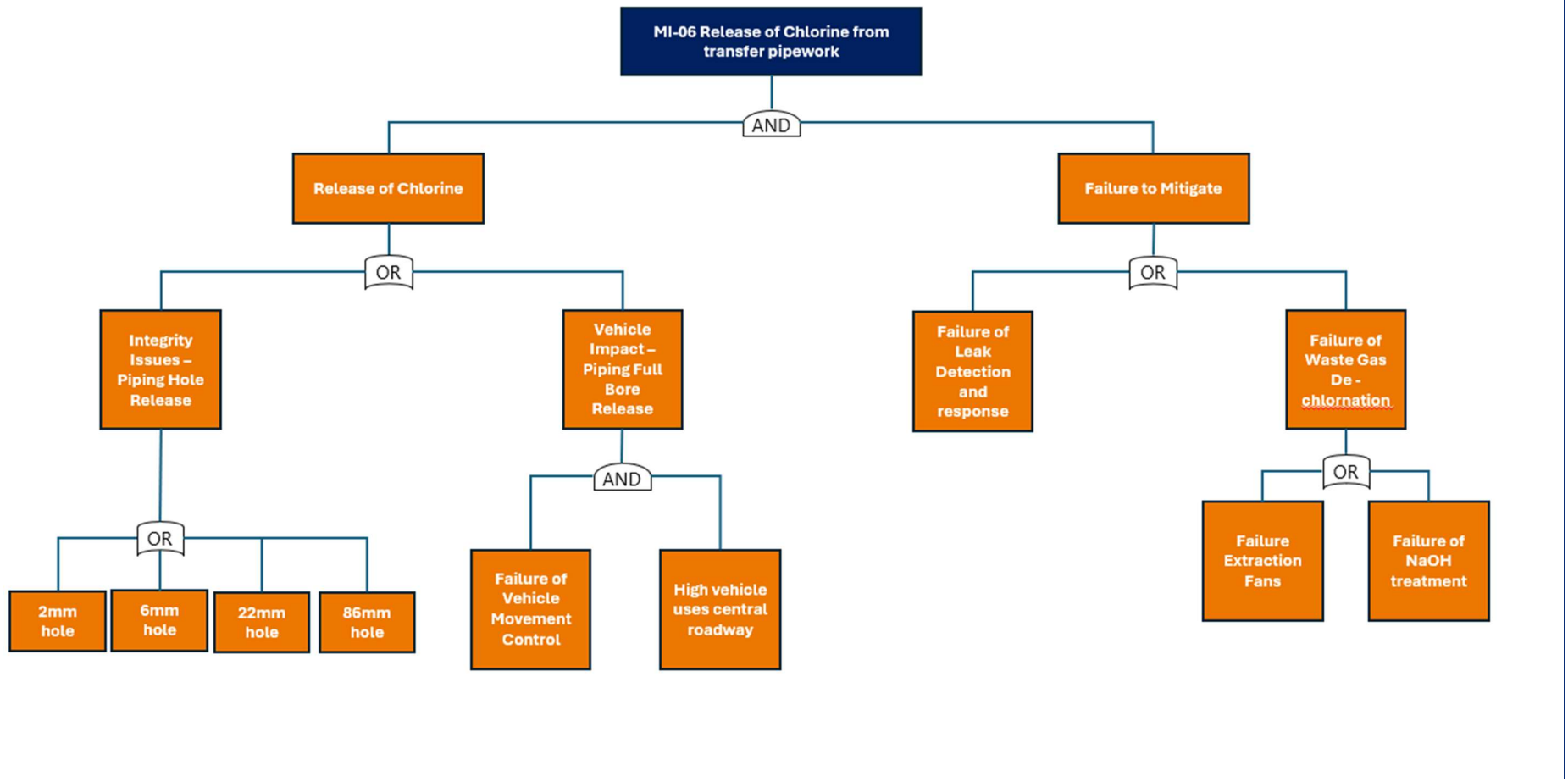
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Fault Tree - MI-05 Release of Chlorine from Chlorine Compressor Building



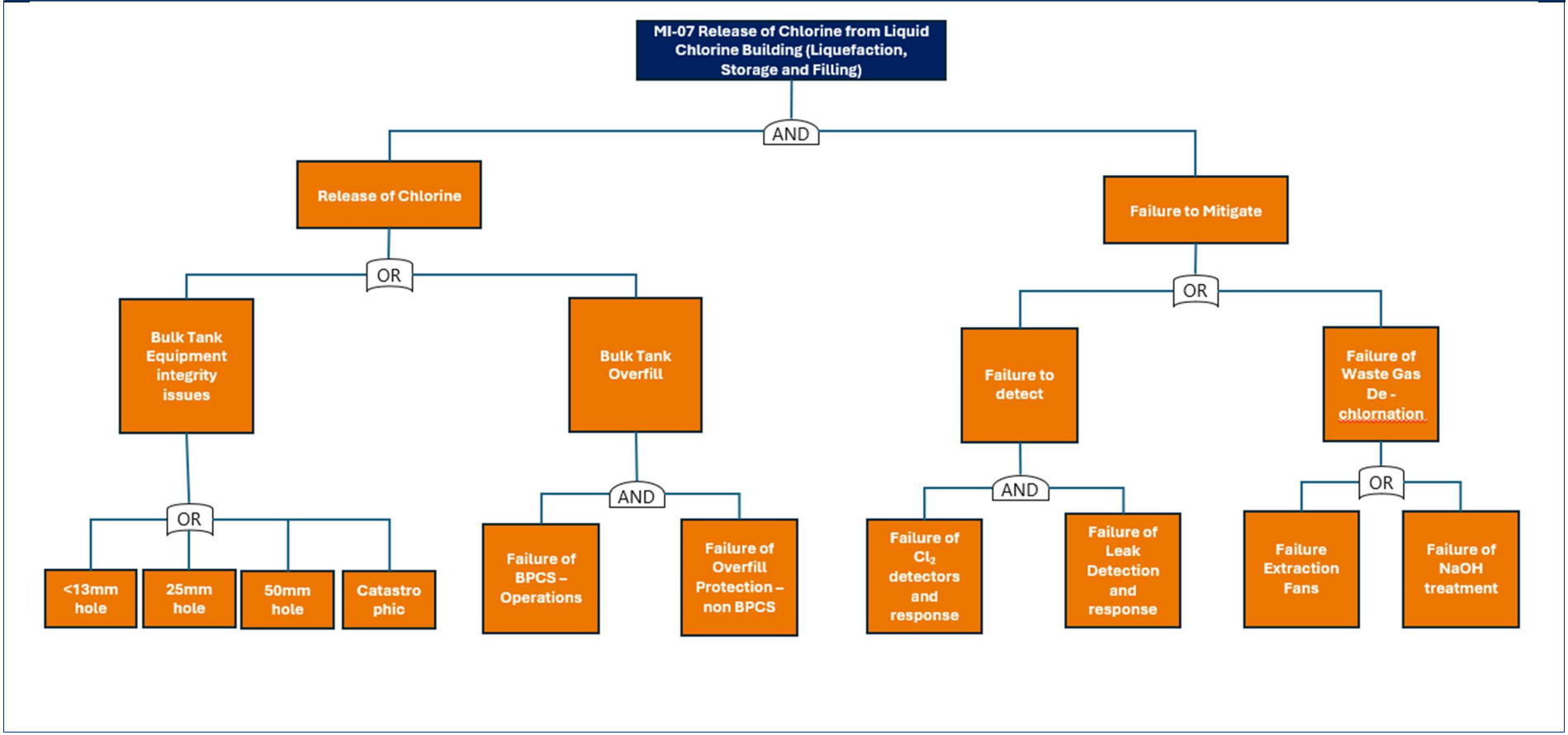
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Fault Tree - MI-06 Release of Chlorine from transfer pipework



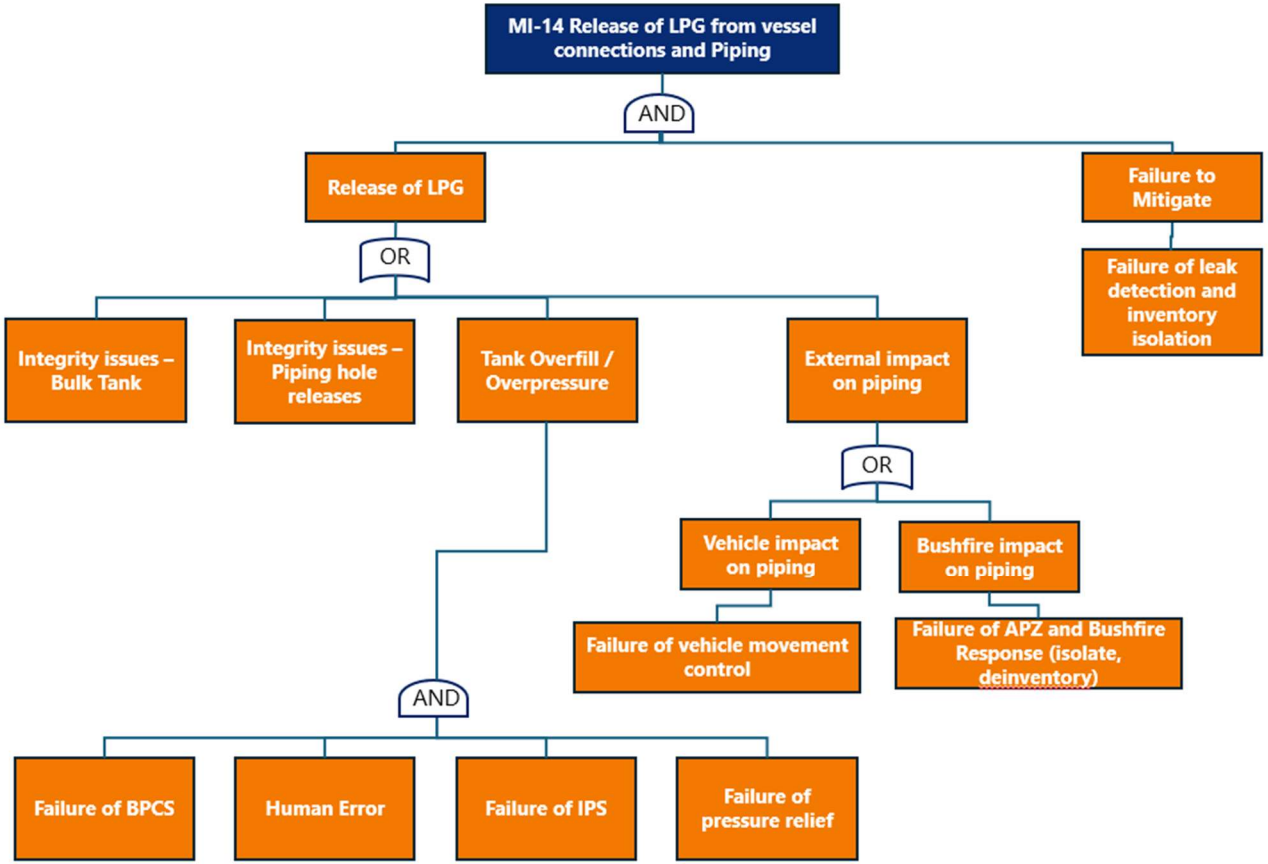
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Fault Tree - MI-07 Release of Chlorine from Liquid Chlorine Building (Liquefaction, Storage and Filling) – Bulk Storage Tanks



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Fault Tree - MI-14 Release of LPG from vessel connections and piping



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Appendix I. Risk Control Measures

Table 47 Substitution controls

Process Area	Control Measure	Description	PO(s) Supported	How the control supports the PO benchmark
24 Chlorine Storage & Filling	Storage Vessel Container Size	The total liquid chlorine storage has been split across multiple smaller tanks.	PO1-PO5	Reduces the maximum quantity that could be released in a single storage vessel loss of containment.
General	Nil hydrogen storage	No compressed hydrogen storage will occur on-site	PO1-PO5	Reduces escalation pathways and off-site fire/explosion risk

Table 48 Isolation controls

Process Area	Control Measure	Description	PO(s) Supported	How the control supports the PO benchmark
07 Anolyte Dechlorination	Hydrogen Peroxide Dosing	Hydrogen peroxide is dosed to the anolyte to achieve dechlorination within a closed system (removal of free chlorine)	PO1-PO5	Removes free chlorine within a closed system, reducing toxic inventory and the potential severity of any downstream venting or upset conditions.

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Table 49 Preventative engineering controls

Process Area	Control Measure	Description	PO(s) Supported	How the control supports the PO benchmark
General	Facility physical layout and segregation	The physical layout of the facility, including segregation distances between units and chemical storage areas, and segregation practices for chemicals.	PO1–PO5, PO6	Minimising the potential for identified major incidents and the escalation of major incidents between areas.
General	Basic Process Control Systems	A Basic Process Control Systems (BPCS) will be in place to monitor and control the chlor-alkali industrial processes, ensuring safe, stable, and efficient operations by maintaining process variables such as temperature, pressure, and flow within set limits.	PO1–PO5	Prevents abnormal operating conditions that could result in loss of containment and off-site exposure to hazardous chemicals.
11 Electrolyzer	Single Element Electrode Unit	The standalone electrolysis cell consists of the anode and cathode within a steel frame unit with polytetrafluoroethylene sealing system and integrated headers minimises leaks from the unit	PO1–PO5	Reduces the likelihood of chlorine or hydrogen leakage at source through inherently safer equipment design
11 Electrolyzer	Hydrogen Vent Stack	Excess hydrogen within the Electrolyzer is vented to a safe location in a closed process via the hydrogen stack vent within required limits.	PO1–PO5	Safely discharges hydrogen to a controlled location, preventing accumulation or ignition that could escalate to off-site consequences.

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Process Area	Control Measure	Description	PO(s) Supported	How the control supports the PO benchmark
51 HCl Production	Hydrogen and chlorine feed rates to burner	Hydrogen is to be kept at constant stoichiometric excess of 10-15% to ensure that all chlorine reacts and avoid free chlorine content in the vent gas.	PO1-PO5	Minimises free chlorine in vent gas by ensuring reaction completion; reduces toxic inventory in vents, thereby reducing off-site dangerous dose potential.
General	Enclosed building for Chlorine processes	Electrolyzer, Chlorine Compression, Chlorine Liquefaction Chlorine Storage & Filling operations are contained within a fully enclosed buildings to contain any potential chlorine leaks.	PO1-PO5	Prevents uncontrolled dispersion of chlorine by containing releases within structures linked to treatment systems.
		These buildings are also linked to the Gas Dechlorination System and are always maintained at a slight negative pressure.		Ensures air flows inward, drawing any leaks toward mitigation systems rather than allowing escape to the environment.
24 Chlorine Storage & Filling	Chlorine Bulk tank level control and over fill protection	Chlorine storage tanks are provided with weighing indicator with alarm (local and remote), a weighing switch with alarm (local and remote), a level indicator with alarm (local and remote), and a pressure indicator with alarm (local and remote). Redundant automatic system controlled by DCS. The process has an empty storage tank for emergencies and ability through closed loop to push gas into the emergency tank as or when required.	PO1-PO5	Prevents overfilling and loss of containment events that could result in large-scale chlorine releases. Provides layered safeguards against operator or instrument failure, reducing the likelihood of major release scenarios.

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Process Area	Control Measure	Description	PO(s) Supported	How the control supports the PO benchmark
24 Chlorine Storage & Filling	Chlorine Bulk tank over pressure protection	Chlorine storage tanks are provided with dual burst disk/pressure relief valves to mitigate overpressurisation (as final protection). Vented chlorine from the pressure relief valves is directed to the Waste Gas Dechlorination System for safe neutralisation within a controlled closed process that is always in operation when the plant is operating	PO1-PO5	Prevents catastrophic tank failure and routes relief discharges to treatment systems to avoid off-site toxic impact
24 Chlorine Storage & Filling	Rupture disks releasing to expansion vessels on liquid chlorine fill lines	Rupture disks provide a control release point in case isolated fill lines over-pressurise due to liquid chlorine expansion/vapourisation. Rupture disk releases to expansion vessels and are directed to the Waste Gas Dechlorination System for safe neutralisation. Four tanks are in use for liquefied chlorine gas with one being a failsafe always remaining empty in the event gas needs to be transferred to the empty vessel in an emergency.	PO1-PO5	Protects fill lines from thermal overpressure and ensures any discharge is safely contained and treated.
24 Chlorine Storage & Filling	Displaced gas directed to Waste Gas Dechlorination System	Displaced gases (padding air, chlorine) from the filling and testing of cylinders and containers are directed to the Waste Gas Dechlorination System for safe neutralisation.	PO1-PO5	Prevents chlorine-bearing displaced gases from venting untreated during filling and testing operations.

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Process Area	Control Measure	Description	PO(s) Supported	How the control supports the PO benchmark
27 Sodium Hypochlorite Storage	Hypochlorite Bulk Storage Design	Sodium hypochlorite bulk storage in accordance with AS 3780 *The storage and handling of corrosive substances* (Tank design, overfill protection, bunding design etc.) Bulk sodium hypochlorite does not share a common bund or bund drain with other products in particular hydrochloric acid or sulphuric acid	PO1-PO5, PO9	Reduces likelihood of incompatible reactions and uncontrolled releases that could generate chlorine gas affecting off-site receptor
Brine Processing	Hydrogen Peroxide Storage	Hydrogen peroxide storage will be in accordance with AS 4326:2008 *The storage and handling of oxidizing agents*.	PO1–PO5, PO6*, PO9	Controls oxidiser hazards and reduces fire and decomposition risk; supports early detection and escalation control consistent with PO6 intent where applicable.
32 Caustic Soda Storage	Caustic Bulk Storage Design	Caustic soda bulk storage in accordance with AS 3780 T*he storage and handling of corrosive substances* (Tank design, overfill protection, bunding design etc.) Bulk caustic soda does not share a common bund or bund drain with other products in particular hydrochloric acid or sulphuric acid	PO1–PO5, P09	Provides compliant containment and segregation, preventing escalation or secondary reactions.
51 HCl Production	Burner Management System	The natural gas- or LPG-fuelled burner will be a Type B appliance and will have a Burner Management System that meets the requirements of AS/NZS 3814:2018, Industrial and commercial gas-fired appliances.	PO1–PO5	Minimises the potential for an uncontrolled combustion event.

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Process Area	Control Measure	Description	PO(s) Supported	How the control supports the PO benchmark
51 HCl Production	Instrumented Protection System with fuel inventory isolation	As the natural gas or LPG-fuelled burner will be a Type B appliance, automated isolation of the fuel feed will be incorporated in the design.	PO1–PO5	Provides automated alarms and protective actions that enable early intervention and controlled shutdown, limiting the likelihood and duration of hazardous chemical releases
52 Hydrochloric Acid Storage	Hydrochloric Acid Bulk Storage Design	Hydrochloric acid bulk storage in accordance with AS 3780 The storage and handling of corrosive substances (Tank design, overfill protection, bunding design etc.) Bulk hydrochloric acid does not share a common bund or bund drain with other products in particular sodium hypochlorite or caustic soda	PO1–PO5, PO9	Prevents incompatible mixing (e.g. with hypochlorite) that could generate chlorine gas and off-site toxic impacts.
91 Sulphuric Acid Filling and Storage	Sulphuric Acid Bulk Storage Design	Sulphuric acid bulk storage in accordance with AS 3780 *The storage and handling of corrosive substances* (Tank design, overfill protection, bunding design etc.) Bulk sulphuric acid does not share a common bund or bund drain with other products in particular sodium hypochlorite or caustic soda	PO1–PO5, PO9	Reduces likelihood of containment failure and escalation, protecting surrounding land uses and infrastructure

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Process Area	Control Measure	Description	PO(s) Supported	How the control supports the PO benchmark
General	Facility Structural Design	In line with the requirements of the National Construction Code (NCC) the design and construction of the facility will address the specific requirements for buildings and structures to resist natural hazard events such as floods, earthquakes, cyclones, and bushfires.	PO10	Improves facility resilience to external natural hazards, supporting the overall off-site risk reduction intent underpinning PO1–PO5 and the code's broader purpose statement.
LPG Storage	Mounded LPG Storage Vessel	Mounding the LPG vessel removes exposure to external fire impingement and credible BLEVE scenarios. This eliminates a high-consequence risk scenario, reduces reliance on active fire protection systems and emergency response, and provides a permanent, passive risk reduction measure.	PO1–PO5	Minimises the potential for physical impact or fire impingement on the vessel.

Table 50 Mitigative engineering controls

Process Area	Control Measure	Description	PO(s) Supported	How the control supports the PO benchmark
11 Electrolyzer	Electrode Unit leak detection	Pressure differential is measured across each electrolysis cell with any pin hole leaks immediately identified by the distributed control system	PO1–PO5	Enables early identification of pin-hole leaks, allowing rapid intervention to limit release duration and prevent escalation to off-site impacts.

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Process Area	Control Measure	Description	PO(s) Supported	How the control supports the PO benchmark
General	Ambient air chlorine gas detectors	Chlorine gas detectors are strategically positioned throughout the plant to identify chlorine releases and initiate early mitigation action (process shutdown, Waste Gas Dechlorination System, etc). The chlorine gas detectors are integrated into the distributed control which alarm when activated, enabling the operator to isolate the process within the production facility.	PO1–PO5	Provides early detection of chlorine releases and initiates alarms and automated responses, enabling rapid isolation and mitigation to limit off-site exposure.
General	Process Leak detection	The venting of chlorine gas lines to the 26 – Waste Gas Dechlorination process unit is managed through automated control process loops and precise pressure differentiation measures, allowing pin-hole accuracy in determining when venting is required. The system utilises dedicated pressure transmitters and interlocks to continuously monitor line pressure and trigger venting sequences when pre-set thresholds are reached. Automatic process loops govern the opening and closing of isolation and vent valves, ensuring a controlled flow path and maintaining process safety. This fully automated control philosophy minimises manual intervention while providing reliable venting, with all valve activations sequenced through the DCS to prevent uncontrolled releases and maintain stable downstream operating conditions.	PO1–PO5	Automated pressure monitoring and interlocked venting routes gases to treatment systems under controlled conditions, reducing reliance on manual response and preventing uncontrolled emissions.

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Process Area	Control Measure	Description	PO(s) Supported	How the control supports the PO benchmark
General	Waste Gas Dechlorination System	Emergency chlorine gases from the plant are directed to the sodium hydroxide scrubber unit to neutralise chlorine gas emissions within a controlled closed process. The duty/standby fans require suction on the on-chlorine lines, preventing chlorine leaks within the plant. These fans are always in operation when the plant is operating. The resulting sodium hypochlorite is returned into the system within a closed loop for reprocessing.	PO1–PO5	Detects deviations and automatically routes gases to neutralisation under controlled logic, reducing the chance of uncontrolled emissions and improving reliability of mitigation
41 Hydrogen Cooling	Hydrogen Vent Stack	Excess hydrogen (not required for HCl production) is vented to a safe location via the hydrogen stack vent under minimal pressure.	PO1–PO5	Ensures excess hydrogen is safely discharged to a controlled location, reducing ignition risk and preventing escalation that could impact surrounding land uses.
23 Chlorine Liquefaction	Sniff gas management	Sniff gas (uncondensed chlorine, nitrogen, oxygen and carbon dioxide) from the liquefaction unit are directed to sodium hypochlorite production and/or Waste Gas Dechlorination System to prevent chlorine releases in vent gas within a controlled closed process that is always in operation when the plant is operating	PO1–PO5	Prevents routine/foreseeable vent streams containing chlorine from being discharged untreated; ensures controlled capture and neutralisation.

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Process Area	Control Measure	Description	PO(s) Supported	How the control supports the PO benchmark
24 Chlorine Storage & Filling	Spare Emergency Chlorine Bulk Tank	In the event of an emergency process upset or integrity issue with one of the in-use bulk chlorine storage tanks, chlorine can be transferred to the spare emergency chlorine bulk tank for containment, reuse or directed to Waste Gas Dechlorination System for safe neuralisation.	PO1–PO5	Enables rapid transfer of inventory during upset conditions, reducing duration and severity of potential release scenarios.
24 Chlorine Storage & Filling	Chlorine Bulk tank bunding	Chlorine storage tanks are provided with external bunding to contain any chlorine release and initiate early mitigation action (directed to the Waste Gas Dechlorination System for safe neutralisation within a controlled, closed process that is always in operation when the plant is operating).	PO1–PO5, PO8	Provides secondary containment to limit spread and support controlled mitigation, reducing escalation potential following a release.
LPG Storage	Application of AS/NZS1596, specifically leak and fire detection and protection requirements	The design will be compliant with AS/NZS 1596 The storage and handling of LP Gas, including leak detection, fire detection and fire protection requirements.	PO1–PO5, PO6	Provides early identification and control of fire exposure, preventing escalation to integrity failure or catastrophic release and reducing the likelihood of off-site impact.
Chlorine General	Application of AS/NZS2927, specifically leak and fire detection and protection requirements	The design will be compliant with AS/NZS 2927:2019 The storage and handling of liquefied chlorine gas, including leak detection, fire detection and fire protection requirements.	PO1–PO5, PO6	Prevent fire-induced loss of containment of chlorine storage, maintaining vessel integrity and reducing the likelihood of toxic gas releases that could impact off-site

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Process Area	Control Measure	Description	PO(s) Supported	How the control supports the PO benchmark
General	10kW/m^2 Asset Protection Zone	The APZ provides a fuel-reduced, physical separation between the new buildings/structures and bush fire hazards, it is a key element in the suite of bush fire measures and dictates the type of construction necessary to mitigate bushfire attack. In practical terms, the setback of each building/structure will form part of the APZ.	PO1–PO5	Reduces bushfire radiant heat experienced within the facility and exposure of hazardous chemical infrastructure, maintaining the integrity of safety-critical systems and reducing the likelihood of bushfire-initiated releases that could impact off-site

Table 51 Administrative controls

Process Area	Control Measure	Description	PO(s) Supported	How the control supports the PO benchmark
General	Process areas unoccupied during chlorine operations	Chlorine process areas, and specifically enclosed buildings, will be unoccupied during chlorine operations to minimise the risk to personnel to chlorine exposure and to detain and manage any chlorine within the building in the event of an accidental chlorine release from process equipment.	PO1–PO5	Removes personnel from the immediate hazard zone, reduces human-initiated escalation, and supports rapid, unimpeded emergency response, thereby assisting engineered controls in preventing off-site impacts of hazardous chemicals in accordance with PO1–PO5.

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Process Area	Control Measure	Description	PO(s) Supported	How the control supports the PO benchmark
General	Emergency Response Plan	A comprehensive Emergency Response Plan (ERP) for the Grenof Project Halogen operations will be developed. This ERP will include clear on-site and off-site emergency notification and communication protocols, evacuation and shelter-in-place procedures, assignment of roles and responsibilities, emergency resources etc. The ERP will be an integral part of the Safety Management System for the facility.	PO1–PO5	Ensures timely and coordinated response to incidents, limiting release duration and consequence severity
General	Bush Fire Management Plan	A Bushfire Management Plan for the Grenof Project Halogen operations will be developed. This Bushfire Management Plan will outline the strategies protection measures to reduce bushfire risk and protect lives, the facility, and the environment.	PO1–PO5, P10	The Bushfire Management Plan manages external natural hazard risks that could initiate or escalate hazardous chemical releases, supporting the integrity and effectiveness of engineered controls and thereby reducing the likelihood of off-site dangerous dose impacts

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Process Area	Control Measure	Description	PO(s) Supported	How the control supports the PO benchmark
General	Safety Management System	A Safety Management System (SMS) will be established that complies with the WHS Regulations	PO1–PO5	Provides a structured framework to identify, implement, maintain, and verify the effectiveness of engineering and physical controls that manage hazardous chemical risks, supporting ongoing compliance with PO1–PO5 by reducing the likelihood of off-site hazardous impacts. While the SMS itself does not directly prevent or mitigate a hazardous chemical release, it ensures the ongoing effectiveness, integrity and reliability of the engineered controls that underpin compliance with State Code 21
General	Computerized Maintenance Management System (CMMS)	A CMMS will be implemented to manage work orders, schedule and track preventive maintenance, monitor asset history, provide better visibility into asset performance and provide data-driven reporting to improve efficiency, regulatory compliance and safety.	PO1–PO5	Ensures safety-critical plant and mitigation systems are maintained, inspected and repaired in a timely and auditable manner, supporting the ongoing effectiveness of engineered controls and reducing the likelihood of off-site hazardous chemical impacts.
General	Task Specific Operating Procedures	Operating procedures will be in place for those activities requiring manual operation of the facility. This will include, for example, the requirement for the third-party supplier of LPG, to have an operating procedure for the safe filling of the site LPG storage vessel.	PO1–PO5	Standardises how hazardous chemical tasks are performed, and the facility is operated, reducing human error, preventing bypass of engineered controls, and supporting early intervention, thereby assisting in preventing off-site hazardous chemical impacts

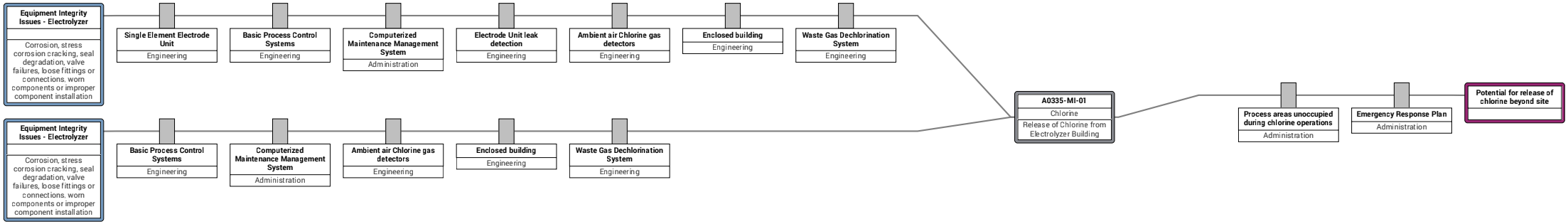
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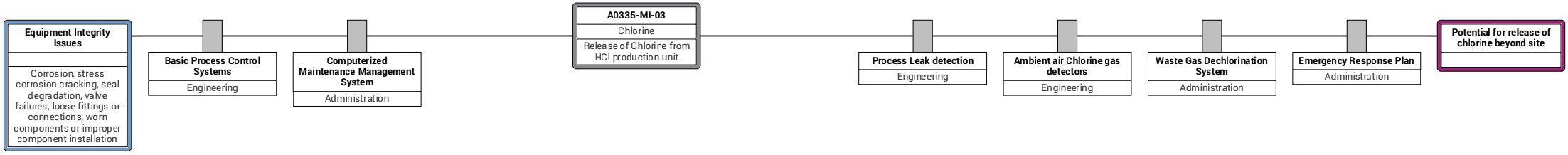
Process Area	Control Measure	Description	PO(s) Supported	How the control supports the PO benchmark
22 Chlorine Compression	Exclusion of Vehicles in proximity of pipe bridge	Vehicle movement will be excluded from the proximity of the pipe bridge crossing the central roadway in the Grenof Project Halogen facility to prevent any external impact to the piping or the pipe bridge structure. The exclusion of vehicle movements will be implemented using physical and procedural methods to be finalised during detailed design.	PO1–PO5	Prevents impact-related damage to chlorine pipework, reducing the likelihood of high-rate releases with off-site hazardous chemical impacts.
General	Facility physical security plans	Facility physical security plan will be implemented including perimeter security fencing, lighting, signage, facility access control and management and surveillance and monitoring. The Grenof Project Halogen operations will be 24/7 with security monitored by the control room.	PO1–PO5	Prevents unauthorised access to or interference with hazardous chemical systems, reducing the likelihood of externally initiated releases and off-site hazardous chemical impacts.
General	Cyber security plans	A Cyber security plan will be implemented to protect against external cyber threats. This will include network segregation isolating OT systems from IT networks, access management, back-up and recovery and integration of cyber security incident response with ERP.	PO1–PO5	Protects process control and safety systems from unauthorised interference, reducing the likelihood of externally initiated releases and off-site hazardous chemical impacts.

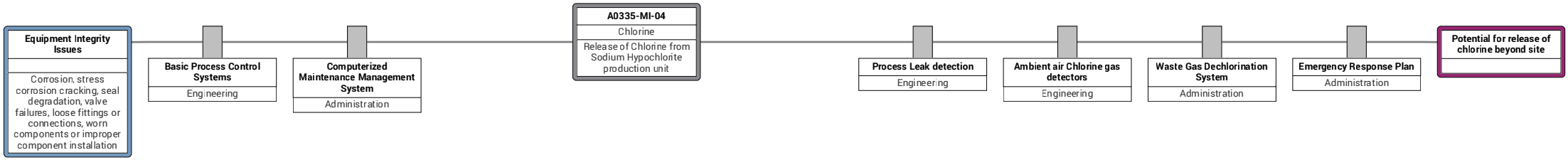
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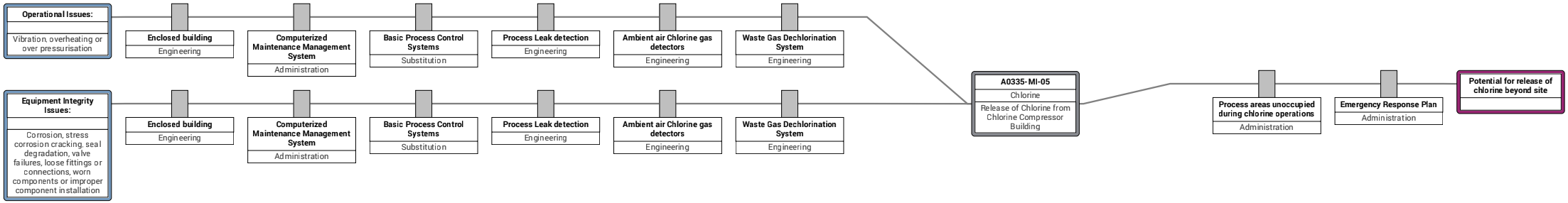
Appendix J. Scenario Bow Ties

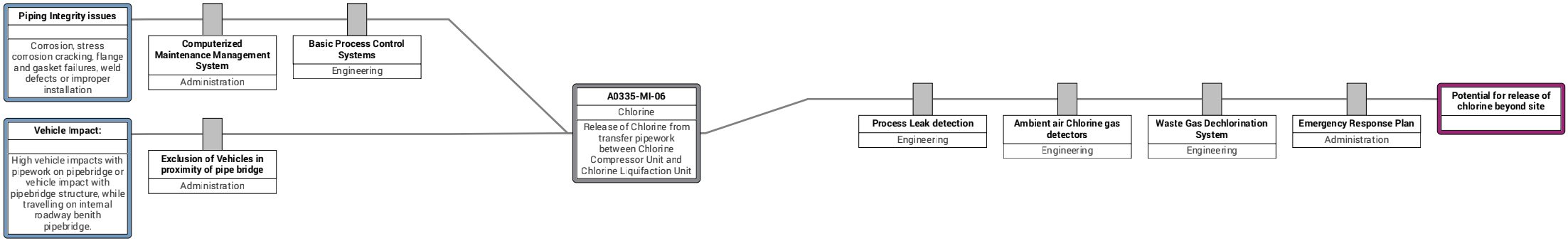
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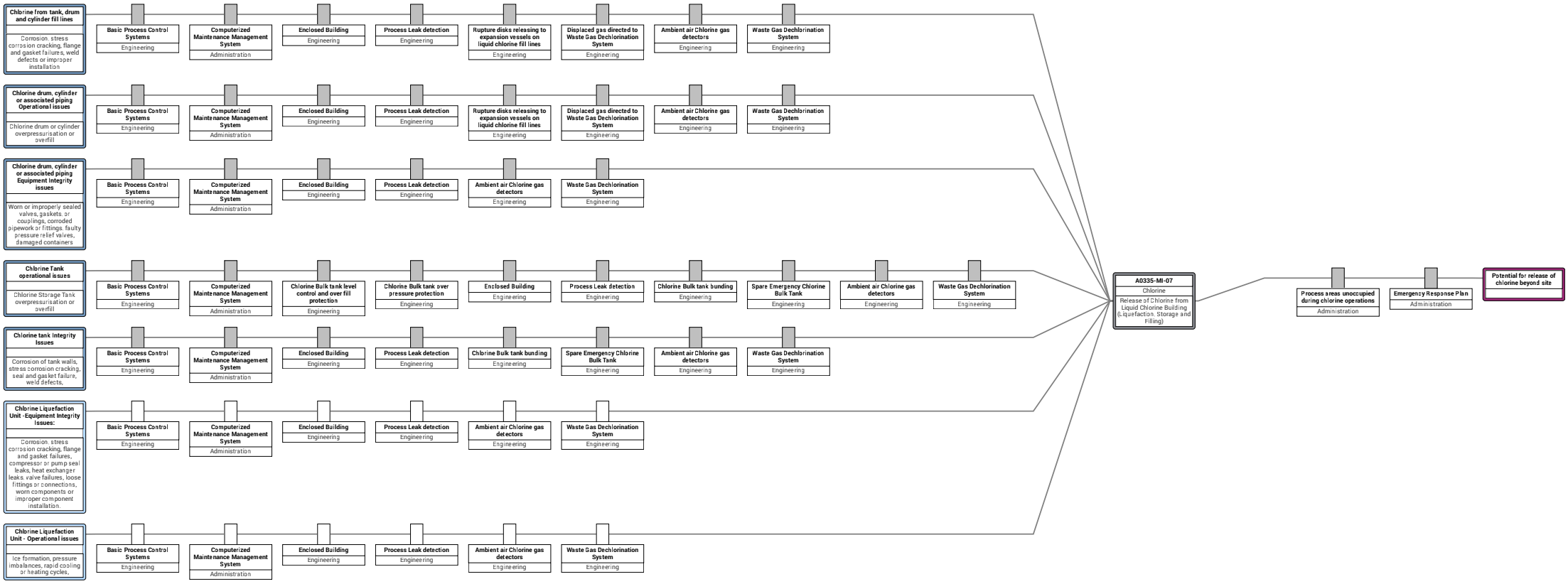

Equipment Integrity Issues - Electrolyzer
Corrosion, stress corrosion cracking, seal degradation, valve failures, loose fittings or connections, worn components or improper component installation
Single Element Electrode Unit
Engineering
Basic Process Control Systems
Engineering
Computerized Maintenance Management System
Administration
Electrode Unit leak detection
Engineering
Ambient air Chlorine gas detectors
Engineering
Enclosed building
Engineering
Waste Gas Dechlorination System
Engineering
Equipment Integrity Issues - Electrolyzer
Corrosion, stress corrosion cracking, seal degradation, valve failures, loose fittings or connections, worn components or improper component installation
Basic Process Control Systems
Engineering
Computerized Maintenance Management System
Administration
Ambient air Chlorine gas detectors
Engineering
Enclosed building
Engineering
Waste Gas Dechlorination System
Engineering
A0335-MI-01
Chlorine
Release of Chlorine from Electrolyzer Building
Process areas unoccupied during chlorine operations
Administration
Emergency Response Plan
Administration
Potential for release of chlorine beyond site

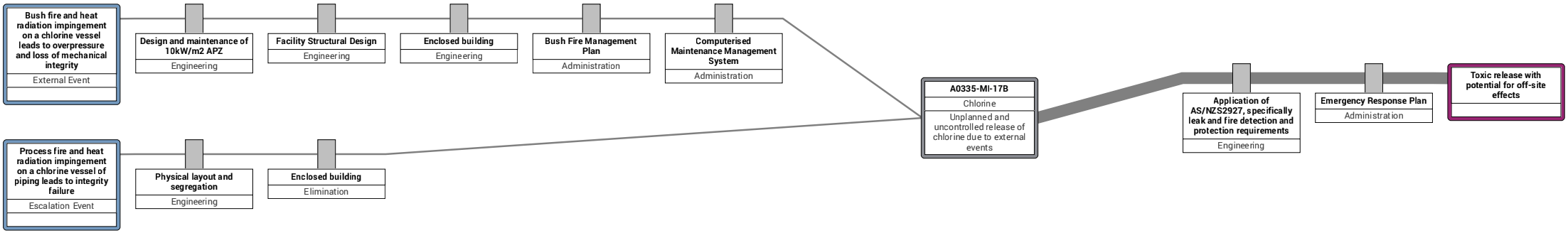

Equipment Integrity Issues
Corrosion, stress corrosion cracking, seal degradation, valve failures, loose fittings or connections, worn components or improper component installation
Basic Process Control Systems
Engineering
Computerized Maintenance Management System
Administration
A0335-MI-03
Chlorine
Release of Chlorine from HCl production unit
Process Leak detection
Engineering
Ambient air Chlorine gas detectors
Engineering
Waste Gas Dechlorination System
Administration
Emergency Response Plan
Administration
Potential for release of chlorine beyond site


Equipment Integrity Issues
Corrosion, stress corrosion cracking, seal degradation, valve failures, loose fittings or connections, worn components or improper component installation
Basic Process Control Systems
Engineering
Computerized Maintenance Management System
Administration
A0335-MI-04
Chlorine
Release of Chlorine from Sodium Hypochlorite production unit
Process Leak detection
Engineering
Ambient air Chlorine gas detectors
Engineering
Waste Gas Dechlorination System
Administration
Emergency Response Plan
Administration
Potential for release of chlorine beyond site

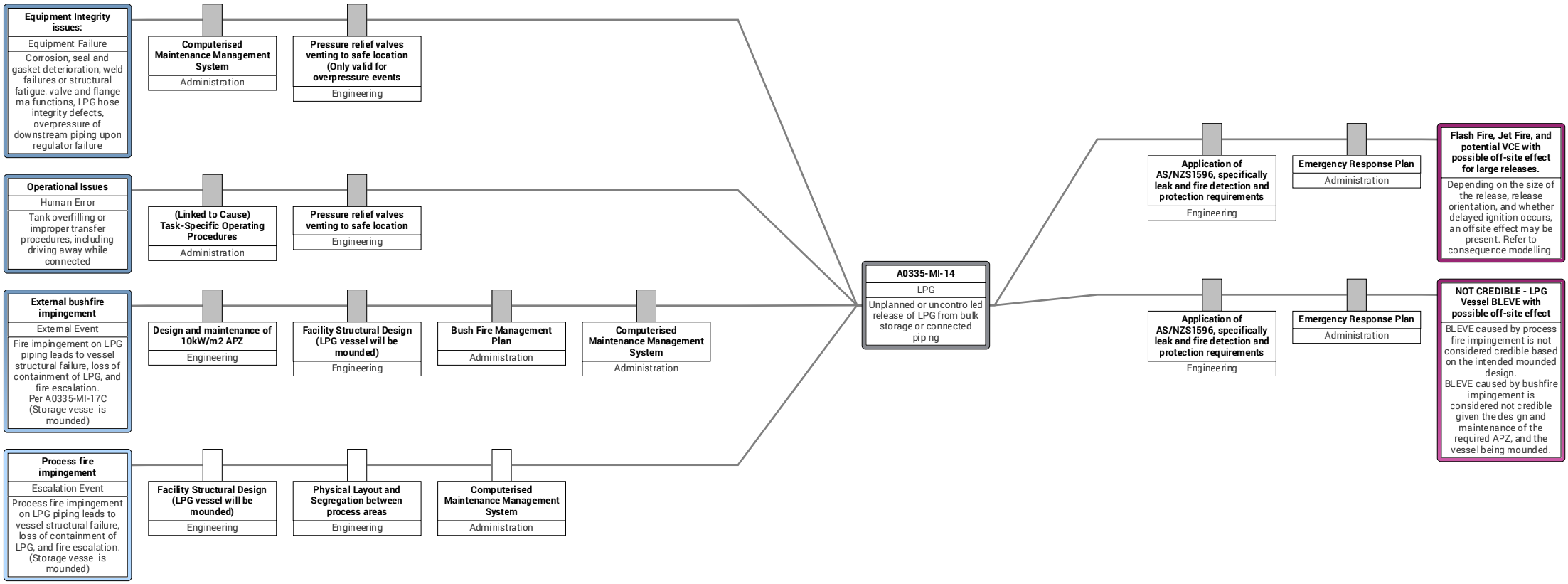

Operational Issues:
Vibration, overheating or over pressurisation
Enclosed building
Engineering
Computerized Maintenance Management System
Administration
Basic Process Control Systems
Substitution
Process Leak detection
Engineering
Ambient air Chlorine gas detectors
Engineering
Waste Gas Dechlorination System
Engineering
Equipment Integrity Issues:
Corrosion, stress corrosion cracking, seal degradation, valve failures, loose fittings or connections, worn components or improper component installation
Enclosed building
Engineering
Computerized Maintenance Management System
Administration
Basic Process Control Systems
Substitution
Process Leak detection
Engineering
Ambient air Chlorine gas detectors
Engineering
Waste Gas Dechlorination System
Engineering
A0335-MI-05
Chlorine
Release of Chlorine from Chlorine Compressor Building
Process areas unoccupied during chlorine operations
Administration
Emergency Response Plan
Administration
Potential for release of chlorine beyond site

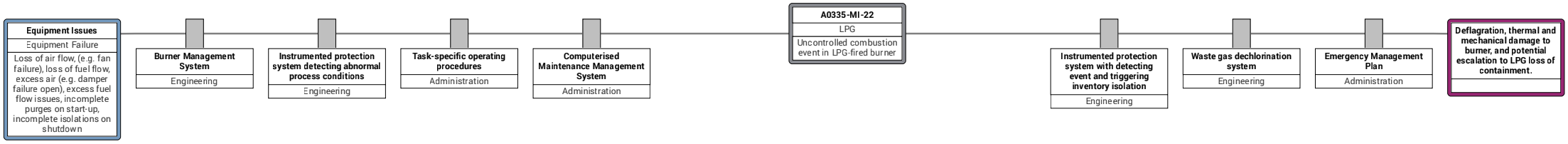

Piping Integrity issues
Corrosion, stress corrosion cracking, flange and gasket failures, weld defects or improper installation
Computerized Maintenance Management System
Administration
Basic Process Control Systems
Engineering
Vehicle Impact:
High vehicle impacts with pipework on pipebridge or vehicle impact with pipebridge structure, while travelling on internal roadway benith pipebridge.
Exclusion of Vehicles in proximity of pipe bridge
Administration
A0335-MI-06
Chlorine
Release of Chlorine from transfer pipework between Chlorine Compressor Unit and Chlorine Liquifaction Unit
Process Leak detection
Engineering
Ambient air Chlorine gas detectors
Engineering
Waste Gas Dechlorination System
Engineering
Emergency Response Plan
Administration
Potential for release of chlorine beyond site


Chlorine from tank, drum and cylinder fill lines
Corrosion, stress corrosion cracking, flange and gasket failures, weld defects or improper installation
Chlorine drum, cylinder or associated piping Operational issues
Chlorine drum or cylinder overpressurisation or overfill
Chlorine drum, cylinder or associated piping Equipment integrity issues
Worn or improperly sealed valves, gaskets, or couplings, corroded pipework or fittings, faulty pressure relief valves, damaged containers
Chlorine Tank operational issues
Chlorine Storage Tank overpressurisation or overfill
Chlorine tank integrity Issues
Corrosion of tank walls, stress corrosion cracking, seal and gasket failure, weld defects,
Chlorine Liquefaction Unit -Equipment Integrity Issues:
Corrosion, stress corrosion cracking, flange and gasket failures, compressor or pump seal leaks, heat exchanger leaks, valve failures, loose fittings or connections, worn components or improper component installation.
Chlorine Liquefaction Unit - Operational issues
Ice formation, pressure imbalances, rapid cooling or heating cycles,
Basic Process Control Systems
Engineering
Computerized Maintenance Management System
Administration
Enclosed Building
Engineering
Process Leak detection
Engineering
Rupture disks releasing to expansion vessels on liquid chlorine fill lines
Engineering
Displaced gas directed to Waste Gas Dechlorination System
Engineering
Ambient air Chlorine gas detectors
Engineering
Waste Gas Dechlorination System
Engineering
Chlorine Bulk tank level control and over fill protection
Engineering
Chlorine Bulk tank over pressure protection
Engineering
Chlorine Bulk tank bunding
Engineering
Spare Emergency Chlorine Bulk Tank
Engineering
Ambient air Chlorine gas detectors
Engineering
A0335-MI-07
Chlorine
Release of Chlorine from Liquid Chlorine Building (Liquefaction, Storage and Filling)
Process areas unoccupied during chlorine operations
Administration
Emergency Response Plan
Administration
Potential for release of chlorine beyond site

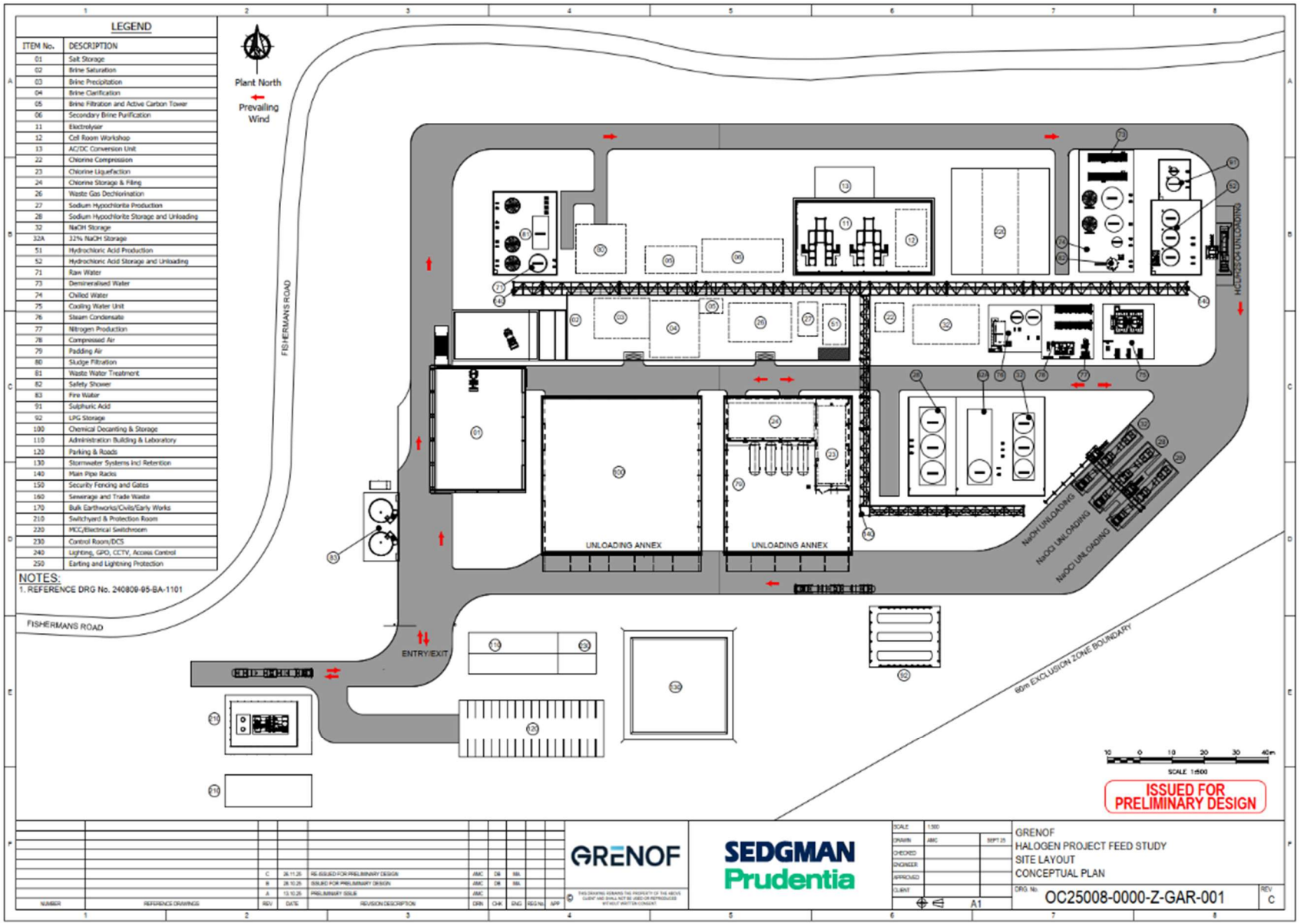

Bush fire and heat radiation impingement on a chlorine vessel leads to overpressure and loss of mechanical integrity
External Event
Design and maintenance of 10kW/m2 APZ
Engineering
Facility Structural Design
Engineering
Enclosed building
Engineering
Bush Fire Management Plan
Administration
Computerised Maintenance Management System
Administration
Process fire and heat radiation impingement on a chlorine vessel of piping leads to integrity failure
Escalation Event
Physical layout and segregation
Engineering
Enclosed building
Elimination
A0335-MI-17B
Chlorine
Unplanned and uncontrolled release of chlorine due to external events
Application of AS/NZS2927, specifically leak and fire detection and protection requirements
Engineering
Emergency Response Plan
Administration
Toxic release with potential for off-site effects

A0335-MI-14 Unplanned or uncontrolled release of LPG from bulk storage or connected piping




Equipment Issues
Equipment Failure
Loss of air flow, (e.g. fan failure), loss of fuel flow, excess air (e.g. damper failure open), excess fuel flow issues, incomplete purges on start-up, incomplete isolations on shutdown
Burner Management System
Engineering
Instrumented protection system detecting abnormal process conditions
Engineering
Task-specific operating procedures
Administration
Computerised Maintenance Management System
Administration
A0335-MI-22
LPG
Uncontrolled combustion event in LPG-fired burner
Instrumented protection system with detecting event and triggering inventory isolation
Engineering
Waste gas dechlorination system
Engineering
Emergency Management Plan
Administration
Deflagration, thermal and mechanical damage to burner, and potential escalation to LPG loss of containment.

Appendix K. Site Layout




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Bushfire Hazard Assessment

Project Halogen: Chlor-Alkali Facility

Gladstone State Development Area

PLANS AND DOCUMENTS
referred to in the
SDA APPROVAL

Queensland Government

SDA approval: AP2025/015

Prepared for

Grenof Water Technologies Pty Ltd

FPA AUSTRALIA
BRONZE MEMBER
Fire Protection Association Australia



23 January 2026
Version 1.4

Document Tracking:

Project Name:	**Bushfire Hazard Assessment - Chlor-Alkali facility** **Gladstone State Development Area**
Client Details:	Grenof Water Technologies Pty Ltd C/o Mr. Scott Lucke Principal Planner CQG Consulting 180 Quay Street, Rockhampton QLD 4700
Project Addresses	Gladstone State Development Area across Lot 1 on MPH32292 and Lot 1 on SP200899
Project Number	J4104
BlackAsh Contact Details	
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Document Control:

Version	Primary Author(s)	Reviewed By	Description	Date Completed
1.4	Lew Short	Lew Short	Final	23 January 2026



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1. Summary

Table 1 is a summary of compliance with relevant documents and approaches to limit bushfire attack and meet the requirements of the Gladstone Regional Council planning scheme (Version 2) framework for new development in Bushfire Prone Areas.

Table 1: Summary

TCP Classification	Material Change of Use Special Industry (chemical manufacturing)
Location	Gladstone State Development Area across Lot 1 on MPH32292 and Lot 1 on SP200899
Local Government Area	Gladstone Regional Council
Can this proposal comply with AS3959:2018	Not applicable
Does this development comply with the purpose of 8.2.4 Bushfire Hazard	Yes
Does this development comply with Section 8.2. Bushfire hazard overlay code	Yes

Assessment Benchmarks	☒ *Bushfire hazard overlay code*
	☒ Meets the deemed to satisfy provisions
	☐ Alternate solution/ performance-based assessment

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2. Definitions

Definitions are provided as per AS3959:2018.

Asset Protection Zone (APZ)	An area between an asset and a bushfire hazard where bushfire fuel has been reduced significantly to protect the asset.
Bushfire	An unplanned fire burning in forest scrub or grassland vegetation, also referred to as a wildfire.
Bushfire attack	Attack by burning debris, radiant heat or flame generated by a bushfire which might result in ignition and subsequent destruction of a building.
Bushfire Attack Level (BAL)	A means of measuring the severity of a building's potential exposure to ember attack, radiant heat and direct flame contact, using increments of radiant heat expressed in kilowatts per metre squared (kWm^2), and the basis for establishing the requirements for construction to improve protection of building elements from attack by bushfire. The following BALs, based on heat flux exposure thresholds are used in this report: (a) BAL—LOW (b) BAL—12.5 (c) BAL—19 (d) BAL—29 (e) BAL—40 (f) BAL—Flame Zone
Bushfire hazard	A fuel complex, defined by volume, type condition, arrangement, and location, that determines the degree of ease of ignition and of resistance to control. Bushfire hazards are variable in their severity, with severity levels usually measured in terms of the fire intensity (kW/m^2) arising from the hazard.
Bushfire prone area	An area that can support a bushfire or is likely to be subject to bushfire attack including forest, woodland, grassland and scrubland as well as nearby stands of vegetation. Bushfire prone areas do not include maintained lawns, parks or gardens, nature strips, plant nurseries, golf courses, vineyards, orchards or vegetation on land that is used for horticultural purposes.
Classified vegetation	Vegetation that has been classified in accordance with Clause 2.2.3 of AS3959.
Fire Danger Index (FDI)	The chance of a fire starting, its rate of spread, its intensity and the difficulty of its suppression, according to various combinations of air temperature, relative humidity, wind speed and both the long- and short-term drought effects.

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3. Introduction

Blackash Bushfire Consulting has been engaged by CQG Consulting on behalf of the proponent Grenof Water Technologies Pty Ltd to provide a Bushfire Hazard Assessment for the proposed Major Hazard Facility at Gladstone State Development Area (GSDA) across Lot 1 on MPH32292 and Lot 1 on SP200899 (the site) which is at Figure 1. The proposed development is a Chlor-Alkali facility (Figure 2).

The Project area is approximately 6.9ha which includes plant and ancillary facilities including a chlor-alkali plant and ancillary facilities including office, car parking and utilities (water, power and communications). The plant is proposed to run 24 hours a day, 365 days per year. The Queensland Investment Corporation is a 50% investment partner. The project is critical infrastructure to mitigate sovereign risk associated with essential chemicals vital for Australia's industrial, economic and public health sectors.

The site lies within an area mapped under the Queensland State Planning Policy's Bushfire Prone Area mapping and the Gladstone Regional Council Planning Scheme Bushfire Hazard Overlay as having Medium Potential Bushfire Intensity (Figure 3). The Gladstone Regional Council planning scheme (Version 2) provides a range of bushfire requirements and considerations for new development on bushfire prone land (see Appendix 2). Section 3.7.2 requires that:

> *Safety and resilience to natural hazards including flooding, bushfire, landslide and coastal hazards is a focus for the future of the region. Development must avoid or be designed to mitigate the risks of natural hazards for the safety and resilience of the population in flood, bushfire, coastal hazard or steep land areas.*

The proposal will comply with this requirement within this report.

As a MHF, the chlor-alkali facility will be subject to a rigorous, legally enforced framework for identifying, controlling, and continuously improving safety measures to prevent catastrophic incidents. GWT's process design and containment systems will maintain minimal, if any chlorine atmospheric releases during normal operation. A significant accidental release of chlorine from the facility, including in the event of a bushfire, is very unlikely.

The separate A0335-REP-001 Hazard Assessment Report Grenof Project Halogen Facility has assessed the potential risks associated with chemical releases and should be viewed for chemical specific considerations and mitigations.

Within the Gladstone Regional Council Planning Scheme, the Bushfire Hazard Overlay Code establishes assessment benchmarks to ensure that development maintains the safety of

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people and property by not exposing them to unacceptable bushfire risk. For land mapped as Medium Potential Bushfire Intensity, development must generally provide a minimum separation of 10 metres to hazardous vegetation (see A05.3 in Appendix 2), adequate access for emergency services, and a reliable water supply for fire-fighting purposes. These provisions are supported by performance outcomes that require siting, design and management measures to reduce the vulnerability of built assets to bushfire impacts (Gladstone Regional Council Planning Scheme v2, Part 8.2.4 – Bushfire Hazard Overlay Code).

The *State Planning Policy* (SPP) 2017 also places emphasis on managing bushfire risk where hazardous materials are stored or handled. It requires that natural hazard impacts, including bushfire, do not exacerbate the risk of hazardous chemicals, flammable substances or toxic releases affecting surrounding communities. In Gladstone, where major industrial activities such as chemical manufacturing and storage are strategically significant, this policy direction is particularly relevant. Developments involving hazardous industries must demonstrate through a Bushfire Hazard Assessment and management measures that the design and operation of facilities will not increase off-site safety risks in the event of bushfire exposure (Queensland Government, *State Planning Policy*, July 2017).

Asset protection zones form a key component of the overall bushfire risk-mitigation strategy for vulnerable uses in accordance with the *Bushfire Resilient Communities Technical Reference Guide*, for the storage or manufacture of hazardous materials, and community infrastructure providing essential services where such development is unavoidable within a Bushfire Prone Area and where the relevant policy conditions are satisfied. For this development, site planning has incorporated an asset protection zone through the establishment of building setbacks that separate the development footprint from the nearest mapped medium, potential bushfire intensity vegetation to a distance sufficient to limit radiant heat exposure to no more than 10 kW/m² at all building boundaries, thereby reducing the potential for flame contact and enhancing the resilience of the proposed buildings to bushfire attack.

Proposals for hazardous industries within areas mapped as Medium Potential Bushfire Intensity must adopt a precautionary approach. This includes incorporating separation from hazardous vegetation, providing defendable space and emergency vehicle access, and ensuring that critical infrastructure such as hazardous material stores, transformers, and control rooms are designed to withstand credible bushfire conditions. By doing so, development can demonstrate compliance with both local planning scheme benchmarks and state policy obligations, and show that risks are reduced to an acceptable or tolerable level consistent with the principle of maintaining public safety.

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As such, bushfire has been a key consideration for the project, not just for meeting the requirements of the government documents, but also considering the vulnerability of the assets to bushfire (and consequence of loss), the potential for significant service interruption, the potential for starting bushfires, and the benefits to ongoing bushfire management within the wider area arising from improved infrastructure and the increased presence of a trained workforce.

Although the site is mapped as having Medium Potential Bushfire Intensity (Figure 3), the fire weather severity map is 63 Fire Danger Index (Figure 4) which provides a landscape setting presenting the potential for large-scale bushfires to develop and impact both the site and the surrounding area, particularly under severe weather conditions. Although the area surrounding the site has a range of existing uses, the connectivity of vegetation across the broader landscape (within Targinie State Forest and surrounding unmanaged natural bushland areas) enables fire to travel rapidly and with intensity, increasing the exposure of the site to ember attack, radiant heat, and potential flame contact. The risk is further compounded by prevailing topography and wind patterns that may drive fire toward the site and could compromise access to and from the site. Accordingly, strategic consideration of bushfire behaviour at the landscape scale is essential to inform development planning and to ensure that appropriate mitigation measures are implemented. As such a conservative approach to site utilisation has been taken.

This assessment has been prepared by Mr. Lew Short, Principal at Blackash Bushfire Consulting (Level 3 FPAA BPAD-A Certified Practitioner No. BPD-PA-16373) who is recognised by the Fire Protection Association of Australia as qualified in bushfire risk assessment in NSW (Queensland does not have an accreditation scheme) and has been accredited by the Fire Protection Association of Australia as a suitably qualified consultant to undertake alternative solution proposals. This assessment is based on a desktop assessment of the study area.

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Figure 1 Site Location

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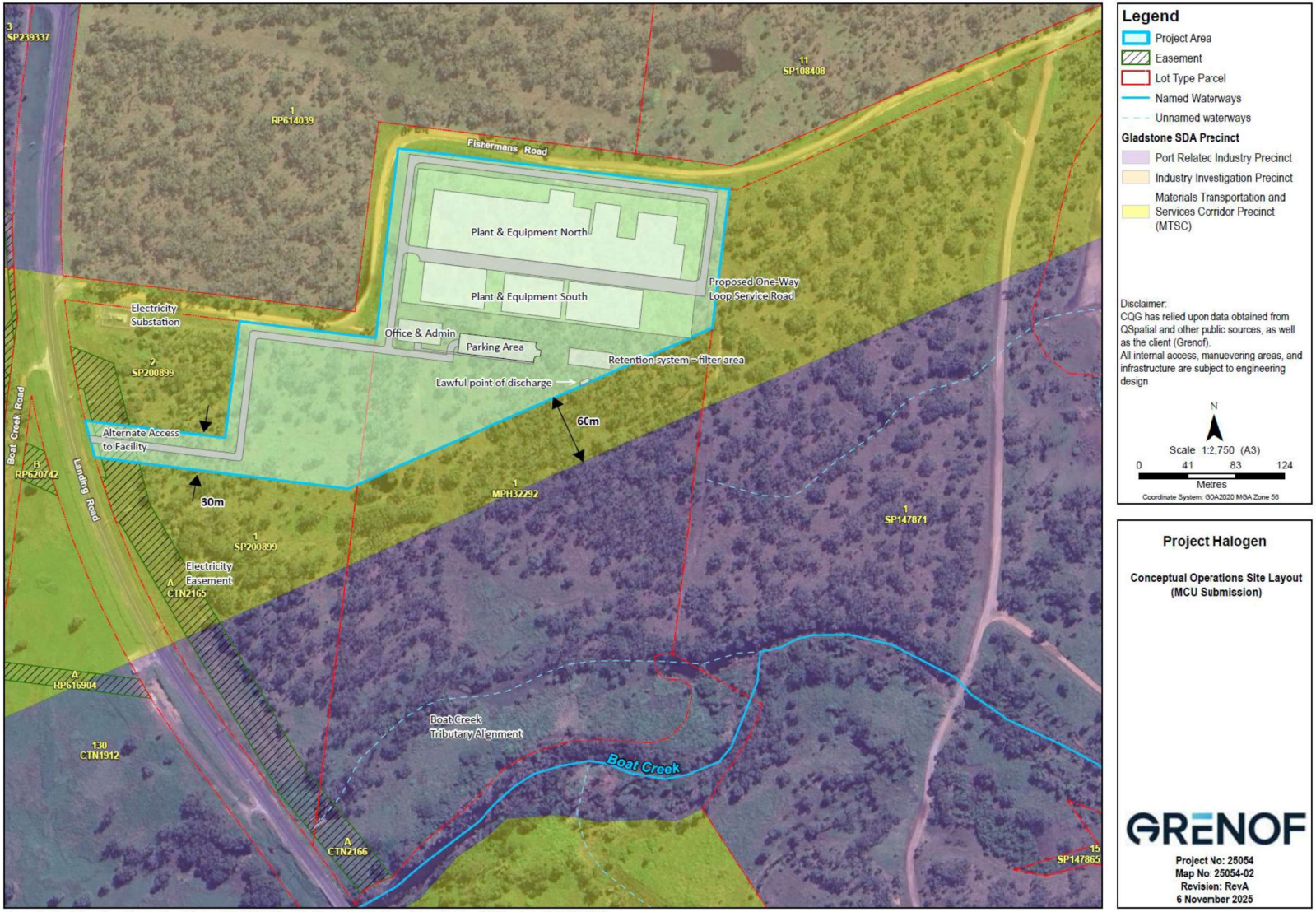


Figure 2 The Proposal

4. Bushfire Risk Associated with the facility

A0335-REP-001 Hazard Assessment Report Grenof Project Halogen Facility has assessed the potential risks associated with chemical releases, including where the radiant/convective heat from a bushfire is the initiating cause or the degradation mechanism for a critical safety system. The design will be compliant with AS/NZS 2927:2019 The storage and handling of liquefied chlorine gas, and AS/NZS 1596 The storage and handling of LP Gas, with a bias towards hazard avoidance.

The Hazard Assessment Report has confirmed that no dangerous agent-firefighting reactions are expected due to the site following:

- Compliance with all safety data sheet guidance for the chemicals produced/ stored on site;
- All chemicals are appropriately segregated in accordance with Australian standards for incompatible materials;
- All end product aqueous production chemicals will be stored in bunded storage tanks preventing any spillage into the environment in the event of a bushfire;
- None of the chemicals produced by the chlor-alkali plant are flammable except for hydrogen which is vented below LEL;
- All pressure vessels that store liquified chlorine gas will be housed in a building and will be compliant with Australian standards for pressure vessels. This is a key compliance obligation that will form part of Grenof's operating protocols;
- The site plans to use piped natural gas for HCl synthesis. Alternatively, LPG will be supplied by a third party, with a moderate on-site inventory required to support production rates
- An emergency firefighting plan for Project Halogen's site will be developed in conjunction with the local firefighting department.

These measures collectively demonstrate compliance with the State Planning Policy (July 2017), particularly the *State Interest – Emissions and Hazardous Activities*, which requires that developments involving hazardous materials are located, designed and managed to minimise risk to people, property and the environment. The project design ensures that the storage, handling and containment of chemicals will not exacerbate bushfire hazard impacts or result in the release of hazardous materials during a bushfire event. This also satisfies Schedule 8.2.4 of the Gladstone Regional Council Planning Scheme – Bushfire Hazard Overlay Code, which requires that *"the potential for the release of hazardous material as a result of a bushfire event is avoided."*

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The facility's compliance with Australian Standards for chemical storage and pressure vessels, bunded containment systems, hydrogen venting protocols all contribute to a robust and defensible hazard-mitigation framework consistent with both State and local planning policy objectives.

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5. Bushfire Prone Areas

Parts of the site are identified as being within 'Bushfire Prone Areas' (BFA), refer to Figure 3 for the purposes of Chapter 2, Part 3 of the *Planning Act 2016* and the legislative requirements for development within BFA are applicable to the site.

BFA is land that has been identified by council, which can support a bushfire or is subject to bushfire attack. BFA maps are prepared by Council and included in Schedule 2.5 Overlay maps.

The Development constraints overlay map (Bushfire hazard) provides a trigger for the development assessment benchmarks and consideration of sites that are bushfire prone. BFA maps are an indication of the potential for bushfire attack and are not a risk assessment of land. The Schedule 2.5 Overlay maps (at Figure 3)identifies two (2) categories of BFA; namely:

- **Medium bushfire hazard area**: which is considered to be a lower bushfire risk than High bushfire hazard areas, but higher than the excluded areas and represented as orange on the bushfire prone area map and is subject to a 30 metre buffer. This category has lower combustibility and/or limited potential fire size due to the vegetation area shape and size, land geography and management practices. This category consists of rainforests, lower risk vegetation parcels, Grasslands and remnant vegetation.
- **High bushfire hazard area**: which is considered to be high bush fire risk vegetation. It is higher in bush fire risk than Medium bushfire hazard areas (and the excluded areas) but lower than Very high bushfire hazard areas. It is represented as light red on a Bush Fire Prone Area map and is subject to a 30 metre buffer. This category consists of: woodlands, pine forests and shrublands.

The site is affected by Medium bushfire hazard area and impact buffer (Figure 3).

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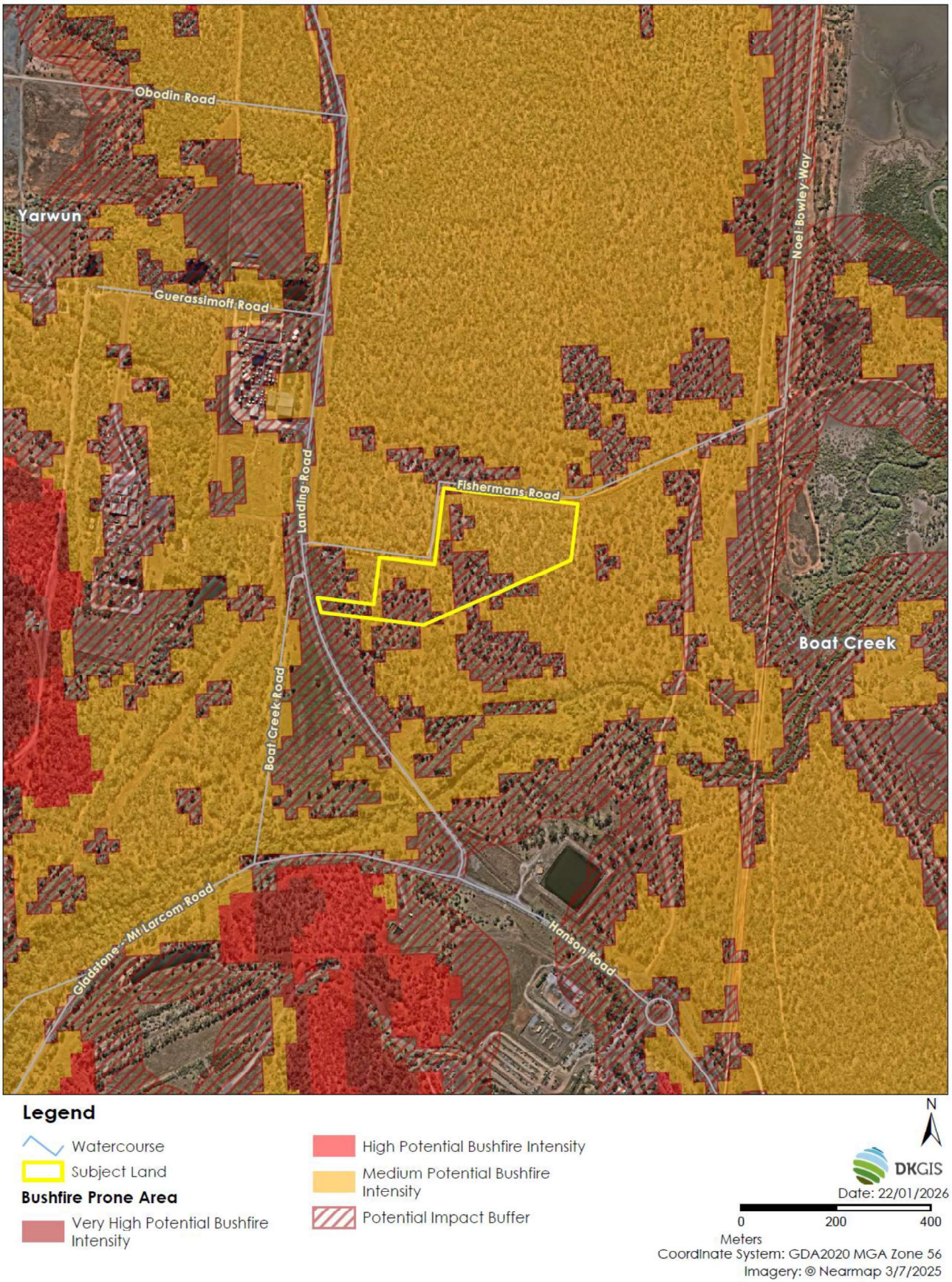


Figure 3 Bushfire Prone Land Map

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6. Weather

The bushfire season in Central Queensland, including the Gladstone Region, generally occurs from August through to December, although bushfires can occur at any time of year under suitable conditions. The official bushfire danger period is not fixed annually as it is in some southern states; instead, Queensland Fire and Emergency Services (QFES) may declare local fire danger periods or fire bans when conditions warrant.

Prevailing fire-weather conditions in the Gladstone area are typically associated with dry westerly to north-westerly winds, high temperatures, and low relative humidity. These conditions are often preceded by periods of dry vegetation and limited rainfall following the winter dry season. Dry lightning storms can occur during the transition to the wet season, and multi-day hot, dry spells with strong winds significantly elevate bushfire risk.

The Australasian Fire and Emergency Services Council (AFAC) Bushfires and Community Safety Position Paper (p. 3) outlines nationally agreed positions for the fire services which states that:

> *Bushfire loss can be reduced or avoided in some cases but cannot be entirely prevented. A balance needs to be struck between measures taken to reduce or avoid harm and loss due to bushfire, and the protection of other values.*

The position paper (p. 3) recognises that:

> *Bushfire is a normal part of Australia's natural environment, particularly in eucalypt forests and grasslands. However, the frequency and intensity of bushfires varies throughout the landscape and the seasons. Bushfires are a common occurrence during the drier periods of the year in most places.*

And that;

> *Bushfires of low or moderate intensity often pose little threat to life, property and community assets, but the potential for changes in wind direction can be a significant hazard. However, bushfires that burn in heavy fuels, steep terrain or on hot, dry and windy days often spread rapidly, crown in forests, produce powerful convection columns and create extensive spot fires ahead of the fire front, often making their control impossible until weather conditions moderate.*

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> *As the Fire Danger Rating reaches 'Extreme', bushfires are often described as 'firestorms' and become impossible to control. When the Fire Danger Rating approaches 'Catastrophic', the risk of serious injury or death to people in the path of a bushfire increases significantly, and many properties and other community infrastructure can become difficult or impossible to defend.*

The QLD planning framework does not seek to stop fires, rather, it recognises the fundamental risk of bushfire affecting new development and puts in place minimum requirements to provide a tolerable approach to risk management. For critical infrastructure, it is up to the asset owner to determine the tolerable risk and meet minimum requirements. The Project's design engineers have performed a detailed assessment on the critical infrastructure.

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7. Bushfire Hazard Assessment

The bushfire assessment considers the likelihood of a bushfire, its potential severity and intensity and the potential impact on life and property in the context of the broader surrounding landscape. The likelihood of a bushfire, its severity and intensity, and the potential impact on life and property varies depending on where a site is located in the landscape. There are a number of factors that influence the potential bushfire behaviour at a landscape scale, including:

- extent and continuity of vegetation;
- topography;
- Accessibility of the landscape for fire response and fire suppression. This can greatly influence the potential fire-fighting strategies and their success;
- the potential fire run (potential size of the fire determined by available fuel) and area that is likely to be impacted by the fire. For example, a large bushfire may impact areas many kilometres in front of the main fire;
- the location and exposure of urban areas, townships, and isolated rural areas to a bushfire; and
- the extent of neighbourhood-scale damage the bushfire may produce.

The Project is exposed to both landscape scale risk (broader landscape) and localised bushfire risk. It is located within a landscape comprising areas of relatively complex terrain with a mix of remnant forest and woodland areas, and grassland hazards which are likely to result in varied fire behaviour based upon localised terrain, fuel and wind conditions.

Grassland fires are fast moving fires that often move quickly through the landscape and are highly dependent on curing (dryness of the grass) and the underlying dryness of the landscape. They can generate enormous amounts of heat, with an average flame height from between 2 to 5 metres. The taller and drier the grass, the more intensely it burns.

Blackash have performed an independent assessment and review for the bushfire risk posed to the infrastructure sites, which is demonstrated in the following sections.

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7.1. Fire Weather

Bushfires are a normal part of the landscape in Central Queensland and are predicted to become more severe, more frequent and an increasingly common part of life. Climate change modelling predicts increasing frequency and severity of fire events correlating with altered rainfall and drought patterns and increasing numbers of severe and intense heat events. As the dryness of more areas increases beyond levels historically considered 'normal', the footprint of areas with a propensity to burn are likely to increase. AS3959:2018 assumes a credible worst-case fire burning under a 1:50 year weather or fire event. This design fire could underrepresent the intensity and frequency of bushfires with climate change.

The fire weather severity map (Figure 4) shows an FDI of 63 for the site and surrounding areas.

Fire weather is presented as a Fire Danger Index (FDI), which identifies the chance of a fire starting, its rate of spread, its intensity and the difficulty potential for its suppression, considering various factors such as temperature, humidity, wind and drought effects. As such, a higher FDI equates to a higher bushfire risk profile for an area of vegetation.

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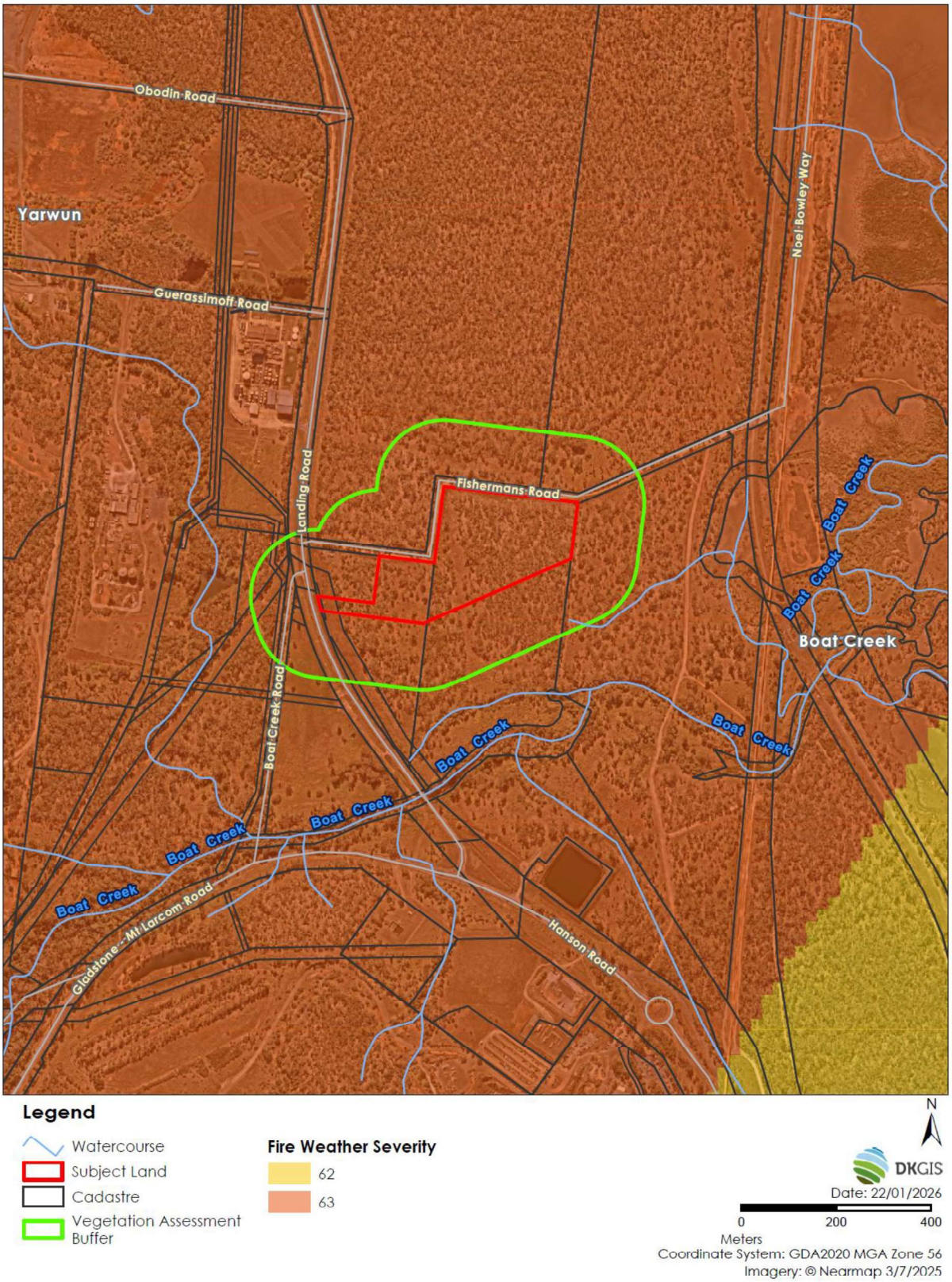


Figure 4 Fire Weather Severity

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7.2. Vegetation Characteristics

The vegetation assessment has been undertaken in accordance with the relevant bushfire planning framework outlined in Section 7.5.2 of the Bushfire Resilient Communities 2019, with vegetation that contributes to bushfire hazard classified using a modified version of Queensland's broad vegetation groups. This process identifies vegetation hazard classes (VHC) and determines whether vegetation is considered bushfire-prone based on its capacity to support a significant bushfire.

The predominant vegetation has been determined over a distance of at least 100 metres in all directions from the proposed work area / structure footprint on the site. Where a mix of vegetation types exist, the type providing the greater hazard is said to predominate. The mapping of vegetation has been completed using available State data sets and air photograph interpretation.

The extent of the mapped VHC within the subject site was reviewed using a combination of recent aerial photography, GIS mapping and data from the Queensland Government data portal, refer to Figure 5. Figure 5 is an extract from the Bushfire Resilient Communities MapViewer showing the vegetation type. The predominant vegetation affecting the site is VHC - Broad Vegetation Hazard Class: 18.2 Dry eucalypt woodlands on sand or depositional plains[1].

7.3. Slopes Influencing Bushfire Behaviour

Slopes have been assessed in accordance with Section 7.5.4, 7.5.5 and 7.5.6 of the Bushfire Resilient Communities 2019 and Clause 2 of AS3959:2018 which requires assessment of the effective slopes impacting on a subject site. The slope of the land under the classified vegetation (effective slope) has a direct influence on the rate of fire spread, the intensity of the fire and the ultimate level of radiant heat flux. The effective slope is the slope of the ground under the hazard (vegetation). In identifying the effective slope, it may be found that there are a variety of slopes covering different distances within the vegetation. The effective slope is considered to be the slope under the vegetation which will most significantly influence the bushfire behaviour for each transect. This is usually the steepest slope.

The 'effective slope' influencing fire behaviour has been assessed in accordance with the methodology specified within AS3959:2018. This is conducted by measuring the worst-case

[1] Accessed from the Queensland Bushfire Resilient Communities MapViewer on 21 January 2026

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scenario slope where the vegetation occurs over a 100 metre transect measured outwards from the development boundary. The slope assessment has been completed to determine the Bushfire Attack Level (BAL) at key project locations. The topography of the study area and surrounds are largely flat (see Figure 7).

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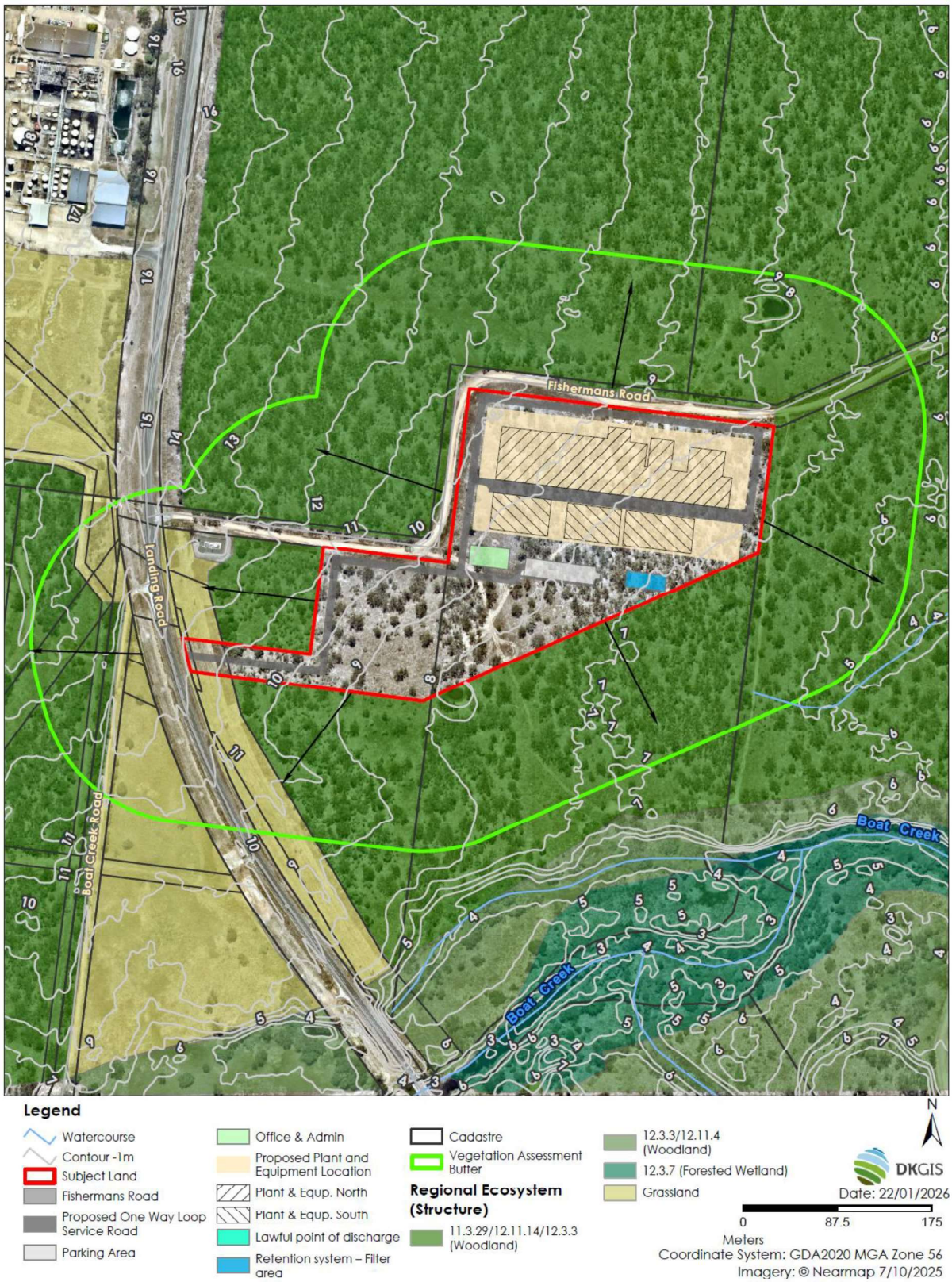


Figure 6 Vegetation & Slope Assessment

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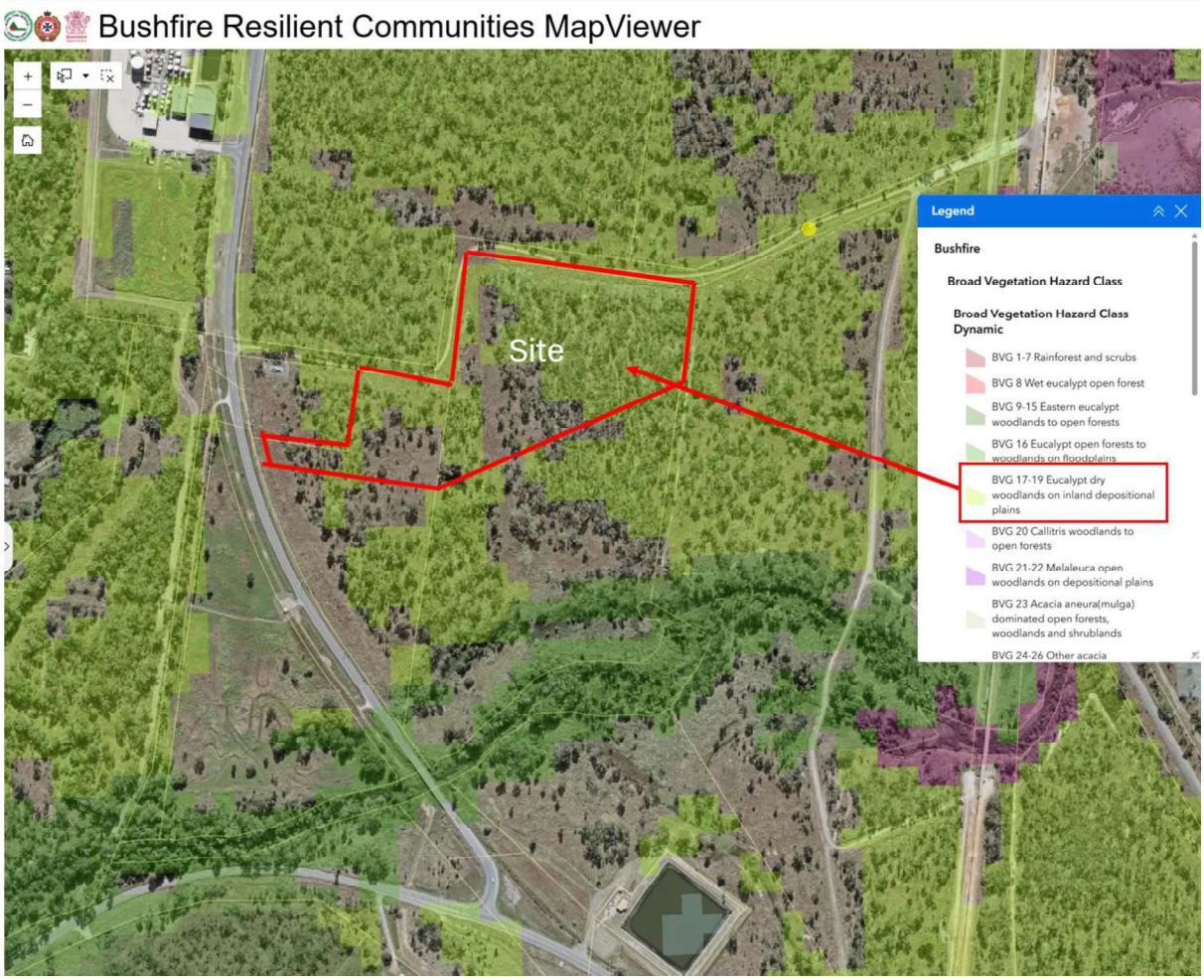


Figure 7 Bushfire Resilient Communities MapViewer

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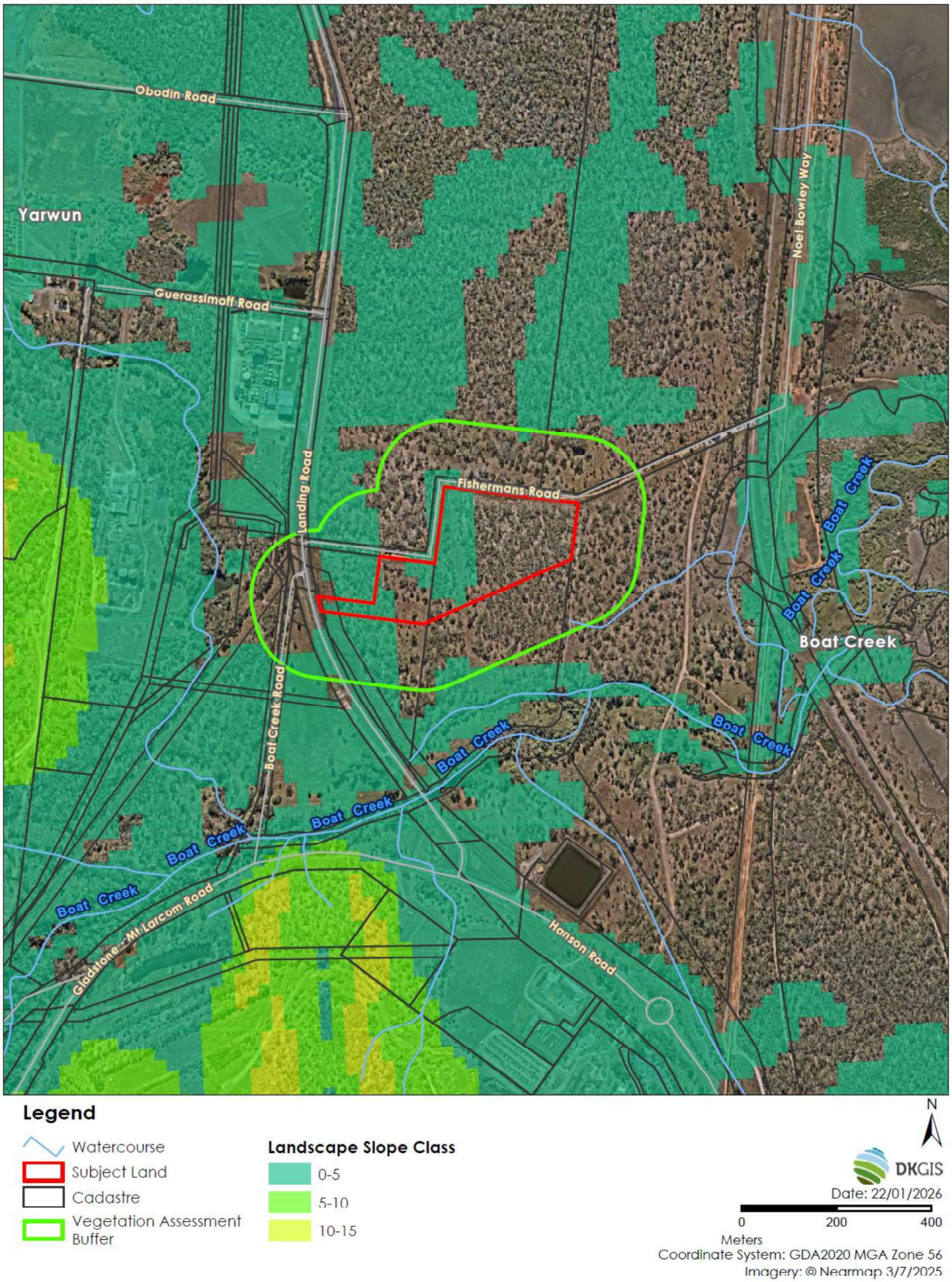


Figure 8 Detailed Slope Assessment

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7.4. Distance from Hazardous Vegetation

For the purposes of this assessment, the managed separation area—commonly referred to as the APZ is defined as the horizontal distance measured in plan between the edge of hazardous vegetation (being the outer edge of the canopy for forest, woodland and heath vegetation hazard classes) and the relevant building reference point. This reference point may include the closest point of a building envelope or lot boundary, the external wall of a building, or supporting posts and columns for unenclosed structures such as decks or carports, consistent with AS 3959–2018.

The proposed buildings are setback by approximately 30 metres (see Figure 2) from unmanaged hazardous vegetation, with the separation distance informed by the identified vegetation hazard class and slope conditions. This setback increases the level of protection by reducing the potential intensity of bushfire attack, as expressed by radiant heat flux, to which the development may be exposed.

7.5. Fire Intensity

The site lies within an area mapped under the Queensland State Planning Policy's Bushfire Prone Area mapping and the Gladstone Regional Council Planning Scheme Bushfire Hazard Overlay as having Medium Potential Bushfire Intensity (Figure 3). This classification indicates that, under severe fire weather, the vegetation, slope, and fuel loads are sufficient to generate a fireline intensity between approximately 1,000 and 15,000 kW/m (based on FDI 80) of fire front (Figure 9). The likely bushfire behaviour includes strong radiant heat, ember attack, possibly flame front spread, though less severe than High or Very High zones.

While the broader setting contains areas of elevated intensity, the immediate site context is predominantly within the lower intensity bands, indicating that with appropriate separation distances, asset protection measures and construction design, future development can be managed to meet the bushfire protection requirements. Careful siting, access design and provision of defendable space will be critical in mitigating radiant heat exposure on the subject land.

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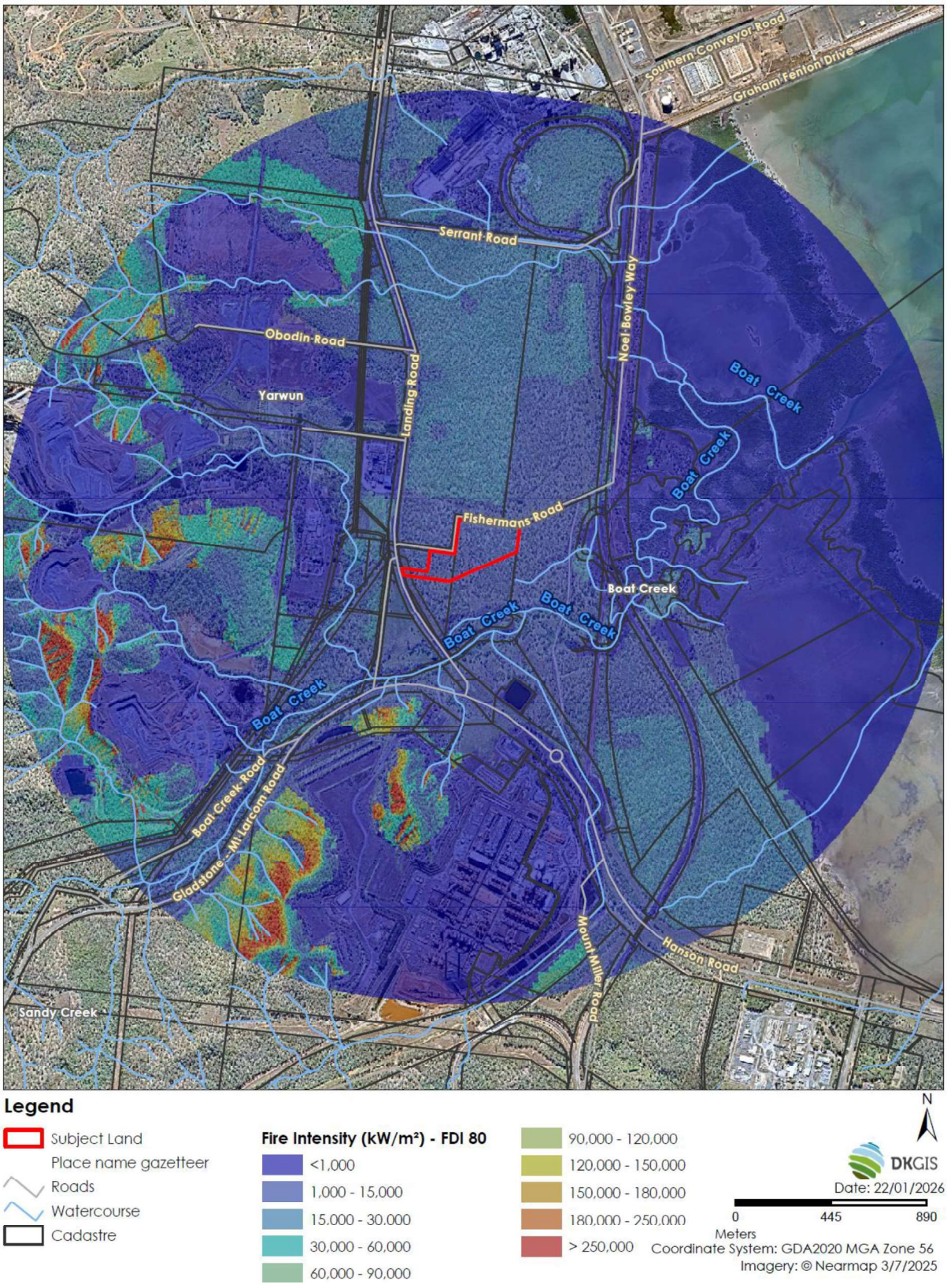


Figure 9 Fire Intensity

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8. Asset Protection Zone (APZ)

A key part of managing bushfire risk is the provision of APZs, which is a is a fuel-reduced, physical separation between an asset and bushfire hazard vegetation, to achieve a prescribed radiant heat level on the relevant building / structure. The APZ also provides a suitable defendable space within which firefighting operations can be carried out.

The critical infrastructure associated with the project should be designed in such a way as to minimise the impact of bushfire on the infrastructure (ignition and propagation) and ensure that critical infrastructure does not cause a bushfire, or that capabilities are not compromised during bushfire emergencies. Bushfire protection measures should be commensurate with the bush fire risk and criticality of the infrastructure. The site should be managed in its entirety as an APZ.

Asset protection zones for vulnerable uses, the storage or manufacture of hazardous materials, and community infrastructure providing essential services form part of the overall risk-mitigation approach where such developments are unavoidable within a Bushfire Prone Area and where the conditions under policies 6, 7 and 8 of this document are met. Site planning may incorporate asset protection zones as part of selected risk-mitigation treatments, including a development footprint plan that is separated from the closest edge of the adjacent mapped medium, high or very high potential bushfire intensity area by a distance (the APZ width) sufficient to achieve a radiant heat flux level of 10 kW/m² or less at all development footprint boundaries.APZ Calculation

In accordance with the *Bushfire Resilient Communities Technical Reference Guide* supporting the *State Planning Policy State Interest – Natural Hazards, Risk and Resilience (Bushfire), Section 9.4 Asset protection zones for vulnerable uses, storage or manufacture of materials that are hazardous and community infrastructure for essential services* requires that APZs are incorporated as part of the site-wide bushfire risk-mitigation strategy for the storage or manufacture of hazardous materials, and community infrastructure providing essential services, where such development is unavoidable within a Bushfire Prone Area.

Site planning integrates APZs as a primary mitigation measure, with the development footprint setback from the nearest edge of mapped medium potential bushfire intensity areas by a distance of approximately 30m which sufficient to limit radiant heat exposure to **10 kW/m² or less** at all development footprint boundaries. The calculations are at Figure 10. Figure 11 shows the proposed building footprints with the 30m APZ. This approach delivers an appropriate level of life safety, asset protection and operational resilience, consistent with the objectives and performance outcomes of the Bushfire Resilient Communities Technical Reference Guide.

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SPP Bushfire Asset Protection Zone Width Calculator			
VARIABLE DESCRIPTION	VARIABLE	UNITS	VALUE
Input Values			
FIRE WEATHER SEVERITY	FDI		63.00
VEGETATION HAZARD CLASS	VHC	-	18.2 Dry eucalypt woodlands on sand or depositional plains
REMNANT STATUS	-	-	Non-Remnant
SLOPE TYPE (UPSLOPE OR DOWNSLOPE)	ST	-	Downslope
EFFECTIVE SLOPE UNDER THE HAZARDOUS VEGETATION	eSlope	degrees	1.00
SLOPE BETWEEN SITE AND HAZARDOUS VEGETATION	θ	degrees	1.00
DISTANCE OF THE SITE FROM HAZARDOUS VEGETATION	d	m	30.00
Output Values			
SURFACE FUEL LOAD	-	t/ha	7.10
NEAR SURFACE FUEL LOAD	-	t/ha	3.30
BARK FUEL LOAD	-	t/ha	0.60
ELEVATED FUEL LOAD	-	t/ha	0.00
TOTAL OVERALL FUEL LOAD	W	t/ha	11.00
TOTAL SURFACE FUEL LOAD	w	t/ha	10.40
POTENTIAL FIRE LINE INTENSITY	I	kW/m	4788
RADIANT HEAT FLUX	q	kW/m^2	9.65
BUSHFIRE ATTACK LEVEL (AS 3959-2018)	BAL	-	BAL 12.5

DISCLAIMER: Fire-line intensity and radiant heat calculations where effective slope exceeds 20 degrees (downslope) or 15 degrees (upslope) may be unreliable. In these locations, specialist assessment is warranted.

Figure 10 APZ Calculation

Asset protection zones form a key component of the overall bushfire risk-mitigation strategy for the storage or manufacture of hazardous materials, and community infrastructure providing essential services where such development is unavoidable within a Bushfire Prone Area and where the relevant policy conditions are satisfied. For this development, site planning has incorporated an asset protection zone through the establishment of building setbacks that separate the development footprint from the nearest mapped medium, high or very high potential bushfire intensity vegetation to a distance sufficient to limit radiant heat exposure to no more than 10 kW/m² at all building boundaries, thereby reducing the potential for flame contact and enhancing the resilience of the proposed buildings to bushfire attack.

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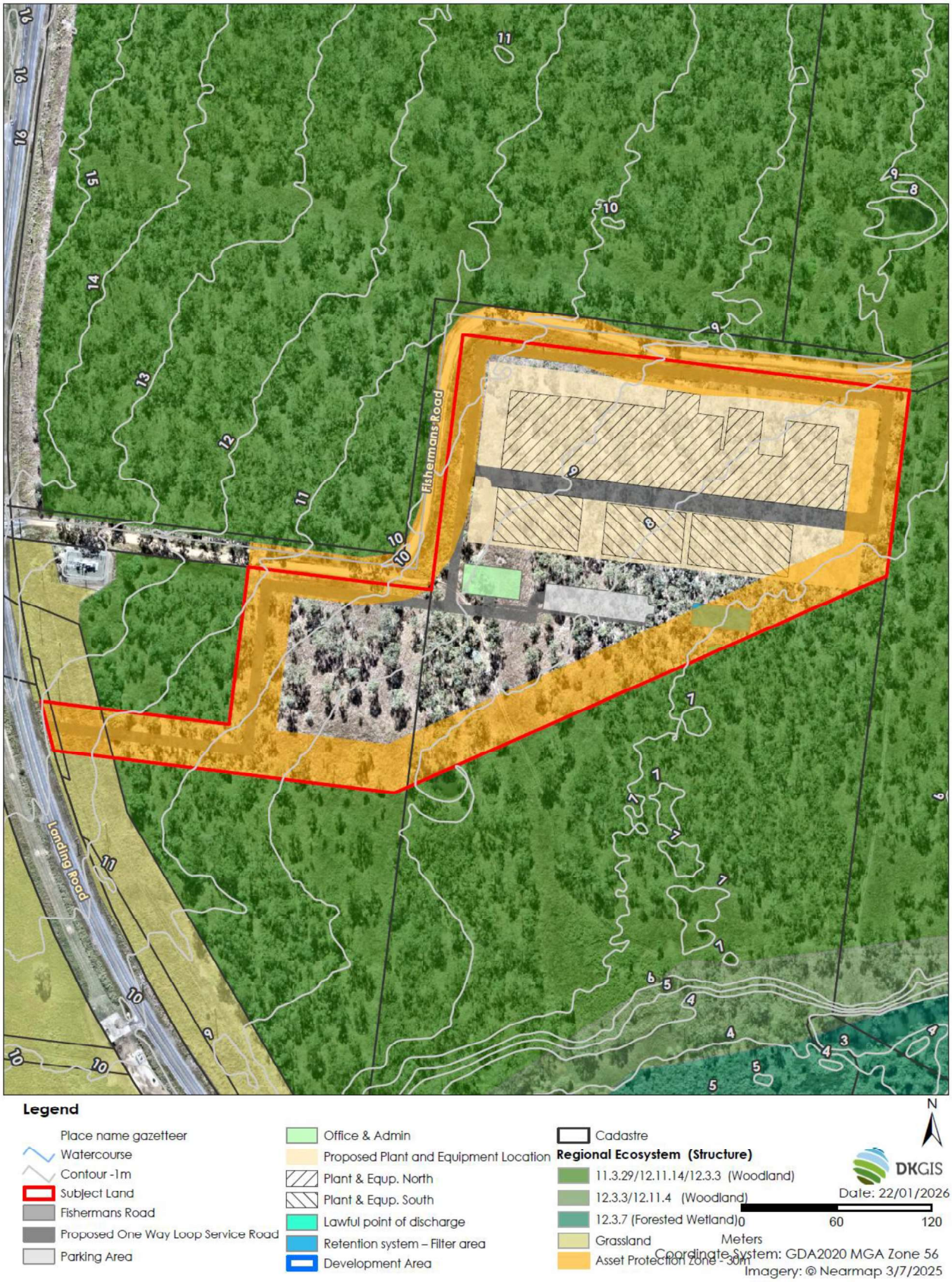


Figure 11 10kW Asset Protection Zone

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9. Access

The following access requirements are applicable to the development:

- The development is designed to allow for efficient emergency access to buildings/structures for firefighting appliances, including by avoiding long, narrow access arrangements.
- An alternative direct access to Landing Road is proposed to provide access to the site.
- All internal access roads, are to be two-wheel drive, all-weather roads;
- Where kerb and guttering is provided on roads adjacent to hazardous vegetation, roll top kerbing should be used to the hazard side of the road;
- the capacity of road surfaces and any bridges/causeways is sufficient to carry fully loaded firefighting vehicles (up to 23 tonnes); bridges/ causeways are to clearly indicate load rating;
- There is suitable access for a Category 1 fire appliance to within 4m of any static water supply where no reticulated supply is available;
- Minimum 4m carriageway width for all access roads (Some short constrictions in the access may be accepted where they are not less than 3.5m wide, extend for no more than 30m and where the obstruction cannot be reasonably avoided or removed);
- Internal access roads have passing bays every 200m that are 20m long by 2m wide, making a minimum trafficable width of 6m at the passing bay;
- A minimum vertical clearance of 4m to any overhanging obstructions, including tree branches;
- Provide suitable turning areas for a Category 1 fire appliances at static water supply locations;
- Curves have a minimum inner radius of 6m and are minimal in number to allow for rapid access and egress;
- The minimum distance between inner and outer curves is 6m;
- The crossfall is not more than 10 degrees; and
- Maximum grades for sealed roads do not exceed 15 degrees and not more than 10 degrees for unsealed roads.

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10. Water Supply

Reticulated water will be supplied to the site. Fire hose reels are constructed in accordance with AS/NZS 1221:1997 and installed in accordance with the relevant clauses of AS 2441:2005.

11. Gas and electrical supplies

Gas services are required to be design and implemented with consideration of the following:

- Reticulated or bottled gas is installed and maintained in accordance with AS/NZS 1596:2014 and the requirements of relevant authorities, and metal piping is used;
- All fixed gas cylinders are kept clear of all flammable materials to a distance of 10m and shielded on the hazard side;
- connections to and from gas cylinders are metal;
- If gas cylinders need to be kept close to the building, safety valves are directed away from the building and at least 2m away from any combustible material, so they do not act as a catalyst to combustion;
- Polymer-sheathed flexible gas supply lines to gas meters adjacent to buildings are not to be used; and
- Above-ground gas service pipes external to the building are metal, including and up to any outlets.

Electrical services are required to be design and implemented with consideration of the following:

- Where practicable, electrical transmission lines are underground; and
- Where overhead, electrical transmission lines are proposed as follows:
    - Lines are installed with short pole spacing (30m), unless crossing gullies, gorges or riparian areas; and
    - No part of a tree is closer to a power line than the distance set out in accordance with the specifications in ISSC3 Guideline for Managing Vegetation Near Power Lines.

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12. Potential Bushfire Impact

The approach to the assessment of bushfire risk involved:

- an assessment of the risks to public safety, paying particular attention to bushfire risks, emergency egress and evacuation, and demonstrate consideration with the Bushfire hazard overlay code;
- determining the bushfire hazards and risk associated to the project from surrounding areas (i.e. bushfire impacting the project);
- consideration of construction and operational activities that may have the potential to cause risks from the project, staff and public (community) health and safety (i.e. the project starting bushfires);
- identification of recommended bushfire mitigation measures for the construction and operation of the project.

12.1. Potential construction impacts

There are a range of activities with the potential to initiate bushfire during construction, such as:

- accidental ignitions (e.g. cigarettes);
- construction vehicles, plant and equipment;
- vegetation removal including mulching/mowing;
- hot works (e.g. welding and grinding);
- activities undertaken at the Laydown Storage Area compound; and
- arson.

During construction of the project, work practices such as complying with Total Fire Ban requirements would assist in minimising the risk posed by these ignition sources. Provision of managed areas in the form of APZs would limit the spread of fires started within the identified works areas. Detailed recommendations relating to construction management measures and relevant work practices have been provided. These construction management measures will form part of the Construction Environmental Management Plan (CEMP).

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12.2. Potential operational impacts

The operation of the project has a similar risk profile to that of the construction phase with regard to potential to initiate bushfires , such as:

- accidental ignitions (e.g. cigarettes);
- construction vehicles, plant and equipment;
- vegetation removal including mulching/mowing;
- hot works (e.g. welding and grinding); and
- arson.

Strategies related to bushfire mitigation include:

- Identification of hazardous bushfire areas that the development traverses focusing on Bushfire Prone Areas;
- Asset condition monitoring (inspections) - strategy pre-summer inspections of above ground infrastructure locations;
- Vegetation management – within the nominated APZs (Figures 8) and inclusive of the 10-meter APZ within the Project corridor.
- Design and construction standards; and
- Fire start reporting and analysis.

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13. Management Measures

Environmental management for the project would be carried out in accordance with an approved Construction Environmental Management Plan (CEMP). Hazards and risks would be managed in accordance with Project's Safety Management system, policies and guidelines. This would seek to avoid, to the greatest extent possible, risks to public safety.

A comprehensive *Bushfire Emergency Management and Evacuation Plan* would be prepared as part of the construction emergency response plan for the project, including:

- protocols for the relocation of workers to nominated safe refuge zones during a bushfire emergency, either within or remote to the work zone (Bushfire Emergency and Evacuation Plan);
- protocols for the management of bushfire risk and fuel management during construction and operation. This would include the restriction and/or prevention of certain activities that present bushfire risks on days with a fire danger rating of equal to or greater than 'high', and as directed by relevant state authorities; and
- training to inform construction and operations workers of bushfire risks and preventative actions, including risks associated with the operation (and maintenance) of vehicles, plant and equipment.

The CEMP would also include strategies and measures for:

- management of hazardous materials and dangerous goods; and
- management of other hazards and risks to the general public and the environment.

Detailed mitigation and management measures have been provided in Section 8 - 11.

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14. Bushfire Risk Assessment – Construction & Operation

This section describes the bushfire risk assessment during construction and operation of the project. Where relevant, the discussion on the bushfire risk assessment has been separated into two parts (with subheadings) as follows:

1) Risk posed by bushfire to the project (ie. Where a fire originating from outside the project footprint threatens the Project; and

2) Risk posed by bushfire ignited by Project activities.

Where the risk posed by bushfire can be clearly articulated without the need for separate discussion, consolidated commentary has been provided.

14.1. Potential Risk Considerations

The landscape potential of fires impacting the site during construction and operation are significant. The broader landscape has significant potential to carry large scale and intense bushfires. Wind and topography of the land create the potential path that a fire would take. The topography of the land through which the project infrastructure is located is typically level or gently undulating within a predominantly open landscape. Fires which occur in this landscape have the potential to spread in the direction of the wind with the dominant fire spread likely from the north-west, west and south-west.

The surrounding area includes designated BFAs, with a history of large-scale bushfire within the bounds of the Project or proximity of the Project. Fires can approach any of the Project infrastructure from any aspect with potential for small fires and large fires impacting the site.

Design and construction standards assist with fire risk management by ensuring appropriate construction specifications are adopted. This builds resilience and reduces the amount of unplanned problems and therefore, fire start risk. This requires consideration during the design, procurement, construction, and commissioning phases.

The potential sources of ignition of bushfires resulting from the construction and operation of the project include:

- Accidental ignitions such as cigarettes;
- construction equipment including bulldozers, excavators and cranes;
- motor vehicles;
- vegetation removal including mulching/mowing;

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- hot works such as welding and grinding;
- electrical faults in equipment;
- chemical fires;
- activities undertaken at the Laydown Storage Area compound; and
- arson.

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14.2. Risk posed by bushfire for project work areas

14.2.1. Project Work Areas

Hot works undertaken within the construction work areas including equipment maintenance which includes welding and grinding and vegetation management such as mechanical slashing can produce sparks which have the capacity to spread for some distance on the wind, resulting in an extreme level of risk of ignition of cured (dry) vegetation. To reduce the level of risk, it is recommended that the site would be managed as an APZ in compliance with Section 8.1. Precaution would be used during all external hot works with shielding and a water supply (such as with an appropriately sized water fire extinguisher or fire fighting pumps) provided close to the works.

External cooking fires (such as BBQ), electrical faults and the inappropriate discarding of lit cigarettes can cause ignition of grassland within and external to the construction and operational work areas. This risk can be managed in accordance with the Total Fire Ban requirements and a water supply (such as with an appropriately sized water fire extinguisher) provided. Fuel free areas (hard stand areas) within the site would be provided that would not provide for ignition of materials.

14.3. Construction & Operational activities within the project work areas

14.3.1. Risk posed by bushfire ignited by project activities

The use of motor vehicles can cause ignition of grass from hot engines and exhaust pipes. Heavy construction equipment used for vegetation removal including bulldozers, and excavators for excavating pads and drilling bore holes can create situations where these activities can give off sparks when steel blades encounter rock, resulting in a high level of risk of ignition of vegetation.

To reduce the level of risk, the use of this equipment in areas where rock is known to occur would be accompanied by a fire-fighting appliance such as a 'slip-on' fire-fighting unit or tanker trailers. This work would also need to include restriction and/or prevention of certain activities that present bushfire risks on days with a fire danger rating of equal to or greater than 'high' based on a risk assessment endorsed by an appropriately qualified person being completed.

Motor vehicle exhaust systems may ignite grassland vegetation through hot engines, exhaust and particle emission. Diesel powered trucks with pollution control devices in the exhaust system have the potential to emit burning diesel particles which ignite grassland vegetation and forest ground fuels, resulting in a high level of risk of ignition of vegetation.

These risks can be managed by water fire extinguishers in vehicles and communications protocols for escalating fires.

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The risk of fire starting and spreading following mitigation measures is considered low – moderate.

14.4. External fires and arson

Significant potential exists for fires to start that are not associated with the project. These fires have potential to run into the construction area, isolating the construction crews and causing bushfire attack on vulnerable assets. During the bushfire danger period, this risk would be managed by a range of actions to monitor the weather and fire starts within proximity to the Project in line with the *Bushfire Emergency Management and Evacuation Plan*. Any fires that have potential to isolate or impact the site would trigger the *Bushfire Emergency Management and Evacuation Plan* for construction and or operation. This risk can be managed.

14.5. Impact of Catastrophic Bushfire Conditions – Plant Shutdown, Evacuation and Loss of Supervisory Control

The proposed chlorine–alkali facility constitutes hazardous industry due to the storage and handling of chlorine and associated process chemicals. Under catastrophic fire weather conditions or during a bushfire burning under catastrophic conditions, continued operation of the facility would present an unacceptable risk to personnel safety and could compromise the integrity of plant systems if human supervisory control were lost.

Accordingly, the Bushfire Emergency Management and Evacuation Plan (BEMEP) would establish clear, mandatory procedures for early cessation of operations, controlled shutdown, and full site evacuation prior to conditions escalating to a level that would require emergency response actions during active fire impact.

Catastrophic Fire Weather Triggers

The BEMEP identifies catastrophic bushfire risk through:

- Official catastrophic fire danger rating declarations for the district
- Activation of total fire bans in conjunction with extreme or catastrophic conditions
- Confirmed bushfire activity within the broader landscape that may threaten access, power supply, or emergency response capacity

These triggers are treated as pre-emptive shutdown conditions, not emergency response thresholds.

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Planned Site Closure and Controlled Shutdown

Upon declaration of catastrophic fire danger or credible confirmation of a bushfire burning under catastrophic conditions, the BEMEP requires:

- Immediate suspension of all non-essential activities
- Initiation of a controlled plant shutdown sequence, including:
    - Isolation of chlorine generation processes
    - Securing and stabilising chlorine storage systems
    - Activation of fail-safe and automated containment measures
- Verification that plant systems are placed into a safe, unattended state capable of remaining secure in the absence of human supervision

These actions are designed to ensure that the facility does not rely on continued human presence to maintain safe storage conditions during periods of elevated bushfire risk.

Full Evacuation and Abandonment Protocols

Where catastrophic conditions persist or escalate, the BEMEP mandates:

- Complete evacuation of all personnel prior to the onset of fire impact
- Early evacuation timed to maintain safe egress and avoid reliance on emergency services
- Prohibition on re-entry until catastrophic conditions have abated and the site has been formally assessed as safe

The plan explicitly recognises that continued human occupancy during catastrophic bushfire conditions is unsafe and impracticable, and that evacuation must occur before conditions compromise visibility, access, power supply, or emergency response capability.

Prevention of Chlorine Release During Loss of Supervisory Control

The BEMEP addresses the risk of chlorine release associated with loss of human supervisory control by:

- Requiring all chlorine systems to be placed in a fail-safe configuration prior to evacuation
- Ensuring automated safety systems operate independently of external power supply where required

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- Confirming that secured storage arrangements do not depend on real-time human intervention to remain stable during bushfire conditions
- Establishing post-event inspection and recommissioning procedures before operations resume

Through these measures, the risk of chlorine release during periods of site abandonment is reduced to a level that is as low as reasonably practicable.

Risk Management Outcome

By mandating early closure, controlled shutdown and evacuation during catastrophic bushfire conditions, the Bushfire Emergency Management and Evacuation Plan ensures that:

- Personnel are not exposed to unacceptable life safety risk
- The facility is not operated under conditions that rely on continuous human supervision
- The potential for unsafe storage conditions or chlorine release during bushfire impact is minimised
- The development aligns with contemporary hazardous industry risk management principles and Queensland bushfire planning expectations

14.6. Emergency Protocols

A detailed *Bushfire Emergency Management and Evacuation Plan* would be developed consistent with Section 14.5 and implemented for the construction and operation that would focus on life and plant safety.

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15. Emergency egress and evacuation

There are no identified difficulties in accessing and suppressing the fires that could occur within the project area.

The national position of fire agencies is that *the safest action to protect life is for people to be away from the bushfire or threat of bushfire*[2]. This is underpinned by comprehensive emergency management arrangements and operational fire management systems that focus on the provision of information, advice, and warnings to assist communities to make informed decisions prior to the impact of bushfire and if necessary be out of Bushfire Prone Areas well before the impact of fire.

Within the QLD planning framework, there is a hierarchy of controls in place to mitigate bushfire risk to communities. The Bushfire Protection Measures work in unison to enhance resilience by the provision of minimum standards for new development while reducing the vulnerability of negative impacts on occupants (including fire fighters) of these areas.

While appreciating these issues, the design team must provide compliant access within the sites that links into existing road infrastructure in a positive way. The road network is capable of sustaining traffic flows in an emergency.

The evacuation options that would be outlined in the *Bushfire Emergency Management and Evacuation Plan* provide flexibility and alternate routes to take if for some reason the primary route to a safer location is blocked.

[2] Australasian Fire and Emergency Services Authorities Council. (2019) *Bushfires and Community Safety Position* (AFAC Publication No. 2028)

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16. Outcomes of the Bushfire hazard overlay code

Compliance summary against the Outcomes Schedule 8.2.4 bushfire hazard planning scheme policy. The Gladstone Regional Council planning scheme states that:

(1) The purpose of the bushfire hazard overlay code is to ensure that:

(a) The risks to life, property, community, economic activity and the environment during uncontrolled bushfire events are minimised.

(b) Development does not increase the potential for bushfire damage or risk on–site or to other property.

(2) The purpose of the code will be achieved through the following overall outcomes:

(a) Development is compatible with the nature of the bushfire hazard except where there is an overriding need for the development in the public interest and no other site is suitable and reasonably available for the proposal.

(b) Development siting, layout, design and access minimises the risks to personal safety, and damage to property, infrastructure and other assets.

(c) Development directly, indirectly and cumulatively avoids an unacceptable increase in severity of bushfires and does not increase the potential for damage on the site or to other properties.

(d) The potential for the release of hazardous material as a result of a bushfire event is avoided.

(e) Evacuation and disaster management response including firefighting and access for emergency services during bushfire events is facilitated.

(f) Community infrastructure is located and designed to function effectively at all times.

The proposed Chlor-Alkali Facility satisfies the purpose and overall outcomes of Schedule 8.2.4 – Bushfire Hazard Overlay Code of the Gladstone Regional Council Planning Scheme and provides adequate APZ to achieve the required 10kW of radiant heat at the buildings. The development minimises risks to life, property, community, economic activity and the environment through appropriate siting, layout and design that respond to the mapped bushfire hazard.

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The facility is located within the Gladstone State Development Area, where its strategic importance and public-interest role justify its location, and no alternative site of comparable suitability is reasonably available.

The design incorporates managed Asset Protection Zones, access provisions suitable for firefighting and emergency response, and non-combustible construction materials that mitigate radiant heat, flame contact and ember attack.

Bushfire risk management measures are integrated with the facility's broader process-safety and emergency-management systems to ensure that the potential for the release of hazardous materials during a bushfire event is avoided.

These measures collectively demonstrate that the proposal will not increase the potential for bushfire damage on-site or to adjoining land, will facilitate effective evacuation and emergency response, and will ensure that critical community infrastructure can function effectively during and after a bushfire event.

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16.1. Bushfire Hazard Overlay Code: Assessment Benchmarks

Section 8.2.4 of the Gladstone Regional Council Planning Scheme establishes the assessment benchmarks for development assessment for the Bushfire Hazard Overlay Code. Table 8.2.4.3.1 of the Gladstone Regional Council Planning Scheme establishes the assessment benchmarks for development within areas affected by bushfire hazard. These benchmarks set out the performance outcomes and acceptable outcomes that ensure new development is appropriately sited, designed, and managed to minimise the potential risk to people, property, and the environment. The criteria address matters such as site suitability, water supply for firefighting, emergency access and evacuation, vegetation management, and the safe handling or storage of hazardous materials. The following assessment evaluates the proposed Chlor-Alkali Facility against the relevant provisions of Table 8.2.4.3.1 to demonstrate that the development achieves compliance with the Bushfire Hazard Overlay Code and maintains an acceptable level of safety and resilience consistent with the intent of Section 8.2.4 as shown in Table 2.

Table 2: Accepted development subject to requirements and assessable development from Table 8.2.4.3.1 - Accepted development subject to requirements and assessable development - *General — site suitability*

Performance Outcomes		Acceptable Outcomes		Proposal Compliance Summary
PO1	Development maintains the safety of people and property by not exposing them to an unacceptable risk from bushfire.	**-**	No acceptable outcome is nominated.	• The development minimises risks to life, property, community, economic activity and the environment through appropriate siting, layout and design that respond to the mapped bushfire hazard.
PO2	Development does not result in a higher concentration of people living, working or congregating in a high or very high bushfire hazard area unless it can be demonstrated: (a) there is an overriding community need in the public interest, and (b) no other site is suitable and reasonably available	**AO2**	The following uses are not located on land within a confirmed medium, high or very high bushfire hazard area: (a) child care facility (b) community care centre (c) educational establishment (d) rooming accommodation (e) hospital (f) multiple dwelling	• No development types for AO2. • Complies with AO1.

Performance Outcomes		Acceptable Outcomes		Proposal Compliance Summary
			(g) non–resident workforce accommodation (h) residential care facility (i) retirement facility (j) shopping centre (k) short–term accommodation (l) tourist attraction (m) tourist park.	
PO3	Development in areas with a reticulated water supply has adequate flow and pressure for fire–fighting purposes at all times.	**AO3**	The water supply network has a minimum sustained pressure and flow of at least 10L per second at 200kPa.	• Water supply can meet these requirements.
PO4	Development in areas without a reticulated water supply has an appropriate dedicated water supply for fire–fighting purposes that are safely located and freely accessible for fire–fighting purposes at all times.	**AO4.1.1**	Development involving a gross floor area greater than 50m2 where a reticulated water supply is not available is: (a) provided with an easily accessible fire resistant on–site water storage of not less than 5,000L (e.g. concrete tank with fire brigade fittings, in–ground swimming pool, dam fed by a permanent water source) that is within 100m of each class 1, 2, 3, or 4 building, and (b) has a hard standing area allowing a heavy rigid fire appliance safe access to within 6m of the storage facility. Note—Plastic water tanks are not considered to be fire resistant unless they are submerged.	• Not applicable. Reticulated water provided within the site.
		AO4.2	The location of water supplies is readily identifiable from the street frontage with clear signage directing firefighters to its access point.	• Water supply can meet these requirements

Performance Outcomes		Acceptable Outcomes		Proposal Compliance Summary
PO5	Roads and fire access trails are designed and constructed to: (a) enable efficient access to buildings and structures for fire–fighting purposes for emergency services, and (b) swift evacuation in emergency situations.	**AO5.1**	**AO5.1** Roads and fire access trails are designed and constructed to: (a) separate the development from the hazardous vegetation (b) have a maximum gradient of 12.5% (c) a minimum cleared width of 6m and a minimum formed width of 4m (d) have adequate drainage and erosion control devices (e) provides passing and turning areas for fire– fighting appliances at intervals of not less than 200m (f) have a vehicular access at each end to roads or a bushfire trail (g) not involve any cul–de–sac (h) have gates locked with a system authorised by QFES, and (i) have suitable arrangements in place to ensure maintenance in perpetuity. **AO5.2** Development has direct access to an evacuation route with a potential fire intensity exposure no greater than 2kw/m2. Note—The distance from hazardous vegetation to achieve 2kw/m2 is generally: • 58m in a very high bushfire hazard areas • 52m in a high bushfire hazard area, and • 44m in a medium bushfire hazard area. **AO5.3**	• Access within the site is available for MR vehicles. • Road access within the site will meet the AO5.1 requirements. Evacuation on existing roads. Emergency management arrangements undertaken in accordance with site emergency management plan and direction from emergency services.

Performance Outcomes		Acceptable Outcomes		Proposal Compliance Summary
			Development incorporates an area of managed vegetation that separates lot boundaries from hazardous vegetation by a distance of: (a) 20m to a high or very high bushfire risk area, or (b) 10m to a medium risk bushfire area and includes a fire access trail.	10m APZ is provided around the buildings.
PO6	Development provides for adequate fire breaks that minimise bushfire hazard by: (a) separating hazardous vegetation from development areas, and (b) facilitating access for firefighting and emergency vehicles.		No acceptable outcome is nominated	• 10m APZ is provided around the buildings. • The site should be managed in its entirety as an APZ in accordance with Section 8.1 of this report. • The development provides for adequate firebreaks consistent with the intent of the Bushfire Hazard Overlay Code. • Firebreaks have been incorporated to effectively separate areas of hazardous vegetation from the proposed development footprint, thereby reducing potential radiant heat and ember exposure. These firebreaks also provide clear and accessible routes for firefighting and emergency service vehicles, ensuring safe and efficient access for suppression activities. • The proposal satisfies the performance outcome by demonstrating that the layout and design minimise bushfire hazard and support

Performance Outcomes		Acceptable Outcomes		Proposal Compliance Summary
				operational firefighting requirements.
PO7	The potential for the release of hazardous materials as a result of a bushfire event is avoided. Note—The term 'hazardous material' is defined in the Glossary of the relevant *State Planning Policy*.	AO7	Development involving the production or storage of hazardous materials in bulk: (a) is not located within a high or very high bushfire hazard area, or (b) complies with a site specific bushfire management plan.	The site is not within a high or very high bushfire hazard area. The site will comply with this Bushfire Hazard Assessment. The project engineers confirmed that smoke release as a result of bushfire impact will not result in a release of hazardous materials.
PO8	Additional lots avoid the risk of bushfire hazard to personal and property safety and increased risk of damage to assets.	AO8	New residential lots (including rear lots) do not occur in a bushfire hazard area.	Not applicable
PO9	Development for community infrastructure is located, designed and sited to: (a) protect the safety of people during a bushfire (b) not increase the exposure of people to the risk from a bushfire event, and (c) function effectively during and immediately after bushfire events.		No acceptable outcome is nominated	The development is located, designed, and sited to protect the safety of occupants and emergency responders during a bushfire through a combination of strategic siting, defendable space, and built-form resilience. Buildings are separated from hazardous vegetation by managed 30m asset protection zones that reduce radiant heat, ember attack, and flame contact to tolerable levels. The development does not increase the exposure of people to bushfire risk, either on-site or in the surrounding area. The proposal avoids intensifying development within areas of highest bushfire hazard and does

Performance Outcomes		Acceptable Outcomes		Proposal Compliance Summary
				not rely on unmanaged vegetation clearance beyond what is necessary for risk mitigation.
		AO9.2	The separation area mentioned in AO9.1 contains a fire access trail that: a) has a minimum cleared and formed width of 6m; b) has vehicular access at each end; c) provides passing bays and turning areas for fire-fighting appliances; and d) are either located on public land, or within an access easement that is granted in favour of council and QFRS.	• Access requirements as per Section 13 of this report.
		AO9.3	Roads and trails: a) have a maximum gradient of 12.5%; and b) do not involve a cul-de-sac.	• Access requirements as per Section 13 of this report.

17. Recommendations

The following recommendations have been made within this report to ensure the proposed development appropriately considers the GRC Planning Scheme Bushfire hazard overlay code:

Recommendation 1 – Asset Protection Zones (APZ) of a minimum of 30m are provided to buildings for the site.

Recommendation 2 – Access is available within the site for a Medium Rigid Vehicle.

Recommendation 3 – Electricity and gas supplies are to be designed and implemented in consideration with Section 11 of this Bushfire Hazard Assessment.

Recommendation 4 – A comprehensive Bushfire Emergency Management and Evacuation Plan would be prepared in accordance with the requirements of Australian Standard *AS3745-2010 Planning for Emergencies in facilities.*

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18. Conclusion

The proposed Chlor-Alkali Facility at Gladstone has been assessed in accordance with the Queensland State Planning Policy (July 2017) and the Gladstone Regional Council Planning Scheme (Version 2), including Schedule 8.2.4 – Bushfire Hazard Overlay Code.

Asset protection zones form a key component of the overall bushfire risk-mitigation strategy for vulnerable uses in accordance with the *Bushfire Resilient Communities Technical Reference Guide*, for the storage or manufacture of hazardous materials, and community infrastructure providing essential services where such development is unavoidable within a Bushfire Prone Area. For this development, site planning has incorporated an asset protection zone through the establishment of building setbacks that separate the development footprint from the nearest mapped medium, potential bushfire intensity vegetation to a distance sufficient to limit radiant heat exposure to no more than 10 kW/m² at all building boundaries, thereby reducing the potential for flame contact and enhancing the resilience of the proposed buildings to bushfire attack.

The assessment demonstrates that the site is capable of accommodating the proposed development with acceptable and manageable bushfire risk, consistent with the State interest in *Safety and Resilience to Hazards* and *Emissions and Hazardous Activities*.

Through the implementation of appropriate Asset Protection Zones, site layout design, and construction standards informed by the *Bushfire Considerations and RFI – Chlor-Alkali Facility Gladstone* report (Blackash, 2025), the development will achieve a tolerable level of bushfire exposure. The facility's engineering design ensures that no hazardous material releases or dangerous agent, firefighting interactions will occur under bushfire conditions or fire fighting arrangements for bushfire.

The proposal represents critical infrastructure of strategic economic importance to the Gladstone State Development Area and the broader Central Queensland industrial network. The development will not exacerbate bushfire hazard within the locality and will contribute positively to regional emergency readiness through the establishment of clear access, on-site water supply, and collaboration with emergency services in the preparation of a site-specific Bushfire Management Plan and Emergency Management Plan.

In summary, the proposed development:

- Minimises risks to life, property, and the environment during bushfire events;
- Avoids the release of hazardous materials as a result of bushfire exposure;

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- Incorporates design and management measures consistent with the SPP 2017 and Gladstone Regional Council Bushfire Hazard Overlay Code; and
- Ensures that bushfire risk is managed to a level that is as low as reasonably practicable (ALARP).

Accordingly, the proposal is considered to satisfy the intent and outcomes of the relevant planning instruments and provides a robust and compliant framework for bushfire risk mitigation, hazardous-material containment, and emergency response integration for the Chlor-Alkali Facility at Gladstone.





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Appendix 1 References

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Appendix 1 APZ – Vegetation Management

The APZ is required to be managed in compliance with the standards as set out below:

Trees

- Tree canopy cover should be less than 15% at maturity;
- Prune or remove trees so that there is not a continuous tree canopy leading from the hazard to the asset.
- Separate tree canopies by two to five metres.
- Trees at maturity should not overhang within two to five metres of a building / structure;
- Lower limbs should be removed up to a height of 2m above the ground;
- Preference should be given to smooth barked and evergreen trees.

Shrubs

- Create large discontinuities or gaps in the vegetation to slow down or break the progress of fire towards buildings/structures should be provided;
- Shrubs should not be located under trees;
- Shrubs should not form more than 10% ground cover; and
- Clumps of shrubs should be separated from exposed windows and doors by a distance of at least twice the height of the vegetation.

Grass

- Grass should be kept mown (as a guide grass should be kept to no more than 100mm in height);
- Ground fuels such as fallen leaves, twigs (less than 6 mm in diameter) and bark should be removed on a regular basis.
- Keeping areas beneath retained or planted trees and shrubs cleared of fuel. This may include vegetation management measures such as:
    - canopy lifting to reduce near-surface or ladder fuel loads and reduce flame heights;
    - clearing of understorey vegetation;
    - removal of accumulated litter and woody debris; and
    - removal of loose bark and dead limbs from standing trees.

As the APZ provides a fuel-reduced, physical separation between the new buildings/structures and bush fire hazards, it is a key element in the suite of bush fire measures and dictates the type of construction necessary to mitigate bushfire attack. In practical terms, the setback of each building/structure will form part of the APZ and will need to be conditioned to be maintained to the standards prescribed above.

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Project Halogen: Air Quality Assessment

Prepared for:

CQG Consulting

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Final

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Glossary

Term	Definition
µg/m^3	micrograms per cubic metre
µm	micrometre
°	degree
°C	degrees Celsius
g/s	grams per second
kg/annum	kilograms per year
km	kilometre
m	metre
m/s	metres per second
m^2	square metre
m^3	cubic metre
m^3/s	cubic metres per second
Nm^3/hr	normalised cubic metres per hour
Nomenclature	**Definition**
Cl_2	chlorine gas
H_2	hydrogen
HCl	hydrogen chloride
PM_{10}	particulate matter with a diameter less than 10 micrometres
$PM_{2.5}$	particulate matter with a diameter less than 2.5 micrometres
Abbreviation	**Definition**
AHD	Australian Height Datum
Air EPP	Environmental Protection (Air) Policy 2019
Air NEPM	National Environmental Protection (Ambient Air Quality) Measure
AWS	automatic weather station
BoM	Bureau of Meteorology
CSIRO	The Commonwealth Scientific and Industrial Research Organisation
CQG	CQG Consulting (CQ Environmental Pty Ltd)
DA	Development Application
DETSI	Department of Environment, Tourism, Science and Innovation
EHP	Department of Environment and Heritage Protection (Qld)
EMP	Environmental Management Plan
EP Act	*Environmental Protection Act 1994*
EPA	Environment Protection Authority
ERA	Environmentally Relevant Activity
Gladstone SDA	Gladstone State Development Area
IAQM	Institute of Air Quality Management
IOA	index of agreement
LPG	liquefied petroleum gas
MCU	material change of use
NEPC	National Environment Protection Council
NPI	National Pollutant Inventory database
POEO Act	Protection of the Environment (Operations) Act 1997
POEO Clean Air Reg	Protection of the Environment Operations (Clean Air) Regulation 2010
QLD	Queensland
RMSE	root mean square error
SDA	State Development Area
TAPM	The Air Pollution Model
UTM	Universal Transverse Mercator

EXECUTIVE SUMMARY

Katestone Environmental Australia Pty Ltd (Katestone) was commissioned by CQG Consulting on behalf of Grenof to complete an air quality assessment of Project Halogen (the Project), a proposed Chlor-Alkali facility located within the Gladstone State Development Area (Gladstone GSDA) across Lot 1 on MPH32292 and Lot 1 on SP200899.

Grenof is seeking to lodge a Development Application (DA) for a material change of use (MCU) for a concurrence environmentally relevant activity (ERA) 7(6d) *Chemical manufacturing: manufacturing in a year, more than 100,000 tonnes of inorganic chemicals* for the proposed Chlor-Alkali facility.

An air quality assessment to support the DA has been prepared in accordance with the Department of Environment, Tourism, Science and Innovation (DETSI) guideline Application requirements for activities with impacts to air (ESR/2015/1840, version 5.0.3, October 2024) and other relevant legislation and regulatory requirements.

The air quality assessment used recognised techniques for dispersion modelling and emission estimation to determine the potential impacts to sensitive receptors and the surrounding environment. The dispersion modelling has assessed the potential impacts to air from the following sources:

- Waste gas dechlorination stack (chlorine (Cl_2) emissions)
- Hydrogen chloride vent burner stack (Cl_2 and hydrogen chloride (HCl) emissions).

The following additional potential sources were identified as negligible so were not included in the dispersion modelling:

- Hydrogen vent stacks (two stacks)
- Leaks and failures in storage tanks, pipes and fittings, connections and filled bottles
- Potential fugitive (wind-blown) particulate matter emissions from the salt stockpile.

The dispersion modelling has been conducted to predict the maximum ground-level concentrations of Cl_2 and HCl at the location of the nearest sensitive land use, located approximately 3.7 km to the west of the Project, as well as the maximum ground-level concentration anywhere within the model domain. Concentrations at these locations have been assessed against the relevant air quality assessment criteria for Cl_2 and HCl.

The results of the dispersion modelling show that peak concentrations, including those within the Project site boundary, **comply** with the relevant assessment criteria for Cl_2 and HCl. The highest concentration of either pollutant anywhere in the model domain is predicted to be less than 0.3 percent of the relevant air quality assessment criteria.

The risks to air quality during the operation phase of the Project are minimised through the following design aspects:

- Best practice membrane cell electrolytic process used in the production of chlorine.
- Hydrogen and chlorine gas detector sensors are installed in buildings and key locations across the site that are linked to the plant operations to assist in identifying, managing and fixing leaks in a timely manner.
- Closed loop design whereby any potential sources of release will be minimal, easily identified, and immediately and automatically rectified.

- Systematic collection and redirection of waste gas stream to the chlorine absorption unit to reduce chlorine to trace levels (< 1 mg/Nm³) prior to release and installation of a scrubber on the HCl synthesis unit to reduce chlorine and hydrogen chloride to low levels (≤ 5 mg/Nm³ and ≤ 30 mg/Nm³, respectively).
- Maintaining a significant buffer zone to sensitive receptor locations.

Risks of dust impacts at sensitive receptor locations during the construction phase of the Project have been identified as negligible; however, under the General Environmental Duty (GED) of the *Environmental Protection Act 1994 (EP Act)*, during both construction and operation of the Project, all reasonably practicable measures should be applied to prevent or minimise any potential environmental harm.

1. INTRODUCTION

Katestone Environmental Australia Pty Ltd (Katestone) was commissioned by CQG Consulting (CQG), on behalf of Grenof, to complete an air quality assessment of Project Halogen (the Project), a proposed Chlor-Alkali facility located within the Gladstone State Development Area (SDA).

Grenof is seeking to lodge a Development Application (DA) for a material change of use (MCU) for a concurrence environmentally relevant activity (ERA) 7(6d) *Chemical manufacturing: manufacturing in a year, more than 100,000 tonnes of inorganic chemicals* for the proposed Chlor-Alkali facility. The Project is to be located within the Gladstone SDA across Lot 1 on MPH32292 and Lot 1 on SP200899.

An air quality assessment to support the DA has been prepared in accordance with the Department of Environment, Tourism, Science and Innovation (DETSI) guideline Application requirements for activities with impacts to air (ESR/2015/1840, version 5.0.3, October 2024) and other relevant legislation and regulatory requirements.

The air quality assessment has addressed the following scope of works:

- Section 2 describes the Project
- The legislative framework for air quality is summarised in Section 3
- The air quality assessment methodology is described in Section 4
- The existing environment of the region surrounding the Project including local terrain, land-use and sensitive receptors is described in Section 5
- Section 6 provides estimates of emissions of air pollutants to the atmosphere that are likely to arise as a result of the Project
- Section 7 details the results of the air quality assessment
- Section 8 describes management measures that will be implemented during the construction and operation phases of the Project
- Section 9 provides conclusions of the air quality assessment.

2. PROJECT DESCRIPTION

The proposed Chlor-Alkali facility is to be located within the Gladstone SDA across Lot 1 on MPH32292 and Lot 1 on SP200899 (Figure 1). The Project triggers the requirements for a concurrence ERA7(6d) *Chemical manufacturing: manufacturing in a year, more than 100,000 tonnes of inorganic chemicals*.

Key aspects of the Project in relation to air quality are as follows:

- 24 hours per day, 365 days per year operation
- Production capacity of 160,000 tonnes per annum (tpa)
- Product outputs include sodium hydroxide (NaOH) (caustic soda), liquefied chlorine gas (Cl_2), hydrogen chloride (HCl), and sodium hypochlorite (NaOCl)
- Best practice membrane cell electrolytic process will be used in the production of chlorine
- All process steam generated by boiler burning an LPG and hydrogen mix.

The typical flow diagram of the membrane cell technique is provided in Figure 2. A schematic view of chlorine electrolysis cells is provided in Figure 3. In comparison to the alternative electrolysis techniques (diaphragm cell process and the mercury cell process), the membrane cell process has the following benefits:

- Low total energy consumption
- Low investment and operating costs
- Does not use mercury or asbestos
- High-purity caustic.

The entire facility will have a closed loop design and consequently will not have any fugitive releases. A potential fugitive source based on facilities elsewhere is the electrolyser room. In the case of the Project, the electrolyser room will be designed so that any leaks will be immediately identified by the control system due to the monitoring of pressure on either side of each electrolyser. The control system will have the capability to detect leaks as small as a pinhole.

Monitoring and preventing the potential exposure of onsite personnel to air pollutants is a critical occupational health and safety issue. A key strategy in the prevention of exposure is the use of hydrogen (H_2) and chlorine (Cl_2) gas detector sensors installed in buildings and key locations across the site that are linked to the plant operations to assist in identifying, managing and fixing leaks in a timely manner. Any fugitive releases would be detected and result in the immediate and automatic shutdown of that part of the plant and process.

Grenof proposes to use hydrogen gas that is produced in the chlor-alkali process to partially fuel the boiler for steam production. The fuel is anticipated to be an 80:20 LPG to hydrogen mix, on an energy basis. The boiler presents negligible risk to air quality.

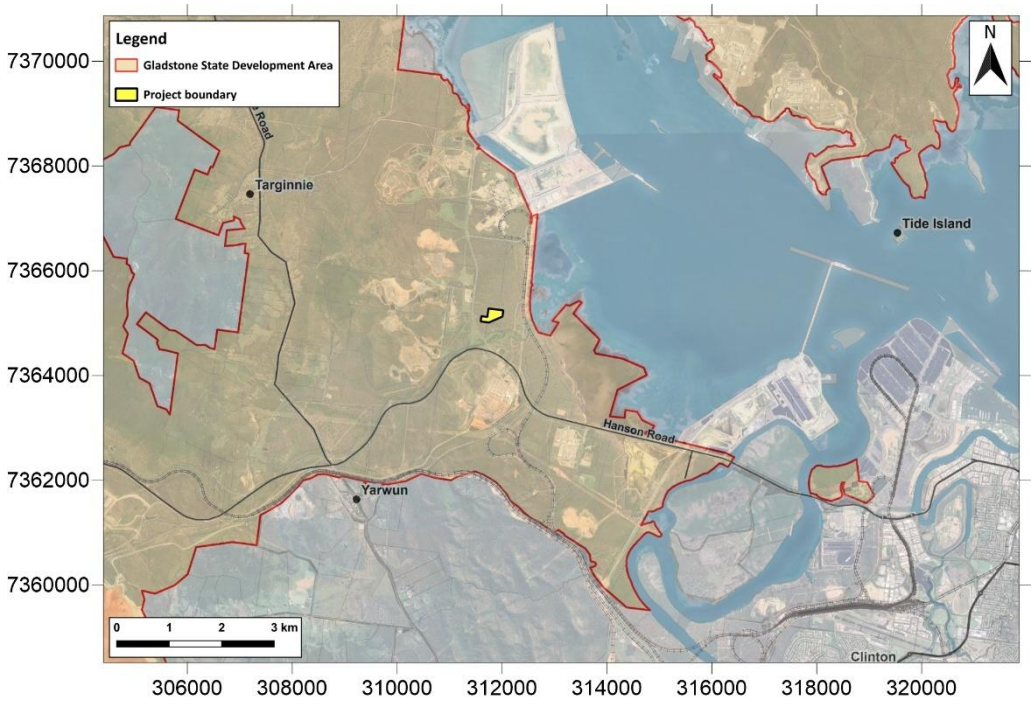


Figure 1 **Project location and setting**

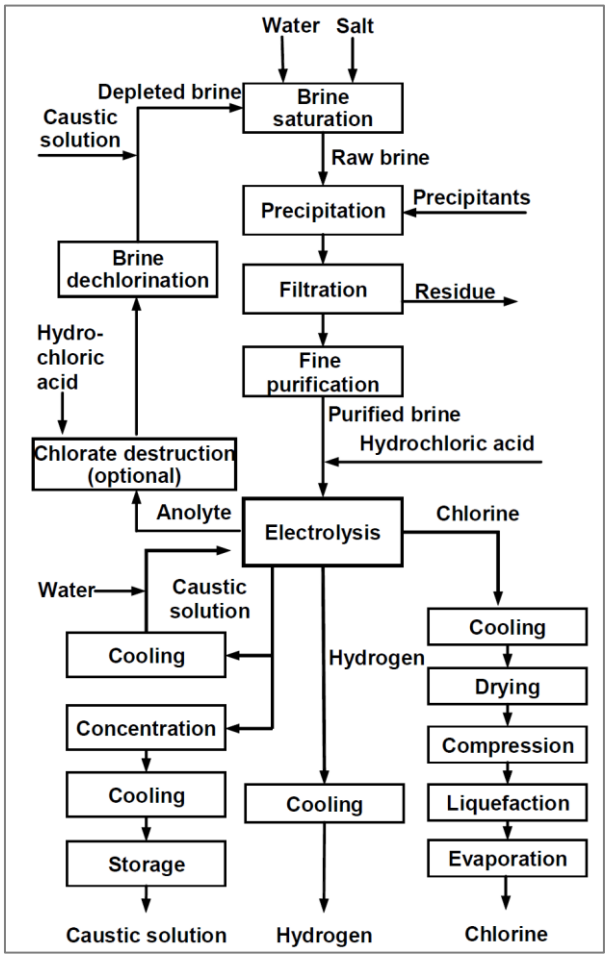


Figure 2 **Typical flow diagram of the membrane cell technique (source: European Commission, 2014, Best Available Techniques (BAT) Reference Document for the Production of Chlor-alkali)**

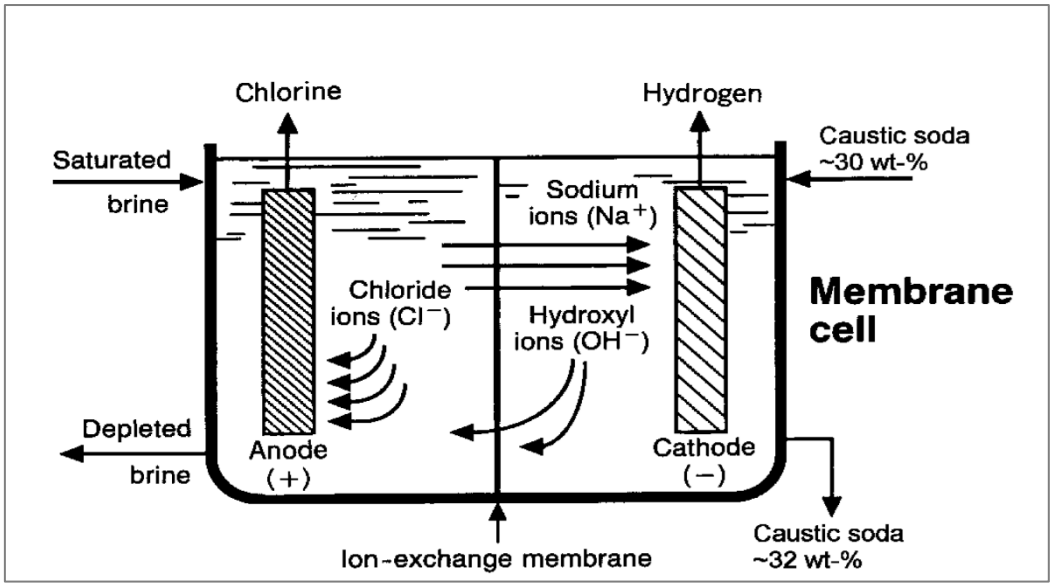


Figure 3 **Schematic view of chlorine electrolysis cells for membrane cell technique (source: European Commission, 2014, Best Available Techniques (BAT) Reference Document for the Production of Chlor-alkali)**

3. LEGISLATIVE FRAMEWORK FOR AIR QUALITY

3.1 Relevant State Policy

3.1.1 Overview

The air quality assessment to support the DA has been prepared in accordance with the DETSI guideline *Application requirements for activities with impacts to air* (ESR/2015/1840, version 5.0.3, October 2024) (DETSI Guideline) and all other relevant legislation and regulatory requirements relating to air quality, including:

- *Environmental Protection Act 1994 (EP Act)*
- *Environment Protection Regulation 2019*
- *Environmental Protection (Air) Policy 2019* and the *Environmental Protection (Air) Amendment Policy 2024* (Air EPP)
- Gladstone Regional Council Planning Scheme
- Gladstone SDA Development Scheme.

3.1.2 EP Act and Air EPP

The *EP Act* provides for the management of the air environment in Queensland. The *EP Act* gives DETSI the power to create Environmental Protection Policies that identify, and aim to protect, environmental values of the atmosphere that are conducive to the health and well-being of humans and biological integrity. The National Environment Protection Council (NEPC) also defines national ambient air quality standards and goals in consultation with, and with agreement from, all Australian state and territory governments.

The *Environmental Protection (Air) Policy* (Air EPP) was made under the *EP Act* and gazetted in 1997. The Air EPP was revised and reissued in 2019. The *Environmental Protection (Air) Amendment Policy 2024* (EPP Air Amendment 2024) commenced on 29 August 2024 and made amendments to the *Environmental Protection (Air) Policy 2019* (EPP Air) to ensure Queensland remains consistent with the NEPC *National Environmental Protection (Ambient Air Quality) Measure* (Air NEPM). Collectively, the *Environmental Protection (Air) Policy 2019* and the *Environmental Protection (Air) Amendment Policy 2024* are referred to as the Air EPP.

3.1.3 Gladstone Regional Council Planning Scheme

The Gladstone Regional Council Planning Scheme Version 2 commenced in July 2017 and provides a framework for managing development in the Gladstone region that advances the purposes of the *Sustainable Planning Act 2009* (the SP Act). The scheme sets out Gladstone Regional Council's intention for future development in the planning scheme area and is reviewed periodically in accordance with the SP Act to ensure that it responds appropriately to the changes of the community at a local, regional and State level.

The scheme applies to the planning scheme areas of the Gladstone Regional Council and interrelates with the surrounding local government areas. Gladstone Region includes three areas declared by the State Government as SDAs. SDAs, including the Gladstone SDA where the Project is located, are clearly defined areas of land established by the Coordinator-General to promote economic development in Queensland.

3.1.4 Gladstone SDA Development Scheme

The Gladstone SDA Development Scheme provides for industrial development of national, State, and regional significance as well as complementary industrial, infrastructure and service uses. Any MCU within the Gladstone SDA requires a development approval.

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.*

The vision is supported by the overall objectives, requiring development in the Gladstone to:

a) *capitalise on Gladstone SDA's strategic location and support the role and function of the Port of Gladstone*

b) *identify and implement opportunities for synergies and co-location between other uses, services and infrastructure to minimise waste and inefficiencies*

c) *use land and infrastructure efficiently and be adequately serviced by infrastructure*

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*

e) *ensure new lots are appropriately sized to accommodate preferred development*

f) *be designed, constructed, and operated to a high quality consistent with best practice*

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*

h) *not adversely impact on the outstanding universal values of the Great Barrier Reef World Heritage Area*

i) *manage the risks associated with the projected impacts of climate change and natural hazards to protect people and property*

j) *manage impacts of air quality on the capacity of the Gladstone airshed.*

The Materials Transportation and Services Corridor Precinct of the Gladstone SDA passes through the Project site. Development in this precinct is required to:

a) *minimise construction and operation footprints and follow a logical sequence of development to maximise opportunities for future linear infrastructure*

b) *avoid adverse impacts on existing infrastructure*

c) *provide and maintain access to the corridor for construction, operation, and maintenance of existing and future linear infrastructure*

d) *co-exist with other linear infrastructure internal and external to the Gladstone SDA*

e) *recognises and manages adverse impacts to sensitive land uses adjacent to the Gladstone SDA.*

An MCU within the Materials Transportation and Services Corridor Precinct of the Gladstone SDA is designated as SDA assessable development requiring an SDA application to be made to the Coordinator-General in accordance with Schedule 2 of the Scheme to obtain SDA approval.

3.2 Relevant air quality criteria

Ambient air quality criteria for chlorine and hydrogen chloride are reproduced in Table 1. There are no air quality criteria or stack emission limits for chlorine or hydrogen chloride in Queensland State legislation or national legislation, therefore, in accordance with the DETSI Guideline the following documentation has also been considered:

- NSW *Protection of the Environment Operations (Clean Air) Regulation 2022* (POEO Clean Air Reg)
- New South Wales (NSW) Environment Protection Authority (EPA) publication Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales 2022 (NSW Approved Methods), referred to in the POEO Clean Air Reg
- Texas Commission on Environmental Quality (TCEQ) prescribed standards known as: Effects Screen Levels (ESL)
- Victoria Environment Protection Authority (VIC EPA) Publication 1961.2 Guideline for assessing and minimising air pollution in Victoria, 2025 (VIC EPA Air Pollution Guideline)
- WHO Air Quality Guidelines for Europe.

Where relevant, the most stringent air quality criteria have been applied for each pollutant.

Table 1 Ambient air quality criteria for chlorine and hydrogen chloride

Air pollutant	Type	Regulatory document	Units	Value	Time period
Chlorine (Cl_2)	Impact assessment criteria	NSW Approved Methods	µg/m³	50	1-hour
	Short-term Effects Screening Level (ESL)	Texas Commission on Environmental Quality	µg/m³	43	1-hour
Hydrogen chloride (HCl)	Air pollution assessment criteria (APAC)	VIC EPA Air Pollution Guideline	µg/m³	2,100	1-hour
				20	1-year
	Impact assessment criteria	NSW Approved Methods	µg/m³	140	1-hour

3.3 Emissions limits

The *Protection of the Environment (Operations) Act 1997* (POEO Act) is applied to the regulation of air pollution in New South Wales. The POEO Act is underpinned by a number of regulatory instruments that address air quality including the *Protection of the Environment Operations (Clean Air) Regulation 2010* (Clean Air Regulation) that imposes generic operational requirements for activities and plant. Section 128 of the POEO Act requires each premises to comply with any air emission standards prescribed by applicable regulations; where standards are not prescribed for a particular air impurity, all practical means must be taken to prevent or minimise air pollution. The Clean Air Regulation specifies emission standards that are relevant to Section 128 of the POEO Act.

In the absence of any State-specific emission standards, where relevant, those under the Clean Air Regulation are typically applied to the assessment of development in Queensland. The standards specified by the POEO Clean Air Reg for in-stack concentrations of hydrogen chloride, chlorine and oxides of nitrogen are shown in Table 2.

Table 2 Air quality emission limits for chlorine and hydrogen chloride

Pollutant	Activity or plant	Regulatory document	Units	Value
Chlorine (Cl_2)	General standard of concentration for an activity or plant	POEO Clean Air Reg	mg/m³	200
Hydrogen chloride (HCl)	General standard of concentration for an activity or plant, an activity, other than the manufacture of glazed terracotta roofing tiles	POEO Clean Air Reg	mg/m³	100
Nitrogen dioxide (NO_2) or nitric oxide (NO) or both nitrogen dioxide and nitric oxide, as NO_2 equivalent	A boiler operating on gas	POEO Clean Air Reg	mg/m³	350

4. AIR QUALITY ASSESSMENT METHODOLOGY

4.1 Existing environment

The assessment includes an analysis of the characteristics of the existing environment (Section 5) in the Project area that are important for the dispersion of air pollutants and that may influence the level of air pollutants at sensitive receptors. Characteristics include terrain features, regional land uses, existing sources of emissions, existing ambient pollutant concentrations and the locations of sensitive receptors relative to the sources.

4.2 Emissions

4.2.1 Construction risk assessment

Construction phase activities can be broadly described as the erection of structures, installation of plant and minor site clearance, where needed. The primary pollutant emitted to air during the construction phase is likely to be dust (i.e., particulate matter). Minor levels of combustion air pollutants may be associated with vehicle and machinery activity. Emissions to air from these activities are expected to be minimal.

The Institute of Air Quality Management (IAQM) has published a risk assessment methodology titled Guidance on the assessment of dust from demolition and construction (IAQM Methodology) (Stoaling et al, 2024). Whilst the IAQM methodology was drafted with the intention of application in the United Kingdom, it is widely used in Australia to assess construction of industrial infrastructure and is suitable for application to the construction phase of the Project.

Potential dust emissions arising from the construction phase of the Project have been addressed using the IAQM Methodology in Section 6.1.

Recommended measures to minimise impacts to air quality during construction are provided in Section 8.

4.2.2 Operational emissions

Emissions to air due to the operation of the Project are discussed in Section 6.2. The potential impact to air quality from the following sources of air pollutant emissions has been assessed using a dispersion modeling assessment:

- Waste gas dechlorination stack
- Hydrogen chloride vent burner stack.

The following additional potential sources have been considered and identified as a negligible risk to air quality at nearest sensitive receptors:

- Hydrogen vent stacks (two stacks) – only contaminant is hydrogen, therefore no health risk
- Boiler stack – worst case estimate – ground-level concentration of NO_2 is likely to be less than 2% of the objective
- Leaks and failures in storage tanks, pipes and fittings, connections and filled bottles – strictly managed to avoid onsite health and safety issues, consequently, offsite levels will be minimal
- Potential fugitive (wind-blown) particulate matter emissions from the salt stockpile.

4.3 Meteorology

A site-specific meteorological data file was generated for the Project by coupling the prognostic model TAPM with the diagnostic metrological model CALMET. The most recent versions of the TAPM (version 4.0.5) and CALMET (version 6.5.0) models at the time of undertaking the study were utilised.

The coupled TAPM/CALMET modelling system was developed to enable high resolution modelling capabilities for regulatory and environmental assessments. The modelling system incorporates synoptic, mesoscale, and local atmospheric conditions, detailed topographic and land use categorisation schemes to simulate synoptic and regional scale meteorology for input into pollutant dispersion models such as CALPUFF.

Technical details of the TAPM and CALMET model configurations are provided in Appendix A, including a validation of the generated data and a summary of the meteorological data generated for the Project. Local meteorology is of paramount importance for dispersion of air pollutants generated by the Project's activities; key features are wind speed, wind direction, atmospheric stability and boundary layer mixing height. Conditions in the local area, as derived from the meteorological modelling carried out for the assessment, are discussed in detail in Appendix A.

4.4 Dispersion modelling

The CALPUFF model (version 7.2.1) was used for dispersion modelling. CALPUFF is an advanced non-steady-state air quality modelling system. Twelve months of modelled meteorological data was used as input for the dispersion model in order to include all weather conditions likely to be experienced in the region during a typical year, as described in Appendix A.

Emission sources were configured in CALPUFF based on the information for each of the following sources:

- Waste gas dechlorination stack (Cl_2 emissions)
- Hydrogen chloride vent burner stack (Cl_2 and HCl emissions).

All other potential Project sources have been discussed and identified as negligible (see Section 6.2). Details of the model configuration are provided in Appendix A.

4.5 Cumulative impacts

There is no representative ambient air quality monitoring data for the air pollutants that are associated with the proposed development, namely chlorine and hydrogen chloride. Therefore, the assessment of the potential impact of the Project has been conducted for the Project in isolation.

4.6 Limitations and uncertainty

This study relies on the accuracy of a number of data sets that feed into the dispersion model, all of which will have uncertainties associated with them. The input data sets include:

- Meteorological monitoring observations from the Bureau of Meteorology (BoM)
- Emissions data provided by the Project team
- Synoptic and surface information datasets from CSIRO.

It is also important to note that numerical models are based on an approximation of governing equations and will inherently be associated with some degree of uncertainty. The more complex the physical model, the greater the number of physical processes that must be included. There will be physical processes that are not explicitly accounted for in the model and, in general, these approximations tend to lead to an over prediction of air pollutant levels.

In addition to the built-in conservatism described above, Katestone has configured the dispersion model with conservative assumptions and, therefore, the assessment is likely to overpredict potential impacts of the Project.

5. EXISTING ENVIRONMENT

5.1 Local terrain and land-use

The proposed development is located in Yarwun, approximately 12 km west northwest of Central Gladstone and 2 km inland of the Gladstone Harbour. The coastal region is dominated by littoral zones with mangroves and very large tidal zones.

The proposed development is in a low-lying area (Figure 4), with elevations between 5 m and 20 m Australian Height Datum (AHD). The terrain surrounding the proposed development is also relatively low lying, with elevation increasing at a small hill between the site and Mount Larcom, which reaches just under 250 m AHD. Further to the west, at approximately 6 km from the site, Mount Larcom rises to a peak of about 470 m AHD.

The Project is located within the Gladstone SDA and, consequently, surrounding land use consists predominantly of heavy industrial activity, including alumina refining, concrete production, oil refining, rock and sand quarrying, hydrogen and coal exportation and chemicals manufacturing.

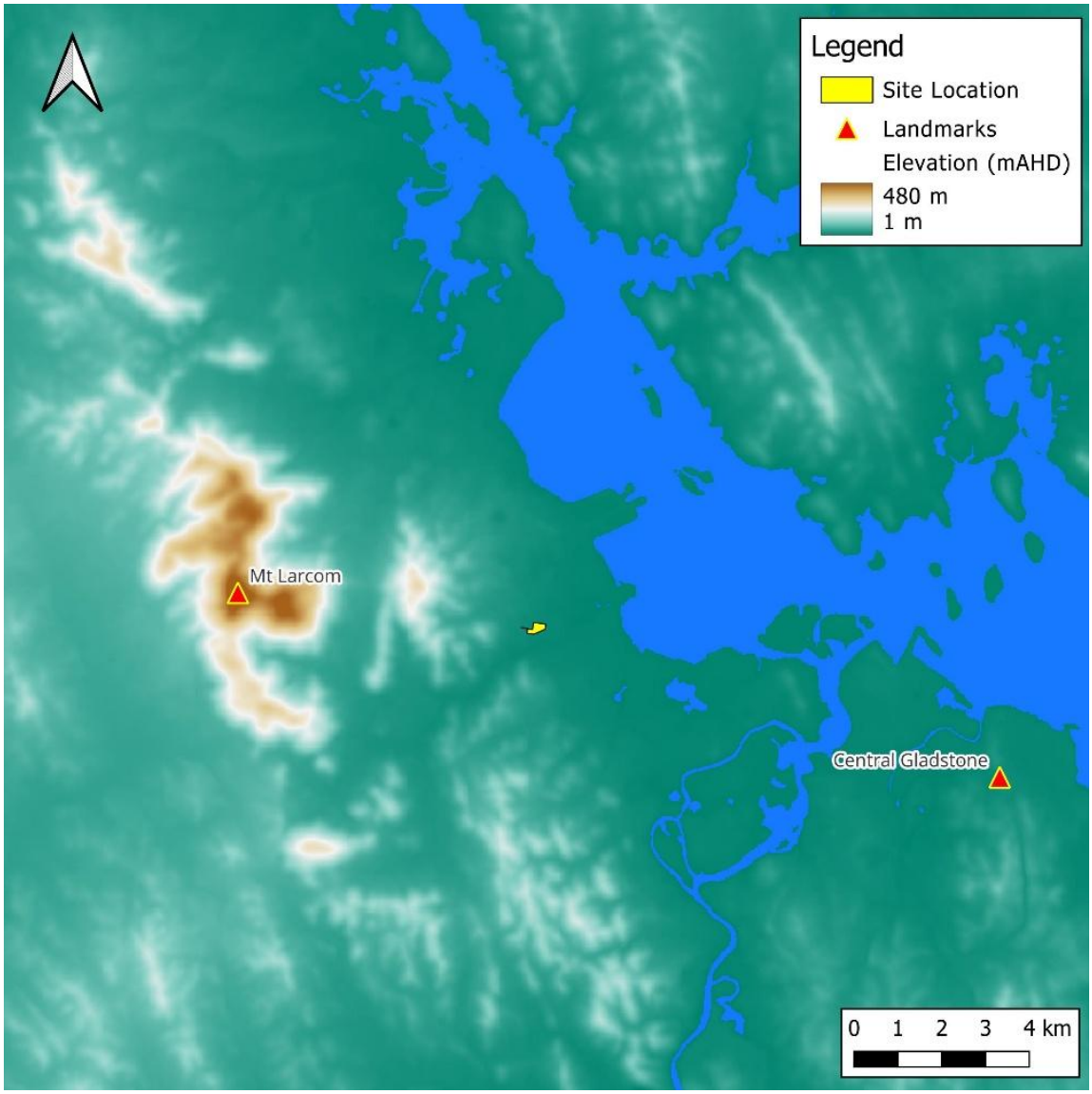


Figure 4 Terrain surrounding the study area

5.2 Sensitive receptors

The Project is located within the Gladstone SDA, an area designated and ready to accommodate large-scale industry, including port related industry, high impact industry, and medium industry. The nearest residential receptor is located 3.7 km to the west of the Project, as shown in Figure 5. The nearest township is Yarwun, approximately 4 km southwest of the site boundary.

Maximum ground-level concentrations of key air pollutants have been predicted at the nearest sensitive receptors. Pollutant concentrations have also been predicted at ground level across a Cartesian grid of receptors (250 m resolution) to enable the production of contour plots of concentration across the study area.

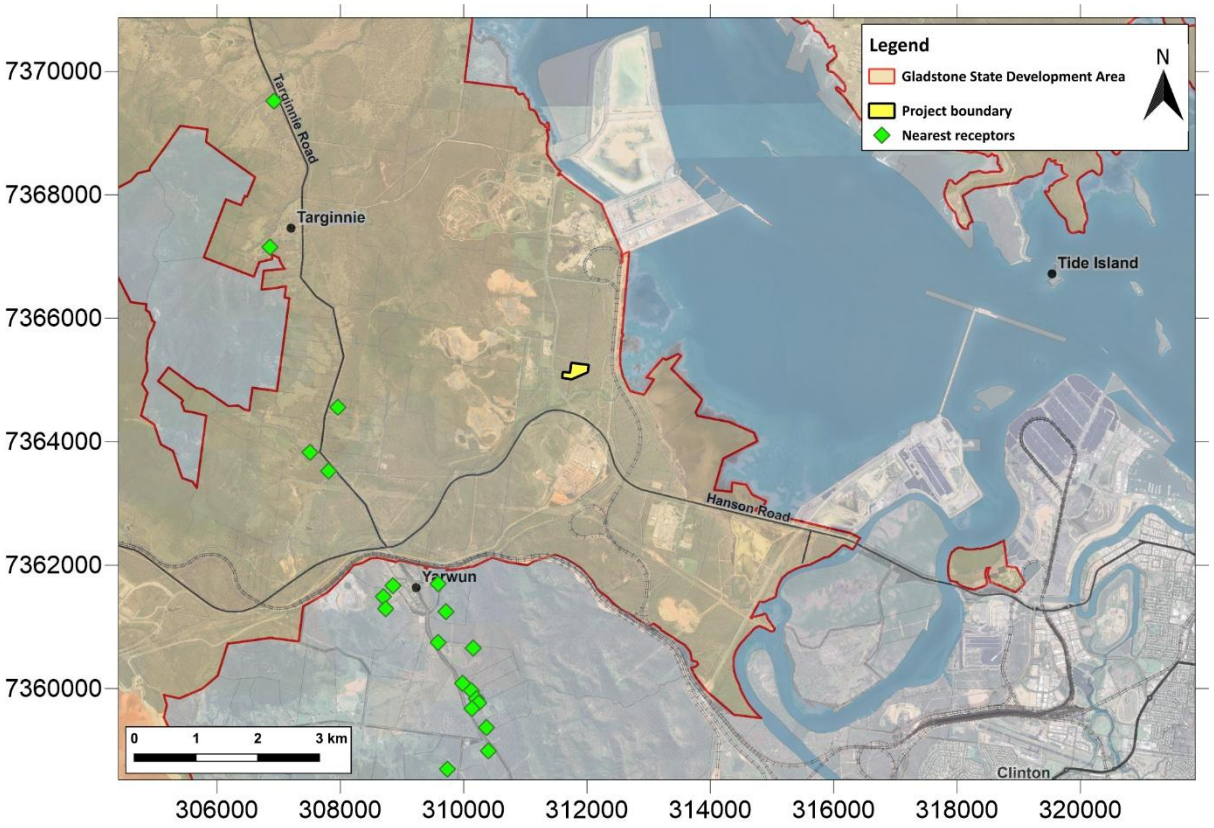


Figure 5 Location of nearest sensitive land uses

5.3 Existing air quality

5.3.1 Existing sources of emissions

The results of a search of the National Pollutant Inventory (NPI) database for the key air pollutants for the 2023/24 reporting year within the Gladstone area are presented in Figure 6 and in Table 3.

The anticipated annual emissions of Cl_2 and HCl from the Project are approximately 13 kg and 3 kg, respectively (see Section 6.2). The Project contribution of HCl is insignificant compared to the levels of this pollutant emitted by other sources in the Gladstone airshed (Table 3). Project emissions of Cl_2 are of similar magnitude to those emitted by other sources in the Gladstone airshed.

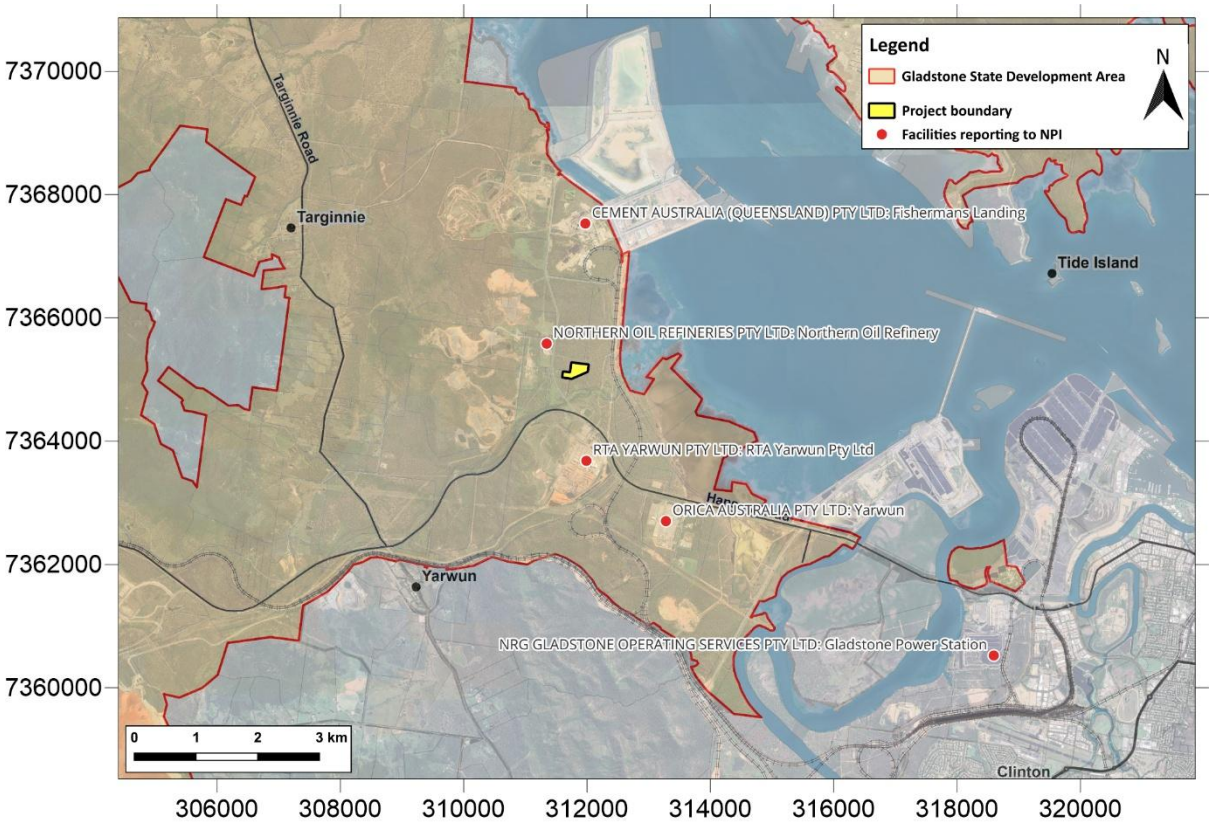


Figure 6 **Gladstone facilities reporting emissions of Cl or HCl to the NPI in the 2023/24 period**

Table 3 **Emissions of Cl and HCl reported to the NPI in the 2023/24 period by Gladstone facilities**

Registered business name	Facility	Main activities	Emissions (kg/year)	
			Chlorine & compounds	Hydrochloric acid
Cement Australia (Queensland) Pty Ltd	Fishermans landing	Cement manufacturing	-	13,600
Northern Oil Refineries Pty Ltd	Northern Oil Refinery	Used oil recycling	-	116
NRG Gladstone Operating Services Pty Ltd	Gladstone Power Station	Electricity generation using coal or coal derived products	4.62	614,000
Orica Australia Pty Ltd	Yarwun	Explosive manufacturing	0.17	0.19
RTA Yarwun Pty Ltd	RTA Yarwun	Alumina refining	-	6,292

5.3.2 Existing ambient air quality

DETSI is responsible for undertaking ambient air quality monitoring in Queensland. No DETSI monitoring stations monitor ambient levels of chlorine compounds or hydrogen chloride anywhere in the state.

6. EMISSIONS TO THE ATMOSPHERE

6.1 Construction dust emissions

Potential dust emissions arising from the construction phase of the Project have been addressed using the IAQM Methodology. This qualitative approach is appropriate due to the temporary nature of the proposed construction activities and well-established mitigation measures that can be applied to minimise potential dust emissions. The magnitude of impacts depends on the mitigation measures adopted. Therefore, the emphasis of the IAQM is primarily on classifying the risk of dust impacts from a site to then identify suitable mitigation measures to reduce those risks.

The IAQM sets out initial screening criteria for determining the need to conduct a construction dust risk assessment, with a risk assessment required where a 'human receptor' is within:

- 250 m of the boundary of the site; or
- 50 m of the route(s) used by construction vehicles on the public highway, up to 250 m from the site entrance(s).

Where the nearest sensitive receptors are located outside the defined distances above, no further assessment is required. Review of the Project boundary and the locations of the nearest sensitive receptors (Section 5.2) against the screening criteria indicates that a detailed risk assessment is not necessary.

Consequently, the risk of dust impacts at sensitive receptor locations during the construction phase of the Project are determined to be negligible. Risks can be minimised further through the application of standard dust management and mitigation measures, which should be applied regardless of risk, in accordance with the general environmental duty (GED) of the *EP Act*. These are discussed in Section 8.

6.2 Operation emissions

6.2.1 Overview of chlor-alkali industry emissions

The National Pollutant Inventory (NPI) reports both inputs and pollutant emissions from the chlor-alkali industry as '*relatively small, both in number and volume'*. As per the NPI Emission Estimation Handbook Inorganic Chemicals Manufacturing (version 2.0, February 2004):

> *Emissions of gaseous pollutants have decreased in recent years as the industry moves away from the mercury and diaphragm cell processes to the more efficient (in terms of material and energy inputs and emissions) membrane cell process. In addition, improved cell part materials have been developed, such as DSA anodes and Modified Diaphragms, which are more stable and create less undesirable by-products.*

With respect to the membrane cell technology that is proposed for the project, the NPI reports that:

> *Chlorine is emitted in relatively small amounts as fugitive emissions from the cells and in the process tail gases. Process tail gases are wet scrubbed with soda ash or caustic soda solutions to remove chlorine. Residual chlorine emissions in tail gases after treatment are negligible. The spent caustic solution is neutralised prior to discharge.*

The spent caustic solution at the proposed facility will not be discharged and will instead be re-used in the production of sodium hypochlorite at the facility.

The following potential sources of air pollutant emissions during operation of the project have been considered:

- Stack and vent sources

- Fugitive sources.

6.2.2 Stack and vent sources

The Project will have four stack or vent sources that will emit to air:

- Waste gas dechlorination stack
- Hydrogen chloride vent burner stack
- Hydrogen vent stacks (two stacks).

The hydrogen vent stacks emit only steam and hydrogen at concentrations below its lower explosive limit. Therefore, the hydrogen vent stacks present negligible risk to air quality and have not been considered further.

Regarding the waste dechlorination stack and the hydrogen chloride vent burner stack, relevant details of stack characteristics and emission rates are provided in Table 4. The air pollutants that are emitted from these sources are chlorine gas (Cl_2) and hydrogen chloride (HCl). These parameters and emission rates have been used in the dispersion modelling assessment of these sources.

As shown in Table 4, the concentrations of hydrogen chloride and chlorine in the emissions from the Project are significantly lower than the emissions standards specified by the POEO Clean Air Regulations (see Table 2), being 30 percent (HCl) and 2.5 percent (Cl_2) of the standards.

Table 4 Stack characteristics and emission rates

Parameter	Unit	Source	
		Waste gas dechlorination stack	Hydrogen Chloride vent burner stack
Stack height	m	20	22
Stack diameter	m	0.2	0.05
Flow rate [a]	Nm³/hr	1,400	11.5
Temperature	°C	45	45
Exit velocity	m/s	13.5	1.77
Pollutant concentration and emission rate			
Chlorine (Cl_2)	mg/Nm³	1.0	5.0
	ppm	0.34	1.70
	g/s	0.00039	0.000016
	kg/annum	12.26	0.51
Hydrogen chloride (HCl)	mg/Nm³	-	30
	ppm	-	19.8
	g/s	-	0.000096
	kg/annum	-	3.03
Table note: [a] Normalised to 20°C, 101.3 kPa			

6.2.3 Fugitive sources

A summary of the fugitive sources during operation of the project, along with an assessment of their risk to air quality, is provided in Table 5. Sources include:

- Leaks and failures in storage tanks, pipes and fittings, connections and filled bottles
- Potential fugitive (wind-blown) particulate matter emissions from the salt stockpile.

As shown in Table 5, the potential impact to air quality from fugitive sources at the project has been identified as minimal. Consequently, these sources have not been included in the dispersion modelling assessment.

Table 5 Fugitive sources

Source	Description	Assessment of risk to air quality at sensitive land uses	Summary of risk
Storage tanks	Leaks and overflows of storage tanks (brine, NaOH, HCl, liquefied chlorine gas, LPG, NaCl storage tanks)	• Tanks are largely contained in storage sheds/buildings • Leaks and overflows very unlikely to occur • Onsite monitoring of Cl_2 and H_2 will identify elevated ambient concentrations onsite before they result in offsite impacts • Cl_2 sniffers will also be installed that will notice any leaks and have the ability to automatically shut-down the facility in the event of a leak • Leaks are an occupational health and safety issue so will be strictly monitored and immediately resolved	Minimal
Pipes, fittings, connections and filled bottles	Leaks		Minimal
Salt stockpile	Potential fugitive (wind-blown) particulate matter emissions from surface of stockpile	• Salt is coarse material and the salt stockpile will quickly form a crust, reducing potential for lift-off of material • The stockpile will be covered and enclosed from three sides, minimising exposure to strong wind and capturing any material lift-off	Minimal

7. RESULTS

Results of the dispersion modelling for Cl_2 and HCl are provided in Table 2. Results are provided as:

- Maximum ground-level concentration at the location of the nearest sensitive receptor, located approximately 3.7 km to the west of the Project
- Maximum ground-level concentration anywhere within the model domain.

Contour plots of maximum ground-level concentration across the model domain are also provided for 1-hour Cl_2, 1-hour HCl, and annual average HCl in Plate 1 to Plate 3, respectively. All results show predicted concentration due to the Project assessed in isolation.

The results of the dispersion modelling show that peak concentrations, including those within the Project site boundary, **comply** with the relevant assessment criteria for Cl_2 and HCl by a significant margin. In particular, the highest concentration of either pollutant anywhere in the model domain is predicted to be less than 0.3 percent of the relevant air quality assessment criteria.

Table 6 Predicted maximum ground-level concentration of key air pollutants at nearest sensitive receptors

Location	Pollutant concentration (µg/m³)		
	Chlorine (Cl_2)	Hydrogen chloride (HCl)	
	Maximum 1-hour average	Maximum 1-hour average	Annual average
Nearest sensitive receptor	0.014	0.007	0.00004
Maximum on model domain	0.104	0.033	0.0007
Maximum concentration as percentage of criterion	0.21%	0.02%	0.004%
Criteria	**50**	**140**	**20**

8. MANAGEMENT MEASURES

8.1 Construction stage

As demonstrated in Section 6.1, risks of dust impacts at sensitive receptor locations during the construction phase of the Project have been identified as negligible. However, under the general environmental duty (GED) of the *EP Act*, during both construction and operation of the Project, all reasonably practicable measures should be applied to prevent or minimise any potential environmental harm. Therefore, it is recommended that the risks of potential offsite dust impacts during the construction phase be further minimised through the inclusion of dust management within the Project's Environmental Management Plan (EMP) and the implementation of standard dust control and mitigation measures such as those in the IAQM Methodology. Key measures include:

- Erect solid screens or barriers around dust activities or the site boundary
- Cover, seed or fence stockpiles and/or exposed surfaces to prevent wind erosion and re-vegetate exposed surfaces as soon as possible
- Seal site haul roads or apply water suppression and minimise vehicle speed on unsurfaced roads
- Use suitable dust suppression techniques (water sprays, local extraction, etc.) during use of cutting, grinding or sawing equipment
- Ensure an adequate water supply on the site for effective dust and particulate matter suppression or mitigation, using non-potable water where possible and appropriate
- Implement a wheel-washing system and ensure vehicles entering and leaving the site are covered.

8.2 Operation stage

The risks to air quality during the operation phase of the Project are minimised through the following:

- The facility will use the best practice membrane cell electrolytic process in the production of chlorine, which, compared to alternative electrolysis techniques (diaphragm cell process and the mercury cell process) has no use of mercury or asbestos
- The use of hydrogen and chlorine gas detector sensors installed in buildings and key locations across the site that are linked to the plant operations to assist in identifying, managing and fixing leaks in a timely manner. Any fugitive releases will be detected and result in the immediate and automatic shutdown of that part of the plant and process.
- The entire facility will have a closed loop design and consequently will not have any fugitive releases. The design of the facility is such that any potential sources of release will be minimal, easily identified, and immediately and automatically rectified.
- Systematic collection and redirection of waste gas stream to the chlorine absorption unit to reduce chlorine to trace levels (< 1 mg/Nm^3) prior to release
- Scrubber on HCl synthesis unit to reduce chlorine and hydrogen chloride to low levels (≤ 5 mg/Nm^3 and ≤ 30 mg/Nm^3, respectively)
- Maintaining a significant buffer zone to sensitive receptor locations.

9. CONCLUSIONS

An air quality assessment has been carried out for Project Halogen, a proposed Chlor-Alkali facility proposed to be located within the Gladstone SDA. The assessment has been prepared in accordance with the DETSI guideline (2024) and all other relevant legislation and regulatory requirements to support a DA for a MCU for a concurrence ERA 7(6d) *Chemical manufacturing: manufacturing in a year, more than 100,000 tonnes of inorganic chemicals* for the proposed Chlor-Alkali facility.

The air quality assessment used recognised techniques for dispersion modelling and emission estimation to determine the potential impacts to sensitive receptors and the surrounding environment. The dispersion modelling has assessed the potential impacts to air from the following sources:

- Waste gas dechlorination stack (Cl_2 emissions)
- Hydrogen chloride vent burner stack (Cl_2 and HCl emissions).

The following additional potential sources were identified as negligible so were not included in the dispersion modelling:

- Hydrogen vent stacks (two stacks)
- Leaks and failures in storage tanks, pipes and fittings, connections and filled bottles
- Potential fugitive (wind-blown) particulate matter emissions from the salt stockpile.

The dispersion modelling has been conducted to predict the maximum ground-level concentrations of Cl_2 and HCl at the location of the nearest sensitive land use located approximately 3.7 km to the west of the Project, as well as the maximum ground-level concentration anywhere within the model domain. Maximum concentrations at these locations have been assessed against the relevant air quality assessment criteria for Cl_2 and HCl.

The results of the dispersion modelling show that peak concentrations, including those within the Project site boundary, **comply** with the relevant assessment criteria for Cl_2 and HCl. The highest concentration of either pollutant anywhere in the model domain is predicted to be less than 0.3 percent of the relevant air quality assessment criteria.

The risks to air quality during the operation phase of the Project are minimised through the following design aspects:

- Best practice membrane cell electrolytic process used in the production of chlorine
- Hydrogen and chlorine gas detector sensors are installed in buildings and key locations across the site that are linked to the plant operations to assist in identifying, managing and fixing leaks in a timely manner
- Closed loop design whereby any potential sources of release will be minimal, easily identified, and immediately and automatically rectified.
- Systematic collection and redirection of waste gas stream to the chlorine absorption unit to reduce chlorine to trace levels (< 1 mg/Nm³) prior to release and installation of a scrubber on the HCl synthesis unit to reduce chlorine and hydrogen chloride to low levels (≤ 5 mg/Nm³ and ≤ 30 mg/Nm³, respectively)
- Maintaining a significant buffer zone to sensitive receptor locations.

Risks of dust impacts at sensitive receptor locations during the construction phase of the Project have been identified as negligible; however, under the GED of the *EP Act*, during both construction and operation of the Project, all reasonably practicable measures should be applied to prevent or minimise any potential environmental harm.

10. REFERENCES

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11. CONTOUR PLOTS

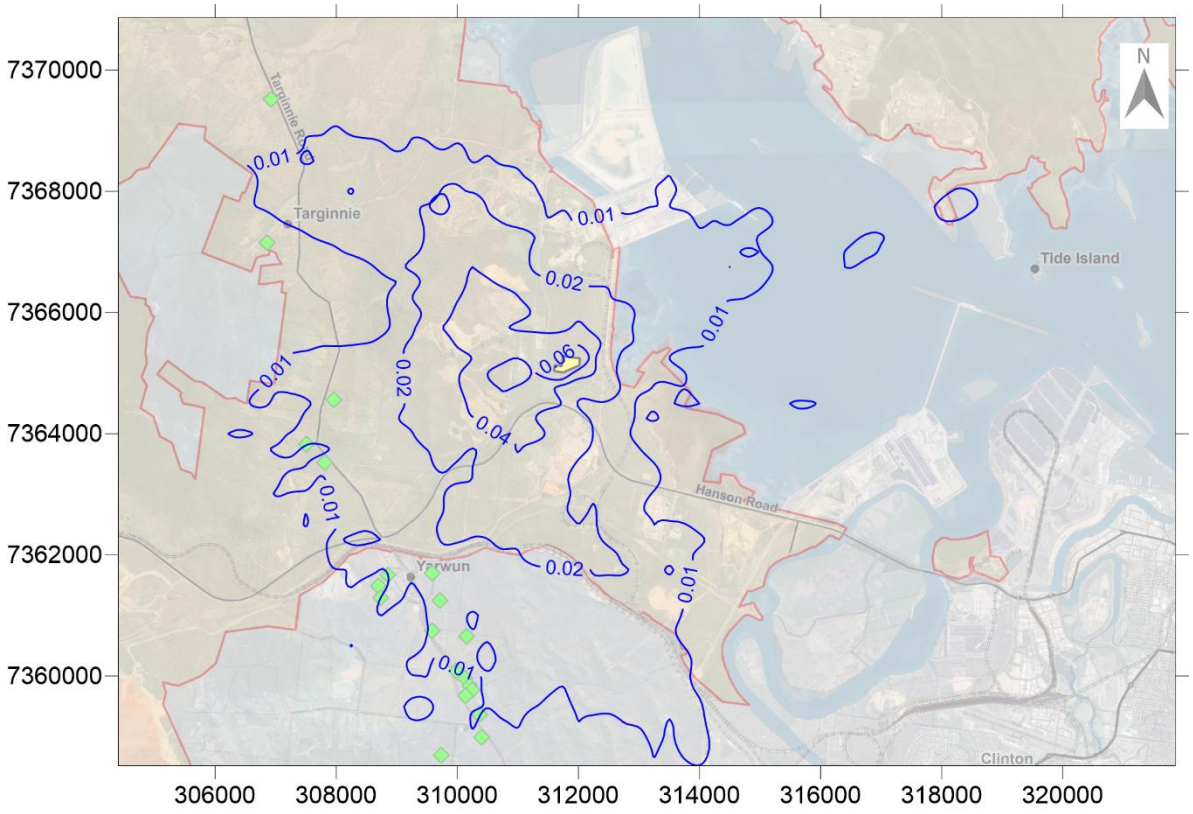


Plate 1 **Chlorine gas (Cl_2): Predicted maximum 1-hour average ground-level concentrations due to emissions from the Facility in isolation**

Location:	**Averaging period:**	**Data source:**	**Units:**
Gladstone, Queensland	1-hour	CALPUFF	µg/m^3
Type:	**Objective:**	**Prepared by:**	**Date:**
Maximum contour plot	50 µg/m^3 (NSW Approved Methods	Sarah Richardson	October 2025

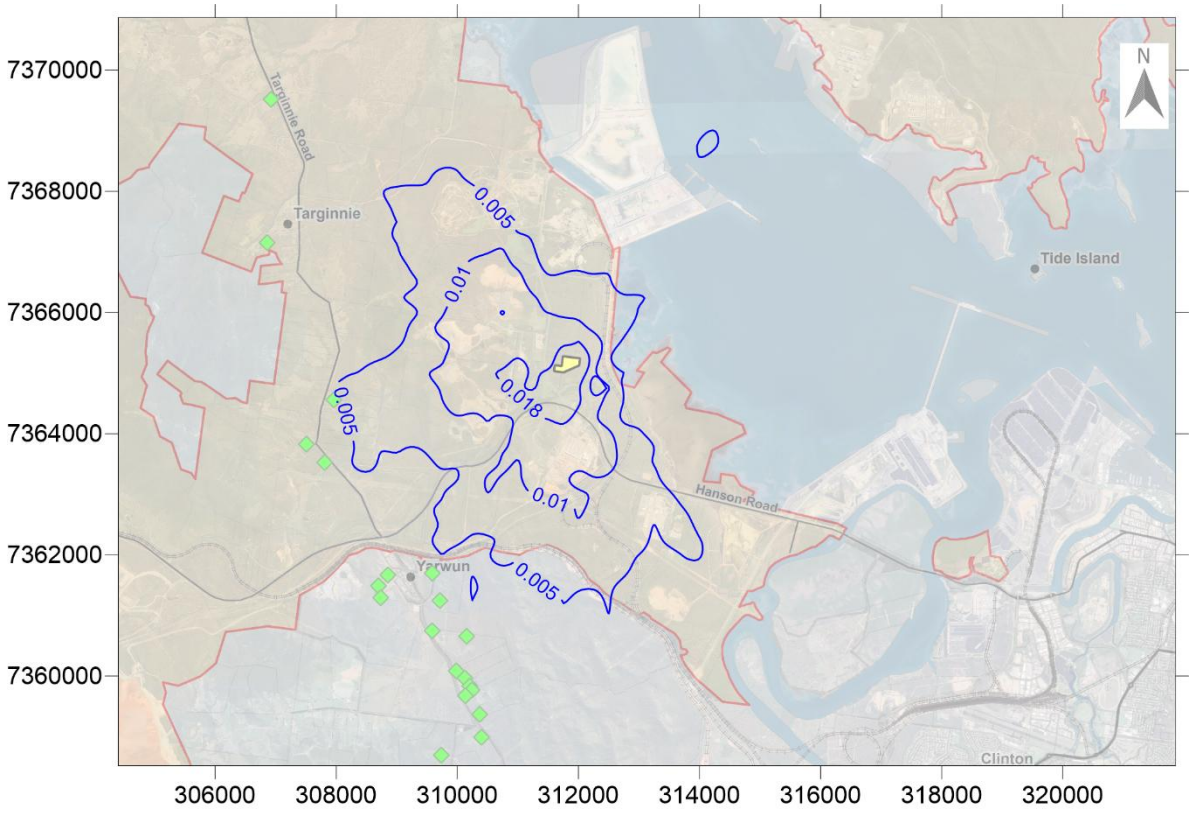


Plate 2 **Hydrogen chloride (HCl): Predicted maximum 1-hour average ground-level concentrations due to emissions from the Facility in isolation**

Location: Gladstone, Queensland	**Averaging period:** 1-hour	**Data source:** CALPUFF	**Units:** µg/m^3
Type: Maximum contour plot	**Objective:** 140 µg/m^3 (NSW Approved Methods) 2,100 µg/m^3 (VIC EPA APAC)	**Prepared by:** Sarah Richardson	**Date:** October 2025

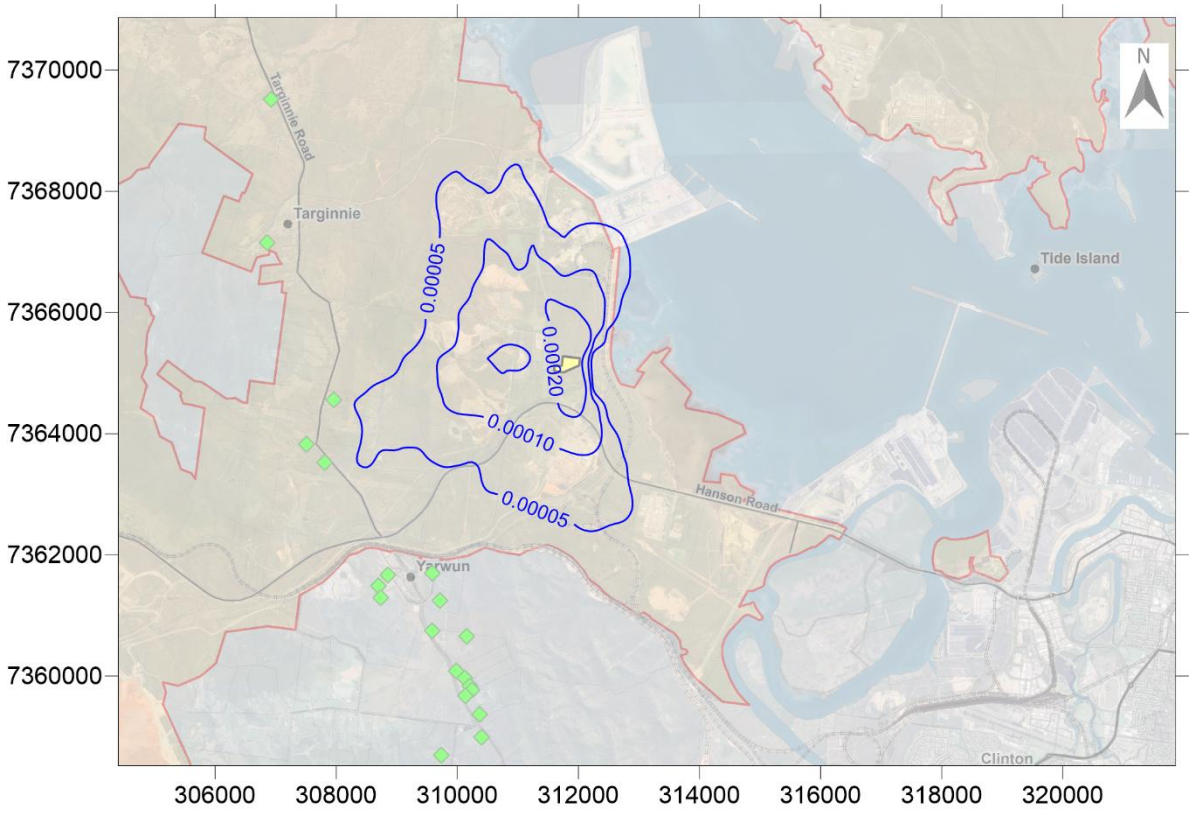


Plate 3 **Hydrogen chloride (HCl): Predicted annual average ground-level concentrations due to emissions from the Facility in isolation**

Location: Gladstone, Queensland	**Averaging period:** Annual	**Data source:** CALPUFF	**Units:** µg/m^3
Type: Maximum contour plot	**Objective:** 20 µg/m³ (VIC EPA APAC)	**Prepared by:** Sarah Richardson	**Date:** October 2025

APPENDIX A METEOROLOGICAL AND DISPERSION MODELLING METHODOLOGY

A1 Meteorology

The meteorological modelling methodology for the Project included the following steps:

- Selection of a representative year
- TAPM modelling and validation
- CALMET modelling.

The following sections describe each step of the meteorological modelling conducted for the Project. A summary of the meteorological data generated is provided in Section A1.5.

A1.1 Selection of representative year

A representative year is required to be selected at the beginning of the meteorological modelling process. Using a representative year in the air quality assessment ensures that the typical conditions experienced at the Project site are reflected in the model.

Selection of a representative year has been done through statistical analysis of historical meteorological observations at the Bureau of Meteorology (BoM) automatic weather station (AWS) located at Gladstone Airport. Meteorological observations from the past five years (2020 to 2024) at Gladstone Airport were analysed to assess the inter-annual variability.

Figure A1 presents annual wind roses for the five years and shows that annual conditions are typically very similar. Figure A2 presents frequency distribution plots for humidity, wind direction, wind speed and temperature, and demonstrates that there is relatively little variation in the distribution of these variables' year-on-year. Figure A3 presents Z-Scores for each variable for each year, these being a measure of the variation of values in each individual year against the mean of values across all years.

The calendar year 2023 has been used for the modelling as it is judged to be the year with the least variation from the mean when averaged across all of the parameters considered.

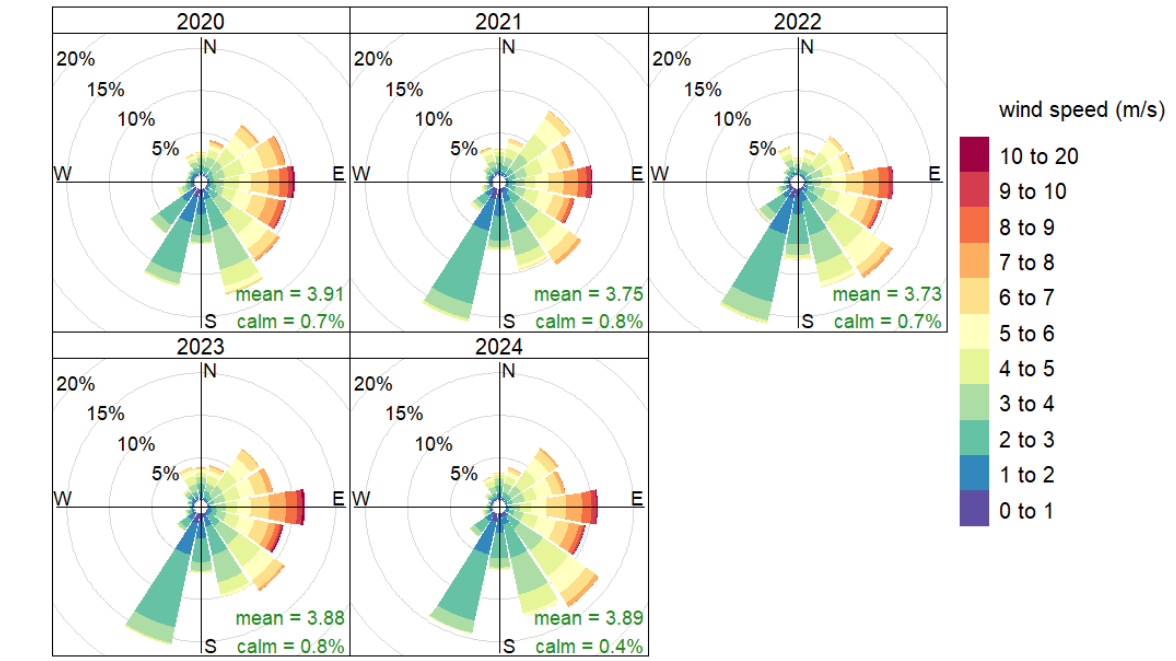


Figure A1 Annual wind roses for Gladstone Airport between 2020 and 2024

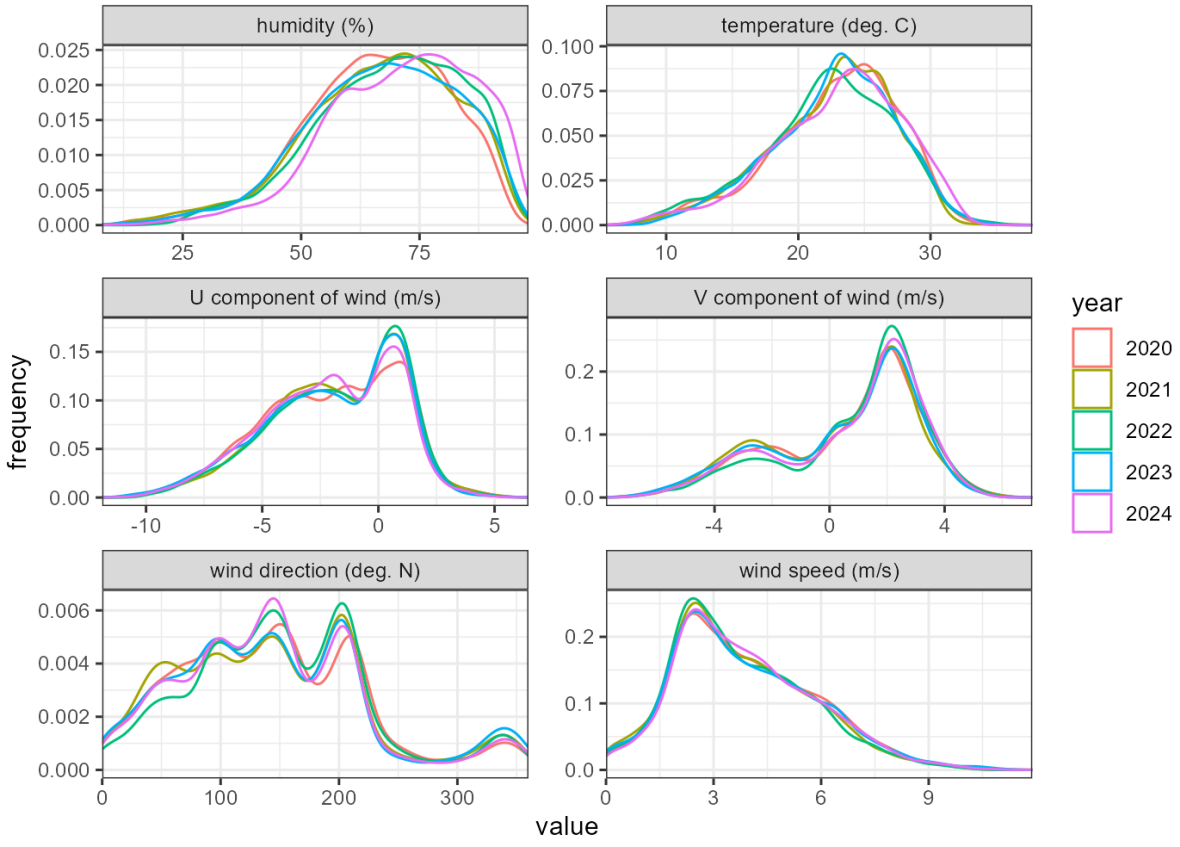


Figure A2 Annual frequency distributions plots for Gladstone Airport between 2020 and 2024

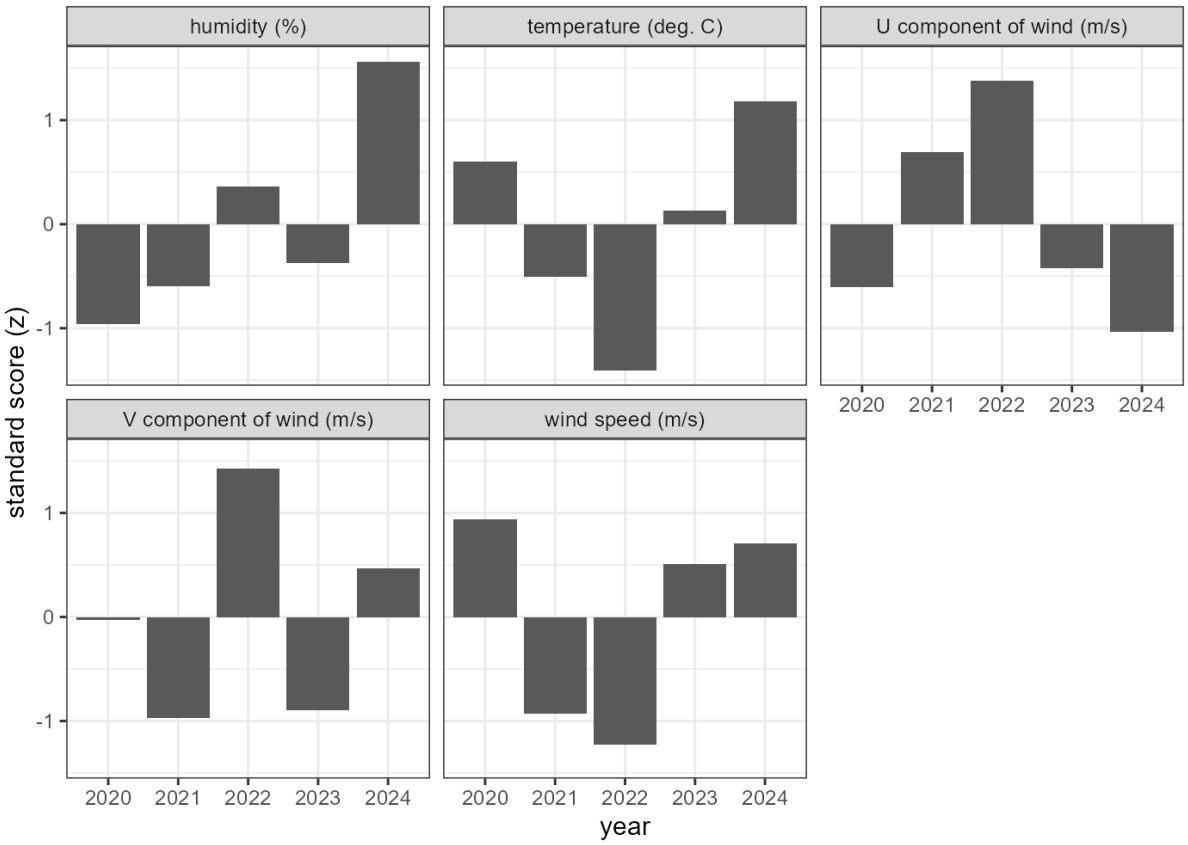


Figure A3 Z-Scores for Gladstone Airport between 2020 and 2024

A1.2 TAPM meteorological modelling configuration

TAPM (The Air Pollution Model) was developed by the CSIRO and has been validated by the CSIRO, Katestone and others for many locations in Australia, in south-east Asia and in North America (CSIRO, 2008). Katestone has extensive experience with TAPM for sites throughout Australia and in parts of America, Bangladesh, New Caledonia and Vietnam. The model performs well in simulating regional wind patterns and has proven to be a useful tool for simulating meteorology in locations where monitoring data providing the vertical distribution of meteorological parameters are unavailable.

TAPM is a prognostic meteorological model which predicts the flows important to regional and local scale meteorology, such as sea breezes and terrain-induced flows from the larger-scale meteorology provided by the synoptic analyses. TAPM solves the fundamental fluid dynamics equations to predict meteorology at a mesoscale (20 km to 200 km) and at a local scale (down to a few hundred metres). TAPM includes parameterisations for cloud/rain micro-physical processes, urban/vegetation canopy, soil type and radiative fluxes.

TAPM requires synoptic meteorological information for the region. This information is generated by a global model similar to the large-scale models used to forecast the weather. The data were supplied on a grid resolution of approximately 75 km, and at elevations of 100 m to 5 km above the ground. TAPM uses this synoptic information, along with specific details of the location such as surrounding terrain, land-use, soil moisture content and soil type to simulate the meteorology of a region as well as at a specific location.

TAPM version 4.0.5 was configured with the following parameters:

- Modelling period from 1 January 2023 to 31 December 2023
- 65 x 65 grid point domain with nesting resolutions of 20 km, 10 km, 3 km, and 1 km

- 30 vertical levels
- Grid centred on latitude -23° 43.5', longitude 151° 11.0'
- Geoscience Australia 9 second DEM terrain data
- TAPM default land cover data edited to be consistent with aerial imagery
- Default options selected for advanced meteorological inputs
- No data assimilation.

A1.3 Comparison of TAPM output with observational data

A1.3.1 Overview

Validation of the TAPM predicted meteorological data was carried out by comparing observational data with data derived from running TAPM. The TAPM predicted meteorological data was compared to BoM observational data at the Gladstone Airport, Gladstone Radar and Rundle Island monitoring station sites.

Comparison of the observational data with the model predictions at these three sites showed that the model generally performed well at simulating the meteorology across the region. While TAPM slightly under-predicted the frequency of strong winds across the three sites, the statistical analysis, wind roses and probability density functions illustrate good agreement between predicted and observed meteorological data at all three locations. The dataset was determined to be appropriate for use in the assessment.

The results of the validation of the TAPM run at the location of the Gladstone Airport site are presented in the following section.

A1.3.2 Validation of TAPM modelling

Figure A4 shows probability density functions that graphically compare statistical distributions of meteorological parameters between the TAPM output and the BoM AWS Gladstone Airport observational data. Figure A5 shows annual wind roses of TAPM output and the BoM AWS Gladstone Airport observational data. Table A1 presents statistical comparisons of TAPM output (wind speed and temperature) to meteorological data recorded at the BoM AWS Gladstone Airport site. The TAPM output was extracted from the closest inner grid point to the location of the weather station.

The following statistical measures of model accuracy are presented in the tables:

- The mean bias, which is the mean model prediction minus the mean observed value. Values of the mean bias close to zero show good prediction accuracy.
- The root mean square error (RMSE), which is the standard deviation of the differences between predicted values and observed values. The RMSE is non-negative and values of the RMSE close to zero show good prediction accuracy. The RMSE is given by

$$\mathrm{RMSE} = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(P_i - O_i)^2}$$

  where N is the number of observations, P_i are the hourly model predictions and O_i are the hourly observations
- The index of agreement (IOA), which takes a value between 0 and 1, with 1 indicating perfect agreement between predictions and observations. The IOA is calculated following a method described in Willmott (1982), using the equation

$$\mathrm{IOA} = 1 - \frac{\sum_{i=1}^{N}(P_i - O_i)^2}{\sum_{i=1}^{N}(|P_i - O_{mean}| + |O_i - O_{mean}|)^2}$$

where N is the number of observations, P_i are the hourly model predictions, O_i are the hourly observations and O_{mean} is the observed observation mean.

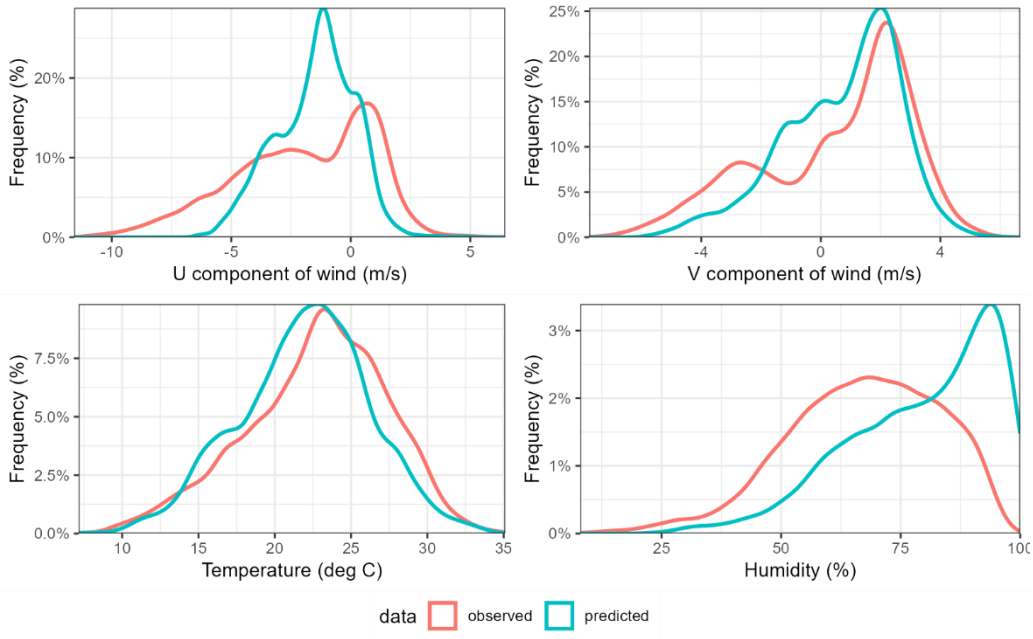


Figure A4 Probability density functions comparing 2023 observational data (blue) with TAPM data (red) at the location of the BoM AWS Gladstone Airport site

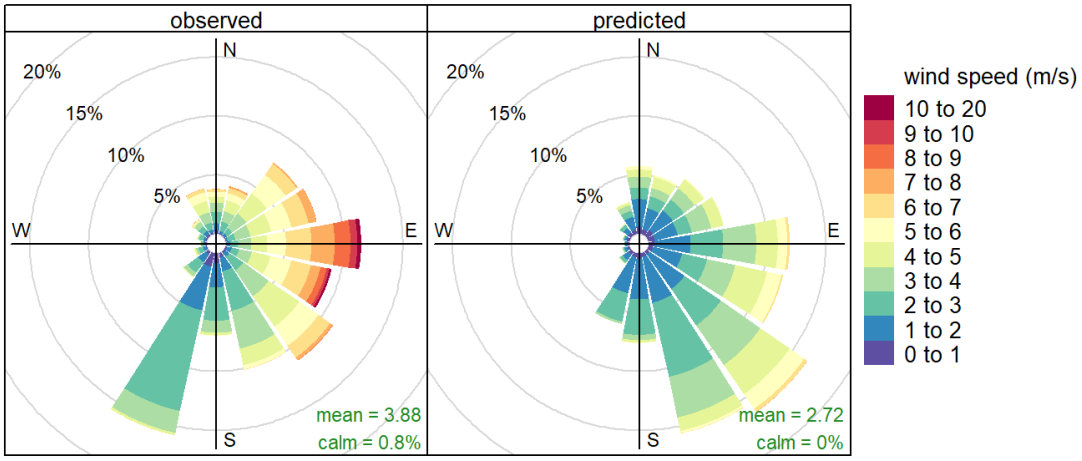


Figure A5 Annual wind rose of 2023 observational data (left) and TAPM data (right) at the location of the BoM AWS Gladstone Airport site

Table A1 Comparison of the observed meteorological data with the TAPM output for 2023 at the location of the BoM AWS Gladstone Airport site

Statistic	"Good" value	Wind speed			Temperature		
		Benchmark	Observational data	TAPM	Benchmark	Observational data	TAPM
Mean	-	-	3.9	2.7	-	22.7	21.9
SD	-	-	2.0	1.3	-	4.6	4.3
Min	-	-	0.0	0.0	-	7.2	7.2
Max	-	-	11.6	7.9	-	35.1	34.4
Bias	0	< ± 0.5 m/s	-1.16		< ± 0.5°C	-0.78	
RMSE	Close to 0	< 2 m/s	1.77		-	1.88	
IoA	Close to 1	> 0.6	0.74		≥ 0.8	0.95	

A1.4 CALMET meteorological modelling configuration

CALMET is an advanced non-steady-state diagnostic 3D meteorological model with micro-meteorological modules for overwater and overland boundary layers. The model is the meteorological pre-processor for the CALPUFF modelling system. CALMET is capable of reading hourly meteorological data as data assimilation from multiple sites within the modelling domain; it can also be initialised with the gridded three-dimensional prognostic output from other meteorological models such as TAPM. This can improve dispersion model output, particularly over complex terrain as the near surface meteorological conditions are calculated for each grid point.

CALMET version 6.5.0 was used to simulate meteorological conditions in the region. The CALMET simulation was initialised with the gridded TAPM 3D wind field data from the 1 km grid. CALMET treats the prognostic model output as the initial guess field for the CALMET diagnostic model wind fields. The initial guess field is then adjusted for the kinematic effects of terrain, slope flows, blocking effects and 3D divergence minimisation.

CALMET was configured using default options and parameters, with the following selections:

- Modelling period from 1 January 2023 to 31 December 2023
- 50 x 50 grid point domain with 500 m resolution, nested within the TAPM inner domain
- 12 vertical levels at heights of 20, 60, 100, 150, 200, 250, 350, 500, 800, 1600, 2600 and 4600 metres
- Prognostic wind fields generated by TAPM input as MM5/3D.DAT at surface and upper air for "initial guess" field (no-observations mode)
- Gridded cloud cover from prognostic relative humidity at all levels
- No extrapolation of surface wind observations to upper layers
- Terrain radius of influence of 1 km.

A1.5 CALMET meteorological outputs

The following sections provide a description of the CALMET outputs as utilised in the CALPUFF dispersion modelling for the meteorological parameters that are important for the dispersion of air pollutants in the atmosphere, namely wind speed, wind direction, atmospheric stability, mixing layer height, and temperature. These parameters have been extracted from the CALMET dataset at the Project site.

A1.5.1 Wind speed and wind direction

The annual distribution of winds predicted by CALMET for 2023 is presented in Figure A6. The seasonal and diurnal distributions of winds are presented in Figure A7 and Figure A8.

Winds across the study area are predicted to be predominantly light to moderate (up to around 6 m/s) and from the east-northeast through to south-southwest direction. Winds from the west are least frequent.

The seasonal breakdown of winds shows that winds at the site are more east to southeasterly during spring and summer, shifting to more southerly during autumn and winter. Spring and summer also experience an increase in winds form the north-northwest to north-northeast.

The diurnal breakdown of winds shows that the strongest winds are predicted during the afternoon (midday to 6pm) when winds are predominantly from the northeast to southeast. The lightest winds are predicted during the night (midnight to 6am) when winds are predominantly from the south-southeast to southwest direction.

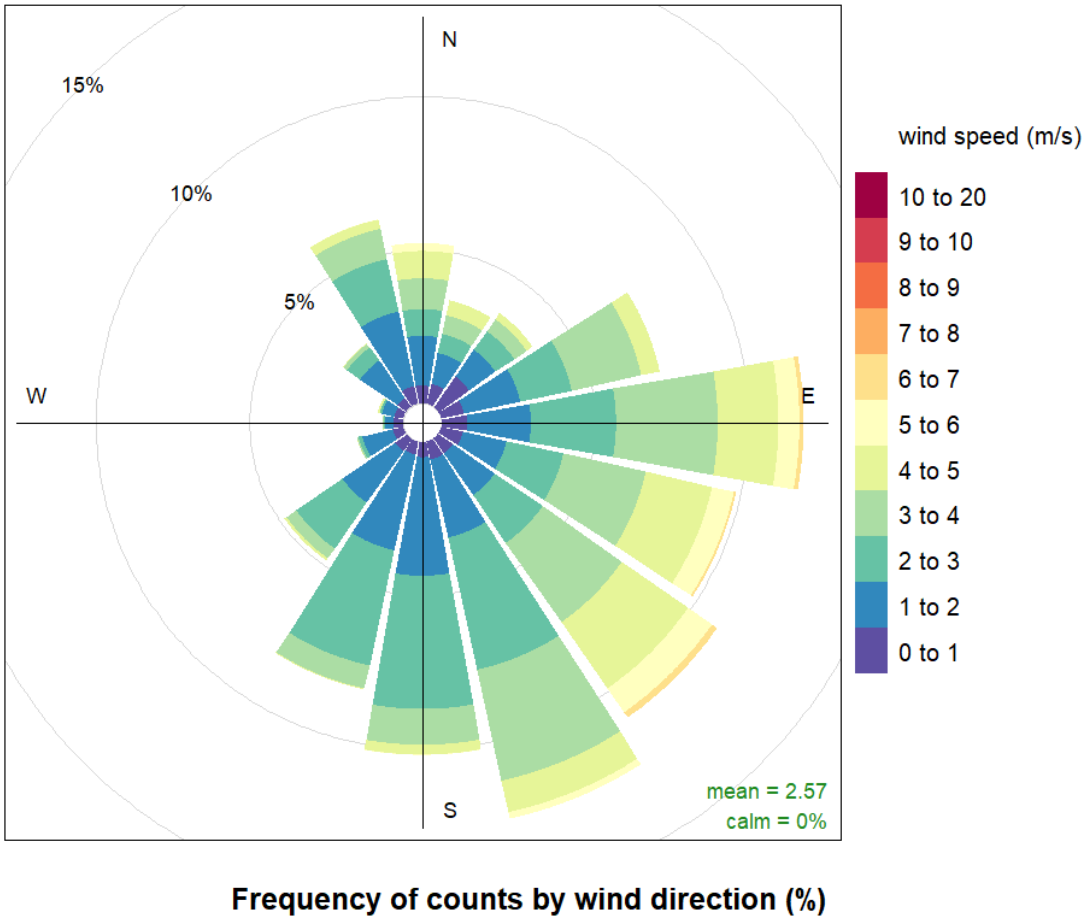


Figure A6 2023 annual distribution of winds predicted by CALMET

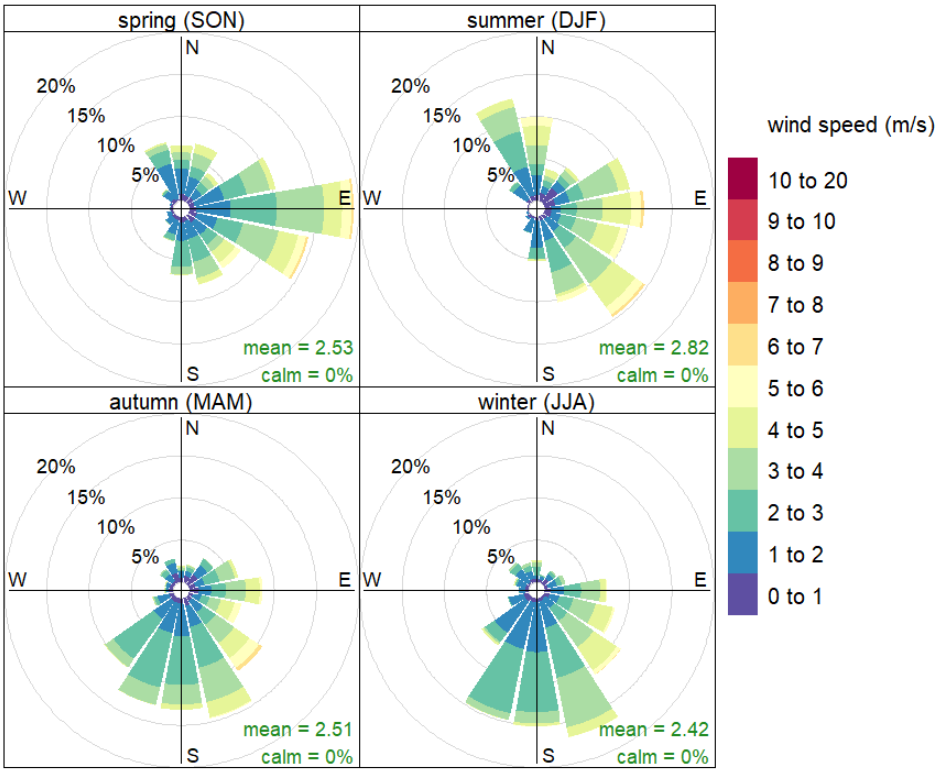


Figure A7 2023 seasonal distribution of winds predicted by CALMET

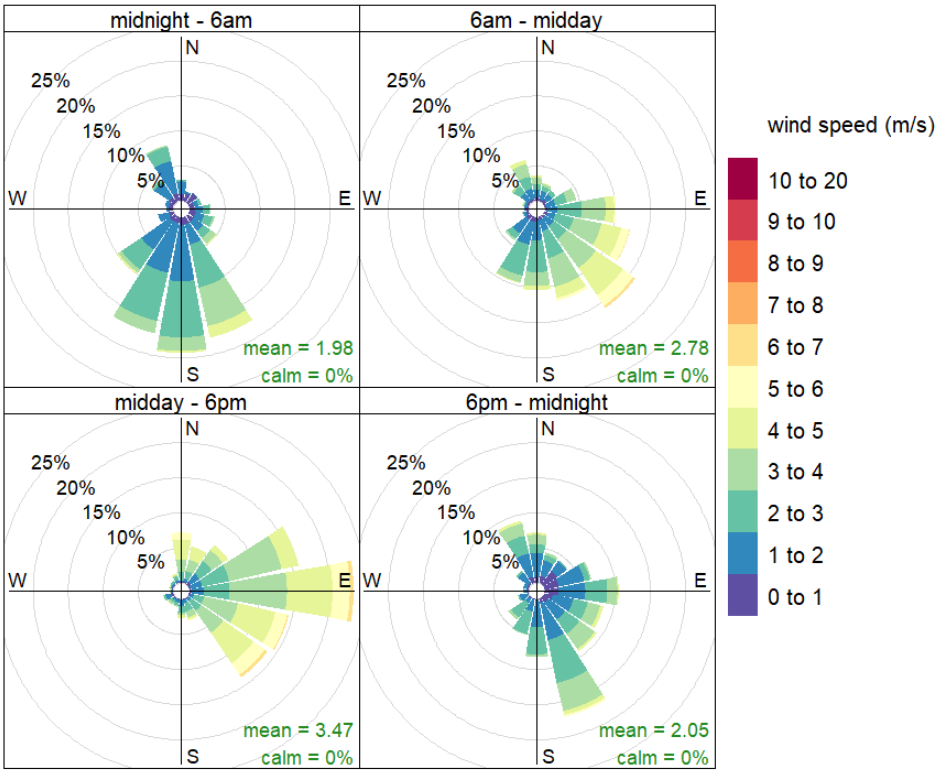


Figure A8 2023 diurnal distribution of winds predicted by CALMET

A1.5.2 Atmospheric stability

Stability classification is a measure of the stability of the atmosphere and can be determined from wind measurements and other atmospheric observations. The stability classes range from A Class, which represents very unstable atmospheric conditions that may typically occur on a sunny day, to F Class, which represents very stable atmospheric conditions that typically occur during light wind conditions at night. Unstable conditions (Classes A to C) are characterised by strong solar heating of the ground that induces turbulent mixing in the atmosphere close to the ground. This turbulent mixing is the main driver of dispersion during unstable conditions. Dispersion processes for Class D conditions are dominated by mechanical turbulence generated as the wind passes over irregularities in the local surface. During the night, the atmospheric conditions are generally stable (often Classes E and F).

Figure A9 shows the distribution of stability classes extracted from the CALMET dataset, where Class A represents the most unstable conditions and Class F represents the most stable. Neutral (D class) conditions are present throughout the day, comprising 43% of total time. Stable (E class) and very stable (F class) conditions are the next most frequent, comprising 37% of total time, and only occur between 5 pm and 7 am.

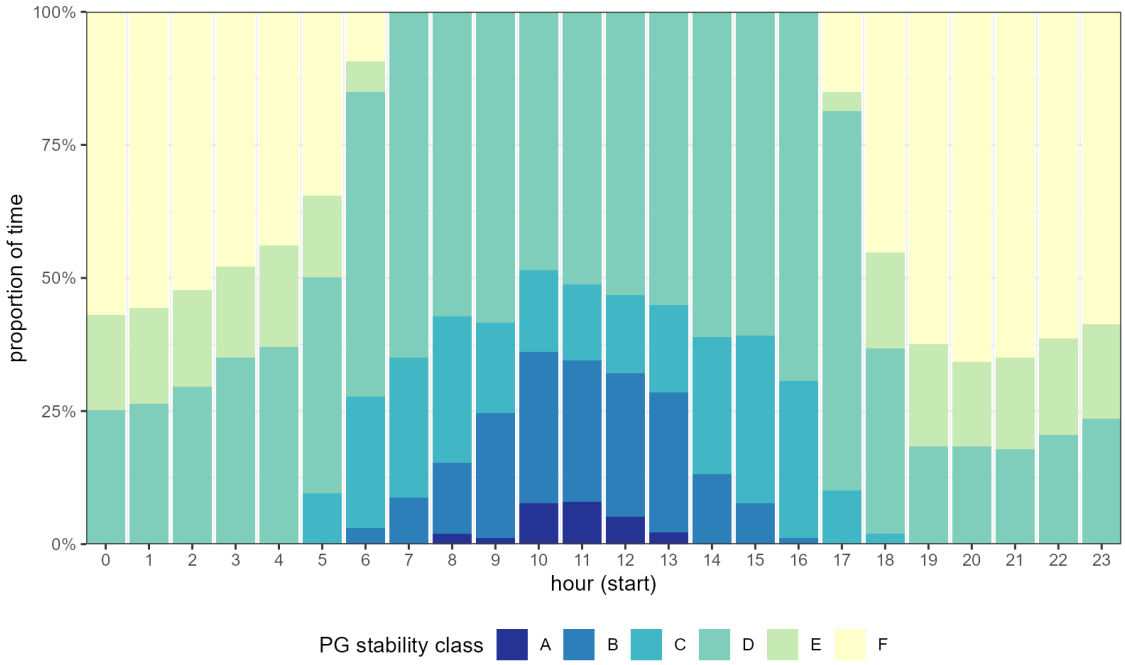


Figure A9 2023 frequency distribution of atmospheric stability conditions predicted by TAPM/CALMET

A1.5.3 Mixing height

The mixing height defines the height of the mixed atmosphere above the ground (mixed layer), which varies diurnally. Air pollutants released at or near the ground will become dispersed within the mixed layer. During stable atmospheric conditions, the mixing height is often quite low, and dispersion is limited to within this layer. During the day, solar radiation heats the ground and causes the air above it to warm, resulting in convection and an increase to the mixing height. The growth of the mixing height is dependent on how well the warmer air from the ground can mix with the cooler upper-level air and, therefore, depends on meteorological factors such as the intensity of solar radiation and wind speed. Strong winds cause the air to be well mixed, resulting in a high mixing height.

Mixing height information extracted from the CALMET dataset are presented as a diurnal frequency (box and whisker) plot in Figure A10. The plot shows that, on average, the mixing height begins to increase around 6am and peaks around 3- 4pm before descending rapidly into the evening.

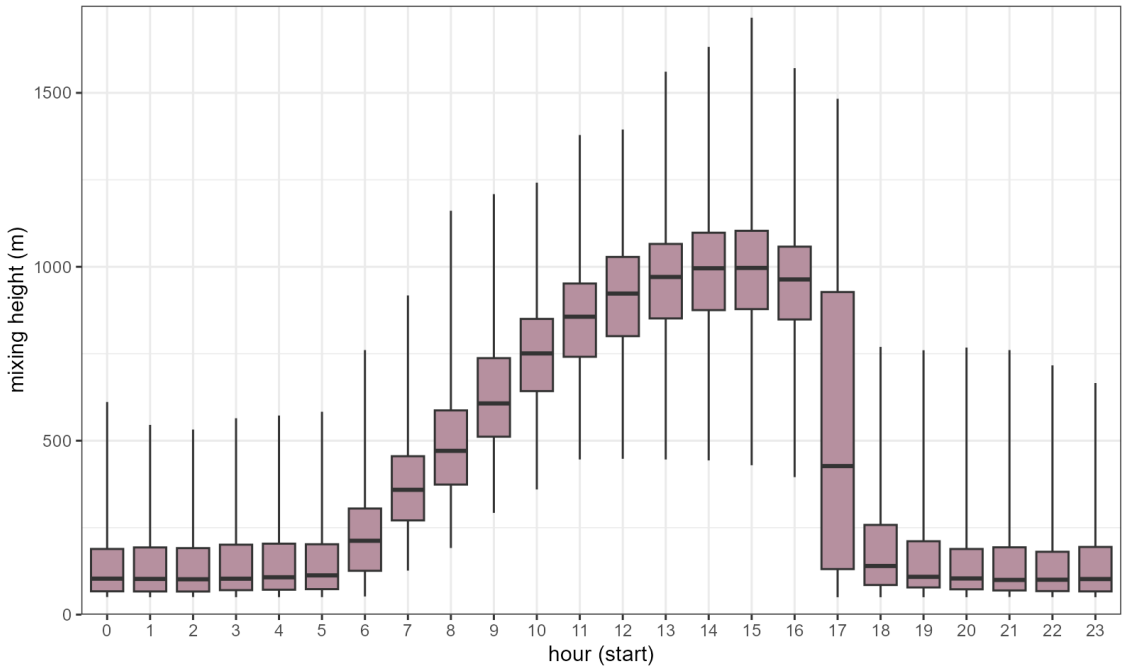


Figure A10 2023 diurnal profile of mixing height predicted by CALMET

A1.5.4 Temperature

The hourly distribution of CALMET predicted temperature is provided in Figure A11 and the monthly distribution is provided in Figure A12. Over the twelve-month meteorological simulation, the temperature was predicted to range between 8.1°C and 34.4°C (average of 21.9°C).

During winter the temperature was predicted to range between 10.2°C and 28.2°C (average of 18.4°C). During summer the temperature was predicted to range between 19.9°C and 34.4°C (average of 25.6°C).

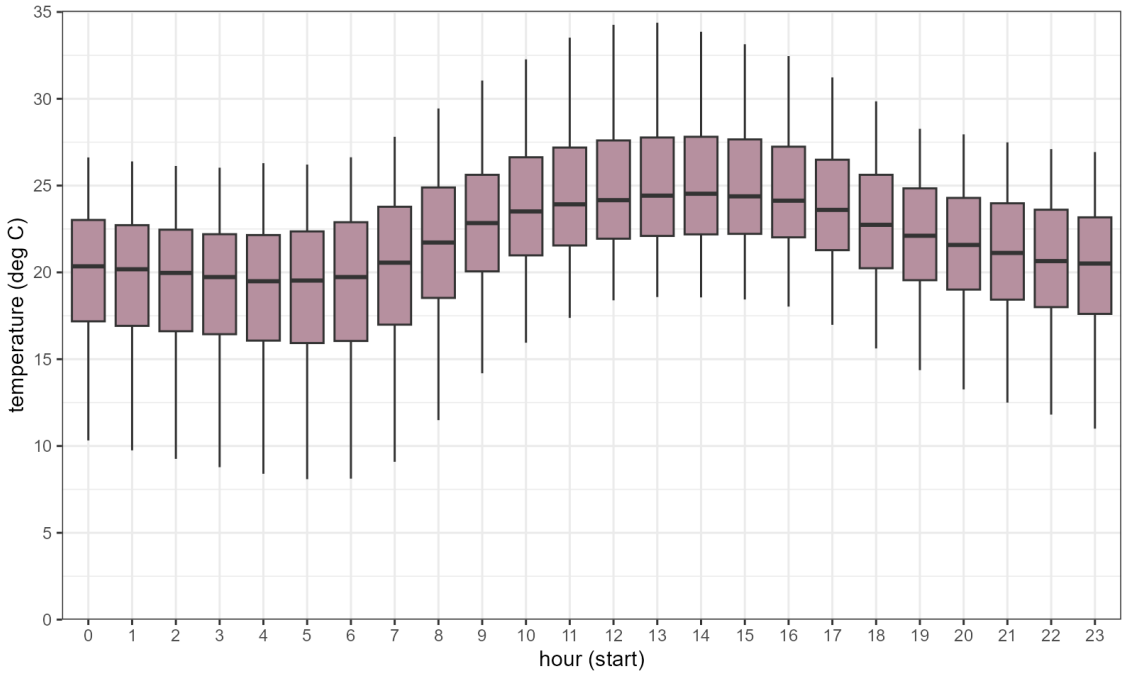


Figure A11 2023 hourly distribution of CALMET predicted temperature

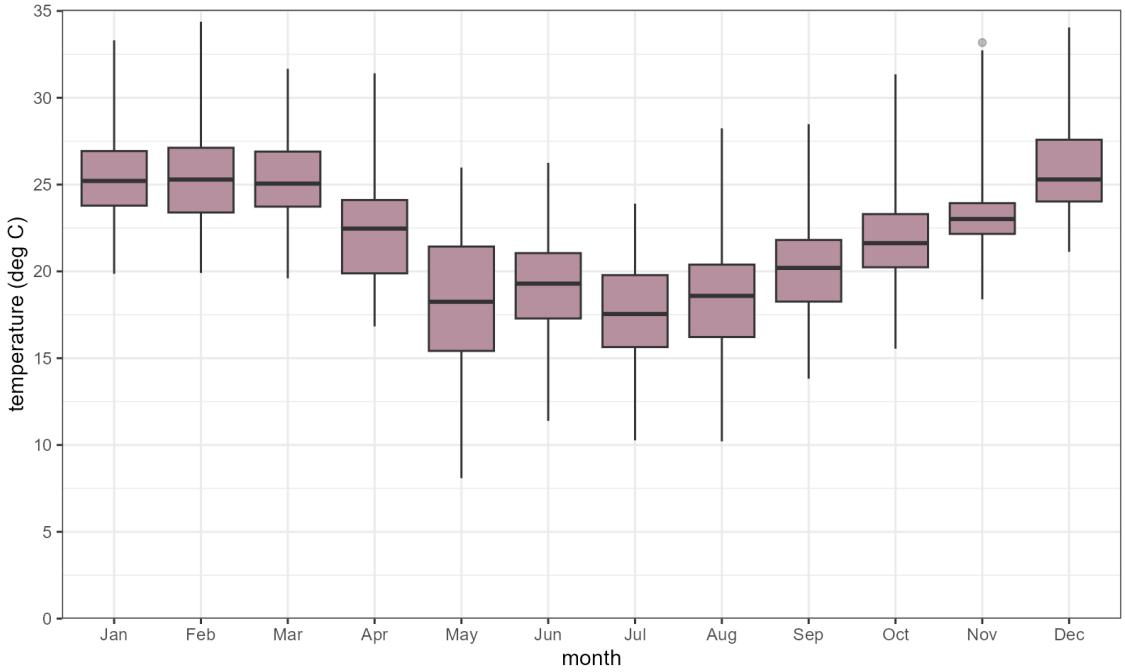


Figure A12 2023 monthly distribution of CALMET predicted temperature

A2 Dispersion modelling

CALPUFF simulates the dispersion of air pollutants to predict ground-level concentration and deposition rates across a network of receptors spaced at regular intervals, and at identified discrete locations. CALPUFF is a non-steady-state Lagrangian Gaussian puff model containing parameterisations for complex terrain effects, overwater transport, coastal interaction effects, building downwash, wet and dry removal, and simple chemical transformation. CALPUFF employs the 3D meteorological fields generated from the CALMET model by simulating the effects of time and space varying meteorological conditions on pollutant transport, transformation, and removal.

CALPUFF takes into account the geophysical features of the study area that affect dispersion of pollutants and ground-level concentrations of those pollutants in identified regions of interest. CALPUFF contains algorithms that can resolve near-source effects such as building downwash, transitional plume rise, partial plume penetration, sub-grid scale terrain interactions, as well as the long-range effects of removal, transformation, vertical wind shear, overwater transport and coastal interactions. Emission sources can be characterised as arbitrarily varying point, area, volume and lines or any combination of those sources within the modelling domain.

Key features of CALPUFF used to simulate dispersion:

- Domain area of 100 by 100 grids at 0.25 km spacing, nested within the domain defined in CALMET
- 365 days modelled (1 January 2023 to 31 December 2023)
- Gridded 3D hourly-varying meteorological conditions generated by CALMET
- Partial plume path adjustment for terrain modelled
- Dispersion coefficients calculated internally from sigma v and sigma w using micrometeorological variables
- Stack tip downwash, transitional plume rise and PDF used for dispersion under convective conditions
- Building wakes included for onsite structures shown in Figure A13
- All other options set to default.

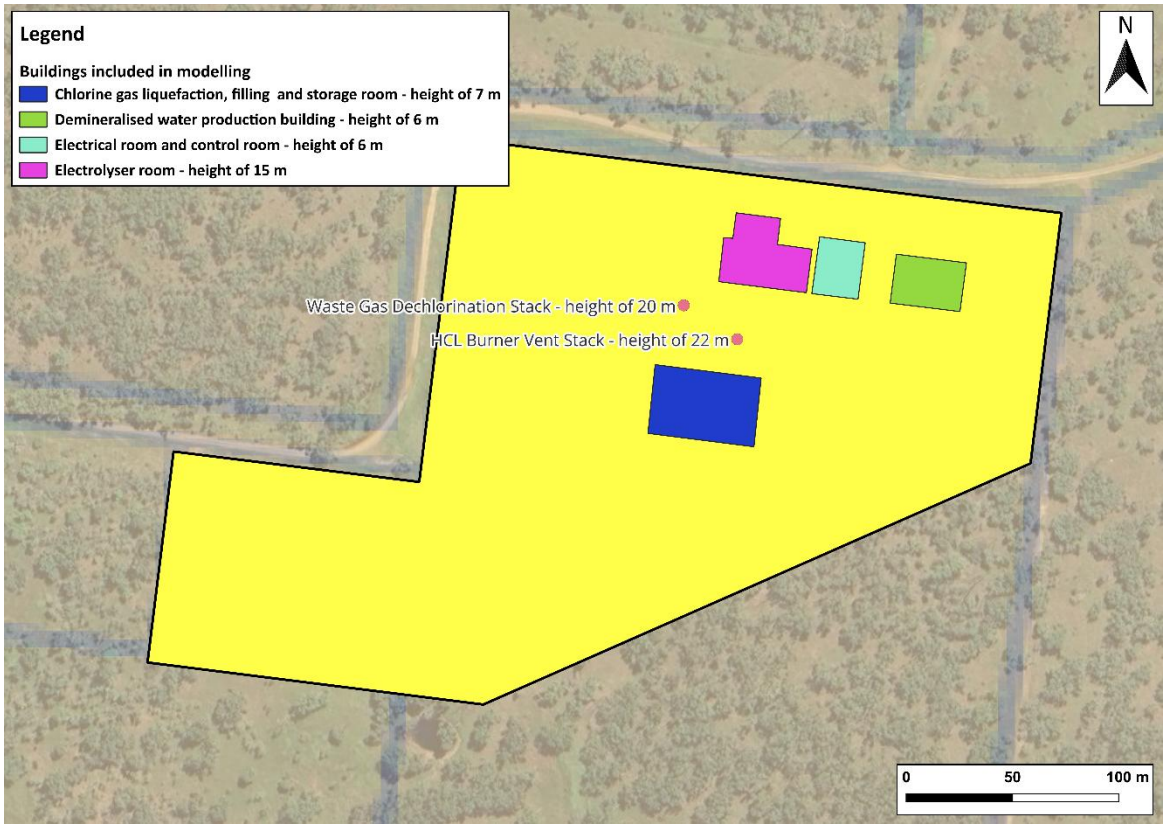


Figure A13 Onsite building wake structures included in the assessment

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Our Ref: P003805-L01-DKB-rev1

20/11/2025

PLANS AND DOCUMENTS
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SDA APPROVAL
Queensland Government
SDA approval: AP2025/015

Greg Usher
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Dear Greg

ADDENDUM TO PROJECT HALOGEN TRAFFIC IMPACT ASSESSMENT

This letter has been prepared as an addendum to the Project Halogen Traffic Impact Assessment (P003805-R01-RevA1) dated 3 November 2025 previously submitted for the proposed development by Grenof Water Technologies of a Chlor-alkali facility at 56 Fishermans Road, Yarwun. This addendum identifies and addresses the effect of relocating the site access from Fishermans Road to Landing Road on the findings of P003805-R01-RevA1. It also provides supporting justification to demonstrate that the "alternative preferred access location" is appropriate and that the development will continue to operate satisfactorily within the surrounding road network.

Except for the access relocation discussed herein, all other aspects, assumptions, and findings of P003805-R01-RevA1 remain valid and unchanged.

Proposed Development Site Access

In the P003805-R01-RevA1, it was proposed to pave and seal approximately 150m of Fishermans Road between Landing Road and the proposed entry gate to provide access to the development (refer Figure 1). In section 5.4.3 of the P003805-R01-RevA1, the Fishermans Road / Landing Road intersection layout indicated that the existing 20m wide Fishermans Road reserve and public utility plant (PUP) presents geometric and spatial constraints that make it difficult to accommodate the required B-double swept paths. Achieving compliant access from Fishermans Road would likely necessitate the relocation of existing PUP within the road reserve. In contrast, Landing Road provides a suitably wide road reserve with appropriate alignment and sight distances to safely accommodate all anticipated vehicle movements associated with the development. Hence an alternative solution put forward was to relocate the proposed development access from Fishermans Road to the alternative preferred access location on Landing Road south of the existing electricity substation.

Figure 1 - Original Site Access on Fishermans Road



As proposed in Figure 26 of P003805-R01-RevA1, the site access is proposed to be relocated to Landing Road approximately 130m south of Fishermans Road generally in accordance with Figure 2 below. The internal site layout remains unchanged apart from extension of the internal roadway connecting internal facilities to the external road network.

Figure 2 – Preferred Alternative Access Location on Landing Road

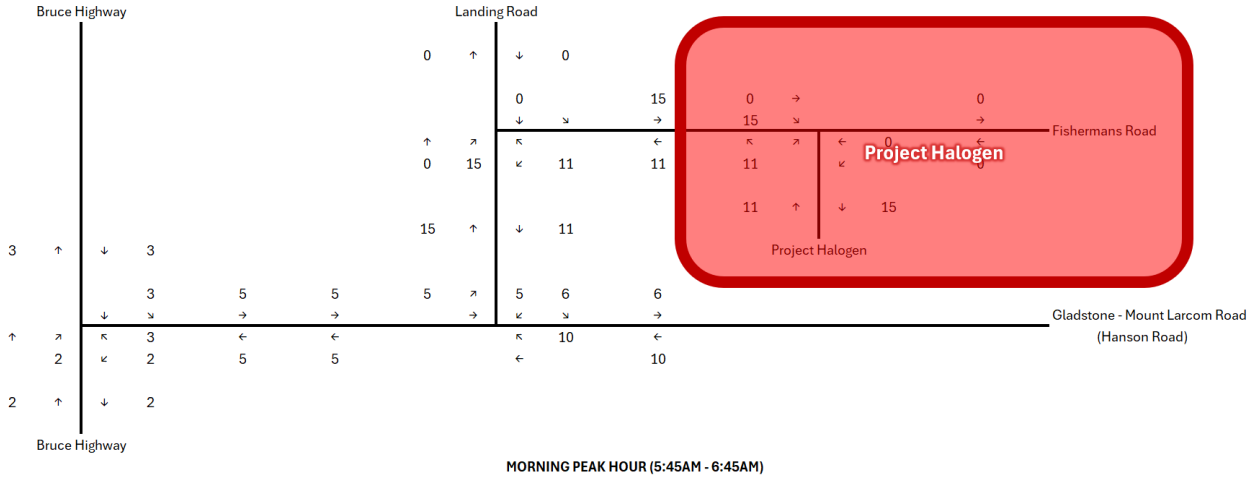


Development Traffic

Relocation of the development site access will not alter the traffic generation or trip distribution of the development.

The only change to development traffic volumes on the network is that development traffic will access Landing Road directly instead of accessing Fishermans Road directly and then accessing Landing Road via Fishermans Road. All traffic diagrams in the report remain valid subject to the change demonstrated by Figure 3. All traffic diagrams from Figure 16 onwards of P003805-R01-RevA1 should be interpreted as having the change demonstrated by Figure 3 below.

Figure 3 – Development Traffic Volumes on the Network Example



Construction Traffic Impact Assessment

As outlined in section 5.2 of the P003805-R01-RevA1, construction activities are not expected to generate:

- Over-size-over-mass (OSOM) vehicle movements; or
- More vehicle movements than peak operations traffic

Therefore, assessment of design peak period traffic during operations is considered to provide adequate assessment of construction traffic.

The proposed relocation of the site access from Fishermans Road to the preferred alternative access at Landing Road does not change this expectation, therefore the original Construction Traffic Impact Assessment remains unchanged.

Road Safety Impact Assessment

Over 16 years no crashes were reported on Fishermans Road or at the Landing Road / Fishermans Road intersection. Therefore, the Road Safety Impact Assessment in Section 5.3 of P003805-R01-RevA1 based on development access via Fishermans Road is considered equally valid for the creation of a new access on Landing Road as a direct access to the development. Therefore, the proposed relocation of the site access from Fishermans Road to the alternative preferred access location on Landing Road does not change the conclusions of the Road Safety Impact Assessment that:

- The proposed development is not expected to increase the risk score of any existing risk items above their "without development" level and no action is required to mitigate existing road safety issues;
- Site access on Landing Road should be designed in accordance with the recommendations of an Access and Frontage Impact Assessment as per the discussion below based on Section 5.4 of P003805-R01-RevA1; and
- Changes to the road environment should be subject to a road safety audit by an accredited road safety auditor at the detailed design stage.

Access and Frontage Impact Assessment

The Access and Frontage Impact Assessment contained Section 5.4 of P003805-R01-RevA1 includes turn warrant assessment, intersection analysis and sight distances for the:

- Originally development access on Fishermans Road;
- Landing Road / Fishermans Road intersection; and
- Gladstone – Mount Larcom Road (Hanson Road) / Landing Road intersection.

The relocation of the site access from Fishermans Road to Landing Road renders the previously completed turn warrant and sight distance assessments for Fishermans Road access redundant, and proposed changes to Fishermans Road are not required.

The previously completed assessment of the Landing Road / Fishermans Road intersection provides a conservative assessment of the proposed Landing Road access as the Landing Road / Fishermans Road intersection assessment assumed 4vph as background traffic on Fishermans Road. The previous assessment concluded that the Landing Road / Fishermans Road intersection warranted the minimum standard of turn treatments permitted in the normal design domain (NDD) and that capacity analysis was unnecessary.

Upgrading of the Landing Road / Fishermans Road intersection as shown in Appendix I of P003805-R01-revA1 is not required, however, the general scheme as detailed in Premise Sketch P003805-SKC005-rev3 may still be valid subject to relocation of the access from the northern side of the existing substation (Fishermans Road) to south of the substation as proposed. The relocated access is less geometrically constrained than the Landing Road / Fishermans Road intersection because:

- The preferred alternative access is to be constructed within a 30m wide corridor which is wider than the 20m wide Fishermans Road reserve; and
- Relocating the access reduces conflict with PUP.

Sight distance requirements at the preferred alternative access location would be the same as at the Landing Road / Fishermans Road intersection and sight distance at both locations is expected to be compliant.

Even though a concept layout has not been prepared for the preferred alternative access location, the detail provided in this letter and P003805 should be sufficient for conditions of development to be written which support approval of the development with relocation of the access from Fishermans Road to the preferred alternative access location on Landing Road.

Relocation of the development access from Fishermans Road to the preferred alternative access location on Landing Road does not change any of the Gladstone – Mount Larcom Road (Hanson Road) / Landing Road intersection assessment.

Road Link Capacity Assessment

Section 5.5 of P003805-R01-RevA1 outlines the recommended typical section of Fishermans Road between Landing Road and the original development access. Relocation of the site access from Fishermans Road to Landing Road renders the previously completed road link assessment redundant, and proposed changes to Fishermans Road are not required.

Section 5.5 of P003805-R01-RevA1 also states that all other roads in the study area have a cross section which exceeds the minimum standard for a Rural Industrial Road and are currently approved for use by B-doubles up to 26m in length. Relocation of the access from Fishermans Road to the preferred alternative access location on Landing Road does not change this assessment.

Pavement Impact Assessment

Relocation of the development access from Fishermans Road to the preferred alternative access location on Landing Road will not alter development traffic and therefore development pavement impacts as calculated in Appendix J of P003805-R01-RevA1 except that the development will have no impact on Fishermans Road. With respect to the conclusions of the Pavement Impact Assessment contained in Section 5.6 of P003805-R01-RevA1:

- There is no change to pavement impact assessment for state-controlled roads (SCR) and the conclusion with respect to SCR remains valid that:
  - If the development commences operation prior to 2028, a one (1) off payment of $20,818.01 would mitigate the development's impact on SCR pavements; but
  - If the development does not commence operation until 2028 or later, the development impact on SCR pavements will not be significant (<5%) and no payment should be made.
- Fishermans Road does not need to be upgraded as development traffic will not travel on Fishermans Road.
- Development traffic will continue to impact on Landing Road, however, relocation of the development access from Fishermans Road to the preferred alternative access location on Landing Road will reduce the length of Landing Road impacted by development traffic by approximately 130m, (that is from 800m to 670m). The annual pavement impact on Landing Road between Gladstone – Mount Larcom Road (Hanson Road) and the preferred alternative access location on Landing Road will remain:
  - Outbound (southbound) = 3.49 x 10^4 ESAs (SAR4s) per annum
  - Inbound (northbound) = 1.32 x 10^4 ESAs (SAR4s) per annum

Transport Infrastructure Impact Assessment

As the proposed relocation of the site access from Fishermans Road to Landing Road will not change development traffic crossing bridges, culverts or railway lines, Section 5.7 of P003805-R01-RevA1 remains unchanged and there continues to be no significant (<5%) increase in traffic volumes crossing any bridges or culverts on the SCR network, or railway lines.

Conclusions and Recommendations

This addendum to Project Halogen Traffic Impact Assessment (P003805-R01-RevA1) dated 3 November 2025 identifies and addresses the effect of relocating the site access from Fishermans Road to Landing Road on the findings of P003805-R01-RevA1. It also provides supporting justification to demonstrate that the "alternative preferred access location" is appropriate and that the development will continue to operate satisfactorily within the surrounding road network.

Relocation of the development access from Fishermans Road to the preferred alternative access location on Landing Road results in no change to the development's impacts on the state-controlled road networks.

The findings of the P003805-R01-RevA1 with respect to local government roads remain valid and unchanged except for the following:

- No changes are required to the existing Landing Road / Fishermans Road intersection or Fishermans Road between Landing Road and the originally proposed development access as relocation of the access avoids all development impacts on Fishermans Road and the Landing Road / Fishermans Road intersection.
- Conditions of approval for the development can be written based on provision of a rural industrial access for which can accommodate simultaneous entry and exit by B-doubles at the preferred alternative access location on Landing Road. Based on the turn warrant assessment for the Landing Road / Fishermans Road intersection contained in P003805-R01-RevA1, the access warrants the minimum standard of turn treatments permitted in the normal design domain (NDD).
- The length of Landing Road impacted by development traffic is reduced from 800m to 670m. Other than the avoidance of development impacts on Landing Road north of the preferred alternative access location, there is no change to the development impact on Landing Road between Gladstone – Mount Larcom Road (Hanson Road) and the preferred alternative access location.



BRADLEY JONES (RPEQ 19986)
PRINCIPAL TRAFFIC ENGINEER

Simpson Engineering Group

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Document Type:

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Prepared for:

Grenof Water Technologies Pty Ltd

Document & Date issued:

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Reviewed by: Christopher M Simpson BE

Authorised and signed:

by:.....
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Executive Summary

This Environmental Noise and Vibration Assessment investigates the potential noise and vibration impacts of the proposed Chlor-Alkali (chlorine caustic soda) plant at Yarwun, located within the Gladstone State Development Area (GSDA).

The site is located in the MTSC Precinct of the GSDA. There are other existing industrial facilities near the site, including Rio Tinto alumina refinery and consequently industrial noise is a feature of the area. There is eucalypt forest between the industrial uses; forests help to reduce noise by absorption and deflection. There are quarries located to the west of the site on the elevated hills. The nearest residential community, Yarwun Village, is approximately 4.3 km southwest of the site. Yarwun is outside the GSDA. The intertidal area approximately 1.5km to the east has been identified as a possible sensitive receptor and for conservatism has been included in this assessment. Background noise levels at night in Yarwun Village are estimated at 30 dB(A), consistent with a rural community.

Noise emissions from the development are predominantly continuous noise from pumps, electric motors, and process equipment. Other noises include occasional heavy vehicle noise, front-end loader operations and potentially low-frequency noise from chlorine compressors. The project design has the compressors located in a building specially designed to limit noise emissions.

The environmental values to be preserved comprise:

(a) the qualities of the acoustic environment that are conducive to protecting the health and biodiversity of ecosystems; and
(b) the qualities of the acoustic environment that are conducive to human health and wellbeing, including by ensuring a suitable acoustic environment for individuals to do any of the following-
    a. sleep;
    b. study or learn;
    c. be involved in recreation, including relaxation and conversation; and
(c) the qualities of the acoustic environment that are conducive to protecting the amenity of the community.

Goals developed for this project address:

- preserving sleep quality;
- ability communicate;
- avoiding low-frequency noise impacts;
- maintaining the rural noise landscape at Yarwun Village; and,
- avoiding flight responses for shorebirds in the intertidal area.

Noise modelling was conducted using PEN3D software, incorporating terrain data, meteorological conditions, and conservative assumptions about sound power levels. Noise levels at Yarwun Village are predicted to be well below the noise level goals during all time periods (day, evening, and night). Noise levels in the intertidal area are expected to remain below 45 dB(A), which is unlikely to disturb shorebirds.

The proposed Chlor-Alkali plant is anticipated to have negligible noise and vibration impacts on Yarwun Village and the intertidal area. The project aligns with the GSDA Development Scheme and Environmental Protection (Noise) Policy 2019, preserving the acoustic environment and ensuring no adverse effects on sensitive receptors or ecosystems.

1 Introduction

Simpson Engineering has been retained by CQG on behalf of Grenof Water Technologies Pty Ltd (the proponent) to undertake a noise and vibration assessment of a proposed Chlor-Alkali (chlorine caustic soda) plant located in Yarwun, north of Gladstone.

Simpson Engineering Group is a consulting engineering group specialising in noise, vibration, lighting and air quality assessments.

1.1 Site

The site is situated in the Gladstone State Development Area (GSDA) comprising a portion of Lot 1 on MPH 32292 (56 Fisherman's Road Yarwun) and Lot 1 on SP200899 (26 Landing Road Yarwun), refer to Figure 1. There are numerous industrial uses nearby including:

- Rio Tinto Alumina Refinery;
- Cement Australia Fishermans Landing Plant;
- Northern Oil Refinery;
- Cleanaway Industrial Waste Services;
- Butlers Yarwun Quarries; and,
- Queensland Energy Resources.

The site is situated within the Materials Transportation and Services Corridor (MTSC) Precinct of the GSDA, with Port Related Industry Precinct and Industry Investigation Precincts nearby. The location is close to the western basin of Gladstone Harbour, approximately 1500m to the intertidal zone.

The site and surroundings comprise several industrial uses interspersed with subtropical eucalypt forest and woodland.



Figure 1: Site and Surroundings

1.2 Process Description

The chlor-alkali process is an industrial chemical process used to produce chlorine gas (Cl_2), sodium hydroxide (NaOH), and hydrogen gas (H_2) from the electrolysis of salt water (sodium chloride, NaCl). The chlor-alkali production facility will also produce derivative chemicals from the primary products, which include sodium hypochlorite and hydrochloric acid. Apart from the loading of salt by front end loader, the entire process comprises continuous operation chemical processing plant.

From a noise perspective the noise generated by the site comprises:

- Occasional heavy vehicle noise associated with the delivery and export of materials
- Front-end loader noise associated with salt materials handling
- Continuous noise associated with pumps, electric motors and process equipment.
- Potentially low frequency noise elements associated with the chlorine compressors.

No blasting is proposed for the project. The operational facility equipment as described above does not generate significant vibration. Consequently, vibration is not discussed further in this report.

1.3 Noise Sensitive Receptors

Approximately 4.3km to the southwest is the village of Yarwun, the closest residential community, refer to Figure 1. This community is not within the GSDA. Yarwun village is adjacent to the railway and Earth Commodities Quarry. The railway connects to the Blackwater Rail System and the Moura Rail System with annual exports through the Port of Gladstone of approximately 50 MTPA requiring about 24 train passes daily. Other rail traffic includes containerised freight and passenger trains.

A noise survey has not been undertaken in Yarwun for this project. It is assumed that the rating background noise level at night is likely to be approximately 30 dB(A), i.e. a noise level consistent with a rural community with low-level contributions from industrial and transportation noise, refer to AS1055.3 1997Appendix A: Estimated average background a-weighted sound pressure levels (LA90,t) for different areas containing residences in Australia.

The ambient noise of the intertidal area to the east of the site is likely to be influenced by shipping noise and nearby industrial noise. The ambient noise level is also likely to be approximately 30 dB(A).

2 Noise Level Goals

2.1 Gladstone Regional Council

Since the site is situated in GSDA, material change of use (MCU) applications are administered by the Coordinator-General through the GSDA Development Scheme.

2.2 GSDA Development Scheme

The GSDA Development Scheme has been prepared pursuant to sections 79 to 80 of the SDPWO Act and takes effect on the date stated in the gazette notice published under section 80(1)(a) of the SDPWO Act. The scheme contains the following with respect noise and vibration impacts.

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.
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.
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.

2.3 State Code 22 – Environmentally Relevant Activities

The purpose of the code is to ensure that environmentally relevant activities (ERAs) as described under Schedule 2 of the Environmental Protection Regulation 2019:

1. are located and designed to avoid or mitigate environmental harm on environmental values of the natural environment, adjacent sensitive land uses and sensitive receptors;
2. are designed and located to avoid impacts or, where the matters of state environmental significance cannot be reasonably avoided, impacts are reasonably minimised and mitigated;
3. does not result in a significant residual impact on a matter of state environmental significance unless the significant residual impact is acceptable, and an offset is provided.

The performance outcomes and acceptable outcomes with respect to noise is contained in Table 1.

Table 1: Performance and Acceptable Outcome

Performance Outcome	Acceptable Outcome
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.

2.3.1 ESR/2015/1838

The Guideline ESR/2015/1838 describes types of impacts that ERA's can have in relation to noise and outlines the information to be provided to the department as part of the ERA application process.

There are three key areas to be identified and addressed through the ERA application process:

- Identify the environmental values of the receiving acoustic environment including the identification of any nearby sensitive places.
- Identify the possible impacts due to the proposed activity and all associated risks to environmental values.
- Identify the strategies to mitigate the identified risks to the environmental values

It is necessary to identify the environmental values of the site including but not limited to:

1. Identify sensitive places
2. Provide a site description.
3. Provide details of a background noise survey.

The department seeks to determine possible impacts to identified environmental values. To assist with this the following information is sought:

1. Identify all noise, vibration, and air blast overpressure sources, including stationary and mobile sources, associated with the activity. Also provide a scaled map which shows the source of all noise emissions in relation to any existing noise sensitive places
2. Describe in detail, the characteristics of the noise emissions produced.
3. Describe how noise, vibration or airblast overpressure emissions will be avoided, minimised or otherwise managed in accordance with the noise management hierarchy provided in the EPP (Noise).

If it is not possible to mitigate the impacts associated with the noise emission, applicants are to provide a noise impact assessment, which identifies the likely effect of noise from the activity on nearby sensitive places and include:

- Noise modelling contour maps to show predicted noise levels at all potential noise source locations.
- Analysis on whether noise emissions associated with the activity will adversely affect the environmental values of the receiving environment (including noise sensitive places).
- Description of controls (e.g. noise emission limits or operational controls such as operating hours) which are appropriate to protect environmental values.
- A vibration risk assessment for blasting activities, if applicable.
- If blasting is to occur, that blasting activities will be managed in accordance with AS 2187: Explosives.

Due to the rapid growth and increasing density of noise-producing activities in Queensland, the consideration of cumulative noise impacts and background creep is particularly important. For applications where background creep is likely, applicants are encouraged to use modelling to demonstrate that the activity will, to the extent it is reasonable to do so, ensure that background creep in an area or place is prevented or

minimised. If the acoustic quality objectives for an area or place are not being achieved or maintained, the noise experienced in the area or place must, to the extent it is reasonable to do so, be dealt with in a way that progressively improves the acoustic environment of the area or place.

2.4 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 processes on which life depends.

The EP Act states a person must not carry out any activity that causes, or is likely to cause, environmental harm unless the person takes all reasonable and practicable measures to prevent or minimise the harm. This is termed the 'general environmental duty'.

Environmental harm is defined as any adverse effect, or potential adverse effect (whether temporary or permanent and of whatever magnitude, duration or frequency) on an environmental value, and includes environmental nuisance.

The noise level goals for operations may be determined from the *Environmental Protection (Noise) Policy 2019* (EPP (Noise)). The EPP (Noise) came into effect on 1 Sept 2019.

The purpose of the EPP(Noise) is to achieve the objects of the Act and achieved by:

a) identifying and declaring the environmental values of the acoustic environment; and
a) stating acoustic quality objectives that are directed at enhancing or protecting the environmental values; and
b) providing a framework for making consistent, equitable and informed decisions that relate to the acoustic environment.

The environmental values to be enhanced or protected under the EPP(Noise) are:

(d) the qualities of the acoustic environment that are conducive to protecting the health and biodiversity of ecosystems; and
(e) the qualities of the acoustic environment that are conducive to human health and wellbeing, including by ensuring a suitable acoustic environment for individuals to do any of the following-
    a. sleep;
    b. study or learn;
    c. be involved in recreation, including relaxation and conversation; and
(f) the qualities of the acoustic environment that are conducive to protecting the amenity of the community.

There are two main considerations namely:

1. Acoustic quality objective (noise levels that are conducive to human health and well-being, ensuring a suitable acoustic environment for individuals to sleep, study or learn, be involved in recreation, including relaxation and conversation; and preserve the qualities of the acoustic environment that are conducive to protecting the amenity of the community); and
2. Management Intent

2.4.1 Acoustic Quality Objectives

The 'Acoustic Quality Objectives' described in the EPP(Noise) seek to protect the amenity of an acoustic environment. The indoor night-time goals effectively address sleep disturbance and sleep awakenings, while

during the day it protects conversation. It should be noted that these are not strictly design limits for individual sources but objectives that are considered to provide acceptable health and wellbeing for the community.

The acoustic quality objectives are expressed as indoor noise level goals for dwellings at Night (10 pm to 7 am) and outdoor noise level goals during the Day (7 am to 6 pm) and Evening (6 pm to 10 pm). These objectives are all contained in Table 2.

The equivalent external noise levels (for the dwelling indoor noise level goals in Table 2) measured at least 4 m from the dwelling would be 7 dB higher (to allow for the reduction of noise through the building envelope) for windows wide open, see "Noise and vibration EIS information guideline" dated 2024 by Department of Environment, Science and Innovation. If windows are closed the external noise goals would be 15 dB(A) higher than the internal noise level goals, see Australian Department of Health enHealth Guideline, "The health effects of environmental noise" dated 2018 for the windows closed noise reduction.

Table 2: Acoustic Quality Objectives for Dwellings and Other Receivers Relevant to the Project during the Day (7 am to 6 pm), Evening (6 pm to 10 pm) and Night (10 pm to 7 am).

Location	Time of Day	Acoustic Quality Objectives (Measured at the receptors) dB(A)			Environmental Value
		$L_{Aeq,\ adj,\ 1\ hr}$	$L_{A10,\ adj,\ 1\ hr}$	$L_{A1,\ adj,\ 1\ hr}$	
Dwelling outdoors	Daytime & evening	50	55	65	Health and wellbeing
Dwelling indoors	Daytime & evening	35	40	45	Health and wellbeing
Dwelling indoors	Night-time	30	35	40	Health and wellbeing, in relation to the ability to sleep
Protected area or critical area	anytime	The level of noise that preserves the amenity of the existing area or place			Health and biodiversity of ecosystems

Source: EPP (Noise)

2.4.2 Managing Intent For Noise

It is intended that noise from an activity that affects or may affect an environmental value to be enhanced or protected under the EPP(Noise) be appropriately managed.

To the extent it is reasonable to do so, noise must be dealt with in a way that ensures-

a) the noise does not have any adverse effect, or potential adverse effect, on an environmental value under this policy; and
b) background creep in an area or place is prevented or minimised.

In the situation where existing noise levels exceed the Acoustic Quality objectives, to the extent it is reasonable to do so, noise at that sensitive place must be dealt with in a way that progressively improves the acoustic environment of the area or place.

Background creep, for noise in an area or place, is described as a gradual increase in the total amount of background noise in the area or place.

The EPP(Noise) does not provide any guidance nor limits regarding how to address background creep.

However, the guiding principles are:

i. Background creep in an area is to be prevented or minimised
ii. Any control requirements are to be reasonable

Background creep can be prevented by ensuring the noise from activity is always below the background noise level. However, this may be excessively onerous for many situations. The EPP(Noise) does not include any guidance regarding how to assess “reasonable” noise control. A work practice or abatement measure is feasible if it is capable of being put into practice or of being engineered and is practical to build given project constraints such as safety and maintenance requirements. Selecting reasonable measures from those that are feasible involves making a judgement to determine whether the overall noise-reduction benefits outweigh the overall adverse social, economic and environmental effects, including the cost of the noise abatement measure. To make such a judgement, consideration may be given to aspects such as noise level impacts, noise mitigation benefits, cost effectiveness and community views.

2.5 Sleep Disturbance WHO Guidelines

Research has shown that the ability to get to sleep and, when asleep, the probability of experiencing a change of sleep state or ultimately of awakening are related to both the ambient and maximum instantaneous noise levels at the ear of the sleeper and the number of events during the night period (WHO 1999).

As a rule in planning for short-term or transient noise events, for good sleep over eight hours, the indoor sound pressure level measured as a maximum instantaneous value should not exceed approximately 45dBA maxLpA more than 10-15 times per night. According to the withdrawn Guideline Ecoaccess Planning for Noise Control (EPA 2004), the corresponding external noise level, assuming partially closed windows, is 52dB(A) maxLpA (L_{Amax}), measured in the free field. With fully closed windows the corresponding external noise level is 60dB(A) maxLpA (L_{Amax}). Although now withdrawn, the sleep disturbance approach and calculation methodology in the guideline are still recognised (e.g., in the Model Mining Conditions ESR/2016/1936, last revised 19 February 2024)

For larger number of events per night, the noise level goal is reduced by 10*log(Number of events/10). Hence if there are 100 events per night (over an 8-hour period) the external noise level goal would 10 dB(A) lower than that described above.

2.6 Low Frequency Noise

There are not any current Queensland guidelines dealing with low frequency noise. Recognised noise criteria for low frequency noise are provided in the withdrawn DEHP Ecoaccess Draft Guideline “Assessment of Low Frequency Noise” identifies a number of industrial sources and processes having high noise levels and frequency content less than 200 Hz.

Industrial sources may exhibit a spectrum that characteristically shows a general increase in sound pressure level with decrease in frequency. Annoyance due to low frequency noise can be high, even though the dB(A) level measured is relatively low. Typically, annoyance is experienced in the otherwise quiet environs of residences, offices and factories adjacent to, or near, low frequency noise sources. Generally, low level/low frequency noises become annoying when the masking effect of higher frequencies is absent. This loss of high frequency components may occur as a result of transmission through the fabric of a building, or in propagation over long distances.

Where a noise emission occurs exhibiting an unbalanced frequency spectra, the overall sound pressure level inside residences should not exceed 50 dB(Linear) to avoid complaints of low frequency noise annoyance.

2.7 Road Traffic Noise Goals

Queensland Department of Transport and Main Roads (DTMR) is responsible for setting noise level limits from road traffic on public roads in Queensland. Typically, the planning goals for roads are met close to the road, i.e. distances up to about 30 m or thereabouts. There are no criteria in Queensland to assess the impact of noise from a road traffic-generating development. However, for existing roads with regular traffic an

increase of 3 dB(A) over a short period of time is considered to be a significant increase in traffic noise and an increase which justifies consideration of noise control.

Since the hourly traffic to and from the site is minor, road traffic impacts on public roads will not be considered further.

2.8 Intertidal Areas

Smit, C. J. and Visser, G. J. (1993) Effects of disturbance on shorebirds: a summary of existing knowledge from the Dutch Wadden Sea and Delta area (Wader Study Group Bulletin 68: 6-19) found that an LAmax of 55 dB(A) did not have adverse impacts on roosting waders. Consequently, an L_{Amax} of 55 dB(A) would be an appropriate noise level goal for the intertidal area.

2.9 Summary of Noise Goals

The site is situated in the GSDA area and within the MTSC precinct. The nearby areas contain several very large industrial developments and by comparison this is a modest sized project with low-level continuous noise emissions. The focus of the goals is to ensure that the noise levels do not lead to a deterioration of the noise environment at noise sensitive receptors. Additionally, the preservation of sleep and avoiding low-frequency impacts are important considerations. Traffic from the site will not pass any sensitive receptors prior to combining with existing traffic on Gladstone Mt Larcom Road, a major road traffic arterial route into Gladstone. Consequently, road traffic noise is not considered further in this report.

The development will seek to meet noise level goals at Yarwun Village and ensure other future industrial uses in the GSDA are not compromised by noise emissions from the project.

Application of GSDA Noise Policy

The GSDA has indicated that the noise limits for industrial developments are to comply with acoustic objectives of the EPP (Noise).

Application of State Code 22

The state code requires the indoor noise objectives set out in the EPP (Noise) to be met. This ensures the ability to sleep and converse while inside a residence.

Application of the EP Act and EPP(Noise)

The EP Act provides the framework for all noise impacts. Apart from some selected noise sources, the Act and the EPP(Noise) does not provide source limits for industrial developments, rather it provides noise quality objectives to be met in Queensland, ensuring the quality of the environment does not deteriorate. In this instance the State Code 22/ ESR/2015/1838 indicates the indoor quality objectives are to be used as limits for the development. As discussed in Section 2.4.1 an external noise level goal may be obtained by adding 7 dB(A) to the indoor noise level goal, being the noise reduction from outside to inside assuming wide open windows. Equivalent external noise level goals are more convenient for reporting and comparison purposes.

Application of Low Frequency Noise Goals

It is possible that, due to the propagation of noise over the large separation distances between the source of noise and the receiver, a loss of high frequency components may occur. Thus, the low frequency noise goal of 50 dB(Linear) applies inside noise sensitive receptors. The same 7 dB reduction from outside to inside applies (for partially open windows), i.e. the equivalent external noise is 57 dB(Linear).

Application of WHO Sleep Disturbance Guidelines

It is proposed to adopt an L_{Amax} of 52dB(A) (outside dwellings) as the appropriate noise level goal to protect sleep disturbance.

A summary of the noise goals for this project is contained in Table 3. The limits are component levels, i.e. directly attributable to the use (modelled noise levels), rather than measured levels. Measured noise levels include background and other noise sources.

Table 3: Summary of Component Noise Goals (free-field)

Location	**Time Period**	***$L_{Aeq, adj, 1 hr}$ [dB(A)]***	***$L_{A10, adj, 1 hr}$ [dB(A)]***	***$L_{A01, adj, 1 hr}$ [dB(A)]***	***$L_{Amax, adj, 1 hr}$ [dB(A)]*** ***Sleep disturbance***	**Low Frequency** ***$L_{eq, adj, 1 hr}$*** **[dB]**
All Residential Receptors	Day	*42*	47	52	-	-
	Evening	*42*	47	52	-	-
	Night	37	42	47	52	57

3 Predicted Noise Levels

3.1 Modelling Methodology

A digital terrain noise model of the site and surroundings has been developed using PEN3D software. The PEN3D General Prediction Model (GPM) is based on the method contained in a book by Bies and Hansen (1988, pages 117, 127). The implementation is a more complex and sophisticated variation of the approach to sound propagation described in Concawe (1981). Concawe is one of the most commonly used methodologies to predict outdoor noise propagation from industrial sites. PEN3D also draws on aspects from ISO 9613-2. The PEN3D software was originally developed in 1993 and has been in constant development and review. The basic equation adopted by the GPM is:

$$Lp = Lw - 20 \log_{10}(r) - 10\log_{10}(4\pi) + AE$$

Where:

Lp is the sound pressure level at an observer

Lw is the sound power level of the source, in octave bands from 63 Hz to 8 kHz

$20 \log_{10}(r) + 10\log_{10}(4\pi)$ is the distance attenuation (spherical)

AE is the excess attenuation factors.

The excess attenuation factors AE comprise:

$$AE = Aa + Ag + Am + Ab + Af$$

Where:

Aa = Excess attenuation due to air absorption from Sutherland *et. al*. (1974)

Ag = Excess attenuation due to ground reflection

Am = Excess attenuation due to meteorological effects

Ab = Excess attenuation due to barriers

Af = Excess attenuation due to forests.

PEN3D is a sophisticated environmental noise model incorporating a 3D terrain model that permits accurate representation of the ground, ground cover, tree zones, mounds, barriers and weather conditions. PEN3D calculates a curved noise path based on surface friction, vertical temperature gradients and wind speed. All the noise calculations are based on this curved path. A finite differences approximation method is used to calculate the curved path. The curvature of the path determines the meteorology corrections. The meteorology corrections are frequency and distance dependent and are limited to +12 dB (downwind at night) and –7 dB (upwind and during the day) similar to the Concawe Category 1 and Category 6 meteorological corrections.

The excess attenuation due to ground reflection is obtained by combining the direct wave and the reflected wave incoherently, that is the energy from the ground wave is added to the direct wave. The ground reflection attenuation (or ground effects) will be between 0 and –3 dB (a negative value is an increase in noise levels) for all cases. This contrasts with the coherent reflection approach. The coherent approach is considered to be an “exact” method. For those situations where the source and receiver are located close to the same very hard reflecting plane and the path difference between the direct path and the reflected path is small, then the

addition of the reflected wave and the direct wave will result in 6 dB increase rather than a 3 dB increase. However, at large distances the sound pressure level reduces at 12 dB per doubling with the coherent model (not 6 dB as per the incoherent model). This approach, while “exact”, is dubious as Digital Terrain Models (DTM) models are neither of sufficient accuracy nor can noise models truly account for the effects of atmospheric turbulence. Other methods such as the Nordic method or ISO 9613-2 divide the region between the source and receiver into three zones, and those zones closest to the source and to the receiver can potentially have higher absorption values. Consequently, if a noise source was measured say at a distance of 30 m and the sound power level is calculated by the commonly adopted formula PWL = SPL + 10log10(2 π r^2) then the calculations using the PEN3D methodology would remain conservatively high for all distances.

The ground reflection (or ground effects) is a complex calculation using the flow resistivity for the surface likely to provide the ground reflection and the likely angle of incidence of the reflected wave to the ground. In those instances where the ground is highly absorptive the excess correction will approach zero. For those surfaces which are highly reflective the correction will be - 3dB, i.e. will lead to an increase in noise levels of 3 dB(A) (simulates hemispherical propagation).

While there are numerous methods to calculate ground effects (some of which provide significant attenuation [reduction of noise levels]), the PEN3D implementation is one of the more conservative estimates of ground effect in the far field. Bies & Hansen (1988) indicate “as the distance from the source or frequency increases, the incoherent model will become more appropriate”.

The theoretical approach to meteorology implies that PEN3D is likely to provide more significant corrections than other models. Thus, at night or during downwind predictions, the PEN3D calculations are likely to result in conservatively high results, i.e. the modelled noise levels are likely to be higher than the measured levels.

The likely barrier attenuations are calculated for four possible curved paths, namely:

- source, to the top of barrier then to the receiver;
- source, reflection from ground (source side), top of barrier, receiver;
- source, top of barrier, reflection from ground (receiver side), receiver; and
- source, reflection from ground (source side), top of barrier, reflection from ground (receiver side), receiver.

These are combined to obtain effective barrier attenuation. In the situation where the source and receiver are well above the ground and the barrier just intercepts line-of-sight then the barrier effect will be 5 dB(A). However, if the source and receiver are close to the ground and the noise barrier just intercepts line of sight (a pebble) the barrier effect will tend to zero.

Once the most likely curved path has been calculated, the method determines if it intercepts any tree zones within the digital terrain model. If the curved noise path travels in the lower 75% of the tree zone then the full excess attenuation is applied for the distance travelled through the tree zone. If the curved noise path travels in the upper 25% of the tree zone then:

a) the average propagation height is determined;
b) the length in the zone is determined; and,
c) the forest excess attenuation is taken to be linearly interpolated between zero at the top of the tree zone and full excess attenuation at 75% height.

Tree zones can potentially provide extremely high attenuation if the tree coverage is large. However, in practice, the curved path adopted in the PEN3D methodology usually results in the noise rays passing above tree zones (at night or during downwind conditions) and only intercepting tree zones if they exist on the tops of hills or whenever the noise ray approaches the ground.

3.2 Meteorology

The meteorology for the site has been analysed to address frequent wind speeds, wind directions and inversions.

3.2.1 Temperature Inversions

The total night-time period during winter (June, July and August) has been analysed to determine the frequency of inversions, as presented in Table 4. Temperature inversions generally occur during the night-time and early morning periods. The likelihood of inversions reduces with wind speed. It was determined that inversions are likely about 90% of the time since calm winds are common at night. This indicates that modelling during inversion conditions is appropriate. The wind direction analysis confirmed that the light winds at night are dominantly from the south-east.

It is proposed to model inversions with the following parameters:

- 2 degrees Celsius (°C)/100 m temperature inversion strength.
- Zero wind speed, 2m/s from the southeast and 2m/s from the west.
- Air temperature 15ºC.

Table 4: Wind Speed Analysis For Inversions June to August (6 pm to 7 am)

Wind speeds	Percentage of Time Occurring (%)
Calms	56
Winds less than 1m/s	31
Wind 1 to 2 m/s	3
Wind 2 to 3 m/s	0
Wind 3 to 4 m/s	0
Wind 4 to 5 m/s	0

3.2.2 Wind Effects

Wind effects are typically assessed when wind is a feature of the area. Wind is a feature when source-to-receiver wind speeds (at 10 m height) of 3 m/s or below occur for 30 percent of the time or more in any assessment period (day, evening, night) in any season. This differs from the procedure used with temperature inversions, in that the 30 percent occurrence applies to all seasons and each assessment period–and not just the winter season and night/early morning assessment period. Refer to Table 5 for an analysis of the winds. It is evident that winds from the SE are dominant during the evening and at night throughout the year. However during the day the SE winds do not reach the 30% threshold, however it does when the adjoining SSE direction is included.

Table 5: Wind Speed and Wind Direction Analysis for Winds 0.5m/s to 3m/s

Direction	Day				Evening				Night			
	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	Spring
N	7%	2%	5%	5%	10%	3%	2%	9%	3%	1%	0%	1%
NNE	4%	2%	3%	7%	9%	3%	3%	11%	1%	0%	0%	2%
NE	3%	3%	2%	9%	4%	3%	2%	7%	1%	0%	0%	1%
ENE	21%	16%	17%	22%	11%	6%	1%	9%	2%	0%	0%	3%
E	26%	24%	21%	35%	18%	7%	4%	23%	3%	0%	0%	7%
ESE	12%	11%	13%	8%	20%	11%	16%	23%	5%	1%	2%	6%
SE	9%	8%	6%	4%	13%	15%	19%	7%	15%	4%	6%	13%
SSE	4%	8%	6%	2%	5%	9%	8%	1%	27%	21%	21%	18%
S	1%	2%	2%	0%	1%	1%	1%	0%	2%	4%	3%	2%
SSW	1%	2%	1%	0%	1%	1%	1%	0%	1%	3%	3%	2%
SW	1%	4%	4%	1%	0%	4%	2%	1%	3%	3%	3%	2%
WSW	2%	6%	5%	1%	1%	2%	2%	1%	5%	13%	10%	4%
W	2%	7%	8%	1%	1%	4%	4%	1%	12%	29%	31%	15%
WNW	1%	2%	3%	1%	2%	23%	24%	4%	9%	15%	16%	18%
NW	4%	1%	1%	1%	1%	7%	8%	2%	5%	3%	5%	5%
NNW	3%	2%	2%	2%	5%	2%	4%	2%	5%	1%	0%	2%

The wind direction and wind speeds were analysed to determine whether wind effects need to be considered. For this analysis, the wind speed was limited to 3 m/s since higher wind speeds tend to increase the ambient noise.

The modelling cases adopted in Table 6 are based on the wind distribution. For this project, there are three night cases to consider. The first being the most common no-wind case. The remaining two options being with a south-east breeze and a land breeze from the west.

Table 6: Meteorology Modelling Cases Assessed

Case	Percentage of time Case Occurs	Wind speed [m/s]	Wind Direction [degrees from North]	Vertical Temp Profile [ºC/100 m]	Air Temp [ºC]
Day	51% to 65%	2	90	-2	25
Evening	31% to 43%	2	135	0	20
Night (Inversion no wind)	38% to 48%	0	0	2	10
Night (inversion with SE wind)	13% to 19%	2	160	2	10
Night (inversion with land wind)	11% to 56%	2	270	2	10

3.3 Noise Model Parameters

The DTM was for the site and surrounds was obtained from LIDAR obtained from Elvis - Elevation and Depth - Foundation Spatial Data https://elevation.fsdf.org.au/ It was contoured to 1m intervals. The noise model has an adopted ground cover of 'thick grass' as a representation of the combination of the roughness provided by pasture and the taller vegetation that exists throughout the region. The model does not incorporate excess attenuation factors associated with tree zones.

The $L_{Aeq(60\ min)}$ equipment noise levels are contained in Table 8. The noise levels are expressed as a sound power level. The overall sound power levels are "A" weighted. The "A" weighting emulates the way the human ear responds to sound.
The proponent has not provided any noise levels for the industrial plant. However, the proponent has supplied a typical list of the mechanical plant likely to operate at the plant. These noise sources include:

- Electric motors;
- Liquid pumps;
- Fans;
- Blower (emergency exhauster);
- Shaft gear reducers;
- Chlorine compressors (in a compressor building); and,
- a front-end loader.

There is insufficient information in the documentation to determine the sound power level for the individual items of process plant. However, the specification includes an occupational noise level commitment that a noise level of 85 dB(A) at 1m will be met from all plant and equipment. Thus, staff will not be required to wear hearing protection unless working within 1m of process plant.

For the purposes of determining sound power level from all plant, the enclosing areas 1m from all machinery and assuming a height of 2m has been calculated the enclosing area is 1,500m^2 and assuming the noise level is 85 dB(A) at the surface of the enclosing area the sound power level would be 116 dB(A). Since the most common noise sources are pumps and electric motors then it is proposed to adopt the spectra typically associated with electric motors, refer to Table 7.

Table 7: Sound Power Correction for Electric Motors and Pumps (Source US army)

Noise Source	Value to be subtracted from overall level dB in Octave band centre frequency (Hz)						
	63	125	250	500	1000	2000	4000
Pumps	12	11	9	9	6	9	13
Electric motors	9	7	7	6	9	12	18

Hence the total sound power level for the process plant and the front-end loader is contained in Table 8. The noise sources are positioned 3.0m above the local terrain. It should be noted that the spectra for the process plant are heavily biassed towards the low frequency. This implies that barrier screening effects and air absorption will be low compared with noise containing more high frequency components.

Table 8: Sound Power Levels ($L_{Aeq(1\ hr)}$) in dB(A) for plant

Noise Source	Sound Power Level in dB in Octave band centre frequency (Hz)

	63	125	250	500	1000	2000	4000	8000
Process Plant	141	133	126	121	115	111	105	98
Front End Loader	104	109	95	91	101	88	83	73

3.4 Noise Modelling Results

A single noise case has been developed for the project involving the continuous process plant. A series of noise models was developed for each of the various meteorological cases.

Table 9 and Table 10contains the calculated $L_{Aeq(1\ hour)}$ noise levels at the sensitive receptors (Yarwun Village and intertidal area respectively) for all modelling cases in tabular format, Appendix A contains the noise contour diagrams. The results are summarised for the day, evening and night periods.

Table 9: Calculated Noise Levels - Yarwun Village

Location	**Time Period**	***$L_{Aeq,\ adj,\ 1\ hr}$ [dB(A)]***	***$L_{A10,\ adj,\ 1\ hr}$ [dB(A)]***	***$L_{A01,\ adj,\ 1\ hr}$ [dB(A)]***	***$L_{Amax,\ adj,\ 1\ hr}$ [dB(A)]*** ***Sleep disturbance***	**Low Frequency** ***$L_{eq,\ adj,\ 1\ hr}$*** **[dB]**
Noise Level Goals	**Day**	***42***	**47**	**52**	**-**	**-**
	Evening	***42***	**47**	**52**	**-**	**-**
	Night	**37**	**42**	**47**	**52**	**57**
Predicted Noise Levels Yarwun Village	Day	23	25	26		
	Evening	12	14	15		
	Night No wind	26	28	29	30	49
	Night SE Wind	12	14	15	16	36
	Night West Wind	13	15	16	16	35

Table 10: Calculated Noise Levels – Intertidal Area

Location	**Time Period**	$L_{Amax,\ adj,\ 1\ hr}$ ***[dB(A)]*** ***Shorebird No Response***
Noise Level Goal	**All Hours**	**55**
Predicted Noise Levels in the intertidal area	**Modelling Case**	**-**
	Day	35 to 45
	Evening	35 to 45
	Night No wind	35 to 45
	Night SE Wind	35 to 45
	Night West Wind	38 to 45

4 Assessment of Modelled Noise Levels

Operational Noise Assessment

The noise from the operation of the processing plant is expected to readily comply with the noise level goals at Yarwun Village during all time periods. Indeed, the predicted noise levels are likely to be below the existing background noise levels in Yarwun Village.

It is evident from the noise contours that the ridge running north-south adjacent to the site to the west, provides screening of noise towards the west. The contours to the north and east are not significantly screened by terrain. The noise levels at the intertidal area is likely to be below 45 dB(A). Since the noise is continuous in nature it is unlikely to cause any responses by shorebirds in the intertidal areas.

5 Conclusions

The noise investigation of the proposed Chlor-Alkali (chlorine caustic soda) plant to be located in Yarwun has been based on a conservative modelling methodology.

Initially the meteorology for the site was assessed in detail to determine whether inversions and/or winds were likely to be frequent for the site. It was determined that inversions are frequent in winter. Assessment of wind occurrence indicated that winds occur during the all times of the day, evening and night largely due to it's near coastal location.

The likely noise levels from operating equipment have been robustly established based occupational noise commitments and knowledge of the dominant types of noise sources. It should be noted that the frequency spectra for the process plant are heavily biassed towards the low frequency noise components. This implies that barrier screening effects and air absorption will be low compared with noise sources having relatively more high frequency components. It is likely the sound power estimate from the process plant has been substantially overestimated using the occupational noise level limit for all plant. Many items of plant will be much lower than the occupational noise level limit at 1m from the unit.

The digital terrain model has been based on Lidar data from the public domain. The adoption of these contour levels would provide the major features without over emphasising possible noise screening effects of smaller landforms.

A noise survey was not undertaken in this instance. It has been conservatively assumed that the rating background noise level at night is likely to be approximately 30 dB(A), i.e. a noise level consistent with a rural community with low-level contributions from industrial and transportation noise. It is considered important to retain the rural noise landscape at Yarwun Village as far as possible and comply with noise level goals.

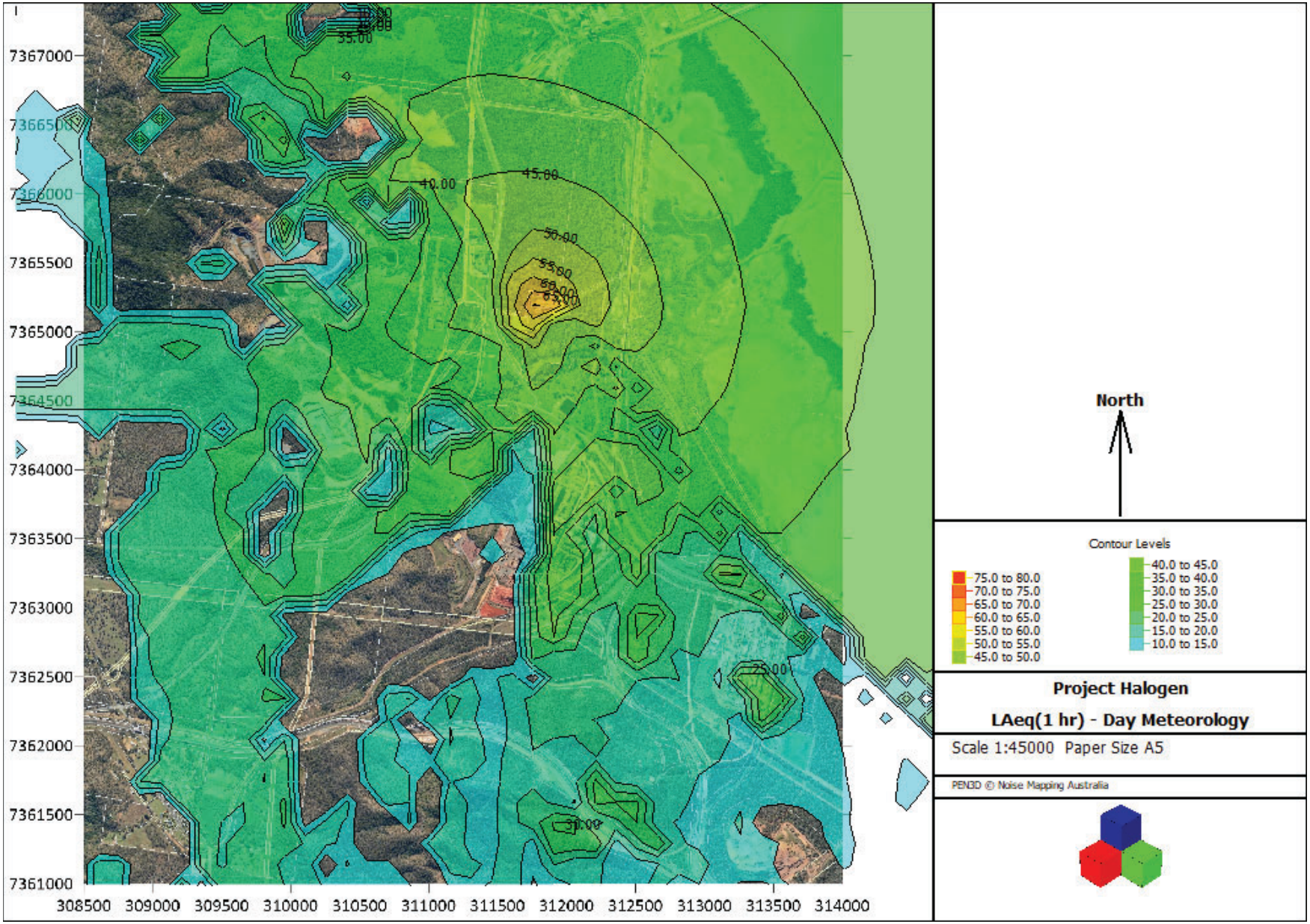
The noise level goals applicable to the site have been reviewed. The site is situated in the GSDA and within the MTSC Precinct. The nearby areas contain several very large industrial developments and by comparison this is a modest sized project having a mostly low-level continuous noise emissions. Hence the focus of the noise level goals is to ensure that the noise levels do not lead to a deterioration of the noise environment at noise sensitive receptors. Additionally, the preservation of sleep and avoiding low-frequency impacts are important considerations. Since traffic from the site will not pass any sensitive receptors prior to combining with existing traffic on Gladstone Mt Larcom Road, road traffic noise was not assessed.

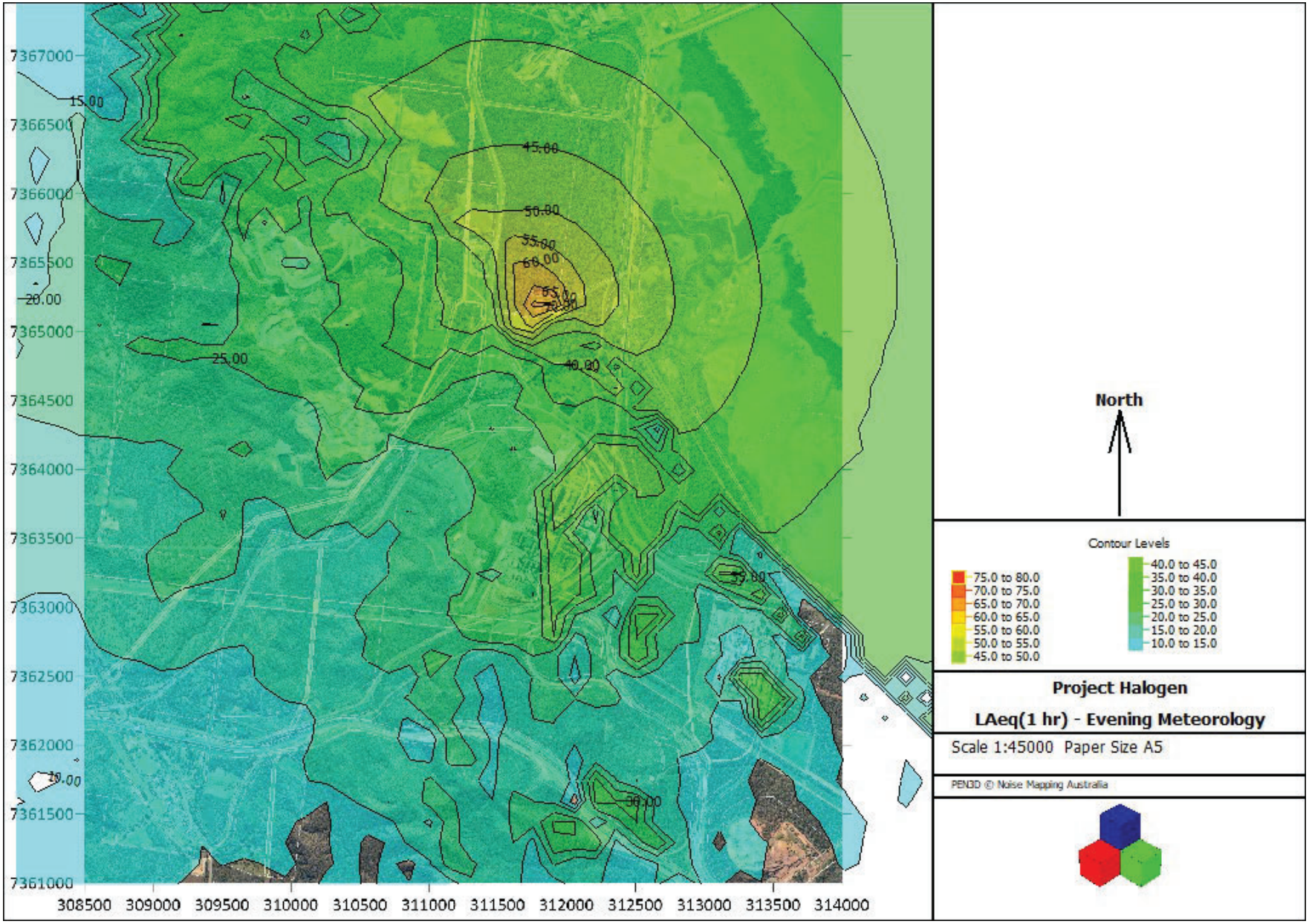
It was determined that noise from the operation of the proposed Chlor-Alkali (chlorine caustic soda) is expected to readily comply with the noise level goals and acoustic quality objectives at Yarwun Village and have a "no response" response from shorebirds in the intertidal area.

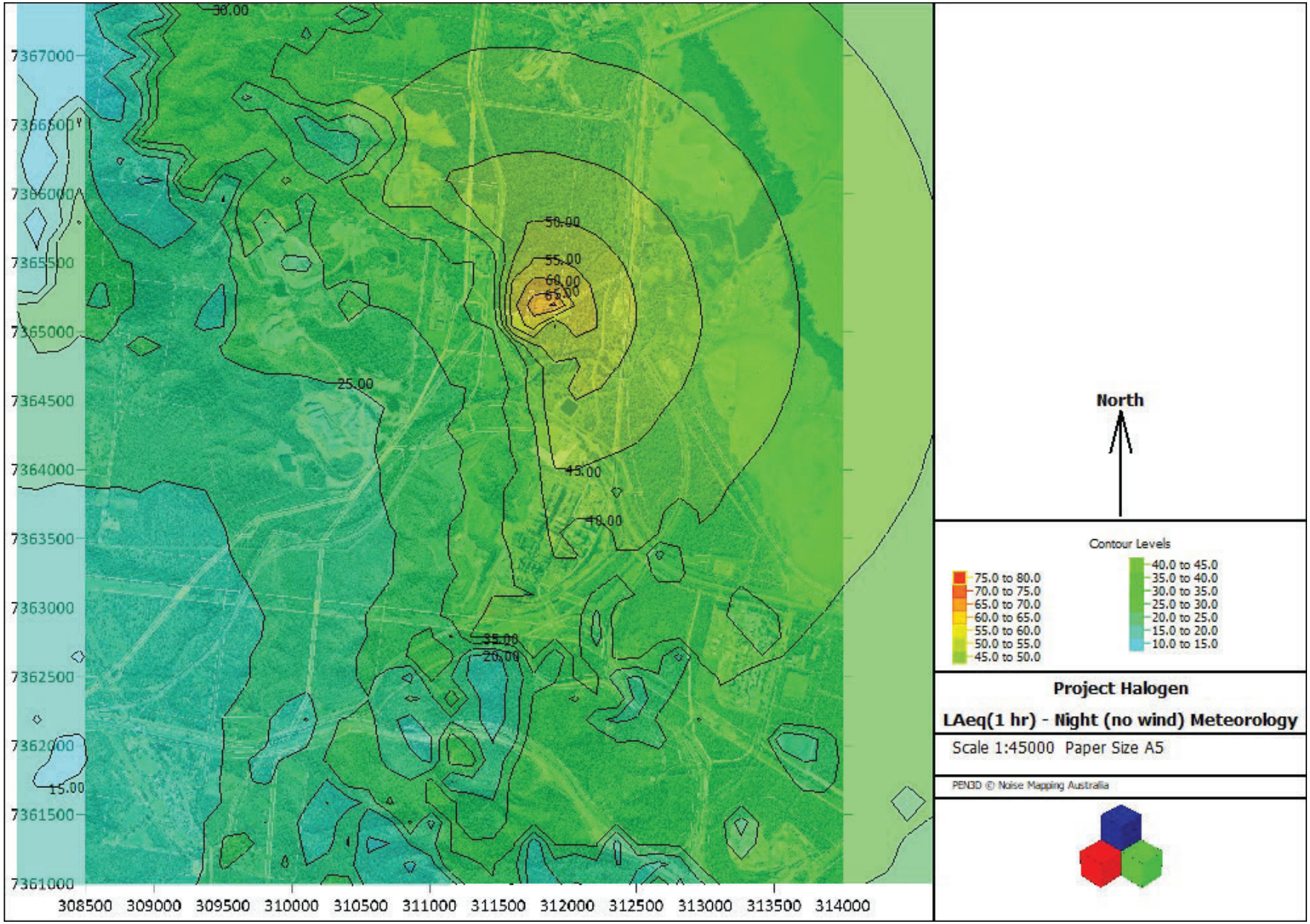
$L_{A01,t}$	The L_{A01} is the "A"-weighted statistical noise level exceeded 1% of the time. Commonly accepted time periods (t) include 10 minutes, 15 minutes, 30 minutes, 60 minutes and 24 hours.
$L_{A10,t}$	The L_{A10} is the "A"-weighted statistical noise level exceeded 10% of the time. Commonly accepted time periods (t) include 10 minutes, 15 minutes, 30 minutes, 60 minutes and 24 hours. It is sometimes referred to as the average maximum noise level.
$L_{A90\ ,t}$	The L_{A90} is the "A"-weighted statistical noise level exceeded 90% of the time. Commonly accepted time periods (t) include 10 minutes, 15 minutes, 30 minutes, 60 minutes and 24 hours. It is commonly referred to as the background noise level.
$L_{Aeq,\ t}$	The L_{Aeq} is the "A"-weighted energy average noise level over the time in question. It is the constant noise level containing the same energy as the actual fluctuating noise level. Commonly accepted time periods (t) include 10 minutes, 15 minutes, 30 minutes, 60 minutes and 24 hours.
Adjusted noise level	The $L_{A01\ adj,t,}$, $L_{A10\ adj,t,,}$ $L_{Aeq\ adj,t,,}$is the A-weighted sound pressure level, adjusted for tonal character or impulsiveness when measured using a fast standardised response time.
Day	Refers to the period between 7 am and 6 pm
Evening	Refers to the period between 6 pm and 10 pm
Night	Refers to the period between after 10 pm and before 7 pm
Ambient noise	The all-encompassing noise associated within a given environment. It is the composite of sounds from many sources, both near and far.
Assessment background level (ABL)	The single-figure background level representing each assessment period–day, evening and night (i.e. three ABLs are determined for each 24 hour period of the monitoring period). ABL is a measure of background noise level in the absence of noise from the source. Determination of the ABL is by the tenth percentile method, i.e sort the recorded hourly LA90's into ascending order and select the are the lowest ten percentile level.
Rating background level (RBL)	The overall single-figure background level representing each assessment period (day/evening/night) over the whole monitoring period (as opposed to over each 24 hour period used for the ABL). It is the median value of the ABL's.
Free field	A position where there are no reflecting surfaces, other than the ground, close enough to influence the sound pressure level. Taken as a minimum of 1.2 metres above ground level and 4m from the closest building façade.
Noise floor	The noise floor, inherent or 'self-noise' of sound level measuring equipment is the combination of the preamplifier's electrical noise and thermal noise from the microphone.
dB (linear) peak	the maximum reading in decibels (dB) obtained using the "P" time – weighting characteristic as specified in AS 1259.1 – 1990 with all frequency-weighted networks inoperative.
Maximum instantaneous charge (MIC)	the maximum amount of explosive in kg on any one specific delay detonator in any one blast hole.
Peak particle velocity (ppv)	is a measure of ground vibration magnitude and is the maximum instantaneous particle velocity at a point during a given time interval in mms-1. (Peak particle velocity can be taken as the vector sum of the three component particle velocities in mutually perpendicular directions).
octas	Is a rating system describing cloud cover. A clear sky is zero octas while full cloud cover is 8 octas.
residence	includes a building, or part of building, capable of being used as a dwelling.
Sensitive	is an area or place where noise is measured.

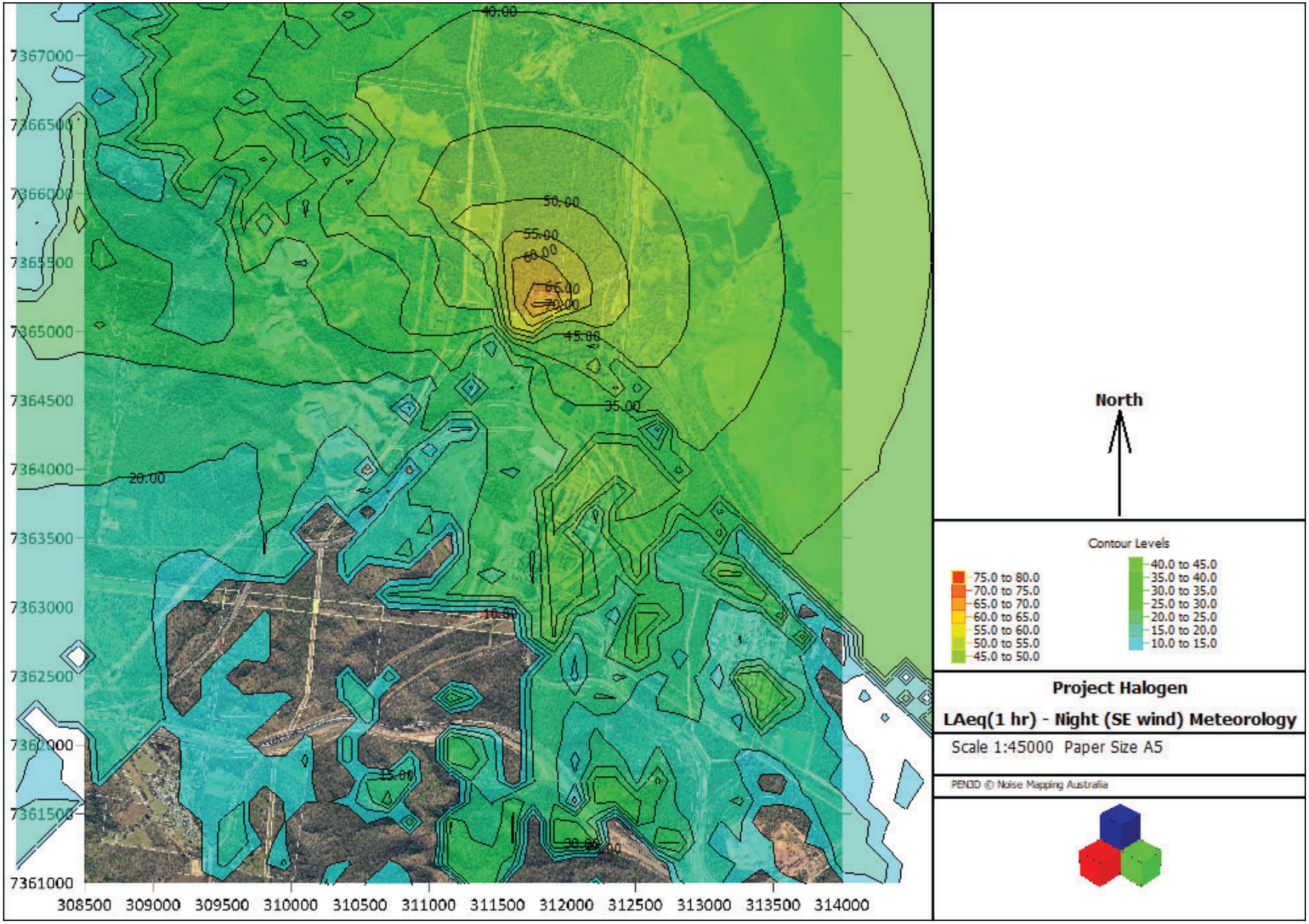
receptor	
Acoustic quality objective	for a sensitive receptor, is the maximum level of noise that should be experienced in the acoustic environment of the sensitive receptor.
Acoustic environment	the part of the environment of an area or place characterised by the total amount of noise that may be experienced there.

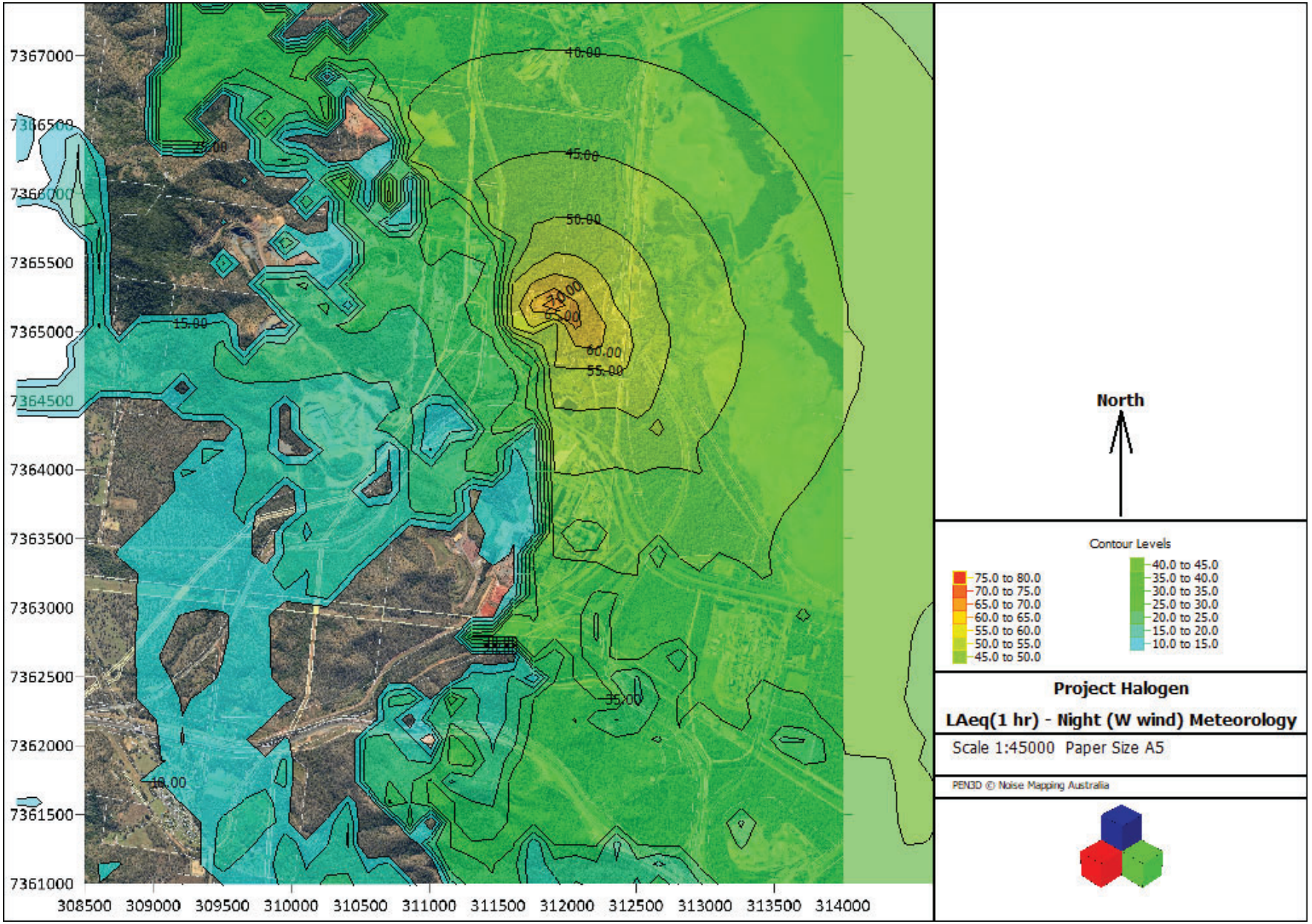
Appendix A – Noise Contour Diagrams


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Project Halogen
LAeq(1 hr) - Day Meteorology
Scale 1:45000 Paper Size A5
PEN3D © Noise Mapping Australia


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Project Halogen
LAeq(1 hr) - Evening Meteorology
Scale 1:45000 Paper Size A5
PEN3D © Noise Mapping Australia


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Project Halogen
LAeq(1 hr) - Night (no wind) Meteorology
Scale 1:45000 Paper Size A5
PEN3D © Noise Mapping Australia


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Contour Levels
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Project Halogen
LAeq(1 hr) - Night (SE wind) Meteorology
Scale 1:45000 Paper Size A5
PEN3D © Noise Mapping Australia


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North
Contour Levels
75.0 to 80.0
70.0 to 75.0
65.0 to 70.0
60.0 to 65.0
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45.0 to 50.0
40.0 to 45.0
35.0 to 40.0
30.0 to 35.0
25.0 to 30.0
20.0 to 25.0
15.0 to 20.0
10.0 to 15.0
Project Halogen
LAeq(1 hr) - Night (W wind) Meteorology
Scale 1:45000 Paper Size A5
PEN3D © Noise Mapping Australia

Project Halogen: Greenhouse Gas Assessment

Prepared for:

CQG Consulting

PLANS AND DOCUMENTS
referred to in the
SDA APPROVAL

Queensland Government

SDA approval: AP2025/015

April 2026

Final

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Figure 2 Schematic view of chlorine electrolysis cells for membrane cell technique (source: European Commission, 2014, Best Available Techniques (BAT) Reference Document for the Production of Chlor-alkali) 10

Glossary

Term	Definition
°	degrees
°C	degrees Celsius
GJ	gigajoules
GK/kL	gigajoules per kilolitre
ha	hectare
kg	kilograms
kL	kilolitres
kt	kilotonnes
kWh	kilowatt hours
m	metres
Mt	million tonnes
$MtCO_2$-e	million tonnes carbon dioxide equivalents
t	tonnes
TJ	terajoules
tpd	tonnes per day
Nomenclature	**Definition**
CH_4	methane
CO_2	carbon dioxide
CO_2-e	carbon dioxide equivalents
NH_3	ammonia
NaOH	sodium hydroxide
Na_2CO_3	sodium carbonate
HCl	hydrogen chloride, hydrochloric acid
H_2O_2	hydrogen peroxide
H_2SO_4	sulfuric acid
Abbreviation	**Definition**
ABS	Australian Bureau of Statistics
ATAP	Australian Transport Assessment and Planning
BAT	Best Available Technologies
BESS	Battery Energy Storage System
BOP	Balance of Plant
CC Act	Climate Change Act 2022 (Commonwealth)
CSIRO	The Commonwealth Scientific and Industrial Research Organisation
CQG	CQG Consulting (CQ Environmental Pty Ltd)
DA	Development Application
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DETSI	Department of the Environment, Tourism, Science and Innovation
ECF	Energy Content Factors
EDQ	Economic Development Queensland
EF	Emission factor
EP Act	Environmental Protection Act 1994
EPA	Environment Protection Authority
ERA	Environmentally Relevant Activity
EV	Electric Vehicle
GSDA	Gladstone State Development Area
GHG	Greenhouse Gases
GWP	Global Warming Potential
IFC	International Finance Corporation
IPCC	Intergovernmental Panel on Climate Change

Term	Definition
LOO	Life of Operation (50 years)
LPG	Liquefied Petroleum Gas
LULUCF	Land Use, Land Use Change and Forestry
MCU	Material Change of Use
MoU	Memorandum of Understanding
NEM	National Electricity Market
NEPC	National Environment Protection Council
NGER	National Greenhouse and Energy Reporting
NPI	National Pollutant Inventory database
NVES	New Vehicle Efficiency Standard
OEM	Original Equipment Manufacturer
ODP	Ozone Depletion Potential
PPA	Power Purchase Agreement
QLD	Queensland
REC	Renewable Energy Certificates
SPP	State Planning Policy
ULP	Unleaded Petrol
UNFCCC	United Nations Framework Convention on Climate Change
ZEV	Zero Emission Vehicle

EXECUTIVE SUMMARY

Katestone Environmental Australia Pty Ltd (Katestone) was commissioned by CQG Consulting (CQG) on behalf of Grenof to undertake a Greenhouse Gas (GHG) Assessment of Project Halogen (the Project). The assessment has been prepared to support a Development Application (DA) for an Environmentally Relevant Activity (ERA) 7(6d) associated with a material change of use (MCU) for chemical manufacturing.

The Project will establish a green chlor-alkali manufacturing facility supplying caustic soda (NaOH), liquid chlorine (Cl_2), sodium hypochlorite (NaClO), and hydrochloric acid (HCl) to domestic markets. By producing these chemicals locally, the Project supports the Gladstone Region's Economic Transition Roadmap 2022–2032 and reduces reliance on imported chemical products. The Project is expected to have an operational life of approximately 50 years following a one-year construction period.

The GHG assessment was undertaken in accordance with the Guideline: Greenhouse gas emissions ESR/2024/6819 (GHG Guideline). Under the Guideline, the Project is classified as a medium-to-high emitter, with estimated operational emissions exceeding 25,000 tonnes of carbon dioxide equivalent (t CO_2-e) per year. As a result, the assessment includes a comprehensive inventory of Scope 1, Scope 2 and Scope 3 emissions, together with an emissions reduction and abatement plan aligned with Queensland's emissions reduction objectives.

The GHG assessment estimates the total construction Scope 1 emissions at ~2,533 t CO_2-e, with ~75% coming from vegetation clearance and ~25% from diesel combustion. Scope 3 emissions during construction are estimated at ~6,624 t CO_2-e, with ~96% of these from embodied emissions in purchased concrete and steel.

The GHG assessment estimates annual abated Scope 1 emissions of ~3,349 t CO_2-e/y giving life-of-operations (LOO) Scope 1 emissions of ~167,425 t CO_2-e. Annual Scope 2 emissions, associated with electricity consumption, are estimated at ~56,413 t CO_2-e/y giving LOO Scope 2 emissions of ~2,820,667 t CO_2-e based on the current Queensland emission factor (EF). Scope 2 emissions will reduce significantly over the LOO as the Queensland grid decarbonises towards net zero in 2050. Scope 3 LOO emissions are estimated at ~771,875 t CO_2-e, with annual Scope 3 emissions of ~15,438 t CO_2-e/y.

Grenof has committed to implementing a structured GHG abatement strategy based on the emissions management hierarchy of Avoid, Reduce, Substitute and Offset, supported by ongoing technology review and continuous improvement.

Under the Avoid principle, emissions cannot be entirely eliminated while producing the required chemical outputs. However, Grenof has committed to investing in and commissioning best-practice chlor-alkali production technology, designed to be significantly more energy efficient than comparable existing Australian facilities. This approach prioritises improved electricity-to-work conversion efficiency and the use of lower-emissions energy sources.

Consequently, the Project will avoid up to% Scope 2 emissions relative to the base case of conventional membrane technology, achieved through the design and procurement of best-practice, high-efficiency production equipment from the commencement of operations. Further, fossil-fuelled transport vehicles will be replaced with electric vehicles (EVs), resulting in a projected avoidance of ~139,025 t CO_2-e Scope 1 emissions over the life of the Project.

Under the Reduce principle, measures will be reviewed and implemented where technically feasible and cost-effective, including onsite renewable energy generation, battery energy storage systems (BESS), and renewable electricity procurement through power purchase agreements (PPAs). In addition to these emissions, the Project is expected to reduce Scope 3 emissions associated with the international shipping of imported chemicals from Asia by approximately 3,500 to 22,000 t CO_2-e per year, due to the localisation of production.

Under the Substitute principle, several fuel and technology substitutions will further reduce emissions. A blend of by-product hydrogen and liquefied petroleum gas (LPG) generated during the production process will be used at project commencement, reducing LOO emissions by a minimum of 33,425 t CO_2-e compared with the base case. In addition, the hydrofluorocarbon refrigerant R-507, used in chlorine liquefaction, will be substituted with natural refrigerants R-717 (ammonia) and R-744 (carbon dioxide) where practicable and cost-effective, reducing emissions by approximately 31,820 t CO_2-e over the LOO.

Residual emissions may be addressed under the Offset principle through the purchase and surrender of Renewable Energy Certificates (RECs) and/or Australian Carbon Credit Units (ACCUs) generated in Queensland or through other recognised voluntary carbon markets, consistent with Grenof's corporate sustainability commitments.

To ensure continuous improvement, Grenof will undertake periodic reviews of the technical readiness level (TRL) and commercial readiness level (CRL) of emerging technologies and process innovations that could further reduce the emissions intensity of production. Feasibility studies will be initiated for options reaching TRL ≥ 6 and CRL ≥ 5, with recommendations for further investment presented to the Board. Potential future initiatives may include higher-efficiency production technologies and the electrification of remaining Scope 1 emission sources, including boilers and materials-handling equipment.

Based on the current assessment, total abated LOO emissions are estimated to represent approximately 0.16–0.14% of Queensland's remaining emissions budget, 0.082% of Australia's remaining budget, and 0.00029% of the global emissions budget consistent with limiting warming to 2.0°C.

The Project will be required to report emissions under the National Greenhouse and Energy Reporting (NGER) Scheme, although it is not expected to be subject to emissions reduction obligations under the current Safeguard Mechanism (Australia). Emissions monitoring and reporting will be supported by annual internal validation and periodic independent auditing. Delivery of key abatement actions will be integrated into operational governance, with relevant key result areas (KRAs) linked to executive key performance indicators (KPIs) consistent with Grenof's organisational accountability framework.

Overall, the Project demonstrates a structured approach to emissions management and decarbonisation while supporting the secure domestic supply of essential industrial chemicals and contributing to regional economic transition.

1. INTRODUCTION

Katestone Environmental Pty Ltd (Katestone) was commissioned by CQG Consulting (CQG) on behalf of Grenof to conduct a Greenhouse Gas (GHG) Assessment of a proposed chlor-alkali facility (the Project) to be located in the Gladstone State Development Area (GDSA). This assessment is to support a Development Application (DA) for a material change of use (MCU) for a concurrence environmentally relevant activity *(ERA) 7(6d) Chemical manufacturing: manufacturing in a year, more than 100,000 tonnes of inorganic chemicals*, for the Project.

Local production of chlor-alkali would support the Gladstone Region's Economic Transition Roadmap 2022-2032, reducing GHG emissions and reducing the need for these products to be imported. Grenof has successfully secured Economic Development Queensland (EDQ) managed land in Yarwun for the Project.

This GHG assessment and abatement plan has been developed to meet the requirements of the *Guideline Greenhouse gas emissions ESR/2024/6819* (GHG Guideline) (section 2.3.1) in support of CQG's application. The requirements in addition to the GHG abatement plan (Table 1) are to:

- Document the applicable State and Federal policy, legislation, standards, and guidelines applicable to GHG emissions from the Project (section 3)
- Describe the methodologies used to estimate GHG emissions, consistent with relevant standards and the GHG Guideline (section 4).

Table 1 Sections of GHG Abatement Plan addressing the GHG Guideline

Requirement	Section
a. Project details	Section 2
b. Emissions projections and commencing abatement measures: i. **Emission inventory and estimates as developed in section 3.1 of the GHG Guideline** ii. **Management practices proposed to be implemented at commencement to reduce GHG emissions as per section 3.3 of the GHG Guideline**	Section 5 Section 6 Table 7
c. GHG emissions reference point: i. Outline the level of emissions against which ongoing reduction of GHG emissions will be assessed throughout the life of the Project (reference point) (based on projected GHG emissions prior to implementation of the GHG abatement plan) ii. **Provide** justification for the reference points proposed	Section 6.2
d. Emission reduction targets: i. Identify interim Scope 1 and Scope 2 GHG emission reduction targets to be applied throughout the life of the Project ii. Identify long-term overall Scope 1 and Scope 2 GHG emission reduction targets. iii. Provide justification for the emission reduction trajectory and targets proposed and how they support the Queensland Government's GHG emission reduction targets	Section 6

e. GHG emission reduction program (as detailed in section 3.3 and Appendix A (Part B) of the GHG guideline), including: i. Implementation details including timeframes for implementation and estimated reduction of emissions expected ii. Risk assessment details including cost, practicality, effectiveness, and risks of each measure iii. Justification for each measure including a comparison of each proposed measure with relevant best practice environmental management standards iv. Estimates of emissions expected to be abated by each measure v. Any ongoing monitoring proposed to be undertaken to ensure the success of emission reduction measures	Section 6, 6.8, 6.10 Table 9
f. Advancing technologies and opportunities: i. Include provisions for regularly reviewing new technologies to identify opportunities to further reduce emissions and energy efficiency	Section 6.7
g. Monitoring and auditing program	Section 6.10
h. Reporting: i. A program for periodic public reporting on progress towards the GHG emission reduction targets outlined in the GHG abatement plan, including details about how public reporting will be undertaken	Section 6.11

2. PROJECT DESCRIPTION

2.1 Process Summary

Grenof is seeking to develop a modular chlor-alkali production facility located in the GDSA. The plant will have a product capacity of 160,000 tonnes per annum (tpa), with product outputs consisting of sodium hydroxide (NaOH) (caustic soda), liquid chlorine (Cl_2), hydrogen chloride (HCl), and sodium hypochlorite (NaOCl). The chlor-alkali production facility will also produce derivative chemicals from the primary products, which include sodium hypochlorite (NaOCl) and hydrochloric acid (HCl).

The electrolytic process uses electricity to convert high-purity brine into Cl_2 gas, H_2 gas, and NaOH, with a membrane separating the resulting products (Figure 2). The entire facility will have a closed loop design and consequently will not have any fugitive releases. A potential fugitive source based on facilities elsewhere is the electrolyser room. In the case of the Project, the electrolyser room will be designed so that any leaks will be immediately identified by the control system due to the monitoring of pressure on either side of each electrolyser. The control system will have the capability to detect leaks as small as a pinhole. There are no GHG emissions resulting from the chemical reactions.

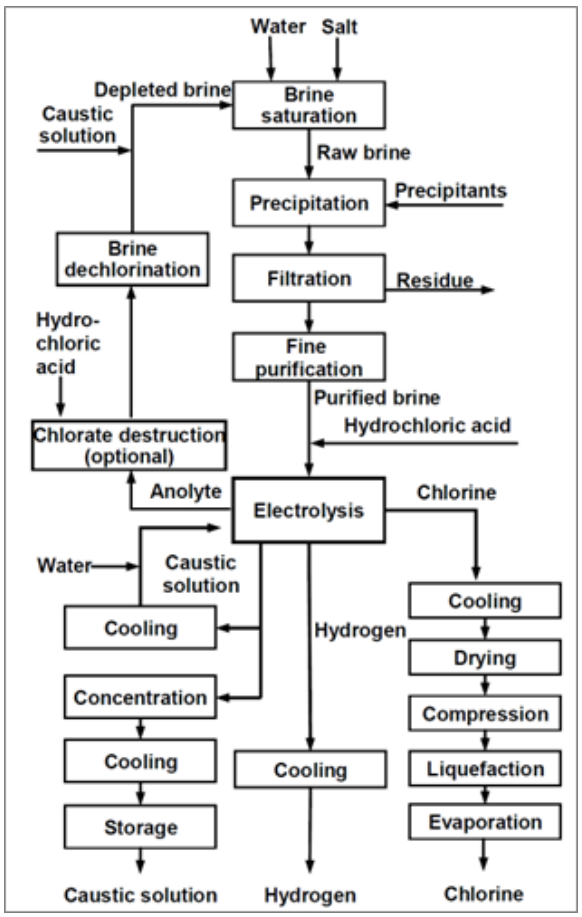


Figure 1 **Typical flow diagram of the membrane cell technique (source: European Commission, 2014, Best Available Techniques (BAT) Reference Document for the Production of Chlor-alkali)**

A schematic view of the chlorine electrolysis cells is provided in Figure 3. In comparison to the alternative electrolysis techniques (diaphragm cell process and the mercury cell process), the membrane cell process has the following benefits:

- Low total energy consumption
- Low investment and operating costs
- Does not use mercury or asbestos
- High-purity caustic production

High-purity caustic.

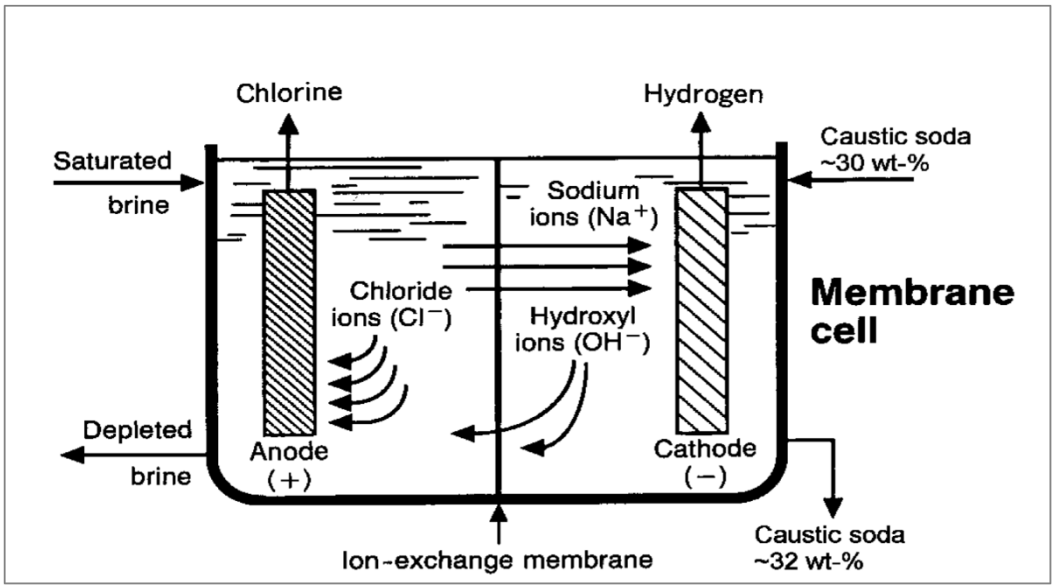


Figure 2 **Schematic view of chlorine electrolysis cells for membrane cell technique (source: European Commission, 2014, Best Available Techniques (BAT) Reference Document for the Production of Chlor-alkali)**

2.2 Project overview

Construction

The construction phase is estimated to occur across the first year. The key activities and sources of Scope 1 GHG emissions are:

- Vegetation clearing
- Heavy machinery earthworks
- Onsite concrete batching
- Onsite generators
- Miscellaneous ancillary equipment
- Light vehicles and logistics

Transport of steel and skid mounted modules to site during construction was omitted from the assessment due to total fuel usage less than 1 kiloliter (kL) and emissions less than 1 tonne of carbon dioxide equivalent (t CO_2-e).

Operation

The operational phase period is expected to last for 50 years. Key activities and sources resulting in Scope 1 and 2 emissions include:

- Electricity used in the chlor-alkali process, balance of plant and charging of electric vehicles (EVs)
- Combustion of liquid petroleum gas (LPG) and H_2 gas blend (80:20) in boilers to generate steam
- Leakage from refrigerants used in chlorine liquefaction
- LPG used in forklifts

Grenof has committed to commissioning leading-edge technology (BM2.7 (Bipolar Membrane) Single Element Technology electrolysers) that will be installed at the commencement of the Project. This technology has key efficiency improvements including an increased accessible area, full zero-gap across the accessible area which enhances current distribution, woven mesh cathode that minimises structural voltage drop, and high-performance coatings and hydraulic design for better release of gas bubbles which minimises voltage losses. This reduces power demand by reduced by up to 23% when compared to a plant running on conventional membrane technology (Liu et al. 2023).

Standard industrial membrane technology, as applied in existing Australian chemical plants requires 2.5 – 2.6 MWh to produce one tonne of Cl2 (Lerch et al. 2024) and between 2.2– 2.6 MWh to produce one tonne of NaOH, whereas the Proposal's demand is 2.01 MWh per tonne of NaOH. Consequently, operation of the Project will result in fewer Scope 2 emissions and a lower emissions intensity per product tonne than a comparable chemical plant. Local production of chemicals will further reduce Scope 3 emissions within chemical procurement supply chains, via a reduction in imported chemicals.

3. POLICY CONTEXT AND REGULATORY FRAMEWORK

3.1 Policy, Guidelines, and Strategy

3.1.1 State Planning Policy

Queensland's State Planning Policy (SPP)[1] expresses the State's interests in land use planning and development. The SPP notes that Queensland's largest source of GHG emissions comes from energy generation and that planning to enable the development of renewable energy will play a key role in reducing emissions.

3.1.2 Environmentally Relevant Activities (ERA) Guidelines

Environmentally relevant activities (ERAs) are prescribed activities with the potential to release emissions which can impact on the environment and surrounding land uses. The Project will require assessment by the Department of the Environment, Tourism, Science and Innovation (DETSI) for a concurrence environmentally relevant activity (ERA) 7(6d) Chemical manufacturing: manufacturing in a year, more than 100,000 tonnes of inorganic chemicals (for the Project).

3.1.3 Gladstone Region Economic Transition Roadmap 2022-2032

The Gladstone Region Economic Transition Roadmap 2022–2032 strategy supports the *Climate Change Act 2022 (Cwlth)* by helping Australia and Queensland reduce greenhouse gas emissions and reach net zero by 2050. It outlines a shift away from carbon-intensive industries, such as coal power and liquefied natural gas (LNG) towards low-emission alternatives like renewable energy, green hydrogen, and sustainable manufacturing.

3.1.4 National Hydrogen Strategy 2024

The National Hydrogen Strategy 2024 outlines a coordinated vision and roadmap for developing Australia's hydrogen industry. It sets strategic priorities, goals, and actions to support investment, innovation, and market development. It serves as a framework to guide government and industry efforts towards a low-emissions hydrogen economy.

3.1.5 Zero Emission Vehicle Strategy 2022-2032 (Qld)

Queensland's Zero Emission Vehicle Strategy 2022–2032 sets a strategic direction for reducing transport emissions by accelerating the uptake of zero emission vehicles (ZEVs). Released with an action plan in March 2022, it supports the state's broader climate goals: 50% renewable energy by 2030, a 30% emissions reduction from 2005 levels by 2030, and net zero emissions by 2050, while ensuring the energy network can support this transition.

3.1.6 National Electric Vehicle Strategy 2023

Australia's National Electric Vehicle Strategy, launched in April 2023, is a comprehensive policy framework aimed at accelerating the adoption of EVs across the country. The strategy focuses on reducing emissions, enhancing public health, and improving the well-being of Australians through increased EV uptake.

[1] https://dsdmipprd.blob.core.windows.net/general/spp-july-2017.pdf

3.2 International Agreements

3.2.1 Paris Agreement

The Australian Government signed the legally binding Paris Agreement[2] to take actions to keep global warming to 'well below' 2°C and strive to limit warming to 1.5°C. The current Australian target (Nationally Determined Contribution) is to reduce emissions to 43% below 2005 levels by 2030, and 62 - 70% by 2035, including land use, land use change, and forestry (LULUCF) and using Global Warming Potential (GWP) values from the IPCC's Fifth Assessment Report (AR5). The intention is to have net zero GHG emissions by 2050.

3.3 Legislation and Regulation

3.3.1 Climate Change Act 2022 (Cwlth)

The *Climate Change Act 2022* (CC Act) provides the legislative framework to implement Australia's net-zero commitments and codifies Australia's 2030, 2035 and 2050 net GHG emissions reductions targets under the Paris Agreement. The legislated targets are to reduce net GHG emissions to 43% below 2005 levels by 2030, and 62 - 70% by 2035, and to reduce net GHG emissions to zero by 2050. The CC Act establishes that 2030 GHG emissions reduction target as a national point target and an emissions budget. The CC Act does not impose obligations directly on companies, but it does signal sector-based reforms to achieve the GHG emissions reduction targets.

3.3.2 Climate Change (Consequential Amendments) Act 2022 (Cwlth)

The *Climate Change (Consequential Amendments) Act* 2022 (CCCA Act) embeds the GHG emissions reduction targets into fourteen Commonwealth Acts, including the *Clean Energy Regulator Act 2011*, *Infrastructure Australia Act 2008*, *National Greenhouse and Energy Reporting Act* 2007, and the *Renewable Energy (Electricity) Act* 2000.

3.3.3 National Greenhouse and Energy Reporting Act 2007 (Cwlth)

The *National Greenhouse and Energy Reporting Act* 2007 (NGER Act) established a national framework for corporations to report GHG emissions and energy consumption.

NGER registration and emissions reporting are mandatory for corporations or facilities that have energy production, energy use, or GHG emissions that exceed specified thresholds (Table 2). These entities are required to report on their Scope 1 and Scope 2 emissions, where:

- Scope 1 emissions – the release of GHG into the atmosphere from a facility as a direct result of an activity or series of activities (including ancillary activities) that constitute the facility. GHG emissions associated with land clearing are effectively a Scope 1 emission but are not included in the NGER scheme.
- Scope 2 emissions –the release of GHG into the atmosphere as a direct result of one or more activities that generate electricity, heating, cooling, or steam at another facility and that is consumed by the facility.

Scope 3 emissions are defined as indirect GHG emissions, other than Scope 2 emissions, that are generated in the wider economy by a facility's supply chain or value chain. They occur because of the activities of a facility, but from sources not owned or controlled by that facility's business. They are not included in NGER reporting due to the potential for double counting.

[2] https://unfccc.int/process-and-meetings/the-paris-agreement

Table 2 NGER annual reporting thresholds – greenhouse gas emissions and energy use

Threshold level	Threshold type	
	GHG ($ktCO_2$-e)	Energy production and/or consumption (TJ)
Facility	25	100
Corporate	50	200
Table Notes: *kt CO_2-e = kilotonnes of carbon dioxide equivalent. TJ = terajoules.*		

3.3.4 Safeguard Mechanism (Crediting) Amendment Act 2023 (Cwlth)

The Safeguard Mechanism provides a framework for Australia's largest emitters to measure, report and manage their emissions. It does this by requiring large facilities, whose net emissions exceed the Safeguard threshold of 100,000 t CO2-e per year, to keep their emissions at or below emissions baselines set by the Clean Energy Regulator. The Clean Energy Regulator is the government body responsible for accelerating carbon abatement for Australia through the administration of the National Greenhouse and Energy Reporting scheme, Renewable Energy Target, and the Emissions Reduction Fund.

3.3.5 Clean Economy Jobs Act 2024 (Qld)

The purpose of the *Clean Economy Jobs Act* 2024 (CEJ Act)[3] is to reduce GHG emissions in Queensland by legislating emissions reduction targets. The CEJ Act sets a target of net zero emissions by 2050, with an emissions reduction target of 62 - 70% below 2005 emissions by 2035. The initial target of a reduction by 30% of 2005 levels by 2030 has already been achieved. Queensland's emissions in 2005 were 197.3 mega tonnes of carbon dioxide equivalents ($MtCO_2$-e) meaning that annual emissions will need to be reduced to 49.3 $MtCO_2$-e or below by 2035.

3.3.6 Environmental Protection Act 1994 (Qld)

The *Environmental Protection Act* 1994 (EP Act)[4] seeks 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 processes on which life depends.

The EP Act does not explicitly regulate the emission of GHG, other than with reference to the storage of GHG regulated under the *Greenhouse Gas Storage Act* 2009. However:

- Regarding air emissions, a contaminant can be a gas (11(a))
- GHG emissions may constitute an environmental harm (14(1)(2)), i.e., "… any adverse effect, or potential adverse effect (whether temporary or permanent and of whatever magnitude, duration or frequency) on an environmental value …" "whether the harm is a direct or indirect result of the activity; or whether the harm results from the activity alone or from the combined effects of the activity and other activities or factors".

3.3.7 Environmental Protection Regulation 2019 (Qld)

The *Environmental Protection Regulation* 2019 prescribes the detail for processes contained in the EP Act.

[3] https://www.legislation.qld.gov.au/view/pdf/inforce/current/act-2024-016
[4] https://www.legislation.qld.gov.au/view/pdf/inforce/current/act-1994-062

3.3.8 Environmental Protection (Air) Policy 2019 (Qld)

The purpose of *Environmental Protection (Air) Policy* 2019 is to achieve the object of the EP Act in relation to the air environment by:

- 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.

3.3.9 DETSI Guideline Greenhouse Gas Emissions

The DETSI *Guideline Greenhouse gas emissions ESR/2024/6819* (GHG Guideline) describes requirements under the EP Act and provides information about how to meet these requirements in relation to GHG emissions for new and amended environmental authority (EA) applications.

The GHG Guideline sets out the minimum expectations for GHG emissions information to be provided with applications and supports rigorous, defensible, and transparent decision making in relation to these emissions. The required information includes:

- An inventory of expected GHG emissions resulting from the Project including the stage at which the emissions will occur and a breakdown by source (Section 5)
- An estimate of projected Scope 1 and Scope 2 CO_2-e emissions over the Life of Operation (LOO), including an unabated and abated emissions scenario (Section 6.8)
- An estimate of annual Scope 3 emissions and total Scope 3 emissions over the LOO (Section 5.2)
- A description of the method used for estimating GHG emissions (Section 4)
- A GHG abatement (decarbonisation) plan in alignment with recommendations made in Appendix A of the GHG Guideline (Section 6)
- A description of risks and the likely magnitude of impacts on environmental values resulting from the Project, including qualitatively describing the impacts of climate change on environmental values and the likely magnitude of such impacts based on the relative scale of the Project's net GHG emissions (Section 7) .

The GHG Guideline identifies expected GHG emission rates for activities as:

- Low emitters if expected annual GHG emissions are less than 25,000 t CO_2-e.
- Medium to high emitters if expected annual GHG emissions are 25,000 t CO_2-e or more at any time during the LOO.

3.3.10 New Vehicle Efficiency Standard Bill 2024 and New Vehicle Efficiency Standard (Consequential Amendments) Bill 2024

The *New Vehicle Efficiency Standard Bill (and consequential amendments)* 2024 (NVES) turn Australia's vehicle emissions targets into law. From 2025, car manufacturers must ensure their new vehicle fleets meet average CO_2 emissions limits, or face penalties. Manufacturers can trade credits with others or bank unused credits, with oversight by the Clean Energy Regulator. This legislation is the core mechanism for cutting transport emissions under the National Electric Vehicle Strategy.

3.3.11 Australia's HFC phase-down

Australia has committed to an international phase-down of hydrofluorocarbons (HFC) under the Montreal Protocol (2016). The HFC phase-down contributes to Australia's 2030 greenhouse gas emissions reduction target and encourages industry to move to alternative technologies using lower or zero global warming potential gases. The phase-down is being managed through an annual import quota that will gradually reduce over 18 years. The end point of the phase-down, 15% of the baseline level, will be reached on 1 January 2036.

4. METHOD

4.1 Definitions

The following gases are considered to be GHGs (section 7A NGER Act):

- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous oxide (N_2O)
- Hydrofluorocarbons (HFC)

4.2 Scope 1, Scope 2, and Scope 3 Emissions

GHG emissions are calculated and reported according to the Scope in which they occur.

Scope 1 GHG emissions are those emissions released to the atmosphere as a direct result of the activity conducted at a facility and that are under the direct control of the facility or operation. The emissions value is obtained by multiplying, for example, the total volume of diesel used during the reporting period with its emission factor (EF).

Scope 2 GHG emissions are those associated with the production of electricity that is purchased and used by the facility. The emissions value is obtained from the total electricity used, in kilowatt hours (kWh), during the reporting period, or that projected to be used in future, multiplied by the EF of the state in which the facility operates.

Scope 3 GHG emissions are those associated with the provision of goods and services purchased by the facility or operation but that are not owned or controlled by the entity responsible for the facility or operation. Emissions are categorised according to Scope 3 Standard. The Scope 3 emissions categories relevant to the Project include:

- Category 1: Purchased goods and services
- Category 2: Capital goods
- Category 3: Fuel and energy related emissions
- Category 4: Upstream transportation and distribution
- Category 5: Waste generated in operations
- Category 7: Employee commuting

4.3 Method for Calculation of GHG emissions

4.3.1 Project Scope 1, Scope 2 and Scope 3 Emissions

This desktop assessment has been prepared by Katestone based on information, data, and assumptions provided by Grenof. Katestone has not independently verified the accuracy, completeness, or validity of the data supplied and makes no representation or warranty regarding its accuracy. The findings and conclusions presented in this assessment are based on the information available at the time of reporting.

Projected Scope 1, Scope 2, and Scope 3 GHG emissions for the Project during construction and operation have been calculated using the methods described in the following resources and through using energy content factors (ECF) and EFs outlined in Table 3:

- The National Greenhouse Accounts Factors 2025 (DCCEEW, 2025)
- National Greenhouse and Energy Reporting (Measurement) Determination 2008, (Compilation 19)

- The Greenhouse Gas Protocol (WRI/WBCSD, 2004)
- Australian Transport Assessment and Planning (ATAP, 2020) Guidelines.

Katestone employs Method 1 as outlined in the NGER Determination for all emissions calculations as this method is adequate to perform a rigorous GHG assessment of the Project. The Method 1 formula is:

$$\boldsymbol{E} = \frac{\boldsymbol{Q} \times \boldsymbol{ECF} \times \boldsymbol{EF}}{\mathbf{1000}},$$

where E represents the total emissions in tCO_2-e, Q is the quantity of the emission source (e.g., with units kL), ECF is the energy content factor of the emission source (e.g., with units GJ/kL), EF is the emission factor that describes the total amount of equivalent carbon dioxide emissions associated with the emission source (i.e., with units kg CO_2-e/GJ), and the 1000 returns the correct units for the emissions.

4.3.2 Emissions from Vegetation clearance

The Full Carbon Accounting Model (FullCAM) (Richards, 2001) is used to assess the carbon stock (tonnes carbon per hectare (t C / ha)) of vegetation within the proposed areas for land clearing resulting from the Project. FullCAM estimates the carbon stock change in ecosystems at a grid scale of 25 m x 25 m including:

- above and belowground biomass
- standing and decomposing debris
- soil carbon resulting from land use and management activities.

FullCAM is the standard method for measuring change in carbon stocks due to land use change and is used to assess the effects of LULUCF in Australia's National Greenhouse Gas Accounts. The carbon stock is multiplied by an emissions factor to give the t CO2-e that would be emitted if all the carbon stock was converted to carbon dioxide at a single point in time.

The clearing footprint (~6.9 ha), supplied by the Grenof as a shapefile, was classified as *Eucalyptus* open woodlands based on aerial mapping. The assessment quantified the total carbon stock loss over the 50-year LOO following clearing.

Emissions were calculated by running FullCAM simulations of 100% clearing for each FullCAM vegetation type. FullCAM returns the total tonnes of carbon per hectare (t C / ha) for the vegetation type (Table 3). The t C values are converted to t CO_2-e by multiplying by the ratio of the molecular weight of carbon dioxide to that of carbon (44/12). The t CO_2-e is then multiplied by the vegetation type area (in hectares) cleared. Land clearing is assumed and modelled as occurring entirely in Year 1, with all pre-clearing carbon stock accounted as emitted in the same calendar or financial year.

4.3.3 Emissions from Hydrofluorocarbons and natural refrigerants

Emissions from hydrofluorocarbons (HFCs) were determined in accordance with Part 4.5, subsection 4.102, Method 1 of the NGER determination. Method 1 is"

$$\mathrm{E_{jk}} = \mathrm{Stock_{jk}} \times \mathrm{L_{jk}}$$

Where, E_{jk} is the emissions of gas (t CO_2-e)

$Stock_{jk}$ is the stock of the gas type determined by the $\mathrm{GWP} \times \mathrm{Mass\ (t)\ of\ gas}$

$\mathrm{L_{jk}}$ is the default leakage rate assumed as 0.16 (industrial refrigeration)

GWP for R-507A was determined using IPCC's fifth assessment report and the composition denoted by DCCEEW (2024). Ammonia (R-717) and carbon dioxide (R-744) were modelled to have GWP's of 5 and 1 respectively (DCCEEW, 2024).

4.4 Emission Factors

This section outlines key emissions factors associated with the Project across Scope 1, Scope 2, and Scope 3, based on commonly accepted values and published emissions inventories (NGER, DCCEEW). These factors are used to estimate GHG emissions from relevant energy and material sources.

Table 3 Energy content factors (ECF) and emission factors (EF) used to calculate Scope 1, Scope 2, and Scope 3 emissions

Emission source	ECF	Units	EF			Units
			Scope 1	Scope 2	Scope 3	
Diesel (transport) [1, 3]	38.6	GJ/kL	70.4	-	17.3	$kgCO_2$-e/GJ
Diesel (stationary) [1, 2, 3]	38.6	GJ/kL	70.2	-	17.3	kg CO_2-e/GJ
Gasoline (ULP) [1, 3]	34.2	GJ/kL	67.62	-	17.2	kg CO_2-e/GJ
Queensland Electricity [1]	0.0036	GJ/kWh	-	0.67	0.09	$kgCO_2$-e/kWh
LPG [3]	25.7	GJ/kL	60.6	-	20.2 [10]	$kgCO_2$-e/GJ
Vegetation clearing- Eucalyptus open woodlands [4]	-	-	75.05	-	-	t C /ha
NaOH sodium hydroxide [5]	-	-	-	-	2.18	$kgCO_2$-e/ kg
HCl hydrochloric acid [6]	-	-	-	-	0.51	$kgCO_2$-e/ kg
H_2O_2 hydrogen peroxide [5]	-	-	-	-	2.38	$kgCO_2$-e/ kg
Na_2CO_3 sodium carbonate [7]	-	-	-	-	0.138	$kgCO_2$-e/ kg
H_2SO_4 sulphuric acid [7]	-	-	-	-	0.14	$kgCO_2$-e/ kg
Active carbon [8]	-	-	-	-	9.5	$kgCO_2$-e/ kg
Concrete 32 – 40 MPa [9]	-	-	-	-	305	$kgCO_2$-e/m^3
Concrete 25 – 32 MPa [9]	-	-	-	-	747	$kgCO_2$-e/m^3
Concrete 20 – 25 MPa [9]	-	-	-	-	222	kgCO2-e/m3

Structural steel (galvanised structural sections) [8]	-	-	-	-	2,400	kgCO_2-e/kg
Commercial and industrial waste	-	-	-	-	1.3	t CO_2-e / t
General Cargo Ship Average[11]					0.0132	t.km / kgCO_2-e
Container Ship Average[11]					0.0161	t.km / kgCO_2-e
Bulk Carrier Average[11]					0.00353	t.km / kgCO_2-e

Table notes:
[1]*DCCEEW, 2025*
[2]*Includes non-road-registered-vehicles*
[3]*National Greenhouse and Energy Reporting (Measurement) Determination 2008, Compilation 19*
[4] *Full Carbon Accounting Model (FullCAM) (Richards, 2001)*
[5]***U.S EPA, 2016***
[6]***Federal Ministry for Economic Affairs and Climate Action. (2024).***
[7] *CarbonCloud, 2025*
[8] ***Vilén** et al., 2022*
[9]*NABERS, 2025*
[10] **Natural gas EF**
[11] ***Department for Energy Security and Net Zero**, 2025*

4.4.1 Emissions from Purchase of Construction Materials

A variation of Method 1 is used to calculate Scope 3 emissions (t CO_2-e) of construction materials, i.e.:

$$\frac{\mathbf{Q} \times \mathbf{EF}}{\mathbf{1000}},$$

where Q is the volume (metres cubed, m^3) or mass (tonnes) of the materials and EF is the published emissions factor (Table 3).

4.4.2 Emissions from Upstream Processing of Chemicals, Fuels, and Energy

Chemicals (Category 2), diesel, and LPG will be consumed throughout the LOO for construction and operation activities. Scope 3 GHG emissions associated with the upstream extraction, processing, and distribution of these fuels were calculated using EFs denoted in Table 3. GHG emissions from transmission and distribution losses associated with purchased electricity were calculated using the same method.

4.4.3 Emissions from Upstream Transportation and Distribution

Emissions from upstream transportation and distribution (Category 4) includes all third-party transportation and distribution services purchased by Grenof which includes inbound and outbound (sold products) logistics. Data relating annual trips, vehicle classes, gross vehicle mass (GVM), and trip distances was provided by Grenof (Table 4). The transportation of products mainly relate to outbound logistics.

Table 4 Summary of inputs for emission from upstream transportation and distribution

Product	Truck type	GVM Loaded (t)	Distance (one way) km	Trips per Year	Total Annual Distance (km)	Fuel Consumption (L/ 100 km)
Salt [1]	B Double	62	75	1351	101,325	79
Caustic Soda Bulk	B Double	62	3	606	1,818	1
Caustic Soda Bulk & IBC	Heavy Rigid	27.5	600	497	298,200	134
Chlorine Gas drums	Semi-Trailer	42.5	600	983	589,800	367
Sodium Hypochlorite - Bulk	B Double	62	600	31	18,600	15
Sodium Hypochlorite - IBC	Heavy Rigid	27.5	600	408	244,800	110
Hydrochloric Acid - Bulk	Heavy Rigid	27.5	600	590	354,000	159
Hydrochloric Acid - IBC	Heavy Rigid	27.5	600	913	547,800	246
Miscellaneous[1]	Passenger	4.5	15	260	3,900	0
Waste	Heavy Rigid	15	15	104	1,560	1

Table Notes:
[1] Inbound
[2] Accounted in waste (Category 5)

Fuel consumption for each vehicle was derived using the ATAP uninterrupted fuel consumption model, with coefficients and base fuel values specified for a road alignment of rise and fall = 0 and curvature of 20°/km (ATAP, 2020). The model accounts for GVM (tare weight plus payload) and incorporates parameters for speed, road roughness (IRI), curvature, and rise and fall to represent uninterrupted flow conditions at an assumed 100 km/h. The respective fuel consumption of each vehicle was multiped by the distance and number of movements and the respective emissions factor for diesel (transport) (Table 3).

Notes: Transport of steel and skid mounted modules to site during construction was omitted from the assessment due to total fuel usage less than 1 kL and emissions less than 1 t CO_2-e concerning the Transport from Gladstone centre (15 km trip). Further, the combustion of hydrogen was omitted from the assessment as 40 tonnes combusted over the LOO will result in less than 0.3 t CO_2-e.

4.4.4 Waste Generated in operations

In assessing the emissions resulting from waste in operations, Grenof's total waste tonnage disposed by third parties was multiplied by the commercial and industrial waste EF (Table 3).

Emissions arising from transportation to the processing facility is optionally included for completeness as determined in section 4.4.3.

4.4.5 Emissions from Worker Commute

The road travel commute covers the construction-phase workforce and operations staff.

- During construction, an estimated 50 workers drive personal vehicles 15 km from Gladstone township to site, totalling 260 return trips or 390,000 km
- During operation, 10 workers operating 12-hour shifts (5 workers each shift) drive a personal vehicle 15 km from Gladstone township to site 7 days a week, totalling 364 return trips or 109,200 km per year. An additional 14 workers, travel the same total distance commuting 5 days a week.

All employee vehicles were assumed to be passenger vehicles, averaging 11.1 L/100 km, based on the Australian Bureau of Statistics (ABS) survey of motor vehicle use (2020). For this analysis, all personal vehicles were assumed and equally divided between diesel and unleaded. Emissions factors in Schedule 1, NGER Determination (Table 3) were then applied to the relative fuel consumptions to evaluate total GHG emissions per year.

4.4.6 Avoided Emissions

- LPG Boilers: 3.6 t LPG/day (base case) vs 3.0 t LPG/day (abated case)
- Road transport: Using the EV charging electricity consumption (kWh) and the equivalent travel distance, emissions avoided are estimated by applying an average 11.1 L/100 km passenger-vehicle intensity (ABS, 2020) to the same distance, with a 50:50 diesel:gasoline split
- International shipping: Avoided emissions estimated using tonne.kilometre (t.km) EFs for general cargo, container, and bulk carrier vessels (Table 3), applied to routes from Tianjin (China) and Jurong (Singapore) to Gladstone Port.

5. GREENHOUSE GAS EMISSIONS INVENTORY

The Project is intentionally designed for best practice process and energy efficiency. The inventory reports emissions following application of the abatement measures described in section 6. Abatement is measured against standard and existing practices in the chemical production industry.

5.1 Scope 1 and Scope 2 Emissions

5.1.1 Construction

Construction is expected to occur across the first year of the Project and contribute a total of 2,533 t CO_2-e including vegetation clearing (Table 5). The largest contribution to emissions apart from vegetation clearing will arise from heavy machinery and plant equipment, excluding vehicles transporting modules (~559 t CO_2-e), followed by light vehicles used on site (~75 t CO_2-e). There are no Scope 2 emissions during construction as no electricity is purchased from the National Electricity Market (NEM).

Table 5 Annual Scope 1 and Scope 2 emissions (t CO_2-e/y) from year 1 (construction) to year 51 (end of operation) and for life of operation (LOO)

Scope	Source	Construction (t CO_2-e/y)	Operation (t CO_2-e/y)	LOO (t CO_2-e)
1	Diesel Stationary	558.88	-	-
	Diesel Transport	74.74	-	-
	Boilers – LPG	-	3,342.53	167,126.74
	Forklifts – LPG	-	4.76	238.10
	Refrigerant	-	1.20	60.00
	Land Clearing	1,899.49	-	-
2	Main Process	-	49,031.94	2,451,597.00
	Balance of Plant	-	7,370.00	368,500.00
	Charging of EVs	-	11.39	569.50
Total Scope 1		**2,533.11**	**3,348.50**	**167,424.84**
Total Scope 2		**-**	**56,413.33**	**2,820,666.50**
Total Scope 1 + 2		**2,533.11**	**59,761.83**	**2,988,091.34**

5.1.2 Operation

At maximum operation, annual Scope 1 and Scope 2 emissions are estimated to be ~3,349 t CO_2-e and ~56,413 t CO_2-e respectively (Table 5). Electricity used for the main chlor-alkali process is the largest contributing emission source (81%) to the operation Scope 1 and Scope 2 inventory, followed by electricity usage for the Balance of Plant (BOP) (12%). LPG gas usage by boilers for steam generation is the third highest contributing source (6%) and main Scope 1 source, estimated at ~3,343 t CO_2-e/y.

LOO Scope 2 emissions are ~2,820,667 t CO_2-e based on the current state EF; however, this EF is projected to decline significantly over the LOO as the grid decarbonises and Scope 2 emissions will decline accordingly.

5.2 Scope 3 Emissions

Across the LOO, the largest Scope 3 category is upstream fuel and energy related activities at ~434,684 t CO_2-e, followed by upstream transport and distribution (~150,886 t CO_2-e) and purchased goods and services (~118,463 t CO_2-e; Table 6).

The Scope 3 emissions of the construction phase are estimated at ~6,624 t CO_2-e. Capital goods contribute the largest share of Scope 3 construction emissions, with upstream manufacture of steel and concrete accounting for ~6,359 t CO_2-e. The upstream production of diesel used on site, and the commute of construction workers is estimated to result in ~156 t CO_2-e, and 109 t CO_2-e respectively.

At maximum operation, purchased fuel and energy related activities are the largest Scope 3 category, estimated at ~8,694 t CO_2-e/y, driven primarily by upstream electricity transmission and distribution losses (~7,578 t CO_2-e/y). The upstream transportation and distribution concerning both inbound and outbound logistic services purchased by Grenof is the second largest Scope 3 category estimated at ~3,018 t CO_2-e/y. The purchasing of goods and services, specifically chemicals required for the chlor-alkali process is the third largest category, estimated at ~2,369 t CO_2-e/y. The processing and transportation of waste and employee commuting are estimated at ~1,219 t CO_2-e/y and ~138 t CO_2-e/y respectively (Table 6).

Table 6 **Annual Scope 3 GHG emissions (t CO_2-e/y) from year 1 (construction) to year 51 (end of operation) and for life of operation (LOO)**

Category	Source	Construction (t CO_2-e/y)	Operation (t CO_2-e/y)	LOO (t CO_2-e)
1. Goods and services	NaOH	-	1,352.68	118,462.50
	HCl	-	632.91	
	H2O2	-	269.30	
	NA2CO3	-	34.25	
	H2SO4	-	76.65	
	Active Carbon	-	3.47	
2. Capital goods	Steel	3,600.00	-	-
	Concrete	2,758.79	-	
3. Fuel and Energy related emissions	LPG	-	1,115.77	434,683.78
	Electricity	-	7,577.91	
	Diesel	156.09	-	
4. Upstream Transportation and Distribution	Inbound	-	215	150,885.99
	Outbound	-	2,802.87	
5. Waste	Processing	-	1,216.80	60,922.85
	Transportation	-	1.66	
7. Employee Commute	Passenger Vehicles	109.00	138.39	6,919.58
Total		**6,623.87**	**15,437.49**	**771,874.70**

6. GREENHOUSE GAS ABATEMENT PLAN

6.1 Introduction

The Project is considered a medium to high emitter, with annual average Scope 1 and Scope 2 GHG emissions predicted to be ~59,762 t CO_2-e annually, during the operational phase, requiring an abatement plan. This GHG Abatement Plan addresses the requirements of the GHG guideline in line with Queensland's emission reduction targets, supporting Grenof in their application for Development Approval. It has been integrated into the planning and design of the Project to ensure best practice operational and process efficiency.

Grenof adheres to the GHG abatement hierarchy, prioritising emission avoidance and reduction through renewable energy, vehicle electrification, and proactive operational measures. Where feasible, lower-emission alternatives are adopted, while offsets may be considered for residual emissions against the company's sustainability targets that cannot be eliminated. Recognised as a leader in clean technology and recipient of the Sunshine Coast Business Award for Clean Technology (Large Business), Grenof embeds sustainability and innovation across its operations. Environmental management aligns with the Equator Principles, IFC Performance Standards, and the Project will be ISO 14001 accredited.

6.2 Reference Point

The GHG emissions reference point for the Project represents the level of emissions against which ongoing reduction of GHG emissions will be assessed throughout the life of the Project, based on projected GHG emissions (excluding land clearing – not NGER reportable) at the commencement of the Project and prior to any future abatement actions.

The projected operational Scope 1 GHG emissions for the Project is estimated at ~3,349 t CO_2-e/y and operational Scope 2 emissions are estimated at ~ 56,413 t CO_2-e/y (Table 5). These serve as the baseline against which all GHG abatement and mitigation measures will be assessed.

Additionally, the emission intensity may serve as an additional reference to the efficiency of operations, estimated at ~0.35 t CO_2-e / t of gross product (160,000 tpa).

6.3 Management Controls to Reduce GHG Emissions

The following management controls will be applied for the Project, where practicable and cost-effective, to achieve the objectives and key result areas (Table 7). Following the GHG Guideline hierarchy, details of the abatement measures that will be implemented to mitigate GHG emissions over the lifetime of the Project include:

- Reducing GHG emissions through planning, appropriate technology, energy efficient processes, upgrading equipment, introducing control technologies, and entering arrangements with third parties
- Substituting remaining GHG emissions processes to low emission processes
- Offsetting mechanisms and carbon crediting as a last resort, after all reasonable avoidance, reduction and substitution measures have been taken.

6.3.1 Avoid

The Project cannot totally avoid GHG emissions and produce the required output of chemicals – however a conscious investment decision has been made to implement a best practice chemical production plant that is significantly more energy efficient that existing Australian plant with similar chemical outputs.

Grenof has committed to commissioning leading-edge technology (BM2.7 (Bipolar Membrane) Single Element Technology electrolysers) [5] that will be installed at the commencement of the Project (KRA 1, Table 7). This technology has key efficiency improvements including an increased accessible area, full zero-gap across the accessible area which enhances current distribution, woven mesh cathode that minimises structural voltage drop, and high-performance coatings and hydraulic design for better release of gas bubbles which minimises voltage losses. This reduces power demand by reduced by up to 23% when compared to a plant running on conventional membrane technology (Liu et al. 2023).

Standard industrial membrane technology requires 2.5 – 2.6 MWh to produce one tonne of Cl_2 (Lerch *et al*. 2024) and between 2.2– 2.6 MWh to produce one tonne of NaOH, whereas the Proposal's demand is 2.01 MWh per tonne of NaOH. Consequently, the Project is expected to reduce emissions by 16,344 t CO_2-e annually against a typical facility base case. Local production of chemicals will further reduce emissions within chemical procurement supply chains, via reducing the required shipping imports as outlined in section 6.5.

Grenof will further substitute all site vehicles with EVs (KRA 2) which will avoid 2,780 t CO_2-e transport emissions annually and 139,025 t CO_2-e over the LOO against a base case using vehicles with internal combustion engines (Table 8). This supports Queensland's Zero Emission Vehicle Strategy 2022–2032 and Australia's National Electric Vehicle Strategy 2023 and will also reduce the Scope 3 emissions that would have been associated with production and transport of the liquid fuel.

6.3.2 Reduce

Grenof will periodically review and implement opportunities to reduce electricity related emissions by shifting supply to lower emissions sources, subject to technical feasibility and cost effectiveness (KRA 3). Potential abatement measures include:

- On site photovoltaic electricity generation and hydrogen generation
- Power Purchase Agreements
- Battery energy storage systems to support renewable generation
- Electrified boilers and forklift fleet

6.3.3 Substitute

Grenof will substitute at least 15% of its LPG by mass with hydrogen generated within the chlor-alkali process at the commencement of the Project (KRA 4). This abatement strategy is expected to reduce annual emissions by a minimum of 669 t CO_2-e and 33,425 t CO_2-e over the LOO (Table 8), as well as supporting industry efforts towards a low emission hydrogen economy (The National Hydrogen Strategy 2024). The combustion of hydrogen was omitted from the assessment as 40 tonnes combusted over the LOO will result in less than 0.3 t CO_2-e.

HFC R-507 traditionally used in process cooling will be substituted with the natural refrigerants R-717 (ammonia) and R-744 (CO_2) in a closed loop system (KRA 5). R-717 and R-744 are intended to be used at the commencement of the Project within a closed loop process resulting in minimal leakage and reducing emissions by 638 t CO_2-e annually (Table 8). The natural non-HFCs have global warming potentials (GWP) of less than 5 in contrast to R-507 which has a GWP of 3,300 (DCCEEW, 2024).

[5] https://cdn.ihsmarkit.com/www/pdf/0621/2021_WHITE-PAPERS-TKUCE_Global_Chlor-Alkali_Electrolysis.pdf

6.3.4 Offset

The Project will not be required to offset its emissions, however, may voluntarily engage in offsets as part of its sustainability strategy. Grenof will consider purchasing renewable energy certificates (RECs), Australian Carbon Credit Units, or credits from other voluntary schemes to offset their carbon footprint, where it cannot practically be achieved through other measures (KRA 6).

6.4 Scope 3 emission management and abatement

Grenof will investigate and implement the following measures to address Scope 3 emissions where economically viable and technically feasible:

- Contract transport and logistics providers based on their verified emissions intensity; select the lowest emission mode per task
- Procure goods and capital goods with lowest verified embodied emissions
- Reduce commuting emissions via car-pooling incentives, public transport support, and flexible work policies

Additionally, Grenof intends to investigate the feasibility of construction of a caustic soda pipeline to a large customer, with the potential to displace emissions from diesel fueled freight carriers.

Risks to effective Scope 3 mitigation may include inconsistent supplier compliance with emissions standards, dependency on third-party reliability with limited control over maintenance standards and disruptions in certified waste disposal logistics.

6.5 Enabled Avoided Emissions

The Project is expected to contribute to the economic abatement of shipping related emissions of chemical imports from Asia. The Project is expected to reduce shipping emissions by ~3,500 t CO_2-e – 22,000 t CO_2-e per annum depending on the shipping method considered.

6.6 Monitoring, Evaluation, and Reporting

Grenof will annually report its GHG emissions and energy production in accordance with requirement of the NGER scheme. It will use this reporting to monitor GHG emissions, and the effectiveness of any conditional GHG emissions management measures implemented for the Project.

6.7 Advancing technologies and opportunities

Grenof will undertake periodic reviews of the technical readiness level (TRL) and commercial readiness level (CRL) of technology and process options that can improve the emissions intensity of production and/or provide new business models. Advancing technologies and opportunities include:

- Lower emission production technologies
- Electrification of remaining Scope 1 GHG sources (boilers and forklifts)

Table 7 Key result areas and management controls for the Project by GHG abatement hierarchy

Priority	Key Result Area	Management Controls and Timing
Avoid	**KRA 1**: Avoid 25% of production electricity use against the base case	Implement highest efficiency Thyssen Krupp Nucera membrane technology in Project
	KRA 2: Reduce GHG emissions due to transport fuel combustion by <95% through use of EVs	Replace fossil-fuel transport vehicles with EVs at commencement of the Project's operational phase
Reduce	**KRA 3:** Reduce Scope 2 emissions with investment in renewable energy technology where feasible and cost-effective	Evaluate cost-effectiveness and feasibility of onsite solar PV and BESS Evaluate cost-effectiveness of PPAs for renewably generated electricity
Substitute	**KRA 4**: Reduce emissions from onsite LPG combustion in boilers by ~15% from the base case	Substitute a proportion of LPG used in boilers for hydrogen at the commencement of the Project
	KRA 5: Reduce potential fugitive refrigerant leakage emissions by >600 t CO_2-e per annum	Substitute R-507 with R-717 (ammonia) and R-744 (carbon dioxide) for closed loop chlorine liquefaction on commissioning
Offset	**KRA 6**: Offset residual emissions where necessary and cost-effective	Annual review of emissions inventory and regulatory requirements for emission offsetting

6.8 Projected GHG Emissions

The Project's projected Scope 1 and Scope 2 GHG emissions from operation, without decarbonisation are ~4,009,561 t CO_2-e (Table 8). Implementing KRAs 1, 2, 4 and 5 from commencement of the Project will reduce emissions by ~1,021,469 t CO_2-e (25.5%) over the LOO to ~2,988,091 t CO_2-e.

Table 8 Base case and abated case LOO GHG emissions and reductions (t CO_2-e)

Scope	Source	Base case LOO (t CO_2-e)	Abated case LOO (t CO_2-e)	LOO emissions reductions (t CO_2-e)
1	Operational Vehicles	139,594.43 [1]	569.50 [2]	**139,024.93**
	Boilers LPG	200,552.09	167,126.74	**33,425.35**
	Forklifts LPG	238 .10	238.10	**-**
	Refrigerants	31,880.00	60.00	**31,820.00**
2	Main Process	3,268,796.00	2,451,597.00	**817,199.00**
	Balance of Plant	368,500.00	368,500.00	**-**
Total Scope 1		372,264.62	167,424.84	**204,839.78**
Total Scope 2		3,637,296.00	2,820,666.50	**816,629.50**
Total		4,009,560.62	2,988,091.34	**1,021,469.28**

Table note
[1] Petrol fuelled (Scope 1)
[2] EV charging (Scope 2)

6.9 Assessment of proposed GHG mitigation measures

An assessment of proposed GHG abatement measures for the Project is provided in Table 9 and considers the timeframe for implementation, key risks, a comparison with relevant best practice environmental management standards, an estimate of emissions reductions resulting from the abatement measure, and consideration of whether the inclusion of an ongoing monitoring program for the abatement measure is necessary.

The timeframes for implementation are presented as Immediate, Near, Medium, and Long-term. These timeframes are relative to the number of Project years. Immediate represents the commencement of the Project (pre or during construction); Near-term represents the first 25% of all Project years; Medium-term represents the middle 25–75% of all Project years; Long term represents the final 25% of Project years and decommissioning.

'Approaching best practice' indicates the abatement measure is dependent on the degree of implementation. An 'embedded' monitoring program requirement indicates the abatement measure should become standard operating procedure once implemented.

6.10 Monitoring and Audit

Grenof will monitor and record all energy use and production within the facility boundary consistent with NGER requirements and methods. This data and the methods for monitoring will be available and subject to periodic internal validation and independent audit.

Grenof will tie the success of the KRAs (Table 7) to executive key performance indicators (KPI) as appropriate to their level of delegation and operational control.

6.11 Reporting

Grenof is required to provide annual reports of its emissions and energy usage through the Commonwealth NGER system. The Project forms a facility for the purposes of NGER, and its emissions and energy production will be included in the company reporting.

Table 9 Assessment of proposed GHG mitigation measures

KRA	Mitigation measure	Timeframe	Risks	Opportunities	Industry Standard	Emissions reduction estimate for the LOO (t CO_2-e)
KRA 1	Reduce production electricity demand by 25% against the base case	Immediate	• High capital costs lead to procurement of less efficient production technologies	• Installation of highest efficiency production technologies provides best return on investment through optimal chemical production and reduced emission intensity of production	Best	817,199
KRA 2	Reduce GHG emissions due to transport fuel combustion by <95% through use of EVs	Immediate	• Additional charging and electrical-upgrade requirements can drive cost overruns and added labour • Reduced overall fire incidence, however fire from misuse or damage can be more intense and harder to extinguish	• Lower reliance on fossil fuels and less exposure to volatile fuel supply chains • Lower operating cost from higher drivetrain efficiency	Best	139,025
KRA 3	Reduce Scope 2 emissions with investment in renewable energy technology where feasible and cost-effective	Immediate	• Inadequate capacity to support electricity demand if not correctly sized in design leading to higher emission intensity of production • Cost overruns, due to high consumption or underestimation of initial costs, delays causing extra labour or equipment costs • Increased maintenance demands or poorly	• Greater self-reliance through on-site generation and storage enabling new revenue streams (e.g. selling of electricity) and reduces exposures to future grid price volatility • Eligibility of incentives and green financing, strengthening tender competitiveness and stakeholder confidence against climate risks	Best	TBD

KRA	Mitigation measure	Timeframe	Risks	Opportunities	Industry Standard	Emissions reduction estimate for the LOO (t CO_2-e)
			integrated backup systems			
KRA 4	Reduce emissions from onsite LPG combustion for boiler by ≥15% from the base case	Immediate	• Cost overruns from workforce training, lead times in procurement and design and construction requirements • Complete electrification and hydrogen fueled options may have low TRLs and CRLs	• Greater energy self - reliance (when paired with KRA 3) improves margins	Best	33,425
KRA 5	Reduce potential fugitive refrigerant leakage emissions by > 600 t CO2-e per annum	Immediate	• Additional system requirements and workforce training can drive cost overruns	• Improved low temperature energy performance, increasing production efficiency • Natural refrigerants support lower emission production, increasing green investment opportunities and lowers supply chain risks associated with HFC phase down	Best	31,820
KRA 6	Investigate offsetting residual emissions where necessary and cost-effective	As practicable	• Current technical and economic feasibility inadequate	• Building sustainability strategy and goals	Emerging	TBD

7. RISKS AND LIKELY MAGNITUDE OF IMPACTS ON ENVIRONMENTAL VALUES

7.1 Impacts of GHG emissions on environmental values

The increasing concentration of greenhouse gases in the atmosphere, primarily due to the combustion of fossil fuels and deforestation, is leading to the warming of oceans, land, and atmosphere. This warming increases the heat energy available in the climate system leading to changed weather patterns including more frequent and intense extreme weather events. Australia is required to provide the UNFCCC with National Inventory Reports annually, biennial reports every 2 years, and National Communications every 4 years. These reports include details on total and sectoral GHG emissions, progress against reduction targets, and mitigation actions.

The Project is located in Central Queensland. It is projected that by 2050, under a high emissions scenario., the key climate risks for the region include (Queensland Government, Department of Energy and Climate, 2024):

- increased frequency of hot days (>35 ºC)
- Increased rainfall variability and a general decrease of annual rainfall
- Increased likelihood of bushfire weather and greater severity when fires occur
- increased pan evaporation rates
- increased frequency and severity of drought
- less frequent but more intense tropical cyclones
- warmer and more acidic ocean
- rising sea levels and more frequent coastal and open ocean extreme events.

Consequently, there is a need to reduce emissions at a state, national, and global level. The Project will be a contributor to Queensland's net emissions reduction through guaranteeing supply of locally produced essential chemicals and avoiding emissions resulting from shipping of Asian chemical imports by ~3,500 t CO_2-e – 22,000 t CO_2-e per annum.

7.2 Comparison of project emissions with state, national and global GHG emission budgets

The remaining global carbon budget, i.e. the maximum CO_2 that can be emitted while staying within 1.5°C, 1.7°C or 2°C, is estimated as 154.221 Gt[6], 476.272 Gt, or 957.080 Gt, respectively (Friedlingstein *et al*. 2025, Global Carbon Budget 2025). Conversion of this CO_2 budget into CO_2-e is a function of "CO_2 budget + ∑(Non-CO_2 emissions converted to CO_2-e)" according to the IPCC integrated assessment model (IAM) pathways. Assuming rapid reductions in methane emissions and moderate N_2O reductions gives a remaining GHG budget of ~1.2 – 1.35 x CO_2 budget, or 185 – 208 Gt CO_2-e, 571 – 643 Gt CO_2-e, and 1,148 – 1,292 Gt CO_2-e, respectively to stay within 1.5°C, 1.7°C or 2°C.

The Climate Change Authority (CCA) advised the Australian Government that the "fair share" national emissions budget was 10.1 Gt CO_2-e for the 37-year period 2013 to 2050 (CCA 2014) to stay within 2°C. In the 10 years between 2013 – 2023, Australia emitted another 5.498 Gt CO_2-e (DCCEEW 2025)[7] leaving a remaining budget of 4.602 Gt.

[6] One gigatonne is equivalent to 1,000 million tonnes
[7] https://www.greenhouseaccounts.climatechange.gov.au/

Climate Analytics (2019) estimated that Queensland's remaining carbon budget from 2018 – 2050 to stay within 1.5°C was 1.2 Gt CO_2, which is ~ 1.3 – 1.5 Gt CO_2-e for the same period. GHG emissions from 2018 – 2023 have been 0.884 Gt CO_2-e[8], therefore the remaining budget to stay within 1.5°C is ~ 0.416 – 0.616 Gt CO_2-e. Proportionally, the remaining budget from 2025 – 2050 for a 50% chance to limit warming to within 2.0°C is ~2.3 – 2.6 Gt CO_2-e.

The projected LOO GHG emissions are estimated to account for 0.16 - 0.14%, 0.082% and 0.00029% of the remaining emissions budgets for Queensland, Australia, and the globe, respectively (Table 10).

Table 10 Comparison of projected LOO GHG emissions at maximum production capacity with current state, national, and global budgets to stay within 2.0°C

Expected LOO Emissions	Queensland		Australia		Global	
Emissions (Mt CO_2-e)	**Emissions (Mt CO_2-e)**	**Project %**	**Emissions (Mt CO_2-e)**	**Project %**	**Emissions (Mt CO_2-e)**	**Project %**
3.76	2,300.00 - 2,600.00	0.16% - 0.14%	4,602.00	0.082%	1,292,000.00	0.00029%

[8] https://www.greenhouseaccounts.climatechange.gov.au/

8. SUMMARY

Katestone Environmental Australia Pty Ltd (Katestone) was commissioned by CQG Consulting (CQG) on behalf of Grenof to complete a Greenhouse Gas (GHG) Assessment of Project Halogen (the Project). The GHG assessment is required to support a Development Application (DA) for an Environmentally Relevant Activity (ERA) 7(6d) regarding a material change of use (MCU) for chemical manufacturing.

The Project will support the Gladstone Region's Economic Transition Roadmap 2022-2032 through green chlor-alkali manufacture, minimising the need for these products to be imported. It is expected to have an operational asset life of 50 years (after 1 year of construction) and will produce caustic soda (NaOH), liquid chlorine (Cl_2), sodium hypochlorite (NaClO), and hydrochloric acid (HCl) for domestic customers.

The GHG assessment was conducted in accordance with the requirements of the *Guideline Greenhouse gas emissions ESR/2024/6819* (GHG Guideline) and classified the Project as a medium to high emitter with annual emissions >25,000 t CO_2-e, requiring a Scope 3 inventory and abatement plan to support Queensland's emission reduction targets.

The GHG assessment estimated the total construction Scope 1 emissions at ~2,533 t CO_2-e, with ~75% coming from vegetation clearance and ~25% from diesel combustion. Scope 3 emissions during construction are estimated at ~6,624 t CO_2-e, with ~96% of these from embodied emissions in purchased concrete and steel.

The GHG assessment estimated the total abated Life of Operations (LOO) Scope 1 emissions at ~167,425 tonnes of carbon dioxide equivalent (t CO_2-e) with annual Scope 1 emissions of ~3,349 t CO_2-e/y. Scope 2 emissions for the LOO are estimated at ~2,820,667 t CO_2-e, with annual Scope 2 emissions of ~56,413 t CO_2-e. LOO Scope 3 emissions are estimated at ~771,875 t CO_2-e, with annual Scope 3 emissions of ~15,438 t CO_2-e/y.

Decarbonisation actions categorised by the GHG hierarchy are:

Avoid

The Project cannot totally avoid GHG emissions and produce the required output of chemicals – however a conscious investment decision has been made to implement a best practice chemical production plant that is significantly more energy efficient that existing Australian plant with similar outputs. The GHG abatement plan focuses on mitigation and substitution, improving the electricity-to-work conversion efficiency to lower the production emission intensity and shifting to lower emissions energy sources.

Scope 2 emissions will be reduced by 25% compared with the base case of conventional membrane technology, achieved from the start of the Project through the design and procurement of best-practice, high-efficiency production technology.

Fossil fuelled transportation vehicles are substituted with electric vehicles (EVs) at the commencement of the Project, avoiding 139,025 t CO_2-e for the LOO.

Reduce

Grenof will review and implement measures to further reduce Scope 2 emissions, where practicable and cost-effective, during future stages of the Project, including:

- Installation of onsite renewable energy generation
- Installation of a battery energy storage system (BESS)
- Renewable power purchase agreements (PPA)

The Project is expected to reduce Scope 3 emissions resulting from shipping of Asian chemical imports by ~3,500 t CO2-e – 22,000 t CO2-e per annum. Grenof is committed to ensuring that the Project contributes to the transition to a low emissions global economy, whilst manufacturing essential chemicals for the region.

Substitute

- Grenof will use a blend by-product hydrogen and liquid petroleum gas (LPG) generated in the production process at the commencement of the Project, to reduce LOO emissions by at least 33,425 t CO_2-e from the base case.
- Hydrofluorocarbon (HFC) refrigerant R-507 used for chlorine liquification will be substituted with natural non- HFC refrigerants R-717 and R-744 (ammonia (NH_3) and carbon dioxide (CO_2)) where cost efficient and practicable, reducing LOO emissions from the base case by 31,820 t CO_2-e.

Offset

Residual emissions against Grenof's cooperate sustainability targets may be offset through the purchase and surrender of Renewable Energy Certificates (REC) and/or Australian Carbon Credit Units (ACCU) originating in Queensland, or other voluntary emissions reduction schemes.

Review and Reporting

Grenof will undertake periodic reviews of the technical readiness level (TRL) and commercial readiness level (CRL) of technology and process options that can improve the emissions intensity of production and/or provide new business models. Feasibility studies will be conducted for options that have a TRL of 6 or greater and a CRL of 5 or greater and recommendations for further investment will be made to the Board as appropriate. Options may include:

- Higher efficiency production technologies
- Electrification of remaining Scope 1 GHG sources (boilers and forklifts)

The projected LOO GHG emissions are estimated to account for 0.16 - 0.14%, 0.082% and 0.00029% of the remaining emissions budgets for Queensland, Australia, and the globe to stay within 2.0°C, respectively.

The Project will be required to report its emissions as a facility under the NGER system, but it will not be subject to the emissions reduction requirements of the Safeguard Mechanism. Annual recording and monitoring will be subject to internal validation and periodic independent auditing, and achievement of abatement key result areas (KRA) will be tied to executive key performance indicators (KPI) as appropriate to Grenof's delegation and operational control.

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Grenof Water Technologies

Project Halogen

Grenof Preliminary Baseline Soil Assessment

11 November 2025

PLANS AND DOCUMENTS
referred to in the
SDA APPROVAL

Queensland Government

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Appendix A: Halogen Project Map – Project Halogen Site Layout

Appendix B: Contaminated Land EMR Search Results

Appendix C: Soil Sampling Locations Figure C.1

Appendix D: Field Observations and Photographs

Appendix E: Laboratory Reports

Appendix F: Analytical Results Tables

Appendix G: RPD Calculations

Glossary

Acronym	Meaning
ACL	Added contaminant limits
Actual acidity	The soluble and exchangeable acidity readily available for reaction, including pore waters containing metal species capable of hydrolysis (e.g. Fe2+, Fe3+ or Al3+ ions). The laboratory analyte for actual acidity is titratable actual acidity.
AHD	Australian Height Datum
ASS	Acid sulfate soils
bgl	Below ground level
BTEXN	Benzene, toluene, ethylbenzene, xylene and naphthalene
$CaCO_3$	Calcium carbonate
CLID	Contaminated land investigation document
CLR	Contaminated Lands Register
COA	Certificate of analysis
COPC	Contaminants of potential concern
CQG	CQ Environmental Pty Ltd trading as CQG Consulting
DDT	Dichlorodiphenyltrichloroethane
EIL	Ecological investigation level
EMR	Environmental Management Register
ESL	Ecological screening level
GSDA	Gladstone State Development Area
Ha	Hectare
HIL	Health investigation level
HSL	Health screening level
km	Kilometres
LoR	Limit of reporting
NATA	National Association of Testing Authorities
NEPM	National Environment Protection Measure

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Acronym	Meaning
Net acidity	The quantitative measure of the acidity hazard of ASS materials. It is determined from an acid base accounting approach
OCP/OPP	Organochlorine and organophosphorus
PAHs	Polyaromatic hydrocarbons
PASS	Potential acid sulfate soil
PFAS	Per- and polyfluoroalkyl substances
PFHxS	Perfluorohexane sulfonic acid
PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctanesulfonic acid
pH KCl	Method to determine soil pH following mixing with potassium chloride solution
pH OX	Method to determine soil pH following oxidisation with 30% hydrogen peroxide
QA	Quality assurance
QASSTM	*Queensland Acid Sulfate Soil Technical Manual*
QC	Quality control
Qld	Queensland
RDP	Relative percentage difference
Retained acidity	This refers to acidity retained by sparingly soluble and insoluble oxidised sulfur compounds (derived from sulfide oxidation) that slowly produce acid (e.g. jarosite, natrojarosite and schwertmannite)
SPOCAS	Suspension peroxide oxidation combined acidity and sulphur suite
SQP	Suitably qualified person
t	Tonnes
The Project	Project Halogen (Chlor-alkali plant)
The Site	Portion of Lot 1 on SP200899 and Lot 1 on MPH32292
TPH	Total petroleum hydrocarbons
TRH	Total recoverable hydrocarbons

1 Introduction

1.1 Objective

Grenof engaged CQG Consulting (CQG) to undertake a preliminary baseline soil assessment for indicators of contaminated land and acid sulfate soils (ASS) for the Project Halogen chlor-alkali plant (the Project), located on a portion of Lot 1 on SP200899 and Lot 1 Plan MPH32292 (the Site), within the Gladstone State Development Area (GSDA).

Details of the Site and Project conceptual plan layout are shown in Appendix A, Figure A.1.

1.2 Site Information

1.2.1 Location

The Site is a greenfield location within the GSDA, approximately 13 kilometres (km) west of Gladstone in Central Queensland.

Nearby land uses include the following activities:

- Landing Road and Ergon electricity easement (Lot A CTN2165) to the west;
- Ergon electricity substation on Lot 2 SP200899 to the west;
- Fishermans Road to the north;
- Intertidal area on Lot 1 SP147871 to the east, with Fisherman's Landing Branch rail line and Rio Tinto Australia Yarwun conveyor further to the east; and
- A tributary of Boat Creek to the south.

1.2.2 Site Geology

The Site is located on soils associated with the Quaternary Period, which is made up of recent deposition, consisting of sand, silt, mud, gravel, and residual soil and colluvium (GeoResGlobe, 2025). Australian Soils Classification for the site is described as:

- "Narrows", colluvial fans and alluvial fans below the coastal range along The Narrows Strait, north of Gladstone, with bleached, loamy or silty surface, sodic texture contrast soils and eucalypt woodland with swamp mahogany, tea tree understorey and gum-topped box woodland.

1.2.3 Land Registers

The Site is not listed on the Queensland Government Environmental Management Register (EMR) or Contaminated Lands Register (CLR).

A copy of the EMR / CLR search is provided in Appendix B.

1.2.4 ASS Mapping

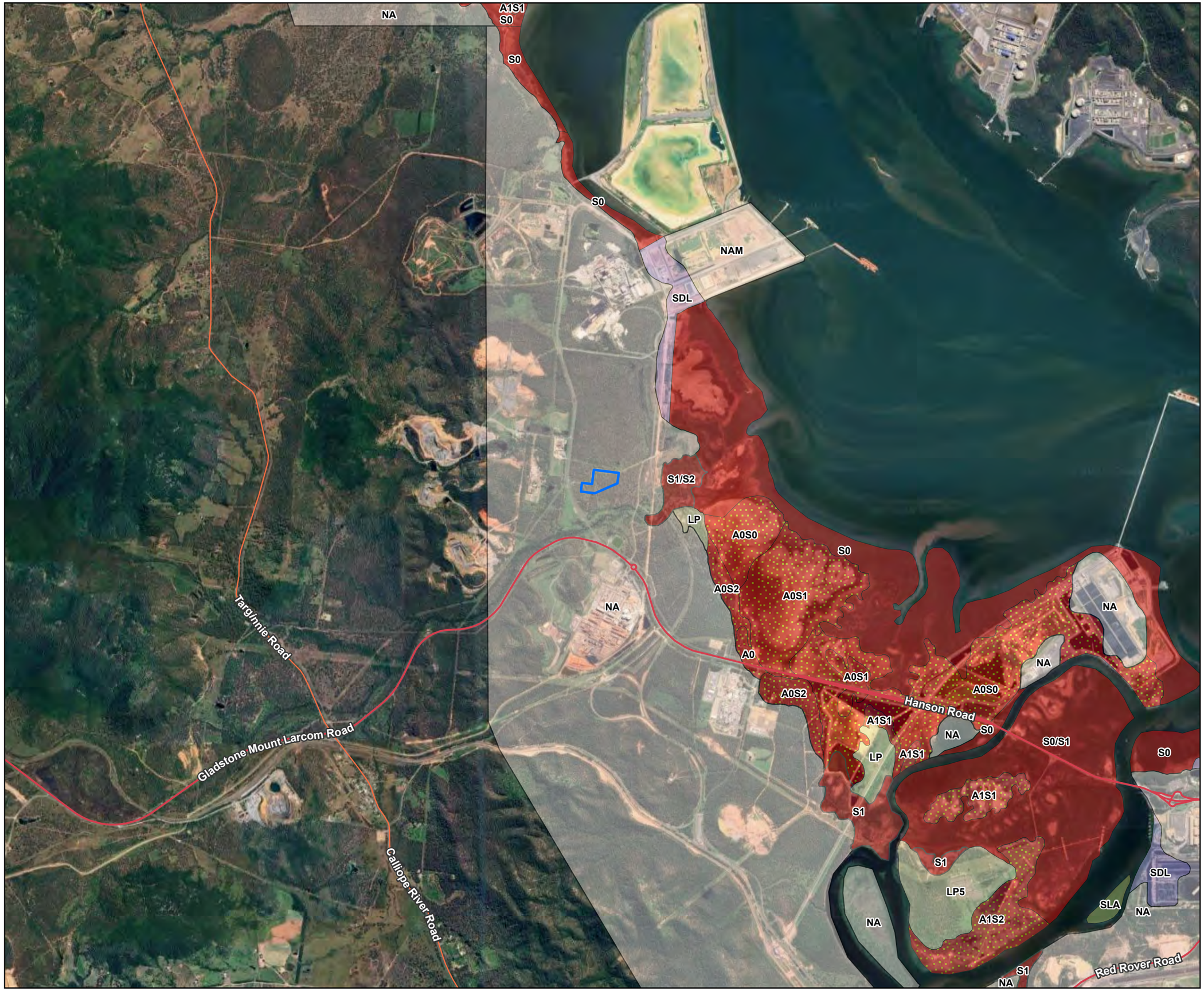
ASS soils, sediments and other materials containing iron sulfides are typically found at coastal and near-coastal locations. They are environmentally benign when left undisturbed in an aqueous, anoxic environment, however, when exposed to oxygen the iron sulfides oxidise, releasing sulfuric acid and soluble iron (Queensland Acid Sulfate Soil Technical Manual (QASSTM), Soil Management Guidelines, Version 5.1, 2024). Both substances have considerable ability to degrade the natural and built environment, and the acid may additionally mobilise chemical species (e.g. aluminium and/or heavy metals) which can be toxic or poisonous at low concentrations to plants and animals. Other hazards including the deoxygenation of surface waters, contaminant metal and metalloid release, malodours, nutrient release have been associated directly with ASS (QASSTM, 2024).

Acid sulfate soils occur naturally over extensive areas of low-lying coastal land along the Queensland coastline, predominantly below 5.0 m Australian Height Datum (AHD). These soils may be found close to the natural ground surface but may also be buried at depth in the soil profile (QASSTM, 2024).

Queensland Globe (QLD Globe 2025) contour mapping indicates that the Site is located between 6.5 mAHD at the south-eastern portion to 10.5 mAHD at the north-western portion. As the Site is above 5.0 mAHD the likely presence of PASS / ASS material is considered low.

QLD Globe ASS mapping (refer to Figure 1.1) indicates the following:

- The Site is located in the zone labelled as “not assessed” during Queensland Government ASS mapping. This is land located above 5.0 mAHD;
- The nearest ASS zone S1 / S2 indicates the potential presence of PASS material at between 0.5 m to 1.0 m depths below surface level. This is based on a 1:50,000 scale which equates to approximately 1 borehole per 25 hectares (Ha), or 2 to 7 boreholes per square kilometre completed as part of the mapping assessment; and
- The S1 / S2 zone lies within a 2.0 mAHD contour area, approximately 500 m east of the Site.



Legend

Project Site

Acid Sulfate Soils (Qld)

- A0
- A0S0
- A0S1
- A0S2
- A1S1
- A1S2
- LP
- LP5
- NA
- NAM
- S0
- S0/S1
- S1
- S1/S2
- SDL
- SLA

Roads and tracks

- Secondary
- Connector

N

Scale 1:40,000 (A3)

0 600 1,200 1,800

Metres

Coordinate System: GDA2020 MGA Zone 56

Figure 1.1

Project Halogen

ASS Mapping in vicinity of Project Site Location

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Project No: 25054
Map No: 25054-21
Revision: Rev0
20 October 2025

Layer Credits- © OpenStreetMap (and) contributors, CC-BY-SA, © State of Queensland (Department of Resources) 2023; QSpatial; CQG

2 Methodology

2.1 Scope of works

Two CQG environmental scientists under the direction of a CQG suitably qualified person (SQP), conducted soil sampling at the Site on 15 and 16 September 2025.

Soil bores were advanced onsite by the geotechnical assessment team (D & N Geotechnical 2025) using a truck mounted drill rig with solid stem auger attachments at three predetermined soil boring locations. Soil samples were collected from near surface (0.5 m) and then at 1.0 m intervals to a maximum depth of 5.0 m from each of the boreholes. Boreholes were advanced further by the geotechnical assessment team.

Five hand auger locations were selected by CQG using a judgemental sampling approach, with soil samples collected from the 0.5 m depth soil profile at each sample location.

Soil samples were collected directly from the drill rig auger using gloved hands, as well as from five hand auger locations (0.5 m depth) and were placed in pre-labelled laboratory supplied sample jars and preserved on ice for laboratory transport. Sample locations were recorded in the field using a GPS device within a lateral 3.0 m to 5.0 m level of accuracy.

Sample locations are shown in Appendix C, Figure C.1.

All soil samples were dispatched to a National Association of Testing Authority (NATA) certified laboratory for analysis of the following:

- Heavy metals x 15 (arsenic (As), barium (Ba), beryllium (Be), boron (B), cadmium (Cd), chromium (Cr), cobalt (Co), copper (Cu), lead (Pb), manganese (Mn), mercury (Hg), nickel (Ni), selenium (Se), vanadium (V) and zinc (Zn));
- Total petroleum hydrocarbons (TPH) and total recoverable hydrocarbons (TRH);
- Benzene, toluene, ethylbenzene, xylene and naphthalene (BTEXN);
- Organochlorine and organophosphorus (OCP/OPP) pesticides;
- Polynuclear aromatic hydrocarbons (PAH's);
- Polychlorinated biphenyls (PCBs);
- Phenolic compounds;
- Two soil samples (0.5 m depth profile) from Borehole 3 (BH03) and Hand Auger 4 (HA04) were analysed for per- and polyfluoroalkyl substances (PFAS); and
- All soil samples collected from the boreholes were analysed for suspension peroxide oxidation combined acidity and sulphur suite (SPOCAS) in the laboratory.

No groundwater monitoring wells were installed, and no groundwater sampling or analysis was completed as part of the work completed by CQG.

2.2 Standards and guidelines

2.2.1 Contaminated land

Soil sampling was performed in accordance with the following standards and procedures:

- AS/NZS 4882.1:2005 Guide to investigation and sampling of sites with potentially contaminated soil – non-volatile and semi-volatile compounds;
- AS/NZS 4882.2:1999 Guide to investigation and sampling of sites with potentially contaminated soil – Volatile Substances; and
- CQG's Internal procedural documents (Soil Sampling Standard Operating Procedure, 2023).

Soil analytical results were compared against the following guidelines:

- National Environment Protection Council (NEPC 2013) National Environment Protection (Assessment of Site Contamination) Measure 1999 (as amended on 16 May 2013) (ASC NEPM); and
- National Chemicals Working Group of the Heads of the EPAs Australia and New Zealand (HEPA), PFAS National Environmental Management Plan (NEMP) Plan 3.0, 2025 (criteria for industrial/commercial).

Analytical results were compared against Commercial / Industrial assessment criteria within Schedule B (1) Guideline on Investigation Levels for Soil and Groundwater of the ASC NEPM, as follows:

- Table 1A(1) Health Investigation Levels (HILs) for soil contaminants (HIL D);
- Table 1A(3) Soil Health Screening Levels (HSLs) for vapour intrusion (C_6 – C_{10}, >C_{10} – C_{16}, BTEXN), clay soils – 0 to 1m depth (HSL D);
- Table 1B(4) ACL generic Pb, generic EILs for As, DDT and Naphthalene – Commercial / Industrial; and
- Table 1B (5) Ecological Screening levels (ESLs) for TPH fractions F1 – F4, BTEX and benzo(a)pyrene in soil (Commercial/Industrial).

Commercial/industrial standards were adopted as applicable to the intent of the GSDA location and proposed special industry (as defined by Coordinator-General 2022) land use for the Site.

For the HSL vapour intrusion 'clay' and ESL (Commercial / Industrial) 'fine' material was selected as representative of material encountered in the top 1.0 m at both the borehole and hand auger locations.

The assessment criteria for PFAS are presented in Table 2.1.

Table 2.1: NEMP Plan 3.0, 2025 PFAS Assessment Criteria – Commercial / Industrial Land Use

Exposure Scenario	Land Use	PFOS + PFHxS	PFOA	PFOS
Soil – Human Health Screening Values	Commercial and Industrial (HIL D) (mg/kg)	20	50	NG
Soil – Ecological Direct Exposure	All land uses (mg/kg)	NG	10	1
Soil – Ecological Indirect Exposure	All land uses (mg/kg)	NG	0.003	0.003
Notes: PFOS = perfluorooctanesulfonic acid, PFOA = perfluorooctanoic acid, PFHxS = perfluorohexane sulfonic acid, NG = no guideline values set.				

2.2.2 Acid sulfate soil

Soil sampling was performed in accordance with the following ASS guidelines:

- *QASSTM, Soil Management Guidelines*, *Version 5.1 (2024)*; and
- CQG's Internal procedural documents (Soil Sampling Standard Operating Procedure, 2023).

Laboratory results were compared against QASSTM – Soil Management Guidelines v5.1 (2024) to assess the potential presence and reactivity of ASS. The assessment criteria for ASS are summarised in Table 2.2.

Table 2.2: QASSTM assessment criteria

Parameter	Trigger Limit	Assessment Criteria
Peroxide pH	pH ox < 3.0	PASS likely
Net Acidity (mole H+ / t)	0 to 1, 000 t material disturbed: - 18 (Sands to loamy sands) - 36 (Clayey sands to light clays) - 62 (Fine to heavy clays/silts) > 1.000 t material disturbed: - 18 (all soil types)	Soil is acidic and/or potentially acid-forming
Net Acidity (% S)	0 to 1, 000 t material disturbed: - 0.03 (Sands to loamy sands) - 0.06 (Clayey sands to light clays) - 0.10 (Fine to heavy clays/silts) > 1.000 t material disturbed: - 0.03 (all soil types)	Soil is acidic and / or potentially acid-forming
Acid Neutralising Capacity (ANC)	Varies (site-specific)	ANC should ≥ potential acidity

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3 Results

3.1 Field observations

A summary of field observations is listed in Table 3.1. A complete set of field observations and photographs is provided in Appendix D.

Table 3.1: Summary of field observations

Location	Depth bgl	Consistency	Plasticity	Soil Type	Colour	Moisture Content	Soil Structure
BH01	0.5 m	Firm	Moderate	Clay	Light brown	Low	Blocky
BH01	1.0 m	Hard	Very low	Medium	Greyish brown	Dry	Granular
BH01	2.0 m	Dense	Moderate to high	Clay to silt	Brown	Moderate	Blocky
BH01	3.0 m	Firm	Moderate	Clay	Brown to greyish brown	Moderate	Blocky
BH01	4.0 m	Very firm	High	Fine	Brown to greyish brown	Moderate	Massive
BH01	5.0 m	Firm	Moderate	Fine to medium	Brown	Low	Blocky
BH02	0.5 m	Loose	NA*	NA*	NA*	NA*	NA*
BH02	1.0 m	Loose to friable	Low	Fine to medium	Light brown to greyish tan	Very dry	Weak granular
BH02	2.0 m	Firm to hard	Low	Medium to coarse	Light brown to grey	Dry	Granular
BH02	3.0 m	Loose	Very low	Fine silt to sand	Light brown to pale tan	Very dry	Structureless
BH02	4.0 m	Moderately firm	Low	Mixed – fine and coarse	Brownish grey	Dry	Weak blocky
BH02	5.0 m	Firm to very firm	Moderate to high	Clay sized	Light Brown	Moderately moist	Massive to blocky
BH03	0.5 m	Firm	Low	Fine to medium	Light greyish to brown	Very low	Weak granular
BH03	1.0 m	Loose to slightly firm	Very low	Fine to medium	Light brown to pale tan	Very low	Weak granular

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Location	Depth bgl	Consistency	Plasticity	Soil Type	Colour	Moisture Content	Soil Structure
BH03	2.0 m	Firm to slightly hard	Medium	Coarse sand to fine gravel	Light brown to greyish tan	Low	Weak granular
BH03	3.0 m	Firm	Low	Fine to medium	Light brown	Dry	Weak blocky
BH03	4.0 m	Loose to slightly firm	Very low	Fine to medium	Light brown to pale tan	Dry	Weak granular
BH03	5.0 m	Firm to very firm	Moderate to high	Clay sized	Dark brown	Moderately moist	Massive to blocky
HA01	0.5 m	Loose	Low	Loose, fine	Light greyish to brown	Very dry	Structureless
HA02	0.5 m	Very firm	Medium	Loose, fine	Grey to brown	Low	Weak granular
HA03	0.5 m	Loose to friable	Low	Fine to medium, some larger clumps	Muted brownish grey	Dry	Weak granular
HA04	0.5 m	Firm to moderately hard	Moderate	Fine to medium	Light brown	Dry	Blocky to granular
HA05	0.5 m	Hard to friable	Very low	Mixed – silt and sand gravel	Greyish brown	Very dry	Structureless to granular
*Note: observation details for BH02 0.5 m were not captured in Survey123 due to in field equipment error.							

3.2 Soil Analytical Results

A total of 25 soil samples, including two quality control assurance (QA) samples (duplicate samples) were collected and analysed in the laboratory. Refer to Appendix E for the laboratory reports.

The suite of analytes selected by CQG for this investigation was dictated by the human health and environmental objectives. To determine whether contaminated soil may pose a hazard to human health and the environment, the levels of contaminants reported in the soil were assessed against recognised standards and guidelines described in Section 2.2.

3.2.1 Contaminated land

A summary of the soil results indicates the following:

- All concentrations of metals reported below the nominated environmental guideline values at all sampling locations, with As, B, Cd, and Se reporting levels below the laboratory limit of reporting (LOR) at all sampling locations. The metal results above the LOR are at ambient conditions for coastal Queensland soils (see results presented in Table F.1, Appendix F);

- Concentrations of petroleum hydrocarbon fractions (TPH, TRH and PAHs) were reported at below the laboratory LOR for all soil sample locations and depths;
- BETXN concentrations were reported below the laboratory LOR for all soil sample locations and sampling depths;
- Pesticide (OCP / OPPs), phenolic compounds, and PCB concentrations were below the laboratory LOR for all soil sample locations and sample depths analysed; and
- PFAS concentrations in the two soil samples analysed at 0.5 m depths reported levels below the laboratory LOR.

3.2.2 ASS

Analytical results indicate the following, when compared to the guidelines presented in Table 2.2 (see results presented in Table F.2, Appendix F).

- Soil pH results when the sample was mixed with a potassium chloride solution (pH KCl) results ranged from 4.7 to 8.8;
- Soil pH results when the sample was mixed with a hydrogen peroxide solution (pH OX) results ranged from 4.9 to 9.2 indicating that pH levels are above the ASS guideline level for the likely presence of PASS;
- Soil samples reported net acidity (sulphur units) below LOR except for BH01 at 0.5 m depth, which reported 0.04 % S. This level lies between the sands to clays and silty clays texture range for 1 – 1000 tonnes (t) material disturbed, however is above the action guideline if > 1,000 t of material is disturbed (0.03 % S); and
- Similarly, soil samples reported net acidity (acidity units) below LOR, except for BH01 at 0.5 m depth, which reported 27 mole H+ / t. This level is between the sands to sandy clays texture range of 18 to 36 mole H+ / t for 0 – 1000 T material disturbed, however is above the action guideline if greater than (>) 1,000 t of material is disturbed (18 mole H+ / t).

In summary, ASS laboratory testing of soil samples from the three soil boreholes to a maximum depth of 5.0 m bgl did not report the presence of ASS forming materials. Whilst an outlier soil sample at BH01 at 0.5 m reported results that are indicative of the potential presence of ASS the overall results do not support the presence of ASS in concentrations that require an Acid Sulfate Soil Management Plan (ASSMP). Should at any stage of the project construction works, strong sulfuric “rotten egg” odours or black oozing soils be encountered during disturbance and excavation, then works should immediately cease, soils covered and advice sought from a qualified environmental practitioner with experience in managing PASS / ASS.

3.3 Quality Assurance / Quality Control

3.3.1 Soil Duplicates

The relative percentage difference (RPD) between primary and duplicate samples is presented in Table G.1, Appendix G. In general, RPD values were within acceptable range (between 20% to 30%) for most analytes. RPD values indicate that sampling procedures including decontamination procedures between soil sampling locations was acceptable.

3.3.2 Laboratory QA / QC

No method blank value outliers, duplicate outliers, or matrix spike outliers, or surrogate recovery outliers for regular sampling matrices occurred. No analysis holding time or quality control sample frequency outliers occurred (refer to Appendix E). Laboratory control outliers were reported for PAHs for analytes phenanthrene, fluoranthene, pyrene, and benzo (b+j) fluoranthene with recovery greater than upper control limit. Results greater than upper control limit indicates a higher bias in analytical method for these parameters, which may result in an overestimate for PAH concentrations in samples. It is noted that no soil samples reported PAH analytes in concentrations above LOR.

4 Conclusion

Soil sampling was conducted at the proposed Grenof Project Halogen Chlor-alkali plant (the Project) on 15 and 16 September 2025 by CQG environmental scientists.

Samples were analysed in the laboratory for a range of parameter concentrations including heavy metals, hydrocarbons (TRH, BTEXN, PAHs), pesticides, biphenyl's, phenol compounds, PFAS and ASS.

Laboratory results indicate concentrations of chemical parameters were below selected environmental and health-based guidelines for commercial / industrial land use and in many cases below the laboratory LOR.

Selected soil samples analysed from the soil boreholes for ASS in the laboratory did not report pH (KCL and OX) values and net acidity values indicative of the presence of ASS that would require any further testing, however, should at any stage of the development work (earthworks / construction) a strong sulfuric "rotten egg" odour or black oozing soil be encountered during disturbance and / or excavation, then works should immediately cease, soils covered and advice sought from a qualified environmental practitioner.

It is important to note that the report findings and conclusions is based on a limited range and location of test samples and there may be areas onsite that report chemical parameters above and / or below the reported baseline values and guideline values.

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Limitations

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- Any error in, or omission in connection with assumptions, or
- Reliance on the report by a third party or use of the report other than for the purpose stated.

The report relates only to the project described herein and must be reviewed by a competent expert before being used for any other purpose. CQG accepts no responsibility for other use of the data.

This report does not provide a complete assessment of the environmental status of the Site but is limited to the scope defined herein.

It is the reader's responsibility to verify the correct interpretation and intention of the recommendations presented herein. CQG assumes no responsibility for misunderstandings or improper interpretations that result in unsatisfactory or unsafe work products. It is the reader's further responsibility to acquire copies of any supplemental reports, addenda or responses to public agency reviews that may supersede recommendations in this report.

This site investigation report is not a Detailed Site Investigation, Hydrogeological report, validation report, remediation action plan, asbestos audit, environmental audit, or geotechnical report. The Site contamination assessment identifies actual subsurface conditions where the samples were taken and when they were taken. The laboratory tests are carried out by an external NATA accredited chemical laboratory and the results together with the field, and other data are interpreted by environmental scientists / engineers. These professionals then render an opinion about the overall subsurface conditions, the nature, mobility, type and extent of the contamination, and its likely impact on a proposed development. The actual conditions may differ from the inferred conditions, as no person (no matter how qualified) or even the most detailed subsurface investigation can predict with confidence what may be hidden by soil or water or may have altered with time.

Often the interface between contamination zones may be more abrupt or gradual than anticipated. The actual conditions in an area may differ from that predicted. Contaminants may be present in areas not surveyed or sampled or may migrate to an area that showed no sign of contamination when previously sampled.

The testing of the analytes is carried out by an independent NATA accredited chemical laboratory and any liability with regards to the testing is solely this laboratory's responsibility.

Site assessments are limited by time. The contamination may be affected by either natural processes such as erosion, mankind altering the ground conditions including the chemical nature of the groundwater or soils or chemical reactions of the contaminants altering the physical characteristics of the soil or water on the Site.

Should further information become available regarding the conditions of the Study Area, CQG reserves the right to review the report in the context of the additional information.

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The scope of this study did not include any site surveys or modelling.

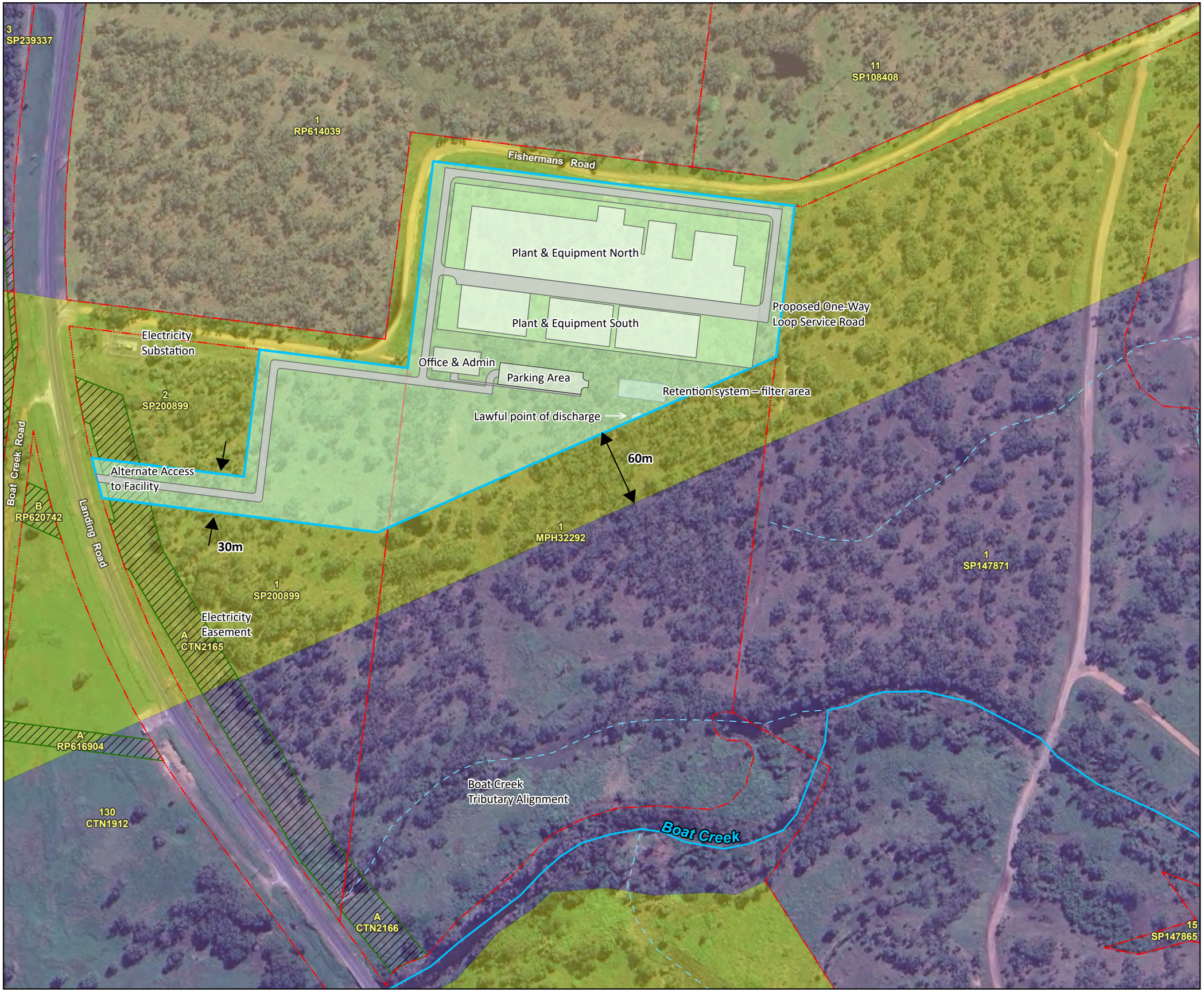
This report is based on information issued and supplied to CQG by others as well as publicly available information.

Where laboratory tests have been performed and data recorded, the responsibility for the accuracy of such data remains with the issuing authority, not with CQG.

[1] *CQ Environmental Pty Ltd (ABN 61 107 574 514) trading as CQG Consulting (CQG)*

Appendix A:

Halogen Project Map – Project Halogen Site Layout



Legend

- Easement
- Lot Type Parcel
- Named Waterways
- Unnamed waterways

Gladstone SDA Precinct

- Port Related Industry Precinct
- Industry Investigation Precinct
- Materials Transportation and Services Corridor Precinct (MTSC)

Disclaimer:
CQG has relied upon data obtained from QSpatial and other public sources, as well as the client (Grenof).
All internal access, manuevering areas, and infrastructure are subject to engineering design

N

Scale 1:2,750 (A3)

0 41 83 124

Metres

Coordinate System: GDA2020 MGA Zone 56

Figure A.1

Project Halogen

Conceptual Operations Site Layout (MCU Submission)

GRENOF

Project No: 25054
Map No: 25054-02
Revision: RevA
10 November 2025

Layer Credits- © OpenStreetMap (and) contributors, CC-BY-SA; QSpatial - Roads, Cadastral Boundaries, Gladstone SDA Precinct; CQG; GRENOF

Appendix B:

Contaminated Land EMR Search Results

Department of the Environment, Tourism, Science and Innovation (DETSI)
ABN 46 640 294 485
GPO Box 2454, Brisbane QLD 4001, AUSTRALIA
www.detsi.qld.gov.au

SEARCH RESPONSE
ENVIRONMENTAL MANAGEMENT REGISTER (EMR)
CONTAMINATED LAND REGISTER (CLR)

Scott lucke
PO Box 8384
Allenstown QLD 4700

Transaction ID: 51027937 EMR Site Id: 28 July 2025
Cheque Number:
Client Reference:

This response relates to a search request received for the site:
Lot: 1 Plan: MPH32292
56 FISHERMANS RD
YARWUN

EMR RESULT

The above site is NOT included on the Environmental Management Register.

CLR RESULT

The above site is NOT included on the Contaminated Land Register.

ADDITIONAL ADVICE

All search responses include particulars of land listed in the EMR/CLR when the search was generated.
The EMR/CLR does NOT include:-

1. land which is contaminated land (or a complete list of contamination) if DETSI has not been notified
2. land on which a notifiable activity is being or has been undertaken (or a complete list of activities) if DETSI has not been notified

If you have any queries in relation to this search please email emr.clr.registry@detsi.qld.gov.au

Administering Authority

Appendix C:

Soil Sampling Locations Figure C.1



Legend

- Project Area

Concept Layout

- Proposed Plant and Equipment Location
- Road/ Proposed Road
- Other

Sample Locations

- Bore Locations
- Test Pit Locations

Cadastral Boundaries

- Easement
- Lot Type Parcel

Roads and tracks

- Local

N

Scale 1:2,000 (A3)

0 30 60 90

Metres

Coordinate System: GDA2020 MGA Zone 56

Figure C.1

Grenof Water Technologies Pty Ltd

Project Halogen

Sample Locations

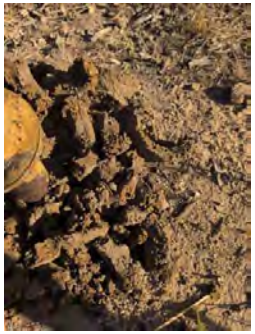
CQG Consulting
180 Quay Street, Rockhampton Q 4700
PO Box 8384, Allenstown 4700
Ph: +61 7 4922 9252 Fax: +61 7 4922 0195

Project No: 25054
Map No: 25054-22
Revision: RevB
10 November 2025

Layer Credits- © OpenStreetMap (and) contributors, CC-BY-SA, © State of Queensland (Department of Resources) 2023; QSpatial; CQG

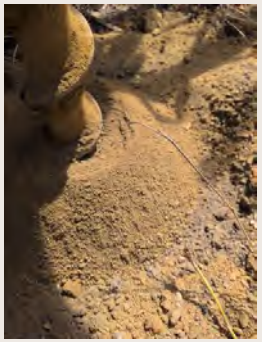
Appendix D:

Field Observations and Photographs

Location	Depth	Time and Date	Lat/Long	Consistency	Plasticity	Soil Type	Colour	Moisture Content	Soil Structure	Comments	Photo
BH01	0.5 m	16/09/2025 16:20	-23.813478 151.153326	Firm	Moderate	Clay	Light brown	Low	Blocky		
BH01	1.0 m	16/09/2025 16:40	-23.813478 151.153326	Hard	Very low	Medium	Greyish brown	Dry	Granular		
BH01	2.0 m	17/09/2025 07:30	-23.813478 151.153326	Dense	Moderate to high	Clay to silt	Brown	Moderate	Blocky		

Location	Depth	Time and Date	Lat/Long	Consistency	Plasticity	Soil Type	Colour	Moisture Content	Soil Structure	Comments	Photo
BH01	3.0 m	17/09/2025 07:40	-23.813478 151.153326	Firm	Moderate	Clay	Brown to greyish brown	Moderate	Blocky		
BH01	4.0 m	17/09/2025 07:50	-23.813478 151.153326	Very firm	High	Fine	Brown to greyish brown	Moderate	Massive		
BH01	5.0 m	17/09/2025 08:10	-23.813478 151.153326	Firm	Moderate	Fine to medium	Brown	Low	Blocky	Brown soil sample coated in fine grey dust from surface soils	
BH02	0.5 m	16/09/2025 12:30	-23.814264 151.152594	Loose	NA*	NA*	NA*	NA*	NA*		NA*

Location	Depth	Time and Date	Lat/Long	Consistency	Plasticity	Soil Type	Colour	Moisture Content	Soil Structure	Comments	Photo
BH02	1.0 m	16/09/2025 12:35	-23.814264 151.152594	Loose to friable	Low	Fine to medium	Light brown to greyish tan	Very dry	Weak granular		
BH02	2.0 m	16/09/2025 13:10	-23.814264 151.152594	Firm to hard	Low	Medium to coarse	Light brown to grey	Dry	Granular		

Location	Depth	Time and Date	Lat/Long	Consistency	Plasticity	Soil Type	Colour	Moisture Content	Soil Structure	Comments	Photo
BH02	3.0 m	16/09/2025 13:25	-23.814264 151.152594	Loose	Very low	Fine silt to sand	Light brown to pale tan	Very dry	Structureless		
BH02	4.0 m	16/09/2025 13:40	-23.814264 151.152594	Moderately firm	Low	Mixed – fine and coarse	Brownish grey	Dry	Weak blocky		

Location	Depth	Time and Date	Lat/Long	Consistency	Plasticity	Soil Type	Colour	Moisture Content	Soil Structure	Comments	Photo
BH02	5.0 m	16/09/2025 14:00	-23.814264 151.152594	Firm to very firm	Moderate to high	Clay sized	Light Brown	Moderately moist	Massive to blocky		
BH03	0.5 m	15/09/2025 15:00	-23.814917 151.151956	Firm	Low	Fine to medium	Light greyish to brown	Very low	Weak granular		

Location	Depth	Time and Date	Lat/Long	Consistency	Plasticity	Soil Type	Colour	Moisture Content	Soil Structure	Comments	Photo
BH03	1.0 m	15/09/2025 15:10	-23.814917 151.151956	Loose to slightly firm	Very low	Fine to medium	Light brown to pale tan	Very low	Weak granular	Minor inclusions of dry grass and surface debris. coarse-textured and rocky. It has a high content of gravel and larger rock fragments mixed with fine particles like sand and silt.	

Location	Depth	Time and Date	Lat/Long	Consistency	Plasticity	Soil Type	Colour	Moisture Content	Soil Structure	Comments	Photo
BH03	2.0 m	15/09/2025 16:00	-23.814917 151.151956	Firm to slightly hard	Medium	Coarse sand to fine gravel	Light brown to greyish tan	Low	Weak granular	Small stones, rock fragments	
BH03	3.0 m	15/09/2025 07:45	-23.814917 151.151956	Firm	Low	Fine to medium	Light brown	Dry	Weak blocky		

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Location	Depth	Time and Date	Lat/Long	Consistency	Plasticity	Soil Type	Colour	Moisture Content	Soil Structure	Comments	Photo
BH03	4.0 m	15/09/2025 08:00	-23.814917 151.151956	Loose to slightly firm	Very low	Fine to medium	Light brown to pale tan	Dry	Weak granular		
BH03	5.0 m	15/09/2025 08:30	-23.814917 151.151956	Firm to very firm	Moderate to high	Clay sized	Dark brown	Moderately moist	Massive to blocky		

Location	Depth	Time and Date	Lat/Long	Consistency	Plasticity	Soil Type	Colour	Moisture Content	Soil Structure	Comments	Photo
HA01	0.5 m	16/09/2025 08:40	-23.814827 151.151888	Loose	Low	Fine	Light greyish to brown	Very dry	Structureless		
HA02	0.5 m	16/09/2025 09:10	-23.814785 151.152637	Very firm clay	Medium	Fine	Grey to brown	Low	Weak granular		
HA03	0.5 m	16/09/2025 10:00	-23.814408 151.153634	Loose to friable	Low	Fine to medium, some larger clumps	Muted brownish grey	Dry	Weak granular		

Location	Depth	Time and Date	Lat/Long	Consistency	Plasticity	Soil Type	Colour	Moisture Content	Soil Structure	Comments	Photo
HA04	0.5 m	16/09/2025 11:00	-23.81367 151.152317	Firm to moderately hard	Moderate	Fine to medium	Light brown	Dry	Blocky to granular		
HA05	0.5 m	16/09/2025 13:00	-23.813495 151.15416	Hard to friable	Very low	Mixed – silt and sand gravel	Greyish brown	Very dry	Structureless to granular		

Appendix E:

Laboratory Reports

CERTIFICATE OF ANALYSIS

Work Order	: **EB2532723**	Page	: 1 of 39
Amendment	: **1**		
Client	: **CQ ENVIRONMENTAL**	Laboratory	: Environmental Division Brisbane
Contact	: OSCAR DALLA PRIA	Contact	: Kelly Schafer
Address	: 15 LORD STREET GLADSTONE QLD 4680	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61 7 4978 7944
Project	: 25054	Date Samples Received	: 19-Sep-2025 11:40
Order number	: 25054	Date Analysis Commenced	: 22-Sep-2025
C-O-C number	: ----	Issue Date	: 07-Oct-2025 16:44
Sampler	: MICHAEL WHITEHEAD		
Site	: ----		
Quote number	: EN/222		
No. of samples received	: 25		
No. of samples analysed	: 25		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Beatriz Llarinas	Senior Chemist	Brisbane Inorganics, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Soil Preparation, Stafford, QLD
Satishkumar Trivedi	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Satishkumar Trivedi	Senior Acid Sulfate Soil Chemist	Brisbane Soil Preparation, Stafford, QLD
Tatijana Markoska	Senior Chemist - Organics	Brisbane Organics, Stafford, QLD
Timothy Creagh	Senior Chemist - Organics	Brisbane Organics, Stafford, QLD

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contract for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ) per the NEPM (2013) is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.cd)pyrene (0.1), Dibenz(a.h)anthracene (1.0), Benzo(g.h.i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero, for 'TEQ 1/2LOR' are treated as half the reported LOR, and for 'TEQ LOR' are treated as being equal to the reported LOR. Note: TEQ 1/2LOR and TEQ LOR will calculate as 0.6mg/Kg and 1.2mg/Kg respectively for samples with non-detects for all of the eight TEQ PAHs.
- EP080: Where reported, Total Xylenes is the sum of the reported concentrations of m&p-Xylene and o-Xylene at or above the LOR.
- EP068: Where reported, Total Chlordane (sum) is the sum of the reported concentrations of cis-Chlordane and trans-Chlordane at or above the LOR.
- EP068: Where reported, Total OCP is the sum of the reported concentrations of all Organochlorine Pesticides at or above LOR.
- EP075(SIM): Where reported, Total Cresol is the sum of the reported concentrations of 2-Methylphenol and 3- & 4-Methylphenol at or above the LOR.
- **Amendment (07/10/2025): This report has been amended and re-released to allow the reporting of additional analytical data, specifically method EG005 for sample EB2532723-001, 007, 013, 019, 020, 021, 022, 023, 024, 025.**
- ASS: EA029 (SPOCAS): Retained Acidity not required because pH KCl greater than or equal to 4.5
- EP075(SIM) - PAH/Phenols: High LCS recovery deemed acceptable as all associated analyte results are less than LOR
- ASS: EA029 (SPOCAS): Laboratory determinations of ANC needs to be corroborated by effectiveness of the measured ANC in relation to incubation ANC. Unless corroborated, the results of ANC testing should be discounted when determining Net Acidity for comparison with action criteria, or for the determination of the acidity hazard and required liming amounts.
- ASS: EA029 (SPOCAS): Liming rate is calculated and reported on a dry weight basis assuming use of fine agricultural lime ($CaCO_3$) and using a safety factor of 1.5 to allow for non-homogeneous mixing and poor reactivity of lime. For conversion of Liming Rate from kg/t dry weight to kg/m3 in-situ soil, multiply reported results x wet bulk density of soil in t/m3.
- EP231: Stable isotope enriched internal standards are added to samples prior to extraction. Target compounds have a direct analogous internal standard with the exception of PFPeS, PFHpA, PFDS, PFTrDA and 10:2 FTS. These compounds use an internal standard that is chemically related and has a retention time close to that of the target compound. The DQO for internal standard response is 50-150% of that established at initial calibration or as per USEPA 1633 limits where listed. PFOS is quantified using a certified, traceable standard consisting of linear and branched PFOS isomers. These practices are in line with recommendations in the National Environmental Management Plan for PFAS and also conform to QSM 5.4 (US DoD) requirements.

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	BH01 - 0.5m	BH01 - 1.0m	BH01 - 2.0m	BH01 - 3.0m	BH01 - 4.0m
			Sampling date / time	16-Sep-2025 16:20	16-Sep-2025 16:45	17-Sep-2025 07:30	17-Sep-2025 07:40	17-Sep-2025 07:50
Compound	CAS Number	LOR	Unit	EB2532723-001	EB2532723-002	EB2532723-003	EB2532723-004	EB2532723-005
				Result	Result	Result	Result	Result
EA029-A: pH Measurements								
pH KCl (23A)	----	0.1	pH Unit	**4.7**	**5.6**	**8.4**	**8.6**	**8.6**
pH OX (23B)	----	0.1	pH Unit	**4.9**	**7.0**	**8.7**	**9.2**	**9.2**
EA029-B: Acidity Trail								
Titratable Actual Acidity (23F)	----	2	mole H+ / t	**27**	**4**	<2	<2	<2
Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	**4**	<2	<2	<2	<2
Titratable Sulfidic Acidity (23H)	----	2	mole H+ / t	<2	<2	<2	<2	<2
sulfidic - Titratable Actual Acidity (s-23F)	----	0.020	% pyrite S	**0.043**	<0.020	<0.020	<0.020	<0.020
sulfidic - Titratable Peroxide Acidity (s-23G)	----	0.020	% pyrite S	<0.020	<0.020	<0.020	<0.020	<0.020
sulfidic - Titratable Sulfidic Acidity (s-23H)	----	0.020	% pyrite S	<0.020	<0.020	<0.020	<0.020	<0.020
EA029-C: Sulfur Trail								
KCl Extractable Sulfur (23Ce)	----	0.020	% S	<0.020	<0.020	<0.020	<0.020	<0.020
Peroxide Sulfur (23De)	----	0.020	% S	<0.020	<0.020	<0.020	<0.020	<0.020
Peroxide Oxidisable Sulfur (23E)	----	0.020	% S	<0.020	<0.020	<0.020	<0.020	<0.020
acidity - Peroxide Oxidisable Sulfur (a-23E)	----	10	mole H+ / t	<10	<10	<10	<10	<10
EA029-D: Calcium Values								
KCl Extractable Calcium (23Vh)	----	0.020	% Ca	**0.063**	<0.020	**0.226**	**0.272**	**0.218**
Peroxide Calcium (23Wh)	----	0.020	% Ca	**0.062**	**0.022**	**0.278**	**0.690**	**0.318**
Acid Reacted Calcium (23X)	----	0.020	% Ca	<0.020	<0.020	**0.052**	**0.417**	**0.099**
acidity - Acid Reacted Calcium (a-23X)	----	10	mole H+ / t	<10	<10	**26**	**208**	**50**
sulfidic - Acid Reacted Calcium (s-23X)	----	0.020	% S	<0.020	<0.020	**0.042**	**0.334**	**0.080**
EA029-E: Magnesium Values								
KCl Extractable Magnesium (23Sm)	----	0.020	% Mg	**0.106**	**0.056**	**0.165**	**0.200**	**0.188**
Peroxide Magnesium (23Tm)	----	0.020	% Mg	**0.103**	**0.059**	**0.221**	**0.285**	**0.223**
Acid Reacted Magnesium (23U)	----	0.020	% Mg	<0.020	<0.020	**0.056**	**0.085**	**0.035**
Acidity - Acid Reacted Magnesium (a-23U)	----	10	mole H+ / t	<10	<10	**46**	**70**	**29**
sulfidic - Acid Reacted Magnesium (s-23U)	----	0.020	% S	<0.020	<0.020	**0.074**	**0.112**	**0.046**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	BH01 - 0.5m	BH01 - 1.0m	BH01 - 2.0m	BH01 - 3.0m	BH01 - 4.0m
				Sampling date / time	16-Sep-2025 16:20	16-Sep-2025 16:45	17-Sep-2025 07:30	17-Sep-2025 07:40	17-Sep-2025 07:50
Compound	CAS Number	LOR	Unit		EB2532723-001	EB2532723-002	EB2532723-003	EB2532723-004	EB2532723-005
					Result	Result	Result	Result	Result
EA029-F: Excess Acid Neutralising Capacity									
Excess Acid Neutralising Capacity (23Q)	----	0.020	% CaCO3		**----**	**0.273**	**1.27**	**2.04**	**0.926**
acidity - Excess Acid Neutralising Capacity (a-23Q)	----	10	mole H+ / t		**----**	**54**	**254**	**407**	**185**
sulfidic - Excess Acid Neutralising Capacity (s-23Q)	----	0.020	% S		**----**	**0.087**	**0.407**	**0.652**	**0.296**
EA029-H: Acid Base Accounting									
ANC Fineness Factor	----	0.5	-		**1.5**	**1.5**	**1.5**	**1.5**	**1.5**
Net Acidity (sulfur units)	----	0.02	% S		**0.04**	<0.02	<0.02	<0.02	<0.02
Net Acidity (acidity units)	----	10	mole H+ / t		**27**	<10	<10	<10	<10
Liming Rate	----	1	kg CaCO3/t		**2**	<1	<1	<1	<1
Net Acidity excluding ANC (sulfur units)	----	0.02	% S		**0.04**	<0.02	<0.02	<0.02	<0.02
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t		**27**	<10	<10	<10	<10
Liming Rate excluding ANC	----	1	kg CaCO3/t		**2**	<1	<1	<1	<1
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%		**13.6**	**----**	**----**	**----**	**----**
EG005(ED093)T: Total Metals by ICP-AES									
Barium	7440-39-3	10	mg/kg		**320**	**----**	**----**	**----**	**----**
Beryllium	7440-41-7	1	mg/kg		<1	**----**	**----**	**----**	**----**
Boron	7440-42-8	50	mg/kg		<50	**----**	**----**	**----**	**----**
Cobalt	7440-48-4	2	mg/kg		**19**	**----**	**----**	**----**	**----**
Manganese	7439-96-5	5	mg/kg		**4160**	**----**	**----**	**----**	**----**
Selenium	7782-49-2	5	mg/kg		<5	**----**	**----**	**----**	**----**
Vanadium	7440-62-2	5	mg/kg		**107**	**----**	**----**	**----**	**----**
Arsenic	7440-38-2	5	mg/kg		<5	**----**	**----**	**----**	**----**
Cadmium	7440-43-9	1	mg/kg		<1	**----**	**----**	**----**	**----**
Chromium	7440-47-3	2	mg/kg		**16**	**----**	**----**	**----**	**----**
Copper	7440-50-8	5	mg/kg		**22**	**----**	**----**	**----**	**----**
Lead	7439-92-1	5	mg/kg		**5**	**----**	**----**	**----**	**----**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	BH01 - 0.5m	BH01 - 1.0m	BH01 - 2.0m	BH01 - 3.0m	BH01 - 4.0m
				Sampling date / time	16-Sep-2025 16:20	16-Sep-2025 16:45	17-Sep-2025 07:30	17-Sep-2025 07:40	17-Sep-2025 07:50
Compound	CAS Number	LOR	Unit		EB2532723-001	EB2532723-002	EB2532723-003	EB2532723-004	EB2532723-005
					Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued									
Nickel	7440-02-0	2	mg/kg		**7**	----	----	----	----
Zinc	7440-66-6	5	mg/kg		**16**	----	----	----	----
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		<0.1	----	----	----	----
EP066: Polychlorinated Biphenyls (PCB)									
Total Polychlorinated biphenyls	----	0.1	mg/kg		<0.1	----	----	----	----
EP068A: Organochlorine Pesticides (OC)									
alpha-BHC	319-84-6	0.05	mg/kg		<0.05	----	----	----	----
Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg		<0.05	----	----	----	----
beta-BHC	319-85-7	0.05	mg/kg		<0.05	----	----	----	----
gamma-BHC - (Lindane)	58-89-9	0.05	mg/kg		<0.05	----	----	----	----
delta-BHC	319-86-8	0.05	mg/kg		<0.05	----	----	----	----
Heptachlor	76-44-8	0.05	mg/kg		<0.05	----	----	----	----
Aldrin	309-00-2	0.05	mg/kg		<0.05	----	----	----	----
Heptachlor epoxide	1024-57-3	0.05	mg/kg		<0.05	----	----	----	----
^ **Total Chlordane (sum)**	----	0.05	mg/kg		<0.05	----	----	----	----
trans-Chlordane	5103-74-2	0.05	mg/kg		<0.05	----	----	----	----
alpha-Endosulfan	959-98-8	0.05	mg/kg		<0.05	----	----	----	----
cis-Chlordane	5103-71-9	0.05	mg/kg		<0.05	----	----	----	----
Dieldrin	60-57-1	0.05	mg/kg		<0.05	----	----	----	----
4.4`-DDE	72-55-9	0.05	mg/kg		<0.05	----	----	----	----
Endrin	72-20-8	0.05	mg/kg		<0.05	----	----	----	----
beta-Endosulfan	33213-65-9	0.05	mg/kg		<0.05	----	----	----	----
^ **Endosulfan (sum)**	115-29-7	0.05	mg/kg		<0.05	----	----	----	----
4.4`-DDD	72-54-8	0.05	mg/kg		<0.05	----	----	----	----
Endrin aldehyde	7421-93-4	0.05	mg/kg		<0.05	----	----	----	----
Endosulfan sulfate	1031-07-8	0.05	mg/kg		<0.05	----	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	BH01 - 0.5m	BH01 - 1.0m	BH01 - 2.0m	BH01 - 3.0m	BH01 - 4.0m
				Sampling date / time	16-Sep-2025 16:20	16-Sep-2025 16:45	17-Sep-2025 07:30	17-Sep-2025 07:40	17-Sep-2025 07:50
Compound	CAS Number	LOR	Unit		EB2532723-001	EB2532723-002	EB2532723-003	EB2532723-004	EB2532723-005
					Result	Result	Result	Result	Result
EP068A: Organochlorine Pesticides (OC) - Continued									
4.4`-DDT	50-29-3	0.2	mg/kg		<0.2	----	----	----	----
Endrin ketone	53494-70-5	0.05	mg/kg		<0.05	----	----	----	----
Methoxychlor	72-43-5	0.2	mg/kg		<0.2	----	----	----	----
^ **Sum of Aldrin + Dieldrin**	309-00-2/60-57-1	0.05	mg/kg		<0.05	----	----	----	----
^ **Sum of DDD + DDE + DDT**	72-54-8/72-55-9/50-2	0.05	mg/kg		<0.05	----	----	----	----
EP068B: Organophosphorus Pesticides (OP)									
Dichlorvos	62-73-7	0.05	mg/kg		<0.05	----	----	----	----
Demeton-S-methyl	919-86-8	0.05	mg/kg		<0.05	----	----	----	----
Monocrotophos	6923-22-4	0.2	mg/kg		<0.2	----	----	----	----
Dimethoate	60-51-5	0.05	mg/kg		<0.05	----	----	----	----
Diazinon	333-41-5	0.05	mg/kg		<0.05	----	----	----	----
Chlorpyrifos-methyl	5598-13-0	0.05	mg/kg		<0.05	----	----	----	----
Parathion-methyl	298-00-0	0.2	mg/kg		<0.2	----	----	----	----
Malathion	121-75-5	0.05	mg/kg		<0.05	----	----	----	----
Fenthion	55-38-9	0.05	mg/kg		<0.05	----	----	----	----
Chlorpyrifos	2921-88-2	0.05	mg/kg		<0.05	----	----	----	----
Parathion	56-38-2	0.2	mg/kg		<0.2	----	----	----	----
Pirimphos-ethyl	23505-41-1	0.05	mg/kg		<0.05	----	----	----	----
Chlorfenvinphos	470-90-6	0.05	mg/kg		<0.05	----	----	----	----
Bromophos-ethyl	4824-78-6	0.05	mg/kg		<0.05	----	----	----	----
Fenamiphos	22224-92-6	0.05	mg/kg		<0.05	----	----	----	----
Prothiofos	34643-46-4	0.05	mg/kg		<0.05	----	----	----	----
Ethion	563-12-2	0.05	mg/kg		<0.05	----	----	----	----
Carbophenothion	786-19-6	0.05	mg/kg		<0.05	----	----	----	----
Azinphos Methyl	86-50-0	0.05	mg/kg		<0.05	----	----	----	----
EP075(SIM)A: Phenolic Compounds									

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	BH01 - 0.5m	BH01 - 1.0m	BH01 - 2.0m	BH01 - 3.0m	BH01 - 4.0m
			Sampling date / time	16-Sep-2025 16:20	16-Sep-2025 16:45	17-Sep-2025 07:30	17-Sep-2025 07:40	17-Sep-2025 07:50
Compound	CAS Number	LOR	Unit	EB2532723-001	EB2532723-002	EB2532723-003	EB2532723-004	EB2532723-005
				Result	Result	Result	Result	Result
EP075(SIM)A: Phenolic Compounds - Continued								
Phenol	108-95-2	0.5	mg/kg	<0.5	----	----	----	----
2-Chlorophenol	95-57-8	0.5	mg/kg	<0.5	----	----	----	----
2-Methylphenol	95-48-7	0.5	mg/kg	<0.5	----	----	----	----
3- & 4-Methylphenol	1319-77-3	1	mg/kg	<1	----	----	----	----
2-Nitrophenol	88-75-5	0.5	mg/kg	<0.5	----	----	----	----
2.4-Dimethylphenol	105-67-9	0.5	mg/kg	<0.5	----	----	----	----
2.4-Dichlorophenol	120-83-2	0.5	mg/kg	<0.5	----	----	----	----
2.6-Dichlorophenol	87-65-0	0.5	mg/kg	<0.5	----	----	----	----
4-Chloro-3-methylphenol	59-50-7	0.5	mg/kg	<0.5	----	----	----	----
2.4.6-Trichlorophenol	88-06-2	0.5	mg/kg	<0.5	----	----	----	----
2.4.5-Trichlorophenol	95-95-4	0.5	mg/kg	<0.5	----	----	----	----
Pentachlorophenol	87-86-5	2	mg/kg	<2	----	----	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	0.5	mg/kg	<0.5	----	----	----	----
Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	----	----	----	----
Acenaphthene	83-32-9	0.5	mg/kg	<0.5	----	----	----	----
Fluorene	86-73-7	0.5	mg/kg	<0.5	----	----	----	----
Phenanthrene	85-01-8	0.5	mg/kg	<0.5	----	----	----	----
Anthracene	120-12-7	0.5	mg/kg	<0.5	----	----	----	----
Fluoranthene	206-44-0	0.5	mg/kg	<0.5	----	----	----	----
Pyrene	129-00-0	0.5	mg/kg	<0.5	----	----	----	----
Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	----	----	----	----
Chrysene	218-01-9	0.5	mg/kg	<0.5	----	----	----	----
Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.5	mg/kg	<0.5	----	----	----	----
Benzo(k)fluoranthene	207-08-9	0.5	mg/kg	<0.5	----	----	----	----
Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	----	----	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	----	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	BH01 - 0.5m	BH01 - 1.0m	BH01 - 2.0m	BH01 - 3.0m	BH01 - 4.0m
				Sampling date / time	16-Sep-2025 16:20	16-Sep-2025 16:45	17-Sep-2025 07:30	17-Sep-2025 07:40	17-Sep-2025 07:50
Compound	CAS Number	LOR	Unit		EB2532723-001	EB2532723-002	EB2532723-003	EB2532723-004	EB2532723-005
					Result	Result	Result	Result	Result
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued									
Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg		<0.5	----	----	----	----
Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg		<0.5	----	----	----	----
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	mg/kg		<0.5	----	----	----	----
^ Benzo(a)pyrene TEQ (zero)	----	0.5	mg/kg		<0.5	----	----	----	----
^ Benzo(a)pyrene TEQ (half LOR)	----	0.5	mg/kg		**0.6**	----	----	----	----
^ Benzo(a)pyrene TEQ (LOR)	----	0.5	mg/kg		**1.2**	----	----	----	----
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	10	mg/kg		<10	----	----	----	----
C10 - C14 Fraction	----	50	mg/kg		<50	----	----	----	----
C15 - C28 Fraction	----	100	mg/kg		<100	----	----	----	----
C29 - C36 Fraction	----	100	mg/kg		<100	----	----	----	----
^ C10 - C36 Fraction (sum)	----	50	mg/kg		<50	----	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
C6 - C10 Fraction	C6_C10	10	mg/kg		<10	----	----	----	----
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg		<10	----	----	----	----
>C10 - C16 Fraction	----	50	mg/kg		<50	----	----	----	----
>C16 - C34 Fraction	----	100	mg/kg		<100	----	----	----	----
>C34 - C40 Fraction	----	100	mg/kg		<100	----	----	----	----
^ >C10 - C40 Fraction (sum)	----	50	mg/kg		<50	----	----	----	----
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	50	mg/kg		<50	----	----	----	----
EP080: BTEXN									
Benzene	71-43-2	0.2	mg/kg		<0.2	----	----	----	----
Toluene	108-88-3	0.5	mg/kg		<0.5	----	----	----	----
Ethylbenzene	100-41-4	0.5	mg/kg		<0.5	----	----	----	----
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg		<0.5	----	----	----	----
ortho-Xylene	95-47-6	0.5	mg/kg		<0.5	----	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	BH01 - 0.5m	BH01 - 1.0m	BH01 - 2.0m	BH01 - 3.0m	BH01 - 4.0m
				Sampling date / time	16-Sep-2025 16:20	16-Sep-2025 16:45	17-Sep-2025 07:30	17-Sep-2025 07:40	17-Sep-2025 07:50
Compound	CAS Number	LOR	Unit		EB2532723-001	EB2532723-002	EB2532723-003	EB2532723-004	EB2532723-005
					Result	Result	Result	Result	Result
EP080: BTEXN - Continued									
^ **Sum of BTEX**	----	0.2	mg/kg		<0.2	----	----	----	----
^ **Total Xylenes**	----	0.5	mg/kg		<0.5	----	----	----	----
Naphthalene	91-20-3	1	mg/kg		<1	----	----	----	----
EP066S: PCB Surrogate									
Decachlorobiphenyl	2051-24-3	0.1	%		**97.3**	----	----	----	----
EP068S: Organochlorine Pesticide Surrogate									
Dibromo-DDE	21655-73-2	0.05	%		**122**	----	----	----	----
EP068T: Organophosphorus Pesticide Surrogate									
DEF	78-48-8	0.05	%		**93.2**	----	----	----	----
EP075(SIM)S: Phenolic Compound Surrogates									
Phenol-d6	13127-88-3	0.5	%		**107**	----	----	----	----
2-Chlorophenol-D4	93951-73-6	0.5	%		**104**	----	----	----	----
2.4.6-Tribromophenol	118-79-6	0.5	%		**82.0**	----	----	----	----
EP075(SIM)T: PAH Surrogates									
2-Fluorobiphenyl	321-60-8	0.5	%		**103**	----	----	----	----
Anthracene-d10	1719-06-8	0.5	%		**106**	----	----	----	----
4-Terphenyl-d14	1718-51-0	0.5	%		**110**	----	----	----	----
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	0.2	%		**74.2**	----	----	----	----
Toluene-D8	2037-26-5	0.2	%		**84.2**	----	----	----	----
4-Bromofluorobenzene	460-00-4	0.2	%		**89.4**	----	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	BH01 - 5.0m	BH02 - 0.5m	BH02 - 1.0m	BH02 - 2.0m	BH02 - 3.0m
			Sampling date / time	17-Sep-2025 08:10	16-Sep-2025 12:30	16-Sep-2025 12:35	16-Sep-2025 13:10	16-Sep-2025 13:25
Compound	CAS Number	LOR	Unit	EB2532723-006	EB2532723-007	EB2532723-008	EB2532723-009	EB2532723-010
				Result	Result	Result	Result	Result
EA029-A: pH Measurements								
pH KCl (23A)	----	0.1	pH Unit	**8.2**	**5.2**	**5.4**	**8.5**	**7.3**
pH OX (23B)	----	0.1	pH Unit	**8.6**	**6.5**	**6.6**	**8.8**	**8.6**
EA029-B: Acidity Trail								
Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	**7**	**10**	<2	<2
Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	<2	<2	<2	<2	<2
Titratable Sulfidic Acidity (23H)	----	2	mole H+ / t	<2	<2	<2	<2	<2
sulfidic - Titratable Actual Acidity (s-23F)	----	0.020	% pyrite S	<0.020	<0.020	<0.020	<0.020	<0.020
sulfidic - Titratable Peroxide Acidity (s-23G)	----	0.020	% pyrite S	<0.020	<0.020	<0.020	<0.020	<0.020
sulfidic - Titratable Sulfidic Acidity (s-23H)	----	0.020	% pyrite S	<0.020	<0.020	<0.020	<0.020	<0.020
EA029-C: Sulfur Trail								
KCl Extractable Sulfur (23Ce)	----	0.020	% S	<0.020	<0.020	<0.020	<0.020	<0.020
Peroxide Sulfur (23De)	----	0.020	% S	<0.020	<0.020	<0.020	<0.020	<0.020
Peroxide Oxidisable Sulfur (23E)	----	0.020	% S	<0.020	<0.020	<0.020	<0.020	<0.020
acidity - Peroxide Oxidisable Sulfur (a-23E)	----	10	mole H+ / t	<10	<10	<10	<10	<10
EA029-D: Calcium Values								
KCl Extractable Calcium (23Vh)	----	0.020	% Ca	**0.194**	**0.031**	**0.095**	**0.293**	**0.163**
Peroxide Calcium (23Wh)	----	0.020	% Ca	**0.221**	**0.039**	**0.120**	**0.496**	**0.172**
Acid Reacted Calcium (23X)	----	0.020	% Ca	**0.028**	<0.020	**0.025**	**0.203**	<0.020
acidity - Acid Reacted Calcium (a-23X)	----	10	mole H+ / t	**14**	<10	**12**	**101**	<10
sulfidic - Acid Reacted Calcium (s-23X)	----	0.020	% S	**0.022**	<0.020	<0.020	**0.162**	<0.020
EA029-E: Magnesium Values								
KCl Extractable Magnesium (23Sm)	----	0.020	% Mg	**0.210**	**0.032**	**0.106**	**0.150**	**0.153**
Peroxide Magnesium (23Tm)	----	0.020	% Mg	**0.236**	**0.035**	**0.138**	**0.198**	**0.164**
Acid Reacted Magnesium (23U)	----	0.020	% Mg	**0.027**	<0.020	**0.032**	**0.048**	<0.020
Acidity - Acid Reacted Magnesium (a-23U)	----	10	mole H+ / t	**22**	<10	**27**	**40**	<10
sulfidic - Acid Reacted Magnesium (s-23U)	----	0.020	% S	**0.035**	<0.020	**0.043**	**0.064**	<0.020

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	BH01 - 5.0m	BH02 - 0.5m	BH02 - 1.0m	BH02 - 2.0m	BH02 - 3.0m
			Sampling date / time	17-Sep-2025 08:10	16-Sep-2025 12:30	16-Sep-2025 12:35	16-Sep-2025 13:10	16-Sep-2025 13:25
Compound	CAS Number	LOR	Unit	EB2532723-006	EB2532723-007	EB2532723-008	EB2532723-009	EB2532723-010
				Result	Result	Result	Result	Result
EA029-F: Excess Acid Neutralising Capacity								
Excess Acid Neutralising Capacity (23Q)	----	0.020	% CaCO3	**0.735**	**0.211**	**0.432**	**1.38**	**0.444**
acidity - Excess Acid Neutralising Capacity (a-23Q)	----	10	mole H+ / t	**147**	**42**	**86**	**275**	**89**
sulfidic - Excess Acid Neutralising Capacity (s-23Q)	----	0.020	% S	**0.235**	**0.068**	**0.138**	**0.441**	**0.142**
EA029-H: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**
Net Acidity (sulfur units)	----	0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
Net Acidity (acidity units)	----	10	mole H+ / t	<10	<10	<10	<10	<10
Liming Rate	----	1	kg CaCO3/t	<1	<1	<1	<1	<1
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	<10	<10	<10	<10	<10
Liming Rate excluding ANC	----	1	kg CaCO3/t	<1	<1	<1	<1	<1
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	**----**	**5.1**	**----**	**----**	**----**
EG005(ED093)T: Total Metals by ICP-AES								
Barium	7440-39-3	10	mg/kg	**----**	**30**	**----**	**----**	**----**
Beryllium	7440-41-7	1	mg/kg	**----**	<1	**----**	**----**	**----**
Boron	7440-42-8	50	mg/kg	**----**	<50	**----**	**----**	**----**
Cobalt	7440-48-4	2	mg/kg	**----**	**6**	**----**	**----**	**----**
Manganese	7439-96-5	5	mg/kg	**----**	**513**	**----**	**----**	**----**
Selenium	7782-49-2	5	mg/kg	**----**	<5	**----**	**----**	**----**
Vanadium	7440-62-2	5	mg/kg	**----**	**76**	**----**	**----**	**----**
Arsenic	7440-38-2	5	mg/kg	**----**	<5	**----**	**----**	**----**
Cadmium	7440-43-9	1	mg/kg	**----**	<1	**----**	**----**	**----**
Chromium	7440-47-3	2	mg/kg	**----**	**13**	**----**	**----**	**----**
Copper	7440-50-8	5	mg/kg	**----**	**9**	**----**	**----**	**----**
Lead	7439-92-1	5	mg/kg	**----**	**5**	**----**	**----**	**----**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	BH01 - 5.0m	BH02 - 0.5m	BH02 - 1.0m	BH02 - 2.0m	BH02 - 3.0m
			Sampling date / time	17-Sep-2025 08:10	16-Sep-2025 12:30	16-Sep-2025 12:35	16-Sep-2025 13:10	16-Sep-2025 13:25
Compound	CAS Number	LOR	Unit	EB2532723-006	EB2532723-007	EB2532723-008	EB2532723-009	EB2532723-010
				Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued								
Nickel	7440-02-0	2	mg/kg	----	<2	----	----	----
Zinc	7440-66-6	5	mg/kg	----	<5	----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	----	<0.1	----	----	----
EP066: Polychlorinated Biphenyls (PCB)								
Total Polychlorinated biphenyls	----	0.1	mg/kg	----	<0.1	----	----	----
EP068A: Organochlorine Pesticides (OC)								
alpha-BHC	319-84-6	0.05	mg/kg	----	<0.05	----	----	----
Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg	----	<0.05	----	----	----
beta-BHC	319-85-7	0.05	mg/kg	----	<0.05	----	----	----
gamma-BHC - (Lindane)	58-89-9	0.05	mg/kg	----	<0.05	----	----	----
delta-BHC	319-86-8	0.05	mg/kg	----	<0.05	----	----	----
Heptachlor	76-44-8	0.05	mg/kg	----	<0.05	----	----	----
Aldrin	309-00-2	0.05	mg/kg	----	<0.05	----	----	----
Heptachlor epoxide	1024-57-3	0.05	mg/kg	----	<0.05	----	----	----
^ Total Chlordane (sum)	----	0.05	mg/kg	----	<0.05	----	----	----
trans-Chlordane	5103-74-2	0.05	mg/kg	----	<0.05	----	----	----
alpha-Endosulfan	959-98-8	0.05	mg/kg	----	<0.05	----	----	----
cis-Chlordane	5103-71-9	0.05	mg/kg	----	<0.05	----	----	----
Dieldrin	60-57-1	0.05	mg/kg	----	<0.05	----	----	----
4.4`-DDE	72-55-9	0.05	mg/kg	----	<0.05	----	----	----
Endrin	72-20-8	0.05	mg/kg	----	<0.05	----	----	----
beta-Endosulfan	33213-65-9	0.05	mg/kg	----	<0.05	----	----	----
^ Endosulfan (sum)	115-29-7	0.05	mg/kg	----	<0.05	----	----	----
4.4`-DDD	72-54-8	0.05	mg/kg	----	<0.05	----	----	----
Endrin aldehyde	7421-93-4	0.05	mg/kg	----	<0.05	----	----	----
Endosulfan sulfate	1031-07-8	0.05	mg/kg	----	<0.05	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	BH01 - 5.0m	BH02 - 0.5m	BH02 - 1.0m	BH02 - 2.0m	BH02 - 3.0m
				Sampling date / time	17-Sep-2025 08:10	16-Sep-2025 12:30	16-Sep-2025 12:35	16-Sep-2025 13:10	16-Sep-2025 13:25
Compound	CAS Number	LOR	Unit		EB2532723-006	EB2532723-007	EB2532723-008	EB2532723-009	EB2532723-010
					Result	Result	Result	Result	Result
EP068A: Organochlorine Pesticides (OC) - Continued									
4.4`-DDT	50-29-3	0.2	mg/kg		----	<0.2	----	----	----
Endrin ketone	53494-70-5	0.05	mg/kg		----	<0.05	----	----	----
Methoxychlor	72-43-5	0.2	mg/kg		----	<0.2	----	----	----
^ **Sum of Aldrin + Dieldrin**	309-00-2/60-57-1	0.05	mg/kg		----	<0.05	----	----	----
^ **Sum of DDD + DDE + DDT**	72-54-8/72-55-9/50-2	0.05	mg/kg		----	<0.05	----	----	----
EP068B: Organophosphorus Pesticides (OP)									
Dichlorvos	62-73-7	0.05	mg/kg		----	<0.05	----	----	----
Demeton-S-methyl	919-86-8	0.05	mg/kg		----	<0.05	----	----	----
Monocrotophos	6923-22-4	0.2	mg/kg		----	<0.2	----	----	----
Dimethoate	60-51-5	0.05	mg/kg		----	<0.05	----	----	----
Diazinon	333-41-5	0.05	mg/kg		----	<0.05	----	----	----
Chlorpyrifos-methyl	5598-13-0	0.05	mg/kg		----	<0.05	----	----	----
Parathion-methyl	298-00-0	0.2	mg/kg		----	<0.2	----	----	----
Malathion	121-75-5	0.05	mg/kg		----	<0.05	----	----	----
Fenthion	55-38-9	0.05	mg/kg		----	<0.05	----	----	----
Chlorpyrifos	2921-88-2	0.05	mg/kg		----	<0.05	----	----	----
Parathion	56-38-2	0.2	mg/kg		----	<0.2	----	----	----
Pirimphos-ethyl	23505-41-1	0.05	mg/kg		----	<0.05	----	----	----
Chlorfenvinphos	470-90-6	0.05	mg/kg		----	<0.05	----	----	----
Bromophos-ethyl	4824-78-6	0.05	mg/kg		----	<0.05	----	----	----
Fenamiphos	22224-92-6	0.05	mg/kg		----	<0.05	----	----	----
Prothiofos	34643-46-4	0.05	mg/kg		----	<0.05	----	----	----
Ethion	563-12-2	0.05	mg/kg		----	<0.05	----	----	----
Carbophenothion	786-19-6	0.05	mg/kg		----	<0.05	----	----	----
Azinphos Methyl	86-50-0	0.05	mg/kg		----	<0.05	----	----	----
EP075(SIM)A: Phenolic Compounds									

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	BH01 - 5.0m	BH02 - 0.5m	BH02 - 1.0m	BH02 - 2.0m	BH02 - 3.0m
				Sampling date / time	17-Sep-2025 08:10	16-Sep-2025 12:30	16-Sep-2025 12:35	16-Sep-2025 13:10	16-Sep-2025 13:25
Compound	CAS Number	LOR	Unit		EB2532723-006	EB2532723-007	EB2532723-008	EB2532723-009	EB2532723-010
					Result	Result	Result	Result	Result
EP075(SIM)A: Phenolic Compounds - Continued									
Phenol	108-95-2	0.5	mg/kg		----	<0.5	----	----	----
2-Chlorophenol	95-57-8	0.5	mg/kg		----	<0.5	----	----	----
2-Methylphenol	95-48-7	0.5	mg/kg		----	<0.5	----	----	----
3- & 4-Methylphenol	1319-77-3	1	mg/kg		----	<1	----	----	----
2-Nitrophenol	88-75-5	0.5	mg/kg		----	<0.5	----	----	----
2.4-Dimethylphenol	105-67-9	0.5	mg/kg		----	<0.5	----	----	----
2.4-Dichlorophenol	120-83-2	0.5	mg/kg		----	<0.5	----	----	----
2.6-Dichlorophenol	87-65-0	0.5	mg/kg		----	<0.5	----	----	----
4-Chloro-3-methylphenol	59-50-7	0.5	mg/kg		----	<0.5	----	----	----
2.4.6-Trichlorophenol	88-06-2	0.5	mg/kg		----	<0.5	----	----	----
2.4.5-Trichlorophenol	95-95-4	0.5	mg/kg		----	<0.5	----	----	----
Pentachlorophenol	87-86-5	2	mg/kg		----	<2	----	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons									
Naphthalene	91-20-3	0.5	mg/kg		----	<0.5	----	----	----
Acenaphthylene	208-96-8	0.5	mg/kg		----	<0.5	----	----	----
Acenaphthene	83-32-9	0.5	mg/kg		----	<0.5	----	----	----
Fluorene	86-73-7	0.5	mg/kg		----	<0.5	----	----	----
Phenanthrene	85-01-8	0.5	mg/kg		----	<0.5	----	----	----
Anthracene	120-12-7	0.5	mg/kg		----	<0.5	----	----	----
Fluoranthene	206-44-0	0.5	mg/kg		----	<0.5	----	----	----
Pyrene	129-00-0	0.5	mg/kg		----	<0.5	----	----	----
Benz(a)anthracene	56-55-3	0.5	mg/kg		----	<0.5	----	----	----
Chrysene	218-01-9	0.5	mg/kg		----	<0.5	----	----	----
Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.5	mg/kg		----	<0.5	----	----	----
Benzo(k)fluoranthene	207-08-9	0.5	mg/kg		----	<0.5	----	----	----
Benzo(a)pyrene	50-32-8	0.5	mg/kg		----	<0.5	----	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg		----	<0.5	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	BH01 - 5.0m	BH02 - 0.5m	BH02 - 1.0m	BH02 - 2.0m	BH02 - 3.0m
				Sampling date / time	17-Sep-2025 08:10	16-Sep-2025 12:30	16-Sep-2025 12:35	16-Sep-2025 13:10	16-Sep-2025 13:25
Compound	CAS Number	LOR	Unit		EB2532723-006	EB2532723-007	EB2532723-008	EB2532723-009	EB2532723-010
					Result	Result	Result	Result	Result
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued									
Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg		----	<0.5	----	----	----
Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg		----	<0.5	----	----	----
^ **Sum of polycyclic aromatic hydrocarbons**	----	0.5	mg/kg		----	<0.5	----	----	----
^ **Benzo(a)pyrene TEQ (zero)**	----	0.5	mg/kg		----	<0.5	----	----	----
^ **Benzo(a)pyrene TEQ (half LOR)**	----	0.5	mg/kg		----	**0.6**	----	----	----
^ **Benzo(a)pyrene TEQ (LOR)**	----	0.5	mg/kg		----	**1.2**	----	----	----
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	10	mg/kg		----	<10	----	----	----
C10 - C14 Fraction	----	50	mg/kg		----	<50	----	----	----
C15 - C28 Fraction	----	100	mg/kg		----	<100	----	----	----
C29 - C36 Fraction	----	100	mg/kg		----	<100	----	----	----
^ **C10 - C36 Fraction (sum)**	----	50	mg/kg		----	<50	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
C6 - C10 Fraction	C6_C10	10	mg/kg		----	<10	----	----	----
^ **C6 - C10 Fraction minus BTEX (F1)**	C6_C10-BTEX	10	mg/kg		----	<10	----	----	----
>C10 - C16 Fraction	----	50	mg/kg		----	<50	----	----	----
>C16 - C34 Fraction	----	100	mg/kg		----	<100	----	----	----
>C34 - C40 Fraction	----	100	mg/kg		----	<100	----	----	----
^ **>C10 - C40 Fraction (sum)**	----	50	mg/kg		----	<50	----	----	----
^ **>C10 - C16 Fraction minus Naphthalene (F2)**	----	50	mg/kg		----	<50	----	----	----
EP080: BTEXN									
Benzene	71-43-2	0.2	mg/kg		----	<0.2	----	----	----
Toluene	108-88-3	0.5	mg/kg		----	<0.5	----	----	----
Ethylbenzene	100-41-4	0.5	mg/kg		----	<0.5	----	----	----
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg		----	<0.5	----	----	----
ortho-Xylene	95-47-6	0.5	mg/kg		----	<0.5	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	BH01 - 5.0m	BH02 - 0.5m	BH02 - 1.0m	BH02 - 2.0m	BH02 - 3.0m
			Sampling date / time	17-Sep-2025 08:10	16-Sep-2025 12:30	16-Sep-2025 12:35	16-Sep-2025 13:10	16-Sep-2025 13:25
Compound	CAS Number	LOR	Unit	EB2532723-006	EB2532723-007	EB2532723-008	EB2532723-009	EB2532723-010
				Result	Result	Result	Result	Result
EP080: BTEXN - Continued								
^ **Sum of BTEX**	----	0.2	mg/kg	----	<0.2	----	----	----
^ **Total Xylenes**	----	0.5	mg/kg	----	<0.5	----	----	----
Naphthalene	91-20-3	1	mg/kg	----	<1	----	----	----
EP066S: PCB Surrogate								
Decachlorobiphenyl	2051-24-3	0.1	%	----	**91.9**	----	----	----
EP068S: Organochlorine Pesticide Surrogate								
Dibromo-DDE	21655-73-2	0.05	%	----	**111**	----	----	----
EP068T: Organophosphorus Pesticide Surrogate								
DEF	78-48-8	0.05	%	----	**89.3**	----	----	----
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	0.5	%	----	**101**	----	----	----
2-Chlorophenol-D4	93951-73-6	0.5	%	----	**97.9**	----	----	----
2.4.6-Tribromophenol	118-79-6	0.5	%	----	**76.0**	----	----	----
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	0.5	%	----	**95.6**	----	----	----
Anthracene-d10	1719-06-8	0.5	%	----	**102**	----	----	----
4-Terphenyl-d14	1718-51-0	0.5	%	----	**103**	----	----	----
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.2	%	----	**62.0**	----	----	----
Toluene-D8	2037-26-5	0.2	%	----	**69.5**	----	----	----
4-Bromofluorobenzene	460-00-4	0.2	%	----	**73.2**	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	BH02 - 4.0m	BH02 - 5.0m	BH03 - 0.5m	BH03 - 1.0m	BH03 - 2.0m
			Sampling date / time	16-Sep-2025 13:40	16-Sep-2025 14:00	15-Sep-2025 15:00	15-Sep-2025 15:10	15-Sep-2025 16:00
Compound	CAS Number	LOR	Unit	EB2532723-011	EB2532723-012	EB2532723-013	EB2532723-014	EB2532723-015
				Result	Result	Result	Result	Result
EA029-A: pH Measurements								
pH KCl (23A)	----	0.1	pH Unit	**7.7**	**7.7**	**5.4**	**5.9**	**8.6**
pH OX (23B)	----	0.1	pH Unit	**8.6**	**8.9**	**6.2**	**6.7**	**8.8**
EA029-B: Acidity Trail								
Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	**5**	<2	<2
Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	<2	<2	<2	<2	<2
Titratable Sulfidic Acidity (23H)	----	2	mole H+ / t	<2	<2	<2	<2	<2
sulfidic - Titratable Actual Acidity (s-23F)	----	0.020	% pyrite S	<0.020	<0.020	<0.020	<0.020	<0.020
sulfidic - Titratable Peroxide Acidity (s-23G)	----	0.020	% pyrite S	<0.020	<0.020	<0.020	<0.020	<0.020
sulfidic - Titratable Sulfidic Acidity (s-23H)	----	0.020	% pyrite S	<0.020	<0.020	<0.020	<0.020	<0.020
EA029-C: Sulfur Trail								
KCl Extractable Sulfur (23Ce)	----	0.020	% S	<0.020	<0.020	<0.020	<0.020	<0.020
Peroxide Sulfur (23De)	----	0.020	% S	<0.020	<0.020	<0.020	<0.020	<0.020
Peroxide Oxidisable Sulfur (23E)	----	0.020	% S	<0.020	<0.020	<0.020	<0.020	<0.020
acidity - Peroxide Oxidisable Sulfur (a-23E)	----	10	mole H+ / t	<10	<10	<10	<10	<10
EA029-D: Calcium Values								
KCl Extractable Calcium (23Vh)	----	0.020	% Ca	**0.223**	**0.181**	**0.030**	**0.063**	**0.298**
Peroxide Calcium (23Wh)	----	0.020	% Ca	**0.232**	**0.202**	**0.032**	**0.074**	**0.627**
Acid Reacted Calcium (23X)	----	0.020	% Ca	<0.020	**0.020**	<0.020	<0.020	**0.329**
acidity - Acid Reacted Calcium (a-23X)	----	10	mole H+ / t	<10	**10**	<10	<10	**164**
sulfidic - Acid Reacted Calcium (s-23X)	----	0.020	% S	<0.020	<0.020	<0.020	<0.020	**0.263**
EA029-E: Magnesium Values								
KCl Extractable Magnesium (23Sm)	----	0.020	% Mg	**0.194**	**0.212**	**0.029**	**0.089**	**0.187**
Peroxide Magnesium (23Tm)	----	0.020	% Mg	**0.202**	**0.234**	**0.031**	**0.097**	**0.260**
Acid Reacted Magnesium (23U)	----	0.020	% Mg	<0.020	**0.022**	<0.020	<0.020	**0.073**
Acidity - Acid Reacted Magnesium (a-23U)	----	10	mole H+ / t	<10	**18**	<10	<10	**60**
sulfidic - Acid Reacted Magnesium (s-23U)	----	0.020	% S	<0.020	**0.029**	<0.020	<0.020	**0.096**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	BH02 - 4.0m	BH02 - 5.0m	BH03 - 0.5m	BH03 - 1.0m	BH03 - 2.0m
			Sampling date / time	16-Sep-2025 13:40	16-Sep-2025 14:00	15-Sep-2025 15:00	15-Sep-2025 15:10	15-Sep-2025 16:00
Compound	CAS Number	LOR	Unit	EB2532723-011	EB2532723-012	EB2532723-013	EB2532723-014	EB2532723-015
				Result	Result	Result	Result	Result
EA029-F: Excess Acid Neutralising Capacity								
Excess Acid Neutralising Capacity (23Q)	----	0.020	% CaCO3	**0.572**	**0.532**	**----**	**0.279**	**2.14**
acidity - Excess Acid Neutralising Capacity (a-23Q)	----	10	mole H+ / t	**114**	**106**	**----**	**56**	**427**
sulfidic - Excess Acid Neutralising Capacity (s-23Q)	----	0.020	% S	**0.183**	**0.170**	**----**	**0.089**	**0.684**
EA029-H: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**
Net Acidity (sulfur units)	----	0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
Net Acidity (acidity units)	----	10	mole H+ / t	<10	<10	<10	<10	<10
Liming Rate	----	1	kg CaCO3/t	<1	<1	<1	<1	<1
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	<10	<10	<10	<10	<10
Liming Rate excluding ANC	----	1	kg CaCO3/t	<1	<1	<1	<1	<1
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	**----**	**----**	**5.3**	**----**	**----**
EG005(ED093)T: Total Metals by ICP-AES								
Barium	7440-39-3	10	mg/kg	**----**	**----**	**80**	**----**	**----**
Beryllium	7440-41-7	1	mg/kg	**----**	**----**	<1	**----**	**----**
Boron	7440-42-8	50	mg/kg	**----**	**----**	<50	**----**	**----**
Cobalt	7440-48-4	2	mg/kg	**----**	**----**	**9**	**----**	**----**
Manganese	7439-96-5	5	mg/kg	**----**	**----**	**829**	**----**	**----**
Selenium	7782-49-2	5	mg/kg	**----**	**----**	<5	**----**	**----**
Vanadium	7440-62-2	5	mg/kg	**----**	**----**	**80**	**----**	**----**
Arsenic	7440-38-2	5	mg/kg	**----**	**----**	<5	**----**	**----**
Cadmium	7440-43-9	1	mg/kg	**----**	**----**	<1	**----**	**----**
Chromium	7440-47-3	2	mg/kg	**----**	**----**	**11**	**----**	**----**
Copper	7440-50-8	5	mg/kg	**----**	**----**	**11**	**----**	**----**
Lead	7439-92-1	5	mg/kg	**----**	**----**	<5	**----**	**----**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	BH02 - 4.0m	BH02 - 5.0m	BH03 - 0.5m	BH03 - 1.0m	BH03 - 2.0m
			Sampling date / time	16-Sep-2025 13:40	16-Sep-2025 14:00	15-Sep-2025 15:00	15-Sep-2025 15:10	15-Sep-2025 16:00
Compound	CAS Number	LOR	Unit	EB2532723-011	EB2532723-012	EB2532723-013	EB2532723-014	EB2532723-015
				Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued								
Nickel	7440-02-0	2	mg/kg	----	----	**4**	----	----
Zinc	7440-66-6	5	mg/kg	----	----	**8**	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	----	----	<0.1	----	----
EP066: Polychlorinated Biphenyls (PCB)								
Total Polychlorinated biphenyls	----	0.1	mg/kg	----	----	<0.1	----	----
EP068A: Organochlorine Pesticides (OC)								
alpha-BHC	319-84-6	0.05	mg/kg	----	----	<0.05	----	----
Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg	----	----	<0.05	----	----
beta-BHC	319-85-7	0.05	mg/kg	----	----	<0.05	----	----
gamma-BHC - (Lindane)	58-89-9	0.05	mg/kg	----	----	<0.05	----	----
delta-BHC	319-86-8	0.05	mg/kg	----	----	<0.05	----	----
Heptachlor	76-44-8	0.05	mg/kg	----	----	<0.05	----	----
Aldrin	309-00-2	0.05	mg/kg	----	----	<0.05	----	----
Heptachlor epoxide	1024-57-3	0.05	mg/kg	----	----	<0.05	----	----
^ Total Chlordane (sum)	----	0.05	mg/kg	----	----	<0.05	----	----
trans-Chlordane	5103-74-2	0.05	mg/kg	----	----	<0.05	----	----
alpha-Endosulfan	959-98-8	0.05	mg/kg	----	----	<0.05	----	----
cis-Chlordane	5103-71-9	0.05	mg/kg	----	----	<0.05	----	----
Dieldrin	60-57-1	0.05	mg/kg	----	----	<0.05	----	----
4.4`-DDE	72-55-9	0.05	mg/kg	----	----	<0.05	----	----
Endrin	72-20-8	0.05	mg/kg	----	----	<0.05	----	----
beta-Endosulfan	33213-65-9	0.05	mg/kg	----	----	<0.05	----	----
^ Endosulfan (sum)	115-29-7	0.05	mg/kg	----	----	<0.05	----	----
4.4`-DDD	72-54-8	0.05	mg/kg	----	----	<0.05	----	----
Endrin aldehyde	7421-93-4	0.05	mg/kg	----	----	<0.05	----	----
Endosulfan sulfate	1031-07-8	0.05	mg/kg	----	----	<0.05	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	BH02 - 4.0m	BH02 - 5.0m	BH03 - 0.5m	BH03 - 1.0m	BH03 - 2.0m
				Sampling date / time	16-Sep-2025 13:40	16-Sep-2025 14:00	15-Sep-2025 15:00	15-Sep-2025 15:10	15-Sep-2025 16:00
Compound	CAS Number	LOR	Unit		EB2532723-011	EB2532723-012	EB2532723-013	EB2532723-014	EB2532723-015
					Result	Result	Result	Result	Result
EP068A: Organochlorine Pesticides (OC) - Continued									
4.4`-DDT	50-29-3	0.2	mg/kg		----	----	<0.2	----	----
Endrin ketone	53494-70-5	0.05	mg/kg		----	----	<0.05	----	----
Methoxychlor	72-43-5	0.2	mg/kg		----	----	<0.2	----	----
^ **Sum of Aldrin + Dieldrin**	309-00-2/60-57-1	0.05	mg/kg		----	----	<0.05	----	----
^ **Sum of DDD + DDE + DDT**	72-54-8/72-55-9/50-2	0.05	mg/kg		----	----	<0.05	----	----
EP068B: Organophosphorus Pesticides (OP)									
Dichlorvos	62-73-7	0.05	mg/kg		----	----	<0.05	----	----
Demeton-S-methyl	919-86-8	0.05	mg/kg		----	----	<0.05	----	----
Monocrotophos	6923-22-4	0.2	mg/kg		----	----	<0.2	----	----
Dimethoate	60-51-5	0.05	mg/kg		----	----	<0.05	----	----
Diazinon	333-41-5	0.05	mg/kg		----	----	<0.05	----	----
Chlorpyrifos-methyl	5598-13-0	0.05	mg/kg		----	----	<0.05	----	----
Parathion-methyl	298-00-0	0.2	mg/kg		----	----	<0.2	----	----
Malathion	121-75-5	0.05	mg/kg		----	----	<0.05	----	----
Fenthion	55-38-9	0.05	mg/kg		----	----	<0.05	----	----
Chlorpyrifos	2921-88-2	0.05	mg/kg		----	----	<0.05	----	----
Parathion	56-38-2	0.2	mg/kg		----	----	<0.2	----	----
Pirimphos-ethyl	23505-41-1	0.05	mg/kg		----	----	<0.05	----	----
Chlorfenvinphos	470-90-6	0.05	mg/kg		----	----	<0.05	----	----
Bromophos-ethyl	4824-78-6	0.05	mg/kg		----	----	<0.05	----	----
Fenamiphos	22224-92-6	0.05	mg/kg		----	----	<0.05	----	----
Prothiofos	34643-46-4	0.05	mg/kg		----	----	<0.05	----	----
Ethion	563-12-2	0.05	mg/kg		----	----	<0.05	----	----
Carbophenothion	786-19-6	0.05	mg/kg		----	----	<0.05	----	----
Azinphos Methyl	86-50-0	0.05	mg/kg		----	----	<0.05	----	----
EP075(SIM)A: Phenolic Compounds									

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	BH02 - 4.0m	BH02 - 5.0m	BH03 - 0.5m	BH03 - 1.0m	BH03 - 2.0m
				Sampling date / time	16-Sep-2025 13:40	16-Sep-2025 14:00	15-Sep-2025 15:00	15-Sep-2025 15:10	15-Sep-2025 16:00
Compound	CAS Number	LOR	Unit		EB2532723-011	EB2532723-012	EB2532723-013	EB2532723-014	EB2532723-015
					Result	Result	Result	Result	Result
EP075(SIM)A: Phenolic Compounds - Continued									
Phenol	108-95-2	0.5	mg/kg		----	----	<0.5	----	----
2-Chlorophenol	95-57-8	0.5	mg/kg		----	----	<0.5	----	----
2-Methylphenol	95-48-7	0.5	mg/kg		----	----	<0.5	----	----
3- & 4-Methylphenol	1319-77-3	1	mg/kg		----	----	<1	----	----
2-Nitrophenol	88-75-5	0.5	mg/kg		----	----	<0.5	----	----
2.4-Dimethylphenol	105-67-9	0.5	mg/kg		----	----	<0.5	----	----
2.4-Dichlorophenol	120-83-2	0.5	mg/kg		----	----	<0.5	----	----
2.6-Dichlorophenol	87-65-0	0.5	mg/kg		----	----	<0.5	----	----
4-Chloro-3-methylphenol	59-50-7	0.5	mg/kg		----	----	<0.5	----	----
2.4.6-Trichlorophenol	88-06-2	0.5	mg/kg		----	----	<0.5	----	----
2.4.5-Trichlorophenol	95-95-4	0.5	mg/kg		----	----	<0.5	----	----
Pentachlorophenol	87-86-5	2	mg/kg		----	----	<2	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons									
Naphthalene	91-20-3	0.5	mg/kg		----	----	<0.5	----	----
Acenaphthylene	208-96-8	0.5	mg/kg		----	----	<0.5	----	----
Acenaphthene	83-32-9	0.5	mg/kg		----	----	<0.5	----	----
Fluorene	86-73-7	0.5	mg/kg		----	----	<0.5	----	----
Phenanthrene	85-01-8	0.5	mg/kg		----	----	<0.5	----	----
Anthracene	120-12-7	0.5	mg/kg		----	----	<0.5	----	----
Fluoranthene	206-44-0	0.5	mg/kg		----	----	<0.5	----	----
Pyrene	129-00-0	0.5	mg/kg		----	----	<0.5	----	----
Benz(a)anthracene	56-55-3	0.5	mg/kg		----	----	<0.5	----	----
Chrysene	218-01-9	0.5	mg/kg		----	----	<0.5	----	----
Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.5	mg/kg		----	----	<0.5	----	----
Benzo(k)fluoranthene	207-08-9	0.5	mg/kg		----	----	<0.5	----	----
Benzo(a)pyrene	50-32-8	0.5	mg/kg		----	----	<0.5	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg		----	----	<0.5	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	BH02 - 4.0m	BH02 - 5.0m	BH03 - 0.5m	BH03 - 1.0m	BH03 - 2.0m
				Sampling date / time	16-Sep-2025 13:40	16-Sep-2025 14:00	15-Sep-2025 15:00	15-Sep-2025 15:10	15-Sep-2025 16:00
Compound	CAS Number	LOR	Unit		EB2532723-011	EB2532723-012	EB2532723-013	EB2532723-014	EB2532723-015
					Result	Result	Result	Result	Result
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued									
Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg		----	----	<0.5	----	----
Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg		----	----	<0.5	----	----
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	mg/kg		----	----	<0.5	----	----
^ Benzo(a)pyrene TEQ (zero)	----	0.5	mg/kg		----	----	<0.5	----	----
^ Benzo(a)pyrene TEQ (half LOR)	----	0.5	mg/kg		----	----	**0.6**	----	----
^ Benzo(a)pyrene TEQ (LOR)	----	0.5	mg/kg		----	----	**1.2**	----	----
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	10	mg/kg		----	----	<10	----	----
C10 - C14 Fraction	----	50	mg/kg		----	----	<50	----	----
C15 - C28 Fraction	----	100	mg/kg		----	----	<100	----	----
C29 - C36 Fraction	----	100	mg/kg		----	----	<100	----	----
^ C10 - C36 Fraction (sum)	----	50	mg/kg		----	----	<50	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
C6 - C10 Fraction	C6_C10	10	mg/kg		----	----	<10	----	----
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg		----	----	<10	----	----
>C10 - C16 Fraction	----	50	mg/kg		----	----	<50	----	----
>C16 - C34 Fraction	----	100	mg/kg		----	----	<100	----	----
>C34 - C40 Fraction	----	100	mg/kg		----	----	<100	----	----
^ >C10 - C40 Fraction (sum)	----	50	mg/kg		----	----	<50	----	----
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	50	mg/kg		----	----	<50	----	----
EP080: BTEXN									
Benzene	71-43-2	0.2	mg/kg		----	----	<0.2	----	----
Toluene	108-88-3	0.5	mg/kg		----	----	<0.5	----	----
Ethylbenzene	100-41-4	0.5	mg/kg		----	----	<0.5	----	----
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg		----	----	<0.5	----	----
ortho-Xylene	95-47-6	0.5	mg/kg		----	----	<0.5	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	BH02 - 4.0m	BH02 - 5.0m	BH03 - 0.5m	BH03 - 1.0m	BH03 - 2.0m
				Sampling date / time	16-Sep-2025 13:40	16-Sep-2025 14:00	15-Sep-2025 15:00	15-Sep-2025 15:10	15-Sep-2025 16:00
Compound	CAS Number	LOR	Unit		EB2532723-011	EB2532723-012	EB2532723-013	EB2532723-014	EB2532723-015
					Result	Result	Result	Result	Result
EP080: BTEXN - Continued									
^ **Sum of BTEX**	----	0.2	mg/kg		----	----	<0.2	----	----
^ **Total Xylenes**	----	0.5	mg/kg		----	----	<0.5	----	----
Naphthalene	91-20-3	1	mg/kg		----	----	<1	----	----
EP231A: Perfluoroalkyl Sulfonic Acids									
Perfluorobutane sulfonic acid (PFBS)	375-73-5	0.0002	mg/kg		----	----	<0.0002	----	----
Perfluorohexane sulfonic acid (PFHxS)	355-46-4	0.0002	mg/kg		----	----	<0.0002	----	----
Perfluorooctane sulfonic acid (PFOS)	1763-23-1	0.0002	mg/kg		----	----	<0.0002	----	----
EP231B: Perfluoroalkyl Carboxylic Acids									
Perfluorobutanoic acid (PFBA)	375-22-4	0.001	mg/kg		----	----	<0.001	----	----
Perfluoropentanoic acid (PFPeA)	2706-90-3	0.0002	mg/kg		----	----	<0.0002	----	----
Perfluorohexanoic acid (PFHxA)	307-24-4	0.0002	mg/kg		----	----	<0.0002	----	----
Perfluoroheptanoic acid (PFHpA)	375-85-9	0.0002	mg/kg		----	----	<0.0002	----	----
Perfluorooctanoic acid (PFOA)	335-67-1	0.0002	mg/kg		----	----	<0.0002	----	----
EP231D: (n:2) Fluorotelomer Sulfonic Acids									
4:2 Fluorotelomer sulfonic acid (4:2 FTS)	757124-72-4	0.0005	mg/kg		----	----	<0.0005	----	----
6:2 Fluorotelomer sulfonic acid (6:2 FTS)	27619-97-2	0.0005	mg/kg		----	----	<0.0005	----	----
8:2 Fluorotelomer sulfonic acid (8:2 FTS)	39108-34-4	0.0005	mg/kg		----	----	<0.0005	----	----
10:2 Fluorotelomer sulfonic acid (10:2 FTS)	120226-60-0	0.0005	mg/kg		----	----	<0.0005	----	----
EP231P: PFAS Sums									
Sum of PFHxS and PFOS	355-46-4/1763-23-1	0.0002	mg/kg		----	----	<0.0002	----	----
Sum of PFAS (WA DER List)	----	0.0002	mg/kg		----	----	<0.0002	----	----
EP066S: PCB Surrogate									
Decachlorobiphenyl	2051-24-3	0.1	%		----	----	**92.7**	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	BH02 - 4.0m	BH02 - 5.0m	BH03 - 0.5m	BH03 - 1.0m	BH03 - 2.0m
				Sampling date / time	16-Sep-2025 13:40	16-Sep-2025 14:00	15-Sep-2025 15:00	15-Sep-2025 15:10	15-Sep-2025 16:00
Compound	CAS Number	LOR	Unit		EB2532723-011	EB2532723-012	EB2532723-013	EB2532723-014	EB2532723-015
					Result	Result	Result	Result	Result
EP068S: Organochlorine Pesticide Surrogate									
Dibromo-DDE	21655-73-2	0.05	%		----	----	116	----	----
EP068T: Organophosphorus Pesticide Surrogate									
DEF	78-48-8	0.05	%		----	----	95.8	----	----
EP075(SIM)S: Phenolic Compound Surrogates									
Phenol-d6	13127-88-3	0.5	%		----	----	103	----	----
2-Chlorophenol-D4	93951-73-6	0.5	%		----	----	99.4	----	----
2.4.6-Tribromophenol	118-79-6	0.5	%		----	----	79.0	----	----
EP075(SIM)T: PAH Surrogates									
2-Fluorobiphenyl	321-60-8	0.5	%		----	----	97.8	----	----
Anthracene-d10	1719-06-8	0.5	%		----	----	103	----	----
4-Terphenyl-d14	1718-51-0	0.5	%		----	----	104	----	----
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	0.2	%		----	----	79.4	----	----
Toluene-D8	2037-26-5	0.2	%		----	----	93.2	----	----
4-Bromofluorobenzene	460-00-4	0.2	%		----	----	100	----	----
EP231S: PFAS Surrogate									
13C4-PFOS	----	0.0002	%		----	----	104	----	----
13C8-PFOA	----	0.0002	%		----	----	97.5	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	BH03 - 3.0m	BH03 - 4.0m	BH03 - 5.0m	HA01 - 0.5m	HA02 - 0.5m
			Sampling date / time	16-Sep-2025 07:45	16-Sep-2025 08:00	16-Sep-2025 08:30	16-Sep-2025 08:40	16-Sep-2025 09:10
Compound	CAS Number	LOR	Unit	EB2532723-016	EB2532723-017	EB2532723-018	EB2532723-019	EB2532723-020
				Result	Result	Result	Result	Result
EA029-A: pH Measurements								
pH KCl (23A)	----	0.1	pH Unit	**8.7**	**8.8**	**8.7**	----	----
pH OX (23B)	----	0.1	pH Unit	**8.7**	**8.5**	**8.9**	----	----
EA029-B: Acidity Trail								
Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	<2	----	----
Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	<2	<2	<2	----	----
Titratable Sulfidic Acidity (23H)	----	2	mole H+ / t	<2	<2	<2	----	----
sulfidic - Titratable Actual Acidity (s-23F)	----	0.020	% pyrite S	<0.020	<0.020	<0.020	----	----
sulfidic - Titratable Peroxide Acidity (s-23G)	----	0.020	% pyrite S	<0.020	<0.020	<0.020	----	----
sulfidic - Titratable Sulfidic Acidity (s-23H)	----	0.020	% pyrite S	<0.020	<0.020	<0.020	----	----
EA029-C: Sulfur Trail								
KCl Extractable Sulfur (23Ce)	----	0.020	% S	<0.020	<0.020	<0.020	----	----
Peroxide Sulfur (23De)	----	0.020	% S	<0.020	<0.020	<0.020	----	----
Peroxide Oxidisable Sulfur (23E)	----	0.020	% S	<0.020	<0.020	<0.020	----	----
acidity - Peroxide Oxidisable Sulfur (a-23E)	----	10	mole H+ / t	<10	<10	<10	----	----
EA029-D: Calcium Values								
KCl Extractable Calcium (23Vh)	----	0.020	% Ca	**0.293**	**0.234**	**0.226**	----	----
Peroxide Calcium (23Wh)	----	0.020	% Ca	**0.902**	**0.342**	**0.353**	----	----
Acid Reacted Calcium (23X)	----	0.020	% Ca	**0.609**	**0.108**	**0.127**	----	----
acidity - Acid Reacted Calcium (a-23X)	----	10	mole H+ / t	**304**	**54**	**63**	----	----
sulfidic - Acid Reacted Calcium (s-23X)	----	0.020	% S	**0.487**	**0.086**	**0.101**	----	----
EA029-E: Magnesium Values								
KCl Extractable Magnesium (23Sm)	----	0.020	% Mg	**0.171**	**0.140**	**0.154**	----	----
Peroxide Magnesium (23Tm)	----	0.020	% Mg	**0.246**	**0.184**	**0.209**	----	----
Acid Reacted Magnesium (23U)	----	0.020	% Mg	**0.075**	**0.044**	**0.054**	----	----
Acidity - Acid Reacted Magnesium (a-23U)	----	10	mole H+ / t	**62**	**36**	**45**	----	----
sulfidic - Acid Reacted Magnesium (s-23U)	----	0.020	% S	**0.099**	**0.058**	**0.072**	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	BH03 - 3.0m	BH03 - 4.0m	BH03 - 5.0m	HA01 - 0.5m	HA02 - 0.5m
				Sampling date / time	16-Sep-2025 07:45	16-Sep-2025 08:00	16-Sep-2025 08:30	16-Sep-2025 08:40	16-Sep-2025 09:10
Compound	CAS Number	LOR	Unit		EB2532723-016	EB2532723-017	EB2532723-018	EB2532723-019	EB2532723-020
					Result	Result	Result	Result	Result
EA029-F: Excess Acid Neutralising Capacity									
Excess Acid Neutralising Capacity (23Q)	----	0.020	% CaCO3		**2.71**	**1.14**	**1.44**	**----**	**----**
acidity - Excess Acid Neutralising Capacity (a-23Q)	----	10	mole H+ / t		**542**	**228**	**288**	**----**	**----**
sulfidic - Excess Acid Neutralising Capacity (s-23Q)	----	0.020	% S		**0.869**	**0.365**	**0.462**	**----**	**----**
EA029-H: Acid Base Accounting									
ANC Fineness Factor	----	0.5	-		**1.5**	**1.5**	**1.5**	**----**	**----**
Net Acidity (sulfur units)	----	0.02	% S		<0.02	<0.02	<0.02	**----**	**----**
Net Acidity (acidity units)	----	10	mole H+ / t		<10	<10	<10	**----**	**----**
Liming Rate	----	1	kg CaCO3/t		<1	<1	<1	**----**	**----**
Net Acidity excluding ANC (sulfur units)	----	0.02	% S		<0.02	<0.02	<0.02	**----**	**----**
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t		<10	<10	<10	**----**	**----**
Liming Rate excluding ANC	----	1	kg CaCO3/t		<1	<1	<1	**----**	**----**
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%		**----**	**----**	**----**	**8.8**	**14.5**
EG005(ED093)T: Total Metals by ICP-AES									
Barium	7440-39-3	10	mg/kg		**----**	**----**	**----**	**120**	**90**
Beryllium	7440-41-7	1	mg/kg		**----**	**----**	**----**	<1	<1
Boron	7440-42-8	50	mg/kg		**----**	**----**	**----**	<50	<50
Cobalt	7440-48-4	2	mg/kg		**----**	**----**	**----**	**20**	**10**
Manganese	7439-96-5	5	mg/kg		**----**	**----**	**----**	**1450**	**473**
Selenium	7782-49-2	5	mg/kg		**----**	**----**	**----**	<5	<5
Vanadium	7440-62-2	5	mg/kg		**----**	**----**	**----**	**66**	**84**
Arsenic	7440-38-2	5	mg/kg		**----**	**----**	**----**	<5	<5
Cadmium	7440-43-9	1	mg/kg		**----**	**----**	**----**	<1	<1
Chromium	7440-47-3	2	mg/kg		**----**	**----**	**----**	**16**	**10**
Copper	7440-50-8	5	mg/kg		**----**	**----**	**----**	**17**	**26**
Lead	7439-92-1	5	mg/kg		**----**	**----**	**----**	<5	**5**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	BH03 - 3.0m	BH03 - 4.0m	BH03 - 5.0m	HA01 - 0.5m	HA02 - 0.5m
			Sampling date / time	16-Sep-2025 07:45	16-Sep-2025 08:00	16-Sep-2025 08:30	16-Sep-2025 08:40	16-Sep-2025 09:10
Compound	CAS Number	LOR	Unit	EB2532723-016	EB2532723-017	EB2532723-018	EB2532723-019	EB2532723-020
				Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued								
Nickel	7440-02-0	2	mg/kg	----	----	----	**10**	**4**
Zinc	7440-66-6	5	mg/kg	----	----	----	**14**	**12**
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	----	----	----	<0.1	<0.1
EP066: Polychlorinated Biphenyls (PCB)								
Total Polychlorinated biphenyls	----	0.1	mg/kg	----	----	----	<0.1	<0.1
EP068A: Organochlorine Pesticides (OC)								
alpha-BHC	319-84-6	0.05	mg/kg	----	----	----	<0.05	<0.05
Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg	----	----	----	<0.05	<0.05
beta-BHC	319-85-7	0.05	mg/kg	----	----	----	<0.05	<0.05
gamma-BHC - (Lindane)	58-89-9	0.05	mg/kg	----	----	----	<0.05	<0.05
delta-BHC	319-86-8	0.05	mg/kg	----	----	----	<0.05	<0.05
Heptachlor	76-44-8	0.05	mg/kg	----	----	----	<0.05	<0.05
Aldrin	309-00-2	0.05	mg/kg	----	----	----	<0.05	<0.05
Heptachlor epoxide	1024-57-3	0.05	mg/kg	----	----	----	<0.05	<0.05
^ **Total Chlordane (sum)**	----	0.05	mg/kg	----	----	----	<0.05	<0.05
trans-Chlordane	5103-74-2	0.05	mg/kg	----	----	----	<0.05	<0.05
alpha-Endosulfan	959-98-8	0.05	mg/kg	----	----	----	<0.05	<0.05
cis-Chlordane	5103-71-9	0.05	mg/kg	----	----	----	<0.05	<0.05
Dieldrin	60-57-1	0.05	mg/kg	----	----	----	<0.05	<0.05
4.4`-DDE	72-55-9	0.05	mg/kg	----	----	----	<0.05	<0.05
Endrin	72-20-8	0.05	mg/kg	----	----	----	<0.05	<0.05
beta-Endosulfan	33213-65-9	0.05	mg/kg	----	----	----	<0.05	<0.05
^ **Endosulfan (sum)**	115-29-7	0.05	mg/kg	----	----	----	<0.05	<0.05
4.4`-DDD	72-54-8	0.05	mg/kg	----	----	----	<0.05	<0.05
Endrin aldehyde	7421-93-4	0.05	mg/kg	----	----	----	<0.05	<0.05
Endosulfan sulfate	1031-07-8	0.05	mg/kg	----	----	----	<0.05	<0.05

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	BH03 - 3.0m	BH03 - 4.0m	BH03 - 5.0m	HA01 - 0.5m	HA02 - 0.5m
				Sampling date / time	16-Sep-2025 07:45	16-Sep-2025 08:00	16-Sep-2025 08:30	16-Sep-2025 08:40	16-Sep-2025 09:10
Compound	CAS Number	LOR	Unit		EB2532723-016	EB2532723-017	EB2532723-018	EB2532723-019	EB2532723-020
					Result	Result	Result	Result	Result
EP068A: Organochlorine Pesticides (OC) - Continued									
4.4`-DDT	50-29-3	0.2	mg/kg		----	----	----	<0.2	<0.2
Endrin ketone	53494-70-5	0.05	mg/kg		----	----	----	<0.05	<0.05
Methoxychlor	72-43-5	0.2	mg/kg		----	----	----	<0.2	<0.2
^ **Sum of Aldrin + Dieldrin**	309-00-2/60-57-1	0.05	mg/kg		----	----	----	<0.05	<0.05
^ **Sum of DDD + DDE + DDT**	72-54-8/72-55-9/50-2	0.05	mg/kg		----	----	----	<0.05	<0.05
EP068B: Organophosphorus Pesticides (OP)									
Dichlorvos	62-73-7	0.05	mg/kg		----	----	----	<0.05	<0.05
Demeton-S-methyl	919-86-8	0.05	mg/kg		----	----	----	<0.05	<0.05
Monocrotophos	6923-22-4	0.2	mg/kg		----	----	----	<0.2	<0.2
Dimethoate	60-51-5	0.05	mg/kg		----	----	----	<0.05	<0.05
Diazinon	333-41-5	0.05	mg/kg		----	----	----	<0.05	<0.05
Chlorpyrifos-methyl	5598-13-0	0.05	mg/kg		----	----	----	<0.05	<0.05
Parathion-methyl	298-00-0	0.2	mg/kg		----	----	----	<0.2	<0.2
Malathion	121-75-5	0.05	mg/kg		----	----	----	<0.05	<0.05
Fenthion	55-38-9	0.05	mg/kg		----	----	----	<0.05	<0.05
Chlorpyrifos	2921-88-2	0.05	mg/kg		----	----	----	<0.05	<0.05
Parathion	56-38-2	0.2	mg/kg		----	----	----	<0.2	<0.2
Pirimphos-ethyl	23505-41-1	0.05	mg/kg		----	----	----	<0.05	<0.05
Chlorfenvinphos	470-90-6	0.05	mg/kg		----	----	----	<0.05	<0.05
Bromophos-ethyl	4824-78-6	0.05	mg/kg		----	----	----	<0.05	<0.05
Fenamiphos	22224-92-6	0.05	mg/kg		----	----	----	<0.05	<0.05
Prothiofos	34643-46-4	0.05	mg/kg		----	----	----	<0.05	<0.05
Ethion	563-12-2	0.05	mg/kg		----	----	----	<0.05	<0.05
Carbophenothion	786-19-6	0.05	mg/kg		----	----	----	<0.05	<0.05
Azinphos Methyl	86-50-0	0.05	mg/kg		----	----	----	<0.05	<0.05
EP075(SIM)A: Phenolic Compounds									

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	BH03 - 3.0m	BH03 - 4.0m	BH03 - 5.0m	HA01 - 0.5m	HA02 - 0.5m
				Sampling date / time	16-Sep-2025 07:45	16-Sep-2025 08:00	16-Sep-2025 08:30	16-Sep-2025 08:40	16-Sep-2025 09:10
Compound	CAS Number	LOR	Unit		EB2532723-016	EB2532723-017	EB2532723-018	EB2532723-019	EB2532723-020
					Result	Result	Result	Result	Result
EP075(SIM)A: Phenolic Compounds - Continued									
Phenol	108-95-2	0.5	mg/kg		----	----	----	<0.5	<0.5
2-Chlorophenol	95-57-8	0.5	mg/kg		----	----	----	<0.5	<0.5
2-Methylphenol	95-48-7	0.5	mg/kg		----	----	----	<0.5	<0.5
3- & 4-Methylphenol	1319-77-3	1	mg/kg		----	----	----	<1	<1
2-Nitrophenol	88-75-5	0.5	mg/kg		----	----	----	<0.5	<0.5
2.4-Dimethylphenol	105-67-9	0.5	mg/kg		----	----	----	<0.5	<0.5
2.4-Dichlorophenol	120-83-2	0.5	mg/kg		----	----	----	<0.5	<0.5
2.6-Dichlorophenol	87-65-0	0.5	mg/kg		----	----	----	<0.5	<0.5
4-Chloro-3-methylphenol	59-50-7	0.5	mg/kg		----	----	----	<0.5	<0.5
2.4.6-Trichlorophenol	88-06-2	0.5	mg/kg		----	----	----	<0.5	<0.5
2.4.5-Trichlorophenol	95-95-4	0.5	mg/kg		----	----	----	<0.5	<0.5
Pentachlorophenol	87-86-5	2	mg/kg		----	----	----	<2	<2
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons									
Naphthalene	91-20-3	0.5	mg/kg		----	----	----	<0.5	<0.5
Acenaphthylene	208-96-8	0.5	mg/kg		----	----	----	<0.5	<0.5
Acenaphthene	83-32-9	0.5	mg/kg		----	----	----	<0.5	<0.5
Fluorene	86-73-7	0.5	mg/kg		----	----	----	<0.5	<0.5
Phenanthrene	85-01-8	0.5	mg/kg		----	----	----	<0.5	<0.5
Anthracene	120-12-7	0.5	mg/kg		----	----	----	<0.5	<0.5
Fluoranthene	206-44-0	0.5	mg/kg		----	----	----	<0.5	<0.5
Pyrene	129-00-0	0.5	mg/kg		----	----	----	<0.5	<0.5
Benz(a)anthracene	56-55-3	0.5	mg/kg		----	----	----	<0.5	<0.5
Chrysene	218-01-9	0.5	mg/kg		----	----	----	<0.5	<0.5
Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.5	mg/kg		----	----	----	<0.5	<0.5
Benzo(k)fluoranthene	207-08-9	0.5	mg/kg		----	----	----	<0.5	<0.5
Benzo(a)pyrene	50-32-8	0.5	mg/kg		----	----	----	<0.5	<0.5
Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg		----	----	----	<0.5	<0.5

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	BH03 - 3.0m	BH03 - 4.0m	BH03 - 5.0m	HA01 - 0.5m	HA02 - 0.5m
				Sampling date / time	16-Sep-2025 07:45	16-Sep-2025 08:00	16-Sep-2025 08:30	16-Sep-2025 08:40	16-Sep-2025 09:10
Compound	CAS Number	LOR	Unit		EB2532723-016	EB2532723-017	EB2532723-018	EB2532723-019	EB2532723-020
					Result	Result	Result	Result	Result
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued									
Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg		----	----	----	<0.5	<0.5
Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg		----	----	----	<0.5	<0.5
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	mg/kg		----	----	----	<0.5	<0.5
^ Benzo(a)pyrene TEQ (zero)	----	0.5	mg/kg		----	----	----	<0.5	<0.5
^ Benzo(a)pyrene TEQ (half LOR)	----	0.5	mg/kg		----	----	----	**0.6**	**0.6**
^ Benzo(a)pyrene TEQ (LOR)	----	0.5	mg/kg		----	----	----	**1.2**	**1.2**
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	10	mg/kg		----	----	----	<10	<10
C10 - C14 Fraction	----	50	mg/kg		----	----	----	<50	<50
C15 - C28 Fraction	----	100	mg/kg		----	----	----	<100	<100
C29 - C36 Fraction	----	100	mg/kg		----	----	----	<100	<100
^ C10 - C36 Fraction (sum)	----	50	mg/kg		----	----	----	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
C6 - C10 Fraction	C6_C10	10	mg/kg		----	----	----	<10	<10
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	10	mg/kg		----	----	----	<10	<10
>C10 - C16 Fraction	----	50	mg/kg		----	----	----	<50	<50
>C16 - C34 Fraction	----	100	mg/kg		----	----	----	<100	<100
>C34 - C40 Fraction	----	100	mg/kg		----	----	----	<100	<100
^ >C10 - C40 Fraction (sum)	----	50	mg/kg		----	----	----	<50	<50
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	50	mg/kg		----	----	----	<50	<50
EP080: BTEXN									
Benzene	71-43-2	0.2	mg/kg		----	----	----	<0.2	<0.2
Toluene	108-88-3	0.5	mg/kg		----	----	----	<0.5	<0.5
Ethylbenzene	100-41-4	0.5	mg/kg		----	----	----	<0.5	<0.5
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg		----	----	----	<0.5	<0.5
ortho-Xylene	95-47-6	0.5	mg/kg		----	----	----	<0.5	<0.5

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	BH03 - 3.0m	BH03 - 4.0m	BH03 - 5.0m	HA01 - 0.5m	HA02 - 0.5m
				Sampling date / time	16-Sep-2025 07:45	16-Sep-2025 08:00	16-Sep-2025 08:30	16-Sep-2025 08:40	16-Sep-2025 09:10
Compound	CAS Number	LOR	Unit		EB2532723-016	EB2532723-017	EB2532723-018	EB2532723-019	EB2532723-020
					Result	Result	Result	Result	Result
EP080: BTEXN - Continued									
^ **Sum of BTEX**	----	0.2	mg/kg		----	----	----	<0.2	<0.2
^ **Total Xylenes**	----	0.5	mg/kg		----	----	----	<0.5	<0.5
Naphthalene	91-20-3	1	mg/kg		----	----	----	<1	<1
EP066S: PCB Surrogate									
Decachlorobiphenyl	2051-24-3	0.1	%		----	----	----	**88.9**	**99.4**
EP068S: Organochlorine Pesticide Surrogate									
Dibromo-DDE	21655-73-2	0.05	%		----	----	----	**114**	**119**
EP068T: Organophosphorus Pesticide Surrogate									
DEF	78-48-8	0.05	%		----	----	----	**97.3**	**93.8**
EP075(SIM)S: Phenolic Compound Surrogates									
Phenol-d6	13127-88-3	0.5	%		----	----	----	**94.2**	**106**
2-Chlorophenol-D4	93951-73-6	0.5	%		----	----	----	**91.3**	**102**
2.4.6-Tribromophenol	118-79-6	0.5	%		----	----	----	**77.7**	**76.0**
EP075(SIM)T: PAH Surrogates									
2-Fluorobiphenyl	321-60-8	0.5	%		----	----	----	**89.7**	**101**
Anthracene-d10	1719-06-8	0.5	%		----	----	----	**99.8**	**107**
4-Terphenyl-d14	1718-51-0	0.5	%		----	----	----	**102**	**109**
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	0.2	%		----	----	----	**74.9**	**82.4**
Toluene-D8	2037-26-5	0.2	%		----	----	----	**89.1**	**99.0**
4-Bromofluorobenzene	460-00-4	0.2	%		----	----	----	**96.4**	**101**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	HA03 - 0.5m	HA04 - 0.5m	HA05 - 0.5m	QCBH02	HA03 DUP
			Sampling date / time	16-Sep-2025 10:00	16-Sep-2025 11:15	16-Sep-2025 13:00	16-Sep-2025 12:30	16-Sep-2025 00:00
Compound	CAS Number	LOR	Unit	EB2532723-021	EB2532723-022	EB2532723-023	EB2532723-024	EB2532723-025
				Result	Result	Result	Result	Result
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	8.1	15.7	12.0	4.4	7.8
EG005(ED093)T: Total Metals by ICP-AES								
Barium	7440-39-3	10	mg/kg	730	40	60	30	460
Beryllium	7440-41-7	1	mg/kg	1	<1	<1	<1	1
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cobalt	7440-48-4	2	mg/kg	70	9	20	6	57
Manganese	7439-96-5	5	mg/kg	6100	466	201	685	3500
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	119	78	88	54	99
Arsenic	7440-38-2	5	mg/kg	<5	<5	<5	<5	<5
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	15	13	10	11	15
Copper	7440-50-8	5	mg/kg	20	28	25	8	18
Lead	7439-92-1	5	mg/kg	10	<5	6	<5	8
Nickel	7440-02-0	2	mg/kg	9	8	5	<2	7
Zinc	7440-66-6	5	mg/kg	12	14	10	<5	10
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EP066: Polychlorinated Biphenyls (PCB)								
Total Polychlorinated biphenyls	----	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EP068A: Organochlorine Pesticides (OC)								
alpha-BHC	319-84-6	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
beta-BHC	319-85-7	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
gamma-BHC - (Lindane)	58-89-9	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
delta-BHC	319-86-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Heptachlor	76-44-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	HA03 - 0.5m	HA04 - 0.5m	HA05 - 0.5m	QCBH02	HA03 DUP
				Sampling date / time	16-Sep-2025 10:00	16-Sep-2025 11:15	16-Sep-2025 13:00	16-Sep-2025 12:30	16-Sep-2025 00:00
Compound	CAS Number	LOR	Unit		EB2532723-021	EB2532723-022	EB2532723-023	EB2532723-024	EB2532723-025
					Result	Result	Result	Result	Result
EP068A: Organochlorine Pesticides (OC) - Continued									
Aldrin	309-00-2	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Heptachlor epoxide	1024-57-3	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
^ **Total Chlordane (sum)**	----	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
trans-Chlordane	5103-74-2	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
alpha-Endosulfan	959-98-8	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
cis-Chlordane	5103-71-9	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Dieldrin	60-57-1	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
4.4`-DDE	72-55-9	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Endrin	72-20-8	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
beta-Endosulfan	33213-65-9	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
^ **Endosulfan (sum)**	115-29-7	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
4.4`-DDD	72-54-8	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Endrin aldehyde	7421-93-4	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Endosulfan sulfate	1031-07-8	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
4.4`-DDT	50-29-3	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2
Endrin ketone	53494-70-5	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Methoxychlor	72-43-5	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2
^ **Sum of Aldrin + Dieldrin**	309-00-2/60-57-1	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
^ **Sum of DDD + DDE + DDT**	72-54-8/72-55-9/50-2	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
EP068B: Organophosphorus Pesticides (OP)									
Dichlorvos	62-73-7	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Demeton-S-methyl	919-86-8	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Monocrotophos	6923-22-4	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2
Dimethoate	60-51-5	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Diazinon	333-41-5	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Chlorpyrifos-methyl	5598-13-0	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	HA03 - 0.5m	HA04 - 0.5m	HA05 - 0.5m	QCBH02	HA03 DUP
				Sampling date / time	16-Sep-2025 10:00	16-Sep-2025 11:15	16-Sep-2025 13:00	16-Sep-2025 12:30	16-Sep-2025 00:00
Compound	CAS Number	LOR	Unit		EB2532723-021	EB2532723-022	EB2532723-023	EB2532723-024	EB2532723-025
					Result	Result	Result	Result	Result
EP068B: Organophosphorus Pesticides (OP) - Continued									
Parathion-methyl	298-00-0	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2
Malathion	121-75-5	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Fenthion	55-38-9	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Chlorpyrifos	2921-88-2	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Parathion	56-38-2	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2
Pirimphos-ethyl	23505-41-1	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Chlorfenvinphos	470-90-6	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Bromophos-ethyl	4824-78-6	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Fenamiphos	22224-92-6	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Prothiofos	34643-46-4	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Ethion	563-12-2	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Carbophenothion	786-19-6	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
Azinphos Methyl	86-50-0	0.05	mg/kg		<0.05	<0.05	<0.05	<0.05	<0.05
EP075(SIM)A: Phenolic Compounds									
Phenol	108-95-2	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
2-Chlorophenol	95-57-8	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
2-Methylphenol	95-48-7	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
3- & 4-Methylphenol	1319-77-3	1	mg/kg		<1	<1	<1	<1	<1
2-Nitrophenol	88-75-5	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
2.4-Dimethylphenol	105-67-9	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
2.4-Dichlorophenol	120-83-2	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
2.6-Dichlorophenol	87-65-0	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
4-Chloro-3-methylphenol	59-50-7	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
2.4.6-Trichlorophenol	88-06-2	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
2.4.5-Trichlorophenol	95-95-4	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Pentachlorophenol	87-86-5	2	mg/kg		<2	<2	<2	<2	<2
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons									

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	HA03 - 0.5m	HA04 - 0.5m	HA05 - 0.5m	QCBH02	HA03 DUP
				Sampling date / time	16-Sep-2025 10:00	16-Sep-2025 11:15	16-Sep-2025 13:00	16-Sep-2025 12:30	16-Sep-2025 00:00
Compound	CAS Number	LOR	Unit		EB2532723-021	EB2532723-022	EB2532723-023	EB2532723-024	EB2532723-025
					Result	Result	Result	Result	Result
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued									
Naphthalene	91-20-3	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthylene	208-96-8	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthene	83-32-9	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Fluorene	86-73-7	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Phenanthrene	85-01-8	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Anthracene	120-12-7	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Fluoranthene	206-44-0	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Pyrene	129-00-0	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Benz(a)anthracene	56-55-3	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Chrysene	218-01-9	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(k)fluoranthene	207-08-9	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene	50-32-8	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
^ Benzo(a)pyrene TEQ (zero)	----	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
^ Benzo(a)pyrene TEQ (half LOR)	----	0.5	mg/kg		**0.6**	**0.6**	**0.6**	**0.6**	**0.6**
^ Benzo(a)pyrene TEQ (LOR)	----	0.5	mg/kg		**1.2**	**1.2**	**1.2**	**1.2**	**1.2**
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	10	mg/kg		<10	<10	<10	<10	<10
C10 - C14 Fraction	----	50	mg/kg		<50	<50	<50	<50	<50
C15 - C28 Fraction	----	100	mg/kg		<100	<100	<100	<100	<100
C29 - C36 Fraction	----	100	mg/kg		<100	<100	<100	<100	<100
^ C10 - C36 Fraction (sum)	----	50	mg/kg		<50	<50	<50	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	HA03 - 0.5m	HA04 - 0.5m	HA05 - 0.5m	QCBH02	HA03 DUP
				Sampling date / time	16-Sep-2025 10:00	16-Sep-2025 11:15	16-Sep-2025 13:00	16-Sep-2025 12:30	16-Sep-2025 00:00
Compound	CAS Number	LOR	Unit		EB2532723-021	EB2532723-022	EB2532723-023	EB2532723-024	EB2532723-025
					Result	Result	Result	Result	Result
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions - Continued									
C6 - C10 Fraction	C6_C10	10	mg/kg		<10	<10	<10	<10	<10
^ **C6 - C10 Fraction minus BTEX (F1)**	C6_C10-BTEX	10	mg/kg		<10	<10	<10	<10	<10
>C10 - C16 Fraction	----	50	mg/kg		<50	<50	<50	<50	<50
>C16 - C34 Fraction	----	100	mg/kg		<100	<100	<100	<100	<100
>C34 - C40 Fraction	----	100	mg/kg		<100	<100	<100	<100	<100
^ **>C10 - C40 Fraction (sum)**	----	50	mg/kg		<50	<50	<50	<50	<50
^ **>C10 - C16 Fraction minus Naphthalene (F2)**	----	50	mg/kg		<50	<50	<50	<50	<50
EP080: BTEXN									
Benzene	71-43-2	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	108-88-3	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	100-41-4	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
ortho-Xylene	95-47-6	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
^ **Sum of BTEX**	----	0.2	mg/kg		<0.2	<0.2	<0.2	<0.2	<0.2
^ **Total Xylenes**	----	0.5	mg/kg		<0.5	<0.5	<0.5	<0.5	<0.5
Naphthalene	91-20-3	1	mg/kg		<1	<1	<1	<1	<1
EP231A: Perfluoroalkyl Sulfonic Acids									
Perfluorobutane sulfonic acid (PFBS)	375-73-5	0.0002	mg/kg		----	<0.0002	----	----	----
Perfluorohexane sulfonic acid (PFHxS)	355-46-4	0.0002	mg/kg		----	<0.0002	----	----	----
Perfluorooctane sulfonic acid (PFOS)	1763-23-1	0.0002	mg/kg		----	<0.0002	----	----	----
EP231B: Perfluoroalkyl Carboxylic Acids									
Perfluorobutanoic acid (PFBA)	375-22-4	0.001	mg/kg		----	<0.001	----	----	----
Perfluoropentanoic acid (PFPeA)	2706-90-3	0.0002	mg/kg		----	<0.0002	----	----	----
Perfluorohexanoic acid (PFHxA)	307-24-4	0.0002	mg/kg		----	<0.0002	----	----	----
Perfluoroheptanoic acid (PFHpA)	375-85-9	0.0002	mg/kg		----	<0.0002	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	HA03 - 0.5m	HA04 - 0.5m	HA05 - 0.5m	QCBH02	HA03 DUP
				Sampling date / time	16-Sep-2025 10:00	16-Sep-2025 11:15	16-Sep-2025 13:00	16-Sep-2025 12:30	16-Sep-2025 00:00
Compound	CAS Number	LOR	Unit		EB2532723-021	EB2532723-022	EB2532723-023	EB2532723-024	EB2532723-025
					Result	Result	Result	Result	Result
EP231B: Perfluoroalkyl Carboxylic Acids - Continued									
Perfluorooctanoic acid (PFOA)	335-67-1	0.0002	mg/kg		----	<0.0002	----	----	----
EP231D: (n:2) Fluorotelomer Sulfonic Acids									
4:2 Fluorotelomer sulfonic acid (4:2 FTS)	757124-72-4	0.0005	mg/kg		----	<0.0005	----	----	----
6:2 Fluorotelomer sulfonic acid (6:2 FTS)	27619-97-2	0.0005	mg/kg		----	<0.0005	----	----	----
8:2 Fluorotelomer sulfonic acid (8:2 FTS)	39108-34-4	0.0005	mg/kg		----	<0.0005	----	----	----
10:2 Fluorotelomer sulfonic acid (10:2 FTS)	120226-60-0	0.0005	mg/kg		----	<0.0005	----	----	----
EP231P: PFAS Sums									
Sum of PFHxS and PFOS	355-46-4/1763-23-1	0.0002	mg/kg		----	<0.0002	----	----	----
Sum of PFAS (WA DER List)	----	0.0002	mg/kg		----	<0.0002	----	----	----
EP066S: PCB Surrogate									
Decachlorobiphenyl	2051-24-3	0.1	%		**97.2**	**101**	**91.0**	**97.5**	**93.6**
EP068S: Organochlorine Pesticide Surrogate									
Dibromo-DDE	21655-73-2	0.05	%		**121**	**124**	**115**	**130**	**114**
EP068T: Organophosphorus Pesticide Surrogate									
DEF	78-48-8	0.05	%		**96.6**	**99.5**	**89.4**	**114**	**91.3**
EP075(SIM)S: Phenolic Compound Surrogates									
Phenol-d6	13127-88-3	0.5	%		**107**	**111**	**101**	**112**	**102**
2-Chlorophenol-D4	93951-73-6	0.5	%		**103**	**108**	**98.0**	**108**	**98.1**
2.4.6-Tribromophenol	118-79-6	0.5	%		**80.9**	**80.0**	**77.6**	**86.0**	**80.4**
EP075(SIM)T: PAH Surrogates									
2-Fluorobiphenyl	321-60-8	0.5	%		**101**	**107**	**96.0**	**107**	**96.7**
Anthracene-d10	1719-06-8	0.5	%		**104**	**110**	**100**	**110**	**101**
4-Terphenyl-d14	1718-51-0	0.5	%		**108**	**114**	**103**	**115**	**104**
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	0.2	%		**67.0**	**76.8**	**96.7**	**89.5**	**88.3**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Sample ID	HA03 - 0.5m	HA04 - 0.5m	HA05 - 0.5m	QCBH02	HA03 DUP
				Sampling date / time	16-Sep-2025 10:00	16-Sep-2025 11:15	16-Sep-2025 13:00	16-Sep-2025 12:30	16-Sep-2025 00:00
Compound	CAS Number	LOR	Unit		EB2532723-021	EB2532723-022	EB2532723-023	EB2532723-024	EB2532723-025
					Result	Result	Result	Result	Result
EP080S: TPH(V)/BTEX Surrogates - Continued									
Toluene-D8	2037-26-5	0.2	%		75.4	90.7	89.1	83.5	80.4
4-Bromofluorobenzene	460-00-4	0.2	%		78.6	99.2	117	115	110
EP231S: PFAS Surrogate									
13C4-PFOS	----	0.0002	%		----	98.5	----	----	----
13C8-PFOA	----	0.0002	%		----	97.0	----	----	----

Surrogate Control Limits

Sub-Matrix: SOIL		Recovery Limits (%)	
Compound	CAS Number	Low	High
EP066S: PCB Surrogate			
Decachlorobiphenyl	2051-24-3	16	134
EP068S: Organochlorine Pesticide Surrogate			
Dibromo-DDE	21655-73-2	10	138
EP068T: Organophosphorus Pesticide Surrogate			
DEF	78-48-8	23	134
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	35	154
2-Chlorophenol-D4	93951-73-6	42	153
2.4.6-Tribromophenol	118-79-6	26	157
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	34	156
Anthracene-d10	1719-06-8	37	153
4-Terphenyl-d14	1718-51-0	42	172
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	53	134
Toluene-D8	2037-26-5	60	131
4-Bromofluorobenzene	460-00-4	59	127
EP231S: PFAS Surrogate			
13C4-PFOS	----	76	136
13C8-PFOA	----	78	131

QUALITY CONTROL REPORT

Work Order	: **EB2532723**	Page	: 1 of 18
Amendment	: **1**		
Client	: **CQ ENVIRONMENTAL**	Laboratory	: Environmental Division Brisbane
Contact	: OSCAR DALLA PRIA	Contact	: Kelly Schafer
Address	: 15 LORD STREET GLADSTONE QLD 4680	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61 7 4978 7944
Project	: 25054	Date Samples Received	: 19-Sep-2025
Order number	: 25054	Date Analysis Commenced	: 22-Sep-2025
C-O-C number	: ----	Issue Date	: 07-Oct-2025
Sampler	: MICHAEL WHITEHEAD		
Site	: ----		
Quote number	: EN/222		
No. of samples received	: 25		
No. of samples analysed	: 25		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Beatriz Llarinas	Senior Chemist	Brisbane Inorganics, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Soil Preparation, Stafford, QLD
Satishkumar Trivedi	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Satishkumar Trivedi	Senior Acid Sulfate Soil Chemist	Brisbane Soil Preparation, Stafford, QLD
Tatijana Markoska	Senior Chemist - Organics	Brisbane Organics, Stafford, QLD
Timothy Creagh	Senior Chemist - Organics	Brisbane Organics, Stafford, QLD

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC
* = The final LOR has been raised due to dilution or other sample specific cause; adjusted LOR is shown in brackets. The duplicate ranges for Acceptable RPD% are applied to the final LOR where applicable.

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Acceptable RPD (%)*
EG005(ED093)T: Total Metals by ICP-AES (QC Lot: 6878183)									
EB2532723-001	BH01 - 0.5m	EG005T: Beryllium	7440-41-7	1	mg/kg	<1	<1	0.0	No Limit
		EG005T: Cadmium	7440-43-9	1	mg/kg	<1	<1	0.0	No Limit
		EG005T: Barium	7440-39-3	10	mg/kg	320	260	17.9	0% - 20%
		EG005T: Chromium	7440-47-3	2	mg/kg	16	16	0.0	No Limit
		EG005T: Cobalt	7440-48-4	2	mg/kg	19	17	10.0	No Limit
		EG005T: Nickel	7440-02-0	2	mg/kg	7	3	62.9	No Limit
		EG005T: Arsenic	7440-38-2	5	mg/kg	<5	<5	0.0	No Limit
		EG005T: Copper	7440-50-8	5	mg/kg	22	21	8.9	No Limit
		EG005T: Lead	7439-92-1	5	mg/kg	5	<5	0.0	No Limit
		EG005T: Manganese	7439-96-5	5	mg/kg	4160	3680	12.3	0% - 20%
		EG005T: Selenium	7782-49-2	5	mg/kg	<5	<5	0.0	No Limit
		EG005T: Vanadium	7440-62-2	5	mg/kg	107	88	19.3	0% - 20%
		EG005T: Zinc	7440-66-6	5	mg/kg	16	9	55.7	No Limit
		EG005T: Boron	7440-42-8	50	mg/kg	<50	<50	0.0	No Limit
EB2532847-001	Anonymous	EG005T: Beryllium	7440-41-7	1	mg/kg	<1	<1	0.0	No Limit
		EG005T: Cadmium	7440-43-9	1	mg/kg	<1	<1	0.0	No Limit
		EG005T: Barium	7440-39-3	10	mg/kg	<10	<10	0.0	No Limit
		EG005T: Chromium	7440-47-3	2	mg/kg	7	8	0.0	No Limit
		EG005T: Cobalt	7440-48-4	2	mg/kg	<2	2	0.0	No Limit
		EG005T: Nickel	7440-02-0	2	mg/kg	3	3	0.0	No Limit
		EG005T: Arsenic	7440-38-2	5	mg/kg	5	5	0.0	No Limit

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Acceptable RPD (%)*
EG005(ED093)T: Total Metals by ICP-AES (QC Lot: 6878183) - continued									
EB2532847-001	Anonymous	EG005T: Copper	7440-50-8	5	mg/kg	<5	<5	0.0	No Limit
		EG005T: Lead	7439-92-1	5	mg/kg	<5	<5	0.0	No Limit
		EG005T: Manganese	7439-96-5	5	mg/kg	138	147	5.9	0% - 20%
		EG005T: Selenium	7782-49-2	5	mg/kg	<5	<5	0.0	No Limit
		EG005T: Vanadium	7440-62-2	5	mg/kg	8	9	0.0	No Limit
		EG005T: Zinc	7440-66-6	5	mg/kg	8	8	0.0	No Limit
		EG005T: Boron	7440-42-8	50	mg/kg	<50	<50	0.0	No Limit
EA029-A: pH Measurements (QC Lot: 6880979)									
EB2532723-001	BH01 - 0.5m	EA029: pH KCl (23A)	----	0.1	pH Unit	4.7	4.7	0.0	0% - 20%
		EA029: pH OX (23B)	----	0.1	pH Unit	4.9	4.9	0.0	0% - 20%
EB2532723-011	BH02 - 4.0m	EA029: pH KCl (23A)	----	0.1	pH Unit	7.7	7.7	0.0	0% - 20%
		EA029: pH OX (23B)	----	0.1	pH Unit	8.6	8.5	0.0	0% - 20%
EA029-B: Acidity Trail (QC Lot: 6880979)									
EB2532723-001	BH01 - 0.5m	EA029: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	0.043	0.043	0.0	No Limit
		EA029: sulfidic - Titratable Peroxide Acidity (s-23G)	----	0.02	% pyrite S	<0.020	<0.020	0.0	No Limit
		EA029: sulfidic - Titratable Sulfidic Acidity (s-23H)	----	0.02	% pyrite S	<0.020	<0.020	0.0	No Limit
		EA029: Titratable Actual Acidity (23F)	----	2	mole H+ / t	27	27	0.0	0% - 50%
		EA029: Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	4	3	0.0	No Limit
		EA029: Titratable Sulfidic Acidity (23H)	----	2	mole H+ / t	<2	<2	0.0	No Limit
EB2532723-011	BH02 - 4.0m	EA029: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.020	<0.020	0.0	No Limit
		EA029: sulfidic - Titratable Peroxide Acidity (s-23G)	----	0.02	% pyrite S	<0.020	<0.020	0.0	No Limit
		EA029: sulfidic - Titratable Sulfidic Acidity (s-23H)	----	0.02	% pyrite S	<0.020	<0.020	0.0	No Limit
		EA029: Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	0.0	No Limit
		EA029: Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	<2	<2	0.0	No Limit
		EA029: Titratable Sulfidic Acidity (23H)	----	2	mole H+ / t	<2	<2	0.0	No Limit
EA029-C: Sulfur Trail (QC Lot: 6880979)									
EB2532723-001	BH01 - 0.5m	EA029: KCl Extractable Sulfur (23Ce)	----	0.02	% S	<0.020	<0.020	0.0	No Limit
		EA029: Peroxide Sulfur (23De)	----	0.02	% S	<0.020	<0.020	0.0	No Limit
		EA029: Peroxide Oxidisable Sulfur (23E)	----	0.02	% S	<0.020	<0.020	0.0	No Limit
		EA029: acidity - Peroxide Oxidisable Sulfur (a-23E)	----	10	mole H+ / t	<10	<10	0.0	No Limit
EB2532723-011	BH02 - 4.0m	EA029: KCl Extractable Sulfur (23Ce)	----	0.02	% S	<0.020	<0.020	0.0	No Limit
		EA029: Peroxide Sulfur (23De)	----	0.02	% S	<0.020	<0.020	0.0	No Limit
		EA029: Peroxide Oxidisable Sulfur (23E)	----	0.02	% S	<0.020	<0.020	0.0	No Limit

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Acceptable RPD (%)*
EA029-C: Sulfur Trail (QC Lot: 6880979) - continued									
EB2532723-011	BH02 - 4.0m	EA029: acidity - Peroxide Oxidisable Sulfur (a-23E)	----	10	mole H+ / t	<10	<10	0.0	No Limit
EA029-D: Calcium Values (QC Lot: 6880979)									
EB2532723-001	BH01 - 0.5m	EA029: KCl Extractable Calcium (23Vh)	----	0.02	% Ca	0.063	0.062	0.0	No Limit
		EA029: Peroxide Calcium (23Wh)	----	0.02	% Ca	0.062	0.065	5.3	No Limit
		EA029: Acid Reacted Calcium (23X)	----	0.02	% Ca	<0.020	<0.020	0.0	No Limit
		EA029: sulfidic - Acid Reacted Calcium (s-23X)	----	0.02	% S	<0.020	<0.020	0.0	No Limit
		EA029: acidity - Acid Reacted Calcium (a-23X)	----	10	mole H+ / t	<10	<10	0.0	No Limit
EB2532723-011	BH02 - 4.0m	EA029: KCl Extractable Calcium (23Vh)	----	0.02	% Ca	0.223	0.221	0.8	0% - 50%
		EA029: Peroxide Calcium (23Wh)	----	0.02	% Ca	0.232	0.234	1.1	0% - 50%
		EA029: Acid Reacted Calcium (23X)	----	0.02	% Ca	<0.020	<0.020	0.0	No Limit
		EA029: sulfidic - Acid Reacted Calcium (s-23X)	----	0.02	% S	<0.020	<0.020	0.0	No Limit
		EA029: acidity - Acid Reacted Calcium (a-23X)	----	10	mole H+ / t	<10	<10	0.0	No Limit
EA029-E: Magnesium Values (QC Lot: 6880979)									
EB2532723-001	BH01 - 0.5m	EA029: KCl Extractable Magnesium (23Sm)	----	0.02	% Mg	0.106	0.107	0.0	No Limit
		EA029: Peroxide Magnesium (23Tm)	----	0.02	% Mg	0.103	0.108	5.0	No Limit
		EA029: Acid Reacted Magnesium (23U)	----	0.02	% Mg	<0.020	<0.020	0.0	No Limit
		EA029: sulfidic - Acid Reacted Magnesium (s-23U)	----	0.02	% S	<0.020	<0.020	0.0	No Limit
		EA029: Acidity - Acid Reacted Magnesium (a-23U)	----	10	mole H+ / t	<10	<10	0.0	No Limit
EB2532723-011	BH02 - 4.0m	EA029: KCl Extractable Magnesium (23Sm)	----	0.02	% Mg	0.194	0.193	0.0	No Limit
		EA029: Peroxide Magnesium (23Tm)	----	0.02	% Mg	0.202	0.204	1.0	0% - 50%
		EA029: Acid Reacted Magnesium (23U)	----	0.02	% Mg	<0.020	<0.020	0.0	No Limit
		EA029: sulfidic - Acid Reacted Magnesium (s-23U)	----	0.02	% S	<0.020	<0.020	0.0	No Limit
		EA029: Acidity - Acid Reacted Magnesium (a-23U)	----	10	mole H+ / t	<10	<10	0.0	No Limit
EA029-F: Excess Acid Neutralising Capacity (QC Lot: 6880979)									
EB2532723-011	BH02 - 4.0m	EA029: Excess Acid Neutralising Capacity (23Q)	----	0.02	% CaCO3	0.572	0.556	2.8	0% - 20%
		EA029: sulfidic - Excess Acid Neutralising Capacity (s-23Q)	----	0.02	% S	0.183	0.178	2.8	No Limit
		EA029: acidity - Excess Acid Neutralising Capacity (a-23Q)	----	10	mole H+ / t	114	111	2.8	0% - 50%
EA029-H: Acid Base Accounting (QC Lot: 6880979)									
EB2532723-001	BH01 - 0.5m	EA029: ANC Fineness Factor	----	0.5	-	1.5	1.5	0.0	No Limit
		EA029: Net Acidity (sulfur units)	----	0.02	% S	0.04	0.04	0.0	No Limit
		EA029: Net Acidity excluding ANC (sulfur units)	----	0.02	% S	0.04	0.04	0.0	No Limit

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Acceptable RPD (%)*
EA029-H: Acid Base Accounting (QC Lot: 6880979) - continued									
EB2532723-001	BH01 - 0.5m	EA029: Liming Rate	----	1	kg CaCO3/t	2	2	0.0	No Limit
		EA029: Liming Rate excluding ANC	----	1	kg CaCO3/t	2	2	0.0	No Limit
		EA029: Net Acidity (acidity units)	----	10	mole H+ / t	27	27	0.0	No Limit
		EA029: Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	27	27	0.0	No Limit
EB2532723-011	BH02 - 4.0m	EA029: ANC Fineness Factor	----	0.5	-	1.5	1.5	0.0	No Limit
		EA029: Net Acidity (sulfur units)	----	0.02	% S	<0.02	<0.02	0.0	No Limit
		EA029: Net Acidity excluding ANC (sulfur units)	----	0.02	% S	<0.02	<0.02	0.0	No Limit
		EA029: Liming Rate	----	1	kg CaCO3/t	<1	<1	0.0	No Limit
		EA029: Liming Rate excluding ANC	----	1	kg CaCO3/t	<1	<1	0.0	No Limit
		EA029: Net Acidity (acidity units)	----	10	mole H+ / t	<10	<10	0.0	No Limit
		EA029: Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	<10	<10	0.0	No Limit
EA055: Moisture Content (Dried @ 105-110°C) (QC Lot: 6875672)									
EB2532718-001	Anonymous	EA055: Moisture Content	----	0.1	%	<0.1	0.1	0.0	No Limit
EB2532723-025	HA03 DUP	EA055: Moisture Content	----	0.1 (1.0)*	%	7.8	7.7	0.0	No Limit
EG035T: Total Recoverable Mercury by FIMS (QC Lot: 6878184)									
EB2532723-001	BH01 - 0.5m	EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
EB2532847-001	Anonymous	EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
EP066: Polychlorinated Biphenyls (PCB) (QC Lot: 6875884)									
EB2532723-001	BH01 - 0.5m	EP066: Total Polychlorinated biphenyls	----	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
EP068A: Organochlorine Pesticides (OC) (QC Lot: 6875883)									
EB2532723-001	BH01 - 0.5m	EP068: alpha-BHC	319-84-6	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: beta-BHC	319-85-7	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: gamma-BHC - (Lindane)	58-89-9	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: delta-BHC	319-86-8	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Heptachlor	76-44-8	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Aldrin	309-00-2	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Heptachlor epoxide	1024-57-3	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Total Chlordane (sum)	----	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: trans-Chlordane	5103-74-2	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: alpha-Endosulfan	959-98-8	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: cis-Chlordane	5103-71-9	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Dieldrin	60-57-1	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: 4.4`-DDE	72-55-9	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Endrin	72-20-8	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: beta-Endosulfan	33213-65-9	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Endosulfan (sum)	115-29-7	0.05	mg/kg	<0.05	<0.05	0.0	No Limit

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Acceptable RPD (%)*
EP068A: Organochlorine Pesticides (OC) (QC Lot: 6875883) - continued									
EB2532723-001	BH01 - 0.5m	EP068: 4.4`-DDD	72-54-8	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Endrin aldehyde	7421-93-4	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Endosulfan sulfate	1031-07-8	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Endrin ketone	53494-70-5	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Sum of DDD + DDE + DDT	72-54-8/72-55-9/50-2	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: 4.4`-DDT	50-29-3	0.2	mg/kg	<0.2	<0.2	0.0	No Limit
		EP068: Methoxychlor	72-43-5	0.2	mg/kg	<0.2	<0.2	0.0	No Limit
EP068B: Organophosphorus Pesticides (OP) (QC Lot: 6875883)									
EB2532723-001	BH01 - 0.5m	EP068: Dichlorvos	62-73-7	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Demeton-S-methyl	919-86-8	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Dimethoate	60-51-5	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Diazinon	333-41-5	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Chlorpyrifos-methyl	5598-13-0	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Malathion	121-75-5	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Fenthion	55-38-9	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Chlorpyrifos	2921-88-2	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Pirimphos-ethyl	23505-41-1	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Chlorfenvinphos	470-90-6	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Bromophos-ethyl	4824-78-6	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Fenamiphos	22224-92-6	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Prothiofos	34643-46-4	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Ethion	563-12-2	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Carbophenothion	786-19-6	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Azinphos Methyl	86-50-0	0.05	mg/kg	<0.05	<0.05	0.0	No Limit
		EP068: Monocrotophos	6923-22-4	0.2	mg/kg	<0.2	<0.2	0.0	No Limit
		EP068: Parathion	56-38-2	0.2	mg/kg	<0.2	<0.2	0.0	No Limit
EP075(SIM)A: Phenolic Compounds (QC Lot: 6875882)									
EB2533001-001	Anonymous	EP075(SIM): Phenol	108-95-2	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): 2-Chlorophenol	95-57-8	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): 2-Methylphenol	95-48-7	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): 2-Nitrophenol	88-75-5	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): 2.4-Dimethylphenol	105-67-9	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): 2.4-Dichlorophenol	120-83-2	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): 2.6-Dichlorophenol	87-65-0	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): 4-Chloro-3-methylphenol	59-50-7	0.5	mg/kg	<0.5	<0.5	0.0	No Limit

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Acceptable RPD (%)*
EP075(SIM)A: Phenolic Compounds (QC Lot: 6875882) - continued									
EB2533001-001	Anonymous	EP075(SIM): 2.4.6-Trichlorophenol	88-06-2	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): 2.4.5-Trichlorophenol	95-95-4	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): 3- & 4-Methylphenol	1319-77-3	1	mg/kg	<1	<1	0.0	No Limit
		EP075(SIM): Pentachlorophenol	87-86-5	2	mg/kg	<2	<2	0.0	No Limit
EB2532723-001	BH01 - 0.5m	EP075(SIM): Phenol	108-95-2	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): 2-Chlorophenol	95-57-8	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): 2-Methylphenol	95-48-7	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): 2-Nitrophenol	88-75-5	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): 2.4-Dimethylphenol	105-67-9	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): 2.4-Dichlorophenol	120-83-2	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): 2.6-Dichlorophenol	87-65-0	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): 4-Chloro-3-methylphenol	59-50-7	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): 2.4.6-Trichlorophenol	88-06-2	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): 2.4.5-Trichlorophenol	95-95-4	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): 3- & 4-Methylphenol	1319-77-3	1	mg/kg	<1	<1	0.0	No Limit
		EP075(SIM): Pentachlorophenol	87-86-5	2	mg/kg	<2	<2	0.0	No Limit
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QC Lot: 6875882)									
EB2533001-001	Anonymous	EP075(SIM): Naphthalene	91-20-3	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Acenaphthene	83-32-9	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Fluorene	86-73-7	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Phenanthrene	85-01-8	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Anthracene	120-12-7	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Fluoranthene	206-44-0	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Pyrene	129-00-0	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Chrysene	218-01-9	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Benzo(k)fluoranthene	207-08-9	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Benzo(a)pyrene TEQ (zero)	----	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
EB2532723-001	BH01 - 0.5m	EP075(SIM): Naphthalene	91-20-3	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Acenaphthene	83-32-9	0.5	mg/kg	<0.5	<0.5	0.0	No Limit

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Acceptable RPD (%)*
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QC Lot: 6875882) - continued									
EB2532723-001	BH01 - 0.5m	EP075(SIM): Fluorene	86-73-7	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Phenanthrene	85-01-8	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Anthracene	120-12-7	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Fluoranthene	206-44-0	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Pyrene	129-00-0	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Chrysene	218-01-9	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Benzo(k)fluoranthene	207-08-9	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP075(SIM): Benzo(a)pyrene TEQ (zero)	----	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 6875010)									
EB2533002-010	Anonymous	EP080: C6 - C9 Fraction	----	10	mg/kg	<10	<10	0.0	No Limit
EB2532718-001	Anonymous	EP080: C6 - C9 Fraction	----	10	mg/kg	25	23	9.9	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 6875881)									
EB2533001-001	Anonymous	EP071: C15 - C28 Fraction	----	100	mg/kg	<100	<100	0.0	No Limit
		EP071: C29 - C36 Fraction	----	100	mg/kg	<100	<100	0.0	No Limit
		EP071: C10 - C14 Fraction	----	50	mg/kg	<50	<50	0.0	No Limit
EB2532723-001	BH01 - 0.5m	EP071: C15 - C28 Fraction	----	100	mg/kg	<100	<100	0.0	No Limit
		EP071: C29 - C36 Fraction	----	100	mg/kg	<100	<100	0.0	No Limit
		EP071: C10 - C14 Fraction	----	50	mg/kg	<50	<50	0.0	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 6876312)									
EB2532723-023	HA05 - 0.5m	EP080: C6 - C9 Fraction	----	10	mg/kg	<10	<10	0.0	No Limit
EB2532976-019	Anonymous	EP080: C6 - C9 Fraction	----	10	mg/kg	<10	<10	0.0	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 6875010)									
EB2533002-010	Anonymous	EP080: C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	0.0	No Limit
EB2532718-001	Anonymous	EP080: C6 - C10 Fraction	C6_C10	10	mg/kg	26	24	10.3	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 6875881)									
EB2533001-001	Anonymous	EP071: >C16 - C34 Fraction	----	100	mg/kg	<100	<100	0.0	No Limit
		EP071: >C34 - C40 Fraction	----	100	mg/kg	<100	<100	0.0	No Limit
		EP071: >C10 - C16 Fraction	----	50	mg/kg	<50	<50	0.0	No Limit
EB2532723-001	BH01 - 0.5m	EP071: >C16 - C34 Fraction	----	100	mg/kg	<100	<100	0.0	No Limit
		EP071: >C34 - C40 Fraction	----	100	mg/kg	<100	<100	0.0	No Limit

Sub-Matrix: **SOIL**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Laboratory Duplicate (DUP) Report					
				LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 6875881) - continued									
EB2532723-001	BH01 - 0.5m	EP071: >C10 - C16 Fraction	----	50	mg/kg	<50	<50	0.0	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 6876312)									
EB2532723-023	HA05 - 0.5m	EP080: C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	0.0	No Limit
EB2532976-019	Anonymous	EP080: C6 - C10 Fraction	C6_C10	10	mg/kg	<10	<10	0.0	No Limit
EP080: BTEXN (QC Lot: 6875010)									
EB2533002-010	Anonymous	EP080: Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	0.0	No Limit
		EP080: Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP080: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP080: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP080: Naphthalene	91-20-3	1	mg/kg	<1	<1	0.0	No Limit
EB2532718-001	Anonymous	EP080: Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	0.0	No Limit
		EP080: Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP080: Ethylbenzene	100-41-4	0.5	mg/kg	0.8	0.7	0.0	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	7.0	6.3	10.7	0% - 50%
		EP080: ortho-Xylene	95-47-6	0.5	mg/kg	6.7	6.0	9.6	0% - 50%
		EP080: Naphthalene	91-20-3	1	mg/kg	<1	<1	0.0	No Limit
EP080: BTEXN (QC Lot: 6876312)									
EB2532723-023	HA05 - 0.5m	EP080: Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	0.0	No Limit
		EP080: Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP080: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP080: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP080: Naphthalene	91-20-3	1	mg/kg	<1	<1	0.0	No Limit
EB2532976-019	Anonymous	EP080: Benzene	71-43-2	0.2	mg/kg	<0.2	<0.2	0.0	No Limit
		EP080: Toluene	108-88-3	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP080: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP080: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	<0.5	0.0	No Limit
		EP080: Naphthalene	91-20-3	1	mg/kg	<1	<1	0.0	No Limit
EP231A: Perfluoroalkyl Sulfonic Acids (QC Lot: 6878674)									
EB2532723-013	BH03 - 0.5m	EP231X: Perfluorobutane sulfonic acid (PFBS)	375-73-5	0.0002	mg/kg	<0.0002	<0.0002	0.0	No Limit
		EP231X: Perfluorohexane sulfonic acid (PFHxS)	355-46-4	0.0002	mg/kg	<0.0002	<0.0002	0.0	No Limit
		EP231X: Perfluorooctane sulfonic acid (PFOS)	1763-23-1	0.0002	mg/kg	<0.0002	<0.0002	0.0	No Limit

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Acceptable RPD (%)*
EP231A: Perfluoroalkyl Sulfonic Acids (QC Lot: 6878674) - continued									
EB2533002-024	Anonymous	EP231X: Perfluorobutane sulfonic acid (PFBS)	375-73-5	0.0002	mg/kg	<0.0002	<0.0002	0.0	No Limit
		EP231X: Perfluorohexane sulfonic acid (PFHxS)	355-46-4	0.0002	mg/kg	<0.0002	<0.0002	0.0	No Limit
		EP231X: Perfluorooctane sulfonic acid (PFOS)	1763-23-1	0.0002	mg/kg	<0.0002	<0.0002	0.0	No Limit
EP231B: Perfluoroalkyl Carboxylic Acids (QC Lot: 6878674)									
EB2532723-013	BH03 - 0.5m	EP231X: Perfluoropentanoic acid (PFPeA)	2706-90-3	0.0002	mg/kg	<0.0002	<0.0002	0.0	No Limit
		EP231X: Perfluorohexanoic acid (PFHxA)	307-24-4	0.0002	mg/kg	<0.0002	<0.0002	0.0	No Limit
		EP231X: Perfluoroheptanoic acid (PFHpA)	375-85-9	0.0002	mg/kg	<0.0002	<0.0002	0.0	No Limit
		EP231X: Perfluorooctanoic acid (PFOA)	335-67-1	0.0002	mg/kg	<0.0002	<0.0002	0.0	No Limit
		EP231X: Perfluorobutanoic acid (PFBA)	375-22-4	0.001	mg/kg	<0.001	<0.001	0.0	No Limit
EB2533002-024	Anonymous	EP231X: Perfluoropentanoic acid (PFPeA)	2706-90-3	0.0002	mg/kg	<0.0002	<0.0002	0.0	No Limit
		EP231X: Perfluorohexanoic acid (PFHxA)	307-24-4	0.0002	mg/kg	<0.0002	<0.0002	0.0	No Limit
		EP231X: Perfluoroheptanoic acid (PFHpA)	375-85-9	0.0002	mg/kg	<0.0002	<0.0002	0.0	No Limit
		EP231X: Perfluorooctanoic acid (PFOA)	335-67-1	0.0002	mg/kg	<0.0002	<0.0002	0.0	No Limit
		EP231X: Perfluorobutanoic acid (PFBA)	375-22-4	0.001	mg/kg	<0.001	<0.001	0.0	No Limit
EP231D: (n:2) Fluorotelomer Sulfonic Acids (QC Lot: 6878674)									
EB2532723-013	BH03 - 0.5m	EP231X: 4:2 Fluorotelomer sulfonic acid (4:2 FTS)	757124-72-4	0.0005	mg/kg	<0.0005	<0.0005	0.0	No Limit
		EP231X: 6:2 Fluorotelomer sulfonic acid (6:2 FTS)	27619-97-2	0.0005	mg/kg	<0.0005	<0.0005	0.0	No Limit
		EP231X: 8:2 Fluorotelomer sulfonic acid (8:2 FTS)	39108-34-4	0.0005	mg/kg	<0.0005	<0.0005	0.0	No Limit
		EP231X: 10:2 Fluorotelomer sulfonic acid (10:2 FTS)	120226-60-0	0.0005	mg/kg	<0.0005	<0.0005	0.0	No Limit
EB2533002-024	Anonymous	EP231X: 4:2 Fluorotelomer sulfonic acid (4:2 FTS)	757124-72-4	0.0005	mg/kg	<0.0005	<0.0005	0.0	No Limit
		EP231X: 6:2 Fluorotelomer sulfonic acid (6:2 FTS)	27619-97-2	0.0005	mg/kg	<0.0005	<0.0005	0.0	No Limit
		EP231X: 8:2 Fluorotelomer sulfonic acid (8:2 FTS)	39108-34-4	0.0005	mg/kg	<0.0005	<0.0005	0.0	No Limit
		EP231X: 10:2 Fluorotelomer sulfonic acid (10:2 FTS)	120226-60-0	0.0005	mg/kg	<0.0005	<0.0005	0.0	No Limit

Method Blank (MB) and Laboratory Control Sample (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **SOIL**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Acceptable Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EG005(ED093)T: Total Metals by ICP-AES (QCLot: 6878183)								
EG005T: Arsenic	7440-38-2	5	mg/kg	<5	30.5 mg/kg	89.6	84.0	123
EG005T: Barium	7440-39-3	10	mg/kg	<10	187 mg/kg	90.4	89.0	129
EG005T: Beryllium	7440-41-7	1	mg/kg	<1	----	----	----	----
EG005T: Boron	7440-42-8	50	mg/kg	<50	----	----	----	----
EG005T: Cadmium	7440-43-9	1	mg/kg	<1	----	----	----	----
EG005T: Chromium	7440-47-3	2	mg/kg	<2	27.3 mg/kg	95.8	83.0	125
EG005T: Cobalt	7440-48-4	2	mg/kg	<2	9.3 mg/kg	100	82.0	118
EG005T: Copper	7440-50-8	5	mg/kg	<5	112 mg/kg	93.5	86.0	122
EG005T: Lead	7439-92-1	5	mg/kg	<5	84.2 mg/kg	90.3	84.0	119
EG005T: Manganese	7439-96-5	5	mg/kg	<5	409 mg/kg	94.6	84.0	113
EG005T: Nickel	7440-02-0	2	mg/kg	<2	28.7 mg/kg	97.1	81.5	118
EG005T: Selenium	7782-49-2	5	mg/kg	<5	----	----	----	----
EG005T: Vanadium	7440-62-2	5	mg/kg	<5	23.3 mg/kg	96.4	88.0	127
EG005T: Zinc	7440-66-6	5	mg/kg	<5	176 mg/kg	94.9	80.0	120
EA029-A: pH Measurements (QCLot: 6880979)								
EA029: pH KCl (23A)	----	0.1	pH Unit	<0.1	4.7 pH Unit	98.8	70.0	130
EA029: pH OX (23B)	----	0.1	pH Unit	<0.1	4.5 pH Unit	82.4	70.0	130
EA029-B: Acidity Trail (QCLot: 6880979)								
EA029: Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	23.5 mole H+ / t	109	70.0	130
EA029: Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	<2	46.5 mole H+ / t	117	70.0	130
EA029: Titratable Sulfidic Acidity (23H)	----	2	mole H+ / t	<2	----	----	----	----
EA029: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.020	----	----	----	----
EA029: sulfidic - Titratable Peroxide Acidity (s-23G)	----	0.02	% pyrite S	<0.020	----	----	----	----
EA029: sulfidic - Titratable Sulfidic Acidity (s-23H)	----	0.02	% pyrite S	<0.020	----	----	----	----
EA029-C: Sulfur Trail (QCLot: 6880979)								
EA029: KCl Extractable Sulfur (23Ce)	----	0.02	% S	<0.020	0.064 % S	99.1	70.0	130
EA029: Peroxide Sulfur (23De)	----	0.02	% S	<0.020	0.167 % S	99.8	70.0	130
EA029: Peroxide Oxidisable Sulfur (23E)	----	0.02	% S	<0.020	----	----	----	----
EA029: acidity - Peroxide Oxidisable Sulfur (a-23E)	----	10	mole H+ / t	<10	----	----	----	----
EA029-D: Calcium Values (QCLot: 6880979)								

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Acceptable Limits (%): Low	Acceptable Limits (%): High
EA029-D: Calcium Values (QCLot: 6880979) - continued								
EA029: KCl Extractable Calcium (23Vh)	----	0.02	% Ca	<0.020	0.17 % Ca	107	70.0	130
EA029: Peroxide Calcium (23Wh)	----	0.02	% Ca	<0.020	0.197 % Ca	96.8	70.0	130
EA029: Acid Reacted Calcium (23X)	----	0.02	% Ca	<0.020	----	----	----	----
EA029: acidity - Acid Reacted Calcium (a-23X)	----	10	mole H+ / t	<10	----	----	----	----
EA029: sulfidic - Acid Reacted Calcium (s-23X)	----	0.02	% S	<0.020	----	----	----	----
EA029-E: Magnesium Values (QCLot: 6880979)								
EA029: KCl Extractable Magnesium (23Sm)	----	0.02	% Mg	<0.020	0.23 % Mg	105	70.0	130
EA029: Peroxide Magnesium (23Tm)	----	0.02	% Mg	<0.020	0.239 % Mg	109	70.0	130
EA029: Acid Reacted Magnesium (23U)	----	0.02	% Mg	<0.020	----	----	----	----
EA029: Acidity - Acid Reacted Magnesium (a-23U)	----	10	mole H+ / t	<10	----	----	----	----
EA029: sulfidic - Acid Reacted Magnesium (s-23U)	----	0.02	% S	<0.020	----	----	----	----
EA029-F: Excess Acid Neutralising Capacity (QCLot: 6880979)								
EA029: Excess Acid Neutralising Capacity (23Q)	----	0.02	% CaCO3	<0.020	----	----	----	----
EA029: acidity - Excess Acid Neutralising Capacity (a-23Q)	----	10	mole H+ / t	<10	----	----	----	----
EA029: sulfidic - Excess Acid Neutralising Capacity (s-23Q)	----	0.02	% S	<0.020	----	----	----	----
EA029-H: Acid Base Accounting (QCLot: 6880979)								
EA029: ANC Fineness Factor	----	0.5	-	<0.5	----	----	----	----
EA029: Net Acidity (sulfur units)	----	0.02	% S	<0.02	----	----	----	----
EA029: Net Acidity (acidity units)	----	10	mole H+ / t	<10	----	----	----	----
EA029: Liming Rate	----	1	kg CaCO3/t	<1	----	----	----	----
EA029: Net Acidity excluding ANC (sulfur units)	----	0.02	% S	<0.02	----	----	----	----
EA029: Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	<10	----	----	----	----
EA029: Liming Rate excluding ANC	----	1	kg CaCO3/t	<1	----	----	----	----
EG035T: Total Recoverable Mercury by FIMS (QCLot: 6878184)								
EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	0.1 mg/kg	102	70.0	125
EP066: Polychlorinated Biphenyls (PCB) (QCLot: 6875884)								
EP066: Total Polychlorinated biphenyls	----	0.1	mg/kg	<0.1	1 mg/kg	113	71.6	155
EP068A: Organochlorine Pesticides (OC) (QCLot: 6875883)								
EP068: alpha-BHC	319-84-6	0.05	mg/kg	<0.05	0.5 mg/kg	108	72.8	127
EP068: Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg	<0.05	0.5 mg/kg	111	71.0	127
EP068: beta-BHC	319-85-7	0.05	mg/kg	<0.05	0.5 mg/kg	105	67.5	126
EP068: gamma-BHC - (Lindane)	58-89-9	0.05	mg/kg	<0.05	0.5 mg/kg	105	72.7	127
EP068: delta-BHC	319-86-8	0.05	mg/kg	<0.05	0.5 mg/kg	103	70.6	122

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Acceptable Limits (%)	
				Result	Concentration	LCS	Low	High
EP068A: Organochlorine Pesticides (OC) (QCLot: 6875883) - continued								
EP068: Heptachlor	76-44-8	0.05	mg/kg	<0.05	0.5 mg/kg	116	64.8	127
EP068: Aldrin	309-00-2	0.05	mg/kg	<0.05	0.5 mg/kg	109	72.4	122
EP068: Heptachlor epoxide	1024-57-3	0.05	mg/kg	<0.05	0.5 mg/kg	119	67.4	125
EP068: Total Chlordane (sum)	----	0.05	mg/kg	<0.05	----	----	----	----
EP068: trans-Chlordane	5103-74-2	0.05	mg/kg	<0.05	0.5 mg/kg	117	65.6	124
EP068: alpha-Endosulfan	959-98-8	0.05	mg/kg	<0.05	0.5 mg/kg	102	70.4	122
EP068: cis-Chlordane	5103-71-9	0.05	mg/kg	<0.05	0.5 mg/kg	117	65.6	125
EP068: Dieldrin	60-57-1	0.05	mg/kg	<0.05	0.5 mg/kg	103	69.1	124
EP068: 4.4`-DDE	72-55-9	0.05	mg/kg	<0.05	0.5 mg/kg	100	72.4	125
EP068: Endrin	72-20-8	0.05	mg/kg	<0.05	0.5 mg/kg	103	63.2	127
EP068: beta-Endosulfan	33213-65-9	0.05	mg/kg	<0.05	0.5 mg/kg	96.3	69.7	120
EP068: Endosulfan (sum)	115-29-7	0.05	mg/kg	<0.05	----	----	----	----
EP068: 4.4`-DDD	72-54-8	0.05	mg/kg	<0.05	0.5 mg/kg	105	61.2	124
EP068: Endrin aldehyde	7421-93-4	0.05	mg/kg	<0.05	0.5 mg/kg	95.3	55.5	125
EP068: Endosulfan sulfate	1031-07-8	0.05	mg/kg	<0.05	0.5 mg/kg	92.9	57.1	117
EP068: 4.4`-DDT	50-29-3	0.2	mg/kg	<0.2	0.5 mg/kg	113	51.9	125
EP068: Endrin ketone	53494-70-5	0.05	mg/kg	<0.05	0.5 mg/kg	89.8	46.5	122
EP068: Methoxychlor	72-43-5	0.2	mg/kg	<0.2	0.5 mg/kg	82.2	34.0	130
EP068: Sum of DDD + DDE + DDT	72-54-8/72-5 5-9/50-2	0.05	mg/kg	<0.05	----	----	----	----
EP068: Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.05	mg/kg	<0.05	----	----	----	----
EP068B: Organophosphorus Pesticides (OP) (QCLot: 6875883)								
EP068: Dichlorvos	62-73-7	0.05	mg/kg	<0.05	0.5 mg/kg	94.8	55.8	126
EP068: Demeton-S-methyl	919-86-8	0.05	mg/kg	<0.05	0.5 mg/kg	90.5	45.9	136
EP068: Monocrotophos	6923-22-4	0.2	mg/kg	<0.2	0.5 mg/kg	36.1	20.0	147
EP068: Dimethoate	60-51-5	0.05	mg/kg	<0.05	0.5 mg/kg	85.2	44.1	125
EP068: Diazinon	333-41-5	0.05	mg/kg	<0.05	0.5 mg/kg	100	70.3	125
EP068: Chlorpyrifos-methyl	5598-13-0	0.05	mg/kg	<0.05	0.5 mg/kg	110	63.2	124
EP068: Parathion-methyl	298-00-0	0.2	mg/kg	<0.2	0.5 mg/kg	99.4	44.2	129
EP068: Malathion	121-75-5	0.05	mg/kg	<0.05	0.5 mg/kg	104	52.3	133
EP068: Fenthion	55-38-9	0.05	mg/kg	<0.05	0.5 mg/kg	108	62.9	126
EP068: Chlorpyrifos	2921-88-2	0.05	mg/kg	<0.05	0.5 mg/kg	102	69.2	123
EP068: Parathion	56-38-2	0.2	mg/kg	<0.2	0.5 mg/kg	115	37.6	138
EP068: Pirimphos-ethyl	23505-41-1	0.05	mg/kg	<0.05	0.5 mg/kg	119	59.6	131

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Acceptable Limits (%)	
				Result	Concentration	LCS	Low	High
EP068B: Organophosphorus Pesticides (OP) (QCLot: 6875883) - continued								
EP068: Chlorfenvinphos	470-90-6	0.05	mg/kg	<0.05	0.5 mg/kg	96.2	46.4	144
EP068: Bromophos-ethyl	4824-78-6	0.05	mg/kg	<0.05	0.5 mg/kg	108	56.8	128
EP068: Fenamiphos	22224-92-6	0.05	mg/kg	<0.05	0.5 mg/kg	75.0	24.4	135
EP068: Prothiofos	34643-46-4	0.05	mg/kg	<0.05	0.5 mg/kg	106	55.9	123
EP068: Ethion	563-12-2	0.05	mg/kg	<0.05	0.5 mg/kg	97.4	45.0	138
EP068: Carbophenothion	786-19-6	0.05	mg/kg	<0.05	0.5 mg/kg	106	41.6	141
EP068: Azinphos Methyl	86-50-0	0.05	mg/kg	<0.05	0.5 mg/kg	48.4	20.0	145
EP075(SIM)A: Phenolic Compounds (QCLot: 6875882)								
EP075(SIM): Phenol	108-95-2	0.5	mg/kg	<0.5	1.5 mg/kg	127	78.0	134
EP075(SIM): 2-Chlorophenol	95-57-8	0.5	mg/kg	<0.5	1.5 mg/kg	120	78.0	132
EP075(SIM): 2-Methylphenol	95-48-7	0.5	mg/kg	<0.5	1.5 mg/kg	118	78.0	132
EP075(SIM): 3- & 4-Methylphenol	1319-77-3	1	mg/kg	<1	3 mg/kg	121	77.2	135
EP075(SIM): 2-Nitrophenol	88-75-5	0.5	mg/kg	<0.5	1.5 mg/kg	109	42.9	156
EP075(SIM): 2.4-Dimethylphenol	105-67-9	0.5	mg/kg	<0.5	1.5 mg/kg	111	70.3	141
EP075(SIM): 2.4-Dichlorophenol	120-83-2	0.5	mg/kg	<0.5	1.5 mg/kg	104	69.9	135
EP075(SIM): 2.6-Dichlorophenol	87-65-0	0.5	mg/kg	<0.5	1.5 mg/kg	122	72.9	136
EP075(SIM): 4-Chloro-3-methylphenol	59-50-7	0.5	mg/kg	<0.5	1.5 mg/kg	120	53.3	138
EP075(SIM): 2.4.6-Trichlorophenol	88-06-2	0.5	mg/kg	<0.5	1.5 mg/kg	132	50.9	140
EP075(SIM): 2.4.5-Trichlorophenol	95-95-4	0.5	mg/kg	<0.5	1.5 mg/kg	94.8	45.5	140
EP075(SIM): Pentachlorophenol	87-86-5	2	mg/kg	<2	3 mg/kg	57.4	20.0	130
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QCLot: 6875882)								
EP075(SIM): Naphthalene	91-20-3	0.5	mg/kg	<0.5	1.5 mg/kg	127	72.6	133
EP075(SIM): Acenaphthylene	208-96-8	0.5	mg/kg	<0.5	1.5 mg/kg	123	63.2	144
EP075(SIM): Acenaphthene	83-32-9	0.5	mg/kg	<0.5	1.5 mg/kg	123	66.0	132
EP075(SIM): Fluorene	86-73-7	0.5	mg/kg	<0.5	1.5 mg/kg	128	76.2	134
EP075(SIM): Phenanthrene	85-01-8	0.5	mg/kg	<0.5	1.5 mg/kg	# 141	71.8	137
EP075(SIM): Anthracene	120-12-7	0.5	mg/kg	<0.5	1.5 mg/kg	125	77.1	143
EP075(SIM): Fluoranthene	206-44-0	0.5	mg/kg	<0.5	1.5 mg/kg	# 141	74.1	140
EP075(SIM): Pyrene	129-00-0	0.5	mg/kg	<0.5	1.5 mg/kg	# 140	72.0	139
EP075(SIM): Benz(a)anthracene	56-55-3	0.5	mg/kg	<0.5	1.5 mg/kg	114	58.0	145
EP075(SIM): Chrysene	218-01-9	0.5	mg/kg	<0.5	1.5 mg/kg	121	63.0	147
EP075(SIM): Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.5	mg/kg	<0.5	1.5 mg/kg	# 150	70.5	142
EP075(SIM): Benzo(k)fluoranthene	207-08-9	0.5	mg/kg	<0.5	1.5 mg/kg	130	75.5	138

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Acceptable Limits (%)	
				Result	Concentration	LCS	Low	High
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QCLot: 6875882) - continued								
EP075(SIM): Benzo(a)pyrene	50-32-8	0.5	mg/kg	<0.5	1.5 mg/kg	137	68.5	140
EP075(SIM): Indeno(1.2.3.cd)pyrene	193-39-5	0.5	mg/kg	<0.5	1.5 mg/kg	120	58.4	143
EP075(SIM): Dibenz(a.h)anthracene	53-70-3	0.5	mg/kg	<0.5	1.5 mg/kg	122	52.1	149
EP075(SIM): Benzo(g.h.i)perylene	191-24-2	0.5	mg/kg	<0.5	1.5 mg/kg	119	64.6	140
EP080/071: Total Petroleum Hydrocarbons (QCLot: 6875010)								
EP080: C6 - C9 Fraction	----	10	mg/kg	<10	18 mg/kg	95.6	64.2	107
EP080/071: Total Petroleum Hydrocarbons (QCLot: 6875881)								
EP071: C10 - C14 Fraction	----	50	mg/kg	<50	334 mg/kg	117	63.3	125
EP071: C15 - C28 Fraction	----	100	mg/kg	<100	432 mg/kg	114	56.1	122
EP071: C29 - C36 Fraction	----	100	mg/kg	<100	----	----	----	----
EP080/071: Total Petroleum Hydrocarbons (QCLot: 6876312)								
EP080: C6 - C9 Fraction	----	10	mg/kg	<10	18 mg/kg	106	64.2	107
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 6875010)								
EP080: C6 - C10 Fraction	C6_C10	10	mg/kg	<10	22.5 mg/kg	94.0	63.5	105
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 6875881)								
EP071: >C10 - C16 Fraction	----	50	mg/kg	<50	446 mg/kg	114	61.2	132
EP071: >C16 - C34 Fraction	----	100	mg/kg	<100	299 mg/kg	121	52.6	130
EP071: >C34 - C40 Fraction	----	100	mg/kg	<100	----	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 6876312)								
EP080: C6 - C10 Fraction	C6_C10	10	mg/kg	<10	22.5 mg/kg	101	63.5	105
EP080: BTEXN (QCLot: 6875010)								
EP080: Benzene	71-43-2	0.2	mg/kg	<0.2	1 mg/kg	95.9	68.0	107
EP080: Toluene	108-88-3	0.5	mg/kg	<0.5	1 mg/kg	91.6	69.0	108
EP080: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	1 mg/kg	93.4	68.0	109
EP080: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	2 mg/kg	96.5	70.0	114
EP080: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	1 mg/kg	96.9	74.0	116
EP080: Naphthalene	91-20-3	1	mg/kg	<1	1 mg/kg	92.0	74.0	109
EP080: BTEXN (QCLot: 6876312)								
EP080: Benzene	71-43-2	0.2	mg/kg	<0.2	1 mg/kg	89.0	68.0	107
EP080: Toluene	108-88-3	0.5	mg/kg	<0.5	1 mg/kg	91.3	69.0	108
EP080: Ethylbenzene	100-41-4	0.5	mg/kg	<0.5	1 mg/kg	95.4	68.0	109
EP080: meta- & para-Xylene	108-38-3 106-42-3	0.5	mg/kg	<0.5	2 mg/kg	90.4	70.0	114
EP080: ortho-Xylene	95-47-6	0.5	mg/kg	<0.5	1 mg/kg	111	74.0	116

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Acceptable Limits (%): Low	Acceptable Limits (%): High
EP080: BTEXN (QCLot: 6876312) - continued								
EP080: Naphthalene	91-20-3	1	mg/kg	<1	1 mg/kg	98.7	74.0	109
EP231A: Perfluoroalkyl Sulfonic Acids (QCLot: 6878674)								
EP231X: Perfluorobutane sulfonic acid (PFBS)	375-73-5	0.0002	mg/kg	<0.0002	0.0011 mg/kg	92.3	67.0	123
EP231X: Perfluorohexane sulfonic acid (PFHxS)	355-46-4	0.0002	mg/kg	<0.0002	0.00118 mg/kg	94.5	62.0	125
EP231X: Perfluorooctane sulfonic acid (PFOS)	1763-23-1	0.0002	mg/kg	<0.0002	0.00116 mg/kg	102	63.0	131
EP231B: Perfluoroalkyl Carboxylic Acids (QCLot: 6878674)								
EP231X: Perfluorobutanoic acid (PFBA)	375-22-4	0.001	mg/kg	<0.001	0.00625 mg/kg	91.9	66.0	130
EP231X: Perfluoropentanoic acid (PFPeA)	2706-90-3	0.0002	mg/kg	<0.0002	0.00125 mg/kg	94.0	64.0	127
EP231X: Perfluorohexanoic acid (PFHxA)	307-24-4	0.0002	mg/kg	<0.0002	0.00125 mg/kg	98.0	65.0	127
EP231X: Perfluoroheptanoic acid (PFHpA)	375-85-9	0.0002	mg/kg	<0.0002	0.00125 mg/kg	96.0	66.0	126
EP231X: Perfluorooctanoic acid (PFOA)	335-67-1	0.0002	mg/kg	<0.0002	0.00125 mg/kg	96.4	64.0	128
EP231D: (n:2) Fluorotelomer Sulfonic Acids (QCLot: 6878674)								
EP231X: 4:2 Fluorotelomer sulfonic acid (4:2 FTS)	757124-72-4	0.0005	mg/kg	<0.0005	0.00117 mg/kg	94.0	57.0	140
EP231X: 6:2 Fluorotelomer sulfonic acid (6:2 FTS)	27619-97-2	0.0005	mg/kg	<0.0005	0.00118 mg/kg	100	59.0	135
EP231X: 8:2 Fluorotelomer sulfonic acid (8:2 FTS)	39108-34-4	0.0005	mg/kg	<0.0005	0.0012 mg/kg	108	60.0	132
EP231X: 10:2 Fluorotelomer sulfonic acid (10:2 FTS)	120226-60-0	0.0005	mg/kg	<0.0005	0.0012 mg/kg	112	54.8	124

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **SOIL**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report: Spike Concentration	SpikeRecovery(%): MS	Acceptable Limits (%): Low	Acceptable Limits (%): High
EG005(ED093)T: Total Metals by ICP-AES (QCLot: 6878183)							
EB2532847-002	Anonymous	EG005T: Arsenic	7440-38-2	50 mg/kg	88.7	70.0	130
		EG005T: Cadmium	7440-43-9	50 mg/kg	85.8	70.0	130
		EG005T: Chromium	7440-47-3	50 mg/kg	90.2	70.0	130
		EG005T: Copper	7440-50-8	250 mg/kg	99.1	70.0	130
		EG005T: Lead	7439-92-1	250 mg/kg	88.6	70.0	130
		EG005T: Nickel	7440-02-0	50 mg/kg	91.2	70.0	130
		EG005T: Selenium	7782-49-2	50 mg/kg	93.4	70.0	130
		EG005T: Zinc	7440-66-6	250 mg/kg	81.3	70.0	130
EG035T: Total Recoverable Mercury by FIMS (QCLot: 6878184)							
EB2532847-002	Anonymous	EG035T: Mercury	7439-97-6	0.5 mg/kg	90.6	70.0	130
EP066: Polychlorinated Biphenyls (PCB) (QCLot: 6875884)							

Sub-Matrix: **SOIL**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Acceptable Limits (%)	
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EP066: Polychlorinated Biphenyls (PCB) (QCLot: 6875884) - continued							
EB2532723-007	BH02 - 0.5m	EP066: Total Polychlorinated biphenyls	----	1 mg/kg	102	70.0	130
EP068A: Organochlorine Pesticides (OC) (QCLot: 6875883)							
EB2532723-007	BH02 - 0.5m	EP068: gamma-BHC - (Lindane)	58-89-9	0.5 mg/kg	104	70.0	136
		EP068: Heptachlor	76-44-8	0.5 mg/kg	114	65.0	130
		EP068: Aldrin	309-00-2	0.5 mg/kg	108	70.0	130
		EP068: Dieldrin	60-57-1	0.5 mg/kg	102	67.0	129
		EP068: Endrin	72-20-8	0.5 mg/kg	104	60.0	137
		EP068: 4.4`-DDT	50-29-3	0.5 mg/kg	115	51.9	130
EP068B: Organophosphorus Pesticides (OP) (QCLot: 6875883)							
EB2532723-007	BH02 - 0.5m	EP068: Diazinon	333-41-5	0.5 mg/kg	98.9	70.0	131
		EP068: Chlorpyrifos-methyl	5598-13-0	0.5 mg/kg	110	63.2	130
		EP068: Pirimphos-ethyl	23505-41-1	0.5 mg/kg	118	59.6	130
		EP068: Bromophos-ethyl	4824-78-6	0.5 mg/kg	108	56.8	130
		EP068: Prothiofos	34643-46-4	0.5 mg/kg	108	55.9	134
EP075(SIM)A: Phenolic Compounds (QCLot: 6875882)							
EB2532723-007	BH02 - 0.5m	EP075(SIM): Phenol	108-95-2	1.5 mg/kg	112	70.0	130
		EP075(SIM): 2-Chlorophenol	95-57-8	1.5 mg/kg	109	70.0	130
		EP075(SIM): 2-Nitrophenol	88-75-5	1.5 mg/kg	108	42.9	156
		EP075(SIM): 4-Chloro-3-methylphenol	59-50-7	1.5 mg/kg	107	53.3	138
		EP075(SIM): Pentachlorophenol	87-86-5	3 mg/kg	87.2	20.0	130
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons (QCLot: 6875882)							
EB2532723-007	BH02 - 0.5m	EP075(SIM): Acenaphthene	83-32-9	1.5 mg/kg	109	66.0	132
		EP075(SIM): Pyrene	129-00-0	1.5 mg/kg	123	70.0	130
EP080/071: Total Petroleum Hydrocarbons (QCLot: 6875010)							
EB2532723-001	BH01 - 0.5m	EP080: C6 - C9 Fraction	----	8 mg/kg	87.3	70.0	130
EP080/071: Total Petroleum Hydrocarbons (QCLot: 6875881)							
EB2532723-007	BH02 - 0.5m	EP071: C10 - C14 Fraction	----	334 mg/kg	112	70.0	130
		EP071: C15 - C28 Fraction	----	432 mg/kg	116	70.0	130
EP080/071: Total Petroleum Hydrocarbons (QCLot: 6876312)							
EB2532723-024	QCBH02	EP080: C6 - C9 Fraction	----	8 mg/kg	121	70.0	130
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 6875010)							
EB2532723-001	BH01 - 0.5m	EP080: C6 - C10 Fraction	C6_C10	8 mg/kg	87.6	70.0	130
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 6875881)							
EB2532723-007	BH02 - 0.5m	EP071: >C10 - C16 Fraction	----	446 mg/kg	112	70.0	130
		EP071: >C16 - C34 Fraction	----	299 mg/kg	122	70.0	130
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 6876312)							

Sub-Matrix: **SOIL**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Acceptable Limits (%)	
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*Concentration*	*MS*	*Low*	*High*
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 6876312) - continued							
EB2532723-024	QCBH02	EP080: C6 - C10 Fraction	C6_C10	8 mg/kg	121	70.0	130
EP080: BTEXN (QCLot: 6875010)							
EB2532723-001	BH01 - 0.5m	EP080: Benzene	71-43-2	2 mg/kg	92.0	70.0	130
		EP080: Toluene	108-88-3	2 mg/kg	87.5	70.0	130
EP080: BTEXN (QCLot: 6876312)							
EB2532723-024	QCBH02	EP080: Benzene	71-43-2	2 mg/kg	88.1	70.0	130
		EP080: Toluene	108-88-3	2 mg/kg	91.2	70.0	130
EP231A: Perfluoroalkyl Sulfonic Acids (QCLot: 6878674)							
EB2532723-022	HA04 - 0.5m	EP231X: Perfluorobutane sulfonic acid (PFBS)	375-73-5	0.0011 mg/kg	85.9	72.0	128
		EP231X: Perfluorohexane sulfonic acid (PFHxS)	355-46-4	0.00118 mg/kg	90.7	67.0	130
		EP231X: Perfluorooctane sulfonic acid (PFOS)	1763-23-1	0.00116 mg/kg	102	68.0	136
EP231B: Perfluoroalkyl Carboxylic Acids (QCLot: 6878674)							
EB2532723-022	HA04 - 0.5m	EP231X: Perfluorobutanoic acid (PFBA)	375-22-4	0.00625 mg/kg	96.7	71.0	135
		EP231X: Perfluoropentanoic acid (PFPeA)	2706-90-3	0.00125 mg/kg	92.0	69.0	132
		EP231X: Perfluorohexanoic acid (PFHxA)	307-24-4	0.00125 mg/kg	95.2	70.0	132
		EP231X: Perfluoroheptanoic acid (PFHpA)	375-85-9	0.00125 mg/kg	101	71.0	131
		EP231X: Perfluorooctanoic acid (PFOA)	335-67-1	0.00125 mg/kg	96.8	69.0	133
EP231D: (n:2) Fluorotelomer Sulfonic Acids (QCLot: 6878674)							
EB2532723-022	HA04 - 0.5m	EP231X: 4:2 Fluorotelomer sulfonic acid (4:2 FTS)	757124-72-4	0.00117 mg/kg	95.3	62.0	145
		EP231X: 6:2 Fluorotelomer sulfonic acid (6:2 FTS)	27619-97-2	0.00118 mg/kg	113	64.0	140
		EP231X: 8:2 Fluorotelomer sulfonic acid (8:2 FTS)	39108-34-4	0.0012 mg/kg	113	65.0	137
		EP231X: 10:2 Fluorotelomer sulfonic acid (10:2 FTS)	120226-60-0	0.0012 mg/kg	118	54.8	124

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EB2532723**	Page	: 1 of 13
Amendment	: **1**		
Client	: **CQ ENVIRONMENTAL**	Laboratory	: Environmental Division Brisbane
Contact	: OSCAR DALLA PRIA	Telephone	: +61 7 4978 7944
Project	: 25054	Date Samples Received	: 19-Sep-2025
Site	: ----	Issue Date	: 07-Oct-2025
Sampler	: MICHAEL WHITEHEAD	No. of samples received	: 25
Order number	: 25054	No. of samples analysed	: 25

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Matrix Spike outliers occur.**
- **Laboratory Control outliers exist - please see following pages for full details.**
- **For all regular sample matrices, where applicable to the methodology, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **NO Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

- **NO Quality Control Sample Frequency Outliers exist.**

Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **SOIL**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Laboratory Control Spike (LCS) Recoveries							
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons	QC-6875882-002	----	**Phenanthrene**	85-01-8	141 %	71.8-137%	**Recovery greater than upper control limit**
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons	QC-6875882-002	----	**Fluoranthene**	206-44-0	141 %	74.1-140%	**Recovery greater than upper control limit**
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons	QC-6875882-002	----	**Pyrene**	129-00-0	140 %	72.0-139%	**Recovery greater than upper control limit**
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons	QC-6875882-002	----	**Benzo(b+j)fluoranthene**	205-99-2 205-82-3	150 %	70.5-142%	**Recovery greater than upper control limit**

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA029-A: pH Measurements							
Snap Lock Bag - frozen (EA029) BH03 - 0.5m, BH03 - 1.0m, BH03 - 2.0m	**15-Sep-2025**	**24-Sep-2025**	10-Jun-2028	✓	**24-Sep-2025**	23-Dec-2025	✓
Snap Lock Bag - frozen (EA029) BH01 - 0.5m, BH01 - 1.0m, BH02 - 0.5m, BH02 - 1.0m, BH02 - 2.0m, BH02 - 3.0m, BH02 - 4.0m, BH02 - 5.0m, BH03 - 3.0m, BH03 - 4.0m, BH03 - 5.0m	**16-Sep-2025**	**24-Sep-2025**	11-Jun-2028	✓	**24-Sep-2025**	23-Dec-2025	✓
Snap Lock Bag - frozen (EA029) BH01 - 2.0m, BH01 - 3.0m, BH01 - 4.0m, BH01 - 5.0m	**17-Sep-2025**	**24-Sep-2025**	12-Jun-2028	✓	**24-Sep-2025**	23-Dec-2025	✓

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA029-B: Acidity Trail							
Snap Lock Bag - frozen (EA029) BH03 - 0.5m, BH03 - 1.0m, BH03 - 2.0m	**15-Sep-2025**	**24-Sep-2025**	10-Jun-2028	✓	**24-Sep-2025**	23-Dec-2025	✓
Snap Lock Bag - frozen (EA029) BH01 - 0.5m, BH01 - 1.0m, BH02 - 0.5m, BH02 - 1.0m, BH02 - 2.0m, BH02 - 3.0m, BH02 - 4.0m, BH02 - 5.0m, BH03 - 3.0m, BH03 - 4.0m, BH03 - 5.0m	**16-Sep-2025**	**24-Sep-2025**	11-Jun-2028	✓	**24-Sep-2025**	23-Dec-2025	✓
Snap Lock Bag - frozen (EA029) BH01 - 2.0m, BH01 - 3.0m, BH01 - 4.0m, BH01 - 5.0m	**17-Sep-2025**	**24-Sep-2025**	12-Jun-2028	✓	**24-Sep-2025**	23-Dec-2025	✓
EA029-C: Sulfur Trail							
Snap Lock Bag - frozen (EA029) BH03 - 0.5m, BH03 - 1.0m, BH03 - 2.0m	**15-Sep-2025**	**24-Sep-2025**	10-Jun-2028	✓	**24-Sep-2025**	23-Dec-2025	✓
Snap Lock Bag - frozen (EA029) BH01 - 0.5m, BH01 - 1.0m, BH02 - 0.5m, BH02 - 1.0m, BH02 - 2.0m, BH02 - 3.0m, BH02 - 4.0m, BH02 - 5.0m, BH03 - 3.0m, BH03 - 4.0m, BH03 - 5.0m	**16-Sep-2025**	**24-Sep-2025**	11-Jun-2028	✓	**24-Sep-2025**	23-Dec-2025	✓
Snap Lock Bag - frozen (EA029) BH01 - 2.0m, BH01 - 3.0m, BH01 - 4.0m, BH01 - 5.0m	**17-Sep-2025**	**24-Sep-2025**	12-Jun-2028	✓	**24-Sep-2025**	23-Dec-2025	✓
EA029-D: Calcium Values							
Snap Lock Bag - frozen (EA029) BH03 - 0.5m, BH03 - 1.0m, BH03 - 2.0m	**15-Sep-2025**	**24-Sep-2025**	10-Jun-2028	✓	**24-Sep-2025**	23-Dec-2025	✓
Snap Lock Bag - frozen (EA029) BH01 - 0.5m, BH01 - 1.0m, BH02 - 0.5m, BH02 - 1.0m, BH02 - 2.0m, BH02 - 3.0m, BH02 - 4.0m, BH02 - 5.0m, BH03 - 3.0m, BH03 - 4.0m, BH03 - 5.0m	**16-Sep-2025**	**24-Sep-2025**	11-Jun-2028	✓	**24-Sep-2025**	23-Dec-2025	✓
Snap Lock Bag - frozen (EA029) BH01 - 2.0m, BH01 - 3.0m, BH01 - 4.0m, BH01 - 5.0m	**17-Sep-2025**	**24-Sep-2025**	12-Jun-2028	✓	**24-Sep-2025**	23-Dec-2025	✓

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA029-E: Magnesium Values							
Snap Lock Bag - frozen (EA029) BH03 - 0.5m, BH03 - 1.0m, BH03 - 2.0m	**15-Sep-2025**	**24-Sep-2025**	10-Jun-2028	✓	**24-Sep-2025**	23-Dec-2025	✓
Snap Lock Bag - frozen (EA029) BH01 - 0.5m, BH01 - 1.0m, BH02 - 0.5m, BH02 - 1.0m, BH02 - 2.0m, BH02 - 3.0m, BH02 - 4.0m, BH02 - 5.0m, BH03 - 3.0m, BH03 - 4.0m, BH03 - 5.0m	**16-Sep-2025**	**24-Sep-2025**	11-Jun-2028	✓	**24-Sep-2025**	23-Dec-2025	✓
Snap Lock Bag - frozen (EA029) BH01 - 2.0m, BH01 - 3.0m, BH01 - 4.0m, BH01 - 5.0m	**17-Sep-2025**	**24-Sep-2025**	12-Jun-2028	✓	**24-Sep-2025**	23-Dec-2025	✓
EA029-F: Excess Acid Neutralising Capacity							
Snap Lock Bag - frozen (EA029) BH03 - 0.5m, BH03 - 1.0m, BH03 - 2.0m	**15-Sep-2025**	**24-Sep-2025**	10-Jun-2028	✓	**24-Sep-2025**	23-Dec-2025	✓
Snap Lock Bag - frozen (EA029) BH01 - 0.5m, BH01 - 1.0m, BH02 - 0.5m, BH02 - 1.0m, BH02 - 2.0m, BH02 - 3.0m, BH02 - 4.0m, BH02 - 5.0m, BH03 - 3.0m, BH03 - 4.0m, BH03 - 5.0m	**16-Sep-2025**	**24-Sep-2025**	11-Jun-2028	✓	**24-Sep-2025**	23-Dec-2025	✓
Snap Lock Bag - frozen (EA029) BH01 - 2.0m, BH01 - 3.0m, BH01 - 4.0m, BH01 - 5.0m	**17-Sep-2025**	**24-Sep-2025**	12-Jun-2028	✓	**24-Sep-2025**	23-Dec-2025	✓
EA029-G: Retained Acidity							
Snap Lock Bag - frozen (EA029) BH03 - 0.5m, BH03 - 1.0m, BH03 - 2.0m	**15-Sep-2025**	**24-Sep-2025**	10-Jun-2028	✓	**24-Sep-2025**	23-Dec-2025	✓
Snap Lock Bag - frozen (EA029) BH01 - 0.5m, BH01 - 1.0m, BH02 - 0.5m, BH02 - 1.0m, BH02 - 2.0m, BH02 - 3.0m, BH02 - 4.0m, BH02 - 5.0m, BH03 - 3.0m, BH03 - 4.0m, BH03 - 5.0m	**16-Sep-2025**	**24-Sep-2025**	11-Jun-2028	✓	**24-Sep-2025**	23-Dec-2025	✓
Snap Lock Bag - frozen (EA029) BH01 - 2.0m, BH01 - 3.0m, BH01 - 4.0m, BH01 - 5.0m	**17-Sep-2025**	**24-Sep-2025**	12-Jun-2028	✓	**24-Sep-2025**	23-Dec-2025	✓

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA029-H: Acid Base Accounting							
Snap Lock Bag - frozen (EA029) BH03 - 0.5m, BH03 - 1.0m, BH03 - 2.0m	**15-Sep-2025**	**24-Sep-2025**	10-Jun-2028	✓	**24-Sep-2025**	23-Dec-2025	✓
Snap Lock Bag - frozen (EA029) BH01 - 0.5m, BH01 - 1.0m, BH02 - 0.5m, BH02 - 1.0m, BH02 - 2.0m, BH02 - 3.0m, BH02 - 4.0m, BH02 - 5.0m, BH03 - 3.0m, BH03 - 4.0m, BH03 - 5.0m	**16-Sep-2025**	**24-Sep-2025**	11-Jun-2028	✓	**24-Sep-2025**	23-Dec-2025	✓
Snap Lock Bag - frozen (EA029) BH01 - 2.0m, BH01 - 3.0m, BH01 - 4.0m, BH01 - 5.0m	**17-Sep-2025**	**24-Sep-2025**	12-Jun-2028	✓	**24-Sep-2025**	23-Dec-2025	✓
EA055: Moisture Content (Dried @ 105-110°C)							
Soil Glass Jar - Unpreserved (EA055) BH03 - 0.5m	**15-Sep-2025**	**----**	----	----	**22-Sep-2025**	29-Sep-2025	✓
Soil Glass Jar - Unpreserved (EA055) BH01 - 0.5m, BH02 - 0.5m, HA01 - 0.5m, HA02 - 0.5m, HA03 - 0.5m, HA04 - 0.5m, HA05 - 0.5m, QCBH02, HA03 DUP	**16-Sep-2025**	**----**	----	----	**22-Sep-2025**	30-Sep-2025	✓
EG005(ED093)T: Total Metals by ICP-AES							
Soil Glass Jar - Unpreserved (EG005T) BH03 - 0.5m	**15-Sep-2025**	**23-Sep-2025**	14-Mar-2026	✓	**24-Sep-2025**	14-Mar-2026	✓
Soil Glass Jar - Unpreserved (EG005T) BH01 - 0.5m, BH02 - 0.5m, HA01 - 0.5m, HA02 - 0.5m, HA03 - 0.5m, HA04 - 0.5m, HA05 - 0.5m, QCBH02, HA03 DUP	**16-Sep-2025**	**23-Sep-2025**	15-Mar-2026	✓	**24-Sep-2025**	15-Mar-2026	✓
EG035T: Total Recoverable Mercury by FIMS							
Soil Glass Jar - Unpreserved (EG035T) BH03 - 0.5m	**15-Sep-2025**	**23-Sep-2025**	13-Oct-2025	✓	**24-Sep-2025**	13-Oct-2025	✓
Soil Glass Jar - Unpreserved (EG035T) BH01 - 0.5m, BH02 - 0.5m, HA01 - 0.5m, HA02 - 0.5m, HA03 - 0.5m, HA04 - 0.5m, HA05 - 0.5m, QCBH02, HA03 DUP	**16-Sep-2025**	**23-Sep-2025**	14-Oct-2025	✓	**24-Sep-2025**	14-Oct-2025	✓

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP066: Polychlorinated Biphenyls (PCB)							
Soil Glass Jar - Unpreserved (EP066) BH03 - 0.5m	**15-Sep-2025**	**23-Sep-2025**	29-Sep-2025	✓	**24-Sep-2025**	02-Nov-2025	✓
Soil Glass Jar - Unpreserved (EP066) BH01 - 0.5m, BH02 - 0.5m	**16-Sep-2025**	**23-Sep-2025**	30-Sep-2025	✓	**24-Sep-2025**	02-Nov-2025	✓
Soil Glass Jar - Unpreserved (EP066) HA01 - 0.5m, HA02 - 0.5m, HA03 - 0.5m, HA04 - 0.5m, HA05 - 0.5m, QCBH02, HA03 DUP	**16-Sep-2025**	**23-Sep-2025**	30-Sep-2025	✓	**25-Sep-2025**	02-Nov-2025	✓
EP068A: Organochlorine Pesticides (OC)							
Soil Glass Jar - Unpreserved (EP068) BH03 - 0.5m	**15-Sep-2025**	**23-Sep-2025**	29-Sep-2025	✓	**24-Sep-2025**	02-Nov-2025	✓
Soil Glass Jar - Unpreserved (EP068) HA01 - 0.5m, HA02 - 0.5m, HA03 - 0.5m	**16-Sep-2025**	**23-Sep-2025**	30-Sep-2025	✓	**24-Sep-2025**	02-Nov-2025	✓
Soil Glass Jar - Unpreserved (EP068) BH01 - 0.5m, BH02 - 0.5m, HA04 - 0.5m, HA05 - 0.5m, QCBH02, HA03 DUP	**16-Sep-2025**	**23-Sep-2025**	30-Sep-2025	✓	**25-Sep-2025**	02-Nov-2025	✓
EP068B: Organophosphorus Pesticides (OP)							
Soil Glass Jar - Unpreserved (EP068) BH03 - 0.5m	**15-Sep-2025**	**23-Sep-2025**	29-Sep-2025	✓	**24-Sep-2025**	02-Nov-2025	✓
Soil Glass Jar - Unpreserved (EP068) HA01 - 0.5m, HA02 - 0.5m, HA03 - 0.5m	**16-Sep-2025**	**23-Sep-2025**	30-Sep-2025	✓	**24-Sep-2025**	02-Nov-2025	✓
Soil Glass Jar - Unpreserved (EP068) BH01 - 0.5m, BH02 - 0.5m, HA04 - 0.5m, HA05 - 0.5m, QCBH02, HA03 DUP	**16-Sep-2025**	**23-Sep-2025**	30-Sep-2025	✓	**25-Sep-2025**	02-Nov-2025	✓
EP075(SIM)A: Phenolic Compounds							
Soil Glass Jar - Unpreserved (EP075(SIM)) BH03 - 0.5m	**15-Sep-2025**	**23-Sep-2025**	29-Sep-2025	✓	**25-Sep-2025**	02-Nov-2025	✓
Soil Glass Jar - Unpreserved (EP075(SIM)) BH01 - 0.5m, BH02 - 0.5m, HA01 - 0.5m, HA02 - 0.5m, HA03 - 0.5m, HA04 - 0.5m, HA05 - 0.5m, QCBH02, HA03 DUP	**16-Sep-2025**	**23-Sep-2025**	30-Sep-2025	✓	**25-Sep-2025**	02-Nov-2025	✓

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons							
Soil Glass Jar - Unpreserved (EP075(SIM)) BH03 - 0.5m	**15-Sep-2025**	**23-Sep-2025**	29-Sep-2025	✓	**25-Sep-2025**	02-Nov-2025	✓
Soil Glass Jar - Unpreserved (EP075(SIM)) BH01 - 0.5m, BH02 - 0.5m, HA01 - 0.5m, HA02 - 0.5m, HA03 - 0.5m, HA04 - 0.5m, HA05 - 0.5m, QCBH02, HA03 DUP	**16-Sep-2025**	**23-Sep-2025**	30-Sep-2025	✓	**25-Sep-2025**	02-Nov-2025	✓
EP080/071: Total Petroleum Hydrocarbons							
Soil Glass Jar - Unpreserved (EP080) BH03 - 0.5m	**15-Sep-2025**	**22-Sep-2025**	29-Sep-2025	✓	**24-Sep-2025**	29-Sep-2025	✓
Soil Glass Jar - Unpreserved (EP071) BH03 - 0.5m	**15-Sep-2025**	**23-Sep-2025**	29-Sep-2025	✓	**25-Sep-2025**	02-Nov-2025	✓
Soil Glass Jar - Unpreserved (EP080) BH01 - 0.5m, BH02 - 0.5m, HA01 - 0.5m, HA02 - 0.5m, HA03 - 0.5m, HA04 - 0.5m, HA05 - 0.5m, QCBH02, HA03 DUP	**16-Sep-2025**	**22-Sep-2025**	30-Sep-2025	✓	**24-Sep-2025**	30-Sep-2025	✓
Soil Glass Jar - Unpreserved (EP071) BH01 - 0.5m, BH02 - 0.5m, HA01 - 0.5m, HA02 - 0.5m, HA03 - 0.5m	**16-Sep-2025**	**23-Sep-2025**	30-Sep-2025	✓	**25-Sep-2025**	02-Nov-2025	✓
Soil Glass Jar - Unpreserved (EP071) HA04 - 0.5m, HA05 - 0.5m, QCBH02, HA03 DUP	**16-Sep-2025**	**23-Sep-2025**	30-Sep-2025	✓	**26-Sep-2025**	02-Nov-2025	✓

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions							
Soil Glass Jar - Unpreserved (EP080) BH03 - 0.5m	**15-Sep-2025**	**22-Sep-2025**	29-Sep-2025	✓	**24-Sep-2025**	29-Sep-2025	✓
Soil Glass Jar - Unpreserved (EP071) BH03 - 0.5m	**15-Sep-2025**	**23-Sep-2025**	29-Sep-2025	✓	**25-Sep-2025**	02-Nov-2025	✓
Soil Glass Jar - Unpreserved (EP080) BH01 - 0.5m, BH02 - 0.5m, HA01 - 0.5m, HA02 - 0.5m, HA03 - 0.5m, HA04 - 0.5m, HA05 - 0.5m, QCBH02, HA03 DUP	**16-Sep-2025**	**22-Sep-2025**	30-Sep-2025	✓	**24-Sep-2025**	30-Sep-2025	✓
Soil Glass Jar - Unpreserved (EP071) BH01 - 0.5m, BH02 - 0.5m, HA01 - 0.5m, HA02 - 0.5m, HA03 - 0.5m	**16-Sep-2025**	**23-Sep-2025**	30-Sep-2025	✓	**25-Sep-2025**	02-Nov-2025	✓
Soil Glass Jar - Unpreserved (EP071) HA04 - 0.5m, HA05 - 0.5m, QCBH02, HA03 DUP	**16-Sep-2025**	**23-Sep-2025**	30-Sep-2025	✓	**26-Sep-2025**	02-Nov-2025	✓
EP080: BTEXN							
Soil Glass Jar - Unpreserved (EP080) BH03 - 0.5m	**15-Sep-2025**	**22-Sep-2025**	29-Sep-2025	✓	**24-Sep-2025**	29-Sep-2025	✓
Soil Glass Jar - Unpreserved (EP080) BH01 - 0.5m, BH02 - 0.5m, HA01 - 0.5m, HA02 - 0.5m, HA03 - 0.5m, HA04 - 0.5m, HA05 - 0.5m, QCBH02, HA03 DUP	**16-Sep-2025**	**22-Sep-2025**	30-Sep-2025	✓	**24-Sep-2025**	30-Sep-2025	✓
EP231A: Perfluoroalkyl Sulfonic Acids							
HDPE Soil Jar (EP231X) BH03 - 0.5m	**15-Sep-2025**	**23-Sep-2025**	14-Mar-2026	✓	**24-Sep-2025**	02-Nov-2025	✓
HDPE Soil Jar (EP231X) HA04 - 0.5m	**16-Sep-2025**	**23-Sep-2025**	15-Mar-2026	✓	**24-Sep-2025**	02-Nov-2025	✓
EP231B: Perfluoroalkyl Carboxylic Acids							
HDPE Soil Jar (EP231X) BH03 - 0.5m	**15-Sep-2025**	**23-Sep-2025**	14-Mar-2026	✓	**24-Sep-2025**	02-Nov-2025	✓
HDPE Soil Jar (EP231X) HA04 - 0.5m	**16-Sep-2025**	**23-Sep-2025**	15-Mar-2026	✓	**24-Sep-2025**	02-Nov-2025	✓
EP231D: (n:2) Fluorotelomer Sulfonic Acids							
HDPE Soil Jar (EP231X) BH03 - 0.5m	**15-Sep-2025**	**23-Sep-2025**	14-Mar-2026	✓	**24-Sep-2025**	02-Nov-2025	✓
HDPE Soil Jar (EP231X) HA04 - 0.5m	**16-Sep-2025**	**23-Sep-2025**	15-Mar-2026	✓	**24-Sep-2025**	02-Nov-2025	✓

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP231P: PFAS Sums							
HDPE Soil Jar (EP231X) BH03 - 0.5m	**15-Sep-2025**	**23-Sep-2025**	14-Mar-2026	✓	**24-Sep-2025**	02-Nov-2025	✓
HDPE Soil Jar (EP231X) HA04 - 0.5m	**16-Sep-2025**	**23-Sep-2025**	15-Mar-2026	✓	**24-Sep-2025**	02-Nov-2025	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **SOIL**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Moisture Content	EA055	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (SIM)	EP075(SIM)	2	18	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Per- and Polyfluoroalkyl Substances (PFAS) by LCMSMS	EP231X	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	1	10	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Polychlorinated Biphenyls (PCB)	EP066	1	10	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Suspension Peroxide Oxidation-Combined Acidity and Sulphate	EA029	2	18	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	4	37	**10.81**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
PAH/Phenols (SIM)	EP075(SIM)	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Per- and Polyfluoroalkyl Substances (PFAS) by LCMSMS	EP231X	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	1	10	**10.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Polychlorinated Biphenyls (PCB)	EP066	1	10	**10.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Suspension Peroxide Oxidation-Combined Acidity and Sulphate	EA029	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	2	37	**5.41**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
PAH/Phenols (SIM)	EP075(SIM)	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Per- and Polyfluoroalkyl Substances (PFAS) by LCMSMS	EP231X	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	1	10	**10.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Polychlorinated Biphenyls (PCB)	EP066	1	10	**10.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Suspension Peroxide Oxidation-Combined Acidity and Sulphate	EA029	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	2	37	**5.41**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
PAH/Phenols (SIM)	EP075(SIM)	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Per- and Polyfluoroalkyl Substances (PFAS) by LCMSMS	EP231X	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **SOIL**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Matrix Spikes (MS) - Continued							
Pesticides by GCMS	EP068	1	10	**10.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Polychlorinated Biphenyls (PCB)	EP066	1	10	**10.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	2	37	**5.41**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Suspension Peroxide Oxidation-Combined Acidity and Sulphate	EA029	SOIL	In house: Referenced to Ahern et al 2004 - a suspension peroxide oxidation method following the 'sulfur trail' by determining the level of 1M KCL extractable sulfur and the sulfur level after oxidation of soil sulphides. The 'acidity trail' is followed by measurement of TAA, TPA and TSA. Liming Rate is based on results for samples as submitted and incorporates a minimum safety factor of 1.5.
Moisture Content	EA055	SOIL	In house: A gravimetric procedure based on weight loss over a 12 hour drying period at 105-110 degrees C. This method is compliant with NEPM Schedule B(3).
Total Metals by ICP-AES	EG005T	SOIL	In house: Referenced to APHA 3120; USEPA SW 846 - 6010. Metals are determined following an appropriate acid digestion of the soil. The ICPAES technique ionises samples in a plasma, emitting a characteristic spectrum based on metals present. Intensities at selected wavelengths are compared against those of matrix matched standards. This method is compliant with NEPM Schedule B(3)
Total Mercury by FIMS	EG035T	SOIL	In house: Referenced to APHA 3112 Hg - B (Flow-injection (SnCl2) (Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. Mercury in solids are determined following an appropriate acid digestion. Ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM Schedule B(3)
Polychlorinated Biphenyls (PCB)	EP066	SOIL	In house: Referenced to USEPA SW 846 - 8270 Extracts are analysed by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM Schedule B(3).
Pesticides by GCMS	EP068	SOIL	In house: Referenced to USEPA SW 846 - 8270 Extracts are analysed by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. This technique is compliant with NEPM Schedule B(3).
TRH - Semivolatile Fraction	EP071	SOIL	In house: Referenced to USEPA SW 846 - 8015 Sample extracts are analysed by Capillary GC/FID and quantified against alkane standards over the range C10 - C40. Compliant with NEPM Schedule B(3).
PAH/Phenols (SIM)	EP075(SIM)	SOIL	In house: Referenced to USEPA SW 846 - 8270. Extracts are analysed by Capillary GC/MS in Selective Ion Mode (SIM) and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM Schedule B(3)
TRH Volatiles/BTEX	EP080	SOIL	In house: Referenced to USEPA SW 846 - 8260. Extracts are analysed by Purge and Trap, Capillary GC/MS. Quantification is by comparison against an established 5 point calibration curve. Compliant with NEPM Schedule B(3) amended.
Per- and Polyfluoroalkyl Substances (PFAS) by LCMSMS	EP231X	SOIL	In-house: Analysis of soils by solvent extraction followed by negative mode LC-ESI-MS/MS using MRM and isotope dilution or internal standard quantitation. A portion of homogenised sample is extracted along with isotope dilution standards (where commercially available) in a solution of ammonium acetate in acetonitrile/methanol. Where relevant, interferences from co-extracted organics are removed using dispersive clean-up media (dSPE). A portion of extract is combined with an equal volume of reagent water and filtered for instrumental analysis.

Preparation Methods	Method	Matrix	Method Descriptions

Preparation Methods	Method	Matrix	Method Descriptions
Drying at 85 degrees, bagging and labelling (ASS)	EN020PR	SOIL	In house
Hot Block Digest for metals in soils sediments and sludges	EN69	SOIL	In house: Referenced to USEPA 200.2. Hot Block Acid Digestion 1.0g of sample is heated with Nitric and Hydrochloric acids, then cooled. Peroxide is added and samples heated and cooled again before being filtered and bulked to volume for analysis. Digest is appropriate for determination of selected metals in sludge, sediments, and soils. This method is compliant with NEPM Schedule B(3).
Methanolic Extraction of Soils for Purge and Trap	ORG16	SOIL	In house: Referenced to USEPA SW 846 - 5030A. 5g of solid is shaken with surrogate and 10mL methanol prior to analysis by Purge and Trap - GC/MS.
Tumbler Extraction of Solids	ORG17	SOIL	In house: Mechanical agitation (tumbler). 10g of sample, Na2SO4 and surrogate are extracted with 30mL 1:1 DCM/Acetone by end over end tumble. The solvent is decanted, dehydrated and concentrated (by KD) to the desired volume for analysis.
QuECheRS Extraction of Solids	ORG71	SOIL	In house: Sequential extractions with Acetonitrile/Methanol by shaking. Extraction efficiency aided by the addition of salts under acidic conditions. Where relevant, interferences from co-extracted organics are removed with dispersive clean-up media (dSPE). The extract is either diluted or concentrated and exchanged into the analytical solvent.

SAMPLE RECEIPT NOTIFICATION (SRN)

Work Order : **EB2532723**

Client	: **CQ ENVIRONMENTAL**	Laboratory	: Environmental Division Brisbane
Contact	: OSCAR DALLA PRIA	Contact	: Kelly Schafer
Address	: 15 LORD STREET GLADSTONE QLD 4680	Address	: 2 Byth Street Stafford QLD Australia 4053
E-mail	: oscar.dallapria@cqgroup.com.au	E-mail	: kelly.schafer@alsglobal.com
Telephone	: ----	Telephone	: +61 7 4978 7944
Facsimile	: ----	Facsimile	: +61-7-3243 7218
Project	: 25054	Page	: 1 of 3
Order number	: 25054	Quote number	: EB2017CQENVIRO0004 (EN/222)
C-O-C number	: ----	QC Level	: NEPM 2013 B3 & ALS QC Standard
Site	: ----		
Sampler	: MICHAEL WHITEHEAD		

Dates

Date Samples Received	: 19-Sep-2025 11:40	Issue Date	: 19-Sep-2025
Client Requested Due Date	: 26-Sep-2025	Scheduled Reporting Date	: **26-Sep-2025**

Delivery Details

Mode of Delivery	: Carrier	Security Seal	: Intact.
No. of coolers/boxes	: 1	Temperature	: 1.2, 1.0, 1.1°C - Ice present
Receipt Detail	: Esky	No. of samples received / analysed	: 25 / 25

General Comments

- This report contains the following information:
  - Sample Container(s)/Preservation Non-Compliances
  - Summary of Sample(s) and Requested Analysis
  - Proactive Holding Time Report
  - Requested Deliverables
- ***Samples were originally received by ALS Gladstone on 18/9/2025 and have been forwarded to ALS Brisbane for analysis. Temperature on arrival in ALS Brisbane has been noted above.**
- Discounted Package Prices apply only when specific ALS Group Codes ('W', 'S', 'NT' suites) are referenced on COCs.
- Please direct any turn around / technical queries to the laboratory contact designated above.
- Sample Disposal - Aqueous (3 weeks), Solid (2 months ± 1 week) from receipt of samples.
- Unless otherwise stated, analytical work for this work order will be conducted by ALS Brisbane, NATA accreditation no. 825, site no. 818.
- **Breaches in recommended extraction / analysis holding times (if any) are displayed overleaf in the Proactive Holding Time Report table.**
- Please be aware that APHA/NEPM recommends water and soil samples be chilled to less than or equal to 6°C for chemical analysis, and less than or equal to 10°C but unfrozen for Microbiological analysis. Where samples are received above this temperature, it should be taken into consideration when interpreting results. Refer to ALS EnviroMail 85 for ALS recommendations of the best practice for chilling samples after sampling and for maintaining a cool temperature during transit.
- **Please refer to the Proactive Holding Time Report table below which summarises breaches of recommended holding times that have occurred prior to samples/instructions being received at the laboratory. The laboratory will process these samples unless instructions are received from you indicating you do not wish to proceed. The absence of this summary table indicates that all samples have been received within the recommended holding times for the analysis requested.**

Sample Container(s)/Preservation Non-Compliances

All comparisons are made against pretreatment/preservation AS, APHA, USEPA standards.

- **No sample container / preservation non-compliance exists.**

Summary of Sample(s) and Requested Analysis

Some items described below may be part of a laboratory process necessary for the execution of client requested tasks. Packages may contain additional analyses, such as the determination of moisture content and preparation tasks, that are included in the package.
If no sampling time is provided, the sampling time will default 00:00 on the date of sampling. If no sampling date is provided, the sampling date will be assumed by the laboratory and displayed in brackets without a time component

Matrix: **SOIL**

Laboratory sample ID	*Sampling date / time*	*Sample ID*	SOIL - EA029 SPOCAS	SOIL - EA055-103 Moisture Content	SOIL - EP231 (solids) PFAS - Short Suite (12 analytes)	SOIL - S-19 TRH/BTEXN/PAH/Phi/OC/OP/PCB/8 metals
EB2532723-001	16-Sep-2025 16:20	BH01 - 0.5m	✓	✓		✓
EB2532723-002	16-Sep-2025 16:45	BH01 - 1.0m	✓			
EB2532723-003	17-Sep-2025 07:30	BH01 - 2.0m	✓			
EB2532723-004	17-Sep-2025 07:40	BH01 - 3.0m	✓			
EB2532723-005	17-Sep-2025 07:50	BH01 - 4.0m	✓			
EB2532723-006	17-Sep-2025 08:10	BH01 - 5.0m	✓			
EB2532723-007	16-Sep-2025 12:30	BH02 - 0.5m	✓	✓		✓
EB2532723-008	16-Sep-2025 12:35	BH02 - 1.0m	✓			
EB2532723-009	16-Sep-2025 13:10	BH02 - 2.0m	✓			
EB2532723-010	16-Sep-2025 13:25	BH02 - 3.0m	✓			
EB2532723-011	16-Sep-2025 13:40	BH02 - 4.0m	✓			
EB2532723-012	16-Sep-2025 14:00	BH02 - 5.0m	✓			
EB2532723-013	15-Sep-2025 15:00	BH03 - 0.5m	✓	✓	✓	✓
EB2532723-014	15-Sep-2025 15:10	BH03 - 1.0m	✓			
EB2532723-015	15-Sep-2025 16:00	BH03 - 2.0m	✓			
EB2532723-016	16-Sep-2025 07:45	BH03 - 3.0m	✓			
EB2532723-017	16-Sep-2025 08:00	BH03 - 4.0m	✓			
EB2532723-018	16-Sep-2025 08:30	BH03 - 5.0m	✓			
EB2532723-019	16-Sep-2025 08:40	HA01 - 0.5m		✓		✓
EB2532723-020	16-Sep-2025 09:10	HA02 - 0.5m		✓		✓
EB2532723-021	16-Sep-2025 10:00	HA03 - 0.5m		✓		✓
EB2532723-022	16-Sep-2025 11:15	HA04 - 0.5m		✓	✓	✓
EB2532723-023	16-Sep-2025 13:00	HA05 - 0.5m		✓		✓
EB2532723-024	16-Sep-2025 12:30	QCBH02		✓		✓
EB2532723-025	16-Sep-2025 00:00	HA03 DUP		✓		✓

Proactive Holding Time Report

Sample(s) have been received within the recommended holding times for the requested analysis.

Requested Deliverables

ACCOUNTS PAYABLE		
- A4 - AU Tax Invoice (INV)	Email	accounts@cqgroup.com.au
ESDAT ESDAT		
- EDI Format - ESDAT (ESDAT)	Email	esdat+cqgroup@esdatlabsync.net
OSCAR DALLA PRIA		
- *AU Certificate of Analysis - NATA (COA)	Email	oscar.dallapria@cqgroup.com.au
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	oscar.dallapria@cqgroup.com.au
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	oscar.dallapria@cqgroup.com.au
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	oscar.dallapria@cqgroup.com.au
- Chain of Custody (CoC) (COC)	Email	oscar.dallapria@cqgroup.com.au
- EDI Format - ESDAT (ESDAT)	Email	oscar.dallapria@cqgroup.com.au
- EDI Format - XTab (XTAB)	Email	oscar.dallapria@cqgroup.com.au
PATRICE BROWN		
- *AU Certificate of Analysis - NATA (COA)	Email	patrice.brown@cqgroup.com.au
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	patrice.brown@cqgroup.com.au
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	patrice.brown@cqgroup.com.au
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	patrice.brown@cqgroup.com.au
- Chain of Custody (CoC) (COC)	Email	patrice.brown@cqgroup.com.au
- EDI Format - ESDAT (ESDAT)	Email	patrice.brown@cqgroup.com.au
- EDI Format - XTab (XTAB)	Email	patrice.brown@cqgroup.com.au

CHAIN OF CUSTODY

ALS Laboratory: please tick →

GLADSTONE 46 Callemondah Drive Clinton QLD 4680
Ph: 07 4975 7044 E: ALSEnviro.gladstone@alsglobal.com

CLIENT: GQG Consulting	TURNAROUND REQUIREMENTS: ☐ Standard TAT (List due date):	FOR LABORATORY USE ONLY (Circle)	
OFFICE: GLADSTONE	(Standard TAT may be longer for some tests e.g., Ultra Trace Organics) ☐ Non Standard or urgent TAT (List due date):	Custody Seal Intact?	Yes No N/A
PROJECT: 25054 PROJECT NO.:	ALS QUOTE NO.:	Free ice / frozen ice bricks present upon receipt?	Yes No N/A
ORDER NUMBER: PURCHASE ORDER NO.:	COUNTRY OF ORIGIN:	Random Sample Temperature on Receipt:	°C
PROJECT MANAGER: CONTACT PH:	COC SEQUENCE NUMBER (Circle) COC: (1) 2 3 4 5 6 7 OF: 1 (2) 3 4 5 6 7	Other comment:	
SAMPLER: Michael Whitehead SAMPLER MOBILE: 0403 443 329	RELINQUISHED BY: Michael DATE/TIME: 15-9 16:45	RECEIVED BY: Kschaefer DATE/TIME: 15.9.25 1645	RELINQUISHED BY: GW 15.00 DATE/TIME: 18.9.25
COC Emailed to ALS? NO EDD FORMAT (or default):			RECEIVED BY: DATE/TIME: 19/9/25 11.40
Email Reports to (will default to PM if no other addresses are listed): oscar.dallapria@cqgroup.com.au; Patrice.Brown@cqgroup.com.au			
Email Invoice to (will default to PM if no other addresses are listed): accounts@cqgroup.com.au			

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

ALS USE ONLY	SAMPLE DETAILS MATRIX: Solid(S) Water(W)			CONTAINER INFORMATION		ANALYSIS REQUIRED Including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).								Additional Information
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL BOTTLES	S-19 (TRH/BTEXN /PAH/Phenols/OC/OP/PCB, 15 Metals)	EP231 (PFAS – Short Suite (12 analytes))	EA029 - SPOCAS Suite						Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
1	BH01 - 0.5m	16.9.25 1620	SOIL			X		X						
2	BH01 - 1.0m	16.9.25 1645	SOIL					X						
3	BH01 - 2.0m	17.9.25 730	SOIL					X						
4	BH01 - 3.0m	17.9.25 740	SOIL					X						
5	BH01 - 4.0m	17.9.25 750	SOIL					X						
6	BH01 - 5.0m	17.9.25 810	SOIL					X						
7	BH02 - 0.5m	16.9.25 1230	SOIL			X		X						
8	BH02 - 1.0m	16.9.25 1235	SOIL					X						
9	BH02 - 2.0m	16.9.25 1310	SOIL					X						
10	BH02 - 3.0m	16.9.25 1325	SOIL					X						
11	BH02 - 4.0m	16.9.25 1340	SOIL					X						
12	BH02 - 5.0m	16.9.25 1400	SOIL					X						
13	BH03 - 0.5m	15-9-25 1500	SOIL			X	X	X						
14	BH03 - 1.0m	15-9 15:10	SOIL	ASS				X						
				TOTAL										

Environmental Division
Brisbane
Work Order Reference
EB2532723

Telephone : +61-7-3552-8685

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP = Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass; Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag; LI = Lugols Iodine Preserved Bottles; STT = Sterile Sodium Thiosulfate Preserved Bottles.

CHAIN OF CUSTODY

ALS Laboratory: please tick →

GLADSTONE 46 Callemondah Drive Clinton QLD 4680
Ph: 07 4978 7044 E: ALSEnviro.gladstone@alsglobal.com

CLIENT: GQG Consulting	TURNAROUND REQUIREMENTS : (Standard TAT may be longer for some tests e.g. Ultra Trace Organics) ☐ Standard TAT (List due date): ☐ Non Standard or urgent TAT (List due date):	FOR LABORATORY USE ONLY (Circle)	
OFFICE: GLADSTONE		Custody Seal Intact?	Yes No N/A
PROJECT: 25054 PROJECT NO.:	ALS QUOTE NO.:	Free ice / frozen ice bricks present upon receipt?	Yes No N/A
ORDER NUMBER: PURCHASE ORDER NO.:	COUNTRY OF ORIGIN:	Random Sample Temperature on Receipt:	°C
PROJECT MANAGER: CONTACT PH:	COC SEQUENCE NUMBER (Circle) COC: 1 (2) 3 4 5 6 7 OF: 1 (2) 3 4 5 6 7	Other comment:	
SAMPLER: Michael Whitehead SAMPLER MOBILE: 0403 443 329	RELINQUISHED BY: DATE/TIME: 15-9 16:45	RECEIVED BY: DATE/TIME: 15-9-25 16:45	RELINQUISHED BY: DATE/TIME:	RECEIVED BY: DATE/TIME: 16/9/25 11:40
COC Emailed to ALS? NO EDD FORMAT (or default):				
Email Reports to (will default to PM if no other addresses are listed): oscar.dallapria@cqgroup.com.au; Patrice.Brown@cqgroup.com.au				
Email Invoice to (will default to PM if no other addresses are listed): accounts@cqgroup.com.au				

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

ALS USE ONLY	SAMPLE DETAILS MATRIX: Solid(S) Water(W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).								Additional Information
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL BOTTLES	S-19 (TRH/BTEXN /PAH/Phenols/OC/OP/PCB, 15 Metals)	EP231 (PFAS – Short Suite (12 analytes))	EA029 - SPOCAS Suite						Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
15	BH03 - 2.0m	15-9 16:00	SOIL	ASS				X						
16	BH03 - 3.0m	16.9.25 745	SOIL					X						
17	BH03 - 4.0m	16.9.25 800	SOIL					X						
18	BH03 - 5.0m	16.9.25 830	SOIL					X						
19	HA01 - 0.5m	16.9.25 840	SOIL			X								
20	HA02 - 0.5m	16.9.25 910	SOIL			X								
21	HA03 - 0.5m	16.9.25 1000	SOIL			X								
22	HA04 - 0.5m	16.9.25 11:15	SOIL			X	X							
23	HA05-0.5m	16.9.25 1300	SOIL			X								
24	QCBH02 - 0.5m	16-9.25 1230	SOIL			X								
25	HA03 - DUP		SOIL			X								
			SOIL											
			SOIL											
			SOIL											
				TOTAL										

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag; U = Lugols Iodine Preserved Bottles; STT = Sterile Sodium Thiosulfate Preserved Bottles.

Appendix F:

Analytical Results Tables

Table F.1: Analytical soil results reported against relevant NEMP 2013 guidelines

Parameter	Unit	LoR	NEPM 2013 Table 1A(1) HILs Comm/Ind Soil	NEPM 2013 Table 1A(3) HSLs (0 - <1 m) Comm/Ind	NEPM 2013 Table 1B(4) EILs Comm/Ind	NEPM 2013 Table 1B(5) ESLs Comm/Ind (soil type = fine)	BH01 - 0.5m	BH02 - 0.5m	BH03 - 0.5m	HA01 - 0.5m	HA02 - 0.5m	HA03 - 0.5m	HA04 - 0.5m	HA05 - 0.5m	QC BH02	HA03 DUP
Arsenic	mg/kg	5	3000	NA	170	NA	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Barium	mg/kg	10	NA	NA	NA	NA	320	30	80	120	90	730	40	60	30	460
Beryllium	mg/kg	1	500	NA	NA	NA	<1	<1	<1	<1	<1	1	<1	<1	<1	1
Boron	mg/kg	50	300000	NA	NA	NA	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
Cadmium	mg/kg	1	800	NA	NA	NA	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chromium	mg/kg	2	3000	NA	NA	NA	16	13	11	16	10	15	13	10	11	15
Cobalt	mg/kg	2	4000	NA	NA	NA	19	6	9	20	10	70	9	20	6	57
Copper	mg/kg	5	250,000	NA	NA	NA	22	9	11	17	26	20	28	25	8	18
Lead	mg/kg	5	1,500	NA	1,800	NA	5	5	<5	<5	5	10	<5	6	<5	8
Manganese	mg/kg	5	40,000	NA	NA	NA	4160	513	829	1450	473	6100	466	201	685	3500
Nickel	mg/kg	2	4,000	NA	NA	NA	7	<2	4	10	4	9	8	5	<2	7
Selenium	mg/kg	5	10000	NA	NA	NA	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Vanadium	mg/kg	5	NA	NA	NA	NA	107	76	80	66	84	119	78	88	54	99
Zinc	mg/kg	5	400,000	NA	NA	NA	16	<5	8	14	12	12	14	10	<5	10

Parameter	Unit	LoR	NEPM 2013 Table 1A(1) HILs Comm/Ind Soil	NEPM 2013 Table 1A(3) HSLs (0 - <1 m) Comm/Ind	NEPM 2013 Table 1B(4) EILs Comm/Ind	NEPM 2013 Table 1B(5) ESLs Comm/Ind (soil type = fine)	BH01 - 0.5m	BH02 - 0.5m	BH03 - 0.5m	HA01 - 0.5m	HA02 - 0.5m	HA03 - 0.5m	HA04 - 0.5m	HA05 - 0.5m	QC BH02	HA03 DUP
TRH Fraction ($C_6 – C_{10}$)	mg/kg	10	NA	310	NA	215	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Benzene	mg/kg	0.2	NA	4	NA	95	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
F2 ($>C_{10} – C_{16}$)	mg/kg	50	NA	NA	NA	170	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
F3 ($>C_{16} – C_{34}$)	mg/kg	100	NA	NA	NA	2500	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
F4 ($>C_{34}$)	mg/kg	100	NA	NA	NA	6600	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
Toluene	mg/kg	0.5	NA	NA	NA	135	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	0.5	NA	NA	NA	185	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Xylenes	mg/kg	0.5	NA	NA	NA	95	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene	mg/kg	0.5	NA	NA	NA	1.4	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Naphthalene	mg/kg	1.0	NA	NA	370	NA	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
DDT	mg/kg	0.2	NA	NA	640	NA	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2

Table F.2: Parameters reported against QASSTM guidelines

ASS Indicator Parameter	Unit	LoR	Qld ASS trigger limit	BH01 - 0.5m	BH01 - 1.0m	BH01 - 2.0m	BH01 - 3.0m	BH01 - 4.0m	BH01 - 5.0m	BH02 - 0.5m	BH02 - 1.0m	BH02 - 2.0m	BH02 - 3.0m	BH02 - 4.0m	BH02 - 5.0m	BH03 - 0.5m	BH03 - 1.0m	BH03 - 2.0m	BH03 - 3.0m	BH03 - 4.0m	BH03 - 5.0m
Actual Acidity pHKCl (23A)	pH	0.1	< 4.0	4.7	5.6	8.4	8.6	8.6	8.2	5.2	5.4	8.5	7.3	7.7	7.7	5.4	5.9	8.6	8.7	8.8	8.7
Actual Acidity pHOX (23B)	pH	0.1	< 3.0	4.9	7	8.7	9.2	9.2	8.6	6.5	6.6	8.8	8.6	8.6	8.9	6.2	6.7	8.8	8.7	8.5	8.9
Net Acidity (acidity units)	mole H+ / t	10	0 - 1, 000 t material disturbed - 18 (Sands to loamy sands) - 36 (Clayey sands to light clays) - 62 (Fine to heavy clays/silts) > 1.000 t material disturbed 18	27	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Net Acidity (Equivalent Sulphur)	%S	0.02	0 - 1, 000 t material disturbed - 0.03 (Sands to loamy sands) - 0.06 (Clayey sands to light clays) - 62 (Fine to heavy clays/silts) > 1.000 t material disturbed 0.03	0.04	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
ANC Fineness Factor	-	0.5	> Potential Acidity	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Potential Sulphic Acidity Peroxide Oxidisable Sulfur	mole H+ / t	10		<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10

Appendix G:

RPD Calculations

Table G.1: RPD Calculations

EB2532723 Analyte grouping/Analyte	CAS Number	Unit	Limit of reporting	HA03 - 0.5m	HA03 DUP	H03 RPD(%)	BH02 - 0.5m	QCBH02	BH02 RPD(%)
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content		%	1.0	**8.1**	**7.8**	3.703703704	**5.1**	**4.4**	13.7254902
EG005(ED093)T: Total Metals by ICP-AES									
Arsenic	7440-38-2	mg/kg	5	<5	<5	0	<5	<5	0
Barium	7440-39-3	mg/kg	10	**730**	**460**	36.98630137	**30**	**30**	0
Beryllium	7440-41-7	mg/kg	1	1	**1**		<1	<1	0
Boron	7440-42-8	mg/kg	50	<50	<50		<50	<50	0
Cadmium	7440-43-9	mg/kg	1	<1	<1	0	<1	<1	0
Chromium	7440-47-3	mg/kg	2	**15**	**15**	0	**13**	**11**	15.38461538
Cobalt	7440-48-4	mg/kg	2	**70**	**57**		**6**	**6**	
Copper	7440-50-8	mg/kg	5	**20**	**18**	10	**9**	**8**	11.11111111
Lead	7439-92-1	mg/kg	5	**10**	**8**	20	**5**	<5	0
Manganese	7439-96-5	mg/kg	5	**6100**	**3500**	42.62295082	**513**	**685**	33.52826511
Nickel	7440-02-0	mg/kg	2	**9**	**7**	22.22222222	<2	<2	0
Selenium	7782-49-2	mg/kg	5	<5	<5	0	<5	<5	0
Vanadium	7440-62-2	mg/kg	5	**119**	**99**	16.80672269	**76**	**54**	28.94736842
Zinc	7440-66-6	mg/kg	5	**12**	**10**	16.66666667	<5	<5	0
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	mg/kg	0.1	<0.1	<0.1	0	<0.1	<0.1	
EP066: Polychlorinated Biphenyls (PCB)									
Total Polychlorinated biphenyls		mg/kg	0.1	<0.1	<0.1	0	<0.1	<0.1	
EP068A: Organochlorine Pesticides (OC)									
alpha-BHC	319-84-6	mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0
Hexachlorobenzene (HCB)	118-74-1	mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0
beta-BHC	319-85-7	mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0
gamma-BHC - (Lindane)	58-89-9	mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0
delta-BHC	319-86-8	mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0
Heptachlor	76-44-8	mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0
Aldrin	309-00-2	mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0
Heptachlor epoxide	1024-57-3	mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0
Total Chlordane (sum)		mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0
trans-Chlordane	5103-74-2	mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0
alpha-Endosulfan	959-98-8	mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0
cis-Chlordane	5103-71-9	mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0
Dieldrin	60-57-1	mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0
4.4`-DDE	72-55-9	mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0
Endrin	72-20-8	mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0
Endosulfan (sum)	115-29-7	mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0
beta-Endosulfan	33213-65-9	mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0

EB2532723 Analyte grouping/Analyte	CAS Number	Unit	Limit of reporting	HA03 - 0.5m	HA03 DUP	H03 RPD(%)	BH02 - 0.5m	QCBH02	BH02 RPD(%)
4.4`-DDD	72-54-8	mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0
Endrin aldehyde	7421-93-4	mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0
Endosulfan sulfate	1031-07-8	mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0
4.4`-DDT	50-29-3	mg/kg	0.2	<0.2	<0.2	0	<0.2	<0.2	0
Endrin ketone	53494-70-5	mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0
Methoxychlor	72-43-5	mg/kg	0.2	<0.2	<0.2	0	<0.2	<0.2	0
Sum of DDD + DDE + DDT	72-54-8/72-55-9/50-2	mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0
Sum of Aldrin + Dieldrin	309-00-2/60-57-1	mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0
EP068B: Organophosphorus Pesticides (OP)									
Dichlorvos	62-73-7	mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0
Demeton-S-methyl	919-86-8	mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0
Monocrotophos	6923-22-4	mg/kg	0.2	<0.2	<0.2	0	<0.2	<0.2	0
Dimethoate	60-51-5	mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0
Diazinon	333-41-5	mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0
Chlorpyrifos-methyl	5598-13-0	mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0
Parathion-methyl	298-00-0	mg/kg	0.2	<0.2	<0.2	0	<0.2	<0.2	0
Malathion	121-75-5	mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0
Fenthion	55-38-9	mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0
Chlorpyrifos	2921-88-2	mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0
Parathion	56-38-2	mg/kg	0.2	<0.2	<0.2	0	<0.2	<0.2	0
Pirimphos-ethyl	23505-41-1	mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0
Chlorfenvinphos	470-90-6	mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0
Bromophos-ethyl	4824-78-6	mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0
Fenamiphos	22224-92-6	mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0
Prothiofos	34643-46-4	mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0
Ethion	563-12-2	mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0
Carbophenothion	786-19-6	mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0
Azinphos Methyl	86-50-0	mg/kg	0.05	<0.05	<0.05	0	<0.05	<0.05	0
EP075(SIM)A: Phenolic Compounds									
Phenol	108-95-2	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0
2-Chlorophenol	95-57-8	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0
2-Methylphenol	95-48-7	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0
3- & 4-Methylphenol	1319-77-3	mg/kg	1	<1	<1	0	<1	<1	0
2-Nitrophenol	88-75-5	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0
2.4-Dimethylphenol	105-67-9	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0
2.4-Dichlorophenol	120-83-2	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0
2.6-Dichlorophenol	87-65-0	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0
4-Chloro-3-methylphenol	59-50-7	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0
2.4.6-Trichlorophenol	88-06-2	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0
2.4.5-Trichlorophenol	95-95-4	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0

EB2532723 Analyte grouping/Analyte	CAS Number	Unit	Limit of reporting	HA03 - 0.5m	HA03 DUP	H03 RPD(%)	BH02 - 0.5m	QCBH02	BH02 RPD(%)
Pentachlorophenol	87-86-5	mg/kg	2	<2	<2	0	<2	<2	0
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons									
Naphthalene	91-20-3	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0
Acenaphthylene	208-96-8	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0
Acenaphthene	83-32-9	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0
Fluorene	86-73-7	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0
Phenanthrene	85-01-8	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0
Anthracene	120-12-7	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0
Fluoranthene	206-44-0	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0
Pyrene	129-00-0	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0
Benz(a)anthracene	56-55-3	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0
Chrysene	218-01-9	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0
Benzo(b+j)fluoranthene	205-99-2 205-82-3	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0
Benzo(k)fluoranthene	207-08-9	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0
Benzo(a)pyrene	50-32-8	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0
Indeno(1.2.3.cd)pyrene	193-39-5	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0
Dibenz(a.h)anthracene	53-70-3	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0
Benzo(g.h.i)perylene	191-24-2	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0
Sum of polycyclic aromatic hydrocarbons		mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0
Benzo(a)pyrene TEQ (zero)		mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0
Benzo(a)pyrene TEQ (half LOR)		mg/kg	0.5	**0.6**	**0.6**	0	**0.6**	**0.6**	0
Benzo(a)pyrene TEQ (LOR)		mg/kg	0.5	**1.2**	**1.2**	0	**1.2**	**1.2**	0
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction		mg/kg	10	<10	<10	0	<10	<10	0
C10 - C14 Fraction		mg/kg	50	<50	<50	0	<50	<50	0
C15 - C28 Fraction		mg/kg	100	<100	<100	0	<100	<100	0
C29 - C36 Fraction		mg/kg	100	<100	<100	0	<100	<100	0
C10 - C36 Fraction (sum)		mg/kg	50	<50	<50	0	<50	<50	0
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
C6 - C10 Fraction	C6_C10	mg/kg	10	<10	<10	0	<10	<10	0
C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	mg/kg	10	<10	<10	0	<10	<10	0
>C10 - C16 Fraction		mg/kg	50	<50	<50	0	<50	<50	0
>C16 - C34 Fraction		mg/kg	100	<100	<100	0	<100	<100	0
>C34 - C40 Fraction		mg/kg	100	<100	<100	0	<100	<100	0
>C10 - C40 Fraction (sum)		mg/kg	50	<50	<50	0	<50	<50	0
>C10 - C16 Fraction minus Naphthalene (F2)		mg/kg	50	<50	<50	0	<50	<50	0
EP080: BTEXN									
Benzene	71-43-2	mg/kg	0.2	<0.2	<0.2	0	<0.2	<0.2	0
Toluene	108-88-3	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0
Ethylbenzene	100-41-4	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0

EB2532723 Analyte grouping/Analyte	CAS Number	Unit	Limit of reporting	HA03 - 0.5m	HA03 DUP	H03 RPD(%)	BH02 - 0.5m	QCBH02	BH02 RPD(%)
meta- & para-Xylene	108-38-3 106-42-3	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0
ortho-Xylene	95-47-6	mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0
Total Xylenes		mg/kg	0.5	<0.5	<0.5	0	<0.5	<0.5	0
Sum of BTEX		mg/kg	0.2	<0.2	<0.2	0	<0.2	<0.2	0
Naphthalene	91-20-3	mg/kg	1	<1	<1	0	<1	<1	0