KALGOORLIE THERMAL POWER PROJECT

WORKS APPROVAL APPLICATION

January 2026

Prepared for:

NORTHERN STAR RESOURCES LTD

Prepared by:

Martinick Bosch Sell Pty Ltd
ABN: 60 102 614 478
4 Cook Street
West Perth WA 6005
Phone: (08) 9226 3166
Email: info@mbsenvironmental.com.au
Web: www.mbsenvironmental.com.au

MBS ENVIRONMENTAL

KALGOORLIE THERMAL POWER PROJECT

WORKS APPROVAL APPLICATION

Distribution List

Company	Contact Name	Date
Northern Star (EGP) Pty Ltd	Cliff Bennison	9/01/2026

Document Control for Job Number: ZEKCGMAA

Document Status	Prepared By	Authorised By	Date
Draft Report	Elodie Payet	Kristy Sell	8/07/2025
Draft Report	Orla Tone	Kristy Sell	4/12/2025
Final Report	Orla Tone	Kristy Sell	9/01/2026

CONTENTS

TABLES

FIGURES

CHARTS

APPENDICES

APPENDIX A : PROOF OF OCCUPIER STATUS AND ASIC COMPANY EXTRACT

APPENDIX B : DESIGN DRAWINGS

APPENDIX C : STAKEHOLDER ENGAGEMENT REGISTER (CONFIDENTIAL)

APPENDIX D : AIR QUALITY ASSESSMENT

APPENDIX E : ENVIRONMENTAL ACCOUSTIC ASSESSMENT

APPENDIX F : SURFACE WATER ASSESSMENT

APPENDIX G : HERITAGE SITES (CONFIDENTAL)

1. Introduction

1.1 Background

Northern Star EGP Pty Ltd (Northern Star) and Zenith Energy are working to develop additional power supply sources in Kalgoorlie in Western Australia to supply power to Northern Star's mining operations.

Northern Star has a 50% share of the existing Parkeston Power Station (Parkeston). Northern Star is proposing to construct and operate a new thermal power station to provide a long-term, reliable and lower emissions electricity supply to Kalgoorlie Consolidated Gold Mines. Following implementation of the Proposal, the existing Parkeston power station will continue to operate and be available to provide emergency backup power to the South West Interconnected System (SWIS) and Wholesale Electricity Market (WEM). The new Kalgoorlie thermal power station is anticipated to be more efficient and have lower emissions than the current Parkeston power station.

The Project will require installation of a new substation, additional transmission lines and a lateral gas pipeline from the Eastern Goldfields gas pipeline. A 132kV line to the SWIS will enable the power station to continue to have power during maintenance shutdowns.

Construction and operation of the new facility would be targeted at providing power supply for KCGM by late 2027 to match scheduled completion of the Fimiston Gold plant expansion at KCGM. Thermal power is anticipated to provide the full KCGM power needs for a period of 12–24 months with decreasing reliance over time as other alternative energy supply options are assessed and ultimately constructed and become available.

The new Power Station will be situated on Yarri Road on Lot 94, Williamstown, approximately 0.5 km north of the Aboriginal Community of Ninga Mia, 2.4 km west of Williamstown and 1.8 km east of the Kalgoorlie township (Figure 1).

1.2 Purpose

This Works Approval application seeks approval for construction and commissioning of the proposed natural gas fuelled power station (Attachment 2: Premise Maps - Figure 2). This also includes construction of a diesel storage facility with capacity of 1,000,000 L noting that diesel will be used infrequently for black startup actions and also as a backup/contingency in case the natural gas supply is unavailable.

Information presented in this document aims to assist DWER in assessing the adequacy of the proposed pollution prevention and control measures to ensure adverse environmental impacts are prevented or minimised to levels where appropriate environmental standards can be compiled with.

1.3 Structure of Submission

This application is structured into eight sections as follows:

- Section 1 provides an introduction to the Thermal Power Project, including background details, the purpose of the application and proposed prescribed premise categories.

- Section 1.9 addresses the requirements of Attachment 1A and 1B of the DWER application form and includes Proof of Ownership and AISC Company Extract.
- Section 2 addresses the requirements of Attachment 2 of the DWER application form and includes premises maps that are relevant to the application.
- Section 3 addresses the requirements of Attachment 3B of the DWER application form and summarises the proposed activities, including key characteristics, design specifications and timeline for developments.
- Section 4 addresses the requirements of Attachment 5 of the DWER application form and provides a list of key stakeholders for the Project.
- Section 5 addresses the requirements of Attachment 6A of the DWER application form, describing the potential emissions or discharges arising from the proposed activities.
- Section 6 address the requirements of Attachment 6B of the DWER application form describing Commissioning of the Power Station.
- Section 7 addresses the requirements of Attachment 7 of the DWER application form, describing pollution control measures as they apply to discharges to land, water, air, and noise emissions to reduce adverse environmental impacts.
- Section 8 addresses the requirements of Attachment 10 of the DWER application form and outlines the fee calculation for the Project.

1.4 Prescribed Premise and Categories

Specific infrastructure and activities proposed for the Thermal Power Project are classified as Prescribed Premises under Schedule 1 of the *Environmental Protection Regulations* (Australian Government, 1987).

This Works Approval application for prescribed activities (premises) is listed in Table 1. A proposed prescribed premise boundary and proposed layout for the power station facility is provided in Attachment 2: Premise Maps and Figure 2.

Table 1: Proposed Project Prescribed Premise Categories

Category No.	Category Description	Prescribed Premise Threshold	Infrastructure
52	Electric power generation: premises (other than premises within category 53 or an emergency or standby power generating plant) on which electrical power is generated using a fuel.	20 MW or more in aggregate (using natural gas)	Power Station
73	Bulk storage of chemicals etc.: premises on which acids, alkalis or chemicals that: • contain at least one carbon to carbon bond; and • are liquid at standard temperature and pressure).	1,000 m^3 in aggregate	Diesel Storage Tank

1.5 Tenure

The Project is located on mining tenements M26/261 and M26/495, held by Northen Star (KLV) Pty Ltd and Northern Star (Saracen Kalgoorlie) Pty Ltd. Tenement details are provided in Table 2.

Table 2: Tenement Details

Tenement	Area(ha)	Grant Date	Expiry Date
M26/261	332.7	17/12/1990	16/12/2032
M26/495	774.9	06/10/2009	05/10/2030

1.6 Licensee Information

The proponent of the Project is Northern Star (EGP) Pty Ltd.

All compliance and regulatory requirements regarding this assessment document should be forwarded by email, post or courier to the proponent as detailed in Table 3.

Table 3: Proponent and Key Contact Details

Proponent	
Name	Northern Star (EGP) Pty Ltd
Address	Level 4, 500 Hay St, Subiaco WA 6008
ABN/ACN	ABN: 46 655 582 415
Proponent and Application Key Contact	
Name	[redacted]
Company	Northern Star
Position	Environment Manager - Approvals
Phone	[redacted]
Email	[redacted]

1.7 Timeline for Development

Subject to all approvals for the Project being received, construction is scheduled to commence in Q2 2026 and operations in Q4 2027. The proposed schedule for the Project is outlined in Table 4

Table 4: Proposed Schedule for the Project

Project Milestone	Schedule
Construction Commence	Q2 2026
Construction Complete	Q2 2027
Commissioning Commence	Q2 2027
Commissioning Complete	Q3 2027
Operations	Q4 2027

1.8 Other Approvals

The Project requires a number of other approvals prior to construction and commissioning. These are summarised in Table 5.

Table 5: Other Approval Requirements for the Project

Approval	Component	Purpose	Status
Part IV EP Act Referral	Power Station, Sub Station, Gas Pipeline and Transmission Lines	• Construction and operation of the power station for supply of power to KCGM operations.	Referral submitted December 2025. Under Assessment by EPA.
Mining Development and Closure Proposal	Black Street Substation	• Construction and operation of the substation.	Approved (AS-01079)
	Power Station and transmission lines	• Construction and operation of the power station and transmission line between power station and sub station.	To be submitted Q4 2025
	Gas Pipeline	• Construction and operation of gas pipeline.	To be submitted Q1 2026
Environmental Licence	Power Station	Categories: • 52 – Electric Power generation >20 MW • 73 – Chemical Storage >1,000 m^3	Future application

1.9 Attachment 1A and 1B: Proof of Occupier Status and ASIC Company Extract

Proof of Occupier Status (Attachment 1A) and an ASIC company extract (Attachment 1B) are provided in Appendix A.

2. Attachment 2: Premise Maps

The Project location is shown in Figure 1.

The proposed Prescribed Premises boundary, tenements within the Prescribed Premises and conceptual footprint of project components within the Prescribed Premise Boundary (PPB) is provided in Figure 2.

The layout and design of the Power Station and Diesel Storage are shown in Figure 3.

Scale: 1: 150,000
Original Size: A4
Grid: GDA2020 / MGA zone 51
(EPSG:7851)
0 2.5 5 km

Legend
State Road
Local Road

Figure 1

Project Location

MBS ENVIRONMENTAL

W:\Zenith Energy\GIS\Zenith Energy_Location_2025.qgz 17/12/2025 F1 Project Location

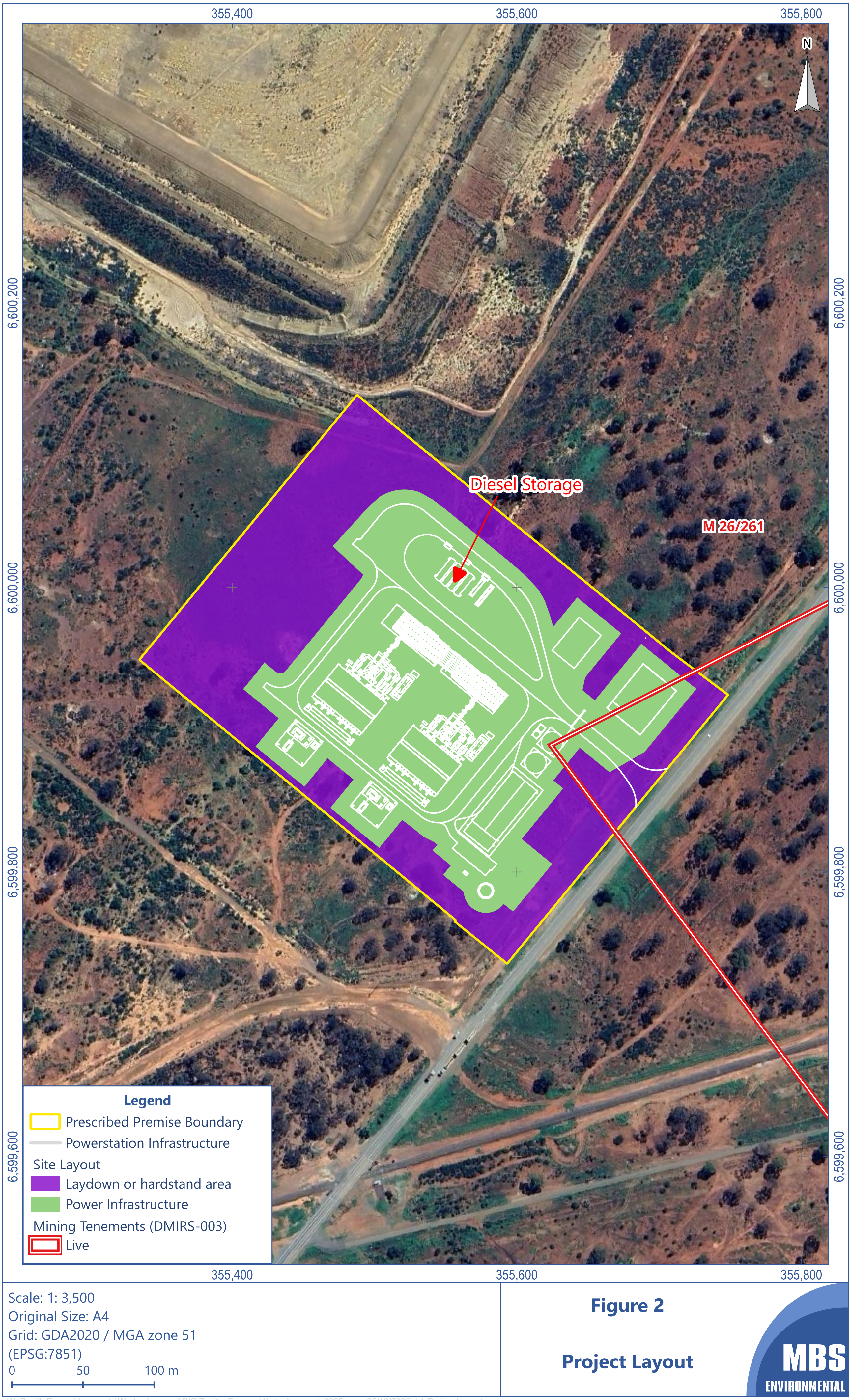
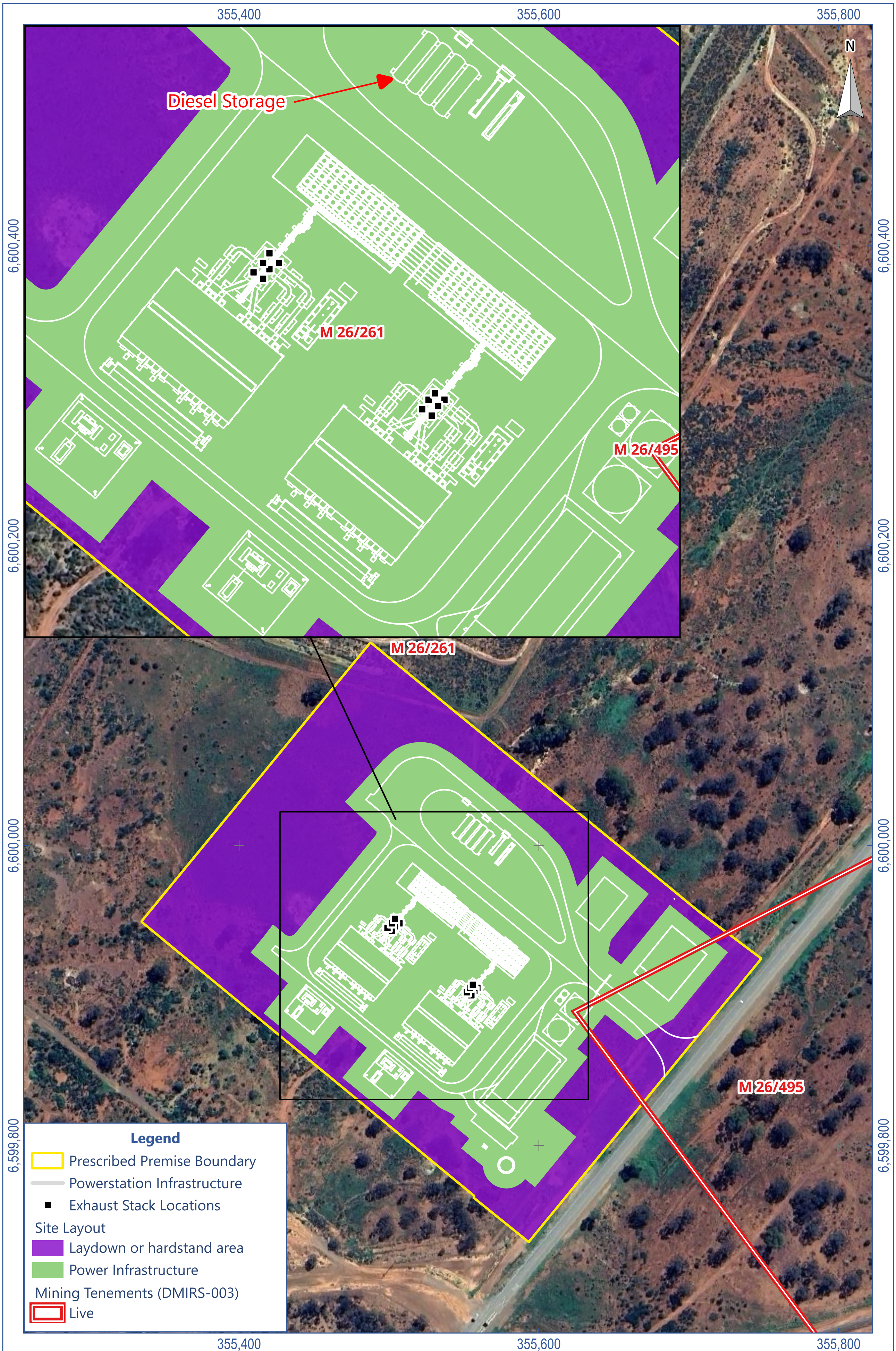


Figure 2

Project Layout

W:\Zenith Energy\Approvals\Works Approval\GIS\Zenith_Energy_WorksApproval_2025.qgz 05/12/2025 L1 Project Layout



Scale: 1: 3,500
Original Size: A4
Grid: GDA2020 / MGA zone 51
(EPSG:7851)
0 50 100 m

Figure 3

Power Plant Design

MBS ENVIRONMENTAL

W:\Zenith Energy\Approvals\Works Approval\GIS\Zenith_Energy_WorksApproval_2025.qgz 17/12/2025 L2 Power Plant Design

3. Attachment 3B: Project Activities

Infrastructure subject to Schedule 1 of the Environmental Protection Regulations (Australian Government, 1987) include:

- Power Station - Category 52.
- Diesel Storage Tank - Category 73.

3.1 Category 52: Power Station

3.1.1 Key Characteristics

The proposed power station will consist of two fully enclosed engine halls each housing six Wartsila engines. The individual engine exhaust stacks are to be 30 m high with a separation distance of about 68 m for each stack cluster. Three cooling radiator systems comprising of three fans are required for each engine. Charge air intakes are required for each engine as well as passive ventilation intakes and outlets. Insulated exhaust gas ducting will be fitted from the engine hall to the stacks.

Key Characteristics of the power station are provided in Table 6.

Table 6: Power Station Key Characteristics

Characteristic	Description
Tenement Holder	Northern Star (EGP) Pty Ltd
Life of Project	Approximately 25 years
Project Operational Time	24 hours per day, 7 days a week, 365 days per year
Quantity	12 x 12-MW reciprocating gas / diesel engine generators
Output	Buried transmission lines to distribute 132 kV power
Generation Capacity	144 MW
Fuel Consumption	Approximately 10,621 TJ p/a at 141 MW Electrical Output

The power station will be connected via a purpose built 700 m gas pipeline to the existing Parkeston gas lateral pipeline. The additional gas pipeline is not included within this application as it is not a prescribed activity under Schedule 1 of the EP Regulations.

Power will be supplied to site transformers within the power station and power lines will be installed to distribute 132 kV power to a substation to be constructed at Black Street. Transmission lines from the power station to the substation are planned to be buried and will typically align with roads and established pipeline corridors to minimise additional vegetation disturbance.

The new generators will be managed through dedicated power station control system.

3.1.2 Engine Hall and Stack Design

The engines will be housed in a purpose-built building. The elevation of the building pad will be sufficient to prevent ingress of water with site drainage design to consider protection of bunds and sumps a priority, with the general level of concrete foundations 100 mm above ground level to prevent any flood water that maybe present entering the building/bund/culvert area. Acoustic air inlet louvres will be utilised to minimise noise transfer from power generation activities.

The building and genset foundations will be constructed of concrete with the building floor area drained to a 150 mm wide culvert running the full length of the building. The building has been designed to ensure all hydrocarbon spills and contaminated water are contained within the building area and directed through to a spill containment pit.

Gas generator exhaust will be directed to individual stacks within the prescribed premises boundary. Exhaust stack location details are provided in Table 7 and are shown in Attachment 2: Premise Maps Figure 3. These reflect location of six stacks in each of the two engine halls.

Table 7: Power Station Exhaust Location Details (GDA2020 Zone 51)

Engine Hall & Stack No.	Easting (m)	Northing (m)
1-1	355,559	6,599,905
1-2	355,557	6,599,903
1-3	355,555	6,599,900
1-4	355,552	6,599,902
1-5	355,554	6,599,905
1-6	355,556	6,599,907
2-1	355,507	6,599,948
2-2	355,504	6,599,946
2-3	355,502	6,599,943
2-4	355,499	6,599,945
2-5	355,502	6,599,948
2-6	355,504	6,599,951

Drawings for the power hall and associated facilities are provided in Appendix B.

3.2 Category 73: Diesel Storage

Fuel on site and the type of fuel storage infrastructure and location are shown in Table 8.

Table 8: Proposed Hydrocarbon Storage Facilities

Fuel Type	Use	Storage Volume (L)
Lube Oil	Equipment and maintenance purposes	50,000
Waste Oil	Storage before offsite disposal	28,000
Diesel Fuel	Equipment and LV service vehicle use	1,000,000

Fuel and oil will be delivered to site in oil tankers and stored in purpose-built self-bunded storage tanks. The bowsers and oil delivery inlets will be situated on concrete pads to contain any drips and spills and will have a sump to collect rainwater and any fuel spillage. The liquid will be transferred to an oil/water separator. Bunds and other spill containment structures will be designed to contain 110% of the largest hydrocarbon storage tank located within the containment area.

Fuels and other petroleum products will be stored in a designated fuel storage area in accordance with:

- DEMIRS's "Storage and Handling of Dangerous Goods Code of Practice".
- Australian Standards AS1940, AS1692, AS3780 and AS4452.

A materials inventory (register), including annual consumption figures and stored quantity, will be prepared and maintained.

Waste oils produced on site will be collected and removed from site for recycling or reuse in accordance with Environmental Protection (Controlled Waste) Regulations 2004.

No new fuel facilities will be installed to supply construction needs for the power station. Fuel will be sourced from existing fuel facilities either at KCGM or other existing facilities within the City of Kalgoorlie Boulder.

All equipment that has the potential for hydrocarbon leaks will be contained using bunds or culverts to eliminate the potential of contamination to the surrounding soil. Containment measures will include:

- The small enclosed black-start diesel generators will be installed a on concrete pad (no bund containment is required as the generator enclosures are self-bunded).
- Lube and waste oil bund will be constructed of concrete and designed in accordance with AS1940. The bund will drain directly into the containment pit.
- 3 m x 3 m concrete drip pad will be installed at the tanker loading/unloading area to contain any oil drips when coupling hoses to delivery trucks.
- The transformer will be separately bunded with a concrete structure designed in accordance with AS1940 and AS2067.
- A containment pit will be constructed of concrete with dimensions of approximately 2 m x 1 m x 1 m deep (~2,000-L capacity).

- An oily water separator will be installed on top of the containment pit to ensure all spills that may occur at the separator are contained.
- Fluids from the power station containment pit will be pumped through the power station oily water separator with the treated water then pumped to the main oily water facility on site.

Drawings for the bulk hydrocarbon storages are provided in Appendix B.

4. Attachment 5: Consultation

Northern Star strives to engage early, openly, honestly, and regularly with communities potentially impacted by the Company's operations and consider their views in their decision-making with respect to key planning, operational and closure aspects.

Northern Star's approach to Stakeholder Engagement is informed by the Company's Stakeholder Mapping and Engagement Global Standard (NSR-ER-002-STA). This outlines Northern Star's methodology for stakeholder identification, prioritisation and the impact and influence of each stakeholder.

Stakeholder engagement for this Project has been undertaken through an inclusive and transparent process, ensuring meaningful involvement of all relevant stakeholders. These activities form part of a broader consultation program supporting Northern Star Resources' regional growth initiatives (e.g. underground development, renewable energy projects, mill expansion etc.), and reflect the company's commitment to fostering long-term, trust-based relationships with stakeholders.

4.1 Stakeholder Engagement

Table 9 summarises the stakeholders identified with relevance to the power station and their key interests associated with the Project.

Table 9: Key Stakeholders for the Thermal Power Station, Sub Station and Transmissions Lines

Stakeholder Sector	Organisation	Interest
State Government Departments	Department of Planning, Lands and Heritage (DPLH)	• Indigenous requirements. • Heritage, cultural, ethnographic and archaeological sites.
	Department of Mines, Petroleum and Exploration (DMPE)	• Compliance with Mining Act and Tenement conditions. • Conformance with Mining Development and Closure Proposals and MCP. • Relinquishment of tenements. • Mining rehabilitation fund. • Rehabilitation standards and closure criteria.
	Department of Water and Environmental Regulation (DWER)	• Administers *EP Act*. • Administers Part V (*EP Act*), Industry Regulation and Licensing and *Contaminated Sites Act 2003*.
	Department of Fire and Emergency Services (DFES)	• Fire breaks. • Provision of emergency services.
	Department of Biodiversity, Conservation and Attractions (DBCA)	• Flora, fauna and habitat conservation. • Baseline surveys and licences to take flora and fauna.

Stakeholder Sector	Organisation	Interest
Local Government Authorities	City of Kalgoorlie-Boulder (CKB)	• Use of public roads. • Community amenity.
Indigenous Groups	Traditional Owners: • Marlinyu Ghoorlie (MG)	• Access to and use of Traditional Owner land. • Cultural heritage values. • Working conditions and artefact salvage, if necessary.
Asset Owners	Weld Pastoral Company Pty Ltd	• Land occupation agreement.
Local Residents	• Williamstown • Ninga Mia	• Residents.

4.2 Key Issues

Stakeholder engagement commenced in May 2025 with a focus on Ninga Mia and Williamstown communities. Engagement included both the thermal power generation, renewable power generation and power transmission line plans.

The key issues for stakeholders relating to the Project are summarised and presented in Table 10.

Table 10: Key Stakeholder Issues for the Project

Stakeholder	Key Issue	Response
Marlinyu Ghoorlie Native Title Claim Group	Marlinyu Ghoorlie representatives expressed a desire to learn more about procurement and contracting opportunities available through the broader Kalgoorlie Regional Renewable Energy (KRRE) Project.	• Marlinyu Ghoorlie Business Development Manager connected with Zenith Energy to discuss opportunities directly in May 2025. • Annual briefing meeting with Northern Star and claimants held in June 2026. • Committed to continued engagement with Claimants as project progresses including development of a CHMP. • Site avoidance survey conducted with claimants in November 2025.
	Protection of Aboriginal cultural heritage.	• All identified heritage sites will be avoided, with no disturbance, through construction and operation of the Black Street substation. • Northern Star to continue engagement with Marlinyu Ghoorlie as the project progresses.
Williamstown Residents	Workforce requirements and the demand for dedicated workforce accommodation.	Maps provided on potential locations for proposed workforce accommodation option at the Yarri Rd Core Yard to support future projects.
City of Kalgoorlie Boulder (CKB)	Workforce requirements for cumulative growth projects.	Ongoing discussions with CKB regarding suitable options for workforce accommodation.
	Positive response to potential back up supply to the Western Power grid; following reduced reliance from KCGM on the South West Interconnected System.	Northern Star to highlight this benefit to the community at the next scheduled 'Town Hall' information session.
	Interaction of transmission lines with CKB owned and managed roads.	Requirements for approvals for disturbance and construction provided by City. More information

		to be provided to the City by NSR as designs are progressed to allow receipt of approvals in approriate timeframes.
Kalgoorlie Boulder Chamber of Commerce	Positive response to move towards development of self-sustaining energy supply to meet demands of industry & CKB.	NSR to provide project updates as the project commences.
Kalgoorlie Boulder Community	Positive response to the move towards development of self-sustaining energy supply to meet demands of industry & CKB. Increase in workforce demand and impacts on infrastructure. Procurement opportunities.	NSR to provide quarterly project updates as the project commences.
Western Power	Interface with existing power network infrastructure.	Project established within Western Power systems to allow guidance to be provided to NSR. Noted requested works are common activities for Western Power.

4.3 Stakeholder Engagement Register

A full stakeholder consultation register is provided in Appendix C.

5. Attachment 6A: Emissions and Discharges

5.1 Emissions to Air

Generation of thermal power using natural gas and diesel will result in the generation of gaseous emissions. Gaseous emissions generated during operations have the potential to affect environmental and human health values.

MRP Technical Consultants were engaged to undertake an air quality assessment for the power station. This included input into project design to ensure compliance with relevant standards at sensitive receptors. A copy of the assessment report is provided as Appendix D and has been used to inform this section.

5.1.1 Sources

Gaseous emissions and dust generated during construction of the power station has the potential to affect environmental values. The Project has potential to impact air quality through the generation of dust via diffuse emissions including:

- Access roads and construction activities.
- Material handling and transport activities.
- Vehicle movements on unsealed roads.

The Project has the potential to impact air quality through generation of greenhouse gas emissions including carbon monoxide, carbon dioxide, sulfur dioxide and nitrous oxides via:

- Engine exhausts from construction equipment, mining equipment and light vehicles.
- The use of diesel fuel for black start during operations.
- The use of natural gas for power generation.
- Transport of materials to the project area and removal of packaging wastes during construction.

5.1.2 Potential Impacts

The potential impacts from gaseous emissions, dust, particulates and odour as a result of Project implementation are:

- A decrease in human and fauna health through inhalation.
- Poor aesthetics within and outside of the project area.
- A decrease in vegetation health and condition in adjacent areas due to dust covering vegetation, blocking stomata and reducing the plant's ability to photosynthesise.
- Reduction in local air quality from an increase in greenhouse gas emissions and particulates due to power generation and use.

- Reduction in local air quality from an increase in mobile equipment emissions from engine exhausts including particulates, carbon monoxide, carbon dioxide, sulfur dioxide and nitrous oxides.

The proposed emissions are typical of gas-fired power station operations in Western Australia.

The primary emissions anticipated from the power station are expected to be Oxides of nitrogen (NOx), particulate matter (expressed as $PM_{2.5}$), sulphur dioxide (SO_2), carbon monoxide (CO) and formaldehyde (CH_2O).

5.1.3 Air Quality Criteria

Table 11 displays the air quality standards for the pollutants relevant to the Project.

Table 11: Relevant Air Quality Criteria

Compound	Averaging Period	Concentration (µg/m³)[1]	Source
NO_2	1-hour	151	(NEPC, 2021)
	Annual	28	
$PM_{2.5}$	24-hour	18	(NEPC, 2021)
	Annual	6.4	
SO_2	1-hour	196	(NEPC, 2021)
	24-hour	52	
	Annual	52	(DWER, 2019)
CO	1-hour	30,000	(DWER, 2019)
	8-hour	10,000	(NEPC, 2021)
CH_2O	1-hour	20	(DWER, 2019)
	24-hour[2]	49	(NEPC, 2011)

1. *Referenced to 25°C, and 101.3 kPa*
2. *This is a monitoring investigation level. As defined in the NEPM (AT) (NEPC, 2011), monitoring investigation levels are established for use in assessing the significance of the monitored levels of air toxics with respect to protection of human health. If the monitoring investigation level is exceeded, then some form of further investigation by the relevant jurisdiction of the cause of the exceedance is appropriate.*

5.1.4 Receptors

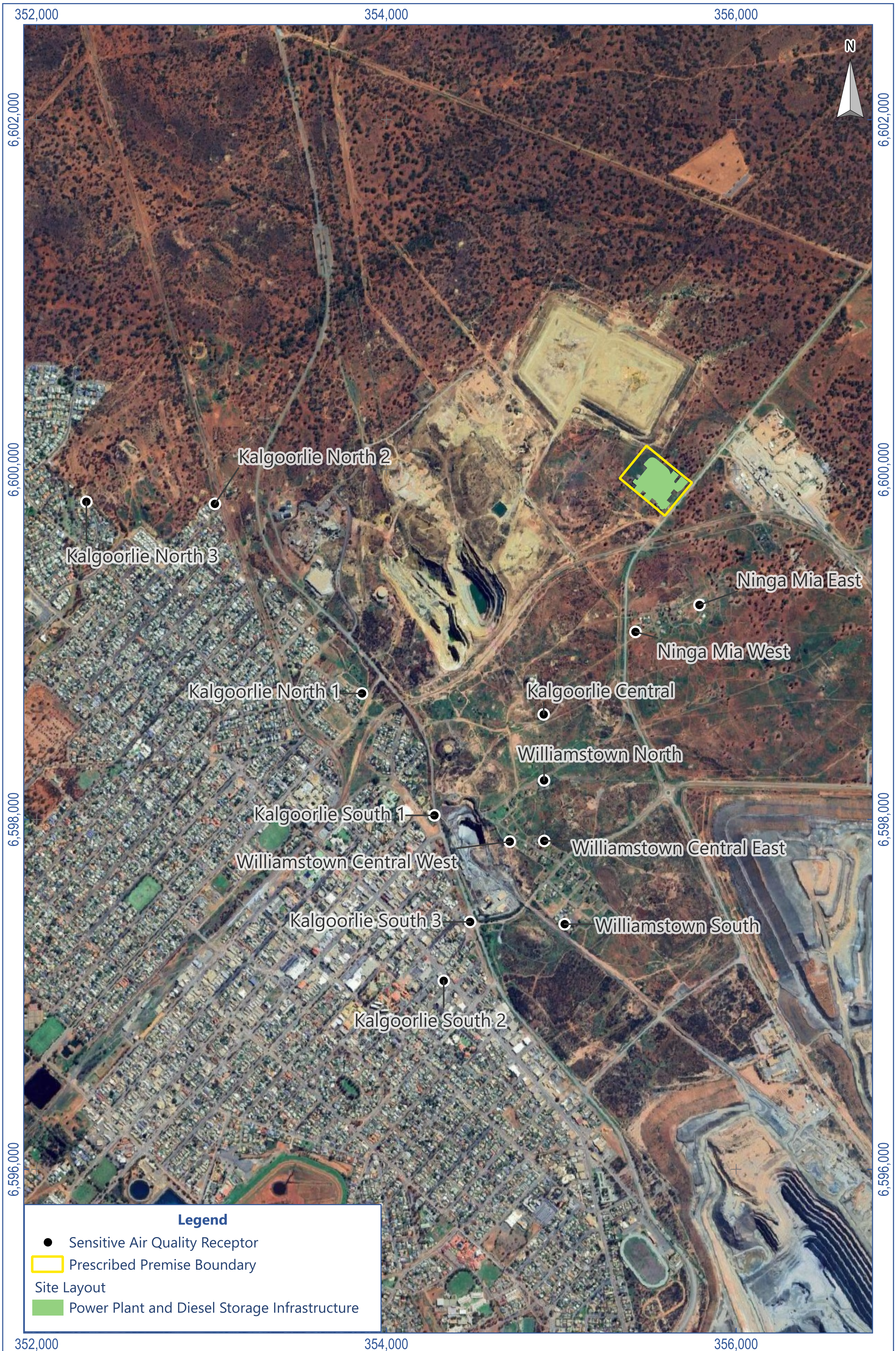
The closest air quality receptors to the Power Station are:

- Various residences within the Kalgoorlie township located about 2 km west-northwest and southwest of the power station, with the Kalgoorlie Regional Hospital approximately 2.4 km west.
- Residences within the Aboriginal community of Ninga Mia located approximately 0.5 km south of the power station.
- Residences within the Williamstown township located about 1.8 km south and southwest of the power station.

The nominated sensitive receptors used for the air quality assessment are detailed in Table 12 and are shown in Figure 4.

Table 12: Sensitive Air Quality Receptor Locations

Receptor	Easting (GDA2020 Zone 51) (m)	Northing (GDA2020 Zone 51) (m)	Distance to Power Station (km)
Ninga Mia East	355,791	6,599,225	0.7
Ninga Mia West	355,425	6,599,071	0.8
Kalgoorlie North 3	352,284	6,599,815	3.3
Kalgoorlie North 2	353,019	6,599,803	2.5
Kalgoorlie North 1	353,861	6,598,719	2.1
Kalgoorlie Central	354,090	6,598,599	2.0
Kalgoorlie South 1	354,275	6,598,022	2.3
Kalgoorlie South 2	354,328	6,597,706	2.5
Kalgoorlie South 3	354,479	6,597,413	2.7
Williamstown North	354,902	6,598,222	1.8
Williamstown Central East	354,903	6,597,876	2.1
Williamstown Central West	354,706	6,597,872	2.2
Williamstown South	355,020	6,597,400	2.6



Scale: 1: 30,000
Original Size: A4
Grid: GDA2020 / MGA zone 51
(EPSG:7851)
0 500 1000 m

Figure 4

Sensitive Air Quality Receptors of the Project

MBS ENVIRONMENTAL

5.1.5 Emissions Estimates

5.1.5.1 Air Quality Impact Assessment Results - Operations

Air dispersion modelling was conducted to assess the proposed emissions under four operating scenarios in relation to nearby sensitive receptors. The Calpuff model considered emissions from 12 engines, each with a stack of 30 m height with six engines located in each engine hall, with the engine halls being separated by a distance of about 40 m.

The power station is typically expected to operate in gas mode and only operate in diesel liquid fuel (LFO) mode when in the event that natural gas is unavailable. The four scenarios are documented in the assessment report and included operation in both gas mode and LFO mode with emissions just from the power station (i.e. in isolation) and cumulative impacts considering existing background concentrations. Operation in gas mode is considered to be the "normal" operating condition. Diesel is anticipated to be used for "black start" of engines and in the event of gas supply interruption. Operational review of the existing Parkeston power station found that diesel had not been used in the last 10 years (MRP, 2025).

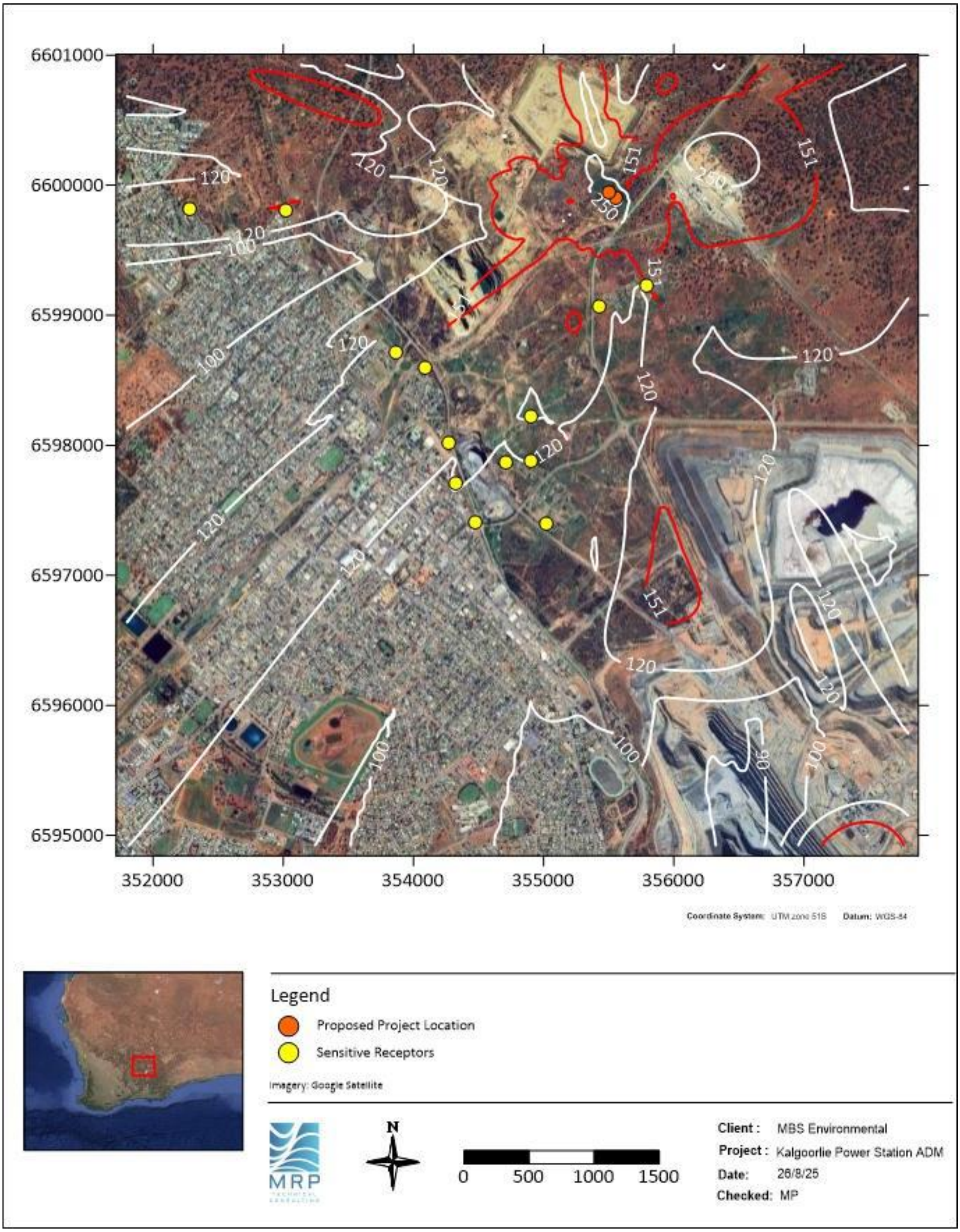
The modelling did not predict exceedances of $PM_{2.5}$, SO_2, CO or CH_2O at any of the sensitive receptor locations for any scenario or averaging period.

Exceedances of the cumulative 1-hour average ambient air quality criterion for NO_2 were predicted at two nearby sensitive receptors (Ninga Mia East and Kalgoorlie North 2) for operations in the LFO mode (i.e Scenario 4), however no exceedances were predicted for gas mode when considered cumulatively with background concentrations. This is shown in Figure 5.

The predicted values at the receptors were 104% and 100% of the 1-hour ambient guideline values (AGV). When considered in isolation (i.e. Scenario #3), no exceedance was predicted for the 1-hour criterion for NO_2. It is noted that the magnitude and the frequency of predicted exceedances of the 1-hour AGV for NO_2 (assuming continuous operations in LFO mode) is low. The power station is not expected to operate in LFO mode unless natural gas is unavailable. The probability that potential worst case meteorological conditions would occur during instances where the power station may be required to operate in LFO mode is low. The risk to human health at nearby receptors associated with the proposed operational profile of the power station in LFO mode is considered low.

Scenarios #3 and #4 when exceedances were modelled are considered representative of startup and shutdown conditions and are expected to occur infrequently and for short durations.

Figure 5: Predicted Cumulative 1-hour Maximum Ground level Concentrations of NO_2 in LFO Mode



5.1.5.2 Dust During Construction

During construction, dust emissions from land clearing, construction of foundations and trenching for transmission lines and the gas pipeline have potential to impact nearby sensitive receptors. A range of mitigation measures will be applied, including minimising clearing wherever practicable, implementing dust suppression using water carts, applying speed restrictions on unsealed roads, and ceasing dust-generating activities if noticeable impacts occur.

Impacts to air quality as a result of construction activities will be localised and only persist for a short period of time. The proposed measures to minimise PM_{10} and $PM_{2.5}$ emissions are consistent with industry standards and will minimise emissions to as low as reasonably practicable.

5.1.5.3 Greenhouse Gas Emissions

The Project has been referred to the EPA to determine if assessment under Part IV of the EP Act is required. Northern Star Resources Ltd is a registered controlling corporation under the *National Greenhouse and Energy Reporting Act 2007* (NGER Act) and already reports emissions and energy for its operations under the NGER Scheme. For the purposes of NGER and any Safeguard obligations:

- Northern Star (EGP) Pty Ltd is expected to be the entity with operational control of the new power station, as it will hold the relevant approvals and licences and have authority to introduce and implement operating and environmental policies at the facility. Emissions and energy data for the new power station will be reported under the NGER Scheme by Northern Star Resources Ltd through Northern Star (EGP) Pty Ltd.
- If the facility becomes a designated large facility under the Safeguard Mechanism, Northern Star will comply with all relevant requirements, including any sectoral or facility-specific baselines and decline rates applied to electricity-sector facilities. The facility will be grid connected and therefore the sectoral baseline is expected to apply.

Construction activities are expected to be limited and include the assembly of infrastructure on cleared/prepared land and, the movement of vehicles and equipment to site. Emissions from construction are not expected to be material (i.e. below the EPA's 100,000 t CO_2^e/a) and any estimate provided at this stage would be highly speculative. On this basis, construction GHG emissions estimates have not been provided.

Northern Star hold the view that the power station will provide a net reduction in GHG emissions to atmosphere compared to continuing to utilise the existing Parkeston Power Station and SWIS connection to fulfill the increased electricity demands of KCGM operations.

Table 13 presents the estimated KCGM GHG emissions under various operating scenarios for the period 2029 to 2052, (it is anticipated in 2029 the new Kalgoorlie power station will be fully operational). Both scenarios exclude consideration of the potential retirement of existing technologies or substitution with lower-emission alternatives (e.g. renewables). The scenarios are:

- Scenario 1: KCGM operations source electricity from the new Kalgoorlie Thermal Power Project and SWIS.

- Scenario 2: KCGM operations continue to source electricity from Parkeston power station and SWIS.

Table 13: Estimated KCGM GHG Emissions from 2029 - 2052 (t CO2e)

Source of Electricity	Scenario 1	Scenario 2
	Annual Average Emissions	Annual Average Emissions
Kalgoorlie Thermal Power Project	349,003	N/A
Parkeston Power Station	N/A	334,579
SWIS	41,100	108,697
Total	**390,103**	**443,276**

The proposed power station is expected to achieve greater CO_2^e/MWh efficiency compared to the existing Parkeston power station. The emissions intensity is approximately 0.485 t CO_2^{-e}/MWh sent-out, based on an average heat rate of 9.35 GJ/MWh (HHV) and an effective mixed-fuel emission factor of 51.9 kg CO_2^{-e}/GJ (HHV).This is approximately 15% lower than the emissions intensity of the existing Parkeston power station supplying KCGM (approximately 0.567 t CO_2^{-e}/MWh on a comparable basis). This improved efficiency, combined with a reduced reliance on the SWIS, is estimated to result in a reduction of approximately 397,793 tCO_2^e emissions at KCGM Operations over the life of the facility.

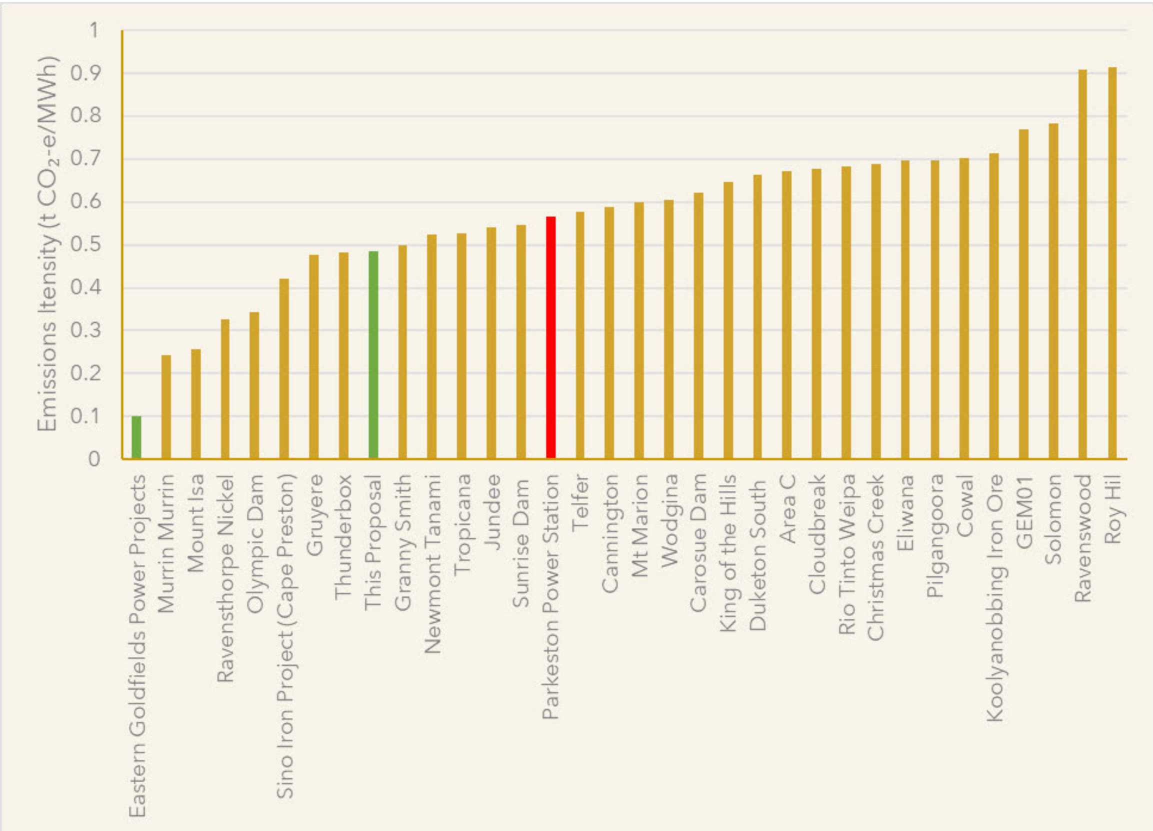


Chart 1: Emissions Intensity Data for Electricity Generation from Metal Ore Mining

5.1.6 Control Measures

The Project design has considered exposure to dust and emissions in order to minimise adverse impacts.

Northern Star will implement dust control measures during construction and operational stages of the Project to ensure compliance with occupational health and environmental standards. Adherence to best practice in relation to dust management will also assist to maintain plant aesthetics and prevent potential impacts to human health, fauna and adjacent vegetation.

The following management measures will be implemented during construction and operation stages of the Project.

5.1.6.1 Dust

- Site selection considered proximity to sensitive receptors.
- Land disturbance will be kept to the minimum necessary for development of the Project.
- Dust minimisation measures will be implemented for excavation activities including using water carts and watering stockpiled materials.
- During high winds, topsoil stripping and spreading activities will be restricted if dust cannot be adequately controlled.
- Implementation of speed limits on unsealed roads and tracks to reduce dust creation.
- Stop dusting generating construction activities if noticeable impact is observed.

5.1.6.2 Emissions

- Site selection for power station considered location of sensitive receptors and climatic conditions.
- Powerstation to operate on natural gas.
- Diesel to be used only for start-up of engines and in the event of short-term failure of natural gas supply.
- Stack heights to be no less than 30 m.
- Power station is constructed and operated as per design specifications.
- Power station engines to be serviced and maintained in accordance with manufacturers specifications.

5.1.7 Predicted Residual Environmental Risk

Use of standard dust suppression techniques during the construction phase of the Project will ensure that air quality is maintained and emissions are minimised. Excessive dust emissions during the construction phase will be localised, short term and can be effectively managed by stopping work if required.

Annual and one hour air quality emission concentrations attributable to operation of the power station under normal operating conditions (natural gas) are expected to comply with the NEPM air quality criteria for all pollutants at sensitive receptors.

In the event that the worst-case meteorological conditions occur at the same time the power station is required to operate in LFO mode for an extended period, a marginal exceedance of the one hour average NO_2 concentration may occur. As gas supply at the existing Parkeston power station has not been interrupted in the last 10 years, the likelihood of this is considered low. The risk to human health at nearby receptors associated with the proposed operational profile of the power station in LFO mode would be considered low and unlikely.

Greenhouse gas emissions will be managed and reported as pre requirements of the Safeguard Mechanism as Scope 1 emissions will be more than the 100,000 tCO_2^e per annum.

Northern Star considers that the proposed management measures and regulation under Part V of the EP Act will ensure that the EPA's Air Quality factor objective is met.

5.2 Noise Emissions

Generation of thermal power using natural gas and fuel has to potential for generation of noise emissions. Noise emissions generated during operations has the potential to affect environmental values.

Herring Storer Acoustics were commissioned to undertake a noise assessment for the Proposal to understand the potential impacts on sensitive receptors in accordance with the *Environmental Protection (Noise) Regulations 1997*. The noise assessment report is located in Appendix E.

5.2.1 Sources

Potential sources of noise associated with the Project include:

- Construction and earthwork activities for the Power Station and associated infrastructure.
- Warning alarms in the Power Station plant and reversing sirens on mobile machinery and equipment used during construction and operations.
- Transport of equipment and supplies to and from the Project area during construction.
- Noise from engines during operations.

5.2.2 Potential Impacts

The potential impacts from noise emissions as a result of Project implementation are:

- A decrease in human and fauna health due to increased localised noise.
- Reduced amenity within and outside of the project area due to noise emissions.

5.2.3 Receptors

The Proposal is located east of the city of Kalgoorlie Boulder within an area used historically and currently for various mining and other related activities. All components of the Proposal are located immediately adjacent to Yarri Road and or Black Street which are well trafficked roads.

Roads used for transport of materials and equipment to Kalgoorlie or Perth are public roads, predominantly highways, that are already subject to significant use by heavy vehicles. Noise impacts associated with use of public roads is outside the scope of this Project.

The definition of noise sensitive premises from the *Environmental Protection (Noise) Regulations 1997* was applied to identify the nearest noise sensitive receivers to the Proposal. The noise assessment considered three sensitive receptors:

- R1 - residences within the Ninga Mia community located about 630 m south of the proposed Power Station.
- R2 - residences within the Williamstown community located about 1,750 m to the west and southwest of the proposed Power Station.
- R3 - residences within the City of Kalgoorlie at Victoria Street East located about 1,950 m to the west and southwest of the proposed Power Station.

These are essentially the same as those considered for the air quality assessment as described in Section 5.1.4.

There is no ambient noise data for the Proposal area.

5.2.4 Noise Criteria

Table 14 documents the allowable noise levels applicable to each of the three sensitive receptors considered in the noise assessment in accordance with the Noise Regulations. This includes provision of an influencing factor of 2 dB recognising the influence of traffic on adjacent roads and adjacent land uses. The allowable noise level at the nearest noise sensitive receptors needs to meet the assigned noise level in isolation of other noise sources.

Table 14: Compliance Noise Levels (LA_{10})

Day *0700 -1900* *Mon - Sat*	**Evening** *1900 - 2200* *all days*	**Night** *2200 -0700 Mon- Sat & 2200 - 0900 Sun & Public Holidays*	**Sunday & Public Holidays** *0900 -1900*
47	42	37	42

5.2.5 Emissions Estimate

Construction of the Proposal will generate noise and vibration of short-term duration (i.e. less than 18 months) within the project area.

Thereafter, the power station will generate constant noise emissions whilst in operation. The outcomes of the acoustic assessment (Appendix E) were used to inform design of the power station and assess compliance with the requirements of the Western Australian Noise Regulations.

The results of the acoustic assessment compared to the assigned compliance noise levels are provided in Table 15. This assumes the design features described in the acoustic report are all implemented and the power station is operating at full capacity (12 engines) noting that the more realistic operating plan is for 10 engines to be operational at any one time. This shows that noise received at the sensitive receptors would comply with the Regulatory requirements during the day, evening and night periods. It is noted that during the night period, there would be a reduction in noise emissions, not only due to demand, but due to the lower ambient temperature resulting in less air required for cooling of the engines.

Table 15: Noise Assessment Results Compared to Required Criteria (L_{A10})

Receptor	Period	Assessed Level	Required Level (LA_{10})	Compliance
R1	Day	38	47	Complies
	Evening	38	42	Complies
	Night	36	37	Complies
R2	Day	31	47	Complies
	Evening	31	42	Complies
	Night	29	37	Complies
R3	Day	26	47	Complies
	Evening	26	42	Complies
	Night	25	37	Complies

The acoustic assessment shows that in the worst case, that noise received at the nearby noise sensitive premises is below the assigned noise level. Thus, noise emissions from the proposed Thermal Power Station would be deemed to comply with the requirements of the Regulations.

5.2.6 Control Measures

Project design has considered exposure to noise in order to minimise adverse impacts. The operation period is anticipated to be 12–24 months with decreasing reliance over time as other alternative energy supply options are assessed and ultimately constructed and become available. The noise controls are based around silencers and engineering controls to both the engine halls and the external noise sources. The proposed design controls include:

- Engine Halls:
  - Walls of Halls Concrete 150 mm panel on northwest, southeast and southwest sides.
  - Northeast wall lightweight – RW 53 (Ceiling: + Panel 1: 1 x 0.6 mm Custom Orb (0.55 mm) + Frame: Steel C-Joist (1.0-1.6 mm) (254 mm x 38 mm), Stud spacing 600 mm,

Cavity Width 254 mm + 90 mm Bradford Gold R1.8 Wall + Panel 2: 1 x 9 mm BGC 9 m CFC Panels + Details: Panel Size 2.7 m x 4.0 m, Partition surface mass = 20.4 kg/m^2).

- Roof for Halls Rw53.
- Top Hall Passive Ventilation – Required 1,200 mm Louvers/ baffles.
- Additional barrier (extension of walls) 2 m above roofline.
- Ventilation Intake (Ground Level) – Unattenuated.

- Stacks/Ducting:
  - Stacks and pre stack silences (35 dB).
  - Insulating ducting pipes.
- Cooling Radiators:
  - Day Operations - Noise level 2, 3-fan cooling radiator (Three per Engine) SWL 102 dB(A).
  - Night Operations - Noise level 2, 3-fan cooling radiator (Three per Engine) SWL 99dB(A) – (allowance for cooler operations and diversity during the night period).

5.2.7 Predicted Residual Environmental Risk

Noise impacts have been assessed against local context and Regulatory requirements. It is unlikely that noise will be a significant impact as:

- The noise modelling assessment has been based on the power station operating at full capacity. Under this scenario, noise received at the residences would comply with the Regulatory requirements during the day, evening, and night periods.
- Noise emissions have been considered in design of the process flow sheet and during equipment selection.
- Adequate control measures will be implemented to minimise localised impacts.

Ongoing stakeholder engagement will provide opportunity for grievances to be expressed during construction and operations.

Northern Star considers that the proposed management measures and regulation under the Noise Regulations will ensure that the EPA's Social Surroundings factor objective is met.

5.3 Emissions to Land, Surface Water and Groundwater

The sources of discharges to land, surface water and groundwater may potentially originate from:

- Hydrocarbon spills or leaks from vehicles, equipment use or maintenance activities.
- Spillage, leakage or seepage of hydrocarbons used and stored onsite.

5.3.1 Potential Impacts

Sources of discharge from the Project infrastructure have the potential to:

- Contaminate land due to spillages or leaks of hydrocarbons.
- Contaminate surface water due to spillages or leaks of hydrocarbons.
- Contaminate groundwater and land due to spillages or leaks of hydrocarbons.

5.3.2 Control Measures

- All hydrocarbon storages will be designed and constructed in accordance with Australian Standards AS1940 and AS1692.
- Engines will be maintained in accordance with manufacturers specifications.
- Vehicle maintenance will be undertaken offsite.
- The engine halls will drain to a designated sump fitted with an oil water separator.
- Oily water will be removed from sumps by a licenced contractor.
- Minor hydrocarbon spillage occurring due to accidents or breakdowns will be addressed by communicating, controlling, containing and cleaning up the spill and reported through the incident report procedure.
- Spill kits will be located at strategic locations throughout the project area and employees trained in their use.
- If contamination of soils has occurred, the area will be remediated as far as reasonably practicable.

5.3.3 Predicted Residual Risk

The likelihood of contamination of surface water as a result of spillage of diesel is considered low given the absence of surface water features within the project area, particularly in relation to the bulk diesel storage tank.

Given the depth to groundwater (>20 m), the low porosity of bedrock underlying the project area and high natural salinity of groundwater, the risk of contamination of groundwater that would prevent beneficial use by others is considered low.

Contamination of soil with hydrocarbons has the potential to occur, however implementation of standard industry controls for their storage and handling will minimise risks to acceptable levels. Localised soil contamination can be addressed during operations and post closure through removal and remediation of soil.

Impacts to land, surface water and groundwater associated with hydrocarbon use and storage are not expected to be significant after implementing the control measures as described in Section 5.3.2.

6. Attachment 6B: Commissioning Plan

6.1 Commissioning

Environmental commissioning is the process of commencing operation (engineering commissioning) of particular plant and/or equipment and ensuring that the outputs of the activity (i.e. discharges or emissions) meet the criteria or specification nominated by the manufacturer and or in the relevant Works Approval documentation.

The commissioning process for infrastructure subject to this Works Approval and future Environmental Licence application will have four main phases:

- Construction verification – comprising of leak testing of piping systems, machinery alignment and integrity testing of control, power and communications cabling prior to pre-commissioning.
- Pre-commissioning – comprising the checking of instrument settings, protection settings and control system functionality prior to the energisation of auxiliary systems.
- Off load commissioning – comprising powering up the auxiliary systems (coolers, fans, pumps, drives) and firing the engine but without synchronising the generator to Project electrical load.
- On load commissioning – comprising of testing the generating sets performance, reliability and functionality when synchronised and connected to the mine load.

Compliance documentation will be prepared and submitted to DWER on completion of construction and coinciding with the commencement of pre-commissioning activities.

6.2 Time Limited Operations

Following completion of environmental commissioning and upon submission of the relevant documentation to DWER (as required), the Prescribed Premises would enter Time Limited Operations (TLO) which permits operations, post-environmental commissioning, to continue under the Works Approval prior to the grant of a Licence for the Prescribed Premises.

Northern Star proposes a standard TLO period of 180 days for the power station (Category 52).

Operations under Licence conditions would begin when the Licence is granted.

Conditions are typically included in the Works Approval to regulate emissions and discharges that arise during the TLO phase. These conditions are based on the design performance of the operations at the Prescribed Premises as assessed and conditioned in the Works Approval. Attachment 6A: Emissions and Discharges provided outlines the emissions and discharges from the Prescribed Premises categories expected during operations and the relevant controls. These are also applicable during the TLO phase.

6.3 Compliance Reporting

Any non-compliances with the Works Approval would be reported in accordance with administrative conditions in the Works Approval.

7. Attachment 7: Siting and Location

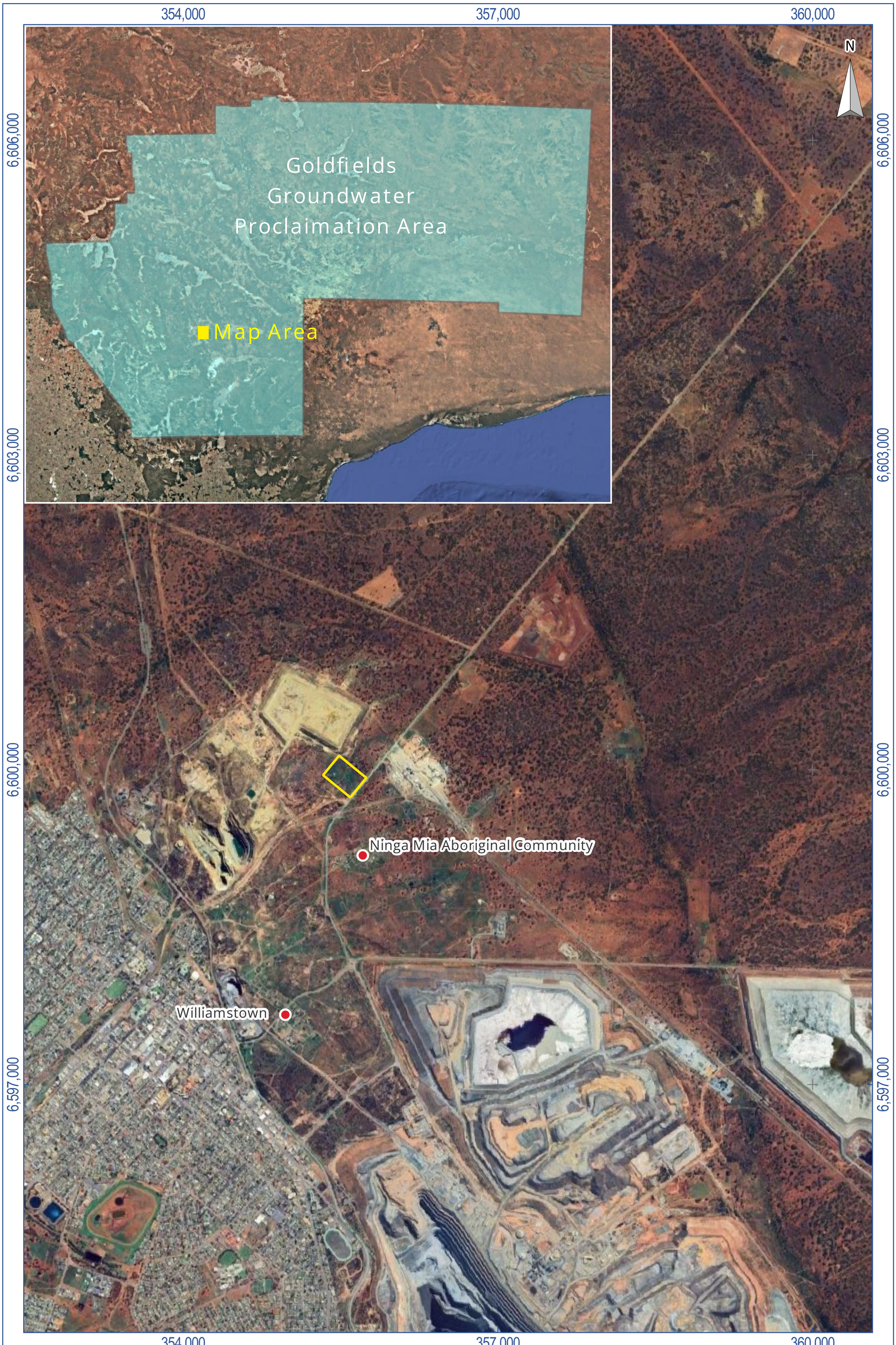
The Project is located within the City of Kalgoorlie-Boulder within the Goldfields region of Western Australia. It is situated approximately 1.8 km from Kalgoorlie township, 2.4 km from Williamstown and approximately 0.5 km from the Ninga Mia Aboriginal Community. The Project is accessed from Yarri Road, Williamstown (Figure 1).

7.1 Environmental Receptors

An assessment of sensitive receptors within or adjacent to the Prescribed Premises boundary, which have the potential to be impacted by activities was undertaken. The results are outlined in Table 16 and shown in Figure 6.

Table 16: Assessment of Potential Sensitive Receptors

Environmental Receptors	Distance from Prescribed Premise
Environmentally Sensitive Areas (ESA)	No ESAs are within or near the Prescribed Premises boundary.
Public Drinking Water Source Area	The Prescribed Premises is not located within a PDWSA.
Surface Water	The project area does not occur within any proclaimed surface water area under the *Rights in Water and Irrigation Act 1991* (*RIWI Act*). The major drainage in the area is the Eastern Floodway which is part of the Hannan Catchment which drains an area of about 230 km with runoff flowing to Hannan Lake south of the area of interest. There are no permanent surface water bodies or watercourses within 1 km of the Prescribed Premises boundary.
Groundwater	The Project is in the Goldfields Groundwater Proclamation Area.
Threatened and Priority Ecological Communities	No TECs or PECs are present within 50 km of the Prescribed Premises boundary.
Threatened/Priority flora	No Threatened flora species are within the Prescribed Premises boundary. *Eremophila praecox* (Priority 2) has been identified at several locations east of the project area but is not present within the project area.
Threatened/Priority fauna	No Threatened or Priority fauna species are within or in proximity to the Prescribed Premises boundary.
Aboriginal and other Heritage Sites	Aboriginal community Ninga Mia is located 0.5 km from the Project. Two registered heritage sites were identified near to the Prescribed Premise Boundary (Ninga Mia FS7 and Aboriginal reserve FS8)
Other	Williamstown Community located 2.4 km from the Project.



Scale: 1: 50,000
Original Size: A4
Grid: GDA2020 / MGA zone 51
(EPSG:7851)
0 1 2 km

Legend

Prescribed Premise Boundary

Figure 6

Location of Environmental Receptors

MBS ENVIRONMENTAL

W:\Zenith Energy\Approvals\Works Approval\GIS\Zenith_Energy_WorksApproval_2025.qgz 05/12/2025 L4 Location of Environmental Receptors

7.2 Landuse

The Project is within the central western Goldfields region of Western Australia. This area contains Unallocated Crown Land, reserves, pastoral and mining leases and is used for grazing, tourism, exploration and mining.

The Project is located on Lot 94 Deposited Plan 213070 and Vacant Crown Land (Miscellaneous Licence Tenure L26/313), zoned as Rural and special control zone *Road and Rail Buffer* (SCA7 - SPP5.4) as per the City of Kalgoorlie-Boulder *Local Planning Scheme*.

The power station is proposed to be located completely within and surrounded by rehabilitated and historically cleared land.

7.3 Climate

7.3.1 Rainfall and Temperature

The Kalgoorlie Boulder area is subject to a semi-arid climate, with mild winters and hot summers. Precipitation is typically well below evapotranspiration rates, creating dry conditions. Temperatures range from a mean maximum of 33.7°C in summer and drop to a mean maximum of 16.8°C in winter. Mean minimum temperatures follow a similar trend and range from 18.3°C in summer to 5.1°C in winter (Chart 2).

Annual rainfall varies between 108 and 530 mm, with an average of 266 mm (BoM, 2025). Rainfall occurs during all months of the year. Pan evaporation rates exceed average rainfall rates for every month of the year and the average annual pan evaporation is 2,646 mm, approximately 10 times the average annual rainfall. Average relative humidity is highest during the winter months (up to 74% at 9:00 am and up to 48% at 3:00 pm) and lowest during the summer (up to 57% at 9:00 am and up to 34% at 3:00 pm) (Ramboll, 2023).

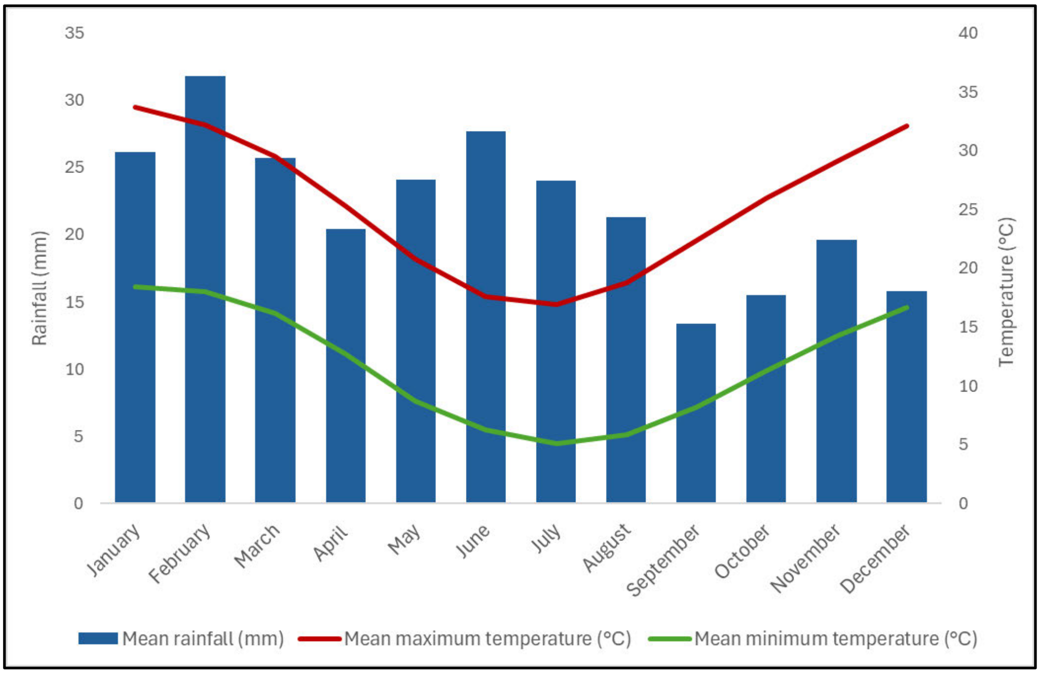
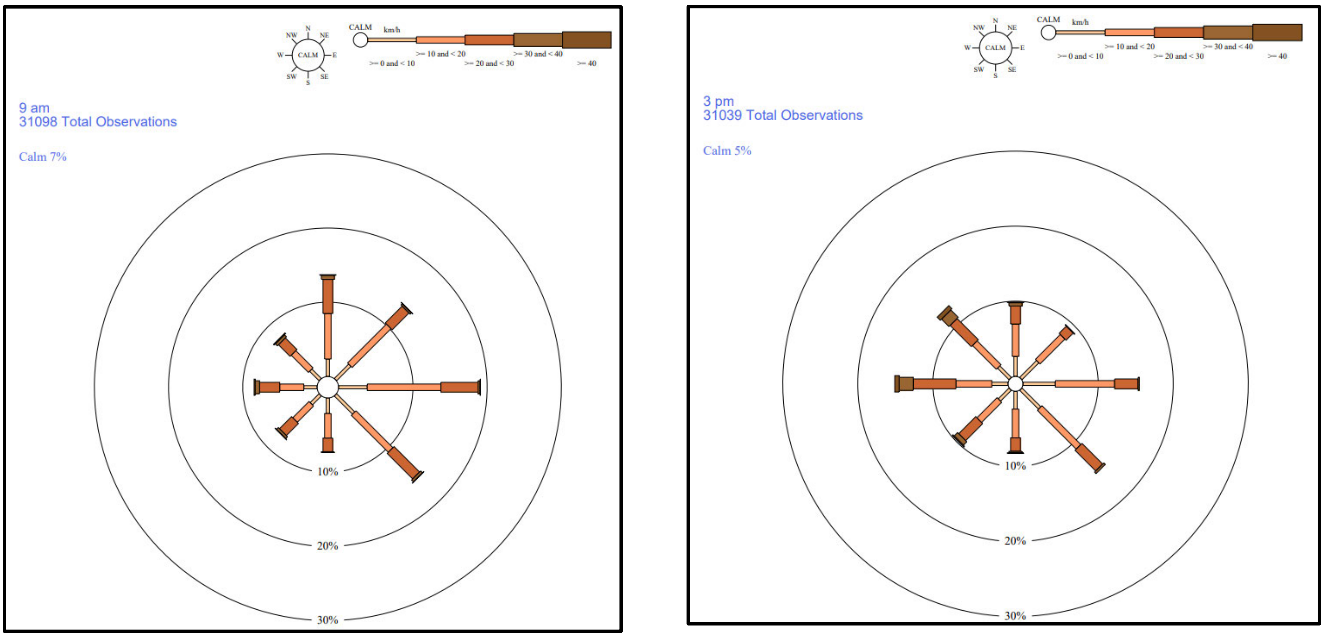


Chart 2: Climate Data for Kalgoorlie-Boulder Station (BoM, 2025)

7.3.2 Wind

Predominant wind direction and wind speeds for the Kalgoorlie-Boulder region from between 1939 and 2020 show an annual 9am wind speed of 15.0 km/hr and a 3pm wind speed of 15.9 km/hr. Summer and autumn are dominated by an easterly wind regime. The lowest recorded mean wind speeds for the period 1939–2020 generally occur in April to June (11.8–13.7 km/hr). In winter the wind regime changes to a westerly, with the highest recorded mean wind speeds occurring between September and October (17.1–17.8 km/hr; (Ramboll, 2023). The 9am and 3pm wind roses for the Kalgoorlie Boulder Meteorological Site (No. 012038) are shown in Chart 3.



Source: BOM 2024

Chart 3: 9am and 3pm Wind Roses for the Kalgoorlie-Boulder Meteorological Site

7.4 Geology

7.4.1 Regional Geology

The site is located in the Coolgardie (COOL 56) Interim Biogeographical Regionalisation of Australia (IBRA) region. The region is described as granite strata of Yilgarn Craton with Archaean Greenstone intrusions in parallel belts. Drainage is occluded. Mallees and scrubs on sandplains associated with lateritised uplands, playas and granite outcrops. Diverse woodlands rich in endemic eucalypts, on low greenstone hills, valley alluvials and broad plains of calcareous earths. In the west, the scrubs are rich in endemic Proteaceae, in the east they are rich in endemic acacias. Arid to Semi-arid Warm Mediterranean (Thackway, R. and Cresswell, I. D. (Editors), 1995).

Greenstones in the Kalgoorlie Terrane general stratigraphy consists of a lower mafic–ultramafic succession overlain by, and locally interbedded with, an association of dominantly felsic volcanic and volcaniclastic rocks, the Black Flag Group. Greenstones in the Kalgoorlie Terrane are unconformably overlain by a late-basin succession of turbiditic metasedimentary rocks, represented in the Kalgoorlie area by conglomerate and sandstone of the Kurrawang Formation. The mafic–ultramafic succession typically contains a lower basalt unit, a komatiite unit, and an upper basalt unit, although the basalt units are not necessarily present in all domains (Wyche, 2007).

7.5 Soils and Landform

The site is located in the Atlas Landscape System (Mx43) which is described as gently undulating valley plains and pediments with some outcrop of basic rock. Surface geology is typically colluvium, sheetwash talus; gravel piedmonts and aprons over and around bedrock; clay-silt-sand with sheet and nodular kankar; alluvial and aeolian sand-silt-gravel in depressions and broad valleys in Canning Basin; local calcrete, reworked laterite (Phoenix, 2024a).

The site area is predominantly flat and sits at an elevation of 375 – 378 m.

The proposed power station site has previously been disturbed by historic mineral exploration, and mining and is located adjacent to a tailings waste landform. A baseline soils assessment has been undertaken to determine presence or absence of potential contaminants within the Prescribed Premises Boundary. Results will be incorporated into Project design where relevant.

7.6 Water

7.6.1 Surface Hydrology

The site is in the Salt Lake hydrogeological region that comprises numerous drainage systems flowing to terminal Salt Lake systems, clay pans and other natural surface depressions. No wetlands occur within or within a 1km radius of the project area.

The project area does not occur within a proclaimed surface water area under the RIWI Act. The major drainage in the area is the Eastern Floodway which is part of the Hannan Catchment which drains an area of about 230 km^2 with runoff flowing to Hannan Lake south of the area of interest. The Eastern Floodway only flows after heavy rainfall events that occur on a frequency of less than once per year. Flow conveyance along the Eastern Floodway is controlled by floodways (low-lying road sections designed to overtop during flood events) across Bulong Road, the TSF Haul Road connecting Kaltails and Fimiston II TSFs to the Fimiston WRDs, and Mt Monger Road. Stormwater flow through the Eastern Floodway tributary network is controlled by several sets of culverts beneath Bulong Road, the raised TAR embankment, and the Kaltails Haul Road at several locations (WSP, 2023). Regional Hydrology is shown on Figure 7 with Local Catchments shown in Figure 8.

A site-specific surface water assessment has been undertaken for the power station, included as Appendix F The foundations will be built up above current ground level to prevent flooding of electrical infrastructure.

7.6.2 Local Hydrogeology

The site is located within the regional province of the Yilgarn Block, which consists of linear "greenstone" belts of Archean supracrustal rocks (metasedimentary and volcanic rocks) interspersed with granitic intrusions. The main bedrock aquifers are found in the Tertiary palaeochannels, particularly the Roe Palaeodrainage, however the sources of groundwater for both the yields and salinity are highly variable. These aquifers are primarily composed of sands at the base of the palaeochannels and calcretes. Groundwater in these aquifers is generally brackish to hypersaline, with some minor fresh groundwater resources in specific areas (Commander, Kern and Smith, 1992) with salinity ranging from 3, 000 mg/L to 190,000 mg/kg. Small supplies of groundwater also occur in colluvium and alluvium, with groundwater salinity dependent largely on the position in topography (Cassidy *et al*., 2006).

7.6.3 Groundwater

The site is situated within the Goldfields Groundwater Area and Combined Fractured Rock groundwater province. Groundwater within areas of fractured rock is anticipated to be at depths between 20 and 50 mbgl and is generally brackish to hypersaline. Salinity levels can range from 1,000 to over 50,000 mg/L of total dissolved solids (TDS). This high salinity is typical due to the region's arid climate and the presence of salt deposits.

Groundwater often contains elevated levels of minerals such as sodium, chloride, and sulfate, which are naturally occurring and can be influenced by the geological formations through which the groundwater flows.

Scale: 1: 120,000
Original Size: A4
Grid: GDA2020 / MGA zone 51
(EPSG:7851)
0 2 4 km

Legend

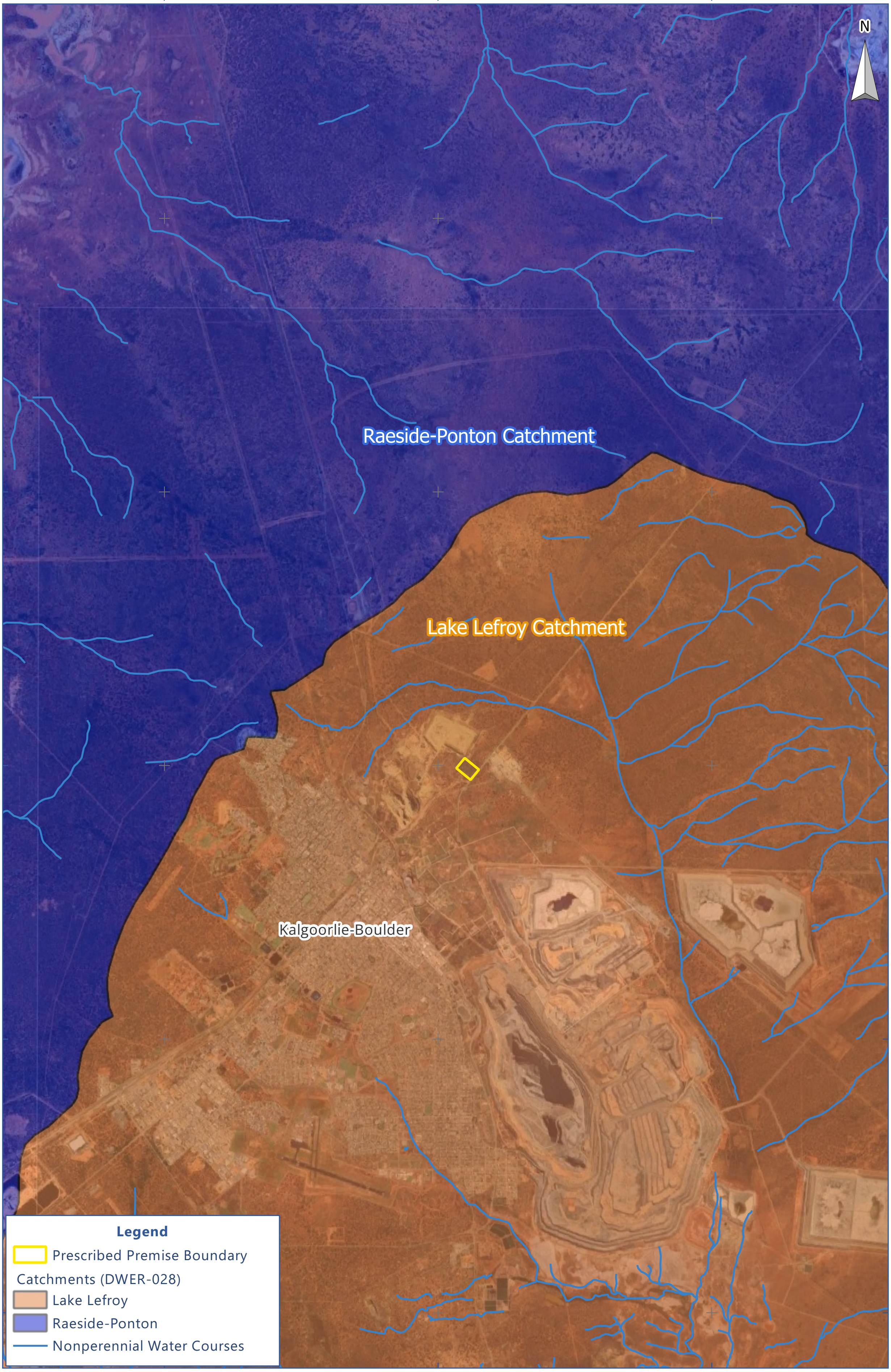
Prescribed Premise Boundary
Watercourse
Surface Hydrology
Lake

Figure 7

Regional Hydrology

MBS ENVIRONMENTAL

W:\Zenith Energy\Approvals\Works Approval\GIS\Zenith_Energy_WorksApproval_2025.qgz 04/12/2025 L5 Regional Hydrology



Scale: 1: 100,000
Original Size: A4
Grid: GDA2020 / MGA zone 51
(EPSG:7851)
0 2 4 km

Figure 8

Local Catchments

MBS ENVIRONMENTAL

W:\Zenith Energy\Approvals\Works Approval\GIS\Zenith_Energy_WorksApproval_2025.qgz 04/12/2025 L6 Local Catchments

7.7 Ecological Factors

The site is not located within an Environmentally Sensitive Area, Nature Reserve or DBCA managed land.

No TECs or Priority Ecological Communities (PECs) as listed by DCCEEW or DBCA are present within 50 km of the Project.

Phoenix Environmental Sciences Pty Ltd (Phoenix) was commissioned by KCGM in 2021 to undertake a gap analysis of biological values at the Fimiston Operational Area, and to conduct baseline surveys in areas identified as data deficient. This included the area of the power station.

7.7.1 Flora and Vegetation

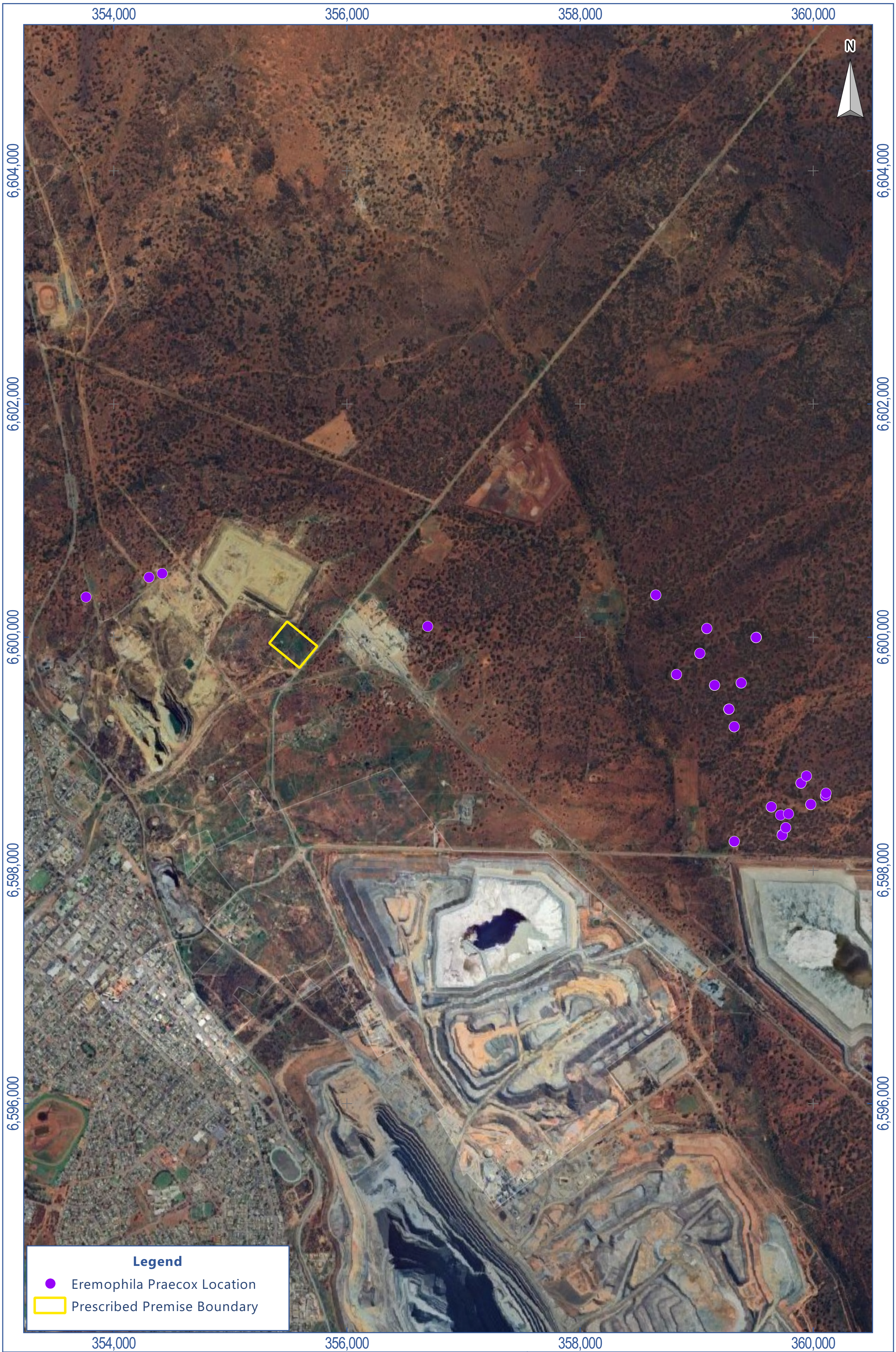
The power station site is mapped as rehabilitation/dust abatement zone comprising of a mosaic of non-local species with completely degraded vegetation condition.

No Threatened or significant flora species pursuant to the Commonwealth's *EPBC Act* or Western Australia's *BC Act* were identified within or adjacent to the site. One DBCA listed Priority Flora, *Eremophila praecox* (Priority 2), has been identified at several locations east of the Prescribed Premise Boundary (PPB), and not present within the PPB (Figure 9).

7.7.2 Fauna

The Phoenix 2024 terrestrial fauna assessment for the Fimiston South Project contains fauna habitat mapping and records of significant fauna. Habitat fauna for the site is mapped as Rehabilitation habitat type and is surrounded by areas mapped as Cleared. Rehabilitation areas were described as having low value for foraging/dispersal for fauna occupying adjacent areas (Phoenix, 2024b).

No significant fauna species were recorded within the site and are not considered to likely occur due to the close proximity of the City of Kalgoorlie Boulder and the poor habitat quality.



Scale: 1: 45,000
Original Size: A4
Grid: GDA2020 / MGA zone 51
(EPSG:7851)
0 1 2 km

Figure 9

Priority Flora Locations

MBS ENVIRONMENTAL

9. References

Australian Government (1987) *Environmental Protection Regulation*.

BoM, (Bureau of Meteorology) (2025) *Climate Data Online*. Available at: http://www.bom.gov.au/climate/data/.

Cassidy, K.F. *et al.* (2006) *A revised geological framework for the Yilgarn Craton, Western Australia*. Perth: Geological Survey of Western Australia.

Commander, D.P., Kern, A.M. and Smith, R.A. (1992) *Hydrogeology of the Tertiary palaeochannels in the Kalgoorlie region (Roe Palaeodrainage). Record 1991/10*. 1991/10. Australia: Geological Survey of Western Australia, Department of Minerals and Energy.

DWER, (Department of Water and Environmental Regulation) (2019) "Guideline: Air Emissions. for external consultation." Government of Western Australia.

de Gand, (de Gand and Associates Pty Ltd) (2011) *Draft Report on an Aboriginal Heritage Assessment of the Central Corridor and Eight Mile Dam Project Areas in Kalgoorlie Western Australia*. Unpublished report, February 2011.

MRP, (MRP Technical Consulting) (2025) *Kalgoorlie Power Station Air Quality Assessment*. Report prepared for Northern Star Resources Limited and Zenith Energy Pty Ltd, September 2025.

NEPC, (National Environmental Protection Council) (2011) *National Environment Protection (Air Toxics) Measure 2011*. Commonwealth of Australia.

NEPC, (National Environmental Protection Council) (2021) "National Environment Protection (Ambient Air Quality) Measure Variation Instrument 2021." Commonwealth of Australia.

Phoenix, (Phoenix Environmental Services) (2024a) *Flora and Vegetation Assessments for the Fimiston Gold Mine Operations (Revised)*. Report prepared for Kalgoorlie Consolidated Mines Pty Ltd.

Phoenix, (Phoenix Environmental Services) (2024b) *Terrestrial Fauna Assessments for the Fimiston Gold Mine Operations (Revised)*. Report prepared for Kalgoorlie Consolidated Mines Pty Ltd.

Ramboll, (Ramboll Australia) (2023) *Fimiston South Project Qualitative Air Quality Impact Assessment*. Report prepared for Kalgoorlie Consolidated Mines Pty Ltd.

Terra Rosa Consulting (2021) *Heritage desktop assessment and review of ten reports for Northern Star Resources Limited*. Report prepared for Northern Star Resources Limited, December 2021.

Terra Rosa Consulting (2025) *An Archaeological and Ethnographic Site Avoidance heritage survey of Kalgoorlie Regional Renewable Energy*. Perpared for Northern Star Resources Ltd, November 2025.

Thackway, R. and Cresswell, I. D. (Editors) (1995) *An Interim Biogeographic Regionalisation for Australia*. Version 4.0. Australian Nature Conservation Agency, Canberra.

WSP, (WSP Environmental Pty Ltd) (2023) *Hydrological Assessment of Eastern Floodway*. Report prepared for Kalgoorlie Consolidated Mines Pty Ltd.

Wyche, S. (Compiler) (2007) "Stratigraphy and Structure of the Kalgoorlie Terrain at Hannan Lake and Mount Hunt: a Field Guide – Geological Survey of Western Australia." Department of Industry and Resources; Government of Western Australia.

APPENDIX A:

PROOF OF OCCUPIER STATUS AND ASIC COMPANY EXTRACT

APPENDIX A

Current Company Extract for NORTHERN STAR (EGP) PTY LTD

Extracted from ASIC database on 22 January 2026 02:24 PM AEST

This extract contains information derived from the Australian Securities and Investment Commission's (ASIC) database under section 1274A of the Corporations Act 2001. Please advise ASIC of any error or omission which you may identify.

Organisation Details

Name:	NORTHERN STAR (EGP) PTY LTD
A.C.N:	655582415
A.B.N:	46655582415
Status:	Registered
Registered In:	WA
Registration Date:	24/11/2021
Review Date:	01/07/2026
Ultimate Holding Company	NORTHERN STAR RESOURCES LTD
Name Start Date:	23/01/2025
Type:	Australian Proprietary Company
Organisation Number Type:	Australian Company Number
Details Start Date:	23/01/2025
Class:	Limited By Shares
Subclass:	Proprietary Company
Disclosing Entity:	No
Registered charity:	No
Document Number:	

Organisation Address

Status	Address Type	Address	Start Date	Doc Number
Current	Registered Office	NORTHERN STAR RESOURCES LTD LEVEL 4 500 HAY STREET SUBIACO WA 6008	01/03/2023	7ECB38939
Current	Principal Place of Business	LEVEL 4 500 HAY STREET SUBIACO WA 6008	01/03/2023	7ECB38939

Organisation Officers

Role	Officer Details	Address	Appointment Date	Court Details	Doc Number
Director	[redacted]	[redacted]	24/11/2021		2ERL27104
Director	[redacted]	[redacted]	24/11/2021		2ERL27104
Director	[redacted]	[redacted]	24/11/2021		2ERL27104
Secretary	[redacted]	[redacted]	24/11/2021		2ERL27104
Secretary	[redacted]	[redacted]	19/01/2026		7EDV49248
Ultimate Holding Company	NORTHERN STAR RESOURCES LTD ACN: 092832892 ABN: 43092832892				2ERL27104

Share Structure

Share Class	No. Issued	Amount Paid	Amount Unpaid	Doc Number
ORD ORDINARY SHARES	1	$1.00	$0.00	2ERL27104

Note: For each class of shares issued by a proprietary company, ASIC records the details of the twenty members of the class (based on shareholdings). The details of any other members holding the same number of shares as the twentieth ranked member will also be recorded by ASIC on the database. Where available, historical records show that a member has ceased to be ranked amongst the twenty members. This may, but does not necessarily mean, that they have ceased to be a member of the company.

Shareholders

Class	No. Held	Beneficially Held	Fully Paid	Shareholder Details	Document Number
ORD	1	Yes	Yes	NORTHERN STAR RESOURCES LTD LEVEL 4 500 HAY STREET SUBIACO WA 6008 ACN: 092832892 ABN: 43092832892	7ECB60897

Documents

Form Code	Description	# of pages	Received	Processed	Effective	Doc Number
484	484E Change to Company Details Appointment or Cessation of A Company Officeholder	0	22/01/2026	22/01/2026	22/01/2026	7EDV49248
484	484E Change to Company Details Appointment or Cessation of A Company Officeholder	2	17/09/2025	17/09/2025	17/09/2025	7EDQ64269
205	205A Notification of Resolution Changing Company Name Alters 7ED D71 914	3	23/01/2025	23/01/2025	23/01/2025	7EDF28314
410	410B Application For Reservation of a New Name Upon Change Of Name Altered by 7ED F28 314	1	09/12/2024	09/12/2024	09/12/2024	7EDD71914
488	488E Application to Change Review Date of an Entity - Syn. With Holding Company (10+ Coys/schemes)- Fee Applies	4	11/11/2024	18/12/2024	11/11/2024	032104549
484	484A2 Change to Company Details Change Member Name or Address	2	01/03/2023	01/03/2023	01/03/2023	7ECB60897
484	484 Change to Company Details 484B Change of Registered Address 484C Change of Principal Place of Business (Address)	2	22/02/2023	22/02/2023	22/02/2023	7ECB38939
484	484E Change to Company Details Appointment or Cessation of A Company Officeholder	2	08/09/2022	08/09/2022	08/09/2022	7EBW20007
352	352 Assumption Deed Relating to Class Order	10	17/06/2022	30/06/2022	17/06/2022	031542102
201	201C Application For Registration as a Proprietary Company	3	24/11/2021	24/11/2021	24/11/2021	2ERL27104

APPENDIX B:

DESIGN DRAWINGS

APPENDIX B

REV	BY	DATE	DESCRIPTION
2	KSH	11/09/2025	ISSUED FOR INFORMATION
1	VJO	09/04/2025	ISSUED FOR REFERENCE

APPROVAL SIGNATURE

PRELIMINARY REVISION , SUBJECT TO CHANGE

Zenith energy

DO NOT SCALE

DIMENSIONS IN MILLIMETRES

TITLE
EASTERN GOLDFIELDS POWER HYBRID POWER STATION
THERMAL STATION
SITE LAYOUT

SCALE	SIZE	DRG. No.	SHEET	REV.
1 : 500	A1	113-DM-0023	1 OF 1	2

APPENDIX D:

AIR QUALITY ASSESSMENT

APPENDIX D

MBS ENVIRONMENTAL

Intended For
Zenith Energy Pty Ltd

Document type
Final Report

Date
12th December 2025

Kalgoorlie Power Station Air Quality Assessment

MBS Environmental

Project Name **Kalgoorlie Power Station Air Quality Assessment**
Project No. **01-0053**
Document Type **Final Report**
Version **Final**
Date **12th December 2025**
Prepared By **Caelan Whiting**
Approved By **Martin Parsons**

Revision	Date	Made by	Approved by	Description
A	2nd September 2025	Caelan Whiting	Martin Parsons	Initial issue
B	19th September 2025	Caelan Whiting	Martin Parsons	Updated draft
Final	12th December 2025	Caelan Whiting	Martin Parsons	Final report

MRP Technical Consulting Pty Ltd prepared this report in accordance with the scope of work as outlined in our proposal to Martinick Bosch Sell Pty Ltd dated 16 May 2025 and in accordance with our understanding and interpretation of current regulatory standards.

The conclusions presented in this report represent MRP's professional judgement based on information made available during the course of this assignment and are true and correct to the best of MRP's knowledge as at the date of the assessment.

MRP did not independently verify all of the written or oral information provided during the course of this investigation. While MRP has no reason to doubt the accuracy of the information provided to it, the report is complete and accurate only to the extent that the information provided to MRP was itself complete and accurate.

This report does not purport to give legal advice. This advice can only be given by qualified legal advisors.

This report has been prepared for MBS Environmental and may not be relied upon by any other person or entity without MRP's express written permission.

MRP Technical Consulting Pty Ltd
ACN: 679 732 453
ABN: 15679732453

Table of Contents

Tables

Figures

1 Introduction

Zenith Energy Pty Ltd (Zenith) is working with Northern Star Resources (Northern Star) to develop additional power supply sources for the Kalgoorlie Consolidated Gold Mines (KCGM) operations which are located in Kalgoorlie in Western Australia, approximately 600 km east of Perth. Additional power supply is required to meet increasing power demands for the operation as a direct result of significant expansion of ore processing throughput rates at the Fimiston Gold Plant.

Zenith and Northern Star have identified supplementing the existing aging 110 MW natural gas thermal power supply at Parkeston with a new thermal power generation facility with a capacity of circa 140 MW. The new power station would provide the additional power required for increased ore processing. Construction and operation of the new facility would be targeted at providing power supply for KCGM by late 2027 to match scheduled completion of the Fimiston Gold Plant expansion at KCGM. Thermal power is anticipated to provide the full KCGM power needs for a period of 12–24 months with decreasing reliance over time as other alternative energy supply options are assessed and ultimately constructed and become available. Zenith and Northern Star are planning to construct the new 140 MW power station to the northwest of the existing Parkeston Power Station. The power station will comprise two engine halls, each with 6 engines and associated stacks. The two clusters of stacks will have a separation distance of approximately 68 m. The assessment considered the following potential air pollutants from the power station: oxides of nitrogen (NOx), particulate matter ($PM_{2.5}$), sulphur dioxide (SO_2), carbon monoxide (CO) and formaldehyde (CH_2O).

Martinick Bosch Sell Pty Ltd (hereafter "MBS Environmental" or the "Client") requested that MRP Technical Consulting Pty Ltd (MRP) undertake an air quality assessment in support of relevant environmental approvals and licenses associated with the proposed power station.

2 Methodology

2.1 Air dispersion model

The CALPUFF modelling system was utilised to undertake air dispersion modelling. CALPUFF is a multi-layer, multi-species, non-steady-state puff dispersion model. It utilises three-dimensional wind fields to simulate the effects of the temporal and spatial meteorological conditions on pollutant transport, transformation and removal. CALPUFF also allows for three-dimensional characterisation of land use and surface characteristics such as height and density of vegetation. CALPUFF was selected for this assessment to account for impacts on meteorology associated with the complex terrain at the nearby Fimiston Open Pit.

The following model set-up options within CALPUFF were used:

- Meteorological grid of 15.75 km by 13.5 km;
- Meteorological grid spacings of 0.15 km
- Sampling grid of 6 km by 6 km and 50 m spacing; and

- No chemical transformation.

In addition to the gridded receptors for CALPUFF, a number of discrete receptors were selected throughout the modelled domain representing nearby residential dwellings and recreational locations to provide a quantitative assessment of ground level concentrations (GLCs) in sensitive areas of interest. These discrete receptors are summarised in Table 2-1 and are also highlighted in Figure 2-1.

Table 2-1: Discrete receptor locations

Receptor	Easting (UTM Zone 51) (m)	Northing (UTM Zone 51) (m)	Distance to Project (km)
Ninga Mia East	355,791	6,599,225	0.7
Ninga Mia West	355,425	6,599,071	0.8
Kalgoorlie North 3	352,284	6,599,815	3.3
Kalgoorlie North 2	353,019	6,599,803	2.5
Kalgoorlie North 1	353,861	6,598,719	2.1
Kalgoorlie Central	354,090	6,598,599	2.0
Kalgoorlie South 1	354,275	6,598,022	2.3
Kalgoorlie South 2	354,328	6,597,706	2.5
Kalgoorlie South 3	354,479	6,597,413	2.7
Williamstown North	354,902	6,598,222	1.8
Williamstown Central East	354,903	6,597,876	2.1
Williamstown Central West	354,706	6,597,872	2.2
Williamstown South	355,020	6,597,400	2.6

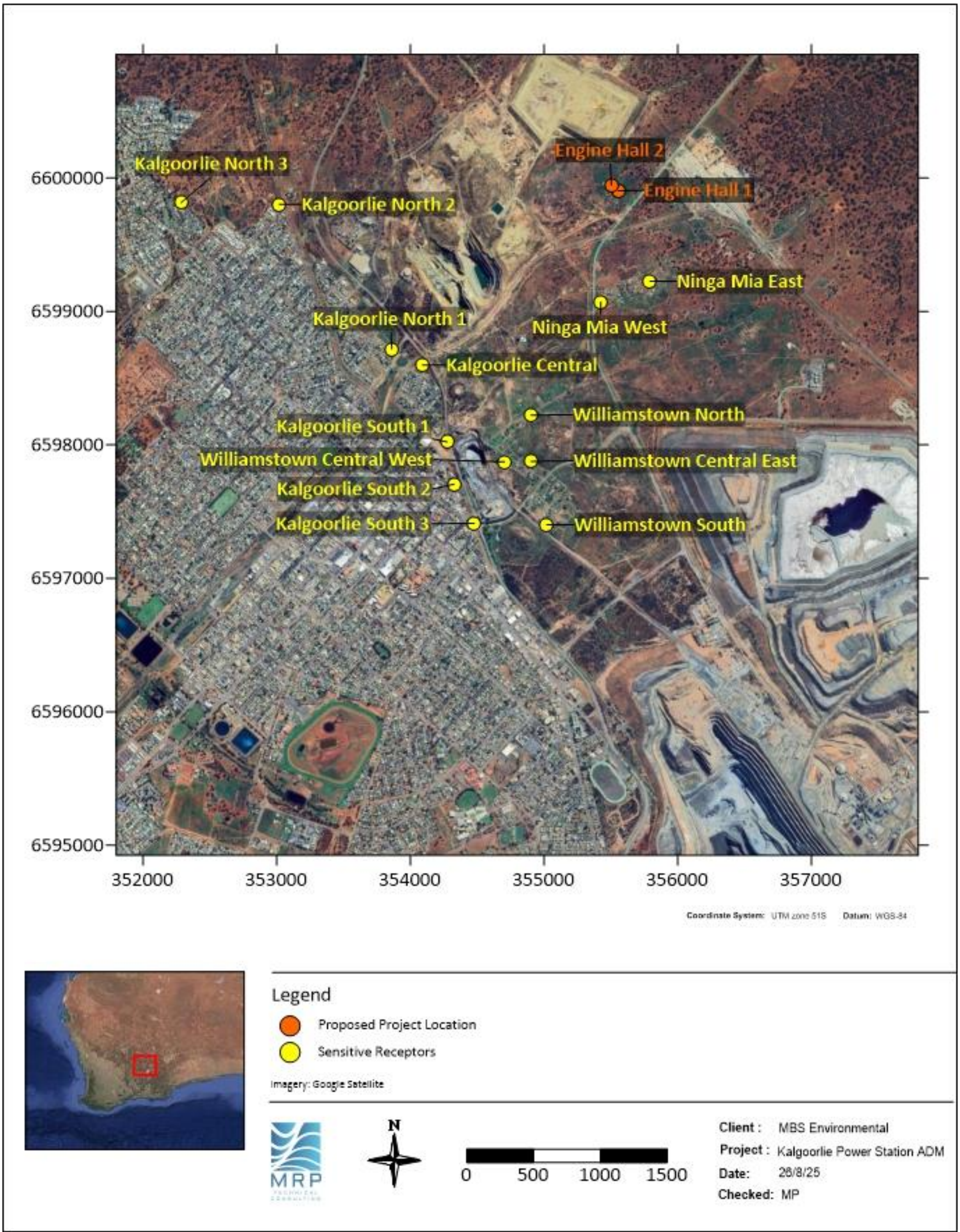


Figure 2-1 :Kalgoorlie power station project location and nominated sensitive receptors

2.2 Meteorological data

The meteorology of the required site was simulated using the Weather Research and Forecasting Model (Michalakes et al. 2001), subsequently referred to as “WRF”. This is a state-of-the-art numerical model, which uses the basic laws of physics and thermodynamics to calculate the evolution of a region's meteorology in time and space. While originally released in 2001, it has been continuously updated since that date. Version 4.6 has been used in this assessment.

It represents the interactions of many variables, including wind velocity, air pressure, temperature and humidity, cloud, rain, snow, plus surface characteristics like soil moisture, land use type, vegetation structure, ground roughness and water surface temperature. These are represented on a set of three-dimensional grids, covering the full depth of the atmosphere and a horizontal region that may be only a few kilometres wide, or cover the whole globe. Normally it is used in "nested" mode, in which the broader scales surrounding a region of particular interest are represented at coarse resolution, while those centred on that region are represented on a fine scale.

2.2.1 Meteorological model configuration

The model run used five nests, with south-north resolution 81000, 27000, 9000, 3000 and 1000 metres, and west-east resolution approximately 85% of these values.

The centre of the modelling region was set at 32.683°S, 21.496°E. A polar grid setup was used. The innermost four nested grids were of size 31 by 31 cells, with the outermost 25 by 19. The innermost two were each centred within the next largest, with the third and fourth displaced northward within the next outermost (Figure 2-2). This arrangement was chosen to ensure that the transport of moisture, and so rainfall, from the ocean, and effects of winds from the southern coast, were adequately represented.

The run simulated the period 1 January to 31 December 2020. This period was preceded by a single day's "run up", provided to permit model parameters to stabilise. Experience has shown that since the model was initialised using high-resolution measured data, a good match between modelled and measured values developed within a few hours.

Input boundary and initial conditions for the model were obtained using the ERA5 reanalyses (Herzbach et al. 2023). The data used comprised a subset of the global data set, at 1° horizontal resolution with 16 levels from the surface to 50 hPa, covering the region from 90° to 165°E and 65° to 0°S.

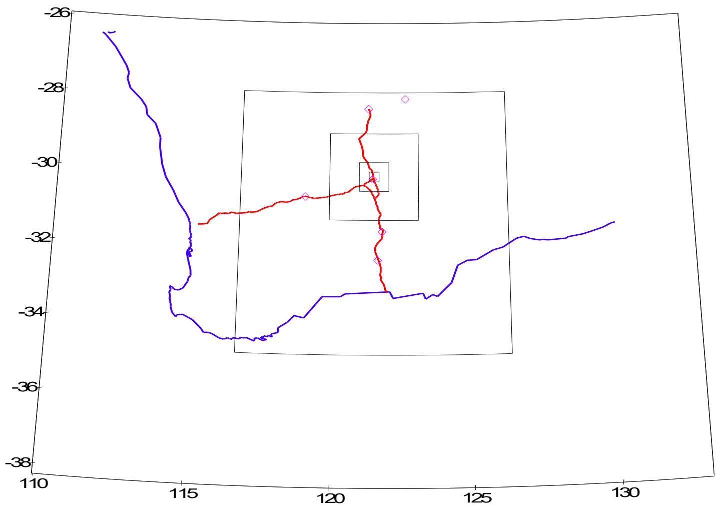


Figure 2-2: Boundaries of the five nested grids used for modelling, with an outline of the Western Australian coastline (blue) and major roads (red) for reference.

Other important configuration choices comprised:

- Providing for time-varying sea surface temperatures, based on global data records;
- Output of model results at hourly intervals for the two innermost grids, three-hourly intervals for the next two and six-hourly for the outermost;
- Lateral boundary conditions for the outermost nest provided by global measured data, with two-way transfer of boundary data at the edges of inner nests;
- Adaptive time steps, to speed execution. Experience has shown that while there are small differences between model results for fixed and adaptive time steps, both approaches give similar accuracy;
- 28 model layers, with interfaces between near-surface layers at heights of about 20, 50, 90, 160, 250, 360, 550 and 760 m;
- Microphysics using the WRF Single-Moment 6-class scheme (option 6), cumulus physics using the newer Tiedeke scheme (option 16), longwave radiation using the Rapid Radiative Transfer Model (option 4), shortwave radiation using the Dudhia scheme (option 1), surface layer using the revised MM5 surface layer scheme (option 1). These were found not to be crucial options, all reasonable choices giving similar results;
- Surface physics using the Noah Land Surface Model;
- Surface heights obtained for the Geoscience Australia 9-second data set;
- 4 soil layers;
- Boundary layer physics using the YSU scheme. This choice has been found to give reliable results, and also permits the use of the topographic wind adjustment scheme. The topographic wind adjustment factor ("topo_wind") was set to zero, this being appropriate for the low topography of the Kalgoorlie region. However, it was found to have negligible effect in this case;
- Non-hydrostatic modelling for all nests; and
- Nested boundary relaxation width of 4 cells;

Land use classes employed in the model were based on the MODIFIED_IGBP_MODIS_NOAH 30 second data set, with the exception that the urban area of Kalgoorlie was adjusted to match satellite imagery, and the area of Kalgoorlie Airport was set to the "barren ground" classification. Brief checks showed that these alterations had little effect on model results.

For the model run which is the focus of this report, WRF was run using only the standard initial and boundary condition inputs:

- Site measurements were not included, because it was desired to be able to compare model estimates with measurements. Should data from measurement sites have been incorporated in the model run, this would not have been feasible, since the validation process would have involved comparison of measurements with a derivative of those measurements; and
- Nudging of model calculations towards the ongoing values in the ERA5 analyses (using the "grid nudging" approach) was not used, since previous work had shown little effect on model results.

The CALMET meteorology files were generated for the period 31 December 2018 to 31 December 2019 (noting that the initial day was a run-up period for WRF) with a grid size of 105 points west-east and 90 points south-north, and 14 levels corresponding to the lowest 14 levels used by WRF. The southwest grid origin was located at UTM zone 51, 348125 m east and 6588250 m north, using grid intervals of 50 m. This grid was located well within innermost WRF modelling grid.

2.2.2 Analysis of the meteorological model results

The sole nearby site for which validation data were available was the Bureau of Meteorology station at Kalgoorlie Airport (located 30.7844°S, 121.4542°E). This is located on open ground, with the nearest buildings 50 m to the west and 70 m to the north west.

The modeled region was relatively flat, with only small, broad rises in topography. Corresponding modeled wind field variations were therefore relatively gradual (Figure 2-3).

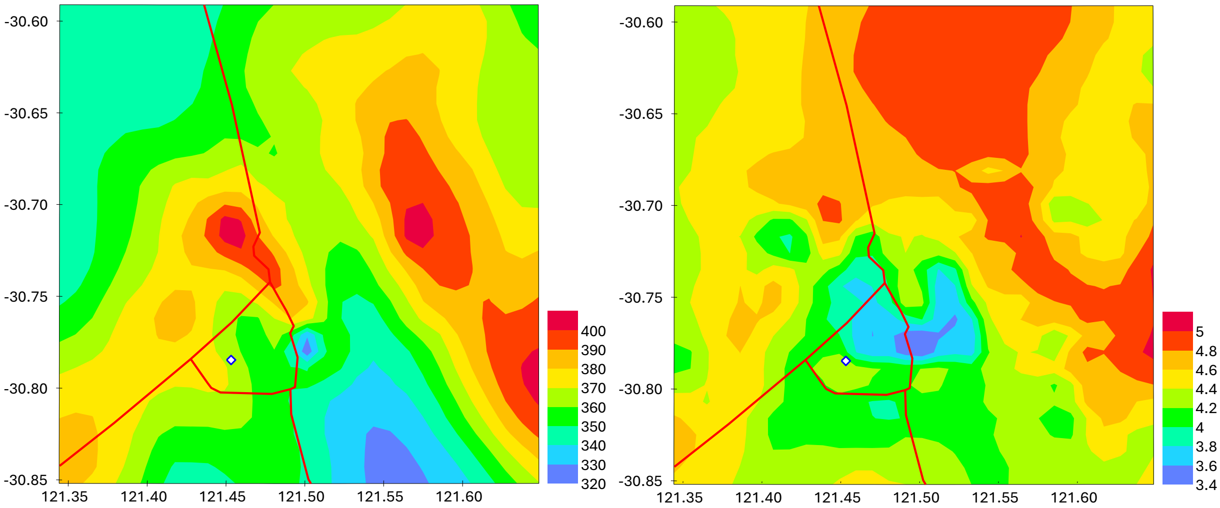


Figure 2-3: Surface heights (m) (Left) and modelled mean wind speeds (m/s) for the innermost model grid (Right). Red lines indicate major roads and the diamond shows the location of the Kalgoorlie Airport measurement site.

The model simulation showed reasonable performance at the Kalgoorlie Airport site. Sample plots of wind speed and direction are shown in Figure 2-4 and Figure 2-5, and statistics relating to the validation quality for wind speed, wind direction and air temperature are shown in Table 2-2.

Total modeled rainfall at Kalgoorlie Airport was 172.0 mm, while the measured total was 163.6. Figure 2-6 shows the trends of measured and modeled rainfall. It can be seen that there are some rainfall events in which modeled rainfall was heavier, others in which measured rainfall was heavier. This is a normal occurrence, particularly when modeling rainfall in semi-arid areas. As found by Rye (2021), matching of the time of rainfall events is the more important objective.

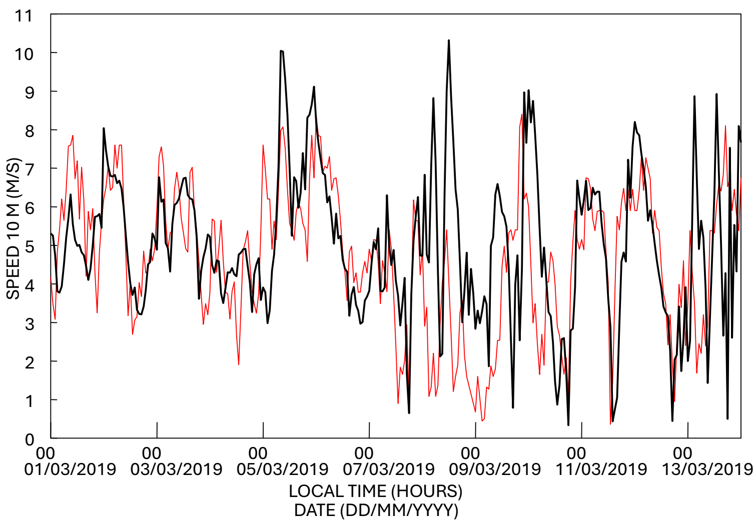


Figure 2-4: Sample plot comparing modeled (black line) and measured (red line) wind speeds at Kalgoorlie Airport

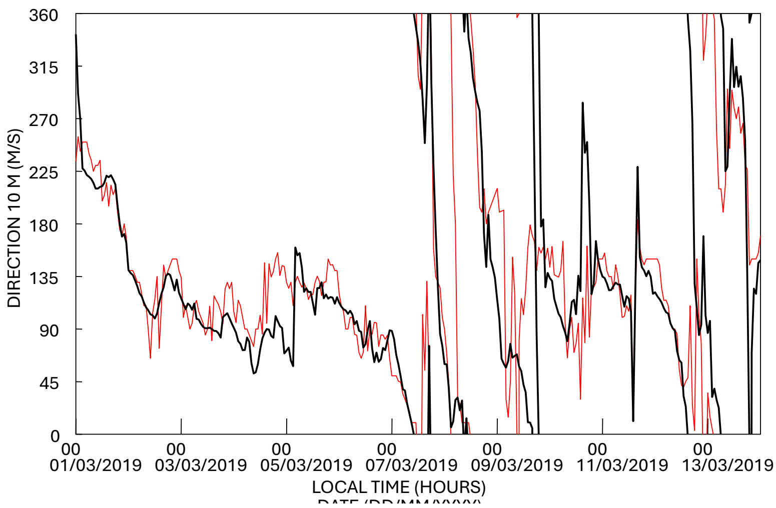


Figure 2-5: Sample plot comparing modeled (black line) and measured (red line) wind directions at Kalgoorlie Airport

Table 2-2: Model validation statistics for Kalgoorlie Airport

Variable	Wind Speed 10m	Wind Direction 10m	Air Temperature 2m
Gross Error	1.10 m/s	26.45º	2.04ºC
Index of Agreement	0.836	N/A	0.9794
Linear Fit Slope	1.025	0.985	1.046
Linear Fit Constant	-0.106 m/s	-1.633º	-2.421ºC
Standard Deviation	1.381 m/s	39.974º	1.976ºC
Correlation coefficient (r)	0.836	0.959	0.988

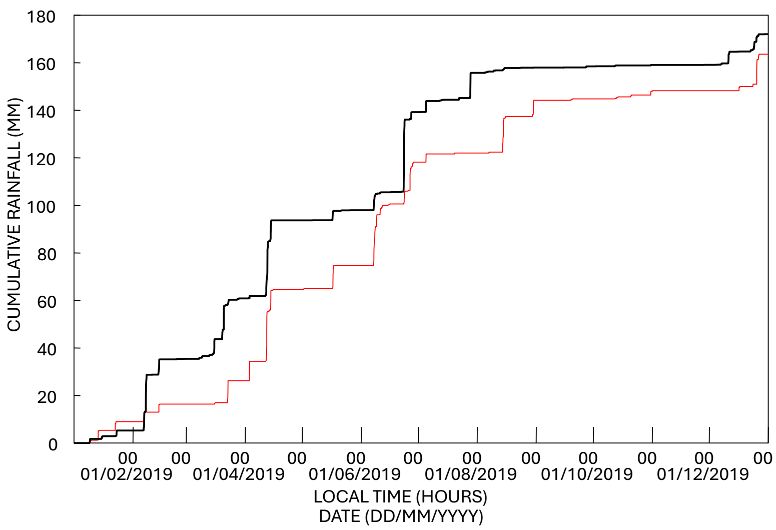


Figure 2-6: Comparison of modeled (black line) and measured (red line) cumulative rainfall at Kalgoorlie Airport.

Table 2-3 and Figure 2-7 show model estimates the occurrence of stability classes A-F, using the scheme of Golder (1972). While no validation of these estimates is possible, the greater relative frequency of high stability (class F) for wind direction sectors from north to east might be noted.

Table 2-3: Stability class distribution changes with wind direction.

Direction Sector	Stability Class					
	A	B	C	D	E	F
N	17	41	62	46	34	136
NE	38	72	81	24	52	213
E	71	141	146	169	134	219
SE	65	110	149	255	179	130
S	48	42	59	111	103	67
SW	29	57	91	48	151	109
W	22	42	105	127	107	72
NW	28	23	54	78	69	67
Totals	318	528	747	858	829	1013

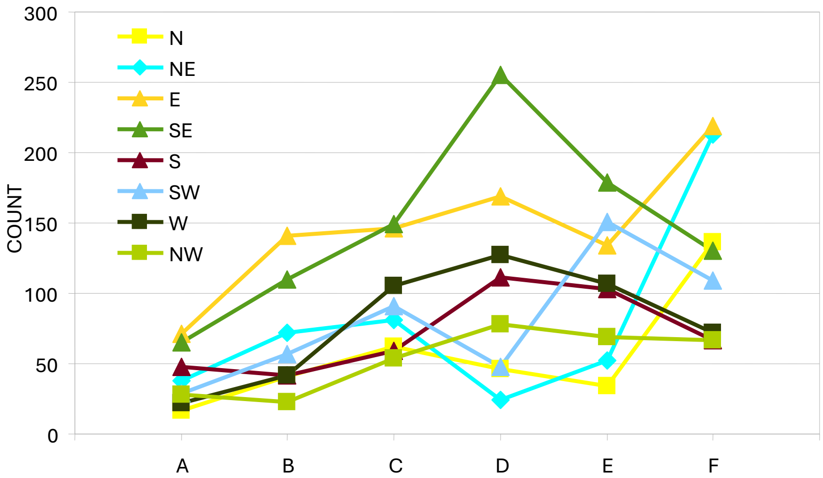


Figure 2-7: Stability class distribution changes with wind direction.

2.2.3 Buoyancy enhancement

Combined plume rise or plume rise enhancement is often used to account for the effect that nearby plumes will tend to merge and increase the overall plume rise of each individual plume. Plume rise enhancement was used in the model validations for the Karratha Gas Plant by Physick and Blockley (2001) who argued it was required to explain the observed concentrations, and also in the later model validation by Pitts et al (2011).

To better represent the effective plume rise from the proposed stack configuration at the Kalgoorlie Power Station, a buoyancy enhancement factor was applied in this assessment. The enhancement is based on work previously undertaken by Briggs (Briggs, 1975; 1984) and was later described by CSIRO (Manins et al., 1992). The approach defines a buoyancy enhancement factor (NE) as follows:

Equation 2-1

$$NE = \left[\frac{[n+S]}{[1+S]}\right]^{1/3}$$

Where *n* is the number of stacks and *S* is the dimensionless separation factor, defined as:

Equation 2-2

$$S = 6 * \left[\frac{(n-1)\Delta s}{n^{1/3}\Delta z}\right]^{3/2}$$

Where Δ*s* is the stack separation and Δ*z* is the rise of an individual plume above the top of the stack (i.e. for a single stack in isolation). The relevant Δ*z* was estimated for a single stack in isolation, whilst Δ*s* was based on the stack separation. The separation factor and buoyancy enhancement factor were then estimated in accordance with Equation 1 and Equation 2. The CALPUFF model was then re-run to provide hourly plume rise profiles incorporating buoyancy enhancement. The buoyancy enhancement factor was applied to separate clusters of six proposed stacks.

An equivalent diameter of 3.68 m was adopted in the modelling, based on an original stack diameter of 1.4 m, to reflect this enhancement. This adjustment is intended to provide a more realistic representation of plume behaviour under operational conditions and improve the accuracy of predicted ground level concentrations.

2.3 Particulate emissions

In this assessment, whilst emissions of total particulates have been modelled, the results have only been compared against the $PM_{2.5}$ (particulate matter ≤2.5 µm in diameter) guideline. The $PM_{2.5}$ criteria is more conservative than the PM_{10} criteria and $PM_{2.5}$ is widely recognised as posing a greater risk to human health than PM_{10}, due to its ability to penetrate deeper into the respiratory system and enter the bloodstream (DEC, 2011). As such, this guideline has been adopted as the primary indicator for assessing potential health impacts from airborne particulates.

2.4 Background concentrations

The Department of Water and Environmental Regulation (DWER) collects air quality data in Western Australia from a number of monitoring stations throughout the Perth, Kwinana, Southwest, Kalgoorlie and Midwest regions of the state. No specific guidance for selection of an appropriate background level is provided in Western Australia. Accordingly, in Victoria, the State Environment Protection Policy (Ambient Air Quality) (SEPP (AQM)) (EPA Victoria, 2001) states that the 70th percentile concentration (concentration which is exceeded by 30% of concentrations for that averaging period) should be adopted as the background level. DWER reports annually the 75th percentile for NO_2, $PM_{2.5}$, SO_2, and CO short-term averages at its monitoring stations in Western Australia. Hence, in the absence of reported 70th percentile values, the highest recorded 75th percentile for short-term averages and the annual average concentrations measured at any of the DWER monitoring stations for the most recent published monitoring period (2022) were utilised in this study to represent the ambient background concentrations (Table 2-4) of the pollutants of concern. Where there was 75th percentile and annual average monitoring data available for the Kalgoorlie region, that data takes precedence.

In the absence of monitoring data in the DWER document (2022), regional concentrations were adapted from the Copernicus Atmosphere Monitoring Service (CAMS) global reanalysis dataset (Copernicus, 2024) (Table 2-5).

Table 2-4: DWER monitored ambient background concentrations

Pollutant	Averaging period	Concentration (µg/m³)[1]	Monitoring station
NO_2	75th percentile 1-hour	35.7	Duncraig & South Lake
	Annual	11.3	South Lake
$PM_{2.5}$	75th percentile 24-hour	4.7	Kalgoorlie
	Annual	4.2	Kalgoorlie
SO_2	75th percentile 1-hour	13.1	Kalgoorlie
	75th percentile 24-hour	5.2	Kalgoorlie
CO	75th percentile 8-hour	343.5	Duncraig & South Lake

Notes
1. Referenced to 25ºC, and 101.3 kPa

Table 2-5: CAMS monitored background concentrations

Pollutant	Averaging Period	Concentration (µg/m³)[1]
SO_2	Annual	0.098
CO	70th percentile 1-hour	84
CH_2O	70th percentile 1-hour	2.0
	70th percentile 24-hour	2.1

Notes
1. Referenced to 25ºC, and 101.3 kPa

2.5 Treatment of oxides of nitrogen

A key element in assessing the potential environmental impacts from ground level NO_2 concentrations is estimating NO_2 concentrations from modelled NO_x emissions. The final NO_2 concentration is a combination of the NO emitted as NO_2 from the source stacks and the amount of NO that is converted to NO_2 by oxidation in the plume after release.

Generally, after the NO_x is emitted from the stack, additional NO_2 is formed as the plume mixes and reacts with the surrounding air. There are several reactions that both form and destroy NO_2, but the primary reaction is oxidation with ozone according to the following reaction (Calvert et al, 2015):

$$NO + O_3 \rightarrow NO_2 + O_2$$

This reaction is essentially instantaneous as the plume entrains the surrounding air. It is limited by the amount of ozone available and by how quickly the plume mixes with the surrounding air. Thus, the ratio of NO_2 to NO_x increases as the plume disperses downwind. After release, the NO is converted to NO_2 by chemical reactions, primarily involving ozone in the presence of sunlight and to a lesser extent due to other reactive gases.

MRP has applied the Ozone Limiting Method (OLM) to predict ground level concentrations of NO_2 as specified by the USEPA (see Cole and Summerhays 1979; Tikvart 1996) and NSW Environment Protection Authority (NSW EPA, 2016). This method assumes that all the available ozone in the atmosphere will react with nitrogen oxide (NO) in the plume until either all the available ozone or all the NO is used up. This approach is conservative in that it assumes that the atmospheric reaction is instant when in reality, the reaction takes place over a number of hours.

In the absence of ozone monitoring data in the Kalgoorlie region, regional 3-hourly ozone concentrations were adapted from the Copernicus Atmosphere Monitoring Service (CAMS) global reanalysis dataset (Copernicus, 2024) and utilised in this assessment.

2.6 Scenarios

A number of scenarios representing potential future operations under normal operating conditions were modelled as part of the assessment. It is noted that the power station is typically expected to operate in gas mode (Scenario #1 and #2). The power station will operate in liquid fuel (LFO) mode only in the event that natural gas is unavailable. An investigation into the frequency of historic gas supply interruptions was undertaken. Northern Star Resources has verbally communicated that the gas supply has not been interrupted during normal operation conditions in the previous ten (10) years and that the Parkeston facility has not previously experienced any interruptions to their gas supply. An overview of the scenarios modelled as part of this assessment is provided below.

Scenario #1: Gas mode - in isolation

- 12 stacks from 2 engine halls (6 stacks for each engine hall) operating in gas mode
  - 370 mg/m^3 NOx emissions, dry at 15% O_2
  - 220 mg/m^3 carbon monoxide emissions, dry at 15% O_2
  - 14 mg/m^3 sulphur dioxide emissions, dry at 15% O_2
  - 7 mg/m^3 particulate matter as $PM_{2.5}$ emissions, dry at 15% O_2
  - 30 mg/m^3 formaldehyde emissions, dry at 15% O_2

Scenario #2: Gas mode - cumulative

- Scenario #1 emissions with background concentrations.

Scenario #3: LFO mode - in isolation

- 12 stacks from 2 engine halls (6 stacks for each engine hall) operating in LFO mode

- 1700 mg/m^3 NOx emissions, dry at 15% O_2
- 30 mg/m^3 carbon monoxide emissions, dry at 15% O_2
- 70 mg/m^3 sulphur dioxide emissions, dry at 15% O_2
- 25 mg/m^3 particulate matter as $PM_{2.5}$ emissions, dry at 15% O_2

Scenario #4: LFO mode - cumulative.

- Scenario #3 emissions with background concentrations.

In terms of potential upset conditions, Zenith Energy indicated that emissions from startup and shutdown operations will not significantly differ from normal operations (per comms: 9th & 10th August 2025). Startup operations occur for short duration with a maximum startup time of 5 minutes where the overall concentration of pollutants within the emissions stream is similar to normal operations (as represented in scenarios #1 & #4).

2.7 Stack parameters and emissions estimates

Table 2-6 presents the emissions estimates and stack parameters from the operation of the power station using gas fuel and diesel (Gas mode and LFO mode) respectively used in the air dispersion modelling. Table 2-5 displays the coordinates of the stacks based on the information provided by Zenith.

Table 2-6: Summary of estimated emissions per engine

Parameter	Units	Gas mode	LFO mode
Height	**m**	30	30
Diameter	**m**	1.4 (3.68)[1]	1.4 (3.68)[1]
Temp	**K**	610	553
Exit velocity	**m/s**	22.4	22.7
Emission estimates			
Oxide of nitrogen (NOx)	**g/s**	7.8	38.6
PM_{25}	**g/s**	0.1	0.6
Sulphur dioxide (SO_2)	**g/s**	0.3	1.6
Carbon monoxide (CO)	**g/s**	4.6	0.7
Formaldehyde (CH_2O)	**g/s**	0.6	NE

Notes
1. The value in brackets is an equivalent diameter calculated using the buoyancy enhancement factor as outlined in Section 2.2.3.
2. NE = Negligible emissions

Table 2-7: Stack locations

Stack description	Easting (UTM zone 51) (m)	Northing (UTM zone 51) (m)
Engine hall 1-1	355,559	6,599,905
Engine hall 1-2	355,557	6,599,903
Engine hall 1-3	355,555	6,599,900
Engine hall 1-4	355,552	6,599,902

Stack description	Easting (UTM zone 51) (m)	Northing (UTM zone 51) (m)
Engine hall 1-5	355,554	6,599,905
Engine hall 1-6	355,556	6,599,907
Engine hall 2-1	355,507	6,599,948
Engine hall 2-2	355,504	6,599,946
Engine hall 2-3	355,502	6,599,943
Engine hall 2-4	355,499	6,599,945
Engine hall 2-5	355,502	6,599,948
Engine hall 2-6	355,504	6,599,951

3 Air quality criteria

Ambient air quality standards are generally designed to protect human health, with an adequate margin of safety, including sensitive populations such as children, the elderly, and individuals suffering from respiratory diseases. They are generally applied at residential areas or places where people may congregate in public areas, such as beaches or picnic areas. In this instance, nearby residences would be the nearest sensitive receptors where ambient air quality standards would apply.

The Department of Water and Environmental Regulation (DWER) published the Guidance Statement for Risk Assessments in February 2017 (DWER, 2017) and the draft Guideline: Air Emissions in October 2019 (DWER, 2019), which refer to air quality criteria that may be considered in determining public health and environment impacts. The publications containing air quality criteria relevant to this assessment include:

- National Environment Protection (Ambient Air Quality) Measure (NEPM) (NEPC, 2021), noting that a proposed variation to the $PM_{2.5}$ and SO_2 standards have recently come into effect as of January 2025;
- NEPM (Air Toxics) (NEPC, 2011); and
- Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (AMMAAP) (NSW EPA, 2022).

Table 3-1 displays standards for pollutants relevant to this assessment. Where there is available framework in both the NEPM (NEPC, 2021) and the DWER guideline (2019), the NEPM criteria is used.

Table 3-1: Relevant air quality criteria

Compound	Averaging period	Concentration (µg/m³)[1]	Source
NO_2	1-hour	151	(NEPC, 2021)
	Annual	28	
$PM_{2.5}$	24-hour	18	(NEPC, 2021)
	Annual	6.4	
SO_2	1-hour	196	(NEPC, 2021)
	24-hour	52	
	Annual	52	(DWER, 2019)
CO	1-hour	30,000	(DWER, 2019)
	8-hour	10,000	(NEPC, 2021)
CH_2O	1-hour	20	(DWER, 2019)
	24-hour[2]	49	(NEPC, 2011)

Notes
1. Referenced to 25ºC, and 101.3 kPa
2. This is a monitoring investigation level. As defined in the NEPM (AT) (NEPC, 2011), monitoring investigation levels are established for use in assessing the significance of the monitored levels of air toxics with respect to protection of human health. If the monitoring investigation level is exceeded then some form of further investigation by the relevant jurisdiction of the cause of the exceedance is appropriate.

4 Modelling results

4.1 Nitrogen dioxide

Contour plots showing predicted concentrations of NO_2 can be found in Figure 4-1 to Figure 4-8 below, with relevant air quality criteria displayed as a red contour line. Table 4-1presents the predicted GLCs at nearby sensitive receptors in the region.

Results of the modelling indicated that for the normal operations scenario, no exceedances of relevant 1-hour maximum or annual average ambient guideline values (AGVs) for NO_2 were predicted at any nearby sensitive receptors. Concentrations of NO_2 are predicted to meet and/or exceed the 1-hour NO_2 AGV at the sensitive receptors: Ninga Mia East and Kalgoorlie North 2, with predicted values of 104% and 100% respectively for scenario 4 (LFO mode – cumulative). It is noted that Northern Star Resources has verbally communicated that the gas supply has not been interrupted during normal operation conditions in the previous ten (10) years and that the Parkeston facility has not previously experienced any interruptions to their gas supply. Given the low likelihood of the gas supply being interrupted and the low probability that it would occur under worst case meteorological conditions, the likelihood of an exceedance occurring would be considered negligible. When considered in isolation, the same receptors reach 80% and 77% of the 1-hour AGVs respectively.

Table 4-1: Summary of predicted NO_2 concentrations at the closest sensitive receptors

1-hour maximum NO_2 ground level concentrations												
Receptor		Criteria	Background		Scenario 1 Gas mode - isolation		Scenario 2 Gas mode - cumulative		Scenario 3 LFO mode - isolation		Scenario 4 LFO mode - cumulative	
		(µg/m³)[1]	(µg/m³)[1]	% Guideline	(µg/m³)[1]	% Guideline	(µg/m³)[1]	% Guideline	(µg/m³)[1]	% Guideline	(µg/m³)[1]	% Guideline
Rec_001	Ninga Mia East	151	35.7	24%	53	35%	89	59%	121	80%	157	104%
Rec_002	Ninga Mia West				60	40%	96	64%	91	61%	127	84%
Rec_003	Kalgoorlie North 3				54	36%	90	59%	100	66%	136	90%
Rec_004	Kalgoorlie North 2				54	36%	90	60%	116	77%	151	100%
Rec_005	Kalgoorlie North 1				52	35%	88	58%	96	64%	132	87%
Rec_006	Kalgoorlie Central				55	36%	91	60%	93	62%	129	86%
Rec_007	Kalgoorlie South 1				54	36%	90	59%	90	60%	126	84%
Rec_008	Kalgoorlie South 2				57	38%	93	62%	85	56%	121	80%
Rec_009	Kalgoorlie South 3				38	25%	76	50%	71	47%	107	71%
Rec_010	Williamstown North				46	30%	85	56%	79	52%	118	78%
Rec_011	Williamstown Central East				45	30%	81	53%	85	56%	122	81%
Rec_012	Williamstown Central West				46	30%	82	54%	75	50%	111	73%
Rec_013	Williamstown South				44	29%	80	53%	76	51%	112	74%
Annual average NO_2 ground level concentrations												
Receptor		Criteria	Background		Scenario 1 Gas mode - isolation		Scenario 2 Gas mode - cumulative		Scenario 3 LFO mode - isolation		Scenario 4 LFO mode - cumulative	
		(µg/m³)[1]	(µg/m³)[1]	% Guideline	(µg/m³)[1]	% Guideline	(µg/m³)[1]	% Guideline	(µg/m³)[1]	% Guideline	(µg/m³)[1]	% Guideline
Rec_001	Ninga Mia East	28	11.3	40%	0.7	3%	12.1	43%	1.7	6%	13.1	47%
Rec_002	Ninga Mia West				0.7	3%	12.1	43%	1.8	6%	13.1	47%
Rec_003	Kalgoorlie North 3				1.3	5%	12.7	45%	3.4	12%	14.8	53%
Rec_004	Kalgoorlie North 2				1.5	5%	12.9	46%	3.7	13%	15.1	54%
Rec_005	Kalgoorlie North 1				0.8	3%	12.3	44%	2.3	8%	13.8	49%
Rec_006	Kalgoorlie Central				0.8	3%	12.3	44%	2.1	8%	13.6	49%
Rec_007	Kalgoorlie South 1				0.6	2%	12.8	46%	1.7	6%	13.9	50%
Rec_008	Kalgoorlie South 2				0.6	2%	12.2	44%	1.6	6%	13.2	47%
Rec_009	Kalgoorlie South 3				0.5	2%	12.0	43%	1.5	5%	13.0	46%
Rec_010	Williamstown North				0.6	2%	12.2	44%	1.6	6%	13.2	47%
Rec_011	Williamstown Central East				0.6	2%	12.2	44%	1.6	6%	13.2	47%
Rec_012	Williamstown Central West				0.6	2%	12.2	44%	1.6	6%	13.2	47%
Rec_013	Williamstown South				0.5	2%	12.2	43%	1.4	5%	13.1	47%

Notes

1. Referenced to 25ºC, and 101.3 kPa

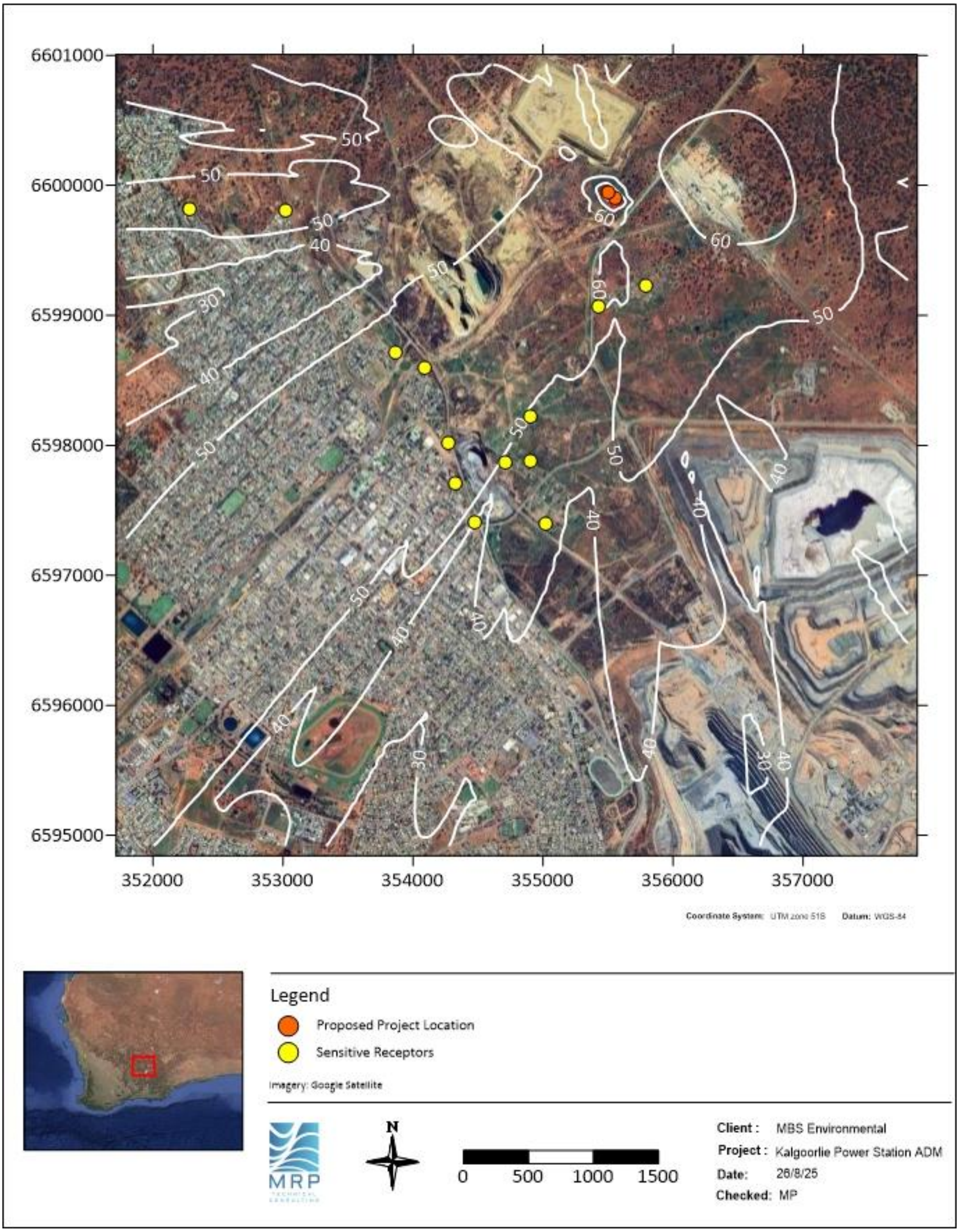


Figure 4-1: Predicted 1-hour maximum GLCs of NO_2 ($\mu g/m^3$) in isolation – gas mode (Scenario 1)

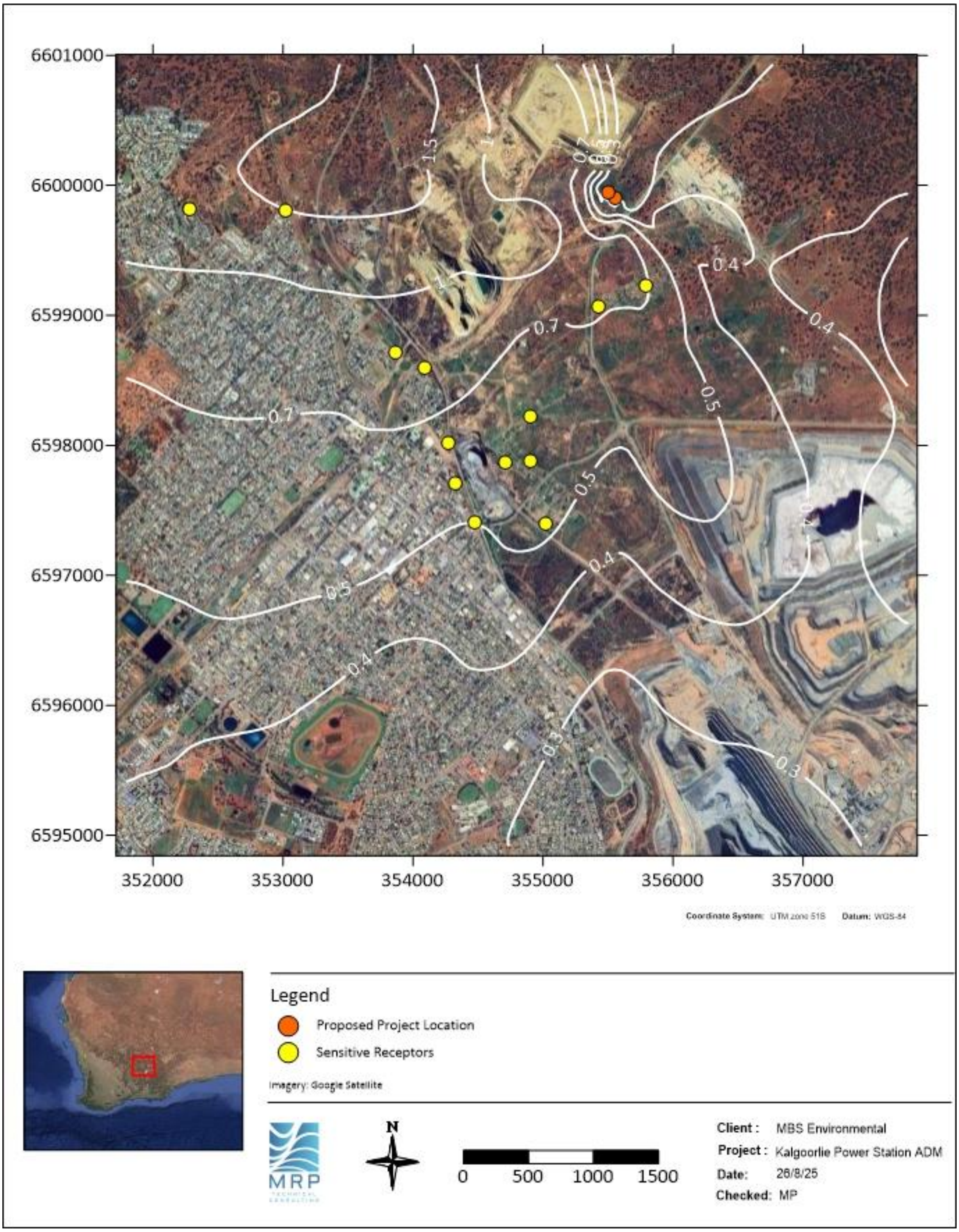


Figure 4-2: Predicted annual average GLCs of NO_2 (μg/m^3) in isolation – gas mode (Scenario 1)

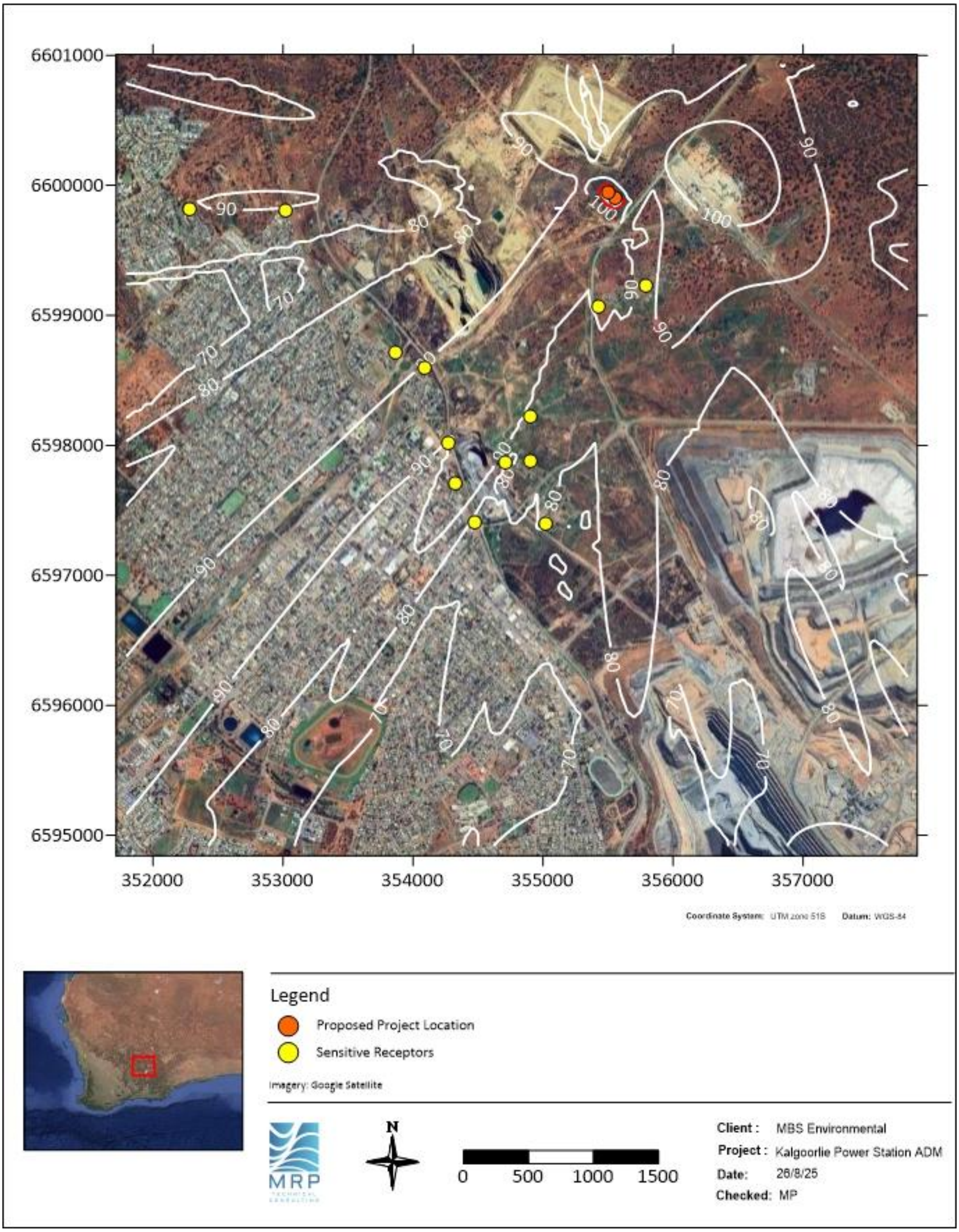


Figure 4-3: Predicted cumulative 1-hour maximum GLCs of NO_2 (µg/m^3) – gas mode (Scenario 2)

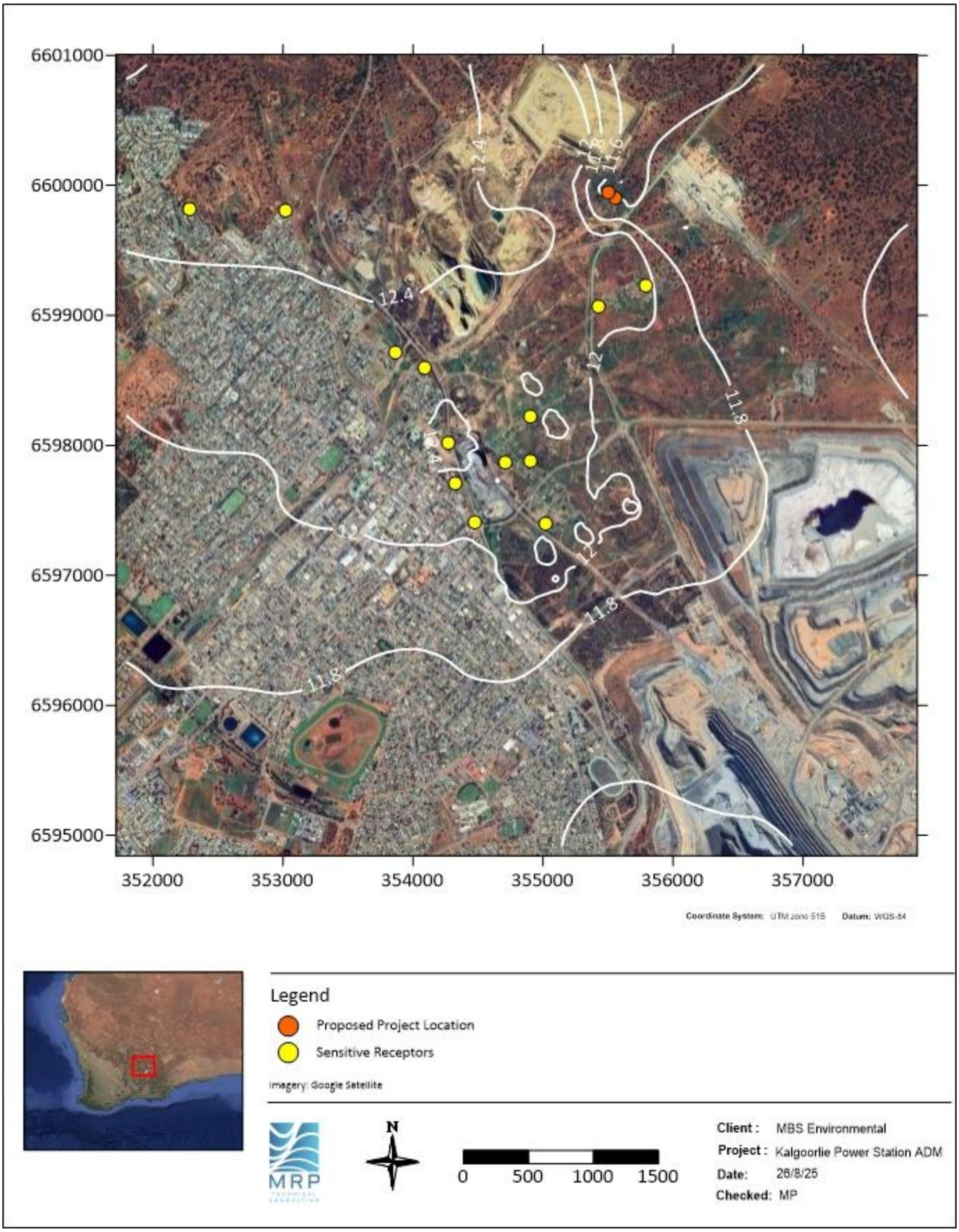


Figure 4-4: Predicted cumulative annual average GLCs of NO_2 (µg/m^3) – gas mode (Scenario 2)

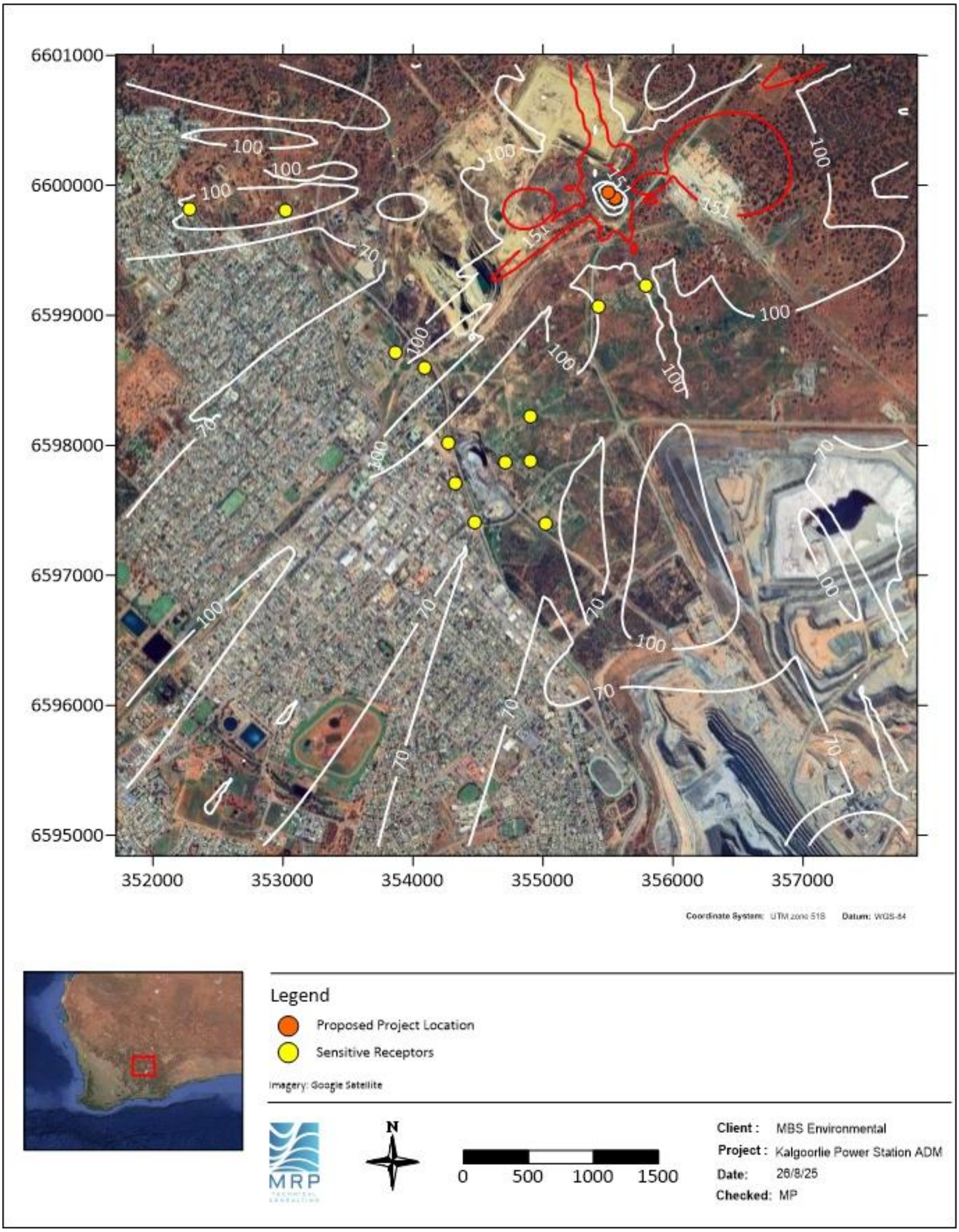


Figure 4-5: Predicted 1-hour maximum GLCs of NO_2 (µg/m[3]) in isolation – LFO mode (Scenario 3)

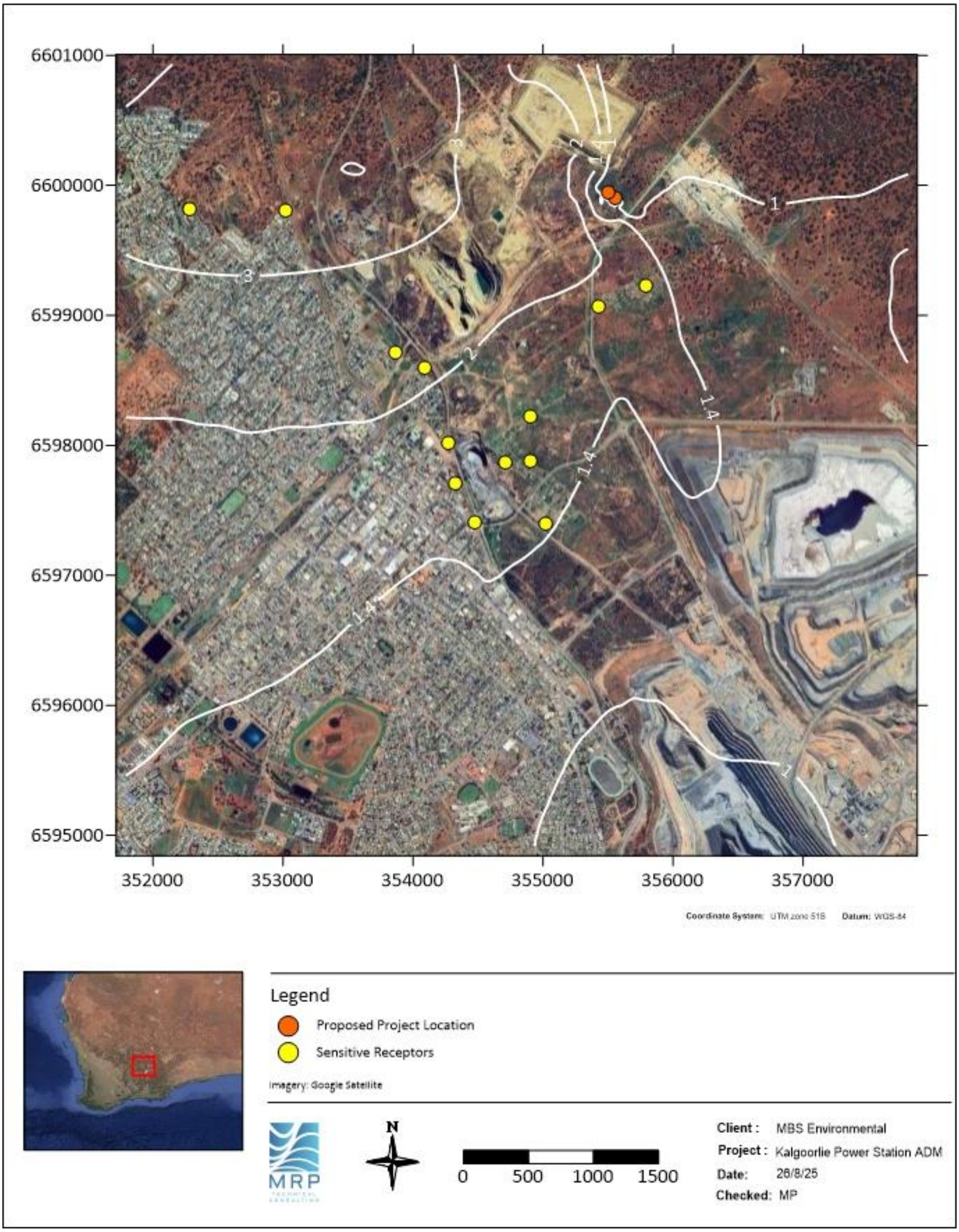


Figure 4-6: Predicted annual average GLCs of NO_2 (μg/m^3) in isolation – LFO mode (Scenario 3)

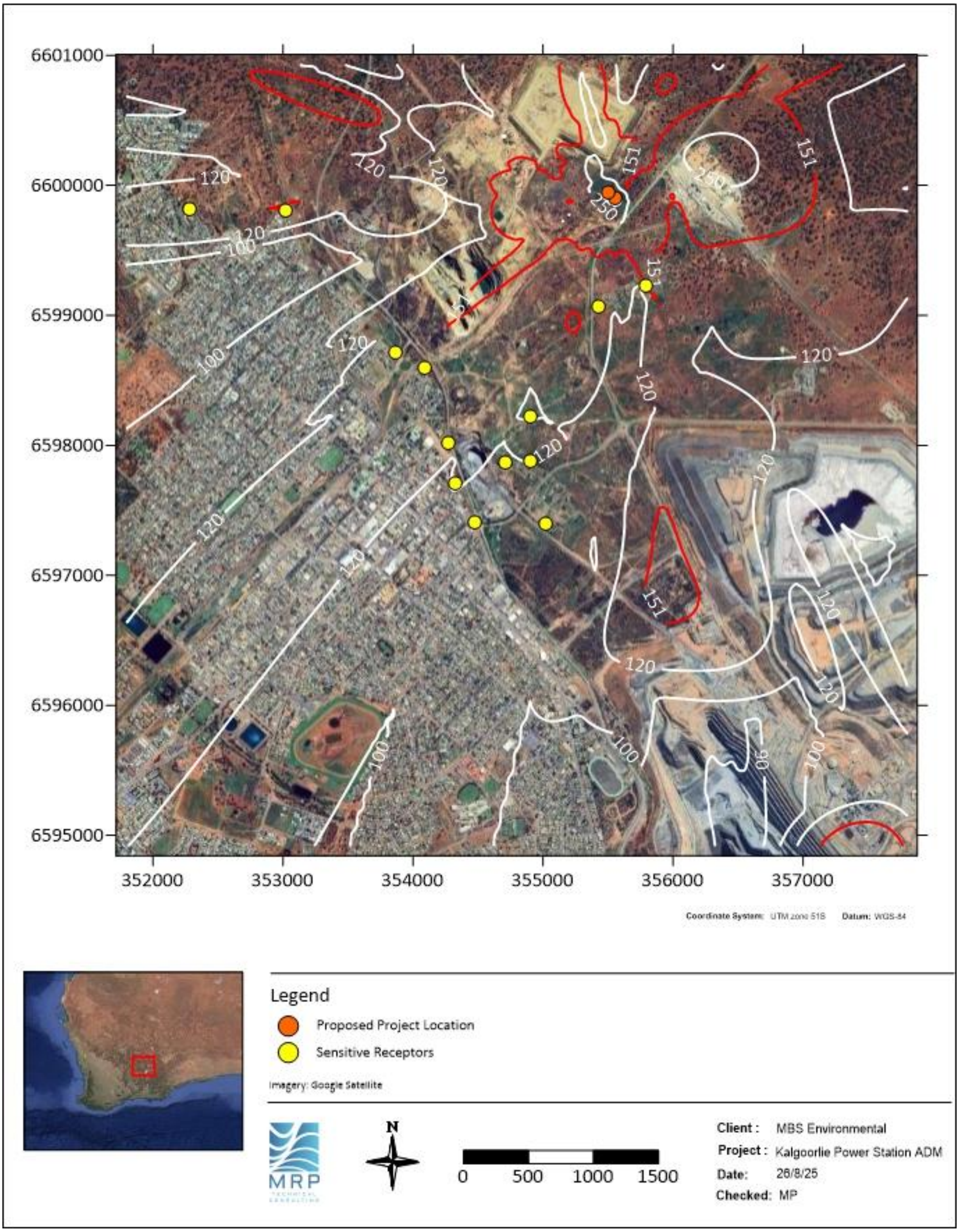


Figure 4-7: Predicted cumulative 1-hour maximum GLCs of NO_2 (μg/m^3) – LFO mode (Scenario 4)

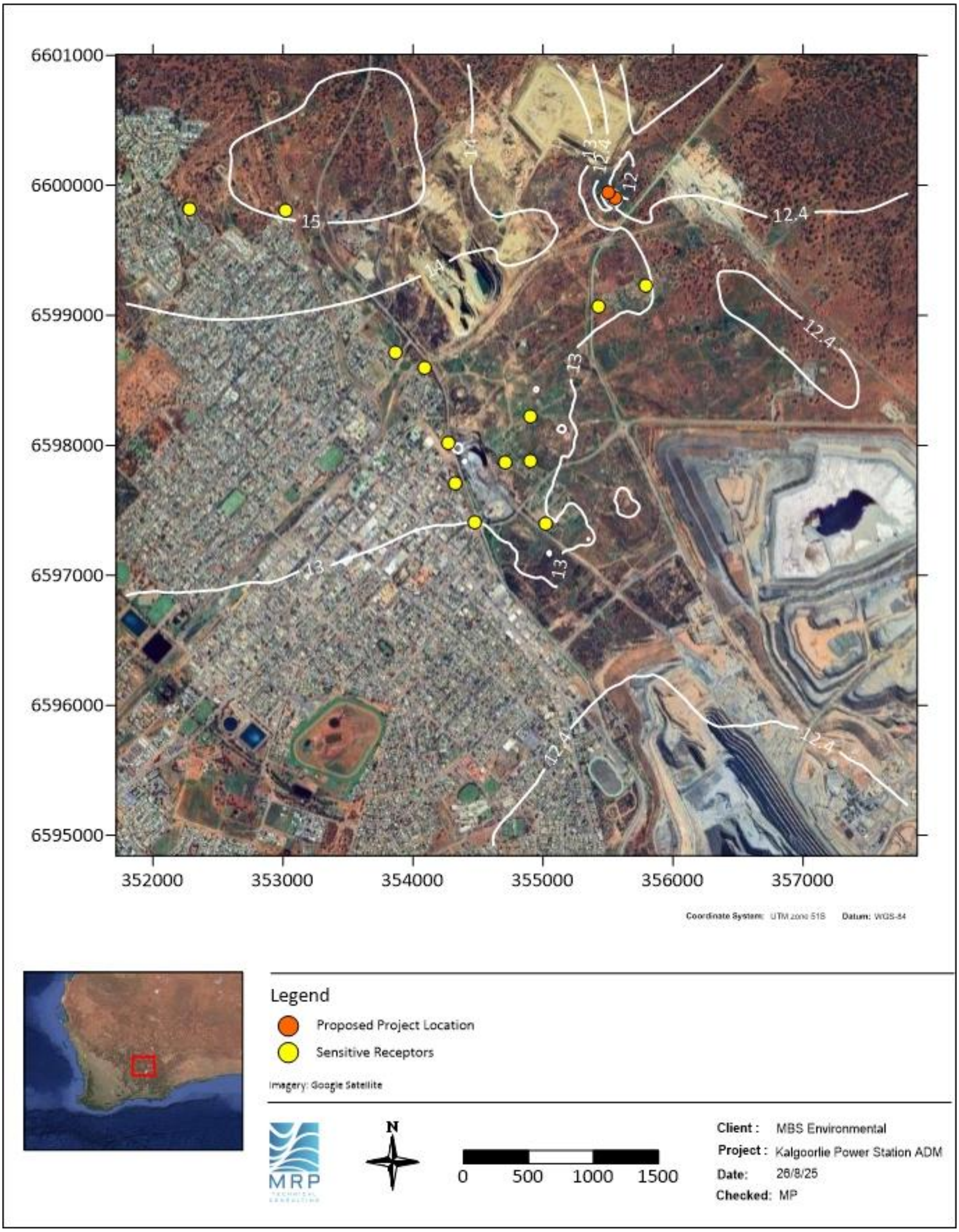


Figure 4-8: Predicted cumulative annual average GLCs of NO_2 (µg/m^3) – LFO mode (Scenario 4)

4.2 Particulate matter ($PM_{2.5}$)

Contour plots showing predicted concentrations of $PM_{2.5}$ can be found in Figure 4-9 to Figure 4-16 below, with relevant air quality criteria displayed as a red contour line. Table 4-2 presents the predicted GLCs at nearby sensitive receptors in the region.

Results of the modelling indicated that there were no exceedances of the relevant 24-hour maximum or annual average AGVs for $PM_{2.5}$ predicted at any of the nearby sensitive receptors for any of the modelled scenarios.

Table 4-2: Summary of predicted $PM_{2.5}$ concentrations at the closest sensitive receptors

24-hour maximum $PM_{2.5}$ ground level concentrations												
Receptor		Criteria	Background		Scenario 1 Gas mode - isolation		Scenario 2 Gas mode - cumulative		Scenario 3 LFO mode - isolation		Scenario 4 LFO mode - cumulative	
		(µg/m³)[1]	(µg/m³)[1]	% Guideline	(µg/m³)[1]	% Guideline	(µg/m³)[1]	% Guideline	(µg/m³)[1]	% Guideline	(µg/m³)[1]	% Guideline
Rec_001	Ninga Mia East	18	4.7	26%	0.35	2%	5.05	28%	1.34	7%	6.04	34%
Rec_002	Ninga Mia West				0.31	2%	5.01	28%	1.29	7%	5.99	33%
Rec_003	Kalgoorlie North 3				0.29	2%	4.99	28%	1.16	6%	5.86	33%
Rec_004	Kalgoorlie North 2				0.35	2%	5.05	28%	1.35	8%	6.05	34%
Rec_005	Kalgoorlie North 1				0.25	1%	5.01	28%	1.07	6%	5.77	32%
Rec_006	Kalgoorlie Central				0.23	1%	5.05	28%	1.04	6%	5.74	32%
Rec_007	Kalgoorlie South 1				0.21	1%	5.18	29%	0.87	5%	5.60	31%
Rec_008	Kalgoorlie South 2				0.15	1%	5.00	28%	0.60	3%	5.42	30%
Rec_009	Kalgoorlie South 3				0.15	1%	4.92	27%	0.67	4%	5.39	30%
Rec_010	Williamstown North				0.16	1%	4.93	27%	0.70	4%	5.44	30%
Rec_011	Williamstown Central East				0.16	1%	4.89	27%	0.64	4%	5.38	30%
Rec_012	Williamstown Central West				0.16	1%	4.94	27%	0.71	4%	5.45	30%
Rec_013	Williamstown South				0.16	1%	4.95	28%	0.65	4%	5.39	30%
Annual average $PM_{2.5}$ ground level concentrations												
Receptor		Criteria	Background		Scenario 1 Gas mode - isolation		Scenario 2 Gas mode - cumulative		Scenario 3 LFO mode - isolation		Scenario 4 LFO mode - cumulative	
		(µg/m³)[1]	(µg/m³)[1]	% Guideline	(µg/m³)[1]	% Guideline	(µg/m³)[1]	% Guideline	(µg/m³)[1]	% Guideline	(µg/m³)[1]	% Guideline
Rec_001	Ninga Mia East	6.4	4.2	66%	0.019	0.3%	4.22	66%	0.075	1.2%	4.28	67%
Rec_002	Ninga Mia West				0.020	0.3%	4.22	66%	0.082	1.3%	4.29	67%
Rec_003	Kalgoorlie North 3				0.032	0.5%	4.24	66%	0.129	2.0%	4.33	68%
Rec_004	Kalgoorlie North 2				0.038	0.6%	4.24	66%	0.152	2.4%	4.36	68%
Rec_005	Kalgoorlie North 1				0.020	0.3%	4.23	66%	0.082	1.3%	4.29	67%
Rec_006	Kalgoorlie Central				0.018	0.3%	4.23	66%	0.077	1.2%	4.29	67%
Rec_007	Kalgoorlie South 1				0.014	0.2%	4.29	67%	0.061	1.0%	4.33	68%
Rec_008	Kalgoorlie South 2				0.012	0.2%	4.24	66%	0.052	0.8%	4.28	67%
Rec_009	Kalgoorlie South 3				0.011	0.2%	4.23	66%	0.045	0.7%	4.27	67%
Rec_010	Williamstown North				0.013	0.2%	4.24	66%	0.057	0.9%	4.28	67%
Rec_011	Williamstown Central East				0.013	0.2%	4.24	66%	0.054	0.8%	4.28	67%
Rec_012	Williamstown Central West				0.012	0.2%	4.24	66%	0.053	0.8%	4.28	67%
Rec_013	Williamstown South				0.012	0.2%	4.24	66%	0.047	0.7%	4.27	67%

Notes

1. Referenced to 25ºC, and 101.3 kPa

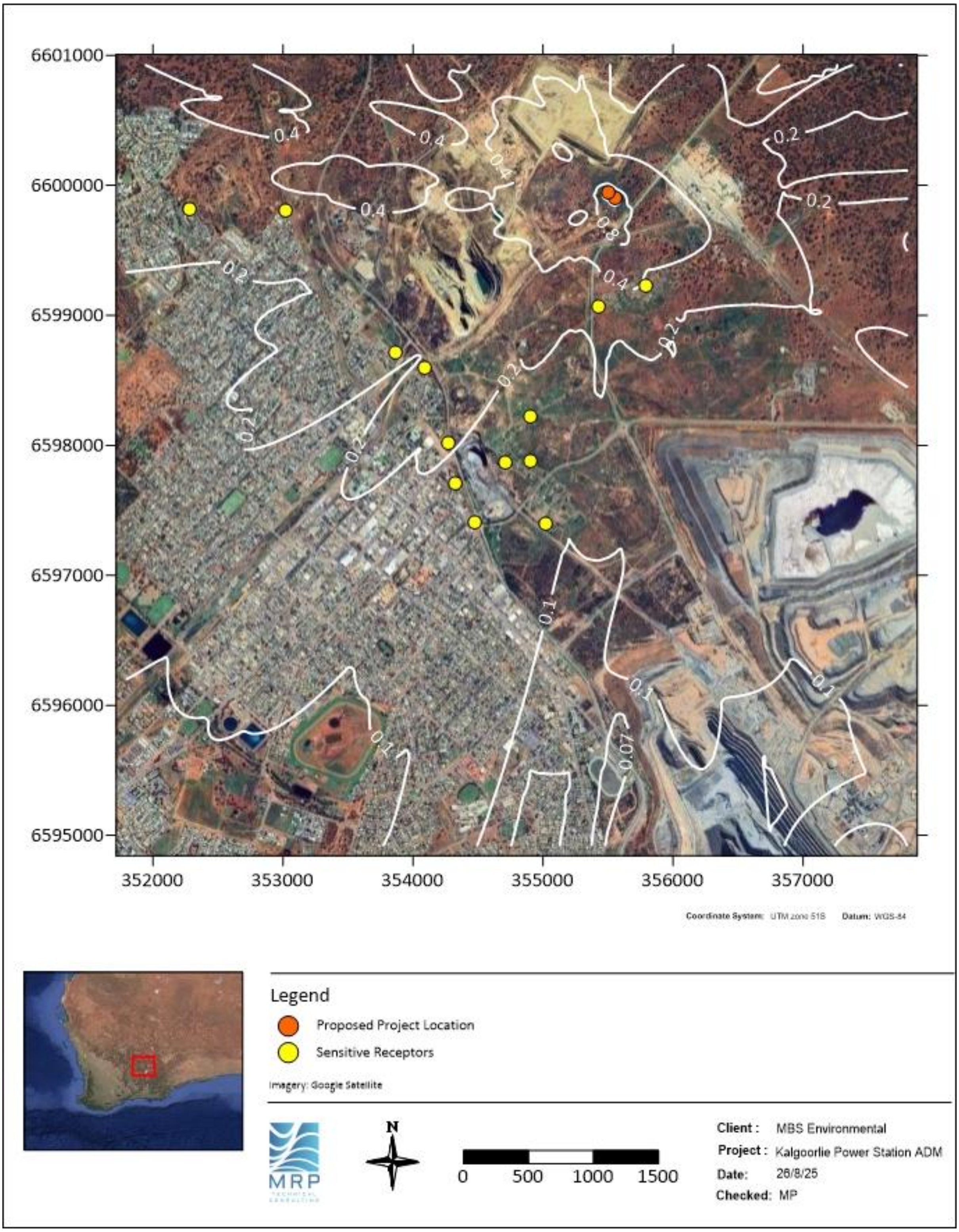


Figure 4-9: Predicted 24-hour maximum GLCs of $PM_{2.5}$ ($\mu g/m^3$) in isolation – gas mode (Scenario 1)

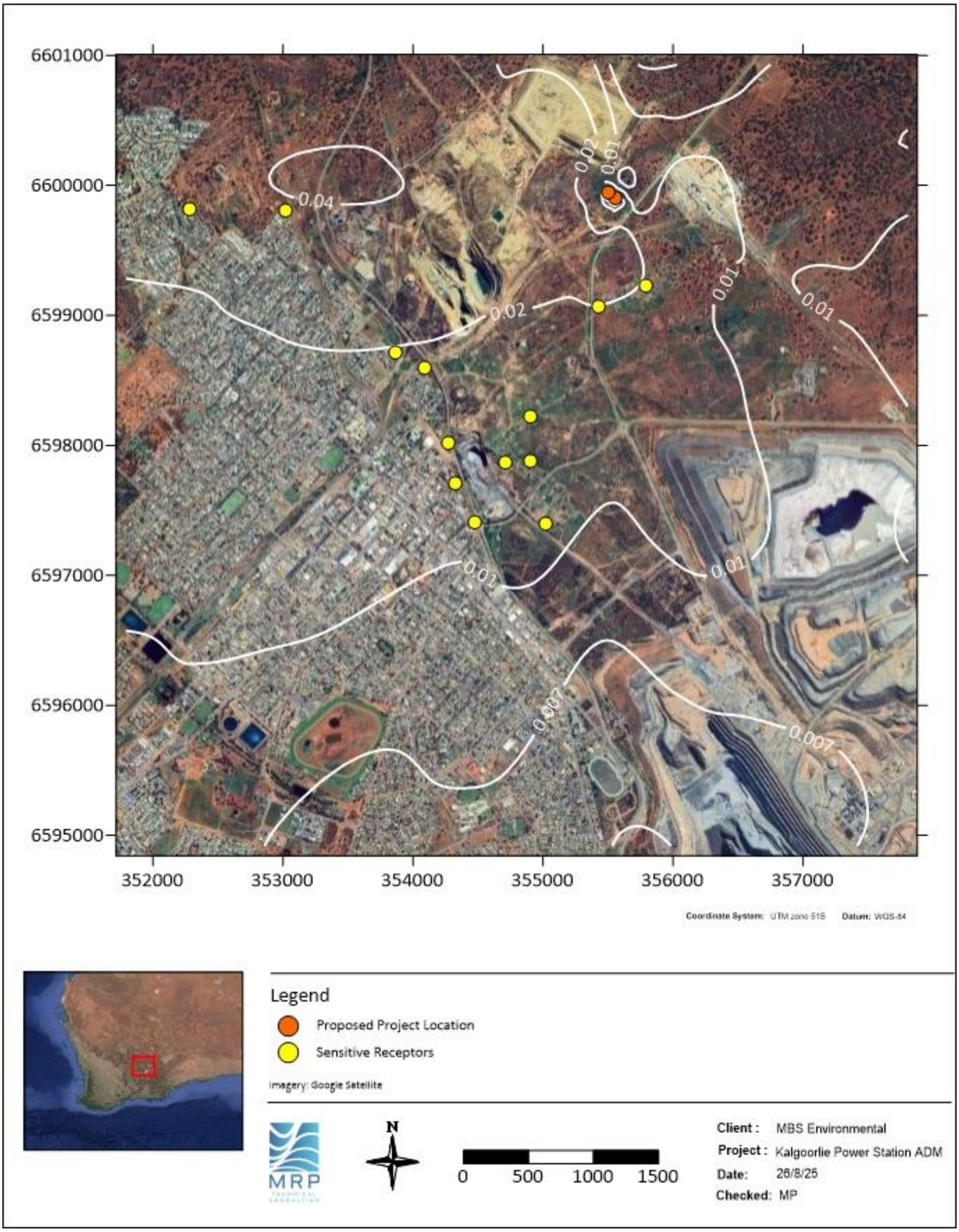


Figure 4-10: Predicted annual average GLCs of $PM_{2.5}$ (µg/m³) in isolation – gas mode (Scenario 1)

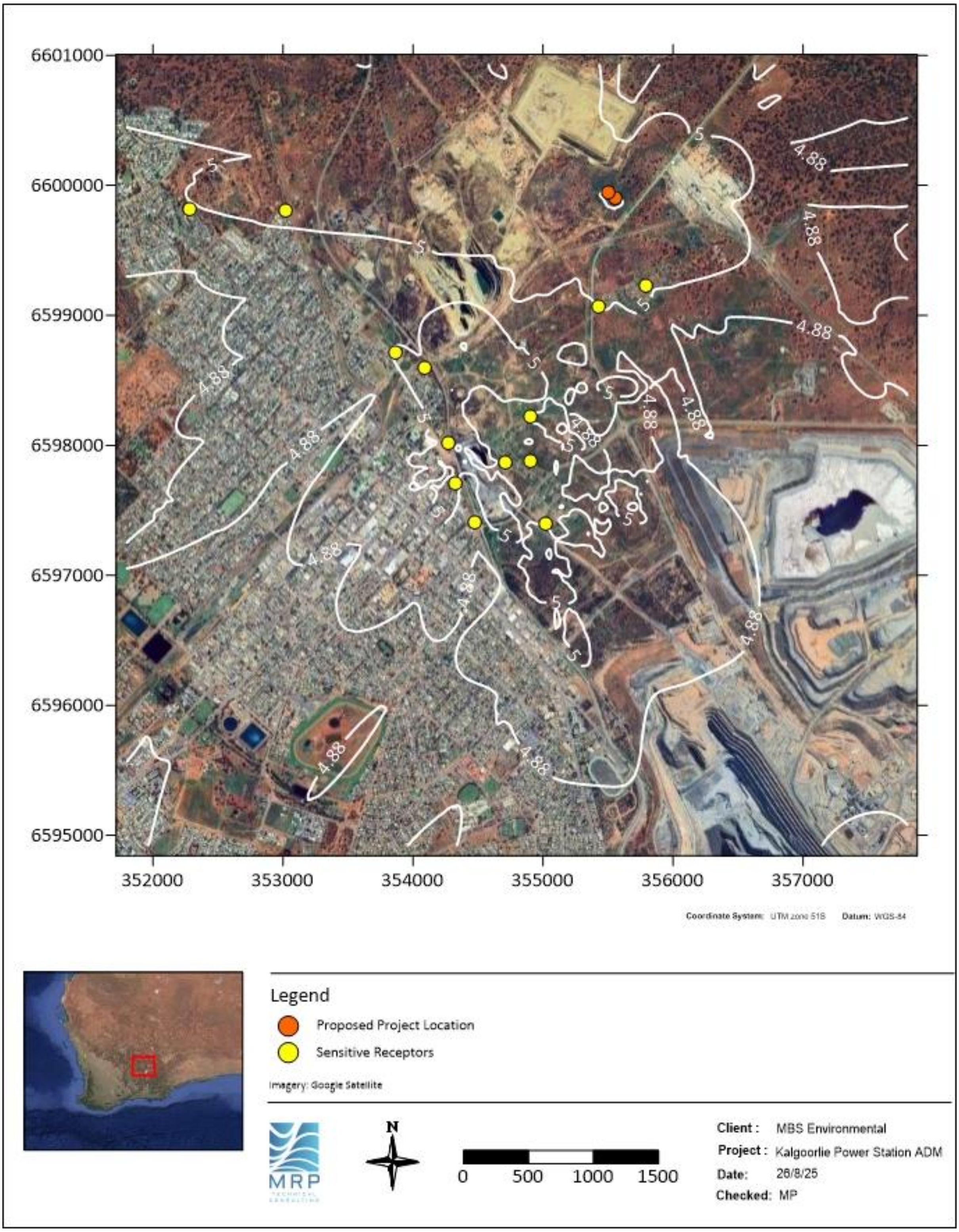


Figure 4-11: Predicted cumulative 24-hour maximum GLCs of $PM_{2.5}$ ($\mu g/m^3$) – gas mode (Scenario 2)

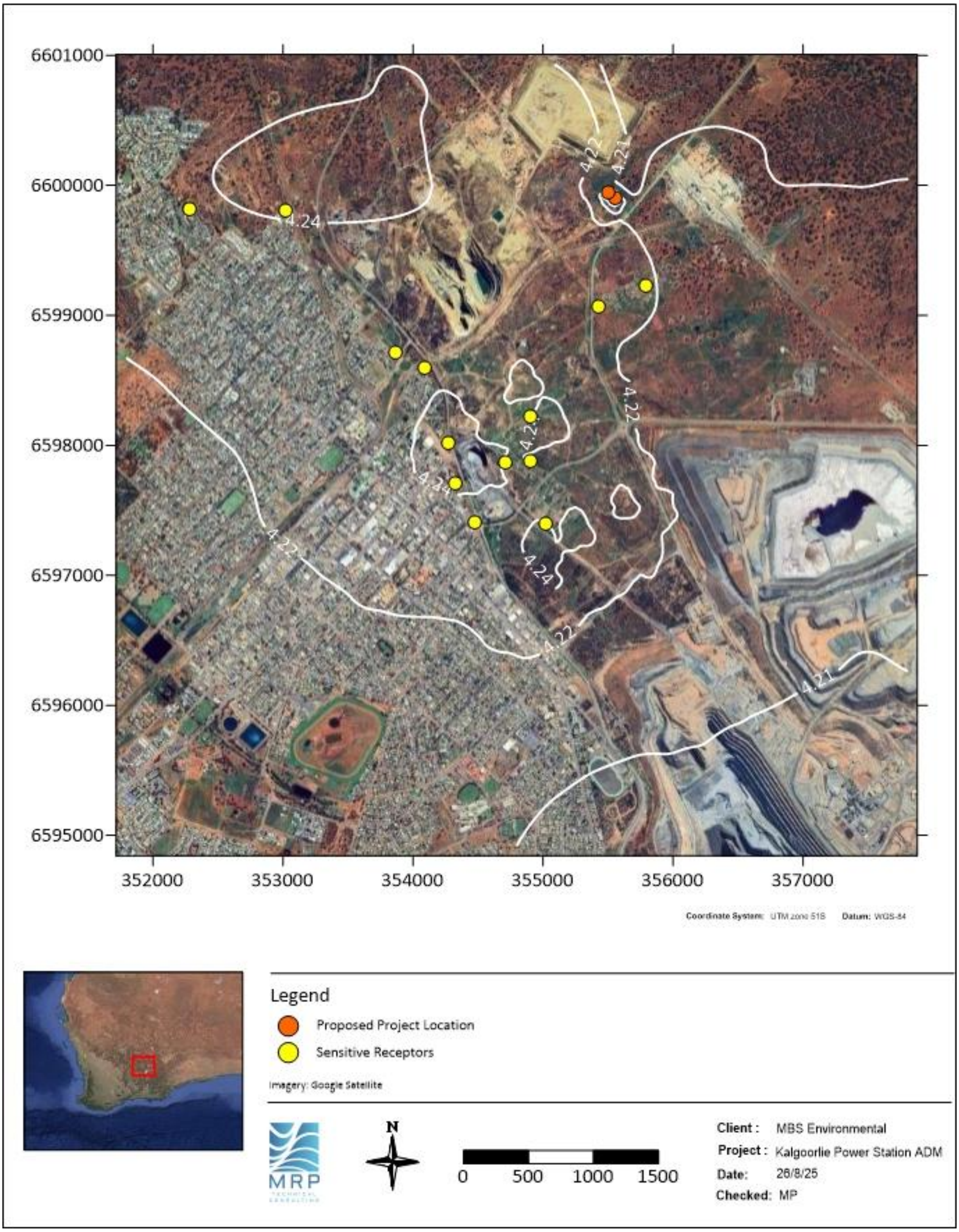


Figure 4-12:Predicted cumulative annual average GLCs of $PM_{2.5}$ ($\mu g/m^3$) – gas mode (Scenario 2)

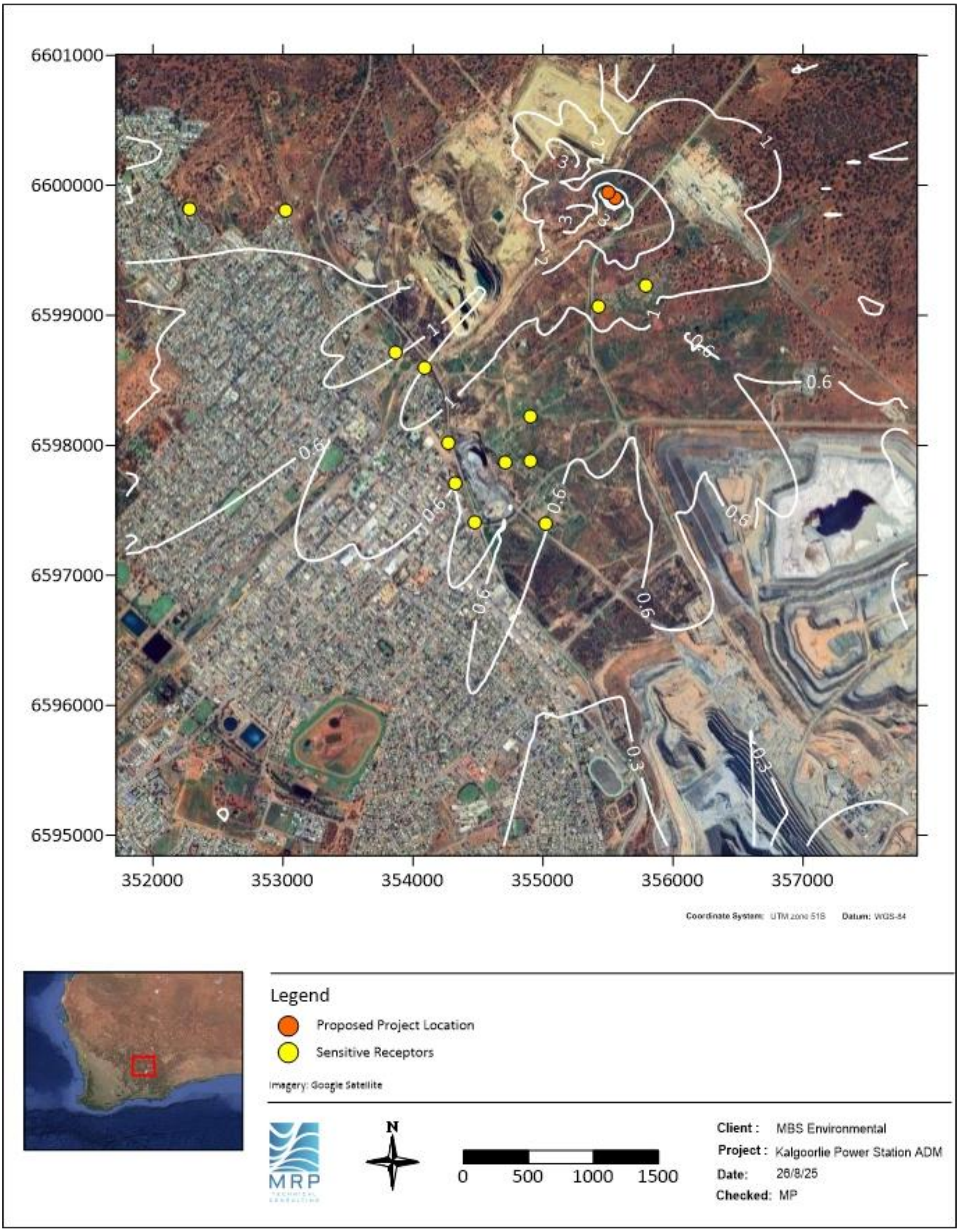


Figure 4-13: Predicted 24-hour maximum GLCs of $PM_{2.5}$ ($\mu g/m^3$) in isolation – LFO mode (Scenario 3)

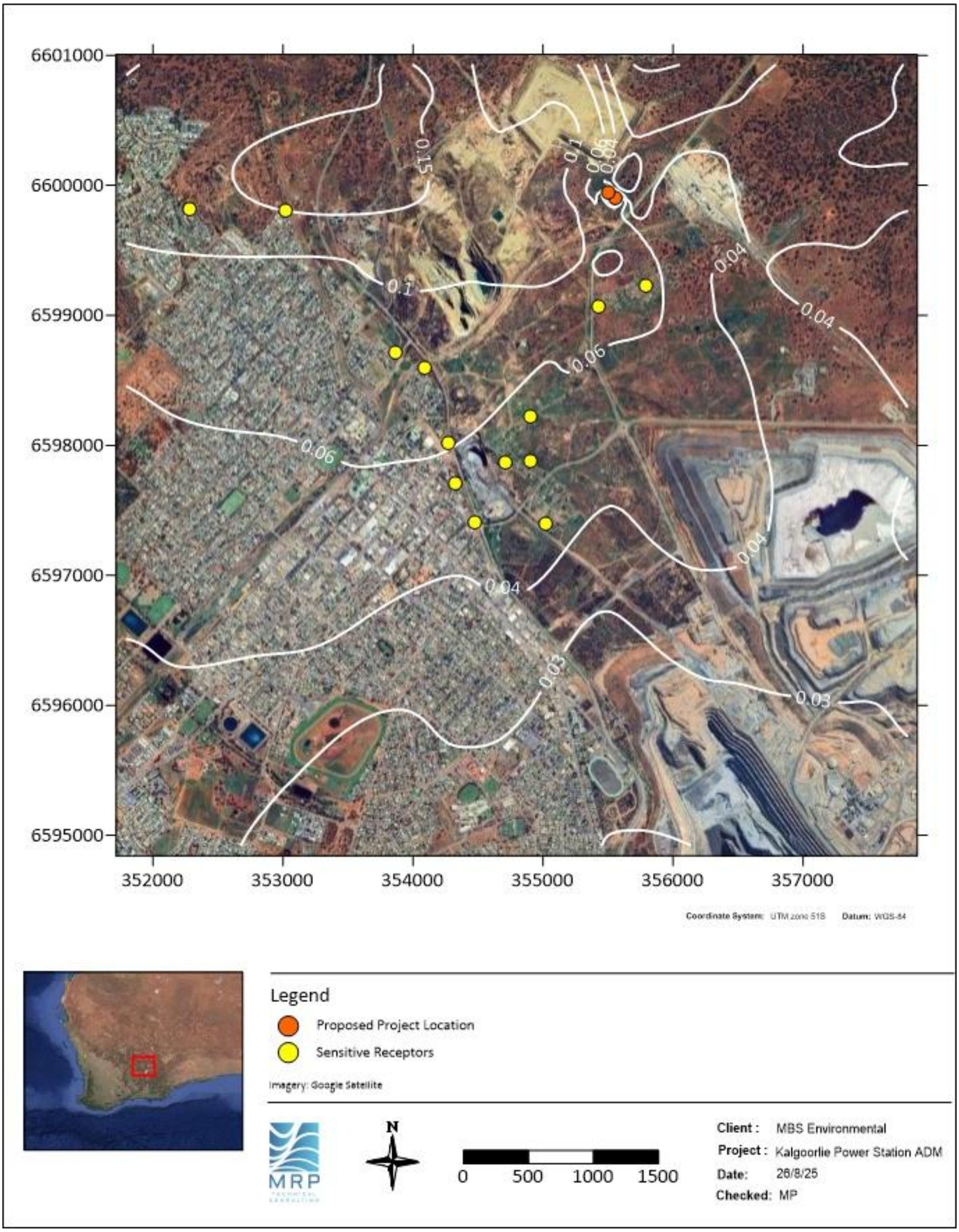


Figure 4-14: Predicted annual average GLCs of $PM_{2.5}$ (µg/m³) in isolation – LFO mode (Scenario 3)

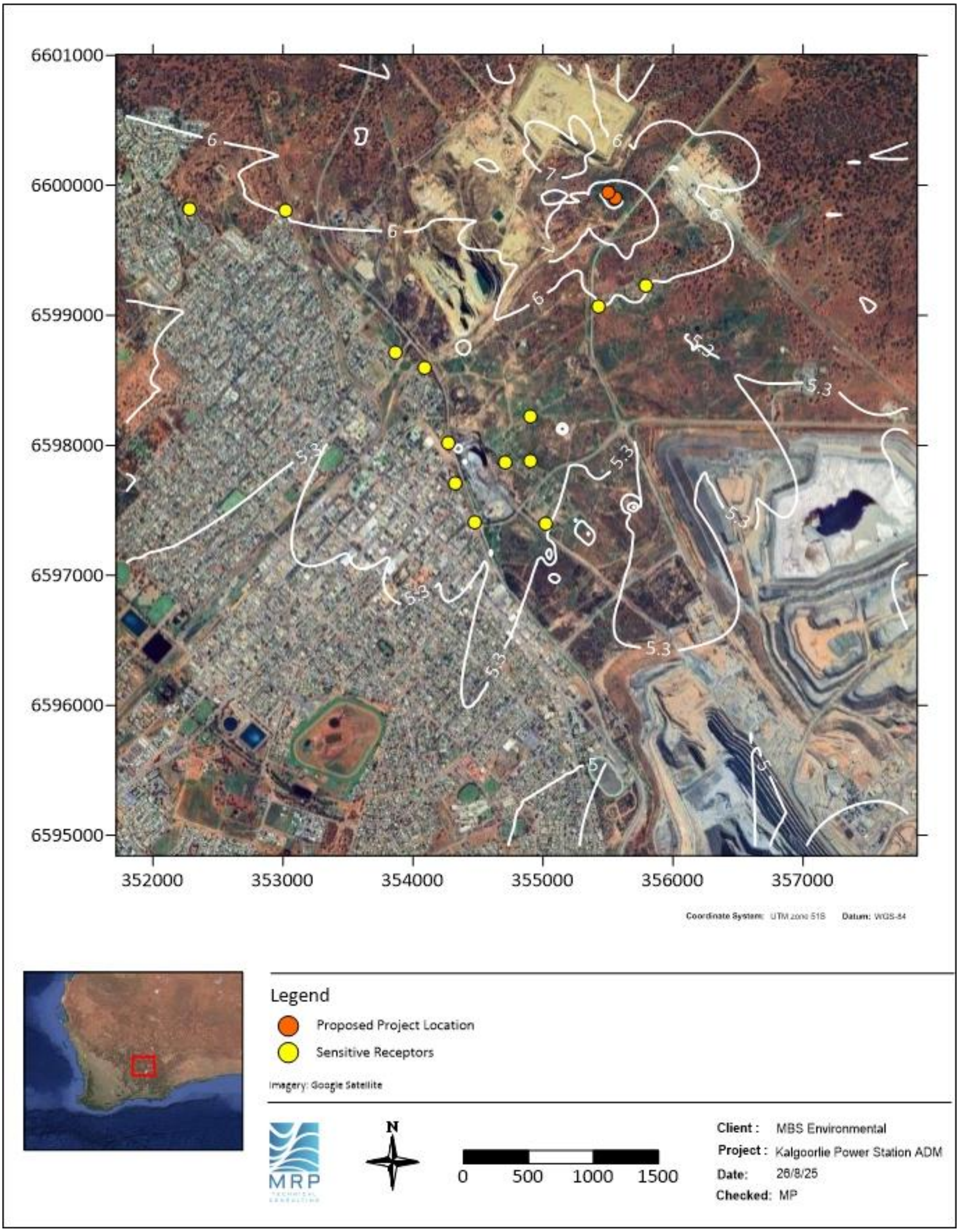


Figure 4-15: Predicted cumulative 24-hour maximum GLCs of $PM_{2.5}$ (µg/m^3) – LFO mode (Scenario 4)

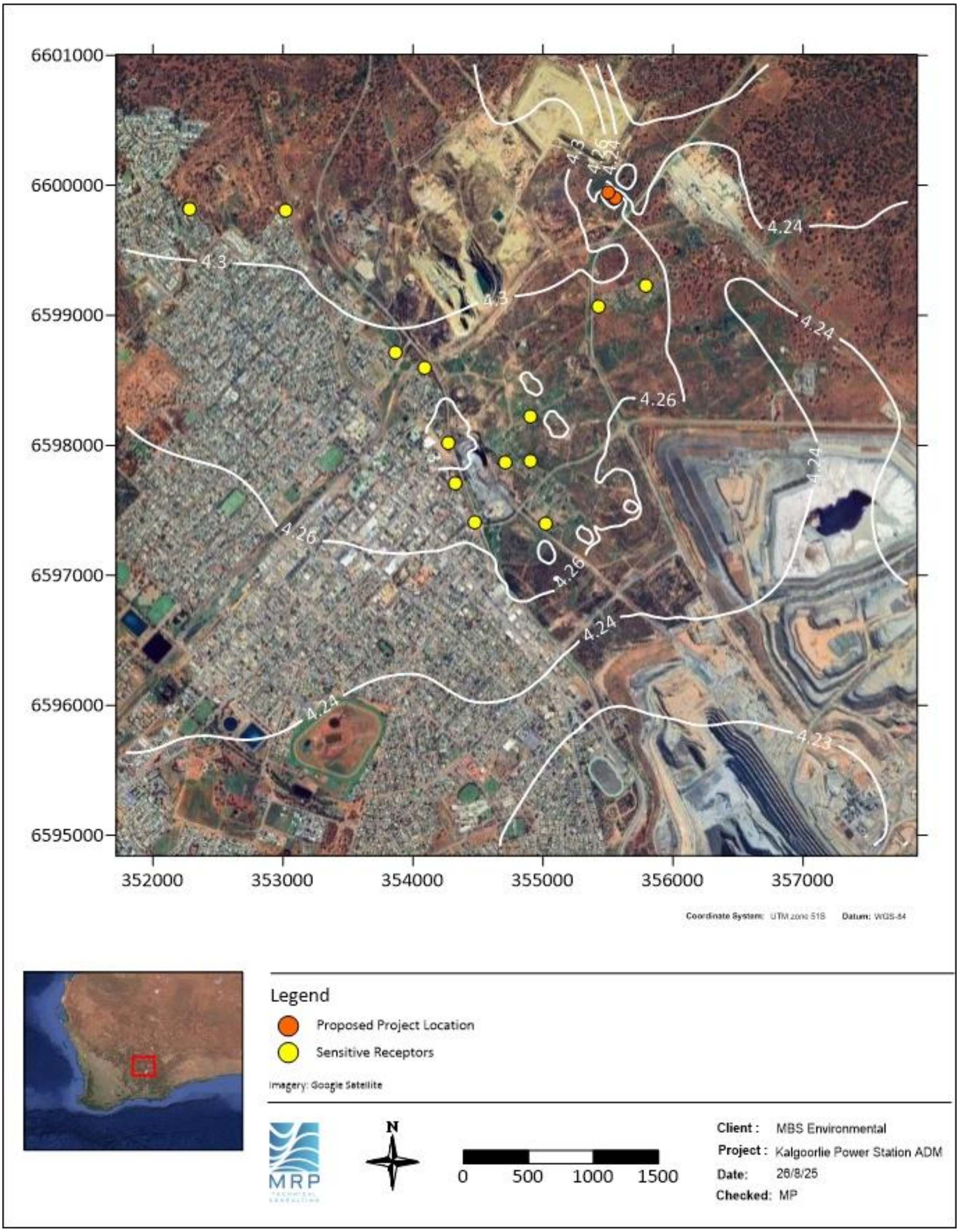


Figure 4-16: Predicted cumulative annual average GLCs of $PM_{2.5}$ (µg/m^3) – LFO mode (Scenario 4)

4.3 Sulphur dioxide

Contour plots showing predicted concentrations of SO_2 can be found in Figure 4-17 to Figure 4-28 below, with relevant air quality criteria displayed as a red contour line. Table 4-3 presents the predicted GLCs at nearby sensitive receptors in the region.

Results of the modelling indicated that there were no exceedances of the relevant 1-hour or 24-hour maximum or annual average AGVs for SO_2 predicted at any of the nearby sensitive receptors for any of the modelled scenarios.

Table 4-3: Summary of predicted SO_2 concentrations at the closest sensitive receptors

Receptor		Criteria	Background		Scenario 1		Scenario 2		Scenario 3		Scenario 4	
1-hour maximum SO_2 ground level concentrations												
					Gas mode - isolation		Gas mode - cumulative		LFO mode - isolation		LFO mode - cumulative	
		(µg/m³)[1]	(µg/m³)[1]	% Guideline	(µg/m³)[1]	% Guideline	(µg/m³)[1]	% Guideline	(µg/m³)[1]	% Guideline	(µg/m³)[1]	% Guideline
Rec_001	Ninga Mia East	196	13	7%	5.0	2.5%	18	9%	36	18%	49	25%
Rec_002	Ninga Mia West				4.0	2.1%	17	9%	22	11%	35	18%
Rec_003	Kalgoorlie North 3				4.2	2.1%	17	9%	24	12%	37	19%
Rec_004	Kalgoorlie North 2				4.4	2.3%	18	9%	31	16%	44	23%
Rec_005	Kalgoorlie North 1				5.7	2.9%	19	10%	30	15%	43	22%
Rec_006	Kalgoorlie Central				4.2	2.2%	17	9%	24	12%	37	19%
Rec_007	Kalgoorlie South 1				3.3	1.7%	16	8%	19	9%	32	16%
Rec_008	Kalgoorlie South 2				2.7	1.4%	16	8%	17	9%	30	15%
Rec_009	Kalgoorlie South 3				2.0	1.0%	15	8%	15	7%	28	14%
Rec_010	Williamstown North				2.8	1.4%	16	8%	26	13%	39	20%
Rec_011	Williamstown Central East				2.4	1.2%	16	8%	28	14%	41	21%
Rec_012	Williamstown Central West				2.5	1.3%	16	8%	24	12%	37	19%
Rec_013	Williamstown South				2.3	1.2%	15	8%	16	8%	29	15%
24-hour maximum SO_2 ground level concentrations												
Receptor		Criteria	Background		Scenario 1		Scenario 2		Scenario 3		Scenario 4	
					Gas mode - isolation		Gas mode - cumulative		LFO mode - isolation		LFO mode - cumulative	
		(µg/m³)[1]	(µg/m³)[1]	% Guideline	(µg/m³)[1]	% Guideline	(µg/m³)[1]	% Guideline	(µg/m³)[1]	% Guideline	(µg/m³)[1]	% Guideline
Rec_001	Ninga Mia East	52	5.2	10%	0.71	1.4%	5.91	11.3%	3.74	7.1%	8.94	17%
Rec_002	Ninga Mia West				0.62	1.2%	5.82	11.1%	3.61	6.9%	8.81	17%
Rec_003	Kalgoorlie North 3				0.59	1.1%	5.79	11.0%	3.24	6.2%	8.44	16%
Rec_004	Kalgoorlie North 2				0.70	1.3%	5.90	11.3%	3.79	7.2%	8.99	17%
Rec_005	Kalgoorlie North 1				0.51	1.0%	5.71	10.9%	2.99	5.7%	8.19	16%
Rec_006	Kalgoorlie Central				0.46	0.9%	5.66	10.8%	2.90	5.5%	8.10	15%
Rec_007	Kalgoorlie South 1				0.42	0.8%	5.62	10.7%	2.44	4.7%	7.64	15%
Rec_008	Kalgoorlie South 2				0.29	0.6%	5.49	10.5%	1.69	3.2%	6.89	13%
Rec_009	Kalgoorlie South 3				0.31	0.6%	5.51	10.5%	1.87	3.6%	7.07	13%
Rec_010	Williamstown North				0.31	0.6%	5.51	10.5%	1.95	3.7%	7.15	14%
Rec_011	Williamstown Central East				0.32	0.6%	5.52	10.5%	1.81	3.4%	7.01	13%
Rec_012	Williamstown Central West				0.32	0.6%	5.52	10.5%	1.99	3.8%	7.19	14%
Rec_013	Williamstown South				0.32	0.6%	5.52	10.5%	1.81	3.5%	7.01	13%

Notes

1. Referenced to 25ºC, and 101.3 kPa

Annual average SO_2 ground level concentrations													
Receptor		Criteria	Background		Scenario 1		Scenario 2		Scenario 3		Scenario 4	
					Gas mode - isolation		Gas mode - cumulative		LFO mode - isolation		LFO mode - cumulative	
		(µg/m³)[1]	(µg/m³)[1]	% Guideline	(µg/m³)[1]	% Guideline	(µg/m³)[1]	% Guideline	(µg/m³)[1]	% Guideline	(µg/m³)[1]	% Guideline
Rec_001	Ninga Mia East	52	0.098	0.2%	0.037	0.072%	0.135	0.26%	0.209	0.40%	0.307	0.59%
Rec_002	Ninga Mia West				0.040	0.077%	0.138	0.26%	0.229	0.44%	0.327	0.63%
Rec_003	Kalgoorlie North 3				0.064	0.123%	0.162	0.31%	0.362	0.70%	0.460	0.89%
Rec_004	Kalgoorlie North 2				0.075	0.144%	0.173	0.33%	0.425	0.82%	0.523	1.01%
Rec_005	Kalgoorlie North 1				0.039	0.076%	0.137	0.26%	0.230	0.44%	0.328	0.63%
Rec_006	Kalgoorlie Central				0.036	0.070%	0.134	0.26%	0.216	0.42%	0.314	0.60%
Rec_007	Kalgoorlie South 1				0.029	0.055%	0.127	0.24%	0.171	0.33%	0.269	0.52%
Rec_008	Kalgoorlie South 2				0.025	0.048%	0.123	0.24%	0.147	0.28%	0.245	0.47%
Rec_009	Kalgoorlie South 3				0.022	0.042%	0.120	0.23%	0.127	0.24%	0.225	0.43%
Rec_010	Williamstown North				0.027	0.052%	0.125	0.24%	0.159	0.31%	0.257	0.49%
Rec_011	Williamstown Central East				0.026	0.049%	0.124	0.24%	0.151	0.29%	0.249	0.48%
Rec_012	Williamstown Central West				0.025	0.048%	0.123	0.24%	0.147	0.28%	0.245	0.47%
Rec_013	Williamstown South				0.023	0.045%	0.121	0.23%	0.132	0.25%	0.230	0.44%

Notes

1. Referenced to 25ºC, and 101.3 kPa

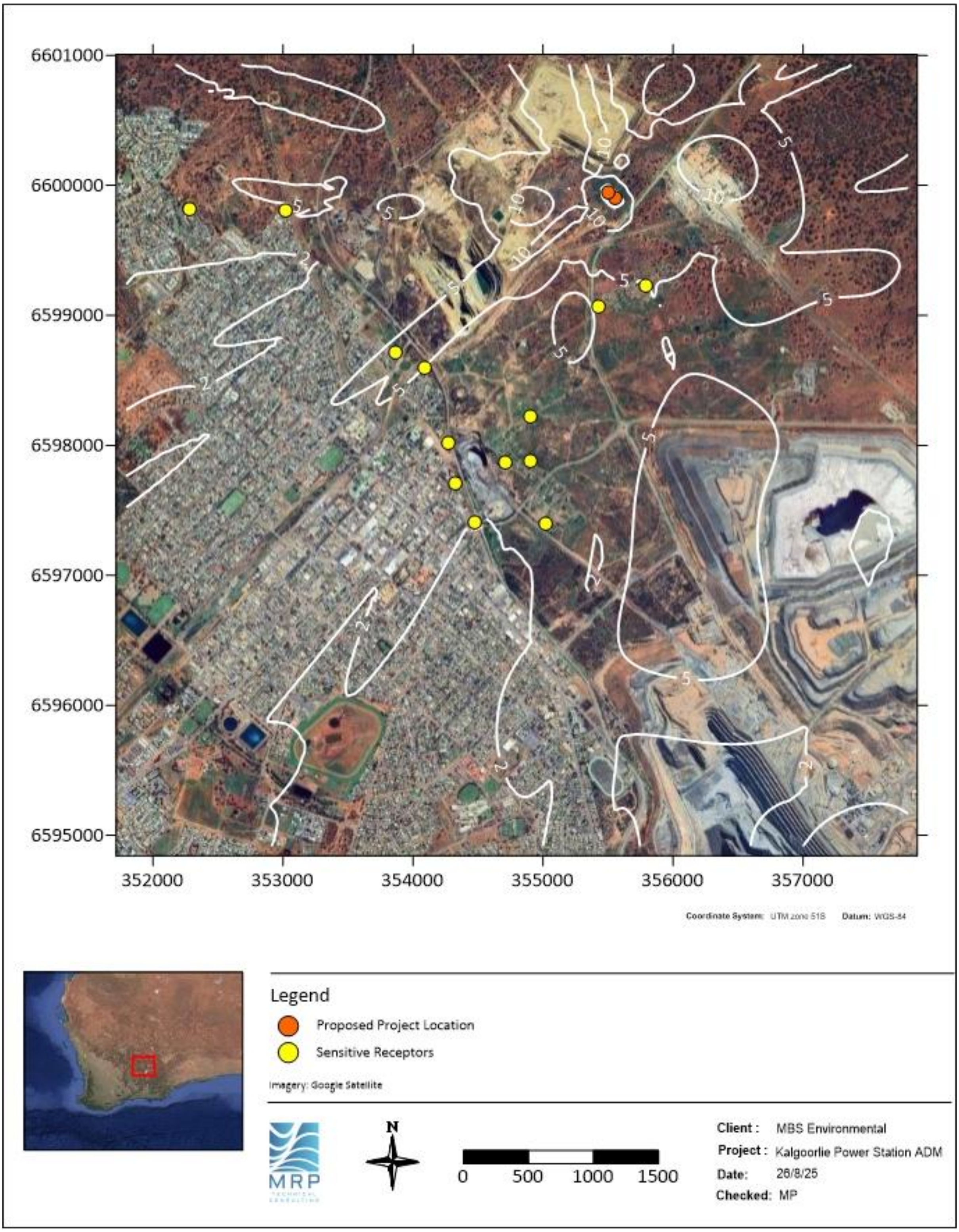


Figure 4-17: Predicted 1-hour maximum GLCs of SO_2 (μg/m^3) in isolation – gas mode (Scenario 1)

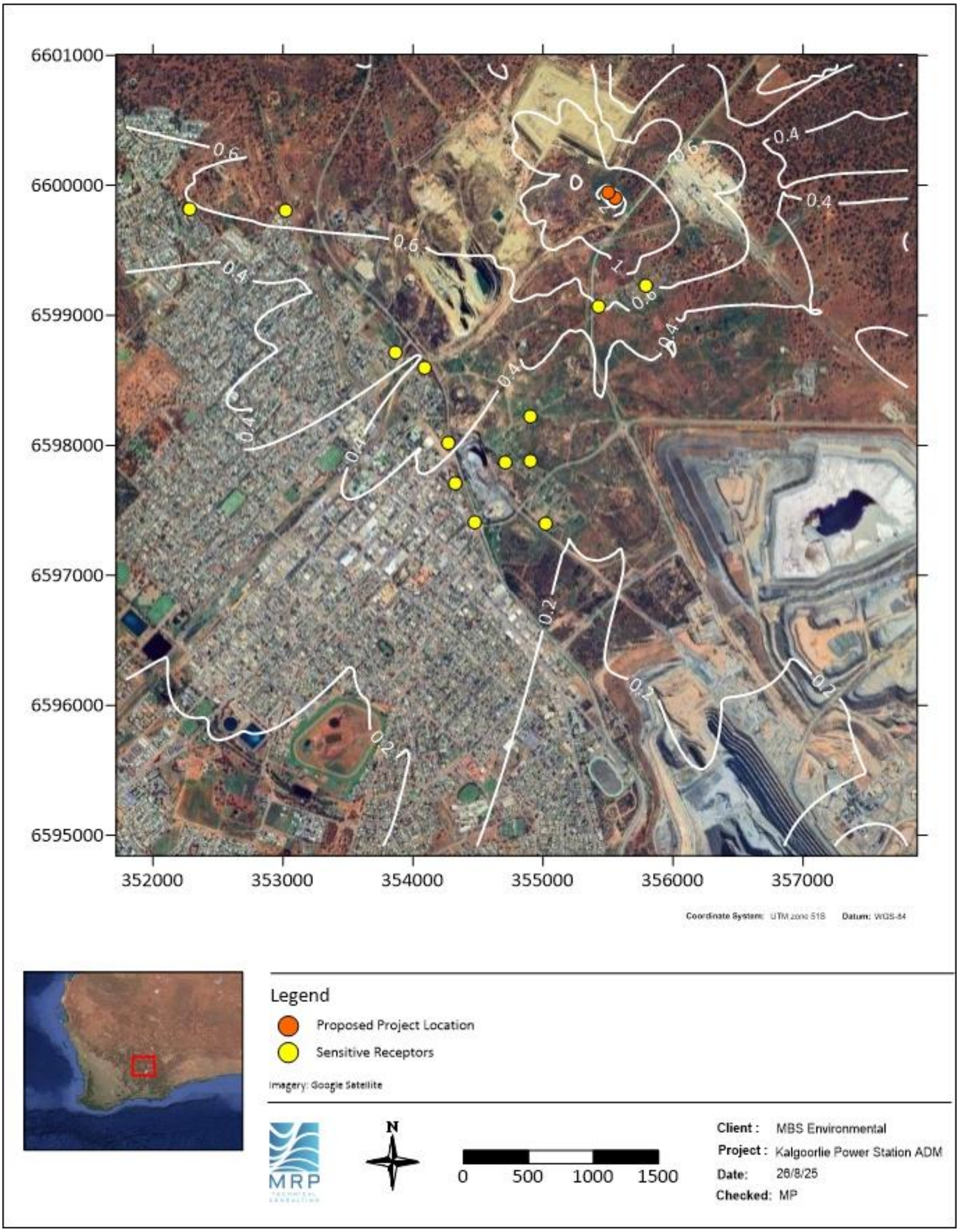


Figure 4-18: Predicted 24-hour maximum GLCs of SO_2 (μg/m³) in isolation – gas mode (Scenario 1)

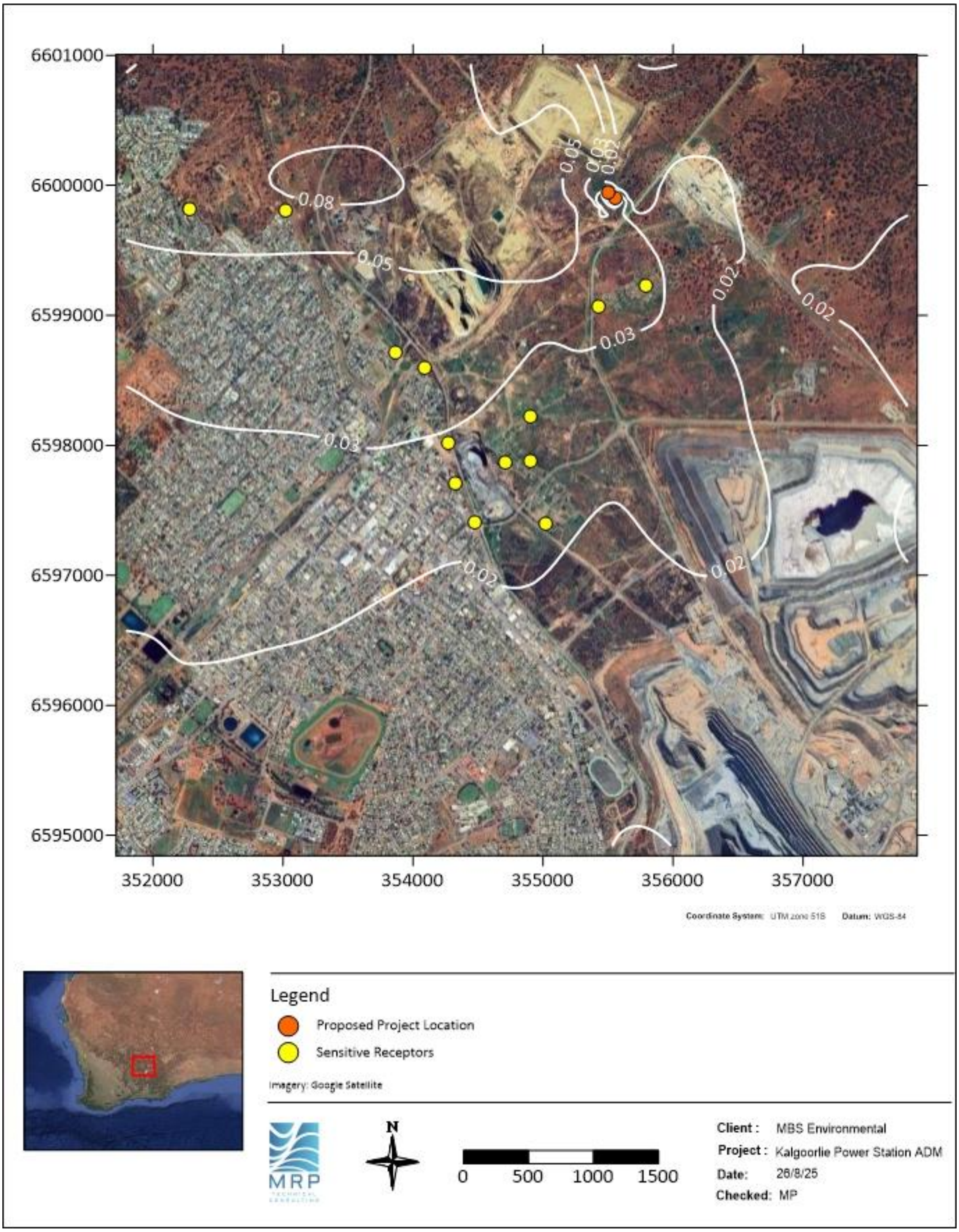


Figure 4-19: Predicted annual average GLCs of SO_2 (µg/m^3) in isolation – gas mode (Scenario 1)

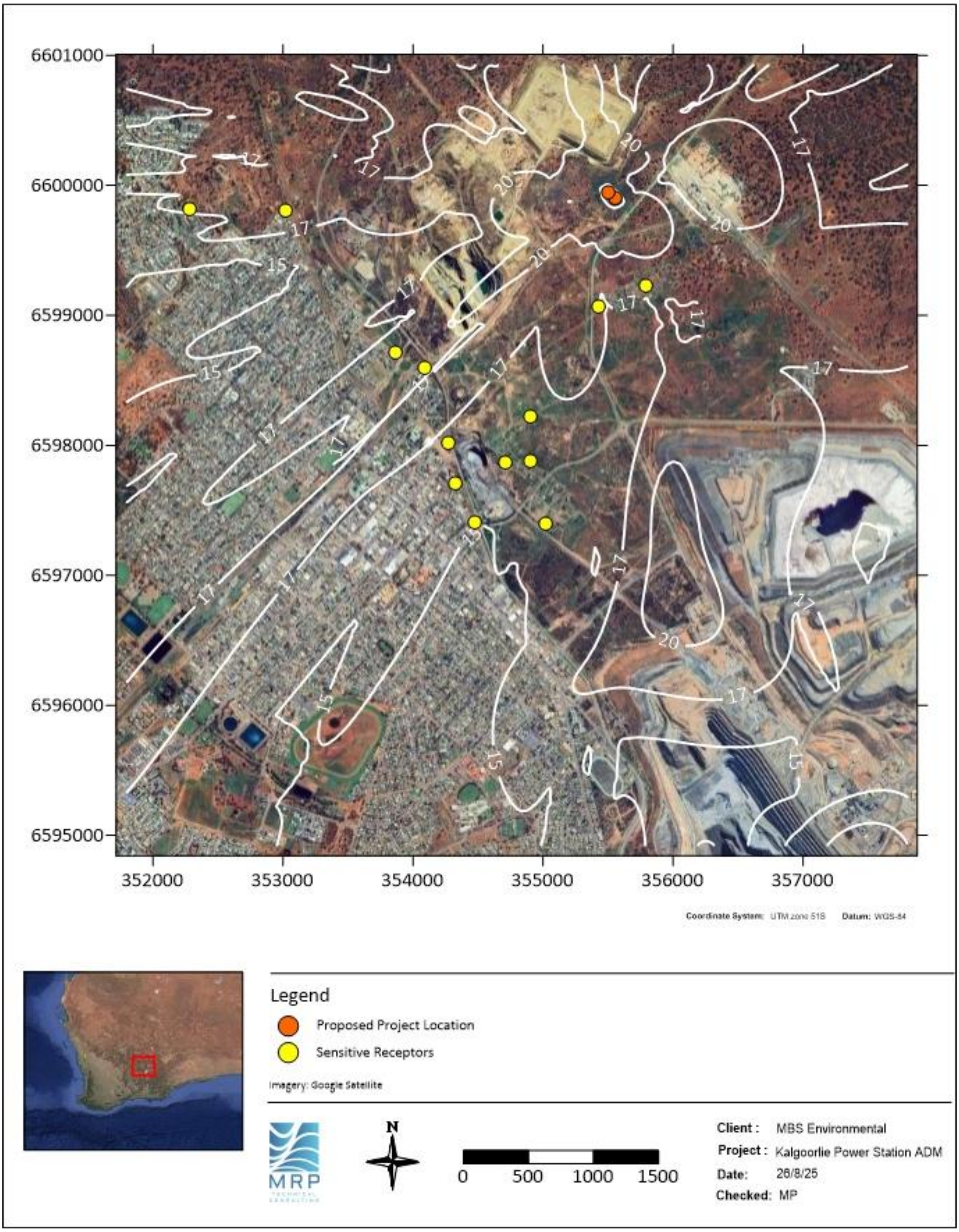


Figure 4-20: Predicted cumulative 1-hour maximum GLCs of SO_2 (µg/m^3) – gas mode (Scenario 2)

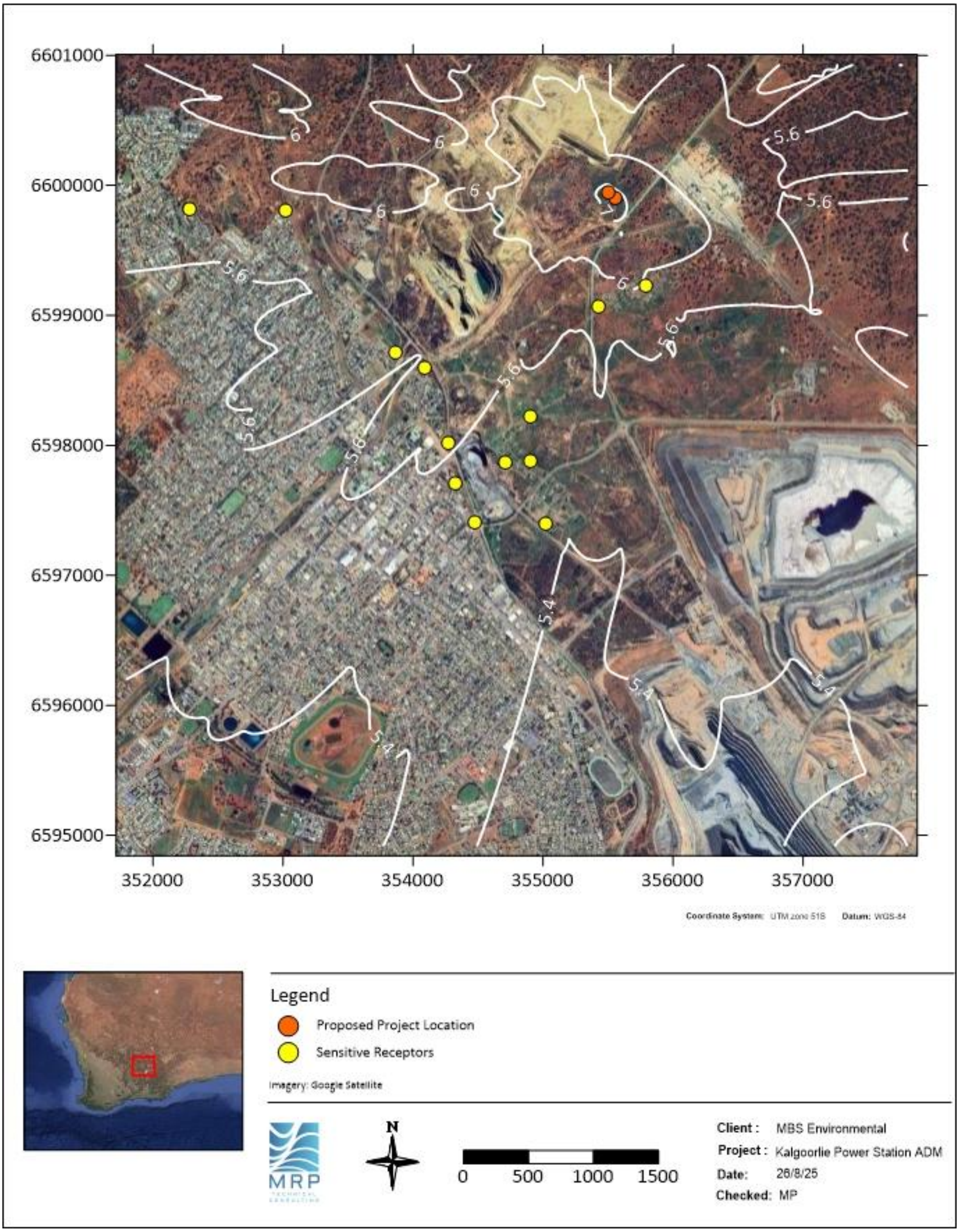


Figure 4-21: Predicted cumulative 24-hour maximum GLCs of SO_2 (µg/m^3) – gas mode (Scenario 2)

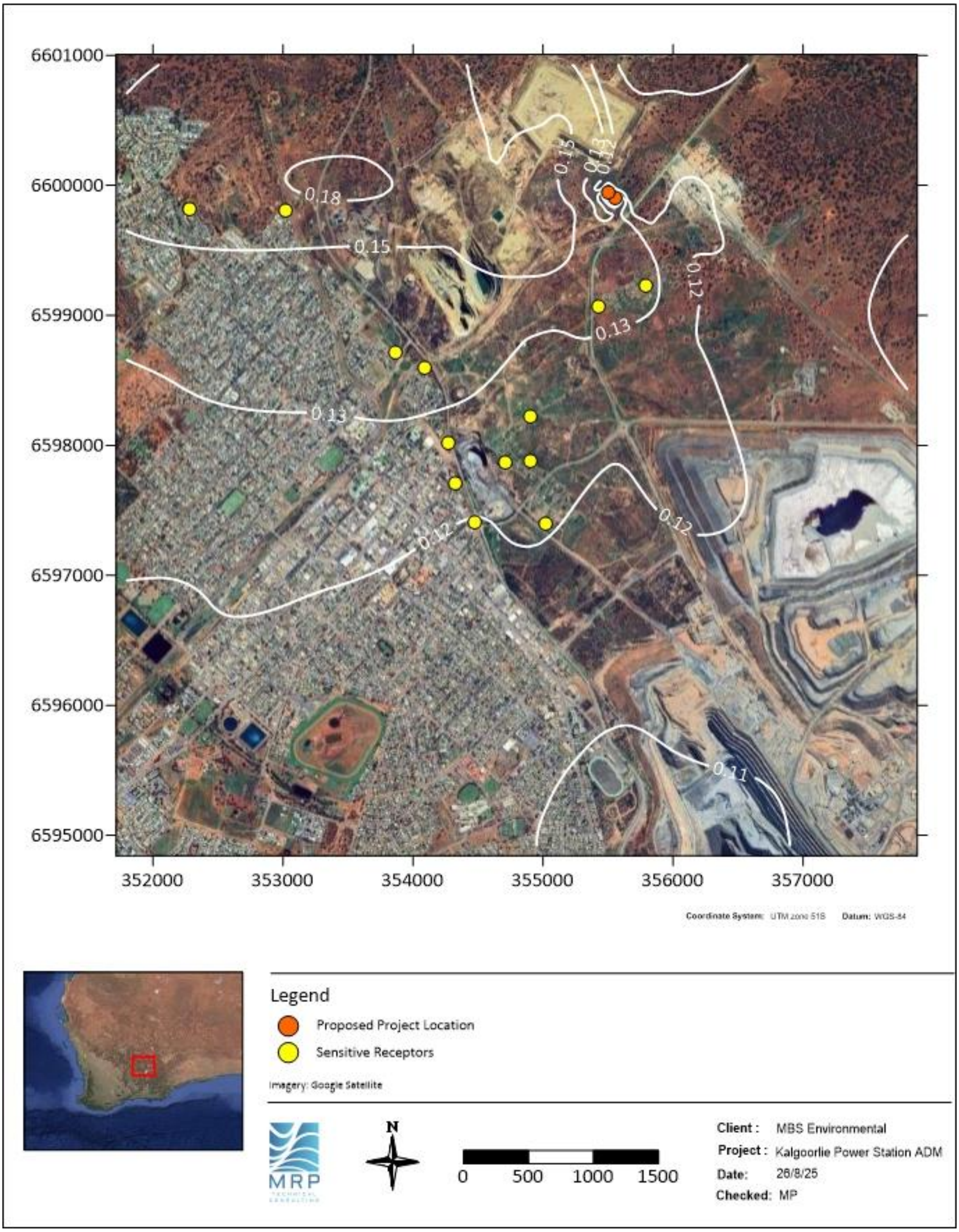


Figure 4-22: Predicted cumulative annual average GLCs of SO_2 (μg/m^3) – gas mode (Scenario 2)

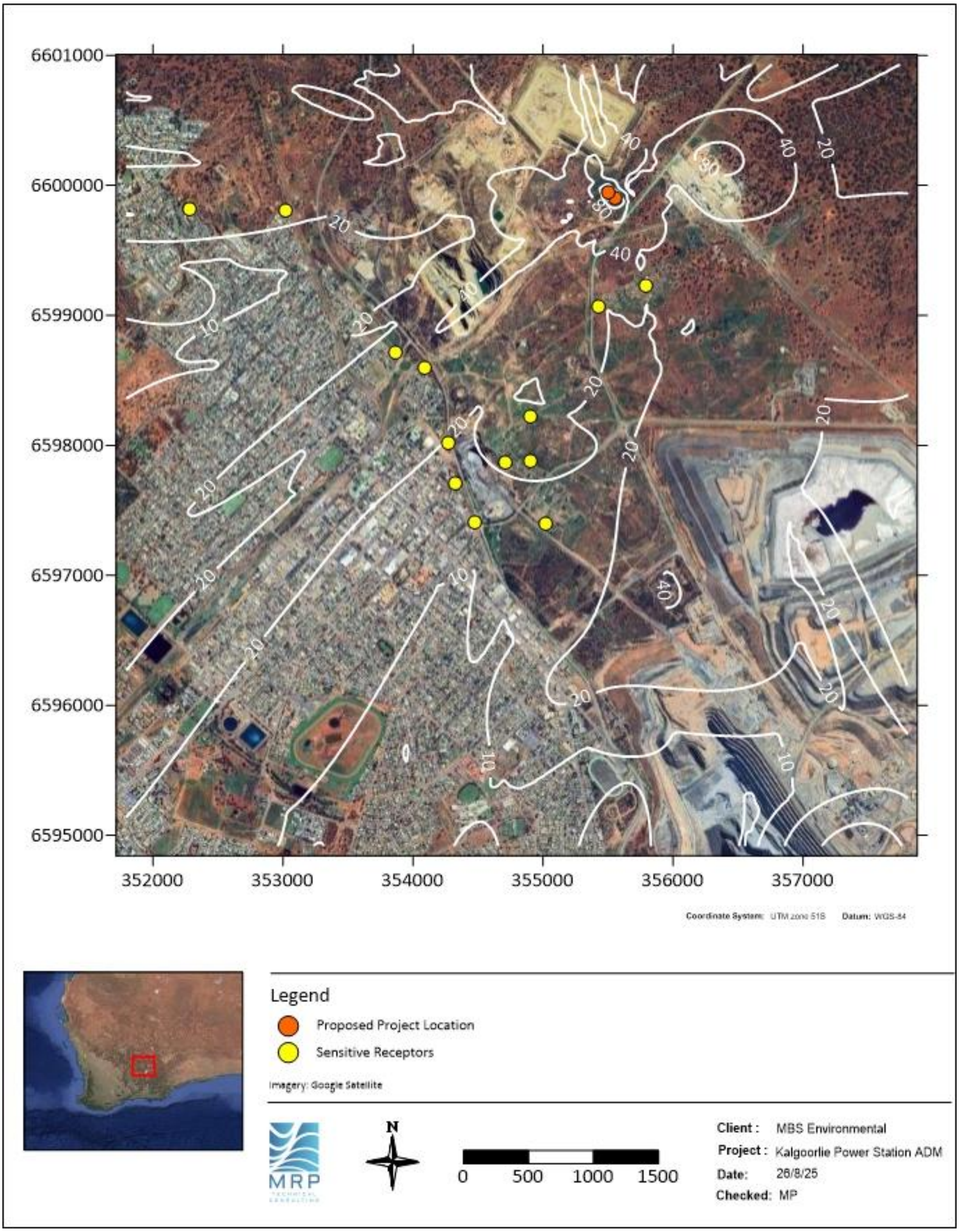


Figure 4-23: Predicted 1-hour maximum GLCs of SO_2 (µg/m^3) in isolation – LFO mode (Scenario 3)

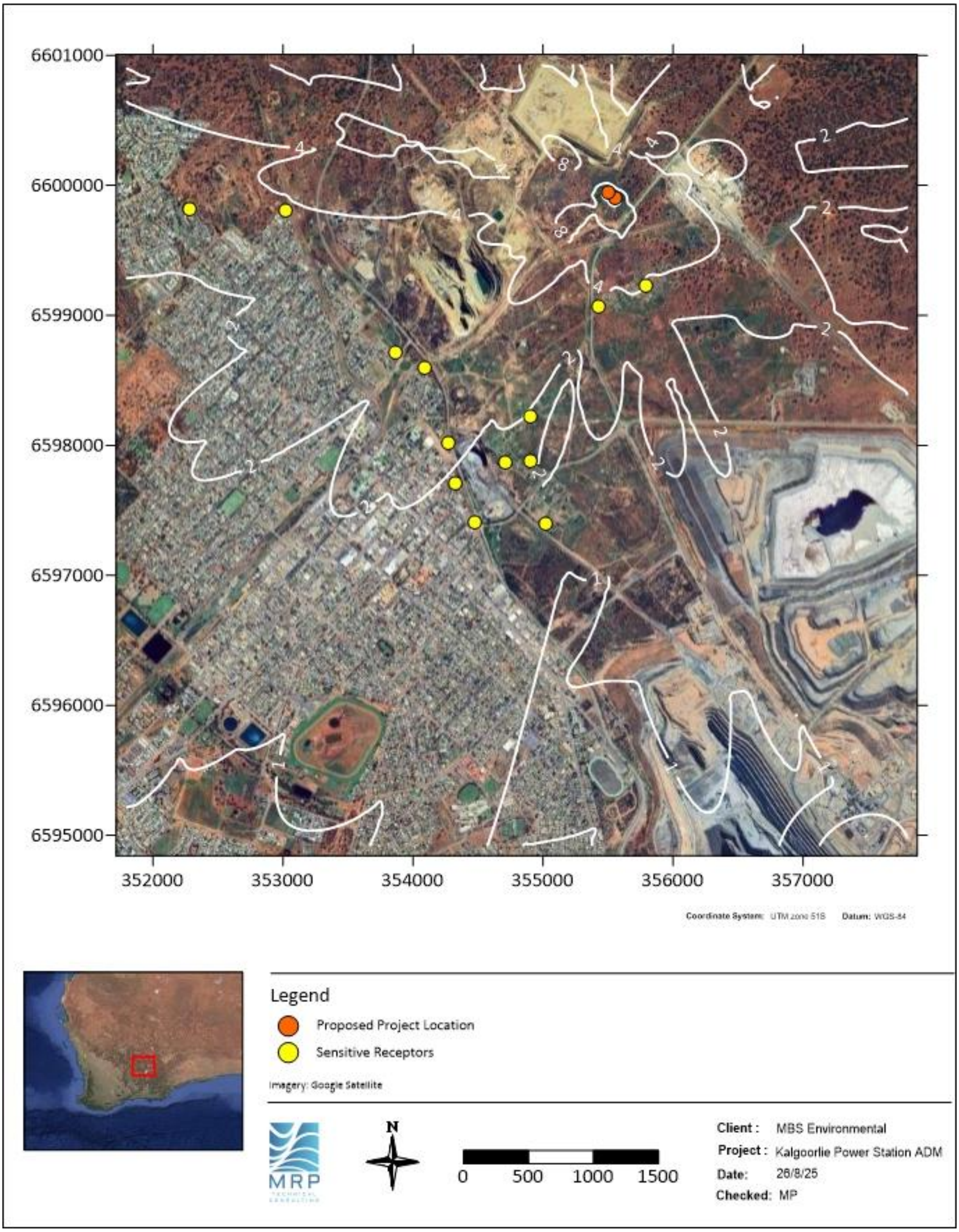


Figure 4-24: Predicted 24-hour maximum GLCs of SO_2 (µg/m^3) in isolation – LFO mode (Scenario 3)

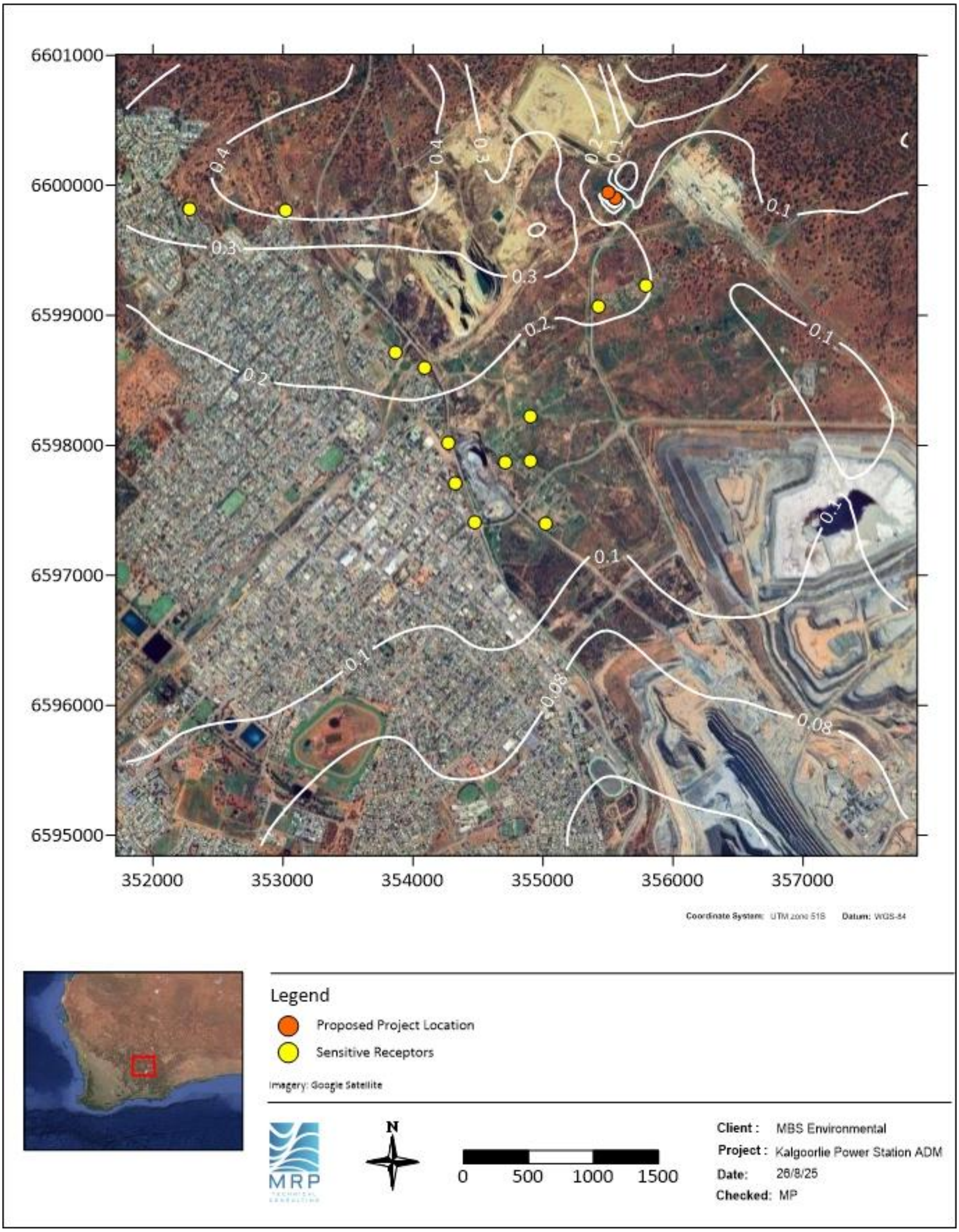


Figure 4-25: Predicted annual average GLCs of SO_2 (μg/m^3) in isolation – LFO mode (Scenario 3)

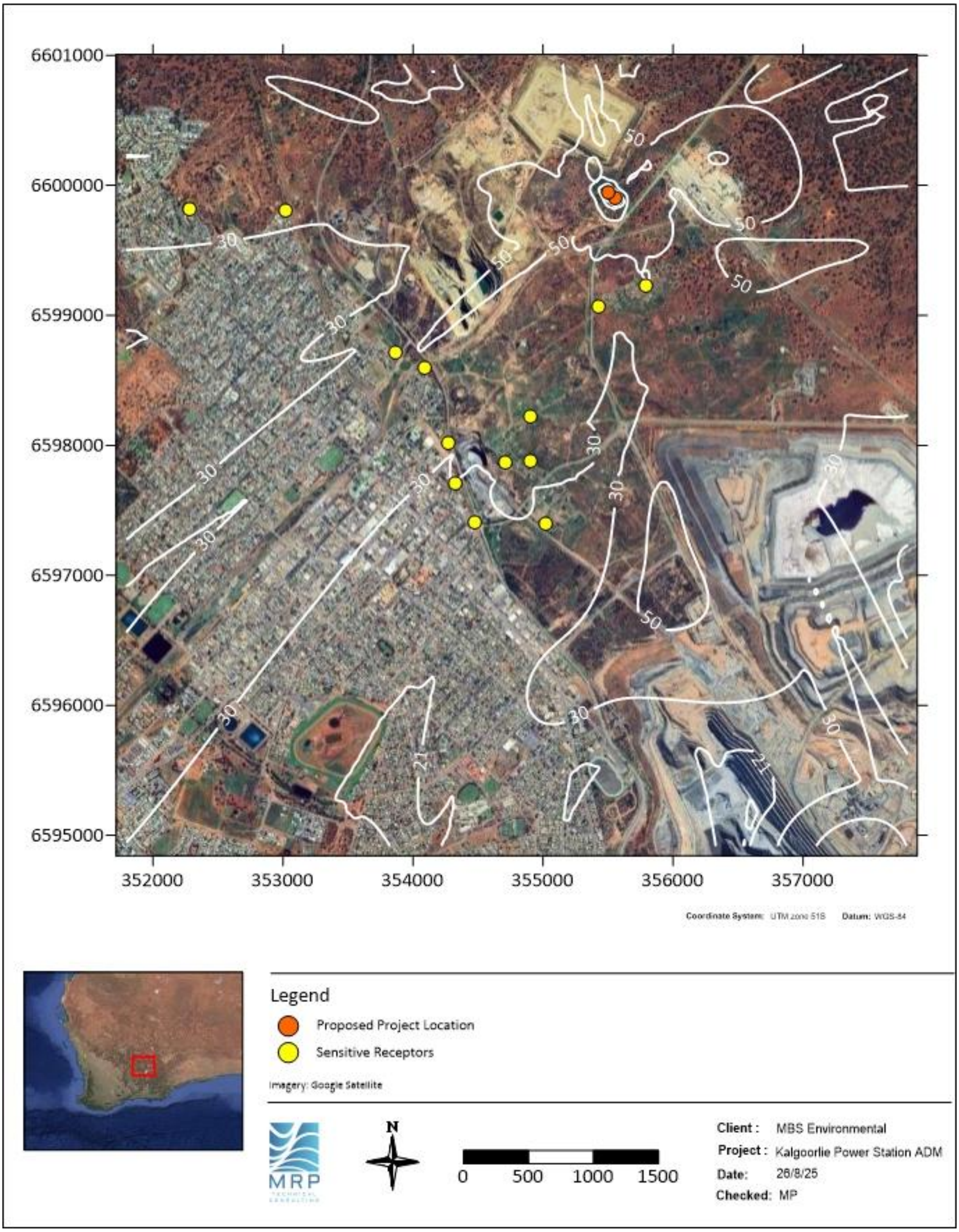


Figure 4-26: Predicted cumulative 1-hour maximum GLCs of NO_2 (µg/m³) – LFO mode (Scenario 4)

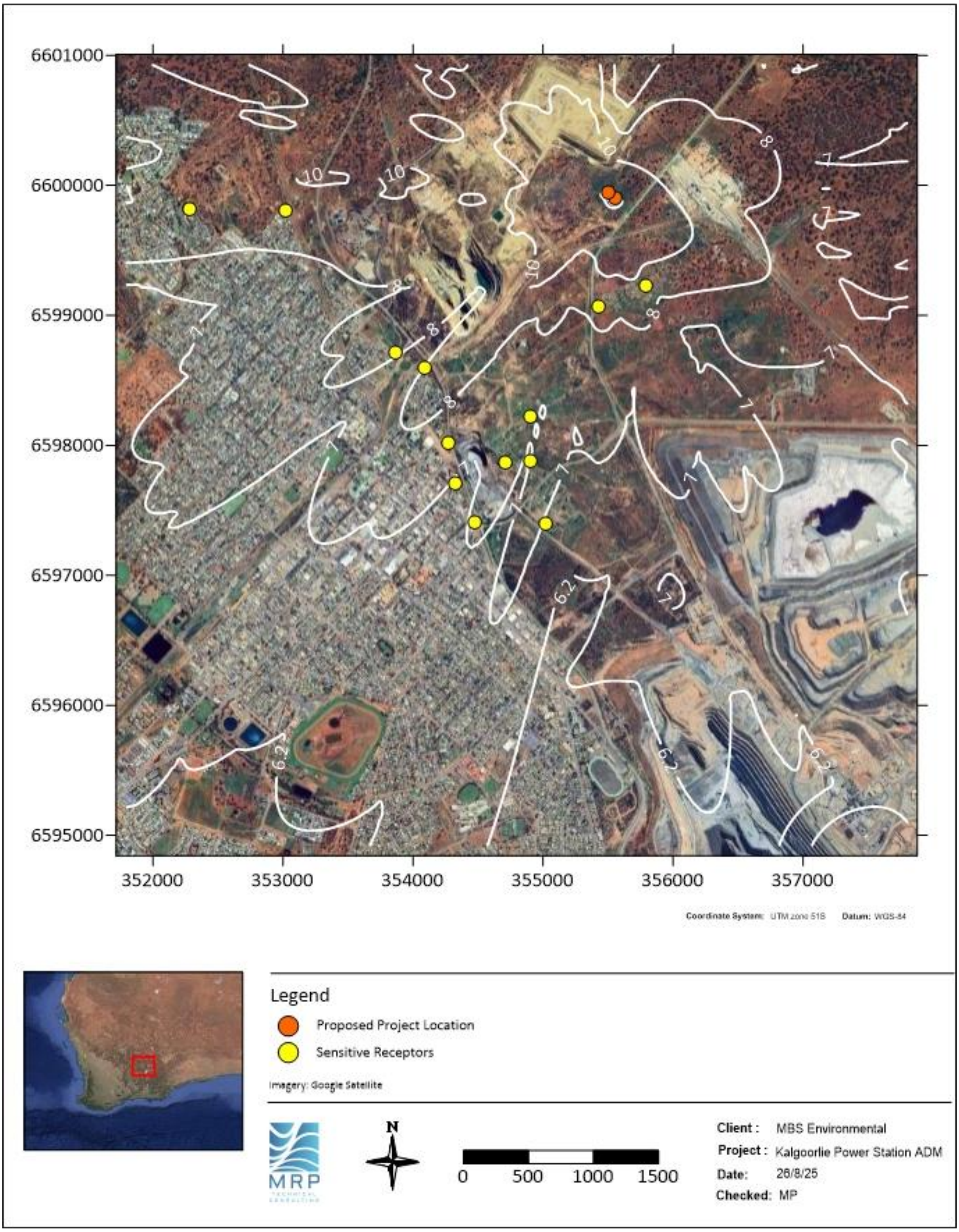


Figure 4-27: Predicted cumulative 24-hour maximum GLCs of SO_2 (μg/m³) – LFO mode (Scenario 4)

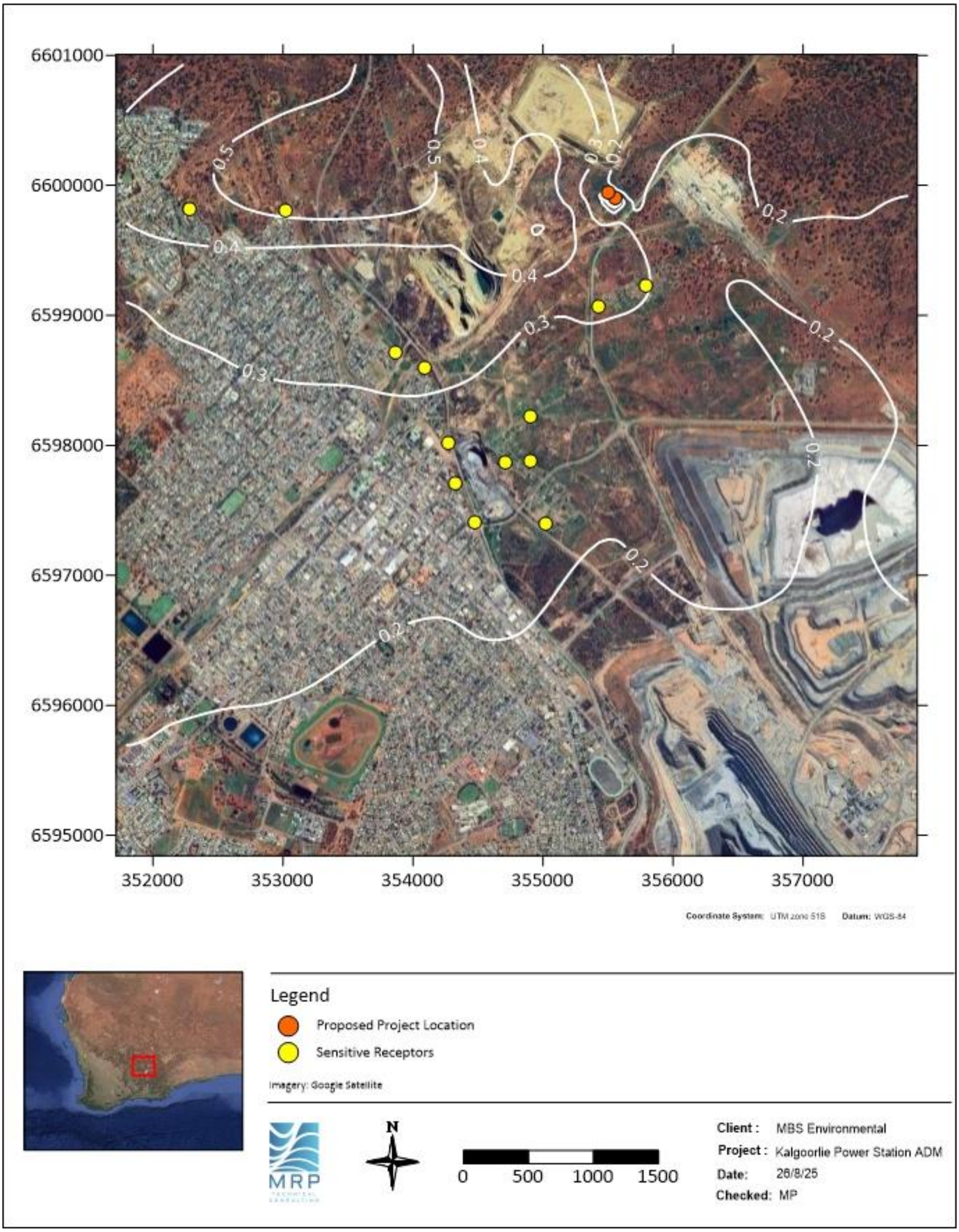


Figure 4-28: Predicted cumulative annual average GLCs of SO_2 (µg/m^3) – LFO mode (Scenario 4)

4.4 Carbon monoxide

Contour plots showing predicted concentrations of CO can be found in Figure 4-29 to Figure 4-36 below, with relevant air quality criteria displayed as a red contour line. Table 4-4 presents the predicted GLCs at nearby sensitive receptors in the region.

Results of the modelling indicated that there were no exceedances of the relevant 1-hour or 8-hour maximum AGVs for CO predicted at any of the nearby sensitive receptors for any of the modelled scenarios.

Table 4-4: Summary of predicted CO concentrations at the closest sensitive receptors

1-hour maximum CO ground level concentrations												
Receptor		Criteria	Background		Scenario 1		Scenario 2		Scenario 3		Scenario 4	
					Gas mode - isolation		Gas mode - cumulative		LFO mode - isolation		LFO mode - cumulative	
		(µg/m^3)[1]	(µg/m^3)[1]	% Guideline	(µg/m^3)[1]	% Guideline	(µg/m^3)[1]	% Guideline	(µg/m^3)[1]	% Guideline	(µg/m^3)[1]	% Guideline
Rec_001	Ninga Mia East				78	0.26%	162	0.54%	15	0.051%	99	0.33%
Rec_002	Ninga Mia West				63	0.21%	148	0.49%	9	0.031%	94	0.31%
Rec_003	Kalgoorlie North 3				65	0.22%	149	0.50%	10	0.034%	95	0.32%
Rec_004	Kalgoorlie North 2				69	0.23%	154	0.51%	13	0.045%	98	0.33%
Rec_005	Kalgoorlie North 1				90	0.30%	174	0.58%	13	0.043%	97	0.32%
Rec_006	Kalgoorlie Central				66	0.22%	150	0.50%	10	0.034%	95	0.32%
Rec_007	Kalgoorlie South 1	30,000	84	0.28%	52	0.17%	136	0.45%	8	0.027%	92	0.31%
Rec_008	Kalgoorlie South 2				42	0.14%	126	0.42%	7	0.024%	91	0.30%
Rec_009	Kalgoorlie South 3				31	0.10%	115	0.38%	6	0.021%	91	0.30%
Rec_010	Williamstown North				45	0.15%	129	0.43%	11	0.037%	95	0.32%
Rec_011	Williamstown Central East				38	0.13%	122	0.41%	12	0.040%	96	0.32%
Rec_012	Williamstown Central West				39	0.13%	123	0.41%	10	0.034%	94	0.31%
Rec_013	Williamstown South				36	0.12%	120	0.40%	7	0.023%	91	0.30%

8-hour maximum CO ground level concentrations												
Receptor		Criteria	Background		Scenario 1		Scenario 2		Scenario 3		Scenario 4	
					Gas mode - isolation		Gas mode - cumulative		LFO mode - isolation		LFO mode - cumulative	
		(µg/m^3)[1]	(µg/m^3)[1]	% Guideline	(µg/m^3)[1]	% Guideline	(µg/m^3)[1]	% Guideline	(µg/m^3)[1]	% Guideline	(µg/m^3)[1]	% Guideline
Rec_001	Ninga Mia East				33	0.33%	376	3.8%	5	0.047%	348	3.5%
Rec_002	Ninga Mia West				27	0.27%	370	3.7%	4	0.042%	348	3.5%
Rec_003	Kalgoorlie North 3				19	0.19%	363	3.6%	3	0.030%	346	3.5%
Rec_004	Kalgoorlie North 2				22	0.22%	365	3.7%	3	0.034%	347	3.5%
Rec_005	Kalgoorlie North 1				21	0.21%	365	3.6%	3	0.034%	347	3.5%
Rec_006	Kalgoorlie Central				16	0.16%	360	3.6%	3	0.026%	346	3.5%
Rec_007	Kalgoorlie South 1	10,000	344	3.4%	19	0.19%	363	3.6%	3	0.031%	347	3.5%
Rec_008	Kalgoorlie South 2				13	0.13%	357	3.6%	2	0.022%	346	3.5%
Rec_009	Kalgoorlie South 3				15	0.15%	358	3.6%	2	0.024%	346	3.5%
Rec_010	Williamstown North				15	0.15%	358	3.6%	2	0.025%	346	3.5%
Rec_011	Williamstown Central East				13	0.13%	356	3.6%	2	0.021%	346	3.5%
Rec_012	Williamstown Central West				15	0.15%	359	3.6%	3	0.025%	346	3.5%
Rec_013	Williamstown South				14	0.14%	357	3.6%	2	0.021%	346	3.5%

Notes

1. Referenced to 25ºC, and 101.3 kPa

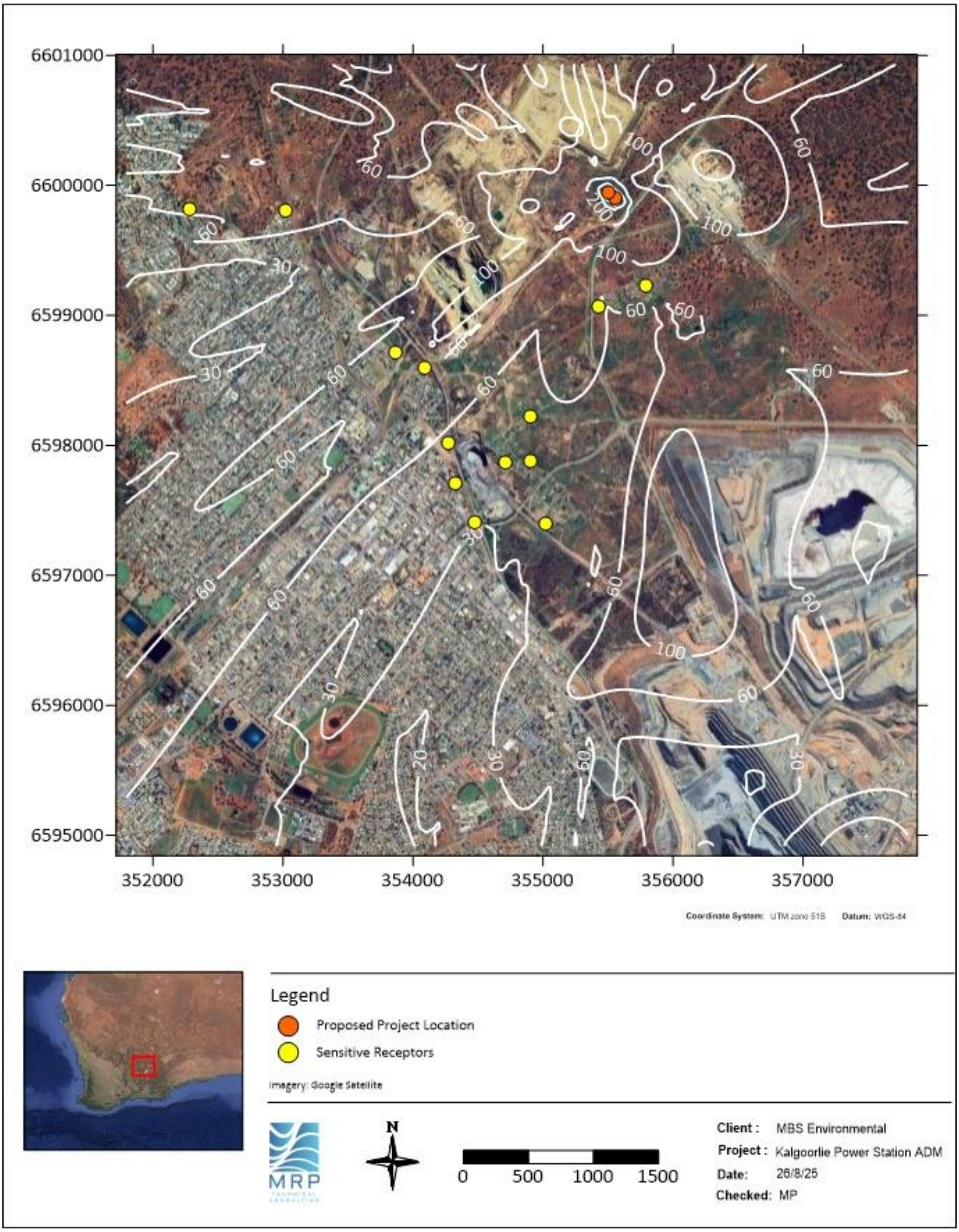


Figure 4-29: Predicted 1-hour maximum GLCs of CO (µg/m^3) in isolation – gas mode (Scenario 1)

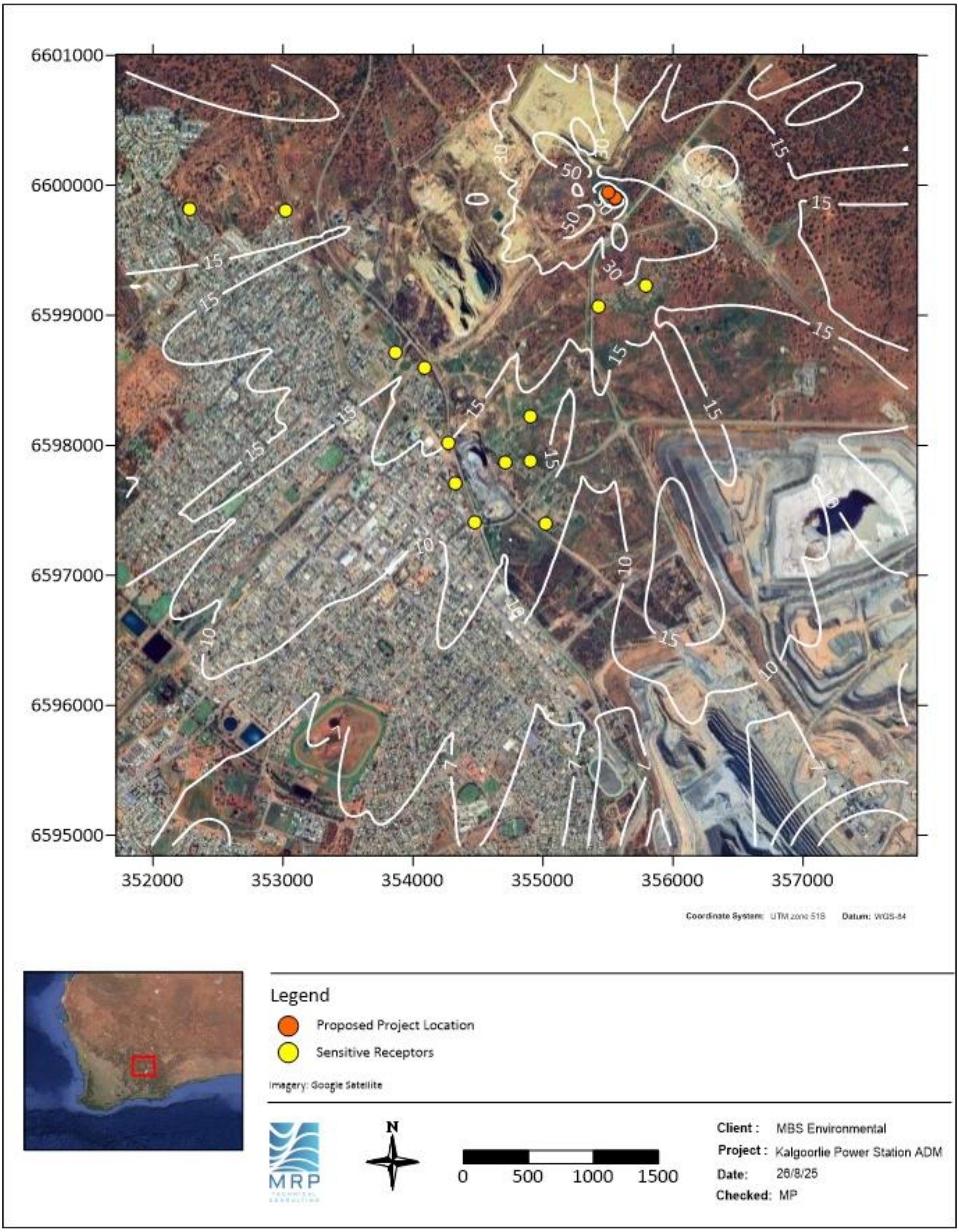


Figure 4-30: Predicted 8-hour maximum GLCs of CO (μg/m³) in isolation – gas mode (Scenario 1)

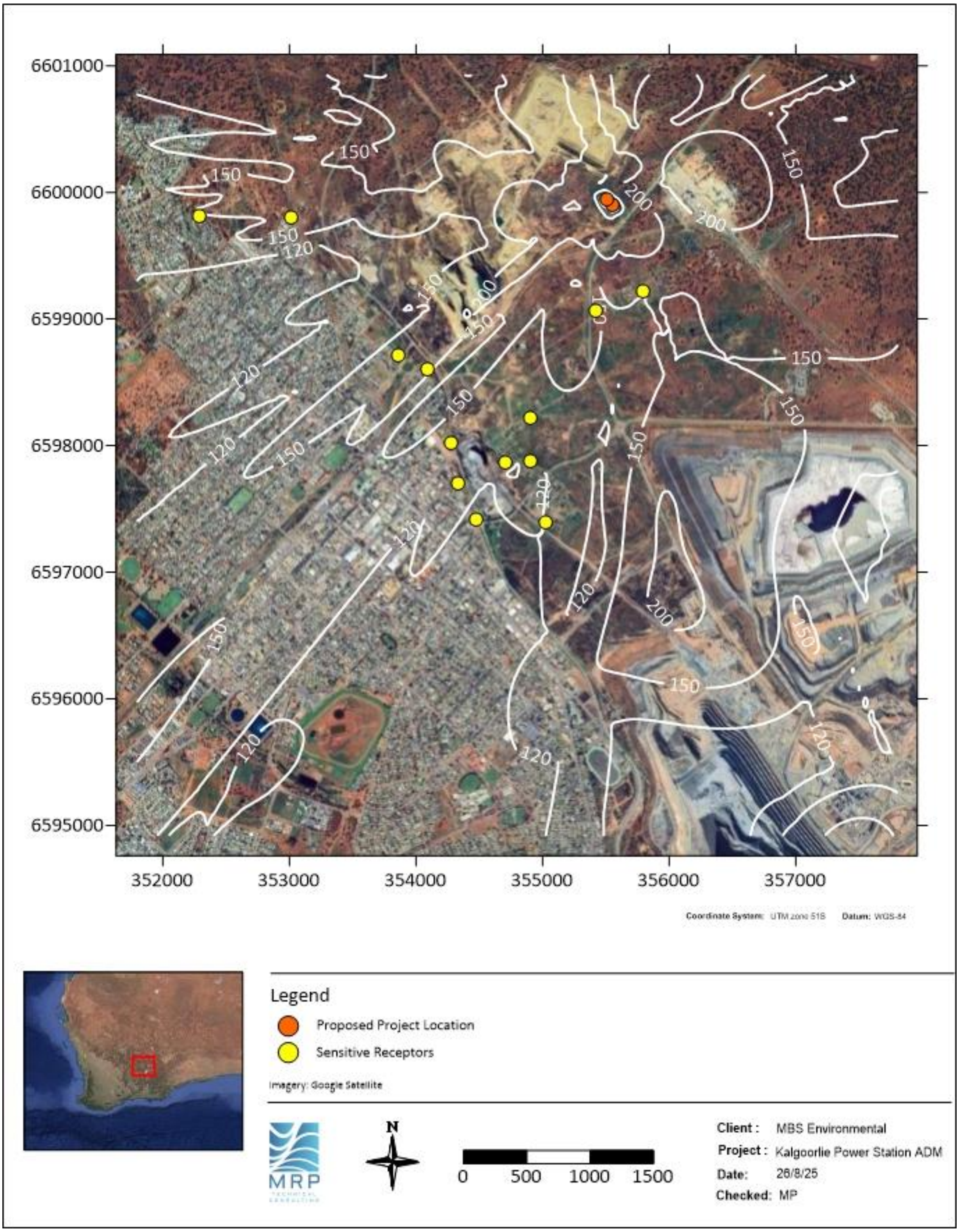


Figure 4-31: Predicted cumulative 1-hour maximum GLCs of CO (µg/m³) – gas mode (Scenario 2)

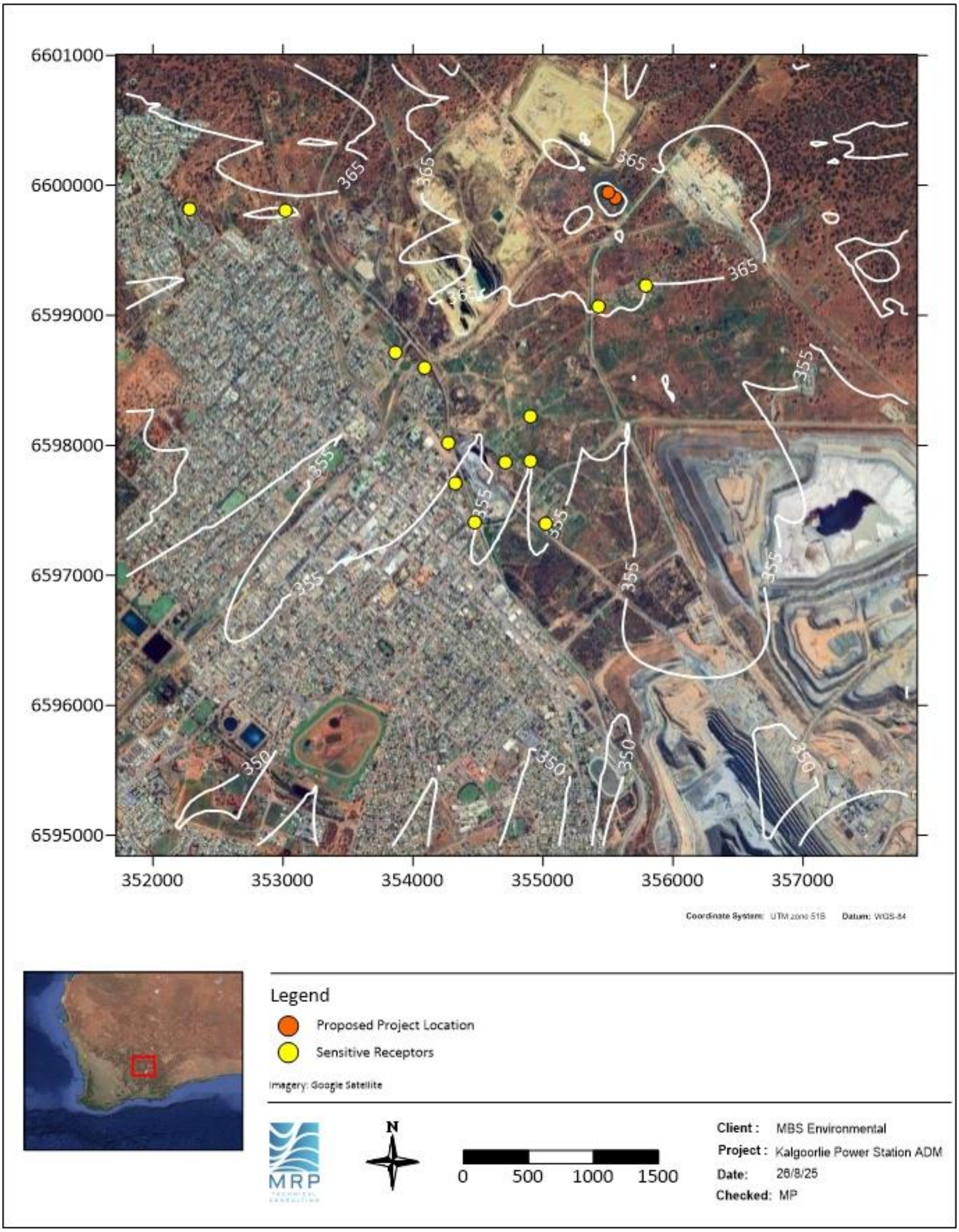


Figure 4-32: Predicted cumulative 8-hour maximum GLCs of CO (µg/m³) – gas mode (Scenario 2)

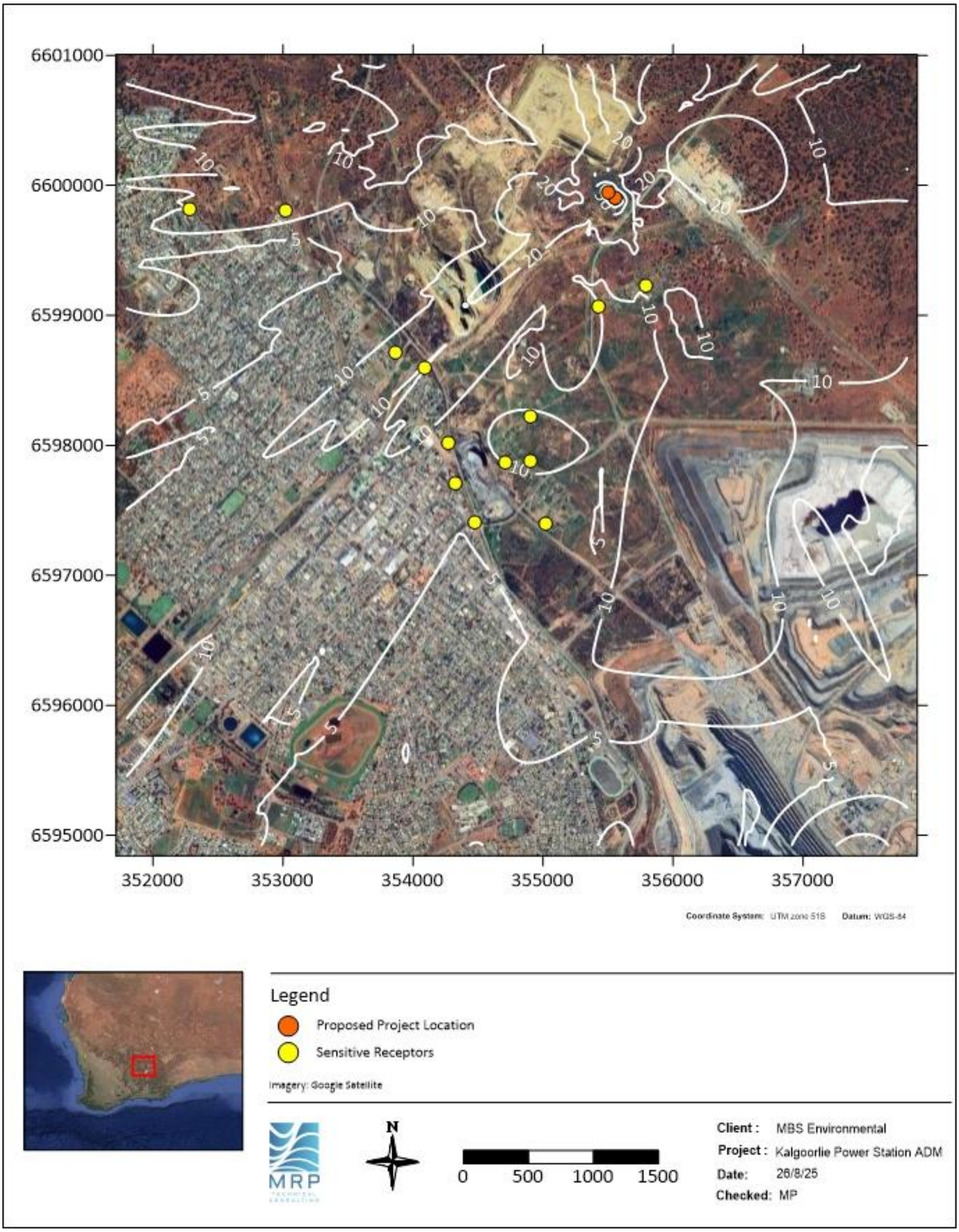


Figure 4-33: Predicted 1-hour maximum GLCs of CO (µg/m³) in isolation – LFO mode (Scenario 3)

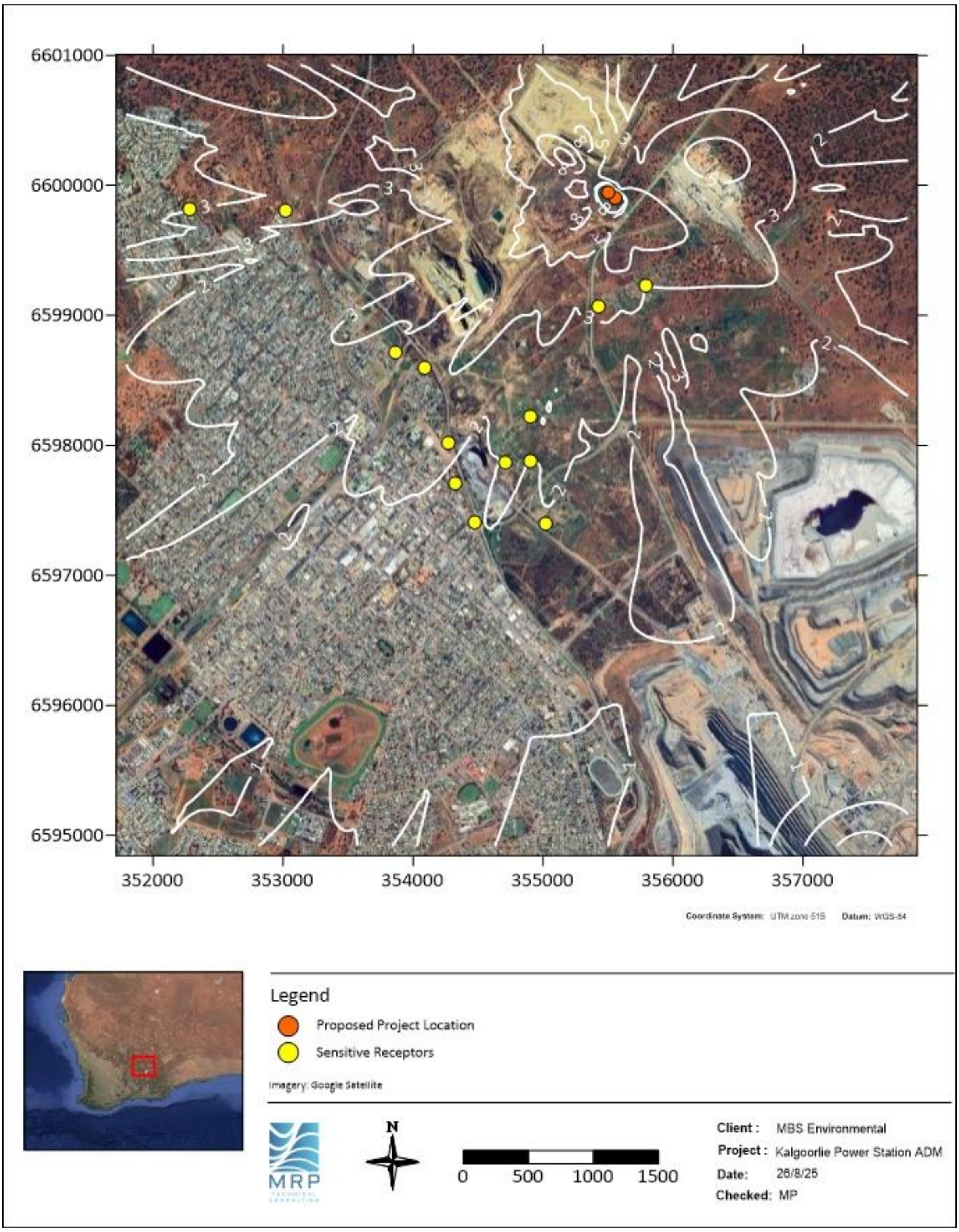


Figure 4-34: Predicted 8-hour maximum GLCs of CO (µg/m³) in isolation – LFO mode (Scenario 3)

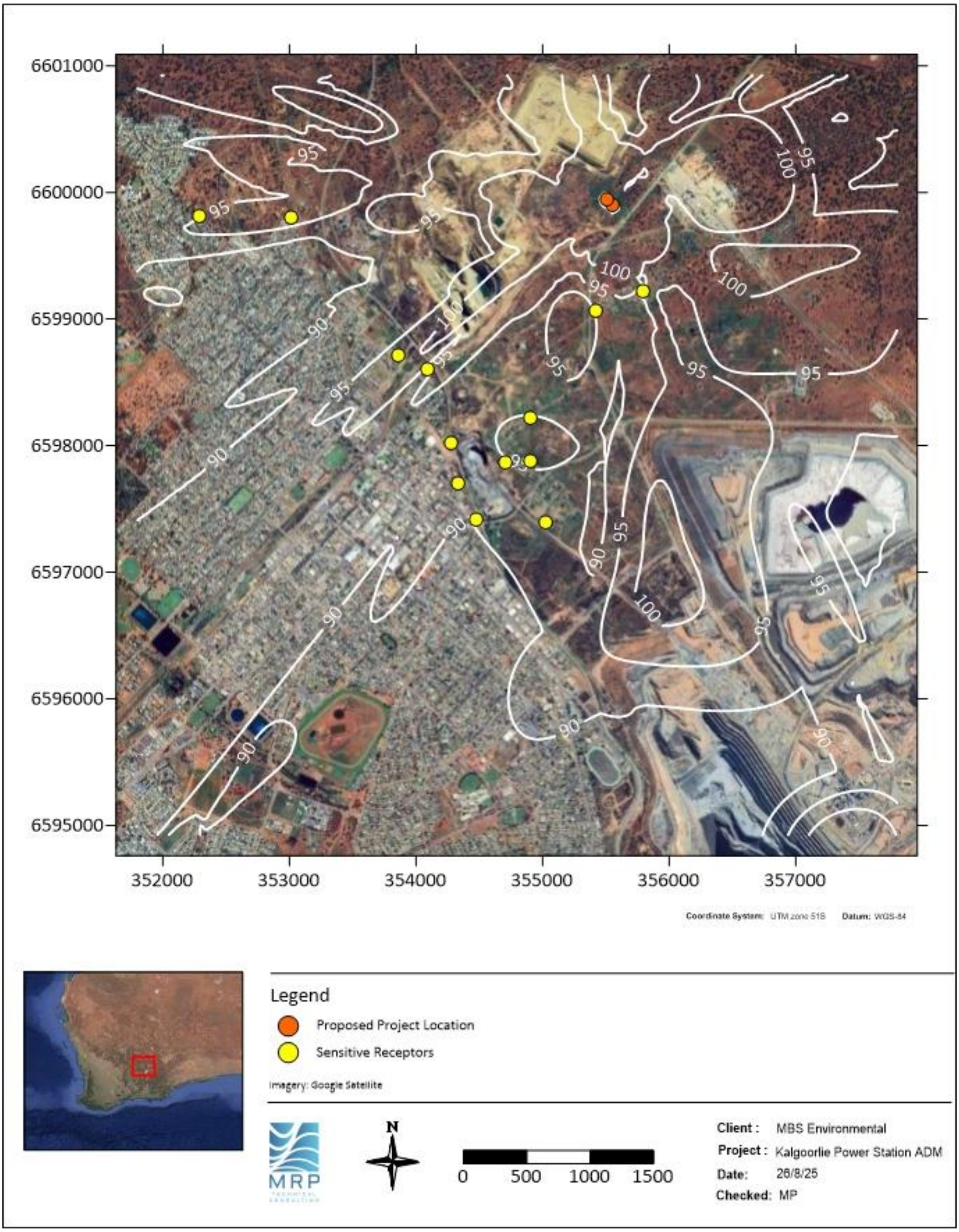


Figure 4-35: Predicted cumulative 1-hour maximum GLCs of CO (µg/m³) – LFO mode (Scenario 4)

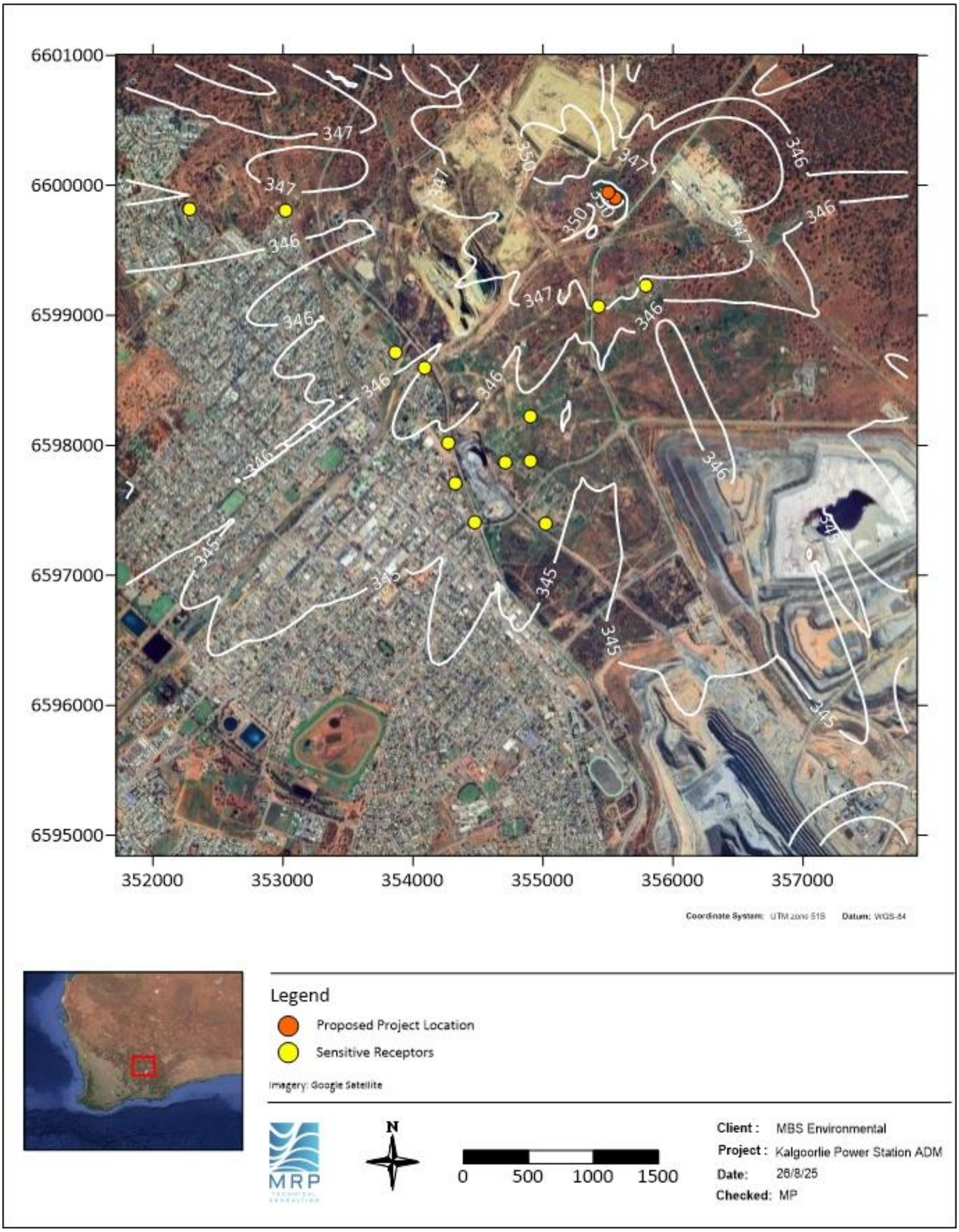


Figure 4-36: Predicted cumulative 8-hour maximum GLCs of CO (µg/m³) – LFO mode (Scenario 4)

4.5 Formaldehyde

Contour plots showing predicted concentrations of CH_2O can be found in Figure 4-37 to Figure 4-40 below, with relevant air quality criteria displayed as a red contour line. Table 4-5 presents the predicted GLCs at nearby sensitive receptors in the region.

Results of the modelling indicated that there were no exceedances of the relevant 1-hour or 24-hour maximum AGVs for CH_2O predicted at any of the nearby sensitive receptors or outside of the facility boundary for any of the modelled scenarios.

Table 4-5: Summary of predicted CH_2O concentrations at the closest sensitive receptors

1-hour maximum CH_2O ground level concentrations								
Receptor		Criteria	Background		Scenario 1 Gas mode - isolation		Scenario 2 Gas mode - cumulative	
		(µg/m³)[1]	(µg/m³)[1]	% Guideline	(µg/m³)[1]	% Guideline	(µg/m³)[1]	% Guideline
Rec_001	Ninga Mia East	20	1.96	10%	10.76	54%	12.71	64%
Rec_002	Ninga Mia West				8.71	44%	10.66	53%
Rec_003	Kalgoorlie North 3				8.97	45%	10.93	55%
Rec_004	Kalgoorlie North 2				9.53	48%	11.49	57%
Rec_005	Kalgoorlie North 1				12.32	62%	14.28	71%
Rec_006	Kalgoorlie Central				9.11	46%	11.07	55%
Rec_007	Kalgoorlie South 1				7.10	35%	9.06	45%
Rec_008	Kalgoorlie South 2				5.78	29%	7.73	39%
Rec_009	Kalgoorlie South 3				4.29	21%	6.24	31%
Rec_010	Williamstown North				6.13	31%	8.09	40%
Rec_011	Williamstown Central East				5.19	26%	7.14	36%
Rec_012	Williamstown Central West				5.33	27%	7.29	36%
Rec_013	Williamstown South				4.90	25%	6.86	34%
1-hour 99.9th Percentile CH_2O ground level concentrations								
Facility Boundary		20	1.96	10%	13.20	66%	15.15	76%

Notes

1. Referenced to 25ºC, and 101.3 kPa

24-hour maximum CH_2O ground level concentrations								
Receptor		Criteria	Background		Scenario 1 Gas mode - isolation		Scenario 2 Gas mode - cumulative	
		(µg/m³)[1]	(µg/m³)[1]	% Guideline	(µg/m³)[1]	% Guideline	(µg/m³)[1]	% Guideline
Rec_001	Ninga Mia East	49	2.10	4%	1.53	8%	3.63	18%
Rec_002	Ninga Mia West				1.34	7%	3.44	17%
Rec_003	Kalgoorlie North 3				1.27	6%	3.36	17%
Rec_004	Kalgoorlie North 2				1.52	8%	3.61	18%
Rec_005	Kalgoorlie North 1				1.09	5%	3.19	16%
Rec_006	Kalgoorlie Central				0.99	5%	3.09	15%
Rec_007	Kalgoorlie South 1				0.91	5%	3.01	15%
Rec_008	Kalgoorlie South 2				0.63	3%	2.72	14%
Rec_009	Kalgoorlie South 3				0.67	3%	2.76	14%
Rec_010	Williamstown North				0.68	3%	2.77	14%
Rec_011	Williamstown Central East				0.69	3%	2.79	14%
Rec_012	Williamstown Central West				0.69	3%	2.79	14%
Rec_013	Williamstown South				0.70	3%	2.80	14%

Notes

1. Referenced to 25ºC, and 101.3 kPa

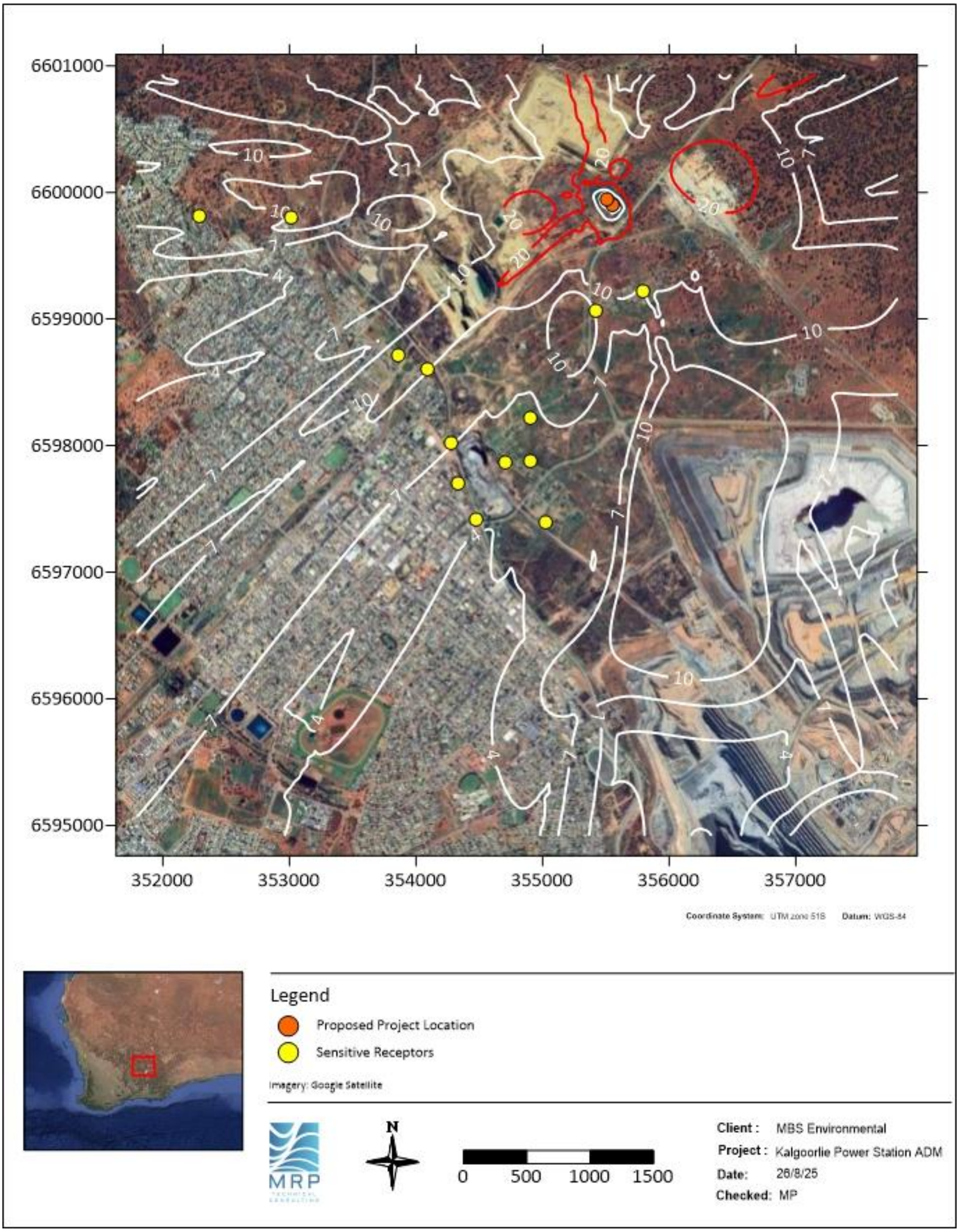


Figure 4-37: Predicted 1-hour maximum GLCs of CH_2O (μg/m^3) in isolation – gas mode (Scenario 1)

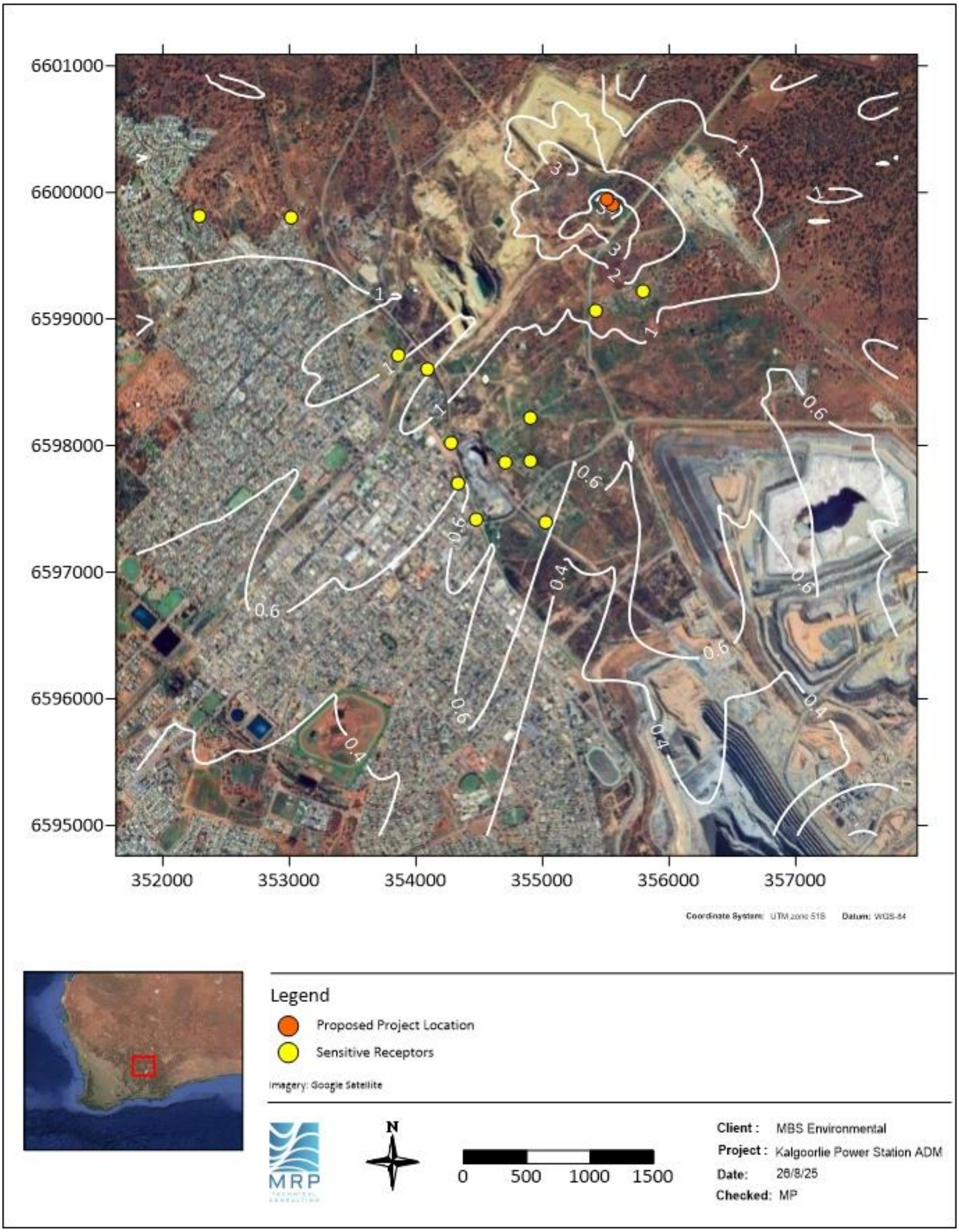


Figure 4-38: Predicted 24-hour maximum GLCs of CH_2O (μg/m^3) in isolation – gas mode (Scenario 1)

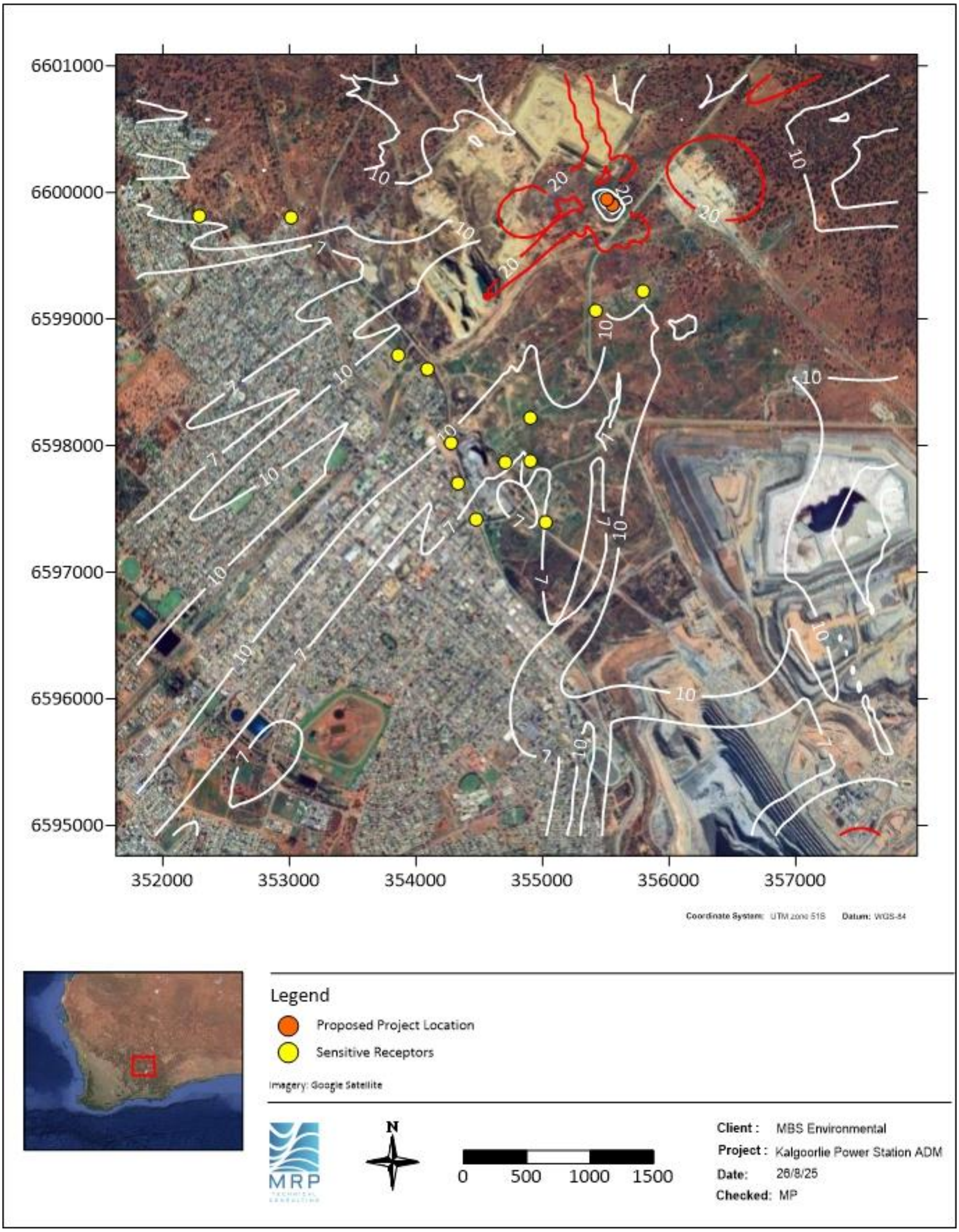


Figure 4-39: Predicted cumulative 1-hour maximum GLCs of CH_2O (µg/m^3) – gas mode (Scenario 2)

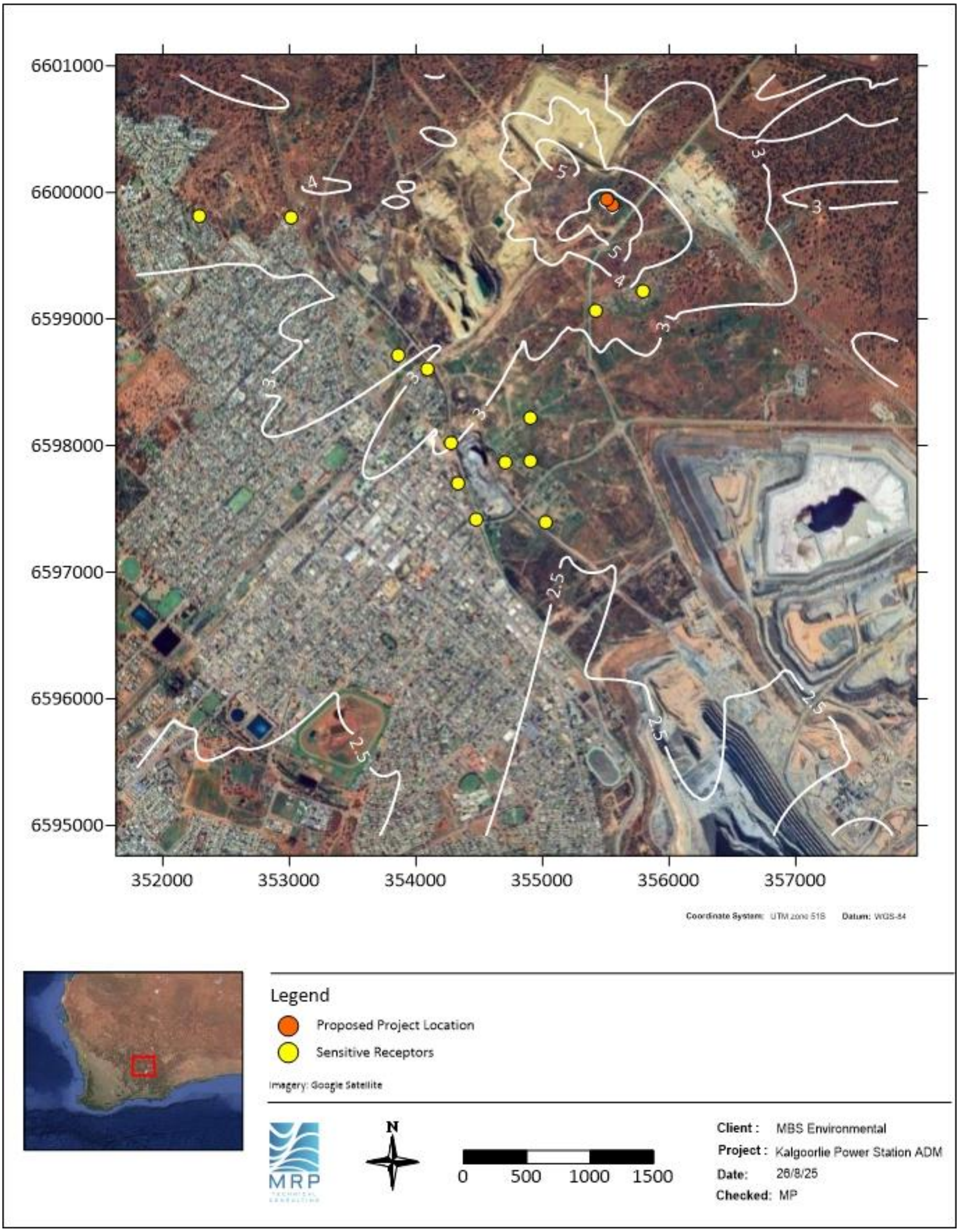


Figure 4-40: Predicted cumulative 24-hour maximum GLCs of CH_2O (µg/m^3) – gas mode (Scenario 2)

5 Conclusion

Zenith is working with Northern Star to develop additional power supply sources for the KCGM operations which are located in Kalgoorlie in Western Australia, approximately 600 km east of Perth. Additional power supply is required to meet increasing power demands for the operation as a direct result of significant expansion of ore processing throughput rates at the Fimiston Gold Plant from 13.4 to about 20 Mtpa.

Zenith and Northern Star have identified supplementing the existing aging 110 MW natural gas thermal power supply at Parkeston with a new thermal power generation facility with a capacity of circa 140 MW. The new power station would provide the additional power required for increased ore processing. Construction and operation of the new facility would be targeted at providing power supply for KCGM by late 2027 to match scheduled completion of the Fimiston Gold Plant expansion at KCGM. Thermal power is anticipated to provide the full KCGM power needs for a period of 12–24 months with decreasing reliance over time as other alternative energy supply options are assessed and ultimately constructed and become available. Zenith and Northern Star are planning to construct the new 140 MW power station northwest of the existing Parkeston Power Station. The assessment considered the following potential air pollutants from the power station: NOx, $PM_{2.5}$, SO_2, CO and CH_2O.

Air dispersion modelling was conducted to assess the proposed operations of the thermal power generation facility. The air dispersion modelling did not predict exceedances of $PM_{2.5}$, SO_2, CO or CH_2O at any of the sensitive receptor locations for any scenario or averaging period.

Exceedances of the 1-hour average ambient air quality criterion for NO_2 were predicted at two nearby sensitive receptors (Ninga Mia East and Kalgoorlie North 2) for operations in the LFO mode (no exceedances were predicted for gas mode) when considered cumulatively with background concentrations (Scenario #4). The predicted values at the receptors were 104% and 100% of the 1-hour AGV. When considered in isolation (Scenario #3), no exceedance was predicted for the 1-hour criterion was predicted for NO_2. It is noted that the magnitude and the frequency of predicted exceedances of the 1-hour AGV for NO_2 (assuming continuous operations in LFO mode) is low. The plant is not expected to operate in LFO mode unless natural gas is unavailable. The probability that potential worst case meteorological conditions would occur at the same time as potential times where the plant may be required to operate in LFO mode is low. Given the above, the risk to human health at nearby receptors associated with the proposed operational profile of the power station in LFO mode is considered low.

Scenarios #3 and #4 are considered representative of startup and shutdown conditions and are expected to occur infrequently and for short durations (5 minutes). Northern Star Resources has verbally communicated that the gas supply has not been interrupted during normal operation conditions in the previous ten (10) years and that the Parkeston facility has not previously experienced any interruptions to their gas supply.

6 References

AGL. 2019. 'Plume Rise Assessment – Newcastle Power Station'. Prepared by ERM for AGL Energy Ltd.

Briggs, G.A. 1975. 'Plume rise from multiple sources'. In Cooling Tower Environment – 1974, S.R Hanna and J. Pells (Eds), University of Maryland Education Center, 4-6 March 1974, NTIS CONF – 740302, pp161-179.

Briggs, G.A. 1984. 'Plume Rise and Buoyancy Effects Science and Production'. In D. Randerson (Ed.), Science and Production.

CASA. 2004. 'Advisory Circular 139-05(0): Guidelines for conducting plume rise assessments.' June 2004.

Calvert, J. G., Orlando, J. J., Stockwell, W. R., & Wallington, T. J. 2015. 'The Oxides of Nitrogen: Their Relation to Tropospheric Ozone'. Oxford University Press.

Cole, H.S. and Summerhays, J.E. 1979. 'A review of the techniques available for estimating short term NO_2 concentrations', Journal of the Air Pollution Control Association, 29(8), 812–17

Copernicus. 2024. 'CAMS Global Reanalysis (EAC4)'. Copernicus Atmosphere Monitoring Service. Retrieved from: https://ads.atmosphere.copernicus.eu/datasets/cams-global reanalysis-eac4?tab=download

Department of Environment and Conservation (DEC). 2011. 'A guideline for managing the impacts of dust and associated contaminants from land development sites, contaminated sites remediation and other related activities'. March 2011.

Department of Water and Environmental Regulation (DWER). 2024. '2022 Western Australian air monitoring report.' November 2024.

Department of Water and Environmental Regulation (DWER). 2019. 'Guideline Air Emissions – Draft for External Consultation.' October 2019.

Department of Water and Environmental Regulation (DWER). 2017. 'Guidance Statement: Risk Assessments.' February 2017.

Environment Protection Authority South Australia (EPA SA). 2016. 'Environmental Protection (Air Quality) Policy 2016'. Retrieved from: https://www.legislation.sa.gov.au/lz?path=%2FC%2FPOL%2FEnvironment%20Protection%20(Air%20Quality)%20Policy%202016

Environmental Protection Authority Victoria (EPA Victoria). 2001. 'State Environment Protection Policy (Air Quality Management).' Published in the Victoria Government Gazette No. S 240, 21 December 2001.

Golder, D. 1972. 'Relation among Stability Parameters in the Surface Layer'. Boundary Layer Met. 3, pp. 47-58.

Manins, P.C., Carras, J.N., and Williams, D.L. 1992. 'Plume Rise From Multiple Stacks'. Clean Air (Australia), Vol. 26, Part 2, pp. 65–68. Retrieved from: https://www.cmar.csiro.au/e-print/open/manins_1992a.pdf

Michalakes, J., S. Chen, J. Dudhia, L. Hart, J. Klemp, J. Middlecoff, and W. Skamarock. 2001. 'Development of a Next Generation Regional Weather Research and Forecast Model. Developments in Teracomputing'. Proceedings of the Ninth ECMWF Workshop on the Use of High Performance Computing in Meteorology. Eds. Walter Zwieflhofer and Norbert Kreitz. World Scientific, Singapore. pp. 269-276.

National Environment Protection Council (NEPC). 2021. 'National Environment Protection (Ambient Air Quality) Measure'.

National Environment Protection Council (NEPC). 2011. 'National Environment Protection (Air Toxics) Measure'.

NSW Department of Planning, Industry and Environment (DPIE). 2021.'Cadia East Gold/Copper Project Modification 14 Increased Processing Rate, Infrastructure Upgrades and Tailings Dam Repair/ Buttressing State Significant Development Modification Assessment'. December 2021

NSW Environmental Protection Authority (NSW EPA). 2022. 'Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales'.

Physick, W, and Blockley, A. 2001. 'An Evaluation of Air Quality Models for the Pilbara Region'. June 2001. CSIRO Atmospheric Research and Department of Environmental Protection.

Pitts, O., Cope, M., Hibberd, M., Meyer., M., Papiccio, E. and Wong, V. 2011. 'Modelling cumulative impacts of bushfire and industrial emissions in the Pilbara region of Australia using TAPM-CTM'. In Clean Air Society Australia and New Zealand Conference Proceedings. Christchurch, New Zealand, 31 July – 2 August 2011. 6pp.

Rye, P.J. 2021. 'Modelling Rainfall using WRF: A Sensitivity Study', Proceedings of the online CASANZ Conference.

Tikvart, J.A. 1996. 'Application of Ozone Limiting Method, Model Clearinghouse Memorandum No. 107', US Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC, USA.

United States Environmental Protection Agency (USEPA). 1998. ‘Compilation of Air Pollutant Emission Factors’

APPENDIX E:

ENVIRONMENTAL ACCOUSTIC ASSESSMENT

APPENDIX E

MBS ENVIRONMENTAL

KCGM HYBRID THERMAL POWER STATION PROJECT
YARRI ROAD, PARKESTON

ENVIRONMENTAL ACOUSTIC ASSESSMENT

FOR

NORTHERN STAR RESOURCES LTD AND ZENITH ENERGY

SEPTEMBER 2025

OUR REFERENCE: 35265-2-25195

Rochdale Holdings Pty Ltd A.B.N. 85 009 049 067 trading as:
HERRING STORER ACOUSTICS
P.O. Box 219, Como, W.A. 6952
(08) 9367 6200
hsa@hsacoustics.com.au

DOCUMENT CONTROL PAGE

ENVIRONMENTAL ACOUSTIC ASSESSMENT
KCGM HYBRID THERMAL POWER STATION PROJECT

Job No: 25195

Document Reference: 35265-2-25195

FOR

NORTHERN STAR RESOURCES LTD AND ZENITH ENERGY

DOCUMENT INFORMATION			
Author:	Paul Daly	**Checked By:**	Tim Reynolds
Date of Issue:	9 September 2025		

REVISION HISTORY				
Revision	**Description**	**Date**	**Author**	**Checked**
1	Client Comments	06/10/2025	PLD	

DOCUMENT DISTRIBUTION				
Copy No.	**Version No.**	**Destination**	**Hard Copy**	**Electronic Copy**
1	2	MBS Environmental Attn: Kristy Sell [redacted]		✓

CONTENTS

APPENDICES

EXECUTIVE SUMMARY

MBS Environmental, on behalf of Zenith Energy and Northern Star Resources Ltd commissioned Herring Storer Acoustics to carry out an acoustic study of noise emissions for a proposed Hybrid Thermal Power Station in Kalgoorlie.

Zenith and Northern Star have proposed to supplement the existing aging 110 MW natural gas thermal power station at Parkeston with a new thermal power generation facility, with a capacity of circa 120 MW.

This acoustic assessment is required for the approval process and is being undertaken prior to the final design of the plant being known. Whilst the plant design is undergoing final consideration, for the purpose of the predictive noise modelling, the current design has been used as a basis for the assessment.

The nearest noise sensitive premises (R1 Nangamia Community) is situated approximately 630m to the south of the proposed plant. The next nearest noise sensitive receivers considered are located in Williamstown (1750m) and Kalgoorlie (1950m) to the west and south west.

For this assessment, there is unique situation where there is existing Regulation 17, Ministerial exemption in place for the noise emissions associated with the KCGM Fimiston operations. This allows for higher assigned noise levels at the residential receivers being assessed in this proposal.

Based on the compliance noise levels for the nearest Regulation 17 reference location (Barton Street, Williamstown) the assigned noise level during the night period is 45 dB(A) plus a weather influencing factor. Predictive noise modelling of the difference between the Regulation 17 reference location and the noise sensitive receivers in this assessment shows a reduction of between 5 to 7 dB. Hence at a complying noise level for the Fimiston operations of 49 dB(A) at the reference location would results in noise levels at the receivers in this study of 42 to 44 dB(A).

However, noise emissions from the proposed power station are assessable under the *Environmental Protection Noise Regulations 1997*. As outlined in the criteria section, the allowable noise level at the nearest noise sensitive receivers needs to meet the assigned noise level in isolation of other noise sources. For the most stringent time period (night) the assigned noise level at R1, the most stringent receptor would be 37 dB(A). The highest predicted noise emissions for the nearest noise sensitive premise would be 36 dB(A). This includes all noise sources associated with the facility operating at 100 percent load, which is an unlikely operating condition at night.

The operating scenarios consider all noise sources from the proposed power station operating at the same time. The calculated noise levels have been assessed under the highest night-time propagation weather conditions. Given this, noise modelling would be considered conservative, as it is unlikely that all noise sources are operating at the same time under the worst-case propagation conditions.

The acoustic assessment shows that in the worst case, that noise received at the surrounding noise sensitive premises is below the assigned noise level. Thus, noise emissions from the proposed Thermal Power Station would be deemed to comply with the requirements of the Regulations.

1. INTRODUCTION

MBS Environmental, on behalf of Zenith Energy and Northern Star Resources Ltd commissioned Herring Storer Acoustics to carry out an acoustic study of noise emissions for a proposed Hybrid Thermal Power Station in Kalgoorlie.

Zenith Energy (Zenith) is working with Northern Star Resources (Northern Star) to develop additional power supply sources for the KCGM operations which are located in Kalgoorlie in Western Australia. Additional power supply is required to meet increasing power demands for the operations as a direct result of significant expansion of ore processing throughput rates at the Fimiston Gold Plant from 13.4 to about 20 Mtpa.

Zenith and Northern Star have identified supplementing the existing aging 110 MW natural gas thermal power station at Parkeston with a new thermal power generation facility with a capacity of circa 120 MW. The new power station would provide the additional power required for increased ore processing. Construction and operation of the new facility would be targeted at providing power supply for KCGM by late 2027 to match scheduled completion of the Fimiston Gold Plant expansion at KCGM. Thermal power is anticipated to provide the full KCGM power needs for a period of 12–24 months with decreasing reliance over time as other alternative energy supply options are assessed and ultimately constructed and become available.

Zenith and Northern Star are planning to construct the new 120 MW power station northwest of the existing Parkeston Power Station within pending Mining Act 1978 tenure L26/313 as shown in Figure 1.1 below.

FIGURE 1.1 – SITE LAYOUT

The nearest noise sensitive premises (R1 Nangamia Community) is situated approximately 630m to the south of the proposed plant. The next nearest noise sensitive receivers considered are located in Williamstown (1750m) and Kalgoorlie (1950m) to the west and south west.

This report assesses both the day and night-time (worst case) noise emissions under maximum propagation conditions for the power station for compliance with the requirements of the Western Australian *Environmental Protection (Noise) Regulations 1997* (WA) *(the Noise Regulations)*.

2. CRITERIA

The allowable noise level at the surrounding locales is prescribed by the Environmental Protection (Noise) Regulations 1997. Regulations 7 & 8 stipulate maximum allowable external noise levels. For the neighbouring residences this is determined by the calculation of an influencing factor, which is then added to the base levels. The influencing factor is calculated for the usage of land within two circles, having radii of 100m and 450m from the premises of concern.

The base noise levels for the times of day being considered as part of this application are shown below in Table 2.1.

TABLE 2.1 – ASSIGNED OUTDOOR NOISE LEVELS

Type of premises receiving noise	Time of day	Assigned level (dB)		
		L_{A10}	L_{A1}	L_{Amax}
Noise sensitive premises: highly sensitive area (i.e within 15m of a dwelling)	0700 to 1900 hours Monday to Saturday	45 + IF	55 + IF	65 + IF
	0900 to 1900 hours Sunday and public holidays	40 + IF	50 + IF	65 + IF
	1900 to 2200 hours all days	40 + IF	50 + IF	55 + IF
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays	35 + IF	45 + IF	55 + IF
Noise sensitive premises: any area other than highly sensitive area	All hours	60	75	80
Commercial premises	All hours	60	75	80
Industrial and utility premises other than those in the Kwinana Industrial Area	All hours	65	80	90

Note: The L_{A10} noise level is the noise that is exceeded for 10% of the time.
The L_{A1} noise level is the noise that is exceeded for 1% of the time.
The L_{Amax} noise level is the maximum noise level recorded.
IF = Influencing Factor

It is a requirement that received noise be free of annoying characteristics (tonality, modulation and impulsiveness), defined below as per Regulation 9.

"impulsiveness" means a variation in the emission of a noise where the difference between L_{Apeak} and $L_{Amax(Slow)}$ is more than 15 dB when determined for a single representative event;

"modulation" means a variation in the emission of noise that –

(a) is more than 3 dB L_{AFast} or is more than 3 dB L_{AFast} in any one-third octave band;
(b) is present for more at least 10% of the representative assessment period; and
(c) is regular, cyclic and audible;

"tonality" means the presence in the noise emission of tonal characteristics where the difference between –

(a) the A-weighted sound pressure level in any one-third octave band; and
(b) the arithmetic average of the A-weighted sound pressure levels in the 2 adjacent one-third octave bands,

is greater than 3 dB when the sound pressure levels are determined as $L_{Aeq,T}$ levels where the time period T is greater than 10% of the representative assessment period, or greater than 8 dB at any time when the sound pressure levels are determined as L_{ASlow} levels. Where the noise emission is not music, if the above characteristics exist and cannot be practicably removed, then any measured level is adjusted according to Table 2.2 below.

TABLE 2.2 - ADJUSTMENTS TO MEASURED LEVELS

Where **tonality** is present	Where **modulation** is present	Where **impulsiveness** is present
+5 dB(A)	+5 dB(A)	+10 dB(A)

Note: These adjustments are cumulative to a maximum of 15 dB.

The most critical "noise sensitive premises" have been used for the assessment being identified using the City of Kalgoorlie Boulder intra maps site, as shown below in Figure 3.1.

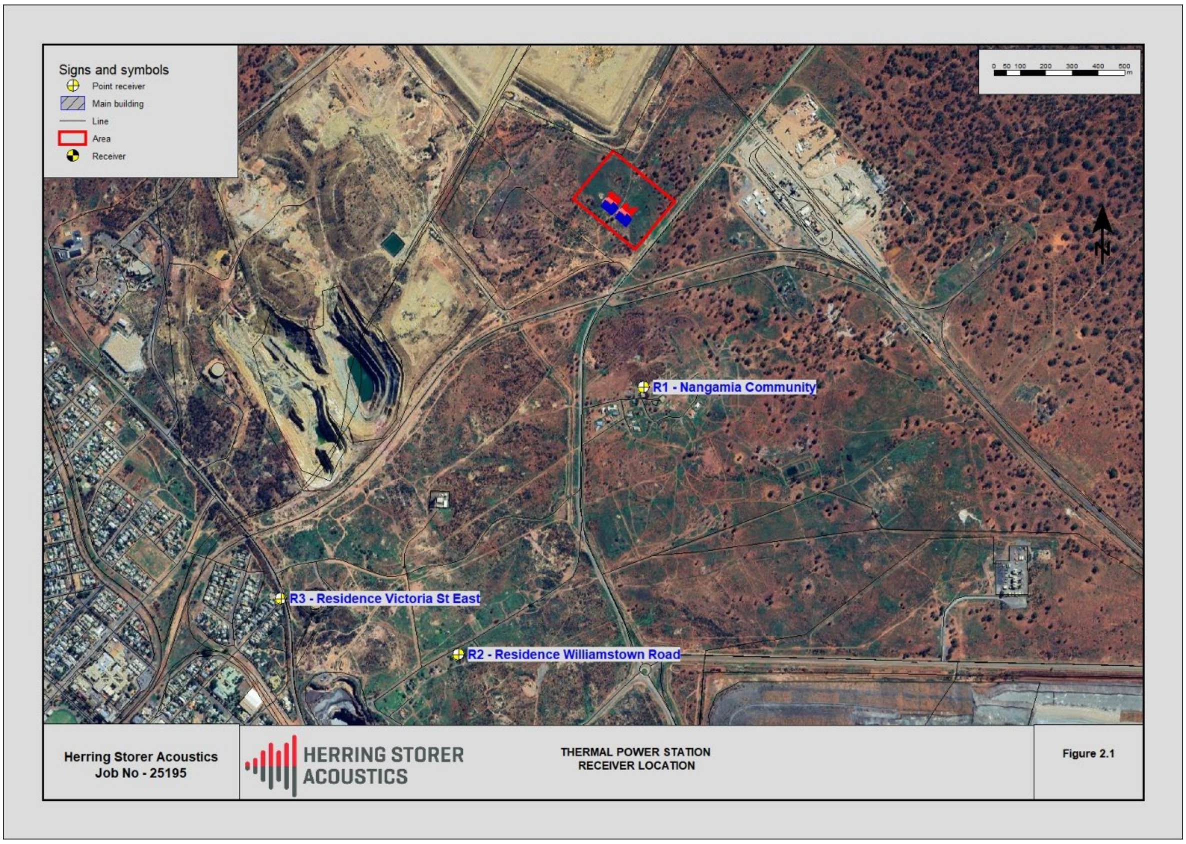


FIGURE 2.1 – RECEIVER POINTS

Review of the surrounding land use and influence of traffic is difficult for multiple receivers. However generally, combined with commercial and industrial land use there is an influence on the majority of receivers within the study area. Therefore, the influencing factor at potential noise sensitive premises has been assessed around 2 dB for the purposes of this study.

Hence, the applicable Assigned Noise Levels are listed in Table 3.1 below.

TABLE 3.1 – ASSIGNED OUTDOOR NOISE LEVEL

Type of premises receiving noise	Time of day	Assigned level (dB)		
		L_{A10}	L_{A1}	L_{Amax}
Noise sensitive premises: highly sensitive area (i.e within 15m of a dwelling)	0700 to 1900 hours Monday to Saturday	47	57	67
	0900 to 1900 hours Sunday and public holidays	42	52	62
	1900 to 2200 hours all days	42	52	57
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays	37	47	57
Noise sensitive premises: any area other than highly sensitive area	All hours	60	75	80

Note: L_{A10} is the noise level exceeded for 10% of the time.
L_{A1} is the noise level exceeded for 1% of the time.
L_{Amax} is the maximum noise level.

3. PROPOSAL

In terms of acoustics, the proposed power station will consist of two fully enclosed engine halls, comprising 6 Wartsila W20V31DF Engines in each hall.

The individual engine exhaust stacks are to be 30m high. Three cooling radiator systems comprise of three fans are required for each engine.

Charge air intakes are required for each engine as well as passive ventilation intakes and outlets.

Additional to the above, insulated exhaust gas ducting will be required from the engine halls to the stacks.

It is noted that considerable noise control has been applied to each of the above components, with this detailed further in Section 4, Modelling.

The proposed plan for the layout is shown in Figure 3.1.

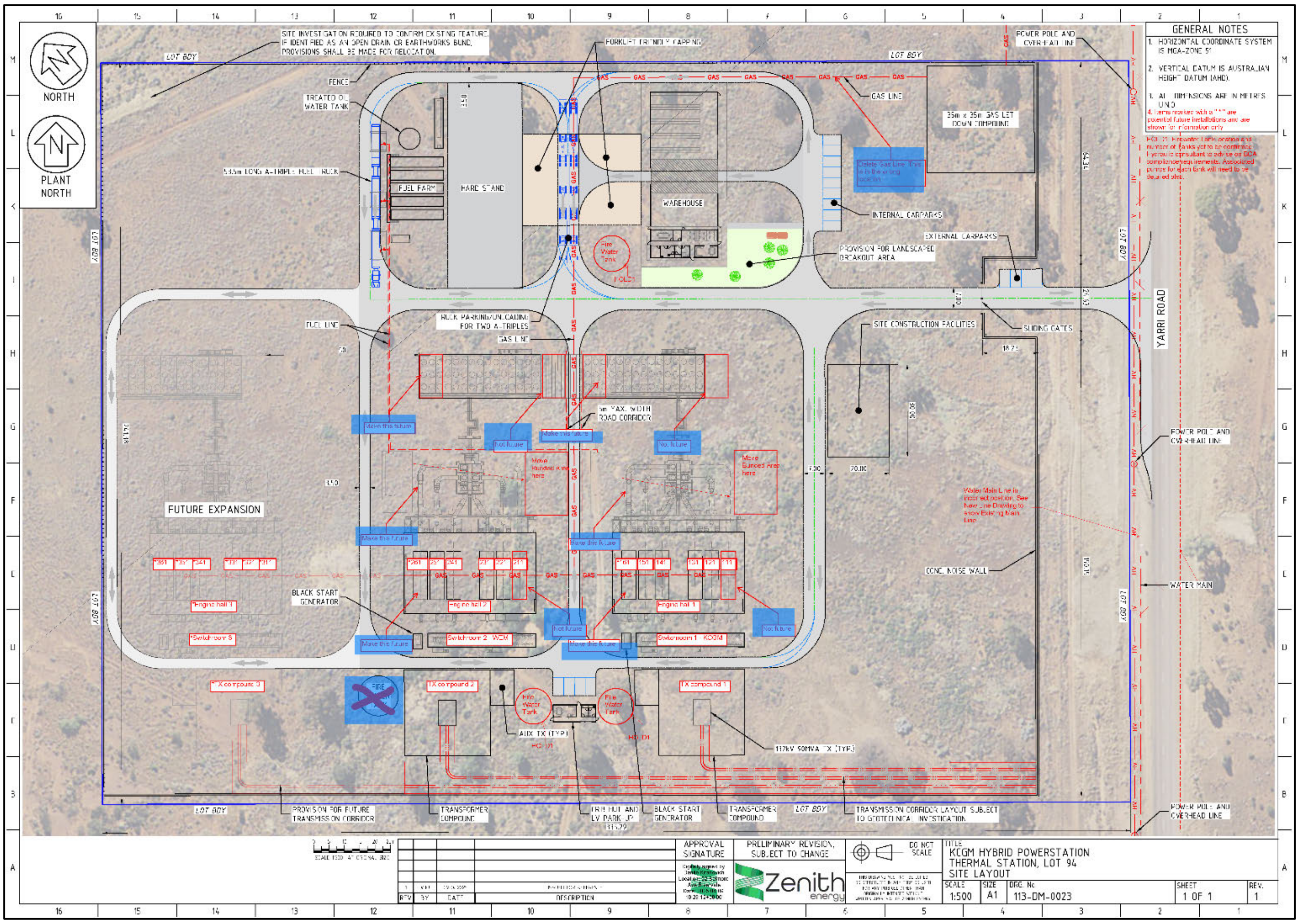


FIGURE 3.1 – POWER STATION LAYOUT

4. MODELLING

To assess the noise received at the neighbouring premises, noise modelling was undertaken using the noise modelling program SoundPlan.

Calculations were carried out using the Department of Water and Environmental Regulation's standard weather conditions for the day and night periods, which relate to worst case noise propagation, as stated in Table 4 of the Department of Environment Regulation Draft Guidance for the "Assessment of Environmental Noise Emissions". These conditions include winds blowing from sources to the receiver(s). For information, the weather conditions, (as stated in Table 4), are shown in the following Table 4.1.

TABLE 4.1 – WEATHER CONDITIONS

Condition	Night	Day
Temperature	15°C	20°C
Relative humidity	50%	50%
Pasquill Stability Class	F	E
Wind speed	3 m/s*	4 m/s*

* From sources, towards receivers.

Information, including sound power level data, has been supplied by the manufacturer, Wartsila.

Initial predictive noise modelling conducted highlighted areas within the proposal which would require further attenuation. The noise control was based around silencers and engineering controls to both the engine halls and the external noise sources, such as the stacks, ducting etc. The information regarding the acoustic data for this was also provided by Wartsila and Zenith Energy.

From data supplied by the client and the manufacturer, the sound power levels used in the noise model were as outlined in Table 5.2.

TABLE 5.2 – SOUND POWER LEVEL - NOISE SOURCES dB(A)

Noise Sources	Sound Power Level dB(A)
Engines	
Wartsila W20V31DF Engine	125
Stacks	
Wartsila W20V31DF Engine - exhaust gas stack 35 dB(A) pre-silencer TL [dB]	100
Wartsila W20V31DF Engine exhaust gas stack Both Exhaust silencer AND 35 dB pre-silencer	88
Charge Air	
Charge air intake with air silencer 35 dB(A)	98
Ducting	
Insulated exhaust gas ducting 35 dB(A) pre-silencer Lw,A [dB/m]	64
Ventilation intake	
Ventilation intake, generator side Lw,A	87
Roof Vent	
Ventilation outlet roof monitor 1200 mm baffles Lw,A [dB/m]	78
Cooling Fans	
Option 1 - Noise level 2, 3-fan cooling radiator Sound power level Lw,A [dB]	102

Based on the above, the predictive noise model was created for the proposed power station, with the noise sources located as follows in Figure 4.2 and 4.3.

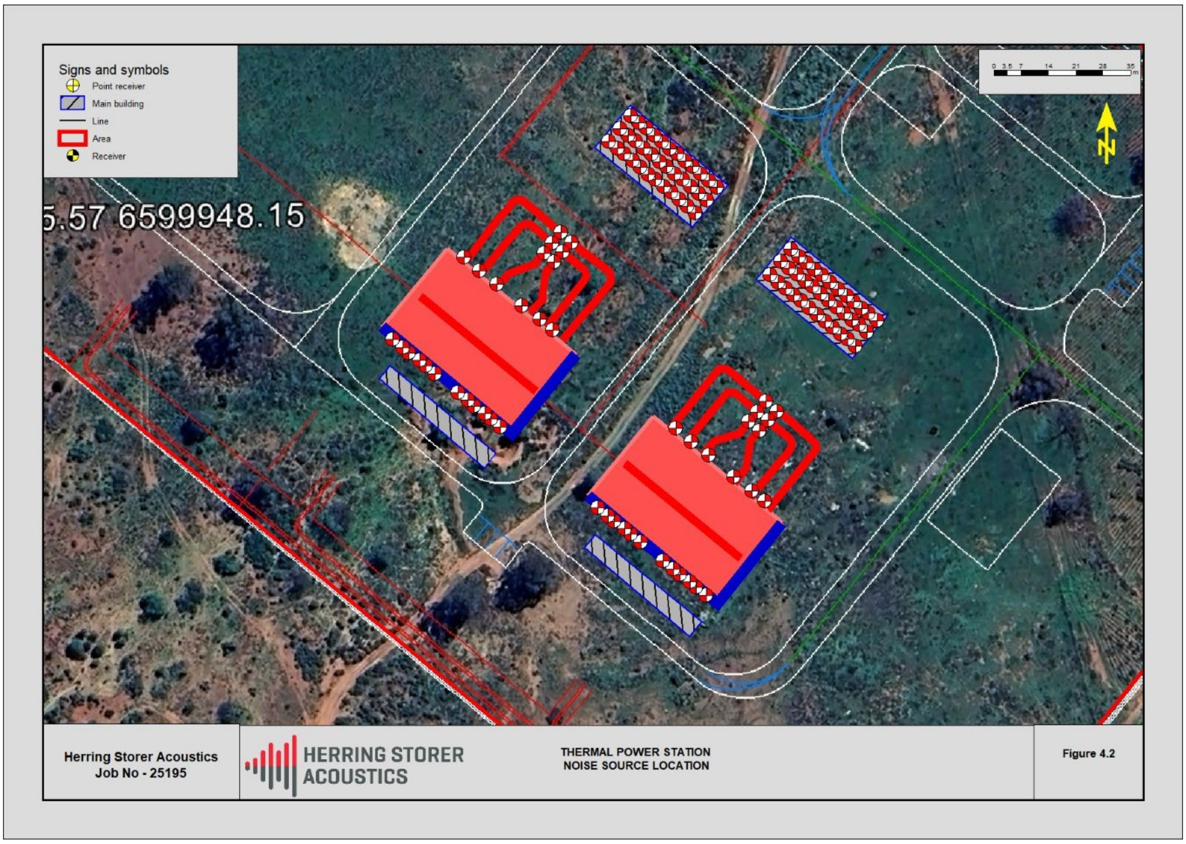


FIGURE 4.1 – POWER STATION LAYOUT

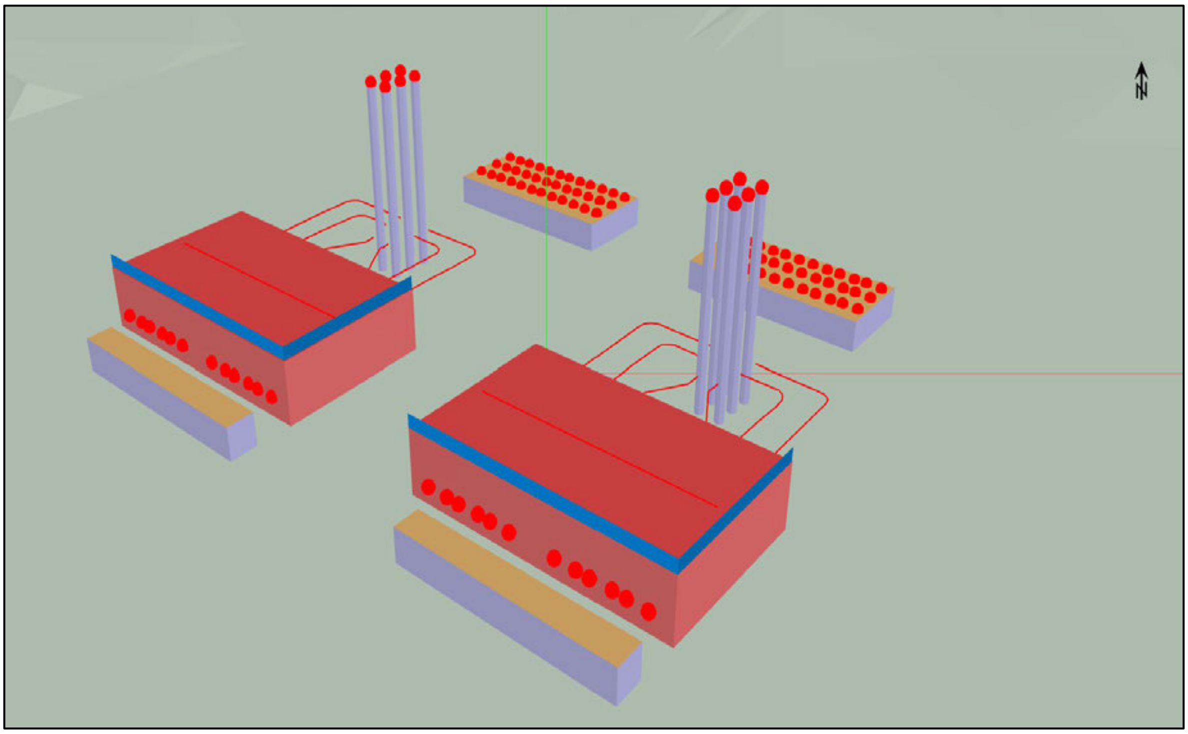


FIGURE 4.2 – POWER STATION RESPECTIVE

Following the preliminary modelling, the following inclusions have been accepted by the client and are to be incorporated in the proposed design:

Engine Halls (Both)

- Walls to Halls Concrete 150mm panel on Northwest, Southeast and Southwest sides.
- Northeast wall lightweight – RW 53 (Ceiling: + Panel 1: 1 x 0.6 mm Custom Orb (0.55mm) + Frame: Steel C-Joist (1.0-1.6mm) (254 mm x 38 mm), Stud spacing 600 mm , Cavity Width 254 mm + 90 mm Bradford Gold R1.8 Wall + Panel 2: 1 x 9 mm BGC 9m CFC Panels + Details: Panel Size 2.7 m x 4.0 m, Partition surface mass = 20.4 kg/m²).
- Roof for Halls Rw53.
- Top Hall Passive Ventilation – Required 1200mm Louvers/ baffles.
- Additional barrier (extension of walls) 2m above roofline.
- Ventilation Intake (Ground Level) – Unattenuated.

Stacks / Ducting

- Stack and pre stack silencer – 35 dB.
- Insulated Ducting Pipes.

Cooling Radiators

- Day Operations - Option 1 - Noise level 2, 3-fan cooling radiator (Three per Engine) SWL 102 dB(A).
- Night Operations - Option 1 - Noise level 2, 3-fan cooling radiator (Three per Engine) SWL 99dB(A) – (allowance for cooler operations and diversity during the night period).

5. RESULTS

A summary of the calculated noise levels for scenarios are shown in Table 6.1.

TABLE 6.1 – CALCULATED NOISE LEVELS, L_{A10} dB(A)

Receiver Name	Calculated Noise Level (dB(A))	
	Day Operations	Night Operations
R1	38	36
R2	31	29
R3	26	25

6. ASSESSMENT

For this assessment, there is unique situation where there is existing Regulation 17, Ministerial exemption in place for the noise emissions associated with the KCGM Fimiston operations. This allows for higher assigned noise levels at the residential receivers being assessed in this proposal.

Based on the compliance noise levels for the nearest Regulation 17 reference location (Barton Street Williamstown) the assigned noise level during the night period is 45 dB(A) plus a weather influencing factor. Predictive noise modelling of the difference between the Regulation 17 reference location and the noise sensitive receivers in this assessment shows a reduction of between 5 to 7 dB. Hence at a complying noise level for the Fimiston operations of 49 dB(A) at the reference location would results in noise levels at the receivers in this study of 42 to 44 dB(A).

Assessment of the proposed power station noise emissions are assessable under the *Environmental Protection Noise Regulations 1997.* As outlined in the criteria section, the allowable noise level at the nearest noise sensitive receivers needs to meet the assigned noise level in isolation of other noise sources.

Based on this, the ambient noise levels at the receiver location would be expected to mask any annoying characteristic associated with the proposed power station noise emissions.

As the noise received from the power station would occur more than 10% of the time, noise received at noise sensitive premises would need to comply with the assigned L_{A10} noise level.

Based on the assessable noise levels above, comparison against the relevant assigned noise level is contained in Table 6.1.

TABLE 6.1 – ASSESSMENT OF NOISE LEVELS

Receiver	Assessable Noise Level, dB(A)	Applicable Times of Day	L_{A10} Compliance Noise Level (dB)	Exceedance to Assigned Noise Level L_{A10}(dB)
R1	38	0700 - 1900 hours Monday to Saturday	47	Complies
		0900 - 1900 hours Sunday and Public Holidays	42	Complies
		1900 - 2200 hours all days	42	Complies
	36	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and Public Holidays	37	Complies
R2	31	0700 - 1900 hours Monday to Saturday	47	Complies
		0900 - 1900 hours Sunday and Public Holidays	42	Complies
		1900 - 2200 hours all days	42	Complies
	29	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and Public Holidays	37	Complies
R3	26	0700 - 1900 hours Monday to Saturday	47	Complies
		0900 - 1900 hours Sunday and Public Holidays	42	Complies
		1900 - 2200 hours all days	42	Complies
	25	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and Public Holidays	37	Complies

7. CONCLUSION

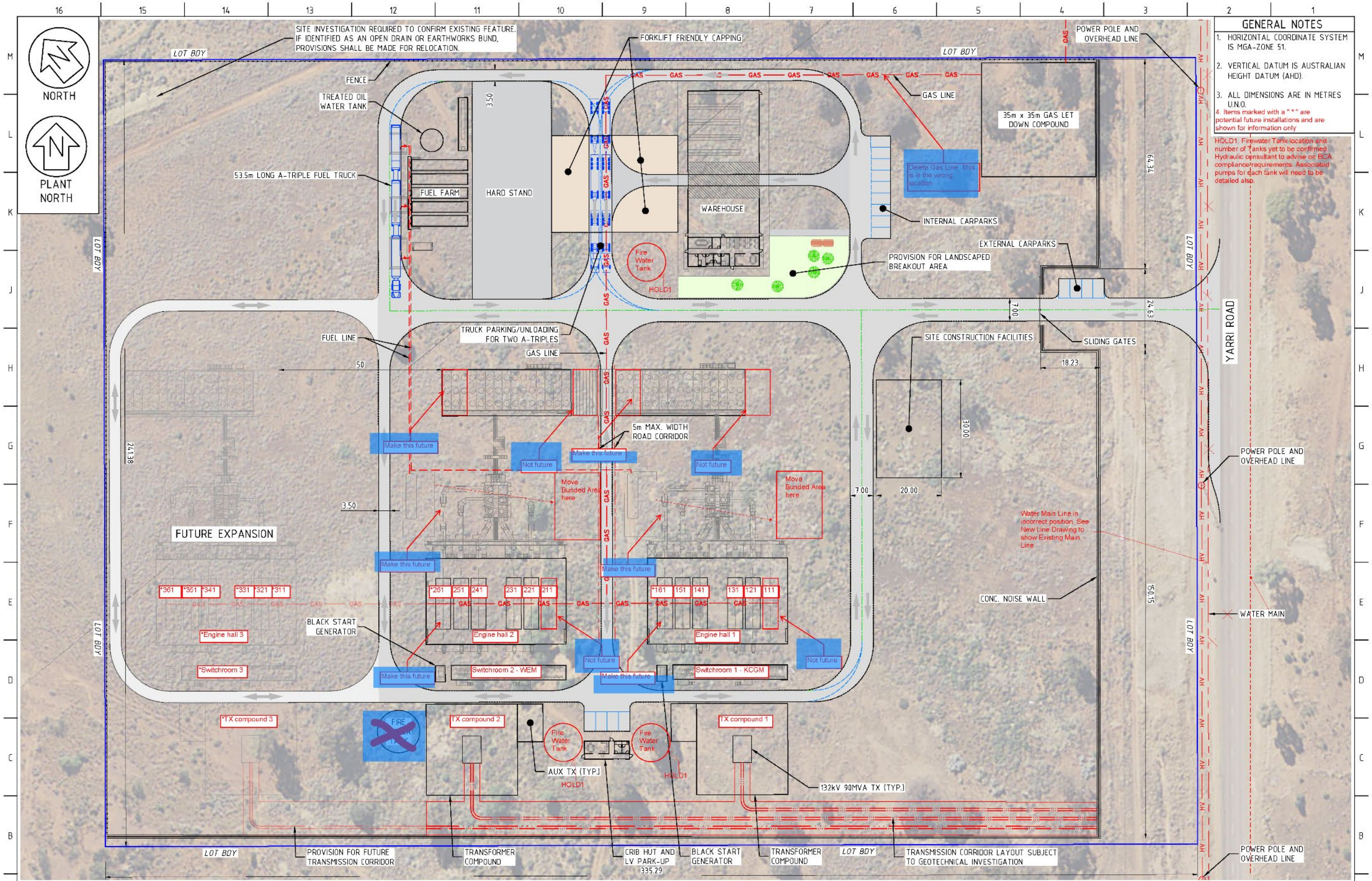
A noise assessment has been undertaken with regards noise received at the residential premises from the proposed Theraml Power Station located in Parkeston, Kalgoorlie.

We note that the assessment has been based on the power station operating at full capacity. Under this scenario, noise received at the residences would comply with the Regulatory requirements during the day, evening and night periods. It is noted that during the night period, there would be a reduction in noise emissions, not only due to demand, but the lower ambient temperature resulting in less air required for cooling.

As part of the design process, noise mitigation options will be incorporated as required to ensure compliance with the Regulatory requirements are achieved.

APPENDIX A

POWER STATION PLANS



SCALE 1:500 @ A1 ORIGINAL SIZE

REV	BY	DATE	DESCRIPTION
1	VJO	09.04.2025	ISSUED FOR REFERENCE

APPROVAL SIGNATURE
Digitally signed by Danilo Kitanovich
Location: 52 Belmont Ave Rivervale
Date: 2025.04.09 10:29:12+08'00'

PRELIMINARY REVISION, SUBJECT TO CHANGE

Zenith energy

DO NOT SCALE

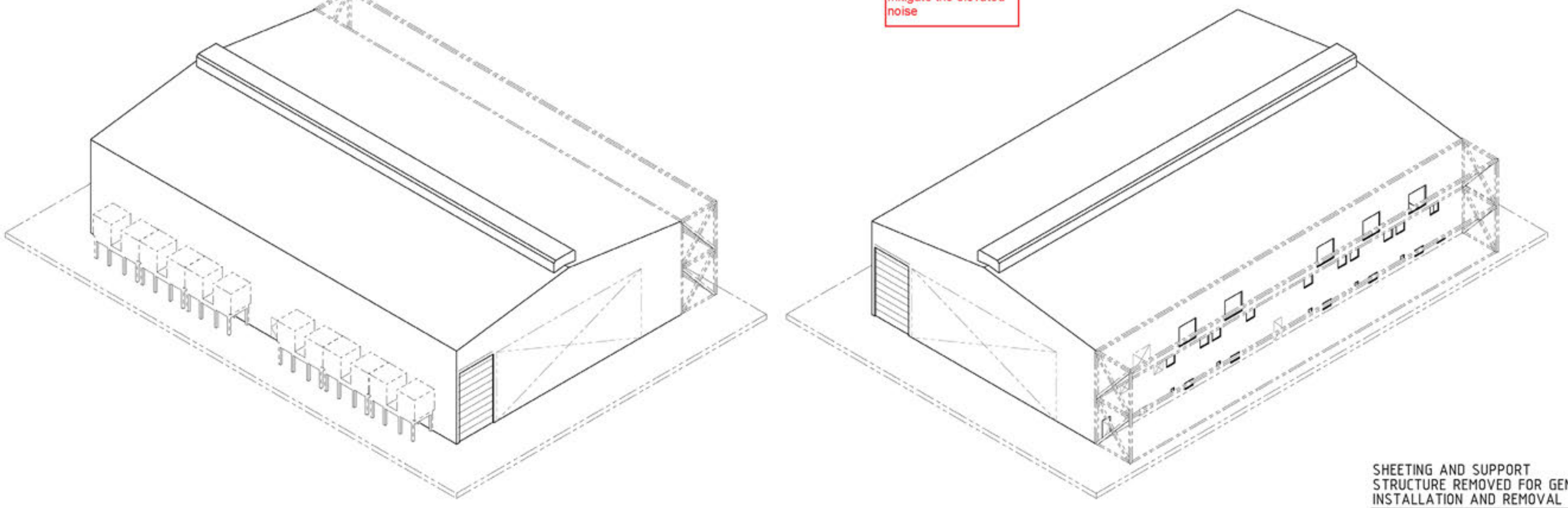
THIS DRAWING MUST NOT BE COPIED OR REPRODUCED IN ANY FORM OR USED FOR ANY PURPOSE OTHER THAN ORIGINALLY INTENDED WITHOUT WRITTEN APPROVAL OF ZENITH ENERGY

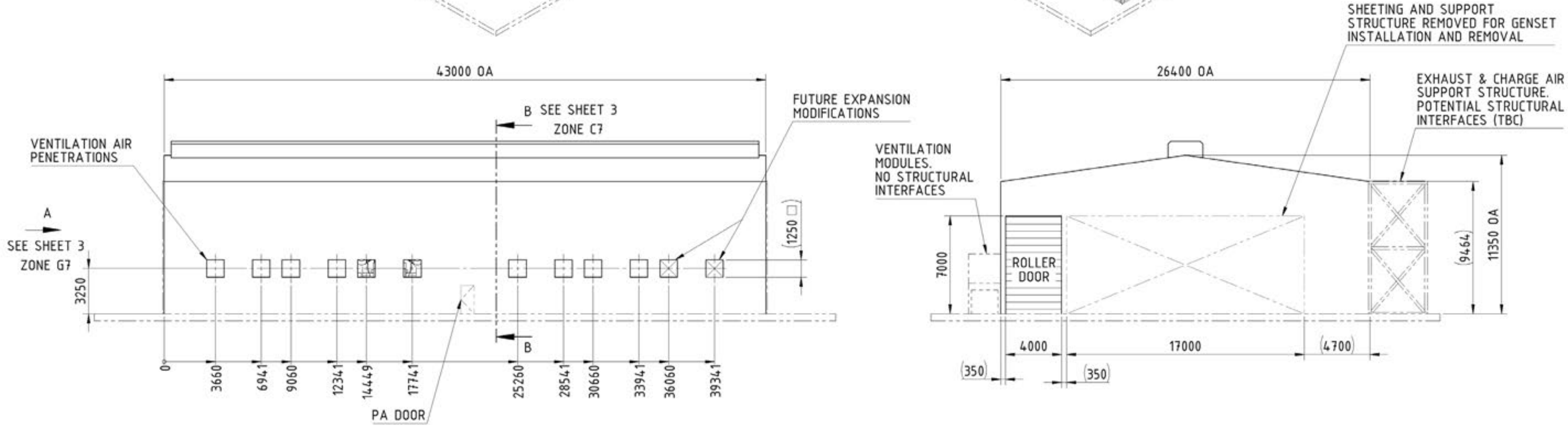
TITLE
KCGM HYBRID POWERSTATION
THERMAL STATION, LOT 94
SITE LAYOUT

SCALE	SIZE	DRG. No.	SHEET	REV.
1:500	A1	113-DM-0023	1 OF 1	1

NOTES:
1. FOR ENGINE HALL SPECIFICATION DETAIL REFER TO 113-IG-0018.
2. FOR CRANE SPECIFICATIONS REFER TO 113-IG-0019.
3. ALL PENETRATION SIZES AND LOCATIONS SUBJECT TO CHANGE AND SHOWN ONLY FOR REFERENCE. ADJUSTMENT PERMITTED BASED ON MANUFACTURER'S RECOMMENDATION WITH ZENITH APPROVAL. ALL PENETRATIONS TO BE FLASHED POST-INSTALLTION.
4. ALL DOOR AND OPENING DIMENSIONS ARE CLEAR OPENING SIZE.
5. REFER TO 113-DM-0002 FOR FURTHER CONTEXTUAL INFORMATION (ENGINE HALL LAYOUT)
6. CONSTRUCTION MATERIAL IS A SUGGESTION ONLY, SHED BUILDER TO SUGGEST MOST APPROPRIATE MATERIAL FOR NOISE AND OTHER REQUIREMENTS.

Noise Consultant can suggest material for building shed to best mitigate the elevated noise





REV	BY	DATE	DESCRIPTION
1	DCO	26.02.2025	ISSUED FOR EXTERNAL REVIEW

APPROVAL SIGNATURE — Ben Penna 2025.02.26 12:54:12+08'00'

DRAWING APPROVED WHEN SIGNED

Zenith energy

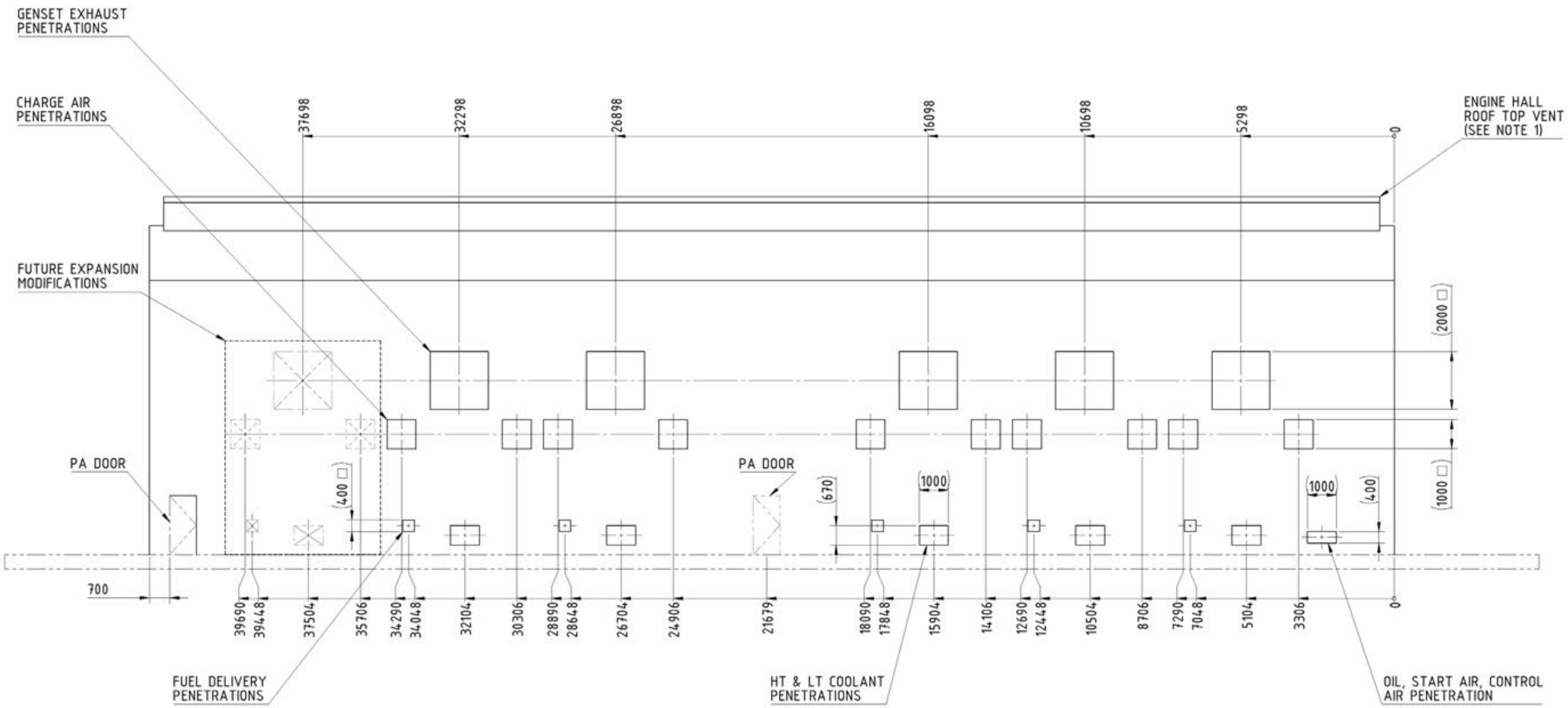
DO NOT SCALE

DIMENSIONS IN MILLIMETRES

THIS DRAWING MUST NOT BE COPIED OR REPRODUCED IN ANY FORM OR USED FOR ANY PURPOSE OTHER THAN ORIGINALLY INTENDED WITHOUT WRITTEN APPROVAL OF ZENITH ENERGY

TITLE
KCGM HYBRID POWERSTATION
THERMAL STATION ENGINE HALL
GENERAL ARRANGEMENT

SCALE	SIZE	DRG. No.	SHEET	REV.
1:200	A2	113-DM-0019	1 OF 4	1



DRAWING APPROVED WHEN SIGNED

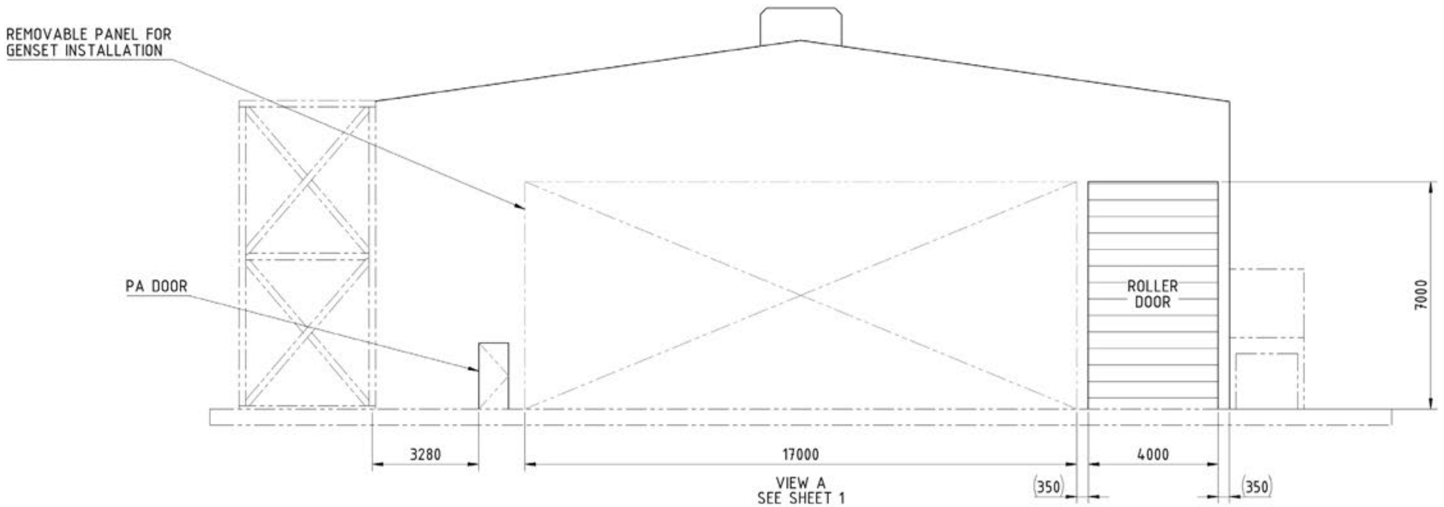
Zenith energy

DO NOT SCALE

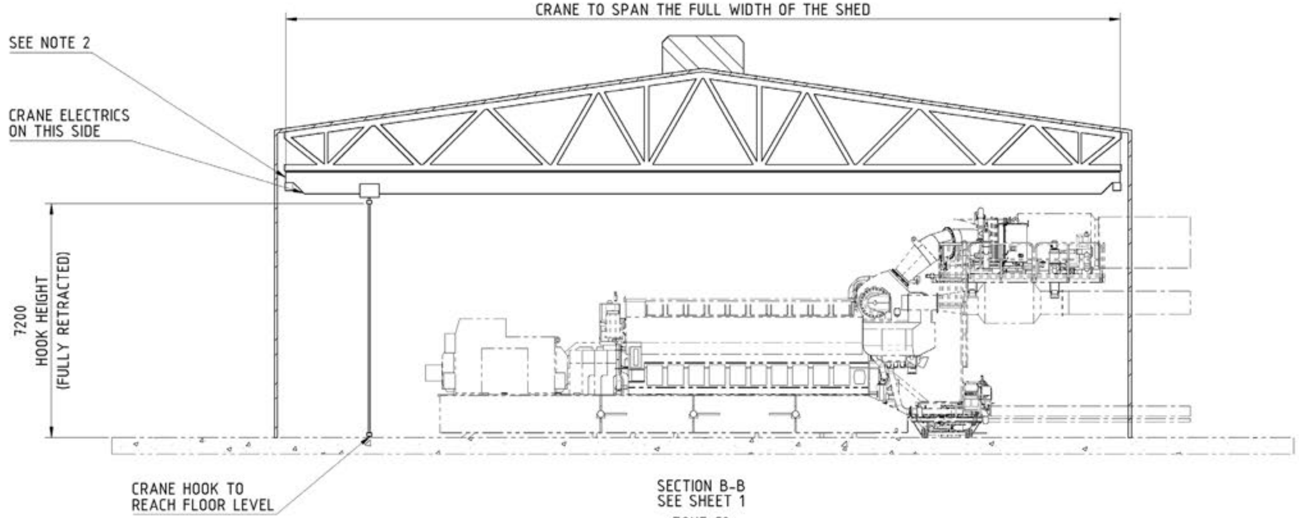
DIMENSIONS IN MILLIMETRES

TITLE
KCGM HYBRID POWERSTATION
THERMAL STATION ENGINE HALL
GENERAL ARRANGEMENT

SCALE	SIZE	DRG. No.	SHEET	REV.
1:100	A2	113-DM-0019	2 OF 4	1

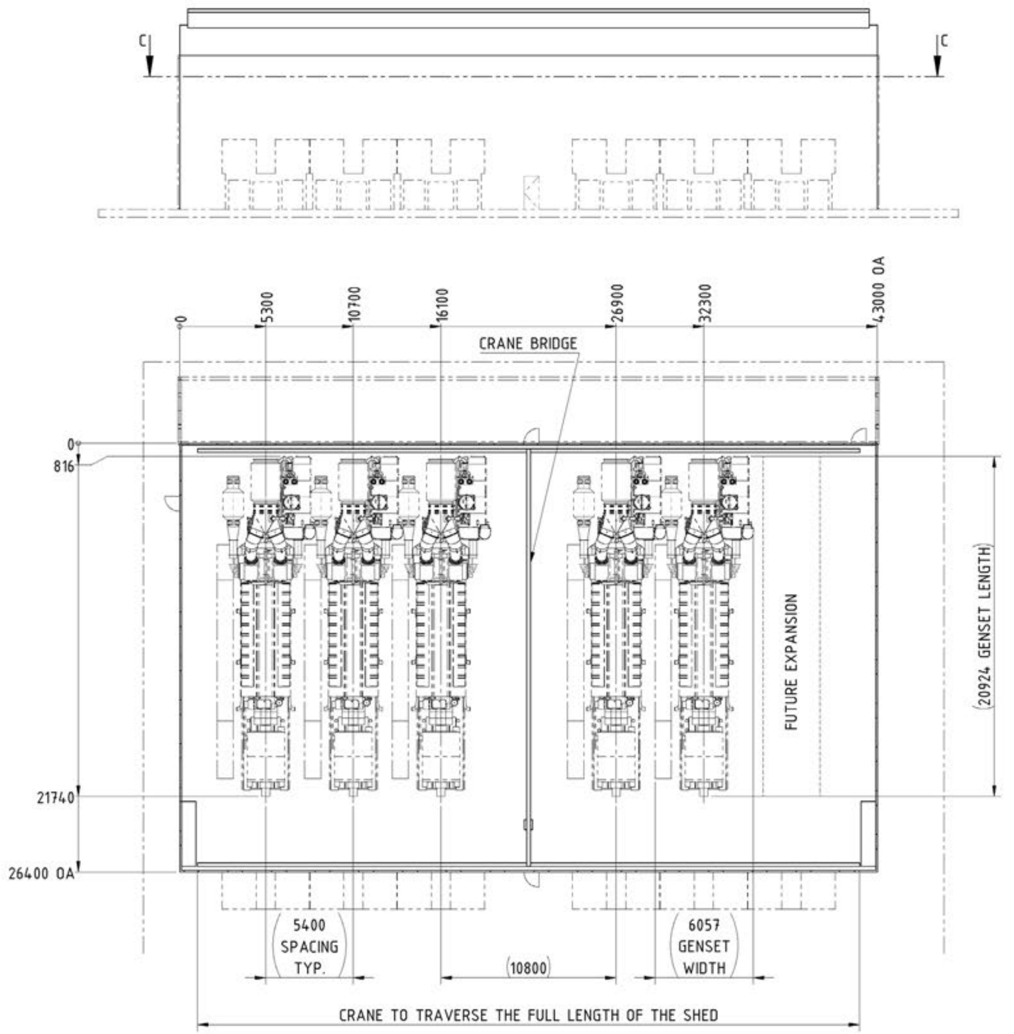


VIEW A
SEE SHEET 1
ZONE C9



SECTION B-B
SEE SHEET 1
ZONE C9

DRAWING APPROVED WHEN SIGNED	DO NOT SCALE DIMENSIONS IN MILLIMETRES	TITLE KCGM HYBRID POWERSTATION THERMAL STATION ENGINE HALL GENERAL ARRANGEMENT
Zenith energy	THIS DRAWING MUST NOT BE COPIED OR REPRODUCED IN ANY FORM OR USED FOR ANY PURPOSE OTHER THAN ORIGINALLY INTENDED WITHOUT WRITTEN APPROVAL OF ZENITH ENERGY	SCALE 1:100 · SIZE A2 · DRG. No. 113-DM-0019 · SHEET 3 OF 4 · REV. 1



SECTION C-C

DRAWING APPROVED WHEN SIGNED

Zenith energy

DO NOT SCALE

DIMENSIONS IN MILLIMETRES

TITLE
KCGM HYBRID POWERSTATION
THERMAL STATION ENGINE HALL
GENERAL ARRANGEMENT

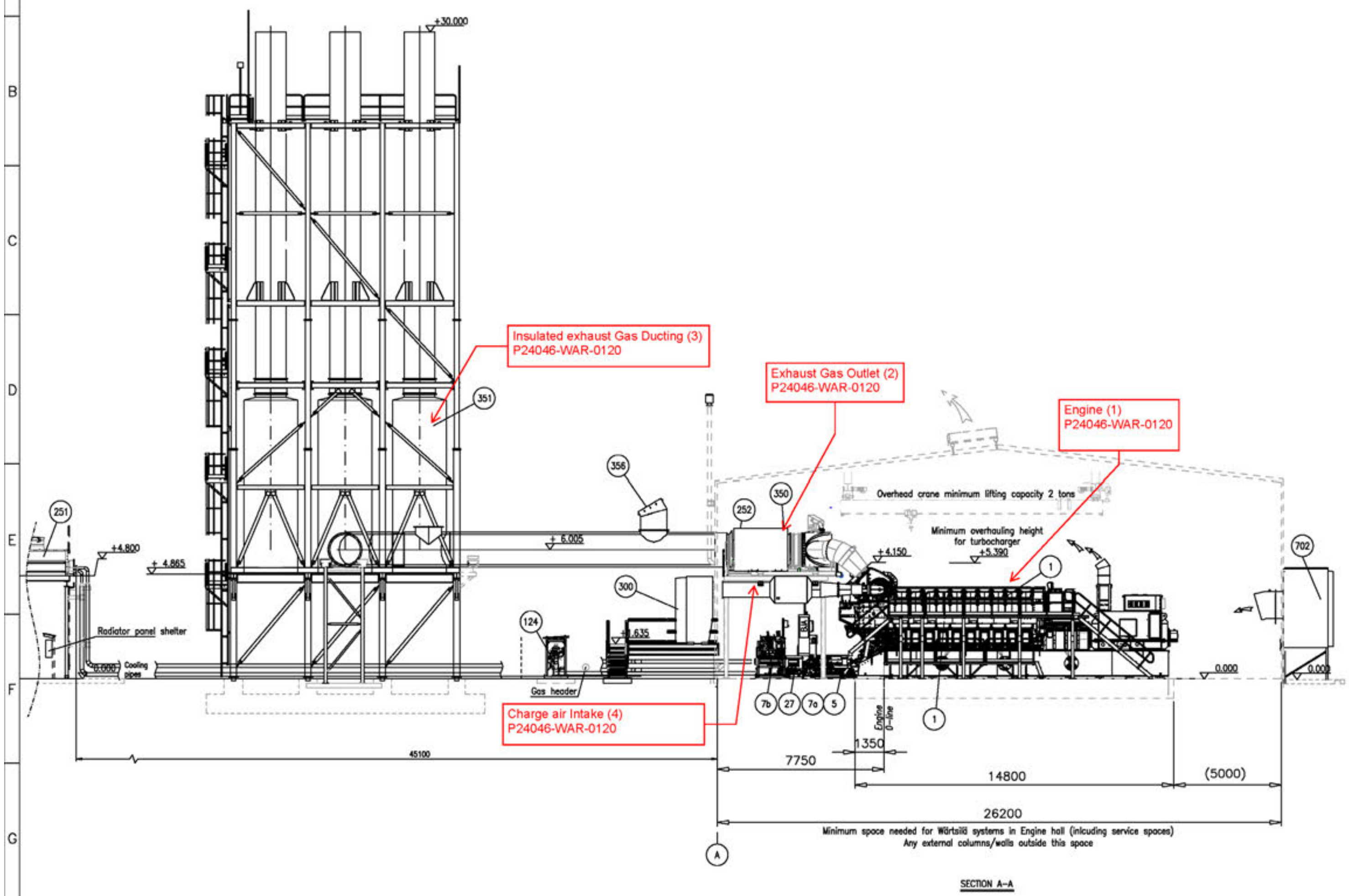
SCALE	SIZE	DRG. No.	SHEET	REV.
1:200	A2	113-DM-0019	4 OF 4	1

ENGINE HALL

Item No.	Pcs.	Code	Description	Volume [m³]	Weight [kg] Operative	Mounting level (Floor level)
1	10	SCA	W20V31 Generating set		187808	+0.000
5	10	MOD	W31 Engine auxiliary module (EAM)		2525	+0.000
7a	10	PCC	W31D Engine fuel booster 1		810	+0.000
7b	10	PCC	W31D Engine fuel booster 2		4775	+0.000
27	10	MOD	Pipe rack		800	+0.000
143	2	PCC	LFO Automatic filter		380	+0.000
144	10	–	LFO Radiator		63	+3.700
157	10	QBF	Oil mist separator unit		480	+4.880
252	10	VEA	Expansion vessel	0.6	768	+5.280
300	20	NGA	Intake air filter		2260	+1.600
350	10	NHA	W31 Exhaust gas module, 1–C		10153	+4.780
668	10	CFE	Local control panel			+0.000
670b	20	BLP	Frequency converter for ventilation unit			+1.380
681	10	BAG	Surge arrester			+0.000
702	20	EAA	Ventilation unit, engine hall	15	1900	+0.000

SITE AREA

Item No.	Pcs.	Code	Description	Volume [m³]	Weight [kg] Operative	Mounting level (Floor level)
124	10	ZAC	Fuel gas supply unit		1355	+0.000
134	1	–	Real-time gas analyser		65	
251	30	VCA	Radiator		5500	+5.000
351	10	NHA	Exhaust gas silencer		7405	+4.865
356	16	–	Rupture disc			
659	2	BFB	Station transformer			



SECTION A–A

Rev.	Date	Made	Checked	Appvd.	Explanation
b	21/03/2025	JSAX20	JJUX11	KVE001	Layout updated
a	06/03/2025	JSAX20	JJUX11	KVE001	Layout updated

WÄRTSILÄ

Master Layout

Engine hall, Section

Product: W20V31DF

ASLY DRG:

Zenith Energy Northern Star
10(+2) x W20V31DF

Proj. no. P/24046

MADE	20-Jan-2025	Juhani Saari	Units: mm/kg
CHKD	21-Jan-2025	Janne Jussila	Page No. 1/1
APPD	22-Jan-2025	Kim Vestman	

Based on Document: | Customer Document:

Scale: 1:100 | Size: A1 | Doc. ID: DECA00045229 b Rev.

APPENDIX F:

SURFACE WATER ASSESSMENT

APPENDIX F

Memo

To:	Gavin Donaghy (Northern Star Resources Limited)
From:	Elham Shafieiyoun, Helvecio Duarte
Subject:	**KCGM Thermal Power Station Hydrological Assessment**
Our ref:	PS227418-WSP-PER-MNG-MEM-001 Rev0
Date:	**16 December 2025**

1. Introduction

Northern Star Resources Limited (NSR) has engaged WSP Australia Pty Limited (WSP) to carry out a stormwater assessment on an area south of the North Kal Mine to support future power station developments, which involves the construction of a Thermal Power Station.

1.1 Background

WSP previously supported Kalgoorlie Consolidated Gold Mines Pty Ltd (KCGM), a subsidiary of NSR, with several hydrological studies (WSP, 2023). As a result, WSP has developed a TUFLOW flood model for the Eastern floodway that was utilised in this study as a flood planning and design tool. WSP has updated the existing TUFLOW model, modifying the model extent to suit the proposed power station footprint and upstream reporting catchment.

1.2 Objectives

The objectives of this study are:

— Review of site setting and project data assessment.

— Undertake an existing (pre-development) and post-development case stormwater assessment to compare changes in flow regime and surface water impacts of the development.

— Delineate catchments for the study extent for the two cases based on available topography.

— Undertake hydrological modelling for pre- and post-development cases.

— Estimate design floods for the 1:100 annual exceedance probability (AEP) and critical duration storm events.

— Undertake two-dimensional (2D) hydraulic modelling for existing and post development cases.

— Provide conceptual design for diversion channel and culvert based on 1:100 AEP storm event.

Lvl 3, Mia Yellagonga Tower 2, 5 Spring St
Perth WA 6000
PO Box 7181
Cloisters Square WA 6850

Tel: +61 8 9489 9700
Fax: +61 8 9489 9777
www.wsp.com

2. Site setting

NSR's proposed Thermal Power Station is located within the Eastern Floodway catchment and is one of the two primary catchments draining into Hannan Lake, located approximately 4 km northeast of Kalgoorlie. The Eastern Floodway water course, located approximately 3 km to the east of the site, runs north to south.

The site is predominantly characterised by natural catchment areas with altered catchment landforms to the east including the Parkeston Train Station and Yarri Road Waste Disposal Centre and to the west including the old Hannan's Mine and North Kal Mine. An overview of the existing site layout including proposed site landform is displayed in Figure 2.1.

Site catchments and drainage lines were delineated for existing and post-development scenarios as shown in Figure 2.2 and Figure 2.3, respectively. Site catchments were assessed based on the latest topographical survey data and landform designs provided by NSR.

LEGEND

- Railway Lines
- Main Roads
- Proposed Thermal Power Station
- Eastern Floodway

Aerial imagery sourced from Google Satellite online

0 500 1,000 m

GDA94 / MGA zone 51 EPSG:28351
Universal Transverse Mercator (UTM)

Project: KCGM Thermal Power Station Hydrological Assessment

Client: Northern Star Resources Limited

Title: Site layout

Version: Final
Project No: PS227418
Rev: 0
Figure No: 2.1

Designed: ES
Prepared: ES
Reviewed: HD
Approved: GH
Date: 09/12/2025

LEGEND

- Railway Lines
- Main Roads
- Eastern Floodway
- Streamlines
- 2m Topographical Contours
- Model Extent

Aerial imagery sourced from Google Satellite online

0 500 1,000 m

GDA94 / MGA zone 51 EPSG:28351
Universal Transverse Mercator (UTM)

Project: KCGM Thermal Power Station Hydrological Assessment

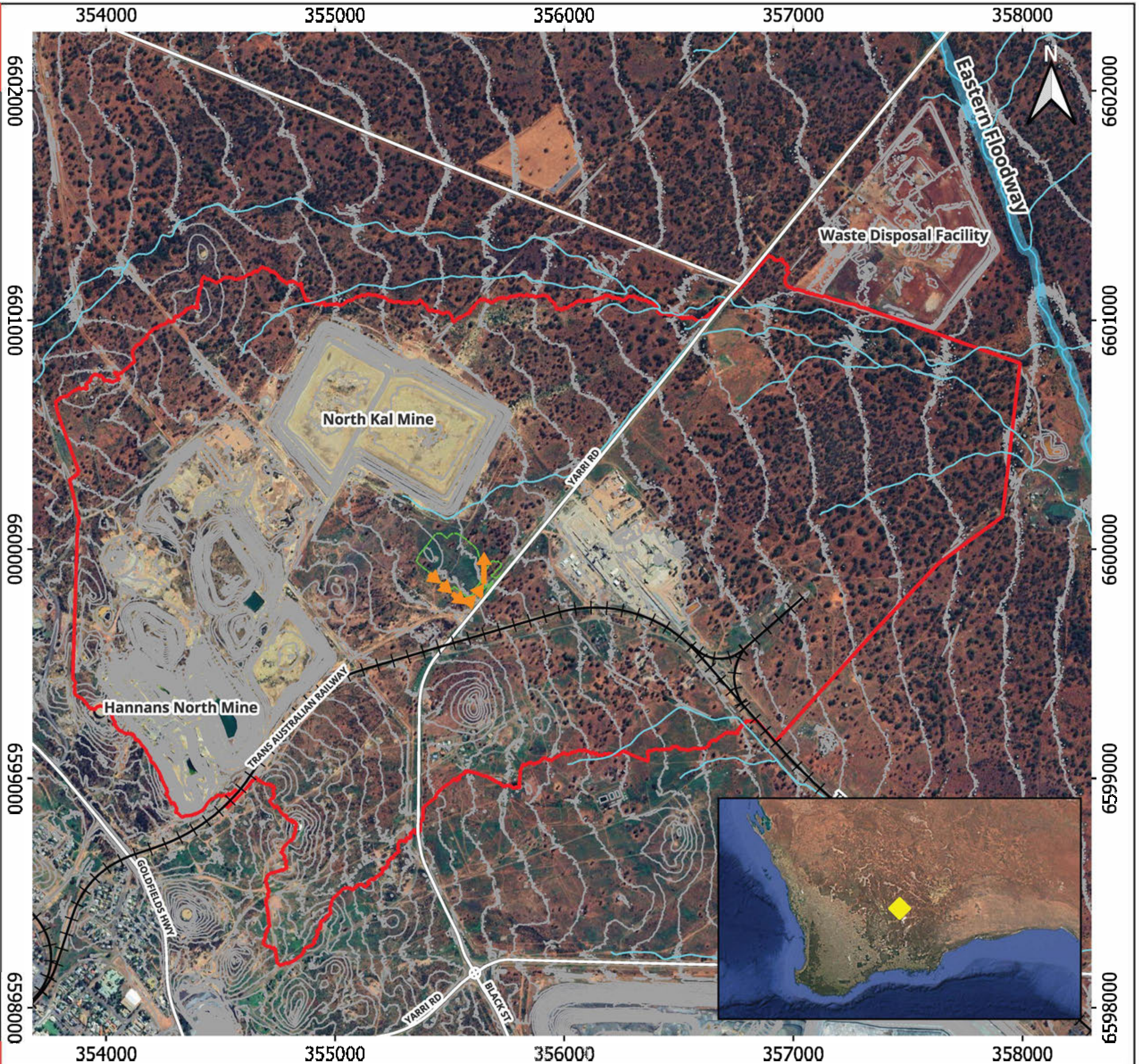
Client: Northern Star Resources Limited

Title: Pre-development scenario with existing hyrology

Version: Final
Project No: PS227418
Rev: 0
Figure No: 2.2

Designed: ES
Prepared: ES
Reviewed: HD
Approved: GH
Date: 04/12/2025

wsp



LEGEND

- Railway Lines
- Main Roads
- Eastern Floodway
- Streamlines
- 2m Topographical Contours
- Proposed diversion channel
- Proposed Thermal Power Station
- Model Extent

Aerial imagery sourced from Google Satellite online

0 500 1,000 m

GDA94 / MGA zone 51 EPSG:28351
Universal Transverse Mercator (UTM)

Project: KCGM Thermal Power Station Hydrological Assessment

Client: Northern Star Resources Limited

Title: Post-development scenario with stormwater management

Version: Final
Project No: PS227418
Rev: 0
Figure No: 2.3

Designed: ES
Prepared: ES
Reviewed: HD
Approved: GH
Date: 04/12/2025

3. Basis of design

A summary of basis of design criteria for diversion channel infrastructure is presented in Table 3.1.

Table 3.1 Design criteria for diversion channel infrastructure

Parameter	Design Input	Established by	Source
Diversion channel (with freeboard allowance)	1:100 AEP (1 in 100-year)	WSP/NSR	(MRWA, 2006)
Freeboard	0.3 m	WSP	-
Side slopes	1V:3H	WSP	-
Minimum longitudinal grade	0.3%	WSP	(MRWA, 2021)
Maximum acceptable flow velocity without erosion protection	2 m/s	WSP	(MRWA, 2006)
Manning's roughness (unlined)	0.03	WSP	(Chow, 1959)

3.1 Proposed power station landform and hydrological impacts

The proposed Thermal Power Station is located the south of the North Kal Mine on the northern side of Yarri Road. Sub-catchment drainage lines flow in an easterly direction and discharge into the Eastern Floodway, which subsequently flows through the Bulong Road floodway and continues further south. The designed earthwork drawings are presented in Appendix A.

3.2 Proposed stormwater management/mitigation

The proposed power station landform intersects several sub-catchment drainage lines that would possibly impact discharge of runoff to the downstream sub-catchments. Without an engineered diversion, the surface runoff from reporting catchment would accumulate against the landform and flow around it, resulting in greater water levels along Yarri Road during rare storm events compared to pre-development conditions.

To improve conveyance of surface water flows and reduce the hydrological impacts of the proposed landform, a major diversion channel is proposed to convey flows from all intersected drainage lines around the southern side of the proposed power station into an existing natural drainage line to the east. This diversion seeks to maximise the return of upstream flows to pre-development drainage lines in downstream catchments and minimise changes to the existing hydrological regime. The designed stormwater diversion drawings are presented in Appendix A.

4. Hydrologic and hydraulic modelling

Hydrologic and hydraulic modelling was undertaken to assess the impacts of the proposed landforms and associated stormwater management infrastructure. A summary of the modelling is provided in the following sections.

4.1 Model description

A 2D hydraulic model was previously developed for the Eastern Floodway catchment upstream of Bulong Road using the TUFLOW modelling software package (BMT WBM, 2023). TUFLOW is a 2D hydraulic model with an unsteady-state flow routing component and is widely used in Australia and globally.

4.2 Model inputs and assumptions

A summary of the hydraulic model inputs and assumptions is outlined below.

- **Digital Elevation Model (DEM)** – The model DEM adopted for the hydraulic modelling was provided by KCGM:
- **KCGM_Superpit2111_DEM-GRID_001_350500_6600000_500m.asc** – A set of 1 m grid cell resolution surveys covering the Eastern Floodway area north of Bulong Road and sub-catchments upstream of Fimiston II TSF to the northeast (dated 20 January 2022).

- **DEM Alterations** – The following alteration was made to the model DEM:
  - The Thermal Power Station landform and diversion channel design were provided by NSR and dated November 2025.
- **Model Extent** – The model area was selected to include the catchment to the west of the Eastern Floodway watercourse downstream of the old Hannan's Mine and North Kal Mine where detailed LiDAR survey was available.
- **Model Inflows** – The direct rainfall method was adopted to simulate catchment runoff in the model based on applying the design rainfalls (presented in Section 4.3) to all cells within the 2D model domain. Aerial reduction factors were applied to the design rainfalls based on the approach outlined in Australian Rainfall and Runoff (ARR) guidelines (Ball, et al., 2019). Rainfall losses were incorporated in the model as described in Section 4.4.
- **Model Outflow Boundary** – A stage–discharge (HQ) boundary was adopted at the model outlet located downstream of Yarri Road. This stage-discharge curve was calculated based on the average bed slope at the model outlet assuming normal depth conditions, and at a sufficient distance downstream of the proposed development such that it had no impact on the model results.
- **Manning's Roughness coefficient** – A summary of the Manning's roughness coefficients applied to the TUFLOW model is presented in Table 4.1.
- **2D Grid resolution** – A 2D grid resolution of 3 m was optimally chosen to maintain model accuracy while minimising model run times.
- **Culverts** – A culvert was incorporated as a one-dimensional link within the model. A summary of the adopted culvert dimension is presented in Table 4.2.

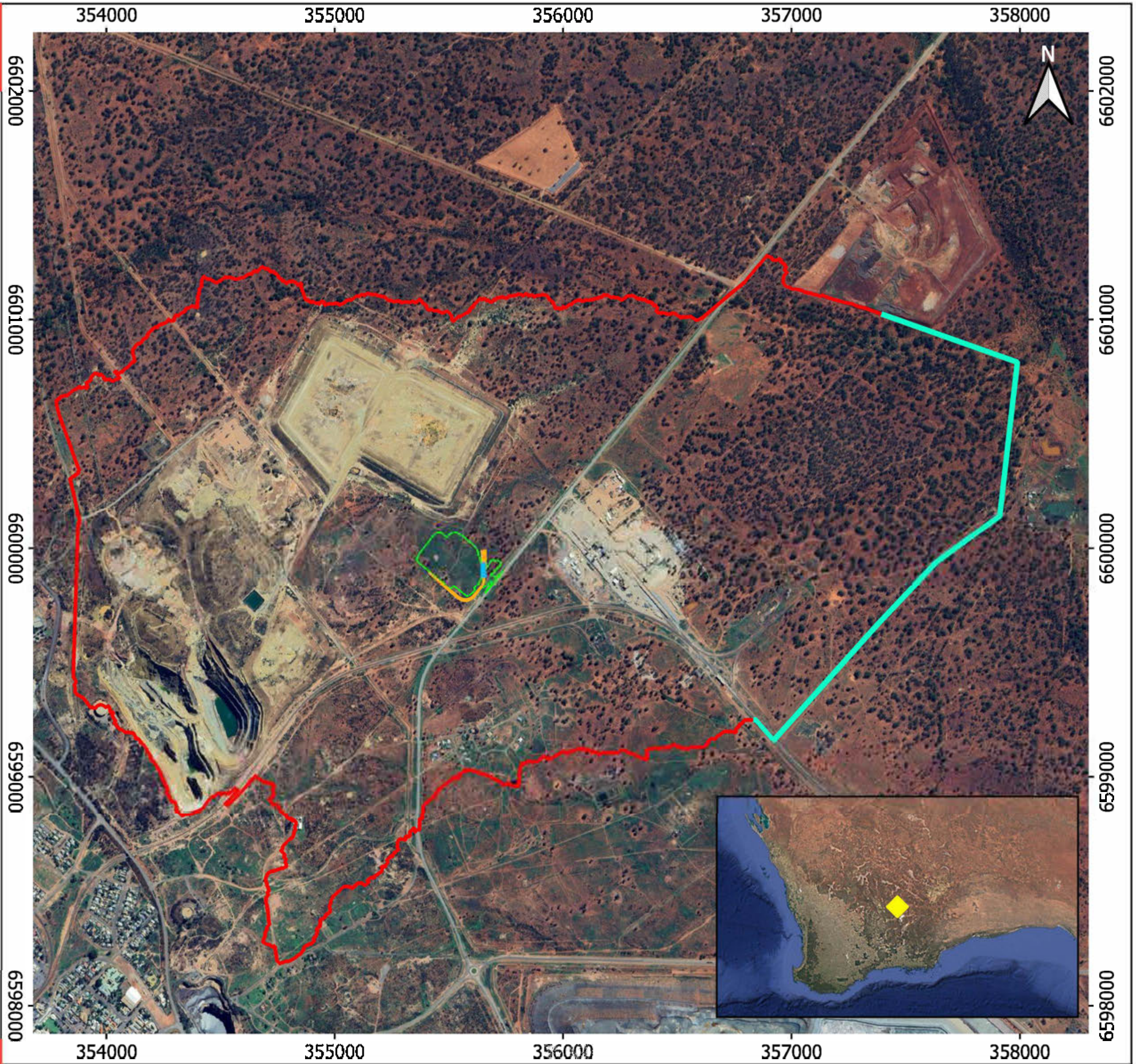
The adopted hydraulic model setup is displayed in Figure 4.1.

Table 4.1 Manning's roughness coefficients adopted within TUFLOW model

Model Area	Manning's Roughness Value Adopted	Flow Path Description	Source
Overland flow areas and floodplains	0.04	Scattered brush and heavy weeds	(Chow, 1959)
Diversion channel	0.03	Unlined earth channels with moderate irregularity	
Thermal Power Station	0.016	Overland flow on asphalt	Adopted
Culvert	0.014	Concrete box	(Main Roads WA, 2019)

Table 4.2 Summary of modelled culvert dimension

Culvert ID	Width (m)	Height (m)	Number of Culvert Barrels	Culvert Type
C1	2.1	0.6	2	Rectangular box culvert



LEGEND

- Model outflow boundary
- Culvert
- Proposed diversion Channel
- Proposed Thermal Power Station
- Model Extent

Aerial imagery sourced from Google Satellite online

0 500 1,000 m

GDA94 / MGA zone 51 EPSG:28351
Universal Transverse Mercator (UTM)

Project: KCGM Thermal Power Station Hydrological Assessment

Client: Northern Star Resources Limited

Title: TUFLOW model setup

Version: Final
Project No: PS227418
Rev: 0
Figure No: 4.1

Designed: ES
Prepared: ES
Reviewed: HD
Approved: GH
Date: 04/12/2025

4.3 Design rainfalls

Design rainfall estimates for the site location (30.72°S, 121.49°E) were sourced from the Bureau of Meteorology Design Rainfall Data System (Bureau of Meteorology (BoM), 2025) for durations between 1 hour and 48 hours for 1:100 AEP event as outlined in Table 4.3.

Table 4.3 Design rainfall depths (mm)

Duration	1:100 AEP
1 hr	50.3
2 hrs	62.5
3 hrs	71.5
6 hrs	91.5
9 hrs	107
12 hrs	119
18 hrs	138
24 hrs	152
30 hrs	164
36 hrs	173
48 hrs	187

4.4 Rainfall losses

Rainfall losses associated with soil infiltration are important to estimate the rainfall-runoff response of a catchment during a storm event. To estimate the amount of rainfall-runoff generated within catchments in the study area the Initial Loss – Continuing Loss (ILCL) model was adopted. The initial loss (IL) is defined as the amount of rainfall lost through infiltration before the start of surface runoff, while the continuing loss (CL) is the ongoing average loss rate throughout the remainder of the rainfall event. Given the Eastern Floodway is located within the arid region where there is a lack of suitable gauged catchments to quantify these parameters, rainfall losses were unavailable through the ARR Data Hub website. Therefore, losses for the Eastern Goldfields region were adopted as described in the previous ARR Guidelines (Pilgrim & Institution of Engineers Australia, 1998) as summarised in Table 4.4. Given the paucity of flow data within arid regions of Western Australian and particularly in the Goldfields region due to a lack of gauged catchments and the ephemeral nature of the hydrology, a high level of uncertainty is therefore associated with the adopted rainfall loss parameters.

Table 4.4 Adopted initial and continuing rainfall losses

Storm AEP	Initial loss (mm)	Continuing loss (mm/hr)
1:100	38	3

4.5 Critical duration analysis

A critical duration analysis was undertaken to select the critical storm events to be adopted within the hydraulic modelling.

For the hydrologic modelling this involved estimating the critical storm durations resulting in the highest peak flows within the catchment at a location upstream of the proposed landform. This modelling was undertaken in TUFLOW modelling software and for the 1:100 AEP storm considered a combination of storm durations each with an ensemble of 10 rainfall temporal patterns. Based on the modelling results, the temporal pattern resulting in the median peak flow at the upstream of the proposed landform within the catchment was selected.

Table 4.6 presents the resulting critical storm duration, associated median storm temporal pattern and adopted peak design flow. The critical duration, which is a function of the rainfall losses reflecting the adopted infiltration by the catchment soils, is estimated to be 6-hours.

Table 4.5 Critical peak discharges for the catchment

AEP	Critical duration (hrs)	Temporal pattern	Peak flow (m^3/s)
1:100	6	3	2

4.6 Conceptual diversion design

The conceptual design for the proposed trapezoidal diversion channel was based on an iterative approach. Initial designs were undertaken within the hydraulic model based on the results of the hydrologic modelling of the contributing upslope catchment. Peak flows conveyed through the diversion channels were subsequently estimated within the hydraulic model and used to refine diversion channel dimensions. Table 4.6 summarises the channel design parameters including the estimated peak flow rate, maximum flow velocity and dimensions of the proposed diversion channels.

Table 4.6 Summary of diversion channel design and dimensions

Design parameter	Diversion channel
1:100 AEP peak flow (m^3/s)	2
1:100 AEP peak velocity (m/s)	1.75
Minimum longitudinal grade (%)	0.3
Side slopes, 1(V):X(H)	3
Base width (m)	2
Manning's roughness coefficient	0.03
Maximum flood depth (m)	0.6

5. Results

5.1 Model scenarios

As outlined previously hydraulic modelling was undertaken for two model scenarios including the pre-development and the post-development including the proposed development and stormwater mitigation infrastructure. Model results showing maximum flood depths within the catchment for both scenarios are included in Appendix B. Table 5.1 summarises the results for the modelled scenarios along with the associated figure references.

Table 5.1 Modelled scenarios and figure references

Scenario	Description	Appendix
Pre-development	— Existing base topography	Appendix B
Post-development	— Existing base topography — Includes KCGM – Thermal Power Station — Includes the stormwater diversions for the proposed landform	Appendix B

Additionally, a flood level difference map has been prepared in Appendix C to compare the difference in flood levels between the pre-development and post-development scenarios. Table 5.2 summaries the figures presented in Appendix C.

Table 5.2 Flood level difference map

Scenario	Description	Appendix
Post-development flood level subtracted from pre-development	This map presents the difference in flood levels between the two cases. Areas coloured blue indicate locations where the flood levels have reduced under post-development conditions and areas coloured yellow-orange indicate locations where the flood levels have increased under post-development conditions.	Appendix C

5.2 Discussion on modelling results

The following key findings are provided based on the results of the hydraulic model results.

— The pre-development condition under the 1:100 AEP flood event (Appendix B) indicated localized inundation along Yarri Road around the development area. Hydraulic modelling results indicated that the floodway at the intersection of Yarri Road and the access road to Hannans North Tourist Mine, located immediately upstream of the proposed landform to the west, is predicted to overtop. The maximum flood depth across the road crest is estimated at approximately 0.08 m, which suggests minor overtopping. Flow routing analysis indicated that a preferred surface runoff floodway originates immediately downstream of Hannans North Mine and flows towards the intended landform footprint following natural topographic gradients. The flow path ultimately converges with the northern branch downstream of the proposed landform footprint, forming a combined flow regime that continues toward the lower catchment.

— For post-development scenario the proposed diversion channel conveys flows from drainage lines along the western flank of the proposed facility around the power station to be discharged at a single location downstream comparable to the pre-development condition. The proposed diversion channel will direct water away from the landform area, conveying stormwater east around the power station, providing flood protection for the thermal power station facility.

— The flood difference map presented in Appendix C shows the locations where flood levels differ under post-development conditions relative to pre-development conditions. The flood level differences are minor (less than 0.2 m) and only occurred in the immediate downstream area of the proposed facility, indicating the flood levels were reduced in areas directly downslope of the proposed landform and adjacent to Yarri Road (flood extents shaded blue). Flood levels increased within the designed stormwater diversion channel and in locations to which stormwater has been diverted (flood extents shaded yellow-orange). There were no additional impact on flood levels across Yarri Road or elsewhere within the model area as a result of the proposed development and diversion channels.

6. Limitations

In undertaking the analyses, it must be acknowledged that there may be limitations in accuracy of the modelling results as outlined below:

— Hydrologic modelling was undertaken to estimate the critical storm durations and associated median temporal pattern for 1:100 AEP that was subsequently applied in hydraulic modelling. The modelling also applies simplified rainfall-runoff routing equations to estimate the peak flow rates within the catchment. Although this approach is well suited to simulate a large number of storm events for a range of AEPs, durations and temporal patterns, a limitation of this technique is that it is unable to account for storage of surface runoff that can occur within topographical depressions or upslope of flow restrictions such as road embankments and mine landforms. As a result, the actual critical storm durations and median temporal patterns for the site may differ marginally to those presented in Section 4.5. Also, where depressions retain runoff that are not modelled the resulting estimated peak discharges downstream are likely to be less than presented in this report.

— Your attention is drawn to the document titled – "Statement of Limitations", which is included in Appendix D of this report. The statements presented in that document are intended to inform a reader of the report about its proper use. There are important limitations as to who can use the report and how it can be used. It is important that a reader of the report understands and has realistic expectations about those matters. The Statement of Limitations document does not alter the obligations WSP has under the contract between it and its client.

7. Closing

We trust that this technical memo provides sufficient information regarding the hydrological assessment of KCGM Thermal Power Station Project. Please do not hesitate to contact us if you require any further elaboration or clarification.

[redacted]	[redacted]	[redacted]
Project Water Resources Engineer	Senior Water Resources Engineer	Principal Hydrologist

References

Ball, J., Babister, M., Nathan, R., Weeks, W., Weinmann, E., Retallick, M., . . . (Editors). (2019). *Australian Rainfall and Runoff: A Guide to Flood Estimation - Version 4.2.* Commonweath of Australia (Geoscience Australia).

BMT WBM. (2023). *TUFLOW Hydraulic Model 2023-03-AE.*

Brisbane City Council (BCC). (2003). *Natual Channel Design Guidelines - Appendix C - Manning's Roughness.* BCC.

Bureau of Meteorology (BoM). (2025). *Design Rainfall Data System (2016).* Retrieved from https://www.bom.gov.au/water/designRainfalls/revised-ifd/

Chow, V. (1959). *Open Channel Hydraulics.* New York: McGraw-Hill.

Main Roads WA. (2019). *Drainage and Waterways - Culverts.*

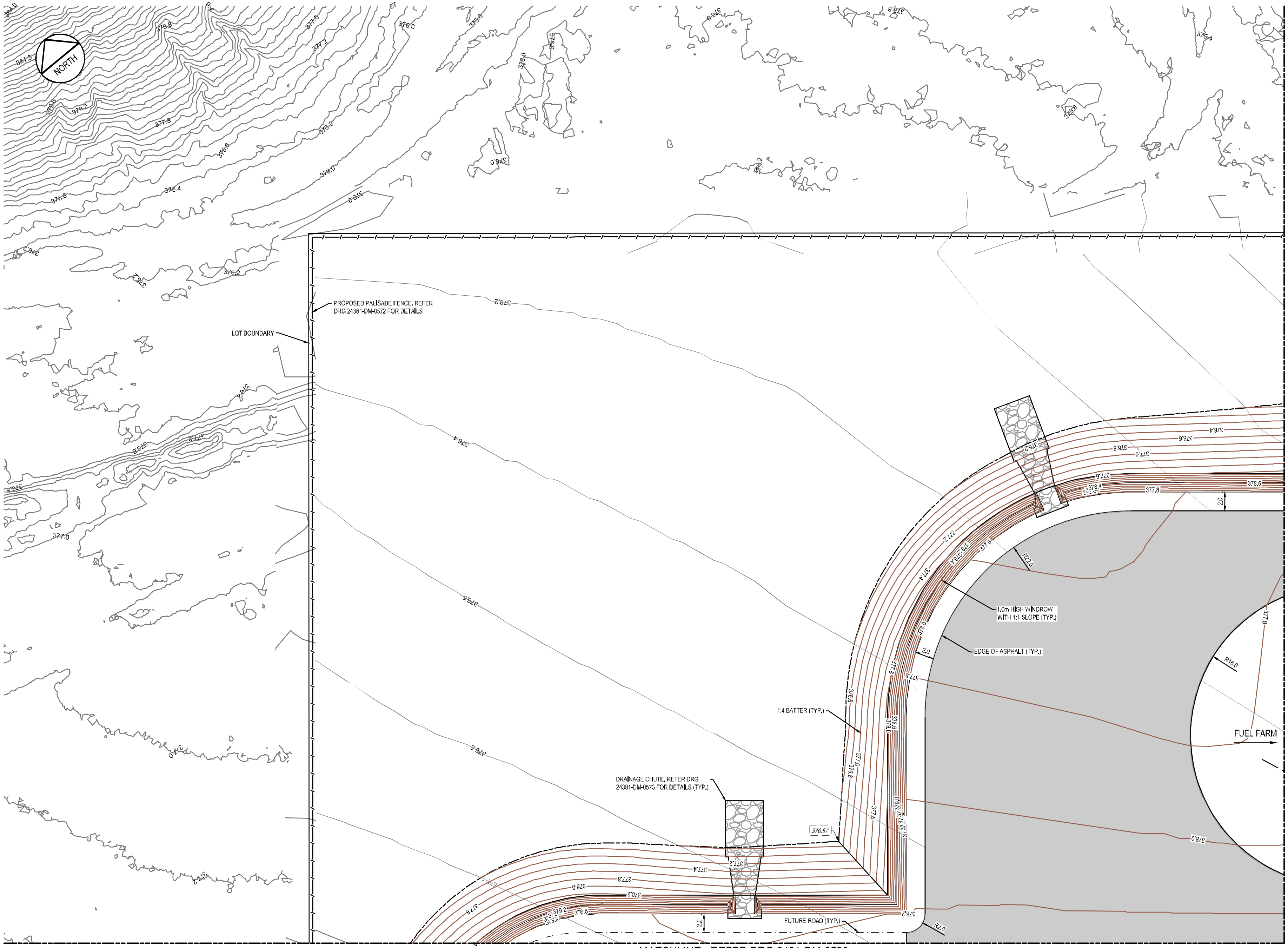
MRWA. (2006). *Floodway Design Guide.* Perth: Main Roads Western Australia (MRWA).

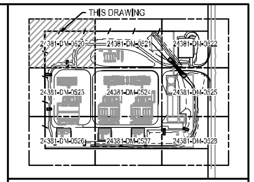
MRWA. (2021). *Supplement to Austroads Guide to Road Design - Part 5.* Perth: Main Roads Western Australia (MRWA).

Pilgrim, D., & Institution of Engineers Australia. (1998). *Australian Rainfall and Runoff: A Guide to Flood Estimation (Volume One): Reprinted Edition.* Canberra: Institution of Engineers Australia.

WSP. (2023). *Kalgoorlie Consolidated Gold Mines Fimiston South Project - Hydrological Aseessment of Eastern Floodway.*

Appendix A Final earthworks drawing





NOTES

1. REFER DRAWING 24381-DM-0501 FOR NOTES.
2. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH ALL RELEVENT DRAWINGS AND SPECIFICATIONS.
3. ALL DIMENSIONS ARE IN METRES U.S.O.

LEGEND

377.0	FINISHED SURFACE CONTOURS
377.0	EXISTING CONTOURS
380.5	PAD R.L.
3%	DESIGN GRADE
377.80	DESIGN LEVEL
377.80	EXISTING LEVEL
	BATTER INTERFACE
	EXISTING PAVEMENT
	PROPOSED HV ASPHALT
	PROPOSED LV ASPHALT AND SKIRTING
	PROPOSED UNSEALED HARDSTAND

PRELIMINARY

BEFORE YOU DIG www.byda.com.au Zero Damage - Zero Harm

SCALE 1:200

REV	DATE	DESCRIPTION	BY	CHK
A	20.11.25	ISSUED FOR CLIENT REVIEW	MFC	KJ

Zenith energy

Colliers

DRAWING STATUS: NOT FOR CONSTRUCTION

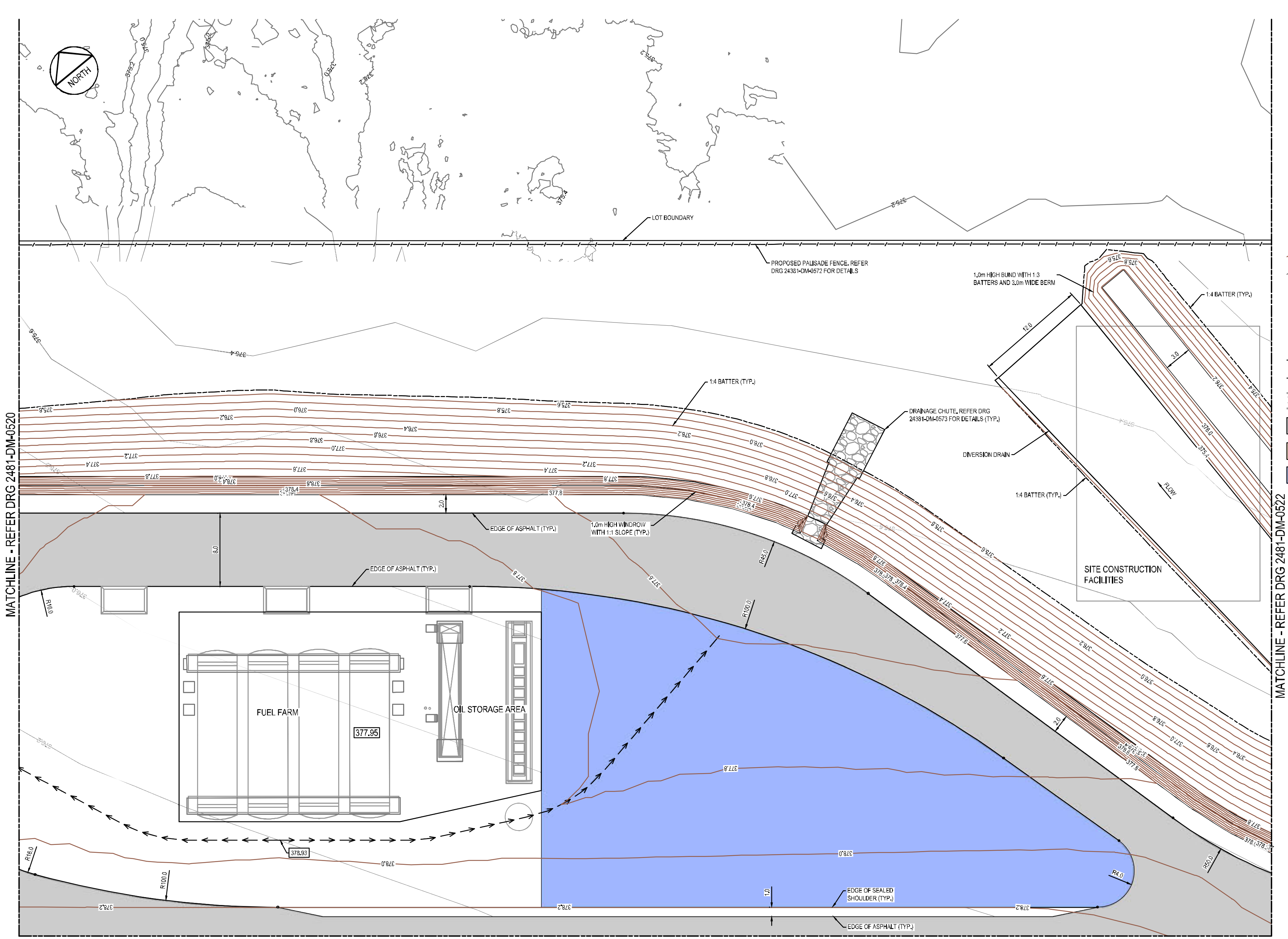
DATE	GRID	DATUM
OCTOBER / 2025	MGA2020	AHD

DESIGNED	DRAWN	CHECKED	APPROVED
MFC	MFC	KJ	PS

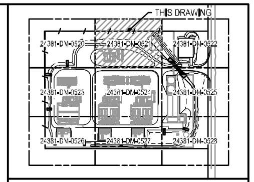
CLIENT: ZENITH ENERGY OPERATIONS PTY LTD
KCGM - THERMAL POWER STATION

TITLE: FINISHED SURFACE AND DRAINAGE PLAN - SHEET 1

CLIENT No.	SCALE	SHEET SIZE	DWG No.	REVISION
113-DM-0520	1:200 @	A1	24381-DM-0520	A



KEY PLAN



NOTES

1. REFER DRAWING 24381-DM-0501 FOR NOTES.
2. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH ALL RELEVENT DRAWINGS AND SPECIFICATIONS.
3. ALL DIMENSIONS ARE IN METRES U.N.O.

LEGEND

- 377.0 — FINISHED SURFACE CONTOURS
- 377.0 — EXISTING CONTOURS
- 380.5 — PAD R.L.
- 3% — DESIGN GRADE
- 377.80 — DESIGN LEVEL
- 377.80 — EXISTING LEVEL
- BATTER INTERFACE
- GRADED DRAIN
- EXISTING PAVEMENT
- PROPOSED HV ASPHALT
- PROPOSED LV ASPHALT AND SKIRTING
- PROPOSED UNSEALED HARDSTAND

PRELIMINARY

BEFORE YOU DIG www.byda.com.au Zero Damage - Zero Harm

SCALE 1:200

REV	DATE	DESCRIPTION	BY	CHKR	REV	DATE	DESCRIPTION	BY	CHKR
A	XX.XX/25	ISSUED FOR CLIENT REVIEW	MFC	KJ					

Zenith energy

Colliers

DRAWING STATUS: NOT FOR CONSTRUCTION

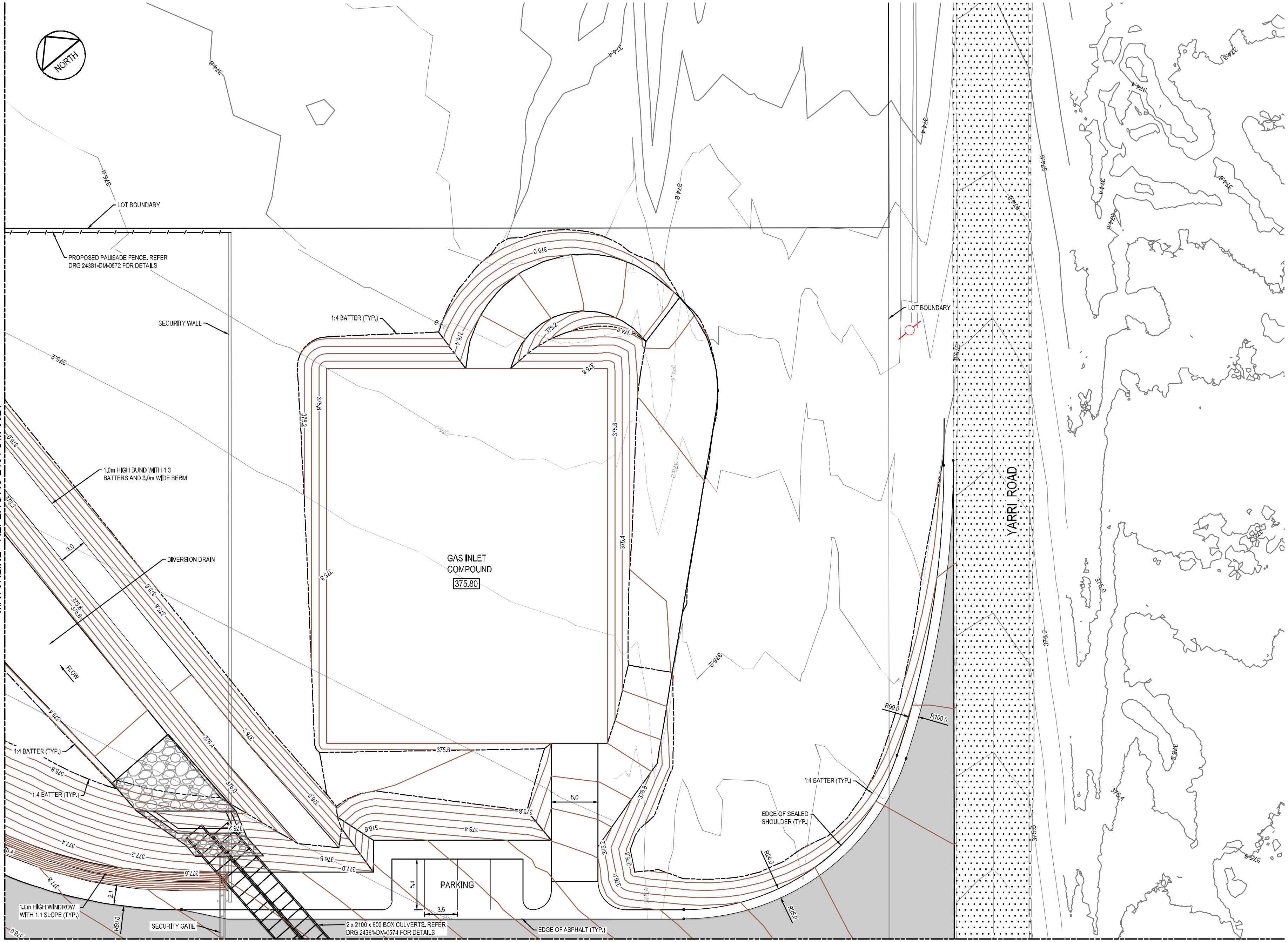
DATE	GRID	DATUM
OCTOBER / 2025	MGA2020	AHD

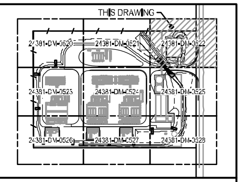
DESIGNED	DRAWN	CHECKED	APPROVED
MFC	MFC	KJ	PS

CLIENT: ZENITH ENERGY OPERATIONS PTY LTD
KCGM - THERMAL POWER STATION

TITLE: FINISHED SURFACE AND DRAINAGE PLAN - SHEET 2

ZENITH	SCALE	SHEET SIZE	DWG No.	REVISION
113-DM-0521	1:200 @	A1	24381-DM-0521	A





KEY PLAN

NOTES

1. REFER DRAWING 24381-DM-0501 FOR NOTES.
2. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH ALL RELEVENT DRAWINGS AND SPECIFICATIONS.
3. ALL DIMENSIONS ARE IN METRES U.N.O.

LEGEND

377.0	FINISHED SURFACE CONTOURS
377.0	EXISTING CONTOURS
380.5	PAD R.L.
3%	DESIGN GRADE
377.80	DESIGN LEVEL
377.80	EXISTING LEVEL
	BATTER INTERFACE
	GRADED DRAIN
	EXISTING PAVEMENT
	PROPOSED HV ASPHALT
	PROPOSED LV ASPHALT AND SKIRTING
	PROPOSED UNSEALED HARDSTAND

PRELIMINARY

BEFORE YOU DIG www.byda.com.au Zero Damage - Zero Harm

SCALE 1:200

REV	DATE	DESCRIPTION	BY	CHK
A	20.11.25	ISSUED FOR CLIENT REVIEW	MFC	KJ

Zenith energy

Colliers

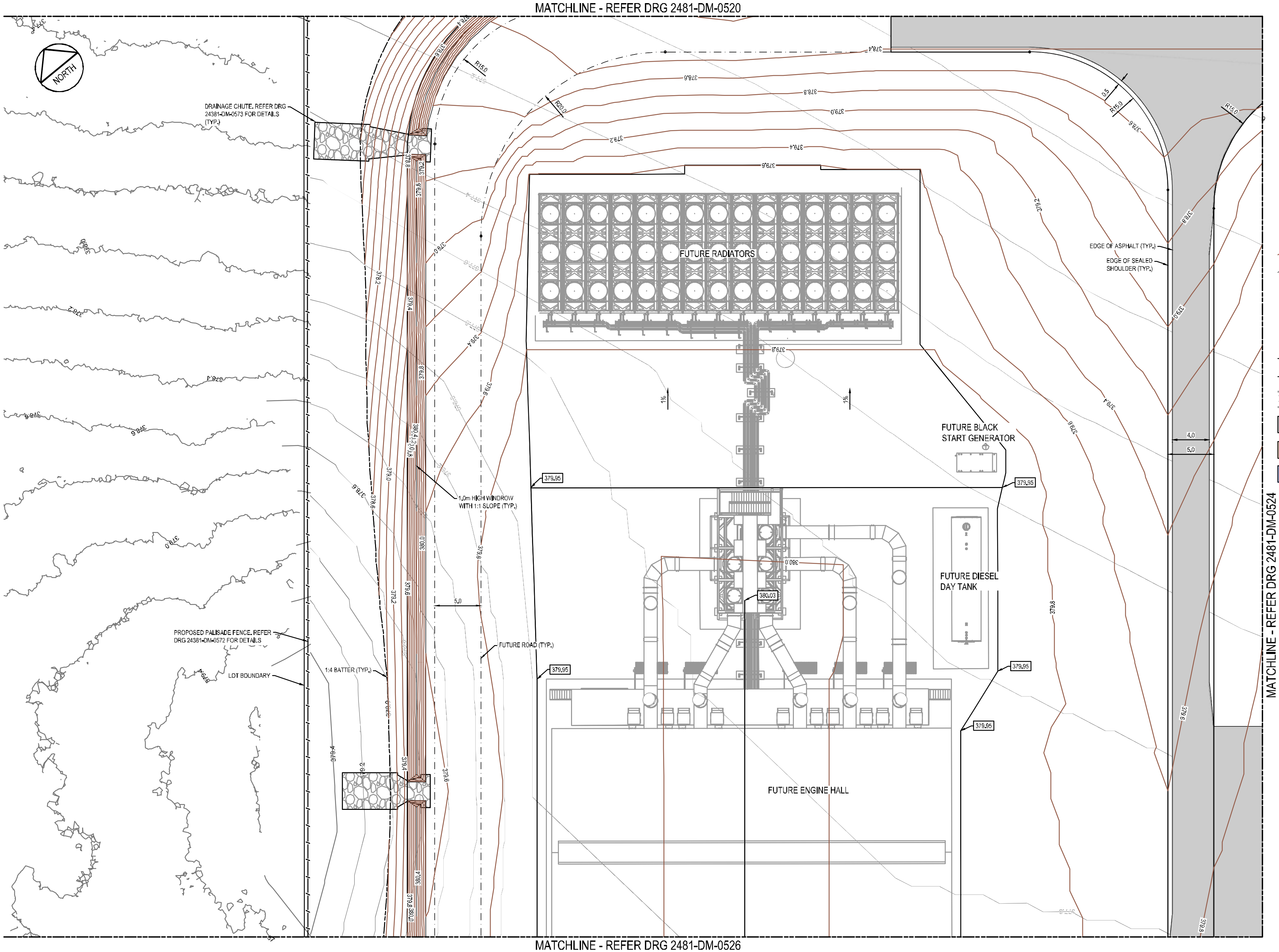
DRAWING STATUS: NOT FOR CONSTRUCTION

DATE: OCTOBER / 2025 | GRID: MGA2020 | DATUM: AHD
DESIGNED: MFC | DRAWN: MFC | CHECKED: KJ | APPROVED: PS

CLIENT: ZENITH ENERGY OPERATIONS PTY LTD
KCGM - THERMAL POWER STATION

TITLE: FINISHED SURFACE AND DRAINAGE PLAN - SHEET 3

113-DM-0522 | SCALE: 1:200 @ A1 | DWG No. 24381-DM-0522 | REVISION A



KEY PLAN

NOTES

1. REFER DRAWING 24381-DM-0501 FOR NOTES.
2. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH ALL RELEVENT DRAWINGS AND SPECIFICATIONS.
3. ALL DIMENSIONS ARE IN METRES U.S.O.

LEGEND

- FINISHED SURFACE CONTOURS
- EXISTING CONTOURS
- PAD R.L.
- DESIGN GRADE
- DESIGN LEVEL
- EXISTING LEVEL
- BATTER INTERFACE
- GRADED DRAIN
- EXISTING PAVEMENT
- PROPOSED HV ASPHALT
- PROPOSED LV ASPHALT AND SKIRTING
- PROPOSED UNSEALED HARDSTAND

PRELIMINARY

BEFORE YOU DIG www.byda.com.au Zero Damage - Zero Harm

SCALE 1:200

REV	DATE	DESCRIPTION	BY	CHK
A	20.11.25	ISSUED FOR CLIENT REVIEW	MFC	KJ

DRAWING STATUS: NOT FOR CONSTRUCTION

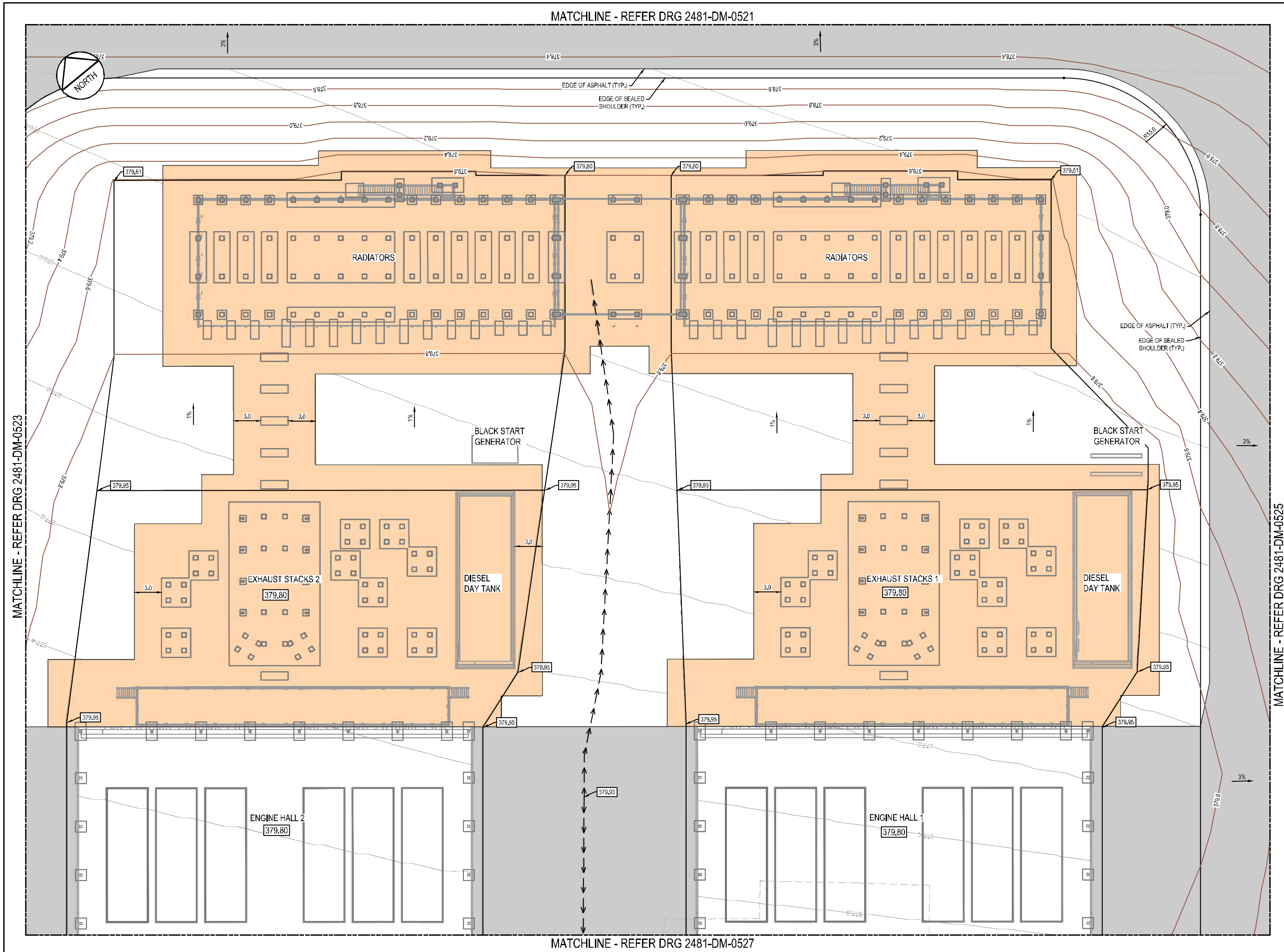
CLIENT: ZENITH ENERGY OPERATIONS PTY LTD
KCGM - THERMAL POWER STATION

TITLE: FINISHED SURFACE AND DRAINAGE PLAN - SHEET 4

DATE	GRID	DATUM
OCTOBER / 2025	MGA2020	AHD

DESIGNED	DRAWN	CHECKED	APPROVED
MFC	MFC	KJ	PS

ZENITH	SCALE	SIZE	DWG No.	REVISION
113-DM-0523	1:200 @	A1	24381-DM-0523	A



KEY PLAN

THIS DRAWING

NOTES

1. REFER DRAWING 24381-DM-0501 FOR NOTES.
2. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH ALL RELEVENT DRAWINGS AND SPECIFICATIONS.
3. ALL DIMENSIONS ARE IN METRES U.S.O.

LEGEND

- 377.0 — FINISHED SURFACE CONTOURS
- 377.0 — EXISTING CONTOURS
- 380.5 — PAD R.L.
- 3% — DESIGN GRADE
- 377.80 — DESIGN LEVEL
- 377.80 — EXISTING LEVEL
- BATTER INTERFACE
- GRADED DRAIN
- EXISTING PAVEMENT
- PROPOSED HV ASPHALT
- PROPOSED LV ASPHALT AND SKIRTING
- PROPOSED UNSEALED HARDSTAND

PRELIMINARY

BEFORE YOU DIG www.byda.com.au Zero Damage - Zero Harm

SCALE 1:200

REV	DATE	DESCRIPTION	BY	CHK
A	20.11.25	ISSUED FOR CLIENT REVIEW	MFC	KJ

Zenith energy

Colliers

DRAWING STATUS: NOT FOR CONSTRUCTION

DATE: OCTOBER / 2025 | GRID: MGA2020 | DATUM: AHD

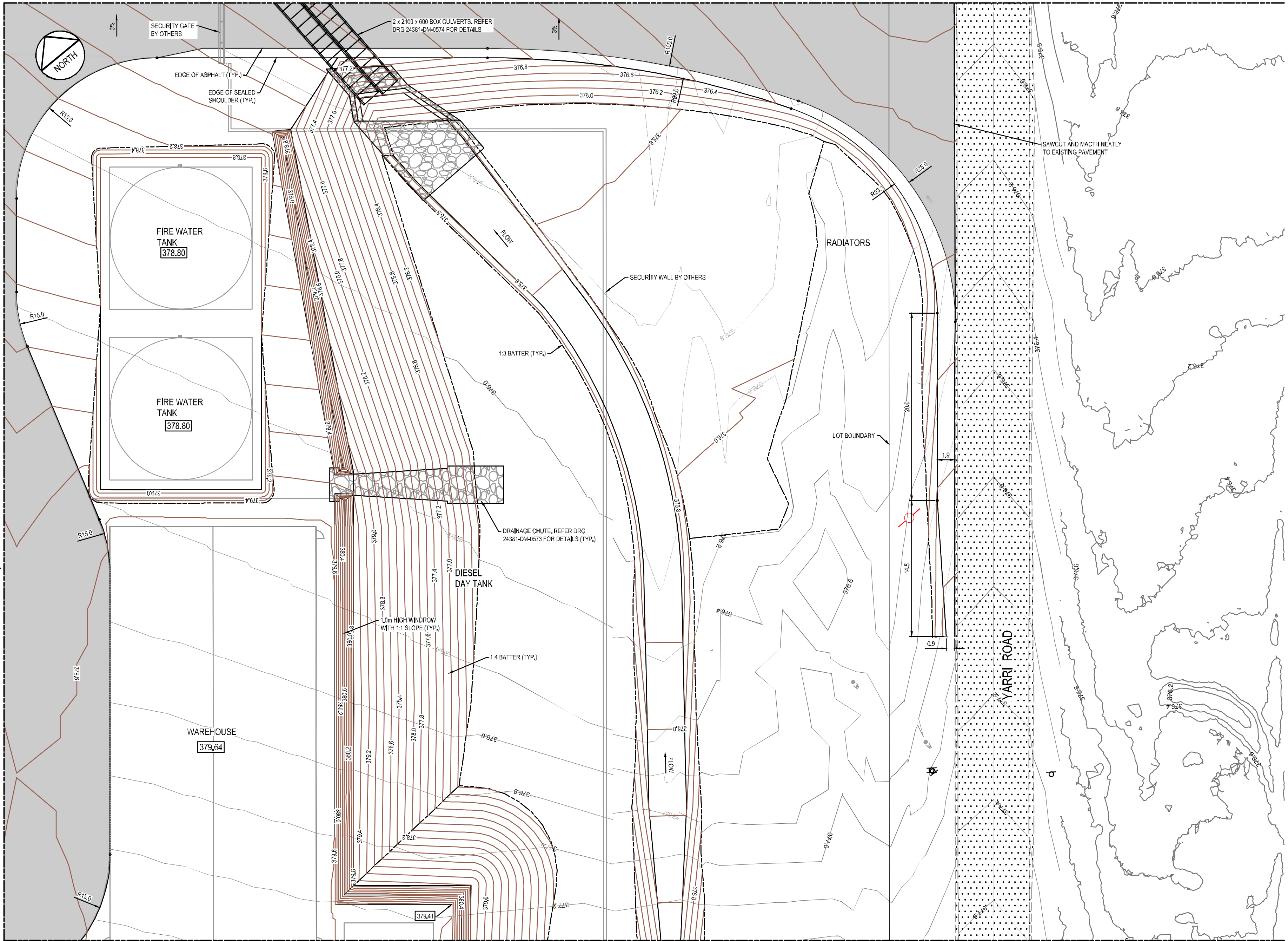
DESIGNED: MFC | DRAWN: MFC | CHECKED: KJ | APPROVED: PS

CLIENT: ZENITH ENERGY OPERATIONS PTY LTD
KCGM - THERMAL POWER STATION

TITLE: FINISHED SURFACE AND DRAINAGE PLAN - SHEET 5

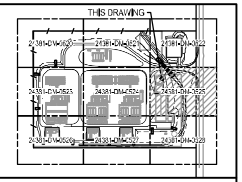
CLIENT No: 113-DM-0524 | SCALE: 1:200 @ A1 | DWG No: 24381-DM-0524 | REVISION: A

MATCHLINE - REFER DRG 2481-DM-0522



MATCHLINE - REFER DRG 2481-DM-0524

MATCHLINE - REFER DRG 2481-DM-0528



KEY PLAN

NOTES

1. REFER DRAWING 24381-DM-0501 FOR NOTES.
2. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH ALL RELEVENT DRAWINGS AND SPECIFICATIONS.
3. ALL DIMENSIONS ARE IN METRES U.N.O.

LEGEND

- FINISHED SURFACE CONTOURS
- EXISTING CONTOURS
- PAD R.L.
- DESIGN GRADE
- DESIGN LEVEL
- EXISTING LEVEL
- BATTER INTERFACE
- GRADED DRAIN
- EXISTING PAVEMENT
- PROPOSED HV ASPHALT
- PROPOSED LV ASPHALT AND SKIRTING
- PROPOSED UNSEALED HARDSTAND

PRELIMINARY

BEFORE YOU DIG www.byda.com.au Zero Damage - Zero Harm

SCALE 1:200

REV	DATE	DESCRIPTION	BY	CHK
A	20.11.25	ISSUED FOR CLIENT REVIEW	MFC	KJ

Zenith energy

Colliers

DRAWING STATUS: NOT FOR CONSTRUCTION

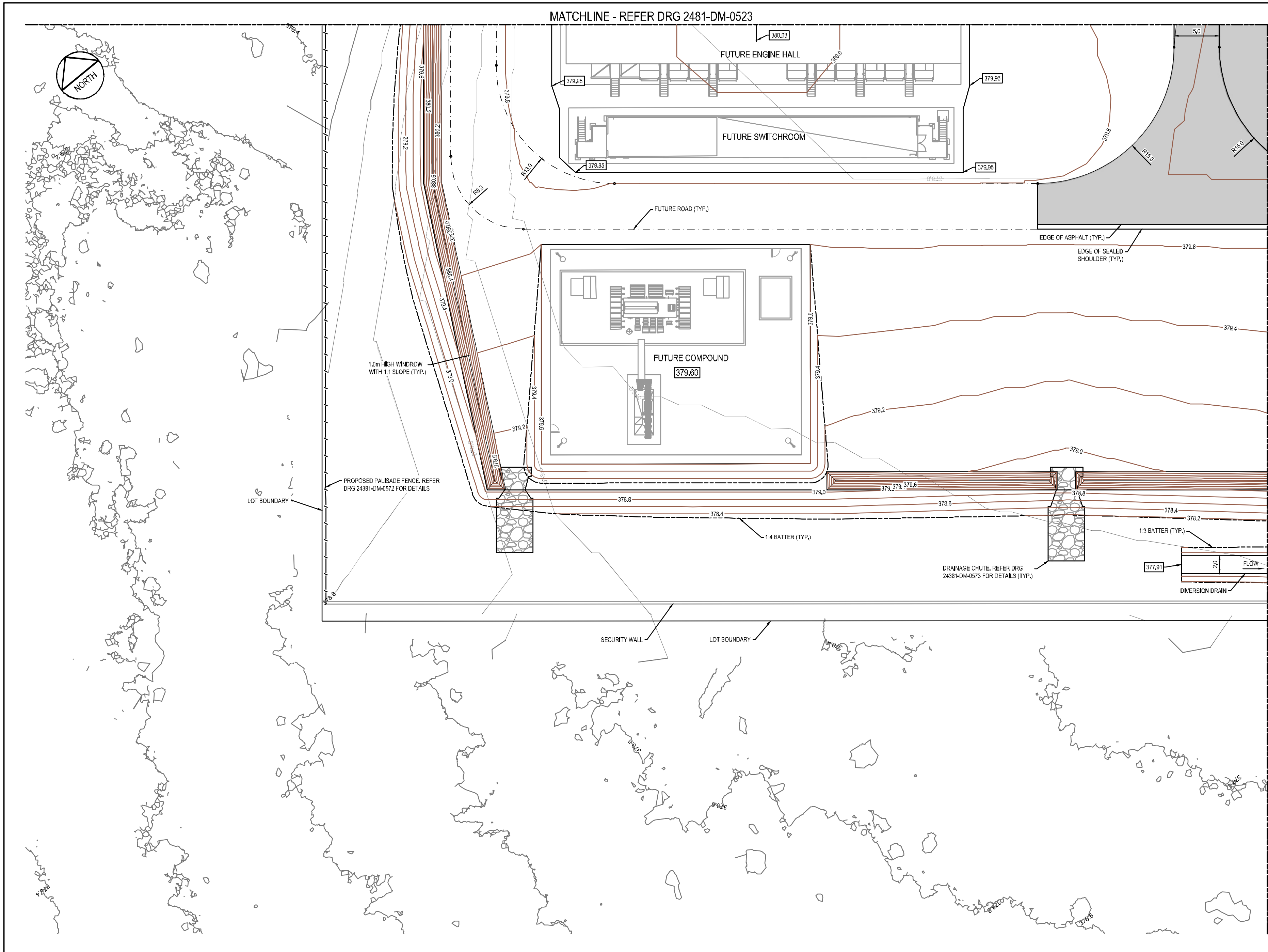
DATE	GRID	DATUM
OCTOBER / 2025	MGA2020	AHD

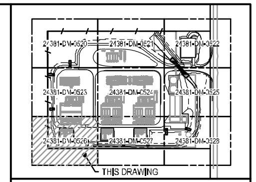
DESIGNED	DRAWN	CHECKED	APPROVED
MFC	MFC	KJ	PS

CLIENT: ZENITH ENERGY OPERATIONS PTY LTD
KCGM - THERMAL POWER STATION

TITLE: FINISHED SURFACE AND DRAINAGE PLAN - SHEET 6

ZENITH	SCALE		SHEET SIZE	DWG No.	REVISION
113-DM-0525	1:200	@	A1	24381-DM-0525	A





KEY PLAN

NOTES

1. REFER DRAWING 24381-DM-0501 FOR NOTES.
2. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH ALL RELEVENT DRAWINGS AND SPECIFICATIONS.
3. ALL DIMENSIONS ARE IN METRES U.S.O.

LEGEND

- FINISHED SURFACE CONTOURS
- EXISTING CONTOURS
- 380,5 PAD R.L.
- 3% DESIGN GRADE
- 377,80 DESIGN LEVEL
- 377,80 EXISTING LEVEL
- BATTER INTERFACE
- GRADED DRAIN
- EXISTING PAVEMENT
- PROPOSED HV ASPHALT
- PROPOSED LV ASPHALT AND SKIRTING
- PROPOSED UNSEALED HARDSTAND

PRELIMINARY

BEFORE YOU DIG www.byda.com.au Zero Damage - Zero Harm

SCALE 1:200

REV	DATE	DESCRIPTION	BY	CHK
A	20.11.25	ISSUED FOR CLIENT REVIEW	MFC	KJ

Zenith energy

Colliers

DRAWING STATUS: NOT FOR CONSTRUCTION

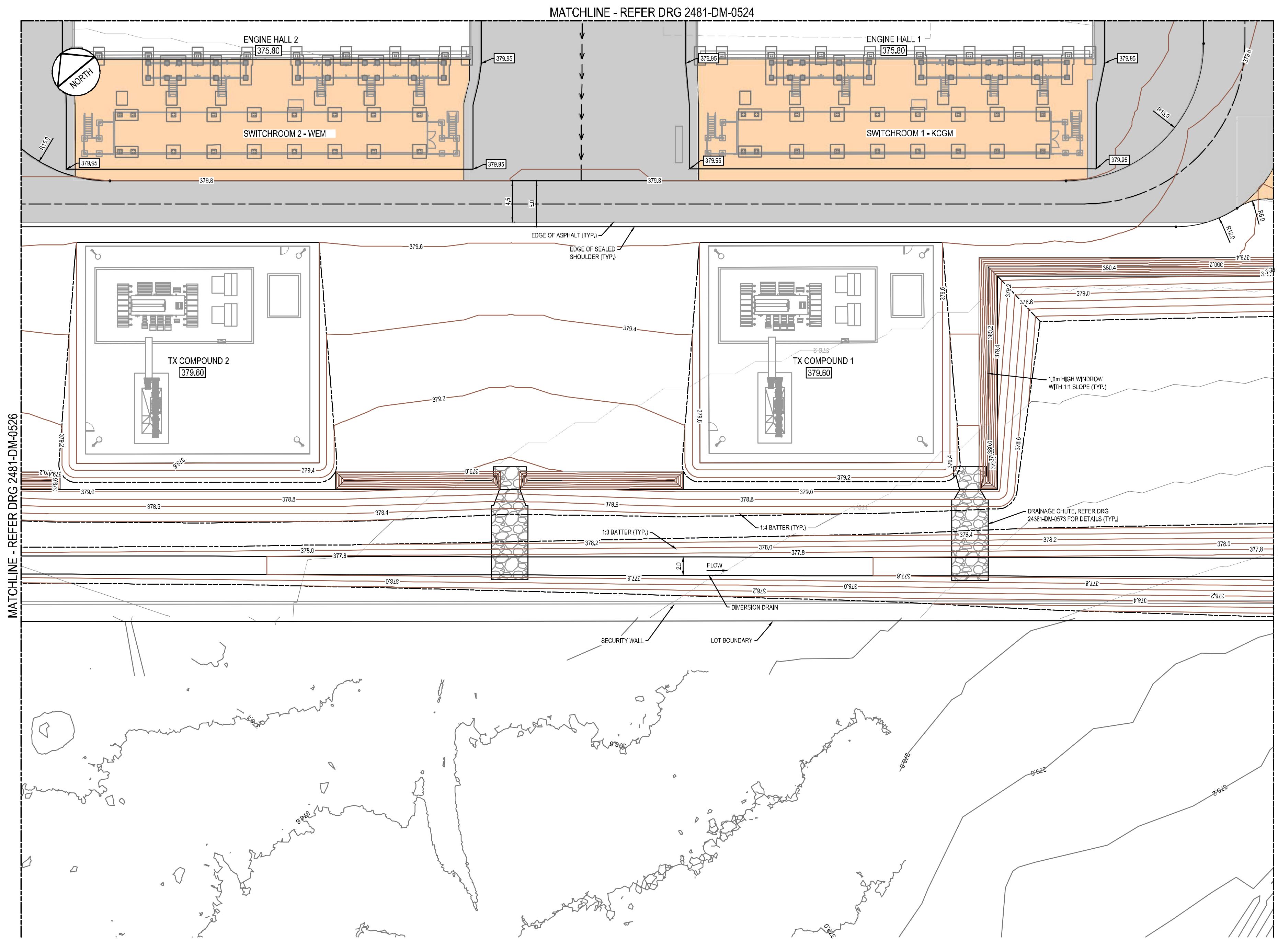
DATE: OCTOBER / 2025 | GRID: MGA2020 | DATUM: AHD
DESIGNED: MFC | DRAWN: MFC | CHECKED: KJ | APPROVED: PS

ZENITH: 113-DM-0526 | SCALE: 1:200 @ A1

CLIENT: ZENITH ENERGY OPERATIONS PTY LTD
KCGM - THERMAL POWER STATION

TITLE: FINISHED SURFACE AND DRAINAGE PLAN - SHEET 7

DWG No.: 24381-DM-0526 | REVISION: A



KEY PLAN

THIS DRAWING

NOTES

1. REFER DRAWING 24381-DM-0501 FOR NOTES.
2. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH ALL RELEVENT DRAWINGS AND SPECIFICATIONS.
3. ALL DIMENSIONS ARE IN METRES U.N.O.

LEGEND

- FINISHED SURFACE CONTOURS
- EXISTING CONTOURS
- 380.5 PAD R.L.
- DESIGN GRADE
- 377.80 DESIGN LEVEL
- 377.80 EXISTING LEVEL
- BATTER INTERFACE
- GRADED DRAIN
- EXISTING PAVEMENT
- PROPOSED HV ASPHALT
- PROPOSED LV ASPHALT AND SKIRTING
- PROPOSED UNSEALED HARDSTAND

PRELIMINARY

BEFORE YOU DIG www.byda.com.au Zero Damage - Zero Harm

SCALE 1:200

REV	DATE	DESCRIPTION	BY	CHK
A	20.11.25	ISSUED FOR CLIENT REVIEW	MFC	KJ

Zenith energy

Colliers

DRAWING STATUS: NOT FOR CONSTRUCTION

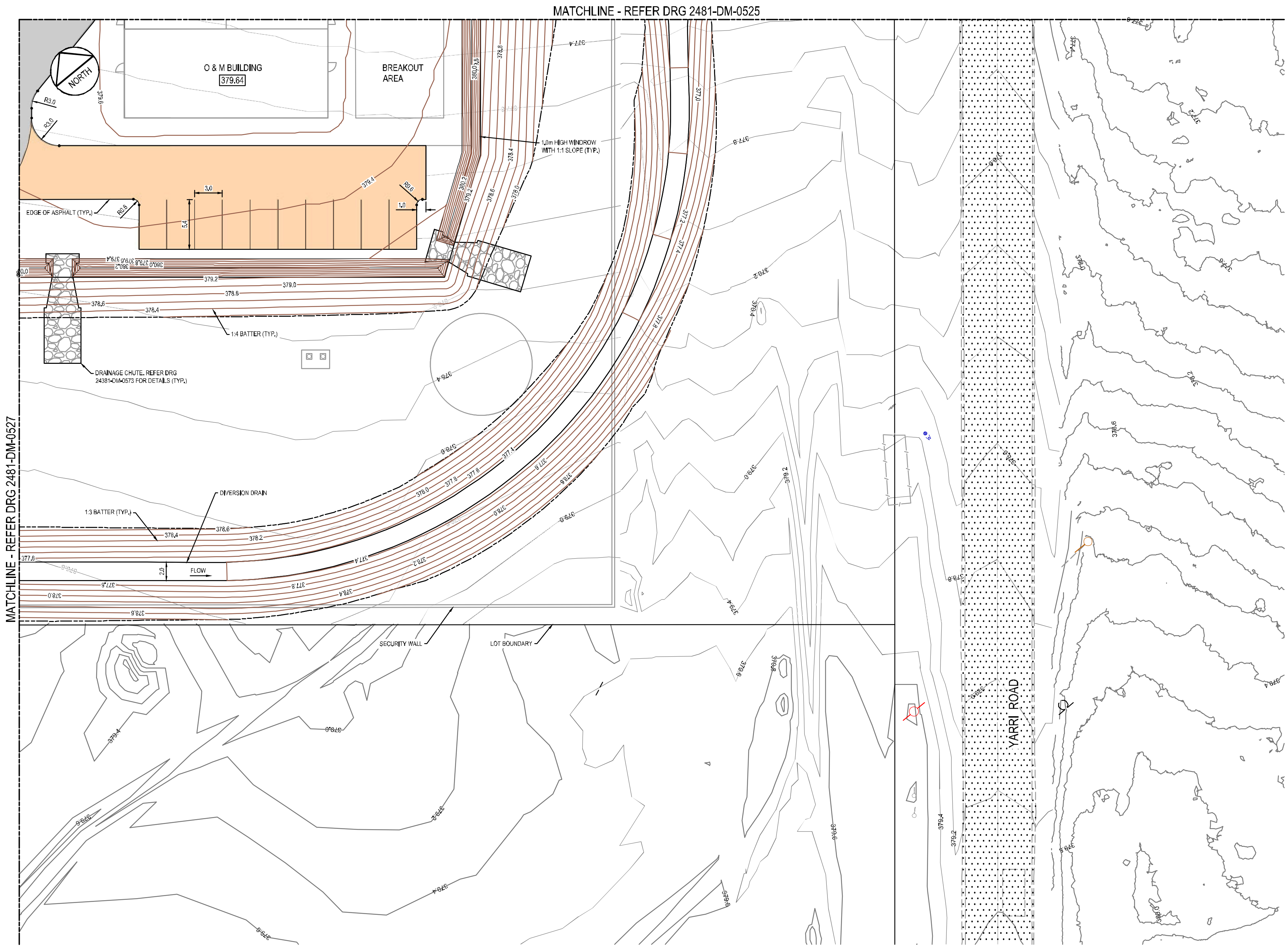
DATE	GRID	DATUM
OCTOBER / 2025	MGA2020	AHD

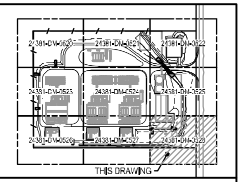
DESIGNED	DRAWN	CHECKED	APPROVED
MFC	MFC	KJ	PS

CLIENT: ZENITH ENERGY OPERATIONS PTY LTD
KCGM - THERMAL POWER STATION

TITLE: FINISHED SURFACE AND DRAINAGE PLAN - SHEET 8

ZENITH	SCALE	SIZE	DWG No.	REVISION
113-DM-0527	1:200 @	A1	24381-DM-0527	A





KEY PLAN

NOTES

1. REFER DRAWING 24381-DM-0501 FOR NOTES.
2. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH ALL RELEVENT DRAWINGS AND SPECIFICATIONS.
3. ALL DIMENSIONS ARE IN METRES U.N.O.

LEGEND

- 377.0 FINISHED SURFACE CONTOURS
- 377.0 EXISTING CONTOURS
- 380.5 PAD R.L.
- 3% DESIGN GRADE
- 377.80 DESIGN LEVEL
- 377.80 EXISTING LEVEL
- BATTER INTERFACE
- GRADED DRAIN
- EXISTING PAVEMENT
- PROPOSED HV ASPHALT
- PROPOSED LV ASPHALT AND SKIRTING
- PROPOSED UNSEALED HARDSTAND

PRELIMINARY

BEFORE YOU DIG www.byda.com.au Zero Damage - Zero Harm

SCALE 1:200

REV	DATE	DESCRIPTION	BY	CHK
A	20.11.25	ISSUED FOR CLIENT REVIEW	MFC	KJ

Zenith energy

Colliers

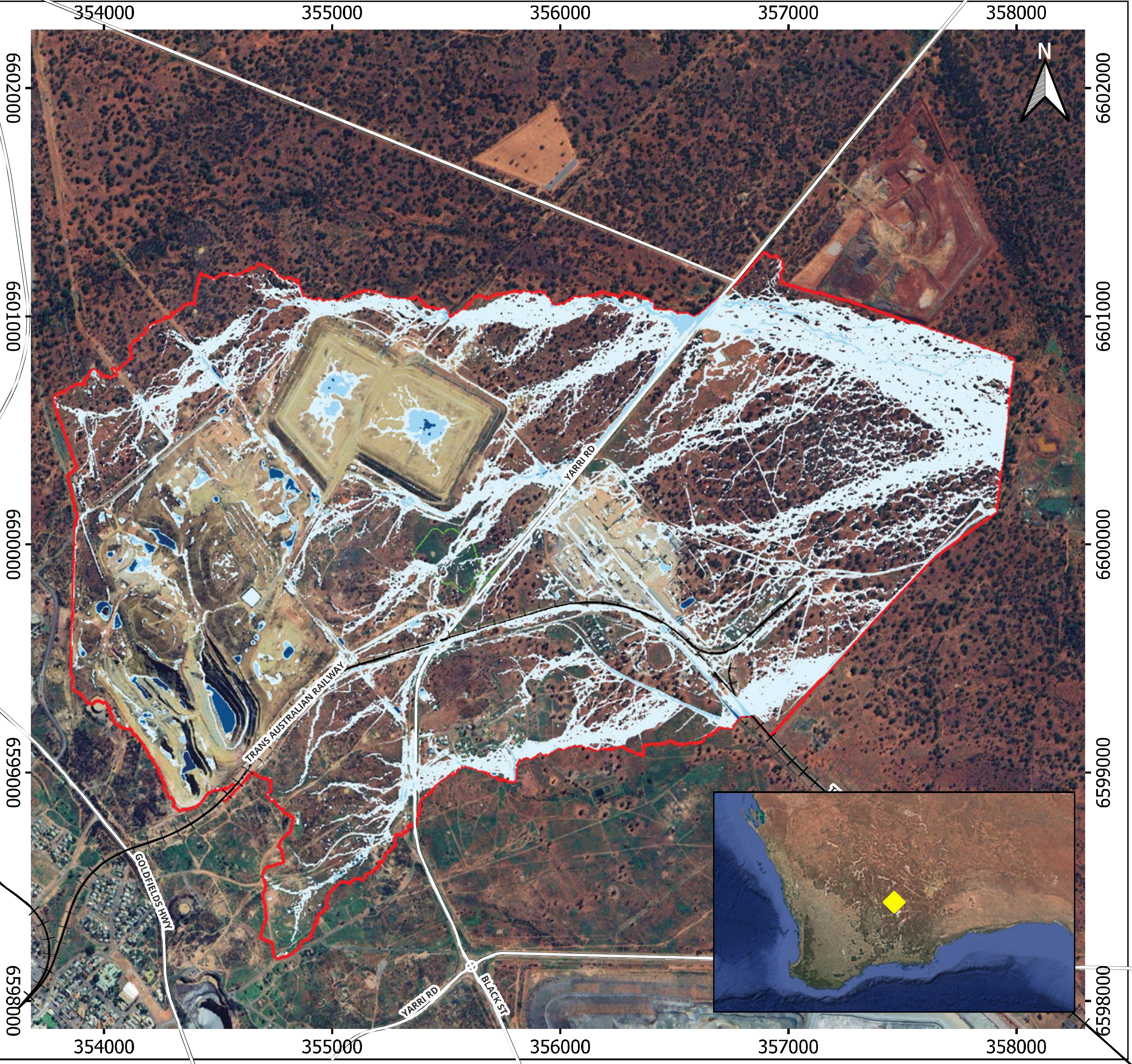
DRAWING STATUS: NOT FOR CONSTRUCTION
DATE: OCTOBER / 2025 | GRID: MGA2020 | DATUM: AHD
DESIGNED: MFC | DRAWN: MFC | CHECKED: KJ | APPROVED: PS
113-DM-0528 | SCALE: 1:200 @ A1

CLIENT: ZENITH ENERGY OPERATIONS PTY LTD
KCGM - THERMAL POWER STATION

TITLE: FINISHED SURFACE AND DRAINAGE PLAN - SHEET 9

DWG No. 24381-DM-0528 | REVISION A

Appendix B Flood inundation maps



wsp

LEGEND

- Railway Lines
- Main Roads
- Proposed Thermal Power Station
- Catchment area

Flood depth (m)

- 0.02 - 0.20
- 0.20 - 0.50
- 0.50 - 1.00
- > 1.00

Aerial imagery sourced from Google Satellite online

0 500 1,000 m

GDA94 / MGA zone 51 EPSG:28351
Universal Transverse Mercator (UTM)

Project: KCGM Thermal Power Station Hydrological Assessment

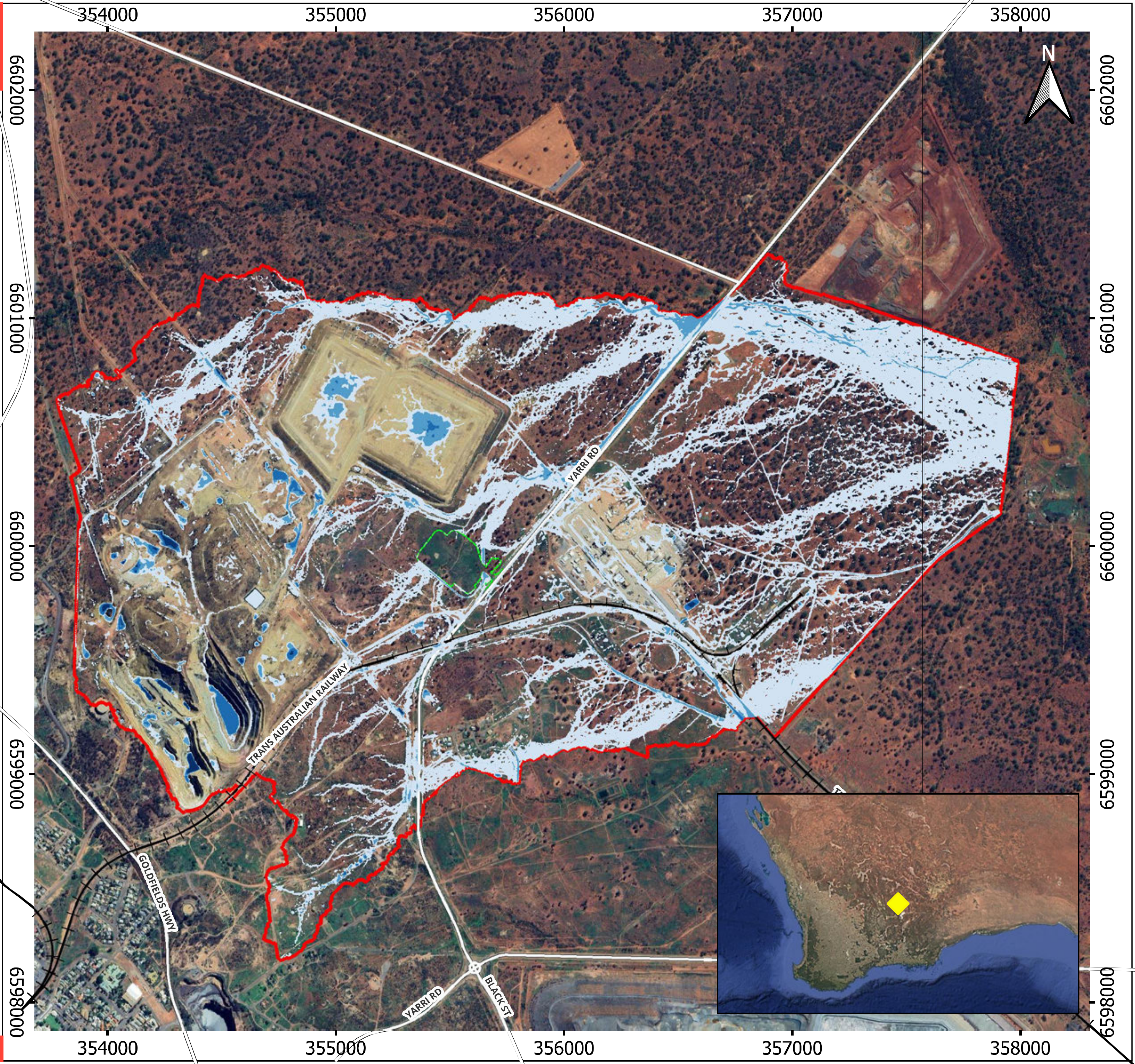
Client: Northern Star Resources Limited

Title: Maximum flood depth - Pre-development scenario, 1:100 AEP, 6-Hour flood event

Version: Final
Project No: PS227418
Rev: 0
Figure No: B1

Designed: ES
Prepared: ES
Reviewed: HD
Approved: GH
Date: 04/12/2025

www.wsp.com



LEGEND

- Railway Lines
- Main Roads
- Proposed Thermal Power Station
- Catchment area

Flood depth (m)

- 0.02 - 0.20
- 0.20 - 0.50
- 0.50 - 1.00
- > 1.00

Aerial imagery sourced from Google Satellite online

0 500 1,000 m

GDA94 / MGA zone 51 EPSG:28351
Universal Transverse Mercator (UTM)

Project: KCGM Thermal Power Station Hydrological Assessment

Client: Northern Star Resources Limited

Title: Maximum flood depth - Post-development scenario with diversion channel, 1:100 AEP, 6-Hour flood event

Version: Final
Project No: PS227418
Rev: 0
Figure No: B2

Designed: ES
Prepared: ES
Reviewed: HD
Approved: GH
Date: 04/12/2025

www.wsp.com

Appendix C Flood level difference map

LEGEND

Railway Lines

Main Roads

Proposed Thermal Power Station

Catchment area

Flood level difference (m)

<= -0.20

-0.20 - -0.02

0.02 - 0.20

> 0.20

Aerial imagery sourced from Google Satellite online

0 500 1,000 m

GDA94 / MGA zone 51 EPSG:28351
Universal Transverse Mercator (UTM)

Project: KCGM Thermal Power Station Hydrological Assessment

Client: Northern Star Resources Limited

Title: Difference in flood levels post-development substracted from pre-development case, 1:100 AEP, 6-Hour flood event

Version: Final
Project No: PS227418
Rev: 0
Figure No: C1

Designed: ES
Prepared: ES
Reviewed: HD
Approved: GH
Date: 04/12/2025

www.wsp.com

Appendix D Statement of limitations

Limitation Statement

This Report is provided by WSP Australia Pty Limited (*WSP*) for Northern Star Resources (Ltd) (*Client*) in response to specific instructions from the Client and in accordance with WSP's proposal dated 21/08/2025 and agreement with the Client dated 28/08/2025 (*Agreement*).

Permitted purpose

This Report is provided by WSP for the purpose described in the Agreement and no responsibility is accepted by WSP for the use of the Report in whole or in part, for any other purpose (*Permitted Purpose*).

Qualifications and assumptions

The services undertaken by WSP in preparing this Report were limited to those specifically detailed in the Report and are subject to the scope, qualifications, assumptions and limitations set out in the Report or otherwise communicated to the Client.

Except as otherwise stated in the Report and to the extent that statements, opinions, facts, conclusion and / or recommendations in the Report (*Conclusions*) are based in whole or in part on information provided by the Client and other parties identified in the report (*Information)*, those Conclusions are based on assumptions by WSP of the reliability, adequacy, accuracy and completeness of the Information and have not been verified. WSP accepts no responsibility for the Information.

WSP has prepared the Report without regard to any special interest of any person other than the Client when undertaking the services described in the Agreement or in preparing the Report.

Use and reliance

This Report should be read in its entirety and must not be copied, distributed or referred to in part only. The Report must not be reproduced without the written approval of WSP. WSP will not be responsible for interpretations or conclusions drawn by the reader. This Report (or sections of the Report) should not be used as part of a specification for a project or for incorporation into any other document without the prior agreement of WSP.

WSP is not (and will not be) obliged to provide an update of this Report to include any event, circumstance, revised Information or any matter coming to WSP's attention after the date of this Report. Data reported and Conclusions drawn are based solely on information made available to WSP at the time of preparing the Report. The passage of time; unexpected variations in ground conditions; manifestations of latent conditions; or the impact of future events (including (without limitation) changes in policy, legislation, guidelines, scientific knowledge; and changes in interpretation of policy by statutory authorities); may require further investigation or subsequent re-evaluation of the Conclusions.

This Report can only be relied upon for the Permitted Purpose and may [redacted] be relied upon for any other purpose. The Report does not purport to recommend or induce a decision to make (or not make) any purchase, disposal, investment, divestment, financial commitment or otherwise. It is the responsibility of the Client to accept (if the Client so chooses) any Conclusions contained within the Report and implement them in an appropriate, suitable and timely manner.

In the absence of express written consent of WSP, no responsibility is accepted by WSP for the use of the Report in whole or in part by any party other than the Client for any purpose whatsoever. Without the express written consent of WSP, any use which a third party makes of this Report or any reliance on (or decisions to be made) based on this Report is at the sole risk of those third parties without recourse to WSP. Third parties should make their own enquiries and obtain independent advice in relation to any matter dealt with or Conclusions expressed in the Report.

Disclaimer

No warranty, undertaking or guarantee whether expressed or implied, is made with respect to the data reported or the Conclusions drawn. To the fullest extent permitted at law, WSP, its related bodies corporate and its officers, employees and agents assumes no responsibility and will not be liable to any third party for, or in relation to any losses, damages or expenses (including any indirect, consequential or punitive losses or damages or any amounts for loss of profit, loss of revenue, loss of opportunity to earn profit, loss of production, loss of contract, increased operational costs, loss of business opportunity, site depredation costs, business interruption or economic loss) of any kind whatsoever, suffered on incurred by a third party.