

Bromelton Energy from Waste Facility – Air Quality Assessment

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Cleanaway Operations Pty Ltd

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Glossary

Units	Definition
$\mu\text{g}/\text{m}^3$	micrograms per cubic metre
μm	microns
$^{\circ}\text{C}$	degrees Celsius
km	kilometre
km/h	kilometre per hour
kPa	kilopascals
m	metre
m/s	metres per second
m^2	square metres
m^3	cubic metres
m^3/s	cubic metres per second
mg/m^3	milligram per cubic metre
MJ/kg	megajoules per kilogram
MW	megawatt
% O_2	percent oxygen content
OU	odour unit
ppm	parts per million
ppb	parts per billion
tpa	tonnes per annum
tph	tonnes per hour

Abbreviation/chemical formula

Abbreviation/chemical formula	Definition
AAQ NEPM	National Environment Protection (Ambient Air Quality) Measure
AHD	Australian Height Datum
Air EPP	<i>Environmental Protection (Air) Policy 2019</i>
APAC	Air pollution assessment criteria
APCr	Air pollution control residues
As	arsenic
AWS	automatic weather station
BaP	benzo(a)pyrene
BAT	Best Available Techniques (refer BREF)
BAT-AEL	Best Available Technique – Associated Emission Level
BERC	Bromelton Energy and Resource Centre
BoM	Bureau of Meteorology
BREF	Best Available Techniques Reference documents (developed under the European Integrated Pollution Prevention and Control Bureau Directive and the Industrial Emissions Directive)
BREF WI	BREF for Waste Incineration Facilities
C&D	Construction and demolition (waste)
C&I	Commercial and industrial (waste)
CALMET	A non-steady state diagnostic 3-D meteorological model
CALPUFF	A regulatory approved dispersion model
Cd	cadmium
CDMP	Construction Dust Management Plan
CEMS	Continuous Emissions Monitoring System
CO	carbon monoxide
Cr(III)	trivalent chromium
Cr(VI)	hexavalent chromium
CSIRO	The Commonwealth Scientific and Industrial Research Organisation
Cu	copper

CV	Calorific Value
DEM	Digital Elevation Model
DETSI	Department of Environment and Tourism, Science and Innovation
EA	Environmental Authority
EfW	Energy from waste
EP Act	<i>Environmental Protection Act 1994</i>
EPA	Environment Protection Authority
ERA	Environmentally Relevant Activity
FGT	Flue Gas Treatment stack
FGTR	Flue Gas Treatment Residuals
FOGO	food organics and garden organics
HCl	hydrogen chloride
HDPE	high density polyethylene
HF	hydrogen fluoride
Hg	mercury
IAQM	Institute of Air Quality Management
IBA	Incinerator bottom ash
IBAA	Incinerator bottom ash aggregate
IOA	index of agreement
LHV	Lower Heating Value
LOI	loss on ignition
LP1	Load Point 1
LP2	Load Point 2
MCR	Maximum continuous rating
Mn	manganese
MSES	Matters of State Environmental Significance
MSW	Municipal Solid Waste
NEPC	National Environment Protection Council
NH ₃	ammonia
Ni	nickel
NO ₂	nitrogen dioxide
NO _x	oxides of nitrogen
NPI	National Pollutant Inventory database
NTP	Normal Temperature and Pressure, 0 degrees Celsius & 101.325 kPa
O ₃	ozone
OTNOC	Other than normal operating conditions
PAH	polycyclic aromatic hydrocarbon
Pb	lead
PCBs	polychlorinated biphenyls
PCDD/F	polychlorinated dioxins and furans
PET	Polyethylene terephthalate
PM ₁₀	particulate matter with a diameter less than 10 micrometres
PM _{2.5}	particulate matter with a diameter less than 2.5 micrometres
QLD	Queensland
RMSE	root mean square error
SDA	State Development Area
SDPWO Act	<i>State Development and Public Works Organisation Act 1971</i>
Sb	antimony
SCNR	selective non-catalytic reduction
SO ₂	sulphur dioxide
TAPM	The Air Pollution Model
TEEP	Technically, environmentally and economically practical

TI	thallium
TOC	total organic carbon (EU IED refers to gaseous and vaporous organic substances expressed as TOC)
TSP	total suspended particulate
TVOC	total volatile organic carbon (BREF WI refers to gaseous organic emissions as TVOC)
UE IED	European Union Industrial Emissions Directive
Vic EPA	Victorian Environmental Protection Authority
VOC	volatile organic compounds
WAP	Waste Acceptance Protocol

EXECUTIVE SUMMARY

Cleanaway Operations Pty Ltd (Cleanaway) is an Australian waste management, recycling, and industrial services company. Cleanaway is developing an energy from waste (EfW) facility in Queensland known as the Bromelton Energy and Resource Centre (BERC) (the Project). The Project will be located within the Special Industry Precinct of the Bromelton State Development Area (SDA), west of Beaudesert.

The BERC has been designed to thermally treat a design capacity of 760,000 tonnes per annum (tpa) of waste feedstock when operating at the design calorific value (CV) of 10.6 MJ/kg (LHV) and assuming 8,000 hours per annum for boiler availability. The waste feedstock is expected to consist of a mix of residual Municipal Solid Waste (MSW) and residual commercial and industrial waste (C&I), which is waste that would otherwise be sent to landfill. Waste feedstock processed by the BERC will be subject to a Waste Acceptance Protocol to determine eligibility and suitability for processing wastes both prior to arrival and upon arrival on-site. The BERC will also incorporate maturation and processing of incinerator bottom ash (IBA) to recover recyclable metals, with the intent to utilise the remaining ash as an aggregate in construction.

Katestone Environmental Pty Ltd (Katestone) has been commissioned by Cleanaway to conduct air quality, odour and plume visibility assessments to support the preparation of a development application under the *Environment Protection Act 1994*.

The air quality assessment has investigated the potential for the Project to affect air quality during construction and operations.

The potential impacts of dust emissions during construction of the Project have been assessed using a risk-based methodology. This 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 potential impacts of emissions during operation of the Project have been assessed using a dispersion modelling approach. Emissions of key pollutants have been assessed for four scenarios:

- Load Point 1 (LP1) daily average operations
 - Nominal waste throughput at 100% thermal input. To accommodate temporary operation at up to 110% thermal input due to normal waste variability, this assessment includes a 10% margin on mass emission rates.
 - Normal operating conditions
 - BREF WI, 2019 - daily average (upper) concentration limits
 - Both lines assumed to be at the daily average (upper) concentration limits.
- LP1 – short-term operations
 - Nominal waste throughput at 100% thermal input, with a 10% margin on mass emission rates.
 - EU IED (2010) - short-term (30-minute average) emission limits to reflect variability in a processing line due to variability in mixed waste feedstock composition and/or combustion characteristics and some process upsets and non-routine operations. As a worst-case assumption, one line will be operating at short-term emission limits whilst the other line will be operating at the daily average (upper) concentration limit
 - These emissions would be short in duration (30-minute) due to the management and mitigation measures (as detailed in Section 10) to be employed by the Project.

- Emissions for metals have been conservatively assumed to include both lines operating at LP1 daily average emission rates and additionally, one line operating at the short-term maximum dust emission limit with fly ash metals composition applied to this value.
- LP2 – daily average operations.
 - Maximum waste throughput at 120% mechanical load
 - 100% thermal input, with a 10% margin on mass emission rates.
 - Normal operating conditions
 - BREF WI, 2019 - daily average (upper) concentration limits.
- LP2 – short-term operations
 - Maximum waste throughput at 120% mechanical load
 - 100% thermal input, with a 10% margin on mass emission rates.
 - EU IED (2010) - short-term (30-minute average) emission limits to reflect variability in a processing line due to variability in mixed waste feedstock composition and/or combustion characteristics and some process upsets and non-routine operations. As a worst-case assumption, one line will be operating at short-term emission limits whilst the other line will be operating at the daily average (upper) concentration limit
 - Emissions for metals have been conservatively assumed to include both processing lines operating at LP2 daily average emission rates and additionally, one line operating at the short-term maximum dust emission limit with metals calculated from this value using fly ash metals composition.

The regulatory-approved dispersion model, CALPUFF, has been used to predict ground-level concentrations of air pollutants. Background levels of air pollutants have been conservatively accounted for by explicitly modelling nearby industry and adding ambient backgrounds from the Department of Environment and Tourism, Science and Innovation (DETSI) ambient air monitoring stations at Springwood and Woolloongabba, both of which are significantly closer to major population centres and industry pollution sources than the Project site. Predicted concentrations have been compared against the relevant health-based and environmental air quality objectives identified by the *Environmental Protection (Air) Policy 2019* and the *Environmental Protection (Air) Amendment Policy 2024*, collectively known as the Air EPP. For pollutants released from the BERC which are not covered by the Air EPP objectives, criteria from the EPA Victoria have been adopted.

Odour from the Project has also been assessed using a risk assessment approach.

For the Project's construction phase the air quality risk assessment identified the following:

- Without mitigation, the preliminary risk of dust soiling associated with the construction of the Project is low.
- Without mitigation, the preliminary risk to human health associated with the construction of the Project is low.
- Without mitigation, the preliminary risk to ecological receptors associated with construction of the Project is low.
- A Construction Dust Management Plan (CDMP) will be prepared and implemented by the construction contractor. The CDMP will include mitigation measures for controlling dust. By implementing the CDMP, the risk of dust emissions from construction causing soiling or potentially adversely affecting human health and ecological receptors is low.

For the Project's operation phase the air quality assessment identified the following:

- With the Project operating at the LP1 daily average (upper) emission concentration limits as specified in the BREF:
 - The Project (in isolation) is predicted to have an **insignificant impact** on air quality as measured against the relevant objectives.
 - Maximum ground-level concentrations due to the Project with cumulative background (where available) do not exceed 95% of the relevant objectives.
- With the Project operating at the LP1 short-term emission concentration limits as specified in the EU IED (2010):
 - The Project (in isolation) is predicted to have an **insignificant impact** on air quality as measured against the relevant objectives.
 - Maximum ground-level concentrations due to the Project with cumulative background (where available) do not exceed 76% of the relevant objectives.
- With the Project operating at the LP2 daily average (upper) emission concentration limits as specified in the BREF:
 - The Project (in isolation) is predicted to have an **insignificant impact** on air quality as measured against the relevant objectives.
 - Maximum ground-level concentrations due to the Project with cumulative background (where available) do not exceed 95% of the relevant objectives.
- With the Project operating at the LP2 short-term emission concentration limits as specified in the EU IED (2010):
 - The Project (in isolation) is predicted to have an **insignificant impact** on air quality as measured against the relevant objectives.
 - Maximum ground-level concentrations due to the Project with cumulative background (where available) do not exceed 76% of the relevant objectives.
- Different calorific values of waste fuel or changes in waste throughput do not significantly affect the emissions due to the Project (i.e., LP1 vs LP2) with predicted ground-level concentrations predicted to vary at most by 3% relative to air quality objectives based on different calorific values of the waste fuel and despite a 20% increase in waste throughput associated with LP2 as compared to LP1.
- In terms of predicted concentrations within Matters of State Environmental Significance (MSES) areas:
 - The Project (in isolation) is predicted to have an **insignificant impact** on air quality as measured against the relevant objectives.
 - Maximum ground-level concentrations due to the Project with cumulative background (where available) do not exceed 41% of the relevant objectives.

The air quality assessment has found that the risk of adverse odour impacts due to the Project is low.

The air quality assessment has found that, with the proposed control measures, the Incinerator Bottom Ash / Incinerator Bottom Ash Aggregate (IBA/IBAA) storage area is predicted to have an insignificant impact on air quality as measured against the relevant objectives.

In terms of plume visibility for LP1, that is, associated with condensing water vapour in the flue gas:

- For the entire five-year period (40,035 hours modelled), the plume has the potential to be visible for 2,380 hours of which 2,278 hours (or only 5.7% of entire period) would be during daylight hours.
- The maximum height above ground at which the plume would be visible has been predicted to range from 103 m to 261 m above ground.
- The horizontal extent that the plume would be visible has been predicted to range from 0.2 m to 262 m downwind, with an average horizontal extent of 21 m.
- In terms of the visible plume extending beyond the site boundary, the distance from the stack to the closest site boundary is 183 m. The modelling shows that the visible plume is predominately contained within the Project site.

In summary, the daily average (i.e., under normal operating conditions) and short-term average air quality modelling results demonstrate that, with the proposed emission limit settings based on the upper end of the BAT-AEL range associated with implementation of BAT for emission control and flue gas treatment, the Project (in isolation) is predicted to have an insignificant impact on air quality, as measured against the relevant health-based and environmental based air quality objectives.

These results, the proposed design and operational management of the Project, as described in this report, demonstrate:

- The appropriate implementation of best practices as described in the BREF WI, and therefore, satisfaction of Policy outcome 7 of Queensland's EfW Policy.
- The Project complies with the objectives in the Air EPP and will meet AO2.1, PO3, and PO7 of State Code 22, and Section 2.5.4 of the Bromelton SDA wide assessment criteria.
- The Project will meet PO1, PO2, PO3, PO6, PO34 of State Code 22 as emissions due to operations comply with the objectives in the Air EPP and plume visibility will not impede the rail corridor and dust during construction will be managed to avoid nuisance.

1. INTRODUCTION

Cleanaway Operations Pty Ltd (Cleanaway) is developing an Energy from Waste (EfW) facility in Queensland known as the Bromelton Energy and Resource Centre (BERC / the Project). The Project will be located within the Special Industry Precinct of the Bromelton State Development Area (SDA), west of Beaudesert within the Scenic Rim Regional Council local government area.

Katestone Environmental Pty Ltd (Katestone) has been commissioned by Cleanaway to conduct air quality, odour and plume visibility assessments to support the preparation of a Development Application under the *Environment Protection Act 1994*.

This assessment comprises the following sections:

- Description of the Project (Section 2)
- Identification of applicable policies and legislation to the Project (Section 3)
- Description of the existing environment including local terrain and land-use, sensitive receptors, meteorology, and ambient air quality (Section 4)
- Outline of the methodology adopted for this assessment (Section 4.5)
- Assessment of construction (Section 6)
- Emissions inventories for operations and assessment of impacts (Section 7)
- Odour risk assessment (Section 8)
- Assessment of plume visibility (Section 9)
- Details of mitigation and risk management strategies and technology to be implemented at the Project (Section 10)
- Conclusions (Section 11)
- Details of modelling inputs, tabulated results, and risk assessment methodologies (Appendices).

2. THE PROJECT

2.1 Overview

The Project has been designed to thermally treat approximately 760,000 tonnes per annum (tpa) of waste feedstock, consisting of residual Municipal Solid Waste (MSW) and residual Commercial and Industrial (C&I) waste. Residual waste is waste that is not technically, environmentally and economically practical (TEEP) to reuse or recycle, which would otherwise be sent to landfill for disposal. The facility's actual annual throughput will vary depending on the calorific value of the feedstock and plant availability. To account for variability in feedstock energy content, the facility will be designed for a maximum processing capacity of up to 10% above the nominal figure (836,000 tpa). The EfW process is summarised in Figure 1.

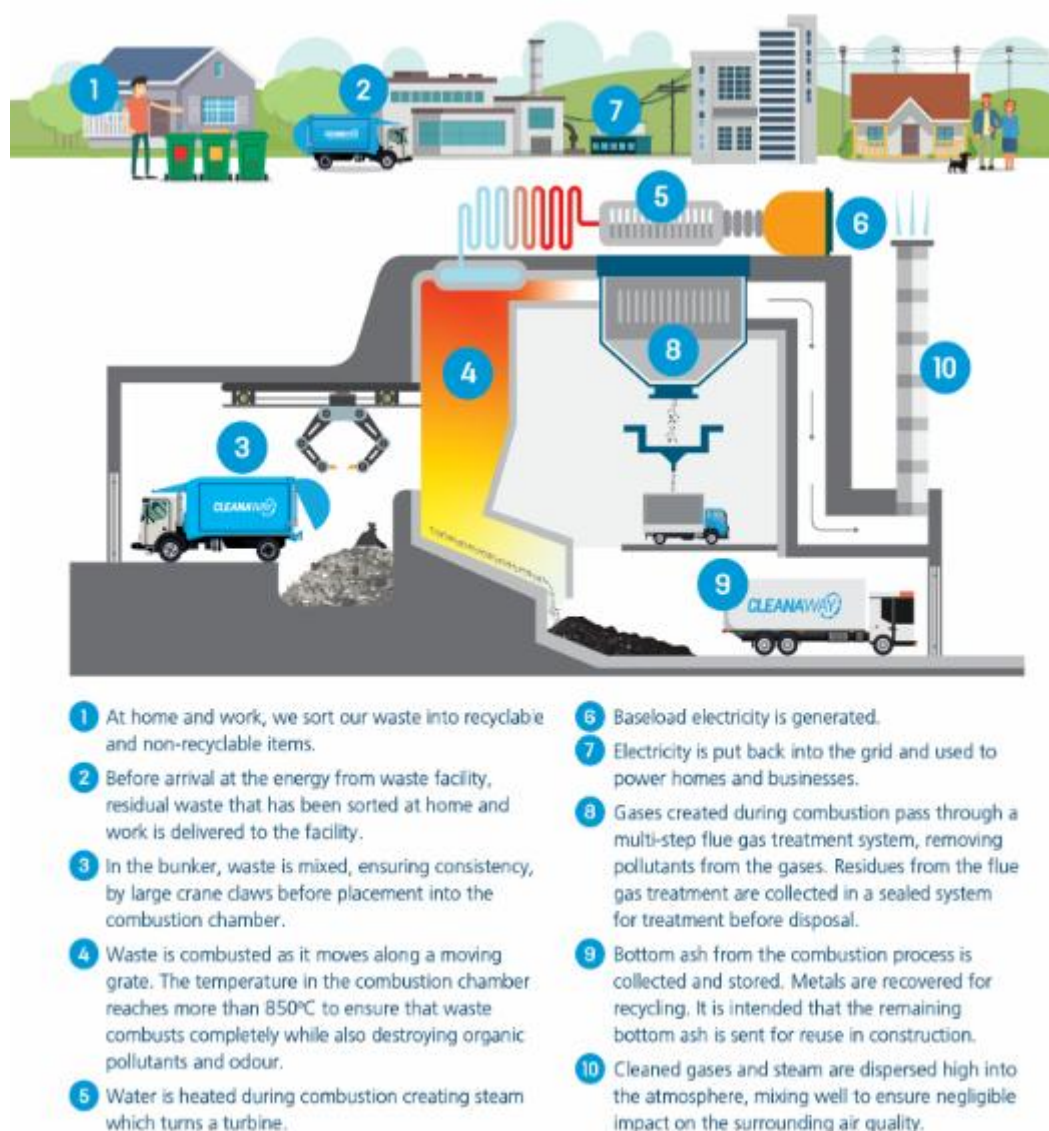


Figure 1 Energy from Waste Process

2.2 Proponent

Cleanaway, an Australian owned company, has operated for more than 50 years, supporting industry, government, communities and households across Australia. Its mission is to make a sustainable future possible, achieved through action across all levels of the waste hierarchy. Waste generation is minimised through extensive education programs, with Cleanaway's 50 education officers reaching over 120 businesses, 30 councils, and almost 33,000 school participants in the last financial year.

Cleanaway invests heavily in recycling, operating several Material Recovery Facilities nationwide and has partnered with Pact Group, Asahi Beverages and Coca-Cola to deliver two large-scale PET (polyethylene terephthalate) recycling facilities and a HDPE (high density polyethylene) recycling facility with Pact Group. In addition, in collaboration with Viva Energy, Cleanaway is developing a soft plastics recycling plant. EfW is recognised by Cleanaway as an important part of the future waste management framework, enabling recovery of energy and other resources from residual waste that cannot otherwise be recycled.

2.3 Policy alignment

The BERC aligns with the Queensland Energy from Waste Policy (2021) (EfW Policy) and the Queensland Energy from Waste Guideline (2021) (EfW Guideline) by diverting residual waste from landfill and delivering economic and social benefits through employment and local business opportunities in South East Queensland.

In accordance with Policy outcome 7 of the Queensland EfW Policy, the BERC will be designed to meet the best practice emission standards and requirements of the European Industrial Emissions Directive (IED) (2010) and the associated Best Available Techniques Reference (BREF) Document for Waste Incineration (2019), which sets the European Union environmental standards for waste incineration.

The Project also supports the Queensland Waste Strategy contributing to its 2050 targets to reduce household waste by 25%, recycle 75% of all waste, and divert 90% from landfill. In doing so, the BERC will play a key role in advancing Queensland's transition to a circular economy and reducing long-term reliance on landfill.

2.4 Key components

The key components of the Project are summarised in Table 1.

Table 1 Key Project Components

Project Component	Detail
Address	Lot 1 Beaudesert Boonah Road, Bromelton, Queensland, 4285 (Lot 1 on RP45234). Refer Figure 2.
Site Area	63 hectares
Summary of proposed works	The Project includes the construction of a main EfW facility for waste processing, incinerator bottom ash (IBA) maturation and processing facility and an air pollution control residue (APCr) facility. It also includes all onsite infrastructure needed for the EfW facility, such as site utilities, internal roads, weighbridges, parking and hardstand areas, stormwater infrastructure, fencing and landscaping. The Project will include a visitor centre to help educate and inform the community on circular economy principles, the waste hierarchy, including waste avoidance, recycling, resource recovery, the benefits of landfill diversion and the EfW process. The intent behind this education is to drive a shift in community awareness and attitudes toward waste management and resource recovery.

Project Component	Detail
Technology Used	The proposed technology is moving grate combustion technology. This has been used globally for over 100 years and is common in many of the 500 similar operational examples across Europe.
Facility Outputs	Approximately 73.2 MW (577,600 MWh/year, corrected for ambient temperature) exported to the grid as baseload electricity. Potential to supply energy in the form of heat and/or process steam to local industrial users. Residual materials include IBA and APCr: - It is intended that the IBA will be mechanically processed on site to create incinerator bottom ash aggregate (IBAA). During this process, both ferrous and non-ferrous metals are recovered for recycling and sale. It is intended that the remaining material is repurposed for use as an aggregate in construction. - The Project includes a facility to stabilise APCr before removal and disposal at a licensed landfill.
Key infrastructure	EfW facility including administration and visitor's centre IBA maturation and processing facility (2 x pads and 2 x sheds) APCr facility (1 x pad, 1 x shed) Transformer yard and switchyard De-coupling area for trucks Weighbridges Internal road network and carparking 2 x combined storm water treatment and detention basin 1 x lined retention basin Access from Beaudesert Boonah Road via a signalised intersection with Recycling Street
Hours of Operation	24 hours per day, seven days per week (365 days per year)
Operational Staff	Approximately 60 staff



Figure 2 Site Location

2.5 Project layout

The proposed development is situated within the locality of Bromelton, Queensland, approximately 47 km inland of the Gold Coast and around 56 km south-southwest of Brisbane CBD. Situated in the Scenic Rim region of Queensland, the Project sits near the base of hills directly to the west, with the township of Beaudesert 7 km to the east.

The Project site design is depicted in Figure 3.

The Project site will incorporate the following key elements:

- Two-line (2 x 140 MW_{th}) EfW facility, with each line comprising: a combustor, boiler, flue gas treatment system, Induced Draft (ID) fan, Continuous Emissions Monitoring System (CEMS) and a dedicated flue. The processing capacity of each line will be approximately 380,000tpa (760,000 tpa cumulative) at the design CV of 10.6 MJ/kg (LHV) and assuming 8,000 hours per annum boiler availability. The two lines will supply steam to a single steam turbine while flue gas will be discharged through a single stack containing two internal flues. Moving grate combustion will be employed as the preferred thermal treatment technology.
- Incinerator Bottom Ash (IBA) treatment area and sorting plant incorporating: a fully enclosed sorting facility, an enclosed conveyor for delivery of IBA from EfW facility to the IBA treatment area, IBA maturation stockpiles (1-2 months) contained within a 3-sided building and open-air stockpiles for sorted and matured IBA aggregate (IBAA) (1-2 months) with dust control using water spraying, and water capture system around the IBA treatment area, segregated from the site stormwater management system.
- APCr undercover stabilisation and storage facilities where treated APCr (a slurry of APCr, cement and water) is allowed to cure into solid blocks prior to transport offsite for landfill disposal.
- Site infrastructure including roads, weighbridges, inspection bays, dangerous goods tanks, firewater and process water tanks, electrical substation, truck movement areas, offices, on-site car parking areas and a separate main staff and visitor car park. A visitor and education centre is also proposed, to be integrated within the site administration building.

2.6 Construction

Construction is anticipated to take approximately 36 months to complete (exclusive of commissioning and proof of performance testing prior to operations) and will have the potential to generate dust emissions from land clearing, the handling of material, windblown dust of exposed areas, vehicle movements and exhaust emissions from emergency diesel generators. Potential impacts from construction emissions are addressed through a construction dust risk assessment detailed in Section 4.5.

2.7 Operations

Figure 1 provides an overview of the operational features of the Project. Further details on specific elements of the facility with relevance to air quality are described in the following sections.

2.7.1 Waste volumes and waste acceptance

The Project will receive approximately 760,000 tpa of a combination of mainly residual MSW and residual C&I waste. The EfW facility is designed to maintain availability of 8,000 hrs/yr per operational line with a nominal throughput for each line of 47.5 tph.

Only wastes that are consistent with the definition of residual waste under the EfW Guideline (DES, 2021) outcome 4 will be accepted as waste feedstock. Examples of non-residual waste include, but are not limited to, uncontaminated comingled recyclables from yellow lid bins; source-separated green waste; and MSW, C&I and C&D waste that has not been source separated.

Waste feedstock supplies by Cleanaway and third-party suppliers will be managed in accordance with the BERC Waste Acceptance Protocol (WAP), which defines both acceptable and unacceptable waste types, along with waste arrival and inspection protocols and provisions to divert or remove unacceptable waste or waste loads. The waste acceptance process essentially involves pre-qualification of waste suppliers and waste types through contractual Waste Supply Agreements, identification and logging of all waste deliveries, radiation detection and inspection of the waste at various stages (Figure 4) for size and suitability, aiming to maintain the composition and combustion characteristics of the waste feedstock within an acceptable range and to remove unacceptable materials that may result in unacceptable contaminant levels or may cause damage or blockages to plant and equipment. Periodic sampling of waste will also be undertaken to determine certain key parameters of the waste profile including ash, moisture, chlorine, sulphur and metallic aluminum. Oversized acceptable waste can be fed to an onsite shredder before being fed to the boiler.

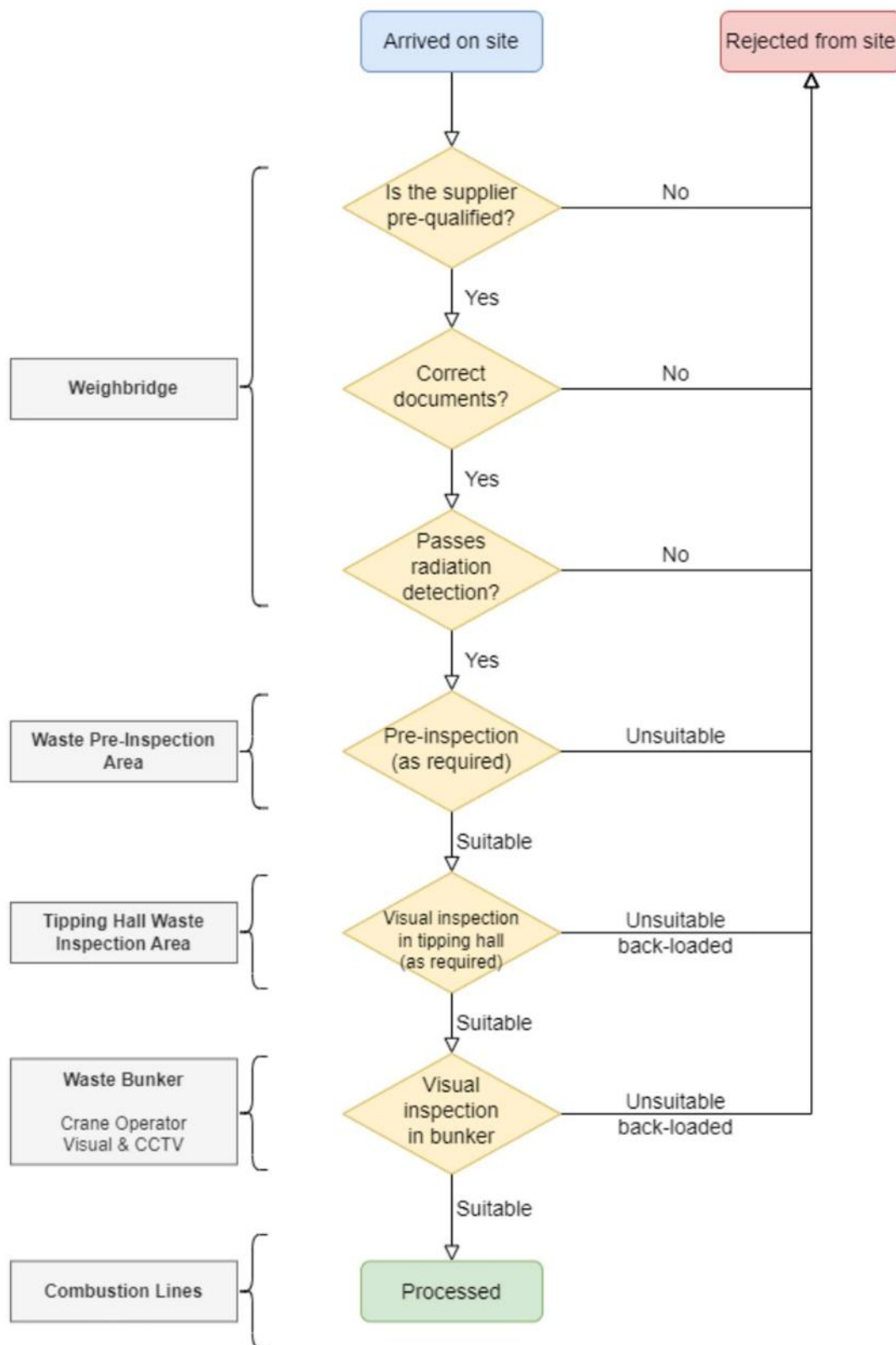


Figure 4 Process on arrival for a waste delivery to the EfW facility

2.7.2 Waste arrival

Waste deliveries will enter the BERC site via a security gate house at the weighbridge where the vehicle will be checked for excessive levels of radiation, weighed and have their delivery details recorded. Waste delivery vehicles may be selected at random to proceed to a designated pre-inspection and quarantine area to allow the BERC operations staff to verify the waste and where feasible, visually inspect the load to confirm its suitability as acceptable waste.

2.7.3 Tipping hall and waste bunker

Waste will be delivered via a tipping hall, expected to operate seven days per week with the majority of deliveries occurring during a 12 hour-a-day window (6 am – 6 pm) although the facility will be able to accept waste 24/7, if required.

The tipping hall will be designed to cope with the facility 'peak hour', which is the hour in the day where the largest number of vehicles is expected to require processing. The preliminary estimate of total waste deliveries is up to approximately 119 waste trucks per day at 10% mechanical overload. The tipping hall will be enclosed and will include quick shutting roller doors for odour control. Negative pressure will be maintained in the hall and waste bunker areas by preferentially drawing potentially odorous air from within the tipping hall and waste bunker area into the boiler furnace as combustion air. Adjustable louvres in the façade of the tipping hall will allow air inflow (for the furnace combustion air system), even if the entry and exit roller doors are closed.

The tipping hall shall include a waste inspection area where random waste loads arriving in compactor size vehicles can be temporarily unloaded for inspection and shall include a waste rejection point to allow removal of unsuitable waste from the bunker.

Tipping hall bays shall include a protection mechanism to mitigate the risk of vehicles overreaching into the bunker.

The waste bunker shall be designed to store approximately seven days of waste at full capacity. The waste bunker is monitored by CCTV in the plant control room.

During delivery hours, the waste crane operators will monitor the operation of the grab cranes, to mix and distribute the waste, and move oversize acceptable waste into the shredder for resizing. The grab cranes will also be used to remove unacceptable waste from the waste bunker. The mixing operation of the grab crane is important for the stable operation of the combustion system and flue gas treatment system, by working to ensure that individual waste loads are mixed together prior to being fed to each grate combustion system.

2.7.4 Combustion system and waste firing

The combustion system will be of a typical moving grate design suitable for combustion of MSW and C&I wastes. The boiler will generate superheated steam suitable for driving the steam turbine. The boiler will be designed to maintain a flue gas temperature of at least 850 degrees Celsius for a residence time of at least two seconds (after last injection of combustion air) to comply with the requirements of EU IED, as required by the EfW Policy (DES, 2021) and EfW Guideline (DES, 2021). The system will include online boiler tube cleaning.

The boiler system will include an allowance for auxiliary fossil fuel burners (e.g., auxiliary diesel fuel burners) for start-up, shutdown and to ensure that the 850 degree Celsius for two seconds residence time criteria is maintained when waste is being combusted.

The capacity diagram (Figure 5) identifies the maximum and minimum design ranges for determining both mechanical and thermal capacity requirements of the process equipment and components. The design point for the firing diagram is:

- 47.5 tph of waste (per line), corresponding to an annualised waste throughput of 760,000 tpa of waste based on 8,000 hours per annum of boiler availability, and
- A calorific value (CV) of 10.6 MJ/kg lower heating value (LHV) (based on a C&I and MSW waste mixer).

The Project is designed to operate across a range of CVs with a reasonably selected design point. This is done to accommodate normal variabilities in waste make-up and associated changes in waste CV. Although the plant has a design point of 760,000tpa with a waste CV of 10.6 MJ/kg (LHV) and 8,000 hours per annum boiler availability, in reality the plant could potentially process up to 836,000 tpa if the waste CV is 10.6 MJ/kg (LHV) (i.e. 10% mechanical overload scenario) and the facility hypothetically maintains a boiler availability of 100% and/or between 100-110% thermal input. Mixed waste streams such as MSW and C&I waste are expected to constantly fluctuate in composition and combustion characteristics, however, the automated combustion control system will act to maintain stable boiler operation by controlling each boiler to a steam flow setpoint. This setpoint will ideally correspond to the 100% thermal input load for each grate-boiler system.

The Capacity Diagram (also known as a Firing Diagram) (Figure 5) shows the valid operating envelope for 1 of 2 grate-boiler lines. Key features of the Capacity Diagram are as follows:

- Diagonal pale green lines: indicate the range of CVs for the waste fuel from 7.4 MJ/kg (Load Point (LP) 8) to 14.6 MJ/kg (LPs 4, 5, and 6). This allows for a variation in fuel CV of 70% to 138% of the design point (10.6 MJ/kg of waste)
- Vertical dashed lines: indicate the waste throughput mechanical load ranging from 33.3 t/hr to 57 t/hr. This allows for variation between 70% to 120% of the design point of 47.5 t/hr
- Horizontal dashed lines: indicate the thermal input ranging from 97.9 MW to 153.8 MW. This represents a range between 70% - 110% of the design point of 140 MW
- Load Points: These indicate valid operational points at the extremities of the valid operating envelope for each grate-boiler system. The Project can continuously operate at all LPs for periods over two hours, except for the region bounded by LP2, 3, 4 and 6, the thermal overload region, which is designed to manage inevitable fluctuations from the preferred continuous operational line LP1, 2, 6, corresponding to 100% thermal input. Continuous operation within the thermal overload region is not recommended.

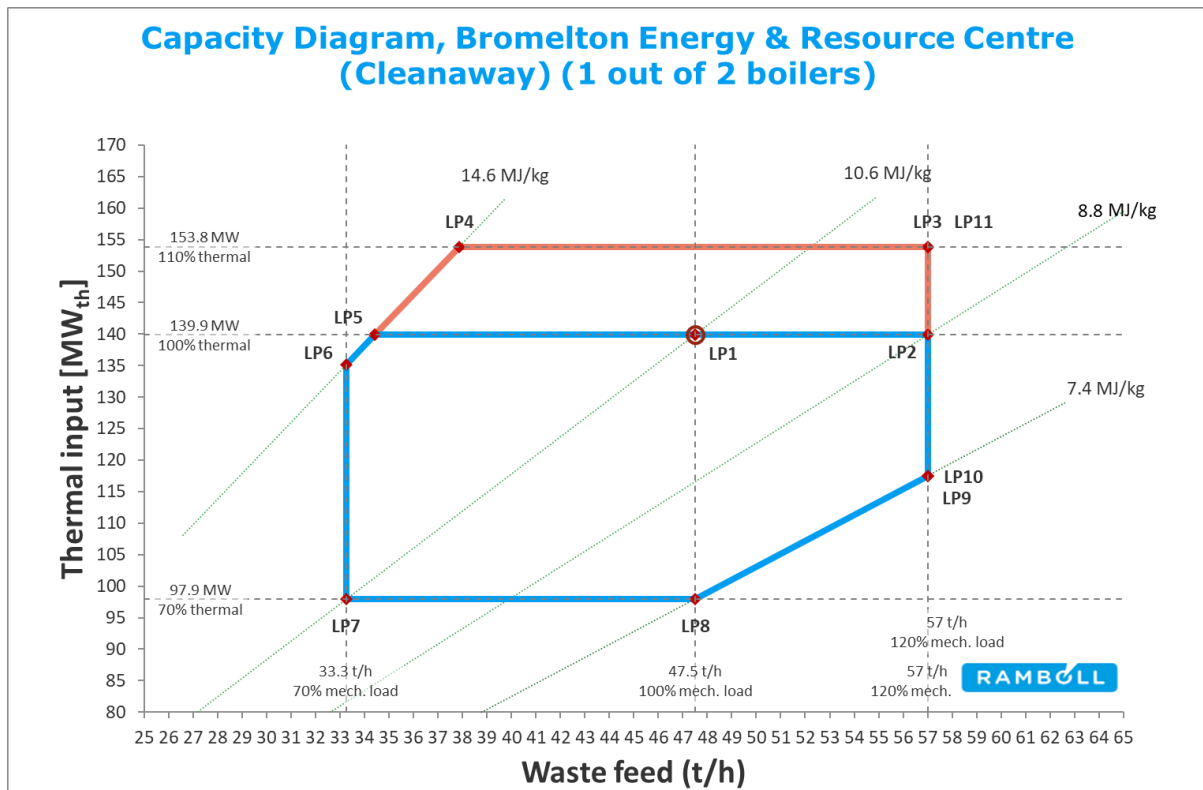


Figure 5 Firing capacity diagram (one line) as provided by Ramboll

2.7.5 Emission controls and flue gas treatment

The concentrations of some air pollutants in the flue gas leaving the combustion system, such as nitrogen oxide, nitrogen dioxide (together referred to as NO_x), carbon monoxide (CO), volatile organic compounds (VOCs), and dioxins and furans, are directly linked to the performance of the combustion system as well as the composition of the waste. Primary emission control involves:

- Mixing of the waste in the waste bunker prior to feeding each combustion system
- An automatic combustion control system that adjusts the feeder speed, movement of the grate (residence time and thickness of waste on the grate), primary and secondary combustion air flows, to maintain a desired steam generation set point from each boiler
- Careful control of combustion air injection such that excess air levels are controlled, helps to control the primary formation of NO_x, though there is a trade-off with CO formation if combustion air levels are too low
- Maintaining stable combustion conditions and ensuring the flue gas temperature remains above 850 degrees Celsius for at least two seconds residence time helps to ensure the destruction of VOCs, dioxins and furans, and other similar organic compounds commonly found in solid fuel combustion systems.

The Project also includes a secondary NO_x abatement system within the boiler known as Selective Non-Catalytic Reduction (SNCR). SNCR involves injecting ammonia or urea solution into the flue gas within a temperature range of ~900 – 1050 degrees Celsius. In this temperature range, the ammonia or urea will reduce the majority of the NO_x that may be present in the flue gas to nitrogen and water.

After the SNCR system, hot flue gas passes through the boiler where it is used to raise steam and then superheat steam and finally, preheat the boiler feedwater in an economiser section. At the exit of the boiler economiser section, the cooled flue gases will be treated using an air emissions control system that consists of semi-dry flue gas treatment (FGT), and a baghouse filter.

Lime injection will be used to control emissions of acid gas pollutants via chemisorption (in particular HCl, HF, and SO₂) while activated carbon injection is used to control volatile heavy metals (such as mercury, lead and cadmium) and any residual organic compounds through adsorption, when coupled with a baghouse filter. Indicative quantities of lime, urea, and activated carbon are detailed in Table 2.

The FGT and air emissions control system will be designed to ensure stack emissions at least meet the upper end of the range of associated emission levels (Section 7.1) of the best available techniques (BAT-AELs) as detailed in the latest Best Available Techniques Reference Document (BREF) for Waste Incineration (WI) (BREF WI) (Newahl F, et.al., 2019) and the short-term (half-hourly average) emission limits specified in the European IED, consistent with international best practice.

Table 2 Indicative quantities of FGT consumables

Consumable	Consumption (kg/h)	Base Case 100% MCR (760,000 tpa @ 10.6 MJ/kg (LHV) - Nominal throughput scenario	10% Mechanical Overload Case (836,000 tpa @ 10.6 MJ/kg (LHV) - Maximum throughput scenario
Quicklime (~90% purity)	1,100 – 1,300	9,200	10,100
40% Urea (or NH ₃ -H ₂ O)	480 - 530	3,800	4,200
Activated carbon	51 - 52	410	420

2.7.6 Bottom ash and residue management

The Project will generate two primary residue streams: IBA and APCr.

IBA will be collected from below the grate using a wet ash extraction system. Wetted IBA will be transported via a long, fully enclosed conveyor to the IBA Treatment area where it will undergo maturation and sorting including the removal of ferrous and non-ferrous metals. Sorting and metals recovery will occur indoors, after a period of maturation. Figure 6 illustrates the process.

After maturation and metals recovery, the IBA aggregate (IBAA) is typically considered (after suitable testing and confirmation during commissioning) to be non-hazardous. Recovered IBAA can then be used as an aggregate in construction (such as road bases). This is common practice for recycled IBAA in Europe and the UK. BERC will repurpose the IBAA in accordance with EfW Policy (DES, 2021).

APCr consists of two separate ash streams:

- Boiler ash (recovered in the hoppers below the horizontal pass/convective section of the boiler)
- Flue gas treatment or air pollution control residues (essentially a purge stream of baghouse filter cake, consisting of flue gas treatment residue and residual fly ash).

Boiler ash from the convective section of the boiler may be considered hazardous. To be conservative and align with precedents set for other EfW facilities currently at the development phase in Australia, this boiler ash will be mixed with APCr, which is hazardous and must be treated as such. APCr must be immobilised to avoid the leaching of heavy metals and other hazardous compounds into the environment. This will be achieved through blending with

cement and water, which cures to form a solid concrete block, immobilising the hazardous elements. Once fully cured, the cement-stabilised APCr will be transported to and disposed of in an appropriately classed landfill.

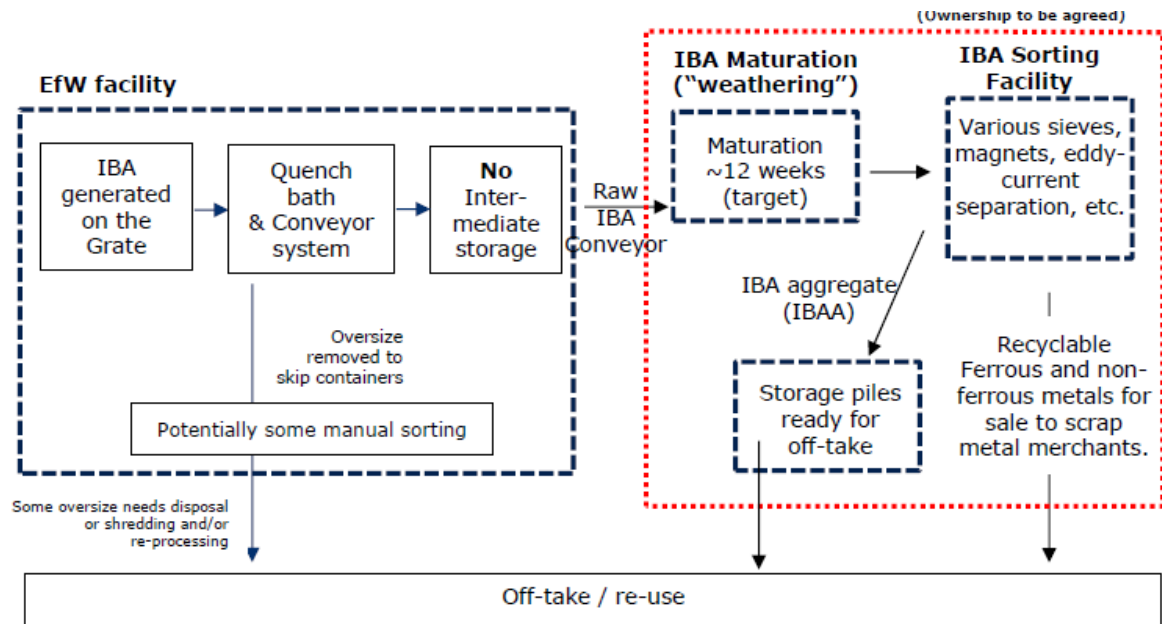


Figure 6 IBA / IBAA process (Source: REN2021N00922-RAM-ME-00020 BERC IBA Memo v2.0 Issued 09JUL2025)

3. POLICY FRAMEWORK AND ASSESSMENT REQUIREMENTS

3.1 Overview

This section describes the legislation within Queensland (QLD) of relevance to EfW projects and air quality. Each of the below items are discussed in the following sections and addressed by the assessment of the BERC Project.

EfW projects in QLD are regulated via the following hierarchy:

- Waste Management and Resource Recovery Strategy (2019) (the Strategy)
- EfW Policy (DES, 2021)
- EfW Guideline (DES, 2021)

Supporting legislation, policy and guidance for the *EP Act* relevant to this assessment are:

- Environmental Protection Regulation 2019 (EP Regulation)
- *Environmental Protection Act 1994 (EP Act)*
- *National Environment Protection (Ambient Air Quality) Measure (Air NEPM), 2021*
- *Environmental Protection (Air) Policy 2019 and Environmental Protection (Air) Policy Amendment 2019 (Air EPP).*

Further to the above, this assessment has been prepared with consideration to:

- Guideline: Application requirements for activities with impacts to air, ESR/2015/1840 (Queensland Government 2025a)
- Guideline: Application requirements for making a decision for an environmental authority for an environmentally relevant activity, ESR/2015/1725 (Queensland Government, 2025b)
- Guideline: Odour impact assessment from developments, ESR/2024/6828 (DESI, 2024)
- Bromelton State Development Area Development Scheme 2017.

The Project has been designed to satisfy best available techniques and emission characteristics common to EfW facilities across Europe as identified in the following:

- European Commission, Best Available Techniques (BAT) Reference Document for Waste Incineration (BREF WI) (2019) and the associated Best Available Techniques Conclusions (BATC) for waste incineration (2019). Due to the various types and combinations of BAT for controlling emissions, the BREF WI specifies a range of associated emission levels (BAT-AELs).
- Directive 2010/75/EU of the European Parliament and the Council on industrial emissions (the Industrial Emissions Directive (IED)) Annex VI.

3.2 Environmental Protection Act 1994

Management of the air environment in Queensland is addressed under two key publications:

- The overarching EP Act, which outlines fundamental principles, objectives, and powers related to environmental regulation, including air quality management
- The subordinate regulation to the EP Act, the EP Regulation, which elaborates how the principles and objectives of the EP Act are to be implemented and enforced.

The EP Act gives the 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 specific policy relating to air quality is the *Environmental Protection (Air) Policy 2019* and its amendment the *Environmental Protection (Air) Amendment Policy 2024* (collectively referred to here as the Air EPP).

The purpose of the Air EPP is to identify the environmental values of the air environment to be enhanced or protected and to achieve the objective of the EP Act, that is, ecologically sustainable development.

The environmental values to be enhanced or protected under the Air EPP are the qualities of the environment that are conducive to:

- Protecting health and biodiversity of ecosystems;
- Human health and wellbeing;
- Protecting the aesthetics of the environment, including the appearance of building structures and other property; and
- Protecting agricultural use of the environment.

The administering authority must consider the requirements of the Air EPP when it decides an application for an EA, amendment of a licence or approval of a draft environmental management plan. Schedule 1 of the Air EPP specifies air quality indicators and objectives for specific air pollutants.

The Air EPP defines air quality objectives for enhancing or protecting the environmental values. The objectives relevant to the key air pollutants generated from the Project are presented in Table 6 including objectives relevant to human health and agricultural and ecological concerns.

Also relevant is DETSI's guideline *Application requirements for activities with impacts to air*, which outlines the information to be provided as part of the application process for environmentally relevant activities and how the information is used. This outlines how the proposed activity will be assessed by comparison with the requirements stipulated in the EP Act. In particular, this requires an application to include, if applicable:

- Description of the site and surrounding areas, including topography, prevailing winds and ambient air quality (Section 4)
- Identification of any nearby sensitive places must be identified and assessed appropriately (Section 4.2)
- Identification and evaluation of possible impacts on air quality (Section 7.1.2)
- Proposed management (Section 10).

The Impacts to Air also indicates that if a guideline is known of for pollutants not covered by the Air EPP that guideline should be applied. In this instance for pollutants released from the BERC not covered by the Air EPP objectives have been adopted from the Environmental Protection Authority (EPA) Victoria Publication 1961.2 *Guideline for assessing and minimising air pollution* (2025) and are included in Table 6.

This air quality assessment has been conducted in accordance with these requirements.

3.3 National Environment Protection Council

The National Environment Protection Council (NEPC) defines national ambient air quality standards and goals in consultation, and with agreement from all Australian State and territory governments. These were first published in 1998 in the *National Environment Protection (Ambient Air Quality) Measure* (AAQ NEPM) and previously varied in 2015. The AAQ NEPM contains, amongst other parameters, standards for particulates and combustion products. Compliance with the AAQ NEPM standards is determined by ambient air quality monitoring undertaken at locations

prescribed by the AAQ NEPM and that are representative of large urban populations. The goal of the AAQ NEPM is to monitor and improve ambient air quality. Whilst the AAQ NEPM is relevant to ambient air quality levels rather than the assessment of emissions from individual facilities, several Australian States including Queensland have adopted the AAQ NEPM standards.

The NEPC approved a variation to the AAQ NEPM standards for ozone, nitrogen dioxide and sulfur dioxide in April 2021. These revisions tightened the ambient air quality standards for nitrogen dioxide and sulfur dioxide to make them some of the strictest standards in the world and to reflect most recent emerging health evidence.

The AAQ NEPM prescribes that from 1 January 2025 the ambient air quality standards for sulfur dioxide and particulates as PM_{2.5} will be further tightened. These are included in Table 6. The standards in the AAQ NEPM are not intended to be applied as environmental standards by regulators without consideration of regulatory impacts in their jurisdictions. The Explanatory Statement clarifies the intent of the AAQ NEPM as a standard for reporting representative ambient air quality within an airshed, and not as a regulatory standard. Nevertheless, the AAQ NEPM standards have been applied in this assessment.

3.4 Waste Management in Queensland

EfW projects in QLD are regulated via the following hierarchy:

- Waste Management and Resource Recovery Strategy (2019) (the Strategy)
- EfW Policy (DES, 2021)
- EfW Guideline (DES, 2021).

The Strategy envisions Queensland as a zero-waste society, where waste is avoided, reused and recycled as much as possible, as part of a transition to a circular economy. This vision is supported by 2050 targets to reduce household waste by 25%, recycle 75% of all waste, and divert 90% of all waste from landfill. The Strategy provides the framework to help deliver coordinated, long-term and sustained growth for the recycling and resource recovery sector while reducing the amount of waste produced and ultimately disposed of, by promoting more sustainable waste management practices for business, industry and households. Under the Waste Strategy and Strategic Priority 2 – Transitioning to a circular economy, a key action was the development of the EfW Policy. The EfW Policy supports the implementation of the Strategy by providing guidance for the establishment of EfW facilities in QLD. The EfW Guideline supports the implementation of the Policy.

The EfW Policy considers the BREF-WI to be suitable best practice for Queensland with proponents expected to demonstrate the use of best practices as set out in the BREF-WI. The European Union industrial emissions directive (IED) 2010/75/EU is the main legislative instrument regulating industrial emissions in Europe. The IED requires BAT in establishing licencing conditions, while the process of determining BAT for different types of industrial facilities results in the BREF documents, in this case the BREF-WI.

To ensure continued protection of Queensland's environment and consistent regulation across Queensland, relevant EfW facilities that are lawfully operating when the EfW Policy commences will be expected to demonstrate, within five years, that their facilities are operating within the limits and best practices stipulated in the applicable BREF.

3.5 State Development

3.5.1 Bromelton State Development Area Development Scheme

State Development Areas (SDAs) are areas declared by regulation under the *State Development and Public Works Organisation Act 1971* (SDPWO Act). The Bromelton State Development Area (Bromelton SDA) was declared in August 2008 by regulation. The Bromelton SDA Development Scheme 2017 outlines the requirements for development within the SDA.

The Bromelton SDA Development Scheme specifies the following SDA-wide assessment criteria with respect to emissions:

Section 2.5.4 Emissions

- (1) *Development is designed to avoid or minimise: (a) adverse impacts from air, noise and other emissions that will affect the health and safety, wellbeing and amenity of communities and individuals and (b) conflicts arising from (but not limited to), spray drift, odour, noise, dust, light spill, smoke or ash emissions with sensitive and/or incompatible land uses.*
- (2) *Development supports the achievement of the relevant acoustic and air quality objectives of the Environmental Protection (Noise) Policy 2008 and the Environmental Protection (Air) Policy 2008.*
- (3) *Development with high levels of emissions is to, in accordance with current best practice, avoid adverse impacts on the cumulative air quality of the Bromelton air shed.*

3.5.2 State Code 22: Environmentally relevant activities

The Project involves the carrying out of various environmentally relevant activities (ERAs) as defined under Schedule 2 of the EP Regulation, which are activities with the potential to release contaminants into the environment that may cause environmental harm.

The Proponent has undertaken a detailed review of the Project operations against the activities described in Schedule 2 of the EP Regulation and, in consultation with the Office of Coordinator General and DETSI through prelodgement processes, has determined the applicable ERAs are as tabulated below (Table 3).

Table 3 Project applicable ERAs

ERA	Threshold	AES*	C*
ERA 14 Electricity generation	14(3)2(a) Generating electricity by using a fuel, other than gas, at a rated capacity of 10MW electrical to 150MW electrical.	76	C
ERA 54 Mechanical waste reprocessing	54(3)2(c) Operating a facility for receiving and mechanically reprocessing, in a year, the following quantity of general waste - more than 10,000t.	31	C
ERA 61 Thermal waste processing and treatment	61(3)1(c) Thermally reprocessing or treating, in a year, the following quantity of general waste - more than 10,000t.	45	C
*AES = aggregate environmental score, C = Concurrence ERA.			

The Director-General of the DETSI is the chief executive of the EP Act, however EAs are administered by a range of Queensland Government and local government agencies, with the relevant agency being the 'administering authority' for the EA.

In this instance, the proposed ERAs are not identified as being those devolved to local government under section 133 of the EP Regulation and therefore DETSI are taken to be the administering authority for the EA application.

The Office of Coordinator General and DETSI have confirmed the application is to be assessed against State Code 22: Environmentally Relevant Activities (State Code 22).

Performance outcomes and acceptable outcomes from State Code 22, which are relevant to the Project regarding air quality are reproduced below in Table 4. This air quality assessment will consider the Project in the context of the outcomes specified by State Code 22.

Table 4 State code 22 – Performance outcomes and acceptable outcomes

Performance Outcomes	Acceptable Outcomes
All ERAs	
PO2 Development is suitably located and designed to avoid or mitigate environmental harm to the air environment.	AO2.1 Development meets the air quality objectives of the Environmental Protection (Air) Policy 2019.
PO3 Development (other than intensive animal industry for poultry farming), is suitably located and designed to avoid or mitigate environmental harm on adjacent sensitive land uses caused by odour.	No acceptable outcome is prescribed.
All development – matters of state environmental significance	
PO7 Development is designed and sited to: 1. avoid impacts on matters of state environmental significance; or 2. minimise and mitigate impacts on matters of state environmental significance after demonstrating avoidance is not reasonably possible; and 3. provide an offset if, after demonstrating all reasonable avoidance, minimisation and mitigation measures are undertaken, the development results in an acceptable significant residual impact on a matter of state environmental significance. Statutory note: For Brisbane core port land, an offset may only be applied to development on land identified as E1 Conservation/Buffer, E2 Open Space or Buffer/Investigation in the Brisbane Port LUP precinct plan.	No acceptable outcome is prescribed.

3.5.3 State Code 2: Development in a railway environment

The application is required to be assessed against State Code 2: Development in a railway environment (State Code 2).

Performance outcomes and acceptable outcomes from State Code 2 are reproduced in Table 5. It is noted that State Code 2 does not identify air quality as a potential issue for the railway corridor, rather refers to safety hazards, obstructions and damage. Notwithstanding this, the air quality assessment has evaluated the Project against State Code 2 through by evaluating compliance with air quality objectives for human health, amenity and plume visibility within the rail corridor. That is, compliance with the relevant objectives also demonstrates that the proposed development:

- Will not create a safety hazard within the railway corridor
- Will not cause damage to the railway corridor
- Will not interfere with or obstruct the rail transport infrastructure or other rail infrastructure
- Will not adversely impact the operating performance of the railway corridor
- Will not cause an obstruction or nuisance in the railway corridor.

Table 5 State Code 2 - Performance outcomes and acceptable outcomes

Performance outcomes	Acceptable outcomes
PO1 Development does not create a safety hazard within the railway corridor	No acceptable outcome is prescribed.
PO2 Development does not cause damage to the railway corridor, rail transport infrastructure or other rail infrastructure	No acceptable outcome is prescribed.
PO3 Development does not interfere with or obstruct the rail transport infrastructure or other rail infrastructure	No acceptable outcome is prescribed.
PO6 Development does not adversely impact the operating performance of the railway corridor	No acceptable outcome is prescribed.
PO34 Filling and excavation material does not cause an obstruction or nuisance in the railway corridor	AO34.1 Fill, spoil or any other material is not stored in, or adjacent to, the railway corridor.

3.6 Assessment air quality objectives

Health based air quality assessment objectives and standards to be utilised for determining compliance of the Project as adopted from the Air EPP, EPA Victoria Publication 1961.2, and the AAQ NEPM ambient air standards, are presented below in Table 6. Environmental air quality assessment objectives are presented in Table 7.

Table 6 Health based and amenity ambient air quality objectives relevant to the Project

Pollutant	Averaging period	Air quality objective ($\mu\text{g}/\text{m}^3$)	Reference
NO ₂	1-hour	164	Air EPP (2024 amendment) / AAQ NEPM (2021)
	1-year	31	Air EPP (2024 amendment) / AAQ NEPM (2021)
SO ₂	1-hour	214	Air EPP (2024 amendment) / AAQ NEPM (2021)
	24-hour	57	Air EPP (2024 amendment) / AAQ NEPM (2021)
CO	8-hour	11,000	Air EPP (2019) / AAQ NEPM (2021)
TSP	1-year	90	Air EPP (2019)
PM ₁₀	24-hour	50	Air EPP (2019) / AAQ NEPM (2021)
	1-year	25	Air EPP (2019) / AAQ NEPM (2021)
PM _{2.5}	24-hour	20	Air EPP (2024 amendment) / AAQ NEPM (2021)
	1-year	7	Air EPP (2024 amendment) / AAQ NEPM (2021)
As	1-year	0.006	Air EPP (2019)
Cd	1-year	0.005	Air EPP (2019)

Pollutant	Averaging period	Air quality objective ($\mu\text{g}/\text{m}^3$)	Reference
Hg	1-year	1.1	Air EPP (2019)
Pb	1-year	0.5	Air EPP (2019) / AAQ NEPM (2021)
Mn	1-year	0.16	Air EPP (2019)
Ni	1-year	0.02	Air EPP (2019)
benzo(a)pyrene (as a marker for polycyclic aromatic hydrocarbons)	1-year	0.3 ng/m^3	Air EPP (2019)
NH ₃	1-hour	3,200	EPA Victoria (2025)
	24-hour	1,184	EPA Victoria (2025)
	1-year	70	EPA Victoria (2025)
HCl	1-hour	2,100	EPA Victoria (2025)
	1-year	20	EPA Victoria (2025)
Formaldehyde	24-hour	54	Air EPP (2019)
	30-minute ⁽¹⁾	109	Air EPP (2019)
Benzene	1-year	5.4	Air EPP (2019)
PCDD/F	1-year	0.00004	EPA Victoria (2025)
Cr(III)	30-day	0.1	EPA Victoria (2025)
Cr(VI)	1-hour	1.3	EPA Victoria (2025)
	1-year	0.005	EPA Victoria (2025)
Cu	1-hour	10	EPA Victoria (2025)
Sb	24-hour	1	EPA Victoria (2025)
	1-year	0.3	EPA Victoria (2025)
V	24-hour	1.1	Air EPP (2019)
Dust deposition	Monthly	120 $\text{mg}/\text{m}^2/\text{day}$	Queensland Government 2025a
Table note: ⁽¹⁾ Protecting aesthetic environment			

Table 7 Environmental air quality objectives relevant to the Project

Pollutant	Environmental value	Averaging period	Air quality objective ($\mu\text{g}/\text{m}^3$)	Reference
NO ₂	Health and biodiversity of ecosystems	1-year	33	Air EPP (2019)
SO ₂	Protecting agriculture	1-year	31	Air EPP (2024 amendment)
	Health and biodiversity of ecosystems (for forests and natural vegetation)	1-year	21	Air EPP (2024 amendment)

Pollutant	Environmental value	Averaging period	Air quality objective (µg/m³)	Reference
HF	Health and biodiversity of ecosystems (other than protected areas)	24-hours	2.9	Air EPP (2019)
		30-day	0.84	Air EPP (2019)
		90-day	0.5	Air EPP (2019)
	Health and biodiversity of ecosystems (for protected areas)	90-day	0.1	Air EPP (2019)
	Protecting agriculture	24-hours	1.5	Air EPP (2019)
		30-day	0.4	Air EPP (2019)
		90-day	0.25	Air EPP (2019)

4. EXISTING ENVIRONMENT

4.1 Local terrain and land-use

The proposed development is located in the locality of Bromelton, Queensland, approximately 47 km inland of the Gold Coast and around 56 km south south-west of Brisbane. Situated in the Scenic Rim region of Queensland, the Project sits near the base of hills directly to the west, with the township of Beaudesert 7 km to the east.

Sitting at an elevation between 80 m and 100 m Australian Height Datum (AHD), the lot for the proposed development is in a particularly low-lying area relative to the surrounding terrain. Hills stretch from north to south adjacent to the Project, reaching maximum elevations of 530 m AHD. Increases in elevation up to 400 m AHD can be seen to the southeast.

The Project is within the Bromelton State Development Area (SDA), and as such, land-use in the region is managed under the Bromelton SDA Development Scheme. The SDA is divided into six precincts, depicted in Figure 7. The Project site falls under the Special Industry Precinct. The purpose of the SDA is to promote economic development in the region, while ensuring that high impact industries are appropriately located. Some examples of industry already established in the Bromelton SDA include food manufacturing, a waste transfer station, quarries, and industrial product manufacturing. Further detail on existing industry in the region relevant to air quality is outlined in Section 4.4.

The locality is well serviced by transport infrastructure including Beaudesert Boonah Road, which is a State controlled road that links the settlements of Beaudesert and Boonah. This road also provides a direct link to the Mount Lindesay Highway, another State controlled road that connects to the major settlements of Logan, Brisbane and the Gold Coast. The locality is also serviced by the Sydney-Brisbane rail line, an interstate freight rail corridor.

The broader locality comprises primarily rural and agricultural land uses. Established and emerging industrial land uses are located within the Bromelton SDA. The State Government website for the Bromelton SDA identifies the following key uses:

- SCT Logistics - a \$30 million intermodal rail freight facility and warehouses on land situated adjacent to the Sydney-Brisbane rail line.
- GELITA Australia Pty Ltd - the Australian plant of the GELITA Group manufactures gelatine, which is sold as edible gelatine for food industry uses.
- Bromelton Protein Recovery facility (operated by A.J. Bush & Sons (Manufactures) Pty Ltd - is recognised internationally as a leading rendering company producing protein meal and tallow. The company utilises onsite clean energy practices by capturing biogas in covered anaerobic lagoons to generate electricity for power and recycles wastewater for irrigation on their substantial landholdings.
- Beaudesert Central Waste Management Facility - a waste transfer station and landfill operated by the Scenic Rim Regional Council.
- Bromelton Quarry - a hard rock quarry established in 2000 which supplies blue rock to the regional area.
- The Neilsen Group quarry - supplying general quarry and gravel products to the regional area.
- Quickcell Technology Products Pty Ltd - concrete manufacturers established in 1993 producing prestressed and precast concrete products.

The Energex Beaudesert Bulk Supply Substation is located approximately 6.5 km to the east of the site at Beaudesert, identified on Lot 183 on SP184476.

The site has a single road frontage of approximately 510 m to Beaudesert Boonah Road along its northern boundary. Established industrial premises, Quickcell Technology Products Pty Ltd and SCT Logistics are located

north of the site across Beaudesert Boonah Road. The site's western boundary is contiguous with the Sydney-Brisbane rail. Land to the south is owned by AJ Bush although its manufacturing operations are more than 1 km south of the site. Land to the west is currently vacant.

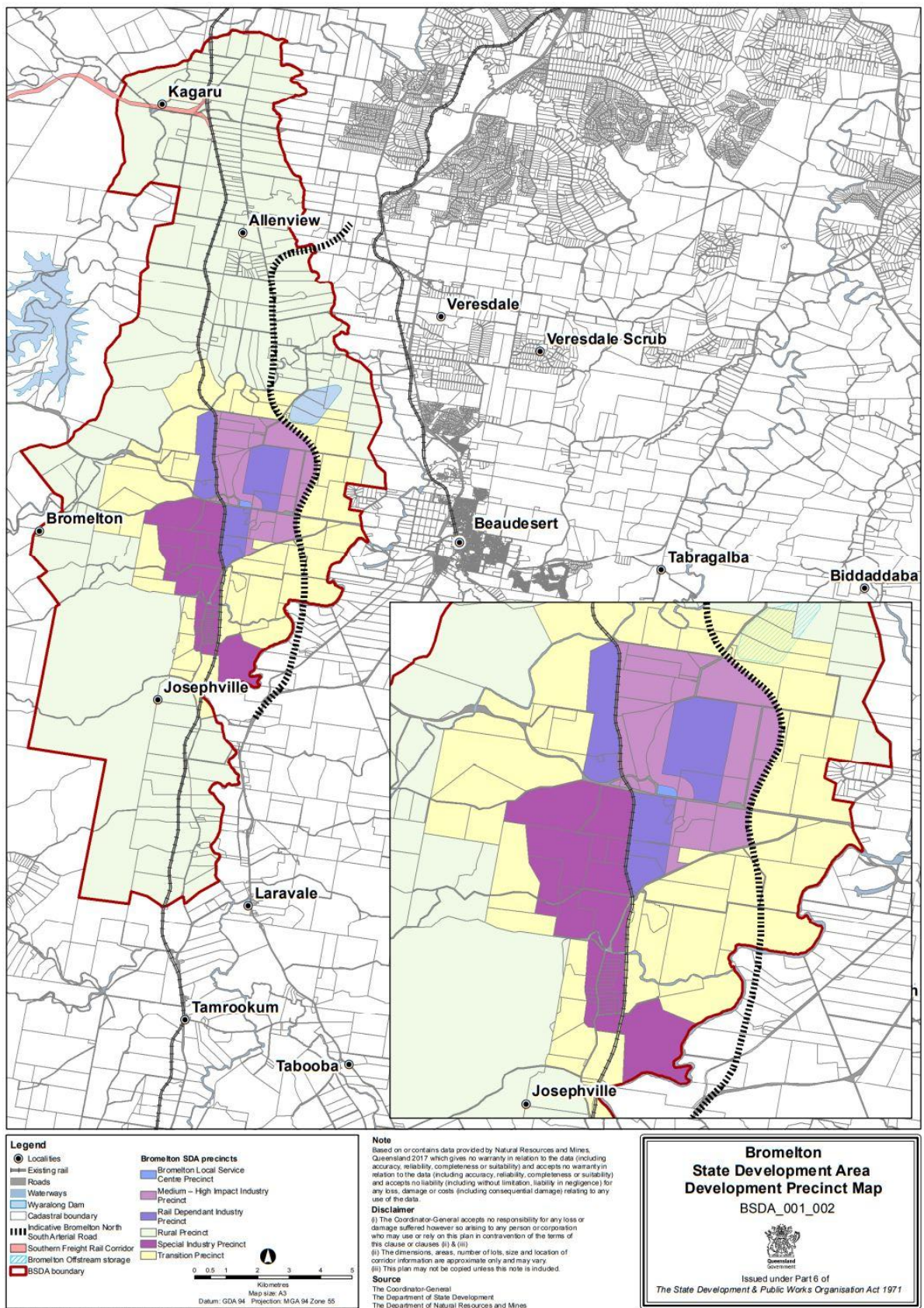


Figure 7 Bromelton State Development Area

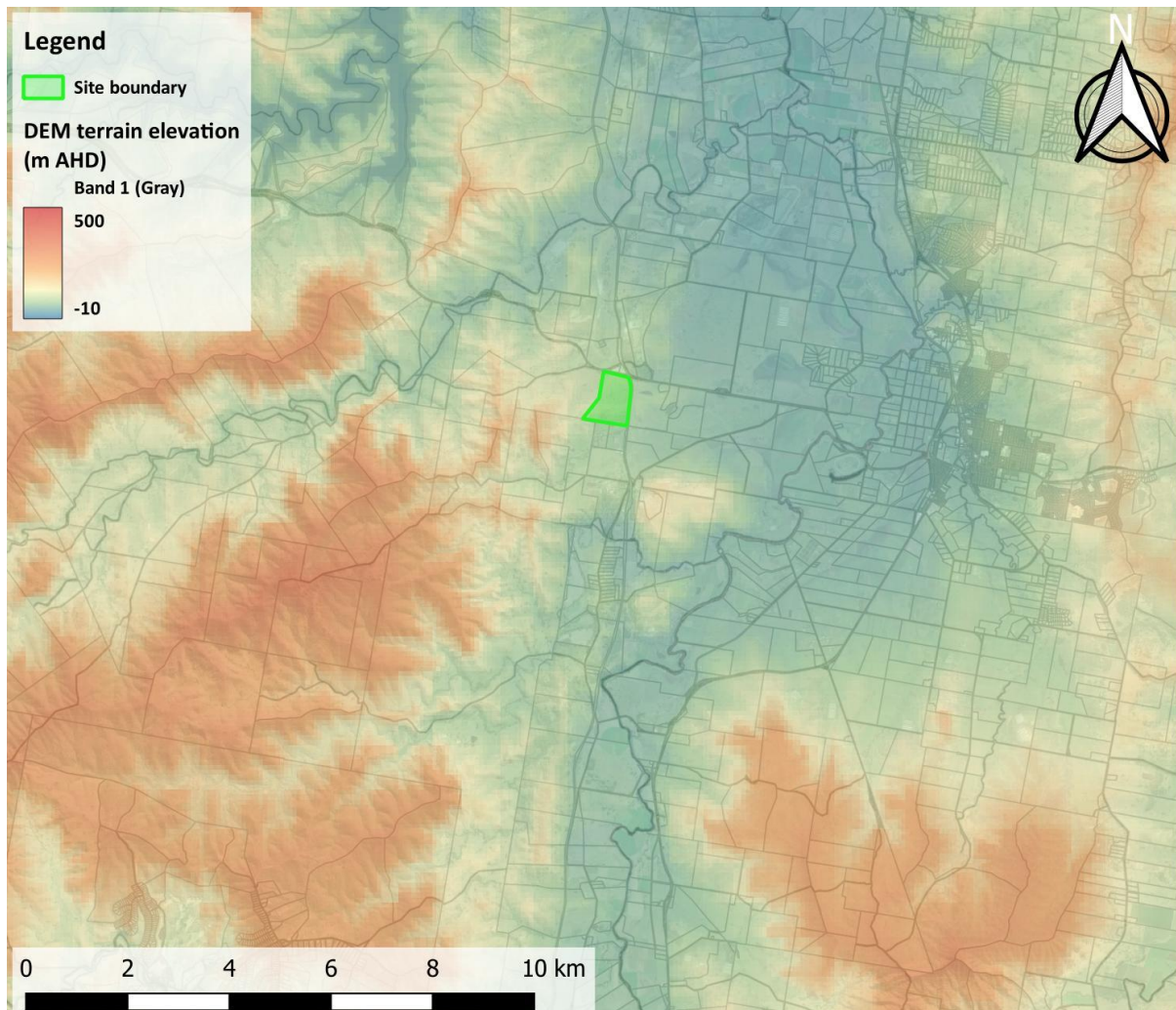


Figure 8 Terrain surrounding the study areas

4.2 Sensitive receptors

DETSI guideline *Application requirements for activities with impacts to air* identifies what land uses constitute a sensitive receptor or place, including:

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

Figure 9 and Table A3 show sensitive receptors in the area surrounding the Project. These receptors include residential locations and commercial receptors (such as Quickcell Technology Products Pty adjacent to the northern edge of the BERL site boundary). The proposed on-site visitor centre, located within the administration

building, has also been included in the dispersion modelling as a receptor. Areas designated as Matters of State Environmental Significance (MSES) have also been assessed for ecological impacts and are depicted in Figure 10. Sensitive receptors were identified based on aerial imagery and in consultation with Cleanaway.

Concentrations of air pollutants have also been predicted across a Cartesian grid of receptors (at 200 m resolution) to enable the production of contour plots of concentrations across the study area.

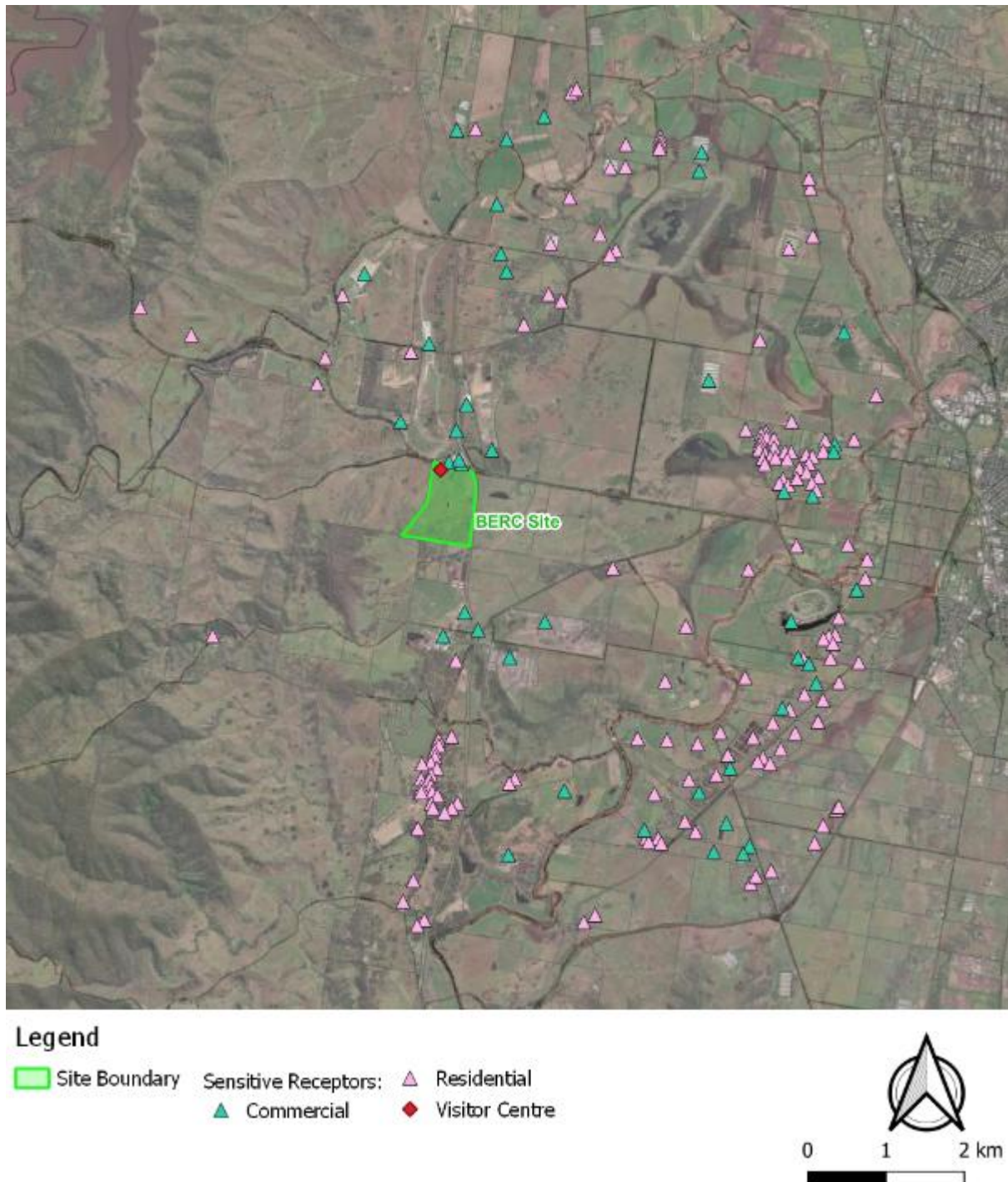
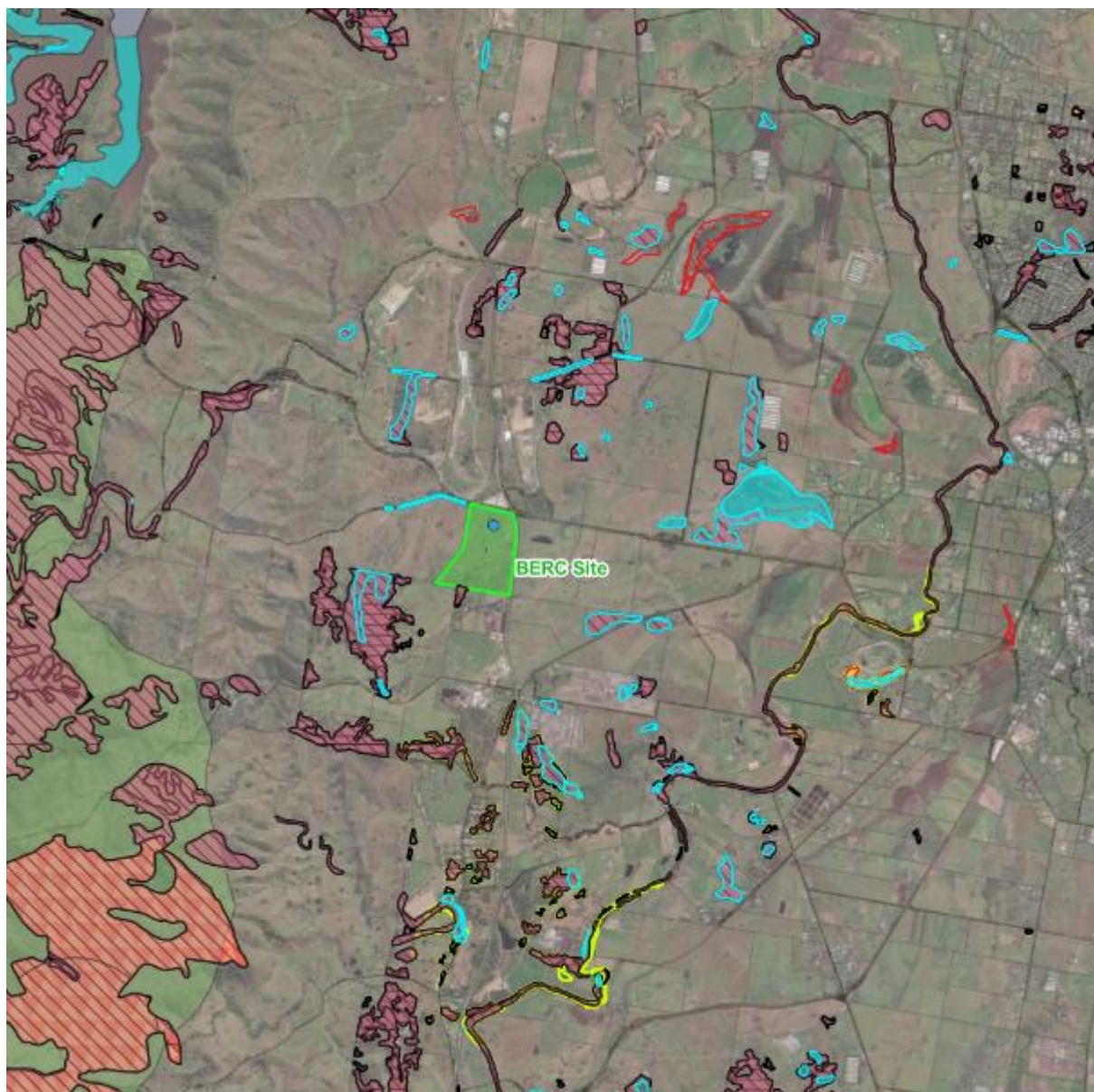


Figure 9 Selected sensitive receptors



Legend

- Stack
- Site Boundary
- MSES
 - MSES High ecological significance wetlands
 - MSES Regulated vegetation essential habitat
 - MSES wildlife habitat koala habitat areas core
 - MSES Regulated vegetation 100m from wetland
 - MSES wildlife habitat special least concern animal
 - MSES Regulated vegetation intersecting a watercourse
 - MSES wildlife habitat endangered or vulnerable wildlife
 - MSES Regulated vegetation category B endangered or of concern
 - MSES Regulated vegetation category C endangered or of concern
 - Regional biodiversity corridor SEQ Regional Plan 2017 - ShapingSEQ



0 1 2 km

Figure 10 MSES areas within the Project dispersion modelling domain

4.3 Meteorology

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. Meteorological conditions at the Project site, as derived from the meteorological modelling carried out for the assessment, are discussed in detail in Section A1.5 of Appendix A.

4.4 Existing air quality

4.4.1 Existing sources of emissions

Existing industrial activities in the study area have been identified through a review of the National Pollutant Inventory (NPI) for the most recent available reporting year (2023-2024). Facilities within 10 km of the Project that report emissions of key air pollutants associated with the Project are summarised in Table 8.

The most significant contributor of particulate matter, oxides of nitrogen, sulfur dioxide and carbon monoxide in the region is the Bromelton Protein Recovery facility. NPI emissions have been utilised to determine a suitable approach to including background concentrations for cumulative assessment of the Project as discussed in Section 5.2.8.

Table 8 NPI reporting facilities within 10 km of the Project

Facility name	Main activities	Distance and direction from Project	Emissions to air (kg/year)				
			PM ₁₀	PM _{2.5}	NO _x	SO ₂	CO
Bromelton Protein Recovery	Manufacturing of protein meals and tallow/oil from animal by-products	1.9 km S	53,378	20,338	84,503	284,191	83,292
Bromelton Quarry	Manufacture and distribution of quarry products	1.8 km SSE	11,100	1,310	18,700	7	6,520
Gelita Australia	Gelatin manufacture	4.7 km S	898	384	16,012	1,362	2,722
LMS Energy – Bromelton (Beaudesert) Facility	Landfill gas flaring	1.2 km NNE	61	61	1,629	471	9,450

4.4.2 Existing ambient air quality

DETSI is responsible for undertaking ambient air quality monitoring in Queensland. DETSI conducts monitoring at several monitoring stations in the study area, as shown in Figure 11. Each monitoring station is located for a specific purpose such as measuring air quality near industry, measuring air quality at roadside or to demonstrate compliance with the requirements of the Air NEPM.

Data from the Springwood monitoring sites have been used to represent background conditions in the study area for PM₁₀, PM_{2.5}, NO₂ and SO₂. These are the closest AAQ-NEPM Performance Monitors to the Project operated by DETSI. DETSI does not monitor CO at Springwood monitor, hence CO monitoring data from South Brisbane and Woolloongabba (the closest monitors to the Project which monitor CO) have been used. It is important to note that these monitoring sites represent highly conservative overestimates of ambient background pollutant concentrations to be used in the modelling assessment. This is due to all monitoring sites being located closer to

major population centres with a greater density of pollution sources compared to the BERC site which is in a relatively unpopulated rural area with few nearby pollution sources.

A summary of the background air quality levels used in this assessment are presented in Table 9. Six years of monitoring data have been analysed for 1-hour and 24-hour averaging periods (the 70th percentile value has been presented in the table). The maximum annual average is also presented.

The highest concentration of each air pollutant over the five years (relevant to each averaging period) has been used as the background value in this assessment (unless otherwise stated).

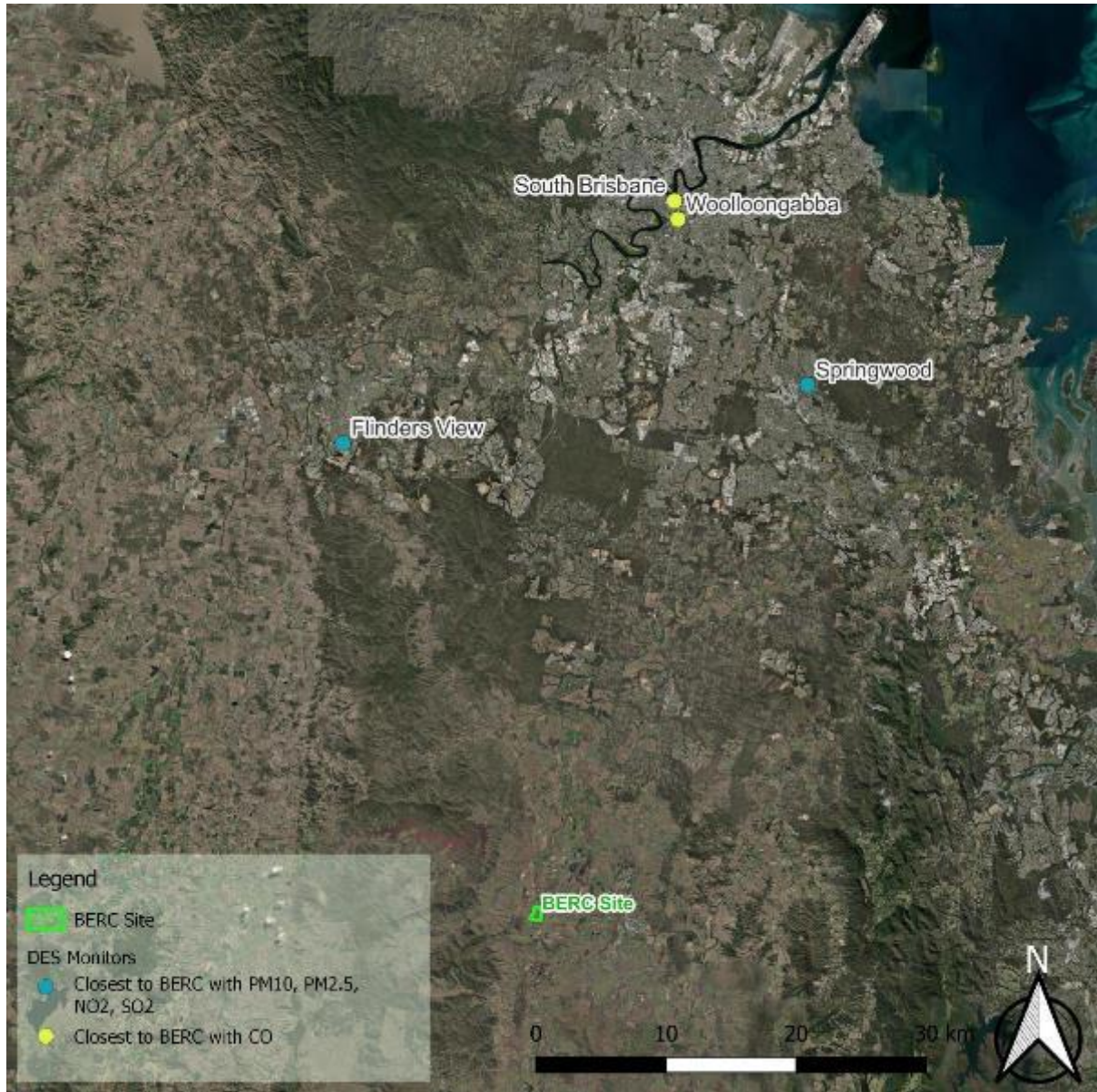


Figure 11 Air quality monitoring locations in the study area

Table 9 Background air quality measured at DETSI monitoring stations

Pollutant	Averaging Period	Objective	Monitor	Concentration ⁽¹⁾ (µg/m ³)								Used in assessment ⁽²⁾
				2017	2018	2019	2020	2021	2022	2023	2024 ⁽⁴⁾	
PM ₁₀	24-hour	50	Springwood	13.5	13.8	16.13	12.5	11.9	12.3	15.0	18.5	18.5 ⁽³⁾
	Annual	25	Springwood	11.6	13.1	16.93	11.8	10.6	10.5	13.4	16.5	16.5 ⁽³⁾
PM _{2.5}	24-hour	20	Springwood	6.1	6.7	6.83	5.6	5.6	6.2	6.8	7.0	7.0 ⁽³⁾
	Annual	7	Springwood	5.4	5.9	6.73	4.7	4.8	5.6	6.2	6.6	6.6 ⁽³⁾
NO ₂	1-hour	164	Springwood	12.3	14.4	16.4	12.3	12.3	12.3	12.3	10.3	16.4
	Annual	31	Springwood	11.3	12.1	12.8	10.6	10.7	10.6	10.8	9.4	12.8
SO ₂	1-hour	214	Springwood	2.9	2.9	2.9	0	0	0	2.9	2.9	2.9
	24-hour	57	Springwood	3	3.8	2	0.9	0.9	1	1.9	2.7	3.8
CO	8-hour	11,000	South Brisbane	203	250	203	179	250	266	225	588	588
			Woolloongabba	375	286	321	297	297	230	264	306	

Table note:

⁽¹⁾ Presented concentrations for averaging periods less than 1 year are 70th percentiles; for averaging periods of 1-year the presented concentrations are annual averages.

⁽²⁾ The values used in this assessment are the maximum 70th percentile/annual average across the eight years considered for that pollutant.

⁽³⁾ PM₁₀ and PM_{2.5} data from the year 2019 has been excluded from analysis due to the large number of bushfires.

⁽⁴⁾ Data accessible through the DETSI live air data portal is not provided in a validated state.

4.5 Future industry

SOILCO Developments Pty Ltd (SOILCO) is preparing a Development Application for a compost manufacturing facility that is proposed to be located approximately 850m to the west of the Project at 260 Mitchell Road, Lot 4, Bromelton. The compost manufacturing facility proposes to process 250,000 tpa of garden organics as well as food organics and garden organics (FOGO). As part of the Development Application, an air quality assessment impact assessment was completed by GHD (GHD, 2024) (GHD report).

The GHD report found the following:

- The main emissions to air will be in the form of odour and dust
- The potential dust emissions from construction were found to be a low risk
- The potential dust emissions from operations were found to be low risk
- The predicted concentrations of odour from operations were found to comply with the odour guideline.
- Air quality impacts from the proposed facility are not expected to cause significant environmental impacts.

It is unlikely that cumulative impacts from the proposed SOILCO compost manufacturing facility and the Project will be significant due to:

- The low risk of odour from the Project (BERC) due to control measures to be implemented (Section 8).
- The low risk of dust during construction of the Project (Section 6)
- The low levels of dust due to operation of both facilities.

Therefore, the proposed SOILCO facility has not been considered further.

5. AIR QUALITY ASSESSMENT METHODOLOGY

5.1 Construction

For certain fugitive emission sources, a full quantitative assessment is prone to such large uncertainties that it is often more effective to invest resources into risk controls rather than into assessment works. This is particularly true of dust emissions from diffuse sources such as construction activities.

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) (IAQM, 2024). Whilst it was drafted with the intention of application in the United Kingdom, the IAQM Methodology is applicable and widely used in Australia.

The potential impacts of dust emissions during construction of the Project have been addressed using the IAQM Methodology. This 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.

There will be no transport of waste to/from the facility or processing of waste at the facility during construction. Odour may arise if the topsoil and subsoil removed during construction is contaminated. However, odour from contaminated soil is generally temporary in nature and dissipates after a few days. The site is not known to contain any contaminated soil and as such the risk of odour during construction is low. Therefore, odour during construction is not assessed. Notwithstanding this, contingencies for removal and treatment of material (if significant odorous material is excavated) will be incorporated into the construction management plan separate to this assessment.

Details of the risk assessment are provided in Section 4.5. The complete dust risk methodology is described in Appendices C1 and C2.

5.2 Operations

5.2.1 Existing environment

The assessment includes an analysis of the characteristics of the existing environment (Section 4) 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.

5.2.2 Meteorology

The dispersion modelling assessment was conducted using 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. A site-specific meteorological data file was generated for the Project site by coupling the prognostic model TAPM with the diagnostic meteorological model CALMET.

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.

5.2.3 Dispersion modelling

The CALPUFF model (version 7.2.1) was used for dispersion modelling across a 20 km x 20 km modelling domain. 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 source detailed above.

Details of the model configuration are provided in Section A2 of Appendix A

5.2.4 Scenarios

Emissions of key air pollutants have been assessed for four scenarios covering proposed daily average (or average over the sampling period for periodically monitored pollutants) and worst case short-term (30-minute average emission concentration limits) operations for both nominal waste throughput (at 100% thermal input, with a 10% margin on mass emission rates) and the maximum instantaneous throughput operating point (120% mechanical load, 100% thermal input with a 10% margin on mass emission rates).

The following four operational scenarios have been considered and relate to Load Points described in the firing capacity diagram provided in Figure 5:

- LP1 – daily average operations
 - Nominal waste throughput at 100% thermal input. To accommodate temporary operation at up to 110% thermal input due to normal waste variability, this assessment includes a 10% margin on mass emission rates.
 - Normal operating conditions
 - BREF WI, 2019 - daily average (upper) concentration limits
 - Both lines assumed to be at the daily average (upper) concentration limits.
- LP1 – short-term operations
 - Nominal waste throughput at 100% thermal input, with a 10% margin on mass emission rates.
 - EU IED (2010) - short-term (30-minute average) emission limits to reflect variability in a processing line due to variability in mixed waste feedstock composition and/or combustion characteristics and some process upsets and non-routine operations. As a worst-case assumption, one line will operate at short-term emission limits whilst the other line will operate at the daily average (upper) concentration limit.
 - These emissions would be short in duration (30-minute) due to the management and mitigation measures (as detailed in Section 10) to be employed by the Project.
 - Emissions for metals have been conservatively assumed to include both Lines operating at LP1 daily average emission rates and additionally, one line operating at the short-term maximum dust emission limit with metals calculated from this value using the fly ash metals composition.
- LP2 – daily average operations.
 - Maximum waste throughput at 120% mechanical load
 - 100% thermal input, with a 10% margin on mass emission rates.

- Normal operating conditions
- BREF WI, 2019 - daily average (upper) concentration limits
- Both lines assumed to be at the daily average (upper) concentration limits.
- LP2 – short-term operations
 - Maximum waste throughput at 120% mechanical load
 - 100% thermal input, with a 10% margin on mass emission rates.
 - EU IED (2010) - short-term (30-minute average) emission
 - Emissions for metals have been conservatively assumed to include both Lines operating at LP2 daily average emission rates and additionally, one line operating at the short-term maximum dust emission limit with metals calculated from this value using the fly ash metals composition.

Start-up and shutdown processes are covered by the “short-term” (30-minute average) emission limit values specified in the EU Industrial Emissions Directive (IED). These cover that portion of a start-up or a shutdown when waste is still being combusted, but not the portion of a start-up or shutdown when only the auxiliary diesel burners are operating. The period of time when waste is still being combusted is most important with respect to emissions to the air. The air-pollution control equipment continues to operate until the plant is fully shut down, ensuring emissions remain controlled throughout the start-up and shutdown process.

Emissions from other sources on site including vehicle exhaust emissions, emergency diesel generator (~5 MW electrical, for emergency and temporary use only) and conveying (i.e., enclosed conveying) and stabilization of APCr are considered to be either insignificant or sufficiently controlled to be considered insignificant and are, therefore, not expected to have any meaningful impact on overall emissions. Therefore, these non-stack sources have not been considered further. The dual-flue gas stack is likely to be the key source of emissions. Other than the dual-flue gas stack, IBA/IBAA emissions have been additional modelled, although these are expected to contribute minimally to dust with IBA sorting occurring within a building and localised dust emission controls being implemented as discussed in Section 7.2.

5.2.5 Emission rates

5.2.5.1 FGT

Emission rates of air pollutants are conservatively based on the upper end of the range of BAT-AEL emission limits defined in the BREF WI, 2019 as presented in Table 17. Although these limits are practicably achievable, in reality the Project will emit below these levels and they, therefore, represent a conservative assumption for modelling purposes. The approach ensures that emission concentrations will be within the BAT-AEL range expected under normal operating conditions, for EfW facilities that have implemented BAT. Stack characteristics for the Project have been provided by Ramboll. Detailed emissions information is provided in Section 7.1.1.

Regarding emissions of total volatile organic compounds (TVOC) BAT-AEL emissions are for undifferentiated VOCs, while the Air EPP objectives are for individual VOCs, making direct comparison inappropriate considering TVOCs incorporate a mixture of a wide range of different compounds. A complete account of every substance within the TVOC parameter is not available; however, incineration generally provides high destruction efficiencies for organic substances. This assessment has conservatively assumed that the TVOC emissions are entirely comprised of formaldehyde or benzene as these two TVOCs have tighter air quality objectives than most other TVOCs. Compliance with these is likely to mean other TVOCs will comply as well. It is important to note that TVOCs are almost completely destroyed within the high-temperature combustion chamber, meaning residual TVOC emissions are minimal and well-managed by the combustion control system and the downstream air-pollution control system. Therefore the assessment is conservative and actual emissions of TVOCs will be lower than assumed in this assessment.

Similarly for polycyclic aromatic hydrocarbons (PAHs), associated emissions have been assumed to be 100% benzo(a)pyrene equivalent (B(a)P), which is a common marker pollutant used in assessments of PAHs.

5.2.5.2 IBA / IBAA storage area

Emission rates of dust, as TSP, PM₁₀, and PM_{2.5}, from IBA / IBAA stockpiles within the IBA / IBAA storage area have been based on published emission factors from the relevant National Pollutant Inventory (NPI) emission estimation technique manuals. Relevant factors from the United States AP-42 air emission factors have been applied where relevant NPI factors are not available. Detailed emissions information is provided in Section 7.2.1.

5.2.6 Nitric oxide to nitrogen dioxide conversion

The modelling results presented in this report have assumed a constant conversion ratio of nitrogen dioxide to oxides of nitrogen (NO₂) of 30% with the addition of an ambient background concentration for NO₂ to provide additional conservatism. The actual degree of conversion of oxides of nitrogen in the plume to nitrogen dioxide will depend on atmospheric conditions at the time that the emissions occur.

The percentage of nitrogen dioxide within the plume exiting the stack usually ranges from 5% to 10%. After release from the stack, nitric oxide gradually oxidises to form nitrogen dioxide. The rate and extent to which this occurs depends on the presence of other atmospheric pollutants such as ozone and volatile organic compounds, and the presence of sunlight.

To support the conversion rate of 30%, a brief review of available literature was undertaken. This identified that for power stations in central Queensland, under worst-case conditions, that a conversion rate of 25% to 40% can occur within the first 10 km of plume travel and suggest a rate of 30% at distances less than ten kilometres. During days with elevated background levels of hydrocarbons (generally originating from bushfires), the conversion is usually below 50% in the first 30 km of travel (Bofinger et al, 1986). Therefore, it is expected that the 30% conversion rate will be appropriate for the Project, and even potentially conservative, particularly with inclusion of an ambient background for NO₂.

5.2.7 Ecological impacts – MSES

Mapping data for areas designated as Matters of State Environmental Significance (MSES) provided by the Queensland Government Queensland Spatial Catalogue – Qspatial was reviewed for the dispersion modelling domain in order to assess potential ecological impacts. Predicted ground-level dispersion modelling concentrations were compared against the biodiversity and agricultural air quality objectives identified in Table 6 for each MSES area. MSES areas are depicted in Figure 10. Impacts were only quantified for the LP1 and LP2 daily average (upper) emission concentration limit scenario as the ecological objectives have averaging periods of 24-hours or longer and should not be impacted by the short-term scenario.

5.2.8 Cumulative impacts

Where available, ambient background concentrations (see Table 9) have been added to the modelled contributions to determine the total cumulative concentrations.

A cumulative assessment has been conducted incorporating the Bromelton Protein Recovery facility and ambient background concentrations from DETSI's monitoring stations (Table 9). The Bromelton Protein Recovery facility has been explicitly modelled as the review of NPI data (Table 8) identified it as a key source of emissions in the area. AJ Bush supplied the stack characteristics and emissions data required to undertake the cumulative dispersion modelling assessment. Details are provided in Appendix B. It was decided not to include modelling of the other facilities within 10 km of the Project site as the NPI emissions identified these as relatively minor sources

compared to Bromelton Protein Recovery facility and it is expected that the ambient background will adequately address contributions from these facilities.

Table 10 summarises sources included in the cumulative assessment.

Table 10 Sources of data for cumulative assessment

Pollutant	BERC	Bromelton Protein Recovery Facility ⁽¹⁾	Ambient monitoring data ⁽²⁾
NO ₂	✓	✓	✓
CO	✓	✓	✓
SO ₂	✓	✓	✓
PM ₁₀	✓	✓	✓
PM _{2.5}	✓	✓	✓
HCl	✓	x	x
HF	✓	x	x
NH ₃	✓	x	x
TVOC (100% formaldehyde)	✓	x	x
TVOC (100% benzene)	✓	x	✓
PAH as BaP	✓	x	x
Dioxins and furans	✓	x	x
Dioxins and furans + dioxin like PCBs	✓	x	x
Cd	✓	x	x
Tl	✓	x	x
As	✓	✓	x
Cr(III)	✓	✓	x
Cr(VI)	✓	✓	x
Cu	✓	✓	x
Hg	✓	x	x
Mn	✓	✓	x
Ni	✓	✓	x
Pb	✓	x	x
Sb	✓	x	x
V	✓	x	x

Table note:

⁽¹⁾ Details of source characteristics and emission rates included in the modelling are provided in Appendix B

⁽²⁾ As summarised in Table 9

5.2.9 Presentation of results

5.2.9.1 FGT

Predicted ground-level concentrations of air pollutants have been presented as maximum 100th percentiles for all averaging periods for all assessment scenarios (LP1 daily average and short-term emissions, and LP2 daily average and short-term operations).

Results have been determined at commercial receptors, at residential receptors, and at the proposed visitor centre located within the administration building. Receptors are summarised in Section 4.2. Maximum offsite concentrations have also been presented.

Ground-level concentrations associated with the Project operating at LP1 and LP2 short-term emission concentrations have been presented for short-term averaging periods only. This is because these scenarios represent conditions that are expected to be relatively short in duration.

Results for LP1 scenarios are presented in Section 7.1.2.1 to Section 7.1.2.3. Results for LP2 and are presented in Section 7.1.2.4 to Section 7.1.2.6.

5.2.9.2 IBA / IBAA

Predicted ground-level concentrations of dust (TSP, PM₁₀, PM_{2.5} and dust deposition) have been presented as maximum 100th percentiles for all averaging periods for the IBA/IBAA storage area.

Results have been determined at commercial receptors, at residential receptors and at the proposed visitor centre summarised in Section 4.2. Maximum offsite concentrations have also been presented. Results have been presented in isolation due to the magnitude of the emissions to air.

5.3 Odour

Fugitive odour is expected to constitute a minor emission from the Project site with most materials either being enclosed or not considered to be odorous. There is a low potential, however, for some odour to escape the tipping hall building when the fast-acting roller doors are open to allow truck access, although the default position of these doors will be closed and the tipping hall will be maintained under negative pressure.

Considering that odour emissions are expected to be minimal due to the predominant containment of odours within the tipping hall building dispersion modelling was not considered suitable to provide an appropriate indication of odour risk. Dispersion modelling would not accurately reflect the highly intermittent minor odour releases from opening and closing the fast-acting rolling doors. Therefore, the odour risk assessment methodology described in the Victorian Environmental Protection Authority (Vic EPA) publication 1883 (2022) was adopted to describe odour risk.

Publication 1883 includes three levels of assessment; this assessment has been conducted to a Level 2 standard. Level 2 assessments are described in Publication 1883 as:

- Consisting of two tools, the cumulative effects test and the source-pathway receiving environment tool.
 - The cumulative effects test takes into consideration the effects of multiple odour sources where there is a different dispersed industry, different clustered industries, and clusters of similar industries.
 - The source-pathway-receiving environment tool gives guidance on determining the level of hazard posed by the odour source, the effectiveness of the exposure pathway and the sensitivity of the receiving environment. It enables the calculation of a risk score. Depending on this score and the quality of the evidence used, further steps in the risk assessment can be identified.

As cumulative effects are not considered to be relevant due to an absence of other odour sources of a similar character to BERC within the surrounding area, the source-pathway-receiving environment tool has been adopted. The outcome from the odour assessment is detailed in Section 7.2.

5.4 Limitations and uncertainty

This study relies on the accuracy of several 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
- Air quality monitoring observations from the DETSI
- 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.

The dispersion model has been configured with conservative assumptions and, therefore, the assessment is likely to overpredict potential impacts of the Project.

6. CONSTRUCTION DUST RISK ASSESSMENT

The IAQM sets out initial screening criteria for determining the need to conduct a construction dust risk assessment. A construction dust risk assessment is required if there is a 'human receptor' 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).

It was determined that the requirements of this screening step were met. Therefore, construction of the Project has been assessed in the following sections.

The complete dust risk methodology is described in Appendices C1 and C2 including matrices defining levels of sensitivity, risk and magnitude.

6.1 Potential magnitude of dust

Table 11 presents the potential dust emission magnitude for construction activities, which has been based on site-specific information provided by Cleanaway. Magnitudes of emissions have been determined following guidance outlined in Table C1.

Table 11 Potential dust magnitude

Construction Element		Units	Site-specific description	Overall Magnitude of Emissions
Demolition	Building volume	m ³	No demolition	NA
	Material type	-	No demolition	
	Height of demolition	m	No demolition	
Earthworks	Site area	m ²	192,200	Large
	Number of heavy earth moving vehicles	#	>10	
	Formation of bunds (height)	M	6	
	Soil type	-	silty/sandy clay	
	Mobile crushing and screening equipment onsite	-	Nil	
	Total material moved	tonnes	431,900	
Construction	Building volume	m ³	16,340 (EfW)	Medium
	Construction material	-	concrete/metal	
	Onsite concrete batching	-	Possible	
	Sandblasting	-	No	
Trackout ⁽¹⁾	Number of heavy vehicles (HDV) in any one day	#	60	Medium
	Unpaved road length	m	>100	
	Surface material type	-	clay gravel	

Table note:

⁽¹⁾ Trackout is defined in the IAQM guidance as being the transport of dust and dirt from the construction/demolition site onto the public road network, where it may be deposited and then re-suspended by vehicles using the network. This arises when heavy duty vehicles (HDVs) leave the construction/demolition site with dusty materials, which may then spill onto the road, and/or when HDVs transfer dust and dirt onto the road having travelled over muddy ground on site

6.2 Sensitivity of the area to dust

The sensitivity of the receptors to dust effects depends on the number of receptors in the area and their proximity to the construction site. It also considers additional site-specific factors such as topography and screening, the nature of the sensitive places whether they are residential, workplaces, schools, hospitals or the like, and in the case of sensitivity to human health effects, ambient existing PM₁₀ concentrations.

Table 12 and Figure 12 present the number of sensitive receptors falling within different buffer distances from the boundary of the Project. The number of receptors for each distance are cumulative with the preceding distance such that if two receptors fall within <50 m and one within <100 m, this is presented as two receptors <50m and three receptors within <100 m (not two within <50 m, and 1 within <100 m).

There are three industrial facility receptors within <250 m of the Project boundary. There are also two Matters of State Environmental Significance (MSES) within the <250 m buffer.

Table 12 Proximity of receptors to the boundary of the Project

Receptors	Distance from Project area (m)			
	<20	<50	<100	<250
Number of sensitive places	0	0	0	0
Number of industrial facilities	0	2	2	3
Ecological receptors	1	1	2	2

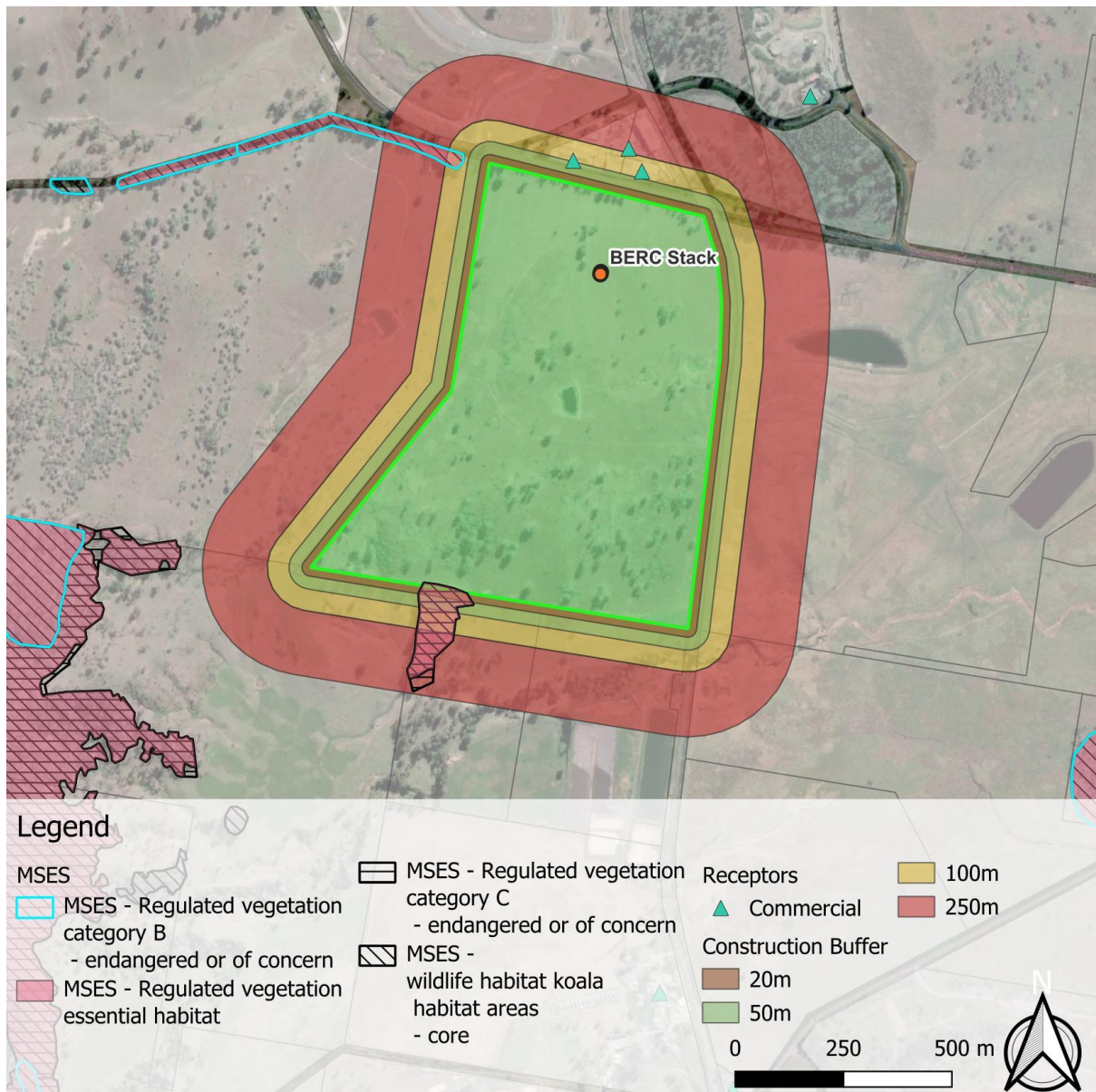


Figure 12 350m boundary buffer from the Project area

Table 13 summarises the sensitivity of the area surrounding the Project before mitigation has been implemented. Sensitivities have been informed by Table C2 to Table C5. The sensitivities are based on the following rationale:

- Dust soiling: The sensitive receptors to the north represent industrial worksites involved in the fabrication of concrete products (beams, walls, floors). The IAQM indicates that, with respect to dust soiling sensitivity, these properties may have medium sensitivity, expecting a reasonable level of amenity, the people are not present continuously, with examples including places of work. Three medium sensitivity receptors to dust soiling within the <50 m distances from the source according to Table C3 have an overall sensitivity of **Low**.
- Human health: Table C2 indicates medium sensitivity receptors to PM₁₀ exposure *"will generally not include workers occupationally exposed to PM₁₀ as protection is covered by Health and Safety legislation"*. As the main sensitive receptors to the north are associated with concrete products occupational health and safety measures will likely result in a low sensitivity to PM₁₀ possibly generated from the Project construction. Low sensitivity, combined with an ambient PM₁₀ concentration of approximately 20 µg/m³ and three receptors, according to Table C4, results in an overall sensitivity of **Low**.

- Ecological: There are two MSES areas, one within <50 m and one within <100 m of the Project boundary. Although these might be considered to constitute medium sensitivity areas, given only a very minor part of the areas are near to the Project boundary while the MSES area to the south is a significant distance from the main construction areas primarily in the north of the Project boundary, it is reasonable to expect very limited impacts from construction. Therefore, the ecological sensitivity is considered to be **Low**.

Table 13 Summary of the sensitivity of the area

Potential Impact	Sensitivity to dust effects
Dust soiling	Low
Human health	Low
Ecological	Low

The dust emission magnitudes (Table 11) are combined with the sensitivity of the area summarised in Table 13 to determine the risk of impacts with no mitigation applied. Table 14 presents the preliminary assessment of the risk due to construction activities associated with the Project. These risk categories have been used to determine the appropriate level of mitigation. Levels of risk have been informed by Table C6 to Table C9.

For almost all construction activities, the aim should be to prevent significant effects on receptors through the use of effective mitigation. Experience shows that this is normally possible. Hence the residual effect will normally be 'not significant' when accounting for the implementation appropriate mitigation. Suitable mitigation measures are presented in Table 15.

Table 14 Summary of dust risk

Potential Impact	Risk			
	Demolition	Earthworks	Trackout	Construction
Dust soiling	NA	Low	Low	Low
Human health	NA	Low	Low	Low
Ecological	NA	Low	Low	Low

6.3 Mitigation measures

Based on the outcome of the risk assessment, the following mitigation measures (Table 15) are to be implemented. These mitigation measures have been determined from the IAQM Methodology. The outlined measures also correspond with mitigation measures presented in the Environmental Risk Assessment for the Project prepared by ARUP. Mitigation measures will be included in a construction dust management plan (CDMP), to be developed and implemented by the construction contractor and managed by a suitable site manager.

Table 15 Construction dust mitigation measures

Activity	Mitigation measures
Communications	Display the name and contact details of person(s) accountable for air quality and dust issues along the periphery of the Project site. This may be the environment manager/engineer or the site manager.
	Display the head or regional office contact information
Site management	Develop and implement a CDMP, which may include measures to control other emissions.

Activity	Mitigation measures
	Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken.
	Make the complaints log available upon request from a regulating authority.
	Record any exceptional incidents that cause dust and/or air emissions, either on- or offsite, and the action taken to resolve the situation in the log book.
Monitoring	Carry out regular site inspections to monitor compliance with the CDMP, record inspection results, and make an inspection log available upon request from a regulating authority.
	Increase the frequency of site inspections by the person accountable for air quality and dust issues on site when activities with a high potential to produce dust are being carried out (such as major excavation works) and during prolonged dry or windy conditions
Site layout	Plan site layout so that machinery and dust causing activities are located away from sensitive receptors, as far as reasonably practicable.
	Avoid site runoff of water or mud.
	Remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on-site. If they are being re-used on-site cover as described below.
	Cover, seed or fence stockpiles to prevent wind whipping.
Operating vehicle/machinery	Ensure all vehicles switch off engines when stationary. There should be no idling vehicles.
	Minimise the use of diesel or petrol powered generators if possible and use mains electricity or battery powered equipment where practicable.
	Impose and signpost a maximum-speed-limit of 25 km/h on surfaced and 15 km/h on unsurfaced haul roads and work areas.
	Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction, e.g., suitable local exhaust ventilation systems.
	Ensure an adequate water supply on the site for effective dust/particulate matter suppression/mitigation, using non-potable water where possible and appropriate.
Waste management	Bonfires and burning of waste materials should not be permitted.
Earthworks	Covering or watering exposed stockpiles when not in use
	Revegetating disturbed areas as soon as is feasible
Construction	Ensuring all fine powder materials such as cement are delivered in closed tankers and stored in silos
	Ensure sand and other aggregates are stored in bunded areas
	Avoid scabbling (roughening of concrete surfaces) if possible
	Minimise drop heights from loading shovels and other loading or handling equipment, use enclosed chutes and cover skips
Trackout	Covering truck cargo when entering or leaving the site
	Hosing down truck tyres before exiting the site
	Avoiding dry sweeping of large areas, instead using hoses, sprays, or water trucks.

Activity	Mitigation measures
	Use water-assisted dust sweeper(s) on the access and local roads, to remove, as necessary, any material tracked out of the site.

6.4 Residual risk

The IAQM guidance is clear that, with appropriate mitigation in place, the residual effects on nearby sensitive receptors from construction dust emissions will normally be 'not significant'. The mitigation measures set out in Section 6.3 are based on the IAQM guidance (Appendix C2). With these measures effectively implemented the residual effects are judged to be low.

The IAQM guidance does, however, recognise that, even with a rigorous dust management plan in place, it is not possible to guarantee that the dust mitigation measures will be effective all the time, for instance under adverse weather conditions. During these events, off-site short-term dust annoyance may occur within close proximity to the site, however, the scale of this would not normally be considered sufficient to change the conclusion that, overall, the effects will be low.

7. OPERATIONS

7.1 FGT

7.1.1 Emissions to air

Emissions from the Project are expected to be from the EfW facility flue gas stack. Emissions from other sources on site including vehicle exhaust emissions, emergency diesel generator (~5 MW electrical, for emergency and temporary use only), conveying (i.e., enclosed conveying) and sorting of IBA and immobilization of APCr are considered to be either insignificant or sufficiently controlled to be considered insignificant.

Stack characteristics for normal operations at the Project are presented in Table 16 for LP1 and LP2. Stack characteristics have been provided for a single flue and two flues. The emissions from the two flues will be exhausted from a single stack. It has been assumed that the Project operates continuously, 24 hours per day for every hour of the year for modelling purposes. In reality, the Project is expected to operate for approximately 8000 hours/year.

Table 16 The Project: Stack characteristics for LP1 and LP2

Parameter	LP1	LP2	Units	Information Source
Stack characteristics for a single line				
Stack height	95	95	m (agl)	Ramboll
Exhaust diameter	2.67	2.67	m	
Exhaust temperature	130	130	°C	
Exhaust velocity	20	21.4	m/s	
Moisture content	18.0	20.4	Volume %	
Oxygen content	7.0	6.8	Volume %, wet	
Flow rate (wet, actual)	403,955	431,144	m³/hour	
Flow rate (dry, NTP, 11%O₂ with 10% additional flow rate ⁽¹⁾)	308,289	318,154	Nm³/hour @ 11% O₂, dry	
Stack characteristics for two lines (single stack)				
Exhaust diameter (effective)	3.8	3.8	m	Calculated
Exit velocity	20	21.4	m/s	
Flow rate (dry, NTP, 11%O₂ with 10% additional flow rate ⁽¹⁾)	616,579	636,308	Nm³/hour @ 11% O₂, dry	
Table note:				
⁽¹⁾ The 10% margin on flow and hence emission rate is to acknowledge the potential for operation within the thermal overload zone of the Capacity Diagram, albeit temporarily, to accommodate expected variability in mixed waste composition and/or combustion characteristics. For conservatism, this margin has not been applied to the stack exit velocity.				

While the actual flow rate of flue gas (wet basis) is used for sizing each individual flue, to meet the exhaust velocity criteria, the flow rate volumetric reference conditions (i.e., dry, NTP of 0 degrees Celsius and 101.325 kPa and 11% O₂) are used to determine the design mass emission rates for individual pollutants, based on the BREF WI/IED emission concentrations selected for the Project (Table 17).

Using the flow rate of flue gas at reference conditions removes the uncertainty associated with the technology provider's choice of excess air ratio, which will not be confirmed until the Project selects a moving grate technology provider.

Emission rates for LP1 and LP2 are based on daily average and short-term concentration, as presented in Table 18. Emission rates of individual metals have been calculated using the metal speciation of clean gas and fly ash as provided by Ramboll (Table 19).

Table 17 The Project: Emission concentration LP1 (daily average and short term) and LP2 (daily average and short term)

Pollutant	Emission concentration ⁽⁹⁾ (mg/Nm ³ @ 11% O ₂ dry)		Information Source						
	LP1 and LP2								
	Daily average ^(3, 5)	Short Term (½hr) ^(4, 6)							
Dust	5	30	EU IED & BREF WI						
TVOC / TOC ⁽⁸⁾	10	20							
HCl	6	60							
HF	1	4							
SO ₂	30	200							
NOx	120	400							
CO	50	100							
NH ₃	10	ND							
Cd+Tl ⁽²⁾	0.02	ND							
Other metals ⁽²⁾	0.3	ND							
Hg ⁽³⁾	0.02	ND							
Dioxins and furans ⁽¹⁾	0.04 (ng I-TEQ/Nm ³ @ 11% O ₂ dry)	ND							
Dioxins and furans + dioxin like PCBs ⁽¹⁾	0.06 (ng WHO-TEQ/Nm ³ @ 11% O ₂ dry)	0.1 (ng WHO-TEQ/Nm ³ @ 11% O ₂ dry)							
PAHs (BaP) ⁽⁷⁾	0.2 µg/Nm ³ @ 11% O ₂ dry	ND							
ND not defined									
Table note:									
⁽¹⁾ Either the daily average BAT-AEL emission concentration for dioxins and furans or the daily average BAT-AEL emission concentration for dioxins and furans + dioxin-like PCBs applies (BREF WI (2019)).									
⁽²⁾ Average emission limit values (mg/Nm ³) for the heavy metals over a sampling period of a minimum of 30 minutes and a maximum of 8 hours.									
⁽³⁾ Daily average (upper) BAT-AEL emission concentration limits for each pollutant as presented in the BREF WI (2019).									
⁽⁴⁾ Short term average emission concentration limits for each pollutant (where applicable) are the half-hourly averages from the IED Annex VI Part 3.									
⁽⁵⁾ IED 2010/75/EU Annex VI Part 6 <i>Monitoring of Emissions</i> clause 1.3 At the daily emission limit value level, the values of the 95 % confidence intervals of a single measured result shall not exceed the following percentages of the emission limit values:									
<table><tr><th>Emission</th><th>Units</th></tr><tr><td>CO</td><td>10%</td></tr><tr><td>SO₂ / NOx</td><td>20%</td></tr></table>				Emission	Units	CO	10%	SO ₂ / NOx	20%
Emission	Units								
CO	10%								
SO ₂ / NOx	20%								

Pollutant	Emission concentration ⁽⁹⁾ (mg/Nm ³ @ 11% O ₂ dry)		Information Source
	LP1 and LP2		
	Daily average ^(3, 5)	Short Term (½hr) ^(4, 6)	
	Particulate / TOC	30%	
	HCl/HF	40%	

⁽⁶⁾ IED 2010/75/EU Annex VI Part 8 *Assessment of compliance with emission limit values* clause 1.2 The half-hourly average values and the 10-minute averages shall be determined within the effective operating time (excluding the start-up and shut-down periods if no waste is being incinerated) from the measured values after having subtracted the value of the confidence interval specified in point 1.3 of Part 6. The daily average values shall be determined from those validated average values.

⁽⁷⁾ BREF WI (2019) Figure 8.121 Emission levels for periodically monitored benzo(a)pyrene (BaP) emissions to air from reference lines incinerating predominantly MSW, for modern facilities with similar flue gas treatment controls to the Project (i.e. activated carbon injection and bag filter), the maximum periodically monitored emission level for BaP is reported to be 0.1 micrograms/Nm³ (at reference conditions), with most averaging between 0 – 0.05 micrograms/Nm³ (at reference conditions). For potential PAH emissions expressed as B(a)P, Ramboll has conservatively assumed 2 x the maximum concentration for potential contributions from others in the PAH family i.e. 0.2 micrograms/Nm³ (at reference conditions).

⁽⁸⁾ BREF WI uses TVOC in reference to gaseous emissions, however the EU IED refers to gaseous and vaporous organic substances expressed as total organic carbon (TOC).

⁽⁹⁾ Assumption that facility will meet BREF WI and IED 2010/75/EU is conservative. Actual emissions are expected to be much lower. By adopting the upper limit values, the outcome of the assessment is independent of the composition of waste and uptake in recycling.

Table 18 The Project: Emission rates for LP1 (daily average and short term) and LP2 (daily average)

Emission rates (per two flues)	LP1 ⁽¹⁾		LP2 ⁽¹⁾	
	Daily average (g/s)	Short Term ⁽⁷⁾ (g/s)	Daily average (g/s)	Short Term ⁽⁷⁾ (g/s)
NO _x	20.55	44.53	21.21	45.96
CO	8.564	12.85	8.838	13.26
SO ₂	5.14	19.70	5.30	20.33
Dust ⁽²⁾	0.856	2.997	0.884	3.093
NH ₃	1.713	ND	1.768	1.768
HCl	1.028	5.652	1.061	5.833
HF	0.171	0.428	0.1768	0.442
TVOC / TOC ⁽⁹⁾ (100% formaldehyde)	1.713 ⁽³⁾	2.569 ⁽³⁾	1.768 ⁽³⁾	2.651 ⁽³⁾
TVOC/ TOC ⁽⁹⁾ (100% benzene)	1.713 ⁽⁴⁾	2.569 ⁽⁴⁾	1.768 ⁽⁴⁾	2.651 ⁽⁴⁾
PAHs (BaP equivalent)	0.0000000343	ND	0.0000000354	ND
Dioxins and furans	0.00000000685	ND	0.0000000077	ND
Dioxins and furans + dioxin like PCBs	0.0000000103	ND	0.0000000106	ND
Cd	0.00203 ⁽⁵⁾	0.00303 ⁽⁶⁾	0.00209 ⁽⁵⁾	0.00313 ⁽⁶⁾
Tl	0.0014 ⁽⁵⁾	0.00209 ⁽⁶⁾	0.0014 ⁽⁵⁾	0.00216 ⁽⁶⁾
As	0.00158 ⁽⁵⁾	0.00192 ⁽⁶⁾	0.00163 ⁽⁵⁾	0.00198 ⁽⁶⁾
Co	0.00128 ⁽⁵⁾	0.00141 ⁽⁶⁾	0.00132 ⁽⁵⁾	0.00146 ⁽⁶⁾

Emission rates (per two flues)	LP1 ⁽¹⁾		LP2 ⁽¹⁾	
	Daily average (g/s)	Short Term ⁽⁷⁾ (g/s)	Daily average (g/s)	Short Term ⁽⁷⁾ (g/s)
Cr(III), Cr(VI) ⁽⁸⁾	0.00516 ⁽⁵⁾	0.00683 ⁽⁶⁾	0.00533 ⁽⁵⁾	0.00705 ⁽⁶⁾
Cu	0.00452 ⁽⁵⁾	0.00760 ⁽⁶⁾	0.00467 ⁽⁵⁾	0.00785 ⁽⁶⁾
Mn	0.00772 ⁽⁵⁾	0.0111 ⁽⁶⁾	0.00797 ⁽⁵⁾	0.01142 ⁽⁶⁾
Hg	0.00343	ND	0.00354	ND
Ni	0.00622 ⁽⁵⁾	0.00658 ⁽⁶⁾	0.00641 ⁽⁵⁾	0.00679 ⁽⁶⁾
Pb	0.0206 ⁽⁵⁾	0.0489 ⁽⁶⁾	0.0213 ⁽⁵⁾	0.0505 ⁽⁶⁾
Sb	0.00362 ⁽⁵⁾	0.00498 ⁽⁶⁾	0.00373 ⁽⁵⁾	0.00514 ⁽⁶⁾
V	0.00064 ⁽⁵⁾	0.000771 ⁽⁶⁾	0.00066 ⁽⁵⁾	0.00080 ⁽⁶⁾
ND not defined Table note: Calculated from emission concentration (Table 17) and flow rates (Table 16), inclusive of a 10% flow margin, noting the potential for operation within the thermal overload zone of the Capacity Diagram, albeit temporarily. ⁽²⁾ It has been conservatively assumed that 100% of the dust emission rate is both PM₁₀ and PM_{2.5} ⁽³⁾ Assumption that 100% of the TVOC is formaldehyde. This is highly conservative given the BREF WI (2019) Figures 8.24 for daily and annual average emission levels of continuously monitored TVOC for most newer facilities are between 0-1 mg/Nm³ (at reference conditions). ⁽⁴⁾ Assumption that 100% of the TVOC is benzene. This is highly conservative since few constituents are likely to form or release benzene. ⁽⁵⁾ Individual emission rates of metals for daily averages are based on speciation of heavy metals in clean gas as provided by Ramboll (Table 19) ⁽⁶⁾ Individual emission rates of metals for short term are based on speciation of heavy metals in fly ash as provided by Ramboll (Table 19) ⁽⁷⁾ Only one line will operate at short term limits, the other line will operate at daily average limits. ⁽⁸⁾ It has been conservatively assume that 100% of chromium is Cr(III) and 100% of Chromium is Cr(VI) ⁽⁹⁾ BREF WI uses TVOC in reference to gaseous emissions, however the EU IED refers to gaseous and vaporous organic substances expressed as total organic carbon (TOC).				

Table 19 Speciation of heavy metals in clean gas and fly ash

Metal	Clean gas		Fly ash	
	Cd and Tl	Other metals	Cd and Tl	Other metals
As	-	3%	-	0.013%
Cd	59%	-	59%	-
Co	-	2%	-	0.005%
Cr	-	10%	-	0.065%
Cu	-	9%	-	0.12%
Mn	-	15%	-	0.13%
Ni	-	12%	-	0.014%
Pb	-	40%	-	1.1%
Sb	-	7%	-	0.053%
Tl	41%	-	41%	-
V	-	1%	-	0.005%

7.1.2 Dispersion modelling results

The following sections describe the dispersion model predicted ground-level concentrations from emissions due to operations.

7.1.2.1 LP1 Daily average (upper) emission concentration limit

Table 20, Table 21, Table 22 and Table 23 present the predicted ground-level concentrations of all air pollutants due to the Project in isolation and cumulatively (with background). Results are presented for the maximum off-site, at a residential receptor, at a commercial receptor and at the on-site Visitor Centre.

Contour plates illustrating the predicted ground-level concentrations across the model domain for key pollutants:

- NO₂ (Plate 1 to Plate 4)
- SO₂ (Plate 5 to Plate 8)
- PM₁₀ (Plate 9 to Plate 12)
- PM_{2.5} (Plate 13 to Plate 16)

The following results summary shows ground-level concentrations as percentage contributions to the respective objective for each pollutant:

- Maximum 1-hour and annual average ground-level concentrations of NO₂ are predicted to comply with the relevant objectives at all off-site locations within the study area, due to the Project in isolation and cumulatively. **Predicted concentrations of NO₂, at a residential receptor, are at most 12% in isolation and 42% with a cumulative background of the relevant objectives. Predicted concentrations of NO₂, at a commercial receptor, are at most 26% in isolation and 43% with a cumulative background of the relevant objectives.**
- Maximum 8-hour average ground-level concentrations of CO are predicted to comply with the relevant objectives at all off-site locations within the study area, due to the Project in isolation and cumulatively. **Predicted concentrations of CO, at a residential receptor, are at most 0.04% in isolation and 6% with a cumulative background of the relevant objectives. Predicted concentrations of CO, at a commercial receptor, are at most 0.1% in isolation and 7% with a cumulative background of the relevant objectives.**
- Maximum 1-hour, 24-hour and annual average ground-level concentrations of SO₂ are predicted to comply with the relevant objectives at all off-site locations within the study area, due to the Project in isolation and cumulatively. **Predicted concentrations of SO₂, at a residential receptor, are at most 7% in isolation and 49% with a cumulative background of the relevant objectives. Predicted concentrations of SO₂, at a commercial receptor, are at most 16% in isolation and 76% with a cumulative background of the relevant objectives.**
- Maximum 24-hour and annual average ground-level concentrations of PM₁₀ are predicted to comply with the relevant objectives at all off-site locations within the study area, due to the Project in isolation and cumulatively. **Predicted concentrations of PM₁₀, at a residential receptor, are at most 0.3% in isolation and 66% with a cumulative background of the relevant objectives. Predicted concentrations of PM₁₀, at a commercial receptor, are at most 1% in isolation and 67% with a cumulative background of the relevant objectives.** Existing sources and background levels of PM₁₀ are the main contributors to ground-level concentrations of PM₁₀.
- Maximum 24-hour and annual average ground-level concentrations of PM_{2.5} are predicted to comply with the relevant objectives at all off-site locations within the study area, due to the Project in isolation and cumulatively. **Predicted concentrations of PM_{2.5}, at a residential receptor, are at most 0.6% in isolation and 95% with a cumulative background of the relevant objectives. Predicted**

concentrations of PM_{2.5}, at a commercial receptor, are at most 2% in isolation and 95% with a cumulative background of the relevant objectives. Existing sources and background levels of PM_{2.5} are the main contributors to ground-level concentrations of PM_{2.5}.

- Maximum 1-hour, 24-hour and annual average ground-level concentrations of NH₃ are predicted to comply with the relevant objectives at all off-site locations within the study area due to the Project in isolation (no cumulative background available). **Predicted concentrations of NH₃, at a residential receptor, in isolation are at most 0.2% of the relevant objectives. Predicted concentrations of NH₃, at a commercial receptor, in isolation are at most 0.4% of the relevant objectives.**
- Maximum 1-hour and annual average ground-level concentrations of HCl are predicted to comply with the relevant objectives at all off-site locations within the study area due to the Project in isolation (no cumulative background available). **Predicted concentrations of HCl, at a residential receptor, in isolation are at most 0.2% of the relevant objectives. Predicted concentrations of HCl, at a commercial receptor, in isolation are at most 0.3% of the relevant objectives.**
- Maximum 24-hour and 30-minute average ground-level concentrations of formaldehyde are predicted to comply with the relevant objectives at all off-site locations within the study area due to the Project in isolation (no cumulative background available). **Predicted concentrations of formaldehyde, at a residential receptor, in isolation are at most 6% of the relevant objectives. Predicted concentrations of formaldehyde, at a commercial receptor, in isolation are at most 14% of the relevant objectives.**
- Annual average ground-level concentrations of benzene are predicted to comply with the relevant objectives at all off-site locations within the study area due to the Project in isolation (no cumulative background available). **Predicted concentrations of benzene, at a residential receptor, are at most 0.3% in isolation and 65% with a cumulative background of the relevant objectives. Predicted concentrations of benzene, at a commercial receptor, are at most 0.4% in isolation and 65% with a cumulative background of the relevant objectives.**
- Annual average ground-level concentrations of PAHs (as BaP) are predicted to comply with the relevant objectives at all off-site locations within the study area due to the Project in isolation (no cumulative background available). **Predicted concentrations of PAHs (as BaP), at a residential receptor, in isolation are at most 0.0001% of the relevant objectives. Predicted concentrations of PAHs (as BaP), at a commercial receptor, in isolation are at most 0.0001% of the relevant objectives.**
- Annual average ground-level concentrations of PCDD/F are predicted to comply with the relevant objectives at all off-site locations within the study area due to the Project in isolation (no cumulative background available). **Predicted concentrations of PCDD/F, at a residential receptor, in isolation are at most 0.0002% of the relevant objectives. Predicted concentrations of PCDD/F, at a commercial receptor, in isolation are at most 0.0002% of the relevant objectives.**
- Maximum predicted ground-level concentrations of any metal in at all off-site locations within the study area comply with the relevant objectives. **The metal contributing the most significantly to ground level concentrations, at a residential receptor, was Cr(VI), constituting 1% of the relevant objectives in isolation and 1% with a cumulative background of the relevant objectives. Predicted concentrations of Cr(VI), at a commercial receptor, are at most 3% in isolation and 3% with a cumulative background of the relevant objectives.** It has been conservatively assumed that chromium is made up of 100% Cr(VI) and therefore ground-level concentrations are expected to be lower.

In summary, the LP1 daily average air quality modelling results demonstrate that with the proposed emission limit settings, based on the upper end of the BAT-AEL range associated with implementation of BAT for emission control and flue gas treatment, the Project (in isolation) is predicted to have an insignificant impact on air quality as measured against the relevant objectives. Furthermore, maximum ground-level concentrations due to the Project with cumulative background (where available) do not exceed 95% of the relevant objectives at a residential or

commercial receptor with ambient background concentrations and existing sources contributing the majority to each objective (Figure 13 and Figure 14).

These results and the operation of the Project as described in this report demonstrate the appropriate implementation of best practices as described in the BREF WI, and therefore, satisfaction of Policy outcome 7 of Queensland's EfW Policy. The results also indicate the Project will satisfy AO2.1 of State Code 22.

Table 20 LP1 daily average – predicted ground-level concentrations of non-metal pollutants (in isolation)

Pollutant	Averaging period	Objective (µg/m³)	Maximum ground-level concentration due to the Project in isolation (µg/m³)			
			Maximum off-site	Maximum at a commercial receptor	Maximum at a residential receptor	Maximum at the Visitor Centre
NO ₂	1-hour	164	42.0	42.0	19.2	27.2
NO ₂	1-year	31	0.32	0.24	0.21	0.10
CO	8-hour	11,000	15.6	15.6	4.35	9.9
SO ₂	1-hour	214	35.0	35.0	16.0	22.6
SO ₂	24-hour	57	3.12	3.12	0.90	1.98
PM ₁₀	24-hour	50	0.52	0.52	0.15	0.33
PM ₁₀	1-year	25	0.013	0.010	0.009	0.004
PM _{2.5}	24-hour	20	0.52	0.52	0.15	0.33
PM _{2.5}	1-year	7	0.013	0.010	0.009	0.004
NH ₃	1-hour	3,200	11.7	11.7	5.33	7.55
NH ₃	24-hour	1,184	1.04	1.04	0.30	0.66
NH ₃	1-year	70	0.026	0.020	0.018	0.009
HCl	1-hour	2,100	7.00	7.00	3.20	4.53
HCl	1-year	20	0.016	0.012	0.011	0.005
Formaldehyde	24-hour	54	1.04	1.04	0.30	0.66
Formaldehyde	30-minute	109	15.2	15.2	6.93	9.82
Benzene	1-year	5.4	0.026	0.020	0.018	0.009
PAH as BAP	1-year	0.0003	5.3E-10	3.9E-10	3.6E-10	1.7E-10
PCDD/F	1-year	0.00004	1.1E-10	7.9E-11	7.1E-11	3.5E-11

Table 21 LP1 daily average – predicted cumulative ground-level concentrations of non-metal pollutants (isolation + background)

Pollutant	Averaging period	Objective (µg/m³)	Maximum ground-level concentration due to the Project with ambient background (µg/m³)			
			Maximum off-site	Maximum at a commercial receptor	Maximum at a residential receptor	Maximum at the Visitor Centre
NO ₂	1-hour	164	59.2	59.2	36.7	44.4
NO ₂	1-year	31	13.4	13.2	13.1	13.0
CO	8-hour	11,000	872.6	743.6	699.3	628.7
SO ₂	1-hour	214	199.7	164.4	105.9	39.0
SO ₂	24-hour	57	17.5	12.0	9.39	6.62
PM ₁₀	24-hour	50	23.4	21.4	20.5	19.2
PM ₁₀	1-year	25	16.8	16.6	16.6	16.6
PM _{2.5}	24-hour	20	8.89	8.13	7.77	7.45
PM _{2.5}	1-year	7	6.71	6.66	6.65	6.63
Benzene	1-year	5.4	3.53	3.52	3.52	3.51

Table 22 LP1 daily average – predicted ground-level concentrations of metals (isolation)

Pollutant	Averaging period	Objective (µg/m³)	Maximum ground-level concentration due to the Project in isolation (µg/m³)			
			Maximum off-site	Maximum at a commercial receptor	Maximum at a residential receptor	Maximum at the Visitor Centre
As	1-year	0.006	0.000024	0.000018	0.000016	0.000008
Cd	1-year	0.005	0.00003	0.00002	0.00002	0.00001
Cr(III)	30-day	0.1	0.00025	0.00013	0.00012	0.00007
Cr(VI)	1-hour	1.3	0.035	0.035	0.016	0.023
Cr(VI)	1-year	0.005	0.00008	0.00006	0.00005	0.00003
Cu	1-hour	10	0.031	0.031	0.014	0.020
Hg	1-year	1.1	0.00005	0.00004	0.00004	0.00002
Mn	1-year	0.16	0.00012	0.00009	0.00008	0.00004
Ni	1-year	0.02	0.00010	0.00007	0.00006	0.00003
Pb	1-year	0.5	0.00032	0.00024	0.00022	0.00010
Sb	24-hour	1	0.0022	0.0022	0.0006	0.0014

Pollutant	Averaging period	Objective (µg/m³)	Maximum ground-level concentration due to the Project in isolation (µg/m³)			
			Maximum off-site	Maximum at a commercial receptor	Maximum at a residential receptor	Maximum at the Visitor Centre
Sb	1-year	0.3	0.00006	0.00004	0.00004	0.00002
V	2-hour	1.1	0.00039	0.00039	0.00011	0.00025

Table 23 LP1 daily average – predicted ground-level concentrations of metals pollutants (isolation + background)

Pollutant	Averaging period	Objective (µg/m³)	Maximum ground-level concentration due to the Project in isolation (µg/m³)			
			Maximum off-site	Maximum at a commercial receptor	Maximum at a residential receptor	Maximum at the Visitor Centre
As	1-year	0.006	0.000037	0.000026	0.000022	0.000013
Cr(III)	30-day	0.1	0.00026	0.00014	0.00012	0.00007
Cr(VI)	1-hour	1.3	0.035	0.035	0.016	0.023
Cr(VI)	1-year	0.005	0.00008	0.00006	0.00005	0.00003
Cu	1-hour	10	0.031	0.031	0.015	0.020
Mn	1-year	0.16	0.00013	0.00009	0.00008	0.00005
Ni	1-year	0.02	0.00010	0.00007	0.00007	0.00003

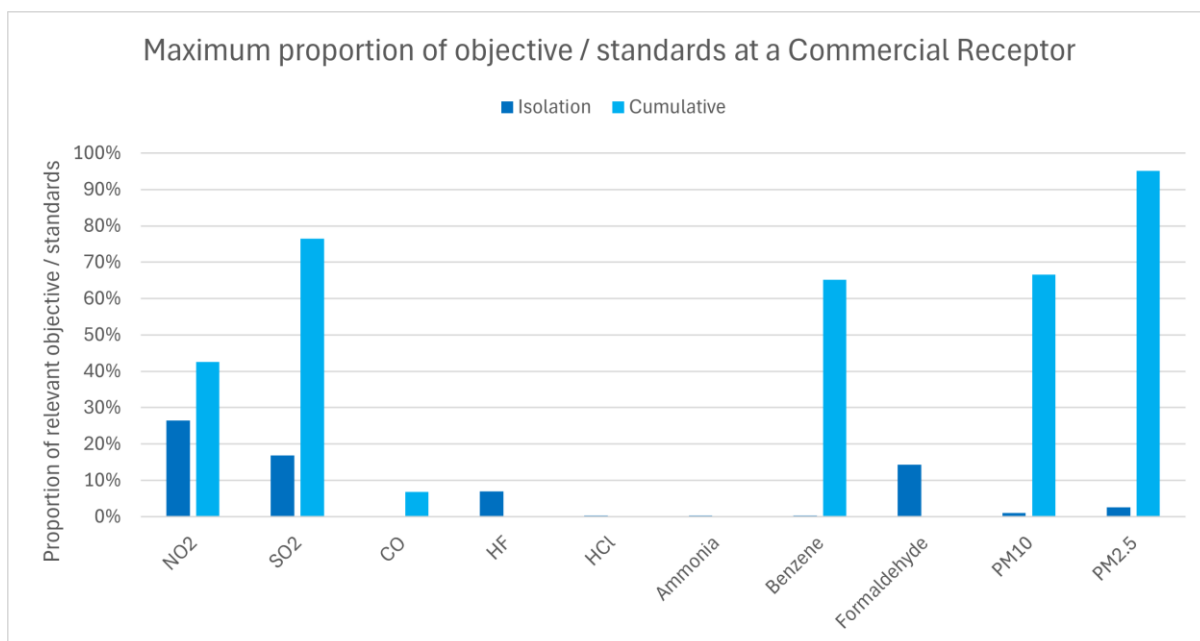


Figure 13 LP1 daily average maximum contributions to Air EPP objectives at a commercial receptor

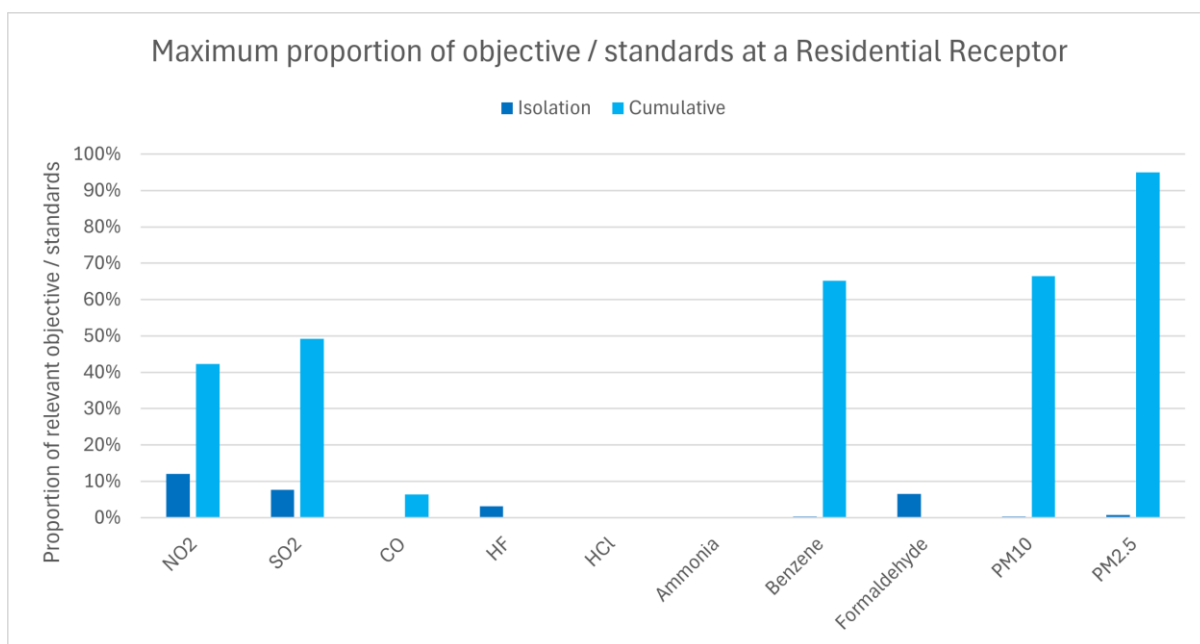


Figure 14 LP1 daily average maximum contributions to Air EPP objectives at a residential receptor

7.1.2.2 LP1 Short-term emission concentration limit

Table 24, Table 25, Table 26 and Table 27 present the predicted ground-level concentrations of all air pollutants due to the Project in isolation and cumulatively (with ambient backgrounds). Results are presented for the maximum off-site, at a residential receptor, at a commercial receptor and at the on-site Visitor Centre (the only non-residential, non-commercial sensitive receptor). Contour plates illustrating the predicted ground-level concentrations across the model domain for key pollutants:

- NO₂ (Plate 17 to Plate 18)
- SO₂ (Plate 19 to Plate 20)

The following results summary shows ground-level impacts as percentage contributions to the respective objectives for each pollutant:

- Maximum 1-hour average ground-level concentrations of NO₂ are predicted to comply with the relevant objectives at all off-site locations within the study area, due to the Project in isolation and cumulatively. **Predicted concentrations of NO₂, at a residential receptor, are at most 25% in isolation and 36% with a cumulative background of the relevant objectives. Predicted concentrations of NO₂, at a commercial receptor, are at most 55% in isolation and 65% with a cumulative background of the relevant objectives.**
- Maximum 1-hour average ground-level concentrations of SO₂ are predicted to comply with the relevant objectives at all off-site locations within the study area, due to the Project in isolation and cumulatively. **Predicted concentrations of SO₂, at a residential receptor, are at most 28% in isolation and 49% with a cumulative background of the relevant objectives. Predicted concentrations of SO₂, at a commercial receptor, are at most 62% in isolation and 76% with a cumulative background of the relevant objectives.**
- Maximum 1-hour average ground-level concentrations of HCl are predicted to comply with the relevant objectives at all off-site locations within the study area due to the Project in isolation (no cumulative background available). **Predicted concentrations of HCl, at a residential receptor, in isolation are at most 1% of the relevant objectives. Predicted concentrations of HCl, at a commercial receptor, in isolation are at most 2% of the relevant objectives.**
- Maximum 30-minute average ground-level concentrations of formaldehyde are predicted to comply with the relevant objectives at all off-site locations within the study area due to the Project in isolation (no cumulative background available). **Predicted concentrations of formaldehyde, at a residential receptor, in isolation are at most 10% of the relevant objectives. Predicted concentrations of formaldehyde, at a commercial receptor, in isolation are at most 21% of the relevant objectives.**
- Maximum predicted ground-level concentrations of any metal in isolation (no cumulative backgrounds available) at all off-site locations within the study area comply with the relevant objectives. **The metal contributing the most significantly to ground level concentrations was Cr(VI), at a residential receptor, constituting 2.0% of the relevant objectives in isolation. Predicted concentrations of Cr(VI), at a commercial receptor, in isolation are at most 4% of the relevant objectives.** It has been conservatively assumed that chromium is made up of 100% Cr(VI) and therefore ground-level concentrations are expected to be lower.

In summary, the short-term air quality modelling results demonstrate that with the proposed emission limit settings for this scenario, the Project (in isolation) is predicted to have an insignificant impact on air quality as measured against the relevant objectives. Furthermore, maximum ground-level concentrations due to the Project with

cumulative background (where available) do not exceed 76% of the relevant objectives at a residential or commercial receptor.

Table 24 LP1 short-term – predicted ground-level concentrations of non-metal pollutants in isolation

Pollutant	Averaging period	Objective (µg/m³)	Maximum ground-level concentration due to the Project in isolation (µg/m³)			
			Maximum off-site	Maximum at a commercial receptor	Maximum at a residential receptor	Maximum at the Visitor Centre
NO ₂	1-hour	164	91.0	91.0	41.5	58.9
SO ₂	1-hour	214	134.1	134.1	61.3	86.8
Formaldehyde	30-minute	109	22.8	22.8	10.4	14.7
HCl	1-hour	2,100	38.5	38.5	17.6	24.9
NH ₃	1-hour	3,200	11.7	11.7	5.3	7.5

Table 25 LP1 short-term – predicted cumulative ground-level concentrations of non-metal pollutants (isolation + ambient background)

Pollutant	Averaging period	Objective (µg/m³)	Maximum ground-level concentration due to the Project with ambient background (µg/m³)			
			Maximum off-site	Maximum at a commercial receptor	Maximum at a residential receptor	Maximum at the Visitor Centre
NO ₂	1-hour	164	108.1	108.1	59.0	76.0
SO ₂	1-hour	214	199.8	164.5	105.9	94.5

Table 26 LP1 short-term – predicted ground-level concentrations of metals (in isolation)

Pollutant	Averaging period	Objective (µg/m³)	Maximum ground-level concentration due to the Project in isolation (µg/m³)			
			Maximum off-site	Maximum at a commercial receptor	Maximum at a residential receptor	Maximum at the Visitor Centre
Cr(VI)	1-hour	1.3	0.047	0.047	0.021	0.030
Cu	1-hour	10	0.052	0.052	0.024	0.034

Table 27 LP1 short-term – predicted ground-level concentrations of metals (isolation + ambient background)

Pollutant	Averaging period	Objective (µg/m³)	Maximum ground-level concentration due to the Project in isolation (µg/m³)			
			Maximum off-site	Maximum at a commercial receptor	Maximum at a residential receptor	Maximum at the Visitor Centre
Cr(VI)	1-hour	1.3	0.047	0.047	0.021	0.030
Cu	1-hour	10	0.052	0.052	0.024	0.034

7.1.2.3 LP1 MSES results daily average (upper) emission concentration limit

Dispersion modelling results for each pollutant with a biodiversity or agricultural air quality objective detailed in Table 28 indicate compliance within each MSES area for each pollutant and averaging period. Percentage contributions reported in the following section are based on the maximum in any MSES area. Where a pollutant has multiple ecological/agricultural objectives, the model predicted concentration has been compared to the most stringent objective for each averaging period. The following results summary shows ground-level impacts as percentage contributions to the respective objectives for each pollutant:

- Maximum annual average ground-level concentrations of NO₂ are predicted to comply with the relevant objectives in all MSES areas, due to the Project in isolation and cumulatively. **Predicted concentrations of NO₂ are at most 1.0% in isolation and 41% with a cumulative background of the relevant objectives.**
- Maximum annual average ground-level concentrations of SO₂ are predicted to comply with the relevant objectives in all MSES areas, due to the Project in isolation and cumulatively. **Predicted concentrations of SO₂ are at most 0.4% in isolation and 22% with a cumulative background of the relevant objectives.**
- Maximum 24-hour, 30-day and 90-day average ground-level concentrations of HF are predicted to comply with the relevant objectives in all MSES areas due to the Project in isolation (no cumulative background available). **Predicted concentrations of HF in isolation are at most 4% of the relevant objectives.**

Significant impacts on MSES areas surrounding the Project are therefore, not expected. These results indicate the Project will satisfy PO7 of State Code 22.

Table 28 LP1 daily average - MSES ground-level predicted concentrations

Contribution	Pollutant	HF	HF	HF	SO ₂	NO ₂
	Averaging Period	24-hour	30-day	90-day	1-year	1-year
	Objective	1.5	0.4	0.1	21	33
	MSES Category	Predicted ground-level concentration (µm³)				
Max Isolation	100m From Wetland	0.031	0.003	0.002	0.039	0.16
	Category B	0.045	0.008	0.004	0.079	0.32

Contribution	Pollutant	HF	HF	HF	SO ₂	NO ₂
	Averaging Period	24-hour	30-day	90-day	1-year	1-year
	Objective	1.5	0.4	0.1	21	33
	MSES Category	Predicted ground-level concentration (µ/m ³)				
	Category C	0.063	0.008	0.004	0.079	0.32
	Essential Habitat	0.063	0.008	0.004	0.079	0.32
	High Significance Wetlands	0.031	0.003	0.003	0.039	0.16
	Koala Habitat Core	0.063	0.008	0.004	0.079	0.32
	Regional Biodiversity Corridor	0.050	0.005	0.003	0.076	0.31
	Wildlife Habitat Endangered Vulnerable	0.044	0.003	0.002	0.041	0.16
	Wildlife Habitat Least Concern	0.032	0.005	0.004	0.062	0.25
Max Cumulative	100m From Wetland	-	-	-	3.9	13.0
	Category B	-	-	-	4.4	13.4
	Category C	-	-	-	4.6	13.4
	Essential Habitat	-	-	-	4.6	13.4
	High Significance Wetlands	-	-	-	3.9	13.0
	Koala Habitat Core	-	-	-	4.6	13.4
	Regional Biodiversity Corridor	-	-	-	4.1	13.1
	Wildlife Habitat Endangered Vulnerable	-	-	-	4.0	13.0
	Wildlife Habitat Least Concern	-	-	-	4.6	13.4

7.1.2.4 LP2 Daily average (upper) emission concentration limit

Table 29, Table 30, Table 31 and Table 32 present the predicted ground-level concentrations of all air pollutants due to the Project in isolation and cumulatively (with ambient backgrounds). Results are presented for the maximum off-site, at a residential receptor, at a commercial receptor and at the on-site Visitor Centre.

Contour plates illustrating the predicted ground-level concentrations across the model domain for key pollutants:

- NO₂ (Plate 21 to Plate 24)
- SO₂ (Plate 25 to Plate 28)
- PM₁₀ (Plate 29 to Plate 32)
- PM_{2.5} (Plate 33 to Plate 36)

The following results summary shows ground-level impacts as percentage contributions to the respective objectives for each pollutant:

- Maximum 1-hour and annual average ground-level concentrations of NO₂ are predicted to comply with the relevant objectives at all off-site locations within the study area, due to the Project in isolation and cumulatively. **Predicted concentrations of NO₂, at a residential receptor, are at most 12% in isolation and 42% with a cumulative background of the relevant objectives. Predicted concentrations of NO₂, at a commercial receptor, are at most 26% in isolation and 36% with a cumulative background of the relevant objectives.**
- Maximum 8-hour average ground-level concentrations of CO are predicted to comply with the relevant objectives at all off-site locations within the study area, due to the Project in isolation and cumulatively. **Predicted concentrations of CO, at a residential receptor, are at most 0.04% in isolation and 6% with a cumulative background of the relevant objectives. Predicted concentrations of CO, at a commercial receptor, are at most 0.1% in isolation and 7% with a cumulative background of the relevant objectives.**
- Maximum 1-hour, 24-hour and annual average ground-level concentrations of SO₂ are predicted to comply with the relevant objectives at all off-site locations within the study area, due to the Project in isolation and cumulatively. **Predicted concentrations of SO₂, at a residential receptor, are at most 8% in isolation and 49% with a cumulative background of the relevant objectives. Predicted concentrations of SO₂, at a commercial receptor, are at most 17% in isolation and 76% with a cumulative background of the relevant objectives.**
- Maximum 24-hour and annual average ground-level concentrations of PM₁₀ are predicted to comply with the relevant objectives at all off-site locations within the study area, due to the Project in isolation and cumulatively. **Predicted concentrations of PM₁₀, at a residential receptor, are at most 0.3% in isolation and 66% with a cumulative background of the relevant objectives. Predicted concentrations of PM₁₀, at a commercial receptor, are at most 1% in isolation and 67% with a cumulative background of the relevant objectives.** Existing sources and background levels of PM₁₀ are the main contributors to ground-level concentrations of PM₁₀.
- Maximum 24-hour and annual average ground-level concentrations of PM_{2.5} are predicted to comply with the relevant objectives at all off-site locations within the study area, due to the Project in isolation and cumulatively. **Predicted concentrations of PM_{2.5}, at a residential receptor, are at most 0.6% in isolation and 95% with a cumulative background of the relevant objectives. Predicted concentrations of PM_{2.5}, at a commercial receptor, are at most 2% in isolation and 95% with a cumulative background of the relevant objectives.** Existing sources and background levels of PM_{2.5} are the main contributors to ground-level concentrations of PM_{2.5}.
- Maximum 1-hour, 24-hour and annual average ground-level concentrations of NH₃ are predicted to comply with the relevant objectives at all off-site locations within the study area due to the Project in isolation (no cumulative background available). **Predicted concentrations of NH₃, at a residential receptor, in isolation are at most 0.2% of the relevant objectives. Predicted concentrations of NH₃, at a commercial receptor, in isolation are at most 0.4% of the relevant objectives.**
- Maximum 1-hour and annual average ground-level concentrations of HCl are predicted to comply with the relevant objectives at all off-site locations within the study area due to the Project in isolation (no cumulative background available). **Predicted concentrations of HCl, at a residential receptor, in isolation are at most 0.2% of the relevant objectives. Predicted concentrations of HCl, at a commercial receptor, in isolation are at most 0.3% of the relevant objectives.**
- Maximum 24-hour and 30-minute average ground-level concentrations of formaldehyde are predicted to comply with the relevant objectives at all off-site locations within the study area due to the Project in isolation (no cumulative background available). **Predicted concentrations of formaldehyde, at a residential receptor, in isolation are at most 7% of the relevant objectives. Predicted concentrations of formaldehyde, at a commercial receptor, in isolation are at most 14% of the relevant objectives.**

- Annual average ground-level concentrations of benzene are predicted to comply with the relevant objectives at all off-site locations within the study area due to the Project in isolation (no cumulative background available). **Predicted concentrations of benzene, at a residential receptor, are at most 0.3% in isolation and 65% with a cumulative background of the relevant objectives. Predicted concentrations of benzene, at a commercial receptor, are at most 0.4% in isolation and 65% with a cumulative background of the relevant objectives.**
- Annual average ground-level concentrations of PAHs (as BaP) are predicted to comply with the relevant objectives at all off-site locations within the study area due to the Project in isolation (no cumulative background available). **Predicted concentrations of PAHs (as BaP), at a residential receptor, in isolation are at most 0.0001% of the relevant objectives. Predicted concentrations of PAHs (as BaP), at a commercial receptor, in isolation are at most 0.0001% of the relevant objectives.**
- Annual average ground-level concentrations of PCDD/F are predicted to comply with the relevant objectives at all off-site locations within the study area due to the Project in isolation (no cumulative background available). **Predicted concentrations of PCDD/F, at a residential receptor, in isolation are at most 0.0002% of the relevant objectives. Predicted concentrations of PCDD/F, at a commercial receptor, in isolation are at most 0.0002% of the relevant objectives.**
- Maximum predicted ground-level concentrations of any metal in at all off-site locations within the study area comply with the relevant objectives. **The metal contributing the most significantly to ground level concentrations, at a residential receptor, was Cr(VI), constituting 1% of the relevant objectives in isolation and 1% with a cumulative background of the relevant objectives. Predicted concentrations of Cr(VI), at a commercial receptor, are at most 3% in isolation and 3% with a cumulative background of the relevant objectives.** It has been conservatively assumed that chromium is made up of 100% Cr(VI) and therefore ground-level concentrations are expected to be lower.

In summary, the LP2 daily average air quality modelling results demonstrate that with the proposed emission limit settings, based on the upper end of the BAT-AEL range associated with implementation of BAT for emission control and flue gas treatment, the Project (in isolation) is predicted to have an insignificant impact on air quality as measured against the relevant objectives. Furthermore, maximum ground-level concentrations due to the Project with cumulative background (where available) do not exceed 95% of the relevant objectives at a residential or commercial receptor with ambient background concentrations and existing sources contributing the majority to each objective.

Different calorific values of waste fuel or changes in waste throughput do not significantly affect the emissions due to the Project (i.e. LP1 vs LP2) with predicted ground-level concentrations predicted to vary at most by 3% relative to air quality objectives based on different calorific values of the waste fuel and despite a 20% increase in waste throughput associated with LP2 as compared to LP1.

These results and the operation of the Project as described in this report demonstrate the appropriate implementation of best practices as described in the BREF WI, and therefore, satisfaction of Policy outcome 7 of Queensland's EfW Policy. The results also indicate the Project will satisfy AO2.1 of State Code 22.

Table 29 LP2 daily average – predicted ground-level concentrations of non-metal pollutants (in isolation)

Pollutant	Averaging period	Objective (µg/m³)	Maximum ground-level concentration due to the Project in isolation (µg/m³)			
			Maximum off-site	Maximum at a commercial receptor	Maximum at a residential receptor	Maximum at the Visitor Centre
NO ₂	1-hour	164	43.3	43.3	19.7	28.4
NO ₂	1-year	31	0.3	0.23	0.21	0.10
CO	8-hour	11,000	15.4	15.4	4.3	10.1
SO ₂	1-hour	214	36.1	36.1	16.4	23.7
SO ₂	24-hour	57	3.07	3.07	0.93	2.02
PM ₁₀	24-hour	50	0.51	0.51	0.16	0.34
PM ₁₀	1-year	25	0.013	0.010	0.009	0.004
PM _{2.5}	24-hour	20	0.51	0.51	0.16	0.34
PM _{2.5}	1-year	7	0.013	0.010	0.009	0.004
NH ₃	1-hour	3,200	12.0	12.0	5.46	7.89
NH ₃	24-hour	1,184	1.02	1.02	0.31	0.67
NH ₃	1-year	70	0.026	0.019	0.018	0.009
HCl	1-hour	2,100	7.22	7.22	3.28	4.74
HCl	1-year	20	0.015	0.012	0.011	0.005
Formaldehyde	24-hour	54	1.02	1.02	0.31	0.67
Formaldehyde	30-minute	109	15.7	15.7	7.11	10.27
Benzene	1-year	5.4	0.026	0.019	0.018	0.009
PAH as BAP	1-year	0.0003	5.2E-10	3.9E-10	3.5E-10	1.7E-10
PCDD/F	1-year	0.00004	1.1E-10	8.4E-11	7.7E-11	3.8E-11

Table 30 LP2 daily average – predicted cumulative ground-level concentrations of non-metal pollutants (isolation + background)

Pollutant	Averaging period	Objective (µg/m³)	Maximum ground-level concentration due to the Project with ambient background (µg/m³)			
			Maximum off-site	Maximum at a commercial receptor	Maximum at a residential receptor	Maximum at the Visitor Centre
NO ₂	1-hour	164	58.4	58.4	35.2	43.5

Pollutant	Averaging period	Objective (µg/m³)	Maximum ground-level concentration due to the Project with ambient background (µg/m³)			
			Maximum off-site	Maximum at a commercial receptor	Maximum at a residential receptor	Maximum at the Visitor Centre
NO ₂	1-year	31	12.7	12.5	12.4	12.3
CO	8-hour	11,000	659.6	530.6	486.4	415.7
SO ₂	1-hour	214	199.7	164.4	105.9	39.0
SO ₂	24-hour	57	17.5	12.0	9.39	6.66
PM ₁₀	24-hour	50	23.4	21.4	20.5	19.2
PM ₁₀	1-year	25	16.8	16.6	16.6	16.6
PM _{2.5}	24-hour	25	8.9	8.13	7.77	7.45
PM _{2.5}	1-year	8	6.7	6.66	6.65	6.63
Benzene	1-year	5.4	3.53	3.52	3.52	3.51

Table 31 LP2 daily average – predicted ground-level concentrations of metals (isolation)

Pollutant	Averaging period	Objective (µg/m³)	Maximum ground-level concentration due to the Project in isolation (µg/m³)			
			Maximum off-site	Maximum at a commercial receptor	Maximum at a residential receptor	Maximum at the Visitor Centre
As	1-year	0.006	0.000024	0.000018	0.000016	0.000008
Cd	1-year	0.005	0.00003	0.000023	0.000021	0.000010
Cr(III)	30-day	0.1	0.00025	0.00013	0.00012	0.00007
Cr(VI)	1-hour	1.3	0.036	0.036	0.016	0.024
Cr(VI)	1-year	0.005	0.00008	0.00006	0.00005	0.00003
Cu	1-hour	10	0.032	0.032	0.014	0.021
Hg	1-year	1.1	0.00005	0.00004	0.00004	0.00002
Mn	1-year	0.16	0.00012	0.00009	0.00008	0.00004
Ni	1-year	0.02	0.00009	0.00007	0.00006	0.00003
Pb	1-year	0.5	0.00031	0.00023	0.00021	0.00011
Sb	24-hour	1	0.0022	0.0022	0.0007	0.0014
Sb	1-year	0.3	0.00005	0.00004	0.00004	0.00002
V	2-hour	1.1	0.00038	0.00038	0.00012	0.00025

Table 32 LP2 daily average – predicted ground-level concentrations of metals pollutants (isolation + background)

Pollutant	Averaging period	Objective (µg/m³)	Maximum ground-level concentration due to the Project in isolation (µg/m³)			
			Maximum off-site	Maximum at a commercial receptor	Maximum at a residential receptor	Maximum at the Visitor Centre
As	1-year	0.006	0.000037	0.000025	0.000022	0.000013
Cr(III)	30-day	0.1	0.00026	0.00013	0.00012	0.00007
Cr(VI)	1-hour	1.3	0.037	0.036	0.017	0.024
Cr(VI)	1-year	0.005	0.00008	0.00006	0.00005	0.00003
Cu	1-hour	10	0.032	0.032	0.015	0.021
Mn	1-year	0.16	0.00013	0.00009	0.00008	0.00005
Ni	1-year	0.02	0.00010	0.00007	0.00007	0.00003

7.1.2.5 LP2 Short-term emission concentration limit

Table 33, Table 34, Table 35 and Table 36 present the predicted ground-level concentrations of all air pollutants due to the Project in isolation and cumulatively (with ambient backgrounds). Results are presented for the maximum off-site, at a residential receptor, at a commercial receptor and at the on-site Visitor Centre. Contour plates illustrating the predicted ground-level concentrations across the model domain for key pollutants:

- NO₂ (Plate 37 to Plate 38)
- SO₂ (Plate 39 to Plate 40)

The following results summary shows ground-level impacts as percentage contributions to the respective objectives for each pollutant:

- Maximum 1-hour average ground-level concentrations of NO₂ are predicted to comply with the relevant objectives at all off-site locations within the study area, due to the Project in isolation and cumulatively. **Predicted concentrations of NO₂, at a residential receptor, are at most 26% in isolation and 37% with a cumulative background of the relevant objectives. Predicted concentrations of NO₂, at a commercial receptor, are at most 57% in isolation and 68% with a cumulative background of the relevant objectives.**
- Maximum 1-hour average ground-level concentrations of SO₂ are predicted to comply with the relevant objectives at all off-site locations within the study area, due to the Project in isolation and cumulatively. **Predicted concentrations of SO₂, at a residential receptor, are at most 29% in isolation and 49% with a cumulative background of the relevant objectives. Predicted concentrations of SO₂, at a commercial receptor, are at most 64% in isolation and 76% with a cumulative background of the relevant objectives.**
- Maximum 1-hour average ground-level concentrations of HCl are predicted to comply with the relevant objectives at all off-site locations within the study area due to the Project in isolation (no cumulative background available). **Predicted concentrations of HCl, at a residential receptor, in isolation are at**

most 1% of the relevant objectives. Predicted concentrations of HCl, at a commercial receptor, in isolation are at most 2% of the relevant objectives.

- Maximum 30-minute average ground-level concentrations of formaldehyde are predicted to comply with the relevant objectives at all off-site locations within the study area due to the Project in isolation (no cumulative background available). **Predicted concentrations of formaldehyde, at a residential receptor, in isolation are at most 10% of the relevant objectives. Predicted concentrations of formaldehyde, at a commercial receptor, in isolation are at most 22% of the relevant objectives.**
- Maximum predicted ground-level concentrations of any metal in isolation (no cumulative backgrounds available) at all off-site locations within the study area comply with the relevant objectives. **The metal contributing the most significantly to ground level concentrations was Cr(VI), at a residential receptor, constituting 2.0% of the relevant objectives in isolation. Predicted concentrations of Cr(VI), at a commercial receptor, in isolation are at most 4% of the relevant objectives.** It has been conservatively assumed that chromium is made up of 100% Cr(VI) and therefore ground-level concentrations are expected to be lower.

In summary, the short-term air quality modelling results demonstrate that with the proposed emission limit settings for this scenario, the Project (in isolation) is predicted to have an insignificant impact on air quality as measured against the relevant objectives. Furthermore, maximum ground-level concentrations due to the Project with cumulative background (where available) do not exceed 76% of the relevant objectives at a residential or commercial receptor.

Different calorific values of waste fuel or changes in waste throughput do not significantly affect the emissions due to the Project (i.e. LP1 vs LP2) with predicted ground-level concentrations predicted to vary at most by 3% relative to air quality objectives based on different calorific values of the waste fuel and despite a 20% increase in waste throughput associated with LP2 as compared to LP1.

Table 33 LP2 short-term – predicted ground-level concentrations of non-metal pollutants (in isolation)

Pollutant	Averaging period	Objective (µg/m³)	Maximum ground-level concentration due to the Project in isolation (µg/m³)			
			Maximum off-site	Maximum at a commercial receptor	Maximum at a residential receptor	Maximum at the Visitor Centre
NO ₂	1-hour	164	93.9	93.9	42.6	61.6
SO ₂	1-hour	214	138.4	138.4	62.8	90.8
Formaldehyde	30-minute	109	23.5	23.5	10.7	15.4
HCl	1-hour	2,100	39.7	39.7	18.0	26.0
NH ₃	1-hour	3,200	11.7	11.7	5.29	7.65

Table 34 LP2 short-term – predicted cumulative ground-level concentrations of non-metal pollutants (isolation + ambient background)

Pollutant	Averaging period	Objective (µg/m³)	Maximum ground-level concentration due to the Project with ambient background (µg/m³)			
			Maximum off-site	Maximum at a commercial receptor	Maximum at a residential receptor	Maximum at the Visitor Centre
NO ₂	1-hour	164	109.1	109.1	58.2	76.7
SO ₂	1-hour	214	199.8	164.5	105.9	98.3

Table 35 LP2 short-term – predicted ground-level concentrations of metals (in isolation)

Pollutant	Averaging period	Objective (µg/m³)	Maximum ground-level concentration due to the Project in isolation (µg/m³)			
			Maximum off-site	Maximum at a commercial receptor	Maximum at a residential receptor	Maximum at the Visitor Centre
Cr(VI)	1-hour	1.3	0.048	0.048	0.022	0.031
Cu	1-hour	10	0.053	0.053	0.024	0.035

Table 36 LP2 short-term – predicted ground-level concentrations of metals (isolation + ambient background)

Pollutant	Averaging period	Objective (µg/m³)	Maximum ground-level concentration due to the Project in isolation (µg/m³)			
			Maximum off-site	Maximum at a commercial receptor	Maximum at a residential receptor	Maximum at the Visitor Centre
Cr(VI)	1-hour	1.3	0.048	0.048	0.022	0.031
Cu	1-hour	10	0.054	0.054	0.025	0.035

7.1.2.6 LP2 MSES results daily average (upper) emission concentration limit

Dispersion modelling results for each pollutant with a biodiversity or agricultural air quality objective detailed in Table 37 indicate compliance within each MSES area for each pollutant and averaging period. Percentage contributions reported in the following section are based on the maximum in any MSES area. Where a pollutant has multiple ecological/agricultural objectives, the model predicted concentration has been compared to the most stringent objective for each averaging period. The following results summary shows ground-level impacts as percentage contributions to the respective objectives for each pollutant:

- Maximum annual average ground-level concentrations of NO₂ are predicted to comply with the relevant objectives in all MSES areas, due to the Project in isolation and cumulatively. **Predicted concentrations of NO₂ are at most 1.0% in isolation and 41% with a cumulative background of the relevant objectives.**
- Maximum annual average ground-level concentrations of SO₂ are predicted to comply with the relevant objectives in all MSES areas, due to the Project in isolation and cumulatively. **Predicted concentrations of SO₂ are at most 0.4% in isolation and 22% with a cumulative background of the relevant objectives.**
- Maximum 24-hour, 30-day and 90-day average ground-level concentrations of HF are predicted to comply with the relevant objectives in all MSES areas due to the Project in isolation (no cumulative background available). **Predicted concentrations of HF in isolation are at most 4% of the relevant objectives.**

Significant impacts on MSES areas surrounding the Project are therefore, not expected. These results indicate the Project will satisfy PO7 of State Code 22.

Table 37 LP2 daily average - MSES ground-level predicted concentrations

Contribution	Pollutant	HF	HF	HF	SO ₂	NO ₂
	Averaging Period	24-hour	30-day	90-day	1-year	1-year
	Objective	1.5	0.4	0.1	21	33
	MSES Category	Predicted ground-level concentration (µm ³)				
Max Isolation	100m From Wetland	0.028	0.004	0.002	0.039	0.16
	Category B	0.045	0.008	0.004	0.077	0.31
	Category C	0.064	0.008	0.004	0.077	0.31
	Essential Habitat	0.064	0.008	0.004	0.077	0.31
	High Significance Wetlands	0.028	0.003	0.003	0.039	0.16
	Koala Habitat Core	0.064	0.008	0.004	0.077	0.31
	Regional Biodiversity Corridor	0.049	0.005	0.003	0.075	0.30
	Wildlife Habitat Endangered Vulnerable	0.046	0.003	0.002	0.040	0.16
	Wildlife Habitat Least Concern	0.032	0.005	0.004	0.060	0.24
Max Cumulative	100m From Wetland	-	-	-	3.9	13.0
	Category B	-	-	-	4.4	13.4
	Category C	-	-	-	4.6	13.4
	Essential Habitat	-	-	-	4.6	13.4
	High Significance Wetlands	-	-	-	3.9	13.0
	Koala Habitat Core	-	-	-	4.6	13.4
	Regional Biodiversity Corridor	-	-	-	4.1	13.1

Contribution	Pollutant	HF	HF	HF	SO ₂	NO ₂
	Averaging Period	24-hour	30-day	90-day	1-year	1-year
	Objective	1.5	0.4	0.1	21	33
	MSES Category	Predicted ground-level concentration (µ/m ³)				
	Wildlife Habitat Endangered Vulnerable	-	-	-	4.0	13.0
	Wildlife Habitat Least Concern	-	-	-	4.6	13.4

7.2 IBA / IBAA storage area

7.2.1 Emissions to air

A range of environmental controls are proposed to address risks associated with the IBA/IBAA maturation/processing and storage areas. These include:

- During the maturation phase, the maturing IBA stockpiles will be contained within a 3-sided IBA maturation building to limit the potential for fugitive dust emissions from raw IBA and limit the interaction of rainwater with the maturing IBA. The IBA maturation stockpiles will be sprayed with water to limit dust formation and to optimise the required chemical reactions (if necessary)
- IBA sorting will occur within the fully enclosed IBA sorting building to control noise, water and dust emissions. Dust management techniques will include a combination of managing the IBA moisture content (if necessary) and the use of enclosed conveyors. This building would have the following controls in place to manage dust emissions:
 - A fugitive dust management system including a baghouse or cartridge filter type dust collector (with an induced draft fan and vent stack) – to be confirmed during detailed design depending on known dust emissions sources and types
 - The discharge point will be via a short vent stack at the exist of the baghouse / air filter to release cleaned air at an elevation above the IBA sorting building roof. The proposed emission limit for dust in the cleaned air (i.e. 5 mg/Nm³ dry, 11% O₂) is in accordance with BAT 26 of the BREF-WI (2019)
 - Discharges of filtered ventilation air would be intermittent (i.e. only during plant operation of 10-12 hours per day). Emissions would be insignificant relative to the EfW process stack emissions, and therefore, not considered a licensable discharge point.
- Inert IBAA stockpiles still have a moisture content of ~10% and will be temporarily stored outside and sprayed with rainwater collected from the IBA area to limit dust formation (subject to detailed design, noting that mains water or excess process water would be used in the case that there is no available stormwater).
- Most of the IBAA will have particle sizes ranging from 0.1 mm to 50 mm, depending on the end use of the material in the construction industry (e.g. for making concrete and / or forming a road base). IBAA may contain smaller 'sand' like particles, but it is unlikely to contain any fine particulates (PM₁₀ and PM_{2.5}) that can be carried longer distances. With water sprays to suppress fugitive dust emissions, IBAA is not expected to be carried significant distances
- Dust suppression will be used on sealed roadways in IBA/IBAA storage area.

- Dust management controls within the IBA/IBAA storage area will also include a solid perimeter fence to contain material within the designated site area, complemented by a vegetated buffer comprising a line of trees beyond the fence that provides an additional dust control measure.

Whilst emissions are expected to be minimal from the IBA/IBAA storage area, emissions of dust were estimated based on:

- Handling of the material (front end loader moving material from stockpiles, to stockpiles and loading trucks)
- Wind erosion of the stockpiled material.

Emissions of metals in the dust were not estimated as these were expected to be insignificant due to the removal of ferrous and non-ferrous metals in the IBA Treatment area.

Table 38 presents the activity data used in determining emissions of dust and Table 39 summarises the emission rates of dust from the IBA/IBAA storage area.

Table 38 IBA/IBAA storage area activity data

Parameter	Units	IBA	IBAA
Quantity in stockpiles	Tonnes	24,356	17,700
Duration on site	Days	45	36
Moisture content	%	20	10
Mean windspeed between 6am and 6pm	m/s	2.2	2.2
Stockpile area	Hectares	1.01	0.67
Control for stockpile area	%	70% for 3-sided building with roof	0%

Table 39 IBA/IBAA storage area emission rates of dust

Activities	Emission rate (g/s)		
	TSP	PM ₁₀	PM _{2.5}
Material handling (IBA)	0.002	0.0008	0.0001
Material handling (IBAA)	0.004	0.002	0.0003
Wind erosion (IBA)	0.0019 ⁽¹⁾	0.0009 ⁽¹⁾	0.0001 ⁽¹⁾
Wind erosion (IBAA)	0.0041 ⁽¹⁾	0.0021 ⁽¹⁾	0.0003 ⁽¹⁾
Total	0.012	0.006	0.0008

Table note:

⁽¹⁾Average emission rate over a year, wind erosion was calculated on an hourly basis with emissions occurring when winds were over a threshold of 5.4m/s (lift off threshold for sand).

7.2.2 Dispersion modelling results

Table 40 presents the predicted ground-level concentrations of all air pollutants due to the Project IBA/IBAA storage area in isolation. Results are presented for the maximum off-site, at a residential receptor, at a commercial receptor and at the on-site Visitor Centre.

The following results summary shows ground-level impacts as percentage contributions to the respective objectives for each pollutant:

- Maximum 24-hour and annual average ground-level concentrations of PM₁₀ are predicted to comply with the relevant objectives at all off-site locations within the study area, due to the IBA/IBAA storage area in isolation. **Predicted concentrations of PM₁₀, at a residential receptor, are at most 0.2% in isolation of the relevant objectives. Predicted concentrations of PM₁₀, at a commercial receptor, are at most 0.3% in isolation of the relevant objectives.**
- Maximum 24-hour and annual average ground-level concentrations of PM_{2.5} are predicted to comply with the relevant objectives at all off-site locations within the study area, due to the IBA/IBAA storage area in isolation. **Predicted concentrations of PM_{2.5}, at a residential receptor, are at most 0.08% in isolation of the relevant objectives. Predicted concentrations of PM_{2.5}, at a commercial receptor, are at most 0.1% in isolation of the relevant objectives.**
- Annual average ground-level concentrations of TSP are predicted to comply with the relevant objectives at all off-site locations within the study area, due to the IBA/IBAA storage area in isolation. **Predicted concentrations of TSP, at a residential receptor, are at most 0.001% in isolation of the relevant objectives. Predicted concentrations of TSP, at a commercial receptor, are at most 0.05% in isolation of the relevant objectives.**
- Maximum monthly dust deposition rates are predicted to comply with the relevant objectives at all off-site locations within the study area, due to the IBA/IBAA storage area in isolation. **Predicted dust deposition at a residential receptor, is at most 0.03% in isolation of the relevant objectives. Predicted dust deposition at a commercial receptor, is at most 0.1% in isolation of the relevant objectives.**

In summary the air quality modelling results demonstrate that with the proposed control measures the IBA/IBAA storage area is predicted to have an insignificant impact on air quality as measured against the relevant objectives.

Table 40 Predicted ground-level concentrations of dust from IBA / IBAA storage

Pollutant	Averaging period	Objectives (µg/m³)	Maximum ground-level concentration due to the Project in isolation (µg/m³)			
			Maximum off-site	Maximum at a commercial receptor	Maximum at a residential receptor	Maximum at the Visitor Centre
PM ₁₀	24-hour	50	6.2	0.14	0.092	0.13
PM ₁₀	1-year	25	0.03	0.023	0.0007	0.011
PM _{2.5}	24-hour	20	0.97	0.024	0.016	0.020
PM _{2.5}	1-year	7	0.005	0.004	0.0001	0.002
TSP	1-year	90	0.063	0.045	0.001	0.021
Dust deposition	Monthly	120 mg/m²/day	2.6	0.15	0.033	0.053

8. ODOUR RISK ASSESSMENT

The Project waste stream consists of source separated MSW and C&I waste subject to the EfW Guideline and the WAP. The waste is primarily contained within the tipping hall maintained under negative pressure behind fast-acting roller doors. The opportunities for odour to escape the building and the intensity of odour from the waste stream are both expected to be low.

Key controls for odour to be implemented by the Project include:

- Waste deliveries will arrive onsite either in fully enclosed vehicles or loads.
- Waste deliveries must be in accordance with the site WAP.
- Good housekeeping within the tipping hall area. Waste placed in the inspection area will be moved to the waste bunker or returned to the delivery vehicle if unacceptable as quickly as possible (~1 hr). Waste dropped in front of the waste bunkers will be regularly cleared into the bunker using a front-end loader.
- Primary odour controls, including building design to segregate the tipping hall and waste bunker areas from other plant areas, the use of fast acting roller doors on entry and exit of tipping hall and maintaining a negative pressure in the tipping hall by extracting combustion air from within the waste bunker area, and pre-mixing of waste within the waste bunker (to avoid potential anaerobic conditions) are highly effective in managing odour during normal operation. Redundancy is also provided as there will be at least two air intakes for the combustion air drawn from the bunker and tipping hall, that is, one for each boiler line.

The Level 2 odour risk assessment for the Project, performed in accordance with Vic EPA Publication 1883 (2022) as discussed in Section 5.2.9, is presented in Table 41. The Level 2 risk potential score ranges from 1 to 12 as defined below:

- 1 to 7 – low risk: risk of odour is low, safe to report
- 8 or 9 – medium risk: borderline cases – there may be one element that can influence the score and tip it into a low or high score. In these cases, this should be explored further
- 10 to 11 – high risk: A level 3 assessment is recommended to fully understand the risk
- 12 – very high risk: A level 3 assessment is not likely to demonstrate risk is acceptable but may provide further illustration on the nature of the risks and/or inform on odour mitigation measures.

This risk assessment resulted in an overall risk potential score of 7 and, therefore, the risk of odour impacts from activities at the Project can be considered low taking into consideration the odour management measures and the separation of the activities from sensitive receptors.

Table 41 Level 2 odour assessment risk potential score matrix

Odour Source	Odour Source Hazard Potential		Odour Exposure Pathway Effectiveness		Receiving Environment Sensitivity		Odour Control Effectiveness Weighting	
	Category	Odour Source Score (OSS)	Category	Odour Pathway Score (OPS)	Existing Uses	Score	Category	Weighting
Tipping Haul	Activity Type	(1) - Low odour potential: Waste to energy plant	Distance	(2) - Medium Distance: Receiving environment is tens to hundreds of metres from the source. Separation distance has not been met or only just met at the threshold distances.	Business areas, single dwelling or isolated rural dwellings, recreational outdoor areas	(2) - Medium	Odour Control Effectiveness	(-1) - High: Tangible mitigation measures in place leading to little or no residual odour; releases, even due to plant failure. Fully enclosed operations.
	Size of Odour Hazard	(3) - Large size: Materials usage hundreds of thousands of tonnes/m3 per year.	Meteorology	(3) - Unfavourable: High frequency of winds from source to receiving environment	-	-	-	-
	Offensive Potential	(2) - Unwelcome Unpleasant odour range: although not likely to be perceived as toxic or unsafe, these odours are usually unwelcomed for most people.	Terrain and Built Form	(2) - Neutral: Moderate vegetation, source is on same altitude as receiving environment. Intervening land use zone contains other non-odorous industry or smaller businesses.	-	-	-	-
	-	-	Hours of Operation	(3) - High frequency: Emissions continually occurring 24/7 or for long periods at a time.	-	-	-	-
Attribute Score	-	3	-	3		2		-1
Overall Risk Rating	7							

9. PLUME VISIBILITY

A plume visibility study has been conducted using ADMS-6 to determine:

- The percentage of time the plume from the flue gas stack is expected to be visible
- The height above ground at which the plume from the flue gas stack may be visible
- The distance from the stack that the plume from the flue gas stack may be visible.

Plume visibility is primarily a function of temperature related condensation of steam in the exhaust air. When this air condenses the water vapour becomes visible.

The results of the plume visibility modelling for the Project operating at LP1 indicate the following:

- For the entire five-year period (40,035 hours modelled), the plume has the potential to be visible for 2,380 hours of which 2,278 hours (or only 5.7% of entire period) would be during daylight hours.
- The maximum height above ground at which the plume would be visible ranges from 103 m to 261 m above ground
- The horizontal extent that the plume would be visible ranges from 0.2 m to 262 m downwind, with an average horizontal extent of 21 m.

The results of the plume visibility modelling for the Project operating at LP2 indicate the following:

- For the entire five-year period (40,035 hours modelled), the plume has the potential to be visible for 3,682 hours of which 3274 hours (or only 8.2% of entire period) would be during daylight hours.
- The maximum height above ground at which the plume would be visible ranges from 100 m to 262m above ground.
- The horizontal extent that the plume would be visible ranges from 0.2 m to 276 m downwind, with an average horizontal extent of 26m.

In terms of the visible plume extending beyond the site boundary, site plans indicate that distance from the stack to the closest site boundary is 181 m and distances from the furthest site boundary is 956 m. The modelling shows that the visible plume will be predominantly contained within the Project site boundary, (Figure 15).

The plume will not cause an issue for the railway corridor as it will not be visible at the height of the railway corridor therefore satisfying P01 of State Code 2.

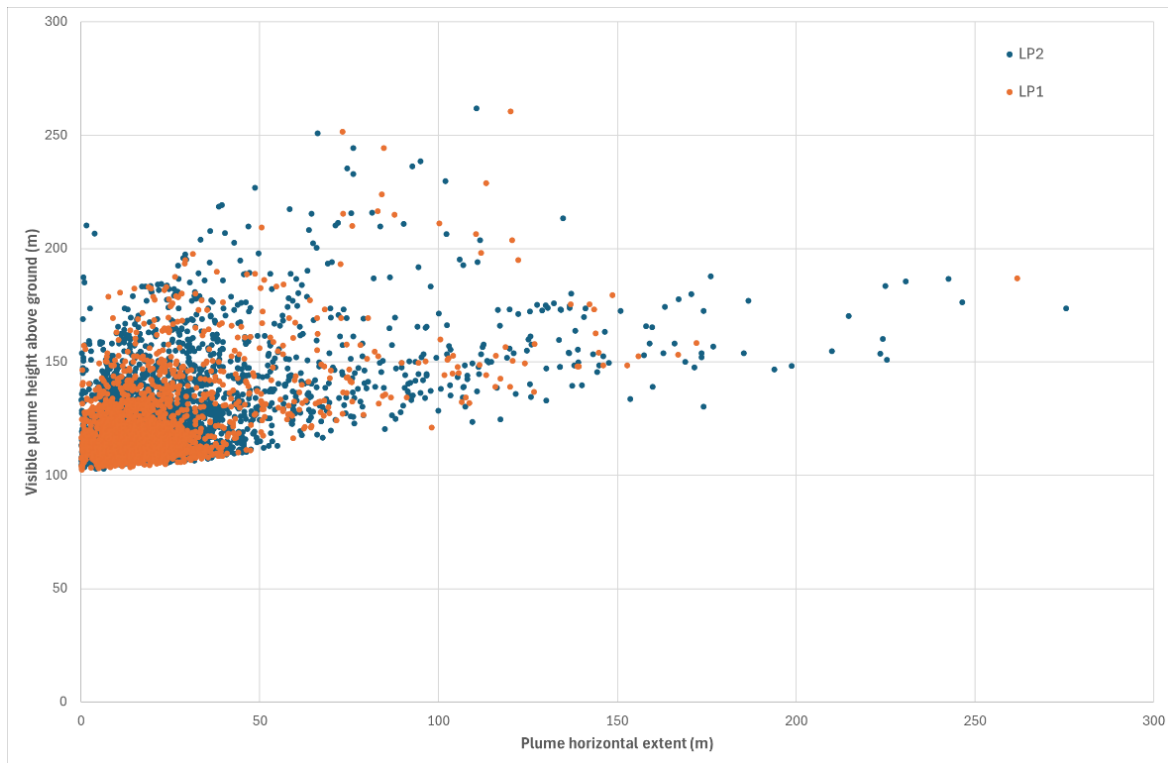


Figure 15 Plume visibility - horizontal and vertical extent

10. MITIGATION AND RISK MANAGEMENT

10.1 Overview

The Project will largely be fully automated, incorporating the latest online emissions monitoring technology, continuous monitoring of operational performance and automatic shut off mechanisms where preprogrammed limits are triggered for key parameters. The operating system will incorporate several layers of contingency to detect system changes and respond to potential incidents. Regular monitoring, alarms and standard operating procedures will be in place to ensure that emissions are monitored continuously and responded to appropriately should the risk of related emissions exceedances or actual exceedance be detected.

All mitigation and risk management measures to be employed at the Project are addressed in the following sections. These aim to achieve the following:

- Reduce risks as far as reasonably practicable
- Implement and maintain systems for identification, assessment and control of risks of harm and to aid evaluation of their controls
- Ensure best practice control standards.

The outlined measures below also correspond with mitigation measures presented in the Environmental Risk Assessment for the Project prepared by Arup. All measures will fall under the Environment Risk Assessment identifier AQ01.

10.2 Plant design and pollution controls

The Project has been designed in line the European IED and the associated BREF-WI document which sets the EU environmental standards for waste incineration as published on 3 December 2019. The EU Commission Implementing Decision (2019/2010) on 12 November 2019 states the BAT conclusions as the main element of the BREF and prescribes them to be adopted by Member States. Due to the various types and combinations of BAT for controlling emissions, the BREF WI specifies a range of associated emission levels (BAT-AELs). The approach ensures that emission concentrations will be within the BAT-AEL range expected for EfW facilities that have implemented BAT.

Primary pollution controls will include:

- Contractual compliance with the site Waste Acceptance Protocol by both waste suppliers, operations staff and plant management to control waste acceptance and suitability (Section 10.3).
- All waste deliveries in enclosed vehicles and no tipping of waste outside the waste receipt hall.
- Enclosed waste receipt hall and waste bunker areas operating under negative air pressure (Section 10.3).
- Pre-mixing of waste in the waste bunker prior to feeding (Section 10.4).
- Selection of moving grate combustion technology and proven boiler technology that is flexible, to accommodate expected mixed waste feedstock variability, and maintainable, to ensure a high level of stable operation and boiler availability, thus reducing the likelihood of Other Than Normal Operating Conditions.
- Sophisticated automated combustion control system (Section 10.4) for each grate-boiler line to control combustion air flow rates and maintain stable operation, thus inhibiting the formation of NO_x while controlling the formation of CO and other products of incomplete combustion.

- Boiler design with high temperature residence time conditions of ≥ 850 degrees Celsius for ≥ 2 seconds after last injection of combustion air to destroy residual TVOCs, dioxins and furans, and rapid cooling through the Boiler Economiser section to limit the reformation of dioxins and furans by de-novo synthesis (Section 10.4).
- Boiler ash hoppers located underneath the boiler to collect coarse particulate matter, which may separate from the flue gas due to a change in direction within the boiler, or due to impact on boiler tube bundles, thus reducing the dust load on the downstream baghouse filter.
- Inclusion of a CEMS (Section 10.6) for each grate-boiler line.

State-of-the-art emission control and flue gas cleaning systems (Section 10.5) for each grate-boiler line provide secondary pollution control, to ensure that emission limits are not exceeded under normal operating conditions.

10.3 Waste receipt hall and bunker

All waste deliveries arriving at the BERC will be via fully enclosed vehicles or loads and waste accepted for processing must be in accordance with the site Waste Acceptance Protocol. The Waste Acceptance Protocol is expected to be a schedule attached to all contractual Waste Supply Agreements between BERC and waste suppliers. The enclosed tipping hall will be designed with automated fast-acting roller doors and will be maintained at negative pressure to minimise potential dust/odour generation. Good housekeeping in the tipping hall will prevent accumulation of potentially odorous materials outside of the waste bunker, while the grab cranes will constantly pre-mix the waste in the waste bunker, to avoid potential anaerobic conditions. The waste bunker and tipping hall are under constant CCTV surveillance, to allow the grab crane operator to observe waste deliveries and remove oversized or unacceptable waste from the bunker for shredding or disposal (if the material is unacceptable waste).

Negative pressure is maintained through constant drawing of air from the tipping hall into the boiler system for combustion while adjustable louvres within the tipping hall can ensure constant ingress of fresh combustion air even when access doors are shut. Furthermore, the waste bunker where incoming waste is tipped and stored will be largely separated from the tipping hall by an internal tipping bay wall. Tipping hall louvres and entry and exit roller doors will typically be closed when the plant is not operating. A dedicated stand-by odour control unit is proposed to manage odour in the tipping hall and waste bunker areas for workplace health and safety purposes in the event of a full plant outage and work is being undertaken in those areas.

10.4 Combustion system

Pre-mixed feedstock will be fed into the furnace from the waste bunker and combusted on a moving grate system incorporating combustion air injection. The automatic combustion control system will be designed to achieve combustion, burnout and emissions outcomes, by adjusting fuel feeding, grate movement and combustion air supply to maintain a steam flow setpoint. Controlling steam flow ensures stable boiler operation, which minimises the products of incomplete combustion of the feedstock. Auxiliary fuel burners (two per boiler) will be provided for start-up (boiler heating prior to introducing waste), shutdown flue gas temperature control and to ensure flue gas temperatures remain above 850 degrees Celsius for at least two seconds after the last injection of combustion air, whenever waste is being combusted. Maintaining the flue gas temperature above 850 degrees Celsius for at least two seconds helps to destroy any residual volatile organic compounds and limit the formation of dioxins and furans.

The moving grate system is designed to additionally agitate and mix waste to facilitate complete combustion, while air flow is fed and distributed from beneath the grate, and secondary air is fed to the furnace as needed to ensure complete burnout of the combustion gases. Primary air flow will be fed from air intakes above the waste bunker while secondary combustion air will be drawn from the warm boiler building headspace. This helps to maintain the negative pressure in the waste bunker and tipping hall, while the warm secondary air from the boiler headspace enhances boiler energy efficiency. The automatic combustion control system monitors flue gas temperature and

controls the waste feed rate, grate speed and primary and secondary combustion air injection rates to maintain a stable steam generation rate from the boiler.

The boiler operates such that complete combustion and sufficient cooling occurs before combustion gases and particles enter the convection stage of the system to avoid corrosion and blockages of internal piping. The convection stage involves flue gas cooling and super heating. The final stage is the boiler economiser where flue gas is further cooled by preheating the boiler feedwater. The rapid cooling of flue gas to around 160 degrees Celsius in the boiler economiser section helps to prevent the formation of dioxins and furans through de-novo synthesis mechanisms.

10.5 Emission control and flue gas treatment system

The Project will be equipped with a Selective Non-Catalytic Reduction (SNCR) system in the combustion chamber and a semi dry flue gas treatment system at the exit of the boiler economizer. The automatic combustion control system, the SNCR, the flue gas treatment system and the Continuous Emission Monitoring System (CEMS) work in concert, under the control of the process control and monitoring system, to abate emissions of dust, NO_x, ammonia slip (unreacted ammonia from the reducing agent), acid gases, heavy metals and dioxins and furans, to maintain emission concentration levels below the upper end of the BAT-AEL emission concentration range during normal operating conditions and within IED short-term emission concentration limits at all times when waste is being combusted.

The proposed emission control and flue gas treatment systems do not include the ability to bypass emission control or flue gas treatment devices. The EU Industrial Emissions Directive Article 50(4) requires waste incineration plants to operate an automatic system to prevent waste feed: (a) at start-up, before the minimum combustion temperature is achieved, (b) if the high temperature residence time criteria of the combustion chamber cannot be maintained during operation or (c) if the continuous emissions monitoring system shows that an emission limit value is exceeded due to a failure or disturbance of a flue gas cleaning device. It is possible to bypass an individual cell within the bag filter to enable maintenance (e.g., bag replacement); however, the bag filter is designed for N+1 operation so that the operating performance is maintained while one cell is offline for maintenance.

10.5.1 Selective non-catalytic reduction (SNCR)

The Project will use an SNCR system as a secondary abatement technique to mitigate NO_x emissions. Ammonia or urea solution is injected into the first pass of the boiler where the flue gas temperature is in the range of 900 – 1050 degrees Celsius (for urea solution). This allows NO_x to react with the ammonia/urea, converting NO_x into free nitrogen and water. Using a SNCR system in which (a) flue gas temperature is monitored and used to select the optimum injection level and (b) the CEMS measured NO_x and residual ammonia concentrations at the stack are used to set the optimum reagent injection rate, will ensure that the Project can achieve emissions of NO_x at or below the upper end of the BAT-AEL range during normal operating conditions, while also meeting the specified BAT-AEL for ammonia slip.

10.5.2 Reactor

Flue gas exiting the boiler economizer is quench cooled with water sprays (or alternatively, by water addition to the lime reagent) to optimize the temperature at the inlet to the scrubbing reactor and enhance the reactivity of the lime reagent. Hydrated lime and recirculating residue recovered by the downstream baghouse filter, are injected into the flue gas stream upstream of a reactor in which acid gases (i.e., HCl, SO₂ and HF) are absorbed and separated from the flue gas (in the downstream baghouse filter) as the corresponding calcium salts together with fly ash from the combustion chamber. Activated carbon is also injected into the reactor to adsorb and capture heavy metals and residual organic compounds, which may include trace amounts of dioxins and furans and VOCs remaining in the gas phase.

10.5.3 Baghouse filter

The baghouse filter removes the mixture of activated carbon, excess hydrated lime and fly ash, as well as the acid gas neutralization reaction products (calcium salts) from the flue gas at the reactor outlet by forming a filter cake. The filter cake provides additional residence time for acid gas-hydrated lime neutralisation reactions to occur, along with further adsorption of heavy metals and organic compounds onto the powdered activated carbon. To prevent excessive pressure loss across the baghouse filter, the filter cake is intermittently dislodged from the filter bags, typically by pulsing the bags with compressed air. The majority of the filter cake, which contains unreacted hydrated lime and excess activated carbon, is recycled to the reactor to enhance the pollutant removal efficiency and minimise reagent consumption. A small purge of the residuals, termed Air Pollution Control residue (APCr) is safely and securely stored in silos prior to treatment with cement and water, to create a concrete slurry. This slurry is allowed to cure for approximately seven days before collection and transportation off-site for disposal at a licensed facility. The baghouse filter will be compartmentalised, to allow individual compartments to be isolated for maintenance (e.g. to replace a leaking filter bag) without needing to shut down the grate-boiler line.

10.6 Continuous emissions monitoring system

Each grate line will be equipped with a CEMS upon commissioning and, thereafter, once the BERC is in operation, the CEMS will provide continuous monitoring of the flue gas to ensure the Project is compliant with EA limits. This also assists in providing real time feedback to the control systems to make automatic adjustments to the injection rates for the flue gas treatment and emission control systems.

Continuous monitoring will be installed for all pollutants that must be continuously monitored including NO_x, CO, particulates, TOC, HCl, HF, NH₃, SO₂ and Hg, noting that the BREF WI has provisions to switch to periodic measurement of HF¹ or either periodic measurement or long-term sampling, in the case of Hg², if emission levels are found to be consistently low and the feedstock is consistently low in these elements.

For pollutants with levels below limits of detection or where continuous monitoring is not feasible, routine sampling and testing will be established to ensure that the facility complies with environmental obligations. Auxiliary parameters such as flow rate, temperature, pressure, moisture content, oxygen and CO₂ will also be measured as part of the CEMS.

10.7 Power failure

During normal operation, the facility will provide its own power. However, in the event of a turbine outage, the facility will continue to operate and process waste by drawing power from the grid and bypassing steam directly to the Air-Cooled Condenser. In addition, the facility can continue to operate in the event of a grid failure, by switching to 'Power Island' mode and providing only the power required to operate the facility.

¹ The continuous measurement of HF may be replaced by periodic measurements with a minimum frequency of once every six months if the HF emission levels are proven to be sufficiently stable. No EN standard is available for the periodic measurement of HF.

² For plants incinerating wastes with a proven low and stable mercury content (e.g. mono-streams of waste of a controlled composition), the continuous monitoring of emissions may be replaced by long-term sampling or periodic measurements with a minimum frequency of once every six months.

11. CONCLUSIONS

The air quality assessment has investigated the potential for the Project to affect air quality during construction and operations.

The potential impacts of dust emissions during construction of the Project have been assessed using a risk-based methodology. This 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. Emissions from other sources on site including vehicle exhaust emissions, emergency diesel generator (~5 MW electrical, for emergency and temporary use only), conveying (i.e. enclosed conveying) and sorting of IBA and immobilization of APCr are either insignificant or sufficiently controlled to be considered insignificant.

The potential impacts of emissions during operation of the Project have been assessed using a dispersion modelling approach. Emissions of key pollutants have been assessed for four scenarios:

- LP1 daily average operations
 - Nominal waste throughput at 100% thermal input. To accommodate temporary operation at up to 110% thermal input due to normal waste variability, this assessment includes a 10% margin on mass emission rates.
 - Normal operating conditions
 - BREF WI, 2019 - daily average (upper) concentration limits
 - Both lines assumed to be at the daily average (upper) concentration limits.
- LP1 – short-term operations
 - Nominal waste throughput at 100% thermal input, with a 10% margin on mass emission rates
 - EU IED (2010) - short-term (30-minute average) emission limits. Only one line will be operating at short-term emission limits whilst the other line will be operating at the daily average (upper) concentration limit.
 - Emissions for metals have been conservatively assumed to include both Lines operating at LP1 daily average emission rates and additionally, one line operating at the short-term maximum dust emission limit with fly ash metals composition applied to this value.
- LP2 – daily average operations.
 - Maximum waste throughput at 120% mechanical load
 - 100% thermal input, with a 10% margin on mass emission rates
 - Normal operating conditions
 - BREF WI, 2019 - daily average (upper) concentration limits
- LP2 – short-term operations
 - Maximum waste throughput at 120% mechanical load
 - 100% thermal input, with a 10% margin on mass emission rates
 - EU IED (2010) - short-term (30-minute average) emission limits. Only one line will be operating at short-term emission limits whilst the other line will be operating at the daily average (upper) concentration limit.

- Emissions for metals have been conservatively assumed to include both Lines operating at LP2 daily average emission rates and additionally, one line operating at the short-term maximum dust emission limit with fly ash metals composition applied to this value.

The regulatory-approved dispersion model, CALPUFF, has been used to predict ground-level concentrations of air pollutants. Background levels of air pollutants have been conservatively accounted for by explicitly modelling nearby industry and adding ambient backgrounds from the DETSI ambient air monitoring stations at Springwood and Woolloongabba, all of which are significantly closer to major population centres and industry pollution sources than the Project site. Predicted concentrations have been compared against the relevant health-based and environmental air quality objectives identified by the Air EPP. For pollutants released from the BERC not covered by the Air EPP objectives, criteria from the EPA Victoria have been adopted.

Odour from the Project has also been assessed using a risk assessment approach.

For the Project's construction phase the air quality risk assessment identified the following:

- Without mitigation, the preliminary risk of dust soiling associated with the construction of the Project is low
- Without mitigation, the preliminary risk to human health associated with the construction of the Project is low
- Without mitigation, the preliminary risk to ecological receptors associated with construction of the Project is low
- A Construction Dust Management Plan (CDMP) will be prepared and implemented by the construction contractor. The CDMP will include mitigation measures for controlling dust. By implementing the CDMP, the risk of dust emissions from construction causing soiling or potentially adversely affecting human health and ecological receptors is low.

For the Project's operation phase the air quality assessment identified the following:

- With the Project operating at the LP1 daily average (upper) emission concentration limits as specified in the BREF:
 - The Project (in isolation) is predicted to have an **insignificant impact** on air quality as measured against the relevant objectives.
 - Maximum ground-level concentrations due to the Project with cumulative background (where available) do not exceed 95% of the relevant objectives.
- With the Project operating at the LP1 short-term emission concentration limits as specified in the EU IED (2010):
 - The Project (in isolation) is predicted to have an **insignificant impact** on air quality as measured against the relevant objectives.
 - Maximum ground-level concentrations due to the Project with cumulative background (where available) do not exceed 76% of the relevant objectives.
- With the Project operating at the LP2 daily average (upper) emission concentration limits as specified in the BREF:
 - The Project (in isolation) is predicted to have an **insignificant impact** on air quality as measured against the relevant objectives.
 - Maximum ground-level concentrations due to the Project with cumulative background (where available) do not exceed 95% of the relevant objectives.

- With the Project operating at the LP2 short-term emission concentration limits as specified in the EU IED (2010):
 - The Project (in isolation) is predicted to have an **insignificant impact** on air quality as measured against the relevant objectives.
 - Maximum ground-level concentrations due to the Project with cumulative background (where available) do not exceed 76% of the relevant objectives.
- Different calorific values of waste fuel or changes in waste throughput do not significantly affect the emissions due to the Project (i.e., LP1 vs LP2) with predicted ground-level concentrations predicted to vary at most by 3% relative to air quality objectives based on different calorific values of the waste fuel and despite a 20% increase in waste throughput associated with LP2 as compared to LP1.
- In terms of predicted concentrations within MSES areas:
 - The Project (in isolation) is predicted to have an **insignificant impact** on air quality as measured against the relevant objectives.
 - Maximum ground-level concentrations due to the Project with cumulative background (where available) do not exceed 41% of the relevant objectives.

The air quality assessment has found that the risk of adverse odour impacts due to the Project is low.

The air quality assessment has that with the proposed control measures the IBA/IBAA storage area is predicted to have an insignificant impact on air quality as measured against the relevant objectives.

In terms of plume visibility for LP1 i.e. associated with condensing water vapour in the flue gas:

- For the entire five-year period (40,035 hours modelled), the plume has the potential to be visible for 2,380 hours of which 2,278 hours (or only 5.7% of entire period) would be during daylight hours.
- The maximum height above ground at which the plume would be visible ranges from 103m to 261m above ground
- The horizontal extent that the plume would be visible ranges from 0.2m to 262m downwind, with an average horizontal extent of 21m
- In terms of the visible plume extending beyond the site boundary, site plans provided indicate that distance from the stack to the closest site boundary is 183m. **The modelling shows that the visible plume is predominately contained within the Project site.**

In summary, the daily average (i.e., under normal operating conditions) and short-term average air quality modelling results demonstrate that with the proposed emission limit settings, based on the upper end of the BAT-AEL range associated with implementation of BAT for emission control and flue gas treatment, the Project (in isolation) is predicted to have an insignificant impact on air quality, as measured against the relevant health-based and environmental based air quality objectives.

These results and the operation of the Project as described in this report demonstrate:

- The appropriate implementation of best practices as described in the BREF WI, and therefore, satisfaction of Policy outcome 7 of Queensland's EfW Policy.
- The Project complies with the objectives in the Air EPP and will meet AO2.1, PO3, and PO7 of State Code 22 and Section 2.5.4 of the Bromelton SDA wide assessment criteria.
- The Project will meet PO1, PO2, PO3, PO6, PO34 of State Code 22 as emissions due to operations comply with the objectives in the Air EPP and plume visibility will not impede the rail corridor and dust during construction will be managed to avoid nuisance.

12. REFERENCES

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13. CONTOUR PLATES

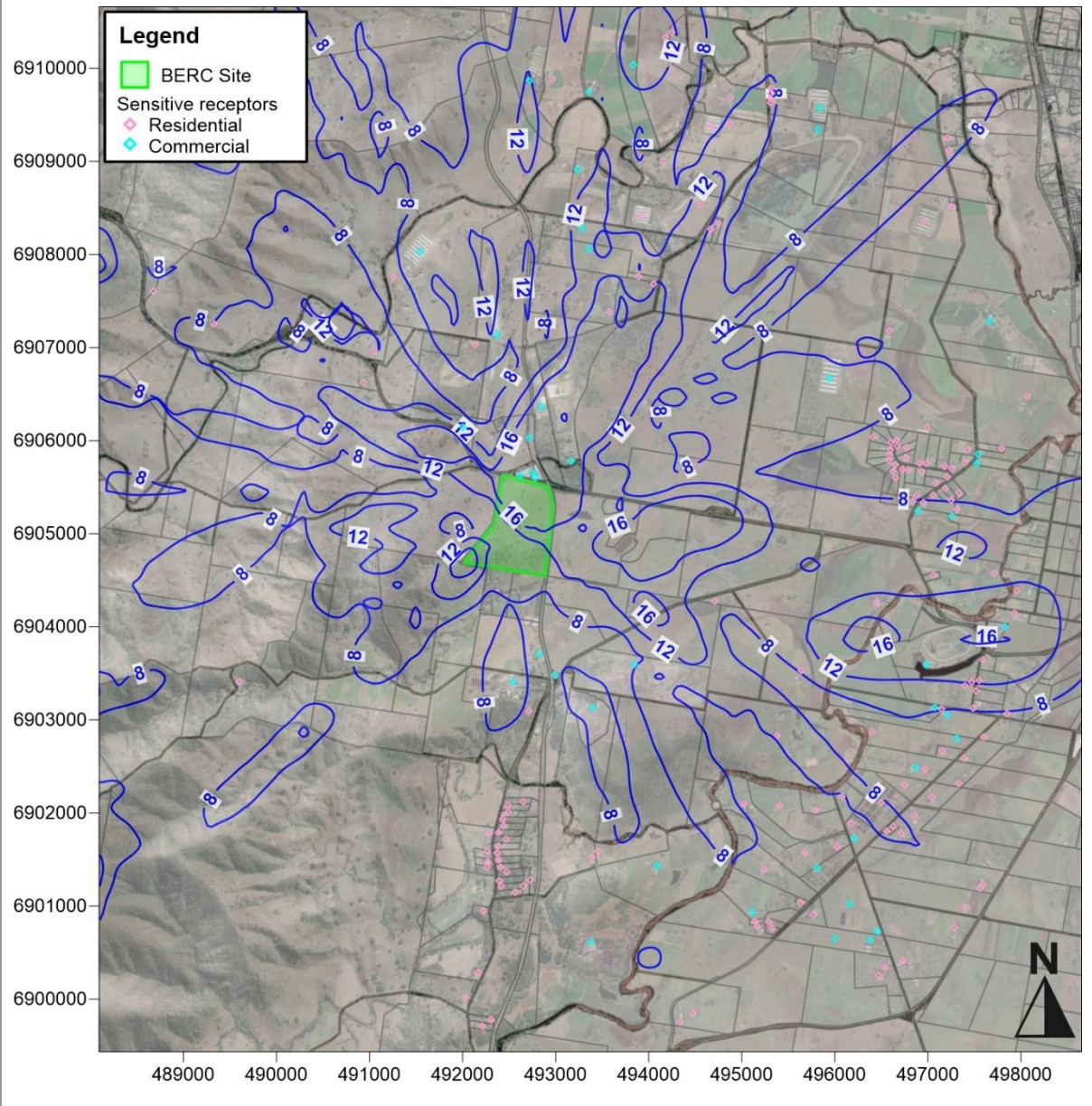


Plate 1 LP1 daily average concentration limits: maximum predicted 1-hour ground-level concentration for NO2 due to the Project in isolation			
Location: Beaudesert, QLD	Averaging period: 1-hour	Data source: CALPUFF	Units: µg/m³
Type: Maximum	Objective: 164 µg/m³	Prepared by: D Gallagher	Date: September 2025

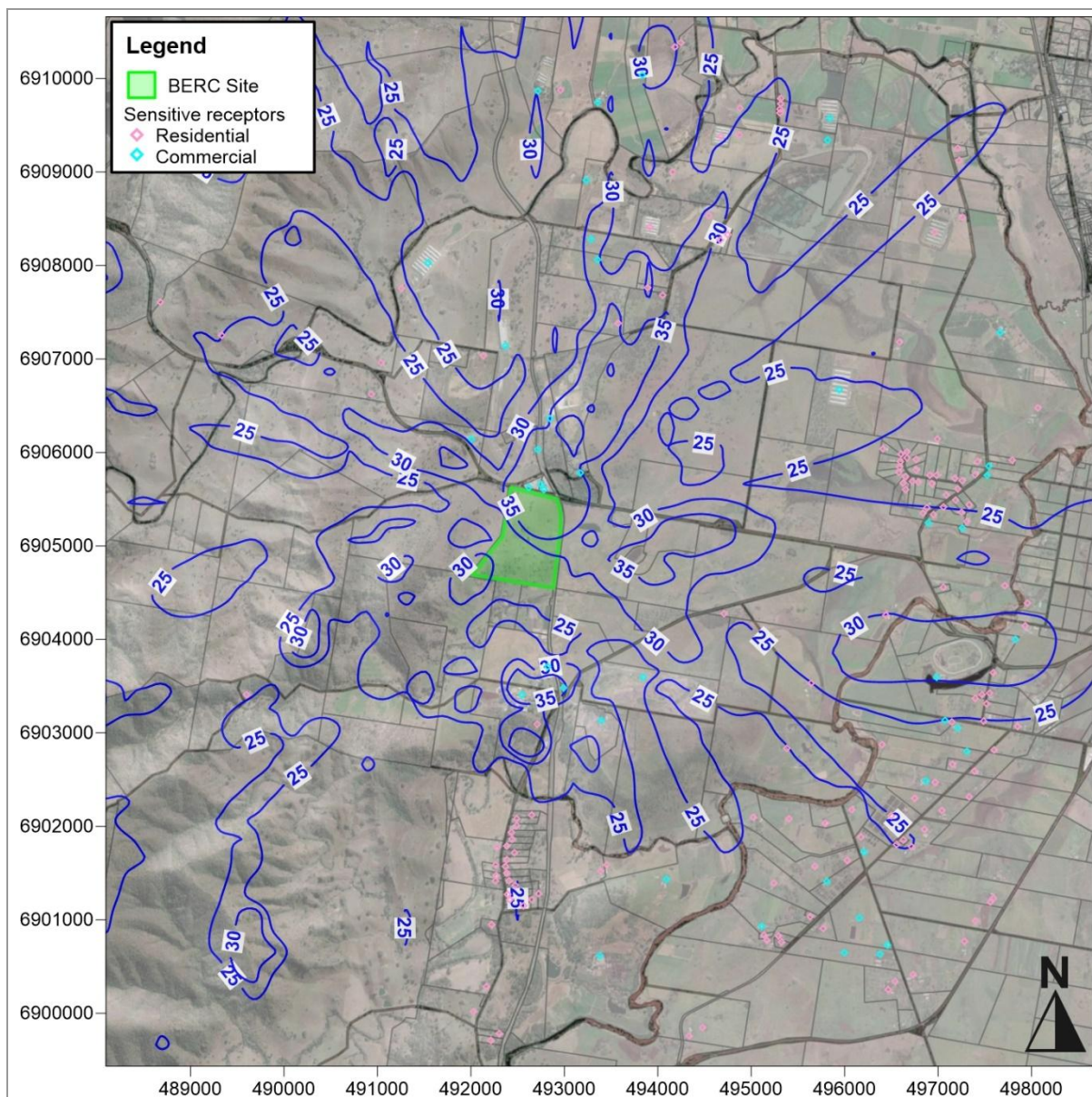


Plate 2 LP1 daily average concentration limits: maximum predicted 1-hour ground-level concentration for NO₂ due to the Project and background

Location: Beaudesert, QLD	Averaging period: 1-hour	Data source: CALPUFF	Units: µg/m ³
Type: Maximum	Objective: 164 µg/m ³	Prepared by: D Gallagher	Date: September 2025

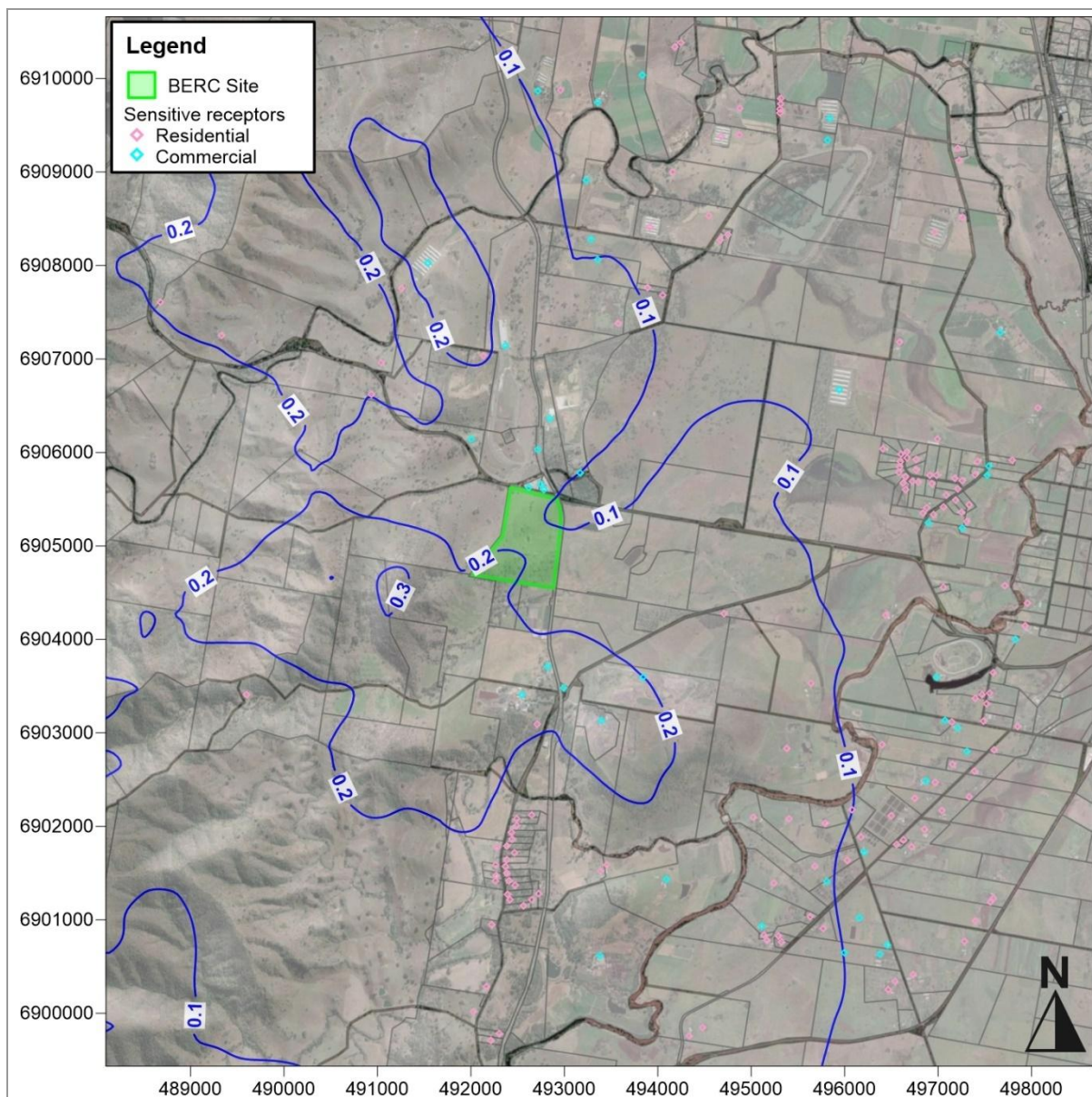


Plate 3 LP1 daily average concentration limits: predicted 1-year average ground-level concentration for NO₂ due to the Project in isolation

Location: Beaudesert, QLD	Averaging period: 1-year	Data source: CALPUFF	Units: µg/m ³
Type: Average	Objective: 31 µg/m ³	Prepared by: D Gallagher	Date: September 2025

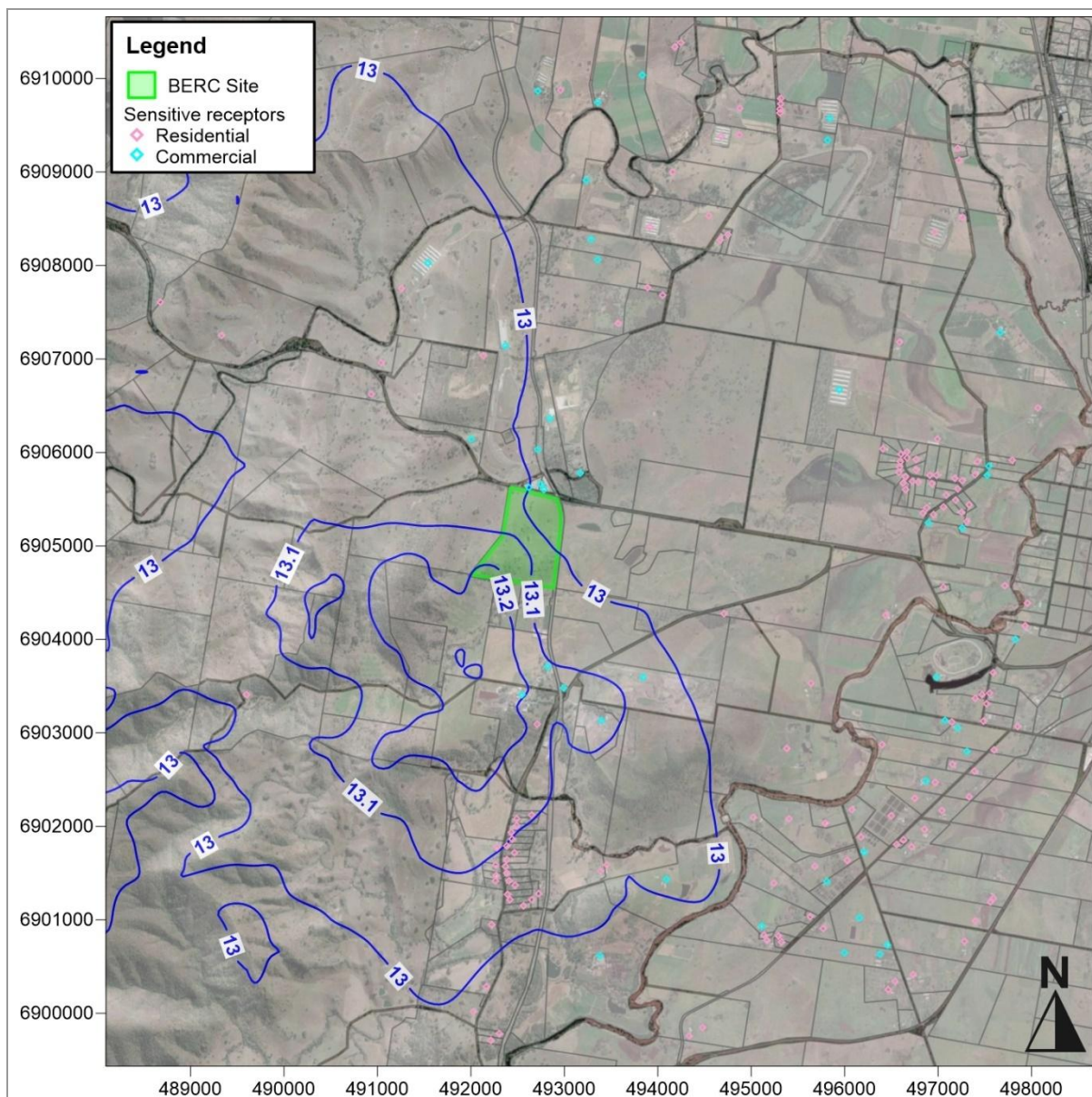


Plate 4 LP1 daily average concentration limits: predicted 1-year average ground-level concentration for NO₂ due to the Project and background

Location: Beaudesert, QLD	Averaging period: 1-year	Data source: CALPUFF	Units: µg/m ³
Type: Average	Objective: 31 µg/m ³	Prepared by: D Gallagher	Date: September 2025

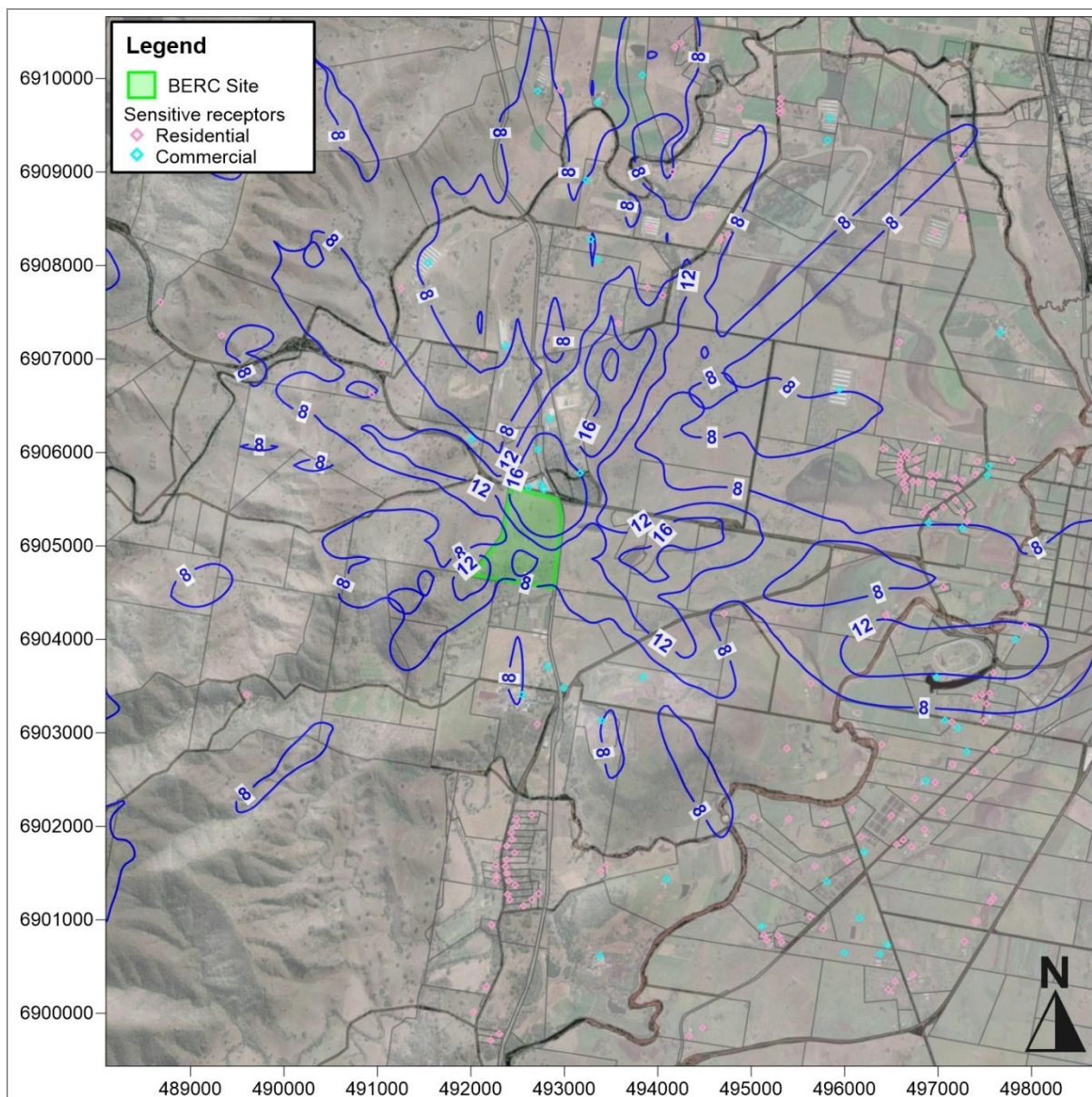


Plate 5 LP1 daily average concentration limits: maximum predicted 1-hour ground-level concentration for SO₂ due to the Project in isolation

Location: Beaudesert, QLD	Averaging period: 1-hour	Data source: CALPUFF	Units: µg/m ³
Type: Maximum	Objective: 214 µg/m ³	Prepared by: D Gallagher	Date: September 2025

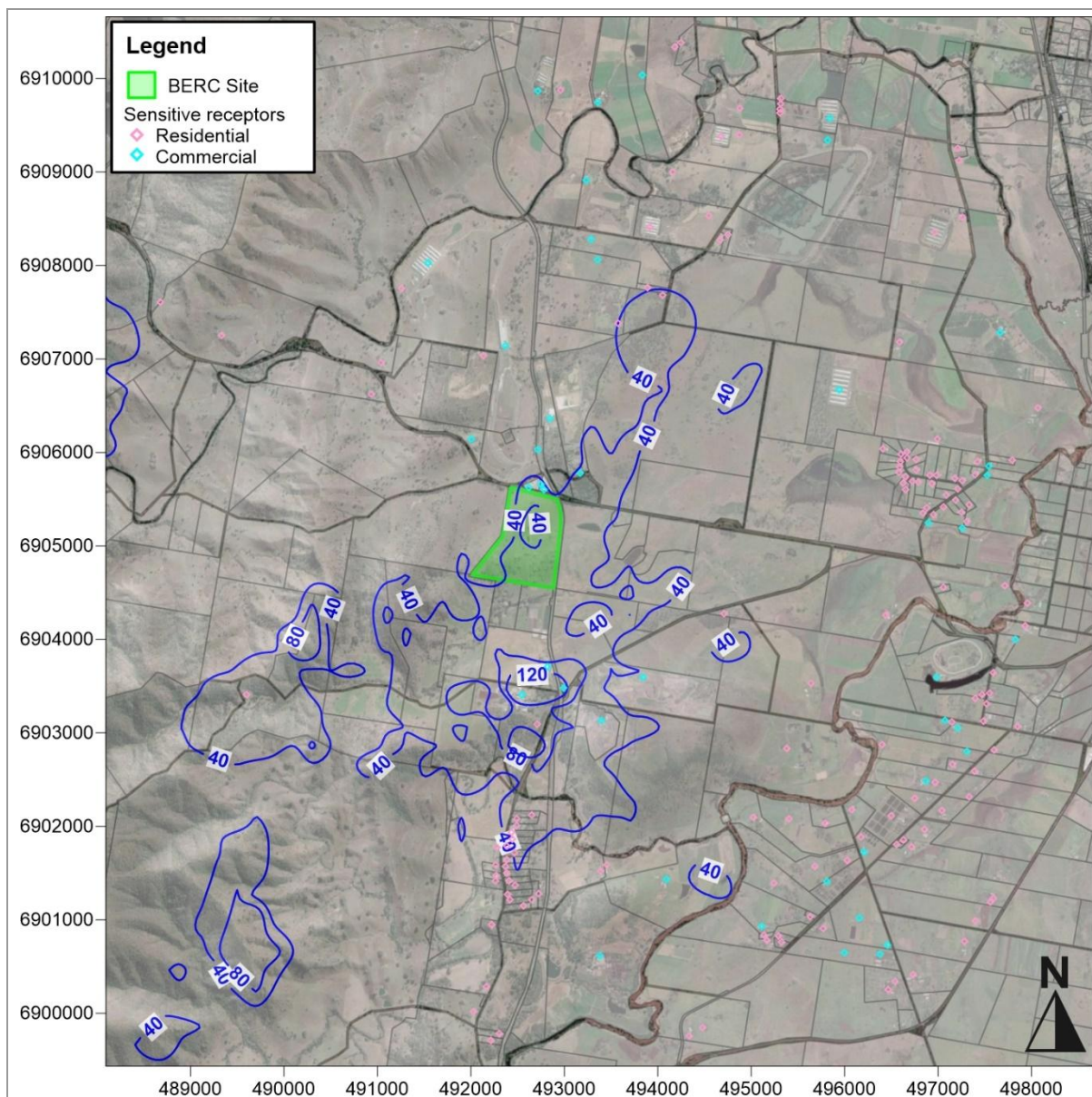


Plate 6 LP1 daily average concentration limits: maximum predicted 1-hour ground-level concentration for SO₂ due to the Project and background

Location: Beaudesert, QLD	Averaging period: 1-hour	Data source: CALPUFF	Units: µg/m ³
Type: Maximum	Objective: 214µg/m ³	Prepared by: D Gallagher	Date: September 2025

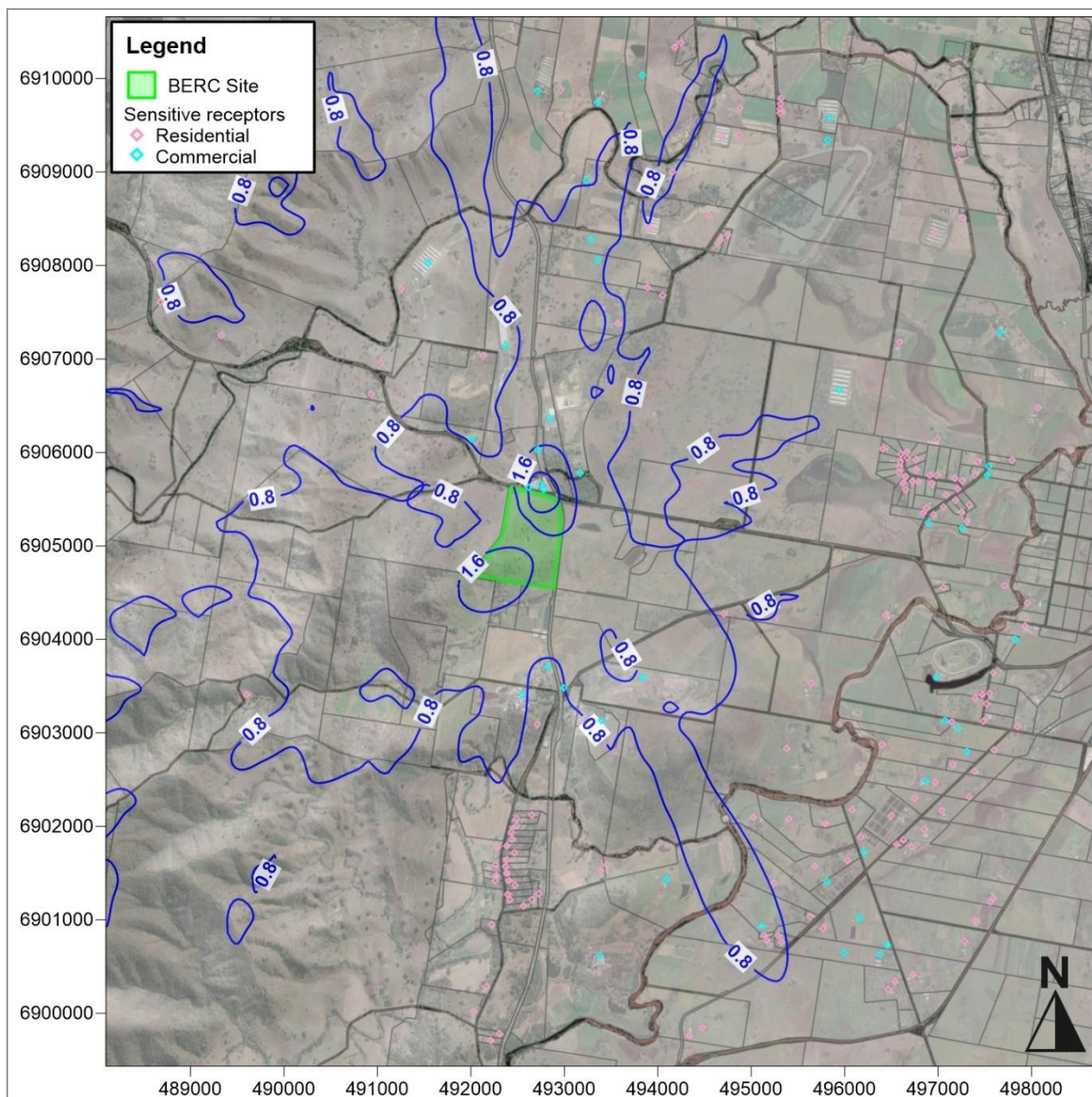


Plate 7 LP1 daily average concentration limits: maximum predicted 24-hour ground-level concentration for SO₂ due to the Project in isolation

Location: Beaudesert, QLD	Averaging period: 24-hour	Data source: CALPUFF	Units: µg/m ³
Type: Maximum	Objective: 57 µg/m ³	Prepared by: D Gallagher	Date: September 2025

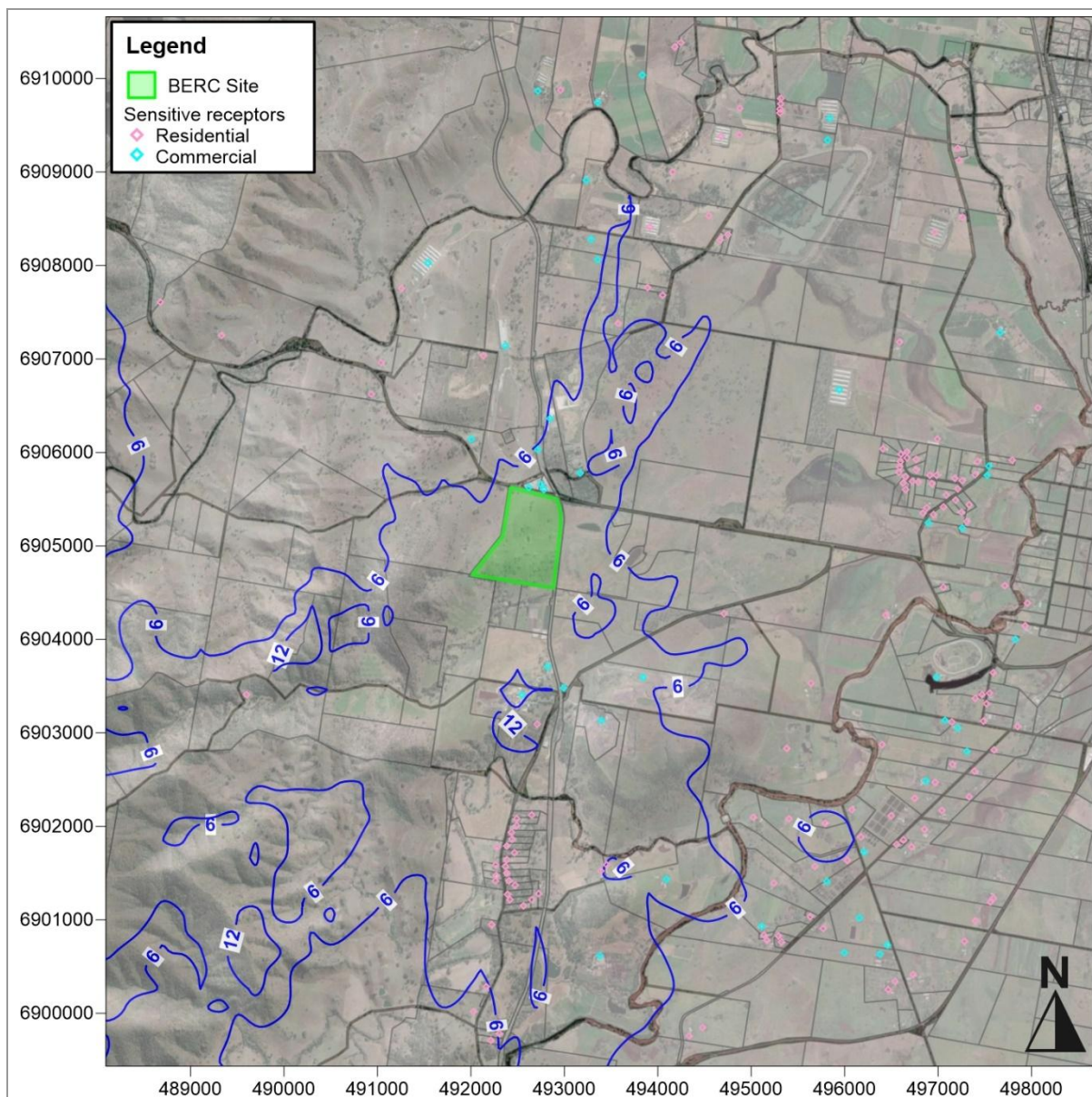


Plate 8 LP1 daily average concentration limits: maximum predicted 24-hour ground-level concentration for SO₂ due to the Project and background

Location: Beaudesert, QLD	Averaging period: 24-hour	Data source: CALPUFF	Units: µg/m ³
Type: Maximum	Objective: 57 µg/m ³	Prepared by: D Gallagher	Date: September 2025

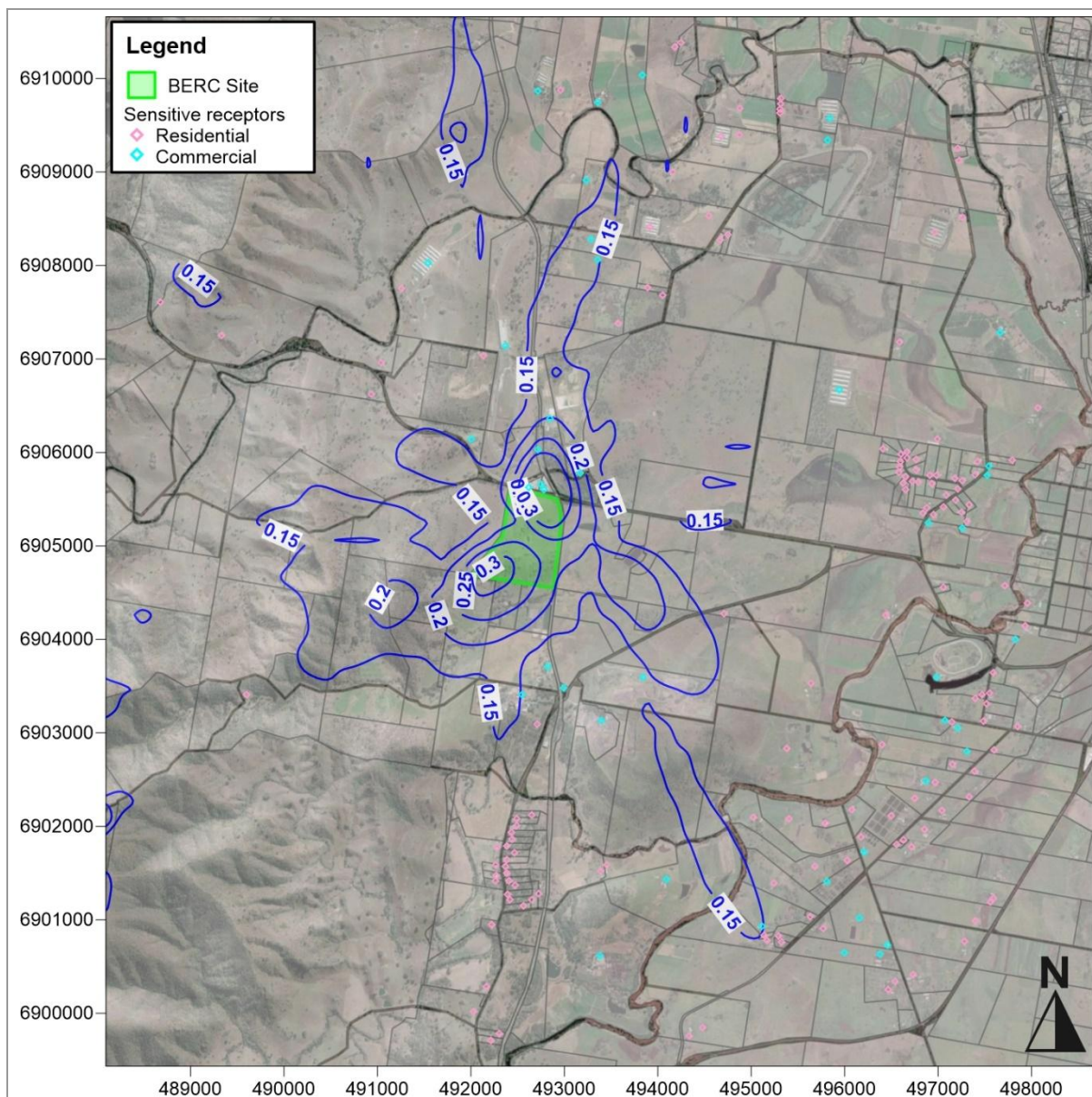


Plate 9 LP1 daily average concentration limits: maximum predicted 24-hour ground-level concentration for PM₁₀ due to the Project in isolation

Location: Beaudesert, QLD	Averaging period: 24-hour	Data source: CALPUFF	Units: µg/m ³
Type: Maximum	Objective: 50 µg/m ³	Prepared by: D Gallagher	Date: September 2025

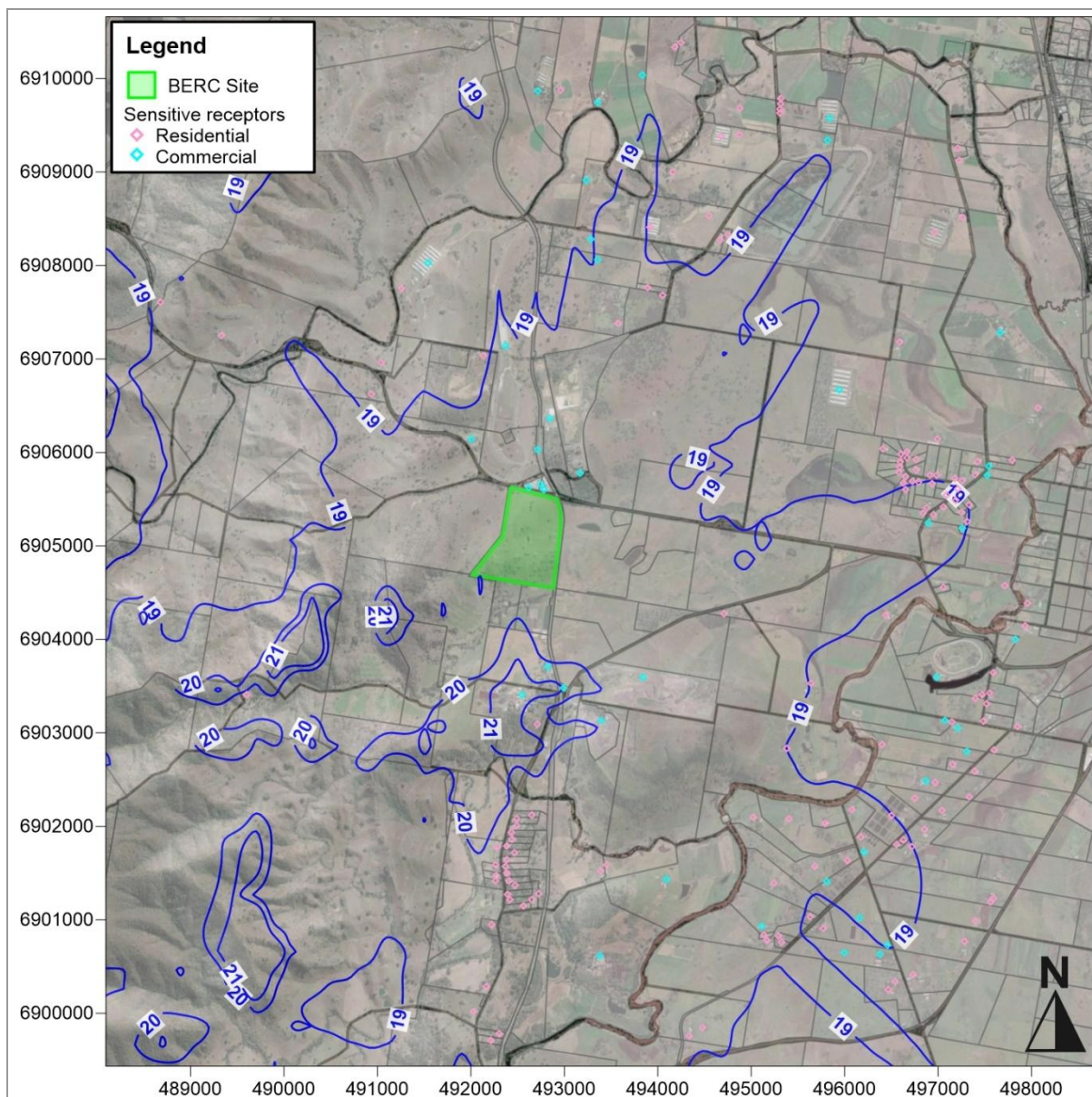


Plate 10 LP1 daily average concentration limits: maximum predicted 24-hour ground-level concentration for PM₁₀ due to the Project and background

Location: Beaudesert, QLD	Averaging period: 24-hour	Data source: CALPUFF	Units: µg/m ³
Type: Maximum	Objective: 50 µg/m ³	Prepared by: D Gallagher	Date: September 2025

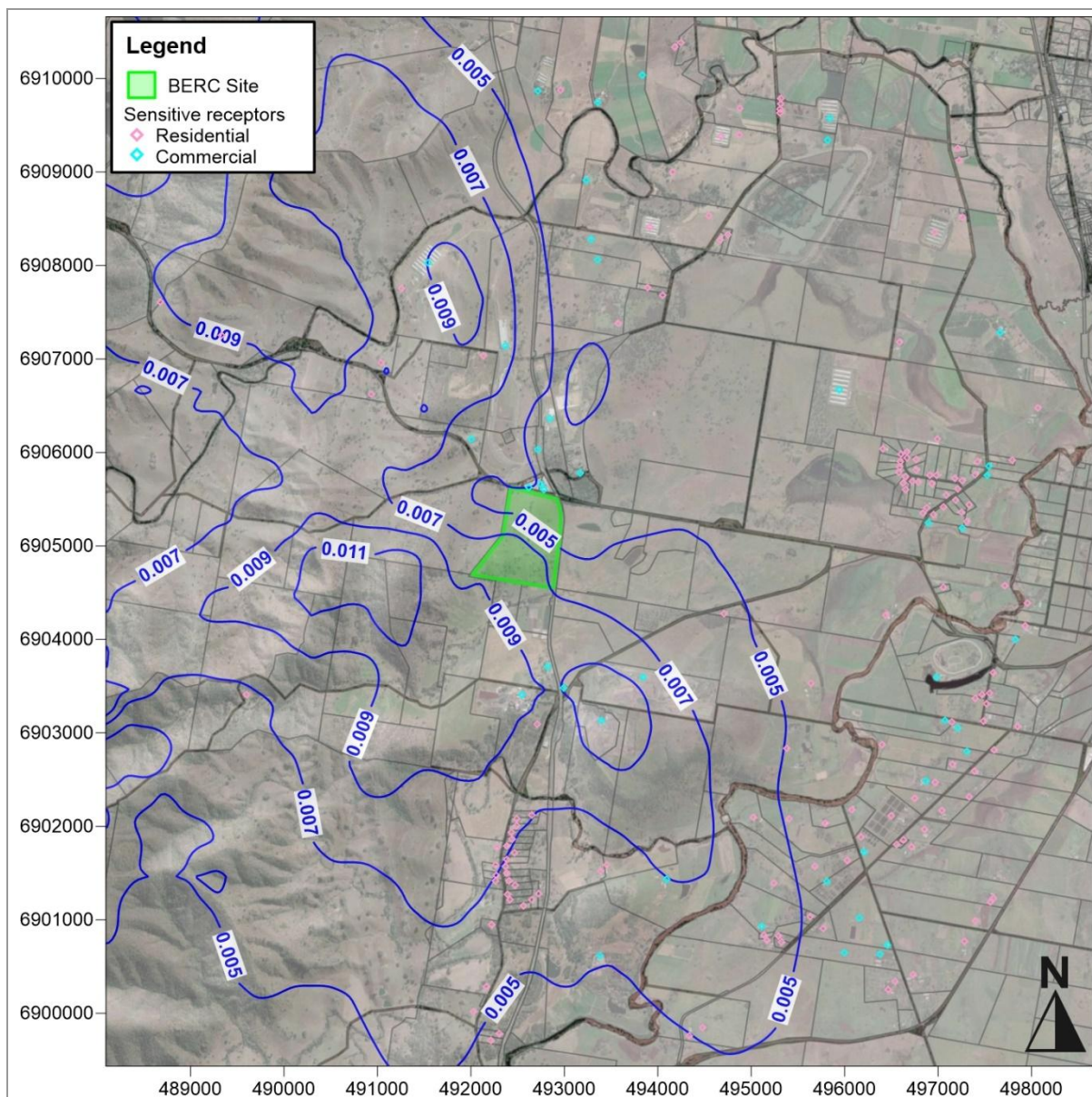


Plate 11 LP1 daily average concentration limits: predicted 1-year average ground-level concentration for PM₁₀ due to the Project in isolation

Location: Beaudesert, QLD	Averaging period: 1-year	Data source: CALPUFF	Units: µg/m ³
Type: Average	Objective: 25 µg/m ³	Prepared by: D Gallagher	Date: September 2025

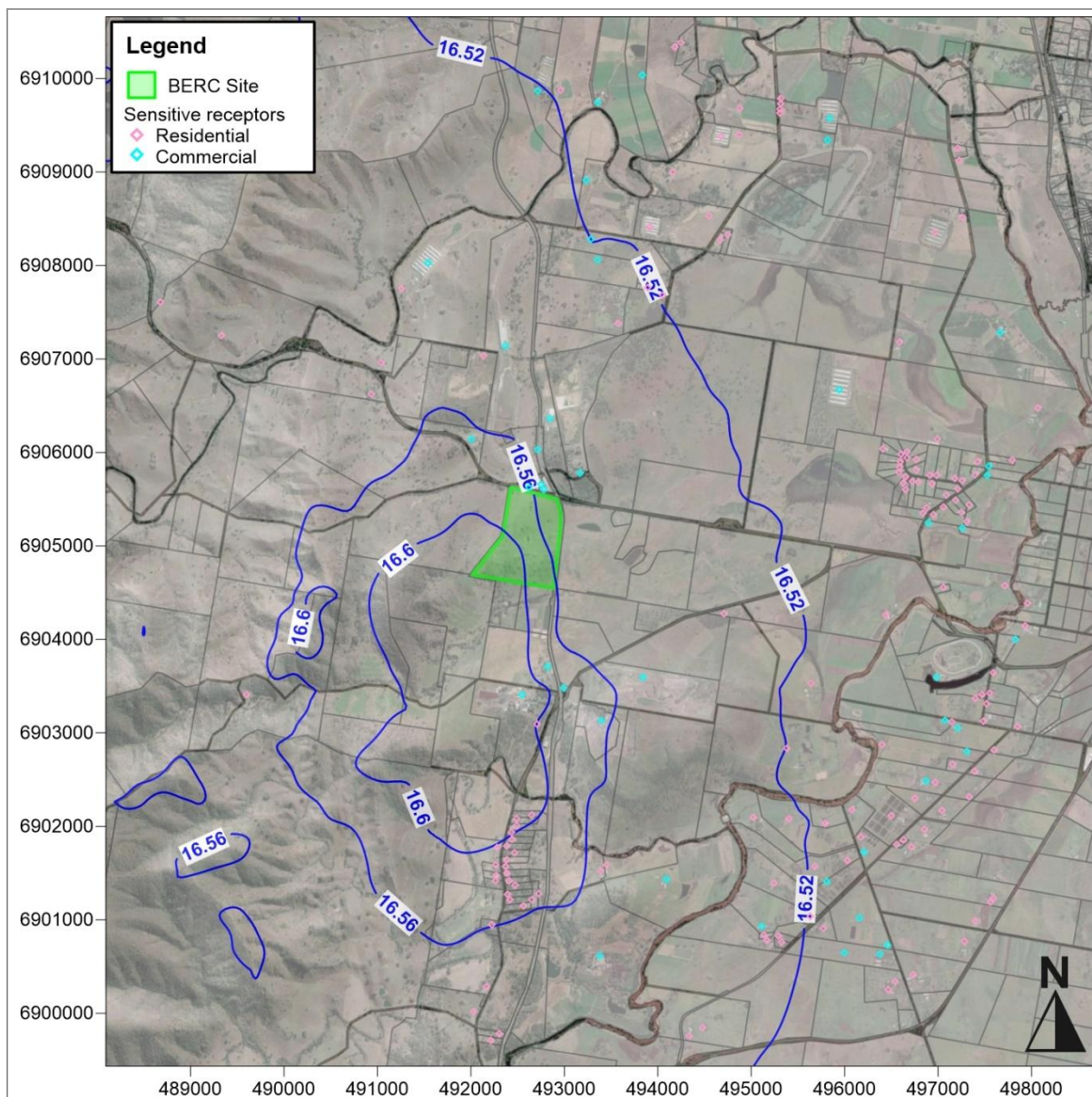


Plate 12 LP1 daily average concentration limits: predicted 1-year average ground-level concentration for PM₁₀ due to the Project and background

Location: Beaudesert, QLD	Averaging period: 1-year	Data source: CALPUFF	Units: µg/m ³
Type: Average	Objective: 25 µg/m ³	Prepared by: D Gallagher	Date: September 2025

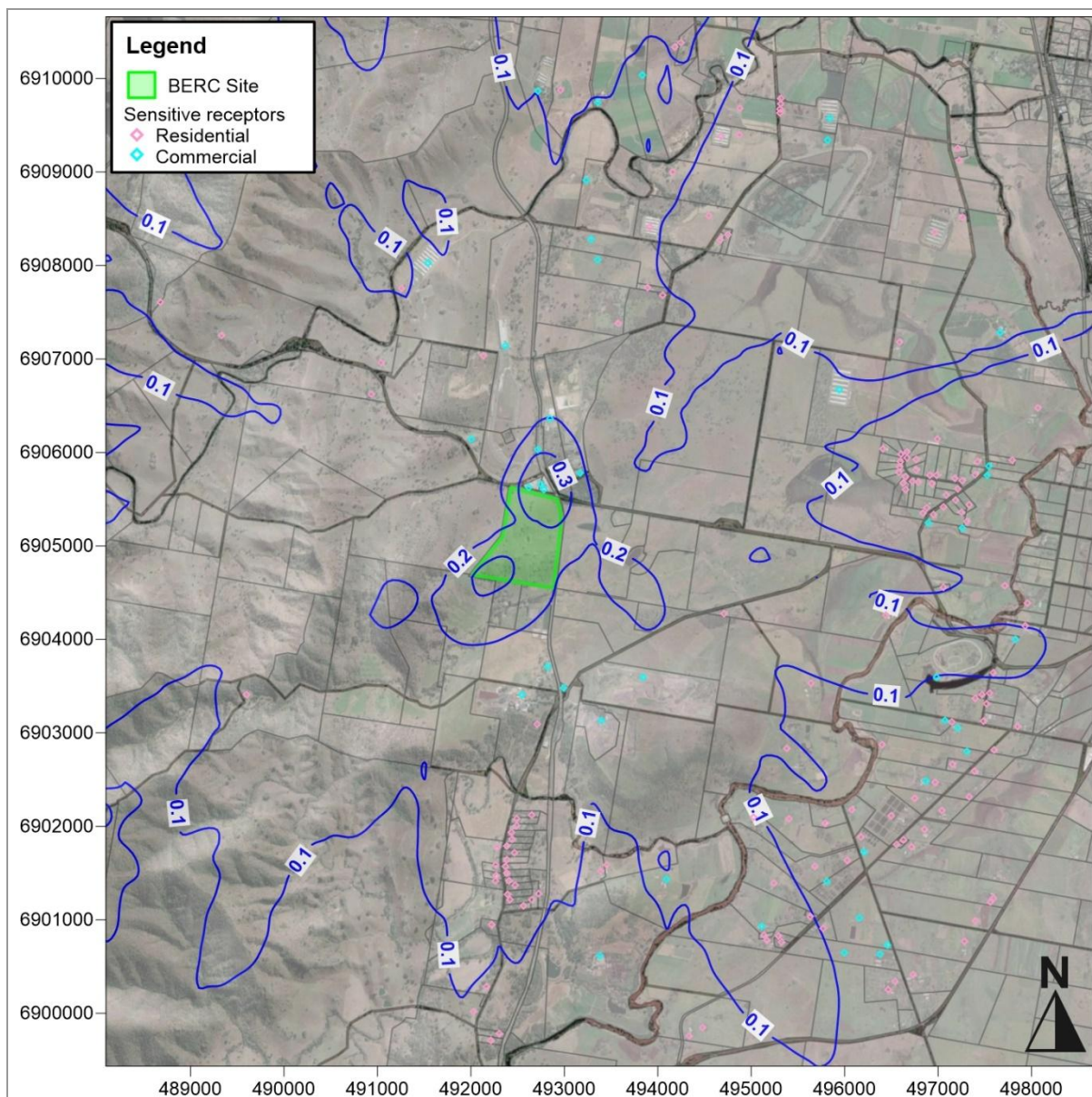


Plate 13 LP1 daily average concentration limits: maximum predicted 24-hour ground-level concentration for PM_{2.5} due to the Project in isolation

Location: Beaudesert, QLD	Averaging period: 24-hour	Data source: CALPUFF	Units: µg/m ³
Type: Maximum	Objective: 20 µg/m ³	Prepared by: D Gallagher	Date: September 2025

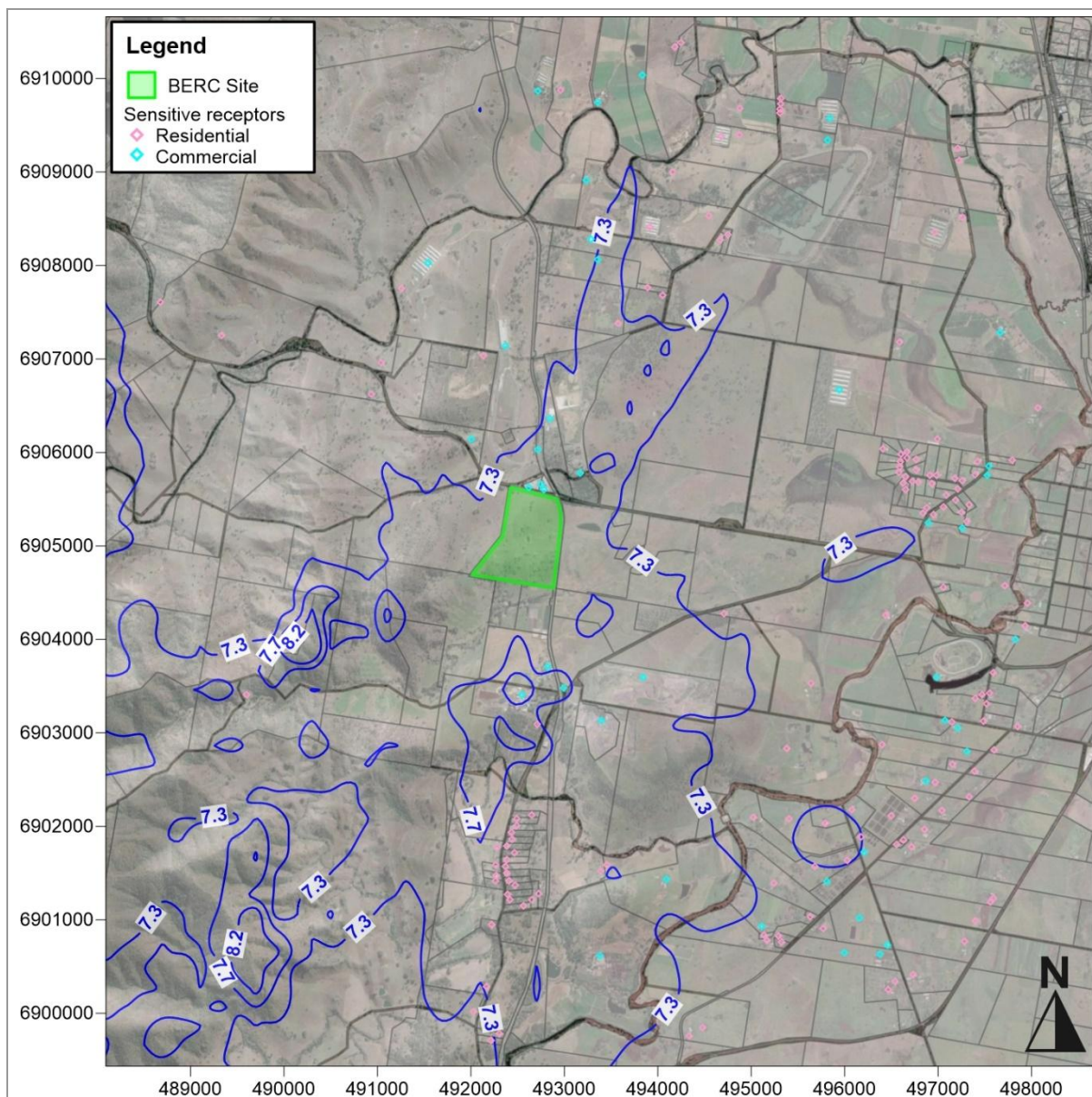


Plate 14 LP1 daily average concentration limits: maximum predicted 24-hour ground-level concentration for $PM_{2.5}$ due to the Project and background

Location: Beaudesert, QLD	Averaging period: 24-hour	Data source: CALPUFF	Units: $\mu g/m^3$
Type: Maximum	Objective: $20 \mu g/m^3$	Prepared by: D Gallagher	Date: September 2025

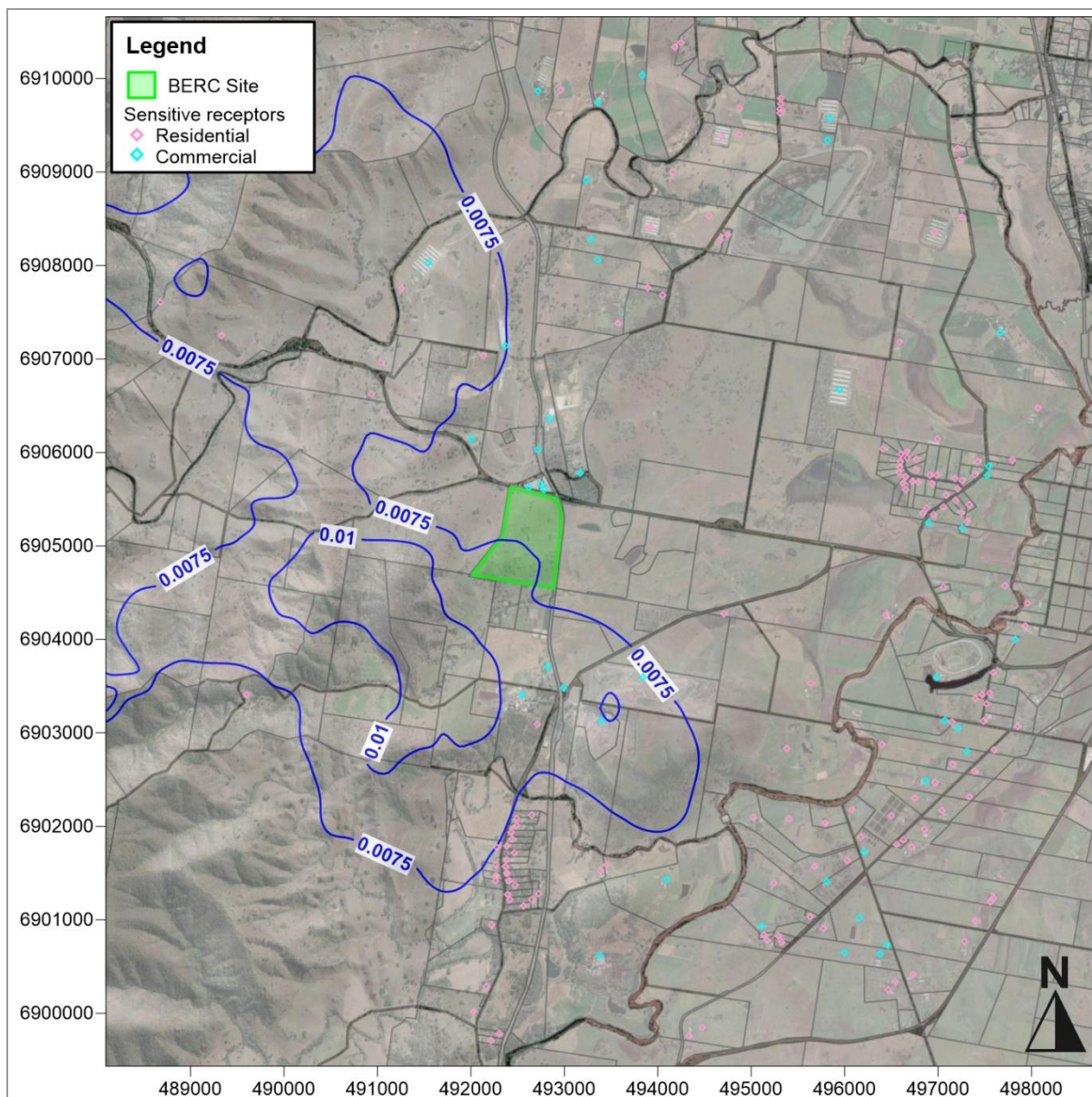


Plate 15 LP1 daily average concentration limits: predicted 1-year average ground-level concentration for PM_{2.5} due to the Project in isolation

Location: Beaudesert, QLD	Averaging period: 1-year	Data source: CALPUFF	Units: µg/m ³
Type: Average	Objective: 7 µg/m ³	Prepared by: D Gallagher	Date: September 2025

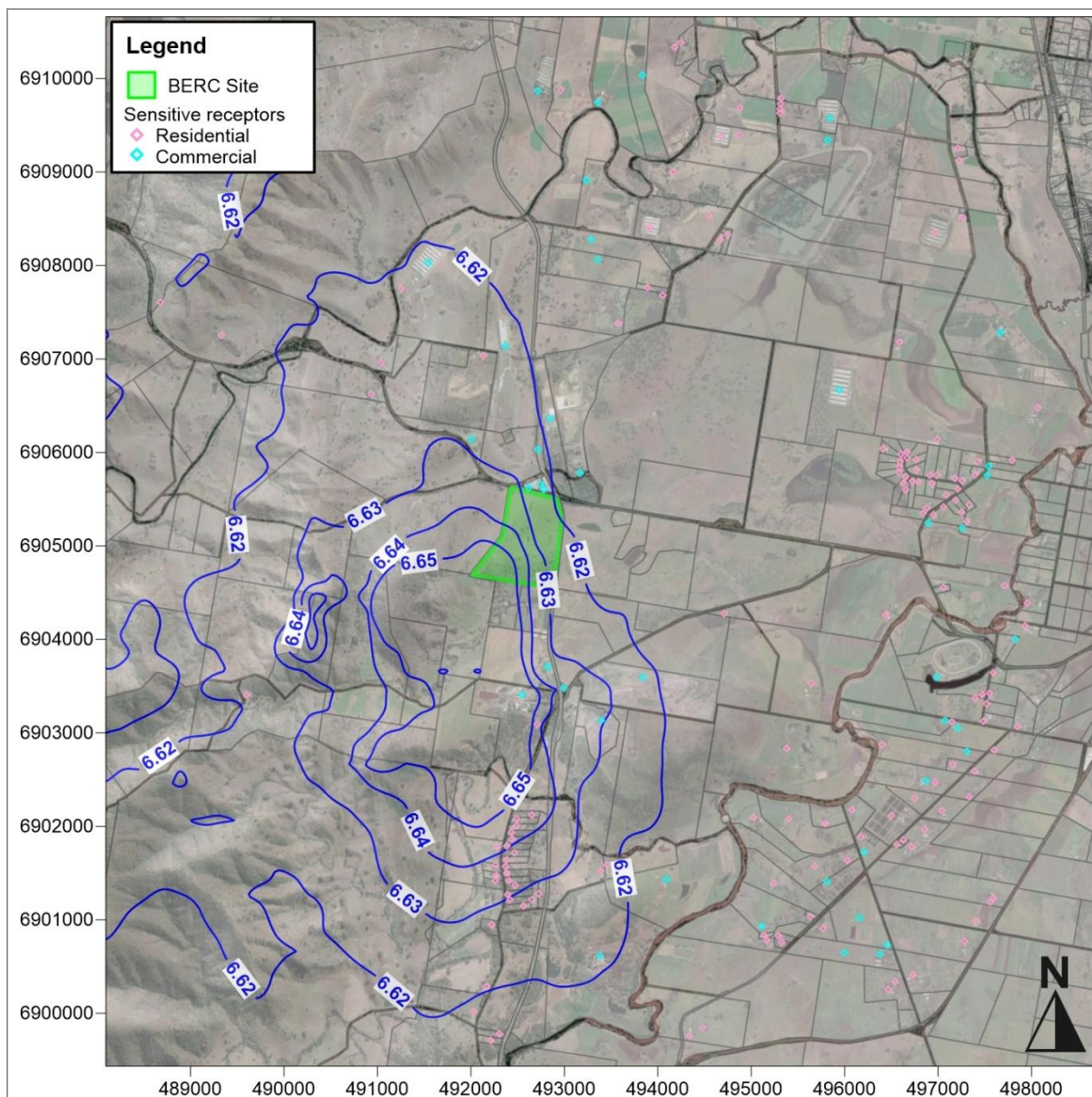


Plate 16 LP1 daily average concentration limits: predicted 1-year average ground-level concentration for PM_{2.5} due to the Project and ambient background

Location: Beaudesert, QLD	Averaging period: 1-year	Data source: CALPUFF	Units: µg/m ³
Type: Average	Objective: 7 µg/m ³	Prepared by: D Gallagher	Date: September 2025

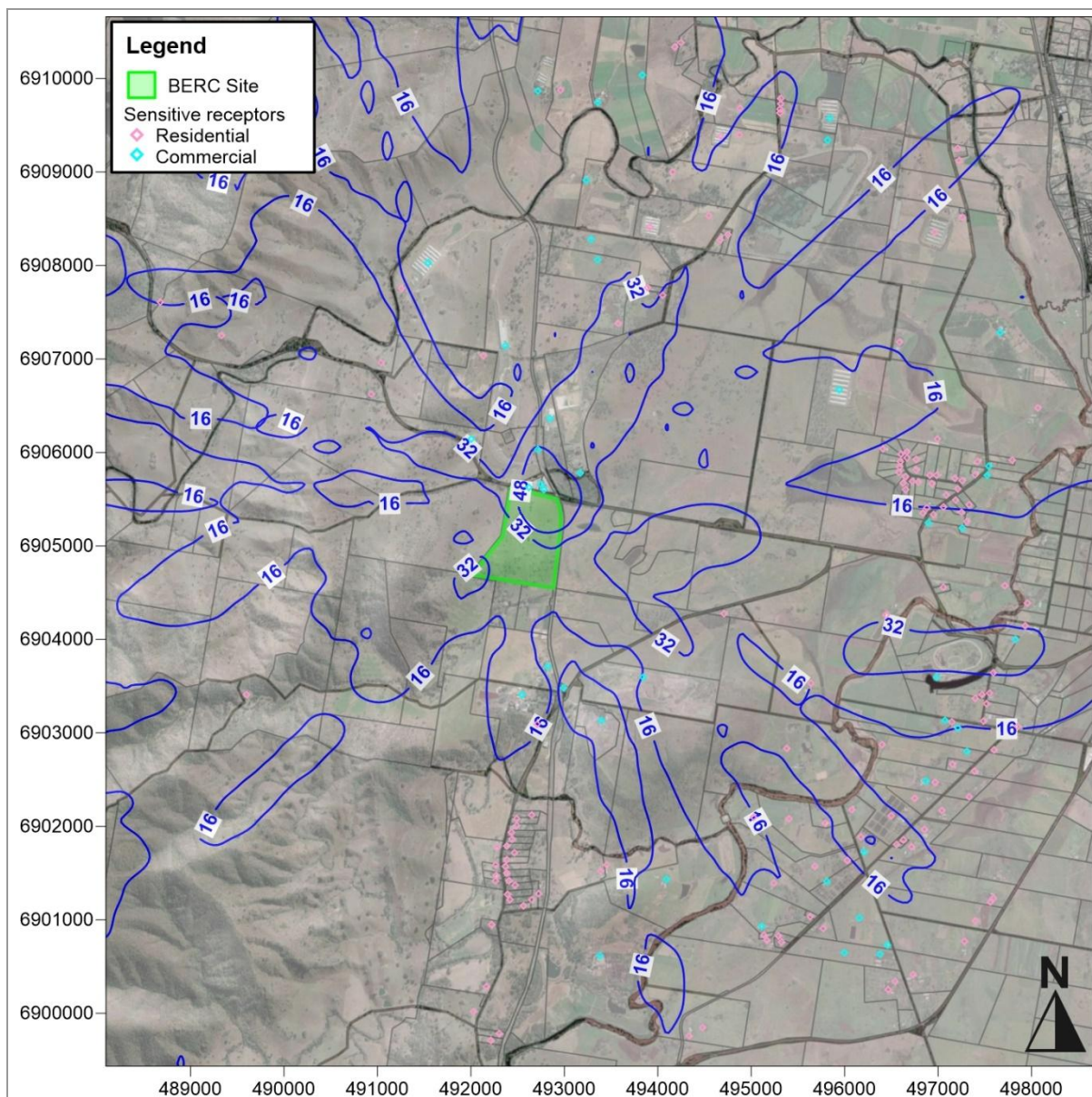


Plate 17 LP1 short-term concentration limits: maximum predicted 1-hour ground-level concentration for NO₂ due to the Project in isolation

Location: Beaudesert, QLD	Averaging period: 1-hour	Data source: CALPUFF	Units: µg/m ³
Type: Maximum	Objective: 164 µg/m ³	Prepared by: D Gallagher	Date: September 2025

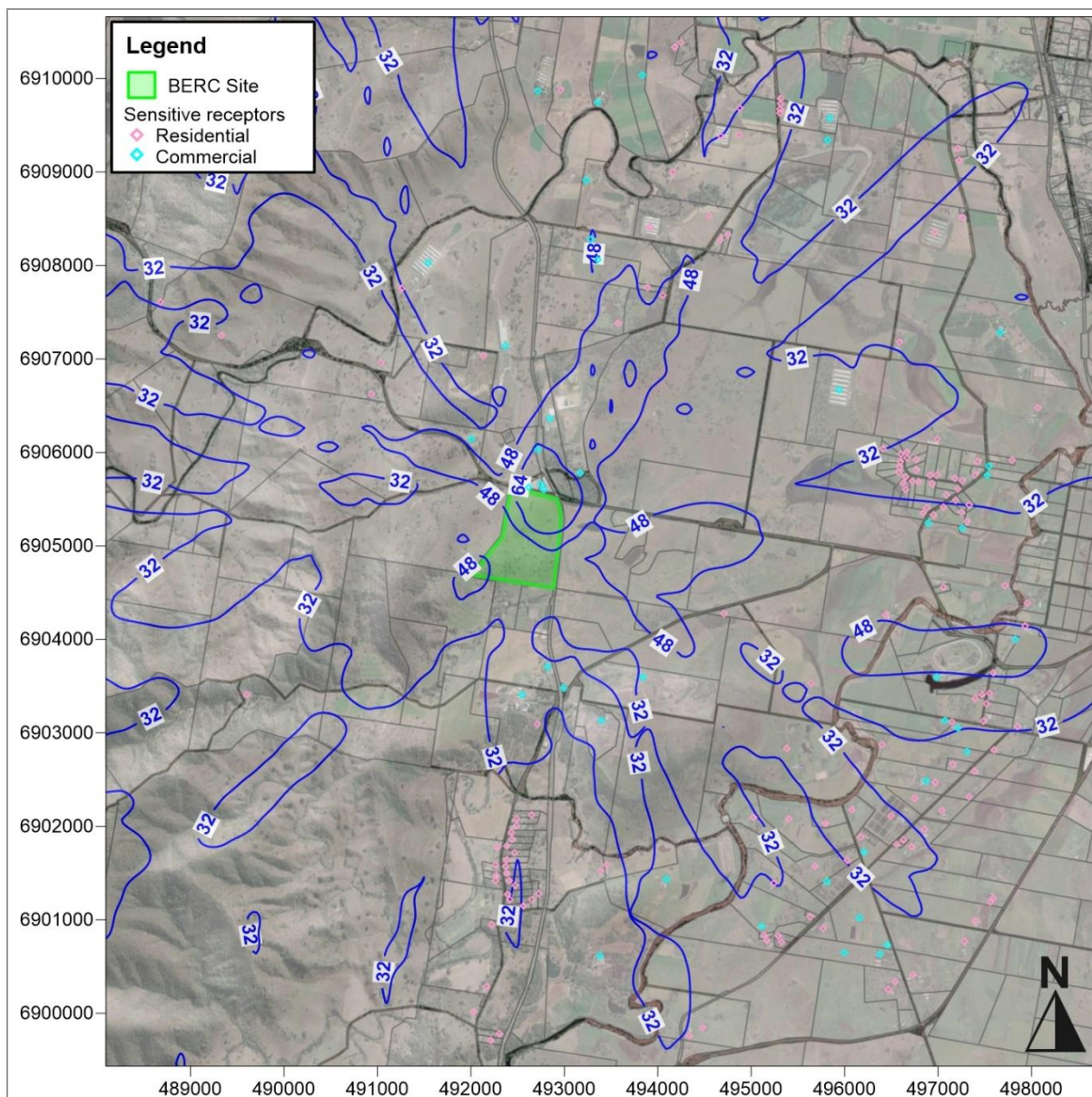


Plate 18 LP1 short-term concentration limits: maximum predicted 1-hour ground-level concentration for NO₂ due to the Project and background

Location: Beaudesert, QLD	Averaging period: 1-hour	Data source: CALPUFF	Units: µg/m ³
Type: Maximum	Objective: 164 µg/m ³	Prepared by: D Gallagher	Date: September 2025

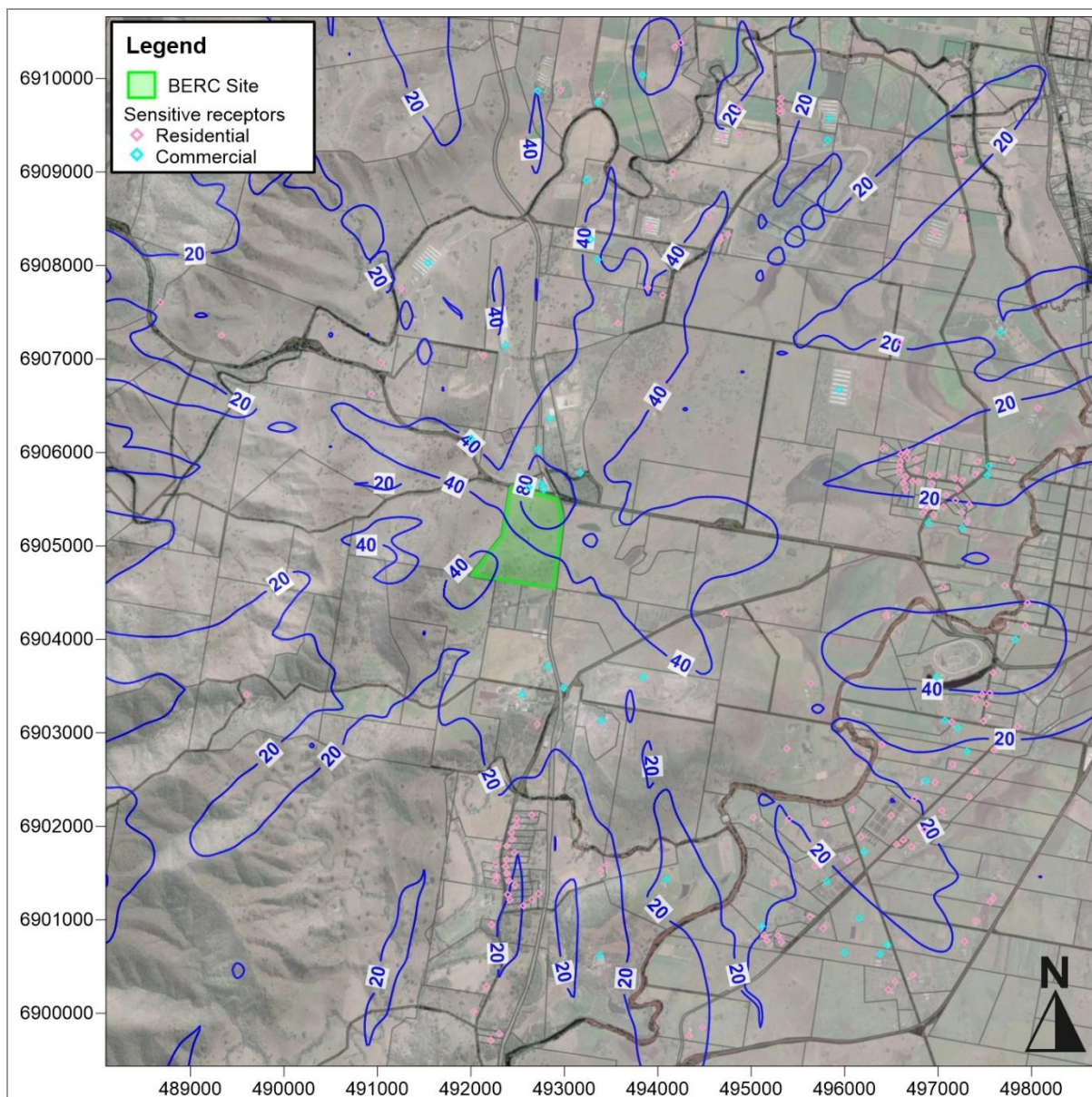


Plate 19 LP1 short-term concentration limits: maximum predicted 1-hour ground-level concentration for SO₂ due to the Project in isolation

Location: Beaudesert, QLD	Averaging period: 1-hour	Data source: CALPUFF	Units: µg/m ³
Type: Maximum	Objective: 214 µg/m ³	Prepared by: D Gallagher	Date: September 2025

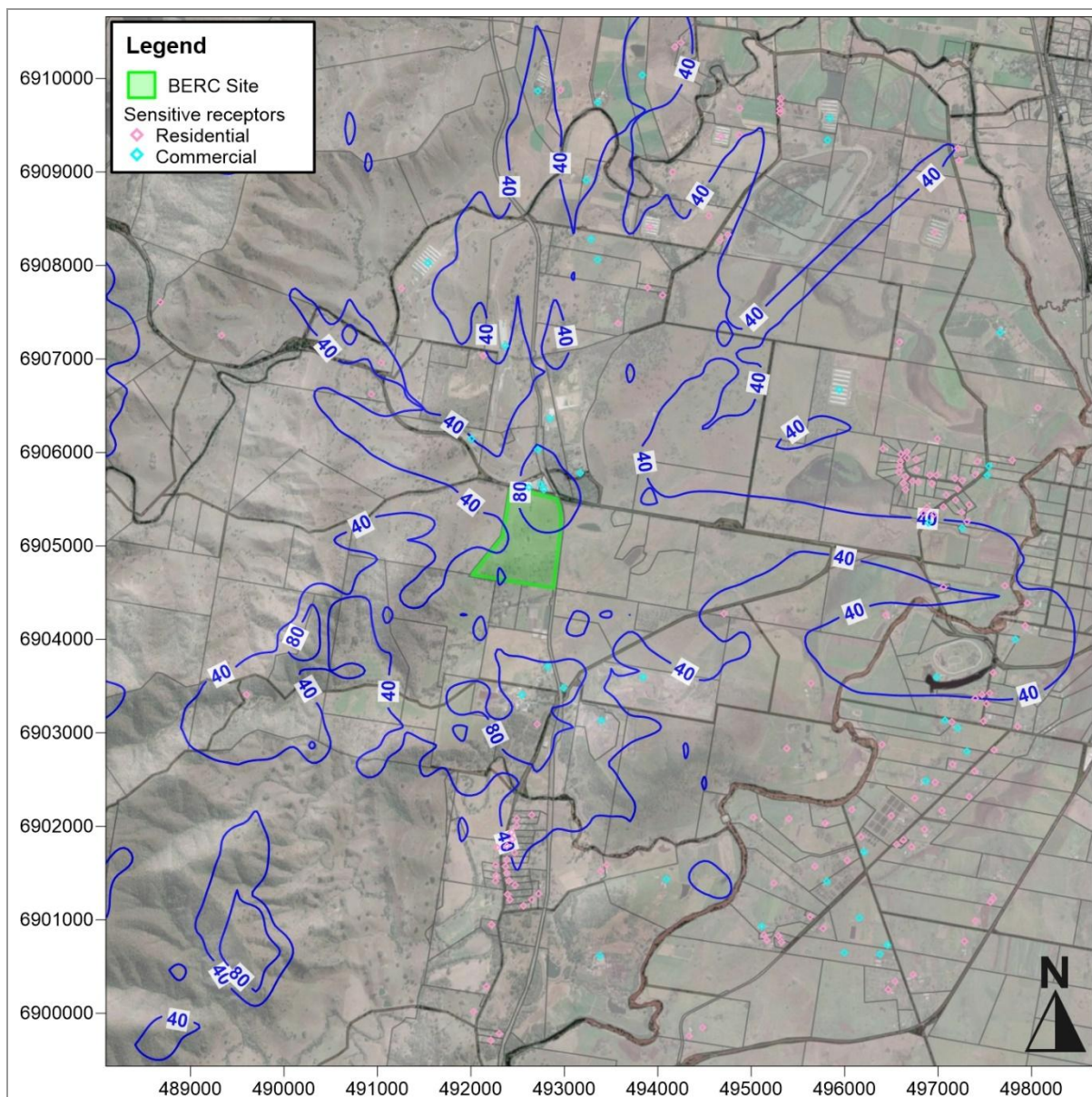


Plate 20 LP1 short-term concentration limits: maximum predicted 1-hour ground-level concentration for SO₂ due to the Project and ambient background

Location: Beaudesert, QLD	Averaging period: 1-hour	Data source: CALPUFF	Units: µg/m ³
Type: Maximum	Objective: 214 µg/m ³	Prepared by: D Gallagher	Date: September 2025

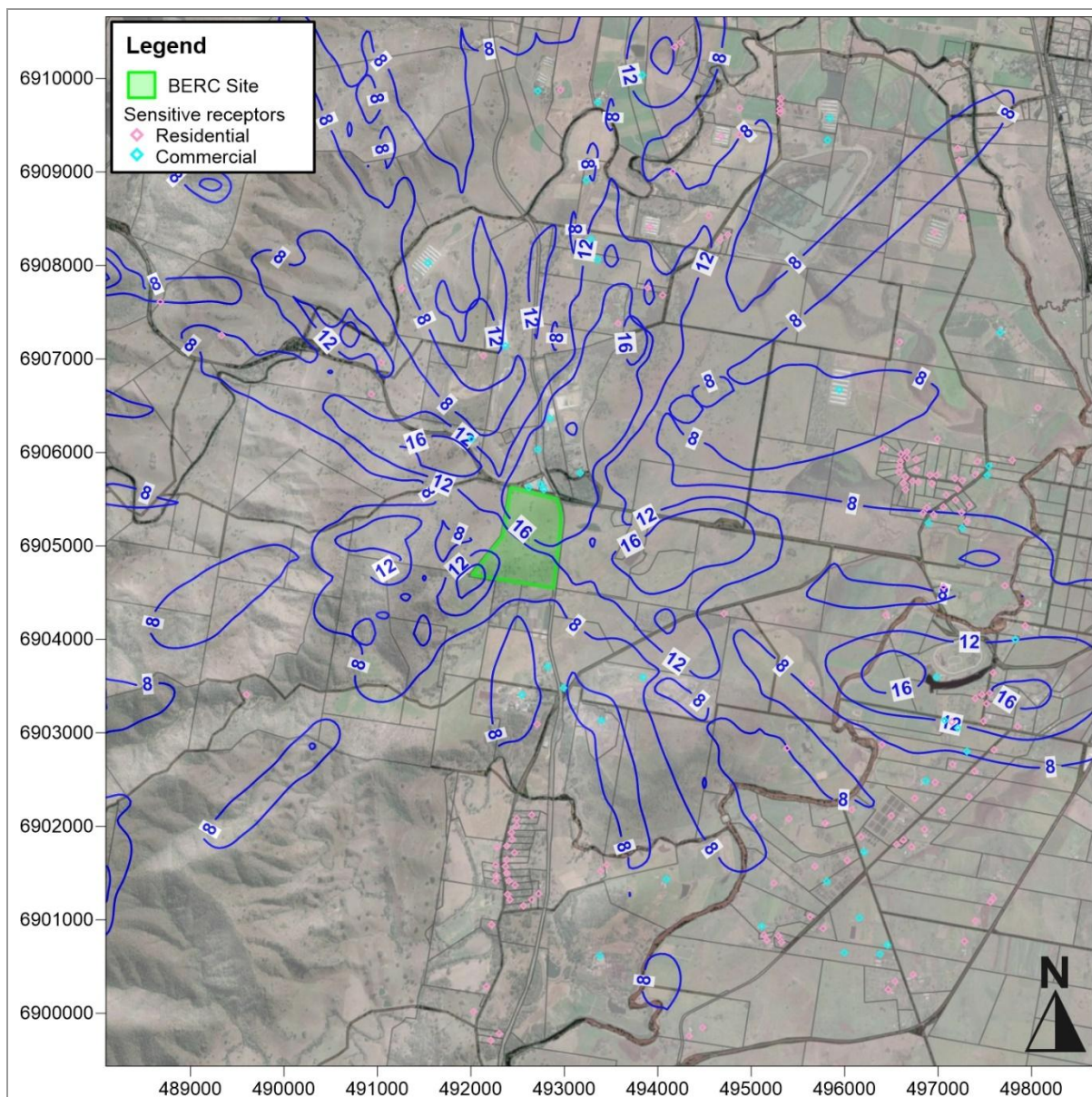


Plate 21 LP2 daily average concentration limits: maximum predicted 1-hour ground-level concentration for NO₂ due to the Project in isolation

Location: Beaudesert, QLD	Averaging period: 1-hour	Data source: CALPUFF	Units: µg/m ³
Type: Maximum	Objective: 164 µg/m ³	Prepared by: D Gallagher	Date: September 2025

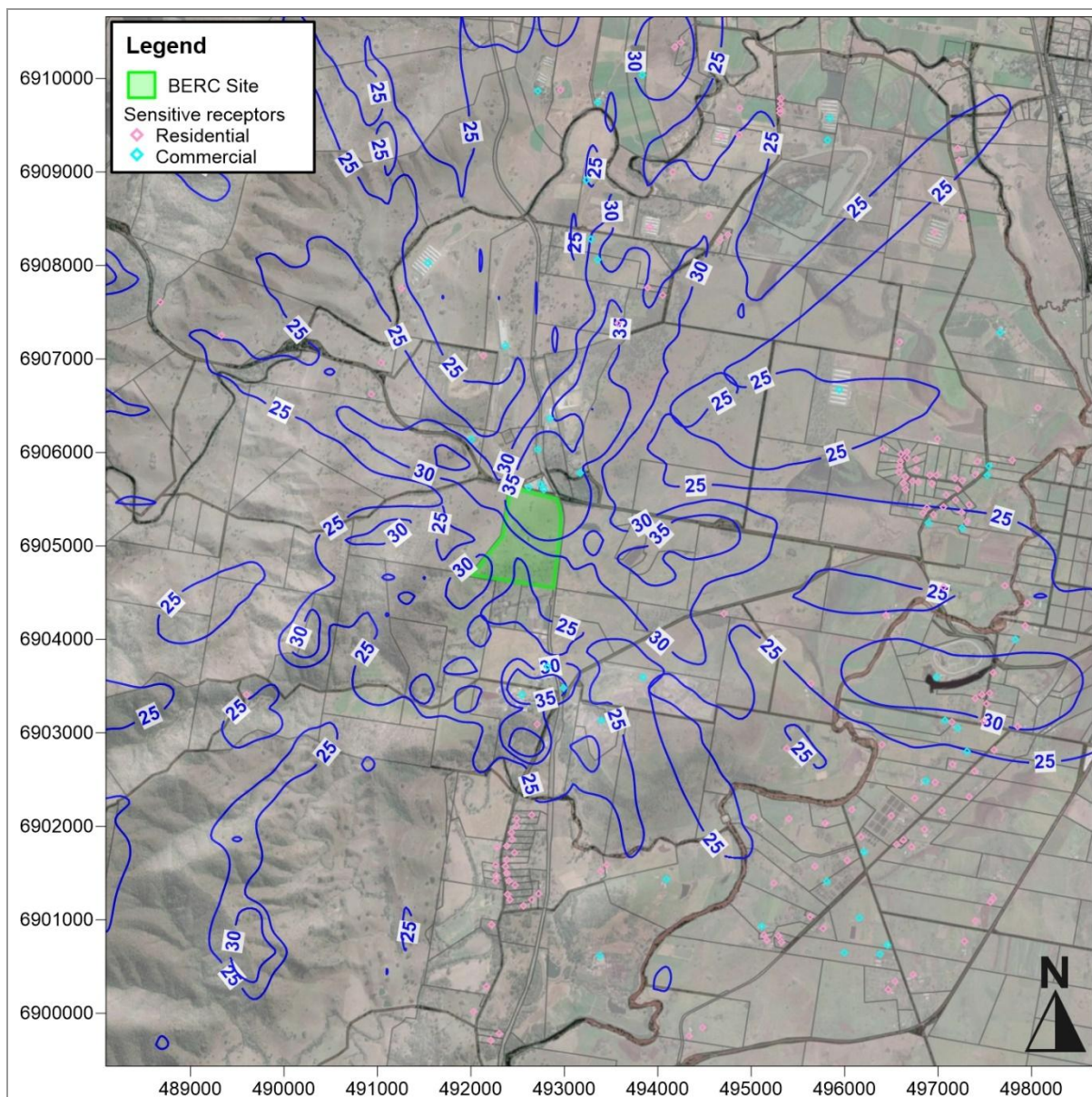


Plate 22 LP2 daily average concentration limits: maximum predicted 1-hour ground-level concentration for NO₂ due to the Project and background

Location: Beaudesert, QLD	Averaging period: 1-hour	Data source: CALPUFF	Units: µg/m ³
Type: Maximum	Objective: 164 µg/m ³	Prepared by: D Gallagher	Date: September 2025

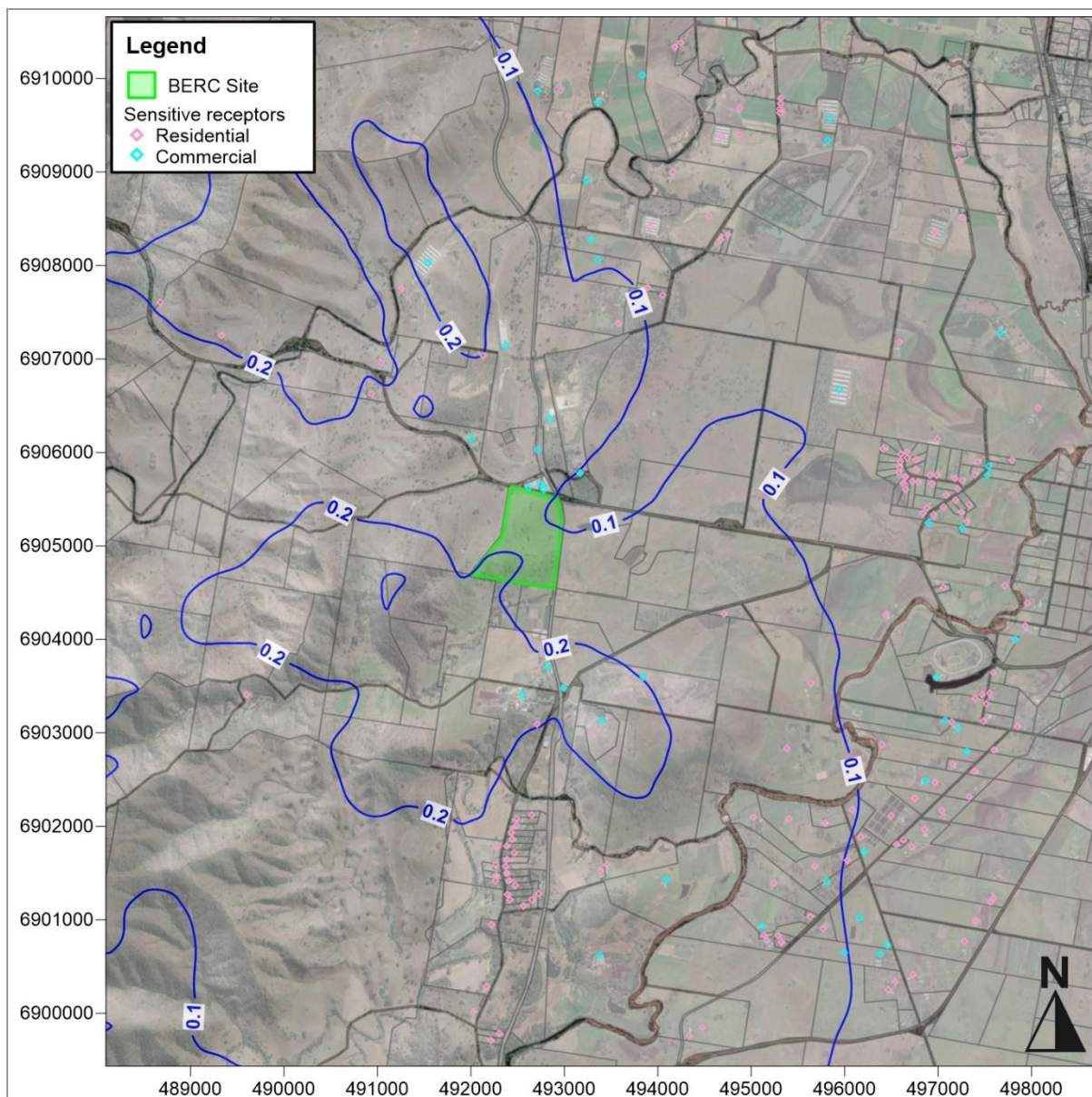


Plate 23 LP2 daily average concentration limits: predicted 1-year average ground-level concentration for NO₂ due to the Project in isolation

Location: Beaudesert, QLD	Averaging period: 1-year	Data source: CALPUFF	Units: µg/m ³
Type: Average	Objective: 31 µg/m ³	Prepared by: D Gallagher	Date: September 2025

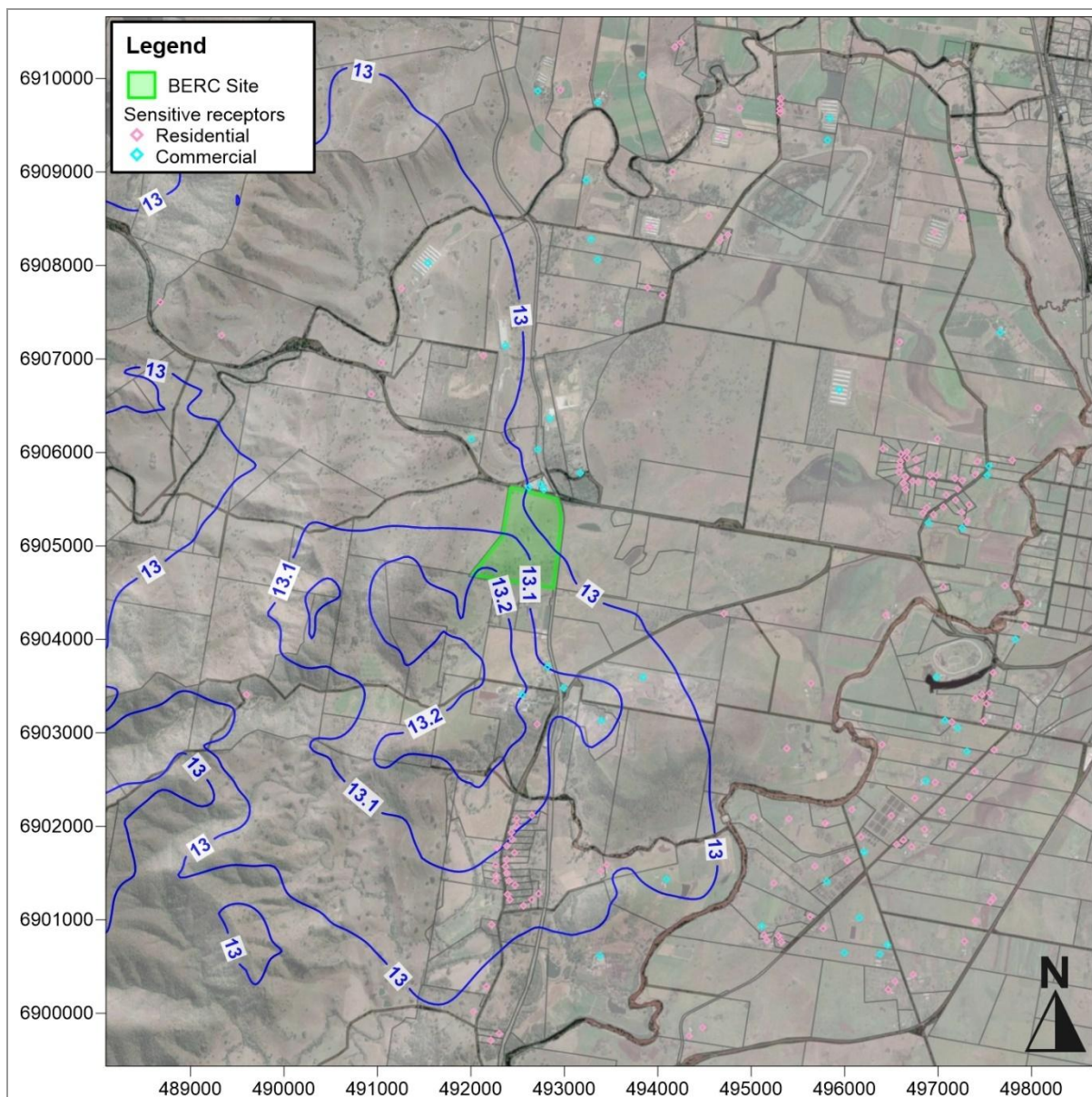


Plate 24 LP2 daily average concentration limits: predicted 1-year average ground-level concentration for NO₂ due to the Project and background

Location: Beaudesert, QLD	Averaging period: 1-year	Data source: CALPUFF	Units: µg/m ³
Type: Average	Objective: 31 µg/m ³	Prepared by: D Gallagher	Date: September 2025

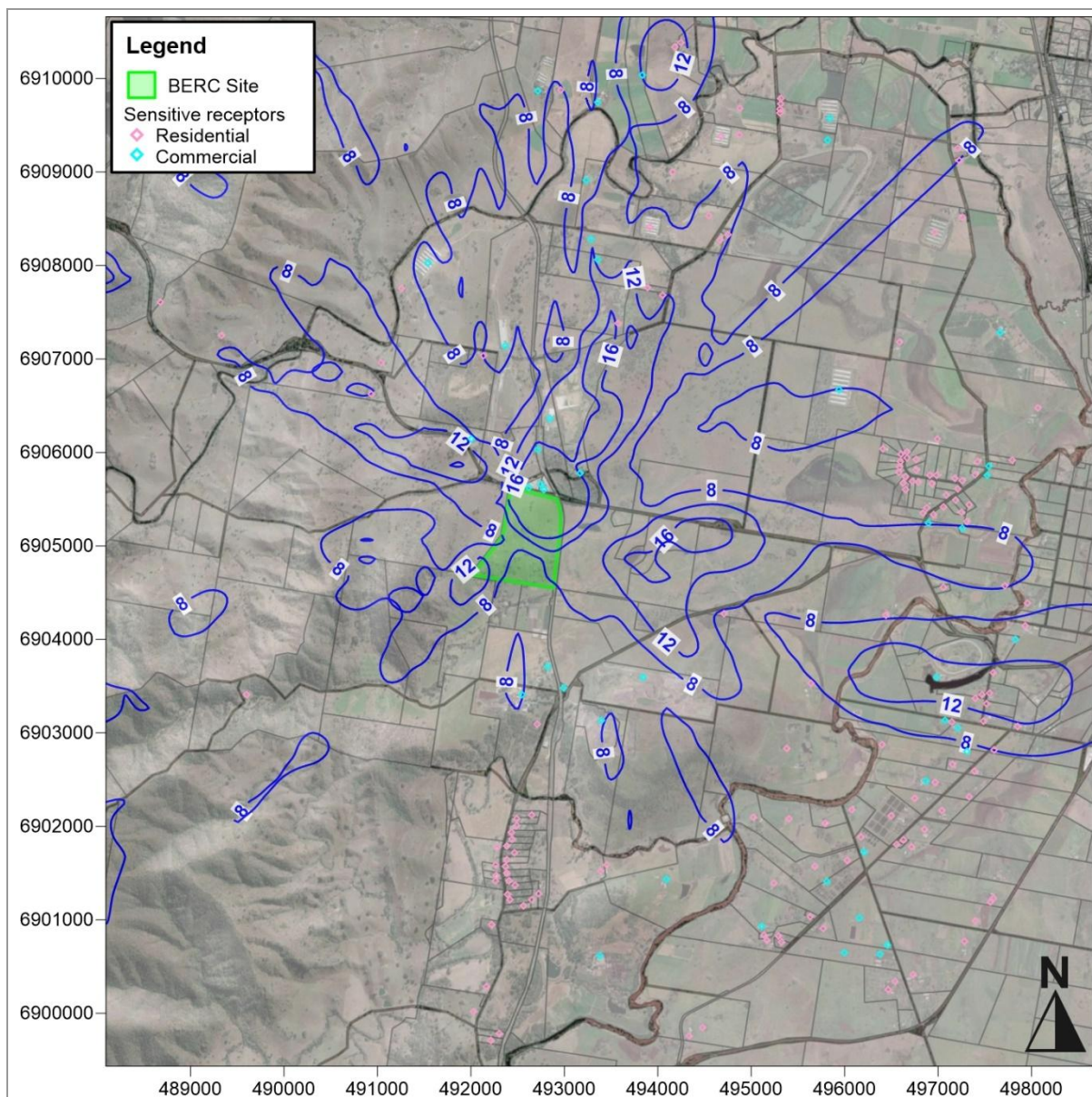


Plate 25 LP2 daily average concentration limits: maximum predicted 1-hour ground-level concentration for SO₂ due to the Project in isolation

Location: Beaudesert, QLD	Averaging period: 1-hour	Data source: CALPUFF	Units: µg/m ³
Type: Maximum	Objective: 214 µg/m ³	Prepared by: D Gallagher	Date: September 2025

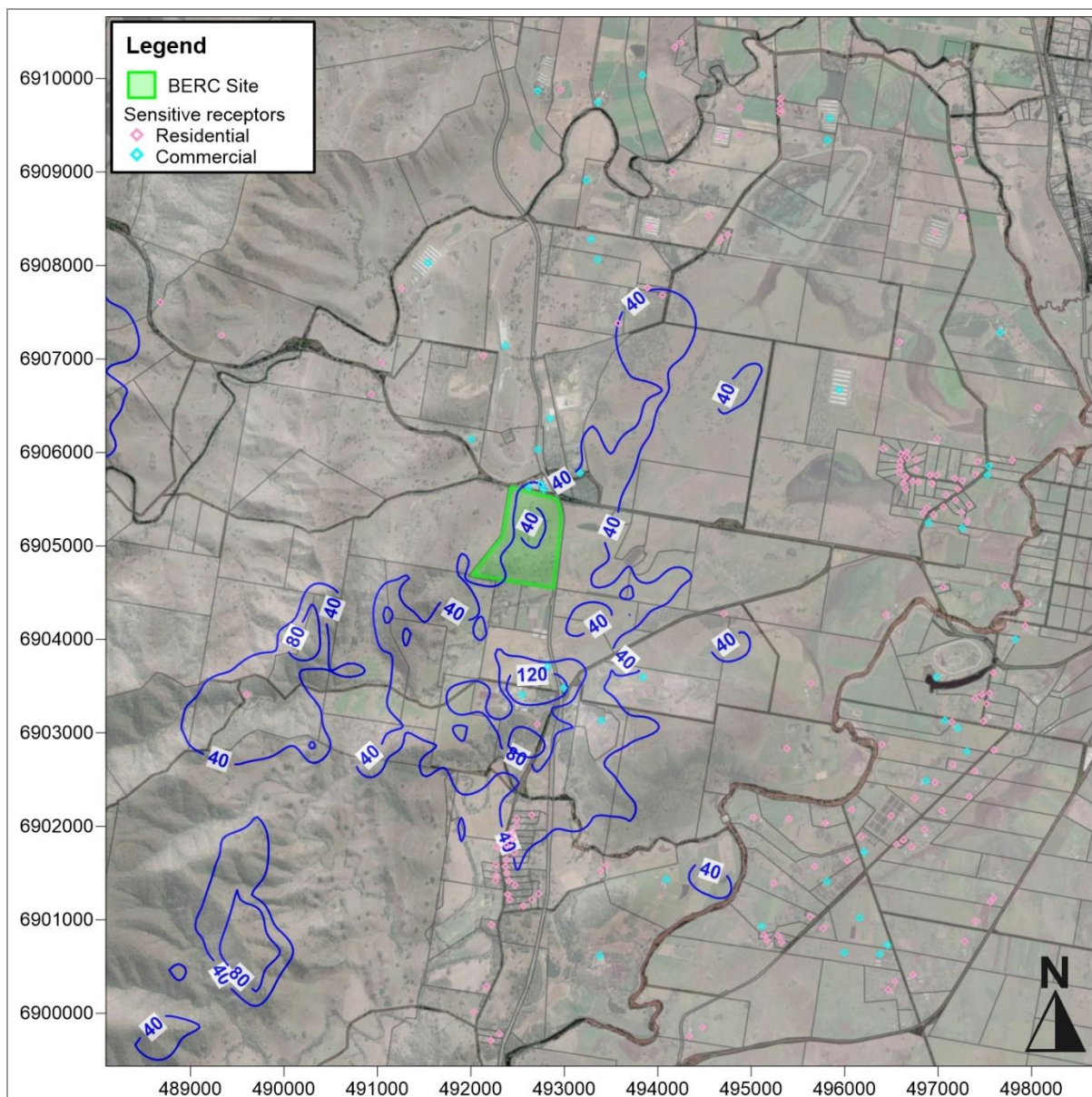


Plate 26 LP2 daily average concentration limits: maximum predicted 1-hour ground-level concentration for SO₂ due to the Project and background

Location: Beaudesert, QLD	Averaging period: 1-hour	Data source: CALPUFF	Units: µg/m ³
Type: Maximum	Objective: 214µg/m ³	Prepared by: D Gallagher	Date: September 2025

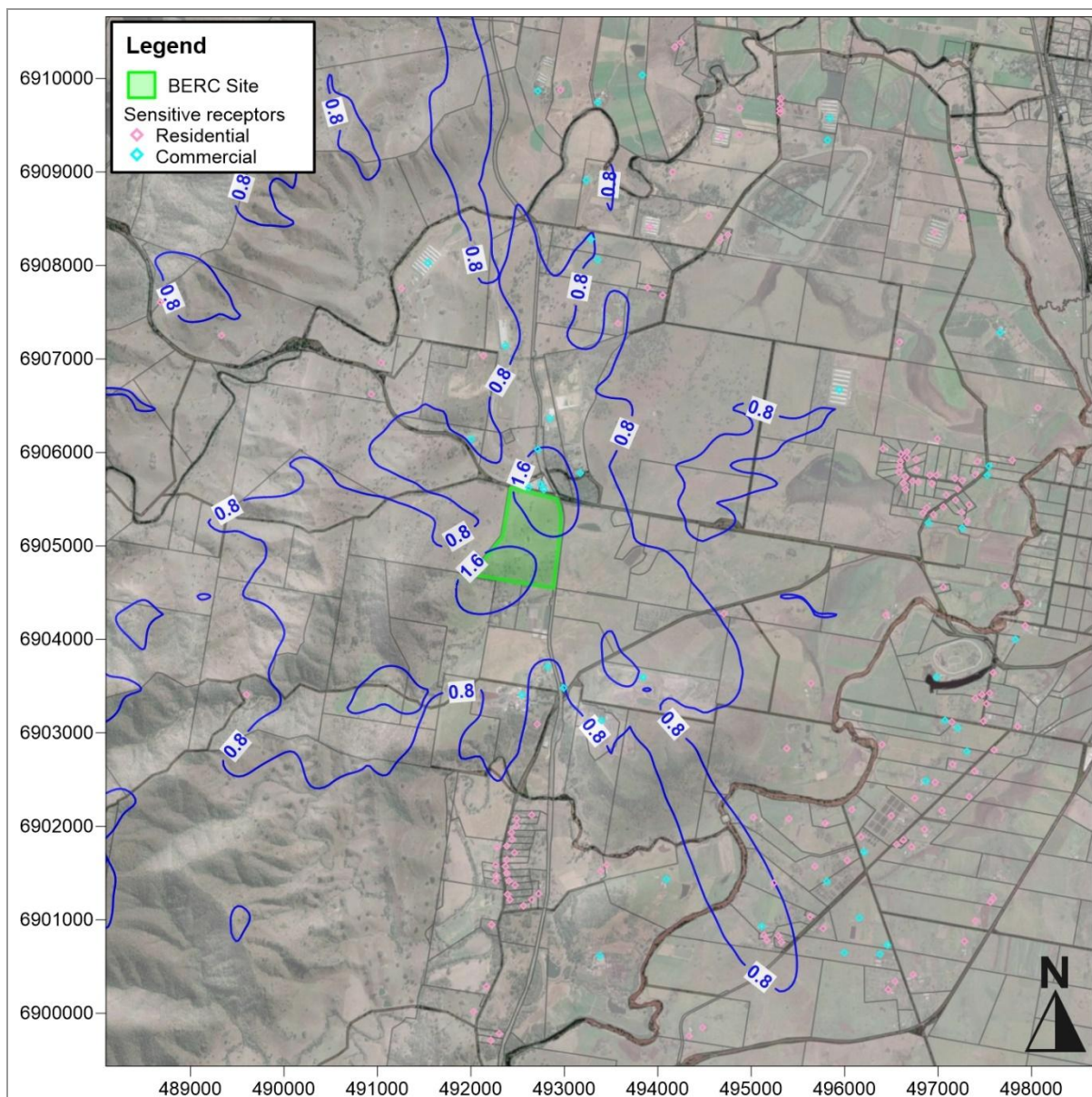


Plate 27 LP2 daily average concentration limits: maximum predicted 24-hour ground-level concentration for SO₂ due to the Project in isolation

Location: Beaudesert, QLD	Averaging period: 24-hour	Data source: CALPUFF	Units: µg/m ³
Type: Maximum	Objective: 57 µg/m ³	Prepared by: D Gallagher	Date: September 2025

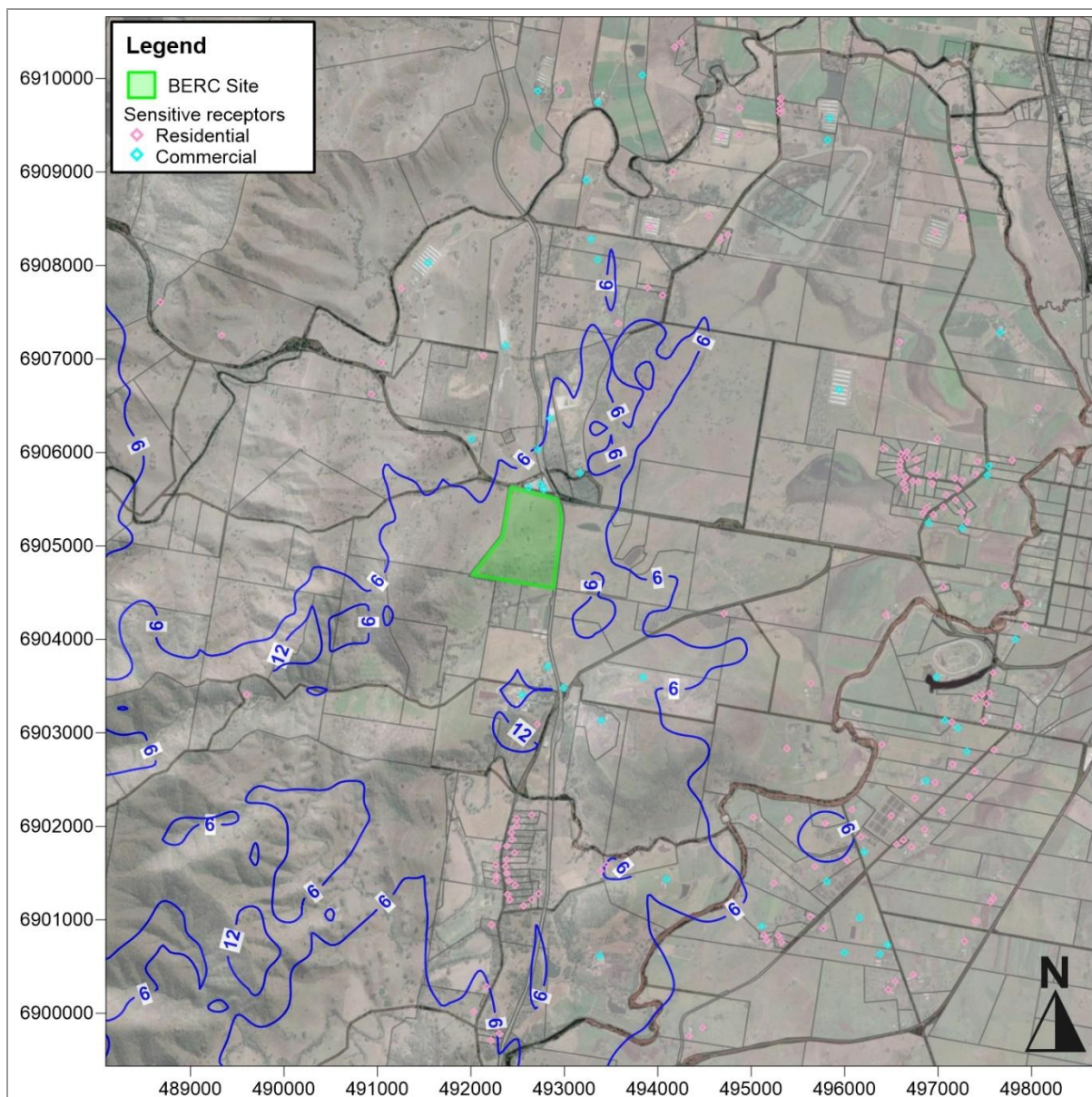


Plate 28 LP2 daily average concentration limits: maximum predicted 24-hour ground-level concentration for SO₂ due to the Project and background

Location: Beaudesert, QLD	Averaging period: 24-hour	Data source: CALPUFF	Units: µg/m ³
Type: Maximum	Objective: 57 µg/m ³	Prepared by: D Gallagher	Date: September 2025

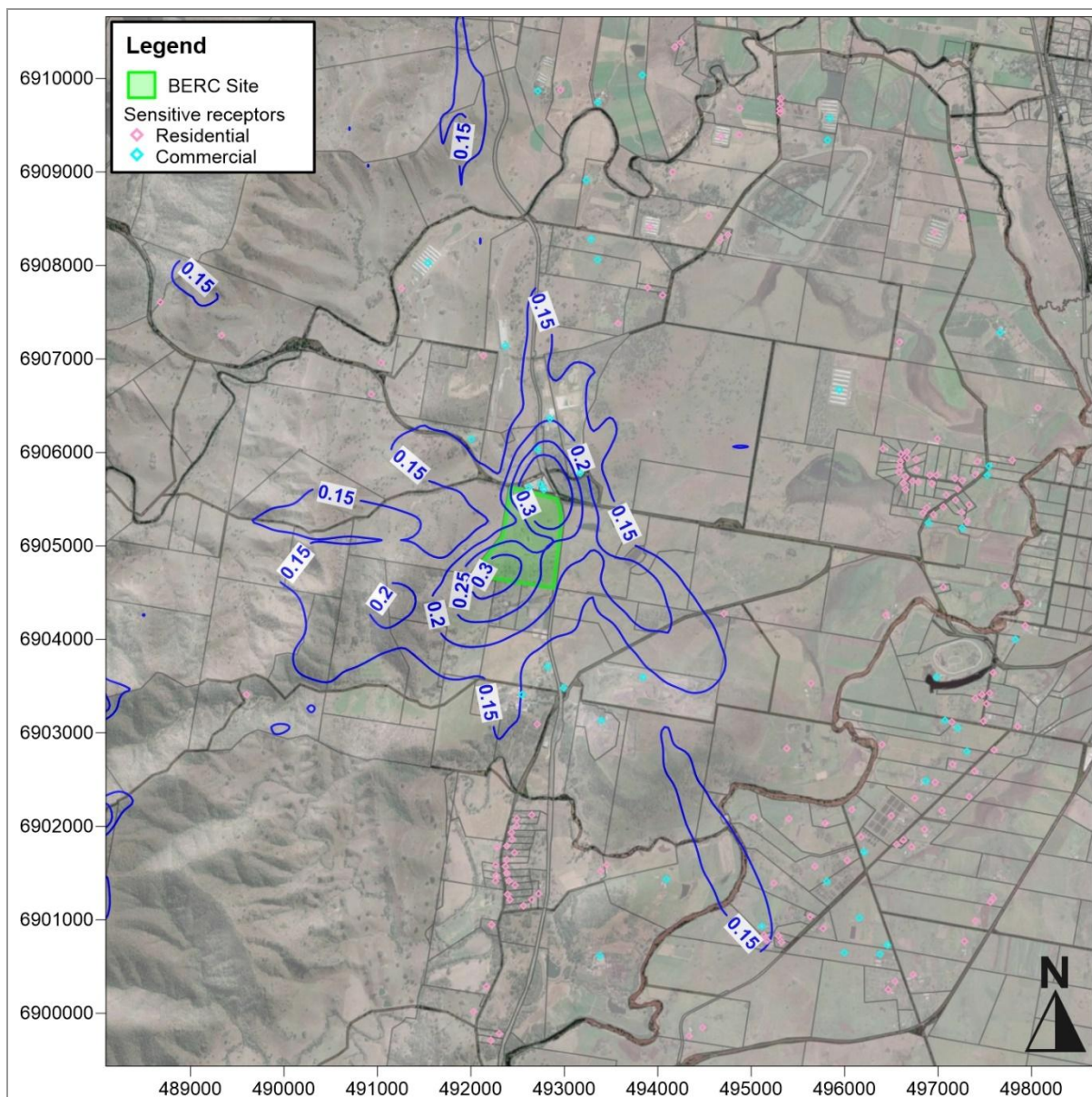


Plate 29 LP2 daily average concentration limits: maximum predicted 24-hour ground-level concentration for PM₁₀ due to the Project in isolation

Location: Beaudesert, QLD	Averaging period: 24-hour	Data source: CALPUFF	Units: µg/m ³
Type: Maximum	Objective: 50 µg/m ³	Prepared by: D Gallagher	Date: September 2025

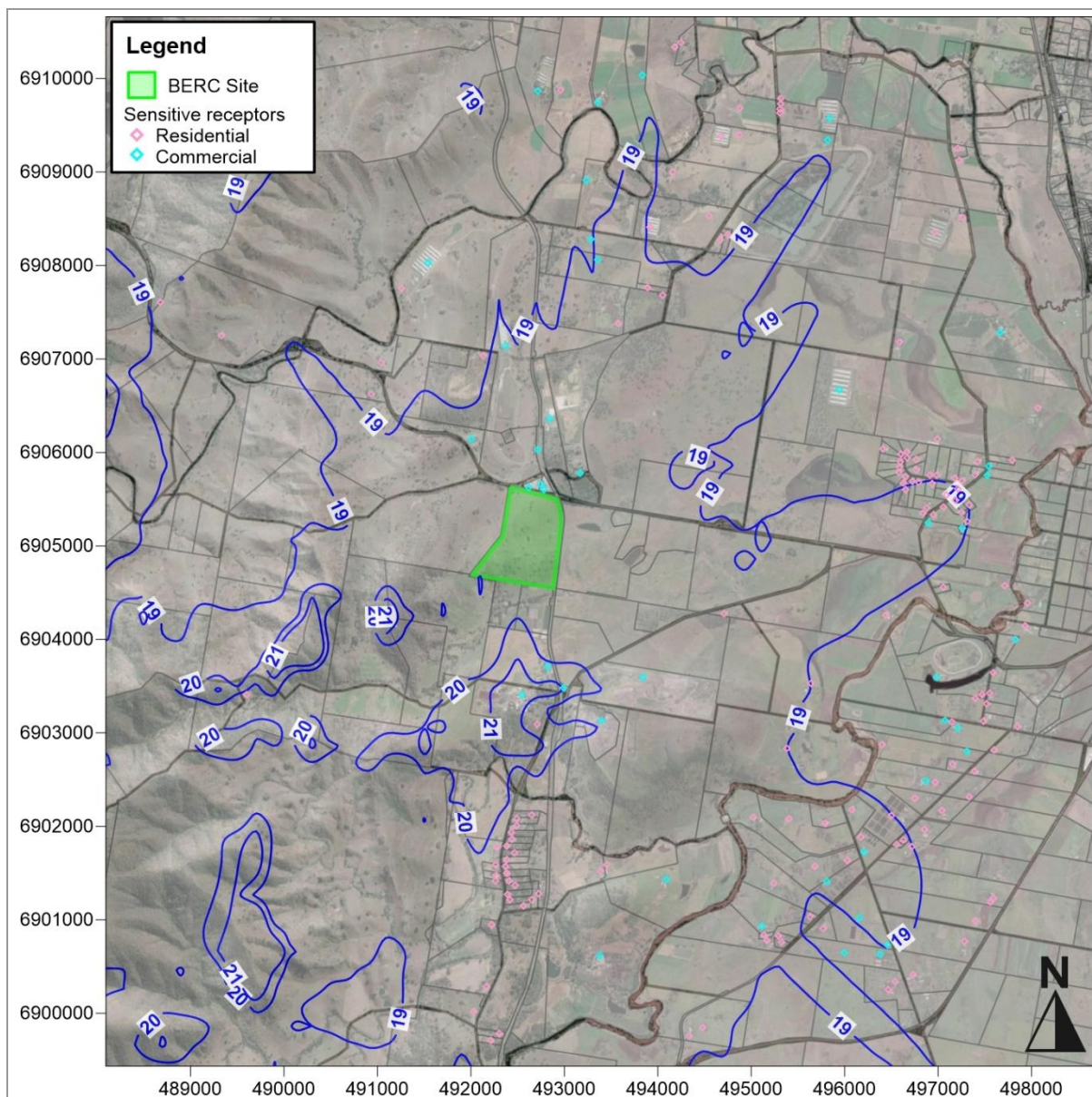


Plate 30 LP2 daily average concentration limits: maximum predicted 24-hour ground-level concentration for PM₁₀ due to the Project and background

Location: Beaudesert, QLD	Averaging period: 24-hour	Data source: CALPUFF	Units: µg/m ³
Type: Maximum	Objective: 50 µg/m ³	Prepared by: D Gallagher	Date: September 2025

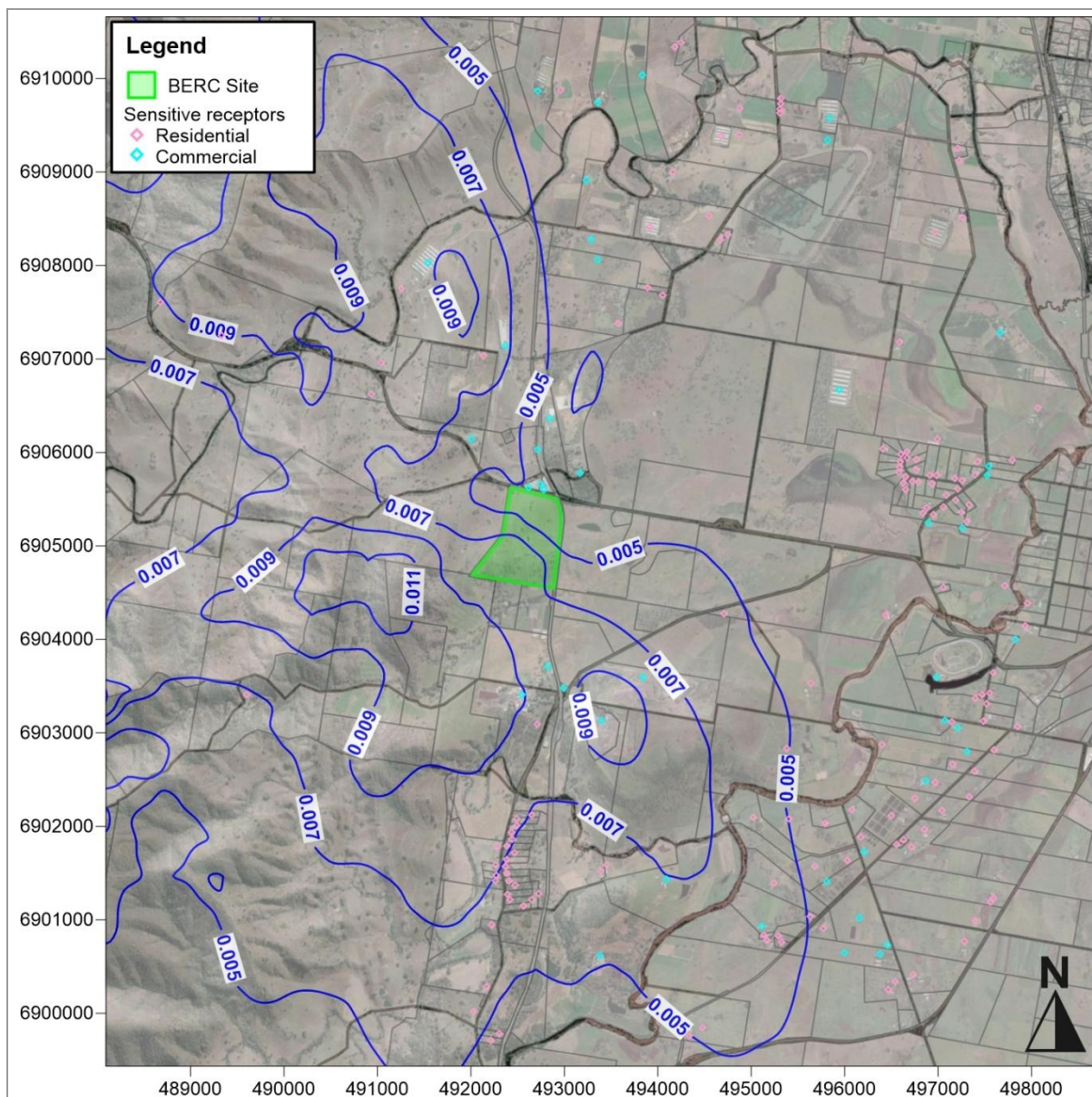


Plate 31 LP2 daily average concentration limits: predicted 1-year average ground-level concentration for PM₁₀ due to the Project in isolation

Location: Beaudesert, QLD	Averaging period: 1-year	Data source: CALPUFF	Units: µg/m ³
Type: Average	Objective: 25 µg/m ³	Prepared by: D Gallagher	Date: September 2025

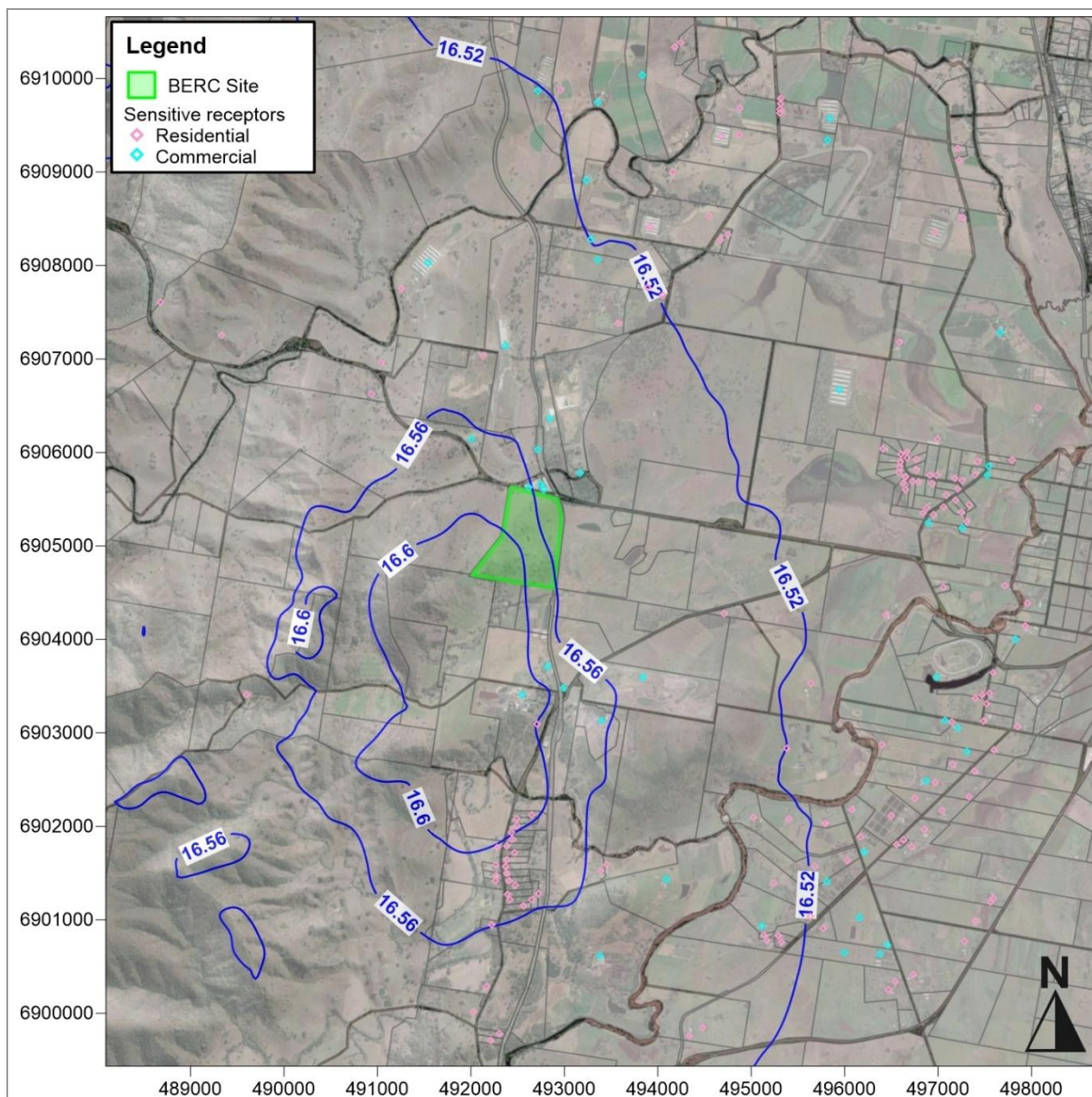


Plate 32 LP2 daily average concentration limits: predicted 1-year average ground-level concentration for PM₁₀ due to the Project and background

Location: Beaudesert, QLD	Averaging period: 1-year	Data source: CALPUFF	Units: µg/m ³
Type: Average	Objective: 25 µg/m ³	Prepared by: D Gallagher	Date: September 2025

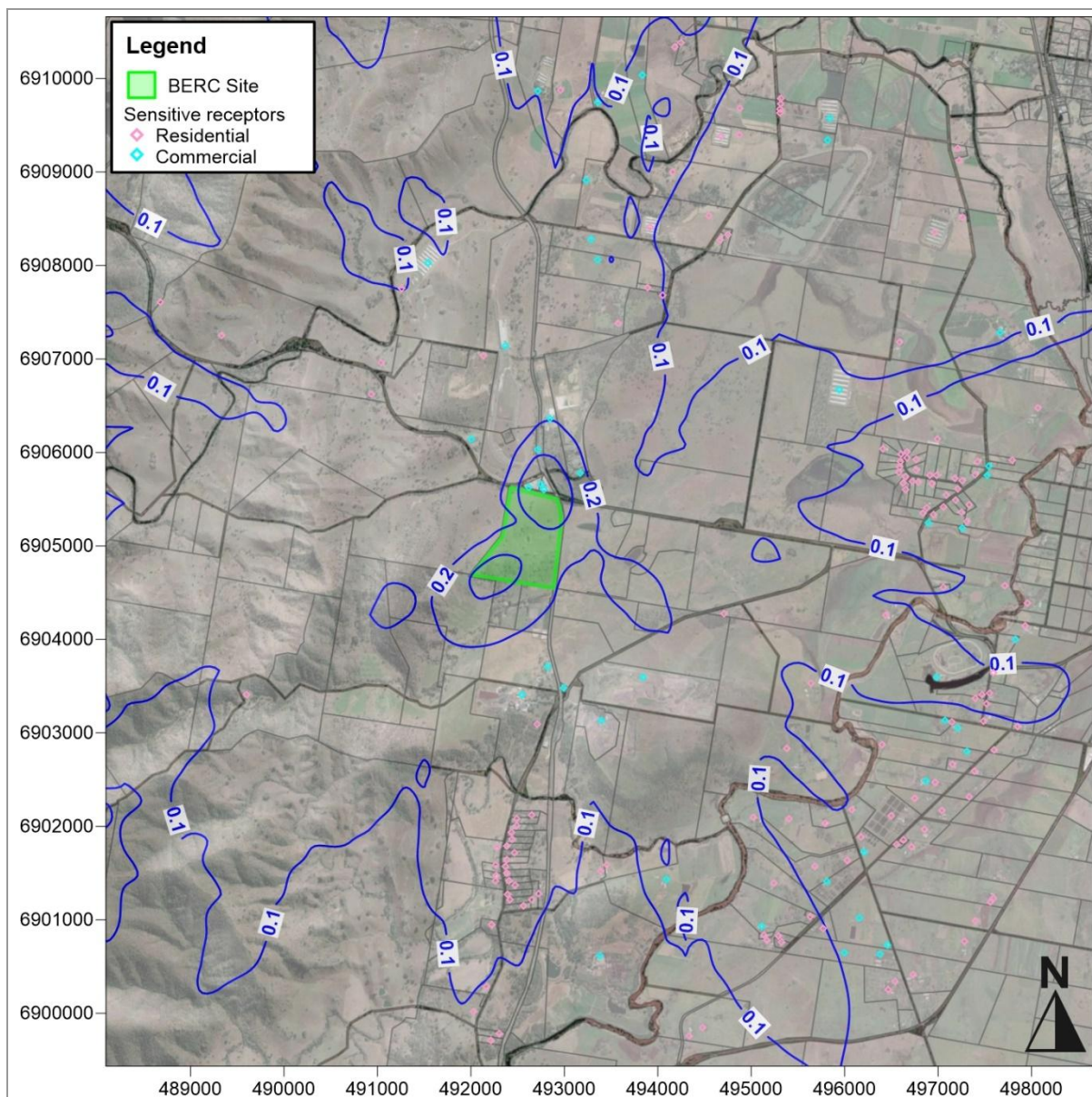


Plate 33 LP2 daily average concentration limits: maximum predicted 24-hour ground-level concentration for PM_{2.5} due to the Project in isolation

Location: Beaudesert, QLD	Averaging period: 24-hour	Data source: CALPUFF	Units: µg/m ³
Type: Maximum	Objective: 20 µg/m ³	Prepared by: D Gallagher	Date: September 2025

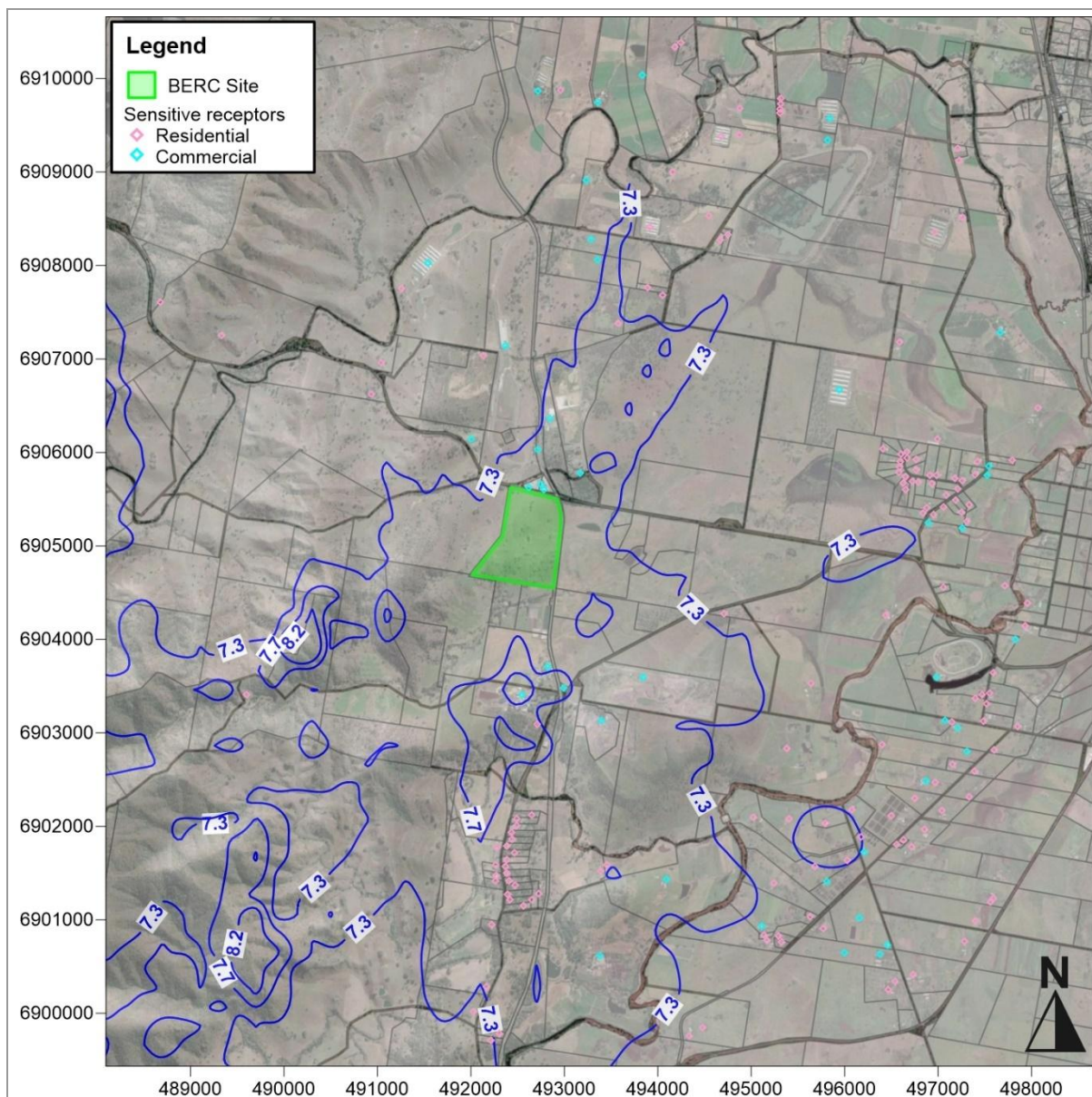


Plate 34 LP2 daily average concentration limits: maximum predicted 24-hour ground-level concentration for PM_{2.5} due to the Project and background

Location: Beaudesert, QLD	Averaging period: 24-hour	Data source: CALPUFF	Units: µg/m ³
Type: Maximum	Objective: 20 µg/m ³	Prepared by: D Gallagher	Date: September 2025

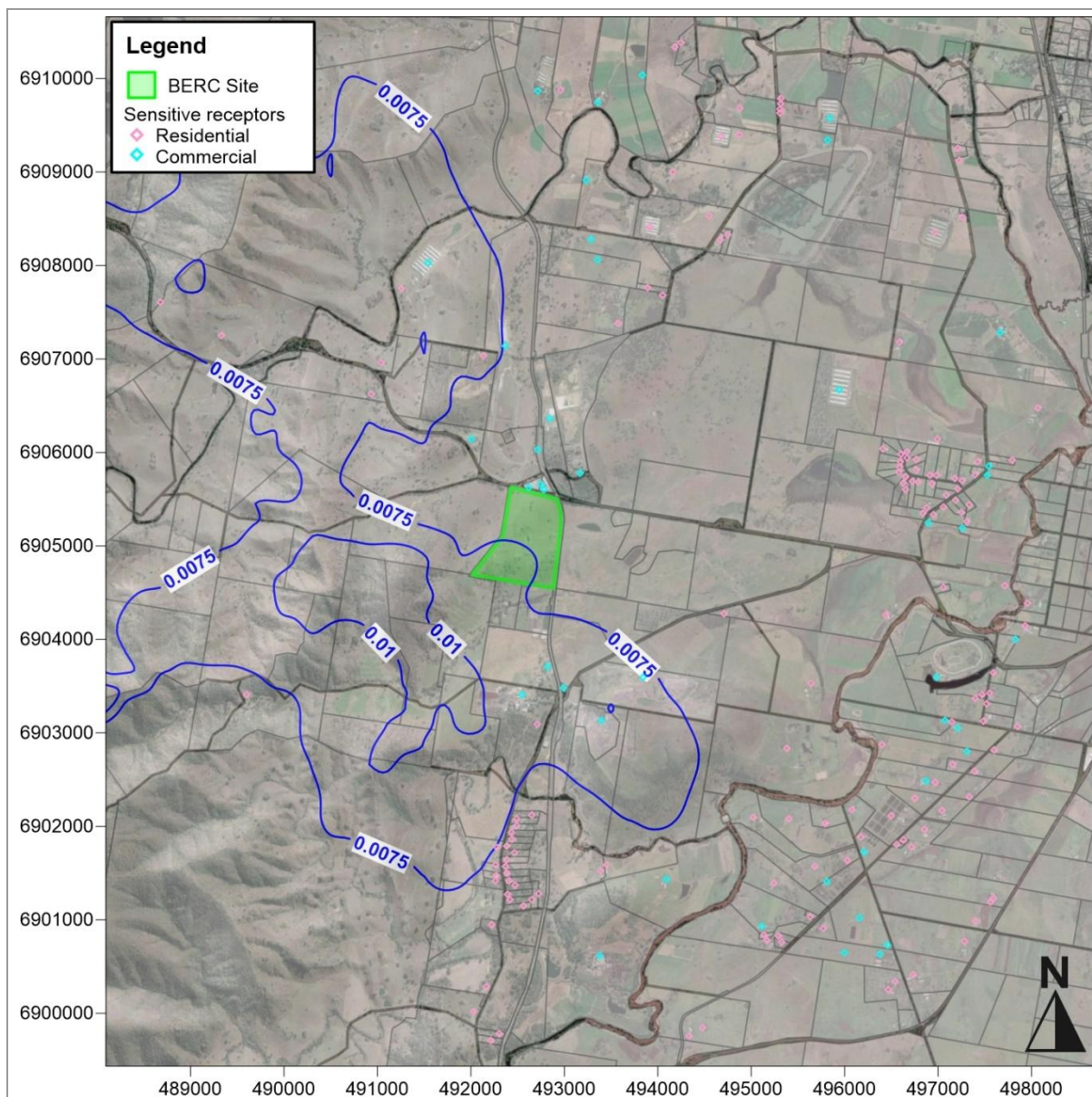


Plate 35 LP2 daily average concentration limits: predicted 1-year average ground-level concentration for PM_{2.5} due to the Project in isolation

Location: Beaudesert, QLD	Averaging period: 1-year	Data source: CALPUFF	Units: µg/m ³
Type: Average	Objective: 7 µg/m ³	Prepared by: D Gallagher	Date: September 2025

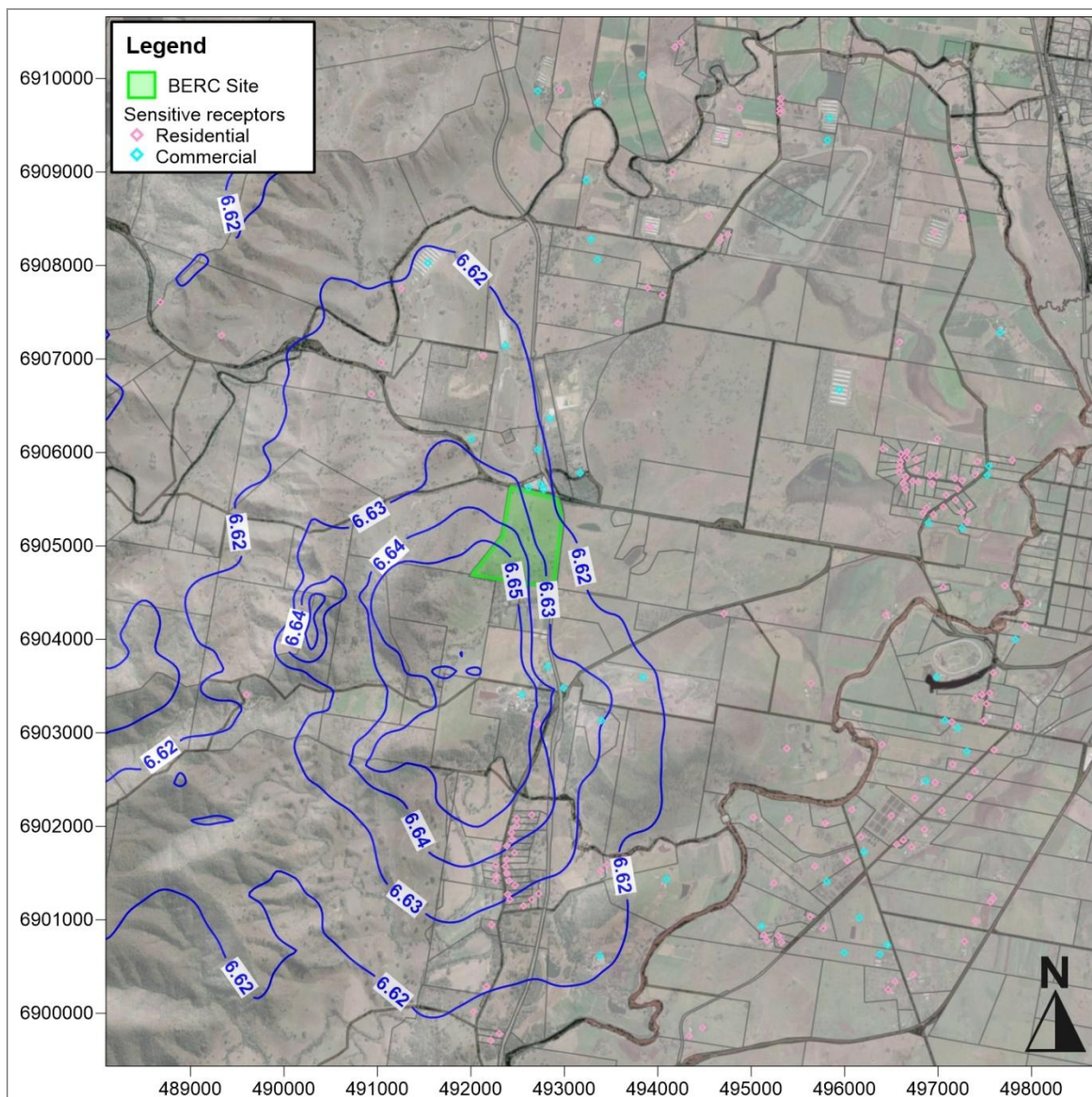


Plate 36 LP2 daily average concentration limits: predicted 1-year average ground-level concentration for PM_{2.5} due to the Project and ambient background

Location: Beaudesert, QLD	Averaging period: 1-year	Data source: CALPUFF	Units: µg/m ³
Type: Average	Objective: 7 µg/m ³	Prepared by: D Gallagher	Date: September 2025

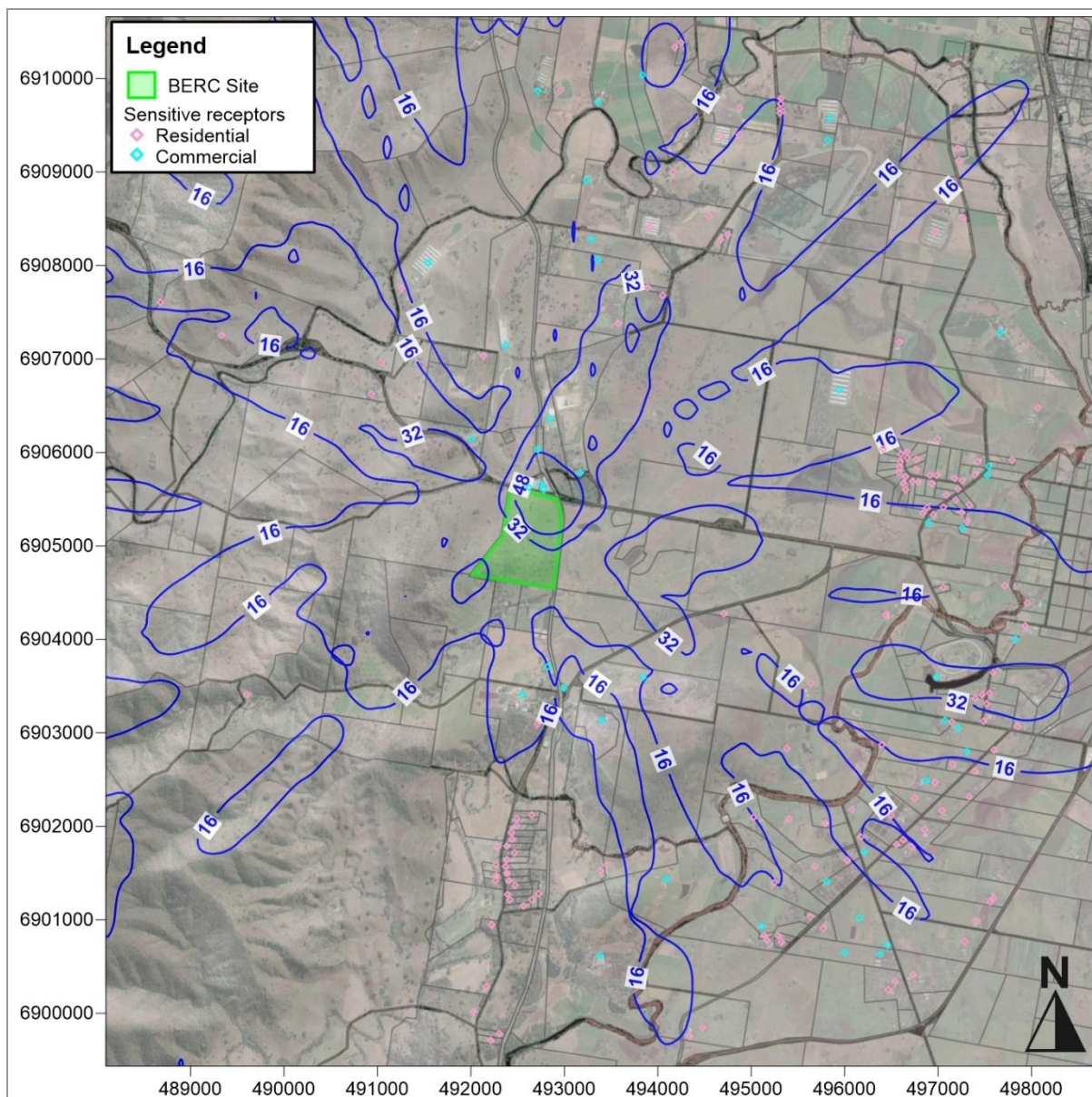


Plate 37 LP2 short-term concentration limits: maximum predicted 1-hour ground-level concentration for NO₂ due to the Project in isolation

Location: Beaudesert, QLD	Averaging period: 1-hour	Data source: CALPUFF	Units: µg/m ³
Type: Maximum	Objective: 164 µg/m ³	Prepared by: D Gallagher	Date: September 2025

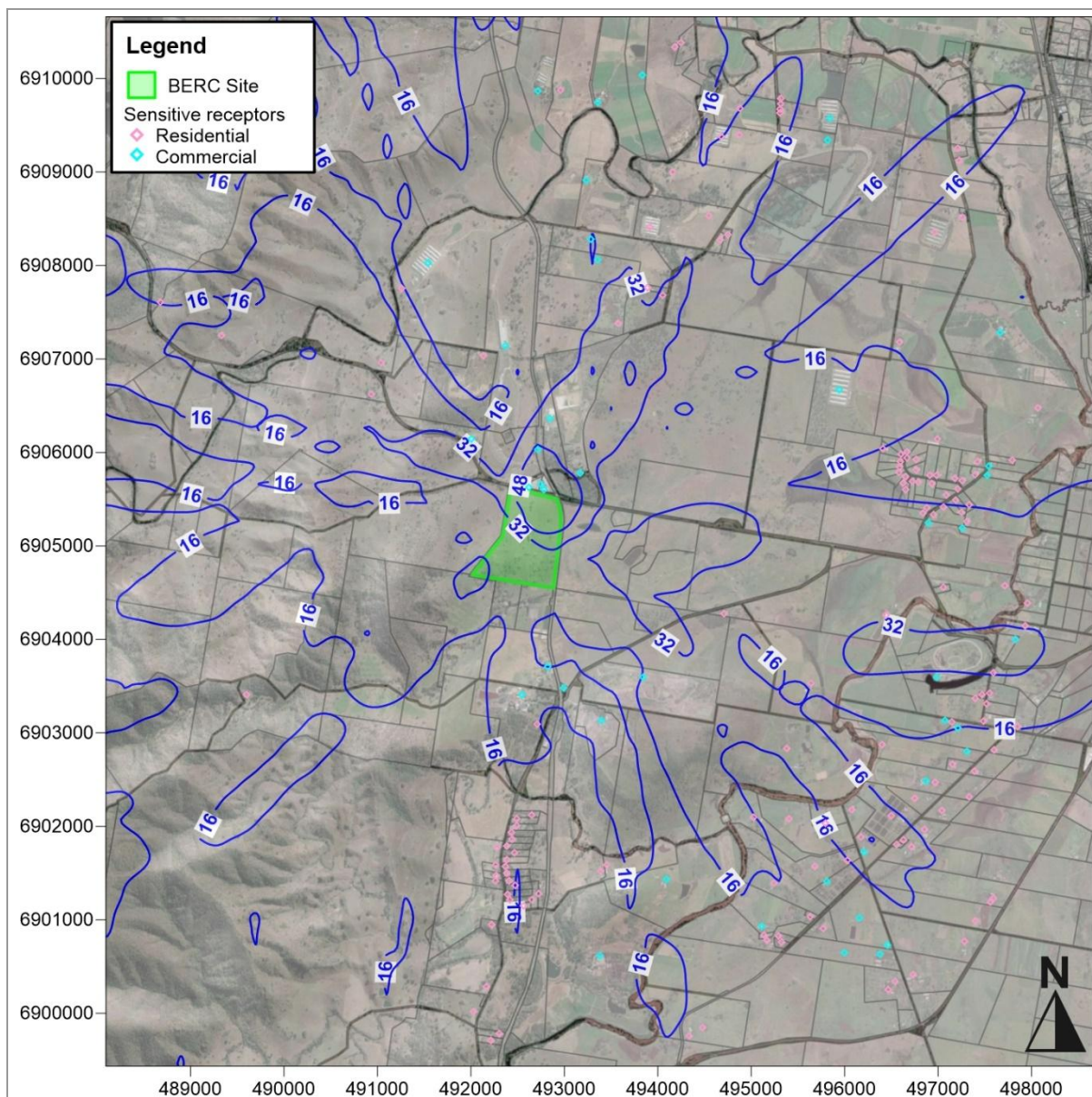


Plate 38 LP2 short-term concentration limits: maximum predicted 1-hour ground-level concentration for NO₂ due to the Project and background

Location: Beaudesert, QLD	Averaging period: 1-hour	Data source: CALPUFF	Units: µg/m ³
Type: Maximum	Objective: 164 µg/m ³	Prepared by: D Gallagher	Date: September 2025

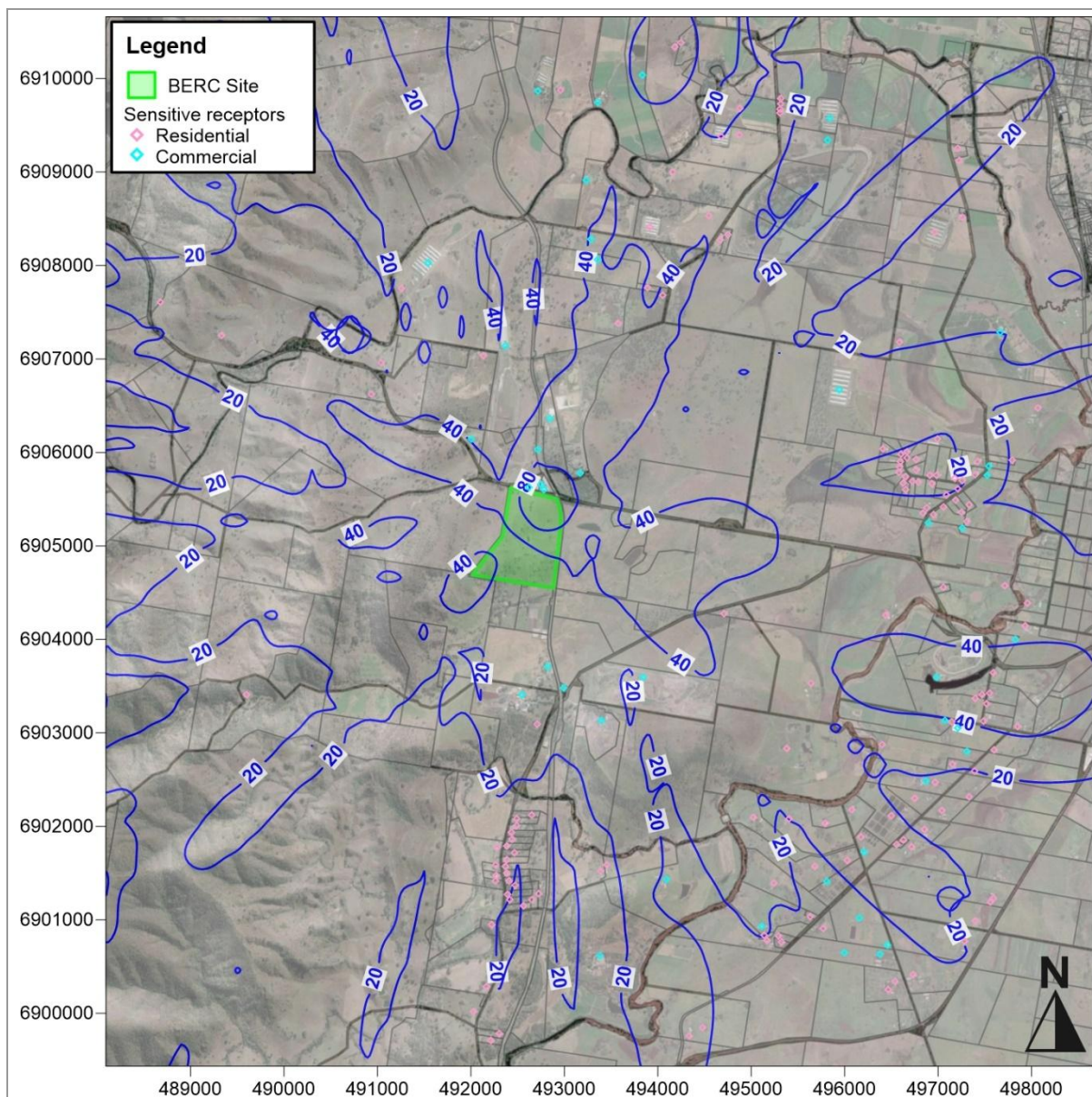


Plate 39 LP2 short-term concentration limits: maximum predicted 1-hour ground-level concentration for SO₂ due to the Project in isolation

Location: Beaudesert, QLD	Averaging period: 1-hour	Data source: CALPUFF	Units: µg/m ³
Type: Maximum	Objective: 214 µg/m ³	Prepared by: D Gallagher	Date: September 2025

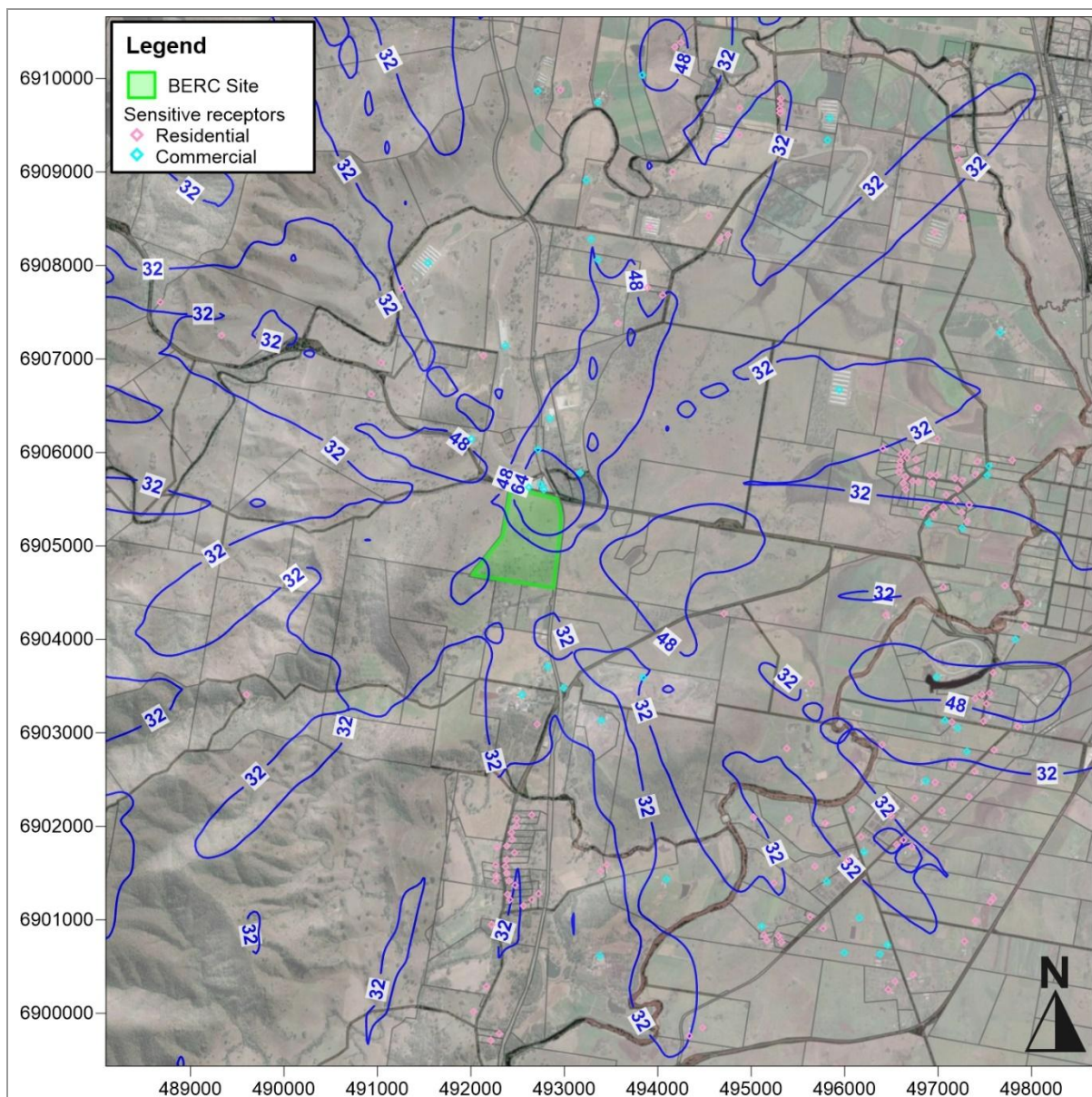


Plate 40 LP2 short-term concentration limits: maximum predicted 1-hour ground-level concentration for SO₂ due to the Project and ambient background

Location: Beaudesert, QLD	Averaging period: 1-hour	Data source: CALPUFF	Units: µg/m ³
Type: Maximum	Objective: 214 µg/m ³	Prepared by: D Gallagher	Date: September 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.

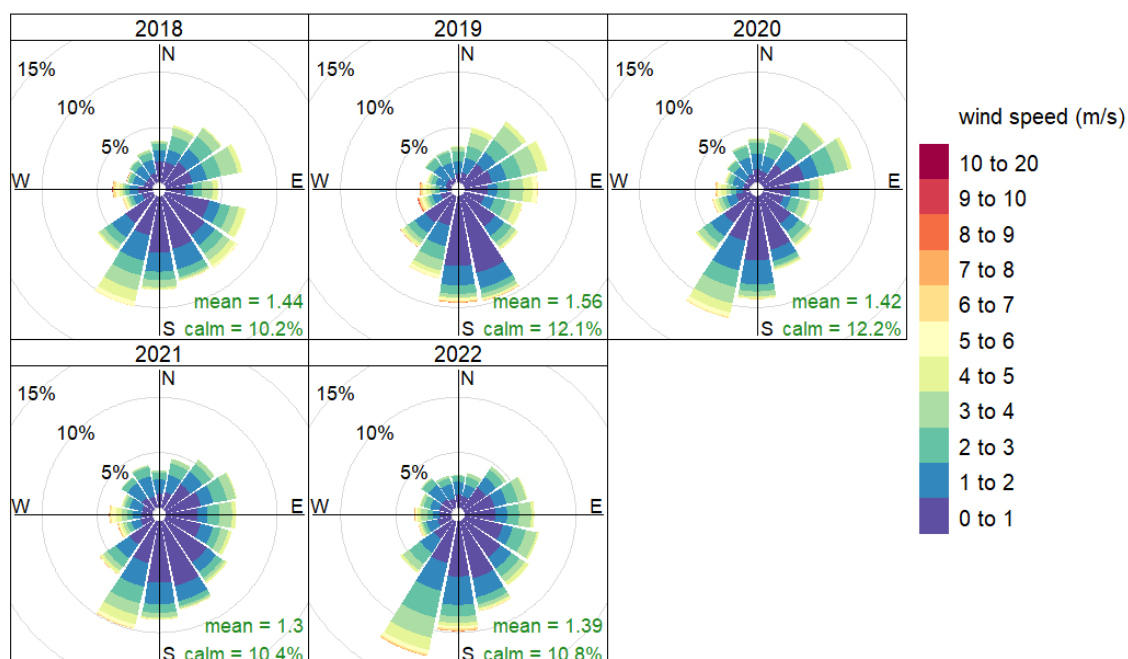
A1.1 Selection of representative year

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 automatic weather station located at Beaudesert Drumley Steet. Meteorological observations from the past five years (2018 to 2022) at Beaudesert Drumley Steet were analysed to assess the inter-annual variability.

Figure A1 presents annual wind roses for the five years and shows that inter-annual conditions are typically very similar. Figure A2 presents frequency distribution plots for humidity, wind direction, wind speed and temperature, with the year 2018 highlighted, and demonstrates that there is relatively little variation in the distribution of these variables year-on-year, though wind-direction shows slightly more variability than the other variables. 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 2018 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.



Frequency of counts by wind direction (%)

Figure A1 Annual wind roses for Beaudesert Drumley Street between 2018 and 2022

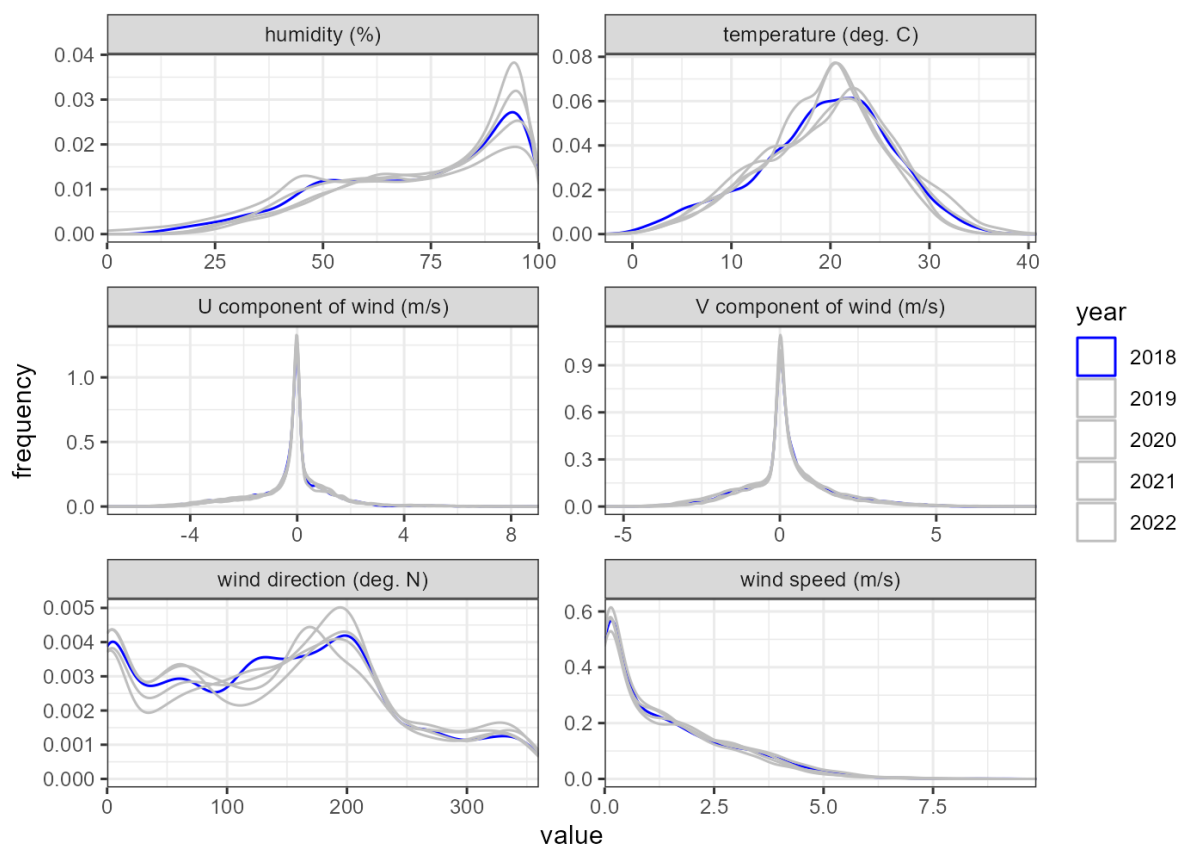


Figure A2 Annual frequency distributions plots for Beaudesert Drumley Street between 2018 and 2022 (2018 highlighted)

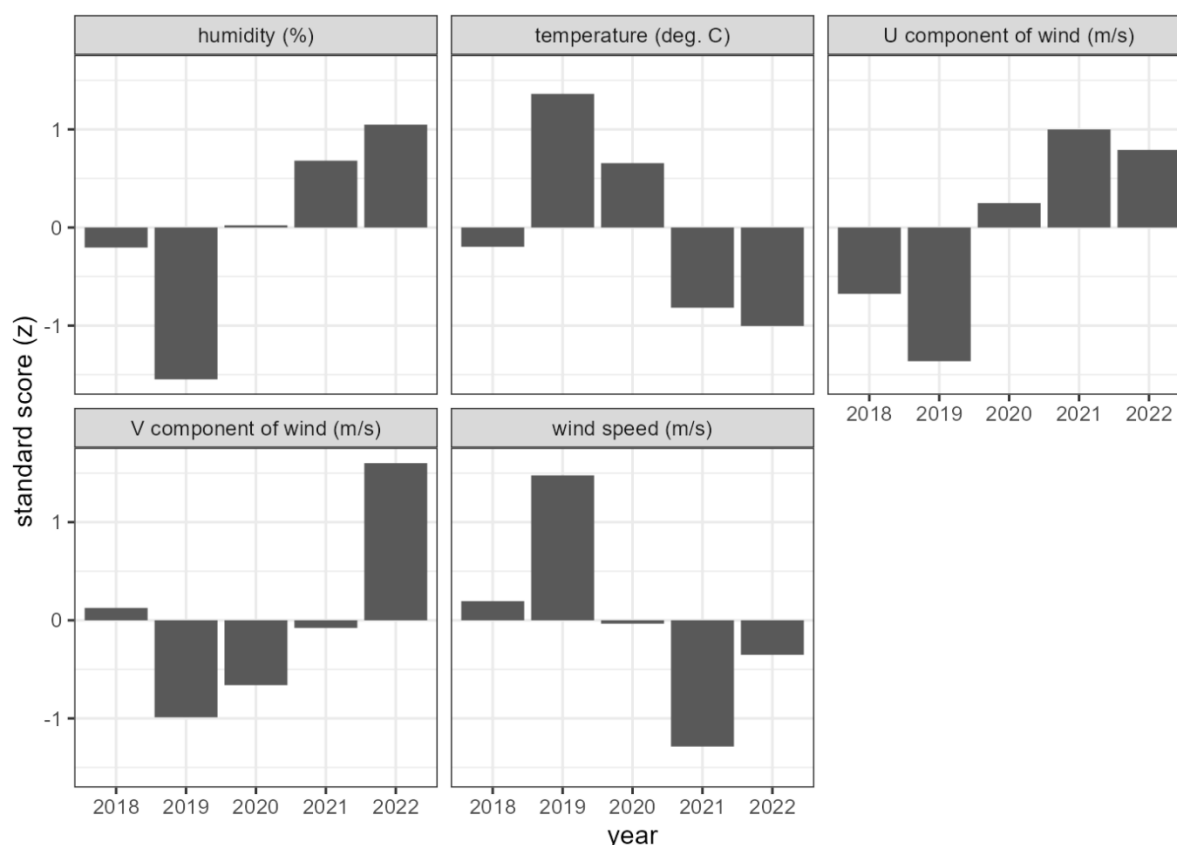


Figure A3 Z-Scores for Beaudesert Drumley Street between 2018 and 2022

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 is 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 (20km to 200km) 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 7.5 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 to 31 December 2018
- 48 x 48 grid point domain with nesting resolutions of 30 km, 10 km, 3 km, and 1 km
- 25 vertical levels

- Grid centred on latitude -20° 0.5', longitude 152° 57.0'
- 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
- Data assimilation as follows:
 - Data from the Bureau of Meteorology's monitoring station at Beaudesert Drumley Street assimilated over three vertical levels with a radius of influence of 5 km and a quality factor of 0.9.
 - Data from the Department of Environment and Science's monitoring station at Josephville assimilated over three vertical levels with a radius of influence of 2 km and a quality factor of 0.9.

A1.3 Comparison of TAPM output with observational data

A1.3.1 Overview

The model validation in this section compares observational data with data derived from running TAPM after assimilating data from the Bureau of Meteorology's monitoring station at Beaudesert Drumley Street and the Department of Environment and Science's monitoring station at Josephville. TAPM was originally run without data assimilation and the predicted meteorological data was compared to observational data Beaudesert Drumley Street and Josephville monitors.

Comparison of the observational data with the model predictions at these two sites showed that the model generally overpredicted wind speeds compared to observations and performed moderately poorly at predicting the distribution of observed wind directions at both sites. It is desirable to accurately predict the meteorology both near to the Project and near to the sensitive receptors, so as to predict dispersion of pollutants in these areas more accurately.

The distinct meteorology at each of the two sites (see the "observed" annual distributions of winds in Figure A6 and Figure A7) in combination with the poor performance of the initial TAPM run motivated running the model with data from both sites assimilated. The final iteration TAPM was therefore run using the assimilation of observational data at both the Josephville and the Beaudesert Drumley Street monitoring sites. The resulting model output was validated against observational data from both monitoring sites.

A1.3.2 Validation of TAPM modelling

The following section presents the results of the validation of the final TAPM run that was used for the dispersion modelling assessment. The model validation compares the DETSI Josephville and Beaudesert Drumley Street BoM observational meteorological data with data extracted from TAPM at the respective monitor locations. The TAPM output was extracted from the closest inner grid points to the locations of the weather stations.

Figure A4 and Figure A5 show probability density functions that graphically compare statistical distributions of meteorological parameters from the TAPM output with observational data from DETSI Josephville and Beaudesert Drumley Street BoM, respectively. Figure A6 and Figure A7 compare the annual distributions of winds based on observational data from the two stations with the annual distributions of winds predicted in the TAPM output.

Table A1 and Table A2 present statistical comparisons of TAPM output (wind speed and temperature) to meteorological data recorded at the DETSI Josephville and Beaudesert Drumley Street BoM monitoring stations, respectively.

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

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

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

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

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.

The wind speeds and temperatures generated by TAPM are within the benchmark ranges for RMSE, index of agreement and bias for both the DETSI Josephville and Beaudesert Drumley BoM monitoring stations. The probability density functions illustrate good agreement between predicted and observed meteorological data, which is to be expected given the assimilation of data at both monitoring locations.

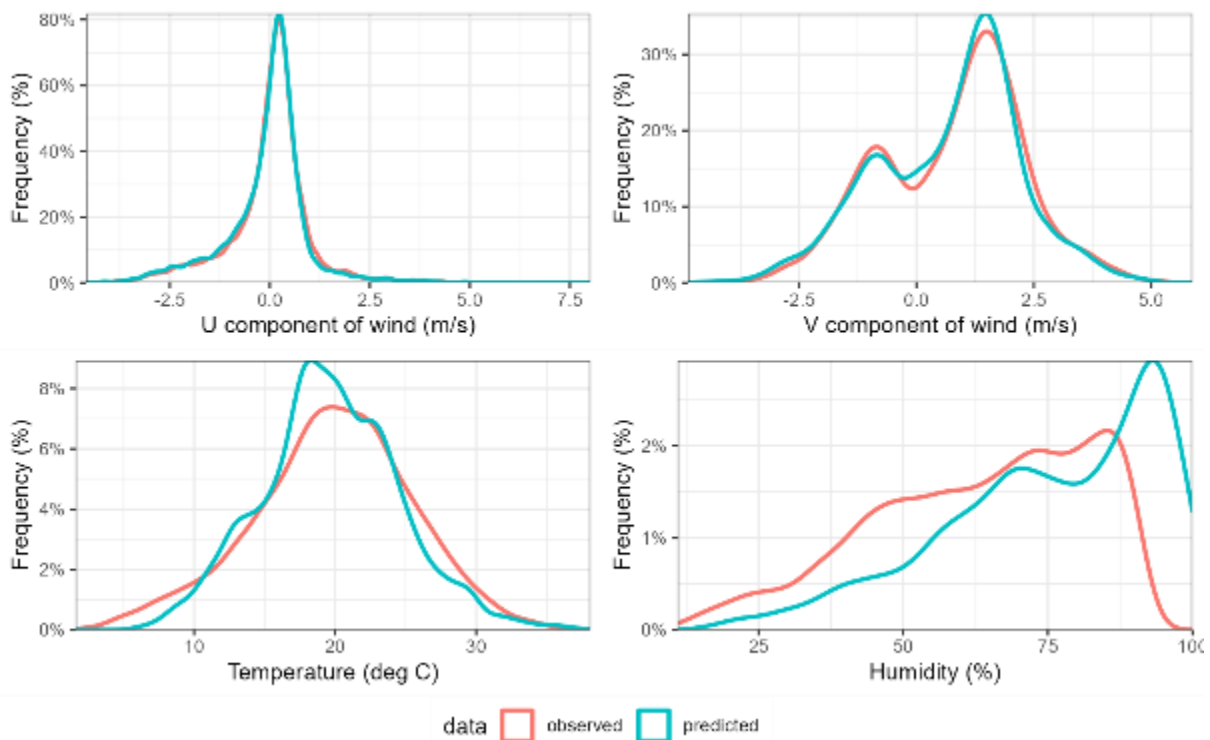


Figure A4 Probability density functions comparing 2018 observational data (blue) with TAPM data (red) at the location of the DETSI Josephville monitoring station

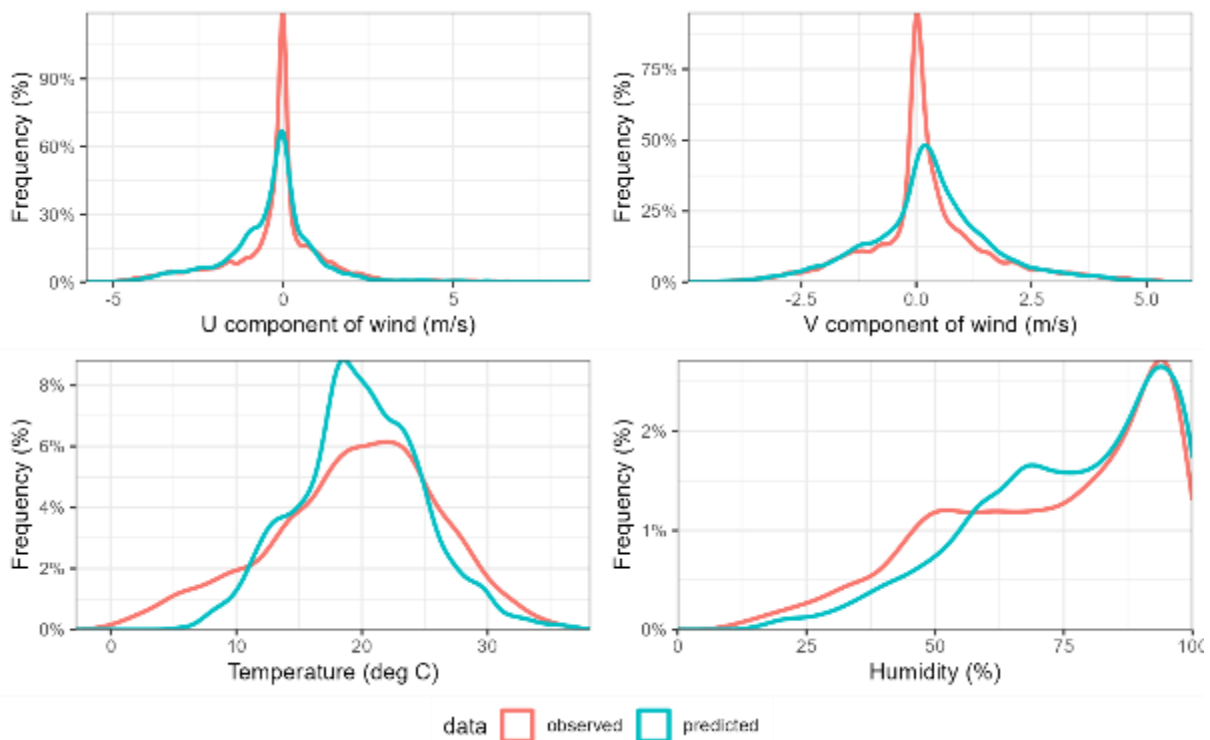
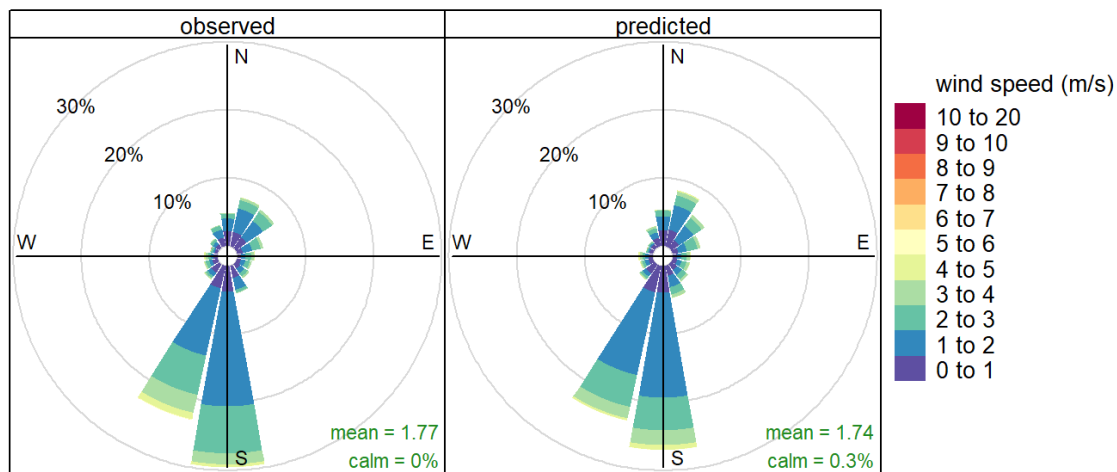
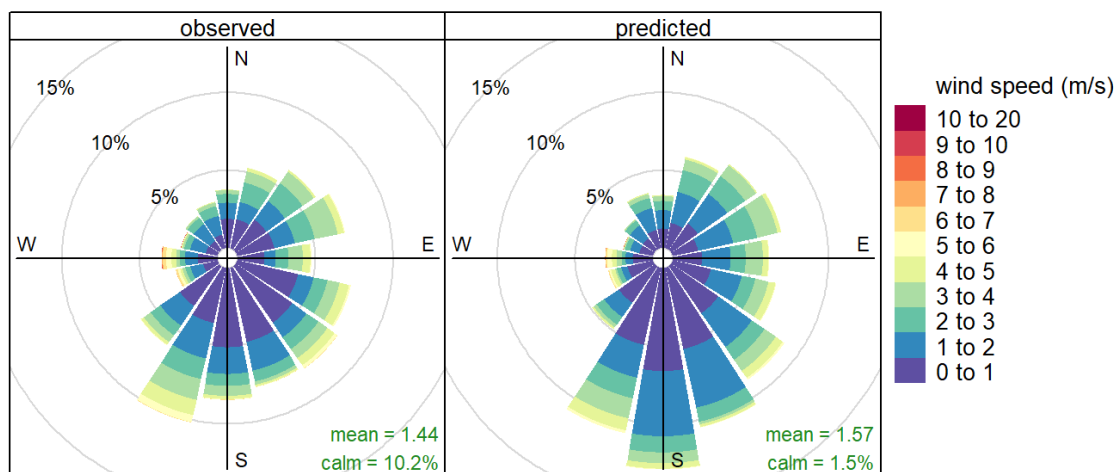


Figure A5 Probability density functions comparing 2018 observational data (blue) with TAPM data (red) at the location of the Beaudesert Drumley Street BoM monitoring station



Frequency of counts by wind direction (%)

Figure A6 Comparison of observed and predicted 2018 annual distribution of winds at the location of the DETSI Josephville monitoring station



Frequency of counts by wind direction (%)

Figure A7 Comparison of observed and predicted 2018 annual distribution of winds at the location of the Beaudesert Drumley Street BoM monitoring station

Table A1 A comparison of the observed meteorological data with the TAPM output for 2018 at the location of the DETSI Josephville monitoring station

Statistic	“Good” value	Wind speed (m/s)			Temperature (°C)		
		Benchmark	Observational data	TAPM	Benchmark	Observational data	TAPM
Mean	-	-	1.8	1.7	-	19.8	19.7
SD	-	-	0.9	1.0	-	5.7	4.9
Min	-	-	0.0	0.0	-	1.6	5.8
Max	-	-	8.3	7.4	-	37.2	38.1
Bias	0	<±0.5m/s	0.03		<±0.5°C	-0.13	
RMSE	Close to 0	<2m/s	0.32		-	2.12	
IoA	Close to 1	>0.6	0.97		≥0.8	0.96	

Table A2 A comparison of the observed meteorological data with the TAPM output for 2018 at the location of the Beaudesert Drumley Street BoM monitoring station

Statistic	“Good” value	Wind speed (m/s)			Temperature (°C)		
		Benchmark	Observational data	TAPM	Benchmark	Observational data	TAPM
Mean	-	-	1.4	1.6	-	19.4	19.8
SD	-	-	1.4	1.3	-	6.8	5.0
Min	-	-	0.0	0.0	-	-2.8	4.9
Max	-	-	9.2	8.6	-	38.2	38.2
Bias	0	<±0.5m/s	-0.13		<±0.5°C	0.40	
RMSE	Close to 0	<2m/s	0.60		-	2.99	
IoA	Close to 1	>0.6	0.95		≥0.8	0.93	

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 1km 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 in accordance with the requirements of the NSW EPA's Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (NSW EPA, 2022). This includes default options and parameters, with the following selections:

- Modelling period from 1 January to 31 December 2018
- 100 x 100 grid point domain with 200 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 m
- 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 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 TAPM/CALMET dataset at the Project site.

A1.5.1 Wind speed and wind direction

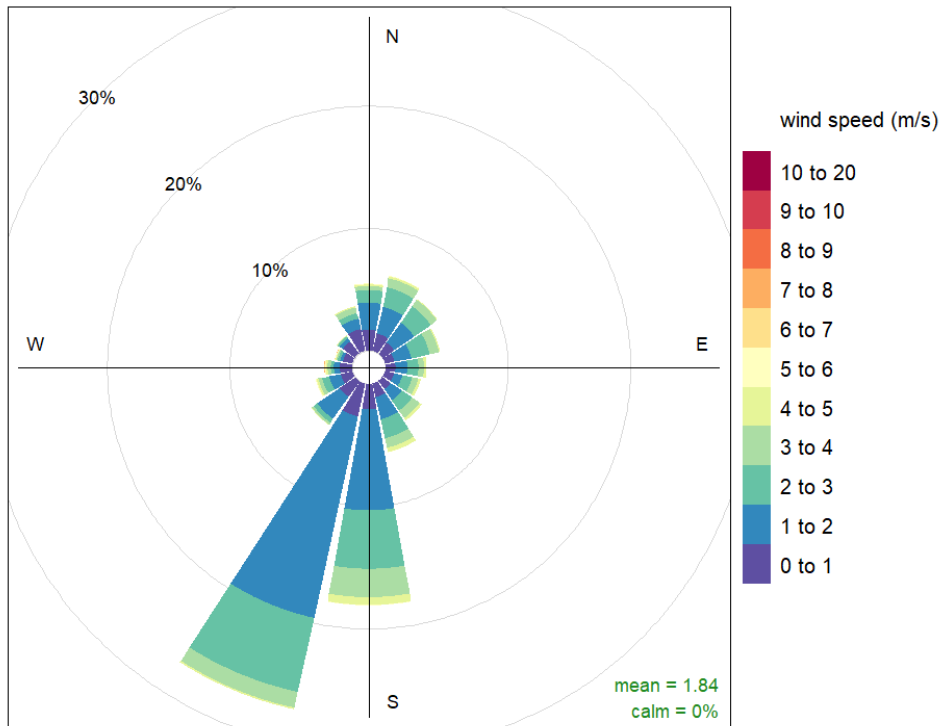
The annual distribution of winds predicted by TAPM/CALMET for 2018 is presented in Figure A8. The seasonal and diurnal distribution of winds is presented in Figure A9 and Figure A10.

Winds across the study area are predominantly light to moderate (up to around 5m/s) and from the south-southwest and south directions. Winds from all other directions occur less frequently and with relatively equal prevalence.

The seasonal breakdown of winds shows that the predominant south-southwesterly winds are most common during the autumn and winter months. Southerly winds are similarly most prevalent in autumn, but occur relatively infrequently in winter. Spring and summer show an increased frequency of winds from the northeast and a decrease in the south-southeasterly and southerly dominance. Wind speeds are relatively consistent across all seasons and all wind directions.

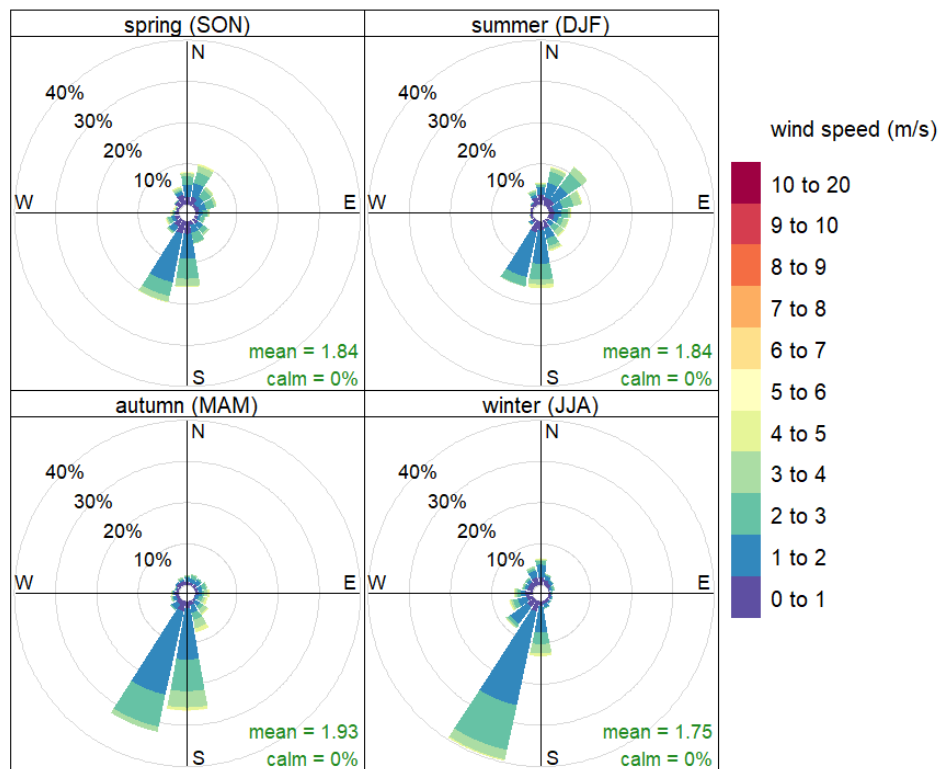
The diurnal breakdown of winds shows that the strongest winds are predicted during the afternoon (midday to 6pm) when winds are predominantly from the northeastern and (less so) southeastern quadrants. This is the only time of day when southerly and/or south-southwesterly winds do not dominate, though southerly winds do still occur with some frequency.

From 6pm to midnight the wind speed drops significantly, and south-southwesterly winds dominate. This dominance continues and intensifies overnight into the early morning (midnight to 6am). In the morning (6am to midday), the dominant wind direction shifts more southerly and wind speeds increase slightly.



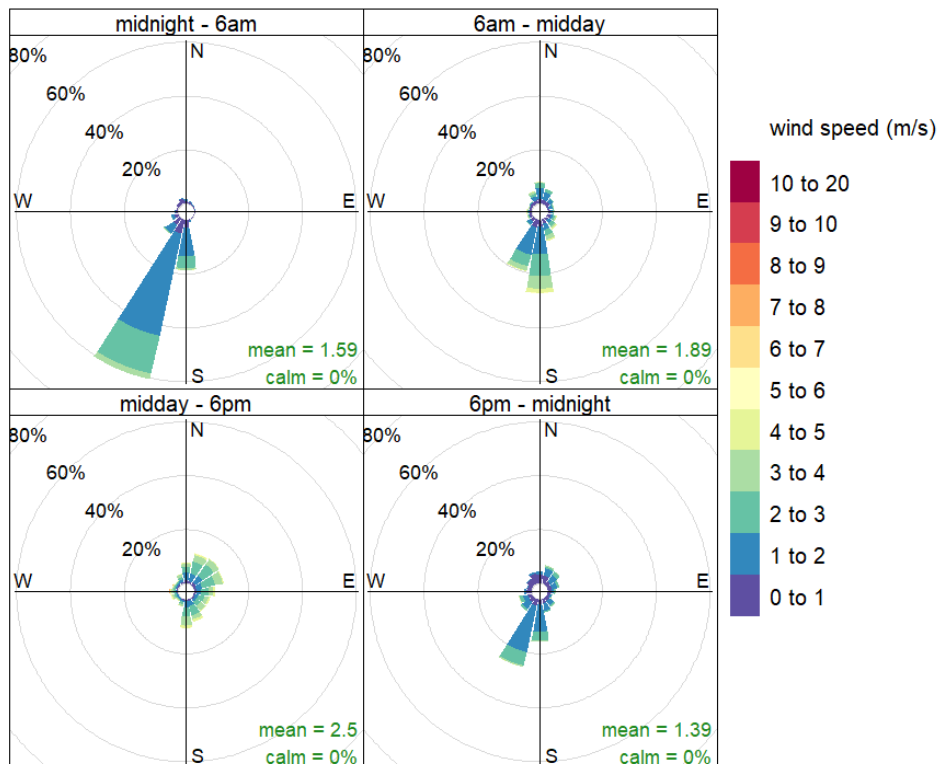
Frequency of counts by wind direction (%)

Figure A8 2018 Annual distribution of winds predicted by TAPM/CALMET



Frequency of counts by wind direction (%)

Figure A9 2018 Seasonal distribution of winds predicted by TAPM/CALMET



Frequency of counts by wind direction (%)

Figure A10 2018 Diurnal distribution of winds predicted by TAPM/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 A11 shows the distribution of stability classes extracted from the TAPM/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 35% of total time. Very stable (F class) conditions are equally frequent (occurring 35% of total time), and only occur between 5 pm and 7 am. Stable (E class) conditions occur an additional 7% of the time. Unstable conditions (Classes A to C) occur only 23% of the time.

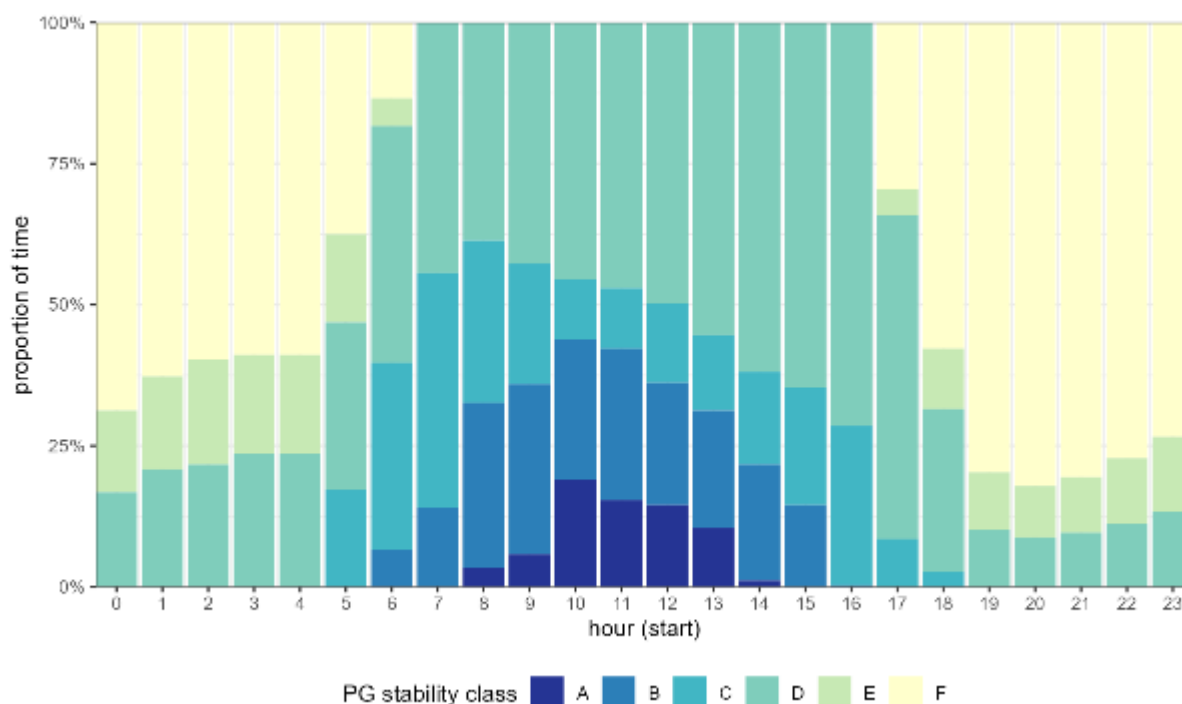


Figure A11 2018 Frequency distribution of atmospheric stability conditions predicted by TAPM/CALMET

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 TAPM/CALMET dataset are presented as a diurnal frequency (box and whisker) plot in Figure A12. 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.

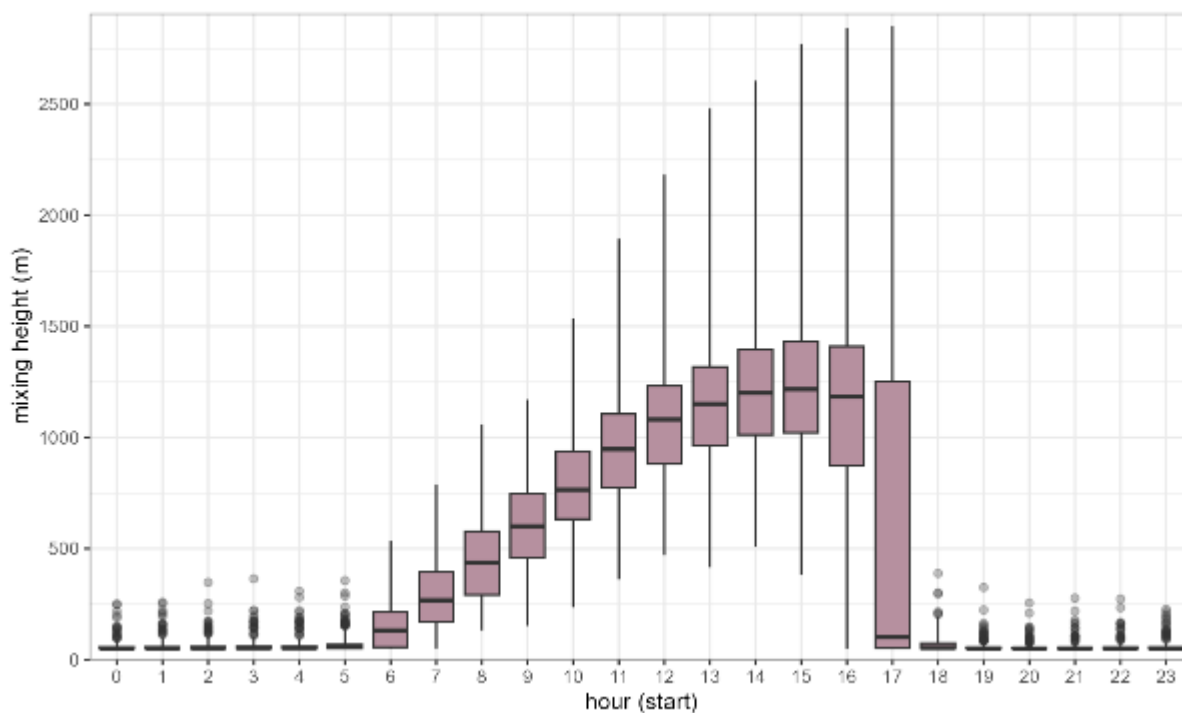


Figure A12 2018 Diurnal profile of mixing height predicted by TAPM/CALMET

A1.5.4 Temperature

The hourly distribution of TAPM/CALMET predicted temperature is provided in Figure A13 and the monthly distribution is provided in Figure A14. Over the twelve-month meteorological simulation, the temperature was predicted to range between 6.0°C and 37.9°C (average of 19.6°C).

During winter the temperature was predicted to range between 6.0°C and 25.9°C (average of 15.2°C). During summer the temperature was predicted to range between 15.6°C and 37.9°C (average of 23.7°C).

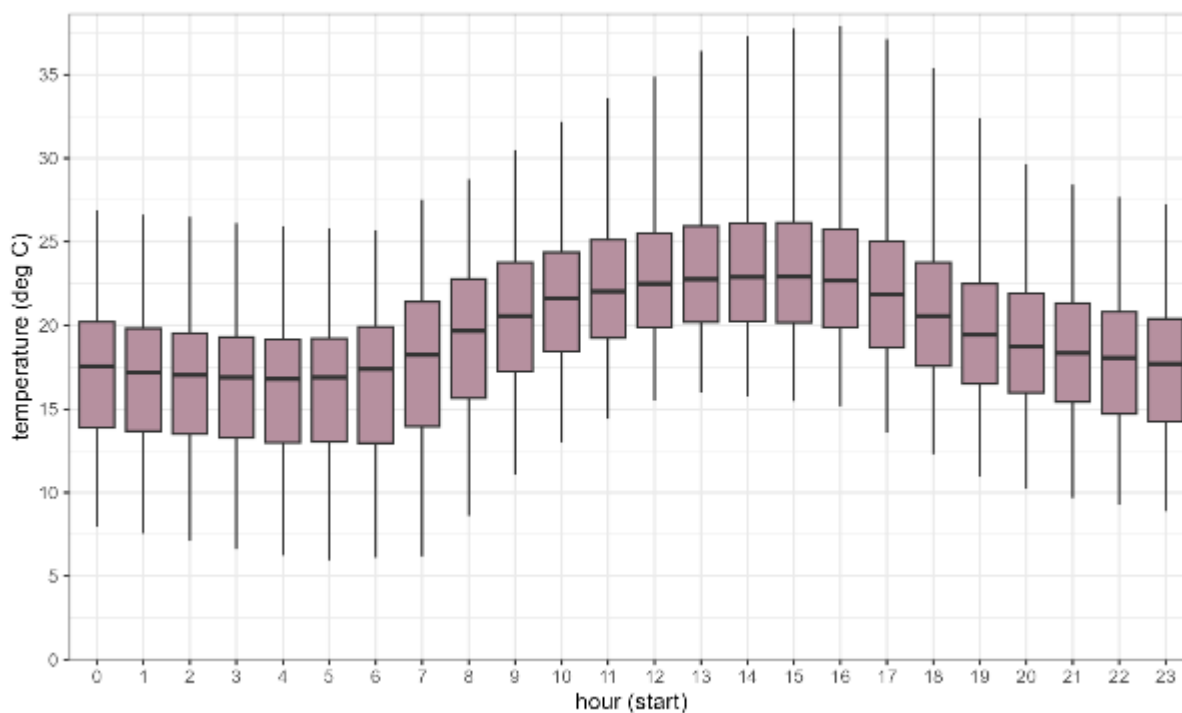


Figure A13 2018 Hourly distribution of TAPM/CALMET predicted temperature

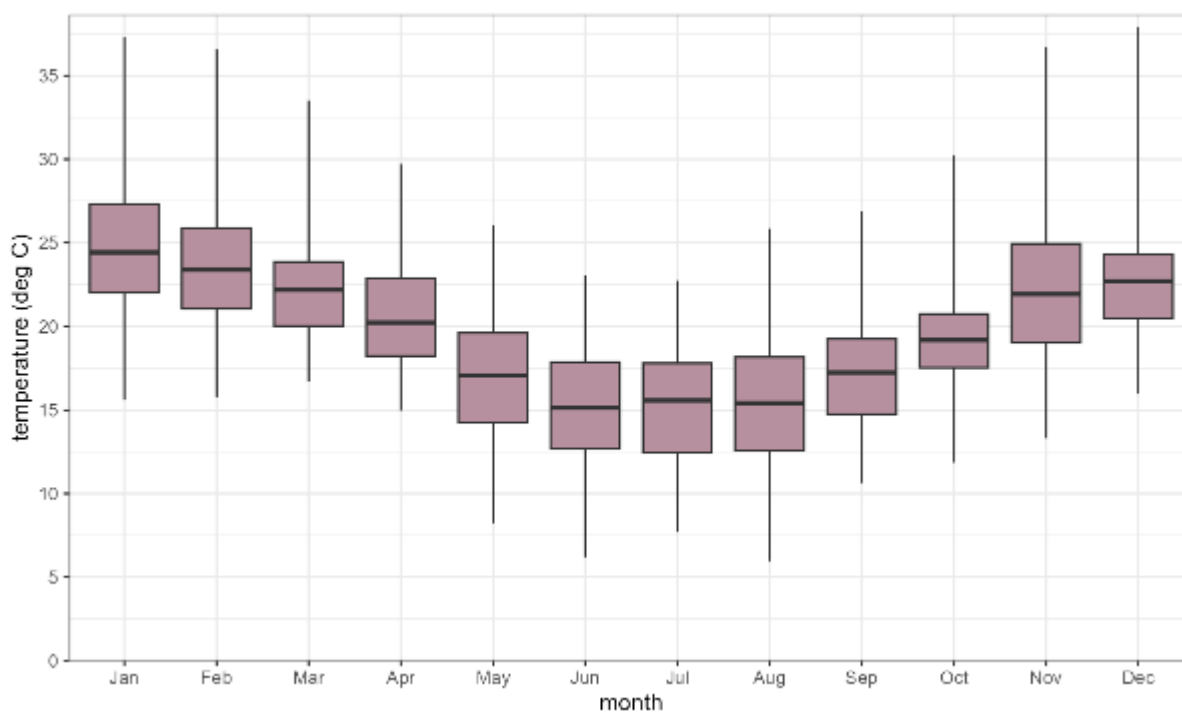


Figure A14 2018 Monthly distribution of TAPM/CALMET predicted temperature

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 affects 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 0.2km spacing, equivalent to the domain defined in CALMET
- 365 days modelled (1 January 2018 to 31 December 2018)
- 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 (Figure A15)
- Discrete receptor coordinates included in the CALPUFF model are presented in Table A3

All other options set to default.

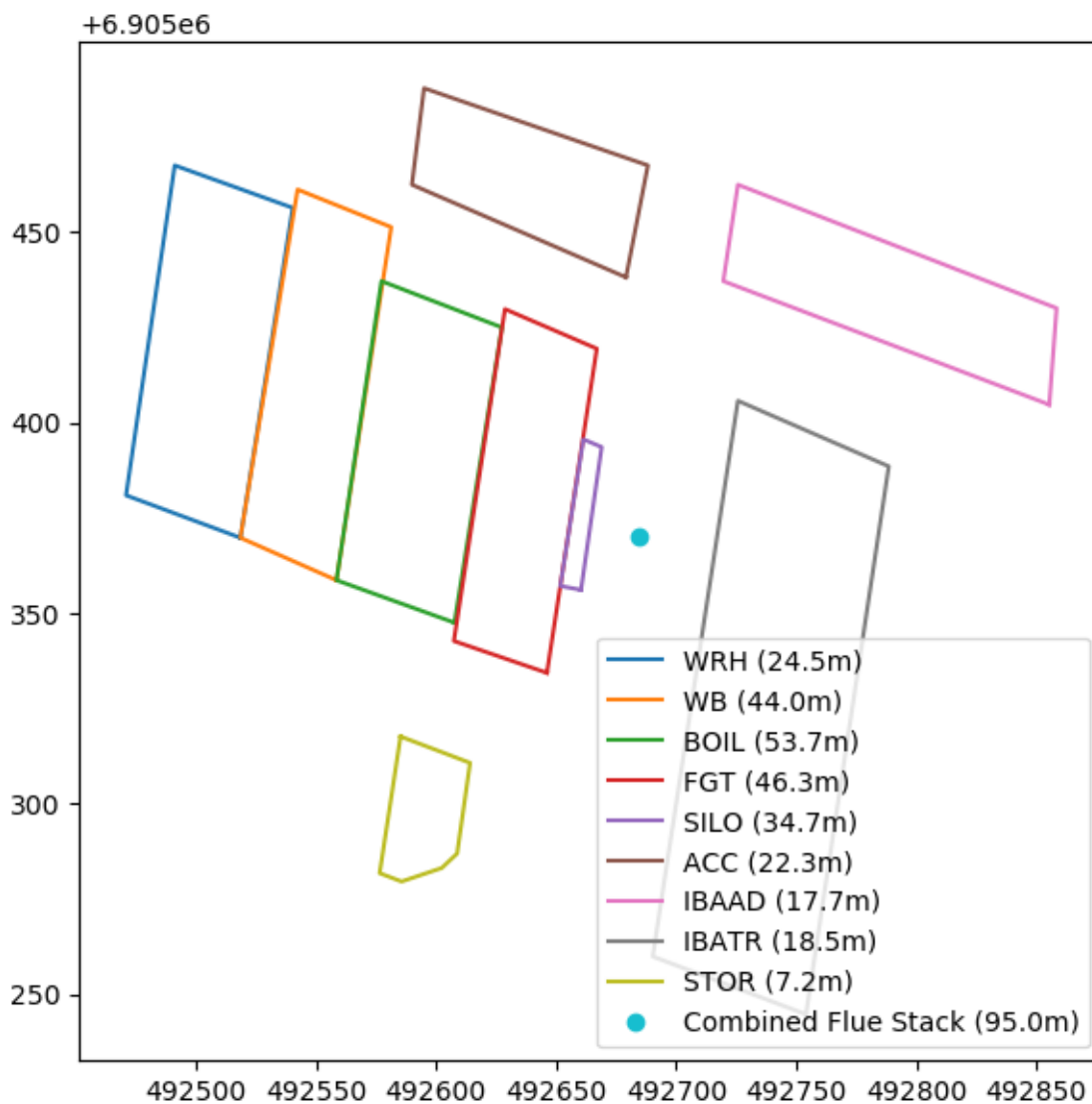


Figure A15 Project buildings included in model (UTM metres northing and easting)

Table A3 Discrete receptors included in CALPUFF

Receptor ID	Receptor Classification	X-coordinate (UTMkm)	Y-coordinate (UTMkm)	Elevation (m above ground)
SR1	Residential	494.179	6910.338	43.9
SR2	Residential	492.959	6909.878	53.8
SR3	Residential	495.318	6909.783	40.6
SR4	Residential	495.318	6909.726	41.2
SR5	Residential	494.878	6909.679	43.1
SR6	Residential	494.68	6909.383	43
SR7	Residential	494.158	6909.004	47.2
SR8	Residential	493.915	6908.413	46.2
SR9	Residential	496.959	6908.356	39
SR10	Residential	494.751	6908.332	44.1
SR11	Residential	494.672	6908.271	46.3

Receptor ID	Receptor Classification	X-coordinate (UTMkm)	Y-coordinate (UTMkm)	Elevation (m above ground)
SR12	Residential	493.891	6907.766	59.4
SR13	Residential	491.261	6907.754	56.4
SR14	Residential	494.054	6907.683	56.2
SR15	Residential	488.677	6907.606	119.2
SR16	Residential	493.576	6907.384	65.9
SR17	Residential	489.331	6907.251	78.9
SR18	Residential	496.588	6907.181	42.1
SR19	Residential	492.135	6907.033	78.8
SR20	Residential	491.041	6906.961	70.2
SR21	Residential	490.937	6906.625	69.2
SR22	Residential	496.993	6906.145	46.5
SR23	Residential	496.408	6906.042	47
SR24	Residential	496.667	6906.009	47.9
SR25	Residential	496.604	6905.984	47.7
SR26	Residential	496.672	6905.94	48.2
SR27	Residential	496.769	6905.923	48.7
SR28	Residential	497.791	6905.914	44.8
SR29	Residential	496.597	6905.904	47.9
SR30	Residential	497.422	6905.903	46.1
SR31	Residential	496.586	6905.845	47.9
SR32	Residential	496.769	6905.813	49
SR33	Residential	496.581	6905.788	47.2
SR34	Residential	497.395	6905.766	47.6
SR35	Residential	496.911	6905.759	50.4
SR36	Residential	496.987	6905.753	49.5
SR37	Residential	496.654	6905.737	47.7
SR38	Residential	497.179	6905.719	48.3
SR39	Residential	497.259	6905.7	48.6
SR40	Residential	496.723	6905.688	48.7
SR41	Residential	496.787	6905.681	49.7
SR42	Residential	496.627	6905.677	46.9
SR43	Residential	496.939	6905.664	51.1
SR44	Residential	497.215	6905.609	49.2
SR45	Residential	496.651	6905.6	47
SR46	Residential	497.091	6905.546	49.4
SR47	Residential	497.184	6905.493	49.5
SR48	Residential	497.335	6905.439	48.3
SR49	Residential	496.883	6905.407	49.1
SR50	Residential	497.251	6905.357	48
SR51	Residential	496.836	6905.353	47.6
SR52	Residential	496.95	6905.332	47.8
SR53	Residential	497.31	6905.265	46.7
SR54	Residential	497.71	6904.572	44.6

Receptor ID	Receptor Classification	X-coordinate (UTMkm)	Y-coordinate (UTMkm)	Elevation (m above ground)
SR55	Residential	497.055	6904.559	46.3
SR56	Residential	494.71	6904.274	59.3
SR57	Residential	496.441	6904.258	47.2
SR58	Residential	497.593	6903.643	46.8
SR59	Residential	495.643	6903.532	51.2
SR60	Residential	497.549	6903.425	48.6
SR61	Residential	489.604	6903.41	157.6
SR62	Residential	497.468	6903.407	49.8
SR63	Residential	497.398	6903.368	51
SR64	Residential	497.521	6903.31	49.8
SR65	Residential	497.489	6903.121	50.3
SR66	Residential	492.709	6903.091	87.7
SR67	Residential	495.379	6902.832	60.8
SR68	Residential	497.157	6902.665	50
SR69	Residential	497.393	6902.59	51.3
SR70	Residential	497.329	6902.315	51
SR71	Residential	496.753	6902.302	52.2
SR72	Residential	496.082	6902.179	51.3
SR73	Residential	497.038	6902.17	51.2
SR74	Residential	492.655	6902.125	58.9
SR75	Residential	496.501	6902.113	52.6
SR76	Residential	495.027	6902.101	54.8
SR77	Residential	492.487	6902.083	66.3
SR78	Residential	495.403	6902.078	52
SR79	Residential	495.794	6902.031	54.5
SR80	Residential	492.492	6902.01	68.6
SR81	Residential	496.854	6901.965	51.6
SR82	Residential	492.436	6901.937	71.1
SR83	Residential	492.44	6901.863	73.4
SR84	Residential	496.626	6901.857	52.3
SR85	Residential	496.559	6901.807	52.1
SR86	Residential	492.389	6901.793	76
SR87	Residential	492.277	6901.777	77.6
SR88	Residential	492.468	6901.717	74
SR89	Residential	492.388	6901.64	78.8
SR90	Residential	493.458	6901.585	62
SR91	Residential	492.263	6901.584	80.7
SR92	Residential	495.682	6901.574	56.1
SR93	Residential	492.368	6901.573	82
SR94	Residential	493.388	6901.526	64.7
SR95	Residential	492.386	6901.497	84.2
SR96	Residential	492.27	6901.475	84.7
SR97	Residential	492.406	6901.415	85.2

Receptor ID	Receptor Classification	X-coordinate (UTMkm)	Y-coordinate (UTMkm)	Elevation (m above ground)
SR98	Residential	492.266	6901.414	85.5
SR99	Residential	495.242	6901.391	57.4
SR100	Residential	492.474	6901.372	82.7
SR101	Residential	492.729	6901.277	70
SR102	Residential	492.394	6901.272	86.7
SR103	Residential	492.415	6901.215	86.2
SR104	Residential	492.655	6901.212	74.3
SR105	Residential	492.564	6901.153	80.4
SR106	Residential	495.631	6901.041	57.7
SR107	Residential	492.223	6900.952	80.7
SR108	Residential	495.767	6900.905	56.2
SR109	Residential	495.14	6900.835	56.4
SR110	Residential	495.291	6900.825	59
SR111	Residential	495.169	6900.777	56.8
SR112	Residential	495.328	6900.763	58.8
SR113	Residential	492.166	6900.287	70.6
SR114	Residential	492.033	6900.02	77.5
SR115	Residential	494.485	6899.846	67.2
SR116	Residential	492.305	6899.784	73.2
SR117	Residential	492.213	6899.711	78.7
SR118	Residential	494.25	6910.388	44.6
SR119	Residential	495.31	6909.669	42
SR120	Residential	495.306	6909.63	42
SR121	Residential	494.872	6909.397	42.8
SR122	Residential	494.546	6908.533	45.7
SR123	Residential	497.264	6908.512	40.3
SR124	Residential	497.06	6905.415	48.8
SR125	Residential	497.958	6904.385	43.4
SR126	Residential	497.934	6904.145	44.2
SR127	Residential	497.824	6904	44.6
SR128	Residential	497.851	6903.07	50.4
SR129	Residential	497.144	6903.119	51.3
SR130	Residential	497.215	6903.054	51.7
SR131	Residential	497.598	6902.814	50.4
SR132	Residential	496.4	6902.877	47.8
SR133	Residential	496.967	6902.471	51.1
SR134	Residential	496.719	6901.78	51.4
SR135	Residential	496.178	6901.888	54
SR136	Residential	496.032	6901.634	56.7
SR137	Residential	494.34	6899.755	61.8
SR138	Residential	496.469	6900.252	66.8
SR139	Residential	496.538	6900.342	65.4
SR140	Residential	496.732	6900.411	64.2

Receptor ID	Receptor Classification	X-coordinate (UTMkm)	Y-coordinate (UTMkm)	Elevation (m above ground)
SR141	Residential	497.286	6900.767	60.2
SR142	Residential	497.394	6900.989	57.7
SR143	Residential	497.563	6901.193	56.1
SR144	Residential	497.594	6901.23	55.9
SR145	Residential	497.232	6909.121	40.2
SR146	Residential	497.214	6909.249	39.8
SR147	Residential	498.072	6906.477	47.4
SR148	Commercial	493.835	6910.038	42.9
SR149	Commercial	492.719	6909.865	61.3
SR150	Commercial	493.355	6909.744	47.3
SR151	Commercial	495.815	6909.34	41.7
SR152	Commercial	493.232	6908.916	49.7
SR153	Commercial	493.281	6908.284	50.6
SR154	Commercial	493.354	6908.059	51.3
SR155	Commercial	492.365	6907.137	68.9
SR156	Commercial	495.937	6906.671	49.9
SR157	Commercial	492.845	6906.362	82.3
SR158	Commercial	492.002	6906.145	92.9
SR159	Commercial	492.714	6906.03	80.5
SR160	Commercial	497.545	6905.854	46.8
SR161	Commercial	493.168	6905.778	74.4
SR162	Commercial	497.531	6905.757	47.2
SR163	Commercial	492.621	6905.63	87
SR164	Commercial	492.78	6905.605	86.9
SR165	Commercial	496.895	6905.247	46.6
SR166	Commercial	497.26	6905.193	45.4
SR167	Commercial	497.825	6903.999	44.6
SR168	Commercial	492.82	6903.709	77.5
SR169	Commercial	496.986	6903.596	46.4
SR170	Commercial	493.845	6903.592	99.4
SR171	Commercial	492.99	6903.485	83.2
SR172	Commercial	492.545	6903.407	86.9
SR173	Commercial	493.395	6903.133	134.2
SR174	Commercial	497.075	6903.133	50.3
SR175	Commercial	497.214	6903.049	51.6
SR176	Commercial	497.307	6902.802	50.5
SR177	Commercial	496.874	6902.488	50.7
SR178	Commercial	496.208	6901.721	54.2
SR179	Commercial	494.093	6901.43	63.4
SR180	Commercial	495.812	6901.41	57.6
SR181	Commercial	496.16	6901.018	54.2
SR182	Commercial	495.113	6900.932	56
SR183	Commercial	496.001	6900.649	56.7

Receptor ID	Receptor Classification	X-coordinate (UTMkm)	Y-coordinate (UTMkm)	Elevation (m above ground)
SR184	Commercial	493.379	6900.613	76.3
SR185	Commercial	492.749	6905.658	85.9
SR186	Commercial	496.455	6900.728	58.2
SR187	Commercial	496.375	6900.629	58.9
SR188	Commercial	497.661	6907.281	44.7
SR189	Commercial	495.845	6909.577	41.2
SR190	Commercial	491.541	6908.032	55.2
SR191	On-site visitor centre	492.560	6905.450	92.0

A3 Plume visibility

The ADMS-6 model setup is summarised in Table A4. All other parameters were set to default values.

Table A4 ADMS-6 model configuration

Parameter	Units	LP1	LP2
Water vapour mixing ratio	kg/kg	0.12	0.13
Molecular mass of emissions	g/mol	28.0	27.7
Roughness length (dispersion site)	metres	0.3	0.3
Roughness length (meteorological site)	metres	0.3	0.3
Latitude (°)	degrees	-27.98	-27.98

APPENDIX B BROMELTON PROTEIN RECOVERY FACILITY

AJ Bush supplied the stack characteristics and emissions data required to undertake the cumulative dispersion modelling assessment. Stack characteristics are provided in Table B1 and emission rates are provided in Table B2.

Table B1 Bromelton Protein Recovery Facility: stack characteristics

Parameter	Value	Units	Information Source
Number of boilers	1	#	AJ Bush
Stack height	36	m	
Exhaust diameter	2.1	m	
Exhaust temperature	146	°C	
Exhaust velocity	11.8	m/s	

Table B2 Bromelton Protein Recovery Facility: emission rates

Parameter	Value	Units	Information Source
NO _x	2.38	g/s	AJ Bush - Stack test October 2023
SO ₂	4.67	g/s	AJ Bush - Stack test October 2023
CO	33.3	g/s	AJ Bush - Stack test October 2023
PM ₁₀	1.69	g/s	FY2023/2024 based on NPI data
PM _{2.5}	0.645	g/s	FY2023/2024 based on NPI data
As	0.000119	g/s	FY2023/2024 based on NPI data
Co	0.0000291	g/s	FY2023/2024 based on NPI data
Cr(III)	0.0000756	g/s	FY2023/2024 based on NPI data
Cr(VI)	0.000023	g/s	FY2023/2024 based on NPI data
Cu	0.000286	g/s	FY2023/2024 based on NPI data
Mn	0.000143	g/s	FY2023/2024 based on NPI data
Ni	0.0000815	g/s	FY2023/2024 based on NPI data

APPENDIX C DUST RISK ASSESSMENT METHODOLOGY APPENDIX

The methodology detailed in the IAQM involves the following steps:

STEP 1 is to screen the requirement for a more detailed assessment (with no further assessment required if there are no receptors within a certain distance of the works).

STEP 2 is to assess the risk of dust impacts. This is done separately for each of the four activities (demolition; earthworks; construction; and trackout) and takes account of:

- The scale and nature of the works, which determines the potential dust emission magnitude (STEP 2A)
- The sensitivity of the area (STEP 2B).

These factors are combined in STEP 2C to give the risk of dust impacts.

Risks are described in terms of there being a low, medium or high risk of dust impacts for each of the four separate potential activities. Where there are low, medium or high risks of an impact, then site-specific mitigation will be required, proportionate to the level of risk.

Based on the threshold criteria and professional judgement one or more of the groups of activities may be assigned a 'negligible' risk. Such cases could arise, for example, because the emissions magnitude is small and there are no receptors near to the activity.

STEP 3 is to determine the site-specific mitigation for each of the four potential activities in STEP 2. This will be based on the risk of dust impacts identified in STEP 2. Where a regulatory authority has issued guidance on measures to be adopted at demolition / construction sites, these should also be considered.

STEP 4 is to examine the residual effects and to determine whether these are significant.

STEP 5 is to prepare the dust assessment report.

Each of the steps is described in more detail in the following sections:

C1 STEP 1: Screen the need for a risk assessment

An assessment will normally be required where there is:

- A 'human receptor' within:
 - 250m of the boundary of the site; or
 - 50m of the route(s) used by construction vehicles on the public highway, up to 250m from the site entrance(s).
- An 'ecological receptor' within:
 - 50m of the boundary of the site; or
 - 50m of the route(s) used by construction vehicles on the public highway, up to 250m from the site entrance(s).

C2 STEP 2: Assess the risk of dust impacts

C2.1 Step 2A – Define the potential dust emission magnitude

The dust emission magnitude is based on the scale of the anticipated works as defined in Table C1.

Table C1 Magnitude of emissions by activity relevant to the Project

Magnitude of emissions	Description
Demolition	
Large	Total building volume >75,000 m ³ , potentially dusty construction material (e.g. concrete), on-site crushing and screening, demolition activities >12 m above ground level
Medium	Total building volume 12,000 m ³ – 75,000 m ³ , potentially dusty construction material, demolition activities 6-12 m above ground level
Small	Total building volume <12,000 m ³ , construction material with low potential for dust release (e.g. metal cladding or timber), demolition activities <6 m above ground, demolition during wetter months
Earthworks	
Large	Total site area >110,000 m ² , potentially dusty soil type (e.g. clay, which will be prone to suspension when dry due to small particle size), >10 heavy earth moving vehicles active at any one time, formation of bunds >6 m in height
Medium	Total site area 18,000 m ² – 110,000 m ² , moderately dusty soil type (e.g. silt), 5-10 heavy earth moving vehicles active at any one time, formation of bunds 3 m – 6 m in height
Small	Total site area <18,000 m ² , soil type with large grain size (e.g. sand), <5 heavy earth moving vehicles active at any one time, formation of bunds <3 m in height
Construction	
Large	Total building volume >75, 000 m ³ , on site concrete batching, sandblasting
Medium	Total building volume 12,000 m ³ – 75,000 m ³ , potentially dusty construction material (e.g. concrete), on site concrete batching
Small	Total building volume <12,000 m ³ , construction material with low potential for dust release (e.g. metal cladding or timber).
Trackout	
Large	>50 HDV (>3.5 t) outward movements in any one day, potentially dusty surface material (e.g. high clay content), unpaved road length >100 m
Medium	20-50 HDV (>3.5 t) outward movements in any one day, moderately dusty surface material (e.g. high clay content), unpaved road length 50 m – 100 m
Small	<20 HDV (>3.5 t) outward movements in any one day, surface material with low potential for dust release, unpaved road length <50 m
Tables notes: HDV = Heavy Duty Vehicle	

C2.2 Step 2B – Define the sensitivity of the area

The sensitivity of the area considers a number of factors:

- The specific sensitivities of receptors in the area
- The proximity and number of those receptors
- In the case of PM₁₀, the local background concentration
- Site-specific factors, such as whether there are natural shelters, such as trees, to reduce the risk of wind-blown dust.

The sensitivity of areas to the effects of dust due to soiling, human health and ecological receptors are each considered. Table C2 provides a description of the range of sensitivities associated with each of these impact categories.

Table C2 Receptor sensitivity to dust effects

Receptor sensitivity	Description
<i>Dust Soiling Effects on People and Property</i>	
High	• users can reasonably expect enjoyment of a high level of amenity; or • the appearance, aesthetics or value of their property would be diminished by soiling; and • the people or property would reasonably be expected to be present continuously, or at least regularly for extended periods, as part of the normal pattern of use of the land. • indicative examples include dwellings, museums and other culturally important collections, medium- and long-term car parks and car showrooms.
Medium	• users would expect to enjoy a reasonable level of amenity, but would not reasonably expect to enjoy the same level of amenity as in their home; or • the appearance, aesthetics or value of their property could be diminished by soiling; or • the people or property wouldn't reasonably be expected to be present here continuously or regularly for extended periods as part of the normal pattern of use of the land. • indicative examples include parks and places of work.
Low	• the enjoyment of amenity would not reasonably be expected; or • property would not reasonably be expected to be diminished in appearance, aesthetics or value by soiling; or • there is transient exposure, where the people or property would reasonably be expected to be present only for limited periods of time as part of the normal pattern of use of the land. • indicative examples include playing fields, farmland (unless commercially sensitive horticultural), footpaths, short term car parks and roads.
<i>Human health effects of PM₁₀</i>	
High	• locations where members of the public are exposed over a time period relevant to the air quality objective for PM₁₀ (in the case of the 24-hour objectives, a relevant location would be one where individuals maybe exposed for eight hours or more in a day) • indicative examples include residential properties. Hospitals, schools and residential care homes should also be considered as having equal sensitivity to residential areas for the purposes of this assessment.
Medium	• locations where the people exposed are workers, and exposure is over a time period relevant to the air quality objective for PM₁₀ (in the case of the 24-hour objectives, a relevant location would be one where individuals may be exposed for eight hours or more in a day). • indicative examples include office and shop workers but will generally not include workers occupationally exposed to PM₁₀, as protection is covered by Health and Safety at Work legislation.
Low	• locations where human exposure is transient • indicative examples include public footpaths, playing fields, parks and shopping streets.

Receptor sensitivity	Description
Ecological effects	
High	- locations with an international or national designation and the designated features may be affected by dust soiling; or - locations where there is a community of a particularly dust sensitive species
Medium	- locations where there is a particularly important plant species, where its dust sensitivity is uncertain or unknown; or - locations with a national designation where the features may be affected by dust deposition
Low	- locations with a local designation where the features may be affected by dust deposition. - indicative example is a local Nature Reserve with dust sensitive features.

Table C3, Table C4, and Table C5 show how the sensitivity of the area is determined for dust soiling, human health and ecosystem impacts, respectively. These tables take account of a number of factors which may influence the sensitivity of the area. When using these tables, it should be noted that distances are measured from the dust source, and so a different area (and therefore, different number of receptors) may be affected by trackout than by on-site works. The highest level of sensitivity from each table should be recorded.

The annual mean PM₁₀ concentrations recommended for use in the UK in the IAQM guidance have been replaced with concentrations reflective of the different Air EPP objectives.

Table C3 Sensitivity of the area to dust soiling effects on people and property

Receptor Sensitivity	Number of Receptors	Distance from the Source (m)			
		<20	<50	<100	<250
High	>100	High	High	Medium	Low
	10-100	High	Medium	Low	Low
	1-10	Medium	Low	Low	Low
Medium	>1	Medium	Low	Low	Low
Low	>1	Low	Low	Low	Low

Table C4 Sensitivity of the area to human health impacts

Receptor Sensitivity	1-year Mean PM ₁₀ concentration (µg/m ³)	Number of Receptors	Distance from the Source (m)				
			<20	<50	<100	<200	<250
High	>25	>100	High	High	High	Medium	Low
		10-100	High	High	Medium	Low	Low
		1-10	High	Medium	Low	Low	Low
	23-25	>100	High	High	Medium	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	High	Medium	Low	Low	Low
	19-23	>100	High	Medium	Low	Low	Low
		10-100	High	Medium	Low	Low	Low

Receptor Sensitivity	1-year Mean PM ₁₀ concentration (µg/m ³)	Number of Receptors	Distance from the Source (m)				
			<20	<50	<100	<200	<250
	<19	1-10	Medium	Low	Low	Low	Low
		>100	Medium	Low	Low	Low	Low
		10-100	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Medium	>25	>10	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	23-25	>10	Medium	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
	19 – 23	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
	<19	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Low	-	≥1	Low	Low	Low	Low	Low

Table C5 Sensitivity of the area to ecological impacts

Receptor Sensitivity	Distance from the Source (m)	
	<20	<50
High	High	Medium
Medium	Medium	Low
Low	Low	Low

C2.3 Step 2C – Define the Risk of Impacts

The dust emission magnitude determined at STEP 2A (Section C2.1) is combined with the sensitivity of the area determined at STEP 2B (Section C2.2) to determine the risk of impacts with no mitigation applied. The matrices in Table C6 to Table C9 provide a method of assigning the level of risk for each activity. This is used to determine the level of mitigation that must be applied. Mitigation is discussed in STEP 3 (Section C2.4). For those cases where the risk category is 'negligible', no mitigation measures beyond those required by legislation is required.

Table C6 Risk of dust impacts – demolition

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Medium Risk
Medium	High Risk	Medium Risk	Low Risk
Low	Medium Risk	Low Risk	Negligible

Table C7 Risk of dust impacts – earthworks

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

Table C8 Risk of dust impacts - construction

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

Table C9 Risk of dust impacts - trackout

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Negligible
Low	Low Risk	Low Risk	Negligible

C2.4 Step 3: Site-specific mitigation

The IAQM recommends that the dust risk categories for each of the four activities determined in STEP 2C be used to define the appropriate, site-specific, mitigation measures to be adopted.

For almost all construction activity, the IAQM guideline notes that the aim should be to prevent significant effects on receptors through the use of effective mitigation and experience shows that this is normally possible.

The IAQM guidelines include appropriate mitigation measures that could be adopted for construction activities that are determined to have low, medium and high preliminary risk of adverse air quality impacts.