Syerston Project

MODIFICATION 4 ENVIRONMENTAL ASSESSMENT

NOVEMBER 2017

PROJECT NAME CHANGE NOTIFICATION

On 2 November 2017, Clean TeQ Holdings Limited announced that the name of the Syerston Project will be changed to the Clean TeQ Sunrise Project.

Any reference to the Syerston Project or the Project in the Environmental Assessment (including Appendices) should be read as the Clean TeQ Sunrise Project.

SYR - Syerston Project and Operation

Modification 4 – Environmental Assessment

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1 Introduction

This document is an Environmental Assessment (EA) for a proposed modification to the Syerston Project (the Project), an approved nickel cobalt scandium mining project. Scandium21 Pty Ltd owns the rights to develop the Project. Scandium 21 Pty Ltd is a wholly owned subsidiary of Clean TeQ Holdings Limited (Clean TeQ).

This Modification is sought under section 75W of the New South Wales (NSW) *Environmental Planning and Assessment Act, 1979* (EP&A Act).

1.1 Overview of the Approved Project

The Project is situated approximately 350 kilometres (km) west-northwest of Sydney, near the village of Fifield, NSW (Figure 1).

Development Consent DA 374-11-00 (Attachment 1) for the Project was issued under Part 4 of the EP&A Act in 2001.

The Project includes the establishment and operation of the following (Figure 1):

- mine (including the processing facility);
- limestone quarry;
- rail siding;
- gas pipeline;
- borefields and water pipeline; and
- associated transport activities and transport infrastructure (e.g. the Fifield Bypass, road and intersection upgrades).

The Project includes an initial scandium oxide focussed production phase (the Initial Production Phase) prior to shifting to scandium oxide and nickel and cobalt precipitate production by developing the full Project (the Full Production Phase).

The Initial Production Phase is a smaller-scale operation compared to the Full Project Phase and will include preferentially mining scandium-rich areas of the Syerston deposit at a run-of-mine (ROM) ore production rate of 100,000 tonnes per annum (tpa) to produce up to 1,000 tpa of nickel and cobalt metal equivalents, as either sulphide or sulphate precipitate products, and up to approximately 80 tpa of scandium oxide.

The Project would transition to the Full Production Phase once scandium-rich areas of the Syerston deposit are depleted or sooner if favourable market conditions prevail for larger scale nickel cobalt scandium production.

The mining and processing will then increase to allow for an autoclave feed rate of 2.5 million tonnes per annum (Mtpa) to produce up to 40,000 tpa of nickel and cobalt metal equivalents, as either sulphide or sulphate precipitate products, and up to approximately 180 tpa of scandium oxide.

Construction of the Project commenced in 2006 with the construction of components of the borefields, however Project operations are yet to commence.

1.2 Overview of the Modification

Clean TeQ has undertaken a Project Optimisation Study to identify opportunities to improve the overall efficiency of the Full Production Phase of the Project. The Modification involves the implementation of these opportunities and would include:

- mining in a more selective manner to initially increase the processing facility ore feed grade;

LEGEND
- National Park/Conservation Area
- State Forest
- Local Government Boundary
- Existing Gas Pipeline
- Mining Lease Application Boundary
- Approved Water Pipeline
- Approved Limestone Quarry Water Pipeline
- Approved Gas Pipeline
- Approved Borefield Infrastructure Corridor
- Modified Water Pipeline Alignment Option
- Approved Fifield Bypass

Source: Black Range Minerals (2000); NSW Department of Industry (2017); NSW Land & Property Information (2017); Office of Environment and Heritage NSW (2017)

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SYERSTON PROJECT MODIFICATION 4

Regional Location

Figure 1

- addition of drilling and blasting at the mine site;
- adoption of the resin-in-pulp (RIP) processing method option (i.e. the counter current decantation processing method option is no longer proposed)[1];
- increased sulphur demand and sulphuric acid production to leach additional nickel, cobalt and scandium from the higher grade ore;
- increased limestone demand to neutralise the additional acid required in the acid leach circuit;
- addition of a crystalliser to the processing facility to extract ammonium sulphate from an existing waste stream for use as a fertiliser product;
- changes to process input and product road transport requirements;
- addition of a water treatment plant to the processing facility to recycle process water and minimise make-up water demand;
- increased tailings storage facility capacity to hold increased tailings volume due to the additional limestone required for acid neutralisation;
- reduced evaporation pond capacity due to the recycling of process water;
- relocation of mine infrastructure to avoid resource sterilisation and improve operational efficiency;
- addition of licensed surface water extraction from the Lachlan River to improve water supply security;
- minor changes to borefield transfer station layout and water pipeline alignment;
- short-term road transport of water from the borefield to the mine site during the initial construction phase; and
- reduced gas demand as the increased sulphuric acid production would generate additional steam for power generation.

The Modification would not involve changes to any aspects of the approved limestone quarry, rail siding or gas pipeline. Table 1 provides a comparative summary of the approved and proposed modified Project.

1.3 Consultation

Consultation has been conducted with key State government agencies and the relevant local councils during the preparation of this EA. A summary of this consultation is provided below.

It is anticipated that consultation with these stakeholders will continue during the assessment of the Modification by the NSW Government.

State Government Agencies

Department of Planning and Environment

A meeting was held with representatives of the Department of Planning and Environment (DP&E) on 28 April 2017 to provide an overview of the proposed Modification, discuss environmental assessment requirements and provisional timing for lodgement of the Modification.

Clean TeQ submitted a request to modify Development Consent DA 374-11-00 to the DP&E in the form of a letter with accompanying application form on 4 May 2017, which sought notification of any environmental assessment requirements relevant to the Modification.

[1] The approved Project includes the option to use either the RIP or counter current decantation processing method.

Table 1 Comparative Summary of the Approved and Modified Project

Component	Approved Syerston Project [1,2]	Modification
Mining Tenement	• Mining Lease Application (MLA) 113, 132, 139, 140, 141 and limestone quarry MLA 162.	• Unchanged.
Mine Life	• 21 years from commencement of mining.	• Unchanged.
Hours of Operation	• 24 hours per day, seven days per week.	• Unchanged.
Open Cut Mining	• Open cut mining method.	• Unchanged, however ore would be mined in a selective manner to initially increase the processing facility ore feed grade.
Blasting	• Blasting undertaken at the limestone quarry only.	• No change limestone quarry blasting. • Blasting undertaken at the mine site.
Waste Rock Management	• Waste rock deposited in open cut voids and in waste rock emplacements.	• Unchanged.
Mineral Processing	• Autoclave feed rate of up to 2.5 Mtpa. • Processing facility consists of counter current decantation or RIP circuit/metals recovery.	• No change to autoclave feed rate. • RIP circuit only (i.e. no counter current decantation circuit). • Addition of a crystalliser to allow production of ammonium sulphate.
Reagent Production	• Up to 700,000 tpa of sulphuric acid would be produced in the sulphuric acid plant. • Hydrogen sulphide, hydrogen and nitrogen would be produced in the processing facility.	• Sulphuric acid demand (and production) would increase to up to 1,050,00 tpa. • Hydrogen sulphide, hydrogen and nitrogen would no longer be produced in the processing facility.
Product	• Up to 180 tpa of scandium oxide. • Up to 40,000 tpa of nickel and cobalt metal equivalents, as either sulphide or sulphate precipitate products.	• No change to scandium oxide production. • Up to 40,000 tpa of nickel and cobalt metal equivalents, as sulphate precipitate products only. • Up to 100,000 tpa of ammonium sulphate.
Tailings Management	• Waste deposited in the tailings storage facility and evaporation ponds.	• Increased tailings storage facility capacity to hold increased tailings volume. • The size of the evaporation ponds would decrease due to the increase in water recycling.
Mine Surface Facilities	• Construction of surface facilities within the approved surface development area.	• Relocation of some infrastructure components inside the approved surface development area to avoid potential resource sterilisation and improve operational efficiency.
Surface Water Management	• Overall objective is to control runoff from the construction and operational areas while diverting upstream water around these areas. • The water management system will include both permanent features that will continue to operate post-closure and temporary structures during mining operations.	• Overall objectives of the surface water management would be unchanged. • A water treatment plant would be added to the processing facility to increase process water recycling and minimise make-up water demand. • Changes to the site water management system to reflect modified layout.

Table 1 Comparative Summary of the Approved and Modified Project (Continued)

Component	Approved Syerston Project [1,2]	Modification
Water Supply	• Development of borefields and water pipeline from the borefields to the mine.	• Borefields unchanged. • Transfer station relocated and reconfigured initially to allow water to be transported to the mine site by road. • Addition of licensed surface water extraction from the Lachlan River to improve water supply security. • Alternative water pipeline alignment through Fifield may be used.
Limestone Supply	• Development of a limestone quarry to extract up to 790,000 tpa of limestone.	• No change in limestone quarry. • Increased limestone demand (990,000 tpa). • Up to 560,000 tpa of limestone would be sourced from third party suppliers.
Power Supply	• On-site gas power plant (34 megawatts [MW]). • Diesel standby generators.	• No change to gas power plant, however gas demand would be reduced as the increased sulphuric acid production would generate additional steam for power generation. • Increased capacity of the diesel standby generators.
Gas Pipeline	• Development of a gas pipeline from an existing gas pipeline to the mine.	• Unchanged.
Material Transport	• Transport of inputs and products via a combination of road and rail (including development of a rail siding).	• Changes to approved transport sources, frequencies, routes and transport method.
Road Upgrades	• Road upgrades in accordance with the Development Consent DA 374-11-00 and Voluntary Planning Agreements (VPAs).	• Minor changes to reflect changes to Project road transport requirements.
Employees	• Approximately 300 people during operations.	• Unchanged.

1 Development Consent DA 374-11-00 (as modified).

2 Full Production Phase (maximum case) has been described.

A response letter from the DP&E was received on 15 June 2017 confirming the Modification can be assessed and determined under section 75W of the EP& Act. Formal Secretary's Environmental Assessment Requirements were not issued, however the DP&E provided advice regarding key aspects for consideration in this EA and consultation requirements.

A letter was provided to the DP&E on 27 September 2017 describing proposed changes to the Modification (i.e. compared to the Modification proposed in the application submitted in May 2017). A response letter from the DP&E was received on 13 October 2017, which provided revised advice regarding key aspects for consideration in this EA.

Meetings were also held with representatives of the DP&E on 24 May 2017 and 29 August 2017 to provide updates on the Modification.

Division of Resources and Geoscience (within the NSW Department of Planning and Environment)

A meeting was held with the Division of Resources and Geoscience (formerly the Division of Resources and Energy within the NSW Department of Industry) on 12 September 2017 to provide an overview of the Modification.

Department of Primary Industries – Water

A meeting was held with the Department of Primary Industries – Water (DPI-Water) on 11 September 2017 to provide an overview of the Modification and an outline of the proposed assessment approach for the Water Management Assessment.

Environment Protection Authority

A meeting was held with representatives of the Environment Protection Authority (EPA) on 12 September 2017 to provide an overview of the Modification and to confirm the proposed assessment methodologies for the air quality and noise assessments would meet the requirements of the relevant policies and guidelines.

Office of Environment and Heritage

A briefing package was provided to the Office of Environment and Heritage (OEH) on 14 September 2017 describing the Modification and offering a meeting to provide further detail.

Roads and Maritime Services

A meeting was held with Roads and Maritime Services (RMS) on 5 September 2017 to provide an overview of the Modification and to discuss the assessment approach for the Road Transport Assessment.

Forestry Corporation of NSW

A meeting was held with the Forestry Corporation of NSW on 11 September 2017 to provide an overview of the Modification. Project interactions with the Fifield State Forest and Forestry Act, 2012 approval requirements were discussed.

Department of Industry – Lands and Forestry

A meeting was held with Lands and Forestry (within the Department of Industry) on 12 September 2017 to provide an overview of the Modification. Project interactions with Crown land and Crown Lands Act, 1989 approvals were also discussed.

Local Government

Consultation has been conducted with the relevant local councils regarding the approved Project, the Modification and revised VPAs during the preparation of this EA. A summary of this consultation is provided below.

Lachlan Shire Council

A meeting was held with representatives of the Lachlan Shire Council (LSC) on 5 September 2017 to provide an overview of the Modification and the proposed approach to the environmental assessment.

In addition, Clean TeQ has regularly consulted with the LSC regarding the terms of the VPA agreement.

Consultation was also undertaken with the LSC in June 2017 with regard to the construction camp.

Parkes Shire Council

A meeting was held with representatives of the Parkes Shire Council (PSC) on 5 September 2017 to provide an overview of the Modification and the proposed approach to the environmental assessment.

In addition to the consultation described above, Clean TeQ has regularly consulted with the PSC regarding the terms of the VPA agreement.

Forbes Shire Council

A meeting was held with representatives of the Forbes Shire Council (FSC) on 5 September 2017 to provide an overview of the Modification and the proposed approach to the environmental assessment.

In addition to the consultation described above, Clean TeQ has regularly consulted with the FSC regarding the terms of the VPA agreement.

Community Consultative Committee

In accordance with Condition 7, Schedule 5 of Development Consent DA 374-11-00, a Community Consultative Committee (CCC) was established for the Project.

A briefing on the Modification was provided during the inaugural CCC meeting held on 10 October 2017.

A further update on the Modification will be provided during the next CCC meeting on 23 November 2017.

Local Community and Landholders

Clean TeQ has also undertaken individual consultation with a number of private landholders that reside in the vicinity of the Project to discuss the upcoming development of the Project.

In addition, community liaison kiosks were established within Fifield, Trundle and Tullamore in August 2017 to provide opportunities for the local community to learn more about the Project and the Modification.

A community newsletter on the Project was distributed to the local community in October 2017. Clean TeQ will continue to provide updates on the Modification in future community newsletters.

Aboriginal Community

Aboriginal community consultation was undertaken in consideration of the requirements of the OEH's *Aboriginal cultural heritage consultation requirements for proponents 2010* (Department of Environment, Climate Change and Water [DECCW], 2010) the *Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation* (Department of Environment and Conservation [DEC], 2005) and clause 80c of the NSW *National Parks and Wildlife Regulation, 2009*.

In accordance with these guidelines and regulations, Clean TeQ consulted with relevant government agencies and Registered Aboriginal Parties (RAPs), as described in Appendix F.

As a result of the registration process undertaken for the Modification in accordance with *Aboriginal cultural heritage consultation requirements for proponents 2010*, a total of seven RAPs registered an interest in the Modification[2], including:

- Wiradjuri Condobolin Corporation.
- Murie Elders Group.
- Binjang Wellington Wiradjuri Aboriginal Heritage Survey.
- West Wyalong Local Aboriginal Land Council (LALC).
- Condobolin LALC.
- Louise Davis.
- Peter Peckham.

Surveys of the additional surface development areas associated with the Modification were undertaken with representatives of the RAPs (Appendix F). All RAPs were consulted regarding the Aboriginal cultural heritage management and mitigation measures documented in this EA.

[2] The Forbes Aboriginal & Community Working Party were originally registered as stakeholders for the consultation process, however at a later date they advised Clean TeQ that they did not wish to be included in the Aboriginal consultation process going forward, and hence have not been described further in this EA.

1.4 Structure of this Document

This EA comprises a main text component and supporting studies. An overview of the main text sections is presented below:

Section 1	Provides an overview of the approved Project and the Modification and the consultation undertaken in relation to the Modification.
Section 2	Provides a description of existing and approved operations at the Project.
Section 3	Provides a description of the Modification.
Section 4	Provides an environmental assessment of the Modification.
Section 5	Provides a description of the approved and proposed rehabilitation strategy for the Project.
Section 6	Describes the general statutory context of the Modification.
Section 7	Provides a conclusion providing justification for the Modification.
Section 8	References.

Attachment 1 and Appendices A to H provide supporting information as follows:

Attachment 1	Project Consolidated Development Consent.
Appendix A	Air Quality Assessment.
Appendix B	Noise and Blasting Assessment.
Appendix C	Preliminary Hazard Analysis.
Appendix D	Water Management Assessment.
Appendix E	Road Transport Assessment.
Appendix F	Aboriginal Cultural Heritage Assessment.
Appendix G	Surface Water Extraction Baseline Flora and Fauna Habitat Report.
Appendix H	Alternative Water Pipeline Alignment Baseline Flora Report.

2 Approved Project

2.1 Approval History

Development Consent DA 374-11-00 for the Project was issued under Part 4 of the EP&A Act in 2001. Three modifications to Development Consent DA 374-11-00 have since been granted under the EP&A Act:

- 2005 – to allow for an increase of the autoclave feed rate, limestone quarry extraction rate and adjustments to ore processing operations;
- 2006 – to allow for the reconfiguration of the borefields; and
- 2017 – to allow for the production of scandium oxide.

The consolidated Development Consent DA 374-11-00, incorporating these modifications, is provided in Attachment 1.

In addition, a Modification application was lodged on 13 October 2017 for changes to hazard study requirements (the Hazard Studies Modification [MOD 5]). The Hazard Studies Modification will be subject to separate environmental assessment and approval.

2.2 Mineral Resource

At the Syerston deposit the nickel-cobalt lateritic mineralisation is largely confined within goethite and siliceous goethite zones at depths of 10 metres (m) to 60 m from the surface in deposits up to 40 m in thickness (Black Range Minerals, 2000).

Scandium mineralisation at the Syerston deposit is developed throughout the lateritic profile, mainly within the overburden, alluvial, and goethite zones on the periphery of the main nickel cobalt deposit. The average depth of the scandium-rich areas is approximately 1 m to 30 m below the surface but tend to be variable across the area dependent upon the lateritic profile (Clean TeQ, 2015).

2.3 General Arrangement

The general arrangement of the approved Project includes the following main components (Figure 1):

- mine (including processing facility);
- limestone quarry;
- rail siding;
- gas pipeline;
- borefields and water pipeline; and
- associated transport activities and transport infrastructure (e.g. the Fifield Bypass and road and intersection upgrades).

During the Initial Production Phase, only the mine (including the mine processing facility), borefield and water pipeline will be developed. The limestone quarry, rail siding and gas pipeline will be developed as part of the Full Production Phase.

A description of the general arrangement of the approved mine is provided in this section. The general arrangements of the other Project components are described in Sections 2.11 to 2.14.

The general arrangement of the approved mine site includes the following main components:

- multiple open cut pits (including small-scale scandium rich open cut pits);
- waste rock emplacements;
- ROM pad ore stockpiles;
- topsoil stockpiles;
- processing facility;
- reagent production plants and storage areas;
- gas-fired power plant and associated power distribution infrastructure;
- tailings storage facility;
- evaporation ponds;
- water storage dam;
- sediment dams, diversion dams, raw water dam, diversions, pumps, pipelines and other water management equipment and structures;
- construction camp;
- concrete batch plant;
- gravel and clay borrow pits (within the footprint of the tailings storage facility and open cut pits);
- offices, workshops, warehouse, laboratory and amenities buildings and car parking facilities;
- fuel storage areas;
- potable water treatment plant;
- wastewater (including sewage) treatment plant;
- laydown areas;
- access road, internal roads and haul roads; and
- other associated minor infrastructure, plant, equipment and activities.

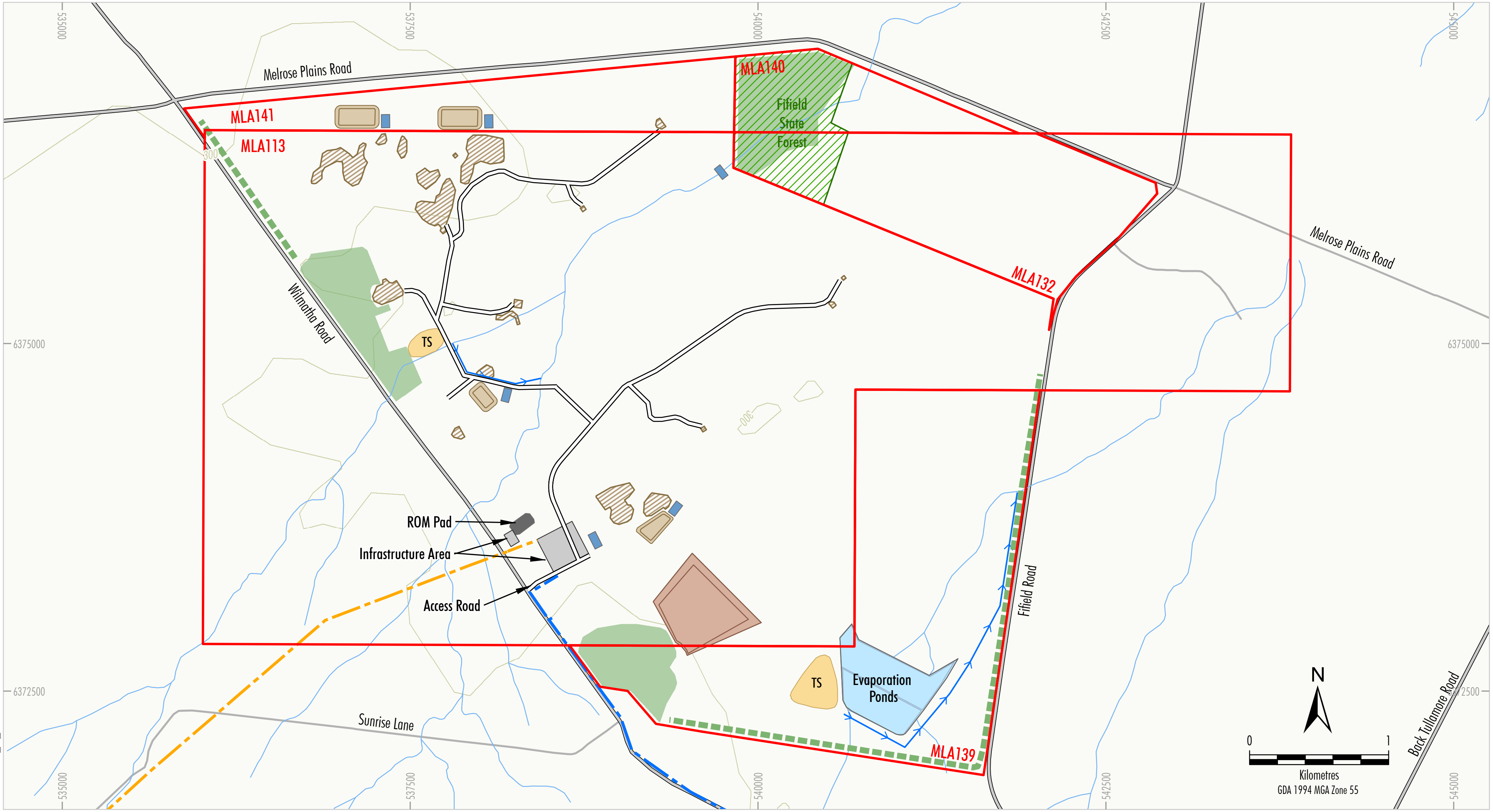
The approved mine general arrangement for the Initial Production Phase and the Full Production Phase are shown on Figures 2a and 2b, respectively.

2.4 Construction Activities

Construction activities for the Initial Production Phase will be required for the development of the mine (including the processing facility), borefields, water pipeline and road upgrades and are anticipated to last approximately two years.

A second construction phase to fully develop all Project components (i.e. limestone quarry, rail siding, gas pipeline) will be required prior to the commencement of the Full Production Phase of the Project. It is anticipated that the second construction phase will require an additional two years to complete.

Construction activities will be undertaken during the approved construction hours outlined in Condition 1, Schedule 3 of Development Consent DA 374-11-00.



LEGEND

- Mining Lease Application Boundary
- Open Cut Pit
- Waste Rock Emplacement
- Tailings Storage Facility
- TS Topsoil Stockpile
- ROM Pad
- Mine Infrastructure Area
- Sediment Dam
- Diversion Structure
- Gas Pipeline
- Water Pipeline
- Vegetation Screening
- Existing Open Woodland
- State Forest

Source: Black Range Minerals (2000); NSW Department of Industry (2017); NSW Land & Property Information (2017)

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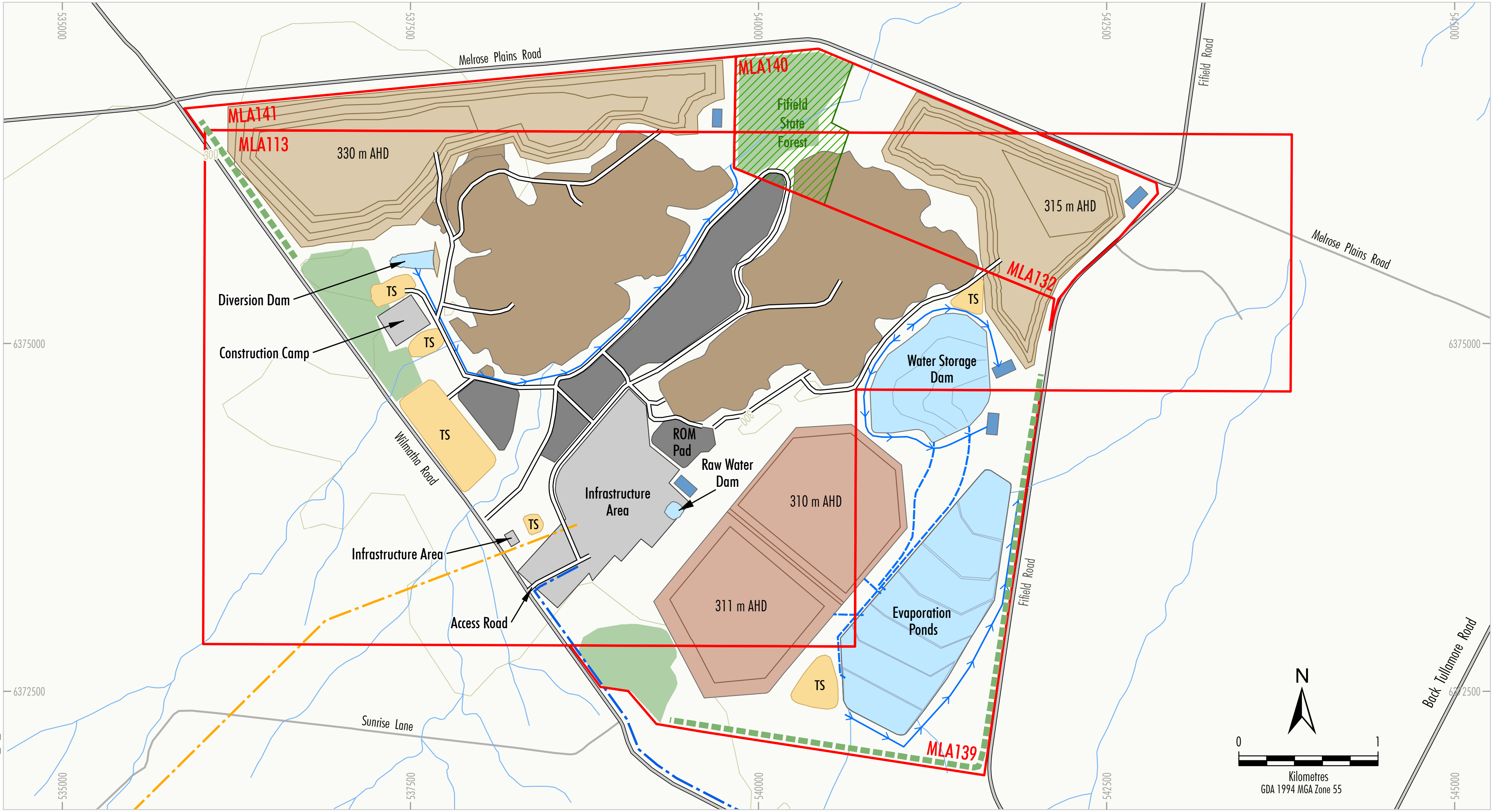
Approved Mine and Processing Facility General Arrangement (Initial Production Phase)

Figure 2a



LEGEND

Mining Lease Application Boundary
Ore Stockpile
Open Cut Pit
Waste Rock Emplacement
Tailings Storage Facility
TS Topsoil Stockpile
Mine Infrastructure Area
Sediment Dam

Diversion Structure
Key Site Water Pipeline
Gas Pipeline
Water Pipeline
Vegetation Screening
Existing Open Woodland to be Maintained
State Forest

Source: Black Range Minerals (2000); NSW Department of Industry (2017); NSW Land & Property Information (2017)

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Approved Mine and Processing Facility General Arrangement (Full Production Phase)

Figure 2b

2.5 Mining Operations

2.5.1 Mining Areas

During the Initial Production Phase, multiple small-scale open cut pits will be developed to target scandium-rich areas of the Syerston deposit (Figure 2a). The small-scale open cut pits will have relatively small footprints (Figure 2a) and be up to 30 m deep.

These small-scale open cut pits will be either incorporated into the larger open cut pits or backfilled during the Full Production Phase (Figure 2b).

The larger open cut pits will have an average depth of 35 m with localised deeper areas up to approximately 55 m.

2.5.2 Mining Method

Conventional open cut mining methods will be used to develop the Syerston deposit.

The rate of open cut mining during the Initial Production Phase will be approximately 100,000 tpa of ROM ore. The mining rate will increase to greater than 2.5 Mtpa during the Full Production Phase, to allow for an autoclave feed rate of 2.5 Mtpa.

Ore will be loaded directly to haul trucks for transfer to the ROM pad or ore stockpiles for processing (Section 2.7).

The approved waste rock management is described in Section 2.6.

Mining operations will be conducted 24 hours per day, seven days per week.

2.5.3 Mining Equipment and Supporting Equipment/Plant

Hydraulic excavators, haul trucks, dozers, graders and front end loaders will be used during mining operations.

A list of the approved major mobile equipment for the Project is provided in the Noise and Blasting Assessment (Appendix B).

2.6 Waste Rock Management

2.6.1 Quantities and Geochemistry

Approximately 125 million tonnes of waste rock will be generated from the Project. Quantities of mine waste material will increase during the mine life as the open pits deepen, reaching up to approximately 8.5 Mtpa.

The waste rock material is highly weathered, oxidised and non-acid forming (Black Range Minerals, 2000).

2.6.2 Waste Rock Emplacement Strategy

Waste rock material generated will be placed either in one of two waste rock emplacements or in small-scale open cut pits located outside the approved open cut pit areas (Figures 2a and 2b).

The development of the waste rock emplacements will entail progressive pre-stripping of the emplacement footprint and systematic development by truck unloading and dozer pushing.

The waste rock emplacements will be up to approximately 20 m and 30 m high. The overall batter slopes of the waste rock emplacements will be 1 vertical (V):4 horizontal (H) with reverse graded berms at approximately 10 m intervals. Intermediate batter slopes will be constructed to 1V:3H grades.

2.7 Processing Facility

2.7.1 Process Description

During the Initial Production Phase, the process facility will use a RIP circuit and will include the following stages:

- **Ore preparation circuit** – removal of oversize material and production of an ore slurry suitable for acid leaching;
- **Acid leach circuit** – leaching of nickel, cobalt and scandium from the ore slurry by application of sulphuric acid under high pressure and temperature in an autoclave to produce an autoclave slurry containing acid and soluble nickel and cobalt sulphates;
- **RIP circuit** – a two stage process that first separates scandium and then nickel and cobalt from residue solids (tailings) contained in the autoclave slurry using ion exchange resin;
- **Tailings neutralisation and thickening circuit** – neutralisation of residue solids slurry (tailings) with a limestone slurry prior to thickening and transfer to the tailings storage facility (Section 2.8); and
- **Metals recovery circuit** – recovery of:
  - scandium oxide from the loaded resin by desorption with sodium carbonate followed by precipitation and calcination; and
  - nickel and cobalt sulphates from the loaded resin by desorption with sulphuric acid followed by solvent extraction and precipitation.

Approximately 100,000 tpa of ore will be processed during the Initial Production Phase to produce up to 1,000 tpa of nickel and cobalt metal equivalents as sulphate precipitate products and up to 80 tpa of scandium oxide.

For the Full Production Phase, the processing facility will either use a RIP circuit and include the same stages as described above for the Initial Production Phase, or a counter current decantation circuit will be used, with the following stages:

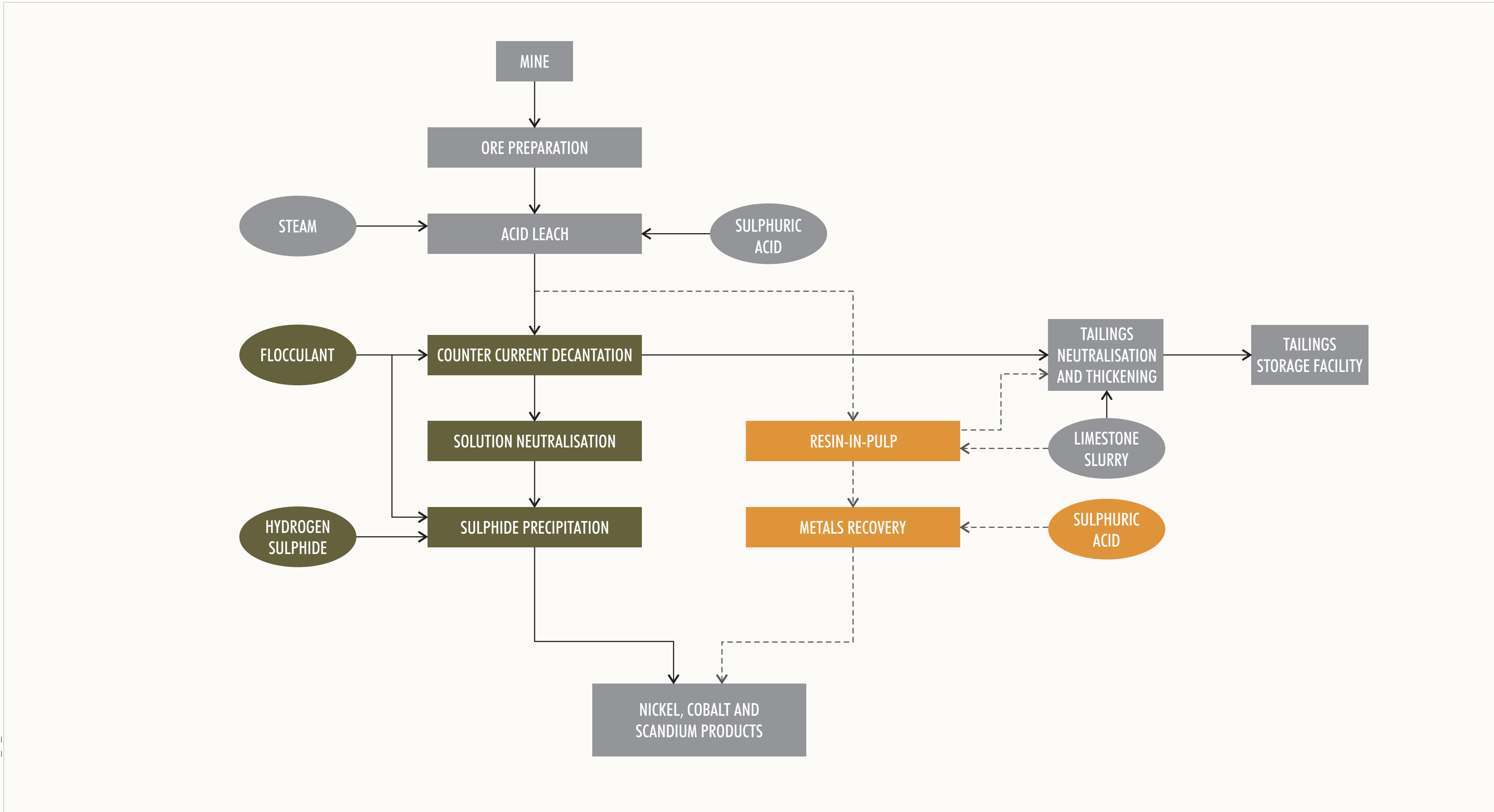
- **Ore preparation circuit** – as per the Initial Production Phase;
- **Acid leach circuit** – as per the Initial Production Phase;
- **Counter current decantation circuit** – separation of free acid and soluble nickel and cobalt sulphates from residue solids (tailings) contained in the autoclave slurry;
- **Tailings neutralisation and thickening circuit** – as per the Initial Production Phase;
- **Solution neutralisation circuit** – neutralisation of free acid and soluble nickel and cobalt solution from the counter current decantation circuit; and
- **Sulphide precipitation circuit** – precipitate a high grade nickel and cobalt product from the neutralised nickel and cobalt solution.

During the Full Production Phase, the processing facility will operate with an autoclave feed rate of 2.5 Mtpa of ore to produce up to 40,000 tpa of nickel and cobalt metal equivalents, as either sulphide or sulphate precipitate products, and up to 180 tpa of scandium oxide.

A conceptual ore processing flowsheet for the approved Project is provided on Figure 3.

A summary of the approved process inputs, atmospheric emissions and liquid waste streams is provided in Table 2.

Processing operations will be conducted 24 hours per day, seven days per week.



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LEGEND
- Counter-current Decantation Process (Full Production Phase Option)
- Resin-in-pulp Process (Initial Production Phase and Full Production Phase Option)
- Process Operations required for both Processes

Source: After SNC-Lavalin (2000); Scandium21 (2016)

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Approved Conceptual Ore Processing Flowsheet

Figure 3

Table 2 Summary of Approved Processing Facility Process Inputs, Process Input Production, Atmospheric Emissions and Liquid Waste Streams

Project Components	Initial Production Phase	Full Production Phase	
	RIP Circuit	RIP Circuit Option	Counter Current Decantation Circuit Option
Process Input Requirements			
Sulphur	-	260,000 tpa	260,000 tpa
Sulphuric Acid	30,000 tpa	-	-
Limestone	25,000 tpa	790,000 tpa	790,000 tpa
Flocculant	20 tpa	1,100 tpa	1,100 tpa
Caustic Soda	1,000 tpa	2,300 tpa	100 tpa
Extracant	200 litres per annum (Lpa)	3,000 Lpa	-
Modifier	100 Lpa	1,500 Lpa	-
Diluent	1,000 Lpa	15,000 Lpa	-
Sodium Carbonate	4,800 tpa	10,500 tpa	-
Minor reagents (e.g. hydrated lime, mill balls, coagulant, diatomaceous earth, hydrochloric acid, ammonia)	Used in ore preparation, thickening and tailings neutralisation, sulphuric acid plant and wastewater treatment plant.	Used in ore preparation, thickening and tailings neutralisation, sulphuric acid plant and wastewater treatment plant.	Used in ore preparation, thickening and tailings neutralisation, sulphuric acid plant and wastewater treatment plant. Diatomaceous earth required.
Atmospheric Emissions			
Carbon Dioxide	0.38 kilograms per second (kg/s)	9.35 kg/s	9.35 kg/s
Extraction Fan over Sulphide Filter Vent (H_2S)	-	-	5.3 Normal cubic metres per second (Nm^3/s) (dry, 273 Kelvin [K], 101.3 kiloPascals [kPa])
Sulphuric Acid Plant Stack (H_2SO_4, SO_3 and SO_2)	-	19.2 Nm^3/s (dry, 273K, 101.3 kPa)	19.2 Nm^3/s (dry, 273K, 101.3 kPa)
Flare Stack (H_2S, SO_2, NO_2 and NO)	-	-	0.65 Nm^3/s (dry, 273K, 101.3 kPa)
Hydrogen Reformer Stack (NO_2 and NO)	-	-	1.42 Nm^3/s (dry, 273K, 101.3 kPa)
Power Plant Heat Recovery Steam Generator (HRSG) (NO_2 and NO)	0.74 Nm^3/s (dry, 273K, 101.3 kPa)	18.4 Nm^3/s (dry, 273K, 101.3 kPa)	18.4 Nm^3/s (dry, 273K, 101.3 kPa)
Liquid Waste			
Liquid Waste Streams	Waste liquid streams associated with tailings neutralisation.		
Reagent Production			
Sulphuric Acid	-	700,000 tpa	700,000 tpa
Hydrogen Sulphide	-	-	88 tonnes per day (tpd)
Hydrogen	-	-	5 tpd
Nitrogen	-	For plant purging.	For plant purging.

2.7.2 Reagent Transport

The following reagents will be transported to the mine (Table 2):

- sulphuric acid (Initial Production Phase only);
- sulphur (Full Production Phase only); and
- limestone (Initial and Full Production Phases only).

Smaller amounts of other reagents will be transported to the mine, such as caustic soda and flocculent.

Additional reagents (e.g. diatomaceous earth) will be required if the counter current decantation circuit is implemented (Table 2).

A summary of the approved process inputs is provided in Table 2.

2.7.3 On-Site Reagent Production

The following reagents are approved to be manufactured at the mine (Table 2):

- sulphuric acid (Full Production Phase);
- lime slurry (Initial and Full Production Phases only);
- nitrogen (Full Production Phase);
- hydrogen (Full Production Phase if the counter current decantation circuit option is selected); and
- hydrogen sulphide (Full Production Phase if the counter current decantation circuit option is selected).

These reagents are approved to be manufactured in reagent production plants located adjacent the process facility inside the mine infrastructure area.

The lime slurry plant will be developed during the Initial Production Phase.

Sulphuric acid and nitrogen plants will be developed during the Full Production Phase as the larger scale operation will then justify the manufacture of these reagents.

If the counter current decantation circuit is adopted during the Full Production Phase, the hydrogen and hydrogen sulphide plants will be developed.

A summary of the reagent production is provided in Table 2.

2.7.4 Production Storage and Transport

Product will be stored in an onsite product storage area for periodic transport from the site.

The nickel and cobalt sulphate precipitates and scandium oxide produced at the mine will be transported by road from the mine site during the Initial Production Phase.

During the Full Production Phase, when the rail siding will be developed, nickel and cobalt sulphide or sulphate precipitates and scandium oxide will be backloaded into sulphur trucks and transported by road to the rail siding for transport by rail.

2.8 Tailings Management

The saline nature of the tailings water (principally magnesium sulphate) prevents the re-use of it in the process facility without additional treatment and an evaporative system is required to remove excess supernatant water from the tailings storage facility.

2.8.1 Tailings Storage Facility

The main engineering components required for the operation of the tailings storage are:

- starter embankment;
- upstream embankment lifts;
- tailings delivery pipeline and discharge spigots;
- underdrainage and seepage collection system;
- decant towers and associated pipeline system to the evaporation ponds; and
- earthfill access causeway to each of the two decant tower structures.

In accordance with Condition 29, Schedule 3 of Development Consent DA 374-11-00, the design of the tailings storage facility will conform to *DSC3A Consequence Categories for Dams* (Dams Safety Committee [DSC], 2015) and *DSC3F Tailings Dams* (DSC, 2012).

An initial starter embankment will be constructed during the construction phase and upstream lifts that increase the height of the tailings storage facility will be constructed in advance of storage requirements throughout the mine life (Figure 4).

In accordance with Condition 29, Schedule 3 of Development Consent DA 374-11-00, the floor and side walls of the tailings storage facility will be designed with a minimum of:

- a 900 millimetre (mm) clay liner with a permeability of no more than 1 x 10-9 metres per second (m/s); or
- a synthetic (plastic) liner of 1.5 mm minimum thickness with a permeability of no more than 1 x 10-14 m/s (or equivalent).

Tailings will be pumped from the processing facility to the tailings storage facility where it will be deposited into two adjoining tailings storage cells (Figure 4).

Sub-aerial tailings deposition in the tailings storage facility will involve peripheral discharge of tailings from a spigotted ring main located around the perimeter embankment of each of the tailings storage cells.

The method of tailings deposition will facilitate the formation of a central decant pond remote from the tailings storage cell perimeter embankment. Decant towers within each of the tailings storage cells will allow the decanting of supernatant water to the evaporation ponds.

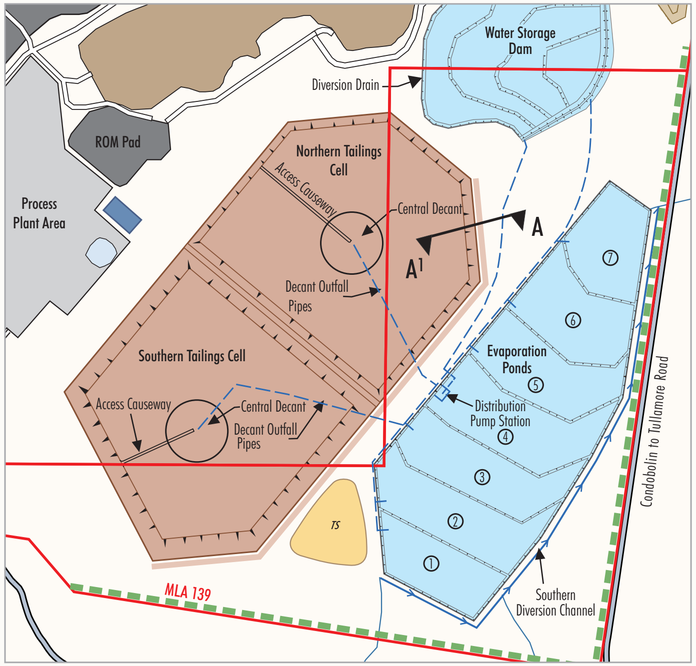
A seepage interception drain will be installed at the inner toe of the initial starter embankment (Figure 4) to intercept seepage through the tailings and near-surface soils under the storage. Seepage collected in the seepage interception drain will be drained through pipes under the tailings storage facility initial starter embankment to seepage collection sumps. These sumps will be dewatered to either the tailings storage facility decant pond or the evaporation ponds.

An earthfill access causeway will be constructed to each of the decant towers. The access causeway and decants will be raised during the development of the tailings storages.

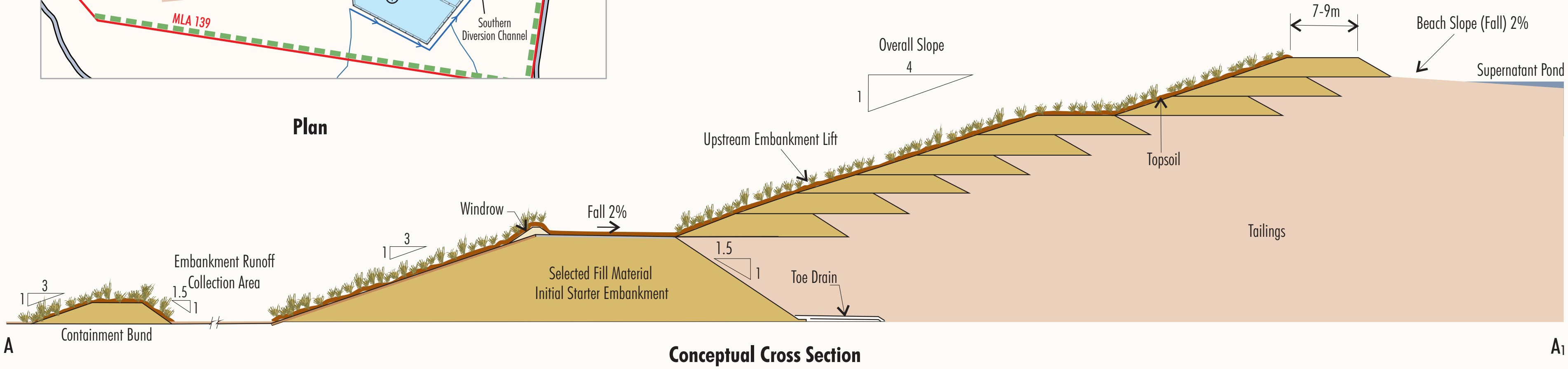
2.8.2 Tailings Storage Facility Water Management

The tailings storage facility will only receive water inflows from the tailings slurry and incident rainfall, as the tailings storage facility will be a ‘turkeys nest’ arrangement with a fully encompassing raised perimeter embankment (Figure 4).

Supernatant waters (including any incident rainfall) decanted from the tailings storage cells will gravitate through the decant pipelines to Evaporation Ponds 3 and 4. This water will then be distributed by gravity to Evaporation Ponds 5, 6 and 7 and/or pumped to Evaporation Ponds 1, 2 and 3 via a distribution pipeline (Figure 4).



Plan



Conceptual Cross Section
Through Tailings Storage Facility Embankment

Not to Scale

CTL-16-02 Mod4_EA_003B

Source: Black Range Minerals (2000)

SYERSTON PROJECT MODIFICATION 4

Approved Tailings Storage Facility
Embankment Details and
Conceptual Storage Cross Section

Figure 4

The tailings storage facility will be operated to maintain a freeboard storage, above the level of the decant pond, in excess of that required to store the volume of runoff generated from a 1 in 100 year average recurrence interval (ARI) rain event of 72 hours duration, in accordance with Condition 29, Schedule 3 of Development Consent DA 374-11-00. The decant system will be designed to remove stored water so that capacity to store a 1 in 100 year ARI rain event of 72 hours duration rain event within five days of the event occurring.

When the evaporation ponds reach full capacity, during prolonged wet periods, flows from the tailings storage cell decants will be redirected to the water storage dam. As storage capacity subsequently becomes available in the evaporation ponds, water will be pumped back from the water storage dam to the evaporation ponds.

Similar to the tailings storage facility, the evaporation ponds and water storage dam only receive water inflows from the tailings slurry and incident rainfall as they will be 'turkeys nest' dams.

In accordance with Condition 29, Schedule 3 of Development Consent DA 374-11-00, the floor and side walls of the evaporation ponds and water storage dam will be designed to the same standard as the tailings storage facility (Section 2.8.1).

The evaporation ponds and water storage dam will also be operated to maintain a freeboard storage in excess of that required to store the volume of runoff generated from a 1 in 100 year ARI rain event of 72 hours duration in accordance with Condition 29, Schedule 3 of Development Consent DA 374-11-00.

2.9 Mine Water Management

2.9.1 Water Demand

The main water demand (usage) for the mine site is the processing facility. Other water demand requirements include dust suppression, cooling water and potable and non-potable uses in the mine infrastructure area.

During the Full Production Phase (i.e. 2.5 Mtpa autoclave feed rate), the total raw water demand for the mine (including the processing facility) was originally estimated and approved to be up to 17.5 million litres per day (ML/day), or on an annualised basis, up to 6,390 million litres per year (ML/year).

The water demand for the Initial Production Phase will be significantly lower (approximately 1.75 ML/day) due to the lower processing rate.

2.9.2 Water Supply

Water for the mine site will be supplied from a number of sources during the life of the Project, including:

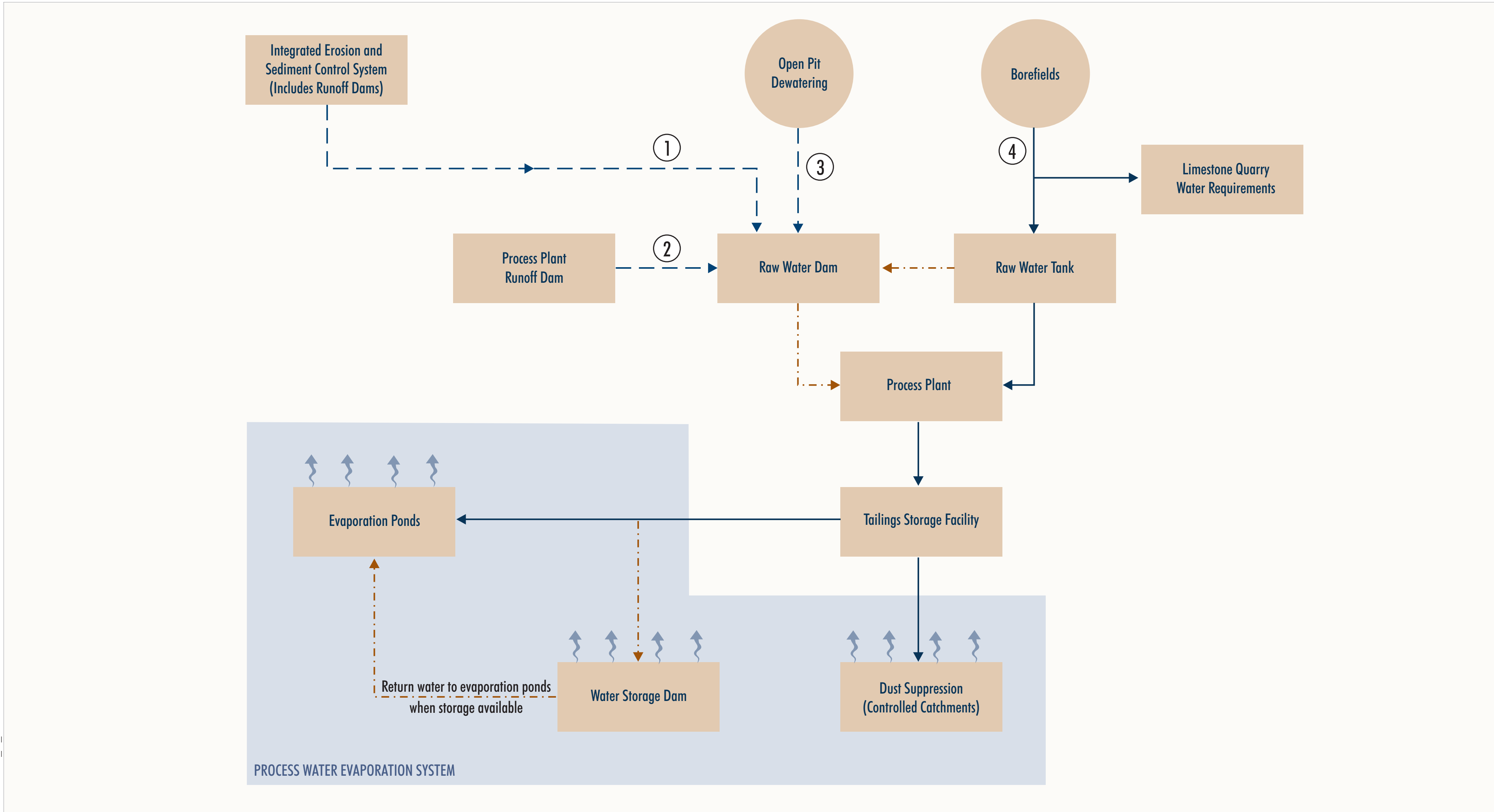
- mine dewatering (in-pit and advance, expected to be negligible);
- internal runoff collection at the mine site (including harvestable rights); and
- the borefields (primary source of water).

The approved water supply scheme layout is shown on Figure 5.

2.9.3 Site Water Management

The overall objective of the water management system is to control runoff from the development/construction areas and the operation areas, while diverting upstream water around these areas.

The water management system will include both permanent features that will continue to operate post-closure (e.g. diversion dam, northern and southern diversion channels) and temporary structures during mining operations.



CTL-16-02 Mod4_EA_007A

LEGEND

1 Water Supply Priority

Intermittent Flow Path (rainfall dependent)

Alternative Flow Path

Evaporation

Source: Black Range Minerals (2000)

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Approved Water Supply Schematic

Figure 5

The water management system will be progressively developed during the construction and operation of the mine as diversion and containment requirements change.

Some existing drainage paths will require diversion around the northern open cut pit and evaporation ponds into exiting drainage lines by development of the northern and southern diversion structures, respectively (Figure 2b). The design will consider long term stability and compatibility with existing hydrological features, landforms and vegetation. A detailed description of the clean water diversion systems will be included in the Surface Water Management Plan in accordance with Condition 30, Schedule 3 of Development Consent DA 374-11-00.

An internal drainage system will be constructed to collect and contain water generated within the development/construction areas and operation areas.

Sediment control structures such as sediment dams and sediment fences will be employed where necessary within and downstream of disturbance areas.

Sediment control structures will be designed, installed and maintained in accordance with *Managing Urban Stormwater: Soils and Construction* in accordance with Condition 29, Schedule 3 of Development Consent DA 374-11-00.

2.10 Construction Camp

A construction camp will be constructed on the mine site (Figure 2b) during Project construction.

The construction camp will house approximately 1,000 persons during the peak construction period.

In accordance with Condition 47, Schedule 3 of Development Consent DA 374-11-00, Clean TeQ will prepare a final layout and location of the construction camp in consultation with the LSC.

2.11 Borefields and Water Pipeline

2.11.1 Borefields

The borefields will comprise six production bores within the Lachlan River Palaeochannel located approximately 65 km to the south of the mine site (Figures 1 and 6).

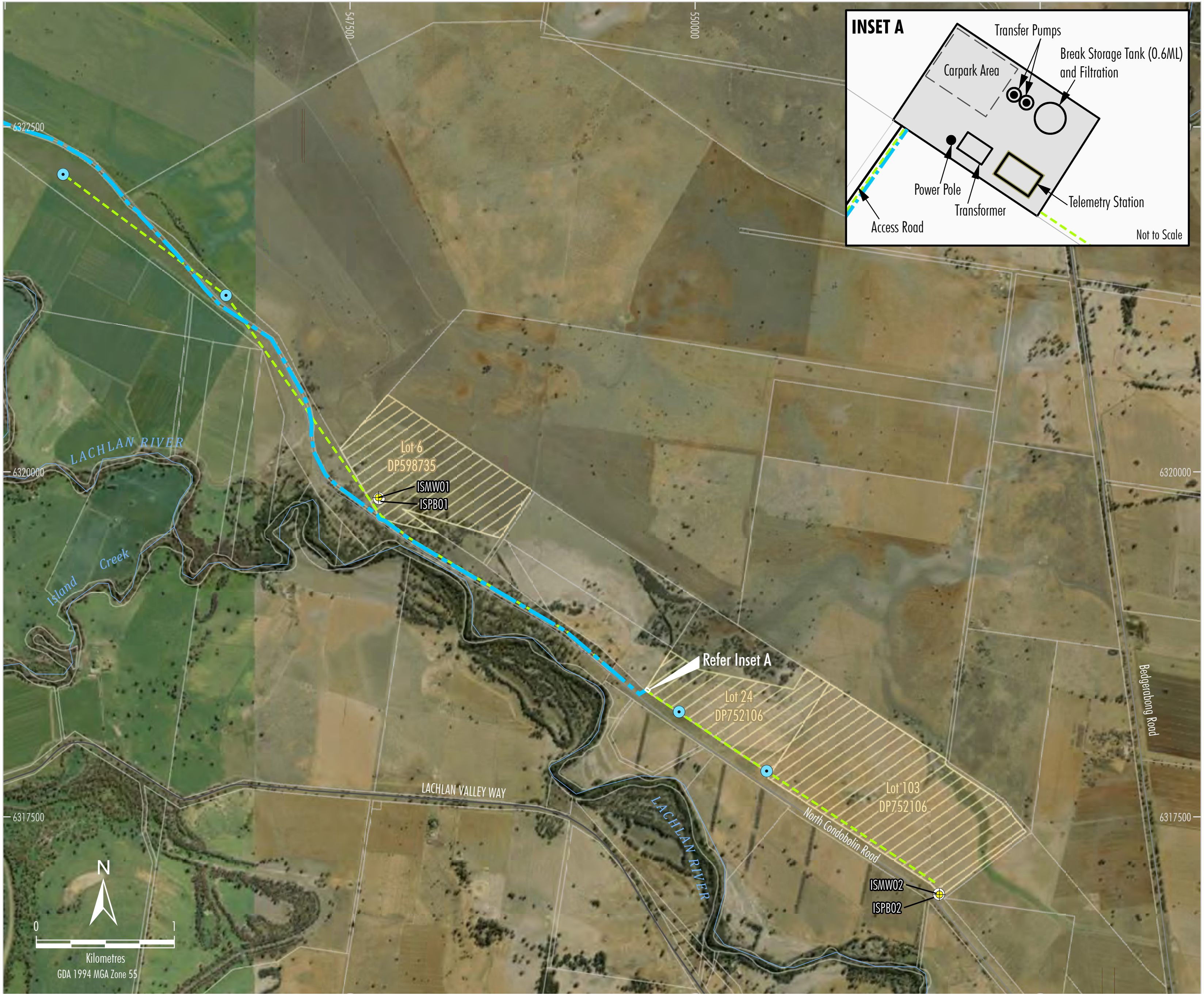
An infrastructure corridor will link the bores to the transfer station (Figure 6). The infrastructure corridor will include linking pipeline, access road and electricity transmission line. Transformers will be located at each of the six bore locations to service each bore pump.

The transfer station will include the following infrastructure (Figure 6):

- break storage tank;
- transfer pumps;
- transformer;
- telemetry station;
- laydown area; and
- access road.

Power will be provided to the borefields from a nearby substation (Black Range Minerals, 2000).

Groundwater investigations and supply feasibility assessments by Coffey Geosciences (2000) indicated that the borefields could maintain a supply of up to approximately 17 ML/day (6,300 ML/year) for a 30 year period (subject to obtaining relevant water access licences [WALs]).



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LEGEND

Property Boundary

Approved Project

Transfer Station

Water Pipeline

Borefield Infrastructure Corridor *

Potential Borefield Location

Approximate Location of Production Bore (not constructed)

Production Bore (constructed)

Monitoring Bore

* Infrastructure Corridor includes linking pipline, access road and electricity transmission line.

Source: NSW Land & Property Information (2017); Ivanplats Syerston (2005)

NSW Imagery: © Department of Finance, Services & Innovation (2017)

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Approved Borefields General Arrangement

Figure 6

Clean TeQ currently holds 3,154 shares (currently equivalent to 3,154 ML/year) in the Upper Lachlan Alluvial Groundwater Source, administered by the *Water Sharing Plan for the Lachlan Unregulated and Alluvial Water Sources, 2012* under the *Water Management Act, 2000*.

In accordance with Condition 30, Schedule 3 of Development Consent DA 374-11-00, the borefields will be operated in accordance with a Groundwater Management Plan.

2.11.2 Water Pipeline

The approved water pipeline alignment between the borefields and mine site is shown on Figure 1. An approximate 12 km spur line will run from the main pipeline to the limestone quarry (the limestone quarry water pipeline) (Figure 1).

The water pipeline alignment generally follows existing road reserves from the borefields to the mine/limestone quarry.

The water pipeline will be buried, where possible, along the route. However, at river and major tributary crossings the pipeline will cross the watercourse on a raised structure.

The reticulation system from the borefields to the mine site will have a capacity of approximately 17 ML/day.

2.12 Power Generation and Gas Pipeline

2.12.1 Power Generation

The mine power requirements during the Full Production Phase of approximately 34 MW will be provided by an on-site gas fired co-generation plant. Gas will be supplied to the mine site via the gas pipeline during the Full Production Phase (Section 2.12.2).

Electricity will be generated by two 20 MW gas turbines each fitted with a HRSG unit and a 10 MW steam turbine.

The steam required for use in the process will be generated through heat recovery from the sulphuric acid plant or from steam produced from the HRSGs or auxiliary boiler.

Emergency power requirements will be provided by three one megavolt amps diesel generators.

The power demand for the Initial Production Phase will be significantly lower due to the lower processing rate. Given the lower power demand during the Initial Production Phase of the Project, gas will be transferred to the mine by road.

2.12.2 Gas Pipeline

Gas will be supplied to the mine during the Full Production Phase via the gas pipeline from the existing Moomba to Sydney Gas Pipeline (Figure 1).

The alignment of the proposed pipeline has been designed in accordance with public safety, environmental impact and pipeline integrity concerns.

The majority of the pipeline is located within road reserves and has been aligned so as to minimise vegetation clearing and avoid areas of significant remnant vegetation.

The section of pipeline within private property has been aligned to run along fencelines and property boundaries where possible, and to minimise interruption to farming practices and the requirement for vegetation clearing.

The infrastructure associated with the gas pipeline will likely include:

- t-junction and valve at the connection point with the Moomba to Sydney gas pipeline;
- scraper station at the connection point and at the mine site;
- compressor (if required);
- metering station at the mine site; and
- mainline valves and cathodic generators and testers (locations to be determined during detailed design).

All monitoring, diagnostic and control signals will be relayed and integrated into the process control system for remote monitoring and control at the central control room at the mine.

The gas for the power generation plant will however be transported to the mine site as liquefied natural gas (LNG) via road during the Initial Production Phase as the relatively small quantity of gas required does not justify the development of the gas pipeline.

2.13 Limestone Quarry

The limestone quarry located approximately 20 km south-east of the mine will provide this limestone during the Full Production Phase of the Project (Figure 1).

Conventional open cut pit drill and blast methods will be used at the limestone quarry to produce approximately 790,000 tpa of crushed limestone.

The limestone will be crushed before being transported by road to the mine.

The limestone quarry will include the open cut, waste rock emplacement, soil stockpiles, haul roads, ROM pad, limestone screening and crushing facility, product stockpile, site buildings (administration and workshop buildings), water storage and treatment plant, fuel storage, explosive storage, access roads and security fencing.

The limestone quarry will have a water demand of approximately 50 ML/year predominately associated with crushing and mining activities. Other water demand requirements include potable water. The water will be supplied via a 12 km spur line from the main water pipeline (the limestone quarry water pipeline) to a raw water dam/tank at the limestone quarry (Figure 1).

The limestone quarry will not be utilised during the Initial Production Phase as the relatively small quantities of limestone required do not justify the development of the limestone quarry. During the Initial Production Phase of the Project, limestone will be sourced from external suppliers.

2.14 Rail Siding

A rail siding will be constructed on the Tottenham to Bogan Gate Railway for the Full Production Phase of the Project and will be used to deliver consumables and product to and from the Project. The rail siding will be located approximately 25 km south-east of the mine site (Figure 1).

The rail siding will include a rail spur, container loading and unloading facilities, equipment compound, office, fuel storage, short-term container storage facilities (hardstands), access roads and security fencing. The rail level crossing on Scotsons Lane will require upgrading.

An average of six train movements per week (three trains) will be required, with a maximum of two trains per day. The trains will arrive or depart according to freight scheduling.

The rail siding will not be utilised during the Initial Production Phase as the relatively small quantities of deliveries and product transport required do not justify the development of the rail siding.

2.15 Road Upgrades and Maintenance

Condition 17, Schedule 2 of Development Consent DA 374-11-00 requires Clean TeQ to enter into VPAs with the LSC, PSC and FSC. The LSC and PSC VPAs must include provision of funding for road upgrades outlined in Appendix 3 of Development Consent DA 374-11-00.

Appendix 3 of the Development Consent DA 374-11-00 requires upgrades to the following roads prior to the commissioning of the (Figure 7):

- Fifield-Trundle Road [SR171] (between The Bogan Way [MR350] and the Parkes Shire boundary);
- Platina Road [SR64] (between the Lachlan Shire Boundary and Fifield Road [MR57]);
- Fifield Road [MR57] (between Platina Road [SR64] and Slee St [in Fifield Village]); and
- Wilmatha Road [SR34] (between Slee St [in Fifield Village] and the mine.

Appendix 3 of the Development Consent DA 374-11-00 also requires upgrades to the following intersections prior to the commissioning of the mine (Figure 7):

- The Bogan Way [MR350] / Fifield-Trundle Road [SR171];
- Platina Road [SR64] / Fifield Road [MR57];
- Fifield Road [MR57] / Slee St [in Fifield Village]; and
- Slee St [in Fifield Village] / Wilmatha Road [SR34] / Fifield Road.

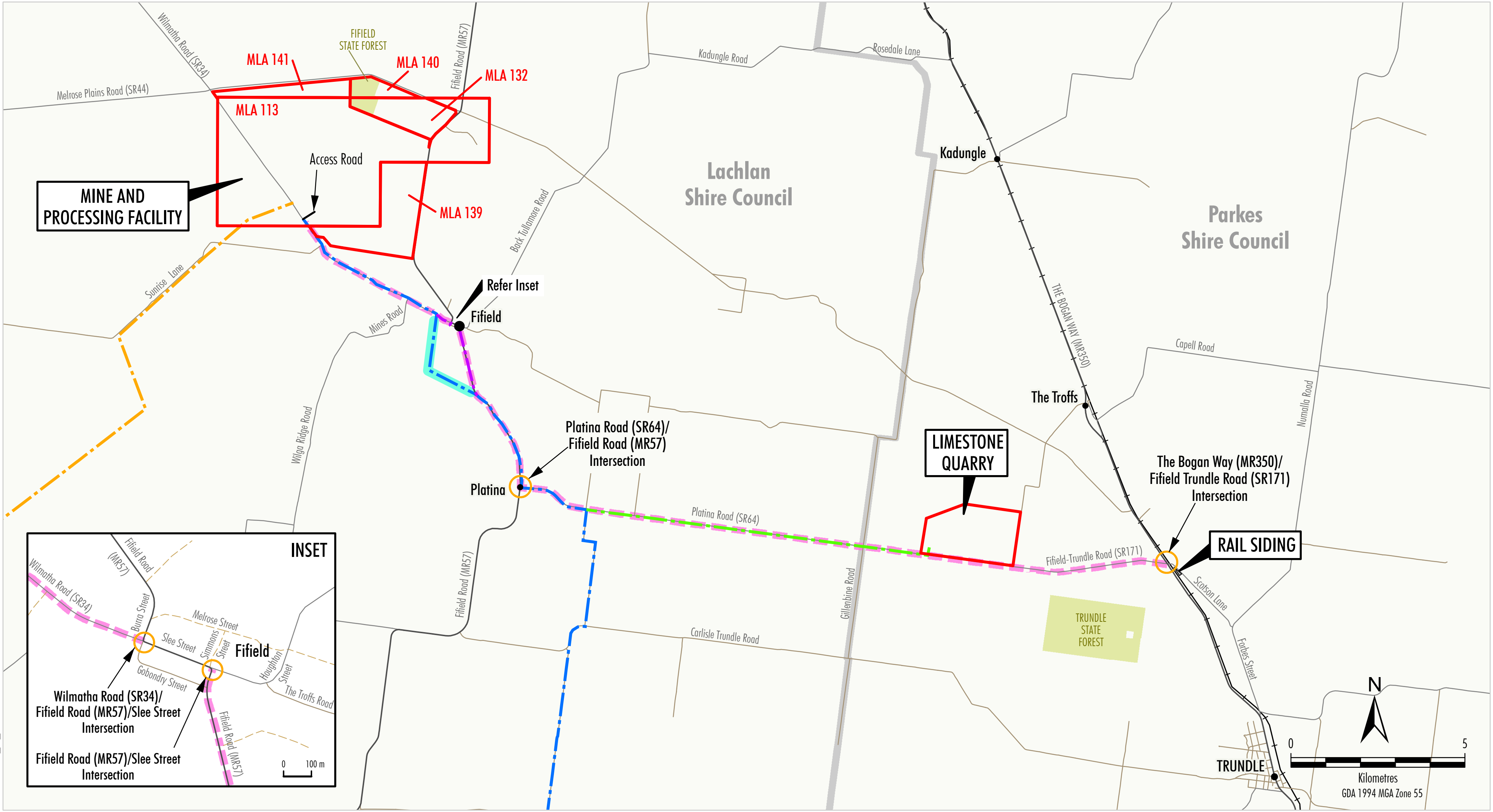
In addition, the intersection upgrades outlined in Appendix 5 of Development Consent DA 374-11-00 are required prior to commissioning of the mine:

- Henry Parkes Way (MR61) and Middle Trundle Road (SR83); and
- Henry Parkes Way (MR61) and The Bogan Way (MR350).

In accordance with the terms of the VPAs, a road safety audit will be conducted prior to the commencement of the commissioning of the limestone quarry and/or rail siding to determine appropriate road upgrade requirements for the Full Production Phase. Prior to the commissioning of the limestone quarry and/or rail siding, Clean TeQ will pay for the road upgrades identified in the road safety audit.

The LSC and PSC VPAs must also include provision of funding for road maintenance as outlined in Appendix 3 of Development Consent DA 374-11-00. Appendix 3 of the Development Consent DA 374-11-00 requires contributions to the maintenance of the following roads:

- Henry Parkes Way [MR61] (between Westlime Road [western outskirts of Parkes] and The Bogan Way [MR350]);
- Henry Parkes Way [MR61] (between Jones Lane [eastern outskirts of Condobolin] and Fifield Road [MR57]).
- Middle Trundle Road [SR83] (between Henry Parkes Way [MR61] and The Bogan Way [MR350]);
- The Bogan Way [MR350] (between Henry Parkes Way [MR61] and Fifield Trundle Road [SR171]);
- Fifield-Trundle Road [SR171] (between The Bogan Way [MR350] and the Parkes Shire boundary);
- Platina Road [SR64] (between the Lachlan Shire Boundary and Fifield Road [MR57]);
- Fifield Road (between Henry Parkes Way and Slee St [in Fifield Village]);
- Slee St [in Fifield Village] (between Fifield Road [MR57] and Wilmatha Road [SR34]);
- Wilmatha Road [SR34] (between Slee St [in Fifield Village] and the mine and processing facility access road).



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LEGEND

- State Forest
- Local Government Boundary
- Mining Lease Application Boundary
- Approved Gas Pipeline
- Approved Water Pipeline
- Approved Limestone Quarry Water Pipeline
- Approved Fifield Bypass
- Extent of Road Upgrade

Source: Black Range Minerals (2000); NSW Department of Industry (2017); NSW Land & Property Information (2017); Office of Environment and Heritage NSW (2107)

Note: The Limstone Quarry, Rail Siding, Limestone Quarry Water Supply Pipeline and Gas Pipeline would not be constructed during the Initial Production Phase.

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SYERSTON PROJECT MODIFICATION 4

Road Upgrades

Figure 7

Condition 43, Schedule 3 of Development Consent DA 374-11-00 requires the preparation of a Road Upgrade and Maintenance Strategy. The Road Upgrade and Maintenance Strategy will detail all road upgrade requirements and a program for their implementation and maintenance.

2.16 Workforce

The Project will require an average construction workforce of approximately 600 personnel (peaking at 1,000 personnel) for the Full Production Phase. The construction workforce will predominately reside in the construction camp.

During operations, an average workforce of approximately 300 personnel will be required for the Full Production Phase. It is expected that the operational workforce will reside in surrounding towns.

For the Initial Production Phase, the construction workforce will be expected to be smaller than the Full Production Phase construction workforce size at approximately 300 personnel (peak).

The operational workforce for the Initial Production Phase will be approximately 45 personnel due to the smaller-scale operation.

An operational workforce of approximately 30 and 5 personnel will be required for the limestone quarry and rail siding, respectively.

2.17 Community Enhancement Contributions

Clean TeQ will make community enhancement contributions to the LSC, PSC and FSC in accordance with Condition 17, Schedule 2 of Development Consent DA 374-11-00.

2.18 Rehabilitation

Rehabilitation objectives and principles, final landform concepts and the revegetation strategy for the Project are described in Section 5.

3 Modification Overview

A description of the Modification is provided in this section, including a comparison of the modified Project to the approved Project.

As described in Section 1.2, the Modification involves the implementation of opportunities to improve the efficiency of the Full Production Phase of the Project identified in the Project Optimisation Study. The Modification would generally not change the approved Initial Production Phase, with the exception of alterations to the Project water supply (Section 3.9).

It is noted that, depending on market conditions, the Project may move straight to the Full Production Phase rather than commencing with the Initial Production Phase.

The modified Project would include the same main project components as described in Section 2.3.

3.1 Construction Activities

There would be no change to the timing of construction activities as described in Section 2.4.

Construction activities would continue to be undertaken during the approved construction hours outlined in Condition 1, Schedule 3 of Development Consent DA 374-11-00.

3.2 General Arrangement

A description of the general arrangement of the modified mine is provided in this section. The general arrangements of the other Project components are described in Sections 3.9, 3.10, 3.12 and 3.13.

The following components of the approved mine site would be modified:

- mine infrastructure area components would be relocated to avoid potential resource sterilisation and improve operational efficiency;
- increased tailings storage facility footprint (capacity) to hold increased tailings volume due to the additional limestone required for acid neutralisation;
- reduced evaporation pond facility footprint (capacity) due to the recycling of process water;
- an explosives magazine would be constructed north of the diversion dam; and
- minor alterations would be made to on-site water management infrastructure (e.g. sediment dams, pipelines, diversions) to account for the modified layout and increased water recycle on-site.

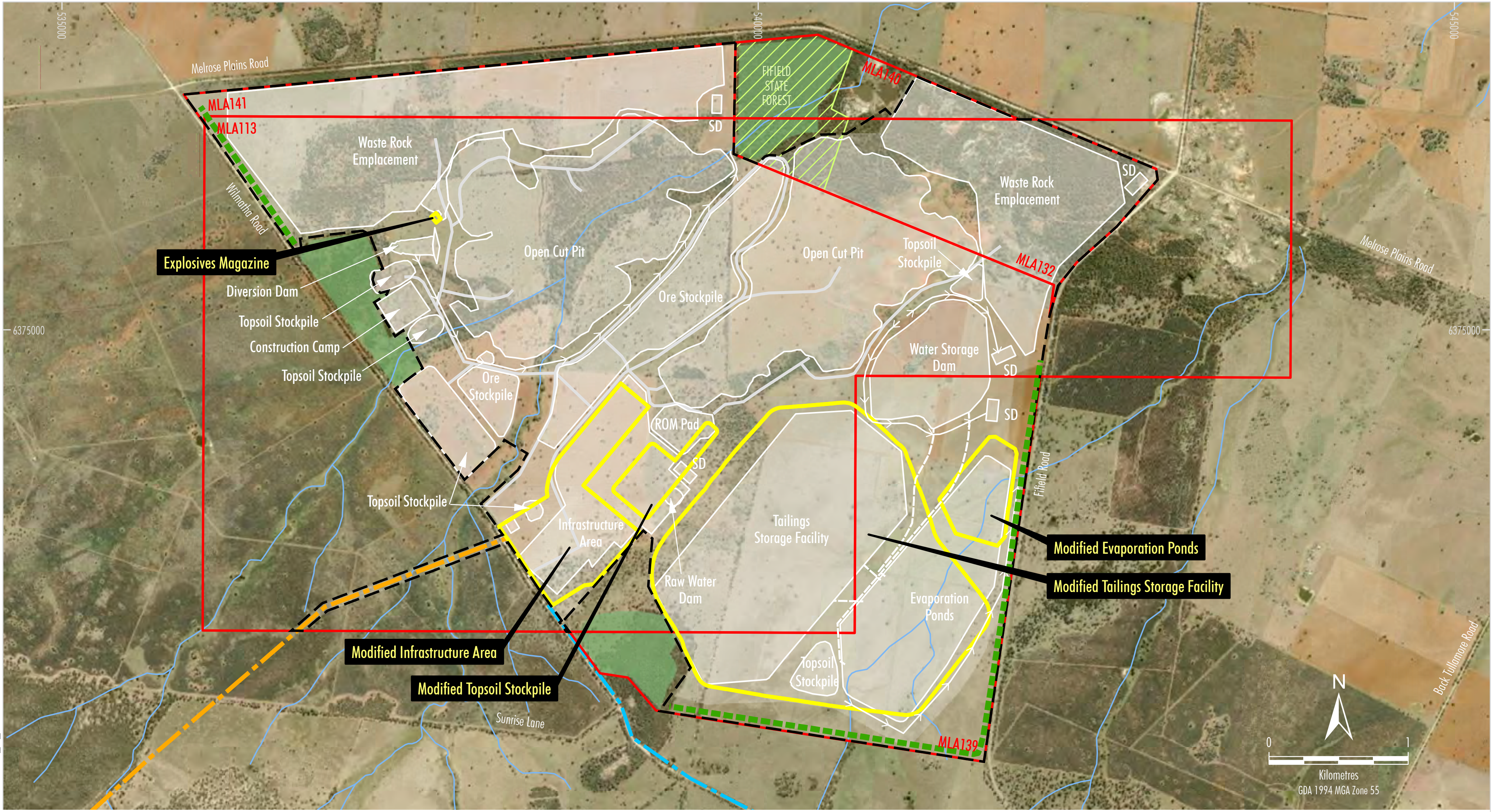
The general arrangement of the modified mine (including the processing facility) is provided on Figure 8. Progressive general arrangements of the modified mine (including the processing facility) are provided on Figures 9 to 12.

In addition to the above, gravel and clay borrow pits would be developed within the waste rock emplacement footprint as well as in the open cut pit and tailings storage facility footprints.

Clean TeQ is considering seeking separate approval for the relocation of the construction camp off the mine site. If the alternative construction camp is approved, the construction camp on the mine site would not be constructed.

3.3 Mineral Resource

The mineral resource developed as part of the Modification would remain unchanged from the approved Project (Section 2.2).



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LEGEND
- State Forest
- Mining Lease Application Boundary
- Approved Surface Development Area
- Approved Mine Footprint
- Diversion Structure
- Key Site Water Pipeline
- Approved Gas Pipeline
- Approved Water Pipeline
- Vegetation Screening
- Existing Open Woodland
- Modified Layout

Source: Black Range Minerals (2005); NSW Department of Industry (2017); NSW Land and Property Information (2017)
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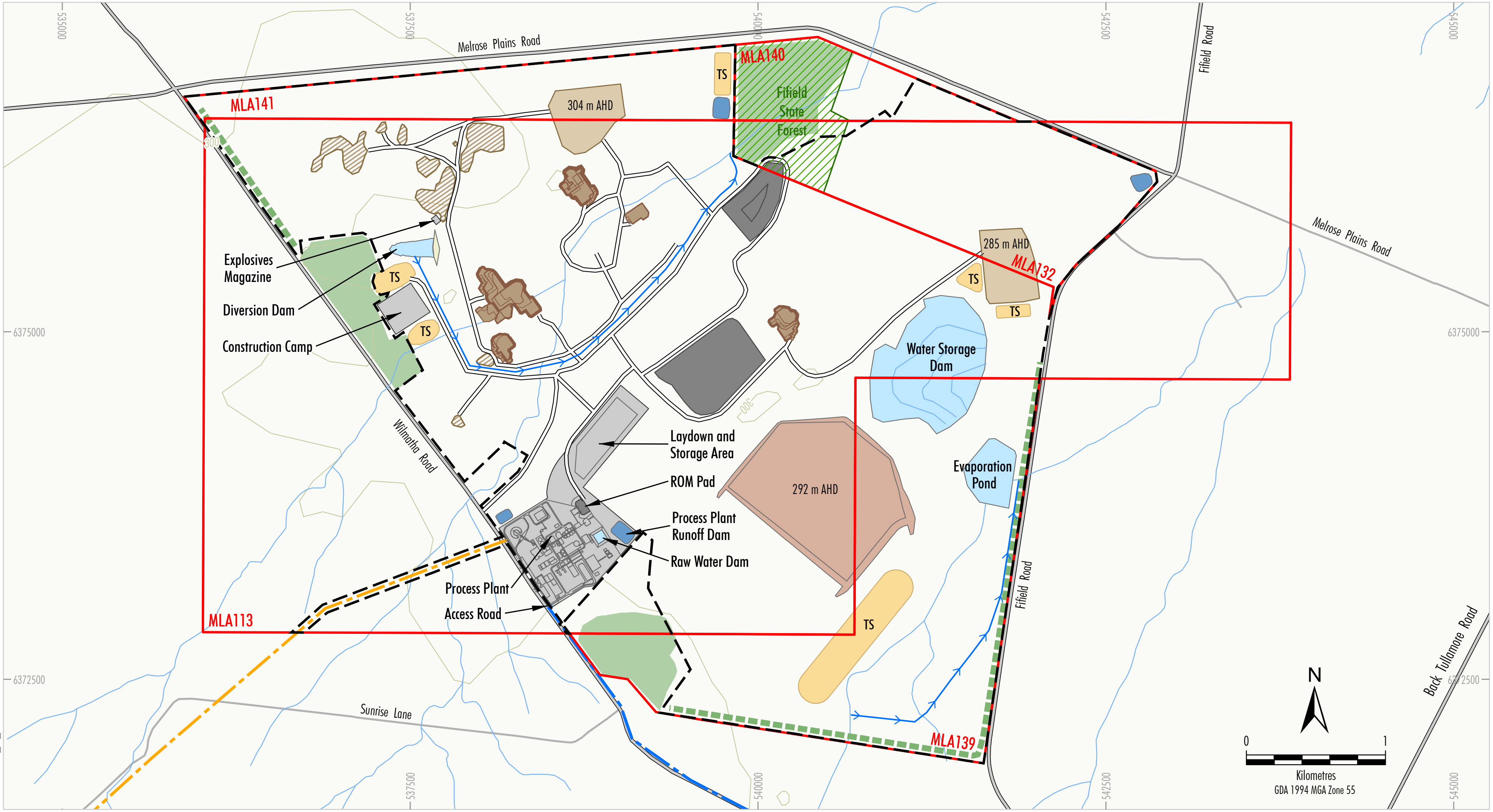
SYERSTON PROJECT MODIFICATION 4

Indicative Modified Mine and Processing Facility General Arrangement

Figure 8



LEGEND

- Mining Lease Application Boundary
- Approved Surface Development Area
- Open Cut Pit (Scandium Oxide)
- Open Cut Pit
- Waste Rock Emplacement
- Tailings Storage Facility
- TS Topsoil Stockpile
- Ore Stockpile
- Mine Infrastructure Area
- Sediment Dam
- Diversion Structure
- Gas Pipeline
- Water Pipeline
- Vegetation Screening
- Existing Open Woodland to be Maintained
- State Forest

Source: Black Range Minerals (2000); NSW Department of Industry (2017); NSW Land & Property Information (2017)

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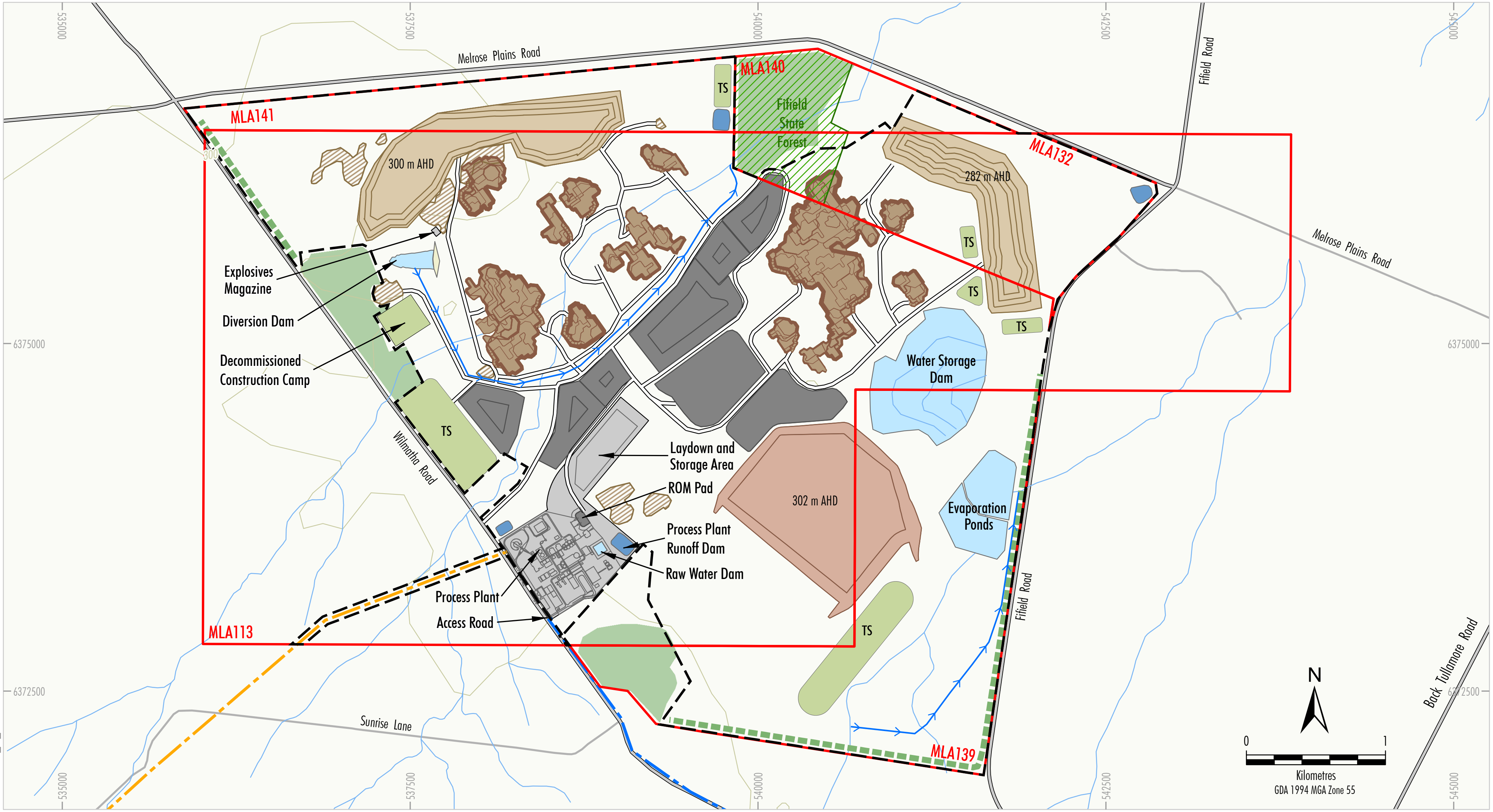
SYERSTON PROJECT MODIFICATION 4

Modified Mine and Processing Facility
Conceptual General Arrangement
Year 1

Figure 9



LEGEND

- Mining Lease Application Boundary
- Approved Surface Development Area
- Open Cut Pit (Scandium Oxide)
- Open Cut Pit
- Waste Rock Emplacement
- Tailings Storage Facility
- TS Topsoil Stockpile
- Ore Stockpile
- Mine Infrastructure Area
- Sediment Dam
- Initial Rehabilitation
- Diversion Structure
- Gas Pipeline
- Water Pipeline
- Vegetation Screening
- Existing Open Woodland to be Maintained
- State Forest

Source: Black Range Minerals (2000); NSW Department of Industry (2017); NSW Land & Property Information (2017)

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SYERSTON PROJECT MODIFICATION 4

Modified Mine and Processing Facility Conceptual General Arrangement Year 6

Figure 10

LEGEND

- Mining Lease Application Boundary
- Approved Surface Development Area
- Open Cut Pit (Scandium Oxide)
- Open Cut Pit
- Waste Rock Emplacement
- Tailings Storage Facility
- TS Topsoil Stockpile
- Ore Stockpile
- Mine Infrastructure Area
- Sediment Dam
- Initial Rehabilitation
- Intermediate/Advanced Rehabilitation
- Diversion Structure
- Gas Pipeline
- Water Pipeline
- Vegetation Screening
- Existing Open Woodland to be Maintained
- State Forest

Source: Black Range Minerals (2000); NSW Department of Industry (2017); NSW Land & Property Information (2017)

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SYERSTON PROJECT MODIFICATION 4

Modified Mine and Processing Facility Conceptual General Arrangement Year 11

Figure 11

LEGEND

- Mining Lease Application Boundary
- Approved Surface Development Area
- Open Cut Pit (Scandium Oxide)
- Open Cut Pit
- Waste Rock Emplacement
- Tailings Storage Facility
- TS Topsoil Stockpile
- Ore Stockpile
- Mine Infrastructure Area
- Sediment Dam
- Initial Rehabilitation
- Intermediate/Advanced Rehabilitation
- Diversion Structure
- Gas Pipeline
- Water Pipeline
- Vegetation Screening
- Existing Open Woodland to be Maintained
- State Forest

Source: Black Range Minerals (2000); NSW Department of Industry (2017); NSW Land & Property Information (2017)

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SYERSTON PROJECT MODIFICATION 4

Modified Mine and Processing Facility
Conceptual General Arrangement
Year 21

Figure 12

3.4 Mining Operations

3.4.1 Mining Areas

The mining areas for the modified Project would be unchanged from the approved Project (Section 2.5.1).

3.4.2 Mining Method

The mining method for the modified Project would be unchanged from the approved Project (i.e. conventional open cut mining method). Mining would however be undertaken in a more selective manner to initially increase the processing facility ore feed grade.

In addition, overburden and ore material that is not able to be easily ripped and excavated by mobile equipment would be drilled and blasted as required (Section 3.4.4)

There would also be no change to the approved mining rate (i.e. greater than 2.5 Mtpa, to allow for an autoclave feed rate of 2.5 Mtpa).There would be no change to the operating hours of the mine (i.e. 24 hours per day, seven days per week).

Waste rock management is described in Section 3.5.

3.4.3 Mobile Equipment and Supporting Equipment/Plant

Hydraulic excavators, haul trucks, dozers, graders and front end loaders would be used during mining operations.

An indicative list of the major mobile equipment that would be used for the modified Project is provided in the Noise and Blasting Assessment (Appendix B).

3.4.4 Blasting

It is proposed to drill and blast overburden and ore material that is not able to be efficiently ripped and excavated by mobile equipment. This is expected to occur in deeper parts of the open cut pits where harder siliceous material may be encountered and in the gravel borrow pits.

An ammonium nitrate based emulsion explosive would be used at an average powder factor of approximately 0.23 kilograms per bank cubic metre. Blast sizes would typically be approximately 22,500 bank cubic metres in volume.

Actual numbers of blasts in any week would be dependent on mine production and overburden/ore material properties. It is estimated, however, that an average of three blasts per week would be required when blasting is required. Blasting would only occur during daylight hours.

Prior to each blast an assessment of meteorological conditions (e.g. wind speed and direction) would be made. Blasts would be modified or delayed, where practicable, during unfavourable conditions to minimise the potential for excessive dust or blast fume migration from the site.

Explosives required for the modified Project would include initiating products and detonators, and ammonium nitrate based emulsion explosives. The explosives magazine would be located to the north of the diversion dam (Figures 9 to 12).

The explosives would be handled and used in accordance with Australian Standard (AS) 2187.2-2006 *Explosives – Storage and Use – Use of Explosives*. AS 2187.2-2006 details the requirements for transport, handling and safe storage of explosives.

3.5 Waste Rock Management

There would be no change to the quantities and geochemistry of the waste rock or the waste rock emplacement strategy for the modified Project.

3.6 Processing Facility

3.6.1 Process Description

The processing facility for the modified Project would utilise a RIP circuit for both the Initial Production Phase and Full Production Phase (i.e. the counter current decantation processing option is no longer proposed). The processing facility would therefore include the following stages (Figure 13):

- **Ore preparation circuit** – removal of oversize material and production of an ore slurry suitable for acid leaching;
- **Acid leach circuit** – leaching of nickel, cobalt and scandium from the ore slurry by application of sulphuric acid under high pressure and temperature in an autoclave to produce an autoclave slurry containing acid and soluble nickel and cobalt sulphates;
- **RIP circuit** – a two stage process that first separates scandium and then nickel and cobalt from residue solids (tailings) contained in the autoclave slurry using ion exchange resin;
- **Tailings neutralisation and thickening circuit** – neutralisation of residue solids slurry (tailings) with a limestone slurry prior to thickening and transfer to the tailings storage facility (Section 2.8); and
- **Metals recovery circuit** – recovery of:
  - scandium oxide from the loaded resin by desorption with sodium carbonate followed by precipitation and calcination; and
  - nickel and cobalt sulphates from the loaded resin by desorption with sulphuric acid followed by solvent extraction and precipitation.

The adoption of the RIP processing method would result in the elimination of the ‘Extraction Fan over Sulphide Filter Vent’, ‘Flare Stack’ and ‘Hydrogen Reformer Stack’ emission release points associated with the counter current decantation circuit (Table 3).

The processing facility would operate with an autoclave feed rate of 2.5 Mtpa to produce up to 40,000 tpa of nickel and cobalt metal equivalents, as sulphate precipitate products, and up to 180 tpa of scandium oxide.

As described in Section 3.4.2, the nickel and cobalt grade of the processing facility ore feed would initially be higher than previously assumed for the approved Project due to the proposed more selective mining method.

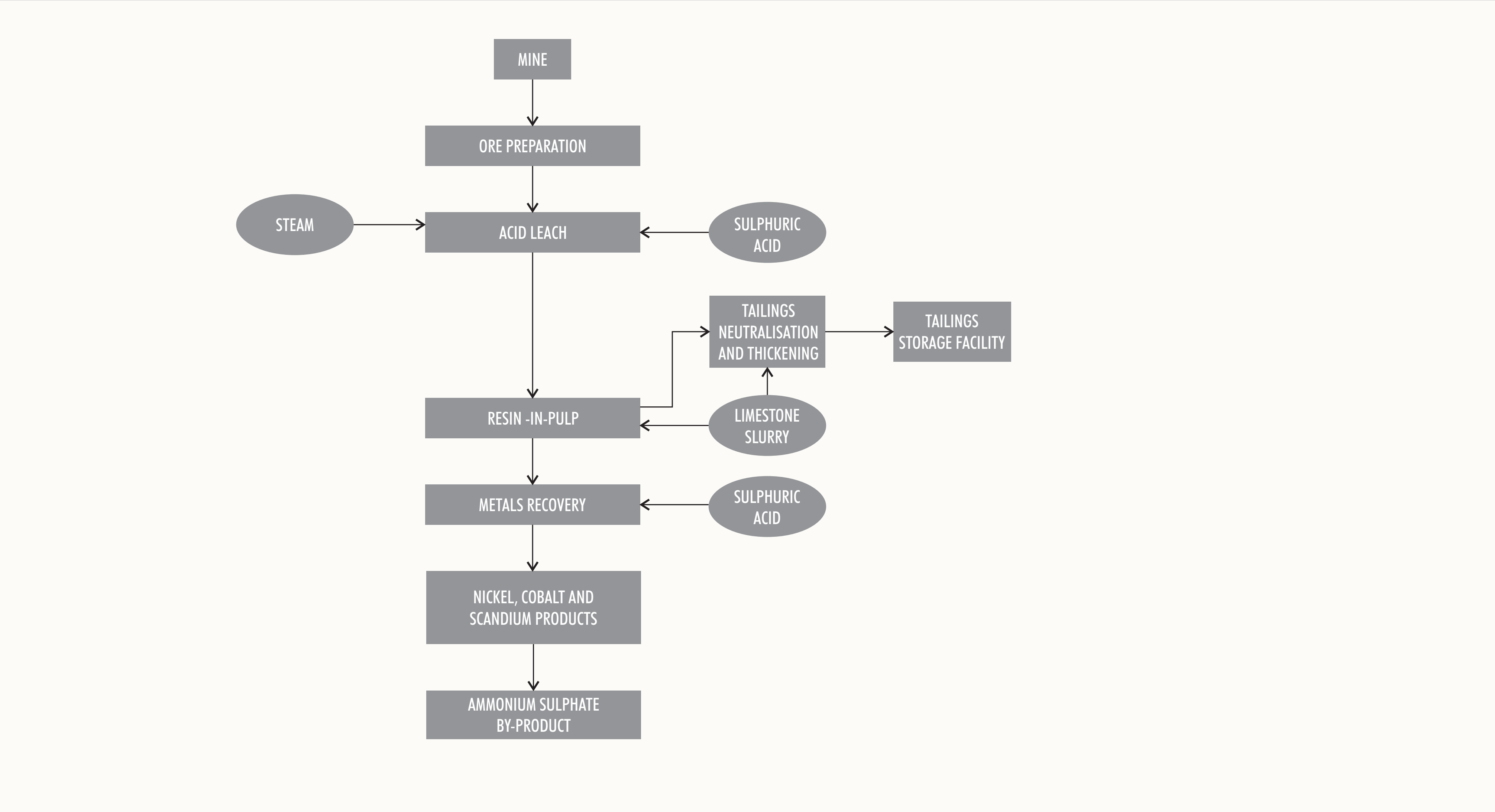
The higher grade in the processing facility feed would require a corresponding increase in sulphuric acid demand in the acid leach circuit from 700,000 tpa to 1,050,000 tpa.

The additional sulphuric acid used in the acid leach circuit would require an increase in limestone demand from 790,000 tpa to up to 990,000 tpa in the tailing neutralisation circuit (Table 3).

A crystalliser would be added to the processing facility to extract ammonium sulphate from an existing waste stream for use as a fertiliser product. Up to 100,000 tpa ammonium sulphate would be produced.

A water treatment plant would also be added to the processing facility to recycle process water and minimise make-up water demand (Section 3.8.4). The water treatment plant would produce a solid waste stream consisting primarily of manganese and magnesium hydroxides. This would be transferred to the tailings storage facility (Section 3.7.1).

A summary of the process inputs, atmospheric emissions and liquid and solid waste streams for the modified processing facility is provided in Table 3.



CTL-16-02 Mod4_EA_005A

Source: Scandium21 (2016)

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SYERSTON PROJECT MODIFICATION 4

Modified Conceptual Ore Processing Flowsheet

Figure 13

Table 3 Summary of Approved and Modified Processing Facility Process Inputs, Process Input Production, Atmospheric Emissions, Liquid Waste Streams and By-product Production

Project Component	Approved Processing Facility [1]	Modified Processing Facility
Process Input Requirements		
Sulphur	260,000 tpa	350,000 tpa
Limestone	790,000 tpa	990,000 tpa
Flocculant	1,100 tpa	820 tpa
Caustic soda	2,300 tpa	330 tpa
Sodium carbonate	10,500 tpa	7,500 tpa
Ammonia	Minor amount	26,000 tpa
Hydrochloric acid	Minor amount	17,000 tpa
Quicklime	Minor amount	40,000 tpa
Sodium metabisulphite	-	5,600 tpa
Formic acid	-	3,400 tpa
Resin, cRIP	Minor amount	720 tpa
Diluent	15,000 Lpa	190,000 Lpa
Extractant	3,000 Lpa	75,000 Lpa
Minor reagents (mill balls, coagulant, oxalic acid, hydrogen peroxide, resin [Sc cLX])	Hydrated lime, mill balls, coagulant, diatomaceous earth, hydrochloric acid	Used in ore preparation, thickening and tailings neutralisation, sulphuric acid plant, RIP circuit and water treatment plant.
Atmospheric Emissions		
Carbon Dioxide	9.35 kg/s	11.1 kg/s
Sulphuric Acid Plant Stack (H_2SO_4, SO_3 and SO_2)	19.2 Nm/s (dry, 273K, 101.3 kPa)	53.2 Nm^3/s (dry, 273K, 101.3 kPa)
Diesel Power Plant (SO_2, NO_2, CO, particulate matter)	Not quantified – start-up only	5.6 Nm^3/s (dry, 273K, 101.3 kPa)
Diesel-fired Auxiliary Boiler (SO_2, NO_2, CO, particulate matter)	Not quantified – start-up only	8.8 Nm^3/s (dry, 273K, 101.3 kPa)
Power Plant HRSG (if utilised) (NO_2 and NO)	18.4 Nm/s (dry, 273K, 101.3 kPa)	No change.
Extraction Fan over Sulphide Filter Vent (H_2S)	5.3 Nm/s (dry, 273K, 101.3 kPa)	-
Flare Stack (H_2S, SO_2, NO_2 and NO)	0.65 Nm/s (dry, 273K, 101.3 kPa)	-
Hydrogen Reformer Stack (NO_2 and NO)	1.42 Nm/s (dry, 273K, 101.3 kPa)	-
Waste Streams		
Liquid Waste Streams	Waste liquid streams associated with tailings neutralisation.	Waste liquid streams associated with tailings neutralisation.
Solid Waste Streams	-	Solid waste stream associated with water treatment plant (primarily magnesium and manganese hydroxide precipitates)
Reagent Production		
Sulphuric Acid	700,000 tpa	1,050,000 tpa
Hydrogen Sulphide	88 tpd	-
Hydrogen	5 tpd	-
By-product Production		
Ammonium sulphate	-	100,000 tpa

1 Maximum of RIP and counter current decantation circuits for the approved Project (refer Table 2).

The conceptual ore processing flowsheet for the modified Project is provided on Figure 13.

There would be no change to the hours of operation of the processing facility (i.e. 24 hours per day, seven days per week).

3.6.2 Reagent Transport

As described in Section 3.6.1, the modified processing facility would have an increased sulphuric acid and limestone demand. This would require an increase in the amount of the following reagents transported to the mine during the Full Production Phase:

- sulphur (increased from 260,000 tpa to 350,000 tpa); and
- limestone (increased from 790,000 tpa to up to 990,000 tpa).

Sulphur would be transported by rail to the rail siding and then by road to the mine site.

Up to approximately 560,000 tpa of limestone from third party suppliers would be used to supplement the limestone quarry supply. This material would have a higher neutralising capacity than limestone from the limestone quarry. The limestone would be transported from external suppliers by road. The combined maximum amount of limestone transported from the limestone quarry and third party suppliers would be 990,000 tpa.

Smaller amounts of other reagents would also continue to be transported to the mine, such as ammonia, quicklime, caustic soda and flocculent.

A summary of the modified process inputs is provided in Table 3.

Condition 42, Schedule 3 of Development Consent DA 374-11-00 requires that no heavy vehicles use The McGrane Way when travelling to or from the Project, unless otherwise agreed by the Secretary. As part of the Modification, it is proposed that heavy vehicles would use The McGrane Way to travel to and from the Project.

There would be no change to the reagent transport requirements during the Initial Production Phase.

3.6.3 On-site Reagent Production

The following reagents would continue to be manufactured at the mine:

- sulphuric acid; and
- lime slurry.

The lime slurry plant would be developed during the Initial Production Phase. The sulphuric acid plant would be developed during the Full Production Phase as the larger scale operation would then justify the manufacture of this reagent.

As described in Section 3.6.1, the amount of sulphuric acid and lime slurry produced would be increased to account for the higher grades in the processing facility feed.

As the RIP processing method would be adopted, the production of hydrogen sulphide, hydrogen and nitrogen would no longer be required.

A summary of the modified reagent production is provided in Table 3.

3.6.4 Product Storage and Transport

Product would continue to be stored in an onsite product storage area for periodic transport from the site.

Nickel and cobalt sulphate precipitates, scandium oxide and ammonium sulphate would be backloaded into sulphur trucks and transported by road to the rail siding for transport by rail.

3.7 Tailings Management

3.7.1 Tailings Storage Facility

The capacity of the tailings storage facility would be increased to hold increased tailings volume due to the additional limestone required for acid neutralisation. To increase the tailings storage facility capacity, the footprint would be increased and the construction methodology would change from upstream to downstream. The final elevation of the tailings storage facility would also slightly increase from approximately 310 metres Australian Height Datum (m AHD) to 314 m AHD.

Other components of the tailings storage facility, such as tailings delivery, underdrainage, seepage collection and decant systems would be generally unchanged. Decant water would however be pumped to the water storage dam rather than the evaporation ponds (Section 3.7.2).

Waste solids from the water treatment plant (Section 3.8.4) would be deposited in the tailings storage facility.

The design (including geotechnical stability) of the modified tailings storage facility would conform to the relevant guidelines and requirements described in Condition 29, Schedule 3 of Development Consent DA 374-11-00. This includes the requirements for permeability of liners, storage capacity and DSC design requirements (Sections 2.8.1 and 2.8.2).

The proposed layout of the modified tailings storage facility and a conceptual cross section through the modified tailings storage facility embankment are provided on Figure 14.

3.7.2 Tailings Storage Facility Water Management

The tailings storage facility would continue to only receive water inflows from the tailings slurry and incident rainfall, as the tailings storage facility would be a ‘turkeys nest’ arrangement with a fully encompassing raised perimeter embankment (Figure 14).

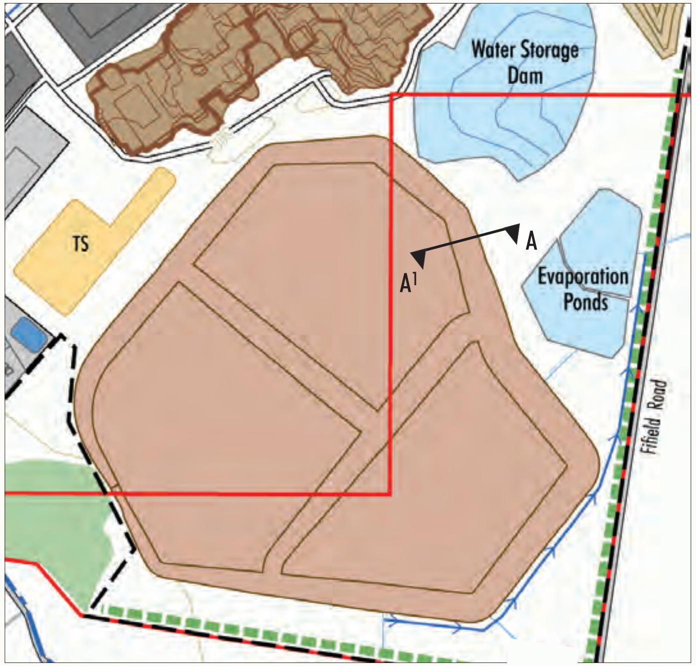
Supernatant waters (including incident rainfall) decanted from the tailings storage cells would be pumped to the water storage dam for reuse in the processing facility. Prior to reuse, a portion of the returned water would be directed to the water treatment plant at the processing facility (Section 3.8.4) for treatment.

An approved liquid waste stream from the processing facility containing high concentrations of chloride would be separated from other processing facility waste streams and pumped to the evaporation ponds. This would prevent the build-up of chloride in the process water as the water in the evaporation ponds would be evaporated rather than be recycled in the site water management system for reuse in the processing facility.

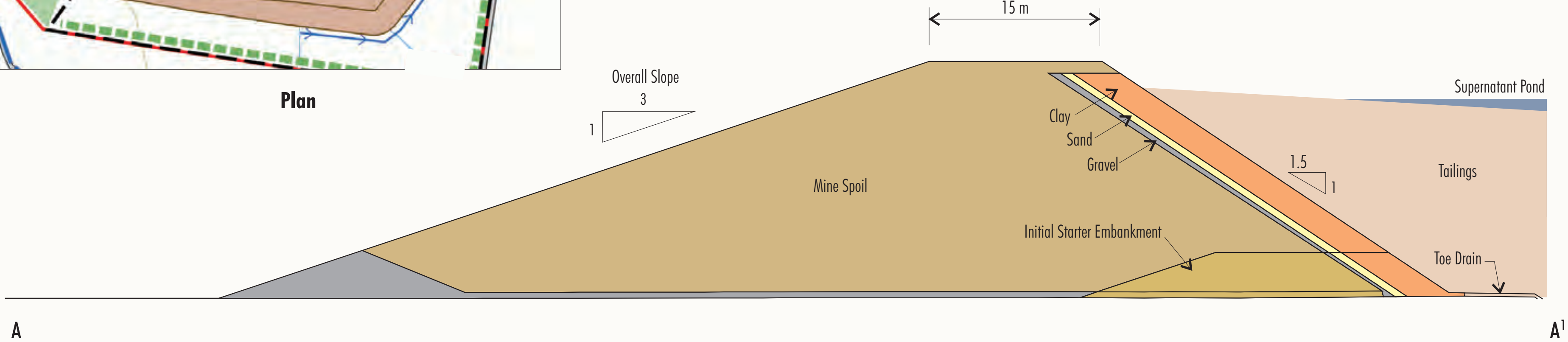
Due to the reduction in water volume reporting to the evaporation ponds, the footprint of the ponds would be reduced (Figure 8).

The tailings storage facility, water storage dam and evaporation ponds would be operated to maintain a freeboard storage in excess of that required to store the volume of runoff generated from a 1 in 100 year ARI rain event of 72 hours duration, in accordance with Condition 29, Schedule 3 of Development Consent DA 374-11-00. The decant system will be designed to remove stored water so that capacity to store a 1 in 100 year ARI rain event of 72 hours duration rain event within five days of the event occurring.

In accordance with Condition 29, Schedule 3 of Development Consent DA 374-11-00, the floor and side walls of the evaporation ponds and water storage dam would be designed to the same standard as the tailings storage facility (Section 3.7.1).



Plan



Conceptual Cross Section
Through Tailings Storage Facility Embankment

Not to Scale

CTL-16-02 Mod4_EA_006B

Source: Clean TeQ (2017)

SYERSTON PROJECT MODIFICATION 4

Modified Tailings Storage Facility Embankment Details and Conceptual Storage Cross Section

Figure 14

3.8 Mine Water Management

3.8.1 Water Demand

The main water demand (usage) for the mine site would continue to be the processing facility. Water would also continue to be required for dust suppression, cooling water and potable and non-potable uses in the mine infrastructure area.

The water treatment plant (Section 3.8.4) would reduce the estimated water demand requirements for the processing facility and increase the volumes of water returned from the tailings storage facility.

A breakdown of the revised water demand requirements is provided below.

Processing Facility

With the implementation of the water treatment plant, raw water requirements for the processing facility are expected to decrease from approximately 17.5 ML/day to approximately 8.1 ML/day, or approximately 2,960 ML/year (Appendix D).

Dust Suppression

The estimated water demand for dust control on haul roads within controlled catchments at the mine site is approximately 0.48 ML/day, or on an annualised basis, 175 ML/year.

3.8.2 Water Supply

Water for the mine site would be supplied from a number of sources during the life of the Project, including:

- internal runoff collection at the mine site (including harvestable rights);
- mine dewatering (in-pit and advance);
- return water from the tailings storage facility;
- the borefields; and
- surface water extraction from the Lachlan River.

Water would continue to be sourced primarily from the borefields (e.g. in accordance with existing WAL 32068). During construction and prior to commissioning of the water pipeline, water would be transported from the borefields to the mine site by road (Section 3.9.3).

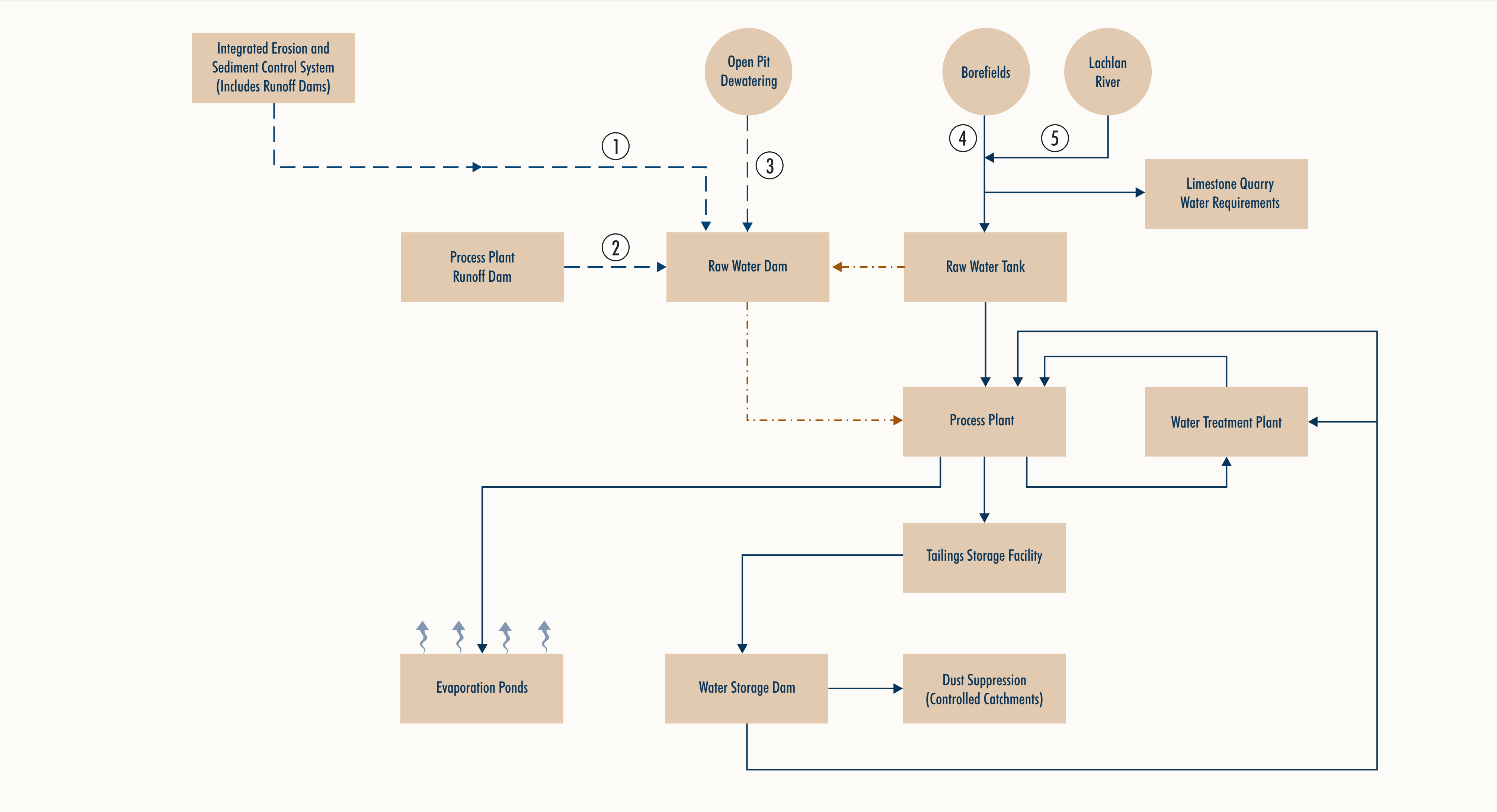
To improve the water supply security of the Project, water extracted from the borefields would be supplemented by licensed surface water extraction from the Lachlan River which is regulated by upstream releases from Wyangala Dam (Section 3.9.2).

In accordance with Condition 26, Schedule 3 of Development Consent DA 374-11-00, Clean TeQ would ensure that sufficient water is supplied for all stages of the development, and obtain the necessary water licences for the development under the *Water Management Act, 2000*, and if necessary, adjust the scale of development on-site to match its available water supply.

The modified water supply scheme layout is shown on Figure 15.

Mine Dewatering

In-pit dewatering is expected to be negligible over the life of the Project as only the deepest area of the open cut pits is predicted to intercept groundwater (Appendix D).



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LEGEND

1 Water Supply Priority

Intermittent Flow Path (rainfall dependent)

Alternative Flow Path

Evaporation

Source: Golder Associates (2017)

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Modified Water Supply Schematic

Figure 15

The predicted pit inflows during the short-term period of mining that intercepts the groundwater table is estimated to be up to approximately 0.07 ML/year in the first year of interception of the groundwater table and would reduce in the long-term to be generally less than 0.002 litres per second (L/s) (Appendix D). Sensitivity analysis (Appendix D) indicates that there is however potential for pit inflows to range up to 0.15 ML/year (in the short term).

Advance dewatering may also occur on a temporary basis in areas in the vicinity of potential groundwater interception to reduce peaks and regulate pit inflows.

Groundwater extracted by mine dewatering (in-pit and advance) from the open cut pit (and immediate surrounds) is located in the Lachlan Fold Belt Murray-Darling Basin Groundwater Source administered by the *Water Sharing Plan for the NSW Murray-Darling Basin (MDB) Fractured Rock Groundwater Sources* under the *Water Management Act, 2000*.

Clean TeQ currently holds 243 share components (currently equivalent to 243 ML/year) in the corresponding Lachlan Fold Belt Murray-Darling Basin Groundwater Source.

Internal Runoff Collection (including Harvestable Rights)

None of the main water storages proposed on-site (i.e. tailings storage facility, water storage dam, or evaporation ponds) would be used to harvest runoff from land as these storages would be used to contain mine water or effluent in accordance with best management practice (Appendix D).

A number of runoff-harvesting and in-stream (farm) dams exist on-site and in the nearby surrounding lands owned by Clean TeQ. Based on the ownership of contiguous lands at the mine site, the maximum harvestable right dam capacity is equal to approximately 105 million litres (ML) (Appendix D). Where the opportunities arise, run-off harvested on-site would be used for the Project.

Water collected from the disturbance footprint (e.g. internal haul roads and waste rock emplacements) would be temporarily contained in sediment basins. Where opportunities arise water would be recycled for dust suppression or use in the processing facility, or otherwise released in accordance with the requirements of an Environment Protection Licence (EPL) issued under Part 3 of the *Protection of the Environment Operations Act, 1997* (POEO Act) by the EPA.

Return Water from the Tailings Storage Facility

All tailings generated in the processing facility would be pumped to and stored in the tailings storage facility.

The tailings slurry would be deposited through a series of spigots located at the perimeter of the cells and a decant pond would be maintained in the centre of each cell. Decant water would be piped to the water storage dam for reuse in the processing facility.

The density of settled tailings has been used based on the results of settling tests (Appendix D), with a maximum dry density of the tailings when dewatered and compacted of approximately 1.8 tonnes per cubic metre.

A GoldSim water balance model has been used by Golder Associates Pty Ltd (Golder Associates) (Appendix D) to simulate the volumetric reliability of water supply from the tailings storage facility return water (including that stored in the water storage dam). The analysis was undertaken for three (3) rainfall scenarios based on the SILO rainfall data record:

- **dry** (cumulative driest sequential 20 years or rainfall data);
- **average** (average sequential 20 years of rainfall data); and
- **wet** (wettest sequential 20 years of rainfall data).

The modelling results indicate that in all scenarios (and with the exception of the short start-up period), the recycled water supply (direct and treated) was able to reliably supply approximately 4 ML/day, or on an annualised basis, 1,451 ML/year.

Borefields

The borefields (Section 3.9.1) would extract groundwater from within Zone 5 of the Upper Lachlan Alluvial Groundwater Source which is administered by the *Water Sharing Plan for the Lachlan Unregulated and Alluvial Water Sources, 2012* under the *Water Management Act, 2000*.

Groundwater investigations and supply feasibility assessments by Coffey Geosciences (2000) indicated that the borefields could maintain a supply of up to approximately 17 ML/day (6,300 ML/year) for a 30 year period (subject to obtaining relevant WALs).

Clean TeQ currently holds 3,154 share components (currently equivalent to 3,154 ML/year) in the corresponding Upper Lachlan Alluvial Groundwater Source.

Lachlan River Surface Water Extraction

To increase water supply security for the Project, Clean TeQ would seek to purchase volumetric allocations from the Lachlan River to allow for licensed surface water extraction and conveyance via the adjacent water pipeline to the mine site.

For the purposes of assessment, Clean TeQ is seeking approval for up to approximately 350 ML/year surface water extraction from the Lachlan River. When compared to the total share components of general security access licences traded since 1 July 2016, this is less than 1% based on an Available Water Determination (AWD) of 1. If the volume per unit of access licence share component was as low as 0.02 (based on previous AWD orders), then this volume would be approximately half of the total volumetric allocation of general security access licences traded since 1 July 2016, and is unlikely to be available to Clean TeQ on the trading market, and consequently groundwater use in accordance with the existing (and/or future) WAL would be preferentially utilised for make-up raw water supply during such times

It is however noted, that if opportunities were to arise (e.g. during wet climate scenarios) to obtain additional access licences for surface water extraction beyond 350 ML/year, Clean TeQ would obtain the necessary water licences in accordance with Condition 26, Schedule 3 of Development Consent DA 374-11-00. This would have a potential additional benefit to then reduce the volumetric allocations required to be obtained in the Upper Lachlan Alluvial Groundwater Source.

An application would therefore be made by Clean TeQ for a new specific purpose WAL or zero share component WAL (for subsequent trading of water on the open market). Further details, including the availability of water on the trading market in the Lachlan River Regulated River Source, are provided in Section 4.8.1.

More detail on the surface water extraction infrastructure is provided in Section 3.9.2.

3.8.3 Site Water Management

The site water management system for the modified Project would be generally unchanged. The southern diversion alignment would be revised to reflect the modified tailings storage facility and evaporation ponds (Figures 9 to 12).

3.8.4 Water Treatment Plant

The water treatment plant would allow greater volumes of process water to be recycled and re-used in the processing facility.

Process water would first be treated in a high-density sludge (HDS) process to remove magnesium and manganese. This would involve using lime to raise the pH sufficiently to precipitate magnesium and manganese. The precipitate solids would be concentrated in a thickener and transferred to the tailings storage facility.

Process water treated in the HDS process would then be advanced to an ammonia membrane. The microporous membrane uses sulphuric acid to strip gaseous ammonia from the process water. This creates a by-product of ammonium sulphate which would be combined with the ammonium sulphate produced elsewhere in the processing facility (Section 3.6.1).

Finally, the process water proceeds to an ion exchange process, which uses two circuits to remove calcium, magnesium, sulphate and other impurities from the process water via a resin. The resin would be washed with sulphuric acid and lime respectively for each circuit and recycled back to the start of the ion exchange process. The wash liquors would be recycled back to the HDS process, eliminating any waste streams.

The treated process water would then be transferred to the processing facility to supplement the raw water supply.

3.9 Borefields and Water Pipeline

3.9.1 Borefields

There would be no change to the location of the existing/approved bores in the borefields for the modified Project. However, the transfer station location would be relocated approximately 300 m to the north-west. The relocation of the transfer station would require the realignment of the associated borefield infrastructure corridor, transfer station access road and water pipeline.

The layout of the modified transfer station once the water pipeline has been commissioned is shown on Figure 16.

3.9.2 Surface Water Extraction from the Lachlan River

To improve the water supply security of the Project, it is proposed to diversify supply sources by including licensed extraction of surface water from the Lachlan River which is regulated by upstream releases from Wyangala Dam.

A pump station would be constructed near the Lachlan River to extract surface water and pump it to the borefield transfer station for transfer to the mine site. The pump station would be connected to the transfer station via a surface water infrastructure corridor that would include a linking pipeline (underground), access road and electricity transmission line. The pump station and surface water infrastructure corridor are collectively known as the surface water extraction infrastructure.

The pump station at the Lachlan River and all associated infrastructure would be constructed to be at an elevation higher than the 1 in 25 year flood event (Golder Associates, 2017a).

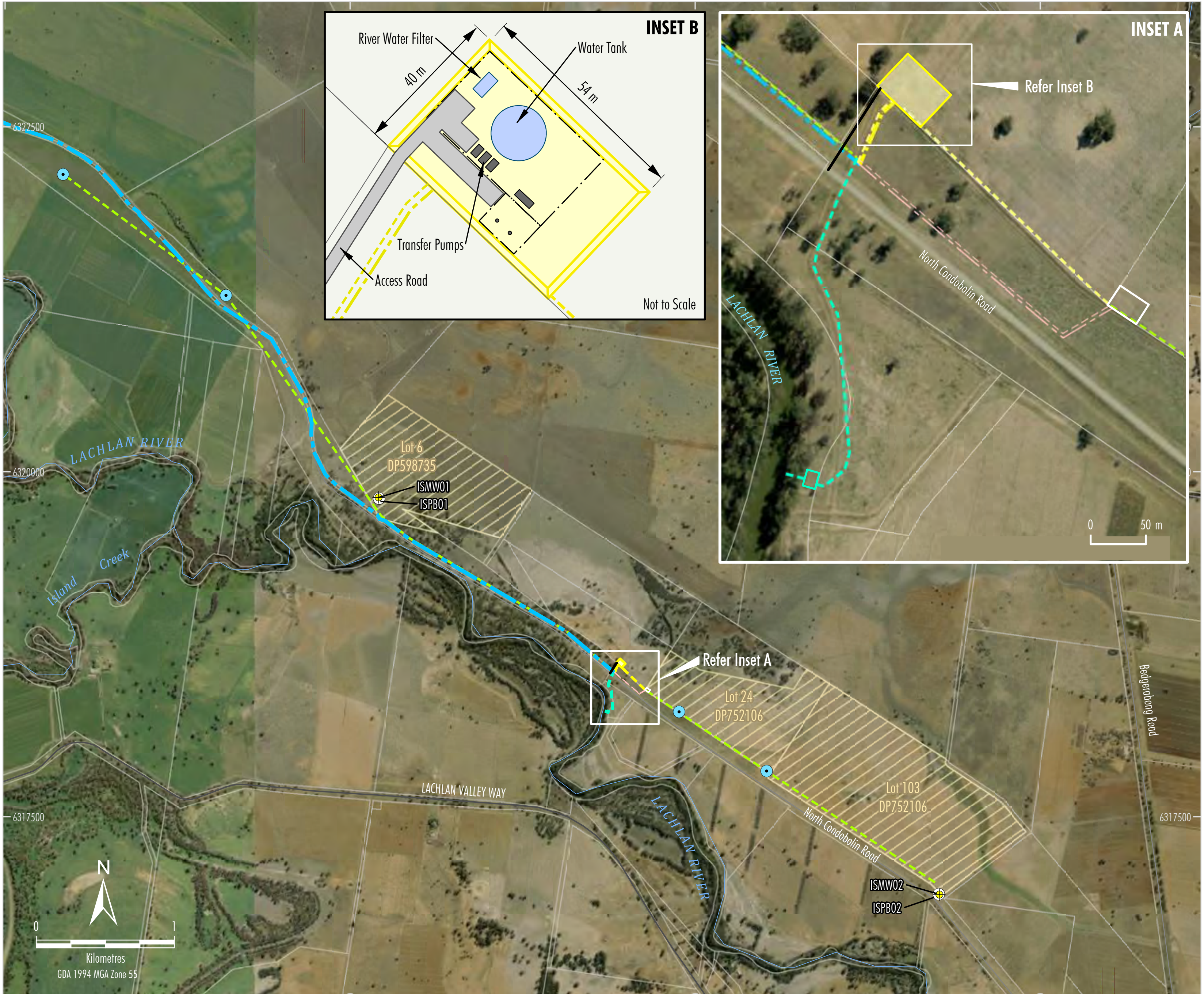
The indicative location of the surface water extraction infrastructure is shown on Figures 16 and 17. The conceptual design of the pump station is shown on Figure 18.

Construction of the pump station would necessitate clearance of understorey and groundcover within River Red Gum Woodland adjacent to the Lachlan River. The proposed pump station has been sited specifically in a location where no mature River Red Gums (i.e. trees old enough to flower) would be cleared. The alignment of the surface water extraction infrastructure corridor would be finalised during detailed design of the Project, however it would not involve the disturbance of any mature River Red Gums (Section 4.12.2).

Relevant water licences to allow for the extraction of surface water from the Lachlan River would be obtained, as described in Section 3.8.2.

3.9.3 Water Supply Prior to the Pipeline Commissioning

During construction and prior to the commissioning of the water pipeline (approximately 6 months), water would be transported from the borefields to the mine site by road.



LEGEND

Property Boundary

Approved Project

Transfer Station

Water Pipeline

Borefield Infrastructure Corridor *

Potential Borefield Location

Approximate Location of Production Bore (not constructed)

Production Bore (constructed)

Monitoring Bore

Modified Project

Transfer Station

Pump Station

Access Road

Water Pipeline

Borefield Infrastructure Corridor *

Surface Water Infrastructure Corridor *

Approved Water Pipeline Section no longer required

Approved Borefield Infrastructure Corridor section no longer required

* Infrastructure Corridor includes linking pipline, access road and electricity transmission line.

Source: NSW Land & Property Information (2017); Ivanplats Syerston (2005)

NSW Imagery: © Department of Finance, Services & Innovation (2017)

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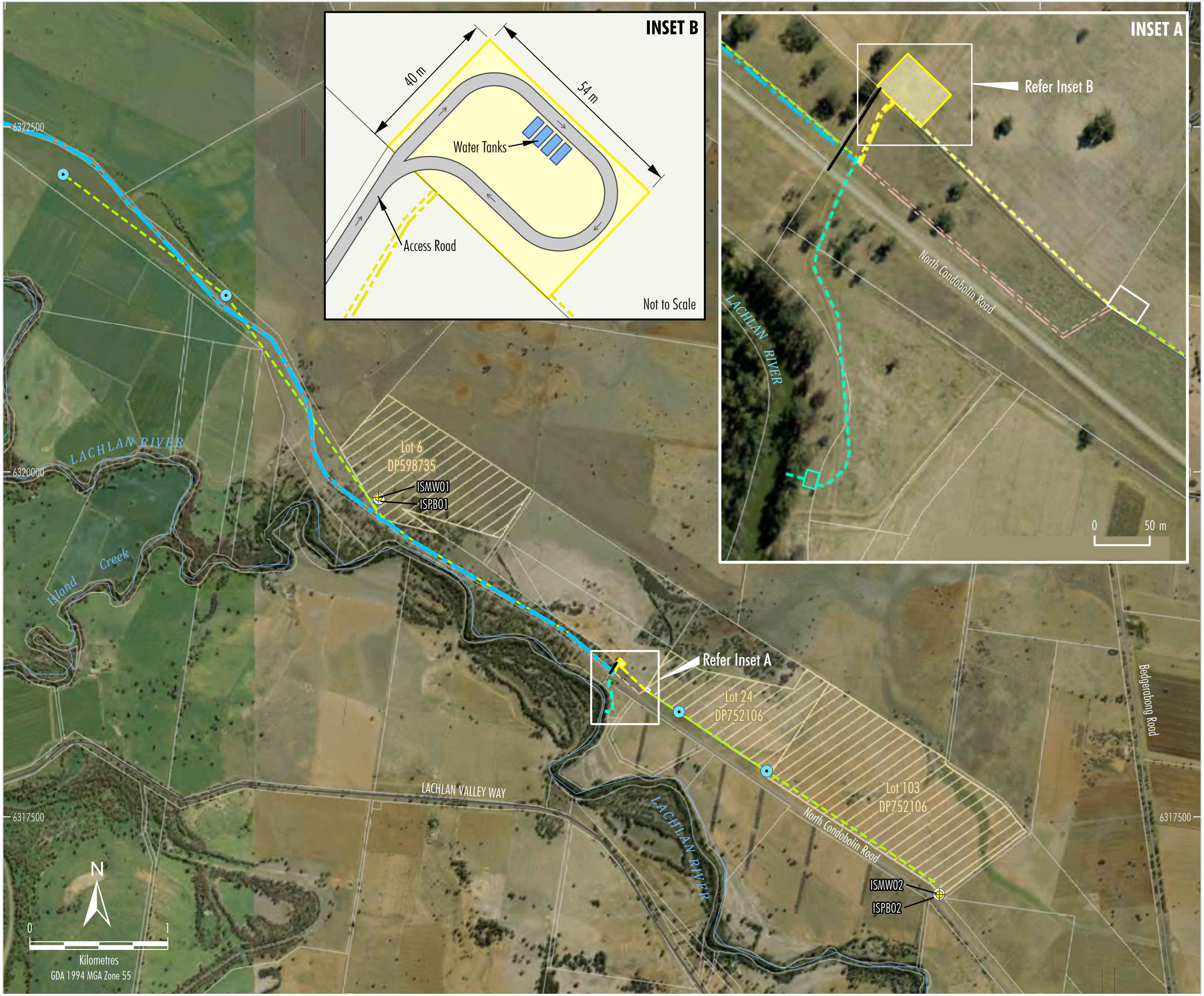
Modified Borefields and Surface Water Extraction - Post Water Pipeline Commissioning

Figure 16

CTL-16-02 Mod4_EA_207D



LEGEND

Property Boundary

Approved Project

Transfer Station

Water Pipeline

Borefield Infrastructure Corridor *

Potential Borefield Location

Approximate Location of Production Bore (not constructed)

Production Bore (constructed)

Monitoring Bore

Modified Project

Transfer Station

Pump Station

Access Road

Water Pipeline

Borefield Infrastructure Corridor *

Surface Water Infrastructure Corridor *

Approved Water Pipeline Section no longer required

Approved Borefield Infrastructure Corridor section no longer required

* Infrastructure Corridor includes linking pipline, access road and electricity transmission line.

Source: NSW Land & Property Information (2016); Ivanplats Syerston (2005)

NSW Imagery: © Department of Finance, Services & Innovation (2017)

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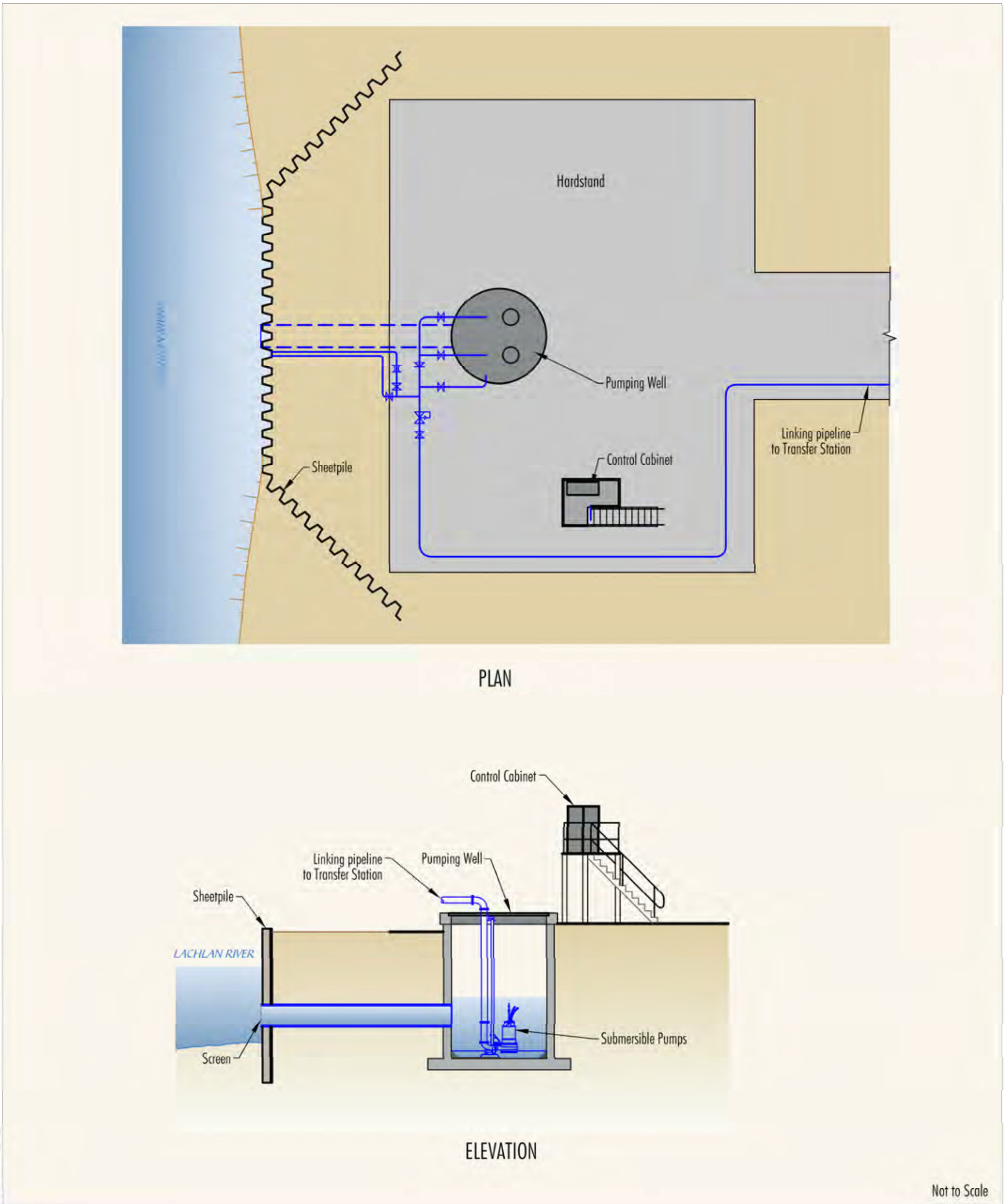
SYERSTON PROJECT MODIFICATION 4

Modified Borefields and Surface Water Extraction - Pre Water Pipeline Commissioning

Figure 17

CTL-16-02 Mod4_EA_208C



Source: Clean TeQ (2017)

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Surface Water Extraction Layout

Figure 18

During this period, the layout of the transfer station would include water tanks, a truck filling pump and a turning circle to allow water trucks to enter and leave the transfer station easily. The layout of the modified transfer station prior to commissioning of the water pipeline is shown on Figure 17.

The proposed short-term construction phase water transport route from the borefields to the mine site is shown on Figure 19. Clean TeQ would continue to consult with the FSC and the final short-term construction phase water transport route would be determined in consultation with the FSC.

3.9.4 Water Pipeline

As described in Section 2.15, a road safety audit would be conducted to determine if the Fifield Bypass is required for the Full Production Phase of the Project. If the road safety audit determines that the approved Fifield Bypass is not required, an alternative transport route may be selected. In the event this occurs, the approved water pipeline alignment may be modified to follow existing road reserves rather than following the alignment of the approved Fifield Bypass (Figure 20). The alternative water pipeline alignment is referred to as the water pipeline alignment option.

The capacity of the water reticulation system (i.e. 17.5 ML/day) would be unchanged.

3.10 Power Generation and Gas Pipeline

3.10.1 Power Generation

The Modification would not change the approved on-site power plant.

Given the proposed increase in sulphuric acid production (Section 3.6.3), there is potential for the modified sulphuric acid plant to produce sufficient steam to power the co-generation plant and meet the power requirements of the mine site. If this was to occur, there would be no need for the external gas supply to generate steam and therefore the gas pipeline would not be constructed.

In the event the gas pipeline is no longer justified, the power generation capacity of the diesel generators would be increased as they would be required to power the mine site when the sulphuric acid plant is not operating (e.g. shut down) and is therefore not generating steam.

Clean TeQ is separately considering importing electricity to the mine via an electricity transmission line to supplement on-site generation. An electricity transmission line would also allow for the export of surplus energy generated at the mine. This electricity transmission line will be subject to separate environmental assessment and approval.

3.10.2 Gas Pipeline

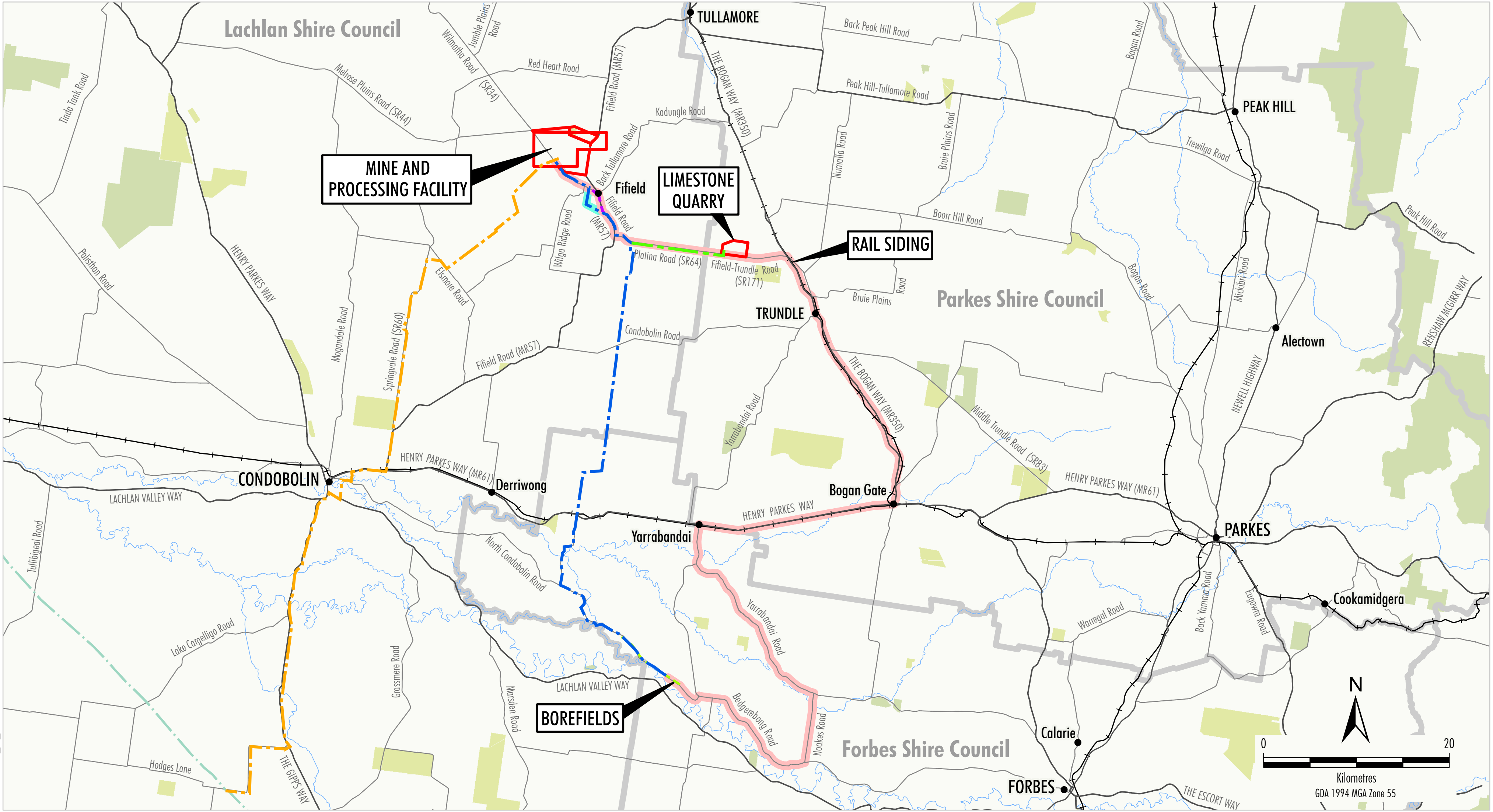
The Modification would not change the approved gas pipeline.

As described in Section 3.10.1, if the modified sulphuric acid plant is able to produce sufficient steam to power the co-generation plant and meet the power requirements of the mine site, there would be no need for the external gas supply to generate steam and therefore the gas pipeline would not be constructed.

3.11 Construction Camp

The Modification would not change the approved construction camp.

In accordance with Condition 47, Schedule 3 of Development Consent DA 374-11-00, Clean TeQ would prepare a final layout and location of the construction camp in consultation with the LSC.



LEGEND

- National Park/Conservation Area
- State Forest
- Local Government Boundary
- Existing Gas Pipeline
- Mining Lease Application Boundary
- Approved Supply Pipeline
- Approved Limestone Quarry Supply Pipeline
- Approved Gas Pipeline
- Approved Linking Pipeline
- Modified Water Pipeline Alignment Option
- Approved Fifield Bypass
- Water Transport Route

Source: Black Range Minerals (2000); NSW Department of Industry (2017); NSW Land & Property Information (2017); Office of Environment and Heritage NSW (2017)

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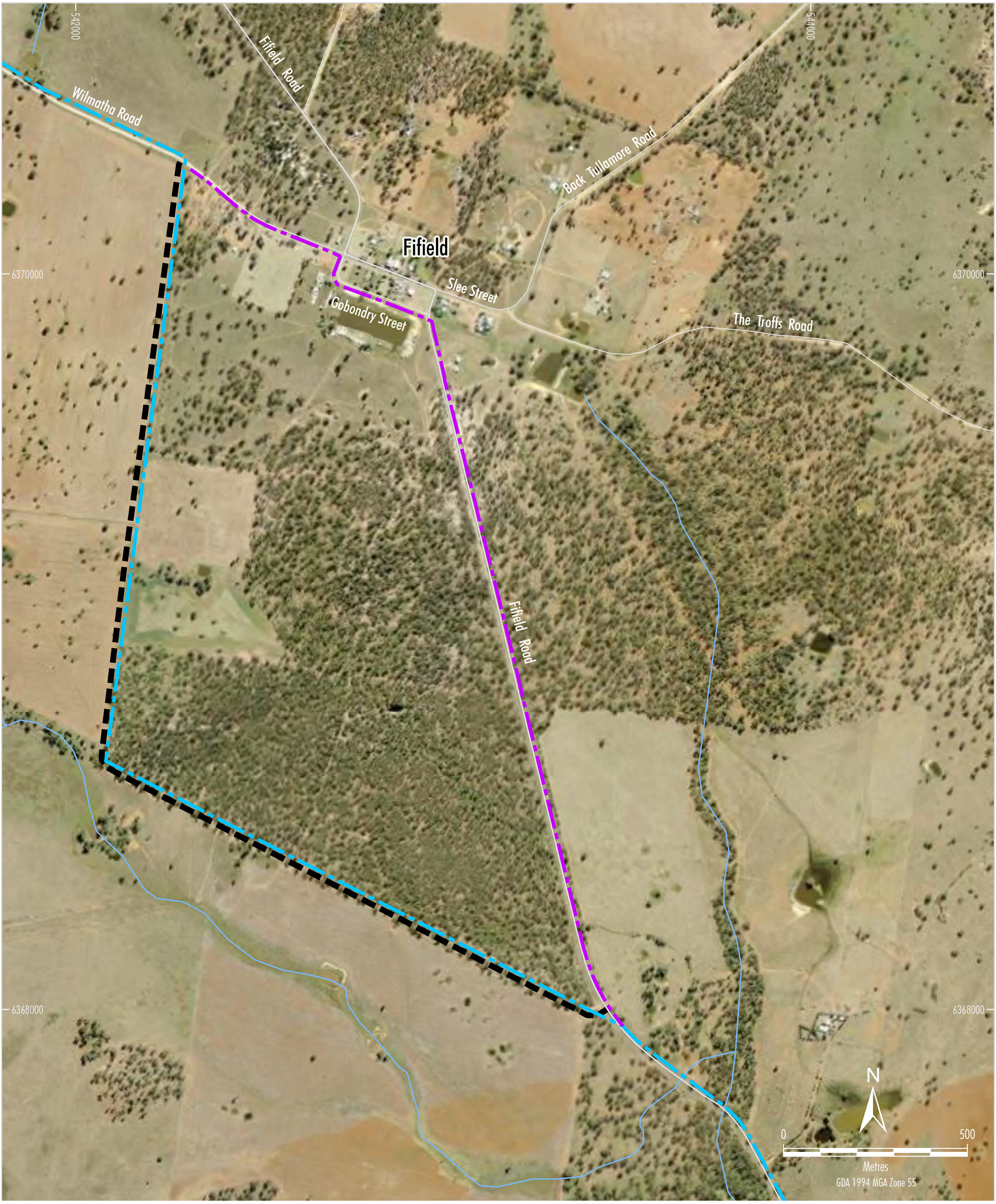
Short Term Construction Phase
Water Transport Route

Figure 19



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LEGEND
Approved Fifield Bypass
Approved Water Pipeline
Modified Water Pipeline Alignment Option

Source: Black Range Minerals (2000); NSW Land & Property Information (2017)
NSW Imagery: © Department of Finance, Services & Innovation (2017)

SYERSTON PROJECT MODIFICATION 4

Modified Water Pipeline Alignment Option

Figure 20

Clean TeQ is separately considering relocating the construction camp off-site on the Sunrise property. This relocation of the construction camp will be subject to separate environmental assessment and approval. If the construction camp relocation is approved, the construction camp on the mine site would not be constructed.

3.12 Limestone Quarry

There would be no change to the approved limestone quarry for the modified Project.

3.13 Rail Siding

There would be no change to the approved rail siding for the modified Project.

3.14 Road Upgrades and Maintenance

The road upgrades and maintenance requirements for the approved Project are outlined in Development Consent DA 374-11-00 and are described in Section 2.15.

The Modification would not change the approved road upgrade requirements. It is however proposed to amend the roads included in the road safety audit to better reflect the key routes to be used by the Project. These changes are detailed in Appendix E.

As part of the road safety audits, the need for upgrading of street lighting and pedestrian facilities on Slee Street in Fifield would be reviewed, and upgrades undertaken as required.

It is proposed to expand the road maintenance requirements based on the recommendations of the Road Transport Assessment (Appendix E) to reflect the proposed limited heavy vehicle use of The McGrane Way (Section 3.6.2). Clean TeQ would contribute to the maintenance of the following additional sections of road:

- Fifield Road [MR 57] (between Slee St [in Fifield Village] and The Bogan Way [MR350]);
- The Bogan Way [MR350] (between Fifield Road [MR57] and The McGrane Way [MR354]); and
- The McGrane Way [MR354] (between The Bogan Way [MR350] and the Parkes Shire Boundary).

Clean TeQ has consulted with the relevant councils regarding the proposed changes to the road safety audit and road maintenance requirements as part of VPA negotiations (Section 1.3).

In addition to the above, Clean TeQ would contribute to the maintenance of the proposed water transport route (Figure 19) south of the Henry Parkes Way including North Condobolin Road (approximately 8 km), Bedgerabong Road (approximately 15 km), Noakes Road (approximately 7 km) and Yarrabandai Road (approximately 24 km) (the other sections of the proposed water transport route are addressed above) during the short-term road transport of water from the borefield to the mine site. As noted in Section 3.9.3, Clean TeQ would continue to consult with the FSC and the final short-term construction phase water transport route would be determined in consultation with the FSC.

It is proposed that prior to the recommencement of construction of the Project, Clean TeQ would commission a condition assessment of this section of the proposed water transport route in consultation with the FSC. A follow-up condition assessment would be undertaken in consultation with the FSC after the water transport has ceased to identify sections of the road requiring maintenance works as a result of the short-term road transport of water. Clean TeQ would then undertake these required maintenance works in consultation with the FSC.

3.15 Workforce

The Modification would not change the approved construction or operational workforce.

3.16 Community Enhancement Contributions

Clean TeQ would make community enhancement contributions to the LSC, PSC and FSC in accordance with Condition 17, Schedule 2 of Development Consent DA 374-11-00.

3.17 Rehabilitation

Rehabilitation objectives and principles, final landform and land use concepts and the revegetation strategy for the modified Project are described in Section 5.

4 Environmental Review

4.1 Identification of Key Issues

The Modification would include changes to the mine (including the processing facility) and the borefields and water pipeline. No changes to any aspects of the approved limestone quarry, rail siding or gas pipeline are proposed as part of the Modification.

Clean TeQ has undertaken a review of the potential environmental impacts of the Modification to identify key potential environmental issues requiring assessment.

The key environmental issues identified are summarised in Table 4 and addressed in Sections 4.2 to 4.13 and the relevant appendices in the EA.

Table 4 Summary of Key Potential Environmental Issues

Environmental Aspect	Key Potential Environmental Issue/Impact	EA Section/Appendix
Land and Agricultural Resources	Additional surface development areas required for the: • minor changes to borefields layout (Section 3.9.1); • new surface water extraction infrastructure (Section 3.9.2); and • new water pipeline alignment option (Section 3.9.4).	Section 4.2
Air Quality, Noise and Vibration	Changes to mine operations, including: • changes to the mine site layout (Section 3.2); • addition of drilling and blasting at the mine (Section 3.4.4); and • changes to the processing facility (Section 3.6).	Sections 4.3 to 4.5 and Appendices A and B
Hazard and Risk	Changes to the processing facility (e.g. increased sulphuric acid production, increased limestone demand, addition of a crystalliser to produce ammonium sulphate) (Section 3.6).	Section 4.6 and Appendix C
Groundwater	Changes to tailings storage facility layout and management (Section 3.7).	Section 4.7 and Appendix D
Surface Water	Changes to mine operations, including: • changes to the mine site layout (Section 3.2); • addition of a water treatment plant to the processing facility to recycle process water and minimise make-up water demand (Section 3.8.4); and • addition of licensed surface water extraction from the Lachlan River to improve water supply security (Section 3.8.2).	Section 4.8 and Appendix D
Road Transport	Changes to road transport requirements due to: • process input and product road transport requirements (Section 3.6); • limited heavy vehicle use of The McGrane Way (Section 3.6.2); and • the short-term road transport of water from the borefield to the mine site during the construction phase (Section 3.9.3).	Section 4.9 and Appendix E
Aboriginal Cultural Heritage and Historic Heritage	Additional surface development areas required for the: • minor changes to borefields layout (Section 3.9.1); • new surface water extraction infrastructure (Section 3.9.2); and • new water pipeline alignment option (Section 3.9.4).	Sections 4.10 and 4.11 and Appendix F

Table 4 Summary of Key Potential Environmental Issues (Continued)

Environmental Aspect	Key Potential Environmental Issue/Impact	EA Section/Appendix
Biodiversity	Additional surface development areas required for the: • minor changes to borefields layout (Section 3.9.1); • new surface water extraction infrastructure (Section 3.9.2); and • new water pipeline alignment option (Section 3.9.4).	Section 4.12 and Appendices G and H
Visual	Changes to the mine site layout, including (Section 3.2): • increased tailings storage facility footprint; • reduced evaporation pond footprint; and • relocation of mine infrastructure.	Section 4.13
Community Infrastructure	As the Modification would not result in any additional demand for employees (Section 3.16), no material alteration to the approved population and community infrastructure demand is expected as a result of the Modification.	-

4.2 Land and Agricultural Resources

As described in Section 4.1, the potential land and agricultural resource impacts associated with the Modification would be related to additional surface development areas required for the surface water extraction infrastructure, the modified borefields layout and the water pipeline alignment option (Section 3.9).

The Modification would not change the approved land and agricultural resource impacts at the other Project components and therefore these Project components have not been considered any further in this section.

4.2.1 Existing Environment

Land Use

Existing land use in the vicinity of the Project is generally characterised by agricultural land uses.

Land use at the new surface water pump station and modified borefield transfer station (Figure 16) includes agriculture and road reserve. Agricultural land uses include dryland cropping (principally grain production).

The water pipeline alignment option (Figure 20) would follow existing road reserves. Land adjacent to the road is characterised by agricultural land, vegetated areas and the village of Fifield.

Soils

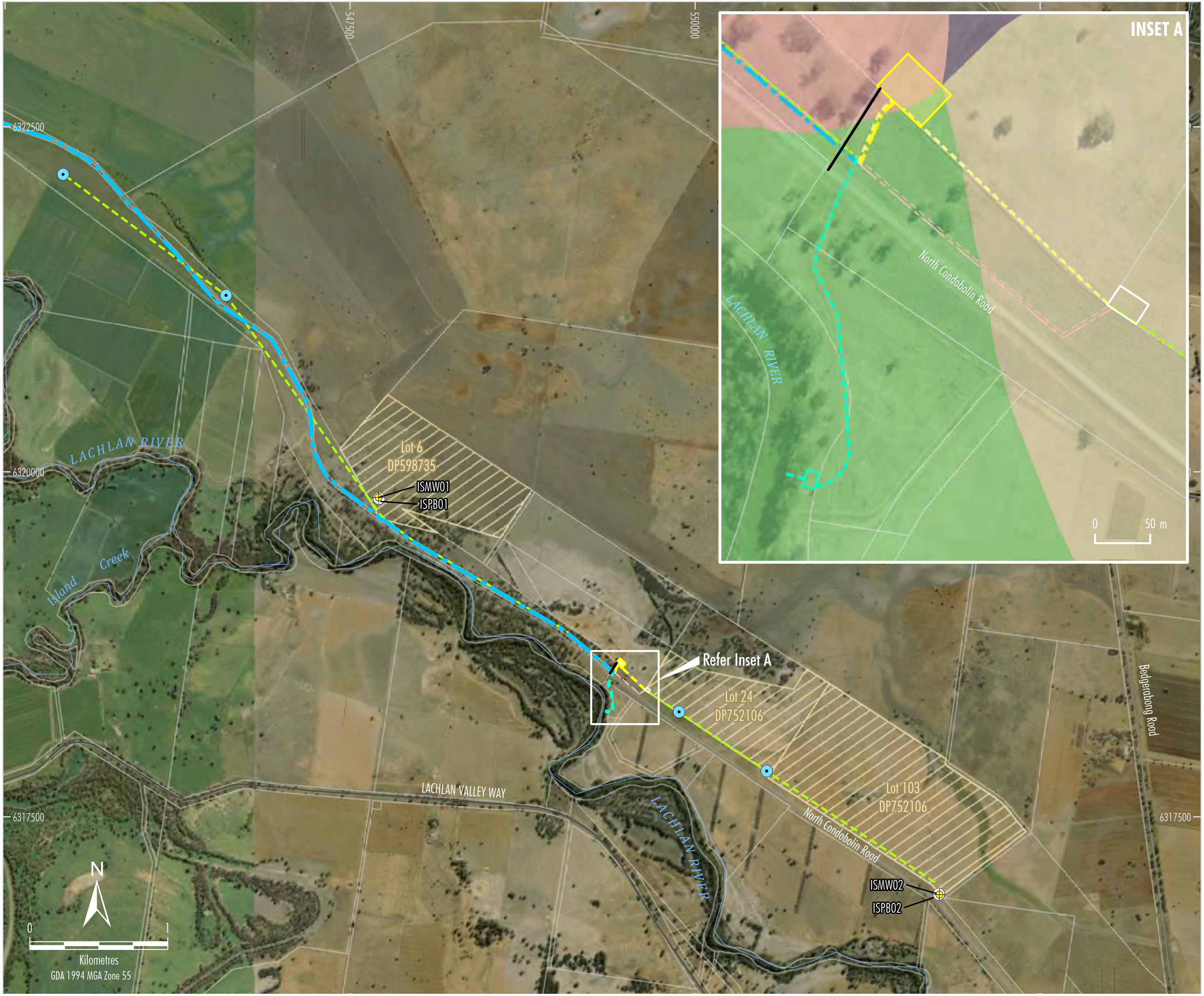
OEH's (2017) regional Australian Soil Classification mapping in the vicinity of the new surface water pump station and modified borefield transfer station is presented on Figure 21. The soils types mapped include Tenosols, Chromosols and Rudosols.

The soil types along the water pipeline alignment option based on regional Australian Soil Classification mapping include Chromosols and Rudosols/Tenosols (OEH, 2017).

Land Soil Capability

The OEH's Land and Soil Capability system is used to give an indication of the land management practices that can be applied to a parcel of agricultural land.

Agricultural land is classified by evaluating biophysical features of the land and soil including landform position, slope gradient, drainage, climate, soil type and soil characteristics to derive detailed rating tables for a range of land and soil hazards (OEH, 2012).



LEGEND

Property Boundary

Approved Project

- Transfer Station
- Water Pipeline
- Borefield Infrastructure Corridor *
- Potential Borefield Location
- Approximate Location of Production Bore (not constructed)
- Production Bore (constructed)
- Monitoring Bore

Modified Project

- Transfer Station
- Pump Station
- Access Road
- Water Pipeline
- Borefield Infrastructure Corridor *
- Surface Water Infrastructure Corridor *
- Approved Water Pipeline Section no longer required
- Approved Borefield Infrastructure Corridor section no longer required

Australian Soil Classification

- Chromosols
- Rudosols
- Tenosols (Alluvial)
- Vertosols

* Infrastructure Corridor includes linking pipline, access road and electricity transmission line.

Source: NSW Land & Property Information (2016); Ivanplats Syerston (2005); Office of Environment & Heritage NSW (2017)

NSW Imagery: © Department of Finance, Services & Innovation (2017)

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SYERSTON PROJECT MODIFICATION 4

Modified Borefields and Surface Water Extraction - Regional Soil Mapping

Figure 21

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OEH's (2017a) regionally mapped Land and Soil Capability Classes in the vicinity of the surface water extraction infrastructure and modified borefields is presented on Figure 22. The additional surface development areas are identified as having Land and Soil Capability Classes of 3 and 4. These Land and Soil Capability Classes are defined as (OEH, 2012):

> *Class 3: High capability land:*
>
> *Land has moderate limitations and is capable of sustaining high-impact land uses, such as cropping with cultivation, using more intensive, readily available and widely accepted management practices. However, careful management of limitations is required for cropping and intensive grazing to avoid land and environmental degradation.*
>
> *Class 4: Moderate capability land:*
>
> *Land has moderate to high limitations for high-impact land uses. Will restrict land management options for regular high-impact land uses such as cropping, high-intensity grazing and horticulture. These limitations can only be managed by specialised management practices with a high level of knowledge, expertise, inputs, investment and technology.*

The Land and Soil Capability Classes along the water pipeline alignment option based on regional soil mapping include Classes 4 and 6 (OEH, 2017a). Land and Soil Capability Class 6 is defined as (OEH, 2012):

> *Class 6:Low capability land:*
>
> *Land has very high limitations for high-impact land uses. Land use restricted to low-impact land uses such as grazing, forestry and nature conservation. Careful management of limitations is required to prevent severe land and environmental degradation.*

4.2.2 Potential Impacts

Soils

Potential impacts of the Modification on soils would relate primarily to:

- disturbance of *in situ* soil resources within additional surface development areas;
- alteration of soil structure beneath infrastructure items, hardstand areas and roads;
- possible soil contamination resulting from spillage of fuels, lubricants and other chemicals; and
- increased erosion and sediment movement due to exposure of soils during construction (e.g. surface water infrastructure corridor).

Land Contamination Potential

Potential land contamination risks include leaks/spills, fires and explosions associated with the transport, storage and use of hydrocarbon and chemicals during construction and maintenance activities.

Agricultural Activities and Productivity

The surface water extraction infrastructure and modified borefields would result in the disturbance or alteration of approximately 1.6 hectares (ha) of existing agricultural lands for the life of the Project.

The potential agricultural activities and productivity impacts associated with these additional disturbance areas would be limited given their small and linear nature. In addition, the additional surface development areas would be located on the perimeter of the properties to minimise potential disruptions to surrounding agricultural activities.

The water pipeline alignment option (Figure 20) would not result in any impacts to agricultural activities or production as it would follow existing road reserves.

LEGEND

Property Boundary

Approved Project

- Transfer Station
- Water Pipeline
- Borefield Infrastructure Corridor *
- Potential Borefield Location
- Approximate Location of Production Bore (not constructed)
- Production Bore (Constructed)
- Monitoring Bore

Modified Project

- Transfer Station
- Pump Station
- Access Road
- Water Pipeline
- Borefield Infrastructure Corridor *
- Surface Water Infrastructure Corridor *
- Approved Water Pipeline Section no Longer Required
- Approved Borefield Infrastructure Corridor section no longer required

Land and Soil Capability

- 3 Moderate Limitations
- 4 Moderate to Severe Limitations

* Infrastructure Corridor includes linking pipline, access road and electricity transmission line.

Source: NSW Land & Property Information (2016); Ivanplats Syerston (2005); Office of Environment & Heritage NSW (2017)

NSW Imagery: © Department of Finance, Services & Innovation (2017)

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SYERSTON PROJECT MODIFICATION 4

Modified Borefields and Surface Water Extraction - Land and Soil Capability

Figure 22

CTL-16-02 Mod4_EA_220A

4.2.3 Mitigation Measures, Management and Monitoring

Soils

General soil management practices would include the stripping and stockpiling of soil resources for use in rehabilitation. The objectives of soil resource management would be to:

- identify and quantify potential soil resources for rehabilitation;
- optimise the recovery of usable soil reserves during soil stripping operations;
- manage soil reserves so as not to degrade the resource when stockpiled; and
- establish effective soil amelioration procedures to maximise the availability and suitability of soil reserves for future rehabilitation works.

Erosion and sediment control would be undertaken in accordance with the Surface Water Management Plan (Section 4.8) required by Condition 30, Schedule 3 of Development Consent DA 374-11-00.

Land Use – Agricultural Activities and Productivity

Agricultural land resource management at the Project would include the following key components:

- minimisation of disturbance to agricultural lands, where practicable;
- management of soil resources at the Project site so that they can be used for rehabilitation; and
- inclusion of agricultural lands in the Project rehabilitation strategy (Section 5).

Land Contamination

General measures to reduce the potential for contamination of land would include the following:

- Contractors transporting dangerous goods loads would be appropriately licensed in accordance with the provisions of the *Australian Code for the Transport of Dangerous Goods by Road and Rail* (National Transport Commission, 2007).
- On-site consumable storage areas would be designed with appropriate bunding and would be operated, where applicable, in compliance with the requirements of AS 1940-2017 *The Storage and Handling of Flammable and Combustible Liquids*.
- Fuel storage areas would be regularly inspected and maintained.

In addition, during construction and operations fuels, oils and other hydrocarbons would be managed to minimise the risk of spills which could cause soil contamination.

4.3 Air Quality

As described in Section 4.1, the potential air quality impacts associated with the Modification would be related to proposed changes to the mine (including the processing facility).

An Air Quality and Greenhouse Gas Assessment for the Modification was undertaken by Ramboll Environ (2017) and is presented as Appendix A. The assessment focused on the mine (including the processing facility) and was conducted in accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (Approved Methods) (EPA, 2016).

The Modification would not change approved air quality impacts at the other Project components and therefore these Project components have not been considered any further in this section.

Potential blasting impacts (including potential blast flumes) and greenhouse gas emissions associated with the Modification are discussed in Sections 4.5 and 4.3.4 respectively.

4.3.1 Existing Environment

Previous Assessments

An air quality assessment was prepared for the Project (Zib & Associates, 2000) which included dispersion modelling of a number of construction and operational scenarios. The air quality assessment found that the Project would comply with relevant air quality goals beyond the site boundary and/or at privately-owned dwellings.

A subsequent assessment completed for Modification 1 demonstrated there would be no material change to the potential air quality impacts of the approved Project (Heggies Australia, 2005). That is, the Project would still comply with the relevant air quality goals.

Air Quality Criteria

Concentrations of Gaseous Pollutants

The processing facility would generate emissions of gaseous pollutants associated with the processing of ore and power generation.

The impact assessment criteria for the gaseous pollutants that may be emitted by the modified processing facility, as specified by the EPA in the Approved Methods (EPA, 2016), are provided in Table 5.

Table 5 Criteria for Gaseous Pollutants

Pollutant	Averaging Periods	Concentration ($\mu g/m^3$)
Carbon monoxide[1]	15-minute	100,000
	1-hour	30,000
	8-hour	10,000
Nitrogen dioxide[1]	1-hour	246
	Annual	62
Sulphur dioxide[1]	10-minute	712
	1-hour	570
	24-hour	228
	Annual	60
Sulphuric acid[2,3]	1-hour	18
1,3-butadiene	1-hour	40
Benzene[2,3]	1-hour	29

After: Approved Methods (EPA, 2016). Note: $\mu g/m^3$ = micrograms per cubic metre.

1 Gas volumes are expressed at 0 degrees Celsius (°C) and at an absolute pressure of 1 atmosphere (101.325 kPa).

2 Gas volumes are expressed at 25°C and at an absolute pressure of 1 atmosphere (101.325 kPa).

3 Expressed as the 99.9th percentile value.

Concentrations of Particulate Matter

Mining operations at the mine have the potential to generate particulate matter (e.g. dust) emissions in the form of:

- total suspended particulate matter (TSP);
- particulate matter with an aerodynamic diameter less than or equal to 10 micrometres (PM_{10}) (a subset of TSP);
- particulate matter with an aerodynamic diameter less than or equal to 2.5 micrometres ($PM_{2.5}$) (a subset of TSP and PM_{10}).

Relevant health-based air quality impact assessment criteria for TSP, PM_{10} and $PM_{2.5}$ are specified by the EPA in the Approved Methods (EPA, 2016), and are provided in Table 6. The impact assessment criteria for TSP and PM_{10} specified in Development Consent DA 374-11-00 are also included in Table 6.

Table 6 Criteria for Particulate Matter Concentrations

Pollutant	Averaging Period	Impact Assessment Criteria[1]	
		Development Consent DA 374-11-00	Approved Methods
TSP	Annual	90 µg/m³	90 µg/m³
PM_{10}	Annual	30 µg/m³	25 µg/m³
	24-hour	50 µg/m³	50 µg/m³
$PM_{2.5}$	Annual	-	8 µg/m³
	24-hour	-	25 µg/m³

After: Development Consent DA 374-11-00 and Approved Methods (EPA, 2016).

1 Total impact (i.e. incremental increase in concentrations due to the development plus background concentrations due to all other sources).

The updated Approved Methods was gazetted in January 2017. In comparison to Development Consent DA 374-11-00, the updated Approved Methods reduces the annual average impact assessment criteria for PM_{10} from 30 µg/m^3 to 25 µg/m^3 and includes impact assessment criteria for $PM_{2.5}$.

Dust Deposition

Particulate matter has the potential to cause nuisance (amenity) effects when it is deposited on surfaces.

The amenity criteria for the maximum increase in dust deposition, as specified in Development Consent DA 374-11-00 and in the Approved Methods, are provided in Table 7. It is noted that the impact assessment criteria in both documents are consistent.

Table 7 Criteria for Dust Deposition (Insoluble Solids)

Averaging Period	Maximum Increase in Deposited Dust Level	Maximum Total Deposited Dust Level
Annual	2 g/m²/month	4 g/m²/month

After: Development Consent DA 374-11-00 and Approved Methods (EPA, 2016).

g/m²/month = grams per square metre per month.

Existing Air Quality

Given there are no commercial or industrial facilities that report to the National Pollutant Inventory or hold an EPL in the vicinity of the Project, it is expected that air quality in the vicinity of the Project would be consistent with a typical rural environment. That is, material concentrations of gaseous pollutants would not be likely, however background levels of particulate matter would be present (e.g. from agricultural activities, wind-blown dust from exposed areas, wheel-generated dust from vehicle movements and other sources).

Ramboll Environ (2017) reviewed available air quality data monitored by the OEH, as well as baseline and compliance monitoring undertaken for other mining projects, to estimate the existing (particulate matter) air quality in the vicinity of the mine site. Concentrations of gaseous pollutants in the vicinity of the Project were assumed to be negligible (Appendix A).

4.3.2 Potential Impacts

Ramboll Environ (2017) assessed both impacts of the processing facility (i.e. gaseous pollutants released from dedicated stacks) and mining operations (i.e. particulate matter generated by mobile equipment, exposed areas and other sources).

The adoption of the RIP processing method would result in the elimination of the 'Extraction Fan over Sulphide Filter Vent', 'Flare Stack' and 'Hydrogen Reformer Stack' emission release points associated with the counter current decantation circuit (Table 3). The potential air quality impacts associated with these approved stacks would not be relevant to the modified Project.

Modelling Methodology

Dispersion Modelling

The AERMOD modelling system was used by Ramboll Environ (2017) to assess potential air quality impacts (from gaseous pollutants and particulate matter) associated with the modified Project.

AERMOD is a NSW EPA approved model steady-state plume dispersion model that provides more refined predictions in comparison to more simplistic steady-state plume dispersion models (Appendix A).

In the model, emission sources were categorised into three source types (Appendix A):

- wind insensitive (where the emission rate is independent of wind speed), including stack sources;
- wind sensitive (where there is a relationship between the emission rate and wind speed); and
- wind erosion (where the emission rate is dependent on wind speed).

The annual emissions for wind insensitive sources were evenly apportioned for each hour of the year, whereas the emission rates for wind sensitive and wind erosion sources were varied in each hour according to the wind speed (Appendix A).

Assessment of Meteorological Conditions

The dispersion modelling completed for the Modification is based on meteorological data sourced from the Bureau of Meteorology automatic weather station (AWS) in Condobolin (Condobolin Airport AWS).

The AERMET pre-processor was supplemented with prognostic meteorological data from The Air Pollution Model (Appendix A).

Meteorology for the period 2011 to 2016 was reviewed to identify a representative year for modelling. Following a review of the data, the 2015 calendar year was selected as the representative year, and was used for the modelling. Details of the analysis of meteorological conditions modelled is provided in Appendix A.

Air Quality Modelling Scenarios

A single modelling scenario representing expected peak emissions was used to assess emissions of gaseous pollutants (Appendix A).

Four scenarios representative of the modified Project were assessed for potential particulate matter impacts (Appendix A):

- Year 1 – representative of initial operations, with preferential mining in high grade ore deposits and construction of the tailings storage facility and evaporation ponds in the south-eastern portion of the site;
- Year 6 – representative of mining across both eastern and western open cut pits with one tailings storage facility cell in operation;
- Year 11 – representative of continued mining across both eastern and western open cut pits with the maximum waste rock emplacement footprints and two tailings storage facility cells in operation; and
- Year 21 – representative of the final years of mining, with the maximum extents of the open cut pits and waste rock emplacements and three tailings storage facility cells in operation.

The scenarios were selected in consideration of maximum potential dust emissions (e.g. to account for the maximum material movements and proximity to sensitive receivers) to evaluate the potential impacts at the nearest privately-owned receivers throughout the life of the modified Project.

The scenario modelled for each year included the peak particulate matter emissions estimated for the processing facility.

Emission Inventories

Estimated emissions of gaseous pollutants from the processing facility used in the modelling were estimated by Clean TeQ based on the current design of the processing facility, and take into account the use of emission control equipment incorporated into the processing operations. The assumed stack emissions are detailed in Appendix A.

Particulate matter emission inventories were prepared for the four scenarios assessed in consideration of the indicative mining activities for each year, including ore extraction, waste rock removal rates, haul distances and routes, active stockpile and pit areas and mobile equipment operating hours. The major sources of dust emissions are predicted to be associated with the following activities (Appendix A):

- hauling of waste rock and ore in trucks on unpaved roads (including diesel particulate emissions);
- wind erosion of exposed areas and stockpiles;
- dozer operations; and
- handling and loading/unloading of waste rock and ore.

Consistent with the Approved Methods (EPA, 2016), emission factors developed by the United States Environmental Protection Agency (US EPA) have been used to estimate the particulate matter emissions generated by the Project (Appendix A).

The emission factors for dust generated by haul trucks sourced from the US EPA include both mechanically generated (i.e. wheel generated) and combustion emissions. However, emission controls applied are often only relevant to the mechanically generated portion of the emissions (e.g. surface treatments do not control combustion emissions). Therefore surface treatment emission controls (e.g. watering haul roads) have only been applied to the portion of total hauling emissions that are mechanically generated (Appendix A).

A full description of the dispersion model methodology and emission inventories is provided in Appendix A.

Mitigation Measures

The processing facility has been designed to minimise potential impacts of gaseous pollutants through the use of emission control equipment incorporated into the processing operations, and design of the stacks (e.g. the sulphuric acid plant stack would be 80 m high).

Best practice dust mitigation measures to be implemented for the modified Project mining operations were developed with reference to the recommendations of the *NSW Coal Mining Benchmarking Study: International Best Practice Measures to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining* (Katestone Environmental, 2011).

Dust mitigation measures that would be implemented for the modified Project would include:

- use of water carts/trucks to control emissions from haul roads;
- use of large vehicles (reducing the number of trips required to haul waste rock or ore on-site);
- restricting speed on haul roads;
- progressive rehabilitation of disturbed areas;
- minimising pre-strip areas;
- minimisation of drop heights for handling of waste rock and ore;
- direct placement of waste rock and ore where possible; and
- delay of blasts during unfavourable weather conditions.

Compliance with Impact Assessment Criteria

Gaseous Pollutants

No exceedances of the criteria for gaseous pollutants described in the Approved Methods were predicted at any receivers, or beyond the site boundary, in Years 1, 6, 11 and 21. For all gaseous pollutants, the predicted concentrations were well below the relevant criteria (i.e. less than 50% of the relevant criteria) (Appendix A).

Figure 23 shows 1-hour average sulphuric acid concentrations for the modified Project only (i.e. excluding background sources). Additional air quality contours are provided in Appendix A.

Ramboll Environ (2017) considered the potential risk of emissions from the processing facility causing the rare phenomenon known as 'acid rain' in the vicinity of the mine site and concluded that any potential impacts from 'acid rain' would be insignificant (Appendix A).

Particulate Matter

No exceedances of the Development Consent DA 374-11-00 or Approved Methods criteria were predicted at any privately-owned receivers in all scenarios for:

- annual average dust deposition levels (both incremental and cumulative);
- cumulative annual average TSP concentrations;
- cumulative annual average and 24-hour PM_{10} concentrations; or
- cumulative annual average and 24-hour $PM_{2.5}$ concentrations.

Figures 24 and 25 show 24-hour average PM_{10} concentrations for Years 1 and 11 for the modified Project only (i.e. excluding background sources). Additional air quality contour plots are provided in Appendix A.

Vacant Land Assessment

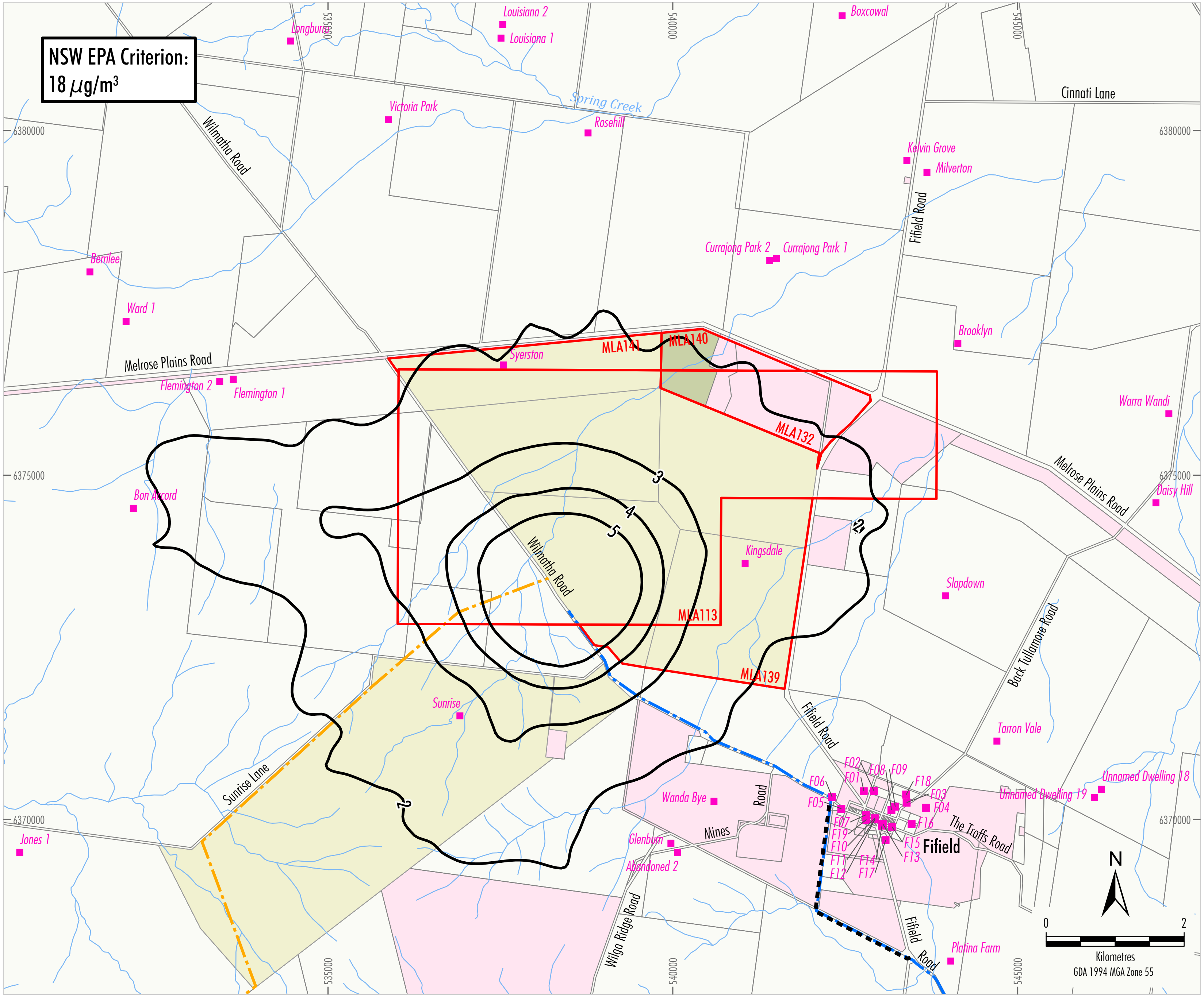
Ramboll Environ (2017) has conducted a vacant land assessment in accordance with contemporary policy and concluded that no additional properties are likely to exceed the criteria based on potential impacts on vacant land (Appendix A).

4.3.3 Mitigation Measures, Management and Monitoring

Air Quality Management Plan

An Air Quality Management Plan would be prepared for the modified Project in accordance with Condition 23, Schedule 3 of Development Consent DA 374-11-00. The Air Quality Management Plan would reflect any changes to Development Consent DA 374-11-00 that arise from the Modification and would include:

- details of the air quality mitigation measures to be implemented for the Project (including those described in Section 4.3.2);
- the air quality monitoring program, including stack monitoring and monitoring of ambient dust levels, which would be undertaken in accordance with an EPL issued under Part 3 of the POEO Act by the EPA;
- details of the dedicated emission release points (stacks);
- details of protocols for measuring environmental performance and triggers for the investigation of additional mitigation measures; and
- complaint management protocols.



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LEGEND

- Mining Lease Application Boundary
- Approved Fifield Bypass
- Approved Gas Pipeline
- Approved Water Pipeline
- Clean TeQ Owned Land
- Crown Land
- Fifield State Forest
- Private Landholder
- Dwelling
- 1-hour Average Sulphuric Acid Air Quality Contour (99.9th Percentile) (μg/m^3)

Source: Ramboll Environ (2017); Black Range Minerals (2000); NSW Department of Industry (2017); NSW Land & Property Information (2017)

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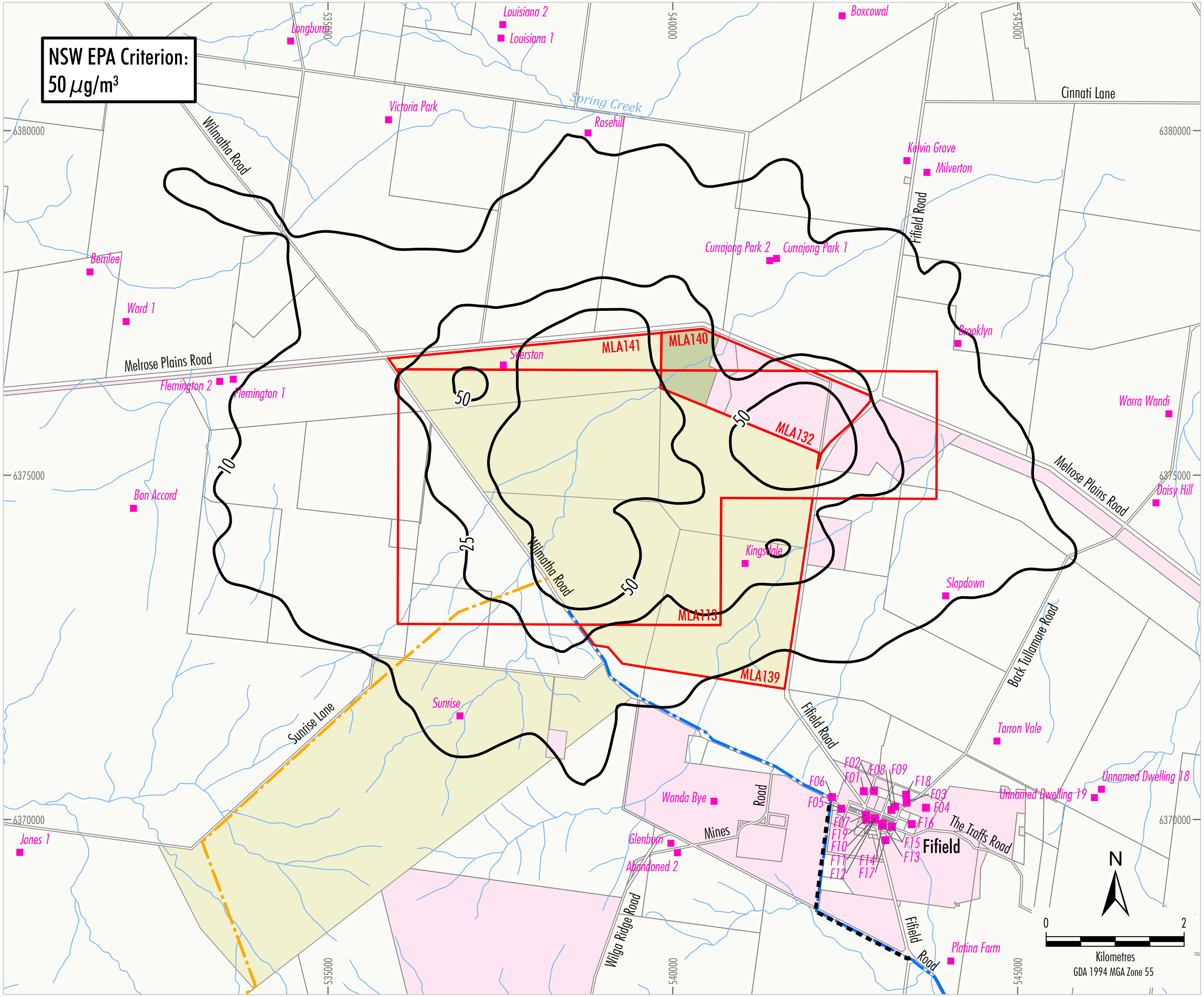
1-hour Average Sulphuric Acid Concentrations

Figure 23



LEGEND

- Mining Lease Application Boundary
- Approved Fifield Bypass
- Approved Gas Pipeline
- Approved Water Pipeline
- Clean TeQ Owned Land
- Crown Land
- Fifield State Forest
- Private Landholder
- Dwelling
- 24-hour Average PM_{10} Air Quality Contour (μg/m³)

Source: Ramboll Environ (2017); Black Range Minerals (2000); NSW Department of Industry (2017); NSW Land & Property Information (2017)

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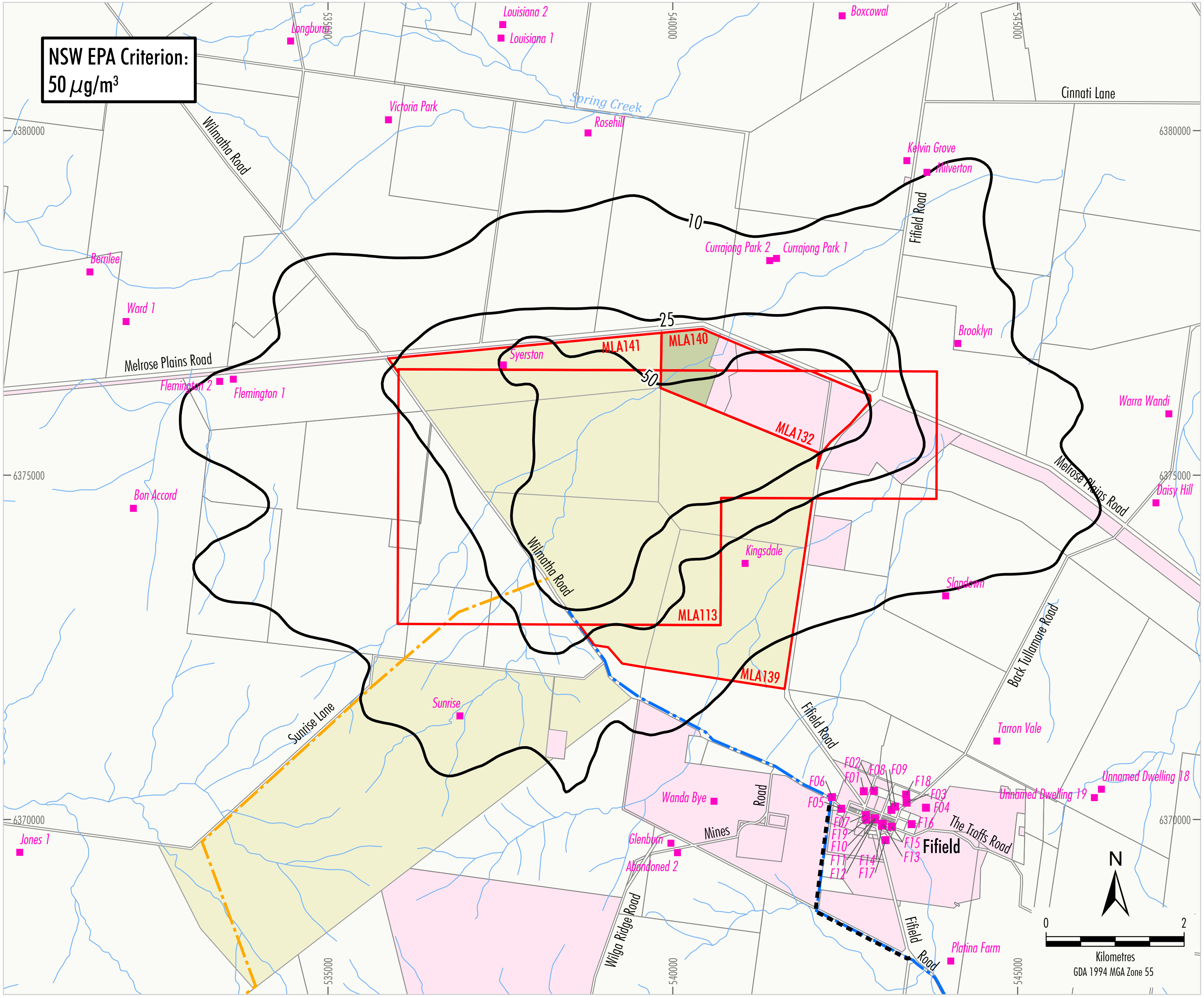
24-hour Average PM_{10} Concentrations
Year 1

Figure 24

CTL-16-02 Mod4_EA_226C



LEGEND

- Mining Lease Application Boundary
- Approved Fifield Bypass
- Approved Gas Pipeline
- Approved Water Pipeline
- Clean TeQ Owned Land
- Crown Land
- Fifield State Forest
- Private Landholder
- Dwelling
- 24-hour Average PM_{10} Air Quality Contour ($\mu g/m^3$)

Source: Ramboll Environ (2017); Black Range Minerals (2000); NSW Department of Industry (2017); NSW Land & Property Information (2017)

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**24-hour Average PM_{10} Concentrations
Year 11**

Figure 25

CTL-16-02 Mod4_EA_227C

4.3.4 Greenhouse Gas Emissions

An assessment of greenhouse gas emissions associated with the Modification was undertaken by Ramboll Environ (2017) and is provided in Appendix A. A summary of the assessment is provided below.

In accordance with the *National Greenhouse Accounts Factors* (Department of the Environment and Energy, 2016), direct greenhouse emissions are referred to as Scope 1 emissions, and indirect emissions are referred to as Scopes 2 and 3 emissions.

The major sources of greenhouse gas emissions associated with the Modification include the following:

- fuel consumption during mining operations (Scope 1);
- fuel consumption in the processing facility (Scope 1);
- carbon dioxide generated by ore processing (Scope 1); and
- product transport (Scope 3).

Annual average Scope 1 emissions associated with the Modification are estimated to be approximately 324 kilotonnes of carbon dioxide equivalent (Appendix A).

Clean TeQ would calculate and report annual greenhouse gas emissions and energy consumption of the Project under the Commonwealth Government National Greenhouse and Energy Reporting System.

4.4 Noise

As described in Section 4.1, the potential noise impacts associated with the Modification would be related to proposed changes to the mine (including the processing facility).

A Noise and Blasting Assessment for the Modification was undertaken by Renzo Tonin & Associates (2017) and is presented in Appendix B. The assessment focused on the mine (including the processing facility) and was conducted in accordance with the NSW *Industrial Noise Policy* (INP) (EPA, 2000), *Interim Construction Noise Guideline* (DECC, 2009) and the *Road Noise Policy* (RNP) (DECCW, 2011).

Consideration was also given to the NSW Government (2014) *Voluntary Land Acquisition and Mitigation Policy – For State Significant Mining, Petroleum and Extractive Industry Developments* (Voluntary Land Acquisition and Mitigation Policy).

Due to the distance to the nearest sensitive receivers (approximately 1.5 km) and the nature of the noise sources associated with the proposed works (i.e. underground pumps), the proposed changes to the borefields were not considered likely to have the potential for noise impacts at the nearest sensitive receivers, and therefore the borefields were not considered in the Noise and Blasting Assessment.

The Modification would not change approved noise impacts at the other Project components and therefore these Project components have not been considered any further in this section

Potential blasting impacts of the Modification are discussed in Section 4.5.

4.4.1 Existing Environment

Noise Measurement and Description

The assessed noise levels presented in Appendix B and summarised in this section are expressed in A-weighted decibels (dBA). The logarithmic dBA scale simulates the response of the human ear, which is more sensitive to high frequency sounds and relatively less sensitive to lower frequency sounds. Table 8 provides information on common noise sources in dBA for comparative reference.

Measured or predicted noise levels are expressed as statistical noise exceedance levels (L_{AN}) which are the levels exceeded for a specific percentage (N) of the interval period. For example, L_{A10} is the noise level that is exceeded for 10% of the sampling period and is also considered to be the average maximum noise level.

Table 8 Relative Scale of Various Noise Sources

Noise Level (dBA)	Relative Loudness	Common Indoor Noise Levels	Common Outdoor Noise Levels
110 to 130	Extremely noisy	Rock band	Jet flyover at 1,000 m
100	Very noisy	Internal demolition work (jackhammer)	Petrol engine lawn mower at 1 m
90	Very noisy	Food blender at 1 m	Diesel truck at 15 m
80	Loud	Garbage disposal at 1 m, shouting at 1 m	Urban daytime noise
70	Loud	Vacuum cleaner at 3 m, normal speech at 1 m	Commercial are heavy traffic at 100 m
60	Moderate to quiet	Large business office	-
50	Moderate to quiet	Dishwasher next room, wind in trees	Quiet urban daytime
40	Quiet to very quiet	Small theatre, large conference room (background), library	Quiet urban night-time
30	Quiet to very quiet	Bedroom at night, concert hall (background)	Quiet rural night-time
20	Almost silent	Broadcast and recording studio	-
0 to 10	Silent	Threshold of hearing	-

After: United States Department of the Interior (1994) and Richard Heggie Associates (1995).

The equivalent continuous noise level (L_{Aeq}) refers to the steady sound level, which is equal in energy to the fluctuating levels recorded over the sampling period.

Previous Assessments

A noise assessment was prepared for the Project (Richard Heggie Associates, 2000) which included noise modelling of a number of construction and operational scenarios. The noise assessment found that the Project would comply with relevant noise goals beyond the site boundary and/or at all privately-owned dwellings except for Currajong Park.

A subsequent assessment completed for Modification 1 demonstrated there would be no material change to the potential noise impacts of the approved Project (Heggies Australia, 2005). That is, the Project would still comply with the relevant noise goals except for Currajong Park.

Background Noise Levels

The Rating Background Level is the background noise level determined without the subject premises in operation, in accordance with the INP.

Given the Project has not commenced operations, and no contemporary background noise levels are available, Renzo Tonin & Associates (2017) conducted background noise surveys for the Modification.

Review of the background noise levels measured indicated the Rating Background Levels would be 30 dBA during all periods, for all receivers. These Rating Background Levels were therefore adopted for the Modification (Appendix B).

Construction Noise Criteria

The Interim Construction Noise Guidelines (ICNG) provides construction noise management levels based on the time of day construction activities occur, with the 'noise affected' construction noise management level being the Rating Background Level plus 10 dBA during recommended standard construction hours and the Rating Background Level plus 5 dBA outside of recommended standard construction hours.

In accordance with Condition 1, Schedule 3 of Development Consent DA 374-11-00, construction of the mine (including the processing facility) would be undertaken 24 hours per day, seven days per week and construction of the borefields and water pipeline would be undertaken between 7.00 am to 6.00 pm, seven days per week. Construction activities would therefore be undertaken both within and outside of the ICNG recommended standard construction hours.

The construction noise management levels for the Project are shown in Table 9.

Table 9 ICNG Construction Noise Management Levels (dBA)

Receiver	Noise Affected		Highly Noise Affected
	Recommendation Standard Hours[1]	Outside Recommended Standard Hours[1]	
All residential receivers	40	35	75
Fire station	70 when in use		-
Church, hall	55 when in use		-

After: Appendix B.

[1] Recommended standard hours are 7.00 am to 6.00 pm Monday to Friday and 8.00 am to 1 pm Saturdays.

Operational Noise Criteria

The INP assessment procedure for industrial noise sources has two components (EPA, 2000):

- controlling potential intrusive noise levels in the short-term for residences; and
- maintaining noise level amenity for particular land uses, for residences and other land uses.

The INP prescribes detailed calculation routines for establishing Project-specific $L_{Aeq(15\ minute)}$ intrusive criteria and $L_{Aeq(period)}$ amenity criteria. The INP Project-specific intrusive and amenity assessment criteria for the Modification (i.e. Project-specific noise levels) are presented in Table 10. Intrusive criteria are applied on a Project-only basis while amenity criteria are applied cumulatively with other industrial noise sources.

Table 10 INP Project-specific Intrusive and Amenity Assessment Criteria for Operational Noise (dBA)

Receiver	Land Use	Intrusive $L_{Aeq(15\ minute)}$ [1]			Amenity $L_{Aeq(period)}$ [1] (Recommended Acceptable)			Amenity $L_{Aeq(period)}$ [1] (Recommended Maximum)		
		Day	Night	Evening	Day	Night	Evening	Day	Night	Evening
All residential receivers	Rural residential	35	35	35	50	45	40	55	50	45
Church, hall		N/A			External 50 dBA when in use			External 55 dBA when in use		

After: Appendix B.

[1] Daytime 7.00 am to 6.00 pm; Evening 6.00 pm to 10.00 pm; Night-time 10.00 pm to 7.00 am.

As the applicable Project-specific intrusive criteria are the most stringent, Appendix B assesses Project-only noise levels against the intrusive criteria and cumulative noise levels against the amenity criteria.

In those cases where the INP Project-specific assessment criteria are exceeded, it does not automatically follow that all people exposed to the noise would find the noise noticeable or unacceptable.

The Voluntary Land Acquisition and Mitigation Policy provides some useful context in regard to characterising the practical implications of exceedances of the INP criteria (Table 11).

For the purposes of assessing potential noise impacts consistent with the Voluntary Land Acquisition and Mitigation Policy, exceedances can be separated into a Noise Management Zone (i.e. negligible, marginal or moderate impacts of 1 to 5 dBA above the criteria) and a Noise Affectation Zone (i.e. greater than 5 dBA above the criteria, with impacts considered to be significant) (Table 11).

Table 11 presents the methodology used for assessing operational noise against the INP Project-specific noise assessment criteria.

The Project-specific intrusive criteria are consistent with the noise criteria described in Condition 3, Schedule 3 of Development Consent DA 374-11-00, with the exception of the Currajong Park property, which is afforded higher evening (39 dBA) and night-time (40 dBA) criteria in Development Consent DA 374-11-00.

Table 11 Characterisation of the Significance of Noise Impacts and Potential Treatments

Residual Noise Exceeds INP Criteria By	Characterisation of Significance of Residual Impacts	Potential Treatment
0 to 2 dBA above the Project-specific noise level	Impacts are considered to be **negligible**	The exceedances would not be discernible by the average listener and therefore would not warrant receiver based treatments or controls.
3 to 5 dBA above the Project-specific noise level in the INP but the development would contribute less than 1 dB to the total industrial noise level	Impacts are considered to be **marginal**	Provide mechanical ventilation/comfort condition systems to enable windows to be closed without compromising internal air quality/amenity.
3 to 5 dBA above the Project-specific noise level in the INP and the development would contribute more than 1 dB to the total industrial noise level	Impacts are considered to be **moderate**	As for marginal impacts but also upgraded façade elements like windows, doors, roof insulation etc. to further increase the ability of the building façade to reduce noise levels.
>5 dBA above the Project-specific noise level in the INP	Impacts are considered to be **significant**	Provide mitigation as for moderate impacts and see Voluntary Land Acquisition and Mitigation Policy provisions.

After: NSW Government (2014).

Transport Noise Criteria

Road traffic noise along public roads was assessed by Renzo Tonin & Associates (2017) in accordance with the RNP, which establishes criteria for the assessment of road noise in NSW (Appendix B). The total traffic noise and relative increase criteria are provided in Table 12.

In relation to situations where exceedances of the road traffic noise assessment criteria are predicted, the RNP states that an increase of up to 2 dBA is considered to be barely perceptible (DECCW, 2011).

Table 12 NSW Road Noise Policy Criteria for Residential Land Uses

Road	Type of Project and Land Use	Total Traffic Noise Criteria[1]	Relative Increase Criteria
Arterial and sub-arterial roads	Land use developments generating additional traffic on existing arterial/sub-arterial roads	Daytime 60 dBA $L_{Aeq(15\ hour)}$	Existing $L_{Aeq(15\ hour)}$ plus 12 dBA
		Night-time 55 dBA $L_{Aeq(9\ hour)}$	Existing $L_{Aeq(9\ hour)}$ plus 12 dBA

After: Appendix B.
[1] Daytime 7.00 am to 10.00 pm; Night-time 10.00 pm to 7.00 am.

4.4.2 Potential Impacts

Construction and Operational Noise Modelling

The Environmental Noise Model was used by Renzo Tonin & Associates to simulate construction and operational activities of the modified Project using noise source information (i.e. indicative sound power levels and locations) and predict noise levels at relevant receiver locations.

The Environmental Noise Model is recommended by the INP (EPA, 2000) and has previously been accepted by the NSW EPA for use in environmental assessments (Appendix B).

The model considers meteorological effects, surrounding terrain, the distance from source to receiver and noise attenuation.

Assessment of Meteorological Conditions

The noise modelling completed for the Modification is based on meteorological data obtained from the Bureau of Meteorology weather station in Condobolin (Condobolin Airport AWS) for the 2015 calendar year. The meteorological data used includes wind speed, wind direction and stability class (Appendix B).

The analysis determined that, in accordance with the procedures documented in the INP, Category F temperature inversions are a feature of the area, but wind effects (i.e. source to receiver winds) were not a feature of the area. Details of the analysis of prevailing meteorological conditions modelled are provided in Appendix B.

Noise Modelling Scenarios

One construction and three operational scenarios of the modified Project were assessed for potential noise impacts (Appendix B):

- Year 1 – representative of construction activities;
- Year 6 – representative of the year of commencement of utilisation of maximum operational fleet;
- Year 11 – maximum operational fleet with the north-western waste rock emplacement at a height of 320 m AHD and the north-eastern waste rock emplacement at a height of 305 m AHD; and
- Year 21 – maximum operational fleet with the north-western waste rock emplacement at the maximum height of 330 m AHD and the north-eastern waste rock emplacement at the maximum height of 315 m AHD.

The modelling scenarios were selected in consideration of maximum potential noise emissions (e.g. to account for the maximum mobile equipment fleet and proximity to sensitive receivers) to evaluate the potential impacts at the nearest privately-owned receivers over the life of the Project.

Assessment of Feasible and Reasonable Noise Mitigation Measures

Renzo Tonin & Associates (2017) conducted an assessment of feasible and reasonable noise mitigation measures for the modified Project, particularly in relation to night-time operations during adverse meteorological conditions.

A number of iterative steps were undertaken to develop noise mitigation measures for the modified Project, including the following (Appendix B):

1. Preliminary noise modelling of scenarios representative of the maximum noise emissions from the modified Project to identify potential for noise exceedances.
2. Evaluation of various combinations of noise management and mitigation measures to assess their relative effectiveness.
3. Review of the effectiveness of these measures and assessment of their feasibility by Clean TeQ.
4. Adoption of management and mitigation measures to appreciably reduce noise emissions associated with the modified Project.

The preliminary noise modelling indicated that in the absence of additional noise mitigation measures, intrusive noise levels at privately-owned dwellings could, with adverse meteorological conditions (i.e. Category F temperature inversion conditions at night), range up to 7 dBA above the Project-specific noise levels (Appendix B).

Privately-owned dwellings on four properties (Currajong Park [M08 and M23], Brooklyn [M22], Slapdown [M29] and Wanda Bye [M31]) were predicted to experience moderate or significant exceedances of the Project-specific noise levels (i.e. greater than or equal to 3 dBA above the Project-specific noise levels) (Appendix B).

Potential noise management and mitigation measures that would achieve a reduction in noise levels associated with the modified Project under adverse meteorological conditions of up to 7 dBA were evaluated with respect to the feasibility of implementing the measures for the modified Project. These measures included significant operational shutdowns (e.g. ceasing overburden emplacement operations on the north-eastern waste rock emplacement as well as ore extraction operations in the eastern open cut pit) and attenuation of a number of major mobile equipment.

Modelling and evaluation of potential noise mitigation benefits, capital and operating costs of mitigation and impacts on related modified Project metrics was undertaken. From this it was identified by Clean TeQ that an appreciable noise reduction of up to 5 dBA could be reasonably achieved *albeit* at significant operating cost to Clean TeQ, by modifying mining operations at night during Category F temperature inversion conditions.

To provide a noise reduction of up to 5 dBA, significant modifications to mining operations at night during Category F temperature inversions would be required, such as ceasing overburden emplacement operations on the north-eastern waste rock emplacement as well as other constraints to mining operations (Appendix B).

The resulting achievable maximum intrusive noise levels of up to 37 dBA would be only marginally above the night time Project-specific noise levels of 35 dBA, and well below the maximum consented noise limit previously approved (i.e. 40 dBA at night at the Currajong Park property).

Given the considerable operating costs associated with significantly modifying mining operations during adverse meteorological conditions, Clean TeQ will seek to enter into negotiated agreements with the owners of the four properties with predicted moderate and significant exceedances in accordance with the NSW Government’s (2014) Voluntary Land Acquisition and Mitigation Policy. Clean TeQ may also seek to purchase these properties.

If negotiated agreements were to be put in place with the owners of the four properties, or these properties were to become mine-owned, significant modifications to mining operations would not be considered reasonable to Clean TeQ, and modifications to mining operations would be less significant, with a noise reduction of less than 5 dBA (e.g. ceasing operation of a small number of noisy equipment such as drills, moving equipment to more sheltered areas, or avoiding the use of intermittently operating auxiliary equipment).

However, if negotiated agreements (or purchase agreements) with the owners of the four properties are not achieved, or are only achieved for a subset of the four properties, Clean TeQ would significantly modify mining operations at night during Category F temperature inversions as required to reduce noise levels by up to 5 dBA.

While technically feasible, measures to achieve up to a 7 dBA reduction at the most-affected receivers were then evaluated in light of the relative costs and benefits that would arise, including potential environmental benefits and corresponding capital and operating costs.

For the purposes of modelling, it was assumed that negotiated agreements (or purchase agreements) are not achieved with the owners of the four properties, and therefore significant modifications to mining operations would be required at night during Category F temperature inversions.

The following significant modifications to mining were assumed for the modelling (Appendix B):

- Ceased overburden emplacement operations on the north-eastern waste rock emplacement.
- Ceased operation of a drill in the eastern pit.
- Ceased operation of an intermittently operated item of plant near the mine infrastructure area (e.g. tractor).

Predicted Noise Levels

Construction Noise

Predicted construction noise levels at all receivers were found to comply with the relevant noise management levels described in the ICNG both within and outside of recommended standard construction hours.

Project-only Operational Noise

There are no privately-owned properties predicted to experience marginal, moderate or significant exceedances of the Project-specific noise levels (i.e. greater than or equal to 3 dBA above the Project-specific noise levels) with the implementation of the assumed mitigation measures (Appendix B).

With the implementation of the assumed mitigation measures, seven properties are predicted to experience negligible exceedances of the Project-specific noise levels (i.e. 1 to 2 dBA above the Project-specific noise levels), including the four properties that Clean TeQ will be seeking negotiated agreements (or purchase agreements) with (Appendix B).

The impact of potential exceedances of the Project-specific noise levels of 1 to 2 dBA is negligible and not discernible by the average listener based on the characterisation of noise impacts described in the Voluntary Land Acquisition and Mitigation Policy (Table 11).

A summary of the privately-owned properties with predicted exceedances of the Project-specific noise levels is provided in Table 13.

Indicative noise contours of the noise predictions for Year 11 at night during adverse meteorological conditions are presented on Figure 26. Additional noise contours are provided in Appendix B.

Table 13 Summary of Potential Operational Noise Exceedences at Privately-owned Receivers under Adverse Meteorological Conditions

Zone	Exceedence Level	Maximum Predicted Noise Level		
		Year 6	Year 11	Year 21
Noise Management Zone	Negligible 0 to 2 dBA above the Project-specific noise levels	Currajong Park [M08 and M23], Wanda Bye [M31]	Abandoned 2 [M04] Currajong Park [M08 and M23], Glenburn [M10], Rosehill [M28], Slapdown [M29], Wanda Bye [M31]	Abandoned 2 [M04] Currajong Park [M08 and M23], Glenburn [M10], Brooklyn [M22], Slapdown [M29], Wanda Bye [M31]
	Marginal/Moderate 3 to 5 dBA above the Project-specific noise levels	-	-	-
Noise Affectation Zone	Significant >5 dBA above the Project-specific noise levels	-	-	-

After: Appendix B.

Cumulative Noise Emissions

Given there are no industrial facilities in the vicinity of the mine site, no exceedances of the amenity noise levels were predicted for the modified Project (Appendix B).

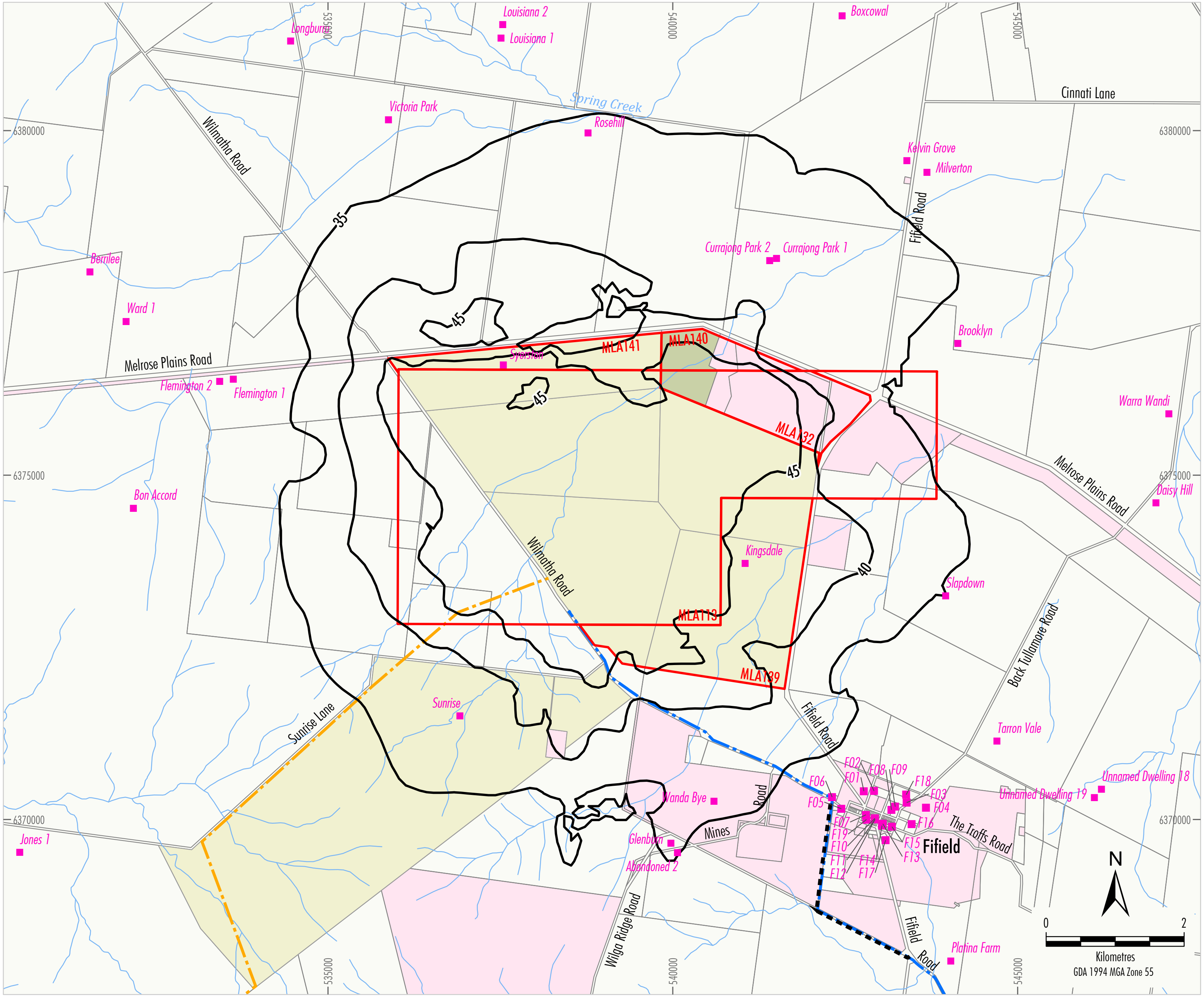
Land Assessment

Renzo Tonin & Associates (2017) also completed a vacant land assessment in accordance with the Voluntary Land Acquisition and Mitigation Policy (NSW Government, 2014) and concluded that no additional properties are likely to exceed the relevant criteria based on potential impacts on vacant land (Appendix B).

Sleep Disturbance

Renzo Tonin & Associates (2017) has conducted an assessment of potential sleep disturbance impacts. A sleep disturbance criterion of $L_{A1(1\ minute)}$ 45 dBA has been adopted by the EPA (Appendix B).

No receivers are predicted to experience exceedances of the relevant sleep disturbance criteria at night as a result of the modified Project (Appendix B).



LEGEND
- Mining Lease Application Boundary
- Approved Fifield Bypass
- Approved Gas Pipeline
- Approved Water Pipeline
- Clean TeQ Owned Land
- Crown Land
- Fifield State Forest
- Private Landholder
- Dwelling
- Noise Contour, $L_{Aeq(15\ minute)}$, dB(A)

Source: Renzo Tonin & Associates (2017); Black Range Minerals (2000); NSW Department of Industry (2017); NSW Land & Property Information (2017)

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Night with Temperature Inversion - Intrusive Noise Contours, $L_{Aeq(15\ minute)}$, dBA Year 11

Figure 26

CTL-16-02 Mod4_EA_228A

Road Noise Emissions

The road noise assessment conducted by Renzo Tonin & Associates (2017) considered road noise associated with operation of the modified Project during the year 2027, including comparison to the predicted traffic noise associated with the approved Project in that year.

No exceedances of the relevant total noise criteria for daytime and night-time, or the 12 dB relative increase criteria, were predicted for any of the roads assessed (Appendix B).

Borefields

Construction of the modified borefields would be undertaken during daytime hours (i.e. 7.00 am to 6.00 pm) in accordance with Condition 1, Schedule 3 of Development Consent DA 374-11-00. Construction activities would be similar in nature to the approved Project, and no impacts at privately-owned dwellings are expected. Given the distance to the nearest privately-owned dwellings and nature of the noise sources associated with the modified borefields, the proposed changes to the borefields are considered unlikely to materially change noise levels experienced at the nearest privately-owned dwellings.

4.4.3 Mitigation Measures, Management and Monitoring

Noise Management Plan

A Noise Management Plan would be prepared for the modified Project in accordance with Condition 9, Schedule 3 of Development Consent DA 374-11-00. The Noise Management Plan would reflect any changes to Development Consent DA 374-11-00 that arise from the Modification and would include:

- the noise monitoring program, which would be undertaken in accordance with the an EPL issued under Part 3 of the POEO Act by the EPA;
- procedures for the implementation of mitigation measures during adverse meteorological conditions (i.e. Category F temperature inversions at night), reflecting the status of negotiations with the four most affected privately-owned properties;
- details of protocols for measuring environmental performance and triggers for the investigation of additional mitigation measures; and
- complaint management protocols.

Traffic Noise

As described in the RNP, projects that generate additional traffic on existing roads are likely to have limited potential for noise control, because these developments are not usually linked to road improvements.

For the modified Project, staff and drivers would be made aware of the potential for noise impacts through site-specific inductions and staff education programs to reinforce quiet driving styles/attitudes.

A Road Transport Protocol for all drivers transporting materials to and from the Project would be included in the Traffic Management Plan prepared in accordance with Condition 45, Schedule 3 of Development Consent DA 374-11-00.

4.5 Blasting

As described in Section 4.1, the potential blasting impacts associated with the Modification would be related to proposed addition of drilling blasting at the mine.

A Noise and Blasting Assessment for the modified Project was undertaken by Renzo Tonin & Associates (2017) and is provided in Appendix B. The assessment focused on the mine and was conducted in accordance with the *Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration* (Australian and New Zealand Environment Conservation Council [ANZECC], 1990).

The Modification would not change approved blasting impacts at the other components of the Project (i.e. the limestone quarry) and therefore these Project components have not been considered any further in this section.

Potential air quality impacts associated with the Modification, including potential blast fumes, are discussed in Section 4.3.

4.5.1 Exiting Environment

Overpressure (or airblast) is reported in linear decibels (dBL) and is the measurable effect of a blast on air pressure, including generated energy that is below the limit of human hearing. Ground vibration is the measurable movement of the ground surface caused by a blast and is measured in millimetres per second (mm/s) as Peak Vector Sum (PVS) vibration velocity.

Discernible blast emission effects can be divided into the three categories listed below:

1. Occupants of a building can be inconvenienced or disturbed (i.e. temporary amenity effects).
2. Contents of a building can be affected.
3. Integrity of a building structure can be affect.

An individual's response to blasting vibration and overpressure is highly dependent on previous experience and expectations.

Blasting Criteria

Ground vibration and overpressure levels which cause human discomfort are generally lower than the recommended structural damage limits. Therefore, compliance with the lowest applicable human comfort criteria generally means that the potential to cause structural damage to buildings is minimal (Appendix B).

The EPA adopts the ANZECC (1990) *Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration* for assessing potential annoyance from blast emissions during daytime hours, as listed below (Appendix B):

- The recommended maximum level for overpressure is 115 dBL.
- The level of 115 dBL may be exceeded on up to 5% of the total number of blasts over a period of 12 months. The level should not exceed 120 dBL at any time.
- The recommended maximum for ground vibration is 5 mm/s PVS vibration velocity.
- The PVS level of 5 mm/s may be exceeded on up to 5% of the total number of blasts over a period of 12 months. The level should not exceed 10 mm/s at any time.

4.5.2 Potential Impacts

Blasting activities for the modified Project are described in Section 3.4.4. Blast sizes would range up to approximately 380 kilograms.

The Noise and Blasting Assessment (Appendix B) provides minimum distances between privately-owned receivers and blasting activities to avoid exceedances of the relevant overpressure and vibration criteria.

No exceedances of the relevant overpressure and vibration criteria are predicted at any privately-owned receivers when blasting within the open cut pits between 6.00 am to 8.00 pm Monday to Saturday (Appendix B).

Blasting within the borrow pits would be undertaken between 9.00 am to 3.00 pm, Monday to Saturday. No exceedances of the relevant overpressure and vibration criteria are predicted at any privately-owned receivers when blasting within the borrow pits.

Flyrock

Flyrock is any material ejected from the blast site by the force of the blast. Flyrock would be managed by appropriate blast design and blast execution in accordance with best practice blast management procedures. These procedures would be described in the Blast Management Plan (Section 4.5.3).

Potential Blast Fume Emissions

Blasting activities have the potential to result in fugitive fume and particulate matter emissions. Particulate matter emissions from blasting are included in the dispersion modelling results (Appendix A). Particulate matter emissions from blasting are controlled during operations by adequate stemming of the blast.

Measures to minimise or avoid imperfect blasts, which may result in oxides of nitrogen (NO_x) fumes being emitted, would be implemented in accordance with *Code of Practice: Prevention and Management of Blast Generated NO_x Gases in Surface Blasting* (Australian Explosives Industry and Safety Group Inc., 2011) and these measures would be incorporated into the Blast Management Plan (Section 4.5.3).

4.5.3 Mitigation Measures, Management and Monitoring

Blast Management Plan

A Blast Management Plan would be developed for the modified Project in accordance with Condition 16, Schedule 3 of Development Consent DA 374-11-00. The Blast Management Plan would reflect any changes to Development Consent DA 374-11-00 that arise from the Modification and would include:

- blast monitoring;
- blast controls and/or blast optimisation measures to enable compliance with relevant criteria at receiver locations; and
- a blast notification list (nominally landowners within 2 km of the Project).

It is anticipated that blast monitoring would be conducted at nearby private receivers (e.g. to the north-east). Exact locations would be determined in consultation with landholders and regulatory bodies.

Fume emissions would be managed in accordance with the *Code of Good Practice: Prevention and Management of Blast Generated NO_x Gases in Surface Blasting* (Australian Explosives Industry and Safety Group Inc., 2011) and would be incorporated into the Blast Management Plan. Measures that would be implemented include:

- the use of risk assessments prior to blasting, in order to review factors such as:
  - geological conditions;
  - ground conditions (e.g. presence of clay or loose/broken ground or heavy rain affected ground);
  - location of the blast relative to previous blasts which may have triggered fume events;
  - blast product selection; and
  - presence of groundwater.
- use of the outcomes of the risk assessment to alter the blasting method where necessary by:
  - minimising the time between drilling and loading, and loading and shooting of the blast;
  - formulation of explosive products to an appropriate oxygen balance to reduce the likelihood of fumes; and
  - adjusting the blast scheduling to avoid unfavourable meteorological conditions.

4.6 Hazards and Risk

As described in Section 4.1, the potential hazards associated with the Modification would be related to proposed changes to the mine (including the processing facility).

A Preliminary Hazard Analysis for the Modification was undertaken by Pinnacle Risk Management (2017) and is provided in Appendix C. The Preliminary Hazard Analysis focussed on the mine (including the processing facility) and was conducted in accordance with the *Hazardous and Offensive Development Application Guidelines, Appling SEPP 33* (NSW Department of Planning, 2011a) and *Hazardous Industry Planning Advisory Paper No 6 – Hazard Analysis* (NSW Department of Planning, 2011b).

Pinnacle Risk Management (2017) considered the detailed process description for the modified processing facility, which includes description of the management of potential ore impurities, increased sulphuric acid production, storage, use and neutralisation and the production, storage and handling of ammonium sulphate.

The Modification would not change approved potential hazards at the other components of the Project and therefore these Project components have not been considered any further in this section.

4.6.1 Background

A Preliminary Hazard Analysis for the Project (SHE Pacific, 2000) was prepared in accordance with the general principles of risk evaluation and assessment provided in *Hazardous Industry Planning Advisory Paper No. 4* (NSW Department of Urban Affairs and Planning, 1992).

Potential hazards of the approved Project associated with the public, property and environment were identified and the consequences and likelihood of hazardous events were assessed qualitatively. Following the implementation of the proposed hazard mitigation measures, no risks posing significant off-site impacts were identified (SHE Pacific, 2000).

The main potential risk areas identified in the Preliminary Hazard Analysis for the Project included (SHE Pacific, 2000):

- gaseous releases including hydrogen sulphide and sulphur dioxide;
- fires including torch (ignition of pressurised flammable liquid), flash (ignition of flammable gas and air), pool (ignition of a pool of flammable liquid) and warehouse (dangerous goods stores) fires; and;
- explosions.

The Preliminary Hazard Analysis for the Project concluded that most incidences related to the mine site (including the processing facility) would have negligible impacts as a result of the distance between the processing facility, the site boundary and the nearest occupied residence (SHE Pacific, 2000).

4.6.2 Potential Hazards

The Preliminary Hazard Analysis for the Modification used a risk-based assessment for credible events that have the potential for off-site impacts. The methodology for hazard analysis and risk assessment included:

- identification of hazards to the public and environment associated with changes to the mine (including the processing facility) and compilation of potential incidents;
- estimation of the magnitude of consequences for these incidents;
- estimation of the frequency with which these incidences may occur;
- estimation of risk (combination of the frequency of the event with the probability of an undesired consequence); and
- assessment of the risk against the relevant guidelines and criteria.

The main additional potential risk events associated with the changes to the mine (including the processing facility) identified in the Preliminary Hazard Analysis for the Modification included (Appendix C):

- decomposition of the ammonium nitrate emulsion (explosives) to be used for blasting at the mine and processing facility;
- large loss of containment of ammonia (e.g. tank or transfer pipe/hose failure); and
- irregular release of sulphur dioxide or sulphur trioxide (e.g. equipment failure).

No hazard events with the potential to cause significant off-site impacts were identified for the modified borefields.

The adoption of the RIP processing method would result in the elimination of the previously assessed hazard events associated with the production of hydrogen sulphide, hydrogen and nitrogen (e.g. gaseous releases of hydrogen sulphide).

Possible initiating events, consequences and prevention/protection measures were identified for the potential incidents. The distances from the processing facility to the site boundary and nearest residences were generally found to control the significance of the incidents and their potential hazardous impacts (Appendix C).

Following estimation of the magnitude of consequences and frequency of each incident, the risk was estimated. The risks of irritation, injury and fatality were found to comply with the relevant criteria both at the site boundary and the nearest private residence (Appendix C).

Societal risk, area cumulative risk, propagation risk, transport risk and environmental risk were also concluded to be acceptable (Appendix C).

4.6.3 Mitigation Measures, Management and Monitoring

A number of mitigation measures/factors were proposed to reduce the potential hazardous risk imposed by the Project. These mitigation measures would generally be applicable to the modified Project.

The modified mine (including the processing facility) would include a number of prevention, detection and mitigation measures to reduce the risk associated with the potential risk events identified, including (Appendix C):

- explosives would be delivered and stored in precursor form and only mixed at the point of use;
- explosives handling would be compliant with the relevant Australian Standards and conducted by trained personnel only;
- tanks and equipment would be designed to the relevant Australian Standards and regularly maintained; and
- the processing facility would include a comprehensive gas monitoring system and other contemporary safety systems (e.g. control systems that initiate shutdowns during upset conditions).

The Preliminary Hazard Analysis for the Modification (Pinnacle Risk Management, 2017) includes a number of recommended mitigation measures specific to lowering the risk of off-site impacts associated with potential releases of ammonia. These mitigation measures would be considered as part of further hazard and risk studies to be completed for the processing facility prior to construction, including the Hazard and Operability (HAZOP) study and the Final Hazard Analysis.

In addition to the mitigation measures described above, Development Consent DA 374-11-00 requires the preparation of the following management plans and studies which aim to reduce the likelihood and/or consequences of potentially hazardous incidents:

- Pre-construction:
  - Fire Safety Study (Condition 52[a], Schedule 3);
  - Final Hazard Analysis (Condition 52[b], Schedule 3);
  - Construction Safety Study (Condition 52[c], Schedule 3); and
  - HAZOP (Condition 52[d], Schedule 3).
- Pre-commissioning:
  - Transport of Hazardous Materials Study (Condition 53[a], Schedule 3);
  - Emergency Plan (Condition 53[b], Schedule 3); and
  - Safety Management System (Condition 53[c], Schedule 3).

These management plans and studies would be prepared for the modified Project in accordance with Development Consent DA 374-11-00.

4.7 Groundwater

As described in Section 4.1, the potential groundwater impacts associated with the Modification would be related to proposed changes to the tailings storage facility layout and management.

A Water Management Assessment for the Modification was undertaken by Golder Associates (2017b) and is presented as Appendix D.

The Modification would not change approved groundwater impacts at the other components of the Project (e.g. the borefields) and therefore these Project components have not been considered any further in this section.

4.7.1 Existing Environment

Previous hydrogeological investigations for the Project have encountered the following four geological formations within the mine site and immediate surrounds (Appendix D):

- Laterite;
- Ultrabasic intrusive rocks (pyroxenite, gabbro, diorite);
- Residual soils/alluvial; and
- Palaeochannel.

The Girilambone Group forms the basement rock beneath the four geological formations. The bedrock is mostly dominated by fine quartz sandstone, siltstones and shale, mostly metamorphoses to quartzite, phyllite and schist (Black Range Minerals, 2000).

The mine site is formed predominantly of an oblate Dunite core intrusion approximately 2 km north-south by 3 km east-west which is surrounded by ultramafic and mafic rocks (gabbro, diorite and olivine pyroxenite) and Laterite. The deposit targeted for mining contains resource grade nickel and cobalt mineralisation within the Laterite profile overlying the Dunite core intrusion.

Residual soil/alluvial covers up to 2 m of low-lying area of the mine site (Golder Associates, 2000a).

In addition to the above, a palaeochannel exists through the mine site in a north-easterly direction. The palaeochannel is up to 1,500 m wide and 35 m deep and comprises silts, clays, gravels, quartz and rock fragments (Golder Associates, 2000a).

Existing Groundwater Regime

Groundwater Levels

A number of groundwater monitoring sites have been established at the mine site and surrounds and are shown on Figure 27. Generally, groundwater levels are 30 m to 60 m below ground level and follow the surface topography, being highest in the western area of the mine site (Appendix D).

Two recent groundwater level measurements (December 2016 and June 2017) have been recorded at the monitoring sites (including logger installation). The standing water level ranged between 210 mAHD to 280 mAHD (Appendix D).

Ground Water Yield

Hydraulic testing (falling head) has been conducted and analysed on five of the existing groundwater monitoring locations (GAM 06, GAM 07, GAM 11, GAM 12 and GAM 15) at the mine site. This hydraulic testing indicates that hydraulic conductivities are very low and the groundwater is typically low yielding (Appendix D).

Groundwater Users

Groundwater use proximal to the mine site is limited. The results of a search of the PINNEENA register for groundwater works in the vicinity of the mine site is presented on Figure 27.

The closest registered groundwater user with recorded information is approximately 7 km east of the mine site (Appendix D).

Groundwater Dependent Ecosystems

The *National Atlas of Groundwater Dependent Ecosystems* (Bureau of Meteorology, 2015) identifies no aquatic groundwater dependent ecosystems (GDEs) at the mine site and a low potential for terrestrial GDEs in the vicinity of the mine site (Appendix D).

Groundwater Quality

Based on the groundwater quality data analysis from Golder Associates (2000b), groundwater salinity across the mine site and surrounds is variable. Fresh groundwater has been encountered in the north-west area of the site, brackish in and near the palaeochannel, and saline in the south-east area of the site.

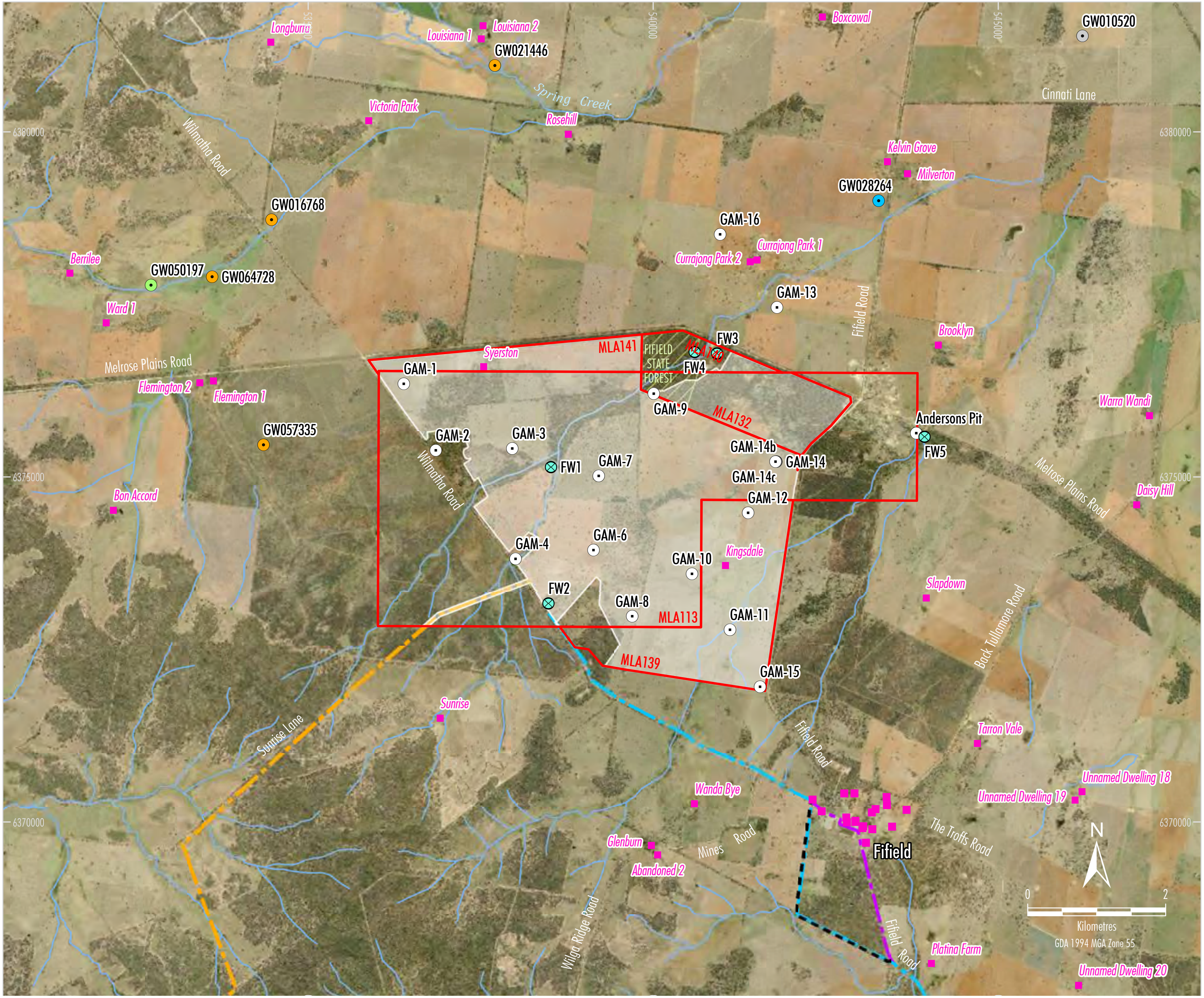
4.7.2 Potential Impacts

The Water Management Assessment prepared by Golder Associates (2017b) has evaluated the potential impacts of the proposed changes to the tailings storage facility layout and management on groundwater resources using a two-dimensional finite element model.

Groundwater Model

Three two-dimensional cross-sectional models (i.e. using Seep/W) were developed across the mine for the purposes of numerical groundwater modelling (Appendix D):

- Cross-section 1 – Runs north-east to south-west direction through deepest section of the open cut pits to estimate groundwater pit inflows and groundwater drawdown.
- Cross-section 2 – Runs north-east to south-west direction across the tailing storage facility and water storage dam to estimate potential seepage from the tailing storage facility and water storage dam.
- Cross-section 3 – Runs north-west to south-east direction through the tailing storage facility and open cut pits to estimate potential seepage from the tailing storage facility.



LEGEND

- State Forest
- Mining Lease Application Boundary
- Approved Surface Development Area
- Approved Fifield Bypass
- Approved Gas Pipeline
- Approved Water Pipeline
- Modified Water Pipeline
- Basline Surface Water Quality Monitoring Location

Bore Purpose

- Monitoring Bore
- Stock
- Stock, Irrigation
- Stock, Domestic
- Unknown

Source: Black Range Minerals (2005); NSW Department of Industry (2016); NSW Land and Property Information (2016); Office of Environment and Heritage NSW (2016)

NSW Imagery: © Department of Finance, Services & Innovation (2015)

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SYERSTON PROJECT MODIFICATION 4

Existing Groundwater and Surface Water Monitoring Network and Groundwater Users - Mine Site

Figure 27

CTL-16-02 Mod4_EA_231B

The modelling has conservatively assumed that the open cut pits are mined out and the tailings storage facility is full (i.e. saturated) from the commencement of the model. The model is therefore likely to overestimate groundwater pit inflows, groundwater drawdown and seepage rates (Appendix D).

Groundwater Inflows

The excavation of the open cut pits would result in the interception of groundwater in the deepest area of the open cut pits resulting in groundwater inflows (Appendix D).

As the Modification would not change the extent of the approved open cut pits, the groundwater inflows would remain unchanged as a result of the Modification.

The potential groundwater drawdown was estimated using the groundwater model and the predicted pit inflows during the short-term period of mining that intercepts the groundwater table is estimated to be up to approximately 0.07 ML/year in the first year of interception of the groundwater table and would reduce in the long-term to be generally less than 0.002 L/s (Appendix D). Sensitivity analysis (Appendix D) indicates that there is however potential for pit inflows to range up to 0.15 ML/year (in the short term).

Groundwater Drawdown

The excavation of the open cut pits would result in the interception of groundwater in the deepest area of the open cut pits and subsequent groundwater drawdown (Appendix D).

As the Modification does not change the extent of the approved open cut pits, the approved groundwater drawdown would however remain unchanged as a result of the Modification.

The potential groundwater drawdown was estimated using the groundwater model and the predicted maximum extent of 1 m groundwater drawdown is estimated to not extend beyond the mine boundary (Appendix D).

Seepage

The potential seepage rates from the tailings storage facility and water storage dam were estimated using the groundwater model.

The tailings storage facility and water storage dam were modelled as including a lined base with a hydraulic conductivity of 1×10^{-9} m/s consistent with Condition 29, Schedule 3 of Development Consent DA 374-11-00.

The long-term seepage rates are estimated to be less than 2.4 L/s for the tailings storage facility (i.e. clay lined) and less than 0.1 L/s for the water storage dam (i.e. HDPE lined) (Appendix D), however it is noted that the model shows high instantaneous seepage rates primarily due to the conservative assumption that the tailings storage facility is full (i.e. saturated) from the commencement of the model.

Consequently, seepage is conservatively predicted to migrate up to 400 m from the mine site boundary following the general flow directions across the site (Appendix D).

As groundwater quality in the vicinity of the tailings storage facility is brackish, and seepage is constrained by the low permeability of the underlying and adjacent soil and rock, the impact to groundwater quality would be very low (Appendix D).

Groundwater Users

As described above, the predicted maximum extent of 1 m groundwater drawdown is estimated to not extend beyond the mine boundary (Appendix D).Given there are no privately-owned bores in the mine boundary, no groundwater drawdown impacts are predicted to groundwater users. The nearest registered groundwater user with recorded information is located approximately 7 km from the site, therefore no groundwater quality impacts on groundwater users are predicted due to seepage.

Groundwater Dependent Ecosystems

As described in Section 4.7.1, no aquatic GDEs are mapped at the mine site and areas of low potential for terrestrial GDEs are mapped in the vicinity of the mine site (Appendix D).

No significant water level or quality impacts are predicted in the areas mapped as low potential for terrestrial GDEs (Appendix D).

4.7.3 Mitigation Measures, Management and Monitoring

Tailings Storage Facilities Underdrainage and Interception Drains

In addition to the clay lining, the tailings storage facility would include the installation of underdrainage and seepage interception drains at the downstream toe of the embankment. These drains would intercept any seepage flowing horizontally through the upper layers of the underlying soils.

Water Management Plan

A Water Management Plan would be prepared for the modified Project in accordance with Condition 30, Schedule 3 of Development Consent DA 374-11-00 and would include a Groundwater Management Plan. The Water Management Plan would reflect any changes to Development Consent DA 374-11-00 that arise from the Modification.

The Groundwater Management Plan would include:

- detail the performance measures and performance indicators, including trigger levels;
- a description groundwater management measures;
- a contingency plan to manage any unpredicted impacts and their consequences; and
- a groundwater monitoring program.

Groundwater Monitoring

Baseline data collected from the existing groundwater monitoring network (GAM Series) at the mine site presented in Section 4.7.1 would continue to be recorded during construction to add to the existing baseline datasets.

The existing monitoring wells near the tailings storage facility would be used as sentinel wells.

Groundwater Licensing

Groundwater extracted by mine dewatering (in-pit and advance) from the open cut pit (and immediate surrounds) is located in the Lachlan Fold Belt Murray-Darling Basin Groundwater Source administered by the *Water Sharing Plan for the NSW Murray-Darling Basin (MDB) Fractured Rock Groundwater Sources* under the *Water Management Act, 2000*.

Clean TeQ currently holds 243 share components (currently equivalent to 243 ML/year) in the corresponding Lachlan Fold Belt Murray-Darling Basin Groundwater Source.

Based on the groundwater modelling, Clean TeQ currently hold licences sufficient to cover the modelled groundwater inflows (including the short-term predictions based on the sensitivity analysis). Sufficient licence allocations could be retired at the completion of the Project to account for long-term groundwater inflows to the voids post-mining.

4.8 Surface Water

As described in Section 4.1, the potential surface water impacts associated with the Modification would be related to proposed changes to the mine (including the processing facility) and the addition of licensed surface water extraction from the Lachlan River.

A Water Management Assessment for the Modification was undertaken by Golder Associates (2017b) and is presented as Appendix D.

The revised water demand, supply configuration and water management systems proposed for the modified Project are described in Section 3.8.

The Modification would not change approved surface water impacts at the other Project components and therefore these Project components have not been considered any further in this section.

4.8.1 Existing Environment

Regional Hydrology

The mine site is located in the Macquarie-Bogan catchment which covers an area of approximately 74,800 square kilometres (km^2) within the Murray-Darling Basin. Regional north-west-flowing rivers (Bogan, Macquarie, Castlereagh, Namoi and Barwon) drain an extensive floodplain north of the mine site.

The borefields and surface water extraction infrastructure are located adjacent the Lachlan River and alluvial plain, approximately 65 km south of the mine site, within the Lachlan River catchment.

Bogan River

The NSW Office of Water operates 91 river flow gauging stations within the Macquarie-Bogan catchment recording flows on a continuous basis, with 6 stations located along the Bogan River. Flows along the Bogan River generally increase with distance downstream as a result of regulated water supplies entering from Albert Priest Canal, Gunningbar Creek and Duck Creek (Appendix D).

Gauging stations along the Bogan River relevant to understanding the regional hydrology are presented in Table 14.

Table 14 Bogan River Gauging Stations

Gauging Station	Catchment Area (km^2)	Mean Daily Flow (ML)	Distance from Bullock Creek Confluence (km)	Period of Record
Upstream of Bullock Creek Confluence				
Peak Hill	1,036	60	60	1967-2017
Downstream of Bullock Creek Confluence				
Dandaloo	5,440	174	20	1971-2017
Neurie Plain	14,760	221	100	1959-2017
Gongolgon	27,970	532	280	1945-2017

After: Appendix D.

Lachlan River

Flow in the Lachlan River is regulated. The main regulating storage is Wyangala Dam, located at the junction of Abercrombie and Lachlan Rivers 48 km upstream of Cowra. The volume and temporal pattern of flow in the river has changed significantly since the construction of Wyangala Dam and the increasing extraction of water for irrigation and other purposes. Since regulation, no-flow periods in the upper parts of the catchment have largely disappeared, and short-duration flow events are more attenuated.

Flow in the Lachlan River reaches a maximum at Forbes but then begins decreasing due to losses to the alluvial expanses west of Forbes. This is caused by recharge of alluvial expanses in the more arid westerly regions, from streamflow generated in the topographically higher (eastern) part of the catchment where rainfall is higher and alluvial tracts are less significant.

Despite the Lachlan River being a tributary of the Murrumbidgee River, the losses make the Lachlan River a quasi-terminal system with little water flowing past the Great Cumbung Swamp at its end. Flow to the Murrumbidgee River only occurs during large flood events.

The DPI-Water operates around 100 flow gauging stations within the Lachlan River catchment which record flows on a continuous basis. Due to the complex stream system along the reach between Forbes and Condobolin (downstream of the proposed surface water extraction infrastructure), there is a lack of continuous and real-time flow gauging station data.

Local Hydrology

Mine Site

The mine site is located in the upper headwaters of Bullock Creek in proximity to the township of Tullamore to the north-east and the headwaters of the Lachlan catchment to the south.

Two small catchment areas (approximately 2,700 ha and 1,950 ha, respectively) to the south-west, contribute to two ephemeral watercourses which cross the mine site. The northern watercourse discharges into Bullock Creek to the north-east which flows north-easterly and then discharges to the Bogan River. The southern watercourse loses definition north-east of the site due to a combination of flat terrain and interruption by remnant mining operations in the area.

Watercourses in the location of the mine (and process facility) are shallow broad vegetated ephemeral channels and as such are not suitable for flow monitoring. There are no gauging stations maintained on Bullock Creek.

Borefields and Surface Water Extraction Infrastructure Area

The topography of the borefields area along the Lachlan River and immediate surrounds is highly advantageous for gravity-driven irrigation. Besides the Lachlan River itself, surface drainage systems include ephemeral streams, irrigation channels (artificial, but ephemeral, watercourses), swamps and intermittent lakes.

The area to the south of the Lachlan River (to Lake Cowal) hosts the Jemalong Irrigation District covering 93,000 ha. Jemalong Irrigation Limited manages the licensed diversion of flows from the Lachlan River at Jemalong Gap and is monitored using the flow gauge 412100.

Results of streamflow and baseflow analysis (Table 15) demonstrate that drainage channels in the Borefields catchment are largely intermittent and consistent with the understanding that leakage from the Lachlan River and other local watercourses are known to be a significant recharge mechanism to the groundwater system, particularly in the areas closer to Jemalong Gap.

Table 15 Results of Streamflow/Baseflow Analysis – Gauging Station 412403

Gauging Station	Catchment Area (km^2)	Averages (As a Proportion of Rainfall)		Period of Record
		Runoff	Baseflow	
Upstream of Lachlan River Confluence				
412403	4,144	0.021	0.0046	1948-1981

Source: After Coffey Geosciences (2016a)

Surface Water Quality

Water Quality Objectives (WQOs) have been developed for NSW rivers and estuaries which provide guideline levels to assist water quality planning and management (NSW Government, 2006). WQOs with accompanying trigger values apply to the following objectives: aquatic ecosystems, visual amenity, recreation, livestock and irrigation, drinking water, and aquatic foods.

A baseline surface water quality monitoring program was commenced in 1997 at monitoring sites FW1, FW2 and FW3 at the mine site and surrounds (Figure 27). Monitoring sites FW4 and FW5 were added to the monitoring program in May 2000. Table 16 presents a statistical summary of the recorded data.

Table 16 Surface Water Quality Monitoring Results – Mine Site

Parameter	Units	Monitoring Results (FW1-FW5)
Electrical Conductivity (EC)	µS/cm	42 to 395
pH	pH units	7.01 to 8.95
Sodium (Na)	mg/L	3 to 48
Potassium (K)	mg/L	2 to 13
Calcium (Ca)	mg/L	<1 to 22
Magnesium (Mg)	mg/L	1 to 22
Iron (Fe)	mg/L	<0.1 to 3.7
Chloride (Cl)	mg/L	<1 to 32
Sulphate (SO_4)	mg/L	<1 to 6
Bicarbonate (HCO_3)	mg/L	22 to 184
Carbonate (CO_3)	mg/L	<1 to 48
Arsenic (As)	mg/L	<0.01
Cadmium (Cd)	mg/L	<0.001 to 0.017
Copper (Cu)	mg/L	<0.001 to 0.006
Nickel (Ni)	mg/L	<0.001 to 0.004
Lead (Pb)	mg/L	<0.001 to 0.002
Zinc (Zn)	mg/L	<0.001 to 0.031
Suspended Solids	mg/L	4 to 40

Source: After Coffey Geoscience (2016a). Note: mg/L = milligrams per litre.

Surface Water Users

Given the ephemeral nature of the drainage lines in the vicinity of the mine site, there are no known surface water users immediately upstream or downstream with an access licence.

As identified in Coffey Geosciences (2016b), surface water users in the region are predominately associated with regulated Lachlan and Macquarie Rivers and to a less extent the unregulated Lachlan water sources.

Lachlan Regulated River Water Source

As described in Section 3.8.2, Clean TeQ would seek to purchase volumetric allocations from the Lachlan River to allow for licensed surface water extraction and conveyance via the adjacent water pipeline to the mine site. An application would therefore be made by Clean TeQ for a new specific purpose WAL or zero share component WAL (for subsequent trading of water on the open market).

As demonstrated below by the available share components in the Lachlan Regulated River Water Source, history of available water determinations (AWDs) orders and recent water trading statistics, while the water market is variable (availability subject to significant rainfall events), it is mature (administered since 2004) and has significant depth of available shares for trading.

Available Share Components

It was estimated at the time of commencement of the *Water Sharing Plan for the Lachlan Regulated River Source, 2016*, the share components of regulated river (high security) access licences authorised to take water from the Lachlan Regulated River Water Source total 27,680 unit shares.

It was estimated at the time of commencement of the *Water Sharing Plan for the Lachlan Regulated River Source, 2016*, the share components of regulated river (general security) access licences authorised to take water from the Lachlan Regulated River Water Source total 592,801 unit shares.

Available Water Determinations

It is noted that AWDs orders are regularly made and applied to water sources to which the *Water Sharing Plan for the Lachlan Regulated River Source, 2016* applies.

Records of past orders made under the *Water Management Act, 2000* for regulated river (general security) and regulated river (high security) access licences since replacement of the *Water Sharing Plan for the Lachlan Regulated River Source, 2016* on 1 July 2016 are summarised in Table 17.

Table 17 Available Water Determination Orders for the Lachlan River Regulated Water Source (since 1 July 2016)

AWD Order	Commenced	Category of Access Licence	Volume per Unit of Access Licence Share Component
Lachlan Regulated River Water Source 2017-2018	14 August 2017	Regulated River (General Security) Access Licence	0.02 ML
Various NSW Regulated River Water Sources (No.2) 2017	27 June 2017	Regulated River (High Security) Access Licence	1.0 ML
		Regulated River (General Security) Access Licence	0.0 ML
Lachlan Regulated River Water Source 2016-2017	15 June 2017	Regulated River (General Security) Access Licence	0.02 ML
	10 April 2017	Regulated River (General Security) Access Licence	0.05 ML
	5 September 2016	Regulated River (General Security) Access Licence	0.09 ML
	5 August 2016	Regulated River (General Security) Access Licence	1.15 ML
	15 July 2016	Regulated River (General Security) Access Licence	0.25 ML
Various NSW Regulated River Water Sources (No.2) 2016	29 June 2016	Regulated River (High Security) Access Licence	1.0 ML
		Regulated River (General Security) Access Licence	0.18 ML

Source: http://www.water.nsw.gov.au/water-management/water-availability/water-allocations

As demonstrated by Table 17, high security access licences have been at 100%, whereas general security access licences are variable (i.e. subject to significant rainfall events).

Prior to 1 July 2016, the NSW Office of Water records on the NSW Water Register show:

- since 1 July 2011, regulated river (high security) access licences for the Lachlan Regulated River Water Source have been at 1 ML per share component;
- between 1 July 2004 and 2 September 2010, regulated river (high security) access licences for the Lachlan Regulated River Water Source were generally at 0.2 ML per share (or less) for 5 of the 6 years (i.e. 0.8 ML per share for 2006-07 and 0.35 ML per share for one week in September 2005);
- since 7 August 2015, regulated river (general security) access licences for the Lachlan Regulated River Water Source was on average approximately 0.07 ML per share component;
- since 7 August 2015, regulated river (general security) access licences for the Lachlan Regulated River Water Source was at 0 ML per share component for approximately 6 weeks in July-August 2017; and
- from 1 July 2011 to 7 August 2015, river (general security) access licences for the Lachlan Regulated River Water Source was at 0 ML per share component.

Water Trading Statistics (since 1 July 2016)

The NSW Office of Water records on the NSW Water Register show:

- since 2004 water trading has occurred regularly for regulated river (high security) access licences and regulated river (general security) access licences for the Lachlan Regulated River Water Source;
- since 1 July 2016, 8 trades for regulated river (high security) access licences for the Lachlan Regulated River Water Source were made for a total of 1,113 share components; and
- since 1 July 2016, 61 trades for regulated river (general security) access licences for the Lachlan Regulated River Water Source were made for a total of 35,738 share components.

Flooding

The local group of west and north-west flowing rivers (Bogan, Macquarie, Castlereagh, Namoi and Barwon Rivers) drain an extensive floodplain north of the mine site at low gradients (less than 1 in 5,000) historically producing large areas of inundation in wet years. The mine site is located some 30 m to 70 m above the estimated upper extent of this floodplain (Golder Associates, 2000b).

The surface water extraction infrastructure is located in the Lachlan River floodplain.

4.8.2 Potential Impacts

Surface Water Flow Regimes

The approved Project will result in changes to flows in local drainage lines due to the progressive development of the mine and associated capture and re-use of drainage from operational disturbance areas.

As the Modification would not increase the extent of the approved surface development area and would only include minor changes to the water management system (e.g. diversions), no significant change to the approved flow impacts in the drainage lines in the vicinity of the mine site would be expected. Given the above, the Modification is expected to result in negligible change to the approved flow impacts in Bullock Creek and the Bogan River.

The Modification would not change the approved final void concepts (Section 5.2.2). Therefore there would be no change in the catchment area excised post-mining.

Lachlan River Surface Water Extraction

As described in Section 3.9.2, licensed water extraction would occur from the Lachlan River to improve the water supply security of the Project. A pump station would be constructed near the Lachlan River to extract surface water and pump it to the borefield transfer station for transfer to the mine site (Figures 16 to 18).

As described in Section 4.8.3, Clean TeQ would make an application for a new specific purpose WAL or zero share component WAL (for subsequent trading of water on the open market). Water would be extracted from the Lachlan River in accordance with the WALs and the rules prescribed in the relevant water sharing plan (i.e. the *Water Sharing Plan for the Lachlan Regulated River Water Source, 2016*).

As all extraction from the Lachlan River would be conducted in accordance with the licensed entitlements issued by the DPI – Water, and in accordance with the rules in the water sharing plan, impacts to the Lachlan River water source are not anticipated to be of any significance, as licensed water extractions are regulated by upstream releases from Wyangala Dam.

Surface Water Quality

Runoff and Contaminants

Surface water runoff from disturbed areas could potentially contain sediments, dissolved solids, oil, grease, metals and salts.

The modified mine water management system is described in Sections 3.8.3. Erosion and sediment controls and land contamination controls that would be applied to the modified Project are described in Section 4.8.3 and 4.2.3.

The water management system is designed to control runoff from the development/construction areas and the operation areas, while diverting upstream water around these areas.

The tailings storage facility, water storage dam or evaporation ponds would be designed in accordance with the existing water management performance measures in Condition 29, Schedule 3 of the Development Consent DA 374-11-00 (i.e. to capture and convey the 100 year, 72-hour ARI rainfall event).

In addition, Clean TeQ would operate the Project in accordance with the requirements of an EPL issued under Part 3 of the PoEO Act.

With these controls in place, the Modification is predicted to have no change to the approved potential water quality impacts in the receiving drainage lines (Appendix D).

Flooding

The Modification is not expected to have any change to the flooding impacts.

The pump station at the Lachlan River and all associated infrastructure would be constructed to be at an elevation higher than the 1 in 25 year flood event (Golder Associates, 2017a).

Post-Mining Surface Water Impacts

The potential post-mining surface water impacts primarily relate to the design of the final voids and performance of the permanent and rehabilitated mine landforms in the long-term and are discussed below. As described in Section 5, the Modification would not significantly change the approved rehabilitation strategy.

Final Void

Consistent with the approved Project, at the cessation of mining, two final voids would remain.

The Modification would not significantly change the rehabilitation strategy for the final voids domain that includes the following objectives:

- Mine planning would target minimising the size and depth of the final voids as far as reasonable and feasible.

- The catchment of the final voids would be minimised with the provision of permanent perimeter bunds, diversion channels and/or bunds/embankment walls.
- The final landform design would provide flood immunity for flood events up to a 1 in 100 year ARI rainfall event.

Rehabilitated Mine Landforms

Storage dams and sediment dams would be retained until the revegetated surface of mine landforms is stable and runoff water quality reflects runoff water quality from similar unmined areas. At this time these drainage controls may be removed and the rehabilitated areas would be free-draining.

4.8.3 Mitigation Measures, Management and Monitoring

Water Management Performance Measures

Clean TeQ has reviewed the water management performance measures included in Condition 29, Schedule 3 of Development Consent DA 374-11-00 in the context of the Modification and concluded that no changes are required for the modified Project.

Water Quality Management Measures

The water management system would be used to protect the integrity of local and regional water sources and separate runoff from undisturbed, rehabilitated and mining affected areas.

An internal drainage system will be constructed to collect and contain water generated within the development/construction areas and operation areas.

Sediment control structures such as sediment dams and sediment fences would be employed where necessary within and downstream of disturbance areas. Consistent with Condition 29, Schedule 3 of Development Consent DA 374-11-00, the sediment control structures will be designed, installed and maintained in accordance with *Managing Urban Stormwater: Soils and Construction*.

Clean TeQ would monitor the water quality of relevant water storages during the life of the Project as part of a surface water monitoring program.

The water management system would be operated throughout the life of the mine to provide sufficient water to meet the Project demand. It would also be designed to provide sufficient water storage capacity.

Water Management Plan

A Water Management Plan would be prepared for the modified Project in accordance with Condition 30, Schedule 3 of Development Consent DA 374-11-00 and would include a Water Balance and Surface Water Management Plan. The Water Management Plan would reflect any changes to Development Consent DA 374-11-00 that arise from the Modification.

Water Balance

A periodic review and revision of the site water balance would be undertaken over the life of the Project to record and document the status of inflows (water capture), storage and consumption (e.g. dust suppression and processing plant water supply) and to optimise water management performance.

Monitoring would be undertaken over the life of the modified Project to provide data for refinement of the site water balance, including:

- mine water storage and raw water dam levels and volumes (stored and freeboard), including development of storage curves;
- mine pit inflows/dewatering (where measurable from pumping records);
- water received at the mine from the borefield and/or surface water extraction;
- potable water supply;

- dust suppression water demands;
- processing water inputs and outputs; and
- any discharges (volume, rate and quality) licensed by an EPL.

Surface Water Management Plan

The Surface Water Management Plan would include:

- a detailed description of the water management system;
- detailed plans, including design objectives and performance criteria;
- trigger levels for investigating any potentially adverse impacts associated with the Project;
- contingency mitigation/compensation/offset measures that would be implemented in the event that downstream surface water users are adversely affected by the Project; and
- a surface water monitoring program.

Surface Water Licensing

In accordance with Condition 26, Schedule 3 of Development Consent DA 374-11-00, Clean TeQ would ensure that sufficient water is supplied for all stages of the development, and obtain the necessary water licences for the development under the *Water Management Act, 2000*, and if necessary, adjust the scale of development on-site to match its available water supply.

Clean TeQ would make an application for a new specific purpose WAL or zero share component WAL (for subsequent trading of water on the open market). As described in Section 3.8.2, based on the available share components in the Lachlan Regulated River Water Source, history of AWDs orders and recent water trading statistics, while the water market is variable (availability subject to significant rainfall events), it is mature (administered since 2004) and has significant depth of available shares for trading.

The *Water Management Act, 2000* gives landholders the right to capture 10% of the average regional rainwater runoff on the land by means of harvestable rights. The landholding owned by Clean TeQ which is attributable to the mine site provides a maximum harvestable right capacity (i.e. maximum dam capacity) of 105 ML (Appendix D), without the requirement for additional surface water licensing

Post-Mining Surface Water Management

The management of surface water resources post-mining is discussed in Section 5.

4.9 Road Transport

A Road Transport Assessment for the Modification was undertaken by GTA Consultants (2017) and is presented as Appendix E.

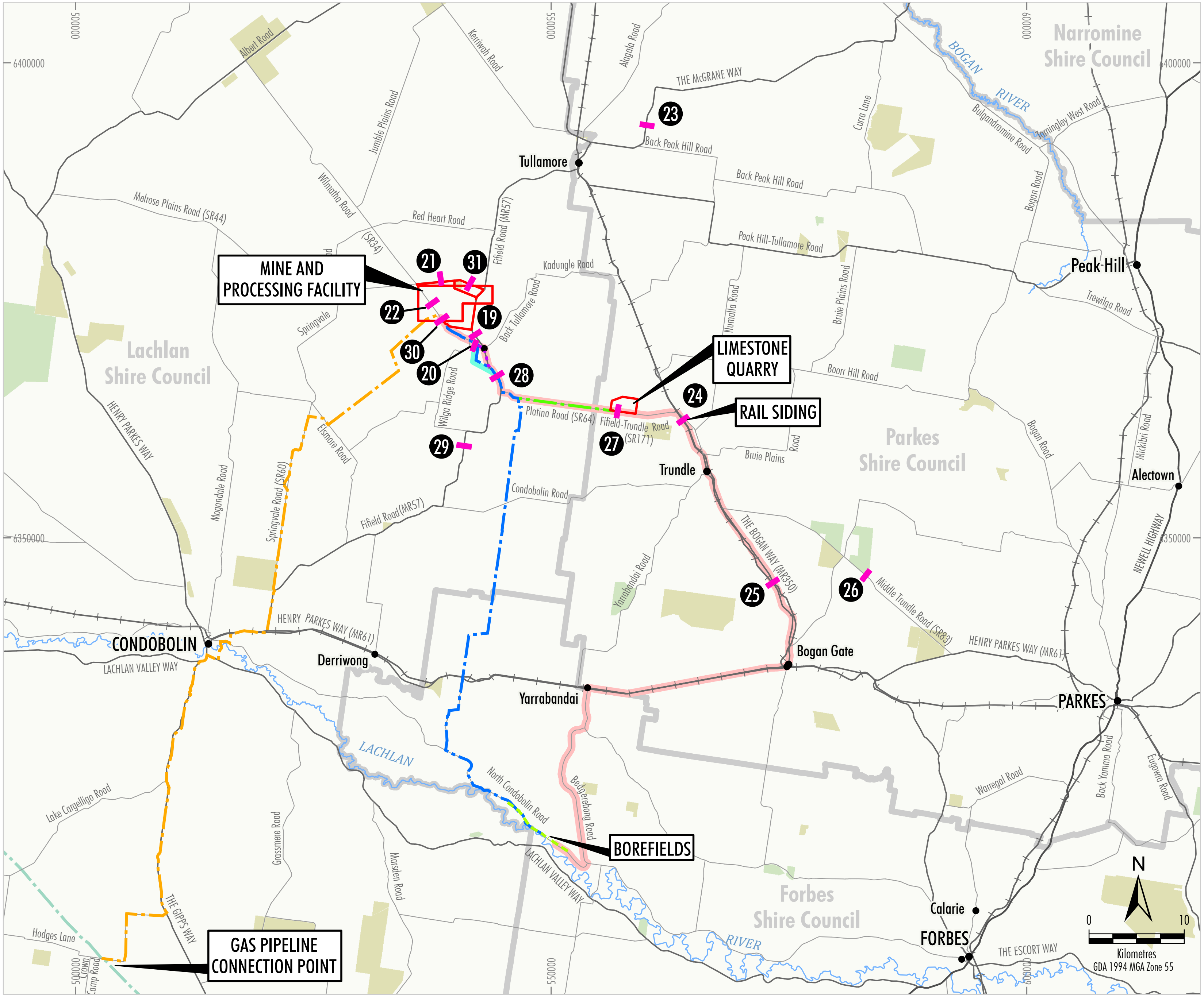
The assessment was prepared in accordance with the *Guide to Traffic Generating Developments* (NSW Roads and Traffic Authority [RTA], 2002), and where relevant, makes reference to the RTA's (1996) *Road Design Guide* and Austroads standards.

4.9.1 Existing Environment

Road Hierarchy

The following key roads are of relevance to the Project (Figure 28):

- Henry Parkes Way [MR61] – extends between Orange and Condobolin through Parkes.
- The Bogan Way [MR350] – extends north from Forbes to Tullamore. The Bogan Way intersects Henry Parkes Way at Bogan Gate.



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LEGEND

- NSW National Parks and Wildlife Service
- State Forest
- Local Government Boundary
- Railway
- Mining Lease Application Boundary
- Existing Gas Pipeline
- Approved Gas Pipeline
- Approved Water Pipeline
- Approved Limestone Quarry Water Pipeline
- Approved Borefield Infrastructure Corridor
- Modified Water Pipeline Alignment Option
- Approved Fifield Bypass
- Short-term Water Transport Route
- Traffic Survey Location

Source: GTA Consultants (2017); Black Range Minerals (2000); NSW Department of Industry (2017); NSW Land and Property Information (2017); Office of Environment and Heritage NSW (2017)

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Traffic Survey Sites

Figure 28

- The McGrane Way [MR357] – extends north-east from north of Tullamore to Narromine. The McGrane Way intersects The Bogan Way near Tullamore.
- Fifield-Trundle Road [SR171]/Platina Road [SR64] – provides an east-west link between The Bogan Way near Trundle to Fifield Road [MR57] south of Fifield.
- Fifield Road [MR57] – extends between Henry Parkes Way east of Condobolin to Tullamore.
- Wilmatha Road [SR34] – extends north-west from Fifield and past the mine site.
- Middle Trundle Road [SR83] – links Henry Parkes Way approximately halfway between Parkes and Bogan Gate to The Bogan Way south of Trundle.
- Yarrabandai Road – links The Bogan Way north-west of Forbes and The Bogan Way at Trundle.
- Noakes Road – links Yarrabandai Road approximately 24 km south of Henry Parkes Way to Bedgerabong Road at Bedgerabong.
- Bedgerabong Road – intersects with North Condobolin Road (which provides access to the borefields) approximately 15 km west of Bedgerabong.

Existing Traffic Volumes

Traffic survey data in the Project area are summarised in Table 18 and the traffic survey locations are shown on Figure 28.

Further details on the road survey data are provided in Appendix E.

Table 18 Surveyed Average Traffic

Site[1]	Road	Survey Location	Peak Hour (vehicles per hour)	Daily (vehicles per day)	Heavy Vehicles (%)	Survey Timing
19	Fifield Road	Between Tullamore and Fifield	21	185	9.5	November 2016
20	Slee Street	In Fifield	26	246	28.5	
21	Melrose Plains Road	East of Wilmatha Road	2	13	49.4	
22	Wilmatha Road	South of Melrose Plains Road	2	21	38.1	
23	The McGrane Way	North of Back Peak Hill Road	14	124	24.1	
24	The Bogan Way	Between Trundle and Fifield-Trundle Road	43	367	19.3	January to March 2017
25	The Bogan Way	Between Bogan Gate and Middle Trundle Road	41	388	24.0	
26	Middle Trundle Road	Between The Bogan Way and Henry Parkes Way	17	118	22.0	
27	Fifield-Trundle Road	Between The Bogan Way and Platina Road	11	78	17.9	
28	Fifield Road	Between Slee Street and Platina Road	28	253	28.9	
29	Fifield Road	Between Platina Road and Springvale Road	20	198	35.4	
30	Wilmatha Road	North of Sunrise Lane	2	19	15.8	
31	Melrose Plains Road	Between Fifield Road and Wilmatha Road	4	11	27.3	

Source: After Appendix E.

[1] Refer to Figure 28 for locations.

Review of the data indicates that existing daily and peak hour traffic volumes are low and the peak periods occur in the morning and in the mid to late afternoon (Appendix E).

The proportion of heavy vehicles varies significantly across road network (9.5% to 49.4%). The total number of heavy vehicles on the road network is low, however, as the background traffic volumes are low (Appendix E).

Roadway Capacity

Austroads (2013) defines theoretical capacities for two-way two lane rural roads. Taking into account the proportion of heavy vehicles, the peak hourly flows on the road network around the Project are very low in comparison to the Austroads (2013) theoretical capacities and a detailed assessment of midblock road capacity is not warranted (Appendix E).

Intersection Performance

There are no intersection operation capacity concerns in the vicinity of the Project (Appendix E).

Road Safety

A review of RMS accident data in the vicinity of the Project during the period 1 January 2011 to 14 November 2016 was undertaken by GTA Consultants (Appendix E). This review indicated that:

- no accidents were reported on Springvale Road, Wilmatha Road, Platina Road, Fifield-Trundle Road, Melrose Plains Road;
- no accidents were reported on the component of the proposed water transport route south of the Henry Parkes Way including North Condobolin Road, Bedgerabong Road and Yarrabandai Road;
- accident rates on Henry Parkes Way, The Bogan Way, The McGrane Way and Fifield Road are below accident rates described as being typical by the RMS for rural roads (RTA, 2004); and
- accident rates on Middle Trundle Road are above accident rates described as being typical by the RMS for rural roads (RTA, 2004), although is not considered to reflect any particular issue with that road, rather that the road is not indicative of the routes used in the calculation of average crash rates.

4.9.2 Potential Impacts

Potential road transport impacts of the Modification on traffic generation, roadway capacity and safety are assessed in Appendix E and summarised below.

The key potential road transport impacts of the Modification would be associated with:

- changes to process input and product road transport requirements (Section 3.6.2), including:
  - increased sulphur transport from 260,000 tpa to 350,000 tpa;
  - increased limestone transport from 790,000 tpa to up to 990,000 tpa;
  - sourcing of up to approximately 560,000 tpa of the required limestone from third party suppliers;
- limited heavy vehicle use of The McGrane Way (Section 3.6.2); and
- short-term road transport of water from the borefield to the mine site during the construction phase (Section 3.9.3).

As ammonium sulphate product would be backloaded in trucks transporting sulphur between the rail siding and the mine site (Section 3.6.4), no additional heavy vehicle movements would be required to transport this new product.

Although the Modification would include the construction of additional Project infrastructure (e.g. water treatment plant and surface water extraction infrastructure), the road transport requirements and potential impacts during the modified construction phase would remain generally consistent with the approved Project (with the exception of the short-term road transport of water) (Appendix E).

Project Traffic Generation

Table 19 summarises the approved and estimated predicted modified Project daily vehicle movements (traffic in both directions).

Table 19 Approved Project and Predicted Modified Two-way Weekday Traffic

Scenario	Daily (vehicles per day)		
	Light	Heavy	Total
Approved Project	263	207	470
Modified Project	424	212	636

Source: After Appendix E.

The Modification would not result in a significant change to the number of Project heavy vehicle movements (Table 19). The proposed increase in heavy vehicle movements associated with the transport of higher volumes of limestone and sulphur would be partly offset by a reduction in other heavy vehicle delivery trips, and changes to some of the transport characteristics assumed in Modification 2 (Masson Wilson Twiney Pty Ltd, 2005) (Appendix E).

The estimated light vehicle generation of the modified Project is higher than that of the approved Project, primarily as a result of changes in the assumptions regarding the workforce present on site and its travel characteristics (Appendix E).

Clean TeQ would minimise the number of heavy vehicles movements by maximising the use of rail transport and consolidating materials and product transport where practicable.

Cumulative Traffic Increases

In order to conservatively consider the potential impacts of the Modification in the context of potential background traffic growth, an annual baseline growth rate has been considered.

Based on the traffic survey data (Table 18), a 2% per annum baseline traffic growth rate was applied to the existing traffic volumes (Appendix E).

GTA Consultants (2017) conducted a review of other significant proposed and approved projects in the area and considered that traffic from these projects did not need to be added to potential background traffic growth.

Table 20 presents the predicted traffic flows on key roads including additional Project traffic flows and estimated background traffic growth. Figure 29 shows the locations of traffic forecast sites.

Roadway Capacity

Austroads (2013) defines a Level of Service as a qualitative measure describing operational conditions within a traffic stream (in terms of speed, travel time, freedom to manoeuvre, safety and convenience) and their perception by motorists and/or passengers. Level of Service A provides the best traffic conditions, with no restriction on desired travel speed or overtaking. Level of Service B to D describes progressively worse traffic conditions. Level of Service E occurs when traffic conditions are at or close to capacity.

Level of Service B is forecast on the road network around the modified Project during peak periods. Level of Service B represents good operating conditions (Appendix E).

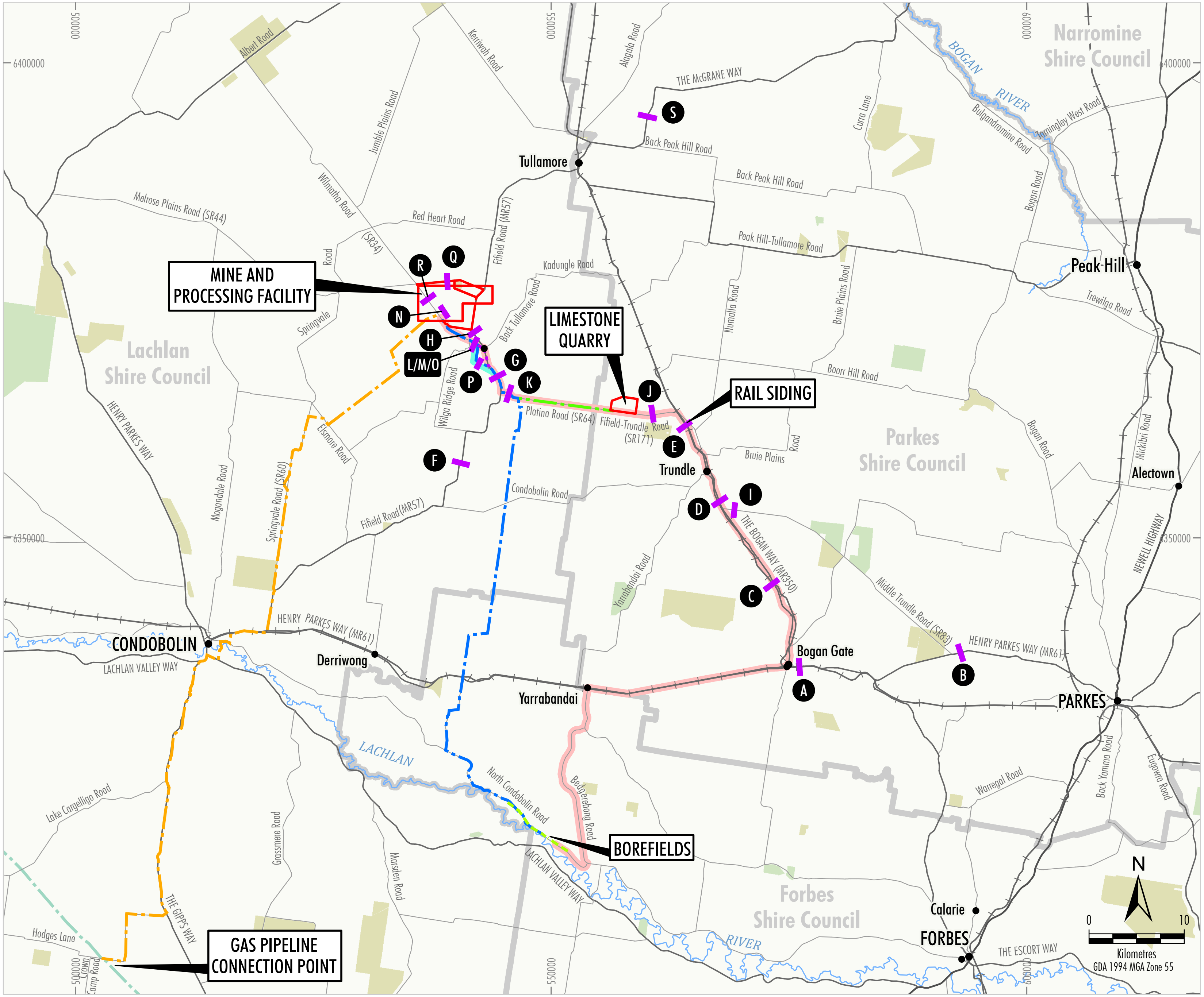
Intersection Performance

GTA Consultants (2017) considered that formal peak hour intersection analysis for key intersections was not warranted given the low predicted traffic volumes.

No capacity concerns regarding the operation of key intersections are expected for the modified Project (Appendix E).

Road Upgrades

The proposed road upgrades for the modified Project are outlined in Section 3.14.



LEGEND
- NSW National Parks and Wildlife Service
- State Forest
- Local Government Boundary
- Railway
- Existing Gas Pipeline
- Mining Lease Application Boundary
- Approved Gas Pipeline
- Approved Water Pipeline
- Approved Limestone Quarry Water Pipeline
- Approved Borefield Infrastructure Corridor
- Modified Water Pipeline Alignment Option
- Approved Fifield Bypass
- Short-term Water Transport Route
- Traffic Forecast Location

Source: GTA Consultants (2017); Black Range Minerals (2000); NSW Department of Industry (2017); NSW Land and Property Information (2017); Office of Environment and Heritage NSW (2017)

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Traffic Forecast Locations

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Figure 29

Table 20 Predicted Cumulative Two-way Weekday Traffic

Site[1]	Road	Location	Approved Project			Modified Project		
			Light	Heavy	Total	Light	Heavy	Total
A	Henry Parkes Way	East of Bogan Gate	1,024	297	1,321	1,024	345	1,369
B		East of Middle Trundle Road	1,122	912	2,034	1,161	968	2,129
C	The Bogan Way	North of Henry Parkes Way	355	146	501	360	194	554
D		North of Middle Trundle Road	624	171	795	668	227	895
E		North of Trundle	543	119	662	611	175	786
F	Fifield Road	North of Henry Parkes Way	224	133	357	298	92	390
G		North of Platina Road	474	295	769	616	296	912
H		North of Wilmatha Road	163	65	228	182	69	251
I	Middle Trundle Road	East of The Bogan Way	291	31	322	330	39	369
J	Fifield-Trundle Road	West of The Bogan Way	265	85	350	333	161	494
K	Platina Road	East of Fifield Road	265	175	440	333	217	550
L	Wilmatha Road	West of Slee Street	282	211	493	443	216	659
N	MPF Access Road	East of Wilmatha Road	263	207	470	424	212	636
O	Slee Street	In Fifield	470	291	761	612	292	904
Q	Melrose Plains Road	East of Wilmatha Road	10	4	14	10	4	14
S	The McGrane Way	North of Black Peak Hill Road	114	36	150	114	40	154

Source: After Appendix E.

[1] Refer to Figure 29 for locations.

The modified road upgrades are based on recommendations of GTA Consultants (2017) and consultation undertaken with the RMS and relevant councils.

Road Safety Review

The modified Project would not result in significant impacts on the safety of the road network with implementation of management and mitigation measures (Appendix E).

Limited Heavy Vehicle Use of The McGrane Way

Condition 42, Schedule 3 of Development Consent DA 374-11-00 requires that no heavy vehicles use The McGrane Way when travelling to or from the Project, unless otherwise agreed by the Secretary.

The Modification proposes the limited use of The McGrane Way by heavy vehicles. The modified Project would have acceptable impacts on the operation of The McGrane Way with no significant impacts on its performance, capacity, efficiency and safety (Appendix E).

In addition, the proposed very low level of additional heavy vehicle traffic would not warrant any upgrading of The McGrane Way (Appendix E).

Clean TeQ would contribute to the maintenance of relevant sections of The McGrane Way (Section 4.9.3).

Road Transport of Construction Water

As described in Section 3.9.3, prior to the commissioning of the water pipeline (approximately 6 months), water would be transported from the borefields to the mine site by road.

The proposed short-term construction phase water transport route from the borefields to the mine site is shown on Figure 19.

The short-term road transport of water would allow for construction to commence at the mine site before the water pipeline has been constructed. This would bring forward the commencement of construction (and subsequent operations) by approximately six months.

The Road Transport Assessment (Appendix E) assessed the potential road transport impacts of the short-term water transport and concluded that the overall impacts of the short-term road transport of water would be small. The predicted traffic would be well within the capacity of the existing roads and it would not exacerbate any existing safety concerns along the route (Appendix E).

Clean TeQ would contribute to the maintenance of the proposed short-term construction phase transport route (Section 4.9.3).

4.9.3 Mitigation Measures and Management

Road Upgrades

The proposed road upgrades for the modified Project are outlined in Section 3.14.

The modified road upgrades are based on recommendations of GTA Consultants (2017) and consultation undertaken with the RMS and relevant councils. These modified road upgrades are consistent with the terms of the VPAs that the relevant councils have provided in-principle support for.

Road Maintenance

The proposed road maintenance contributions for the modified Project are outlined in Section 3.14.

Clean TeQ has consulted with the relevant councils regarding the proposed changes to the road safety audit and road maintenance requirements as part of VPA negotiations (Section 1.3).

Road Upgrades and Maintenance Strategy

A Road Upgrades and Maintenance Strategy would be developed in consultation with the RMS, LSC, PSC and FSC for the modified Project in accordance with Condition 43, Schedule 3 of Development Consent DA 374-11-00.

The Road Upgrades and Maintenance Strategy would reflect any changes to Development Consent DA 374-11-00 that arise from the Modification and would include a program for the implementation of the road upgrades and a program for road maintenance.

Traffic Management Plan

A Traffic Management Plan would be developed in consultation with the RMS, LSC, PSC and FSC for the modified Project in accordance with Condition 45, Schedule 3 of Development Consent DA 374-11-00. The Traffic Management Plan would reflect any changes to Development Consent DA 374-11-00 that arise from the Modification and would include:

- details of transport routes to be used by the Project;
- product transport monitoring program;
- limestone transport monitoring program;
- measures to minimise traffic safety issues and disruption to the local community during the construction of the Project; and
- a Road Transport Protocol for all drivers transporting materials to and from the Project.

4.10 Aboriginal Cultural Heritage

As described in Section 4.1, the potential Aboriginal cultural heritage impacts associated with the Modification would be related to additional surface development areas required for the surface water extraction infrastructure, the modified borefields layout and the water pipeline alignment option (Section 3.9) (the additional surface development areas).

An Aboriginal Cultural Heritage Assessment (ACHA) has been prepared for the Modification by Landskape Natural and Cultural Heritage Management (Landskape) and is presented in Appendix F. The ACHA focusses on these additional surface development areas and has been undertaken in consideration of (but not limited to) the following codes, guidelines and regulations (Appendix F):

- *Aboriginal cultural heritage consultation requirements for proponents 2010* (DECCW, 2010a);
- *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCW, 2010b);
- *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (DECCW, 2010c);
- *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (OEH, 2011);
- *The Burra Charter: The Australia ICOMOS Charter for the Conservation of Places of Cultural Significance* (International Council on Monuments and Sites, 2013);
- *Aboriginal Cultural Heritage: Standards and Guidelines Kit* (NSW National Parks and Wildlife Service, 1997);
- *Ask First: A Guide to Respecting Indigenous Heritage Places and Values* (Australian Heritage Commission, 2002);
- *Engage Early* (Commonwealth Department of the Environment, 2016);
- NSW *Minerals Industry Due Diligence Code of Practice for the Protection of Aboriginal Objects* (NSW Minerals Council, 2010); and
- NSW *National Parks and Wildlife Regulation, 2009.*

The Modification would not change the approved Aboriginal cultural heritage impacts at the other Project components and therefore these Project components have not been considered any further in this section.

4.10.1 Existing Environment

Aboriginal Cultural Heritage Assessment

The ACHA (Appendix F) incorporates relevant information from previous assessments (including for the approved Project), the results of the field surveys and associated consultation with the Aboriginal community, including:

- results from extensive fieldwork and archaeological and cultural investigations previously undertaken at the Project and surrounds;
- search results from the OEH Aboriginal Heritage Information Management System (AHIMS) database and other heritage registers;
- results from extensive consultation with the Aboriginal community regarding archaeological and cultural heritage values; and
- a detailed description of the methods implemented and the results of archaeological and cultural surveys conducted by archaeologists and representatives of the Aboriginal community for the Modification during 2016 and 2017.

The key steps involved in the preparation of the ACHA and associated consultation are described below.

Aboriginal History

Aboriginal people of the Wiradjuri language group were traditionally associated with the region encompassing the Macquarie, Lachlan and Murrumbidgee Rivers (Appendix F). The Wiradjuri appear to have had a semi-sedentary lifestyle, being hunter-fisher-gatherers they were often situated on a particular waterway or drainage catchment area where resources were plentiful (Appendix F).

Aboriginal settlement patterns of the southwest slopes are possibly reflected in the distribution of modified trees (Appendix F). Aboriginal people seem to have spent most of their time situated within close proximity to reliable water sources. Areas that people occupied were also influenced by available food sources, including waterbirds, kangaroos, wallabies, and various plant foods (Appendix F).

An Aboriginal Reserve (reserve number R32512) was gazetted for Aboriginal people on the south bank of the Lachlan River at Condobolin on 13 April 1901. Known as the Condobolin Mission, and later the Willow Bend Mission, the reserve was originally run by the Aborigines Protection Board (later Aborigines Welfare Board). Aboriginal people also resided at a self-managed “fringe camp” at the Murie Reserve, approximately 4 km south of Condobolin, between approximately 1900 and 1970 (Appendix F).

Previous Archaeological Investigations

A number of Aboriginal heritage surveys and assessments have previously been undertaken in the Project area and surrounds, including survey and assessment for the Project. Of relevant to the immediate area include the studies prepared by Appleton (2000, 2005) and Landskape (2017) for the approved Project.

The ACHA prepared by Landskape (2017) as part of an application for an Aboriginal Heritage Impact Permit (AHIP) for the approved Project, covered a portion of the additional surface development areas and included extensive surveys and community consultation.

A detailed description of the investigations and surveys undertaken in the additional surface development areas and surrounds is provided in Appendix F.

Previously Recorded Aboriginal Heritage Sites

Appleton (2000, 2005) identified 14 Aboriginal cultural heritage sites in or near the approved Project area. These comprised one stone artefact scatter, eight isolated finds of stone artefacts, four scarred trees and a site complex with stone artefacts, hearths, a scarred tree and hundreds of flaked lithics (Appendix F).

A more recent assessment undertaken by Landskape (2017) identified an additional 13 Aboriginal heritage sites in or near the approved Project area, including two stone artefact scatters, eight isolated finds of stone artefacts, two stone quarries and a scarred tree (Appendix F).

The closest of these Aboriginal cultural heritage sites located approximately 1 km east of the surface water extraction infrastructure and modified borefields are two isolated finds (AHIMS site numbers 43-2-0049, 43-2-0050). Table 21 provides a summary of Aboriginal heritage sites previously identified within proximity to the additional surface development areas.

Table 21 Summary of Previously Identified Aboriginal Heritage Sites Proximal to the Modification Area

AHIMS	Site Name	Site Type	Easting[1]	Northing[1]
43-2-0050	North Condobolin Road ISO2	Isolated stone artefact	550643	6317884
43-2-0049	North Condobolin Road ISO1	Isolated stone artefact	550673	6317994

[1] GDA94 (Zone55).

As development of the approved Project is yet to recommence, these sites are not actively managed. However, upon recommencement of works these sites would be managed consistent with the requirements of the AHIP #C0003049.

Community Consultation

Consultation for the Modification was undertaken in consideration of the OEH policy *Aboriginal cultural heritage consultation requirements for proponents 2010* (DECCW, 2010a) and clause 80c of the NSW *National Parks and Wildlife Regulation, 2009*.

Table 22 summarises the main stages of the Aboriginal heritage consultation process undertaken for the Modification. A detailed account of the consultation process (including consultation records and a detailed consultation log) is provided in Appendix F.

Table 22 Summary of Aboriginal Heritage Consultation Undertaken for the Modification

Date	Consultation Conducted
Notification of Project and Registrations	
2 December 2016	Modification notifications were sent to the Central West Local Land Services, Condobolin LALC, LSC, National Native Title Tribunal, Native Title Services Corporation Limited, OEH, Office of the Registrar, NSW *Aboriginal Land Rights Act, 1983*, and Peak Hill LALC to identify relevant organisations with a potential interest in the Modification.
6 December 2016 – 18 January 2017	Responses to the above request were received from the Office of the Registrar, NSW *Aboriginal Land Rights Act, 1983*, the OEH, National Native Title Tribunal and LSC.
6 January 2017 & 18 January 2017	Letters seeking registrations of interest were sent to the Aboriginal parties identified by the above step.
11 January 2017	A public notice was placed in the Koori Mail inviting interested Aboriginal parties or groups to register.
18 January 2017	A public notice was placed in the Condobolin Argus inviting interested Aboriginal parties or groups to register.
22 February 2017	The list of RAPs for the Modification, along with the written notifications and public notice, were provided to the OEH, the Condobolin LALC and the West Wyalong LALC.
Proposed Methodology Review and Information Session	
14 February 2017	The Proposed Methodology for undertaking the ACHA was distributed to the RAPs for review and comment.
20 February 2017	An invitation was extended to all RAPs to attend an information session on 8 March 2017 to discuss the Modification and Proposed Methodology.
8 March 2017	Information session held at the Condobolin RSL Club to provide RAPs with an additional opportunity to raise any cultural issues or comments/perspectives regarding the Modification or the Proposed Methodology.
16 March 2017	Comments and feedback on the relevant submissions of the Proposed Methodology were received from the relevant RAPs.
Field Surveys	
23 February 2016 & 22 March 2017	Aboriginal heritage survey was conducted by archaeologists from Landskape accompanied by representatives of the RAPs. The cultural significance of the Modification area was discussed with attending representatives.
Draft ACHA Review, Information Session and Site Inspection	
9 June 2017	A copy of the draft ACHA was provided to all RAPs for their review and comment. The draft ACHA included survey results, archaeological and cultural significance assessment (based on feedback received during consultation and fieldwork), potential impacts and proposed mitigation and management measures. An invitation was also provided to all RAPs to attend an information session on 22 June 2017 to discuss the findings, provide any information on cultural knowledge/significance, provide an opportunity to comment on the draft ACHA and to take part in a site inspection of a selection of identified Aboriginal heritage sites.
22 June 2017	Information session and on-site inspections offered to all RAPs on 22 June 2017.
June/July 2017	Comments received on the draft ACHA were considered and included in the ACHA.

Consultation with the RAPs regarding the approved Project and the Modification has been extensive and involved various methods including public notices, onsite meetings, written and verbal correspondence, archaeological survey attendance and on-site inspections.

Additional information regarding consultation undertaken with the Aboriginal community is provided in Section 1.3.

Survey Design and Methodology

The field investigation of the additional surface development areas was undertaken in two campaigns. The first was completed on 23 February 2016, and the second was completed on the 22 March 2017.

The additional surface development areas were inspected on foot, and the field teams examined the ground surface for any archaeological traces such as stone artefacts, hearths, hearthstones, shells, bones and mounds. All mature trees in the areas of proposed disturbance were inspected for scarring or carving by Aboriginal people. Particular attention was paid to areas with high ground surface visibility such as along stock and vehicle tracks and in scalds, gullies and other eroded areas.

The survey sampled the geographic extent of the additional surface development areas.

Archaeological Findings

No Aboriginal heritage sites were identified in the additional surface development areas, despite the intensive nature of the survey and the generally fair conditions of surface visibility (Appendix F). The lack of identifiable Aboriginal heritage sites may be attributable to past land use of the additional surface development areas as previous land clearing and agricultural activities are likely to have destroyed any pre-existing Aboriginal heritage sites (Appendix F).

The sediments of the additional surface development areas had been well enough exposed by agricultural activities, road and channel construction, vehicular traffic and wind and water erosion to determine that no archaeological material was present on the surface nor is likely to be buried beneath the soil (Appendix F).

Archaeological and Cultural Heritage Values

During the archaeological surveys the attending RAPs did not identify any specific locations within the additional surface development areas as being of exceptionally high or specific cultural significance. However a number of sites were identified in the surrounding areas (e.g. Mulgutherie Mountain) as being of specific value to the Aboriginal community. These sites are outside of the additional surface development areas and hence would not be subject to impacts by the modified Project.

RAPs identified the additional surface development areas as a place that Aboriginal people had occupied in the past. Generally, the Aboriginal representatives viewed all the Aboriginal cultural heritage sites as significant because they preserve a record of how and where people lived in the past.

The Lachlan River and its adjacent plains are considered to be of particular cultural significance to the Aboriginal community. Several of the RAPs involved in the assessment advised that the river areas have special significance to the Aboriginal community. Local Aboriginal people previously and still visit the Lachlan River for significant social events including meetings, fishing, mussel collecting and family outings.

4.10.2 Potential Impacts

Direct and Indirect Impacts

No Aboriginal heritage sites were identified within the additional surface development areas, so no known Aboriginal heritage sites, items or values would be potentially impacted by the Modification.

Although the additional surface development areas were sufficiently surveyed, there remains the potential to uncover previously unidentified Aboriginal heritage within and in immediate proximity to the additional surface development areas (Appendix F). Such previously unidentified features, should they occur, would probably be isolated finds or low-density concentrations of stone artefacts (Appendix F).

A strategy for managing any newly identified Aboriginal objects during the modified Project is considered further in Section 4.10.3.

Cumulative Impacts

Given that no Aboriginal heritage sites have been identified in the additional surface development areas, coupled with the low potential for such heritage to occur, the Modification would not increase cumulative impacts to Aboriginal cultural heritage in the region.

4.10.3 Mitigation Measures and Management

The mitigation, management and monitoring measures detailed below have been developed in consultation with the RAPs, in consideration of the cultural and archaeological significance of the Aboriginal heritage sites predicted to be impacted, and the cultural significance of the broader area.

Heritage Management Plan

A Heritage Management Plan would be developed in consultation with the RAPs and the OEH for the Project in accordance with Condition 40, Schedule 3 of Development Consent DA 374-11-00. The Heritage Management Plan would reflect any changes to Development Consent DA 374-11-00 that arise from the Modification and would be developed prior to the commencement of any surface development works which would harm known Aboriginal heritage sites in the additional surface development areas.

Aboriginal Heritage Impact Permit

Clean TeQ would submit application for a new AHIP under section 90 of the *National Parks and Wildlife Act, 1974* (and/or a variation application to the existing approved AHIP #C0003049).

General Management Measures

The following general management measures would be undertaken to manage Aboriginal heritage during the life of the modified Project (Appendix F):

- Ongoing consultation would be undertaken with the RAPs over the life of the modified Project. Appropriate Aboriginal representation would be facilitated during archaeological fieldwork (e.g. salvage of artefacts prior to disturbance).
- Protocols would be developed that prescribe the involvement of the RAPs in cultural heritage works conducted under the Heritage Management Plan. The intent of this would be to focus on RAPs or RAP groups that represent the wider Aboriginal community.
- Clean TeQ would provide opportunities for Aboriginal community members to access known Aboriginal heritage sites located on company-owned land (e.g. for cultural reasons or as part of scheduled field activities). Such access would be subject to Work Health and Safety requirements.
- A communication protocol would be developed that describes clear methods of communication, including expectations of suitable notification and response time, between the proponent and the RAPs.
- All relevant contractors and staff engaged for the modified Project who may have interactions with Aboriginal heritage sites would receive heritage awareness training as part of the induction process prior to commencing work on-site.
- Should any skeletal remains be detected during the course of the Modification, work with the potential to impact the remains would cease immediately and the find would be reported to the relevant authorities (including the Police, the OEH and RAPs). Subject to the Police requiring no further involvement, the management of any Aboriginal skeletal remains would be determined in consultation with the DP&E, the OEH and the RAPs.
- Erosion and sediment control works would be undertaken in consideration of known Aboriginal heritage sites and management measures.

- Any additional Aboriginal heritage sites which may be identified during the development of the modified Project would be recorded and registered with the OEH in consultation with the RAPs. Should additional Aboriginal heritage sites be identified, they would be managed in accordance with the measures described in the Heritage Management Plan.

4.11 Historic Heritage

As described in Section 4.1, the potential historic heritage impacts associated with the Modification would be related to additional surface development areas required for the surface water extraction infrastructure, the modified borefields layout and the water pipeline alignment option (Section 3.9) (the additional surface development areas).

The Modification would not change the approved historic heritage impacts at the other Project components and therefore these Project components have not been considered any further in this section.

4.11.1 Existing Environment

A European Heritage Survey and Assessment has been previously prepared for the Project (Heritage Management Consultants, 2000).

Heritage Management Consultants (2000) did not identify any historic heritage site of significance along the water pipeline or in the vicinity of the borefields.

During completion of the field investigation of the additional surface development areas for the ACHA (Section 4.10), project archaeologist Dr Matt Cupper from Landskape examined the area for historic heritage items. No historic heritage items were observed in the additional surface development areas.

4.11.2 Potential Impacts

As no historic heritage items were observed within the additional surface development areas, there would be no impacts to historic heritage items associated with the Modification.

4.11.3 Mitigation Measures and Management

A Heritage Management Plan would be developed in consultation with the OEH for the Project in accordance with Condition 40, Schedule 3 of Development Consent DA 374-11-00. The Heritage Management Plan would reflect any changes to Development Consent DA 374-11-00 that arise from the Modification and would be developed prior to the commencement of any surface development works and would include protocols for the management of any previously unidentified historic heritage items.

4.12 Biodiversity

As described in Section 4.1, the potential biodiversity impacts associated with the Modification would be related to additional surface development areas required for the surface water extraction infrastructure, the modified borefields layout and the water pipeline alignment option (Section 3.9) (the additional surface development areas).

The Modification would not change the approved biodiversity impacts at the other Project components and therefore these Project components have not been considered any further in this section.

4.12.1 Existing Environment

The existing environment relevant to biodiversity of the additional surface development areas is discussed below based on the results of database and literature reviews as well as field surveys and assessment.

The biodiversity surveys for the additional surface development areas (Appendices G and H) were completed prior to the commencement of the *Biodiversity Conservation Act, 2016* (BC Act).

Modified Borefields and Surface Water Extraction Infrastructure

The flora and fauna in a study area surrounding the modified borefields and surface water extraction infrastructure was surveyed by AMBS Ecology & Heritage Pty Ltd (AMBS) (2017a, Appendix G) on 30 August 2016, 4 November 2016 and 6 June 2017. In consideration of the minor extent of the proposed disturbance and limited habitat present, survey techniques included vegetation mapping, searches for threatened flora and fauna habitat assessment. This survey approach is consistent with DEC and Department of Primary Industries (DPI) (2004).

The location of the modified borefields and surface water extraction infrastructure largely comprises of cultivated land which is grazed by sheep and dominated by exotic plants (Figure 30; Plate 1). In some previously cleared locations adjacent to the River Red Gum Woodland, there is regeneration of River Red Gum (*Eucalyptus camaldulensis*) occurring (Figure 30; Plate 2). River Red Gum Woodland (also called *River Red Gum – Lignum very tall open forest or woodland wetland on floodplains*) occurs more extensively along the Lachlan River (Plate 3). This riparian vegetation has been subject to historical clearance and recent grazing which has degraded the understorey and introduced exotic plants (Plate 3).

No threatened flora species or ecological communities listed under the BC Act or *Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act) were recorded during the surveys. Further none are considered to potentially occur due to the absence of suitable habitat (AMBS, 2017a) (Appendix G) and lack of nearby database records (after Atlas of Living Australia [ALA], 2017a; OEH, 2017b).

Source: AMBS

Plate 1 Cultivated Land

Source: AMBS

Plate 2 River Red Gum Regeneration

Source: AMBS

Plate 3 River Red Gum Woodland

LEGEND

Property Boundary

Approved Project

Transfer Station

Water Pipeline

Borefield Infrastructure Corridor *

Potential Borefield Location

Approximate Location of Production Bore (not constructed)

Production Bore (constructed)

Monitoring Bore

Modified Project

Transfer Station

Pump Station

Access Road

Water Pipeline

Borefield Infrastructure Corridor *

Surface Water Infrastructure Corridor *

Approved Water Pipeline Section no longer required

Approved Borefield Infrastructure Corridor section no longer required

Vegetation Mapping

River Red Gum - Lignum very tall Open Forest or Woodland Wetland on Floodplains

River Red Gum - Lignum very tall Open Forest or Woodland Wetland on Floodplains (Regenerated)

Cultivated Land

Road

* Infrastructure Corridor includes linking pipline, access road and electricity transmission line.

Source: AMBS (2017); NSW Land & Property Information (2016); Ivanplats Syerston (2005)
NSW Imagery: © Department of Finance, Services & Innovation (2017)

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Modified Borefields General Arrangement - Vegetation Mapping

Figure 30

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The Brown Treecreeper (eastern subspecies) (*Climacteris picumnus picumnus*) (a small bird listed as 'Vulnerable' under the BC Act) has been previously recorded in the River Red Gum Woodland at the locality (AMBS, 2017a) (Appendix G). The Brown Treecreeper (eastern subspecies) has a wide distribution in NSW. A number of other threatened birds and arboreal mammals listed under the BC Act potentially use the River Red Gum Woodland, noting however, that the habitat resource on which these species generally predominantly rely (e.g. mature trees and trees with hollows) are not likely to be adversely impacted by the Modification. Further, no threatened species under the EPBC Act have been recorded within 15 km of the modified borefields and surface water extraction infrastructure (OEH, 2017b).

No threatened flora or fauna populations listed under the BC Act are likely to occur.

The Modification includes extraction of water from the Lachlan River (Plate 3). The Lachlan River is recognised as part of the *Aquatic Ecological Community in the Natural Drainage System of the Lowland Catchment of the Lachlan River Endangered Ecological Community* listed under the *Fisheries Management Act, 1994* (FM Act).

The lower Lachlan River is also recognised habitat for the Sliver Perch (*Bidyanus bidyanus*) (listed as 'Vulnerable' under the FM Act) (DPI, 2016), although it is noted that the only natural occurring self sustaining population of this species occurs in the Murray River, and its anabranches and tributaries (DPI, 2017). No threatened populations listed under the FM Act are likely to occur in the lower Lachlan River.

Alternative Water Pipeline Option

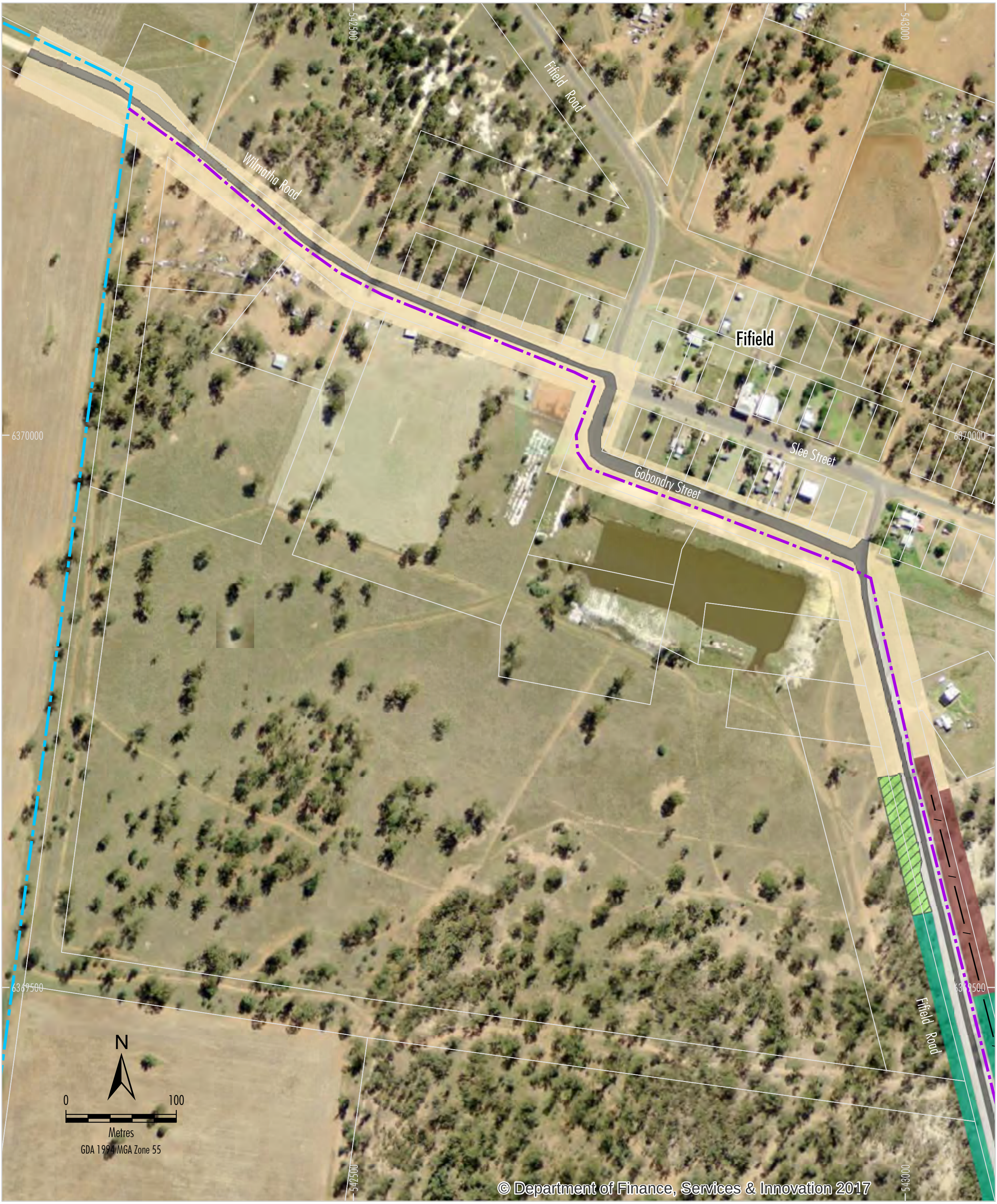
The flora and fauna in a study area surrounding the alternative water pipeline option was surveyed by Dr Colin Driscoll (Hunter Eco, 2017) (Appendix H) and AMBS (2017b in Hunter Eco, 2017 – Appendix H). In consideration of the proposed surface development associated with the alternative water pipeline option (i.e. no clearance of native vegetation communities), survey techniques included vegetation mapping and searches for threatened flora. This survey approach is consistent with DEC and DPI (2005).

The survey identified previously cleared road verges along Wilmatha Road, Gobondry Street and Fifield Road in which the alternative water pipeline option could be constructed (i.e. avoiding the need to clear any areas of native vegetation communities) (Figures 31a to 31c; Plate 4). No threatened flora species or ecological communities listed under the BC Act or EPBC Act were recorded in the cleared road verge where the alternative water pipeline option would be located (Hunter Eco, 2017) (Appendix H).

Native vegetation adjacent to the road verge (which is not proposed to be disturbed) was also surveyed by Hunter Eco (2017, Appendix H) and AMBS (2017b in Hunter Eco, 2017 – Appendix H). The native vegetation comprises Western Grey Box (woodland and derived native grassland) and Mugga Ironbark Woodland (Figures 31a to 31c). The Western Grey Box (woodland and derived native grassland) is equivalent to the following threatened ecological communities (Figures 31a to 31c):

- *Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions Endangered Ecological Community* (Inland Grey Box Woodland EEC) listed under the BC Act; and
- *Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia Endangered Ecological Community* (Grey Box Woodlands and Derived Native Grasslands EEC) listed under the EPBC Act.

Prior to the surveys by AMBS (2017b in Hunter Eco, 2017 – Appendix H), no threatened flora species were known to occur in the locality (after ALA, 2017b; OEH, 2017c). Three threatened flora species were identified in the Western Grey Box Woodland, namely *Tylophora linearis* (approximately 60 plants), Winged Peppercress (*Lepidium monoplocoides*) (approximately 50 plants) and *Austrostipa wakoolica* (one plant) (AMBS, 2017b in Hunter Eco, 2017 – Appendix H) (Figures 31a to 31c).



LEGEND

- Approved Water Pipeline
- Modified Water Pipeline Alignment Option
- Property Boundary
- Fence

Vegetation Mapping

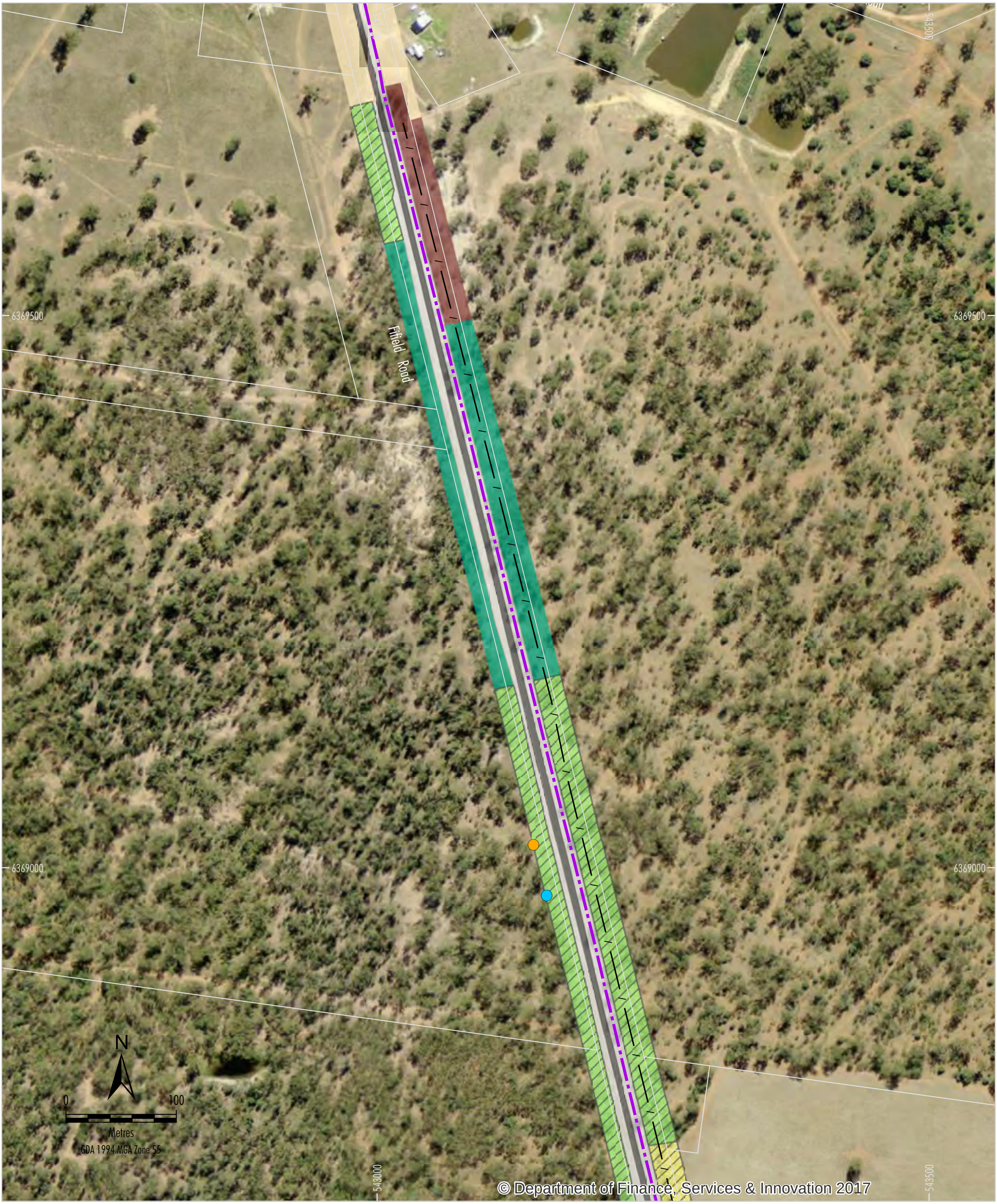
- Mugga Ironbark Woodland
- Western Grey Box Woodland
- Mostly Bare Earth under Trees
- Cleared Land
- Road Verge
- Road
- Grey Box EEC (TSC Act and EPBC Act)

Source: Hunter Eco (2017); NSW Land & Property Information (2017)
NSW Imagery: © Department of Finance, Services & Innovation (2017)

SYERSTON PROJECT MODIFICATION 4

Modified Water Pipeline Alignment Option - Vegetation Mapping

Figure 31a



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LEGEND
- Modified Water Pipeline Alignment Option
- Property Boundary
- Fence

Vegetation Mapping
- Mugga Ironbark Woodland
- Western Grey Box Woodland
- Western Grey Box Derived Native Grassland
- Mostly Bare Earth under Trees
- Cleared Land
- Road Verge
- Road
- Grey Box EEC (TSC Act and EPBC Act)

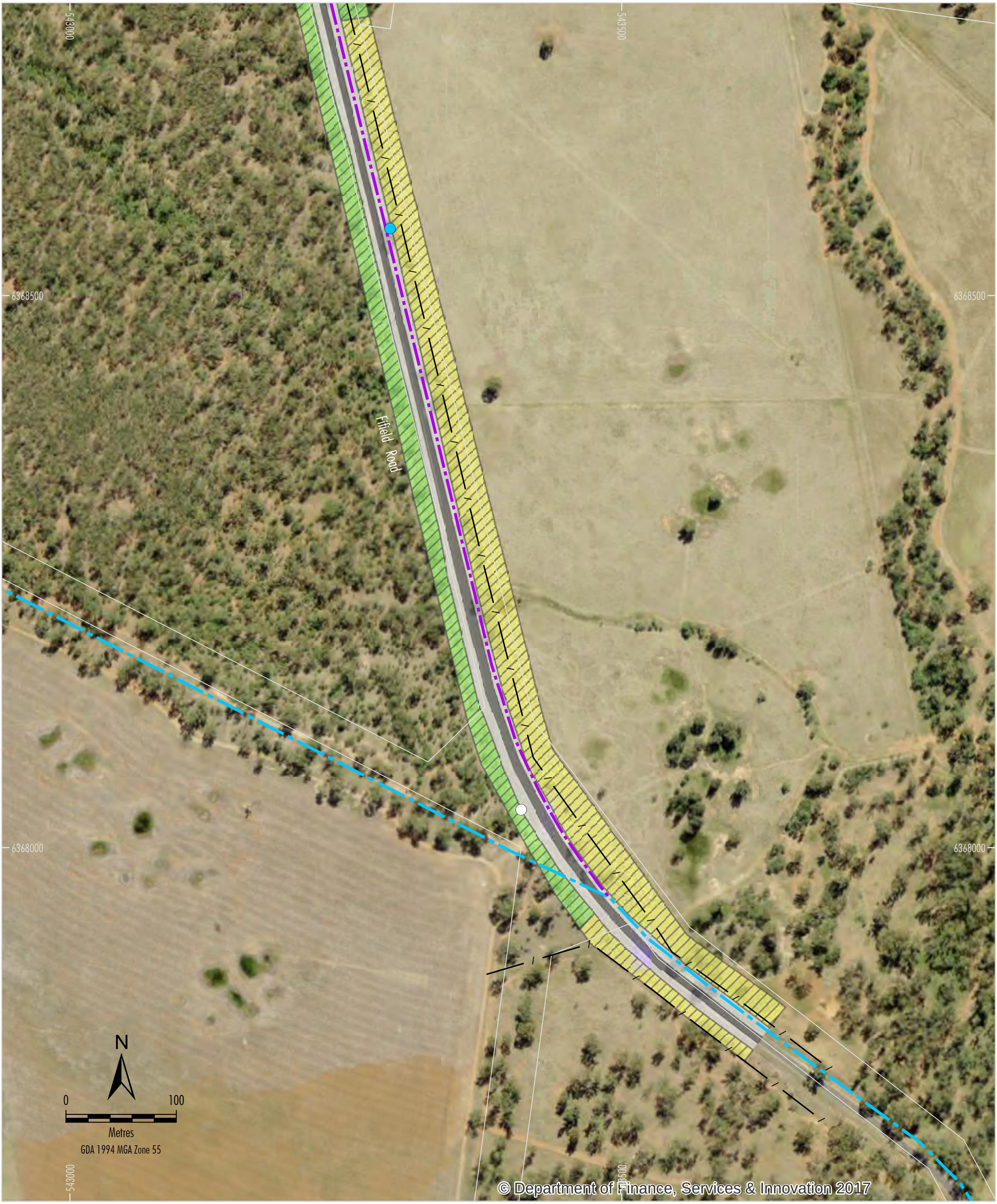
Threatened Flora Records
- *Lepidium monoplocoides*
- *Tylophora linearis*

Source: Hunter Eco (2017); NSW Land & Property Information (2017)
NSW Imagery: © Department of Finance, Services & Innovation (2017)

SYERSTON PROJECT MODIFICATION 4

Modified Water Pipeline Alignment Option - Vegetation Mapping

Figure 31b



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LEGEND

- Approved Water Pipeline
- Modified Water Pipeline Alignment Option
- Property Boundary
- Fence

Vegetation Mapping

- Western Grey Box Woodland
- Western Grey Box Derived Native Grassland
- Road Verge
- Road
- Grey Box EEC (TSC Act and EPBC Act)

Threatened Flora Records

- *Austrostipa wakoolica*
- *Tylophora linearis*

Source: Hunter Eco (2017); NSW Land & Property Information (2017)
NSW Imagery: © Department of Finance, Services & Innovation (2017)

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Modified Water Pipeline Alignment Option - Vegetation Mapping

Figure 31c

Source: Hunter Eco

Plate 4 Example of the Cleared Road Verge along Fifield Road

Native vegetation adjacent to the road verge (which is not proposed to be disturbed) is known habitat for threatened fauna species such as Superb Parrot (*Polytelis swainsonii*), Grey-crowned Babbler (eastern sub-species) (*Pomatostomus temporalis temporalis*) and Brown Treecreeper (eastern subspecies) (Driscoll pers comm. 2017). These birds have a wide distribution in NSW. No additional threatened fauna species have been recorded in the locality based on a review of databases (after ALA, 2017b; OEH, 2017c).

No threatened flora or fauna populations listed under the BC Act are likely to occur in the locality.

4.12.2 Potential Impacts

The potential direct, indirect and cumulative impacts on biodiversity are assessed below considering the *Draft Guidelines for Threatened Species Assessment* (DEC and DPI, 2005) in accordance with the requirements for a modification under Part 3A of the EP&A Act.

Direct Impacts

Vegetation and Habitat Clearance

The modified borefields are located in existing cleared, previously cultivated, paddocks (Figure 30). These components of the additional surface development areas would have no direct or indirect adverse impacts on native biodiversity.

The proposed pump station would be constructed near the Lachlan River, necessitating clearance of understorey and groundcover within an area of regenerating River Red Gum Woodland. The proposed surface water infrastructure corridor would be located through the mapped River Red Gum Woodland (Figure 30). However, the proposed pump station (and pipeline to the Lachlan River) has been specifically sighted in a location where no mature River Red Gums (i.e. trees old enough to flower) would be cleared.

The surface water infrastructure corridor between the proposed pump station and the modified transfer station would be constructed within a 35 m wide corridor, specifically sighted to minimise clearance of River Red Gum Woodland regeneration. The indicative alignment of the surface water infrastructure corridor is shown on Figure 30. The alignment would be finalised during detailed design of the Project, however the access road and water pipeline would not involve the disturbance of any mature trees.

In total, approximately 0.31 ha of native vegetation (groundcover and understorey) would be cleared for the Modification (all of which is associated with the proposed pump station and surface water infrastructure corridor) (Table 23). This area of clearance is very minor considering River Red Gum Woodland occurs extensively along the Lachlan River. There would be no fragmentation or disruption to the connectivity of habitat along the river.

Table 23 Summary of Native Vegetation Clearance

Vegetation Community	BC Act	EPBC Act	Clearance Area (ha)[1]
Regeneration (River Red Gum – Lignum very tall open forest or woodland wetland on floodplains)	Not listed	Not listed	0.15
River Red Gum – Lignum very tall open forest or woodland wetland on floodplains	Not listed	Not listed	0.16
		Total	**0.31**

[1] No mature trees would be cleared.

The alternative water pipeline option would be constructed in previously cleared areas along Wilmatha Road and Gobondry Street (through Fifield) and along Fifield Road (Figures 31a to 31c). The alternative water pipeline option would be mostly constructed along the eastern side of the road (Figure 31a and 31b), but would cross to the western side of the road in the southern section, to specifically avoid clearance of Western Grey Box derived native grassland (Figure 31c).

The cleared road verge comprises bare gravel, exotic plants and native grasses. No native vegetation communities mapped by Hunter Eco (2017, Appendix H) would be cleared for the alternative water pipeline option. Once the pipeline is constructed, the disturbed areas would be subject to progressive rehabilitation and natural regeneration.

Minimal habitat resources would be cleared as a result of the Modification (e.g. overstorey regeneration, understorey, midstorey and groundcover). No mature trees, hollow bearing trees or dead trees (stags) would be removed.

Threatened Species and Threatened Ecological Communities under the BC Act and EPBC Act

No threatened species or threatened ecological communities listed under the BC Act and/or EPBC Act would be directly impacted as a result of the Modification. Indirect impacts are assessed below.

SEPP 44 – Koala Habitat Protection

FSC Local Government Area (LGA) (in which the modified borefields is located) is an LGA relevant to *State Environmental Planning Policy No 44—Koala Habitat Protection* (SEPP 44) for the Koala (*Phascolarctos cinereus*).

SEPP 44 defines ‘potential koala habitat’ as an area of native vegetation where the trees of the types listed in Schedule 2 of SEPP 44 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component. River Red Gum (*Eucalyptus camaldulensis*), which occurs in the River Red Gum Woodland, is a Koala preferred tree species listed in SEPP 44.

As described above, the proposed pump station (and pipeline to the Lachlan River) has been specifically sighted in a location where no mature River Red Gums (i.e. trees old enough to flower) would be cleared.

Indirect Impacts

Threatened Flora and Threatened Ecological Communities under the BC Act

As described in Section 4.12.1, there are no threatened flora species or threatened ecological communities under the BC Act known to occur near the Modified Borefields.

Inland Grey Box Woodland EEC listed under the BC Act was recorded along Fifield Road (outside of the alternative water pipeline option alignment). Three threatened flora species were identified in the Inland Grey Box Woodland EEC, namely *Tylophora linearis,* Winged Peppercress (*Lepidium monoplocoides*) and *Austrostipa wakoolica* (AMBS, 2017b in Hunter Eco, 2017 – Appendix H) (Figures 31a to 31c).

The Inland Grey Box Woodland EEC and these three threatened flora species would not be adversely impacted during construction of the alternative water pipeline option because:

- the alternative water pipeline option would be progressively constructed over a short term (e.g. less than 12 months);
- no clearance (including laydown areas) would be permitted further than 5 m from Fifield Road towards the Grey Box Woodland;
- additional dust would only be temporarily generated during installation of the alternative water pipeline option (e.g. trenching and burial); and
- the risk of soil erosion would be reduced by active progressive rehabilitation and natural regeneration following construction.

Threatened Fauna under the BC Act

The River Red Gum Woodland adjacent to the surface water extraction area has the potential to provide habitat for threatened fauna under the BC Act. Threatened woodland birds and bats are likely to inhabit the River Red Gum Woodland which occurs more extensively along the Lachlan River.

The Grey Box Woodland and Mugga Ironbark Woodland adjacent to the water pipeline alignment option provides habitat for threatened woodland birds under the BC Act, such as the Grey-crowned Babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*) and Brown Treecreeper (eastern subspecies).

The Modification is unlikely to indirectly impact any threatened fauna under the BC Act as potential indirect impacts would be localised and managed (Section 4.12.3).

Threatened Species and Communities under the FM Act

As described in Section 3.9.2, to improve the water supply security of the Project, it is proposed to diversify supply sources by including extraction of surface water from the Lachlan River. Clean TeQ will seek to purchase existing water allocations for the Lachlan River under the Water Sharing Plan for the Lachlan Regulated River Water Source.

As described in Section 4.12.1, the Lachlan River is an endangered ecological community under the FM Act and potential habitat for the Sliver Perch. The Modification is not likely to significantly adversely impact threatened species and communities under the FM Act given the minor clearance of native riparian vegetation (approximately 0.31 ha – Table 23) and use of existing water allocations. Potential impacts on aquatic ecology would be reduced by:

- locating the proposed pump station back from the bank of the river (to reduce the potential for bank erosion), and an underground pipeline would connect the proposed pump station to the river;
- the risk of soil erosion would be reduced by active progressive rehabilitation and natural regeneration following pipeline construction;
- installing a suitable self-cleaning screen that would reduce the intake of fish at the pump inlet; and

- starting the pump slowly and then ramping up velocity to reduce the likelihood of fish in the vicinity of the intake being drawn into the pump.

Threatened Species and Communities under the EPBC Act

The Modification would not adversely impact any threatened species and communities under the EPBC Act because no threatened flora species or communities listed under the EPBC Act occur in the Modification areas and potential indirect impacts would be managed (Section 4.12.3).

Hence, there would be no significant impact on threatened species and communities listed under the EPBC Act as a result of the Modification.

Weeds

The Modification areas are largely in cleared areas dominated by exotic plants (Appendices G and H). Activities that could spread weeds during construction include soil disturbance, vehicle movements and movement of soil. Disturbed areas provide a substrate in which weed species may grow.

Weeds would be managed in accordance with the *Biosecurity Act 2015* and consideration of the *Central West Regional Strategic Weed Management Plan 2017 – 2022* (Central West Local Land Services, 2017).

Animal Pests

The Modification is unlikely to result in an increase in animal pests.

Bushfire Risk

A change in natural fire frequency can impact natural ecosystems. Accidental bushfires could potentially start in a variety of ways if not appropriately managed (e.g. from machinery or vehicles traversing dry grass).

Cumulative Impacts

Cumulative impacts are considered to be the total impact (direct and indirect) on the environment that would result from the incremental impacts of the Modification added to other existing impacts.

The direct and indirect impacts from the Modification area would not substantially increase existing impacts given the small area of native vegetation to be cleared (approximately 0.31 ha – Table 23).

4.12.3 Impact Avoidance and Mitigation Measures

Considerable effort has been made by Clean TeQ to avoid and mitigate impacts on biodiversity from the Modification. The small amount of native vegetation clearance required for the surface water extraction infrastructure (0.31 ha – Table 23), is due to the need for the proposed pump station to be located near the Lachlan River. Table 24 provides a summary of the impact avoidance and mitigation measures.

The modified Project would maintain biodiversity values and not result in significant adverse impacts on any threatened species and communities under the BC Act, FM Act or EPBC Act. As such, no biodiversity offset is proposed considering DEC and DPI (2005) and DPI (2013).

A Biodiversity Management Plan would be developed in consultation with the OEH for the Project in accordance with Condition 35, Schedule 3 of Development Consent DA 374-11-00. The Biodiversity Management Plan would reflect any changes to Development Consent DA 374-11-00 that arise from the Modification and would include detailed management measures, performance and completions criteria and a monitoring program.

4.13 Visual

As described in Section 4.1, the potential visual impacts associated with the Modification would be related to changes to the mine site layout (e.g. increased tailings storage facility footprint).

Table 24 Impact Avoidance and Mitigation Measures

Aspects	Impact Avoidance and Mitigation Measures
Modified Borefields	The proposed transfer station and associated access road, water pipeline and linking pipeline are located in existing cleared, previously cultivated, paddocks.
	The proposed pump station (and pipeline to the Lachlan River) has been specifically sighted in a location where no mature River Red Gums (i.e. trees old enough to flower) would be cleared.
	The surface water infrastructure corridor between the proposed pump station and the modified transfer station has been sighted mostly on cleared, previously cultivated, paddocks to minimise clearance regenerating River Red Gum Woodland and trees.
	The proposed pump station has been sighted away from the bank of the river, and an underground pipeline would connect the proposed pump station to the river.
	A self-cleaning screen would be installed on the proposed pump station that would reduce the intake of fish at the pump inlet.
	The pump on the proposed pump station would be started slowly and then ramping up velocity to reduce the likelihood of fish in the vicinity of the intake being drawn into the pump.
Alternative Water Pipeline Option	The alternative water pipeline option would be constructed in the cleared areas along Wilmatha Road and Gobondry Street (through Fifield) and along Fifield Road.
	The alternative water pipeline option would be progressively constructed over a short term (e.g. less than 12 months).
	No clearance (including laydown areas) would be permitted further than 5 m from Fifield Road towards the Grey Box Woodland.
	Additional dust would only be temporarily generated during installation of the alternative water pipeline option (e.g. trenching and burial).
General	Contractors would be made aware of clearing limits.
	Bushfire management measures would be implemented in accordance with Condition 49, Schedule 3 of Development Consent DA 374-11-00 and would include the site being suitably equipped to fight fires; develop asset protection in accordance with the Rural Fire Service's Planning for Bushfire Protection 2006; and consultation with the Rural Fire Service.
	Weeds would be managed in accordance with the NSW *Biosecurity Act 2015* and consideration of the Central West Regional Strategic Weed Management Plan 2017 – 2022 (Central West Local Land Services, 2017).
	The risk of soil erosion would be reduced by active progressive rehabilitation and natural regeneration following construction.

The Modification would not change the approved visual impacts at the other Project components and therefore these Project components have not been considered any further in this section.

4.13.1 Existing Environment

A Visual Assessment was prepared for the Project by Resource Strategies (2000) and described the potential visual impacts of the Project in the context of the sensitivity of surrounding viewpoints.

The regional visual character of the mine site is characterised by cleared agricultural land for the majority and an area of remnant bushland to the south-west of the site. Previous mining areas exist to the south-east of the mine site, within the north-eastern portions of the site and also to the north-east of the site (Resource Strategies, 2000).

The small village of Fifield is located approximately 4.5 km to the south-east, with Condobolin (the largest nearby town) located approximately 45 km to the south-west (Figure 1).

The topography of the area is relatively flat with the greatest expressions of relief being Boona Mountains approximately 20 km to the west and Gobondry Mountains approximately 10 km to the east (Resource Strategies, 2000).

Views of the mine site from the surrounding region are limited due to the lack of public vantage points, the relatively flat topography and shielding roadside vegetation (Resource Strategies, 2000).

The southern portion of the mine site is visible from Fifield Road when heading north from Fifield and from Wilmatha Road when heading in both approaches to the mine site. The northern view is limited due to vegetation along the northern boundary of the site.

4.13.2 Potential Impacts

The Modification would be generally consistent with the nature and scale of the approved Project.

Notwithstanding, elements of the Modification considered to have the potential to have more material visual impacts include the following:

- the footprint of the tailings storage facility would increase (Section 3.7.1);
- the height of the tailings storage facility would slightly increase from 310 m AHD to 314 m AHD (Section 3.7.1)
- the footprint of the evaporation ponds would reduce (Section 3.7.2); and
- mine infrastructure area components would be relocated (Section 3.2).

The tailings storage facility and evaporation ponds would be visible from sections of Wilmatha Road and Fifield Road. Limited views of the tailings storage facility would be available from private dwellings.

The potential visual impacts associated with the increased footprint and height of the tailings storage facility would be somewhat offset by the reduction in the footprint of the evaporation ponds.

The proposed minor changes to the mine infrastructure area components would not be expected to significantly alter the visual impacts of the approved Project from potentially sensitive viewpoints.

Any potential impact associated with night-lighting required for the Project (i.e. for safety reasons) would be similar to those assessed for the approved Project. These potential impacts would be minimised as far as possible through the implementation of mitigation measures described in Section 4.13.3.

Overall, the Modification is expected to result in similar or lower potential visual impacts at the mine relative to the approved Project.

4.13.3 Mitigation Measures, Management and Monitoring

Clean TeQ would implement a number of measures to minimise potential visual impacts at the modified Project:

- A vegetation screen would be established along the southern and eastern boundaries of the mine (Figures 9 to 12) to limit potential views of the Project from Wilmatha Road and Fifield Road, once established.
- The visual appearance of all ancillary infrastructure (including paint colours, specifications and screening) would blend in as far as possible with the surrounding landscape.
- Mine areas would be rehabilitated as soon as practicable following disturbance (Section 5) in order to reduce the contrast between the mine landforms and the surrounding environment.
- Whilst ensuring that operational safety is not compromised, Clean TeQ would minimise light emissions from the Project by select placement, configuration and direction of lighting so as to reduce off-site nuisance effects where practicable.
- All external lighting at the Project would be operated in accordance with AS 4282 (INT):1997 – *Control of Obtrusive Effects of Outdoor Lighting*.

5 Rehabilitation Strategy

A description of the rehabilitation strategy for the modified Project is provided in this section.

The mine site rehabilitation strategy is discussed in Sections 5.1 to 5.5. The rehabilitation strategy for the other Project components is described in Sections 5.6 to 5.8.

5.1 Rehabilitation Objectives and Principals

Condition 55, Schedule 3 of Development Consent DA 374-11-00 outlines the rehabilitation objectives for the Project and these are reproduced in Table 25.

Table 25 Rehabilitation Objectives

Features	Objective
Site (as a whole)	• Safe, stable and non-polluting. • Materials (including topsoils, substrates and seeds of the disturbed areas) are recovered, appropriately managed and used effectively as resources in the rehabilitation of the site. • Final land forms to: – restore native vegetation communities and ecosystem function (in the applicable domains); – sustain intended land use for the post- mining domains; – minimise visual impacts; – be generally in keeping with the natural terrain features of the area; and – incorporate micro-relief. • Incorporate drainage lines consistent with topography and natural drainage where reasonable and feasible.
Final voids	• Minimise: – the size and depth of the final void/s; – the drainage catchment of the final voids; and – risk of flood interaction for all flood events up to and including a 1 in 100 year or 1% annual exceedance probability storm event.
Surface Infrastructure	• To be decommissioned and removed, unless agreed otherwise by the Secretary of the DP&E.
Agriculture	• Land capability classification for the relevant nominated agricultural pursuit for each domain is established and self-sustaining within a reasonable timeframe.
Community	• Ensure public safety. • Minimise the adverse socio-economic effects associated with mine closure.

The rehabilitation principles for the Project include (Black Range Minerals, 2000):

- Preservation of areas of existing vegetation wherever possible.
- Rehabilitation of mine landforms would be progressive and conducted in accordance with approved plans (i.e. Mining Operations Plan and Rehabilitation Management Plan).
- The newly prepared (i.e. topsoiled) landforms would be protected via the construction of moisture-retaining passive drainage systems, water-holding structures (e.g. surface depressions) and, where appropriate, the use of authorised hybrid cover crops to provide initial erosion protection.
- Where possible, revegetated landforms would form an expansion of, and be continuous with, existing woodland areas.

- Outer embankments of the tailings storage facility would be rehabilitated progressively during operational years.
- Livestock would be excluded from rehabilitated areas where agriculture is not the final land use.
- Rehabilitation concepts should be flexible and allow for adjustments, based on trials.

5.2 Rehabilitation of the Modified Mine Site

In accordance with Condition 56, Schedule 3 of Development Consent DA 374-11-00, Clean TeQ would rehabilitate the site progressively, that is, as soon as is practicable following disturbance.

5.2.1 Post-Mining Land Use and Conceptual Final Land Form

Post-Mining Land Use

The approved post-mining land use is a combination of agriculture (pasture for grazing) and nature conservation (endemic woodland areas) (Black Range Minerals, 2000).

Clean TeQ has assessed potential post-mining land uses (e.g. grazing and native vegetation) taking into account the modified Project, relevant strategic land use objectives of the area in the vicinity of the Project and the potential benefits of the post-mining land use to the environment, future landholders and the community.

Based on this assessment, Clean TeQ proposes the post-mining land use of the modified Project would continue to comprise a combination agriculture (pasture for grazing) and nature conservation (endemic woodland).

The Modification would therefore not change the approved post-mining land uses.

The post-mining land uses are also generally consistent with the relevant objectives of the *Lachlan Shire Local Environmental Plan 2013* (Lachlan LEP) (Section 6.2.2).

Figure 32 illustrates the conceptual rehabilitated final landform and post-mining land uses.

Conceptual Final Landform

Key features of the approved final landform include:

- two final voids;
- two waste rock emplacements to a maximum final elevation of approximately 330 m AHD;
- a tailings storage facility;
- evaporation ponds; and
- water storage dam.

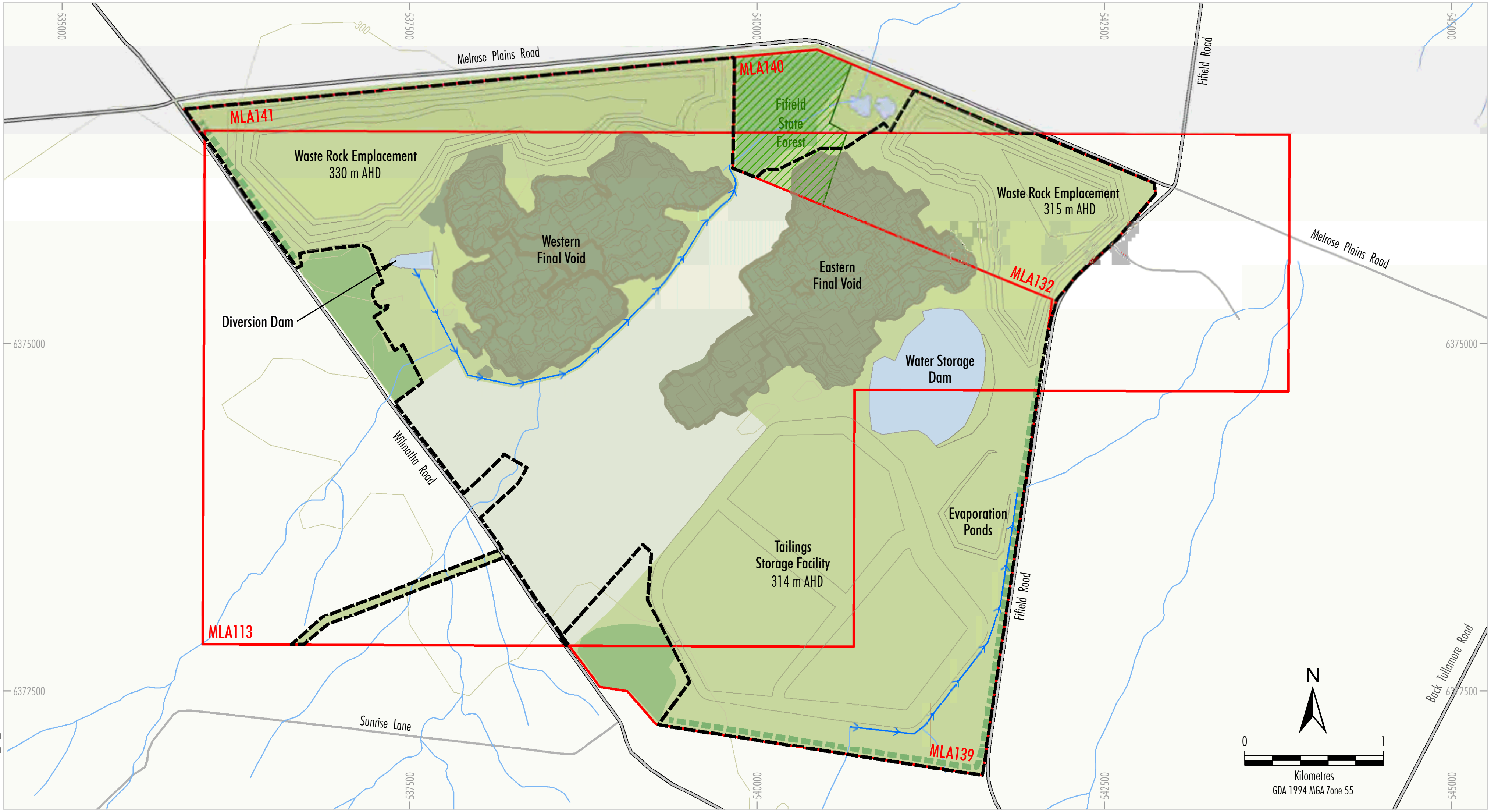
The Modification would result in the following changes to the final landform:

- the footprint of the tailings storage facility would increase (Section 3.7.1);
- the final elevation of the tailings storage facility would slightly increase from approximately 310 m AHD to 314 m AHD (Section 3.7.1); and
- the footprint of the evaporation ponds would reduce (Section 3.7.2).

The Modification would not change the approved final voids or rehabilitated waste rock emplacements.

Figure 32 illustrates the conceptual rehabilitated final landform and post-mining land uses.

Further detail on the final landform is provided in Section 5.2.2



LEGEND
- Mining Lease Application Boundary
- Approved Surface Development Area
- Void
- Rehabilitated/Revegetated Endemic Woodland
- Rehabilitated/Revegetated Pasture
- Water Storage
- Existing Open Woodland to be Maintained
- State Forest
- Vegetation Screening
- Diversion Structure

Source: Black Range Minerals (2000); NSW Department of Industry (2017); NSW Land & Property Information (2017)

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Modified Mine and Processing Facility Conceptual Final Landform and Land Uses

Figure 32

5.2.2 Rehabilitation Domains

The *ESG3: Mining Operations Plan (MOP) Guidelines* (NSW Trade and Investment, Regional Infrastructure and Services – Division of Resources and Energy, 2013) state that for rehabilitation planning and mine closure it is useful to separate a mines site into smaller conceptual domains.

Conceptual broad scale rehabilitation domains for planning purposes are shown on Figure 33. The conceptual broad scale domains are as follows:

- infrastructure;
- waste rock emplacements;
- tailings storage facility;
- final voids; and
- water management.

Key features within these broad domains and the domain objectives are described below.

The progressive refinement of these domains into sub-domains and the development of associated sub-domain objectives would be presented in the Mining Operations Plan.

Infrastructure Domain

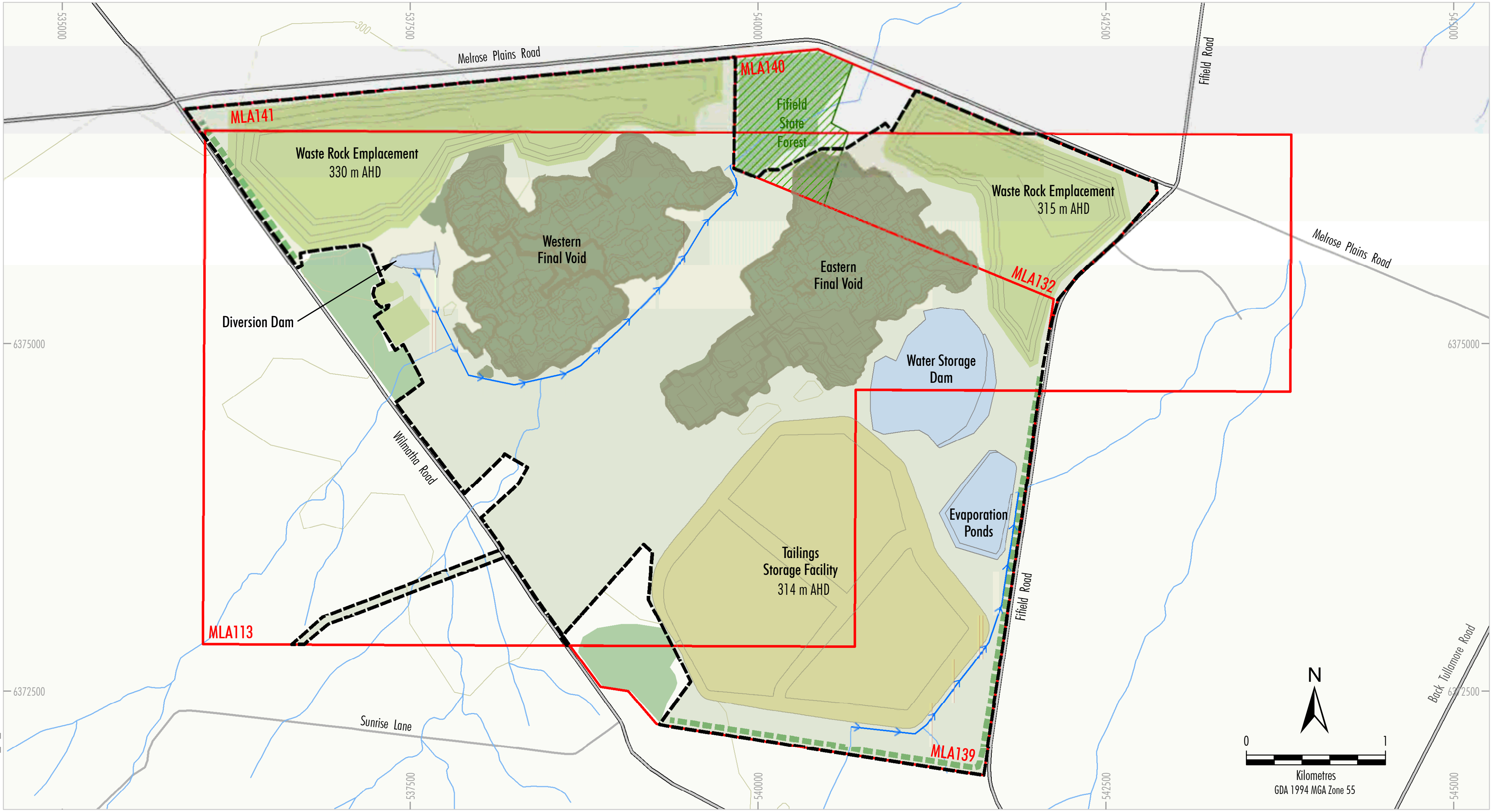
This domain is dominated by the processing facility and general supporting infrastructure. The infrastructure domain would include, but is not limited to:

- processing facility;
- ROM pad ore stockpiles;
- reagent production plants and storage areas;
- gas-fired power plant and associated power distribution infrastructure;
- construction camp;
- concrete batch plant;
- offices, workshops, warehouse, laboratory and amenities buildings and car parking facilities;
- fuel storage areas;
- potable water treatment plant;
- wastewater (including sewage) treatment plant;
- laydown areas;
- access road, internal roads and haul roads; and
- other associated minor infrastructure, plant, equipment and activities.

The Modification would not significantly change the rehabilitation strategy for the infrastructure domain.

The conceptual mine closure and rehabilitation objectives for the infrastructure domain would be:

- Infrastructure with no on-going beneficial use would be decommissioned and removed, unless otherwise agreed by the Secretary of the DP&E.
- Hydrocarbons (petrol, diesel, oils, greases, degreasers and kerosene), explosives, chemicals and liquid and non-liquid wastes unused at the completion of mining would be returned to the supplier in accordance with relevant safety and handling procedures.



LEGEND

Mining Lease Application Boundary
Approved Surface Development Area
Existing Open Woodland to be Maintained
State Forest
Vegetation Screening
Diversion Structure

Rehabilitation Domains

Final Voids
Waste Rock Emplacement
Tailings Storage Facility
Infrastructure
Water Storage

Source: Black Range Minerals (2000); NSW Department of Industry (2017); NSW Land & Property Information (2017)

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Conceptual Broad Scale Rehabilitation Domains

Figure 33

- If there are any contaminated soils associated with the Project, these would be identified and remediated in accordance with the requirements of the NSW *Contaminated Land Management Act 1997*.
- Water management structures and sediment control structures would either be retained as water sources for future land uses or decommissioned and rehabilitated.
- The domain would be profiled to a free-draining landform with runoff reporting to the natural environment and would be revegetated to either endemic woodland or pasture areas.
- An approximate 0.2 m layer of soil would be placed on the landform prior to revegetation (Black Range Minerals, 2000).
- Following rehabilitation, a combination of agriculture (pasture for grazing) and nature conservation (endemic woodland) land uses would occur in the infrastructure domain.

A discussion of the native plant species for revegetation is provided in Section 5.3.3.

Waste Rock Emplacements

Waste rock material generated would be placed either in one of two waste rock emplacements (Figures 9 to 12).

The waste rock emplacements would be up to approximately 20 m and 30 m high (or a maximum elevation of approximately 330 m AHD) (Figures 9 to 12).

The Modification would not significantly change the rehabilitation strategy for the waste rock emplacements domain.

The conceptual mine closure and rehabilitation objectives for the waste rock emplacement domain would be:

- The waste rock emplacement would be profiled to incorporate micro-relief and natural appearing landform features as a component of finalising site landforms and slopes.
- The overall batter slopes of the waste rock emplacements would be 1V:4H with intermediate batter slopes constructed to 1V:3H (Black Range Minerals, 2000).
- Reverse graded berms would be located at approximately 10 m intervals (Black Range Minerals, 2000).
- Batter drainage would be via the reverse-graded berms. The berms would diffusely grade inwards and the surfaces would be kept as rough as possible to maximise absorption, to avoid the use of artificial drainage structures on the batters (Black Range Minerals, 2000).
- Drainage on the top surfaces of the waste rock emplacements would be similarly managed via a series of small shallow basins (i.e. depressions or micro-relief), and endemic woodland vegetation with a high water demand. The use of depressions is aimed at maximising internal drainage without creating permanent ponding (Black Range Minerals, 2000).
- An approximate 0.5 m layer of soil would be placed on the backfilled landform prior to revegetation (Black Range Minerals, 2000).
- Water management structures and sediment control structures would either be retained as water sources for future land uses or decommissioned and rehabilitated.
- Following rehabilitation, conservation (endemic woodland) land use would occur in the waste rock emplacements domain.

A discussion of the native plant species for revegetation is provided in Section 5.3.3.

Final Voids

At the completion of mining, the modified Project final landform would include two final voids (Figures 32 and 33).

Perennial water bodies are not expected to occur in the final voids due to the dominance of evaporation over rainfall at the mine site (Black Range Minerals, 2000).

The Modification would not significantly change the rehabilitation strategy for the final voids domain.

Conceptual mine closure and rehabilitation objectives for the final voids domain would be:

- Mine planning would target minimising the size and depth of the final voids as far as reasonable and feasible.
- Areas of the domain may be revegetated to endemic woodland areas where it is feasible.
- The catchment of the final voids would be minimised with the provision of permanent perimeter bunds, diversion channels and/or bunds/embankment walls.
- The final landform design would provide flood immunity for flood events up to a 1 in 100 year ARI rainfall event.
- Final void access restrictions (e.g. fencing) for safety and exclusion of livestock would be designed and implemented in consultation with relevant authorities.

Tailings Storage Facility

Tailings would be pumped from the processing facility to the tailings storage facility (Figures 9 to 12).

As described in Section 3.7.1, the footprint of the tailings storage facility would increase as a result of the Modification. The final elevation of the tailings storage facility would also slightly increase from approximately 310 m AHD to 314 m AHD.

Other components of the tailings storage facility, such as tailings delivery, underdrainage, seepage collection and decant systems would be generally unchanged.

The design of the modified tailings storage facility would conform to the relevant design (including geotechnical stability) requirements described in Condition 29, Schedule 3 of Development Consent DA 374-11-00. This includes the requirements for permeability of liners, storage capacity and DSC design requirements (Sections 2.8.1 and 2.8.2).

The proposed layout of the modified tailings storage facility and a conceptual cross section through the modified tailings storage facility embankment are provided on Figure 14.

The external batters of the tailings storage facility embankments would be progressively rehabilitated as they become available. Rehabilitation of the top surfaces of the tailings storage could only be undertaken at the completion of its operational life.

Conceptual mine closure and rehabilitation objectives for the tailings storage facility are as follows:

Tailings Storage Facility External Batters

- The overall tailings storage facility external batter slopes would be 1V:4H (Black Range Minerals, 2000).
- Drainage of the external batters would be facilitated by the construction of berms to reverse grade, and be left rough to enhance absorption. The berms would longitudinally fall to low depressions constructed every 50 to 100 m along the berm to cater for high rainfall events (Black Range Minerals, 2000).
- Ripping on the external batters to create surface roughness and absorption prior to revegetation operations would be undertaken.
- An approximate 0.5 m layer of soil would be placed on the backfilled landform prior to revegetation (Black Range Minerals, 2000).

Tailings Storage Facility Top Surface

- The decant area would be allowed to dry and the decant tower would be capped with fill and/or a concrete plug.
- The underdrains and associated sumps would be grouted.
- The tailings discharge pipes and other infrastructure would be dismantled for reuse or disposal.
- A number of surface swale drains would be developed on the top surface to minimise the potential for erosion. The storage surfaces would form contained catchments (i.e. would not spill over the batters).
- Surface materials, a passive drainage regime and revegetation would maximise water storage and/or evapotranspiration (Black Range Minerals, 2000).
- Trials would be undertaken to refine the rehabilitation cover system. Options for surface treatment prior to revegetation would include (Black Range Minerals, 2000):
  - placement of waste rock to serve as a stabiliser and to enhance soil and vegetation trapment;
  - covering the tailings surface directly with variable thicknesses of soil; and
  - direct planting into tailings without the establishment of a soil cover.

Following rehabilitation, conservation (endemic woodland) land use would occur in the tailings storage facility domain.

A discussion of the native plant species for revegetation is provided in Section 5.3.3.

Water Management

The key water management-related landforms at the mine include the evaporation ponds, water storage dam and the diversion structures.

The Modification would include a reduction in the footprint of the evaporation ponds due to the reduction in water volume reporting to the evaporation ponds (Section 3.7.2).

The water storage dam would remain unchanged as a result of the Modification.

The Modification would require a minor change to the southern diversion structure alignment.

Conceptual mine closure and rehabilitation objectives for the water management domain are as follows:

Evaporation Ponds

- The internal partition embankment and the north-eastern external embankment would be breached and profiled to be a free-draining landform with runoff reporting to the natural environment.
- Internal and external embankments and batters would be flattened to a maximum slope of 1V:3H (Black Range Minerals, 2000).
- If there are any contaminated soils associated with the Project, these would be identified and remediated in accordance with the requirements of the NSW *Contaminated Land Management Act 1997*.
- An approximate 0.5 m layer of soil would be placed on the landform prior to revegetation (Black Range Minerals, 2000).
- Following rehabilitation, conservation (endemic woodland) land use would occur on the rehabilitated evaporation ponds.

Water Storage Dam

- It is expected that the water storage dam would be retained as a water storage post-mining (subject to the agreement of the Secretary of the DP&E).
- The external batters would be modified to allow for the collection of runoff.
- An approximate 0.5 m layer of soil would be placed on the external batter of the water storage dam prior to revegetation (Black Range Minerals, 2000).
- Following rehabilitation, conservation (endemic woodland) land use would occur on the external batter of the water storage dam.

Diversions

- The rehabilitated diversions would be safe, stable and non-polluting landform.
- The design would consider long term stability and compatibility with existing hydrological features, landforms and vegetation.

Detailed description of the clean water diversion systems would be included in the Surface Water Management Plan in accordance with Condition 30, Schedule 3 of Development Consent DA 374-11-00.

A discussion of the native plant species for revegetation is provided in Section 5.3.3.

5.2.3 Key Rehabilitation Performance Measures and Strategic Completion Criteria

Key rehabilitation performance measures and strategic completion criteria would be developed for the modified Project. They would be developed with regard to *Leading Practice Sustainable Development Program for the Mining Industry – Mine Closure* (Department of Industry, Innovation and Science, 2016).

The Mining Operations Plan would describe the rehabilitation performance measures and completion criteria including more detailed and quantified criteria where applicable (based on the Development Consent requirements for the modified Project). The rehabilitation performance measures and completion criteria to be included in the Mining Operations Plan would be specific, measureable, achievable, realistic and time-bound.

Over the life of the modified Project, rehabilitation performance measures and completion criteria would periodically be updated and refined in consultation with relevant regulatory stakeholders to reflect evolving site rehabilitation practices and standards.

5.3 General Mine Rehabilitation Practices and Measures

Rehabilitation progress of the modified Project and rehabilitation techniques and materials would be regularly evaluated. The results would inform future rehabilitation initiatives and refinement/amendment of the practices and measures via adaptive management as described below.

5.3.1 Vegetation Clearing Measures

The clearance of vegetation would be undertaken progressively, with the area of vegetation cleared at any particular time generally being no greater than that required to accommodate projected development activities for the next 12 months.

Vegetation clearance protocols would be documented in the Biodiversity Management Plan required by Condition 35, Schedule 3 of Development Consent DA 374-11-00 and the Mining Operations Plan. Key components of the vegetation clearance protocols would include aspects such as the clear delineation of vegetation areas to be cleared, clearing inspections and re-use of cleared vegetation debris in revegetation

5.3.2 Soil Striping and Handling Measures

General soil management practices would include the stripping and stockpiling of soil resources for use in rehabilitation. The objectives of soil resource management would be to:

- identify and quantify potential soil resources for rehabilitation;
- optimise the recovery of usable soil reserves during soil stripping operations;
- manage soil reserves so as not to degrade the resource when stockpiled; and
- establish effective soil amelioration procedures to maximise the availability and suitability of soil reserves for future rehabilitation works.

Soils would be progressively stripped and stockpiled in a manner that minimises the degradation of soil quality, including the following procedures (Black Range Minerals, 2000):

- topsoil and subsoils would be stockpiled separately if different soil horizons are evident;
- stockpiles would not be located in drainage lines or trafficable areas;
- upslope surface water runoff would be diverted around soil stockpiles and ancillary infrastructure;
- stockpiling time would be minimised by prioritising the reuse of these materials;
- stockpiles would be seeded with suitable endemic grass and legume species as soon as practicable after construction, if extended storage is anticipated;
- colonising weed species would be controlled;
- stockpiled soils would be monitored and rejuvenated if necessary; and
- soil stockpiles would be located adjacent to disturbance areas.

The Mining Operations Plan would describe the soil resource management measures that would be used during the Project life.

5.3.3 Selection of Native Plant Species for Woodland Revegetation

Disturbed areas to be revegetated with native vegetation would initially be stabilised with a non-persistent cover crop. Suitable native tube stock and/or seeds would then be planted/sown.

Native species to be planted in revegetation areas would be selected on a site by site basis depending on nearby remnant vegetation associations, soil types, aspect and site conditions.

The list of suitable native plant species to be used in the revegetation of disturbance areas would be documented in the Mining Operations Plan.

5.3.4 Erosion and Sediment Control Works

Erosion and sediment control would be undertaken in accordance with the Surface Water Management Plan (Section 4.8) required by Condition 30, Schedule 3 of Development Consent DA 374-11-00.

Sediment and erosion controls would be periodically updated and regularly reviewed.

Operational sediment and erosion control works would be maintained during the establishment of revegetation. However, once self-sustaining stable final landforms have been achieved within an area, key elements of the operational sediment control structures would either be left as passive water control storages or would be removed and the area would become free-draining.

5.3.5 Land Contamination Management

Mitigation measures to minimise the potential for land contamination at the Project are provided in Section 4.2.

Investigations would be undertaken at mine closure to identify and remediate any contaminated soil materials that may exist (e.g. in infrastructure areas) in accordance with the requirements of the NSW *Contaminated Land Management Act 1997*.

5.3.6 Weed and Pest Control

Project weed and pest control measures are described in Section 4.12.3.

5.3.7 Bushfire Management

Bushfire management measures for the Project are described in Section 4.12.3.

5.4 Mining Operations Plan

The Mining Operations Plan will describe how rehabilitation is undertaken, it will provide rehabilitation performance and completion criteria and address all aspects of rehabilitation including mine closure, final landforms and final land use.

5.5 Rehabilitation Monitoring

Ongoing monitoring and maintenance of rehabilitation areas at the Project would be conducted to assess the:

- progress of rehabilitation areas; and
- the effectiveness of the rehabilitation techniques being used to determine the need for any maintenance and/or contingency measures.

A summary of rehabilitation activities and performance would be provided in the Annual Review.

The rehabilitation monitoring would include:

- recording germination success in endemic woodland and pasture revegetation areas;
- recording pasture establishment success in pasture areas and progression towards suitability for low impact grazing;
- monitoring drains and rehabilitated mine landforms for localised failures or rilling and loss of topsoil after rainfall events;
- identifying potential threats to rehabilitated woodland and pasture areas (e.g. weed invasion, pest species, erosion);
- monitoring the stability of rehabilitated mine landforms; and
- recording key rehabilitation information (e.g. taking photographic records, documenting rehabilitation surveys).

Annual surveys of rehabilitation areas would be undertaken by an appropriately qualified and experienced person to review the progress of rehabilitation and to identify any additional measures required to achieve ongoing progression towards achieving rehabilitation criteria. A monitoring report would be prepared annually that includes a summary of previous monitoring results, results of the current year's monitoring and any planned remedial works, if required. The monitoring results would be summarised in the Annual Review.

The specific rehabilitation parameters and completion criteria would be determined in consultation with relevant government agencies and documented in the Mining Operations Plan.

Clean TeQ would conduct rehabilitation and revegetation trials at the Project with the objective of improving overall rehabilitation outcomes to meet the Project closure objectives and completion criteria.

5.6 Borefields and Surface Water Extraction Infrastructure

The Modification would include:

- minor changes to borefields layout (Section 3.9.1); and
- addition of licensed surface water extraction from the Lachlan River (Section 3.9.2).

The rehabilitation strategy for the modified borefields would however remain unchanged and would be extended to include the surface water extraction infrastructure.

Rehabilitation management strategies post construction that would be implemented include:

- control of weed species; and
- implementation of erosion and sediment control measures.

The following options exist at the decommissioning stage:

- transfer ownership to regional landholders with pump station, bores and transfer stations remaining in working condition; or
- dismantle pump station and cap bores, and remove infrastructure (including borehead facilities).

The decommissioning options would be determined in consultation with landowners and subject to the agreement of the Secretary of the DP&E.

Rehabilitation of the borefields and surface water extraction infrastructure would be undertaken in consultation with immediately affected landowners.

Regeneration of the borefields and surface water extraction infrastructure would reflect the vegetation of the existing environment and would include manage weed species.

5.7 Water Pipeline

The Modification includes an option to modify the water pipeline alignment to follow existing road reserves rather than following the alignment of the approved Fifield Bypass (Section 3.9.4)

The rehabilitation strategy for the alternative water pipeline would however remain unchanged.

The main rehabilitation objectives following construction of the water pipeline are as follows:

- replacement of soil from original location;
- management of weed species;
- management of tree growth; and
- implementation of erosion and sediment control measures.

The following options exist at the decommissioning stage of the water pipeline:

- disconnect and leave the pipeline infrastructure for future use (e.g. town water supply);
- utilise the pipeline for other purposes; or
- dismantle the pipeline and return the area to its former condition.

The final options for pipeline decommissioning are dependent on the future land use requirements of the landowner and local authorities.

If the option to dismantle pipeline infrastructure is selected the following procedures would be followed (Black Range Minerals, 2000):

- remove infrastructure and backfill trenches;
- rehabilitate disturbed areas; and
- provide for stock, native fauna and human safety.

Final rehabilitation objectives would be to (Black Range Minerals, 2000):

- backfill the trenches with soil from the area;
- implement erosion and stabilisation controls at potentially sensitive areas;
- reflect the vegetation of the existing environment; and
- manage weed species.

5.8 Other Project Components

As described in Section 1.2, the Modification would not involve changes to any aspects of the approved limestone quarry, rail siding or gas pipeline.

The approved rehabilitation strategy for these Project components would therefore remain unchanged.

6 Statutory Context

This section outlines the statutory requirements relevant to the assessment of the Modification.

6.1 Applicability of Section 75W of Environmental Planning and Assessment Act, 1979

The Project was approved under Part 4 of the EP&A Act in 2001 (Development Consent DA 374-11-00).

Clause 12 of Schedule 6A of the EP&A Act provides that section 75W of Part 3A of the EP&A Act continues to apply to modification of development consents referred to in clause 8J(8) of the *Environmental Planning and Assessment Regulation, 2000* (EP&A Regulation) following the repeal of Part 3A.

The Project was approved under Part 4 of the EP&A Act in 2001 by development consent under Division 4 of Part 4 of the EP&A Act (relating to State significant development). Therefore Development Consent DA 374-11-00 is a development consent that falls within clause 8J(8)(c) of the EP&A Regulation. That is, section 75W of the EP&A Act continues to apply to modifications to Development Consent DA 374-11-00, notwithstanding its repeal[3].

Approval for the Modification will be sought as a modification to Development Consent DA 374-11-00 under section 75W of the EP&A Act. Section 75W of the EP&A Act relevantly provides:

> **75W Modification of Minister's approval**
>
> *(1) In this section:*
>
> ***Minister's approval*** *means an approval to carry out a project under this Part, and includes an approval of a concept plan.*
>
> ***Modification of approval*** *means changing the terms of a Minister's approval, including:*
>
> *(a) Revoking or varying a condition of the approval or imposing an additional condition of the approval, and*
>
> *(b) Changing the terms of any determination made by the Minister under Division 3 in connection with the approval.*
>
> *(2) The proponent may request the Minister to modify the Minister's approval for a project. The Minister's approval for a modification is not required if the project as modified will be consistent with the existing approval under this Part.*
>
> *(3) The request for the Minister's approval is to be lodged with the Director-General. The Director-General may notify the proponent of environmental assessment requirements with respect to the proposed modification that the proponent must comply with before the matter will be considered by the Minister.*
>
> *(4) The Minister may modify the approval (with or without conditions) or disapprove of the modification...*

6.2 Environmental Planning Instruments

6.2.1 Regional Environmental Plan

The *Central West and Orana Regional Plan* (DP&E, 2017) (the CWO Regional Plan) was released in July 2017 and covers the Project area (including the Lachlan, Parkes and Forbes LGAs).

The CWO Regional Plan includes the following vision:

> *The most diverse regional economy in NSW with a vibrant network of centres leveraging the opportunities of being at the heart of NSW*

[3] Part 3A of the EP&A Act (as in force immediately before its repeal) continues to apply for the Project. The description and quotations of relevant references to clauses of Part 3A in this document are as if Part 3A of the EP&A Act is still in force.

The following regionally focused goals are outlined in the CWO Regional Plan to achieve the vision.

- *The most diverse regional economy in NSW*;
- *A stronger, healthier environment and diverse heritage*;
- *Quality freight, transport and infrastructure networks*; and
- *Dynamic, vibrant and healthy communities*.

The modified Project is consistent with the vision and goals in the CWO Regional Plan.

6.2.2 Local Environmental Plans

The Project area is located within the Lachlan, Parkes and Forbes LGAs, which are covered by the Lachlan LEP, *Parkes Local Environmental Plan, 2012* (Parkes LEP) and *Forbes Local Environmental Plan, 2013* (Forbes LEP), respectively.

Lachlan Local Environmental Plan, 2013

The mine, Fifield bypass, gas pipeline and water pipeline components of the approved Project are located in the Lachlan LGA.

The Modification would include changes to the mine (Sections 3.1 to 3.8) and water pipeline (Section 3.9.4). No changes to the Fifield bypass or gas pipeline are proposed as part of the Modification.

The following identifies the provisions in the Lachlan LEP which may have relevance to the Modification.

Mine Site

The majority of the mine site is located in land zoned “RU1” (Primary Production) under the Lachlan LEP. Under the Lachlan LEP, open cut mining is listed as permissible activity with consent on lands zoned “RU1” (Primary Production).

The remaining section of the mine site is located within land zoned “RU3” (Forestry) under the Lachlan LEP. Under the Lachlan LEP, uses authorised under the *Forestry Act, 2012* are permissible without consent on lands zoned “RU3” (Forestry).

The *Forestry Act, 2012* provides for the dedication, reservation, control and use of State forests, timber reserves and Crown lands for forestry and other purposes.

The Project (approved and modified) would involve activities within Fifield State Forest, which is dedicated as a State Forest pursuant to the *Forestry Act, 2012*.

Section 21 of the *Forestry Act, 2012* provides that land within a State Forest is subject to the provisions of the *Mining Act, 1992* and that the exercise of any right under the *Mining Act, 1992* within a State Forest is subject to conditions relating to forestry or the purpose of the reserve.

For the portion of the Project within the Fifield State Forest, Clean TeQ has lodged MLAs (MLA 132 and MLA 140). Activities within Fifield State Forest would be conducted in accordance with the conditions of the relevant mining tenement.

The effect of section 21 of the *Forestry Act, 2012* and the mining tenements to be issued under the *Mining Act, 1992* is that the Project and the Modification are permissible under the Lachlan LEP.

Clause 2.3(2) of the Lachlan LEP provides:

> *The consent authority must have regard to the objectives for development in a zone when determining a development application in respect of land within the zone.*

The consent authority for the Modification is the Minister for Planning (Section 6.1).

The objectives of the “RU1” (Primary Production) zone include:

- *To encourage sustainable primary industry production by maintaining and enhancing the natural resource base.*
- *To encourage the diversity in primary industry enterprises and systems appropriate for the area.*
- *To minimise the fragmentation and alienation of resource lands.*
- *To minimise conflict between land uses within this zone and land uses within adjoining zones.*

The objectives of the “RU3” (Forestry) zone include:

- *To enable development for forestry purposes.*
- *To enable other development that is compatible with forestry land uses.*

The Modification is consistent with the general objectives of the “RU1” (Primary Production) and “RU3” (Forestry) zones as mining is a primary industry and the Modification would enhance the productivity of the approved mining operations at Project.

The Modification is not expected to change the approved potential impacts on the Fifield State Forest.

The Modification would not significantly alter the compatibility of Project with adjoining land uses.

Water Pipeline Alignment Option

The majority of the water pipeline alignment option (Figure 20) is located in land zoned “RU1” (Primary Production) with a section in Fifield zoned “RU5” (Village) under the Lachlan LEP.

Under the Lachlan LEP, water supply systems is listed as permissible activity with consent on lands zoned “RU1” (Primary Production) and “RU5” (Village).

The objectives of the “RU1” (Primary Production) zone include:

- *To encourage sustainable primary industry production by maintaining and enhancing the natural resource base.*
- *To encourage the diversity in primary industry enterprises and systems appropriate for the area.*
- *To minimise the fragmentation and alienation of resource lands.*
- *To minimise conflict between land uses within this zone and land uses within adjoining zones.*

The objectives of the “RU5” (Village) zone include:

- *To provide for a range of land uses, services and facilities that are associated with a rural village.*

The Modification is consistent with the general objectives of the “RU1” (Primary Production) zone and is not inconsistent with the objectives of the “RU5” (Village) zone.

The Modification would not significantly alter the compatibility of Project with adjoining land uses.

Forbes Local Environmental Plan 2013

The borefields, surface water extraction infrastructure and water pipeline components of the approved Project are located in the Forbes LGA.

The Modification would include the addition of licensed surface water extraction from the Lachlan River (Section 3.9.2) and minor changes to the borefields layout (Section 3.9.1).

The modified to borefields and surface water extraction infrastructure (Figure 16) are located in land zoned “RU1” (Primary Production) under the Forbes LEP. Under the Forbes LEP, water supply systems is listed as permissible activity with consent on lands zoned “RU1” (Primary Production).

Clause 2.3(2) of the Forbes LEP provides:

> *The consent authority must have regard to the objectives for development in a zone when determining a development application in respect of land within the zone.*

The consent authority for the Modification is the Minister for Planning (Section 6.1).

The objectives of the "RU1" (Primary Production) zone include:

- *To encourage sustainable primary industry production by maintaining and enhancing the natural resource base.*
- *To encourage the diversity in primary industry enterprises and systems appropriate for the area.*
- *To minimise the fragmentation and alienation of resource lands.*
- *To minimise conflict between land uses within this zone and land uses within adjoining zones.*
- *To provide opportunities for intensive and extensive agriculture in appropriate locations consistent with the environmental capability of the land.*

The Modification is consistent with the general objectives of the "RU1" (Primary Production) zone as the Project is a primary industry and the Modification would enhance the productivity of the existing mining operations at Project.

The Modification would not significantly alter the compatibility of Project with adjoining land uses.

Parkes Local Environmental Plan 2012

The limestone quarry and rail siding components of the approved Project are located in the Parkes LGA.

No changes to the limestone quarry or rail siding are proposed for the Modification and therefore it the Parkes LEP has not been considered further.

6.2.3 State Environmental Planning Policies

State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007

The *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries)* (Mining SEPP) regularises the various environmental planning instruments that previously controlled mining activities and aims to provide for the proper management of and development of mineral resources.

Clause 5(3) of the Mining SEPP gives it primacy where there is an inconsistency between the provisions of the Mining SEPP and the provisions of any other environmental planning instrument (except the *State Environmental Planning Policy (Major Development) 2005*, *State Environmental Planning Policy No. 14 [Coastal Wetlands]* and *State Environmental Planning Policy No. 26 [Littoral Rainforest]*).

Clause 2 – Aims

Clause 2 sets out the aims of the Mining SEPP as follows:

(a) to provide for the proper management and development of mineral, petroleum and extractive material resources for the purpose of promoting the social and economic welfare of the State, and

(b) to facilitate the orderly and economic use and development of land containing mineral, petroleum and extractive material resources, and

(b1) to promote the development of significant mineral resources, and

(c) to establish appropriate planning controls to encourage ecologically sustainable development through the environmental assessment, and sustainable management, of development of mineral, petroleum and extractive material resources, and

(d) to establish a gateway assessment process for certain mining and petroleum (oil and gas) development:

(i) to recognise the importance of agricultural resources, and

(ii) to ensure protection of strategic agricultural land and water resources, and

(iii) to ensure a balanced use of land by potentially competing industries, and

(iv) to provide for the sustainable growth of mining, petroleum and agricultural industries.

Clause 7 – Permissible Development

Clause 7(1) of the Mining SEPP states that development of any of the following purposes may be carried out only with development consent:

(b) mining carried out:

(i) on land where development for the purposes of agriculture or industry may be carried out (with or without development consent), or

The modified Project activities are on land where development for the purposes of agriculture or industry is permissible under the Lachlan LEP, Parkes LEP or Forbes LEP. Therefore the Modification activities are permissible with development consent.

Clause 12 – Compatibility with Other Land Uses

Clause 12 of the Mining SEPP requires that, before determining an application for consent for development for the purposes of mining, petroleum production or extractive industry, the consent authority must:

(a) consider:

(i) the existing uses and approved uses of land in the vicinity of the development, and

(ii) whether or not the development is likely to have significant impact on the uses that, in the opinion of the consent authority having regard to land use trends, are likely to be the preferred uses of land in the vicinity of the development, and

(iii) any ways in which the development may be incompatible with any of those existing, approved or likely preferred uses, and

(b) evaluate and compare the respective public benefits of the development and the land uses referred to in paragraph (a) (i) and (ii), and

(c) evaluate any measures proposed by the applicant to avoid or minimise any incompatibility , as referred to in paragraph (a) (iii).

Existing and approved land use in the vicinity of the Project is generally characterised by agricultural land uses. Land use at the modified borefields and surface water extraction infrastructure (Figure 16) includes agriculture and road reserve. The water pipeline alignment option (Figure 20) would follow existing road reserves. Land adjacent to the road is characterised by agricultural land, vegetated areas and the village of Fifield.

Consideration of the potential impacts of the Project on agricultural and other land uses is summarised in Section 4.2.2.

The modified Project is not incompatible with existing, approved or likely adjoining land uses. As described in Section 4, the modified Project would be operated in a manner as to minimise potential impacts on the environment and alternative land uses on adjoining lands.

The modified Project would stimulate demand in the local and regional economy leading to increased turnover in a range of sectors and increased employment opportunities.

Clean TeQ would implement a progressive rehabilitation program (Section 5) which aims to rehabilitate the site to a state that would minimise the incompatibility of the Project with existing and future land uses in the area. The rehabilitated final landform would incorporate agriculture (pasture for grazing) and construction (endemic woodland).

Clause 14 – Natural Resource Management and Environmental Management

Clause 14(1) of the Mining SEPP requires that, before granting consent for development for the purposes of mining, petroleum production or extractive industry, the consent authority must consider whether or not the approval should be issued subject to conditions aimed at ensuring that the development is undertaken in an environmentally responsible manner, including conditions to ensure the following:

> *(a) that impacts on significant water resources, including surface and groundwater resources, are avoided, or are minimised to the greatest extent practicable,*
>
> *(b) that impacts on threatened species and biodiversity, are avoided, or are minimised to the greatest extent practicable,*
>
> *(c) that greenhouse gas emissions are minimised to the greatest extent practicable.*

In addition, clause 14(2) requires that, without limiting clause 14(1), in determining a development application for development for the purposes of mining, petroleum production or extractive industry, the consent authority must consider an assessment of the greenhouse gas emissions (including downstream emissions) of the development, and must do so having regard to any applicable state or national policies, programs or guidelines concerning greenhouse gas emissions.

The potential impacts of the Modification on groundwater and surface water resources are discussed in Sections 4.7.2 and 4.8.2, including measures to minimise potential impacts which are described in Sections 4.7.3 and 4.8.3.

The potential impacts of the Modification on threatened species and biodiversity are described in Section 4.12.2, including measures to minimise potential impacts which are described in Section 4.12.3.

The estimated modified Project greenhouse gas emissions are described in Section 4.3.4.

Clause 15 – Resource Recovery

Clause 15 of the Mining SEPP requires that:

> *(1) Before granting consent for development for the purposes of mining, petroleum production or extractive industry, the consent authority must consider the efficiency or otherwise of the development in terms of resource recovery.*
>
> *(2) Before granting consent for the development, the consent authority must consider whether or not the consent should be issued subject to conditions aimed at optimising the efficiency of resource recovery and the reuse or recycling of material.*
>
> *(3) The consent authority may refuse to grant consent to development if it is not satisfied that the development will be carried out in such a way as to optimise the efficiency of recovery of minerals, petroleum or extractive materials and to minimise the creation of waste in association with the extraction, recovery or processing of minerals, petroleum or extractive materials.*

It is in Clean TeQ's financial interest to maximise the efficiency of ore recovery and minimise the generation of process wastes that require disposal.

Clause 16 – Transport

Clause 16(1) of the Mining SEPP requires that, before granting consent for development for the purposes of mining or extractive industry that involves the transport of materials, the consent authority must consider whether or not the consent should be issued subject to conditions that do any or more of the following:

> *(a) require that some or all of the transport of materials in connection with the development is not to be by public road,*
>
> *(b) limit or preclude truck movements, in connection with the development, that occur on roads in residential areas or on roads near to schools,*
>
> *(c) require the preparation and implementation, in relation to the development, of a code of conduct relating to the transport of materials on public roads.*

The potential impacts of the Modification on the road transport network are considered in Section 4.9.2. The Road Transport Assessment, conducted by GTA Consultants, concluded that no significant impacts on the performance capacity, efficiency and safety of the road network are expected to arise as a result of the modified Project (Appendix E).

Clause 16(2) of the Mining SEPP requires that if the consent authority considers that the development involves the transport of materials on a public road, the consent authority must, within seven days after receiving the development application, provide a copy of the application to each roads authority for the road, and the RMS (if it is not a roads authority for the road).

In addition, clause 16(3) of the Mining SEPP requires that the consent authority:

(a) must not determine the application until it has taken into consideration any submissions that it receives in response from any roads authority or the Roads and Traffic Authority within 21 days after they were provided with a copy of the application, and ...

Clean TeQ has consulted with the RMS, LSC, PSC and FSC for the Modification (Section 1.3). These authorities are aware of the proposed Modification and the associated use of relevant roads for the modified Project.

Clause 17 – Rehabilitation

Clause 17 of the Mining SEPP requires that before granting consent for development for the purposes of mining, the consent authority must consider whether or not the approval should be issued subject to conditions aimed at ensuring the rehabilitation of land that will be affected by the development.

In particular, the consent authority must consider whether conditions of the consent should:

(a) require the preparation of a plan that identifies the proposed end use and landform of the land once rehabilitated, or

(b) require waste generated by the development or the rehabilitation to be dealt with appropriately, or

(c) require any soil contaminated as a result of the development to be remediated in accordance with relevant guidelines (including guidelines under section 145C of the Act and the Contaminated Land Management Act 1997), or

(d) require steps to be taken to ensure that the state of the land, while being rehabilitated and at the completion of the rehabilitation, does not jeopardize public safety.

A comprehensive program would be implemented for the progressive rehabilitation of the additional surface development area, including the remediation of any contaminated soil, if applicable (Section 5).

One of the key Project rehabilitation objectives (Section 5) is the creation of safe, stable, adequately drained post-mining landforms that are consistent with the local surrounding landscape.

The proposed management of waste rock material and tailings is discussed in Sections 3.5 and 3.7.

State Environmental Planning Policy No. 33 (Hazardous and Offensive Development)

Clause 12 of SEPP 33 requires a Preliminary Hazard Analysis to be prepared for developments for the purposes of potentially hazardous industries.

The Preliminary Hazard Analysis must be prepared in accordance with the current circulars or guidelines published by the DP&E and submitted with the development application.

Clause 13 of SEPP 33 requires the consent authority to consider the following when determining an application to carry out development for the purposes of a potentially hazardous or potentially offensive industry:

(a) current circulars or guidelines published by the Department of Planning relating to hazardous or offensive development, and

(b) whether any public authority should be consulted concerning any environmental and land use safety requirements with which the development should comply, and

(c) *in the case of development for the purpose of a potentially hazardous industry—a preliminary hazard analysis prepared by or on behalf of the applicant, and*

(d) *any feasible alternatives to the carrying out of the development and the reasons for choosing the development the subject of the application (including any feasible alternatives for the location of the development and the reasons for choosing the location the subject of the application), and*

(e) *any likely future use of the land surrounding the development.*

A Preliminary Hazard Analysis has been conducted from the modified Project in accordance with SEPP 33 (Appendix C).

This Preliminary Hazard Analysis was conducted to evaluate the hazards associated with the modified Project in accordance with the general principles of risk evaluation and assessment outlined in the NSW Department of Planning and Infrastructure (DP&I) (now DP&E) *Assessment Guideline: Multi-level Risk Assessment* (DP&I, 2011).

This Preliminary Hazard Analysis also addressed the requirements of the *Hazardous and Offensive Development Application Guidelines: Applying SEPP 33* (NSW Department of Planning [DoP], 2011a), and has been documented in general accordance with *Hazard Industry Planning Advisory Paper No.6: Hazard Analysis* (DoP, 2011b).

In regard to clause 13(b), consultation has been undertaken with public authorities during the preparation of this EA as described in Section 1.3.

Project alternatives are discussed in Section 7.1.1, which addresses clause 13(d) of SEPP 33.

In regard to clause 13(e), the land surrounding the Project is generally zoned as RU1 (Primary Production) under the Lachlan LEP, Parkes LEP or Forbes LEP (Section 6.2.2) and the Project is generally compatible with the uses that are permissible in adjoining lands.

Consideration of the potential impacts of the Project on agricultural land uses and amenity are assessed in Sections 4.2 to 4.5 and 4.13.

6.2.4 NSW Government Policy

In September 2012, the NSW Government released the following policy documents potentially relevant to the Modification:

- *Strategic Regional Land Use Policy* (NSW Government, 2012a); and
- *Aquifer Interference Policy* (AIP) (NSW Government, 2012b).

Strategic Regional Land Use Policy

As part of the *Strategic Regional Land Use Policy* (NSW Government, 2012a), the NSW Government introduced a 'Gateway Process' for the upfront assessment of the impacts of State Significant mining and coal seam gas proposal on Strategic Agricultural Land.

The Mining SEPP includes mapping of lands identified as Strategic Agricultural Land and none is mapped in the mine site.

The Modification would not change the existing Project MLAs which were submitted in either 1998 or 1999 or require additional MLAs. A Site Verification Certificate or Gateway Certificate is not required for existing mining tenements (clause 20 of Schedule 6A of the EP&A Act).

Notwithstanding the above, the mine site would not be Strategic Agricultural Land as defined in the *Interim protocol for site verification and mapping of biophysical strategic agricultural land* (NSW Government, 2013) because the mine site is not considered to have a reliable water supply as it is located outside:

- reliable rainfall areas mapped by the DPI-Water;
- highly productive groundwater resource areas mapped by the DPI-Water; and

- highly reliable surface water supply mapped by the DPI-Water.

A Site Verification Certificate or Gateway Certificate is not required for project components located outside the mining tenements (clause 17A[2] of the Mining SEPP).

An assessment of potential impacts on agricultural resources is presented in Section 4.2.2.

Aquifer Interference Policy

The AIP has been developed to ensure equitable water sharing between various water users and proper licensing of water taken by aquifer interference activities such that the take is accounted for in the water budget and water sharing arrangements. The AIP also aims to enhance existing regulation, contributing to a comprehensive framework to protect the rights of all water users and the environment in NSW.

The NSW *Water Management Act 2000* defines an aquifer interference activity as that which involves any of the following:

- *the penetration of an aquifer;*
- *the interference with water in an aquifer;*
- *the obstruction of the flow of water in an aquifer;*
- *the taking of water from an aquifer in the course of carrying out mining or any other activity prescribed by the regulations; and*
- *the disposal of water taken from an aquifer in the course of carrying out mining or any*
- *other activity prescribed by the regulations.*

A Water Management Assessment (Appendix D) that considered potential groundwater impacts associated with the modified mine site has been prepared in consideration of the AIP and the key conclusions are summarised below.

The Modification would not change the operation of the approved borefields and therefore there would be no changes to the approved groundwater impacts associated with the borefields.

Water Source

The AIP requires all water taken by aquifer interference activities to be accounted for within the extraction limits set by the relevant Water Sharing Plan.

The Water Sharing Plan relevant to the mine site is the *Water Sharing Plan for the NSW Murray-Darling Basin (MDB) Fractured Rock Groundwater Sources*.

Baseline Groundwater Conditions

Baseline groundwater conditions are presented in Section 4.7.1 and Appendix D.

Modelling of Potential Impacts

The Water Management Assessment (Appendix D) includes predictive modelling of the groundwater impacts at the mine using a groundwater model. Detail on the development of the groundwater model is provided in Appendix D.

Licensing Requirements

Comparison of Clean TeQ's licence entitlements against the predicted annual licensing requirements shows that adequate licences are available to account for the potential take of water associated with the modified Project (Appendix D).

Post-closure annual licensing requirements are expected to be less than the licensing requirements during operation. Given Clean TeQ currently holds adequate licenses to account for the potential take of water associated with the modified Project, it is expected Clean TeQ will have adequate licences to account for the potential post-closure take of water.

Notwithstanding, the groundwater model would be refined over progression of the mine life in order to more accurately calculate the post-closure licensing requirements associated with the modified Project.

Minimal Impact Considerations

The AIP establishes minimal impact considerations for highly productive and less productive groundwater.

DPI-Water mapping of highly productive groundwater in the vicinity of Project, indicates that no highly productive groundwater is present at the mine. The fractured rock aquifers associated with the mine site are considered to be less productive as testing of groundwater and monitoring bores indicate the yield is less than 5 L/s (Appendix D).

Therefore, the following AIP minimal impact considerations apply for groundwater quality at the mine site and have been considered as part of the Water Management Assessment (Appendix D):

1. *Any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40 m from the activity.*
2. *If condition 1 is not met then appropriate studies will need to demonstrate to the Minister's satisfaction that the change in groundwater quality will not prevent the long-term viability of the dependent ecosystem, significant site or affected water supply works.*

While the AIP requires 'cumulative assessment' of groundwater impacts, there are no other known or planned future aquifer interference activities proximal to the mine.

As concluded in Section 4.7.2, given there are no privately-owned bores in the mine boundary, no groundwater drawdown impacts are predicted to groundwater users. The nearest registered groundwater user with recorded information is located approximately 7 km from the site, therefore no groundwater quality impacts on groundwater users are predicted due to seepage.

Further, as groundwater quality in the vicinity of the tailings storage facility is brackish, and seepage is constrained by the low permeability of the underlying and adjacent soil and rock, the impact to groundwater quality would be very low (Appendix D).

As described in Section 4.7.1, no aquatic GDEs are mapped at the mine site and areas of low potential for terrestrial GDEs are mapped in the vicinity of the mine site (Appendix D). No significant water level or quality impacts are predicted in the areas mapped as low potential for terrestrial GDEs (Appendix D).

Relevant Mitigation and Contingency Measures

The Groundwater Management Plan will include a process to deal with a complaint received in relation to loss of groundwater supply. Clean TeQ implement the Groundwater Management Plan for the modified Project.

Clean TeQ would monitor and report groundwater extraction as required under the conditions of its water licences.

6.3 Other Applicable Statutory Approvals

The following approvals would be obtained before the modified Project commences:

- modification of the Development Consent DA 374-11-00 issued under the EP&A Act, and any relevant secondary approvals under the Development Consent conditions (e.g. management plans);
- Mining Leases under the *Mining Act, 1992*;
- Mining Operations Plan prepared under the conditions of the Mining Leases;
- a new AHIP under section 90 of the *National Parks and Wildlife Act, 1974* (and/or a variation application to the existing approved AHIP #C0003049);
- an EPL under the POEO Act;

- necessary consents under section 138 of the *Roads Act, 1993* associated with the road upgrades;
- necessary compensation agreements for activities conducted as a component of the Project within Fifield State Forest under the *Forestry Act, 2012*;
- for all relevant Crown land directly affected by the Project, Clean TeQ would enter into necessary leases or licences under the *Crown Lands Act, 1989* and/or reach agreements under section 265 of the *Mining Act, 1992* to allow Project mining activities to occur; and
- relevant WALs, and water supply works and use approvals under the *Water Management Act, 2000* where applicable.

The following NSW Acts may be applicable to the modified Project:

- *Contaminated Land Management Act, 1997;*
- *Crown Lands Act, 1989;*
- *Dams Safety Act, 1978;*
- *Dangerous Goods (Road and Rail Transport) Act, 2008;*
- *Heritage Act, 1977;*
- *Mining Act, 1992;*
- *National Parks and Wildlife Act, 1974*;
- *Pipelines Act, 1967;*
- POEO Act*;*
- *Roads Act, 1993;*
- *Threatened Species Conservation Act, 1995;*
- *Water Management Act, 2000;*
- *Work Health and Safety Act, 2011; and*
- *Work Health and Safety (Mines) Act, 2013.*

Relevant licences or approvals required under these Acts would be obtained for the modified Project as required.

6.4 Environment Protection and Biodiversity Conservation Act, 1999

The EPBC Act defines proposals that are likely to have a significant impact on a matter of national environmental significance as a ‘controlled action’. Proposals that are, or may be, a controlled action are required to be referred to the Commonwealth Minister for the Environment for a determination as to whether or not the action is a controlled action.

Matters of national environmental significance include:

- world heritage properties;
- wetlands listed under the Ramsar Convention;
- listed threatened species and ecological communities;
- listed migratory species protected under international agreements;
- nuclear actions;
- the Commonwealth marine environment;

- national heritage places; and
- water resources, in relation to coal seam gas development and large coal mining developments.

The Project was referred in 2001, and was determined as ‘not a controlled action’ (EPBC 2001/133).

As described in Section 4.12.2, the Modification would not adversely impact any threatened species and communities under the EPBC Act because no threatened flora species or communities listed under the EPBC Act occur in the Modification areas and potential indirect impacts would be managed. Hence, there would be no significant impact on threatened species and communities listed under the EPBC Act as a result of the Modification.

The other matters of national environmental significance are not relevant to the modified Project.

It is therefore considered that there is no need to refer the Modification to the Commonwealth Minister for the Environment.

7 Conclusion and Modification Justification

7.1 Modification Justification

The Modification involves the implementation of opportunities to improve the overall efficiency of the approved Project that were identified in a Project Optimisation Study undertaken by Clean TeQ.

This EA has demonstrated that the Modification can be implemented with limited additional biophysical and environmental impacts above those already approved at the Project, with the implementation of the mitigation measures described in Section 4.

The modified Project would have substantial economic and social benefits in the region. The modified Project would stimulate demand in the local and regional economy leading to increased turnover in a range of sectors and increased employment opportunities.

7.1.1 Consideration of Alterations

Alternatives to the proposed mining operations, processing operations, limestone supply, mine site layout and water supply and have been considered by Clean TeQ in the development of the Modification. An overview of alternatives to the Modification considered by Clean TeQ is provided below.

Mining Operations

The Modification would include the following changes to the approved mining operations (Section 3.4):

- mining in a more selective manner to initially increase the processing facility ore feed grade; and
- addition of drilling and blasting at the mine site.

No other components of the approved mining operations (e.g. mining method, mining rate, operational hours, open cut pit extent and waste rock management) would change as a result of the Modification.

Selective Mining

Mining in a more selective manner would allow for a higher ore feed grade, which would allow the Project to reach its approved maximum metal production rate (i.e. up to 40,000 tpa of nickel and cobalt metal equivalents as sulphate precipitate products) earlier in the mine life. This would improve the Project economics.

Selective mining would also increase the proportion of ore that would be directly fed to the processing facility, which would reduce the amount of ore stockpiling and double-handling required. This would result in a reduction in potential air quality impacts.

Drilling and Blasting

Drilling and blasting is proposed to improve the efficiency of the mining operations. The Optimisation Study identified the potential for blasting in the deeper parts of the open cut pits where harder siliceous material may be encountered and in the gravel borrow pits. It is expected that in these locations, material may not be easily ripped and excavated by mobile equipment. It is therefore proposed to drill and blast this material to maintain the efficiency of mining operations.

Processing Operations

The Modification would include the following changes to the approved processing operations (Section 3.6):

- adoption of the RIP processing method option (i.e. the counter current decantation processing method option is no longer proposed)[4];

[4] The approved Project includes the option to use either the RIP or counter current decantation processing method.

- increased sulphur demand and sulphuric acid production to leach additional nickel, cobalt and scandium from the higher grade ore;
- increased limestone demand to neutralise the additional acid required in the acid leach circuit;
- addition of a crystalliser to the processing facility to extract ammonium sulphate from an existing waste stream for use as a fertiliser product; and
- addition of a water treatment plant to the processing facility to recycle process water and minimise make-up water demand.

No other changes to the approved processing operations are proposed as part of the Modification.

Processing Method

The Optimisation Study considered the two approved processing methods (i.e. RIP and counter current decantation) and determined that the RIP was the preferred processing option as it is anticipated to be more efficient than the counter current decantation method.

The adoption of the RIP processing method would result in the elimination of the 'Extraction Fan over Sulphide Filter Vent', 'Flare Stack' and 'Hydrogen Reformer Stack' emission release points associated with the counter current decantation circuit (Table 3) and would therefore have lower potential air quality impacts.

Increased Limestone and Sulphuric Acid Demand

As described in Section 3.4.2, the nickel and cobalt grade of the processing facility ore feed would initially be higher than previously assumed for the approved Project due to the proposed more selective mining method.

The higher grade in the processing facility feed would require a corresponding increase in sulphuric acid demand in the acid leach circuit from 700,000 tpa to 1,050,000 tpa.

The additional sulphuric acid used in the acid leach circuit would require an increase in limestone demand from 790,000 tpa to up to 990,000 tpa in the tailings neutralisation circuit (Table 3).

No feasible alternatives to leaching the ore with sulphuric acid or neutralising the tailings with limestone slurry were identified.

The increase in sulphuric acid production would generate additional steam for power generation, reducing the Project gas demand (Section 3.10.1). This would improve the Project economics and reduce greenhouse gas emissions.

Ammonium Sulphate Production

The addition of a crystalliser to the processing facility would allow for the extraction of up to 100,000 tpa of ammonium sulphate from an existing waste stream for use as a fertiliser product.

The crystalliser would be a minor addition to the processing facility and would be located within the approved surface development area.

The proposed ammonium sulphate production would result in a beneficial use of an approved waste product that would otherwise report to the tailings storage facility.

Water Treatment Plant

A water treatment plant would be added to the processing facility to allow greater volumes of process water to be recycled and re-used in the processing facility (Section 3.8.4).

The water treatment plant would be a minor addition to the processing facility and would be located within the approved surface development area.

Modelling results indicate that in all scenarios (and with the exception of the short start-up period), the recycled water supply (direct and treated) was able to reliably supply approximately 4 ML/day, or on an annualised basis, 1,451 ML/year.

The addition of the water treatment plant would therefore significantly reduce the make-up water demand of the Project.

Limestone Supply

Additional limestone would be required for the tailings neutralisation circuit (i.e. increased from 790,000 tpa to up to 990,000 tpa) to neutralise the additional sulphuric acid.

Up to approximately 560,000 tpa of limestone from third party suppliers would be used to supplement the limestone quarry supply. The limestone would be transported from external suppliers by road.

The limestone from third party suppliers would have a higher neutralising capacity than the limestone from the limestone quarry. This would mean that less limestone by mass would be required which would reduce the overall road transport requirements and tailings production of the modified Project.

The Road Transport Assessment, conducted by GTA Consultants, concluded that no significant impacts on the performance capacity, efficiency and safety of the road network are expected to arise as a result of the modified Project (Appendix E).

Mine Site Layout

The Modification would include the following changes to the approved mine site layout (Section 3.2):

- relocation of mine infrastructure;
- increased tailings storage facility capacity; and
- reduced evaporation pond capacity.

Mine Infrastructure Area

The mine infrastructure area would be relocated within the approved surface development area to avoid potential resource sterilisation and improve operational efficiency.

Tailings Storage Facility

The tailings storage facility capacity would be increased to hold increased tailings volume due to the additional limestone required for acid neutralisation. The tailings storage facility footprint would be increased and the construction methodology would change from upstream to downstream. The final elevation of the tailings storage facility would also slightly increase from approximately 310 m AHD to 314 m AHD.

The design of the modified tailings storage facility has been reviewed as part of the Optimisation Study and would conform to the relevant guidelines and requirements described in Condition 29, Schedule 3 of Development Consent DA 374-11-00. This includes the requirements for permeability of liners, storage capacity and DSC design requirements (Sections 2.8.1 and 2.8.2).

Evaporation Ponds

An approved liquid waste stream from the processing facility containing high concentrations of chloride would be separated from other processing facility waste streams and pumped to the evaporation ponds. This would prevent the build-up of chloride in the process water as the water in the evaporation ponds would be evaporated rather than be recycled in the site water management system for reuse in the processing facility.

Due to the reduction in water volume reporting to the evaporation ponds, the footprint of the ponds would be reduced (Figure 8).

Water Supply

The Modification would include the following changes to the approved water supply (Section 3.8):

- addition of licensed surface water extraction from the Lachlan River;
- minor changes to the water pipeline alignment; and

- short-term road transport of water from the borefield to the mine site during the construction phase.

Lachlan River Water Supply

To improve the water supply security of the Project, it is proposed to diversify supply sources by including licensed extraction of surface water from the Lachlan River which is regulated by upstream releases from Wyangala Dam.

For the purposes of assessment, Clean TeQ is seeking approval for up to approximately 350 ML/year surface water extraction from the Lachlan River. It is however noted, that if opportunities were to arise (e.g. during wet climate scenarios) to obtain additional access licences for surface water extraction beyond 350 ML/annum, Clean TeQ would obtain the necessary water licences in accordance with Condition 26, Schedule 3 of the Development Consent. This would have a potential additional benefit to then reduce the volumetric allocations required to be obtained in the Upper Lachlan Alluvial Groundwater Source.

In accordance with Condition 26, Schedule 3 of Development Consent DA 374-11-00, Clean TeQ would ensure that sufficient water is supplied for all stages of the development, and obtain the necessary water licences for the development under the *Water Management Act, 2000*, and if necessary, adjust the scale of development on-site to match its available water supply.

The addition of licensed surface water from the Lachlan River would reduce the reliance on the Project borefields and associated potential groundwater impacts.

Water Pipeline

The approved water pipeline alignment may be modified to follow existing road reserves rather than following the alignment of the approved Fifield Bypass (Figure 20).

As the modified pipeline alignment is located in the existing road reserve (i.e. an existing disturbed area), disturbance of vegetated areas along the approved water pipeline alignment would be avoided if the modified pipeline alignment is adopted.

Construction Water – Short-term Road Transport

During construction and prior to the commissioning of the water pipeline (approximately 6 months), water would be transported from the borefields to the mine site by road.

The short-term road transport of water would allow for construction to commence at the mine site before the water pipeline has been constructed. This would bring forward the commencement of construction (and subsequent operations) by approximately six months, which would improve the Project economics. The earlier construction and operations commencement would also bring forward employment opportunities associated with the Project.

The Road Transport Assessment (Appendix E) assessed the potential road transport impacts of the short-term water transport and concluded that the overall impacts of the short-term road transport of water would be small. The predicted traffic would be well within the capacity of the existing roads and it would not exacerbate any existing safety concerns along the route (Appendix E).

7.2 Conclusion

The Modification involves the implementation of opportunities to improve the overall efficiency of the approved Project that were identified in a Project Optimisation Study undertaken by Clean TeQ.

The Modification involves the implementation of these opportunities and would include:

- mining in a more selective manner to initially increase the processing facility ore feed grade;
- addition of drilling and blasting at the mine site;

- adoption of the RIP processing method option (i.e. the counter current decantation processing method option is no longer proposed)[5];
- increased sulphur demand and sulphuric acid production to leach additional nickel, cobalt and scandium from the higher grade ore;
- increased limestone demand to neutralise the additional acid required in the acid leach circuit;
- addition of a crystalliser to the processing facility to extract ammonium sulphate from an existing waste stream for use as a fertiliser product;
- changes to process input and product road transport requirements;
- addition of a water treatment plant to the processing facility to recycle process water and minimise make-up water demand;
- increased tailings storage facility capacity to hold increased tailings volume due to the additional limestone required for acid neutralisation;
- reduced evaporation pond capacity due to the recycling of process water;
- relocation of mine infrastructure to avoid resource sterilisation and improve operational efficiency;
- addition of licensed surface water extraction from the Lachlan River to improve water supply security;
- minor changes to borefield transfer station layout and water pipeline alignment;
- short-term road transport of water from the borefield to the mine site during the initial construction phase; and
- reduced gas demand as the increased sulphuric acid production would generate additional steam for power generation.

The Modification would not involve changes to any aspects of the approved limestone quarry, rail siding or gas pipeline.

This EA has demonstrated that the Modification can be implemented with limited additional biophysical and environmental impacts above those already approved at the Project, with the implementation of the mitigation measures described in Section 4.

The modified Project would have substantial economic and social benefits in the region. The modified Project would stimulate demand in the local and regional economy leading to increased turnover in a range of sectors and increased employment opportunities.

It is therefore considered that the Modification is justified on environmental, economic and social grounds and that an application to modify Project Development Consent DA 374-11-00 under section 75W of the EP&A Act is appropriate.

[5] The approved Project includes the option to use either the RIP or counter current decantation processing method.

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Syerston Project

MODIFICATION 4 ENVIRONMENTAL ASSESSMENT

Appendix A

Air Quality Assessment

Intended for
Clean TeQ Holdings Limited

Document type
Report

Date
October 2017

Project No.
AS122047

SYERSTON PROJECT MODIFICATION 4
AIR QUALITY AND GREENHOUSE GAS ASSESSMENT

RAMBOLL ENVIRON

SYERSTON PROJECT MODIFICATION 4
AIR QUALITY AND GREENHOUSE GAS ASSESSMENT

Revision	Date	Made by	Checked by	Approved by	Signed
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1. INTRODUCTION

The Syerston Project (the Project) is situated approximately 350 kilometres (km) west-northwest of Sydney, near the village of Fifield, NSW (see **Appendix 1**).

Scandium21 Pty Ltd is the owner and operator of the Syerston Project and is a wholly owned subsidiary of Clean TeQ Holdings Limited (Clean TeQ) (ASX:CLQ).

Development Consent DA 374-11-00 for the Project was issued under Part 4 of the New South Wales (NSW) Environmental Planning and Assessment Act, 1979 (EP&A Act) in 2001.

The Project includes the establishment and operation of the following (see **Appendix 1**):

- mine (including the processing facility);
- limestone quarry;
- rail siding;
- gas pipeline;
- borefields and water pipeline; and
- associated transport activities and transport infrastructure (e.g. the Fifield Bypass and road and intersection upgrades).

The Project includes an initial scandium oxide focussed production phase (the Initial Production Phase) prior to shifting to scandium oxide and nickel and cobalt precipitate production by developing the full Project (the Full Production Phase).

The Initial Production Phase is a smaller-scale operation compared to the Full Project Phase and would include preferentially mining scandium-rich areas of the Syerston deposit at a run-of-mine (ROM) ore production rate of 100,000 tonnes per annum (tpa) to produce up to 1,000 tpa of nickel and cobalt metal equivalents, as either sulphide or sulphate precipitate products, and up to approximately 80 tpa of scandium oxide.

The Project would transition to the Full Production Phase once scandium-rich areas of the Syerston deposit are depleted or favourable market conditions prevail for larger scale nickel cobalt scandium production.

The mining and processing will then increase to allow for an autoclave feed rate of 2.5 million tonnes per annum (Mtpa) to produce up to 40,000 tpa of nickel and cobalt metal equivalents and up to approximately 180 tpa of scandium oxide.

Construction of the Project commenced in 2006 with the construction of some components of the borefields, however Project operations are yet to commence.

1.1 Modification overview

Clean TeQ has undertaken a Project Optimisation Study to identify opportunities to improve the overall efficiency of the Full Production Phase of the Project. The Modification involves the implementation of these opportunities and would include:

- mining in a more selective manner to initially increase the processing facility ore feed grade;
- addition of drilling and blasting at the mine site;
- adoption of the resin-in-pulp (RIP) processing method option (i.e. the counter current decantation processing method option is no longer proposed)[1];
- increased sulphur demand and sulphuric acid production to leach additional nickel, cobalt and scandium from the higher grade ore;
- increased limestone demand to neutralise the additional acid required in the acid leach circuit;
- addition of a crystalliser to the processing facility to extract ammonium sulphate from an existing waste stream for use as a fertiliser product;

[1] The approved Project includes the option to use either the RIP or counter current decantation processing method.

- changes to process input and product road transport requirements;
- addition of a water treatment plant to the processing facility to recycle process water and minimise make-up water demand;
- increased tailings storage facility capacity to hold increased tailings volume due to the additional limestone required for acid neutralisation;
- reduced evaporation pond capacity due to the recycling of process water;
- relocation of mine infrastructure to avoid resource sterilisation and improve operational efficiency;
- addition of surface water extraction from the Lachlan River to improve water supply security;
- minor changes to borefield transfer station layout and water pipeline alignment;
- short-term road transport of water from the borefield to the mine site during the initial construction phase; and
- reduced gas demand as the increased sulphuric acid production would generate additional steam for power generation.

The Modification would not involve changes to any aspects of the approved limestone quarry, rail siding or gas pipeline.

The general arrangement of the modified mine and processing facility and progressive general arrangements of the modified mine and processing facility are provided in **Appendix 1**. A detailed description of the Modification is provided in the main text of the Environmental Assessment (EA).

1.2 Report purpose and requirements

Ramboll Environ has been commissioned to complete an Air Quality Impact Assessment (AQIA) as part of the EA for the proposed Modification. While formal Secretary's Environmental Assessment Requirements have not been issued for the Modification, the NSW Department of Planning and Environment (DP&E) has provided specific advice regarding key issues for consideration in the Environmental Assessment. The AQIA has been prepared to address the specific advice relevant to air quality (**Table 1-1**).

Table 1-1: Summary of key issues for consideration for air quality

Issue for consideration	How issue is addressed
A detailed assessment should be undertaken in accordance with the *Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in NSW*, including the new National Environment Protection Measures standards for $PM_{2.5}$ that have been incorporated into that guideline.	Refer Section 2
The assessment should include detailed measures to monitor and manage increased air quality impacts, particularly in relation to stack emissions and limestone production at the quarry. The measures proposed and presented in the EA must be developed in consultation with the EPA.	Refer Section 9. Note the Modification does not include any changes to the limestone quarry and, consistent with a letter received from the DP&E on 13 October 2017, is not considered in this report.

1.3 Previous air quality assessments of the Project

An air quality assessment was prepared for the approved Project (Zib & Associates Pty Ltd, 2000), which included dispersion modelling for the construction phase (Year 1), ongoing mining operations (Year 5, 10 and 20), the processing plant and the limestone quarry. The air quality assessment found that each component of the Project would comply with the relevant air quality goals beyond the site boundary and / or at private residences.

Subsequent modifications to the approved Project demonstrated that there would be no material change to the potential air quality impacts for the approved Project (i.e. Heggies, 2005).

2. STUDY APPROACH

2.1 Assessment approach

The approach to the assessment follows guidelines recommended in the Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales ("the Approved Methods") (NSW EPA, 2016). Local air quality impacts are assessed using a Level 2 assessment approach (i.e. refined dispersion modelling technique using site-representative input data).

An overview of the approach to the assessment is as follows:

- The Modification is reviewed for potential emission sources and proposed mitigation measures.
- Emissions are estimated for all project related activities, using best practice emission estimation techniques.
- Dispersion modelling using a regulatory dispersion model is used to predict ground level concentrations (GLCs) for key pollutants from the Modification, at surrounding sensitive receivers.
- Cumulative impacts are assessed, taking into account the combined effect of existing baseline air quality, other significant sources of emissions, reasonably foreseeable future emissions and any indirect or induced effects.
- Estimates of the greenhouse gas (GHG) emissions are presented and benchmarked against GHG accounts for NSW and Australia.

2.2 Pollutant indicators

The key emissions to air for the Modification are gaseous emissions generated by the processing facility and fugitive dust or particulate matter (PM), generated during open cut mining. The air quality indicators considered in this report are summarised in **Table 2-1**.

Table 2-1: Air quality indicators for assessment

Phase	Emission source	Air quality indicator
Mining operations	Fugitive dust	Particulate matter (TSP[1], PM_{10}[2] and $PM_{2.5}$[3])
		Nuisance dust (dust deposition)
Processing plant	Sulphuric acid plant	Sulphuric acid mist (H_2SO_4)
		Sulphur dioxide (SO_2)
	Diesel power plant and auxiliary boiler	$PM_{2.5}$ (primarily[4])
		Oxides of nitrogen (NO_x)
		Sulphur dioxide (SO_2)
		Carbon monoxide (CO).
		Volatile organic compounds (VOCs)

Note:
1) Total Suspended Particulate matter
2) Particulate matter less than 10 microns in aerodynamic diameter
3) Particulate matter less than 2.5 microns in aerodynamic diameter
4) ~97% of diesel particulate matter (DPM) is in the $PM_{2.5}$ size fraction

2.3 Assessment criteria for gaseous pollutants

The impact assessment criteria for gaseous pollutants are summarised in **Table 2-2**. Similar to PM, the impact assessment criteria for 'criteria pollutants', as defined in the Approved Methods, are applied at the nearest existing or likely future off-site sensitive receptor and compared against the 100th percentile (i.e. the highest) dispersion modelling prediction.

The impact assessment criteria for other gaseous pollutants are applied at, and beyond, the site boundary and reported as the 99.9th percentile of the dispersion modelling predictions. Only incremental impacts for these pollutants need be reported. Other relevant gaseous pollutants are H_2SO_4 and the various VOC components of diesel exhaust emissions[2].

Table 2-2: Impact assessment criteria for gaseous pollutants

Pollutant	Averaging period	Concentration	
		µg/m³	pphm (4)
NO_2 (1)	1-hour	246	12
	Annual	62	3
SO_2 (1)	10-minute	712	25
	1-hour	570	20
	24-hour	228	8
	Annual	60	2
CO (1)	15-minute	100,000	8,700
	1-hour	30,000	2,500
	8-hour	10,000	900
H_2SO_4 (2),(3)	1-hour	18	-
1,3-butadiene (2),(3)	1-hour	40	1.8
Benzene (2),(3)	1-hour	29	0.9

Note 1: Gas volumes for criteria pollutants expressed at 0°C and 1 atmosphere.
Note 2: Gas volumes for other gaseous pollutants expressed at 25°C and 1 atmosphere.
Note 3: Expressed as the 99.9th Percentile Value.
Note 4: pphm = parts per hundred million.

2.4 Assessment criteria for particulate matter

When first regulated, airborne PM was assessed based on concentrations of "total suspended particulate matter" (TSP). In practice, this typically referred to PM smaller than about 30-50 micrometres (µm) in diameter. As air sampling technology improved and the importance of particle size and chemical composition become more apparent, ambient air quality standards have been revised to focus on the smaller particle sizes, thought to be most dangerous to human health. Contemporary air quality assessment typically focuses on "fine" and "coarse" inhalable PM, based on health-based ambient air quality standards set for PM_{10} and $PM_{2.5}$.

Air quality criteria for PM in Australia are given for particle size metrics including TSP, PM_{10} and $PM_{2.5}$. The 2016 update to the 'Approved Methods', gazetted on 20 January 2017, includes particle assessment criteria that are consistent with revised National Environment Protection (Ambient Air Quality) Measure (AAQ NEPM) national reporting standards (National Environment Protection Council [NEPC], 1998; NEPC, 2015).

For the purpose of this report, predicted GLCs are assessed against the NSW EPA's impact assessment criteria presented in **Table 2-3**.

Table 2-3: Impact assessment criteria for PM

PM metric	Averaging period	Concentration (µg/m^3)
TSP	Annual	90
PM_{10}	24 hour	50
	Annual	25
$PM_{2.5}$	24 hour	25
	Annual	8

Note: µg/m^3 = micrograms per cubic metre.

[2] While many VOC species are emitted from combustion of fossil fuels, benzene and 1,3-butadiene are included in the Approved Methods, are among the species with the most stringent impact assessment criteria and have reported speciation profiles for diesel engines.

The Approved Methods specifies that the impact assessment criteria for 'criteria pollutants[3]' are applied at the nearest existing or likely future off-site sensitive receptor and compared against the 100th percentile (i.e. the highest) dispersion modelling prediction. Both the incremental and cumulative impacts need to be considered (consideration of existing ambient background concentration is required).

The Approved Methods also prescribes nuisance based goals for dust deposition, which relate to amenity type impacts such as soiling of exposed surfaces. The NSW EPA impact assessment criteria for dust deposition are summarised in **Table 2-4**, illustrating the maximum increase and total dust deposition rates which would be acceptable so that dust nuisance can be avoided.

Table 2-4: Dust deposition criteria

Pollutant	Maximum Increase in Dust Deposition	Maximum Total Dust Deposition Level
Deposited dust (assessed as insoluble solids)	2 g/m^2/month	4 g/m^2/month

Note: g/m^2 = grams per square metre.

2.4.1 Voluntary land acquisition and mitigation policy

In December 2014, the NSW DP&E released their Voluntary Land Acquisition and Mitigation Policy for State Significant Mining, Petroleum and Extractive Industry Developments (the VLAMP)[4]. The VLAMP describes the voluntary mitigation and land acquisition policy to address dust (and noise) impacts and outlines mitigation and acquisition criteria for PM. Essentially, the VLAMP formalises the acquisition criteria that have previously been outlined in conditions of approval for major mining and extractive industries.

Under the VLAMP, if an applicant cannot comply with the relevant impact assessment criteria, or if the mitigation or acquisition criteria may be exceeded, the applicant should consider a negotiated agreement with the affected landowner or acquire the land. In doing so, the land is then no longer subject to the impact assessment, mitigation or acquisition criteria, although provisions do apply to "use of the acquired land", primarily related to informing and protecting existing or prospective tenants.

Voluntary mitigation rights apply when a development contributes to exceedances of the criteria set out in **Table 2-5** and voluntary acquisition rights apply when a development contributes to exceedances of the criteria set out in **Table 2-6**. The criteria for voluntary mitigation and acquisition are the same, with the exception of the number of allowable days above short-term impact assessment criteria for PM_{10}, which is zero for mitigation and five for acquisition.

Voluntary mitigation rights apply to any residence on privately owned land or any workplace on privately owned land where the consequences of the exceedance, in the opinion of the consent authority, are unreasonably deleterious to worker health or the carrying out of business. Voluntary acquisition rights also apply to any residence or any workplace on privately owned land but also apply when an exceedance occurs across more than 25% of any privately owned land where there is an existing dwelling or where a dwelling could be built under existing planning controls.

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[3] 'Criteria pollutants' is used to describe air pollutants that are commonly regulated and typically used as indicators for air quality. In the Approved Methods, the criteria pollutants are TSP, PM_{10}, nitrogen dioxide (NO_2), sulphur dioxide (SO_2), carbon monoxide (CO), ozone (O_3), deposited dust, hydrogen fluoride and lead.

[4] http://www.planning.nsw.gov.au/Policy-and-Legislation/~/media/E785D4AFFE7B447487FF9D96111C502B.ashx

Table 2-5: DP&E mitigation criteria

Pollutant	Averaging period	Mitigation Criterion		Impact Type
PM_{10}	24 hour	50 µg/m³ *		Human Health
	Annual	30 µg/m³ **		Human Health
TSP	Annual	90 µg/m³ **		Amenity
Deposited Dust	Annual	2 g/m²/month *	4 g/m²/month **	Amenity
Note: *Incremental increase due to development alone, with zero allowable exceedances over the life of the development. **Cumulative impact due to the development plus background from other sources.				

Table 2-6: DP&E acquisition criteria

Pollutant	Averaging period	Acquisition Criterion		Impact Type
PM_{10}	24 hour	50 µg/m³ *		Human Health
	Annual	30 µg/m³ **		Human Health
TSP	Annual	90 µg/m³ **		Amenity
Deposited Dust	Annual	2 g/m²/month *	4 g/m²/month **	Amenity
Note: *Incremental increase due to development alone, with up to 5 allowable exceedances over the life of the development. **Cumulative impact due to the development plus background from other sources.				

2.5 Dispersion model selection

Local air quality impacts are modelled using AERMOD, the United States Environmental Protection Agency's (US EPA) recommended steady-state plume dispersion model for regulatory purposes. The model is designed to handle a variety of pollutant source types, including surface and buoyant elevated sources, in a wide variety of settings such as rural and urban as well as flat and complex terrain. AERMOD is able to predict pollutant concentrations from point, area and volume sources in addition to 'open pit' sources.

AERMOD replaced the Industrial Source Complex (ISC) model for regulatory purposes in the US in December 2006. Ausplume, a steady state Gaussian plume dispersion model developed by the Victorian EPA and recommended in the Approved Methods for simple near-field applications, is largely based on the ISC model. AERMOD has replaced Ausplume as the regulatory model for EPA Victoria (EPA Victoria, 2013) and will be included in the next updated to the Approved Methods. The model has been used and accepted on a number of open cut mining operations in NSW.

Compared to ISC and Ausplume, AERMOD represents an advanced new-generation model, which requires additional meteorological and land use inputs to provide more refined predictions. The most important feature of AERMOD, compared to ISC and Ausplume, is its modification of the basic dispersion model to account more effectively for a variety of meteorological factors and surface characteristics. In particular, it uses the Monin-Obukhov length scale rather than Pasquill-Gifford stability categories to account for the effects of atmospheric stratification. Whereas Ausplume and ISC parameterise dispersion based on semi-empirical fits to field observations and meteorological extrapolations, AERMOD uses surface-layer and boundary layer theory for improved characterisation of the planetary boundary layer turbulence structure. Further detail on model set up, in particular the process for preparation of meteorological data in the AERMET pre-processor, is provided in **Appendix 2**.

2.6 Cumulative impacts

Cumulative impacts are assessed by combining the contribution from the Project with the existing ambient air quality environment, which is assumed to account for all existing emission sources in the local airshed.

The proposed and approved limestone quarry is located approximately 20 km to the southeast and therefore not considered to interactive cumulatively with the Project, for the purpose of this air quality assessment. As there are no changes to the approved limestone quarry, it is not included in the modelling assessment, however the interaction between the Project and the limestone quarry is considered (i.e. emissions associated with the delivery of limestone raw material to the site). No other foreseeable future emission sources are identified for cumulative assessment.

2.7 Emissions from the combustion of diesel fuel

The combustion of diesel in mining equipment results in combustion-related emissions including $PM_{2.5}$, oxides of nitrogen (NO_x), SO_2, CO, carbon dioxide (CO_2) and volatile organic compounds (VOCs), however with the exception of PM, combustion emissions have not been quantitatively assessed. Gaseous combustion emissions from mining equipment would not result in significant off-site concentrations and are unlikely to compromise ambient air quality goals.

The US EPA AP-42 emission factors developed for coal mine emission inventories do not separate PM emissions from mechanical processes (i.e. crustal material) and diesel exhaust (combustion). However, the emissions controls applied are often only relevant to the crustal fraction of total PM, for example watering of haul roads does not control the diesel component of the emissions (US EPA, 1998a). Adjustments to the emission inventories have been made to account for this and discussed further in **Section 6**. GHG emissions from diesel combustion are considered in **Section 8**.

2.8 POEO (Clean Air) Regulation

The statutory framework for managing air emissions in NSW is provided in the Protection of the Environment Operations (POEO) Act[5] 1997 and the primary regulations for air quality made under the POEO Act are:

- Protection of the Environment Operations (Clean Air) Regulation 2010[6].
- Protection of the Environment Operations (General) Regulation 2009[7].

The Project will comply with the POEO regulations as follows:

- As a scheduled activity under the POEO regulations, the Project will operate under an environment protection licence (EPL) issued by the NSW EPA and will comply with requirements including emission limits, monitoring and pollution reduction programmes (PRPs).
- Best management practice (BMP) is a guiding principle in the POEO Act, and requires that all necessary practicable means are used to prevent or minimise air pollution in NSW. A BMP determination has been made for the Project and is outlined in **Appendix 4**, having regard to all reasonable and feasible avoidance and mitigation measures.
- The Project will manage all aspects of its operations to ensure that offensive odour does not cause 'harm to' or involve 'interfering unreasonably' with the comfort or repose of any person outside the premises. Odour management measures will be outlined in the Air Quality Management Plan.
- No open burning will be performed onsite.

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[5] http://www.legislation.nsw.gov.au/maintop/view/inforce/act+156+1997+cd+0+N
[6] http://www.legislation.nsw.gov.au/maintop/view/inforce/subordleg+428+2010+cd+0+N
[7] http://www.legislation.nsw.gov.au/maintop/view/inforce/subordleg+211+2009+cd+0+N

3. LOCAL SETTING AND RECEPTOR LOCATIONS

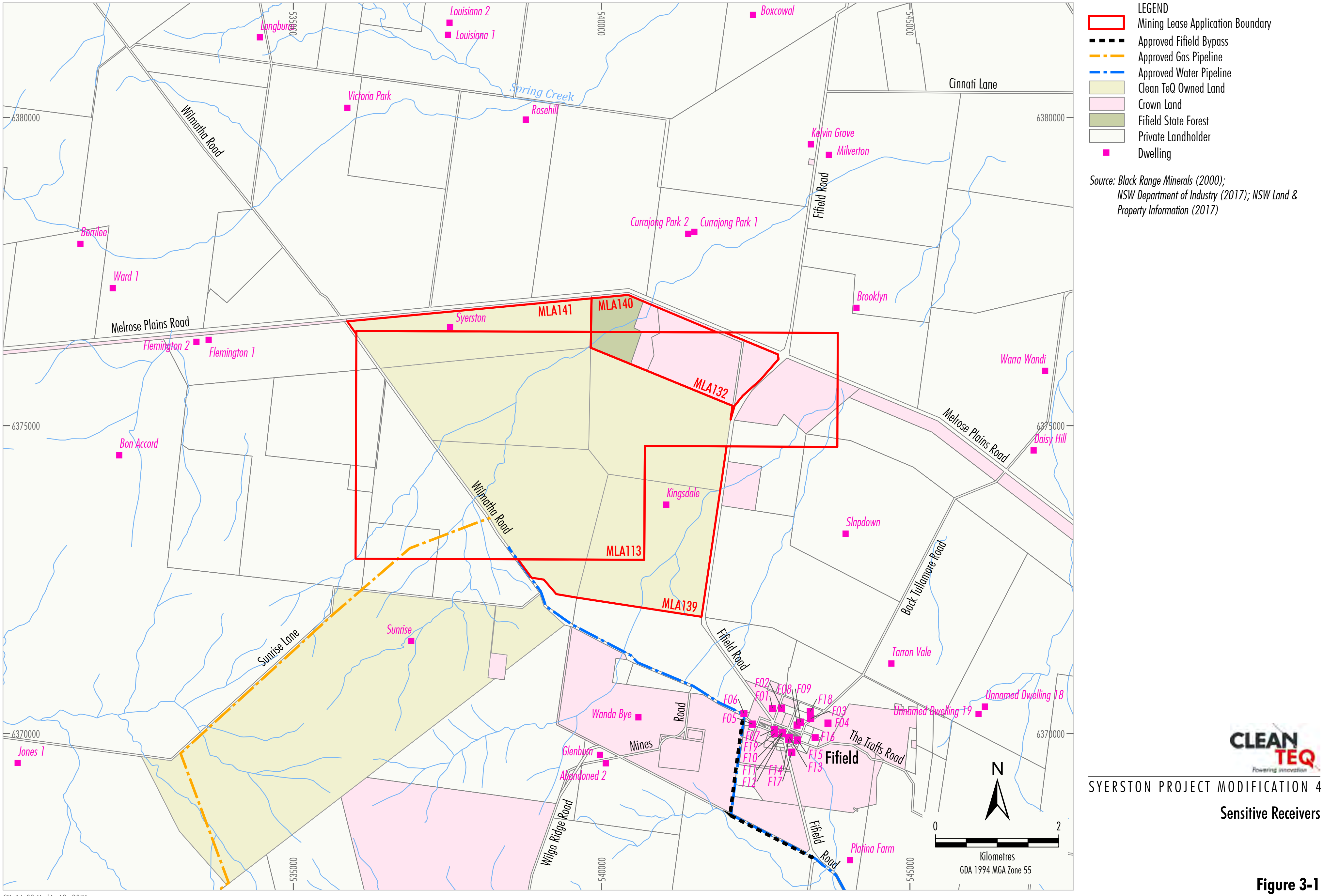
The Project is located near the village of Fifield, approximately 45 km northeast of Condobolin and 80 km northwest of Parkes, in the Central West region of NSW.

The region supports mainly dryland agriculture and the majority of vegetation in the area has been previously cleared for grazing or cropping. The local and regional topography is flat and the elevation of the Project sits at approximately 300 m Australian Height Datum (AHD) with very little variation in elevation across the site.

The local area contains a number of rural-residential properties situated at varying distances from the Project. The locations of the private and mine-owned receptor locations assessed in this report are shown in **Figure 3-1** (note, receptors within the town of Fifield are not labelled).

Receivers M11 (Kingsdale) and M30 (Syerston) would be removed to allow for the development of the mine and have therefore not been considered further.

A tabulated list of receptors locations is provided in **Appendix 3**.



SYERSTON PROJECT MODIFICATION 4

Sensitive Receivers

Figure 3-1

CTL-16-02 Mod4_AQ_207A

4. OVERIVEW OF DISPERION METEOROLOGY

4.1 Introduction

Meteorological mechanisms govern the generation, dispersion, transformation and eventual removal of pollutants from the atmosphere. To adequately characterise the dispersion meteorology of a region, information is needed on the prevailing wind regime, ambient temperature, rainfall, relative humidity, mixing depth and atmospheric stability.

An on-site meteorological monitoring station was installed for the original Environmental Impact Statement (EIS) (in September 1998), however the site is no longer in use and the historical data are not available for this assessment.

Analysis of meteorology for the region is therefore presented based on the closest Bureau of Meteorology (BoM) automatic weather station (AWS) sites, as follows:

- Condobolin Airport AWS – located approximately 40 km south-southwest
- Forbes Airport AWS – located approximately 80 km south-southeast
- Parkes Airport AWS – located approximately 85 km southeast
- Trangie Airport AWS – located approximately 100 km north-northeast
- Dubbo Airport AWS – located approximately 120 km northeast
- West Wyalong Airport AWS – located approximately 103 km south

4.2 Prevailing winds

Five years of hourly data were collected from the six regional BoM AWS sites described above and the regional annual wind roses are presented in **Figure 4-1**. Most sites display a southwest component and a north/northeast component, the exception being Dubbo and Trangie which have a more dominant easterly component.

The most recent annual environmental monitoring review (AEMR) for the Northparkes Mine presents an annual wind rose for 2015 which shows a dominant north-northeast and south-southeast component. The most recent annual review (AR) for the Cowal Mine presents an annual wind rose for 2015 which shows a dominant southwest component.

The closest BoM site to the Project is at Condobolin Airport, and records dominant southwest and north/northeast components and to a lesser extent, winds from most other directions. Similar to the Condobolin Airport site, the original EIS presented a wind rose for the on-site data which showed winds from most directions with a dominant northeast and southwest component for certain hours of the day.

Based on this comparison and the relatively uncomplicated regional terrain, Condobolin Airport BoM data is considered suitable for modelling. Annual wind roses for Condobolin Airport for 2011 to 2016 (**Figure 4-2**) show consistency in wind direction, average wind speeds and the percentage occurrence of calm winds (<= 0.5 m/s). The high degree of consistency in winds across each indicates that each calendar year is suitable for modelling.

2015 is selected as the modelling year. Average winds speeds are approximately 3.6 metres per second (m/s) and the percentage occurrence of calm winds is 12%. Seasonal and diurnal wind roses for 2015 (**Figure 4-3**) demonstrate stronger winds during the day and dominant northeast winds for summer and southwest winds for autumn. Spring and winter wind roses have both northeast and southwest components.

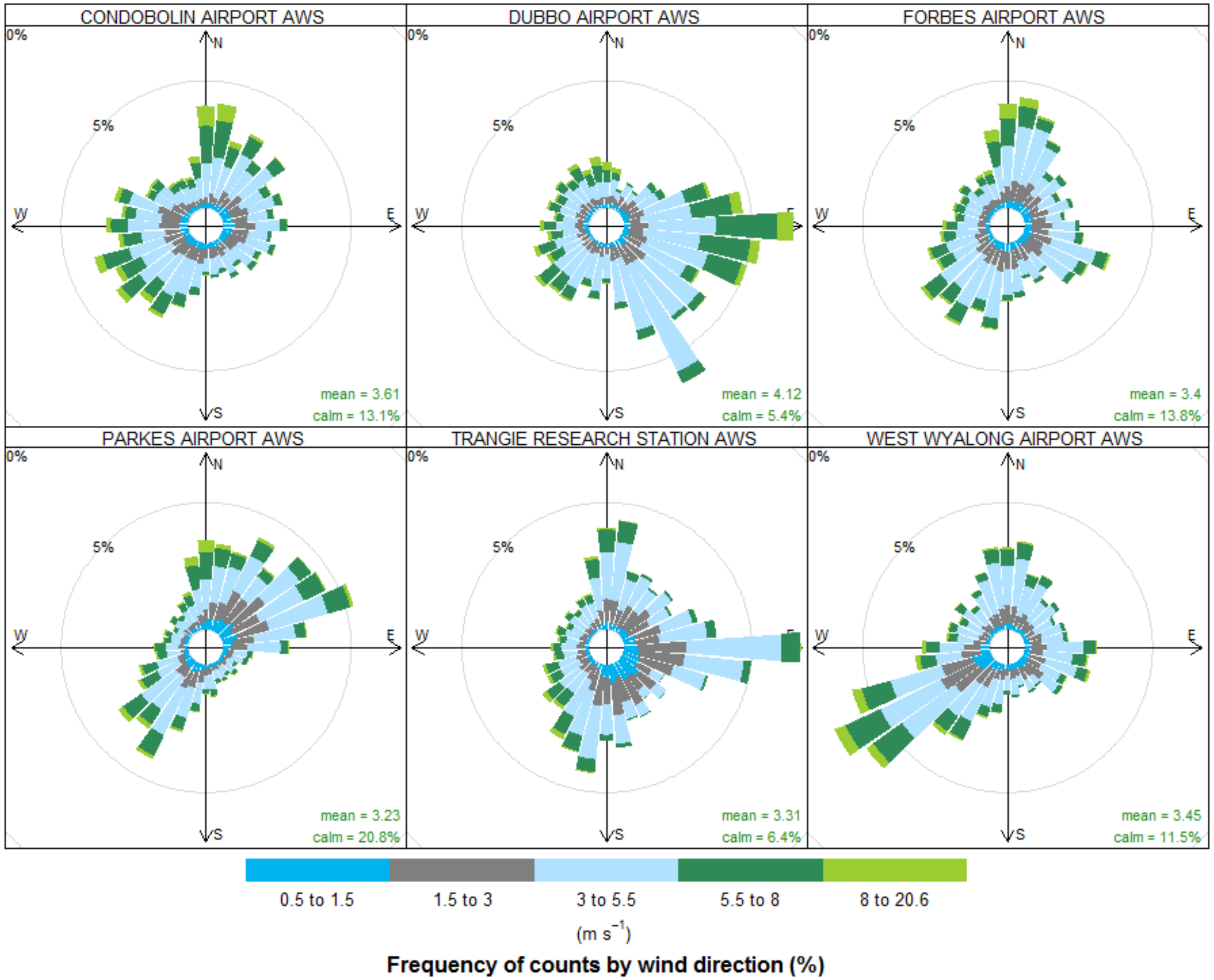


Figure 4-1: Regional wind roses for the Project

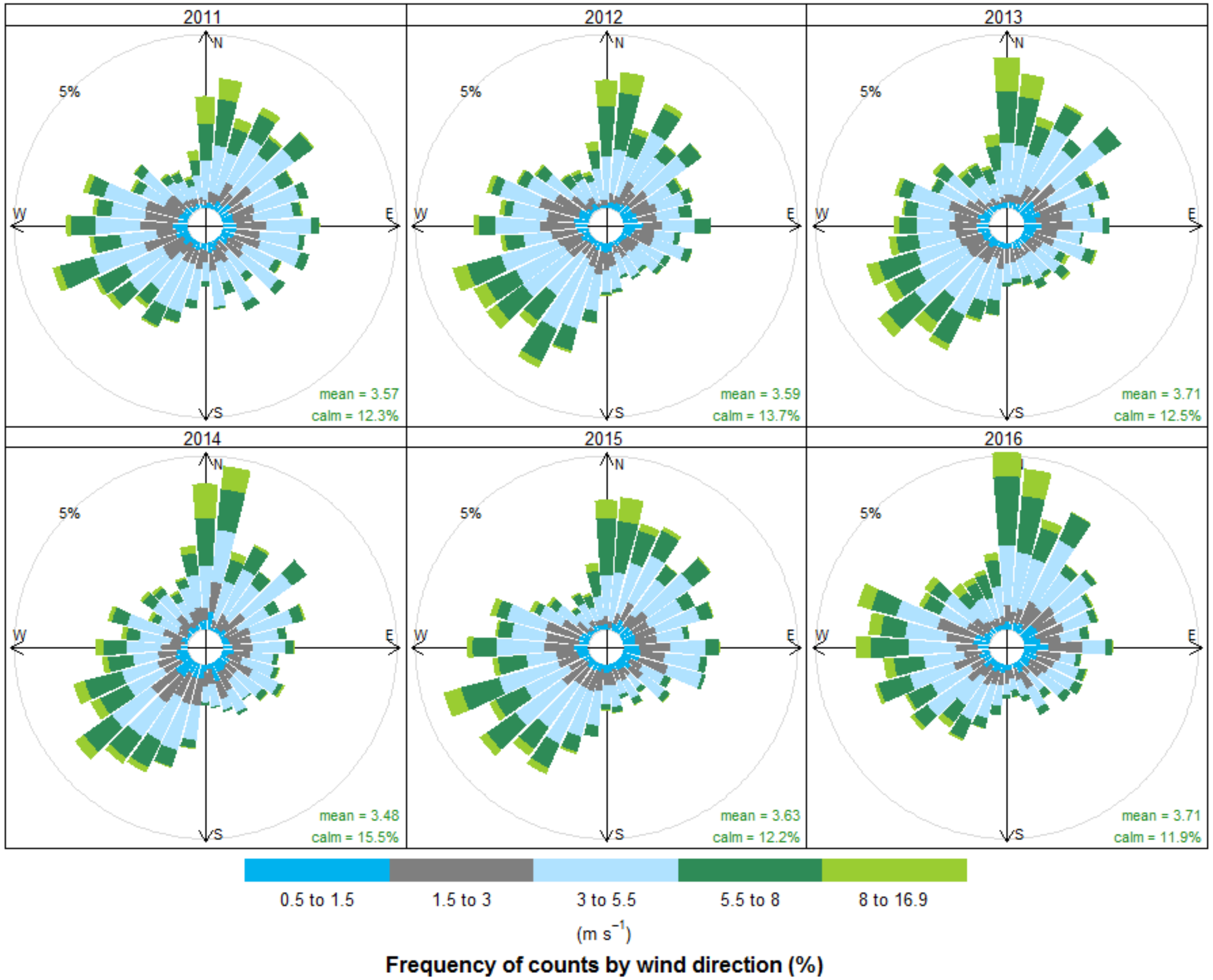


Figure 4-2: Annual wind roses for Condobolin Airport

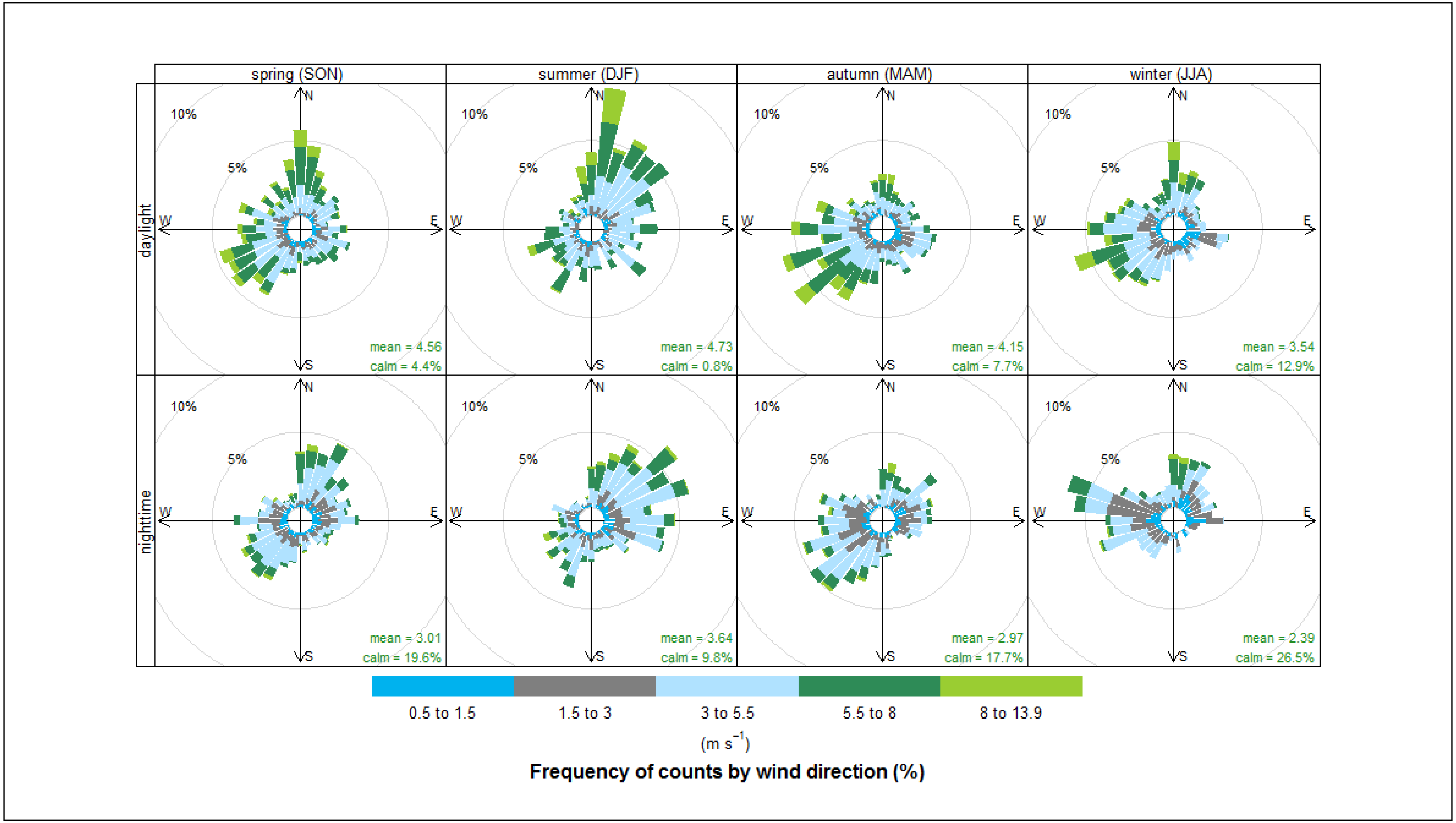
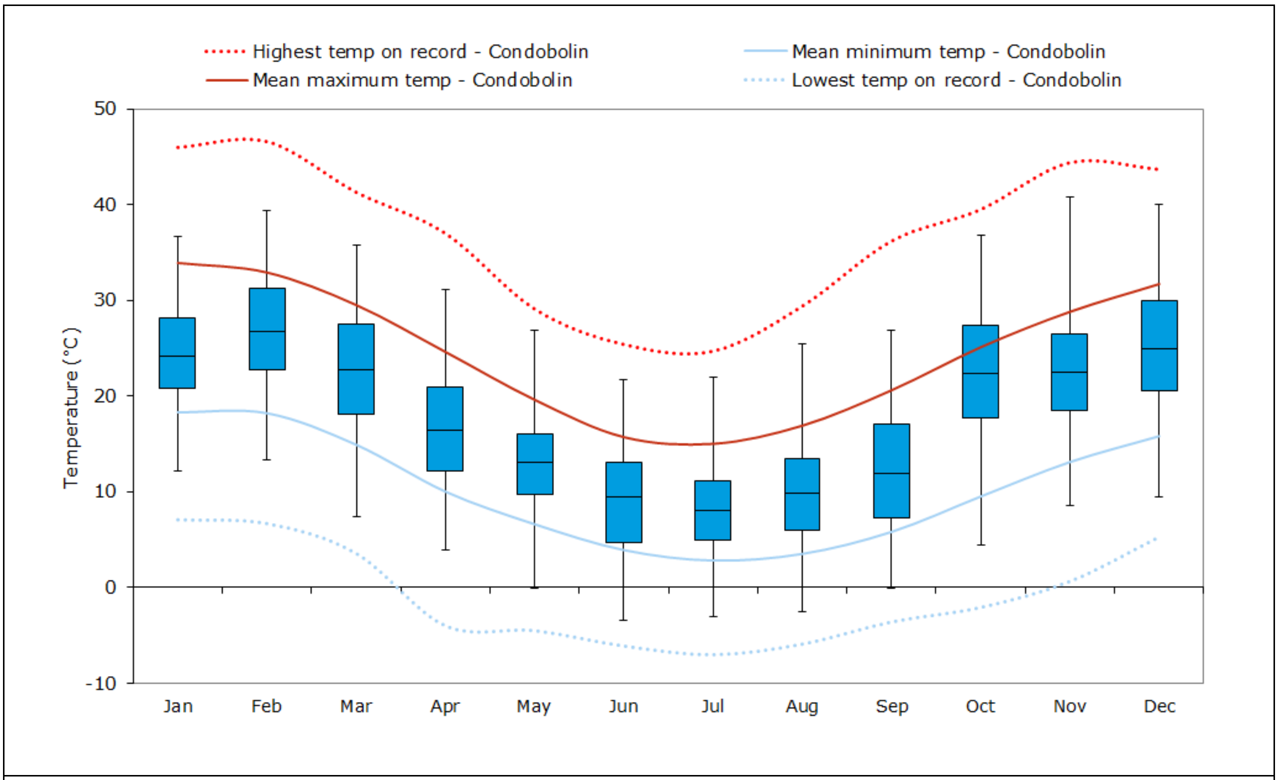


Figure 4-3: Seasonal and diurnal wind roses for Condobolin Airport

4.3 Ambient temperature

The minimum, maximum, mean and upper and lower quartile temperatures for each month of the 2015 modelling dataset are presented as a box and whisker plot shown in **Figure 4-4**. The maximum temperature occurs in November (40.1°C), while the highest mean monthly temperature occurs in February (26.8°C). The lowest recorded minimum temperature occurs in June (-3.4°C), while the lowest monthly mean occurs in July (7.9°C).

The modelling dataset is compared with long-term records at Condobolin (from 1954 to 2017). The modelling dataset correlates well with the long-term historical trends. The upper and lower quartile and mean temperatures fall within the long term mean monthly maximum and minimum temperatures. For all months, the maximum temperatures for 2015 are below the long-term records, while the minimum temperatures for 2015 are all above the long-term minimum temperatures on record.



2015 data are illustrated by the 'box and whisker' plot. Boxes indicate 25th, median and 75th percentile temperature values while upper and lower whiskers indicate maximum and minimum values.

Figure 4-4: Comparison of long-term temperature records with modelling period

4.4 Rainfall

Precipitation is important to air pollution since it impacts on dust generation potential and represents a removal mechanism for atmospheric pollutants. Fugitive emissions may be harder to control during low rainfall periods while drier periods may also result in more frequent dust storms and bushfire activity, resulting in higher regional background dust levels. Rainfall also acts as a removal mechanism for dust, lowering pollutant concentrations by removing them more efficiently than during dry periods.

Long term rainfall records presented in **Figure 4-5** show that the highest monthly rainfall occurs in January and October while the winter months have the greatest number of raindays.

To provide a conservative (upper bound) estimate of the pollutant concentrations, wet deposition (removal of particles from the air by rainfall) was not included in the dispersion calculations for this assessment.

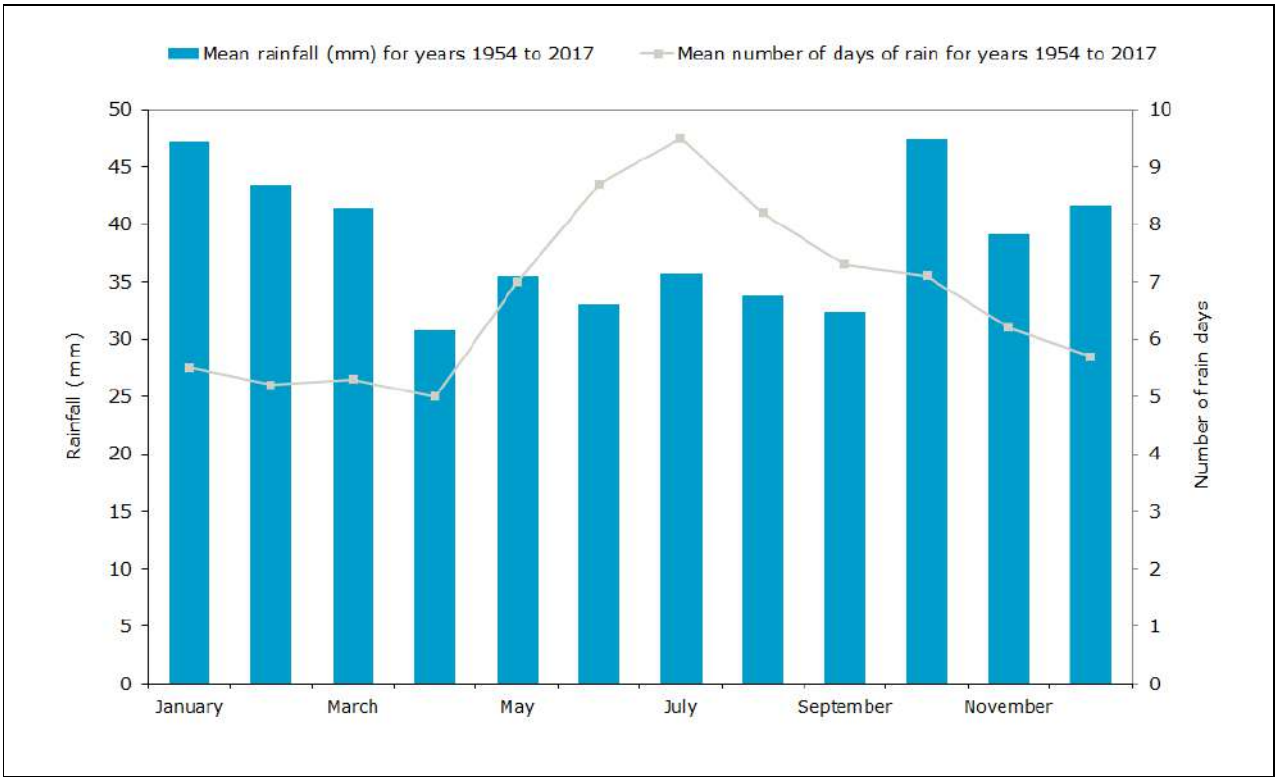


Figure 4-5: Long-term rainfall records for Condobolin AWS

4.5 Boundary layer heights

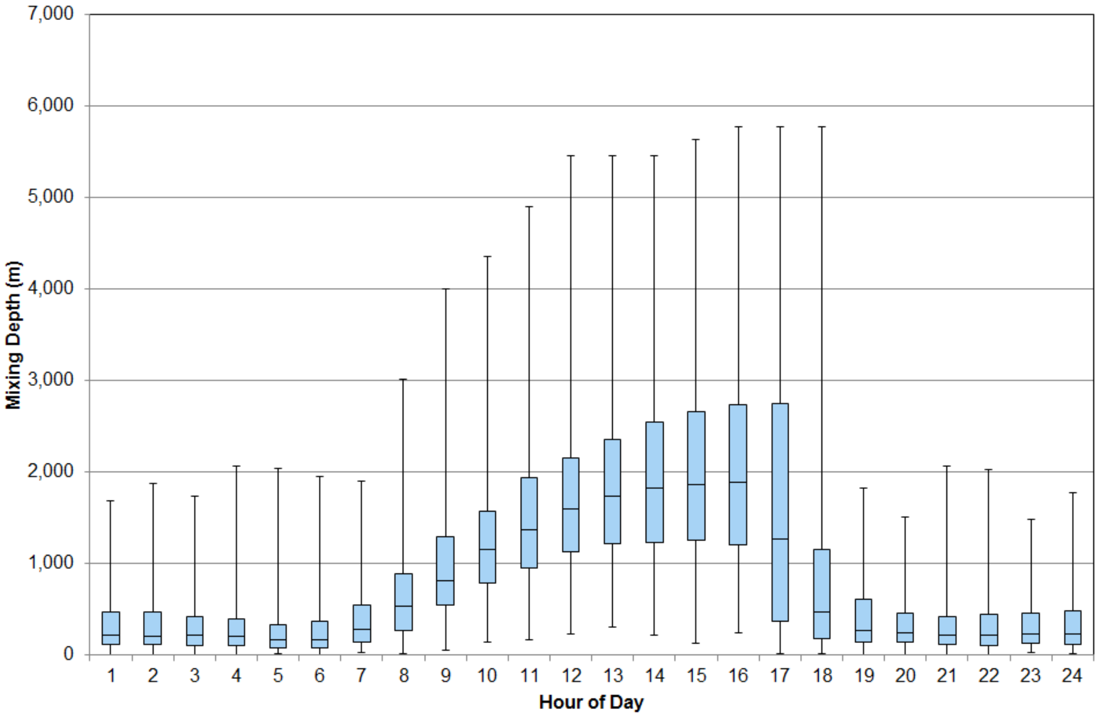
The atmospheric boundary layer constitutes the first few hundred metres of the atmosphere. This layer is directly affected by the earth's surface, either through the retardation of air flow due to the frictional drag of the earth's surface (mechanical mechanisms), or as a result of the heat and moisture exchanges that take place at the surface (convective mixing) (Stull, 1997; Oke, 2003).

During the daytime, the atmospheric boundary layer is characterised by thermal turbulence due to the heating of the earth's surface and the extension of the mixing layer to the lowest elevated subsidence inversion. Elevated inversions may occur for a variety of reasons including anticyclonic subsidence and the passage of frontal systems. Due to radiative flux divergence, nights are typically characterised by weak to no vertical mixing and the predominance of stable conditions. These conditions are normally associated with low wind speeds and hence lower dilution potentials.

Hourly-varying atmospheric boundary layer heights were generated for modelling by AERMET, the meteorological processor for the AERMOD dispersion model, using a combination of surface observations from the Condobolin Airport, sunrise and sunset times and adjusted TAPM[8]-predicted upper air temperature profile (further discussion provided in **Appendix 2**).

The variation in average boundary layer heights by hour of the day is illustrated in **Figure 4-6**. The figure shows that greater boundary layer heights are experienced during the day-time hours, peaking in the mid to late afternoon. Higher day-time wind velocities and the onset of incoming solar radiation increases the amount of mechanical and convective turbulence in the atmosphere. As turbulence increases so too does the depth of the boundary layer, generally contributing to higher mixing depths and greater potential for atmospheric dispersion of pollutants.

[8] The Air Pollution Model, developed by CSIRO



Lower, middle and upper box markers indicate 25th percentile, median and 75th percentile of AERMET-generated mixing height data respectively, while upper and lower whiskers indicate maximum and minimum values.

Figure 4-6: AERMET-generated diurnal variations in average boundary layer depth

4.6 Atmospheric stability

Atmospheric stability refers to the degree of turbulence or mixing that occurs on the atmosphere and is a controlling factor in the rate of atmospheric dispersion of pollutants. The Monin-Obukhov length (L) provides a measure of the stability of the surface layer (i.e. the layer above the ground in which vertical variation of heat and momentum flux is negligible - typically about 10% of the mixing height). Negative L values correspond to unstable atmospheric conditions, while positive L values correspond to stable atmospheric conditions. Very large positive or negative L values correspond to neutral atmospheric conditions.

Figure 4-7 illustrates the diurnal variation of atmospheric stability derived from the Monin-Obukhov length calculated by AERMET for modelling. The diurnal profile presented illustrates that atmospheric instability increases during daylight hours as convective energy increases, whereas stable atmospheric conditions prevail during the night-time. This profile indicates that the potential for atmospheric dispersion of emissions would be greatest during day-time hours and lowest during evening through to early morning hours.

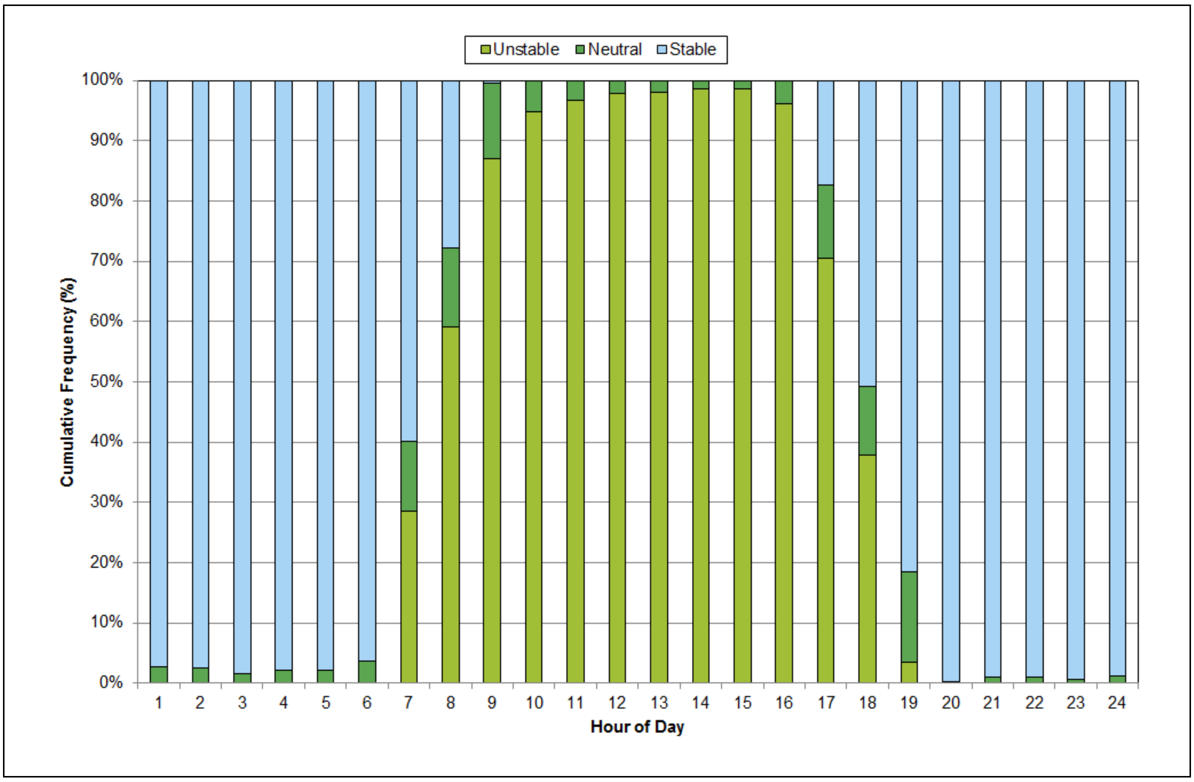


Figure 4-7: Diurnal variations in AERMET-generated atmospheric stability

5. BASELINE AMBIENT AIR QUALITY

To demonstrate compliance with applicable NSW EPA impact assessment criteria, consideration of cumulative impact is required, including how the Project will interact with existing and future sources of emissions. Given the rural setting for the Project, potential existing sources of emissions could include:

- dust entrainment due to vehicle movements along unsealed roads;
- agricultural activities;
- wind-blown dust from exposed areas;
- vehicle exhaust; or
- episodic emissions from vegetation fires or dust storms.

There are no commercial or industrial facilities in the vicinity of Fifield that either report to the National Pollutant Inventory (NPI) or hold an EPL under the POEO Act.

For this report, cumulative impacts are evaluated by adding modelling predictions to a derived baseline or background, which is assumed to include the contribution from all existing local and regional emissions sources. No potential future sources have been identified, other than the approved limestone quarry; however this is too far away to result in localised cumulative impacts and is therefore not considered.

5.1 Regional scale dust indices

The Dust Storm Index (DSI) is a continental scale measure of the frequency and intensity of wind erosion activity, based on observations of visibility made at BoM stations. The DSI is used to monitor wind erosion for reporting in National State of the Environment (SoE) reports and for the Australian Rangeland Information System (ACRIS). The ACRIS project commenced in 1992 and the most recent analysis presents DSI averages for the period 1992 to 2010.

The Project is located within the Cobar Peneplain region (shown by the number 24 in **Figure 5-1**) and has an average DSI of 3.7 (1992-2010). The DSI has increased for the three time periods reported, although the latest DSI increase is a result of the very high wind erosion activity in 2009.

A related program, called the Community DustWatch network, measures dust (as PM_{10}) via a network of instruments at DustWatch Nodes (generally using TSI DustTraks). The data are not used to report on air quality and health-related issues, rather, measurements are used as an indicator for land management (i.e. adequacy of ground cover in delivering healthy soils, clean air, functioning ecosystems and agricultural production).

The Community DustWatch network includes 'Nodes' at Condobolin and Parkes, recording hours of dust activity, defined as PM_{10} concentrations >25 µg/m³. It is useful to note that since 2010 at Condobolin, there has been, on average, only 10 hours of the year where the reported PM_{10} concentrations have been greater than 25 µg/m³. For the most recent year at the time of writing (2015), there were 23 hours where the PM_{10} concentrations measured greater than 25 µg/m³ and 7 hours were the PM_{10} concentrations measured greater than 50 µg/m³.

While these data cannot be used to derive a baseline for air quality assessment, they are useful to provide some initial context to the existing air quality environment for the region.

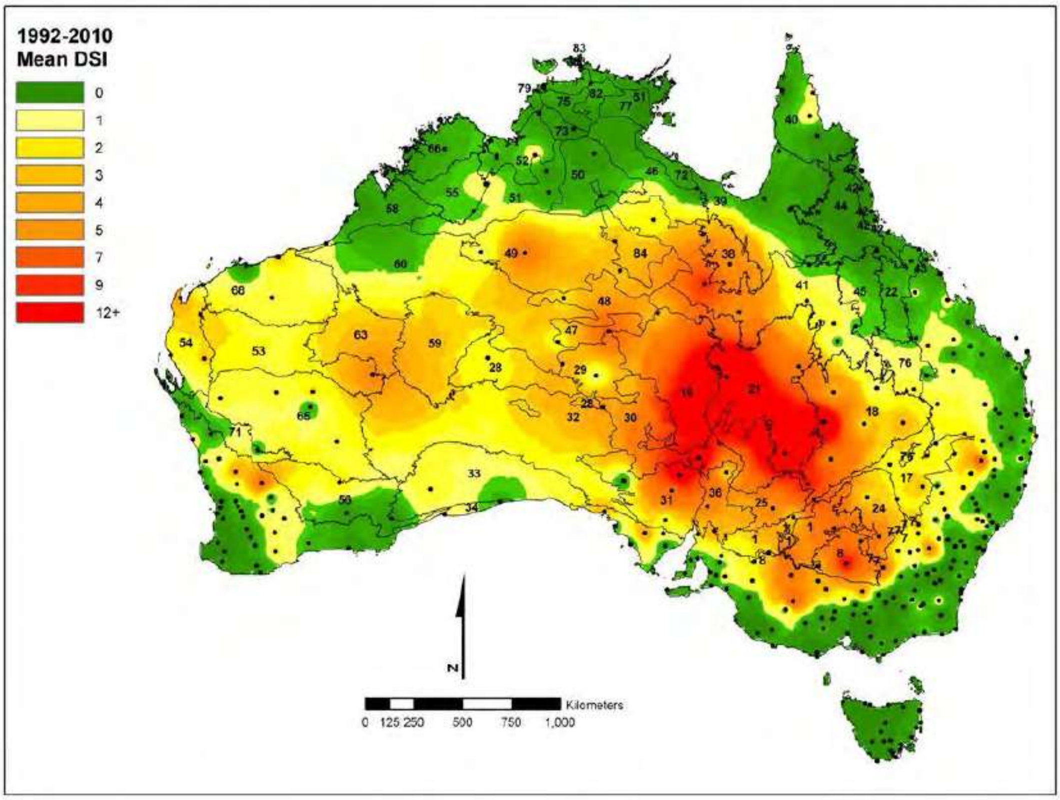


Figure 5-1: Mean dust storm index 1992-2010

Source: McTainsh et al (2011)

5.2 Site specific monitoring

Baseline monitoring was conducted for the original EIS but was limited to dust deposition at five sites for the period September 1997 to August 2000. From the available monitoring data, average dust deposition varied from 1.0 g/m^2/month to 4.9 g/m^2/month across all five sites. The average of all measured monthly dust deposition, across all sites, was 2.5 g/m^2/month. This value is typical of levels recorded in rural areas of NSW.

No other site specific baseline monitoring data are available, therefore a review of regional monitoring data is presented in subsequent sections.

5.3 Other industry operated monitoring sites

There are two operating mines within 100 km of Fifield with air quality monitoring networks used for compliance purposes; Northparkes Mine, located approximately 60 km east-southeast and Cowal Mine, located approximately 100 km south.

Compliance monitoring sites are selected to measure local dust impacts and are therefore not generally suitable for deriving background or baseline for areas removed from the influence of these local sources. In addition to these existing mining projects, rural baseline monitoring data have been collected for a proposed mine located at Bylong, approximately 250 km to the east-northeast and an approved but shelved mine at Cobbora, approximately 180 km northeast.

Publically available monitoring data for each of these sites has been reviewed and is summarised in **Table 5-1**.

For the compliance monitoring at existing sites, the 2015 annual average PM_{10} concentrations range from 10.4 µg/m³ at Northparkes to 15.1 µg/m³ at Cowal. The reported baseline for the Bylong and Cobbora projects ranged from 11.8 µg/m³ to 12.9 µg/m³.

Table 5-1: Regional air quality monitoring data from industry operated sites

Site	Metric	Value	Source/assumption
Northparkes Mine	PM_{10}	10.4 µg/m³	Estimated monthly average PM_{10} concentration, taken from graphs presented in the 2015 AEMR and averaged across three monitoring sites
	TSP	30 µg/m³	Approximate rolling annual average TSP concentration at end of 2015, taken from graphs presented in the 2015 AEMR and averaged across three monitoring sites
	Dust Deposition	2.0 g/m²/month	Approximate rolling annual average dust deposition at end of 2015, taken from graphs presented in the 2015 AEMR and averaged across 11 monitoring sites
Cowal Mine	PM_{10}	15.1 µg/m³	PM_{10} concentrations are not measured but instead derived from TSP data, based on the assumption in their Air Quality Monitoring Plan that 40% of TSP is PM_{10} [9]
	TSP	37.9 µg/m³	Average of reported monitoring data for a single site for 2015[10]
	Dust Deposition	1.3 g/m²/month	Baseline level collected before mining commenced, as reported in the Air Quality Monitoring Plan
Bylong Project	PM_{10}	12.9 µg/m³	As reported in the AQIA for the Bylong Coal Project (PEL, 2015)
	$PM_{2.5}$	6.5 µg/m³	As reported in the AQIA for the Bylong Coal Project (PEL, 2015)
	TSP	32 µg/m³	Derived from PM_{10} data, as reported in the AQIA for the Bylong Coal Project (PEL, 2015)
	Dust Deposition	1.0 g/m²/month	Average across all sites and all years, as reported in the AQIA for the Bylong Coal Project (PEL, 2015)
Cobbora Project	PM_{10}	11.8 µg/m³	Average PM_{10} concentration for modelling period as reported in the AQIA for the Cobbora Coal Project (ENVIRON, 2012)
	TSP	29.4 µg/m³	Derived from PM_{10} data, as reported in the AQIA for the Cobbora Coal Project (ENVIRON, 2012)
	Dust Deposition	1.4 g/m²/month	Average across all sites, as reported in the AQIA for the Cobbora Coal Project (ENVIRON, 2012)

5.4 Regional rural monitoring stations

The NSW Office of Environment and Heritage (OEH) operate a number of rural monitoring stations, including at Bathurst (210 km east-southeast), Wagga Wagga (260 km south), Merriwa (290 km east-northeast) and Albury (370 km south).

5.4.1 PM_{10}

The annual average PM_{10} concentrations over recent years are shown in **Table 5-2**, and range from 11 µg/m³ (2011 at Bathurst) to 22 µg/m³ (2013 at Wagga Wagga). The Bathurst monitoring site is the closest to the Project and the annual average PM_{10} concentrations at Bathurst are similar in magnitude to the rural baseline described for the Bylong and Cobbora projects. It is noted that the significantly higher ambient concentrations of PM_{10} in Wagga Wagga are thought to be mostly due to agricultural (stubble) burning and wood heater use in winter.

Exceedances of the 24-hour average criterion for PM_{10} occur occasionally, for example on average once a year at Bathurst. Long term trends in PM_{10} concentrations indicate that peak 24-hour averages are correlated with years with lower rainfall and consequently a higher risk of dust storms and bushfires.

A timeseries plot of the 24-hour average PM_{10} concentrations measured at Bathurst in 2015, 2016 and 2017 is presented in **Figure 5-2**. To create a complete dataset for cumulative assessment, gaps were filled using the other OEH rural monitoring sites.

[9] http://23crl33wq4oxpmtj2wj16cs9.wpengine.netdna-cdn.com/wp-content/uploads/2016/02/Air-Quality-Management-Plan-2.pdf

[10] http://evolutionmining.com.au/cowal/

Table 5-2: PM_{10} monitoring statistics across OEH rural sites

Site	Statistic	2011	2012	2013	2014	2015	2016
Bathurst	Mean	11	13	15	15	13	13
	Max daily	24	56	145	43	95	34
	99th percentile	22	30	45	38	37	31
	95th percentile	19	24	32	29	29	26
	Days over 50 µg/m³	0	2	3	0	2	0
Merriwa	Mean		14	15	15	13	14
	Max daily		50	43	55	83	42
	99th percentile		37	39	42	37	35
	95th percentile		31	30	32	27	26
	Days over 50 µg/m³		1	0	3	1	0
Wagga Wagga	Mean	17	19	22	21	20	21
	Max daily	56	67	111	88	145	115
	99th percentile	37	45	67	58	66	63
	95th percentile	28	37	47	44	42	48
	Days over 50 µg/m³	1	1	15	14	7	14
Albury	Mean	12	14	16	16	15	15
	Max daily	28	54	59	160	93	51
	99th percentile	25	38	48	77	34	47
	95th percentile	20	26	30	29	26	36
	Days over 50 µg/m³	1	1	2	5	2	1

5.4.2 $PM_{2.5}$

Monitoring for $PM_{2.5}$ is limited to the Wagga Wagga North and Bathurst sites, however monitoring at Bathurst only commenced in April 2016. Annual average $PM_{2.5}$ concentrations at Wagga Wagga regularly approach or exceed the impact assessment criteria, due to stubble burning and wood heater use in winter, and these data are not suitable to describe background for the Project area.

In the absence of $PM_{2.5}$ data for Bathurst for the modelling period (2015), reference is made to all available data from April 2016 to September 2017. The maximum recorded $PM_{2.5}$ for this period is 17.5 µg/m³ while the period average for the available monitoring data is 6.1 µg/m³.

A timeseries plot of the 24-hour average $PM_{2.5}$ concentrations at Bathurst is presented in **Figure** 5-2, showing available measurements from April 2016.

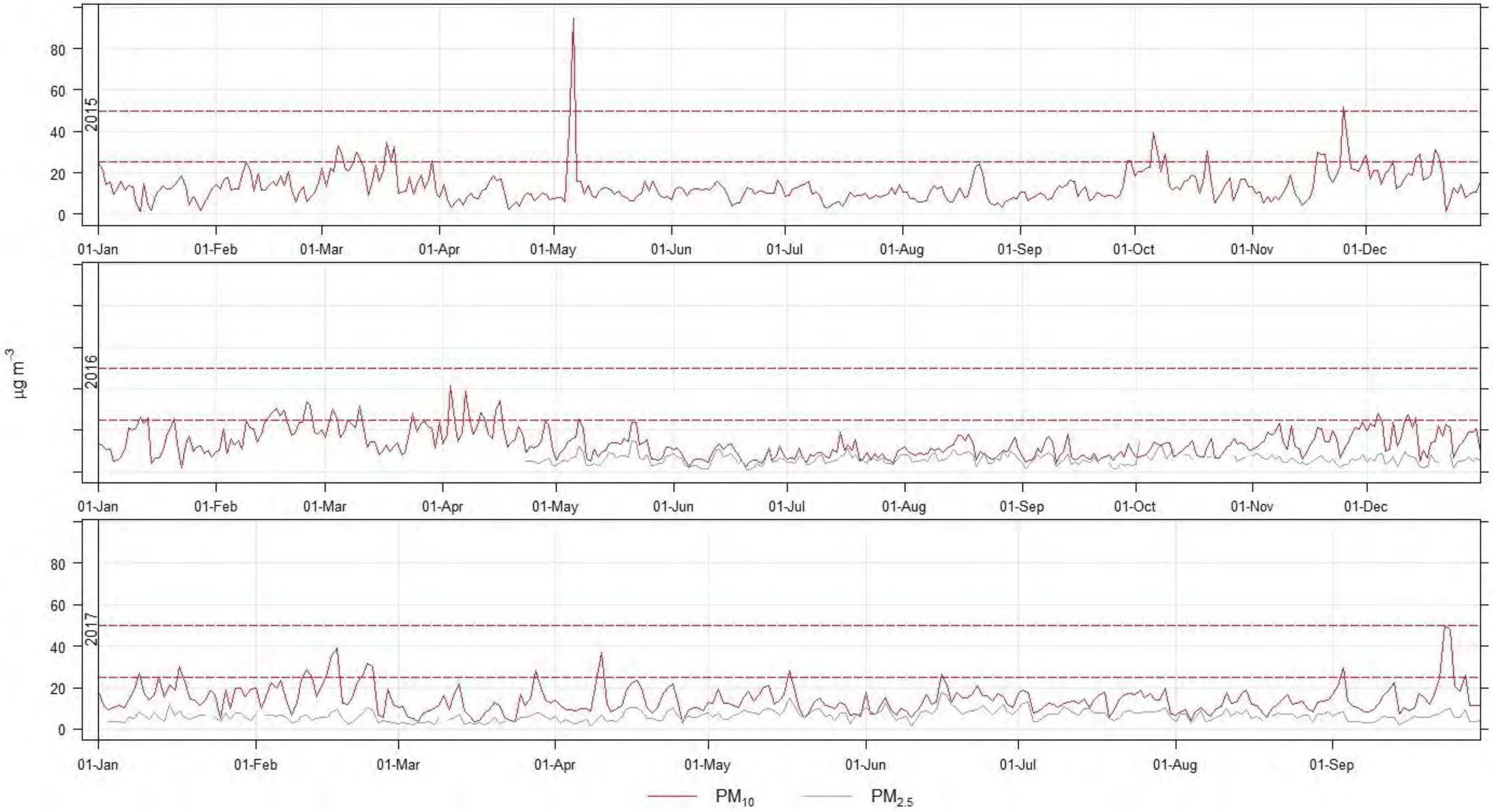


Figure 5-2: Timeseries of 24-hour average PM_{10} and $PM_{2.5}$ concentrations for Bathurst from 2015 to September 2017

5.4.3 Adopted background for cumulative assessment

Cumulative assessment for annual average PM_{10} is based on the 2015 annual average at Bathurst, while for short-term impacts, daily varying concentrations for 2015 are paired with modelling predictions for assessment of cumulative impacts.

In the absence of a contemporaneous dataset for the modelling period, cumulative assessment for annual average $PM_{2.5}$ is based on the period average of available data at Bathurst. For short term impacts, a worst case assessment is presented by combining the maximum daily concentration for the available data with the maximum modelling prediction for each receptor.

Measured annual average TSP concentrations for 2015 range from 38 µg/m³ at Cowal to 30 µg/m³ at Northparkes and the higher of these two measurements is adopted for background.

The baseline dust deposition level recorded before the Cowal Mine became operational (1.3 g/m^2/month) is similar to the historical site specific baseline reported in the EIS (1-1.4 g/m^2/month). However, the more recent 2015 average dust deposition levels across all sites at Northparkes (2 g/m^2/month) and Cowal (2.7 g/m^2/month), provide a more conservative background level for assessment.

For other gaseous pollutants, background concentrations are assumed to be negligible, as there are no significant emissions sources in the locality.

The background values are adopted for cumulative assessment are summarised in **Table 5-3**.

Table 5-3: Adopted background for cumulative assessment

Pollutant	Averaging period	Adopted background value	Source of data
PM_{10}	24-hour average	Daily varying	Bathurst daily monitoring data for 2015
	Annual average	13.4 µg/m³	2015 average concentration from Bathurst
$PM_{2.5}$	24-hour average	17.5 µg/m³	Period maximum concentration from available data at Bathurst
	Annual average	6.1 µg/m³	Period average concentration from available data at Bathurst
TSP	Annual average	38 µg/m³	Annual average TSP concentrations for Cowal in 2015.
Dust deposition	Annual average	2.7 g/m^2/month	Average of data reported at Cowal
SO_2	N/A	Negligible	There are no significant local sources of these pollutants, other than minor contributions from traffic and agricultural plant and equipment
NO_x			
CO			
H_2SO_4	N/A	N/A	Impact assessment criteria are applied to the incremental impact only.
VOCs			

6. EMISSION INVENTORY

6.1 Processing plant stack emissions

Emissions of gaseous pollutants would be generated by the processing facility during the processing of ore, as well as for power generation. The modified Project would adopt the RIP processing method, which includes the following steps:

- Ore preparation circuit – removal of oversize material and production of an ore slurry suitable for acid leaching.
- Acid leach circuit – leaching of nickel, cobalt and scandium from the ore slurry by application of sulphuric acid under high pressure and temperature in an autoclave to produce an autoclave slurry containing acid and soluble nickel and cobalt sulphates.
- RIP circuit – a two stage process that first separates scandium and then nickel and cobalt from residue solids (tailings) contained in the autoclave slurry using ion exchange resin.
- Tailings neutralisation and thickening circuit – neutralisation of residue solids slurry (tailings) with a limestone slurry prior to thickening and transfer to the tailings storage facility.
- Metals recovery circuit – recovery of scandium from the loaded resin by desorption, precipitation and calcinations, and recovery of nickel and cobalt by desorption, solvent extraction and precipitation.

With the adoption the RIP processing method instead of the approved counter current decantation processing method, the production of hydrogen sulphide, hydrogen and nitrogen would no longer be required. Some stacks previously assessed for the Project are therefore no longer required for the Modification (i.e. Extraction Fan over Sulphide Filter Vent [hydrogen sulphide], Flare Stack [hydrogen sulphide, SO_2, NO_2] and Hydrogen Reformer Stack [NO_2]).

Emission of PM from stack sources are included in the fugitive dust emissions inventories presented in **Appendix 5** and modelled together to assess the total Project impact. Stack sources are also modelled separately to assess emissions of gaseous pollutants.

The emission rates for the sulphuric acid plant are provided in **Table 6-1** and derived from the POEO Clean Air Regulation standards of concentrations (general activities). The modelled SO_2 emission rates for the modified Project are higher than what was previously modelled, which is consistent with the increase in sulphuric acid production. It is noted the processing facility would be designed to minimise emissions of gaseous pollutants, where practicable, and comply with the standards of concentration by incorporating appropriate emission control equipment (e.g. scrubbers).

Table 6-1: Emission standards and emission rates for sulphuric acid plant stack

Pollutant	Standard of concentration	Emission rate (g/s)
H_2SO_4	100 mg/m^3	5.3
SO_2	1000 mg/m^3	53.2
NOx (as NO_2)	350 mg/m^3	18.6
NOx	N/A	13.0

Emissions calculations for the diesel power plant and auxiliary boilers are provided in **Table 6-2**, estimated by Clean TeQ engineers based on the current design (energy demand) of the processing facility. It is noted that the proposed diesel power plant would operate mainly during start-up or as emergency/backup power generation. During normal operations, steam generated from the acid plant would be used for power generation in combination with the auxiliary boiler, as required.

Emission rates for NO_x from the power plant have also increased for the modified Project, in line with the production increase and also the use of diesel for power generation, as a worst case assumption. The stack parameters modelled are presented in **Table 6-3**.

Table 6-2: Stack emissions for power generation (g/s)

Stack	SO_2	CO	PM	VOCs	NO_x
Diesel Power plant	0.01	6.1	1.6	0.7	14.6
Diesel fired Auxiliary Boiler	0.01	0.4	0.1	0.02	1.8
Note: The use of diesel for power generation, in lieu of the approved gas plant, provides a worst case estimate of emissions for the two options.					

Table 6-3: Modelled stack parameters

Stack	Height (m)	Diameter (m)	Cross-sectional area (m^2)	Flow rate (Nm^3/s)	Temp (K)	Flow rate (Am^3/s)	Exit velocity (m/s)
Sulphuric acid plant stack	80	1.8	2.5	53.2	348	67.8	26.6
Diesel power plant	10	0.9	0.6	5.6	573	11.8	18.5
Diesel fired auxiliary boiler	10	0.9	0.6	8.7	453	14.4	22.7

6.2 Fugitive dust

Emissions inventories have been developed for four representative years of mining operations, selected to assess the air quality impacts of worst-case operations, as follows:

- Year 1 – representative of initial operations, with preferential mining in the scandium-rich areas, high grade ore deposits and construction of the tailings storage facility (TSF) and evaporation ponds in the south-eastern portion of the site;
- Year 6 – representative of mining across both eastern and western pits with one tailings storage facility cell in operation;
- Year 11 – representative of continued mining across both eastern and western pits with the maxim waste rock emplacement footprints and two tailings storage facility cells in operation; and
- Year 21 – representative of the final years of mining with maximum pit and waste rock emplacement footprints and three tailings storage facility cells in operations.

Consistent with the Approved Methods, emission factors developed by the US EPA[11], have been applied to estimate the amount of dust produced by each activity. The emissions inventories for each year are presented in **Appendix 5**.

Control measures are applied to the most significant emissions sources for the project, consistent with best practice emissions controls (Katestone, 2011). An overview of the BMP determination and summary of the controls is provided in **Appendix 4**.

A summary of the annual emissions is presented in **Figure 6-1**, showing Year 11 has the highest emissions for each of the particle size fractions. Further details on the emission inventory are provided in **Appendix 4**, including the assumptions, input data, emission factors and overview of the BMP determination.

[11] US EPA AP-42 Compilation of Air Pollutant Emission Factors (US EPA, 1998b; US EPA, 2004; US EPA, 2006).

As discussed in **Section 2.7**, emissions of PM_{10} and $PM_{2.5}$ from diesel combustion in mining equipment are assumed to be included in the total emissions for each relevant source and are not explicitly modelled as a separate emission source. However, adjustments have been made to account for the fact that emission reductions applied to the inventory (i.e. watering) are not relevant to the control of diesel exhaust emissions. The emissions inventory applies no controls for dozers and excavators, therefore the adjustments for diesel emissions are only needed for haul road controls. The estimated diesel emissions for hauling are subtracted from the uncontrolled haul road emissions to derive the wheel generated component of emissions for each haul road. The control for watering is then applied to the wheel generated component only, and the diesel emissions are then added back to derive the final emission estimate from haul trucks.

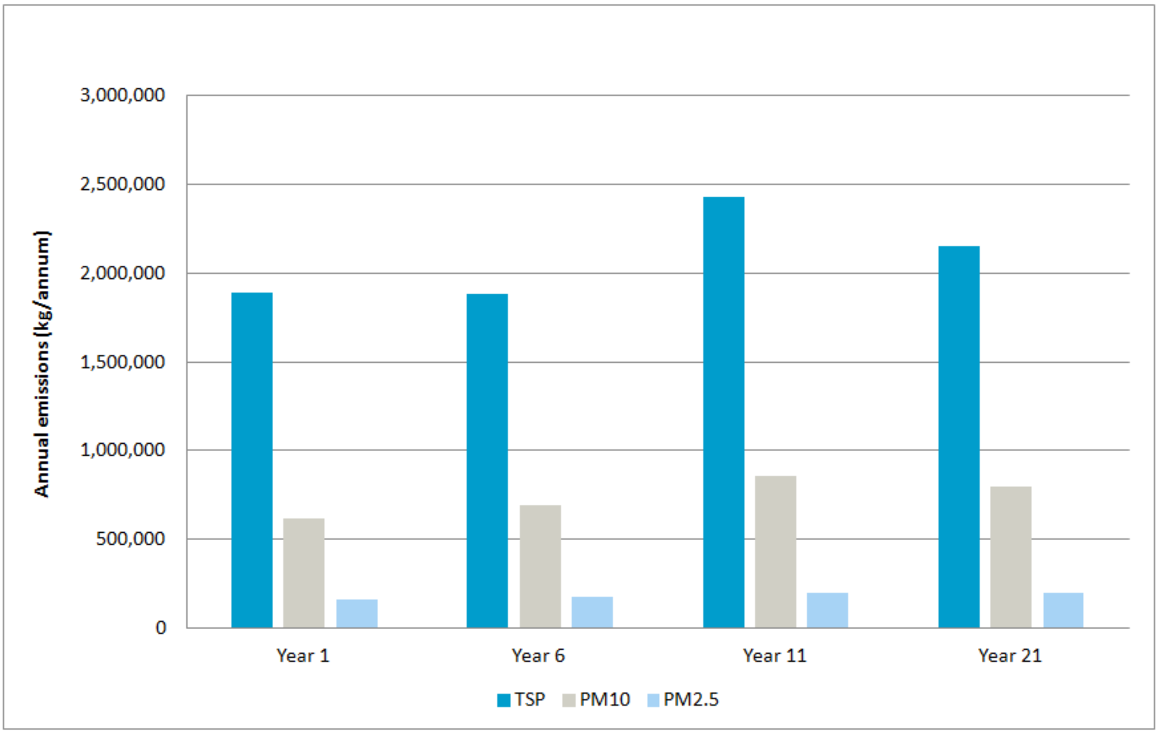


Figure 6-1: Summary of annual emissions (kg/annum)

7. DISPERSION MODELLING RESULTS

7.1 Processing plant stacks

The predicted GLCs from the processing plant stacks are presented in **Table 7-1**, showing the relevant receptor maximum concentration. Contour plots are presented in **Figure 7-1** to **Figure** 7-5. Results in **Table 7-1** for criteria pollutants are presented as discrete receptor maximums, whereas results for H_2SO_4, 1,3-butadiene and benzene are presented as the grid maximum (i.e. highest concentration across the modelling grid).

Results for NO_2 are presented based on an assumption of 100% conversion of NO_x to NO_2, which provides a conservative worst-case assessment of impact. Results for benzene and 1,3-butadiene are derived from total VOCs based on the US EPA speciate profile for diesel engines (i.e. benzene is 7.9% of total VOCs and 1,3-butadiene is 7% of total VOCs).

The predicted concentrations of all gaseous pollutants are well below the relevant criteria for each pollutant (i.e. less than 50% of the relevant criteria). Results are presented as project increment only, noting that background concentrations, with the exception of particulate matter, are expected to be minor and therefore the risk of cumulative impacts is negligible.

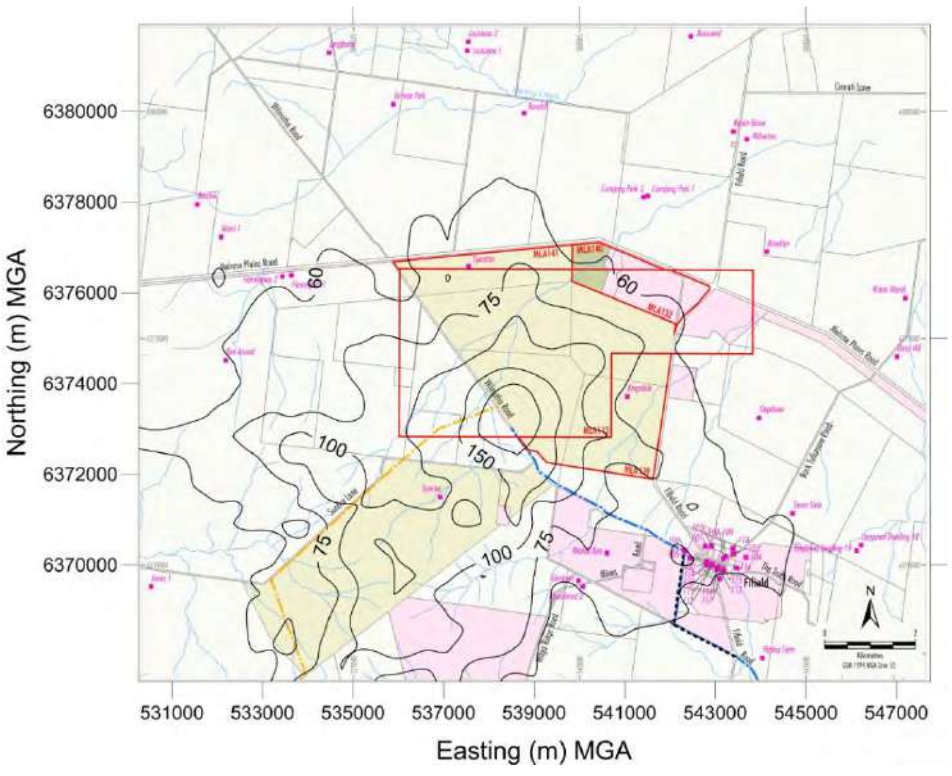
It is noted that particulate matter emissions from the stacks have been included in the assessment for fugitive dust (see **Section 0**), therefore contour plots for stacks alone are not presented (refer to **Appendix 7** for particulate matter contour plots). It is also noted that the results in **Table 7-1** are presented for $PM_{2.5}$ only as diesel particulate matter comprises approximately 97% $PM_{2.5}$ (ENVIRON, 2013).

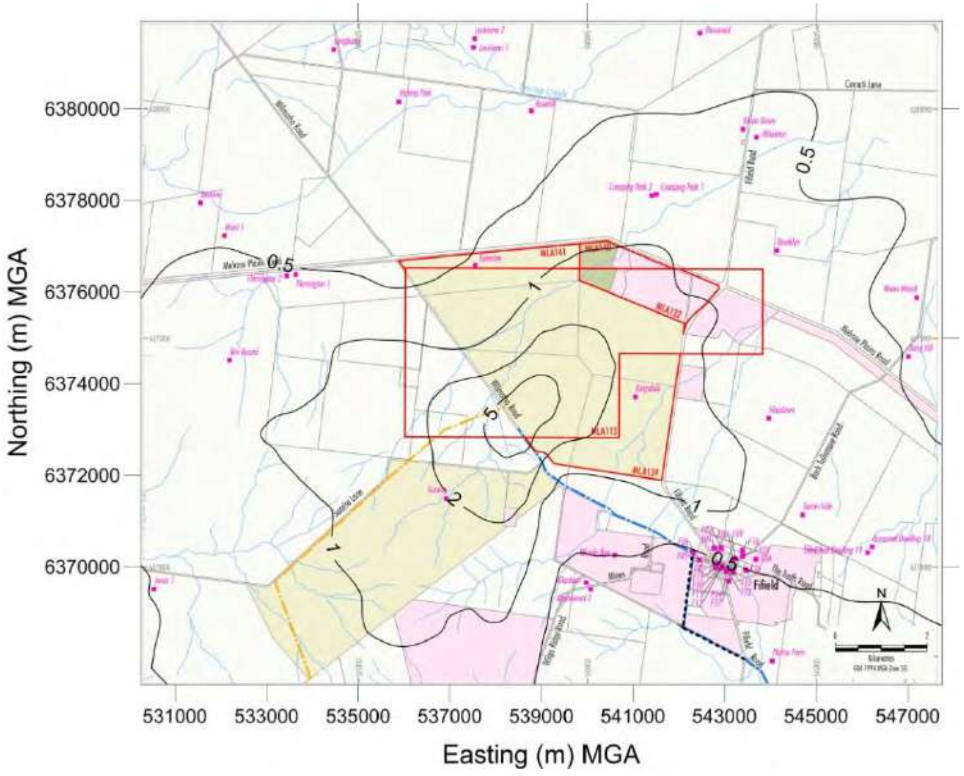
Table 7-1: Predicted maximum concentrations (µg/m³) at receptor locations

Pollutant	Averaging period	Receptor maximum (µg/m³)	Criteria
$PM_{2.5}$	24-hr average	1.3	25
	Annual average	0.2	8
NO_2	1-hr average	97.9	246
	Annual average	1.9	62
SO_2	1-hr average	38.4	570
	24-hr average	7.6	228
	Annual average	0.7	60
CO	1-hr average	38.5	30,000
	8-hr average	14.1	10,000
H_2SO_4	1-hr average (99.9th %ile)	8.1*	18
Benzene	1-hr average (99.9th %ile)	0.9*	29
1,3-butadiene	1-hr average (99.9th %ile)	0.8*	40

* Grid maximum.

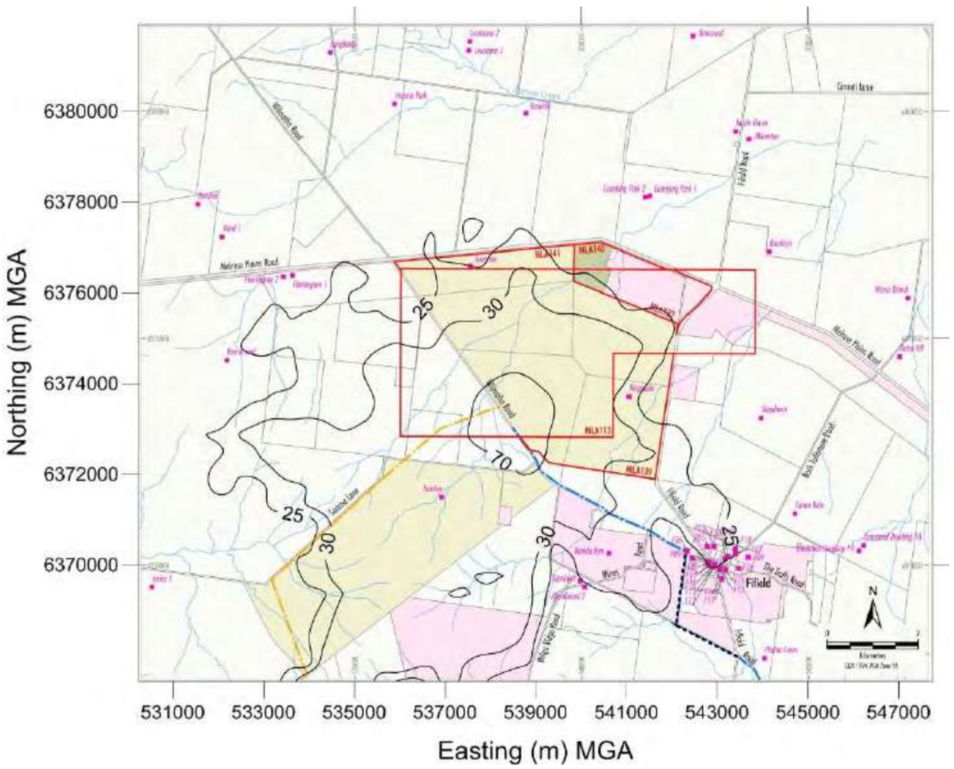
Note: Annual average impacts associated with the diesel power plant are presented as a worst-case, as the majority of the 25 MW power demand would only be during plant start-up, after which steam generated from the acid process would be used for power generation. The exception is a 5 MW boiler which would remain operational after start-up. Furthermore, the use of diesel for power generation, in lieu of the approved gas plant, provides a worst case assessment of impacts for the two options.



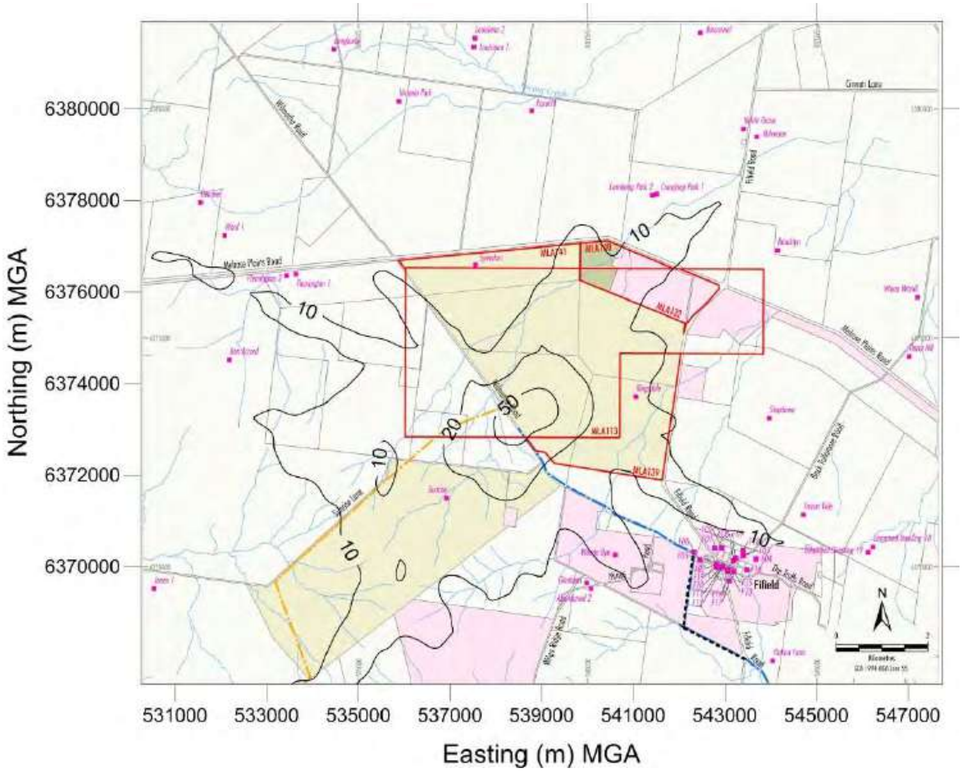


1-hour maximum	Annual average

Figure 7-1: Predicted Project-only 1-hour and annual average NO_2

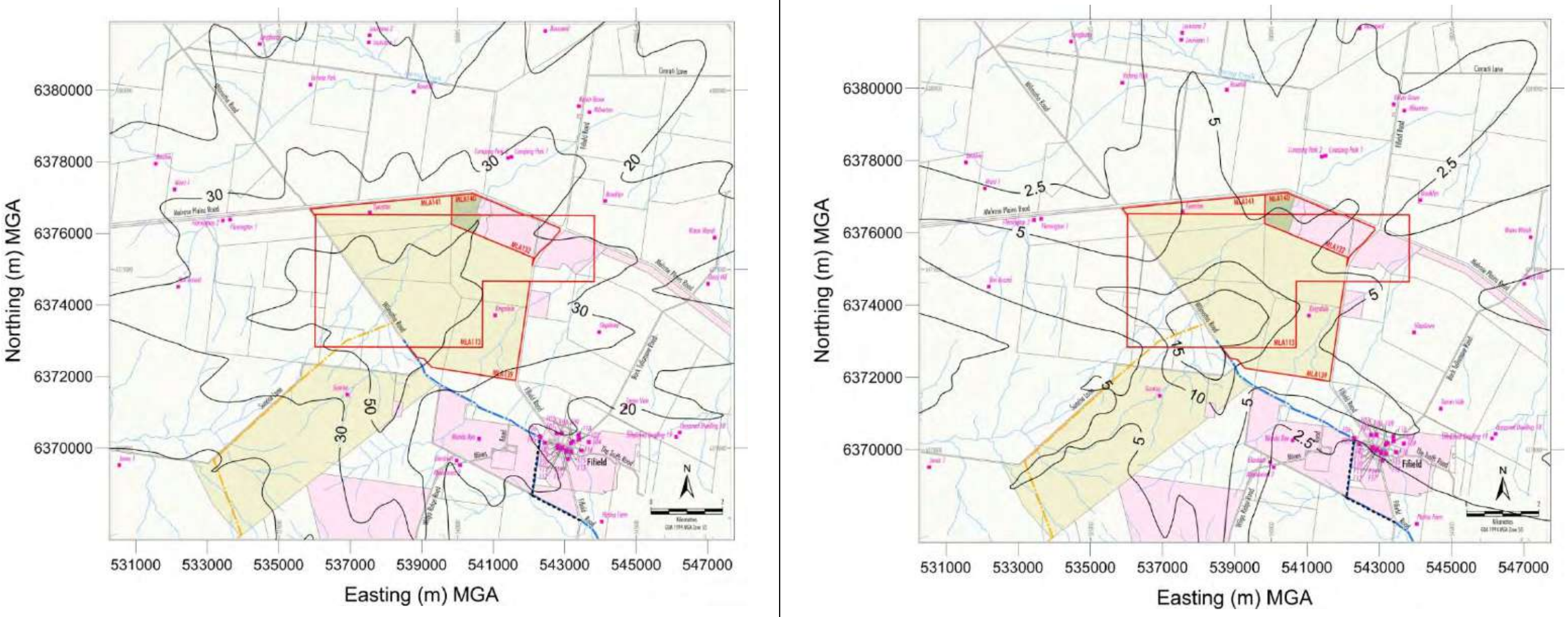


1-hour maximum



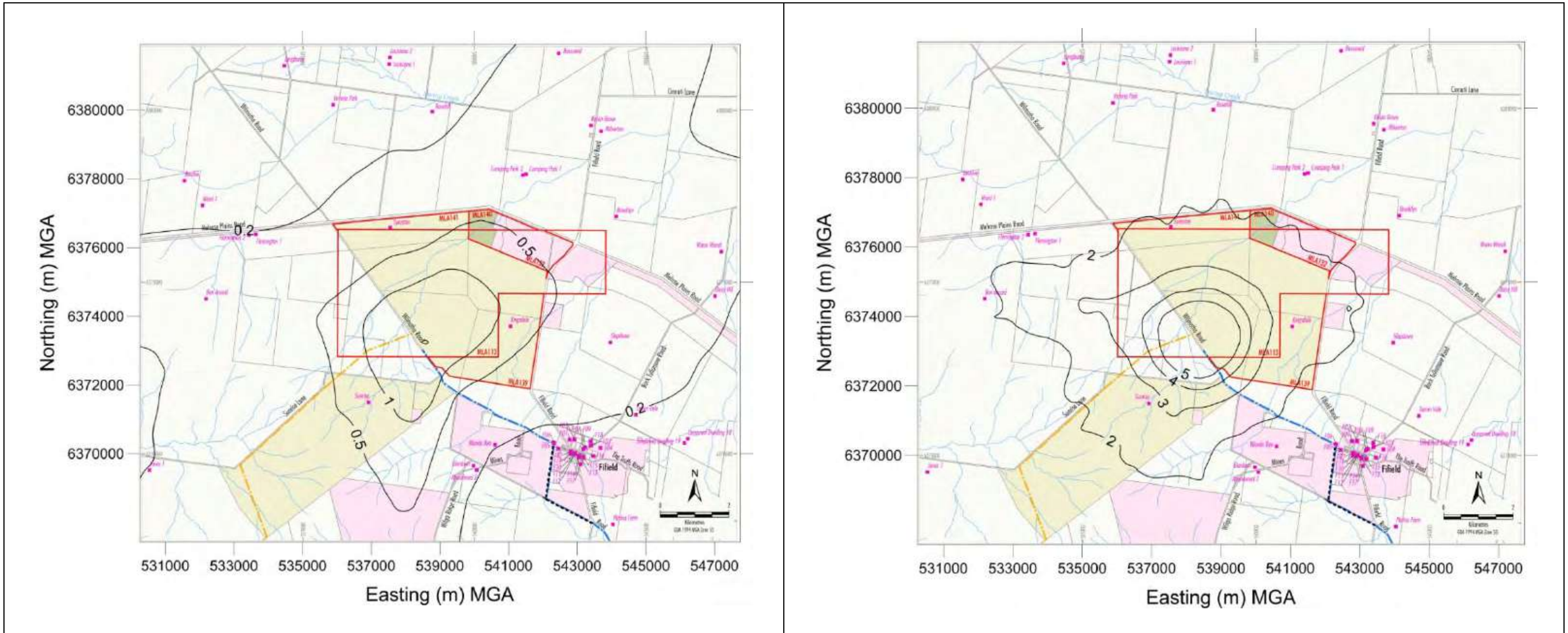
8-hour maximum

Figure 7-2: Predicted Project-only 1-hour and 8-hour average CO



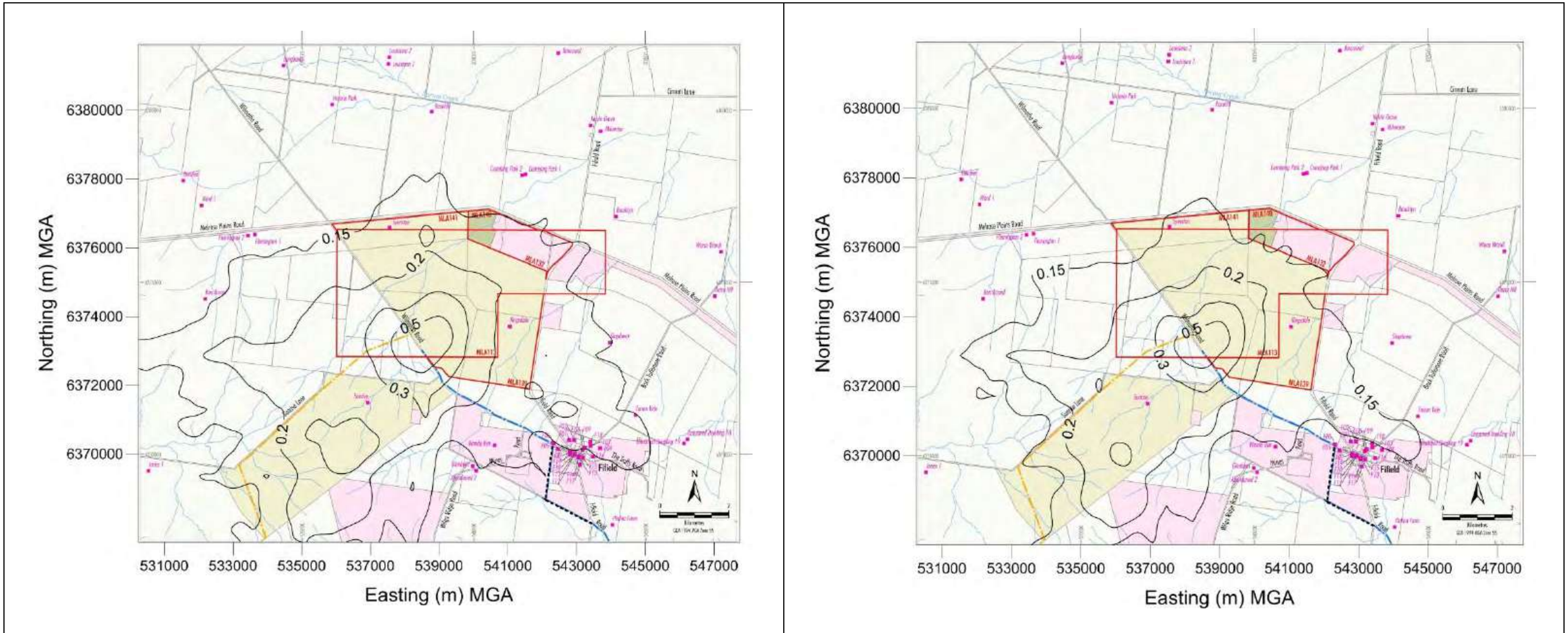
1-hour maximum	24-hour maximum

Figure 7-3: Predicted Project-only 1-hour and 24-hour average SO_2



Annual average SO_2	1-hour average H_2SO_4 (99.9th %ile)

Figure 7-4: Predicted Project-only annual average SO_2 and 1-hour average H_2SO_4



1-hour average benzene (99.9th %ile)	1-hour average 1,2-butadiene (99.9th %ile)

Figure 7-5: Predicted Project-only 1-hour average VOCs

Potential for acid rain

The phenomenon known as acid rain is a process whereby emissions such as SO_x and NO_x react with water in the atmosphere and subsequently fall to the ground as wet or dry deposition. Significant acid rain problems have historically occurred in industrialised areas with high emission loads of SO_x and NO_x (e.g. from coal fired electrical power generation). The issue of acid rain has received less attention in Australia when compared with the Northern Hemisphere due to, for example, the lack of large industrial areas and the lower sulphur content of fuels. Actions over the past 20 years in the US and Europe (i.e. US Clean Air Act Acid Rain Program, EU Sulphur Protocol and Convention on Long-Range Transboundary Air Pollution), have led to significant reductions in the adverse effects of acid deposition in the Northern Hemisphere.

Given the scale of emissions associated with the modified Project, any potential impacts from acid rain are considered insignificant. Furthermore, the process of acid rain formation occurs as pollutants are transported over relatively large distances and over time transform to acid particles and vapours in the atmosphere. Therefore, in the unlikely event acid rain would occur, it would not occur in the vicinity of the modified Project. For the modified Project, we have assessed emissions of SO_2 and NO_2 against human health based impact assessment criteria and present ground level concentrations in the vicinity of the modified Project. When compared against air quality objectives for ecosystem health, biodiversity and agriculture[12], it is clear that the potential impacts from acid deposition are insignificant. Is it also noted that assessment of sulphuric acid mist as a pollutant in this report is not related to the phenomenon of acid rain.

7.2 Particulate matter from mining operations

No exceedances of the relevant criteria were predicted at any private receptors in Years 1, 6, 11 and 21 for:

- annual average dust deposition levels (both incremental and cumulative);
- cumulative annual average TSP concentrations;
- cumulative annual average and 24-hr PM_{10} concentrations; and
- cumulative annual average and 24-hr $PM_{2.5}$ concentrations.

The predicted Project-only and cumulative modelling results are presented in tabular form for each receptor in **Appendix 6**. The modelling results are also presented as contour plots in **Appendix 7**, showing the extent of predicted impacts across private and mine-owned land.

7.3 Voluntary land acquisition on vacant land

Voluntary land acquisition criteria also applies if the development contributes to an exceedance on more than 25% of privately owned land upon which a dwelling could be built under existing planning controls. Analysis of the contour plots presented in **Appendix 7** indicates that Project-only 24-hour PM_{10} concentrations would not exceed 50 µg/m³ across more than 25% of any private land.

To assess against voluntary land acquisition criteria for cumulative annual average PM_{10} and TSP, a background value is added to the incremental contour plots presented in **Appendix 7** for the year with the highest modelling predictions (year 11). Based on this, no additional land would be subject to voluntary land acquisition as the cumulative annual average PM_{10} and TSP contours at the voluntary land acquisition criteria level do not extent beyond the mining lease.

Similarly, for dust deposition, the project only contribution does not exceed 2 g/m^2/month across more than 25% of any private property and the cumulative contribution does not exceed 4 g/m^2/month across more than 25% of any private property.

[12] As prescribed in the Queensland Environmental Protection (Air) Policy 2008.

8. GREENHOUSE GAS ASSESSMENT

The estimation of GHG emissions for the Project is based on the Australian Government Department of the Environment and Energy (DEE) National Greenhouse Accounts Factors (NGAF) workbook (DoE, 2016). The methodologies in the NGAF workbook follow a simplified approach, equivalent to the "Method 1" approach outlined in the National Greenhouse and Energy Reporting (Measurement) Technical Guidelines (DoE, 2014).

Emissions are estimated using the fuel energy contents and Scope 1, 2 and 3 emission factors (EF) in the NGAF workbook.

8.1 Emission sources

The GHG emissions sources included in this assessment are listed in **Table 8-1**, representing the most significant sources associated with the Project. GHG emissions associated with operations at the limestone quarry and rail siding are not included, as the Modification does not propose any changes to these components of the Project. However the interaction between the mine and processing facility and the limestone quarry is considered (i.e. emissions associated with the delivery of limestone raw material to the site) and emissions from the transportation of raw materials and product by rail is also included.

Other minor sources of GHG emissions, such as those generated by employee travel and waste disposal, are anticipated to be negligible in comparison and have not been considered in this assessment.

Table 8-1: Scope 1, 2 and 3 emission sources

Scope 1	Scope 2	Scope 3
Direct emissions from fuel combustion (diesel) by onsite plant and equipment.	None	Indirect upstream emissions from the extraction, production and transport of diesel fuel.
Direct CO_2 emissions from the processing plant stacks.		Downstream emissions generated from transportation (rail) of raw material (sulphur) and product from the rail siding to Newcastle.
Direct emissions from fuel combustion (diesel) for raw material and product transportation by truck		

8.2 Activity data

Activity data for the emission estimates is summarised in **Table 8-2**, along with the assumptions/inputs used to derive the values.

Table 8-2: Activity data and assumptions

Activity	Value	Source of information / assumptions
Diesel - onsite mining equipment	9032 kL/annum	Derived from published fuel consumption data[13] (l/hr) for the main items in the proposed mining fleet. An average of the reported range in fuel consumption for medium load activity is used, for an assumed annual equipment utilisation of 80%.
Diesel - limestone delivery from quarry	360 kL/annum	Assumed to be transported in Clean TeQ operated trucks and derived based on diesel fuel consumption for artic trucks[14] (l/km). The estimated VKT per annum is estimated based on a return travel distance of 40 km and the number of trips required to transport 790,000 tonnes of limestone for a payload of 50 tonnes.

[13] https://www.holtcat.com/Documents/PDFs/2012PerformanceHandbook/Edition%2041%20Full.pdf

[14] http://www.abs.gov.au/ausstats/abs@.nsf/mf/9208.0

Activity	Value	Source of information / assumptions
Diesel - sulphur delivery from rail siding	199 kL/annum	Derived based on diesel fuel consumption for artic trucks (l/km). The estimated VKT per annum is estimated based on a return travel distance of 50 km and the number of trips required to transport 350,000 tonnes of sulphur for a payload of 50 tonnes.
Diesel - product delivery to rail siding	N/A	Assumed to be back loaded to sulphur delivery trucks
Diesel power plant[1]	1.7 kg/s	Client supplied emission rate
PAL vent scrubber stack	2.7 kg/s	Client supplied emission rate
Partial neutralisation vent scrubber stack	6.1 kg/s	Client supplied emission rate
RIP vent scrubber stack	0.6 kg/s	Client supplied emission rate
Diesel - rail transportation (sulphur and product)	141 kL/annum	Derived based on a fuel consumption rate for locomotives of 4.03 l/kt-km. The estimated kt-km per annum is estimated based on a return travel distance of 1000 km and the tonnes transferred per annum.
Note: Annual emissions associated with the diesel power plant are presented as a worst-case, as the majority of the 25 MW power demand would only be during plant start-up or as emergency/back-up power generation. During normal operations, steam generated from the acid process would be used for power generation in combination with the 5 MW auxiliary boiler, as required. Furthermore, the use of diesel for power generation, in lieu of the approved gas plant, provides a worst case estimate of GHG emissions for the two options.		

8.3 Emission estimates

The estimated annual GHG emissions for each source are presented in **Table 8-3**. Annual Scope 1 emissions represent approximately 0.2% of total GHG emissions for NSW and 0.06% of total GHG emissions for Australia, based on the National Greenhouse Gas Inventory for 2015[15].

Table 8-3: Estimated GHG emissions (tonnes CO_2-e)

Scope	Activity	GHG emissions (tonnes CO_2-e)
Scope 1	Diesel - onsite mining equipment	24,474
	Diesel - limestone delivery from quarry	979
	Diesel - sulphur delivery from rail siding	542
	Diesel - product delivery to rail siding	N/A
	Diesel power plant	45,570
	PAL vent scrubber stack	72,375
	Partial neutralisation vent scrubber stack	163,514
	RIP vent scrubber stack	16,083
Scope 3	Diesel - onsite mining equipment	1,255
	Diesel - limestone delivery from quarry	50
	Diesel - sulphur delivery from rail siding	28
	Diesel - product delivery to rail siding	N/A
	Diesel power plant	403
	Diesel - rail transportation (sulphur and product)	24,474

[15] http://ageis.climatechange.gov.au/

9. MANAGEMENT AND MONITORING

The adoption of the RIP processing method instead of the approved counter current decantation processing method (as described in Section 6.1) removes three previously assessed stack emission sources, and hydrogen sulphide would no longer be produced and emitted from the processing facility. Management and monitoring of these emissions would therefore no longer be required for the modified Project. This represents a significant improvement to the approved impacts of the processing facility, as hydrogen sulphide has the potential to materially affect amenity (e.g. due to odour).

As described in Section 6.3, the processing facility would be designed to minimise emissions of gaseous pollutants where practicable, and the estimated emissions used in the assessment of stack emissions account for the use of emission control equipment incorporated into the processing operations (e.g. scrubbers).

The proposed dust management measures for the Project are outlined in **Appendix 4**. Other control measures, while not explicitly applied as reduction factors in the emission calculations, are accounted for in the modelled emissions on the basis of the mine plan, including:

- Site-wide vehicle speed limits.
- Progressive rehabilitation of disturbed areas.
- Minimising the double handling of material, wherever practicable (i.e. direct haul and dump to ROM pad/hopper).
- Avoiding disturbance, or temporary rehabilitation of long-term soil stockpiles.
- Proactive, reactive or corrective measures, for example during periods of dry, windy conditions where watering is not sufficient, certain activities may be ceased or relocated to more sheltered areas.

In addition to the preventative measures outlined above, reactive or corrective measures would be employed. For example, during periods of dry, windy conditions, watering may be increased or certain activities may be ceased or relocated to more sheltered areas.

Further details would be provided in the Air Quality Management Plan for the Project, in accordance with Condition 23, Schedule 3 of Development Consent DA 374-11-00.

9.1 Monitoring

The monitoring requirements for the Project will be outlined in the Air Quality Management Plan for the Project, which would be developed following receipt and review of the revised approval conditions and the Project EPL.

Modelling predictions indicate that the risk from the modified Project is low and additional exceedances of criteria for gaseous pollutants and particulate matter (including cumulative 24-hour PM_{10} and $PM_{2.5}$ concentrations) are unlikely.

Notwithstanding, it is anticipated that meteorological monitoring, regular stack monitoring and monthly dust deposition monitoring would be undertaken for the Project in accordance with the Project EPL.

Monitoring results would be used to inform air quality management as the mine is developed.

10. CONCLUSION

Ramboll Environ has been commissioned to complete an Air Quality Impact Assessment for a proposed Modification to the approved Project, based on the Project Optimisation Study which identified opportunities to improve the overall efficiency of the Full Production Phase of the Project.

The components of the Modification that are particularly important from an air quality perspective include mining in a more selective manner to initially increase the processing facility ore feed grade and adoption of the RIP processing method option (as opposed to the other approved processing method, involving counter current decantation).

The Modification would not involve changes to any aspects of the approved limestone quarry, rail siding or gas pipeline and these are not considered in the AQIA.

Air quality impacts are assessed using a Level 2 assessment approach in accordance with the Approved Methods.

Emissions inventories have been developed for the processing operations and four representative years of mining operations, selected to assess the air quality impacts of worst-case operations. The selected representative years of mining operations are consistent with the air quality assessment for the approved Project, however emission factors and controls have been updated to reflect current best practice and contemporary approaches to emission estimation.

The adoption the RIP processing method for the modified Project eliminates emissions sources that were previously assessed for the Project (i.e. Extraction Fan over Sulphide Filter Vent [hydrogen sulphide], Flare Stack [hydrogen sulphide, SO_2, NO_2] and Hydrogen Reformer Stack [NO_2]). The emission rates for the sulphuric acid plant are derived from the POEO Clean Air Regulation standards of concentrations (general activities). The modelled SO_2 emission rates for the modified Project are higher than what was previously modelled, which is consistent with the increase in sulphuric acid production. Emissions calculations for the diesel power plant and auxiliary boilers are based on the current design (energy demand) of the processing facility. It is noted that the proposed power plant would operate mainly during start-up or as emergency/backup power generation. During normal operations, steam generated from the process itself would be used for power generation in combination with the auxiliary boiler. Emission rates for NO_x from the power plant have also increased for the modified Project, in line with the production increase and the worst case assumption of diesel for power generation.

Dispersion modelling was used to predict GLCs for key pollutants from the modified Project, at surrounding private and mine-owned receptors. Cumulative impacts were assessed by taking into account the existing ambient baseline air quality. Consistent with the air quality assessment for the approved Project, cumulative impacts focus on emissions of particulate matter as background concentrations for gaseous pollutants are assumed to be minor or negligible. However, the focus for the modified Project shifts from TSP to "fine" and "coarse" inhalable PM, based on health-based ambient air quality standards set for PM_{10} and $PM_{2.5}$.

Consistent with the air quality assessment for the approved Project, the predicted concentrations of gaseous pollutants are well below the relevant criteria beyond the site boundary and/or at privately-owned receptors (i.e. less than 50% of the relevant criteria).

Also consistent with the air quality assessment for the approved Project, the predicted Project-only and cumulative annual average PM_{10}, $PM_{2.5}$ and TSP concentrations and dust deposition levels indicate that no private receptors would experience exceedances of the NSW EPA's impact assessment criteria. The predicted cumulative 24-hour average PM_{10} and $PM_{2.5}$ concentrations demonstrated no additional exceedances of the impact assessment criteria at private receptors.

Annual average Scope 1 emissions represent approximately 0.2% of total GHG emissions for NSW and 0.06% of total GHG emissions for Australia, based on the National Greenhouse Gas Inventory for 2015.

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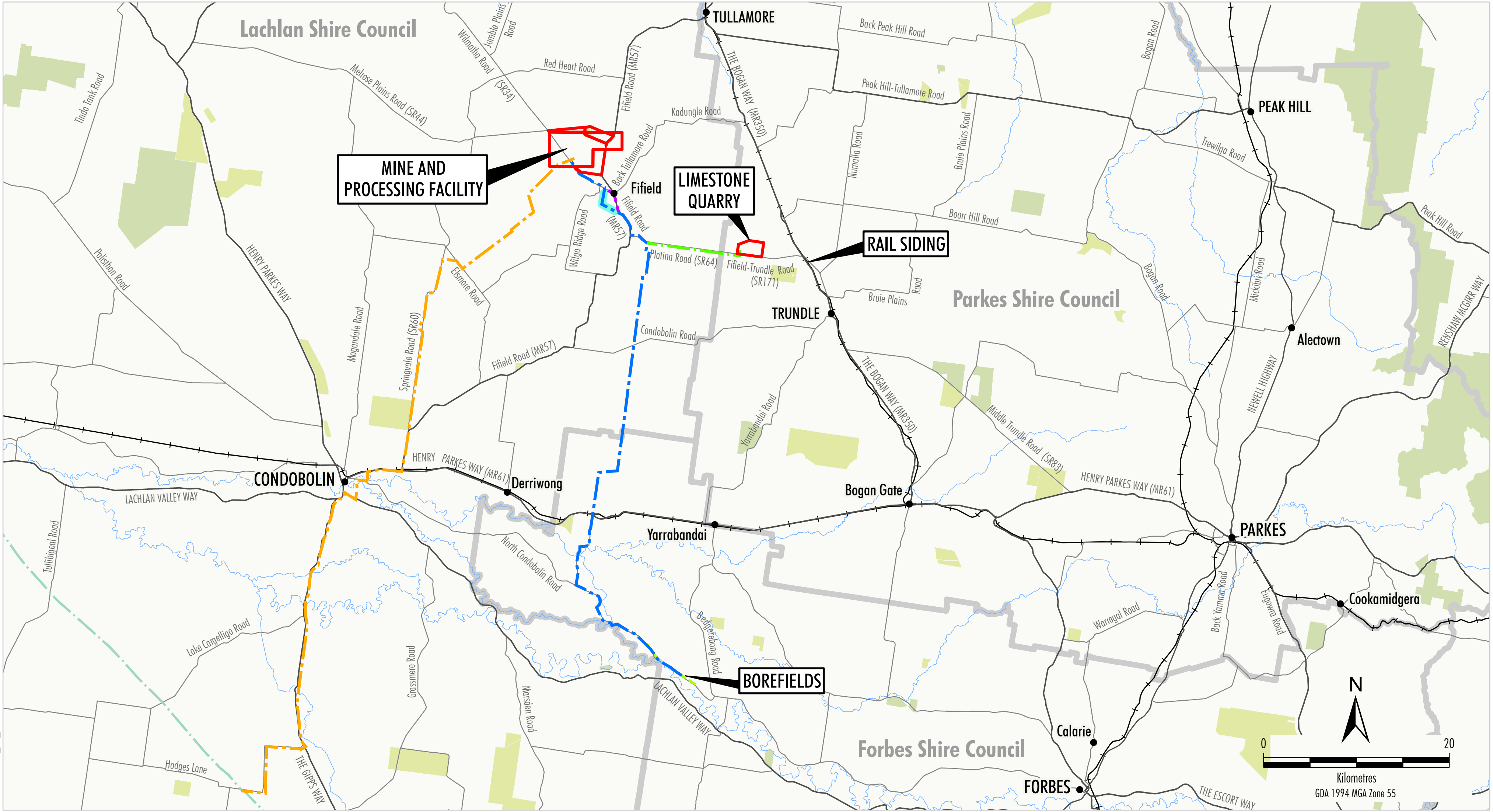
APPENDIX 1
FIGURES



LEGEND
- National Park/Conservation Area
- State Forest
- Local Government Boundary
- Existing Gas Pipeline
- Mining Lease Application Boundary
- Approved Water Pipeline
- Approved Limestone Quarry Water Pipeline
- Approved Gas Pipeline
- Approved Borefield Infrastructure Corridor
- Modified Water Pipeline Alignment Option
- Approved Fifield Bypass

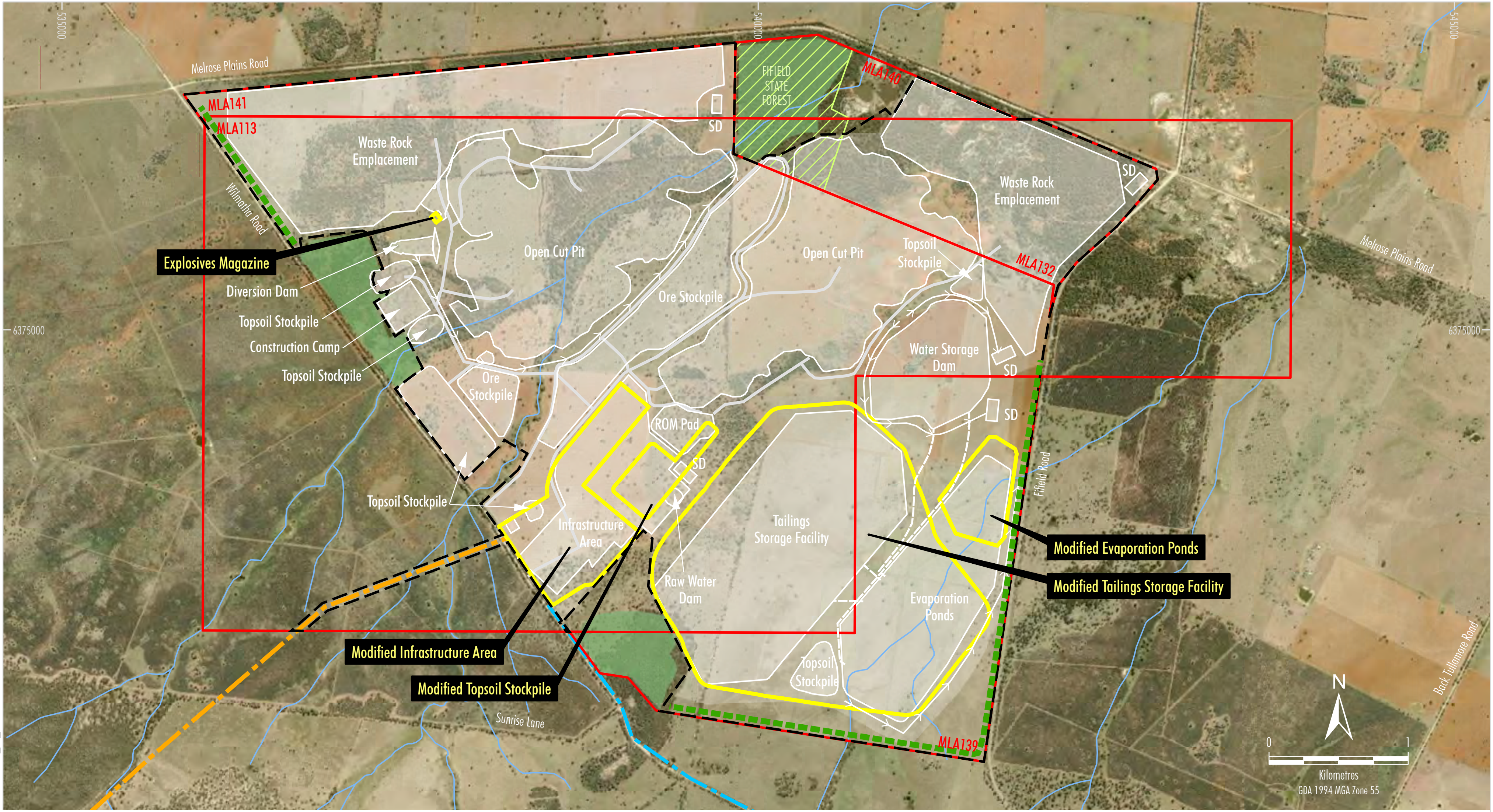
Source: Black Range Minerals (2000); NSW Department of Industry (2017); NSW Land & Property Information (2017); Office of Environment and Heritage NSW (2017)

CLEAN TEQ
Powering innovation

SYERSTON PROJECT MODIFICATION 4

Regional Location

Figure A1-1



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LEGEND

- State Forest
- Mining Lease Application Boundary
- Approved Surface Development Area
- Approved Mine Footprint
- Diversion Structure
- Key Site Water Pipeline
- Approved Gas Pipeline
- Approved Water Pipeline
- Vegetation Screening
- Existing Open Woodland
- Modified Layout

Source: Black Range Minerals (2005); NSW Department of Industry (2017); NSW Land and Property Information (2017)
NSW Imagery: © Department of Finance, Services & Innovation (2017)

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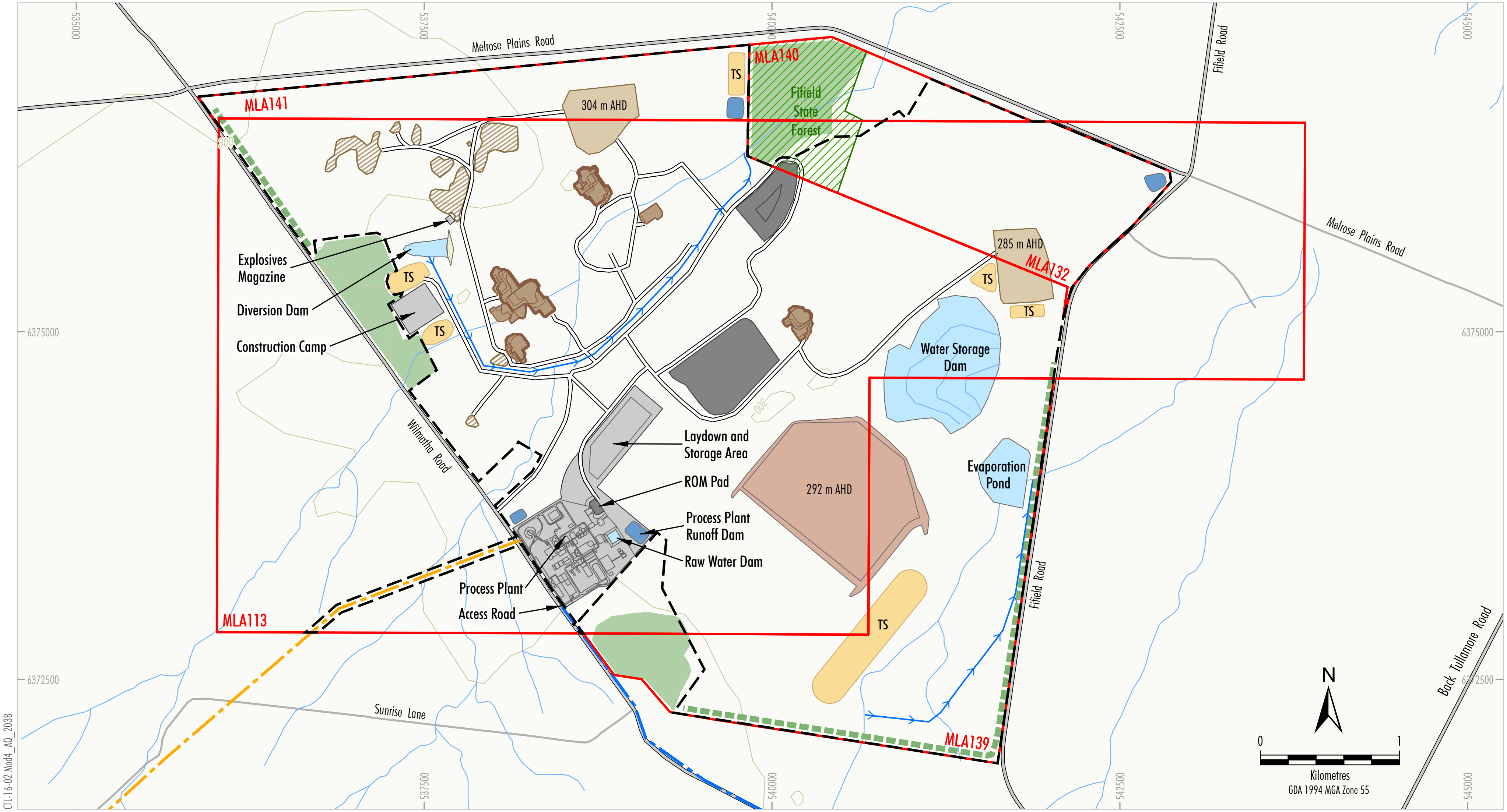
SYERSTON PROJECT MODIFICATION 4

Indicative Modified Mine and Processing Facility General Arrangement

Figure A1-2



LEGEND

- Mining Lease Application Boundary
- Approved Surface Development Area
- Open Cut Pit (Scandium Oxide)
- Open Cut Pit
- Waste Rock Emplacement
- Tailings Storage Facility
- TS Topsoil Stockpile
- Ore Stockpile
- Mine Infrastructure Area
- Sediment Dam
- Diversion Structure
- Gas Pipeline
- Water Pipeline
- Vegetation Screening
- Existing Open Woodland to be Maintained
- State Forest

Source: Black Range Minerals (2000); NSW Department of Industry (2017); NSW Land & Property Information (2017)

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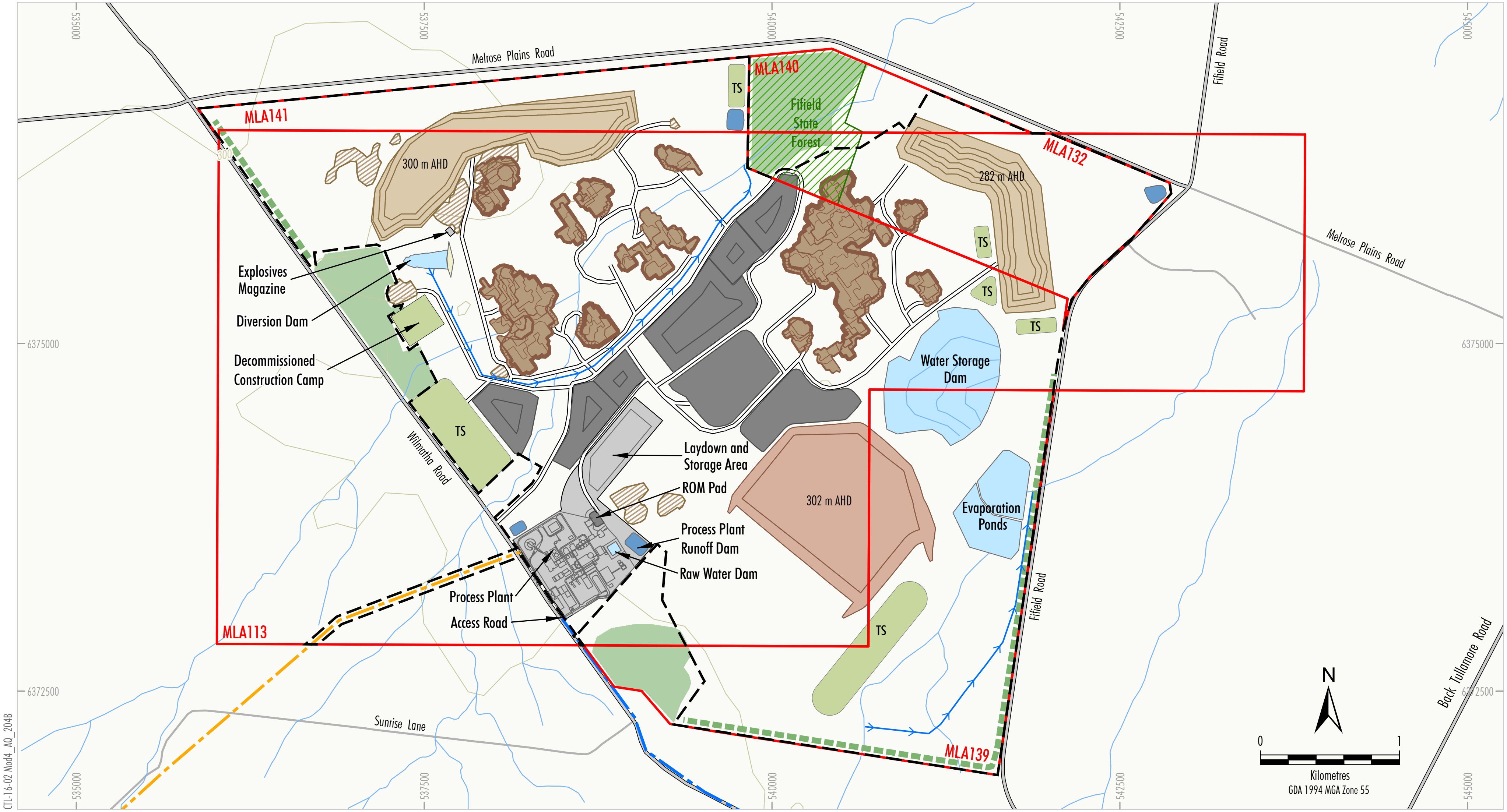
SYERSTON PROJECT MODIFICATION 4

Modified Mine and Processing Facility
Conceptual General Arrangement
Year 1

Figure A1-3



LEGEND

- Mining Lease Application Boundary
- Approved Surface Development Area
- Open Cut Pit (Scandium Oxide)
- Open Cut Pit
- Waste Rock Emplacement
- Tailings Storage Facility
- TS Topsoil Stockpile
- Ore Stockpile
- Mine Infrastructure Area
- Sediment Dam
- Initial Rehabilitation
- Diversion Structure
- Gas Pipeline
- Water Pipeline
- Vegetation Screening
- Existing Open Woodland to be Maintained
- State Forest

Source: Black Range Minerals (2000); NSW Department of Industry (2017); NSW Land & Property Information (2017)

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SYERSTON PROJECT MODIFICATION 4

Modified Mine and Processing Facility Conceptual General Arrangement Year 6

Figure A1-4

LEGEND

- Mining Lease Application Boundary
- Approved Surface Development Area
- Open Cut Pit (Scandium Oxide)
- Open Cut Pit
- Waste Rock Emplacement
- Tailings Storage Facility
- TS Topsoil Stockpile
- Ore Stockpile
- Mine Infrastructure Area
- Sediment Dam
- Initial Rehabilitation
- Intermediate/Advanced Rehabilitation
- Diversion Structure
- Gas Pipeline
- Water Pipeline
- Vegetation Screening
- Existing Open Woodland to be Maintained
- State Forest

Source: Black Range Minerals (2000); NSW Department of Industry (2017); NSW Land & Property Information (2017)

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SYERSTON PROJECT MODIFICATION 4

Modified Mine and Processing Facility Conceptual General Arrangement Year 11

Figure A1-5

LEGEND

- Mining Lease Application Boundary
- Approved Surface Development Area
- Open Cut Pit (Scandium Oxide)
- Open Cut Pit
- Waste Rock Emplacement
- Tailings Storage Facility
- TS Topsoil Stockpile
- Ore Stockpile
- Mine Infrastructure Area
- Sediment Dam
- Initial Rehabilitation
- Intermediate/Advanced Rehabilitation
- Diversion Structure
- Gas Pipeline
- Water Pipeline
- Vegetation Screening
- Existing Open Woodland to be Maintained
- State Forest

Source: Black Range Minerals (2000); NSW Department of Industry (2017); NSW Land & Property Information (2017)

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SYERSTON PROJECT MODIFICATION 4

Modified Mine and Processing Facility Conceptual General Arrangement Year 21

Figure A1-6

APPENDIX 2
OVERVIEW OF DISPERSION MODELLING

Air quality modelling is presented using the AERMOD system, which is composed of two pre-processors that generate the input files required by the AERMOD dispersion model: AERMET (for the preparation of meteorological data) and AERMAP (for the preparation of terrain data).

AERMET is run using the 'onsite' processing option using hourly measurements for 2015 from the Condobolin meteorological station. Gaps in the dataset were supplemented with prognostic meteorological data from TAPM. TAPM was also used to derive a vertical temperature profile for modelling. The TAPM vertical temperature profile was adjusted by first substituting the predicted 10 metre (m) above ground temperature with the hourly measured temperature at 10 m. The difference between the TAPM predicted temperature and the measured 10 m temperature was applied to the entire predicted vertical temperature profile. This modified vertical profile was used in combination with the ambient air temperature throughout the day to calculate convective mixing heights between sunrise and sunset and included in the AERMET input data.

Values for surface roughness length, albedo, and Bowen ratio were selected using the AERSURFACE Utility by assigning appropriate land use types in the vicinity of the Project. Surface roughness length is the height at which the mean horizontal wind speed approaches zero and is related to the roughness characteristics of the surrounding area. For example, low flat landscapes are assigned a lower surface roughness length than urban or forest areas. Bowen ratio relates to the amount of moisture at the surface and plays an important role in deriving Monin-Obukhov length and therefore atmospheric stability. Albedo is defined as the fraction of incoming solar radiation reflected from the ground when the sun is overhead.

Terrain data for the wider modelling domain was sourced from NASA's Shuttle Radar Topography Mission (SRTM) data. This data set provided a high-resolution topography at approximately 30 m spacing.

Mining activities (hauling, dozers, excavators, wind erosion etc.) are represented by a series of volume sources located according to the general mine plan for each year. For modelling volume sources, estimates of horizontal spread (initial sigma y [σy]) and vertical spread (initial sigma z [σz]) need to be assigned. For sources other than hauling, values assigned for sigma y are based on a source separation of either 50 m or 100 m, selected depending on the size of the source. A release height of 2 m is used to assign values for sigma z. For hauling, sigma y is assigned based on source separation (divided by 4.3) and sigma z based on recommendations made in the US EPA Haul Road Workgroup.

Modelling of fugitive dust was completed for three size fractions; TSP, PM_{10} and $PM_{2.5}$ based on particle diameter of 20, 5 and 1 micron respectively.

APPENDIX 3
ASSESSMENT LOCATIONS

Table A3-1: Assessment locations

Property ID	Property Name	Location (m MGA, Zone 55)		Elevation (m AHD)
		Easting	Northing	
Private receptors				
M01	Longburra	534460	6381299	298.71
M02	Victoria Park	535880	6380159	287.93
M03	Ward 1	532074	6377231	300
M04	Abandoned 2	540068	6369522	311.44
M05	Berrilee	531549	6377952	299.7
M06	Bon Accord	532179	6374519	305.77
M07	Boxcowal	542455	6381666	268.2
M08	Currajong Park 2	541407	6378116	275.99
M09	Daisy Hill	547007	6374597	270.19
M10	Glenburn	539974	6369660	312.13
M12	Louisiana 1	537510	6381346	285.53
M13	Louisiana 2	537536	6381538	286.87
M14	Platina Farm	544033	6367948	283.47
M16	Tarron Vale	544700	6371139	288.23
M17	Jones 1	530531	6369523	294.93
M18	Unnamed Dwelling 18	546216	6370438	279.48
M19	Unnamed Dwelling 19	546115	6370320	280.17
M20	Unnamed Dwelling 20	546165	6367633	289.07
M21	Warra Wandi	547194	6375889	264.73
M22	Brooklyn	544134	6376913	273.8
M23	Currajong Park 1	541505	6378145	275.81
M24	Flemington 1	533630	6376389	293.87
M25	Flemington 2	533432	6376363	298
M26	Kelvin Grove	543396	6379565	268.33
M27	Milverton	543687	6379393	266.57
M28	Rosehill	538772	6379967	272.38
M29	Slapdown	543958	6373248	280.6
M31	Wanda Bye	540599	6370264	307

Property ID	Property Name	Location (m MGA, Zone 55)		Elevation (m AHD)
		Easting	Northing	
Private receptors				
M32	Fifield Town Hall	542918	6369990	300
M33	Fifield Fire Station	542895	6369968	298.9
M34	Fifield Hotel	542872	6370013	300.5
M35	St Dympna's Catholic Church	542799	6370059	298.39
F01	Fifield Residences	542770	6370414	302.13
F02		542918	6370415	298.73
F03		543390	6370245	295.5
F04		543672	6370175	296.83
F05		542504	6370163	307
F06		542310	6370326	298.8
F07		542800	6370068	298.8
F08		543170	6370138	295.96
F09		543224	6370187	296.3
F10		542932	6370017	300.9
F11		542932	6370001	300.37
F12		542932	6370001	300.37
F13		543045	6369937	301.08
F14		543033	6369911	297.5
F15		543178	6369894	294.73
F16		543463	6369933	295.45
F17		543086	6369700	296.53
F18		543384	6370362	295.72
F19		542808	6369999	297.2
Mine-owned receptors				
M11	Kingsdale	541049	6373716	284.2
M15	Sunrise	536914	6371503	312.49
M30	Syerston	537544	6376597	316.87

Note: m AHD = metres Australian Height Datum

APPENDIX 4
PARTICULATE MATTER EMISSIONS INVENTORY DEVELOPMENT

Overview

Dust emissions were estimated using US EPA AP-42 emission factors and predictive equations taken from the following chapters:

- Chapter 11.9 Western Surface Coal Mining.
- Chapter 11.19.2 Crushed Stone Processing and Pulverized Mineral Processing.
- Chapter 13.2.2 Unpaved Roads.
- Chapter 13.2.4 Aggregate Handling and Storage Piles.
- Chapter 13.2.5 Industrial Wind Erosion.

The material properties listed in **Table A4-1** are used as input to the various emission factor equations listed in **Table A4-2** to derive site specific uncontrolled emission factors for each source. The values chosen are consistent with the inputs used for the original EIS for the approved project. Emissions were quantified for each particle size fraction, with the TSP size fraction also used to predict dust deposition rates. Fine particles (PM_{10} and $PM_{2.5}$) were estimated using the fraction specific equations or ratios for the different particle size fractions available within the literature (shown in **Table A4-2**).

Table A4-1: Material properties

Properties	Value
Silt content of waste / ore	10 %
Moisture content of waste / ore	2 %
Moisture content of limestone	1 %
Moisture content of sulphur	0.5 %
Moisture content of waste / ore	5 %

Best Management Practice Determination

In June 2011 the NSW EPA published the best practice document 'NSW Coal Mining Benchmarking Study: International Best Practice Measures to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining' (Katestone, 2011). Although specific to coal mines, many of the best practice measures are relevant and applicable to other types of mining and extractive industries. An overview of the BMP determination for the Project, and the emission reductions applied, is presented in **Table A4-3**.

Diesel emission estimates

Emissions of PM_{10} and $PM_{2.5}$ from diesel combustion in mining equipment are assumed to be included in the total emissions for each relevant source and are not explicitly modelled as a separate emission source. However, adjustments have been made to account for the fact that emission reductions applied to the inventory (i.e. watering) are not relevant to control of diesel exhaust emissions. The emissions inventory applies no controls for dozers and excavators, therefore the adjustments for diesel emissions are only needed for haul road controls.

Emissions are calculated based on fuel based emission factors and fuel consumption derived from published fuel consumption data for the proposed haul truck fleet. An average of the reported range in fuel consumption for medium load activity is used, for an assumed annual equipment utilisation of 80%

The estimated diesel emissions for hauling are based on the assumption that new mining equipment would be purchased for the Project that is capable of achieving emission performance equivalent to US EPA Tier 2 emissions performance, as a minimum.The emission performance for the Project, therefore, would be at least 50% lower than the NSW fleet average presented in NSW EPA (2014).

Table A4-2: Equations and emission factors

Inventory activity	Units	TSP emission factor/equation	PM_{10} emission factor/equation	$PM_{2.5}$ emission factor/equation	EF source
Material handling (loading trucks, unloading trucks, rehandle, conveyor transfer)	kg/t	$0.74 \times 0.0016 \times \left(\frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}\right)$	$0.35 \times 0.0016 \times \left(\frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}\right)$	$0.053 \times 0.0016 \times \left(\frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}\right)$	AP42 13.2.4
Dozers on waste / ore and FEL on ore / product reclaim	kg/hr	$2.6 \times \frac{s^{1.2}}{M^{1.3}}$	$0.3375 \times \frac{s^{1.5}}{M^{1.4}}$	0.105 x TSP	AP42 11.9
Wind erosion from exposed ground	kg/ha/yr	0.85×1000	0.5 * TSP	0.075 * TSP	AP42 11.9 & 13.2.5
Stockpile wind erosion and maintenance	kg/ha/hr	1.8 * u	0.5 * TSP	0.075 * TSP	AP42 11.9 & 13.2.5
Hauling on unsealed roads	kg/VKT	$\left(\frac{0.4536}{1.6093}\right) \times 4.9 * \left(\frac{s}{12}\right)^{0.7} \times \left(\frac{W \times 1.1023}{3}\right)^{0.45}$	$\left(\frac{0.4536}{1.6093}\right) \times 1.5 * \left(\frac{s}{12}\right)^{0.9} \times \left(\frac{W \times 1.1023}{3}\right)^{0.45}$	$\left(\frac{0.4536}{1.6093}\right) \times 0.15 * \left(\frac{s}{12}\right)^{0.9} \times \left(\frac{W \times 1.1023}{3}\right)^{0.45}$	AP42 13.2.2
Grading roads	kg/VKT	$0.0034 \times S^{2.5}$	$0.00336 \times S^{2.0}$	$0.0001054 \times S^{2.5}$	AP42 11.9
Ore preparation (sizing)	kg/t	0.0125	0.0043	0.0003	AP42 11.19.2

Note: VKT = vehicle kilometre travelled; U/u = wind speed (m/s); M = moisture content (%); s = silt content (%); W = vehicle weight (t); S = speed (km/hr); ha = hectares.

Table A4-3: BMP determination and emission controls

Activity	BMP	Applied?	Control %	Comment
Hauling	Speed reduction	Yes	N/A	Speed restrictions would apply for the Project, however controls are not applied in the emission inventory.
	Surface improvements	No	N/A	Haul roads will be actively maintained and watered, however specific surface improvements outlined in Katestone (2011) are not practical for this Project and cannot be implemented.
	Surface treatments	Yes	75%	75% control is assumed on the basis of Level 2 watering.
	Use of larger trucks	Yes	N/A	98 t trucks planned for ore and waste hauling.
	Conveyors	No	N/A	Use of conveyors in lieu of hauling is not practical for this Project.
Wind erosion on exposed areas	Minimise pre-strip	Yes	N/A	Incorporated into mine planning, however controls are not applied in the emission inventory.
	Surface stabilisation	Yes	65% - 95%	Controls are applied in the emissions inventory for inactive dump areas or initial rehab (85% for crusting), and soil stockpiles (65% for crusting). Controls are based on ACARP project C22027 (Roddis *et al.*, 2015).
	Wind speed reduction	No	N/A	Not practical for the Project.
Waste dumps	Avoidance	No	N/A	No in-pit dumping proposed.
	Minimising drop heights	Yes	N/A	Would apply for the Project and implemented through driver training, however controls are not applied in the emission inventory.
	Water application	No	N/A	Water application across the large areas of waste dumps is not considered feasible for this Project.
	Modify activities in windy conditions	Yes	N/A	Would apply for the Project and implemented through the Air Quality Management Plan, however controls are not applied in the emission inventory.
	Minimise dozer travel movements	Yes	N/A	Operational efficiency implemented through mine planning and operator training.
	Keep travel routes moist	No	N/A	Not practical for this Project.
Ore handling and processing	Avoidance	Yes	N/A	Achieved through bypassing ore stockpiles where possible and direct dump to ROM pad.
	Minimising drop heights	Yes	30%	Would apply for the Project and implemented through driver training.
	Enclosure of dump hopper	No	N/A	High moisture content for ore negates the need for watering
	Water application	No	N/A	High moisture content for ore negates the need for watering
	Dust extraction	No	N/A	Not practical for the Project.
Stockpiles	Water sprays	No	N/A	Not practical for the Project.

APPENDIX 5
PARTICULATE MATTER EMISSION INVENTORIES

Table A5-1: Year 1 emissions (kg/annum)

Activity	TSP	PM_{10}	$PM_{2.5}$
Eastern pit			
Drilling	1,926	1,136	66
Blasting	1,640	853	49
Excavator ripping and loading trucks in pit	10,906	5,158	781
In pit haulage	24,962	6,469	695
Out of pit haulage to waste rock dump	69,729	18,071	1,941
Trucks unloading at waste rock dump	4,231	2,001	303
Dozers operating in pit/dump	205,242	49,598	21,550
Out of pit haulage - to low grade ore stockpile	0	0	0
Out of pit haulage - to high grade ore stockpile	2,796	725	78
Out of pit haulage - to ROM pad	13,982	3,624	389
Western pit			
Drilling	7,704	4,545	262
Blasting	6,559	3,411	197
Excavator ripping and loading trucks in pit	43,625	20,633	3,124
In pit haulage	99,847	25,877	2,780
Out of pit haulage to waste rock dump	232,429	60,237	6,471
Trucks unloading at waste rock dump	16,925	8,005	1,212
Dozers operating in pit/dump	155,036	37,465	16,279
Out of pit haulage to TSF	28,786	7,460	801
Trucks unloading at TSF	898	425	64
Dozers shaping TSF	25,103	6,066	2,636
Out of pit haulage - to low grade ore stockpile	0	0	0
Out of pit haulage - to high grade ore stockpile	78,299	20,292	2,180
Out of pit haulage - to ROM pad	60,402	15,654	1,682
Evaporation Ponds			
Excavator ripping and loading trucks	11,230	5,311	804
Haulage to western dump	49,348	12,680	1,268
Trucks unloading at western dump	898	425	64
Haulage to eastern dump	16,038	4,157	447
Trucks unloading at eastern dump	1,460	690	105
Haulage to TSF	23,440	6,075	653
Trucks unloading at TSF	2,134	1,009	153
Dozers shaping evaporation ponds	25,103	6,066	2,636
Ore storage and processing			
Unload low grade ore to stockpile	0	0	0
Recover low grade ore from stockpile	0	0	0
Haulage of low grade ore to ROM	0	0	0
Unload high grade ore to stockpile	3,054	1,445	219
Recover high grade ore from stockpile	6,109	2,889	438
Haulage of high grade ore to ROM	69,910	18,118	1,946
Unload at ROM pad (low grade and high grade)	6,109	2,889	438
Load ore to hopper (FEL)	102,621	24,799	10,775
Ore preparation (sizing)	34,000	11,696	790

Activity	TSP	PM_{10}	$PM_{2.5}$
Limestone delivery - haulage to ROM pad	26,182	6,727	673
Limestone - unloading to ROM pad	5,868	2,775	420
Limestone - re-handle to process plant	5,868	2,775	420
Sulphur delivery - haulage to hopper	9,256	2,378	238
Unloading elemental sulphur to hopper	1,642	777	118
Conveyor transfer sulphur to process plant or stockpile	3,285	1,554	235
Loading sulphur stockpile	5,475	2,589	392
Product reclaim (FEL)	11,137	2,456	1,169
Loading trucks with product	150	71	11
Product haulage (back loaded to sulphur trucks)	0	0	0
Rejects			
Loading oversize ore to trucks	1,145	542	82
Haulage oversize to dump	41,946	10,778	1,078
Unload at dump	1,145	542	82
Wind erosion of exposed ground			
Scandium pits	18,564	9,282	1,392
Active pit - eastern	3,740	1,870	281
Active pit - western	18,080	9,040	1,356
Active dump - eastern	16,915	8,458	1,269
Inactive dump - eastern (initial rehab)	0	0	0
Active dump - western	17,085	8,543	1,281
Inactive dump - western (initial rehab	0	0	0
Low grade ore stockpile	24,035	12,017	1,803
High grade ore stockpile	55,318	27,659	4,149
ROM pad	1,431	715	107
TSF	74,800	37,400	5,610
Soil stockpiles - active	8,298	4,149	622
Soil stockpiles - inactive	11,647	5,824	874
Limestone stockpile	46	23	3
Product storage area	56	28	4
Evaporation Ponds	11,815	5,908	886
Miscellaneous			
Grading roads	16,698	5,834	518
Stacks	53,927	53,927	53,927
Total (kg/yr)	**1,888,033**	**620,597**	**163,275**

Table A5-2: Year 6 emissions (kg/annum)

Activity	TSP	PM_{10}	$PM_{2.5}$
Eastern pit			
Drilling	4,815	2,841	164
Blasting	4,099	2,132	123
Excavator ripping and loading trucks in pit	27,793	13,145	1,991
In pit haulage	63,613	16,536	1,819
Out of pit haulage to waste rock dump	106,869	27,780	3,056
Trucks unloading at waste rock dump	10,809	5,112	774

Activity	TSP	PM_{10}	$PM_{2.5}$
Dozers operating in pit/dump	205,242	49,598	21,550
Out of pit haulage - to low grade ore stockpile	10,602	2,756	303
Out of pit haulage - to high grade ore stockpile	15,079	3,920	431
Out of pit haulage - to ROM pad	52,304	13,596	1,496
Western pit			
Drilling	4,815	2,841	164
Blasting	4,099	2,132	123
Excavator ripping and loading trucks in pit	27,793	13,145	1,991
In pit haulage	63,613	16,536	1,819
Out of pit haulage to waste rock dump	106,869	27,780	3,056
Trucks unloading at waste rock dump	10,809	5,112	774
Dozers operating in pit/dump	205,242	49,598	21,550
Out of pit haulage - to low grade ore stockpile	3,675	955	105
Out of pit haulage - to high grade ore stockpile	14,702	3,822	420
Out of pit haulage - to ROM pad	24,738	6,431	707
Ore storage and processing			
Unload low grade ore to stockpile	618	292	44
Recover low grade ore from stockpile	1,235	584	88
Haulage of low grade ore to ROM	14,136	3,675	404
Unload high grade ore to stockpile	2,471	1,168	177
Recover high grade ore from stockpile	4,941	2,337	354
Haulage of high grade ore to ROM	56,545	14,698	1,617
Unload at ROM pad (low grade and high grade)	6,176	2,921	442
Load ore to hopper (FEL)	102,621	24,799	10,775
Ore preparation (sizing)	34,375	11,825	799
Limestone delivery - haulage to ROM pad	26,182	6,727	673
Limestone - unloading to ROM pad	5,868	2,775	420
Limestone - re-handle to process plant	5,868	2,775	420
Sulphur delivery - haulage to hopper	9,256	2,378	238
Unloading elemental sulphur to hopper	1,642	777	118
Conveyor transfer sulphur to process plant or stockpile	3,285	1,554	235
Loading sulphur stockpile	5,475	2,589	392
Product reclaim (FEL)	11,137	2,456	1,169
Loading trucks with product	150	71	11
Product haulage (back loaded to sulphur trucks)	0	0	0
Rejects			
Loading oversize ore to trucks	561	266	40
Haulage oversize to dump	20,562	5,283	528
Unload at dump	561	266	40
Wind erosion of exposed ground			
Scandium pits	20,400	10,200	1,530
Active pit - eastern	56,185	28,093	4,214
Active pit - western	9,397	4,698	705
Active dump - eastern	54,570	27,285	4,093
Inactive dump - eastern (initial rehab)	0	0	0

Activity	TSP	PM_{10}	$PM_{2.5}$
Active dump - western	10,761	5,381	807
Inactive dump - western (initial rehab	0	0	0
Low grade ore stockpile	171,484	85,742	12,861
High grade ore stockpile	107,202	53,601	8,040
ROM pad	1,431	715	107
TSF	67,320	33,660	5,049
Soil stockpiles - active	13,181	6,590	989
Soil stockpiles - inactive	18,502	9,251	1,388
Limestone stockpile	46	23	3
Product storage area	56	28	4
Miscellaneous			
Grading roads	16,698	16,698	518
Stacks	53,927	53,927	53,927
Total (kg/yr)	**1,882,401**	**691,875**	**175,639**

Table A5-3: Year 11 emissions (kg/annum)

Activity	TSP	PM_{10}	$PM_{2.5}$
Eastern pit			
Drilling	5,778	3,409	197
Blasting	4,919	2,558	148
Excavator ripping and loading trucks in pit	33,352	15,775	2,389
In pit haulage	229,006	59,240	6,269
Out of pit haulage to waste rock dump	273,110	70,649	7,477
Trucks unloading at waste rock dump	12,970	6,135	929
Dozers operating in pit/dump	205,242	49,598	21,550
Out of pit haulage - to low grade ore stockpile	28,498	7,372	780
Out of pit haulage - to high grade ore stockpile	2,036	527	56
Out of pit haulage - to ROM pad	41,560	10,751	1,068
Western pit			
Drilling	3,852	2,273	131
Blasting	3,280	1,705	98
Excavator ripping and loading trucks in pit	22,235	10,516	1,592
In pit haulage	152,670	39,494	4,179
Out of pit haulage to waste rock dump	106,078	27,441	2,904
Trucks unloading at waste rock dump	8,647	4,090	619
Dozers operating in pit/dump	205,242	49,598	21,550
Out of pit haulage - to low grade ore stockpile	5,127	1,326	140
Out of pit haulage - to high grade ore stockpile	2,488	644	68
Out of pit haulage - to ROM pad	31,665	8,191	867
Ore storage and processing			
Unload low grade ore to stockpile	1,482	701	106
Recover low grade ore from stockpile	2,965	1,402	212
Haulage of low grade ore to ROM	33,927	8,776	929
Unload high grade ore to stockpile	618	292	44
Recover high grade ore from stockpile	1,235	584	88

Activity	**TSP**	**PM_{10}**	**$PM_{2.5}$**
Haulage of high grade ore to ROM	14,136	3,657	387
Unload at ROM pad (low grade and high grade)	6,176	2,921	442
Load ore to hopper (FEL)	102,621	24,799	10,775
Ore preparation (sizing)	34,375	11,825	799
Limestone delivery - haulage to ROM pad	26,182	6,727	673
Limestone - unloading to ROM pad	5,868	2,775	420
Limestone - re-handle to process plant	5,868	2,775	420
Sulphur delivery - haulage to hopper	9,256	2,378	238
Unloading elemental sulphur to hopper	1,642	777	118
Conveyor transfer sulphur to process plant or stockpile	3,285	1,554	235
Loading sulphur stockpile	5,475	2,589	392
Product reclaim (FEL)	11,137	2,456	1,169
Loading trucks with product	150	71	11
Product haulage (back loaded to sulphur trucks)	0	0	0
Rejects			
Loading oversize ore to trucks	561	266	40
Haulage oversize to dump	20,562	5,283	528
Unload at dump	561	266	40
Wind erosion of exposed ground			
Scandium pits	20,400	10,200	1,530
Active pit - eastern	128,180	64,090	9,614
Active pit - western	15,173	7,586	1,138
Active dump - eastern	105,400	52,700	7,905
Inactive dump - eastern (initial rehab)	2,678	1,339	201
Active dump - western	26,775	13,388	2,008
Inactive dump - western (initial rehab	3,188	1,594	239
Low grade ore stockpile	171,484	85,742	12,861
High grade ore stockpile	56,081	28,040	4,206
ROM pad	1,431	715	107
TSF	143,820	71,910	10,787
Soil stockpiles - active	9,061	4,530	680
Soil stockpiles - inactive	12,718	6,359	954
Limestone stockpile	46	23	3
Product storage area	56	28	4
Miscellaneous			
Grading roads	11,132	3,889	345
Stacks	53,927	53,927	53,927
Total (kg/yr)	**2,427,382**	**860,226**	**197,589**

Table A5-4: Year 21 emissions (kg/annum)

Activity	TSP	PM_{10}	$PM_{2.5}$
Eastern pit			
Drilling	4,815	2,841	164
Blasting	4,099	2,132	123
Excavator ripping and loading trucks in pit	27,793	13,145	1,991
In pit haulage	190,838	49,510	5,363
Out of pit haulage to waste rock dump	49,477	12,836	1,390
Trucks unloading at waste rock dump	10,809	5,112	774
Dozers operating in pit/dump	205,242	49,598	21,550
Out of pit haulage - to low grade ore stockpile	38,168	9,902	1,073
Out of pit haulage - to high grade ore stockpile	0	0	0
Out of pit haulage - to ROM pad	38,168	9,902	1,073
Western pit			
Drilling	4,815	2,841	164
Blasting	4,099	2,132	123
Excavator ripping and loading trucks in pit	27,793	13,145	1,991
In pit haulage	190,838	49,510	5,363
Out of pit haulage to waste rock dump	49,477	12,836	1,271
Trucks unloading at waste rock dump	10,809	5,112	774
Dozers operating in pit/dump	205,242	49,598	21,550
Out of pit haulage - to low grade ore stockpile	10,178	2,641	286
Out of pit haulage - to high grade ore stockpile	0	0	0
Out of pit haulage - to ROM pad	39,581	10,269	1,112
Ore storage and processing			
Unload low grade ore to stockpile	1,544	730	111
Recover low grade ore from stockpile	3,088	1,461	221
Haulage of low grade ore to ROM	35,340	9,169	993
Unload high grade ore to stockpile	0	0	0
Recover high grade ore from stockpile	0	0	0
Haulage of high grade ore to ROM	0	0	0
Unload at ROM pad (low grade and high grade)	6,176	2,921	442
Load ore to hopper (FEL)	102,621	24,799	10,775
Ore preparation (sizing)	34,375	11,825	799
Limestone delivery - haulage to ROM pad	26,182	6,727	673
Limestone - unloading to ROM pad	5,868	2,775	420
Limestone - re-handle to process plant	5,868	2,775	420
Sulphur delivery - haulage to hopper	9,256	2,378	238
Unloading elemental sulphur to hopper	1,642	777	118
Conveyor transfer sulphur to process plant or stockpile	3,285	1,554	235
Loading sulphur stockpile	5,475	2,589	392
Product reclaim (FEL)	11,137	2,456	1,169
Loading trucks with product	150	71	11
Product haulage (back loaded to sulphur trucks)	0	0	0

Activity	TSP	PM_{10}	$PM_{2.5}$
Rejects			
Loading oversize ore to trucks	561	266	40
Haulage oversize to dump	6,359	6,359	6,359
Unload at dump	561	266	40
Wind erosion of exposed ground			
Scandium pits	8,245	4,123	618
Active pit - eastern	165,750	82,875	12,431
Active pit - western	26,138	13,069	1,960
Active dump - eastern	87,550	43,775	6,566
Inactive dump - eastern (initial rehab)	3,060	1,530	230
Active dump - western	18,870	9,435	1,415
Inactive dump - western (initial rehab	4,973	2,486	373
Low grade ore stockpile	171,484	85,742	12,861
High grade ore stockpile	0	0	0
ROM pad	1,431	715	107
TSF	203,490	101,745	15,262
Soil stockpiles - active	9,061	4,530	680
Soil stockpiles - inactive	12,718	6,359	954
Limestone stockpile	46	23	3
Product storage area	56	28	4
Miscellaneous			
Grading roads	11,132	3,889	345
Stacks	53,927	53,927	53,927
Total (kg/yr)	**2,149,657**	**797,210**	**197,330**

The mining activities described in the tables above can be categorised into three emission source types, as follows:

- Wind-insensitive sources (where the emission rate is independent of the wind speed).
- Wind-sensitive sources (where there is a relationship between the emission rate and wind speed).
- Wind erosion sources (where the emission is dependent on the wind speed).

The annual emissions for wind independent sources are evenly apportioned for each hour of the year (no adjustment applied). Hourly varying emissions for wind erosion sources are derived using equation 1, adjusted according to the cube of the hourly average wind speed and normalised so that the total emission over all hours in the year adds up to the estimated annual total emission. The emissions for wind-sensitive sources are converted to hourly emissions in a similar manner, however the wind speed adjustment is made based on equation 2.

Equation 1 (Skidmore, 1998)	**Equation 2** (US EPA, 1987)
$E_i = E_{annual} \times \frac{U_i^3}{\sum_{i=1}^{N} U_i^3}$	$E_i = E_{annual} \times \frac{\left(\frac{U_i}{2.2}\right)^{1.3}}{\sum_{i=1}^{N}\left(\frac{U}{2.2}\right)^{1.3}}$

Where:	$E_i = emissions\ for\ hour\ i$
	$E_{annual} = annual\ emissions$
	$U_i = wind\ speed\ for\ each\ hour\ i$
	$N = number\ of\ hours\ of\ wind\ speed$

APPENDIX 6
PARTICULATE MATTER DISPERSION MODELLING RESULTS

Table A6-1: Predicted Project-only and cumulative annual average PM_{10} concentration ($\mu g/m^3$)

ID	Description	Project-only annual average PM_{10} ($\mu g/m^3$)				Cumulative annual average PM_{10} ($\mu g/m^3$)			
		Year 1	Year 6	Year 11	Year 21	Year 1	Year 6	Year 11	Year 21
Private receptors									
M01	Longburra	0.5	0.4	0.5	0.5	13.9	13.9	14.0	13.9
M02	Victoria Park	0.8	0.7	0.8	0.7	14.2	14.1	14.3	14.2
M03	Ward 1	0.8	0.7	0.9	0.8	14.3	14.2	14.3	14.2
M04	Abandoned 2	0.8	0.8	1.0	0.9	14.3	14.3	14.5	14.4
M05	Berrilee	0.7	0.6	0.7	0.6	14.2	14.1	14.2	14.1
M06	Bon Accord	1.0	0.9	1.0	0.9	14.5	14.4	14.5	14.4
M07	Boxcowal	0.8	0.7	0.9	0.8	14.3	14.2	14.4	14.2
M08	Currajong Park 2	2.7	2.7	3.5	2.9	16.2	16.2	17.0	16.4
M09	Daisy Hill	1.0	0.9	1.2	1.0	14.5	14.4	14.7	14.4
M10	Glenburn	0.9	0.8	1.1	1.0	14.3	14.3	14.5	14.4
M12	Louisiana 1	0.7	0.6	0.7	0.6	14.2	14.1	14.2	14.1
M13	Louisiana 2	0.7	0.6	0.7	0.6	14.1	14.1	14.2	14.1
M14	Platina Farm	0.4	0.4	0.4	0.4	13.9	13.8	13.9	13.9
M16	Tarron Vale	0.9	0.8	0.9	0.8	14.4	14.2	14.4	14.3
M17	Jones 1	0.5	0.4	0.5	0.4	14.0	13.9	14.0	13.9
M18	Unnamed Dwelling 18	0.6	0.6	0.7	0.6	14.1	14.0	14.1	14.0
M19	Unnamed Dwelling 19	0.6	0.5	0.7	0.6	14.1	14.0	14.1	14.0
M20	Unnamed Dwelling 20	0.3	0.3	0.4	0.3	13.8	13.8	13.8	13.8
M21	Warra Wandi	0.9	0.8	1.0	0.8	14.3	14.3	14.5	14.3
M22	Brooklyn	2.0	2.0	2.9	2.2	15.5	15.4	16.4	15.7
M23	Currajong Park 1	2.7	2.7	3.5	2.8	16.2	16.1	16.9	16.3
M24	Flemington 1	1.3	1.2	1.4	1.3	14.8	14.6	14.9	14.7
M25	Flemington 2	1.3	1.1	1.4	1.2	14.8	14.6	14.8	14.7
M26	Kelvin Grove	1.2	1.2	1.6	1.3	14.7	14.7	15.1	14.8
M27	Milverton	1.2	1.2	1.6	1.3	14.7	14.7	15.1	14.8
M28	Rosehill	1.2	1.1	1.3	1.1	14.7	14.5	14.8	14.6
M29	Slapdown	2.0	1.5	2.0	1.6	15.5	15.0	15.4	15.1
M31	Wanda Bye	1.0	1.0	1.2	1.1	14.5	14.4	14.7	14.6
M32	Fifield Town Hall	0.7	0.6	0.7	0.6	14.2	14.1	14.2	14.1
M33	Fifield Fire Station	0.7	0.6	0.7	0.6	14.2	14.1	14.2	14.1
M34	Fifield Hotel	0.7	0.6	0.7	0.6	14.2	14.1	14.2	14.1
M35	St Dympna's Catholic Church	0.7	0.6	0.7	0.6	14.2	14.1	14.2	14.1
F01	Fifield Residences	0.8	0.7	0.8	0.7	14.3	14.1	14.3	14.2
F02		0.8	0.7	0.8	0.7	14.3	14.1	14.3	14.2
F03		0.7	0.6	0.8	0.6	14.2	14.1	14.2	14.1
F04		0.7	0.6	0.7	0.6	14.2	14.1	14.2	14.1
F05		0.7	0.6	0.8	0.6	14.2	14.1	14.2	14.1
F06		0.8	0.7	0.9	0.7	14.3	14.2	14.3	14.2
F07		0.7	0.6	0.7	0.6	14.2	14.1	14.2	14.1
F08		0.7	0.6	0.7	0.6	14.2	14.1	14.2	14.1
F09		0.7	0.6	0.8	0.6	14.2	14.1	14.2	14.1
F10		0.7	0.6	0.7	0.6	14.2	14.1	14.2	14.1
F11		0.7	0.6	0.7	0.6	14.2	14.1	14.2	14.1
F12		0.7	0.6	0.7	0.6	14.2	14.1	14.2	14.1
F13		0.7	0.6	0.7	0.6	14.1	14.0	14.2	14.1
F14		0.7	0.6	0.7	0.6	14.1	14.0	14.2	14.1
F15		0.7	0.6	0.7	0.6	14.1	14.0	14.2	14.1

ID	Description	Project-only annual average PM_{10} ($\mu g/m^3$)				Cumulative annual average PM_{10} ($\mu g/m^3$)			
		Year 1	Year 6	Year 11	Year 21	Year 1	Year 6	Year 11	Year 21
F16	Fifield Residences	0.7	0.6	0.7	0.6	14.1	14.0	14.2	14.1
F17		0.6	0.5	0.7	0.6	14.1	14.0	14.1	14.0
F18		0.7	0.6	0.8	0.7	14.2	14.1	14.3	14.1
F19		0.7	0.6	0.7	0.6	14.2	14.1	14.2	14.1
Mine-owned receptors									
M15	Sunrise	2.2	2.0	2.3	2.1	15.7	15.5	15.8	15.5

Table A6-2: Predicted Project-only and cumulative 24-hour average PM_{10} concentration ($\mu g/m^3$)

ID	Description	Project-only 24-hr average PM_{10} ($\mu g/m^3$)				Cumulative 24-hr average PM_{10} ($\mu g/m^3$)			
		Year 1	Year 6	Year 11	Year 21	Year 1	Year 6	Year 11	Year 21
Private receptors									
M01	Longburra	2.8	2.6	3.4	3.0	41.0	41.0	41.0	41.0
M02	Victoria Park	4.3	3.9	4.5	4.1	41.0	41.0	41.0	41.0
M03	Ward 1	6.2	4.5	5.5	4.7	41.0	41.0	41.0	41.0
M04	Abandoned 2	4.2	4.4	6.0	6.0	42.8	42.9	43.5	43.5
M05	Berrilee	5.7	4.8	5.8	5.2	41.0	41.0	41.0	41.0
M06	Bon Accord	8.1	5.6	6.8	6.2	41.0	41.0	41.0	41.0
M07	Boxcowal	4.1	3.5	4.7	3.7	41.2	41.3	41.2	41.2
M08	Currajong Park 2	13.8	10.1	12.3	11.3	46.1	43.6	43.7	43.6
M09	Daisy Hill	6.3	5.7	8.0	6.3	41.8	41.6	41.6	41.6
M10	Glenburn	5.6	4.4	6.5	5.8	42.9	42.9	43.7	43.7
M12	Louisiana 1	5.5	3.7	4.1	3.7	41.0	41.0	41.0	41.0
M13	Louisiana 2	5.2	3.6	4.0	3.6	41.0	41.0	41.0	41.0
M14	Platina Farm	2.7	2.3	2.7	2.3	41.1	41.0	41.2	41.1
M16	Tarron Vale	6.3	4.2	5.4	4.5	41.6	41.4	41.8	41.3
M17	Jones 1	3.7	2.9	3.4	2.9	41.0	41.0	41.0	41.0
M18	Unnamed Dwelling 18	3.7	3.0	4.5	3.6	41.2	41.2	41.3	41.3
M19	Unnamed Dwelling 19	4.0	3.2	4.7	3.7	41.2	41.2	41.3	41.3
M20	Unnamed Dwelling 20	2.6	2.1	2.6	2.3	41.0	41.0	41.1	41.1
M21	Warra Wandi	5.5	5.7	7.6	6.0	42.3	42.0	42.3	42.1
M22	Brooklyn	11.1	10.2	15.1	11.3	47.8	46.1	48.7	46.6
M23	Currajong Park 1	13.1	10.1	12.1	11.3	45.8	43.5	43.6	43.5
M24	Flemington 1	9.6	9.2	11.5	10.2	41.0	41.0	41.0	41.0
M25	Flemington 2	9.7	9.3	11.7	10.3	41.0	41.0	41.0	41.0
M26	Kelvin Grove	6.9	6.8	8.1	6.6	43.2	43.1	43.1	42.9
M27	Milverton	7.9	7.4	9.7	7.9	43.6	43.1	43.5	43.3
M28	Rosehill	9.2	5.8	6.7	6.1	41.1	41.1	41.1	41.1
M29	Slapdown	10.5	8.0	9.5	7.7	41.4	41.5	41.8	42.0
M31	Wanda Bye	5.7	5.1	6.4	7.0	42.9	44.0	44.1	45.2
M32	Fifield Town Hall	4.4	3.7	4.1	3.5	42.0	41.6	41.8	41.7
M33	Fifield Fire Station	4.4	3.6	4.1	3.5	42.0	41.6	41.8	41.7
M34	Fifield Hotel	4.5	3.7	4.2	3.5	42.0	41.6	41.8	41.7
M35	St Dympna's Catholic Church	4.6	3.7	4.2	3.5	42.1	41.7	42.0	41.7
F01	Fifield Residences	5.0	4.1	4.3	3.9	42.2	41.6	42.2	41.9
F02		5.2	4.2	4.2	3.9	42.0	41.5	41.9	41.8
F03		5.2	4.0	4.1	3.8	41.7	41.3	41.6	41.6
F04		5.3	4.0	4.3	3.9	41.6	41.2	41.5	41.5

ID	Description	Project-only 24-hr average PM_{10} ($\mu g/m^3$)				Cumulative 24-hr average PM_{10} ($\mu g/m^3$)			
		Year 1	Year 6	Year 11	Year 21	Year 1	Year 6	Year 11	Year 21
F05	Fifield Residences	4.8	4.3	4.6	4.3	42.5	42.1	42.2	42.1
F06		4.9	4.0	4.7	4.0	42.6	42.1	42.2	42.1
F07		4.6	3.7	4.2	3.6	42.1	41.7	42.0	41.7
F08		4.9	3.8	3.9	3.6	41.8	41.3	41.7	41.5
F09		5.0	3.9	3.9	3.7	41.8	41.3	41.7	41.6
F10		4.4	3.7	4.1	3.5	42.0	41.6	41.8	41.7
F11		4.4	3.7	4.1	3.5	42.0	41.6	41.8	41.7
F12		4.4	3.7	4.1	3.5	42.0	41.6	41.8	41.7
F13		4.5	3.6	4.0	3.4	41.9	41.5	41.7	41.6
F14		4.2	3.5	4.0	3.3	41.9	41.5	41.7	41.6
F15		4.5	3.5	3.8	3.3	41.7	41.4	41.6	41.5
F16		4.7	3.6	3.7	3.4	41.6	41.2	41.5	41.4
F17		4.0	3.4	3.9	3.2	41.8	41.5	41.6	41.5
F18		5.4	4.2	4.3	4.0	41.7	41.3	41.6	41.6
F19		4.5	3.6	4.2	3.5	42.1	41.7	41.9	41.7
Mine-owned receptors									
M15	Sunrise	14.7	15.6	17.8	16.3	41.1	41.2	41.3	41.3

Table A6-3: Predicted Project-only and cumulative annual average $PM_{2.5}$ concentration ($\mu g/m^3$) at private receptors

ID	Description	Project-only annual average $PM_{2.5}$ ($\mu g/m^3$)				Cumulative annual average $PM_{2.5}$ ($\mu g/m^3$)			
		Year 1	Year 6	Year 11	Year 21	Year 1	Year 6	Year 11	Year 21
Private receptors									
M01	Longburra	0.1	0.1	0.2	0.2	6.2	6.2	6.3	6.3
M02	Victoria Park	0.2	0.2	0.2	0.2	6.3	6.3	6.3	6.3
M03	Ward 1	0.2	0.2	0.3	0.3	6.3	6.3	6.4	6.4
M04	Abandoned 2	0.2	0.2	0.2	0.2	6.3	6.3	6.3	6.3
M05	Berrilee	0.2	0.2	0.2	0.2	6.3	6.3	6.3	6.3
M06	Bon Accord	0.3	0.3	0.3	0.3	6.4	6.4	6.4	6.4
M07	Boxcowal	0.2	0.2	0.2	0.2	6.3	6.3	6.3	6.3
M08	Currajong Park 2	0.7	0.8	0.9	0.9	6.8	6.9	7.0	7.0
M09	Daisy Hill	0.3	0.3	0.3	0.3	6.4	6.4	6.4	6.4
M10	Glenburn	0.2	0.2	0.3	0.3	6.3	6.3	6.4	6.4
M12	Louisiana 1	0.2	0.2	0.2	0.2	6.3	6.3	6.3	6.3
M13	Louisiana 2	0.2	0.2	0.2	0.2	6.3	6.3	6.3	6.3
M14	Platina Farm	0.1	0.1	0.1	0.1	6.2	6.2	6.2	6.2
M16	Tarron Vale	0.3	0.3	0.3	0.3	6.4	6.4	6.4	6.4
M17	Jones 1	0.1	0.1	0.2	0.2	6.2	6.2	6.3	6.3
M18	Unnamed Dwelling 18	0.2	0.2	0.2	0.2	6.3	6.3	6.3	6.3
M19	Unnamed Dwelling 19	0.2	0.2	0.2	0.2	6.3	6.3	6.3	6.3
M20	Unnamed Dwelling 20	0.1	0.1	0.1	0.1	6.2	6.2	6.2	6.2
M21	Warra Wandi	0.3	0.2	0.3	0.3	6.4	6.3	6.4	6.4
M22	Brooklyn	0.6	0.6	0.8	0.7	6.7	6.7	6.9	6.8
M23	Currajong Park 1	0.7	0.8	0.9	0.8	6.8	6.9	7.0	6.9
M24	Flemington 1	0.4	0.4	0.4	0.4	6.5	6.5	6.5	6.5
M25	Flemington 2	0.3	0.4	0.4	0.4	6.4	6.5	6.5	6.5
M26	Kelvin Grove	0.4	0.4	0.4	0.4	6.5	6.5	6.5	6.5
M27	Milverton	0.4	0.4	0.4	0.4	6.5	6.5	6.5	6.5

ID	Description	Project-only annual average $PM_{2.5}$ (µg/m^3)				Cumulative annual average $PM_{2.5}$ (µg/m^3)			
		Year 1	Year 6	Year 11	Year 21	Year 1	Year 6	Year 11	Year 21
M28	Rosehill	0.3	0.3	0.4	0.4	6.4	6.4	6.5	6.5
M29	Slapdown	0.6	0.4	0.5	0.5	6.7	6.5	6.6	6.6
M31	Wanda Bye	0.3	0.3	0.3	0.3	6.4	6.4	6.4	6.4
M32	Fifield Town Hall	0.2	0.2	0.2	0.2	6.3	6.3	6.3	6.3
M33	Fifield Fire Station	0.2	0.2	0.2	0.2	6.3	6.3	6.3	6.3
M34	Fifield Hotel	0.2	0.2	0.2	0.2	6.3	6.3	6.3	6.3
M35	St Dympna's Catholic Church	0.2	0.2	0.2	0.2	6.3	6.3	6.3	6.3
F01	Fifield Residences	0.2	0.2	0.2	0.2	6.3	6.3	6.3	6.3
F02		0.3	0.2	0.2	0.2	6.4	6.3	6.3	6.3
F03		0.2	0.2	0.2	0.2	6.3	6.3	6.3	6.3
F04		0.2	0.2	0.2	0.2	6.3	6.3	6.3	6.3
F05		0.2	0.2	0.2	0.2	6.3	6.3	6.3	6.3
F06		0.3	0.2	0.2	0.2	6.4	6.3	6.3	6.3
F07		0.2	0.2	0.2	0.2	6.3	6.3	6.3	6.3
F08		0.2	0.2	0.2	0.2	6.3	6.3	6.3	6.3
F09		0.2	0.2	0.2	0.2	6.3	6.3	6.3	6.3
F10		0.2	0.2	0.2	0.2	6.3	6.3	6.3	6.3
F11		0.2	0.2	0.2	0.2	6.3	6.3	6.3	6.3
F12		0.2	0.2	0.2	0.2	6.3	6.3	6.3	6.3
F13		0.2	0.2	0.2	0.2	6.3	6.3	6.3	6.3
F14		0.2	0.2	0.2	0.2	6.3	6.3	6.3	6.3
F15		0.2	0.2	0.2	0.2	6.3	6.3	6.3	6.3
F16		0.2	0.2	0.2	0.2	6.3	6.3	6.3	6.3
F17		0.2	0.2	0.2	0.2	6.3	6.3	6.3	6.3
F18		0.2	0.2	0.2	0.2	6.3	6.3	6.3	6.3
F19		0.2	0.2	0.2	0.2	6.3	6.3	6.3	6.3
Mine-owned receptors									
M15	Sunrise	0.6	0.6	0.6	0.6	6.7	6.7	6.7	6.7

Table A6-4: Predicted Project-only and cumulative 24-hour average $PM_{2.5}$ concentration (µg/m^3) at private receptors

ID	Description	Project-only 24-hr average $PM_{2.5}$ (µg/m^3)				Cumulative 24-hr average $PM_{2.5}$ (µg/m^3)			
		Year 1	Year 6	Year 11	Year 21	Year 1	Year 6	Year 11	Year 21
Private receptors									
M01	Longburra	1.1	1.0	1.1	1.1	18.6	18.5	18.6	18.6
M02	Victoria Park	1.4	1.3	1.5	1.5	18.9	18.8	19.0	19.0
M03	Ward 1	1.6	1.3	1.5	1.5	19.1	18.8	19.0	19.0
M04	Abandoned 2	1.3	1.1	1.1	1.3	18.8	18.6	18.6	18.8
M05	Berrilee	1.5	1.5	1.7	1.7	19.0	19.0	19.2	19.2
M06	Bon Accord	2.0	1.8	1.9	1.9	19.5	19.3	19.4	19.4
M07	Boxcowal	1.3	1.0	1.1	1.2	18.8	18.5	18.6	18.7
M08	Currajong Park 2	3.5	3.3	3.7	3.3	21.0	20.8	21.2	20.8
M09	Daisy Hill	1.7	1.5	1.8	1.7	19.2	19.0	19.3	19.2
M10	Glenburn	1.6	1.1	1.2	1.2	19.1	18.6	18.7	18.7
M12	Louisiana 1	1.7	1.4	1.3	1.3	19.2	18.9	18.8	18.8
M13	Louisiana 2	1.6	1.4	1.3	1.3	19.1	18.9	18.8	18.8
M14	Platina Farm	0.8	0.8	0.8	0.9	18.3	18.3	18.3	18.4

ID	Description	Project-only 24-hr average $PM_{2.5}$ (µg/m^3)				Cumulative 24-hr average $PM_{2.5}$ (µg/m^3)			
		Year 1	Year 6	Year 11	Year 21	Year 1	Year 6	Year 11	Year 21
M16	Tarron Vale	1.6	1.5	1.5	1.5	19.1	19.0	19.0	19.0
M17	Jones 1	1.3	1.0	1.1	1.1	18.8	18.5	18.6	18.6
M18	Unnamed Dwelling 18	1.1	1.1	1.2	1.1	18.6	18.6	18.7	18.6
M19	Unnamed Dwelling 19	1.1	1.0	1.2	1.2	18.6	18.5	18.7	18.7
M20	Unnamed Dwelling 20	0.6	0.6	0.6	0.7	18.1	18.1	18.1	18.2
M21	Warra Wandi	1.4	1.6	1.8	1.7	18.9	19.1	19.3	19.2
M22	Brooklyn	3.6	3.0	3.8	3.5	21.1	20.5	21.3	21.0
M23	Currajong Park 1	4.5	3.6	3.5	3.2	22.0	21.1	21.0	20.7
M24	Flemington 1	2.7	3.4	4.0	3.9	20.2	20.9	21.5	21.4
M25	Flemington 2	2.7	3.4	3.9	3.8	20.2	20.9	21.4	21.3
M26	Kelvin Grove	1.7	1.9	2.2	2.1	19.2	19.4	19.7	19.6
M27	Milverton	2.4	2.2	2.5	2.5	19.9	19.7	20.0	20.0
M28	Rosehill	2.4	1.9	1.8	1.9	19.9	19.4	19.3	19.4
M29	Slapdown	3.4	2.3	2.3	2.2	20.9	19.8	19.8	19.7
M31	Wanda Bye	1.9	1.8	1.8	1.9	19.4	19.3	19.3	19.4
M32	Fifield Town Hall	1.6	1.2	1.2	1.2	19.1	18.7	18.7	18.7
M33	Fifield Fire Station	1.4	1.2	1.2	1.2	18.9	18.7	18.7	18.7
M34	Fifield Hotel	1.4	1.2	1.2	1.2	18.9	18.7	18.7	18.7
M35	St Dympna's Catholic Church	1.3	1.2	1.2	1.2	18.8	18.7	18.7	18.7
F01	Fifield Residences	1.5	1.3	1.3	1.3	19.0	18.8	18.8	18.8
F02		1.8	1.3	1.3	1.3	19.3	18.8	18.8	18.8
F03		1.3	1.2	1.2	1.2	18.8	18.7	18.7	18.7
F04		1.3	1.1	1.2	1.2	18.8	18.6	18.7	18.7
F05		1.3	1.3	1.3	1.3	18.8	18.8	18.8	18.8
F06		1.4	1.3	1.3	1.3	18.9	18.8	18.8	18.8
F07		1.3	1.2	1.2	1.2	18.8	18.7	18.7	18.7
F08		1.4	1.1	1.2	1.2	18.9	18.6	18.7	18.7
F09		1.3	1.2	1.2	1.2	18.8	18.7	18.7	18.7
F10		1.7	1.2	1.2	1.2	19.2	18.7	18.7	18.7
F11		1.6	1.2	1.2	1.2	19.1	18.7	18.7	18.7
F12		1.6	1.2	1.2	1.2	19.1	18.7	18.7	18.7
F13		1.6	1.1	1.2	1.2	19.1	18.6	18.7	18.7
F14		1.5	1.1	1.1	1.2	19.0	18.6	18.6	18.7
F15		1.3	1.1	1.1	1.1	18.8	18.6	18.6	18.6
F16		1.2	1.1	1.1	1.1	18.7	18.6	18.6	18.6
F17		1.4	1.1	1.1	1.1	18.9	18.6	18.6	18.6
F18		1.4	1.2	1.2	1.3	18.9	18.7	18.7	18.8
F19		1.3	1.2	1.2	1.2	18.8	18.7	18.7	18.7
Mine-owned receptors									
M15	Sunrise	4.5	4.9	5.2	5.2	22.0	22.4	22.7	22.7

Table A6-5: Predicted Project-only and cumulative annual average TSP (µg/m^3)

ID	Description	Project-only annual average TSP (µg/m^3)				Cumulative annual average TSP (µg/m^3)			
		Year 1	Year 6	Year 11	Year 21	Year 1	Year 6	Year 11	Year 21
Private receptors									
M01	Longburra	0.6	0.6	0.7	0.6	34.6	34.6	34.7	34.6
M02	Victoria Park	1.0	0.9	1.1	1.0	35.0	34.9	35.1	35.0
M03	Ward 1	1.1	1.0	1.2	1.0	35.1	35.0	35.2	35.0
M04	Abandoned 2	1.2	1.2	1.5	1.4	35.2	35.2	35.5	35.4
M05	Berrilee	0.9	0.8	1.0	0.9	34.9	34.8	35.0	34.9
M06	Bon Accord	1.4	1.2	1.4	1.3	35.4	35.2	35.4	35.3
M07	Boxcowal	1.1	1.0	1.3	1.1	35.1	35.0	35.3	35.1
M08	Currajong Park 2	4.3	4.2	5.6	4.5	38.3	38.2	39.6	38.5
M09	Daisy Hill	1.4	1.2	1.7	1.4	35.4	35.2	35.7	35.4
M10	Glenburn	1.3	1.3	1.6	1.5	35.3	35.3	35.6	35.5
M12	Louisiana 1	0.9	0.8	1.0	0.9	34.9	34.8	35.0	34.9
M13	Louisiana 2	0.9	0.8	1.0	0.8	34.9	34.8	35.0	34.8
M14	Platina Farm	0.5	0.5	0.6	0.5	34.5	34.5	34.6	34.5
M16	Tarron Vale	1.2	1.0	1.2	1.0	35.2	35.0	35.2	35.0
M17	Jones 1	0.6	0.5	0.6	0.6	34.6	34.5	34.6	34.6
M18	Unnamed Dwelling 18	0.8	0.7	0.9	0.7	34.8	34.7	34.9	34.7
M19	Unnamed Dwelling 19	0.8	0.7	0.8	0.7	34.8	34.7	34.8	34.7
M20	Unnamed Dwelling 20	0.4	0.4	0.5	0.4	34.4	34.4	34.5	34.4
M21	Warra Wandi	1.2	1.1	1.5	1.2	35.2	35.1	35.5	35.2
M22	Brooklyn	3.2	3.0	4.6	3.5	37.2	37.0	38.6	37.5
M23	Currajong Park 1	4.2	4.1	5.5	4.4	38.2	38.1	39.5	38.4
M24	Flemington 1	1.9	1.6	2.0	1.8	35.9	35.6	36.0	35.8
M25	Flemington 2	1.8	1.6	1.9	1.7	35.8	35.6	35.9	35.7
M26	Kelvin Grove	1.8	1.8	2.4	2.0	35.8	35.8	36.4	36.0
M27	Milverton	1.9	1.8	2.5	2.0	35.9	35.8	36.5	36.0
M28	Rosehill	1.8	1.5	1.9	1.6	35.8	35.5	35.9	35.6
M29	Slapdown	2.8	2.1	2.8	2.3	36.8	36.1	36.8	36.3
M31	Wanda Bye	1.5	1.4	1.8	1.7	35.5	35.4	35.8	35.7
M32	Fifield Town Hall	0.9	0.8	1.0	0.8	34.9	34.8	35.0	34.8
M33	Fifield Fire Station	0.9	0.8	1.0	0.8	34.9	34.8	35.0	34.8
M34	Fifield Hotel	0.9	0.8	1.0	0.8	34.9	34.8	35.0	34.8
M35	St Dympna's Catholic Church	0.9	0.8	1.0	0.8	34.9	34.8	35.0	34.8
F01	Fifield Residences	1.1	0.9	1.1	0.9	35.1	34.9	35.1	34.9
F02		1.1	0.9	1.1	0.9	35.1	34.9	35.1	34.9
F03		0.9	0.8	1.0	0.8	34.9	34.8	35.0	34.8
F04		0.9	0.8	0.9	0.8	34.9	34.8	34.9	34.8
F05		1.0	0.8	1.0	0.9	35.0	34.8	35.0	34.9
F06		1.1	0.9	1.2	1.0	35.1	34.9	35.2	35.0
F07		0.9	0.8	1.0	0.9	34.9	34.8	35.0	34.9
F08		0.9	0.8	1.0	0.8	34.9	34.8	35.0	34.8
F09		0.9	0.8	1.0	0.8	34.9	34.8	35.0	34.8
F10		0.9	0.8	1.0	0.8	34.9	34.8	35.0	34.8
F11		0.9	0.8	1.0	0.8	34.9	34.8	35.0	34.8
F12		0.9	0.8	1.0	0.8	34.9	34.8	35.0	34.8
F13		0.9	0.7	0.9	0.8	34.9	34.7	34.9	34.8
F14		0.9	0.7	0.9	0.8	34.9	34.7	34.9	34.8

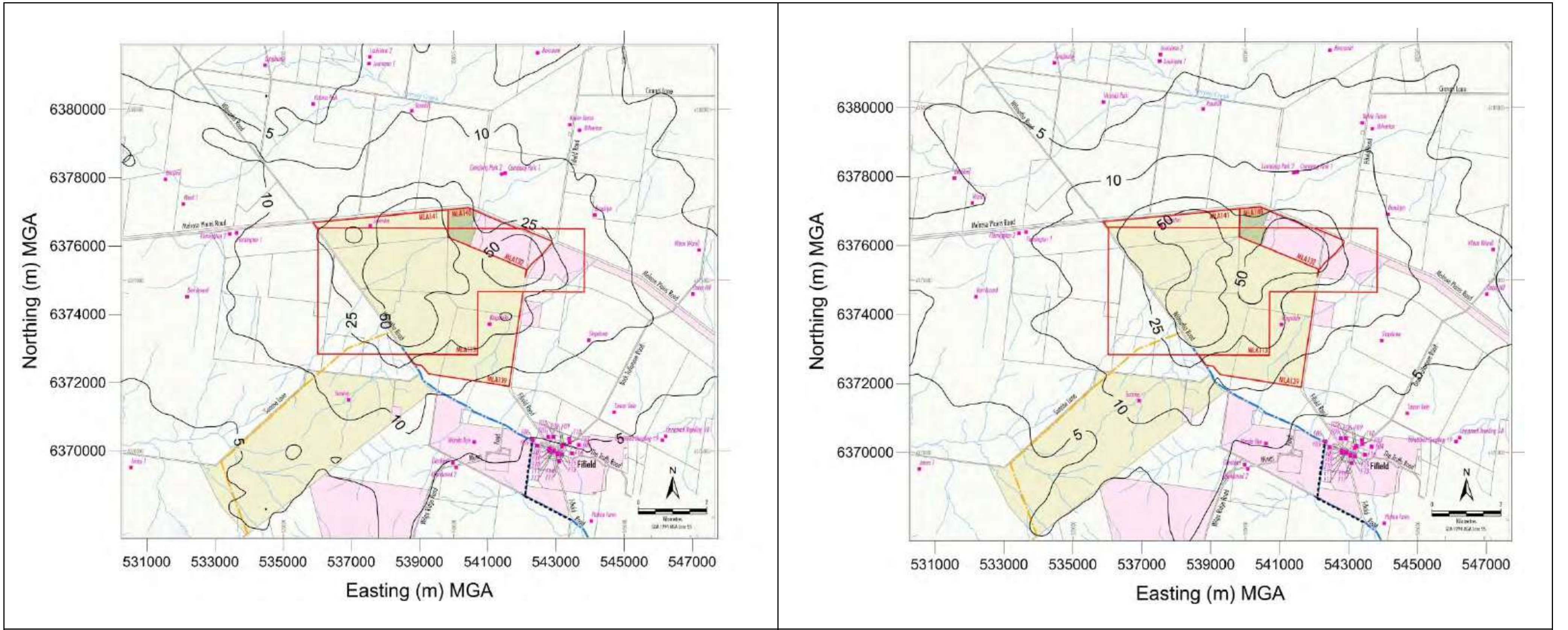
ID	Description	Project-only annual average TSP (µg/m³)				Cumulative annual average TSP (µg/m³)			
		Year 1	Year 6	Year 11	Year 21	Year 1	Year 6	Year 11	Year 21
F15	Fifield Residences	0.9	0.7	0.9	0.8	34.9	34.7	34.9	34.8
F16		0.8	0.7	0.9	0.8	34.8	34.7	34.9	34.8
F17		0.8	0.7	0.9	0.7	34.8	34.7	34.9	34.7
F18		1.0	0.8	1.0	0.9	35.0	34.8	35.0	34.9
F19		0.9	0.8	1.0	0.8	34.9	34.8	35.0	34.8
Mine-owned receptors									
M15	Sunrise	3.4	3.1	3.6	3.1	37.4	37.1	37.6	37.1

Table A6-6: Predicted Project-only and cumulative dust deposition ($g/m^2/month$)

ID	Description	Project-only annual average dust deposition ($g/m^2/month$)				Cumulative annual average dust deposition ($g/m^2/month$)			
		Year 1	Year 6	Year 11	Year 21	Year 1	Year 6	Year 11	Year 21
Private receptors									
M01	Longburra	0.0	0.0	0.0	0.0	2.7	2.7	2.7	2.7
M02	Victoria Park	0.0	0.0	0.0	0.0	2.7	2.7	2.7	2.7
M03	Ward 1	0.0	0.0	0.0	0.0	2.7	2.7	2.7	2.7
M04	Abandoned 2	0.2	0.1	0.1	0.1	2.9	2.8	2.8	2.8
M05	Berrilee	0.0	0.0	0.0	0.0	2.7	2.7	2.7	2.7
M06	Bon Accord	0.0	0.0	0.0	0.0	2.7	2.7	2.7	2.7
M07	Boxcowal	0.0	0.0	0.0	0.0	2.7	2.7	2.7	2.7
M08	Currajong Park 2	0.2	0.2	0.2	0.2	2.9	2.9	2.9	2.9
M09	Daisy Hill	0.1	0.0	0.1	0.0	2.8	2.7	2.8	2.7
M10	Glenburn	0.2	0.1	0.1	0.1	2.9	2.8	2.8	2.8
M12	Louisiana 1	0.0	0.0	0.0	0.0	2.7	2.7	2.7	2.7
M13	Louisiana 2	0.0	0.0	0.0	0.0	2.7	2.7	2.7	2.7
M14	Platina Farm	0.0	0.0	0.0	0.0	2.7	2.7	2.7	2.7
M16	Tarron Vale	0.1	0.0	0.0	0.0	2.8	2.7	2.7	2.7
M17	Jones 1	0.0	0.0	0.0	0.0	2.7	2.7	2.7	2.7
M18	Unnamed Dwelling 18	0.0	0.0	0.0	0.0	2.7	2.7	2.7	2.7
M19	Unnamed Dwelling 19	0.0	0.0	0.0	0.0	2.7	2.7	2.7	2.7
M20	Unnamed Dwelling 20	0.0	0.0	0.0	0.0	2.7	2.7	2.7	2.7
M21	Warra Wandi	0.1	0.0	0.1	0.0	2.8	2.7	2.8	2.7
M22	Brooklyn	0.2	0.1	0.2	0.2	2.9	2.8	2.9	2.9
M23	Currajong Park 1	0.2	0.2	0.2	0.2	2.9	2.9	2.9	2.9
M24	Flemington 1	0.1	0.0	0.0	0.0	2.8	2.7	2.7	2.7
M25	Flemington 2	0.0	0.0	0.0	0.0	2.7	2.7	2.7	2.7
M26	Kelvin Grove	0.1	0.1	0.1	0.1	2.8	2.8	2.8	2.8
M27	Milverton	0.1	0.1	0.1	0.1	2.8	2.8	2.8	2.8
M28	Rosehill	0.0	0.0	0.0	0.0	2.7	2.7	2.7	2.7
M29	Slapdown	0.1	0.1	0.1	0.1	2.8	2.8	2.8	2.8
M31	Wanda Bye	0.2	0.1	0.1	0.1	2.9	2.8	2.8	2.8
M32	Fifield Town Hall	0.0	0.0	0.0	0.0	2.7	2.7	2.7	2.7
M33	Fifield Fire Station	0.0	0.0	0.0	0.0	2.7	2.7	2.7	2.7
M34	Fifield Hotel	0.0	0.0	0.0	0.0	2.7	2.7	2.7	2.7
M35	St Dympna's Catholic Church	0.0	0.0	0.0	0.0	2.7	2.7	2.7	2.7
F01	Fifield Residences	0.0	0.0	0.0	0.0	2.7	2.7	2.7	2.7
F02		0.0	0.0	0.0	0.0	2.7	2.7	2.7	2.7

ID	Description	Project-only annual average dust deposition ($g/m^2/month$)				Cumulative annual average dust deposition ($g/m^2/month$)			
		Year 1	Year 6	Year 11	Year 21	Year 1	Year 6	Year 11	Year 21
F03	Fifield Residences	0.0	0.0	0.0	0.0	2.7	2.7	2.7	2.7
F04		0.0	0.0	0.0	0.0	2.7	2.7	2.7	2.7
F05		0.0	0.0	0.0	0.0	2.7	2.7	2.7	2.7
F06		0.1	0.0	0.0	0.0	2.8	2.7	2.7	2.7
F07		0.0	0.0	0.0	0.0	2.7	2.7	2.7	2.7
F08		0.0	0.0	0.0	0.0	2.7	2.7	2.7	2.7
F09		0.0	0.0	0.0	0.0	2.7	2.7	2.7	2.7
F10		0.0	0.0	0.0	0.0	2.7	2.7	2.7	2.7
F11		0.0	0.0	0.0	0.0	2.7	2.7	2.7	2.7
F12		0.0	0.0	0.0	0.0	2.7	2.7	2.7	2.7
F13		0.0	0.0	0.0	0.0	2.7	2.7	2.7	2.7
F14		0.0	0.0	0.0	0.0	2.7	2.7	2.7	2.7
F15		0.0	0.0	0.0	0.0	2.7	2.7	2.7	2.7
F16		0.0	0.0	0.0	0.0	2.7	2.7	2.7	2.7
F17		0.0	0.0	0.0	0.0	2.7	2.7	2.7	2.7
F18		0.0	0.0	0.0	0.0	2.7	2.7	2.7	2.7
F19		0.0	0.0	0.0	0.0	2.7	2.7	2.7	2.7
Mine-owned receptors									
M15	Sunrise	0.2	0.1	0.2	0.1	2.9	2.8	2.9	2.8

APPENDIX 7
CONTOUR PLOTS



Year 1	Year 6

Figure A7-1: Predicted Project-only 24-hour average PM_{10} - Year 1 and Year 6

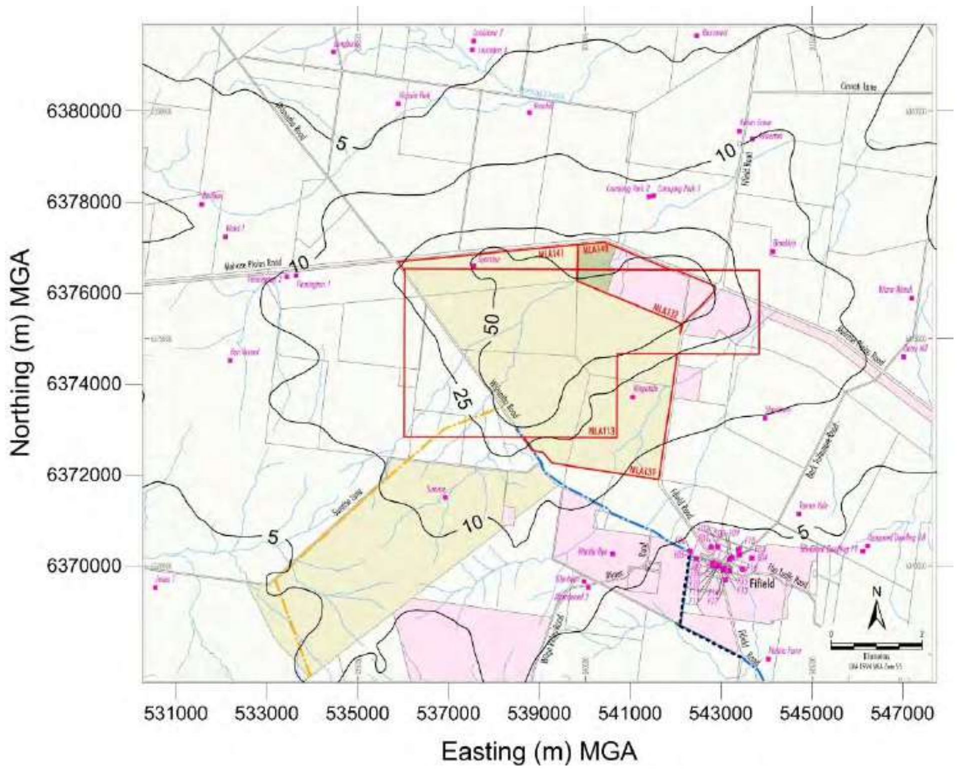
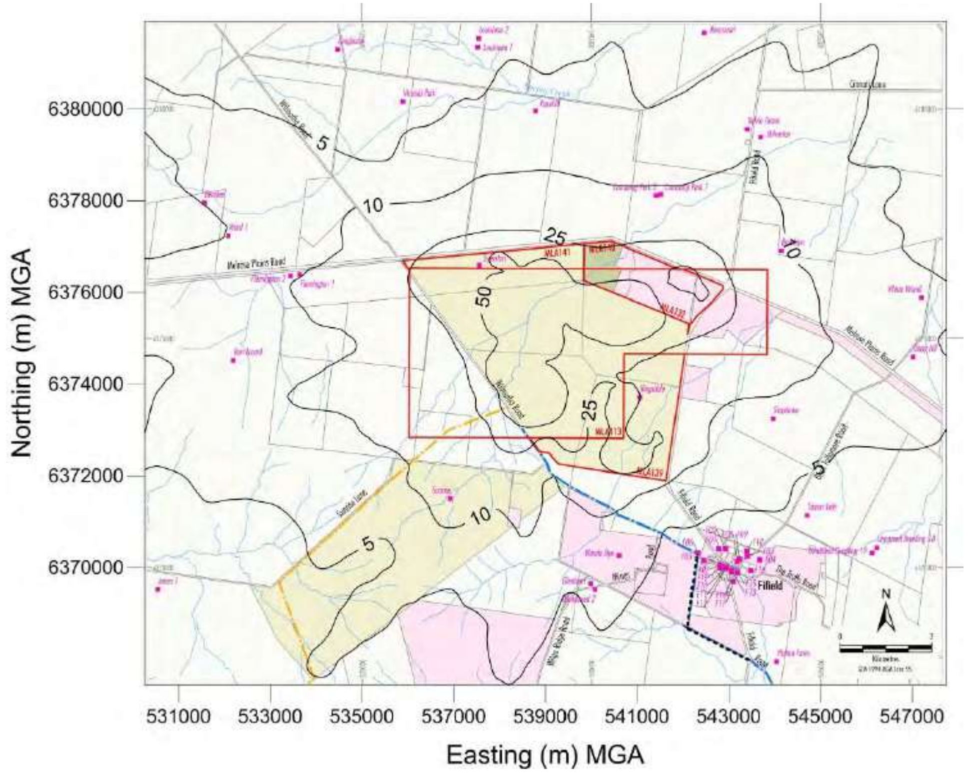
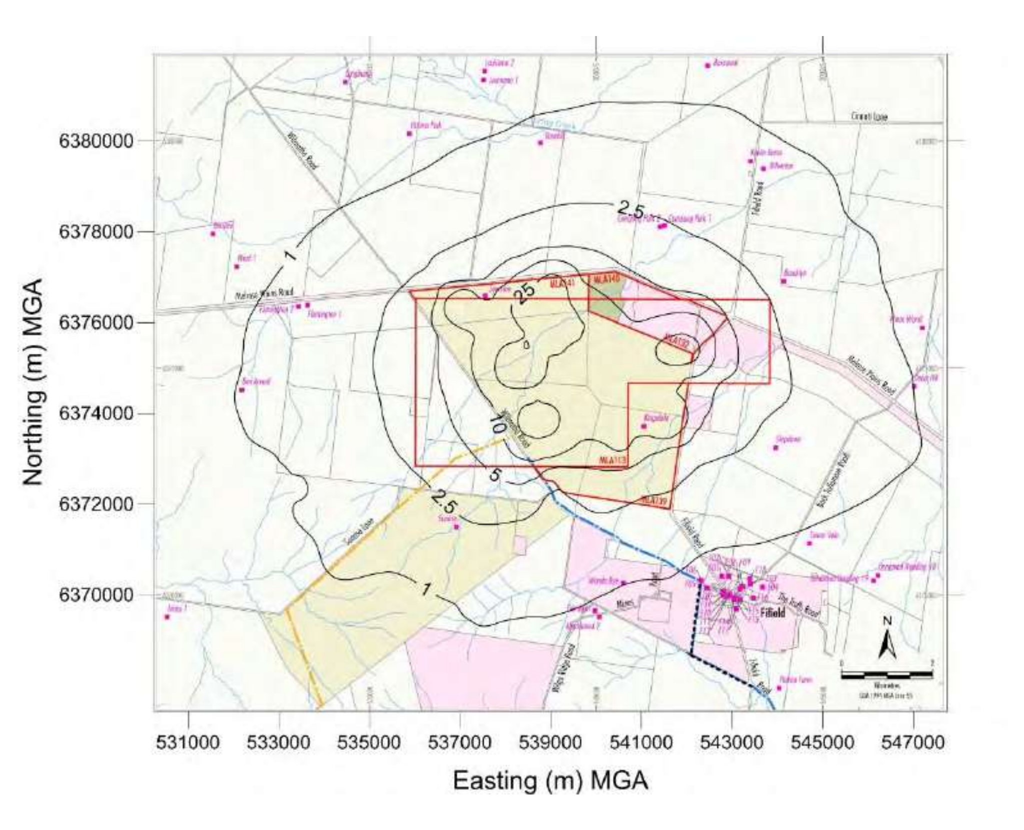
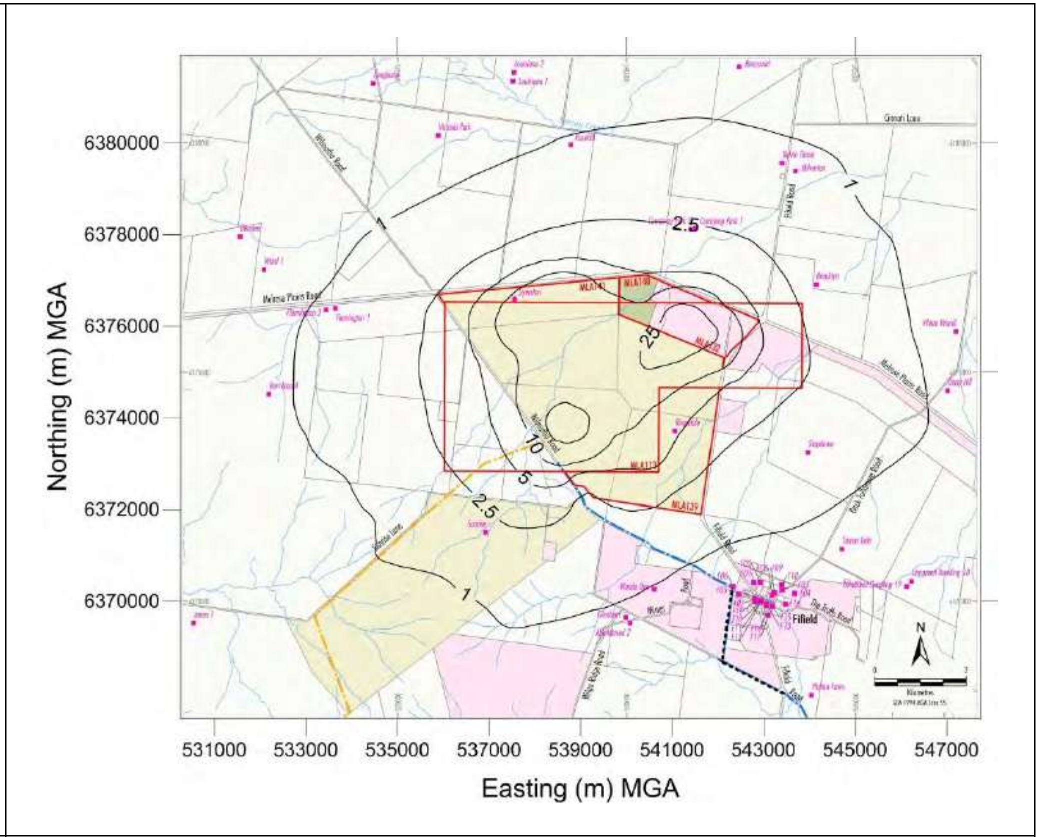
	
Year 11	Year 21

Figure A7-2: Predicted Project-only 24-hour average PM_{10} - Year 11 and Year 21



Year 1



Year 6

Figure A7-3: Predicted Project-only annual average PM_{10} - Year 1 and Year 6

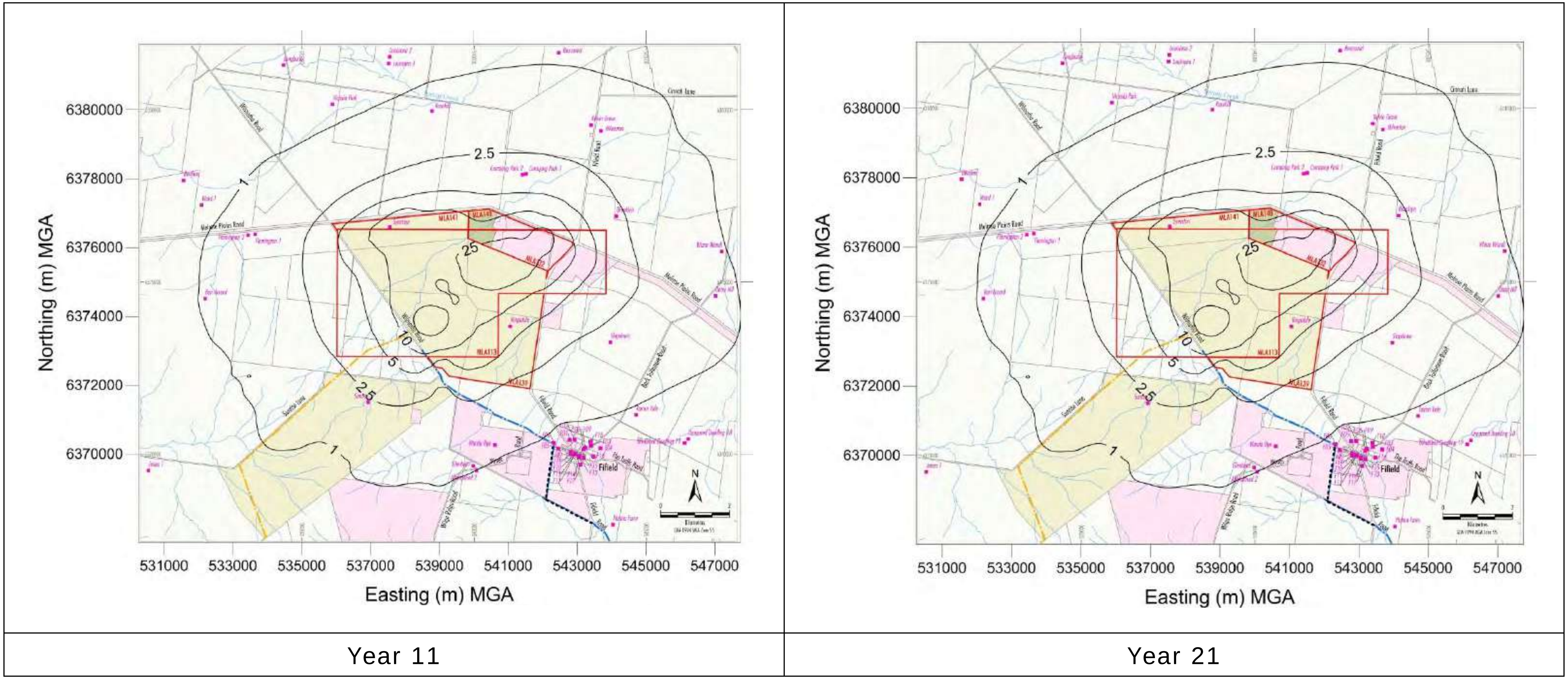


Figure A7-4: Predicted Project-only annual average PM_{10} - Year 11 and Year 21

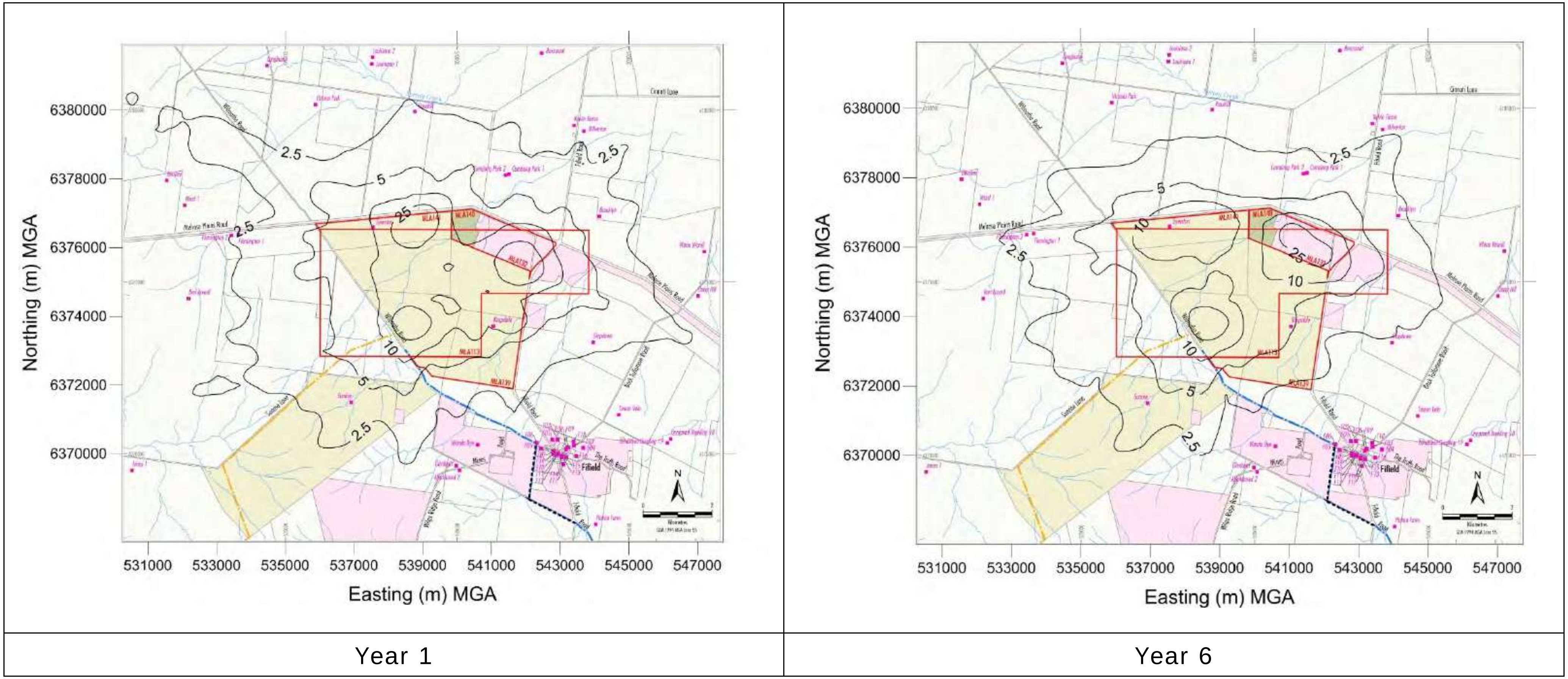


Figure A7-5: Predicted Project-only 24-hour average $PM_{2.5}$ - Year 1 and Year 6

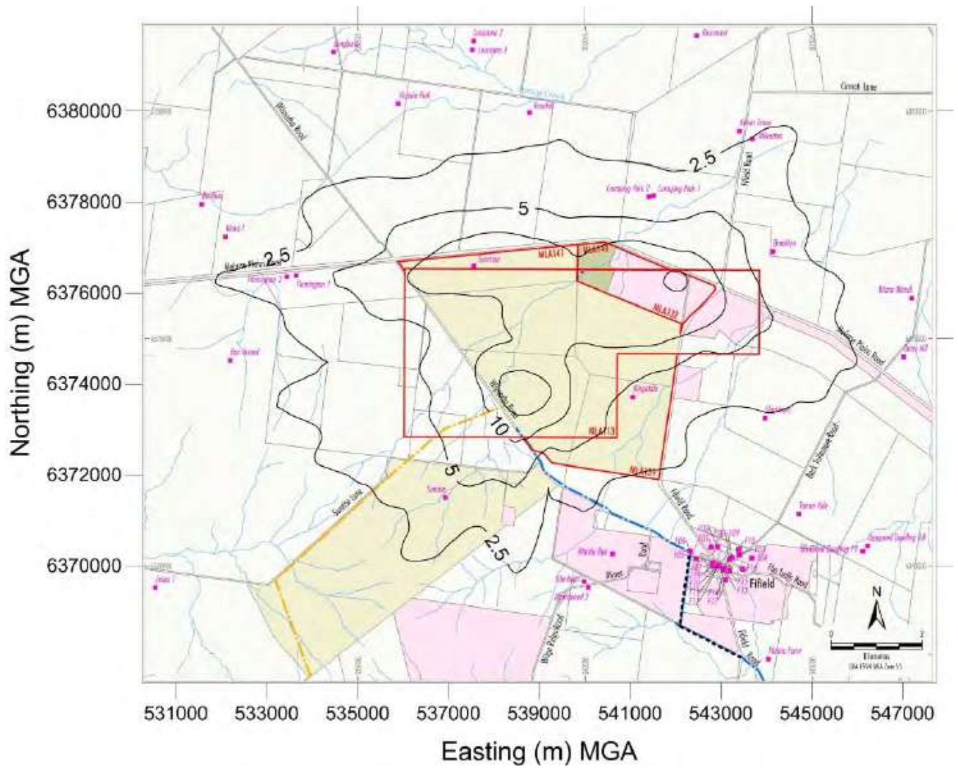
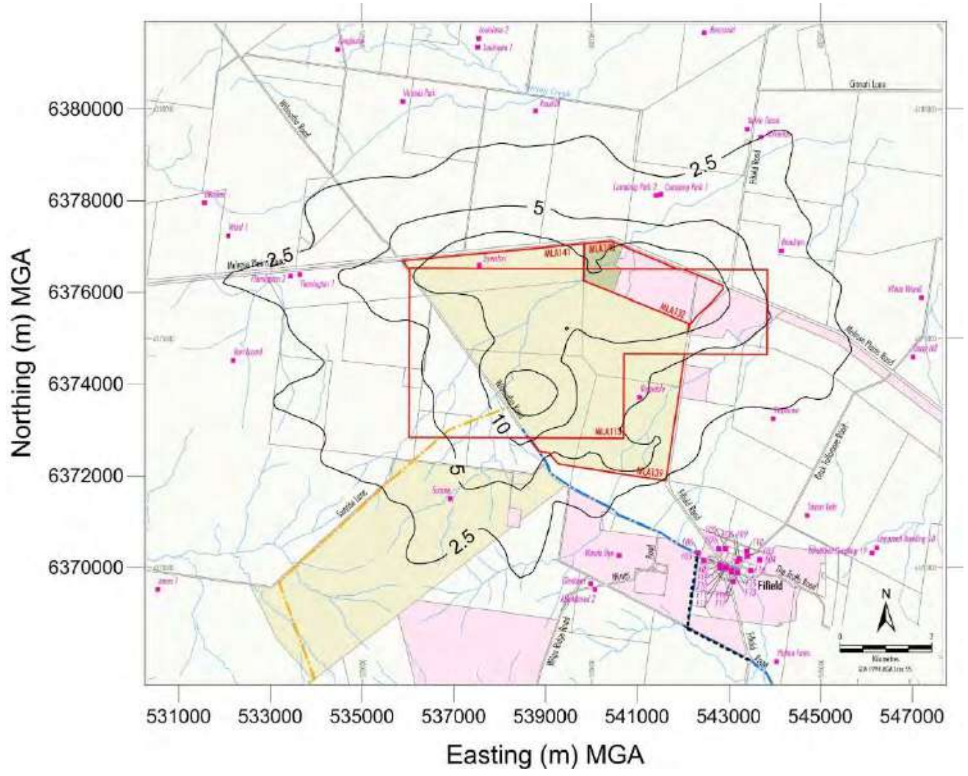
	
Year 11	Year 21

Figure A7-6: Predicted Project-only 24-hour average $PM_{2.5}$ - Year 11 and Year 21

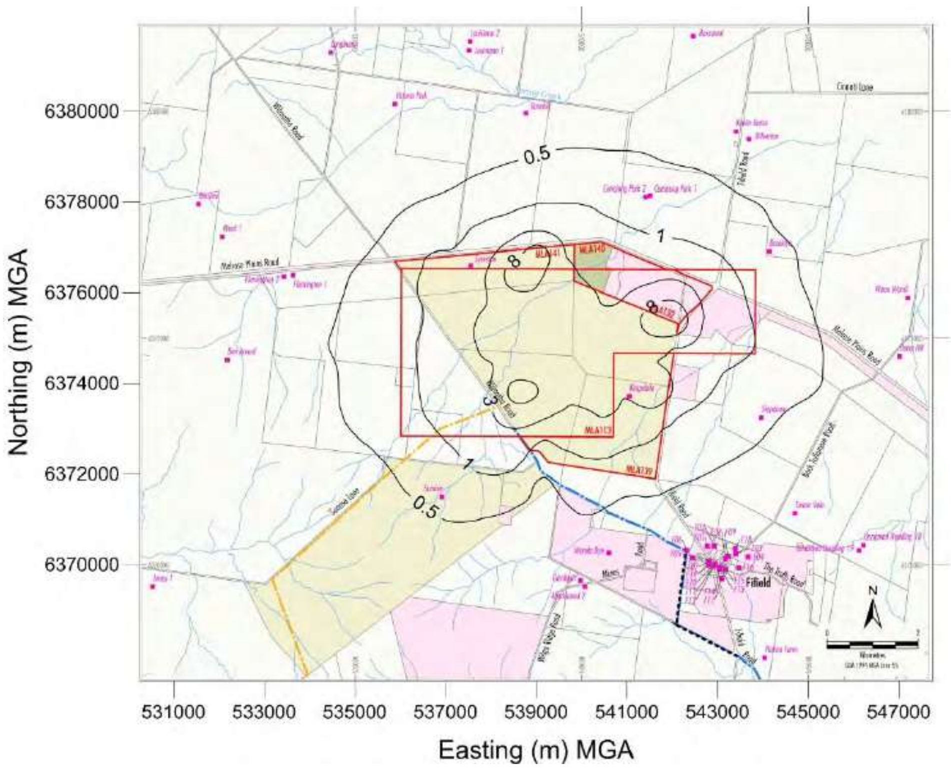
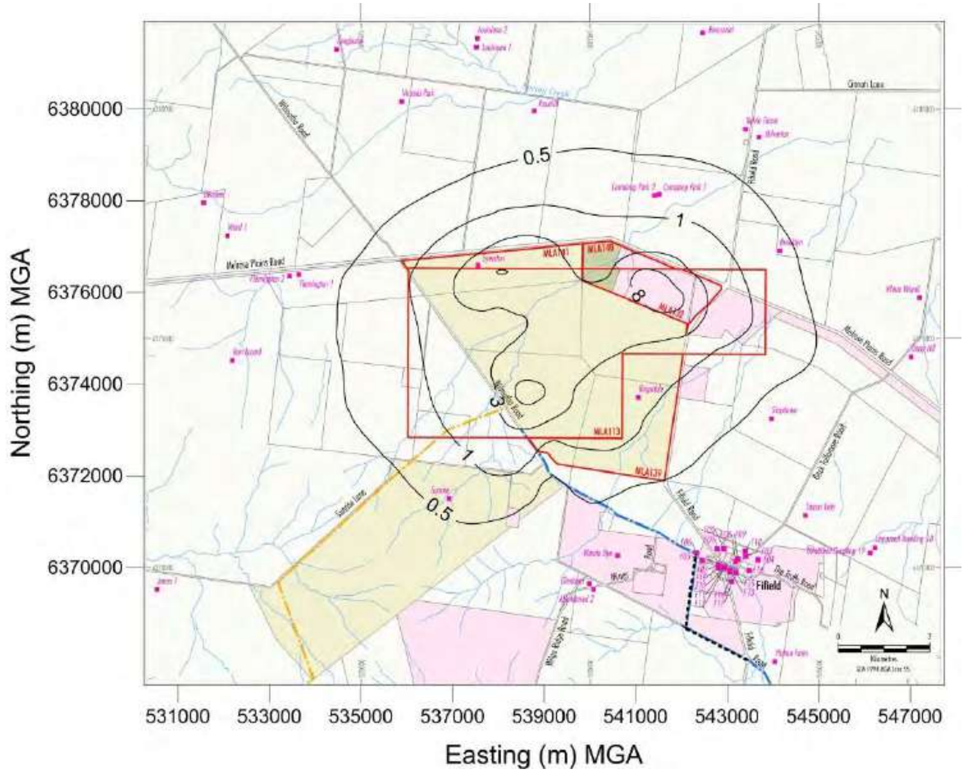
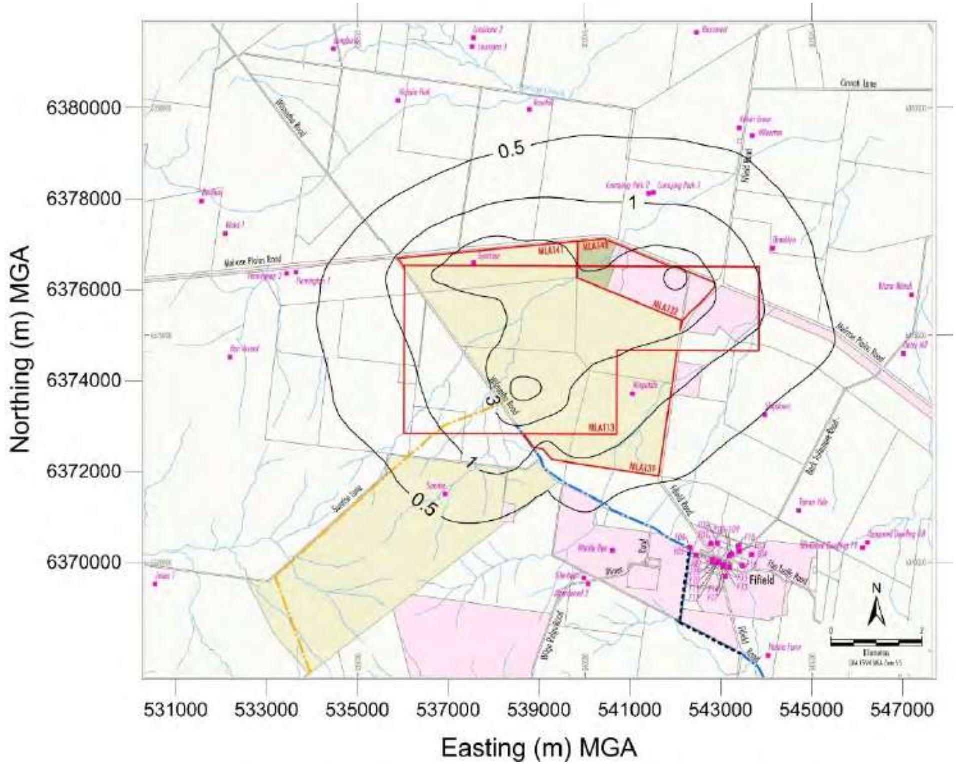
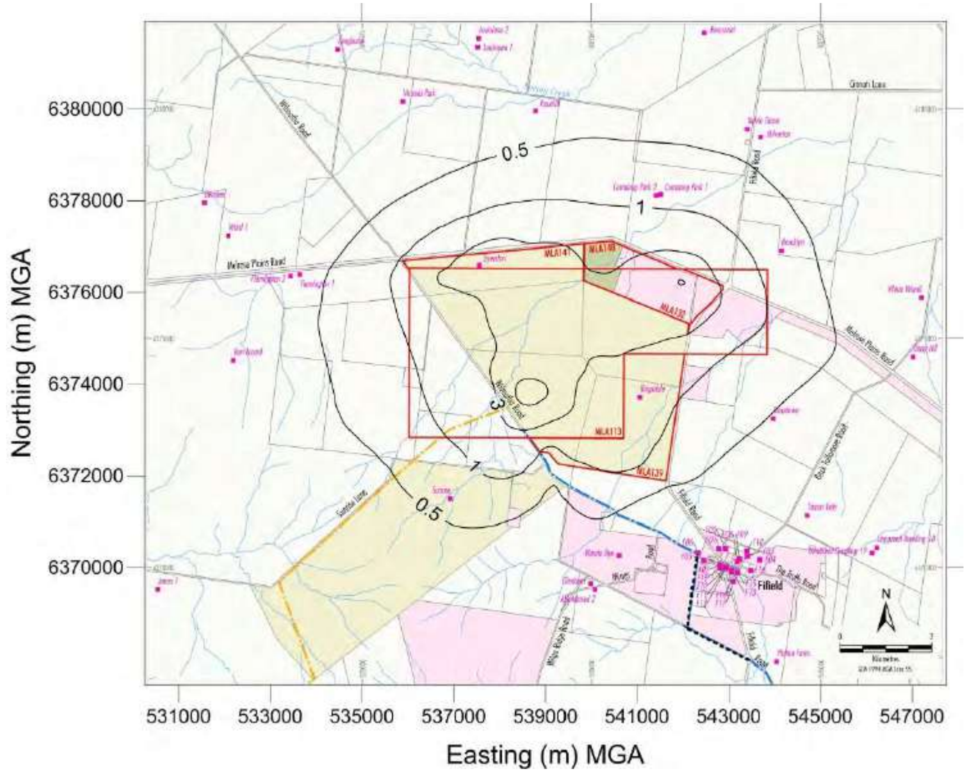
	
Year 1	Year 6

Figure A7-7: Predicted Project-only annual average $PM_{2.5}$ - Year 1 and Year 6



Year 11



Year 21

Figure A7-8: Predicted Project-only annual average $PM_{2.5}$ - Year 11 and Year 21

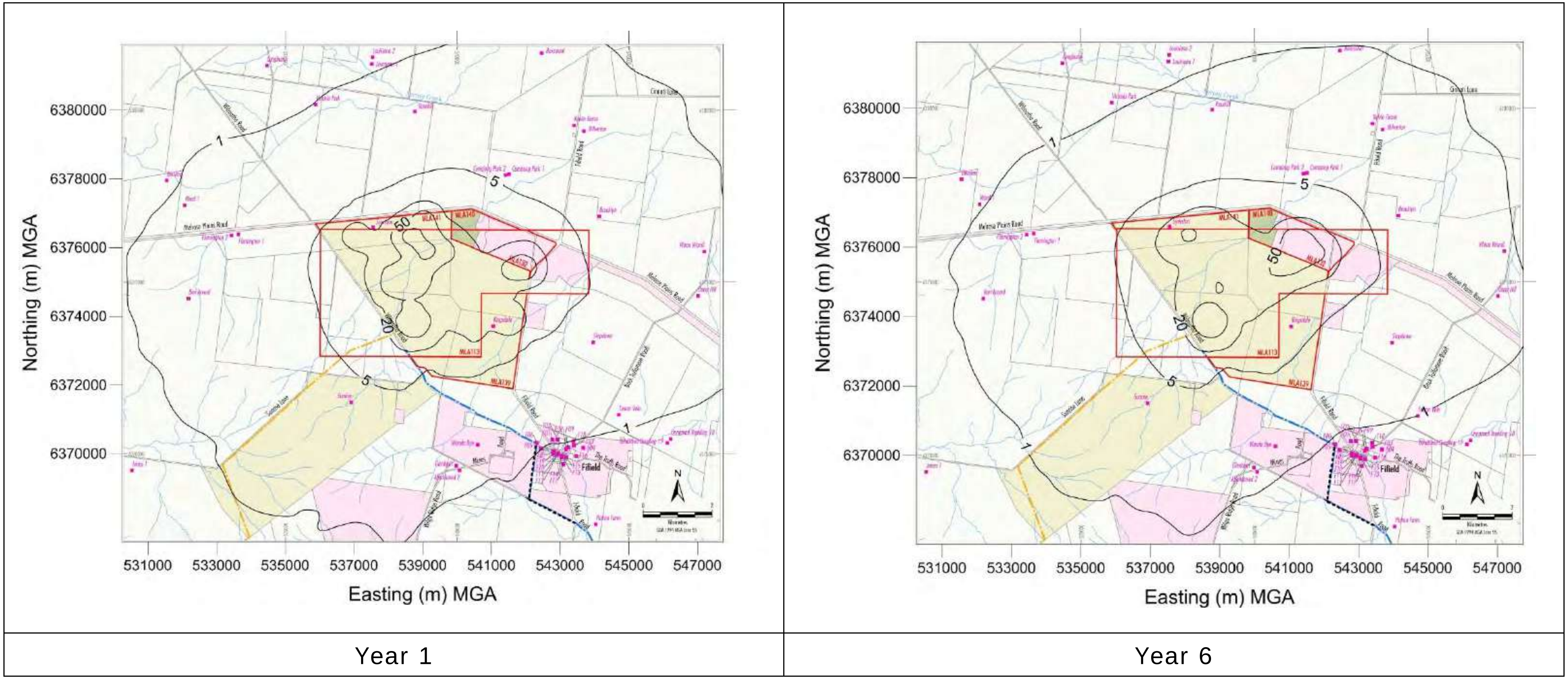
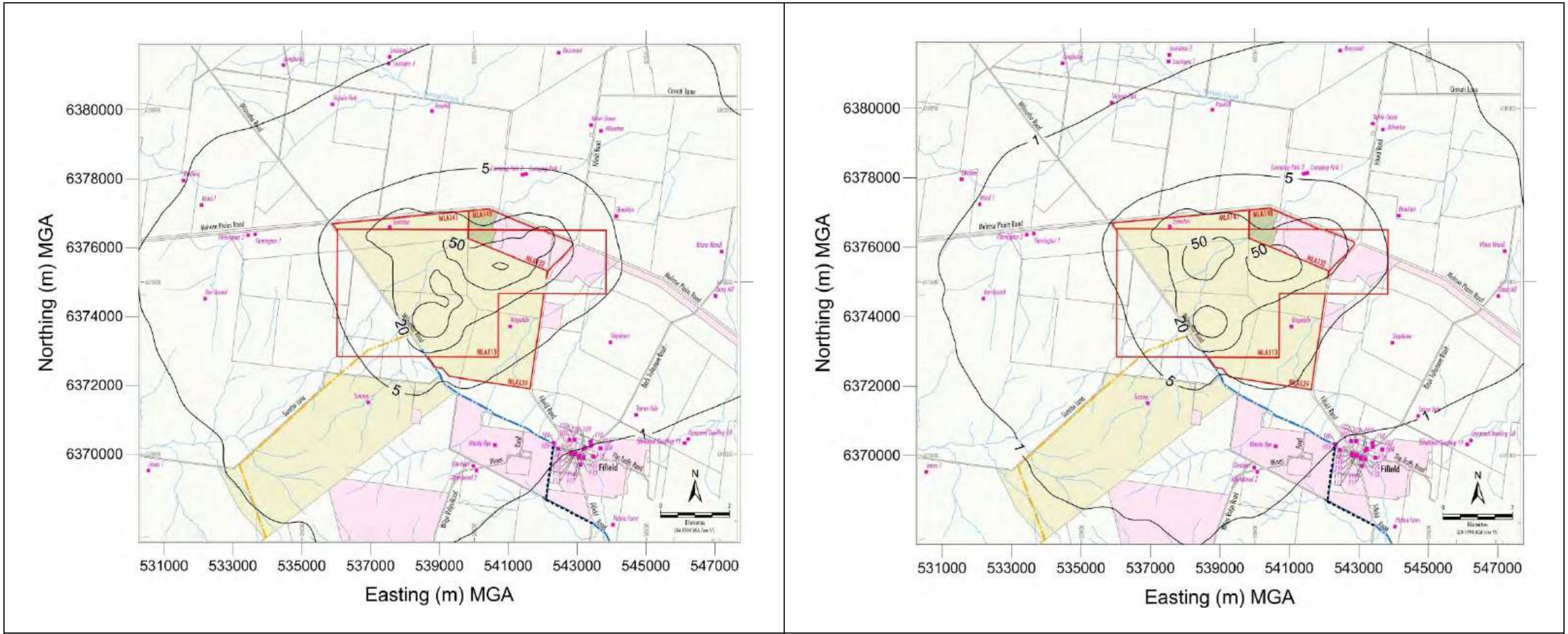
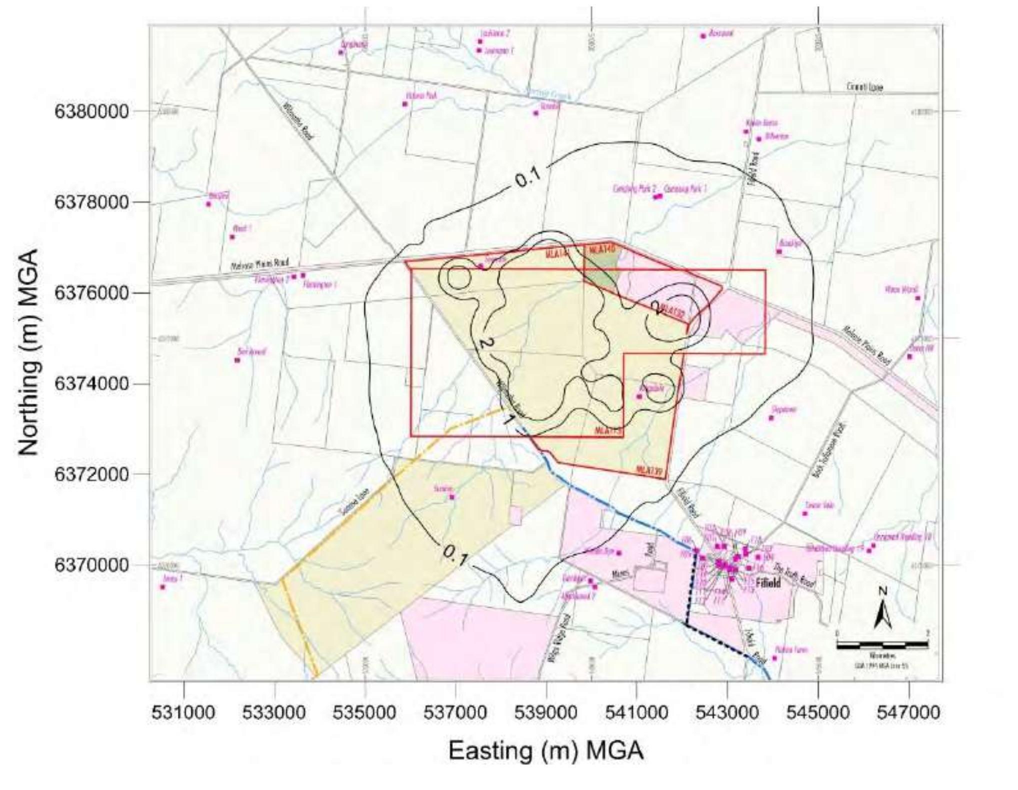


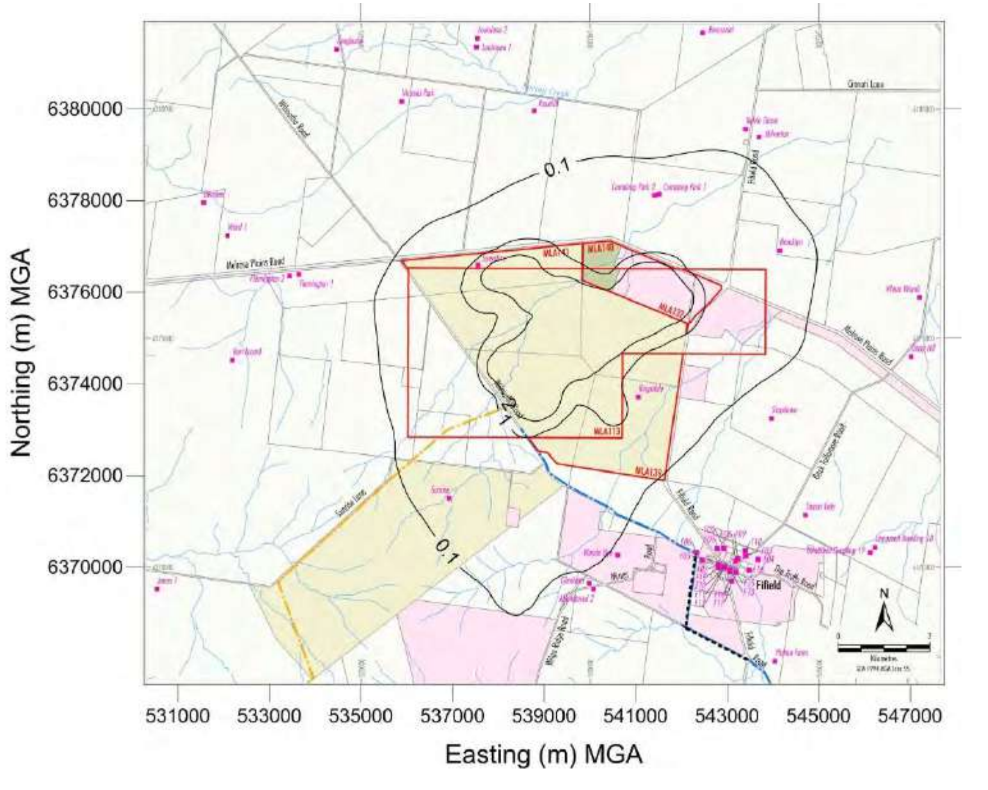
Figure A7-9: Predicted Project-only annual average TSP - Year 1 and Year 6



Year 11	Year 21

Figure A7-10: Predicted Project-only annual average TSP - Year 11 and Year 21





Year 1	Year 6

Figure A7-11: Predicted Project-only annual average dust deposition - Year 1 and Year 6

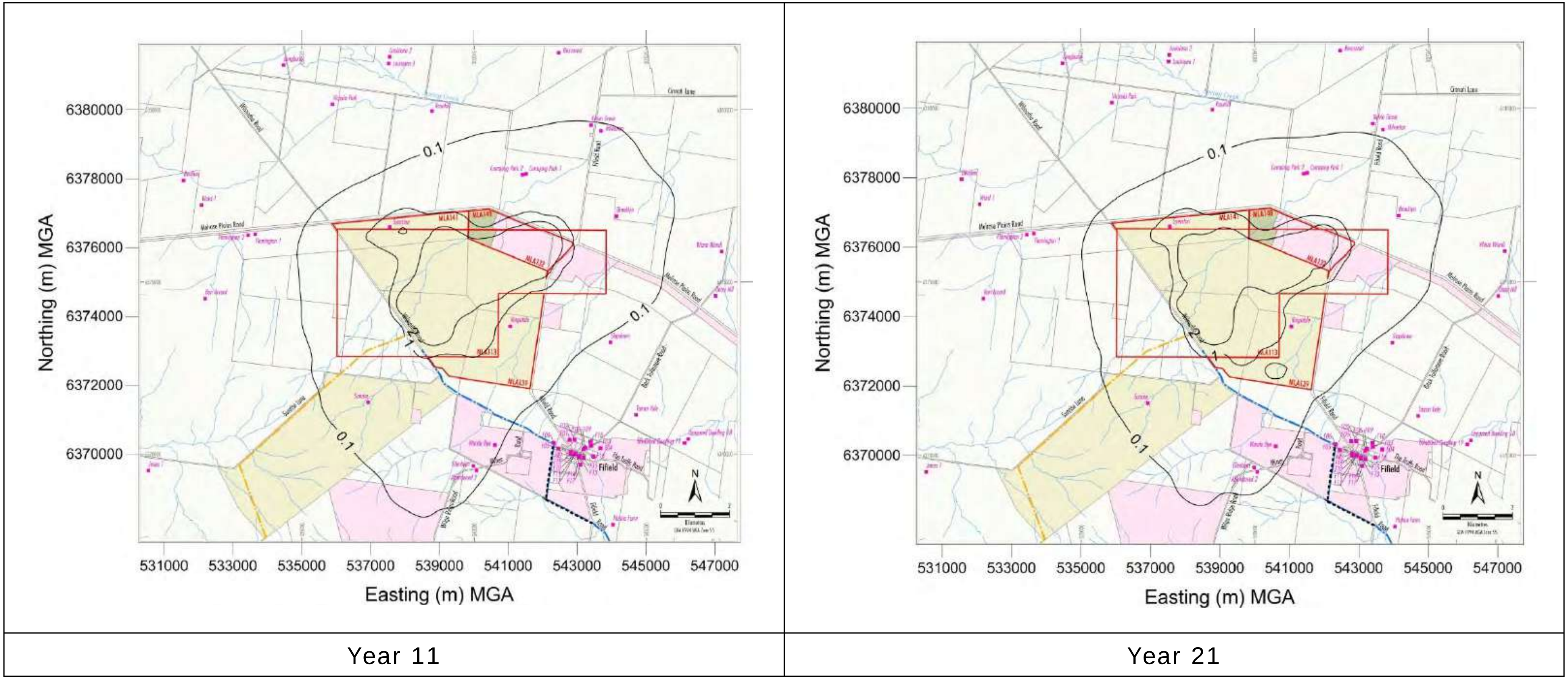


Figure A7-12: Predicted Project-only annual average dust deposition - Year 11 and Year 21

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Syerston Project

MODIFICATION 4 ENVIRONMENTAL ASSESSMENT

Appendix B

Noise and Blasting Assessment

RENZO TONIN & ASSOCIATES
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Acoustics
Vibration
Structural Dynamics

SYERSTON PROJECT - MODIFICATION 4

Noise and Blasting Assessment

8 November 2017

Clean TEQ

TJ345-01F02 Report (r7).docx

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16.10.2017	Second Draft	3-4	5-6	WC		MCH
27.10.2017	Final		7	WC		MCH

Contents

List of Tables

List of Figures

1 Introduction

Scandium21 Pty Ltd owns the rights to develop the approved Syerston Project (the Project), located approximately 350 kilometres (km) west-northwest of Sydney, near the village of Fifield, New South Wales (NSW). Scandium21 Pty Ltd is a wholly owned subsidiary of Clean TeQ Holdings Limited (Clean TeQ). Renzo Tonin & Associates was engaged by Clean TeQ to conduct an assessment examining the potential noise and blasting impacts of a proposed modification to the Project.

The issues addressed in this study include noise emissions from:

- construction activities;
- operational activities;
- blasting activities; and
- road traffic associated with the Project.

Noise impacts are assessed in accordance with a number of policies, guidelines and standards, including:

- NSW *Interim Construction Noise Guideline* (ICNG) (Department of the Environment and Climate Change, 2009);
- NSW *Industrial Noise Policy* (INP) (Environmental Protection Authority [EPA], 2000);
- *Voluntary Land Acquisition and Mitigation Policy – SSD Mining* (NSW Government, 2014);
- *Technical Basis for Guidelines to Minimise Annoyance Due to Blasting Overpressure and Ground Vibration* (Australian and New Zealand Environment Conservation Council [ANZECC], 1990); and
- NSW *Road Noise Policy* (RNP) (Department of Environment, Climate Change and Water, 2011)[1].

The work documented in this report was carried out in accordance with the Renzo Tonin & Associates Quality Assurance System, which is based on Australian Standard/New Zealand Standard ISO 9001. Appendix A contains a glossary of acoustic terms used in this report.

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1 This Policy has replaced the NSW *Environmental Criteria for Road Traffic Noise* (EPA, 1999).

2 Project Overview

2.1 Approved Project Overview

The Project is situated approximately 350 km west-northwest of Sydney, near the village of Fifield, NSW (Figure 1).

Development Consent DA 374-11-00 for the Project was issued under Part 4 of the NSW *Environmental Planning and Assessment Act, 1979* in 2001.

The approved Project includes the establishment and operation of the following (Figure 1):

- mine (including the processing facility);
- limestone quarry;
- rail siding;
- gas pipeline;
- borefields and water pipeline; and
- associated transport activities and transport infrastructure (e.g. the Fifield Bypass and road and intersection upgrades).

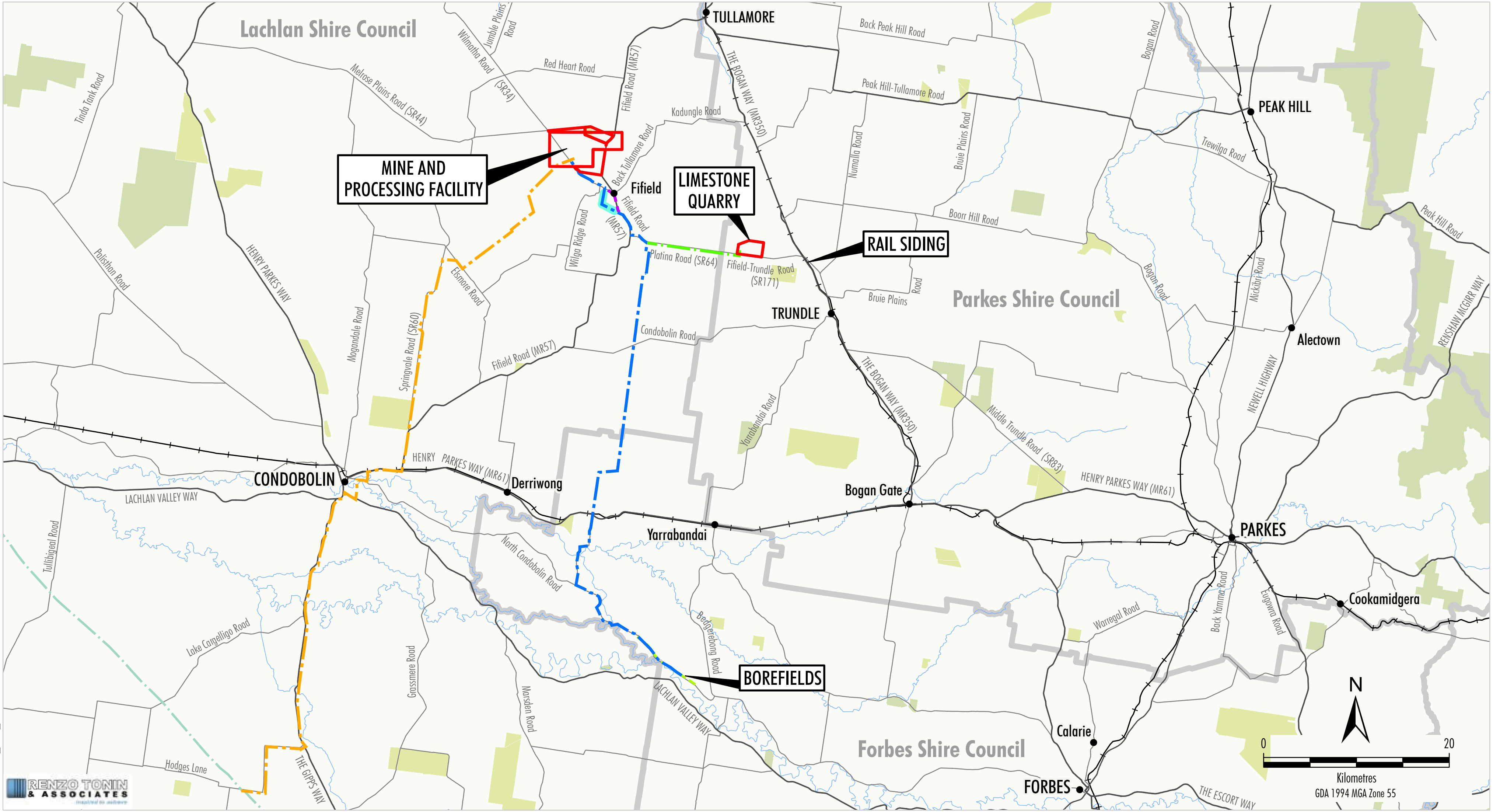
The Project includes an initial scandium oxide focussed production phase (the Initial Production Phase) prior to shifting to scandium oxide and nickel and cobalt precipitate production by developing the full Project (the Full Production Phase).

The Initial Production Phase is a smaller-scale operation compared to the Full Project Phase and would include preferentially mining scandium-rich areas of the Syerston deposit at a run-of-mine ore production rate of 100,000 tonnes per annum (tpa) to produce up to 1,000 tpa of nickel and cobalt metal equivalents, as either sulphide or sulphate precipitate products, and up to approximately 80 tpa of scandium oxide.

The Project would transition to the Full Production Phase once scandium-rich areas of the Syerston deposit are depleted or favourable market conditions prevail for larger scale nickel cobalt scandium production.

The mining and processing will then increase to allow for an autoclave feed rate of 2.5 million tonnes per annum (Mtpa) to produce up to 40,000 tpa of nickel and cobalt metal equivalents and up to approximately 180 tpa of scandium oxide.

Construction and operation of the mine and processing facility is approved 24 hours per day, seven days per week. Construction of the Project commenced in 2006 with the construction of some components of the borefields, however Project operations are yet to commence.



LEGEND

- National Park/Conservation Area
- State Forest
- Local Government Boundary
- Existing Gas Pipeline
- Mining Lease Application Boundary
- Approved Water Pipeline
- Approved Limestone Quarry Water Pipeline
- Approved Gas Pipeline
- Approved Borefield Infrastructure Corridor
- Modified Water Pipeline Alignment Option
- Approved Fifield Bypass

Source: Black Range Minerals (2000); NSW Department of Industry (2017); NSW Land & Property Information (2017); Office of Environment and Heritage NSW (2017)

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SYERSTON PROJECT MODIFICATION 4

Regional Location

Figure 1

2.2 Modification Overview

Clean TeQ has undertaken a Project Optimisation Study to identify opportunities to improve the overall efficiency of the Full Production Phase of the Project. The Modification involves the implementation of these opportunities and would include:

- mining in a more selective manner to initially increase the processing facility ore feed grade;
- addition of drilling and blasting at the mine site;
- adoption of the resin-in-pulp (RIP) processing method option (i.e. the counter current decantation processing method option is no longer proposed)[2];
- increased sulphur demand and sulphuric acid production to leach additional nickel, cobalt and scandium from the higher grade ore;
- increased limestone demand to neutralise the additional acid required in the acid leach circuit;
- addition of a crystalliser to the processing facility to extract ammonium sulphate from an existing waste stream for use as a fertiliser product;
- changes to process input and product road transport requirements;
- addition of a water treatment plant to the processing facility to recycle process water and minimise make-up water demand;
- increased tailings storage facility capacity to hold increased tailings volume due to the additional limestone required for acid neutralisation;
- reduced evaporation pond capacity due to the recycling of process water;
- relocation of mine infrastructure to avoid resource sterilisation and improve operational efficiency;
- addition of surface water extraction from the Lachlan River to improve water supply security;
- minor changes to borefield transfer station layout and water pipeline alignment;
- short-term road transport of water from the borefield to the mine site during the initial construction phase; and
- reduced gas demand as the increased sulphuric acid production would generate additional steam for power generation.

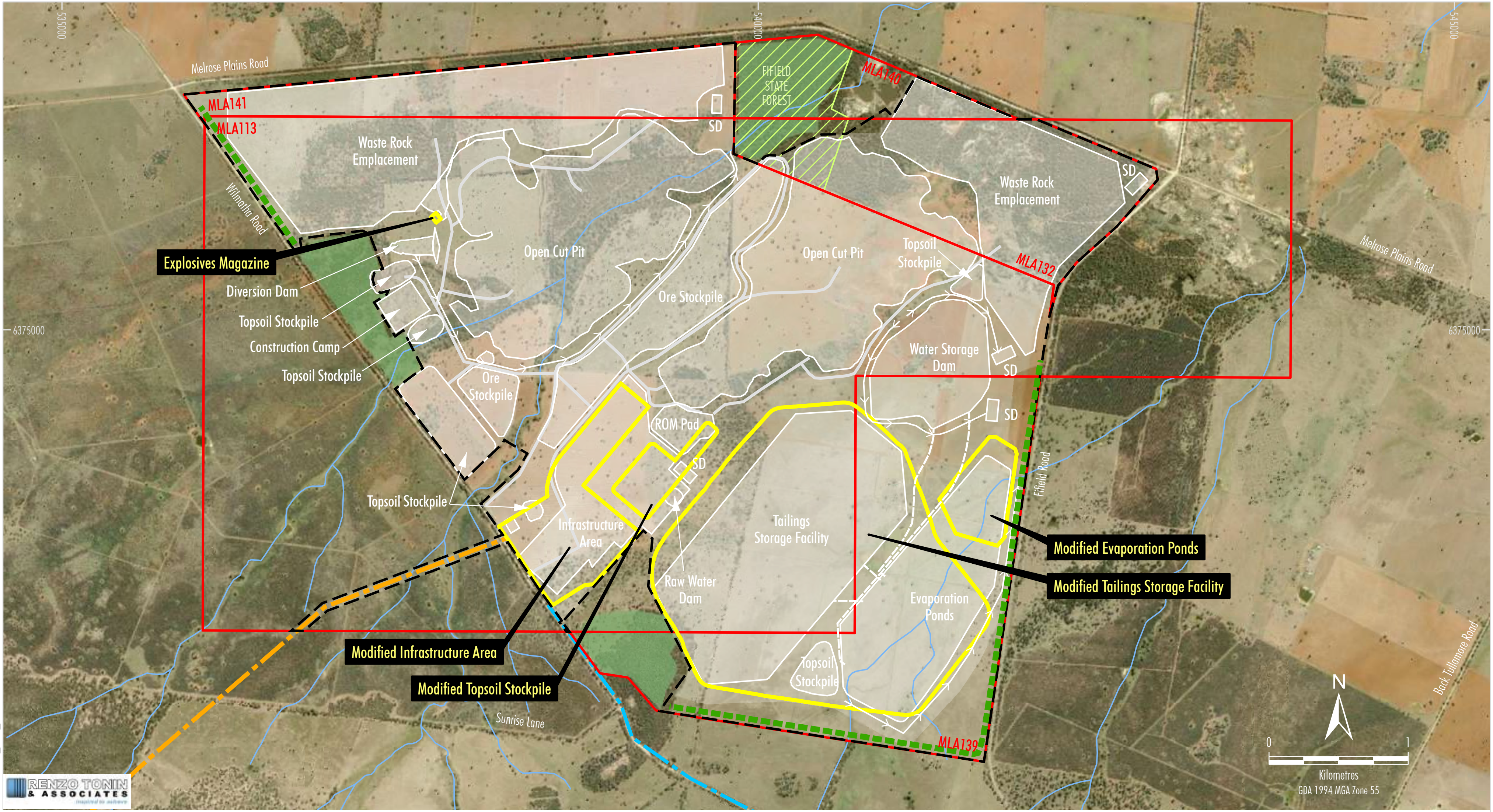
---

2 The approved Project includes the option to use either the RIP or counter current decantation processing method.

The Modification would not involve changes to any aspects of the approved limestone quarry, rail siding or gas pipeline. The construction and operating hours (i.e. 24 hours per day, 7 days per week) would also be unchanged.

The general arrangement of the modified mine and processing facility is provided on Figure 2. Progressive general arrangements of the modified mine and processing facility are provided on Figures 3 to 6.

A detailed description of the Modification is provided in the main text of the Environmental Assessment.



CTL-16-02 Mod4_Noise_202B

LEGEND

- State Forest
- Mining Lease Application Boundary
- Approved Surface Development Area
- Approved Mine Footprint
- Diversion Structure
- Key Site Water Pipeline
- Approved Gas Pipeline
- Approved Water Pipeline
- Vegetation Screening
- Existing Open Woodland
- Modified Layout

Source: Black Range Minerals (2005); NSW Department of Industry (2017); NSW Land and Property Information (2017)
NSW Imagery: © Department of Finance, Services & Innovation (2017)

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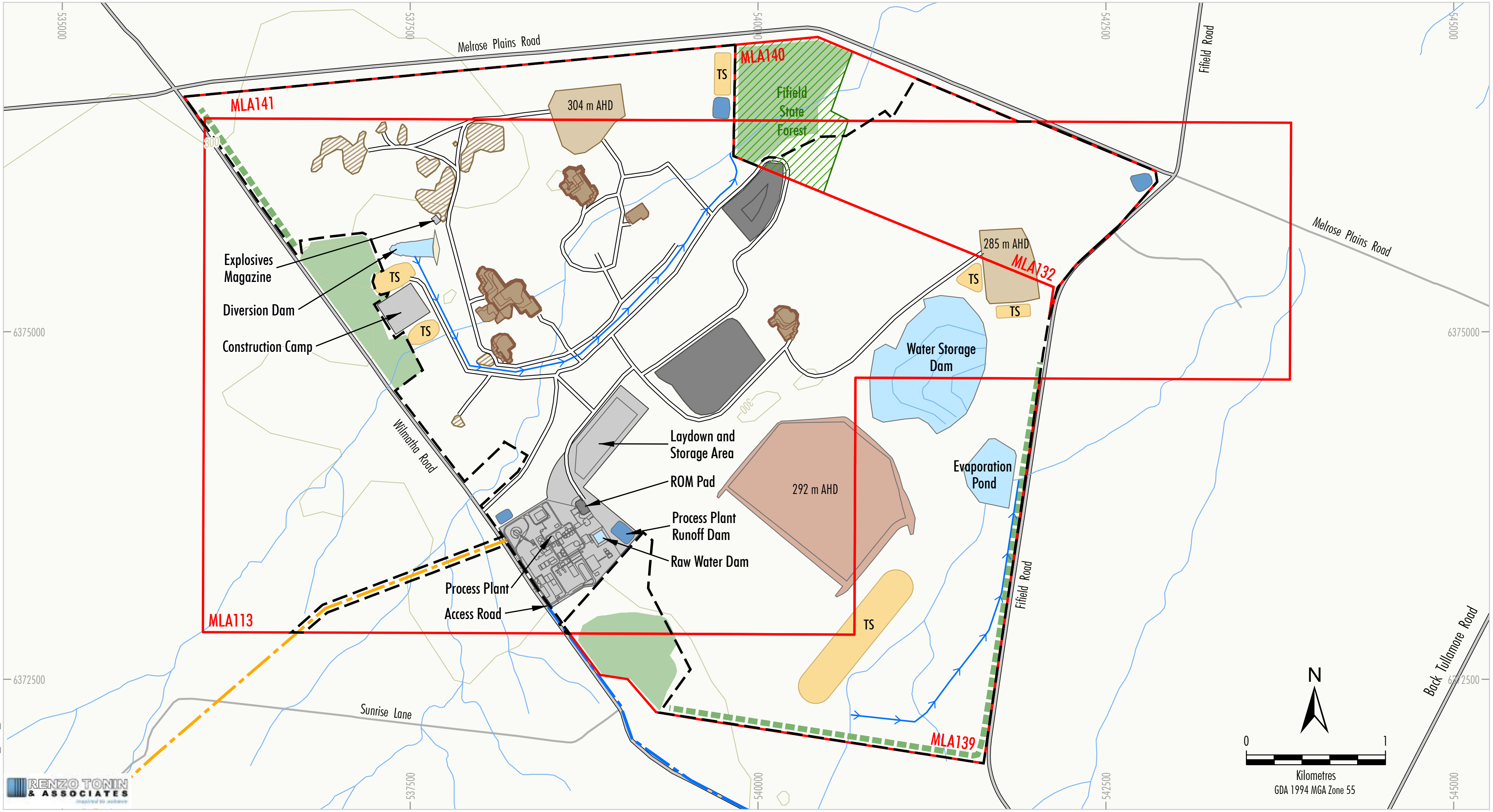
SYERSTON PROJECT MODIFICATION 4

Indicative Modified Mine and Processing Facility General Arrangement

Figure 2



LEGEND

- Mining Lease Application Boundary
- Approved Surface Development Area
- Open Cut Pit (Scandium Oxide)
- Open Cut Pit
- Waste Rock Emplacement
- Tailings Storage Facility
- TS Topsoil Stockpile
- Ore Stockpile
- Mine Infrastructure Area
- Sediment Dam
- Diversion Structure
- Gas Pipeline
- Water Pipeline
- Vegetation Screening
- Existing Open Woodland to be Maintained
- State Forest

Source: Black Range Minerals (2000); NSW Department of Industry (2017); NSW Land & Property Information (2017)

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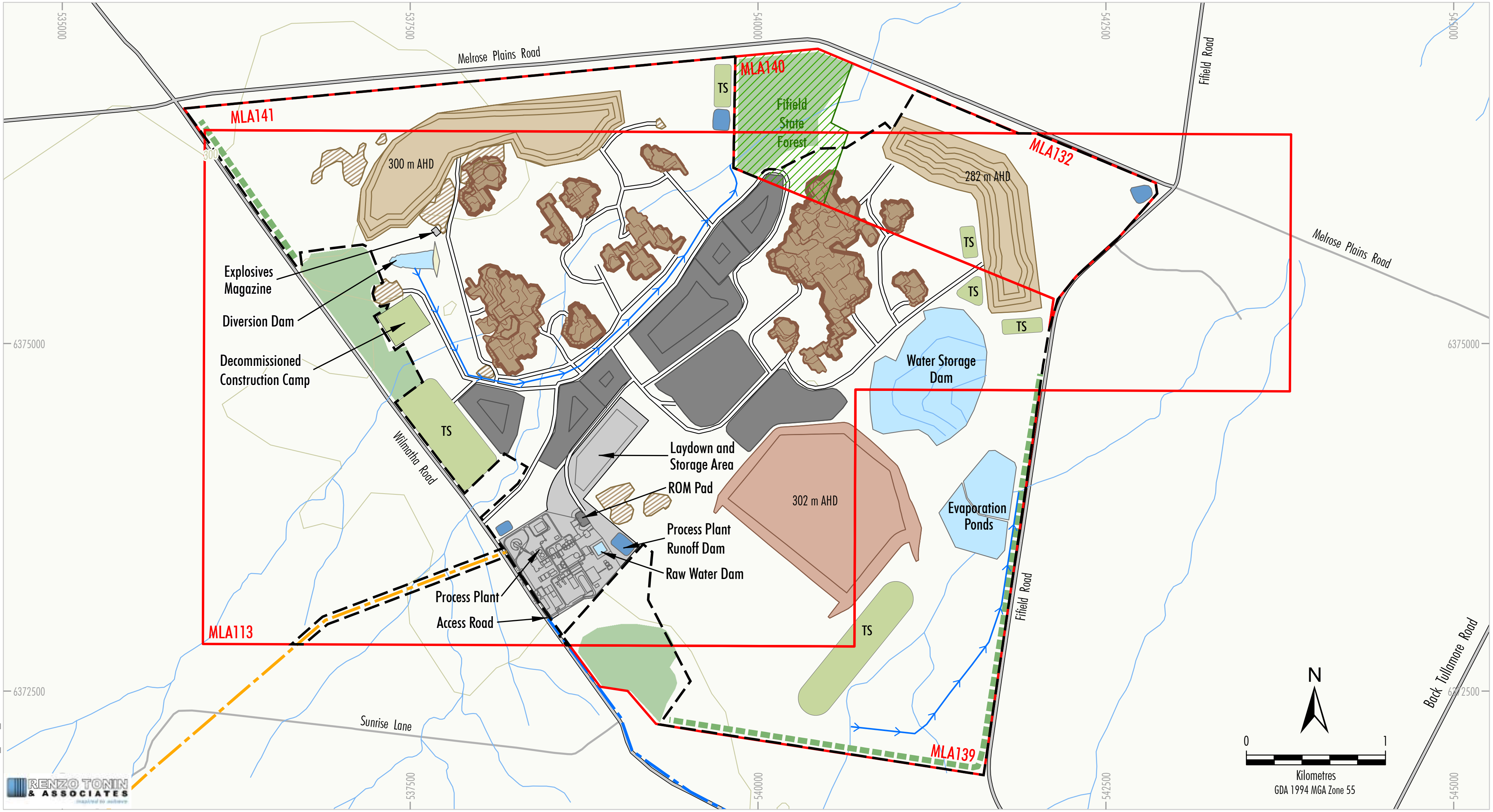
SYERSTON PROJECT MODIFICATION 4

Modified Mine and Processing Facility Conceptual General Arrangement Year 1

Figure 3



LEGEND

- Mining Lease Application Boundary
- Approved Surface Development Area
- Open Cut Pit (Scandium Oxide)
- Open Cut Pit
- Waste Rock Emplacement
- Tailings Storage Facility
- TS Topsoil Stockpile
- Ore Stockpile
- Mine Infrastructure Area
- Sediment Dam
- Initial Rehabilitation
- Diversion Structure
- Gas Pipeline
- Water Pipeline
- Vegetation Screening
- Existing Open Woodland to be Maintained
- State Forest

Source: Black Range Minerals (2000); NSW Department of Industry (2017); NSW Land & Property Information (2017)

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SYERSTON PROJECT MODIFICATION 4

Modified Mine and Processing Facility Conceptual General Arrangement Year 6

Figure 4

LEGEND

- Mining Lease Application Boundary
- Approved Surface Development Area
- Open Cut Pit (Scandium Oxide)
- Open Cut Pit
- Waste Rock Emplacement
- Tailings Storage Facility
- TS Topsoil Stockpile
- Ore Stockpile
- Mine Infrastructure Area
- Sediment Dam
- Initial Rehabilitation
- Intermediate/Advanced Rehabilitation
- Diversion Structure
- Gas Pipeline
- Water Pipeline
- Vegetation Screening
- Existing Open Woodland to be Maintained
- State Forest

Source: Black Range Minerals (2000); NSW Department of Industry (2017); NSW Land & Property Information (2017)

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SYERSTON PROJECT MODIFICATION 4

Modified Mine and Processing Facility Conceptual General Arrangement Year 11

Figure 5

LEGEND

- Mining Lease Application Boundary
- Approved Surface Development Area
- Open Cut Pit (Scandium Oxide)
- Open Cut Pit
- Waste Rock Emplacement
- Tailings Storage Facility
- TS Topsoil Stockpile
- Ore Stockpile
- Mine Infrastructure Area
- Sediment Dam
- Initial Rehabilitation
- Intermediate/Advanced Rehabilitation
- Diversion Structure
- Gas Pipeline
- Water Pipeline
- Vegetation Screening
- Existing Open Woodland to be Maintained
- State Forest

Source: Black Range Minerals (2000); NSW Department of Industry (2017); NSW Land & Property Information (2017)

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SYERSTON PROJECT MODIFICATION 4

Modified Mine and Processing Facility
Conceptual General Arrangement
Year 21

Figure 6

3 Noise Sensitive Receivers

Land use in the local area is predominately agricultural operations (rural). The majority of properties surrounding the Project are privately owned and the remainder are either community properties or mine owned.

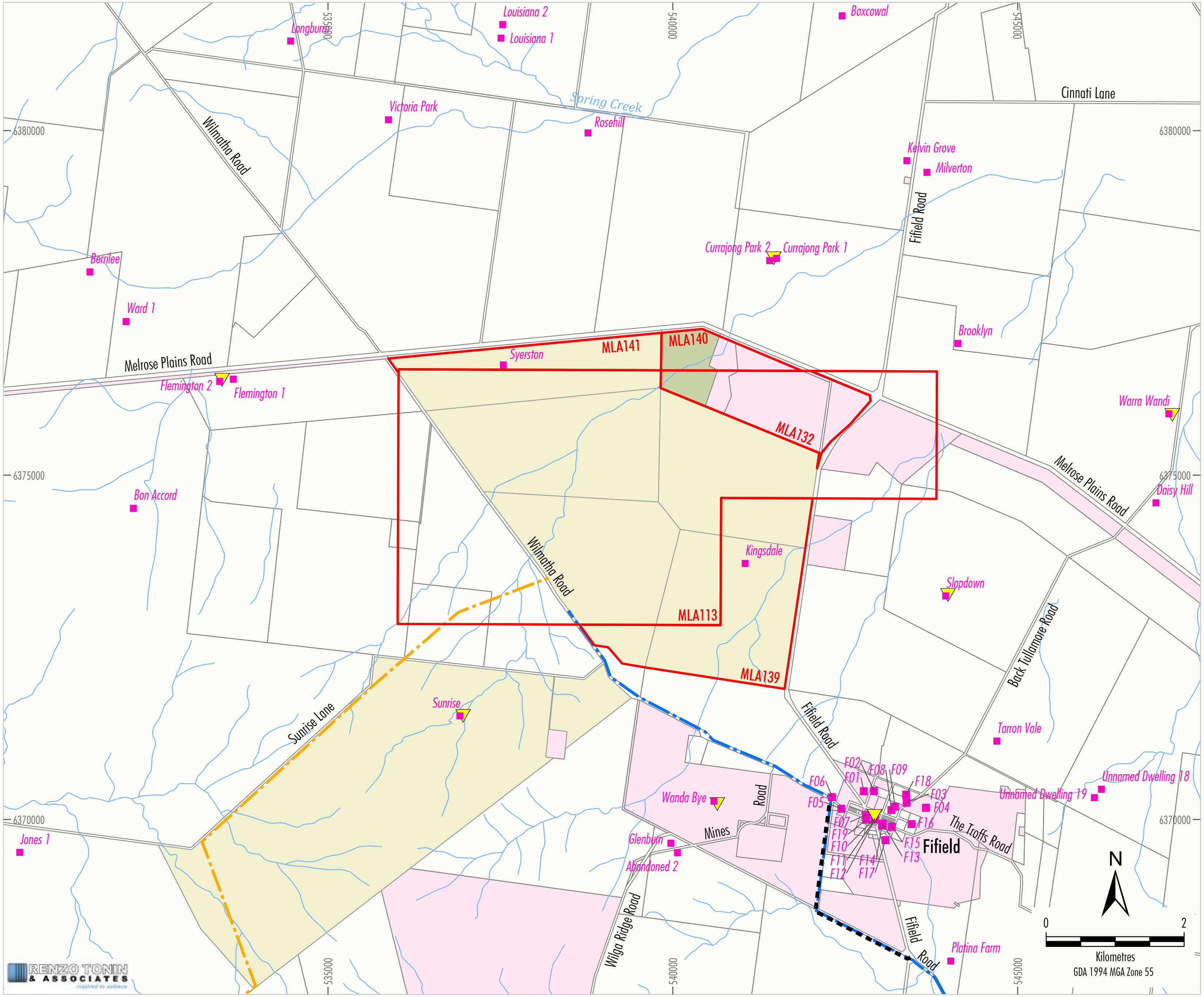
The noise sensitive receiver locations considered in this assessment are listed in Table 3.1 and shown on Figure 7.

Table 3.1 – Receiver Locations and Ownership Details

ID	Description	Easting	Northing	Ownership
M01	Longburra	534460	6381299	Private
M02	Victoria Park	535880	6380159	Private
M03	Ward 1	532074	6377231	Private
M04	Abandoned 2	540068	6369522	Private
M05	Berrilee	531549	6377952	Private
M06	Bon Accord	532179	6374519	Private
M07	Boxcowal	542455	6381666	Private
M08	Currajong Park 2	541407	6378116	Private
M09	Daisy Hill	547007	6374597	Private
M10	Glenburn	539974	6369660	Private
M11[1]	Kingsdale	541049	6373716	Mine-owned
M12	Louisiana 1	537510	6381346	Private
M13	Louisiana 2	537536	6381538	Private
M14	Platina Farm	544033	6367948	Private
M15	Sunrise	536914	6371503	Mine-owned
M16	Tarron Vale	544700	6371139	Private
M17	Jones 1	530531	6369523	Private
M18	-	546216	6370438	Private
M19	-	546115	6370320	Private
M20	-	546165	6367633	Private
M21	Warra Wandi	547194	6375889	Private
M22	Brooklyn	544134	6376913	Private
M23	Currajong Park 1	541505	6378145	Private
M24	Flemington 1	533630	6376389	Private
M25	Flemington 2	533432	6376363	Private
M26	Kelvin Grove	543396	6379565	Private
M27	Milverton	543687	6379393	Private
M28	Rosehill	538772	6379967	Private
M29	Slapdown	543958	6373248	Private
M30[1]	Syerston	537544	6376597	Mine-owned

ID	Description	Easting	Northing	Ownership
M31	Wanda Bye	540599	6370264	Private
M32	Fifield Town Hall	542918	6369990	Community
M33	Fifield Fire Station	542895	6369968	Community
M34	Fifield Hotel	542872	6370013	Private Business
M35	St Dympna's Catholic Church	542799	6370059	Community
F01	Fifield residences	542770	6370414	Private
F02		542918	6370415	Private
F03		543390	6370245	Private
F04		543672	6370175	Private
F05		542504	6370163	Private
F06		542310	6370326	Private
F07		542800	6370068	Private
F08		543170	6370138	Private
F09		543224	6370187	Private
F10		542932	6370017	Private
F11		542932	6370001	Private
F13		543045	6369937	Private
F14		543033	6369911	Private
F15		543178	6369894	Private
F16		543463	6369933	Private
F17		543086	6369700	Private
F18		543384	6370362	Private
F19		542808	6369999	Private

Notes: 1. These receivers would be removed to allow for the development of the mine and have therefore not been considered further.



LEGEND
- Mining Lease Application Boundary
- Approved Fifield Bypass
- Approved Gas Pipeline
- Approved Water Pipeline
- Clean TeQ Owned Land
- Crown Land
- Fifield State Forest
- Private Landholder
- Dwelling
- Modification 4 Background Monitoring Location (2016)

Source: Black Range Minerals (2000); NSW Department of Industry (2017); NSW Land & Property Information (2017)

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SYERSTON PROJECT MODIFICATION 4

Sensitive Receivers and Noise Monitoring Sites

Figure 7

CTL-16-02 Mod4_Noise_207C

4 Existing Acoustic Environment

Criteria for the assessment of operational and construction noise are usually derived from the existing noise environment of an area, excluding noise from the subject development.

Appendix B of the NSW EPA's INP outlines two methods for determining the background noise level of an area, being 'B1 – Long-term background noise method' and 'B2 – Short-term background noise method'. This assessment has used a combination of long-term and short-term noise monitoring.

As the noise environment of an area almost always varies over time, background and ambient noise levels need to be determined for the operational times of the proposed development. For example, in a suburban or urban area the noise environment is typically at its minimum at 3:00 am in the morning and at its maximum during the morning and afternoon traffic peak hours. The INP outlines the following standard time periods over which the background and ambient noise levels are to be determined:

- **Day:** 7:00 am - 6:00 pm Monday to Saturday and 8:00 am- 6:00 pm Sundays & Public Holidays.
- **Evening:** 6:00 pm - 10:00 pm Monday to Sunday & Public Holidays.
- **Night:** 10:00 pm - 7:00 am Monday to Saturday and 10:00 pm - 8:00 am Sundays & Public Holidays.

4.1 Noise Measurement Locations

Noise measurements are ideally carried out at the nearest or most potentially affected locations surrounding a development. An alternative, representative location should be established in the case of access restrictions or if a safe and secure location cannot be identified. Furthermore, representative locations may be established in the case of multiple receivers as it is usually impractical to carry out measurements at all locations surrounding a site.

The long-term and short-term noise measurement locations are outlined in Table 4.1 and shown on Figure 7. Short-term noise measurements were undertaken adjacent to the installed long-term noise monitor locations.

Table 4.1 – Noise Monitoring Locations

ID	Location	Description
L1	9 Wilmatha Fifield Road	• The noise monitor was located within the backyard along the northern boundary of the property. • The noise monitor was placed in the free-field. • The noise monitoring location is considered representative of receiver locations within the town of Fifield.
L2	Slapdown	• The noise monitor was located approximately 30 metres (m) from the dwelling. • The noise monitor was placed in the free-field. • The noise monitoring location is considered representative of receiver locations to the east of the Project.
L3	Wanda Bye	• The noise monitor was located at the end of the driveway and approximately 50 m from the nearest dwelling. • The monitor was placed in the free-field. • The noise monitoring location is considered representative of receiver locations to the south of the Project.
L4	Warra Wandi	• The noise monitor was located at the end of the driveway and approximately 45 m from the dwelling. • The noise monitor was placed in the free-field. • The noise monitoring location is considered to be representative of receiver locations to the north east and east of the Project.
L5	Currajong Park	• The noise monitor was located approximately 30 m from the main dwelling. • The noise monitor was placed in the free-field. • The noise monitoring location is considered to be representative of receiver locations to the north of the Project.
L6	Sunrise	• The noise monitor was located at the end of the driveway and approximately 35 m from the dwelling. • The noise monitor was placed in the free-field. • The noise monitoring location is considered to be representative of receiver locations to south west of the Project.
L7	Flemington	• The noise monitor was located approximately 30 m from the dwelling. • The noise monitor was placed in the free-field. • The noise monitoring location is considered to be representative of receiver locations to the west of the Project.

4.2 Long-Term Noise Monitoring Results

Long-term noise monitoring was carried out from Monday 5 December 2016 to Thursday 15 December 2016. The long-term noise monitoring methodology is detailed in Appendix B, and noise level-vs-time graphs of the data are included in Appendix C.

Table 4.2 presents the overall single Rating Background Levels (RBL) and representative ambient L_{eq} noise levels for each assessment period, determined in accordance with the INP.

Table 4.2 – Long-Term Noise Monitoring Results, dB(A)

Monitoring location	L_{A90} RBL			L_{Aeq} Ambient noise levels[4]		
	Day[1]	Evening[2]	Night[3]	Day[1]	Evening[2]	Night[3]
L1 – 9 Wilmatha Fifield Road	26	29	22	57	55	44
L2 – Slapdown	25	26	21	47	46	41
L3 – Wanda Bye	34	30	25	47	47	43
L4 – Warra Wandi	27	30	27	49	43	40
L5 – Currajong Park	28	26	21	52	47	45
L6 – Sunrise	27	26	22	44	43	41
L7 – Flemington[5]	37	40	37	45	47	43

Notes:
1. Day: 7:00 am - 6:00 pm Monday to Saturday and 8:00 am - 6:00 pm Sundays & Public Holidays.
2. Evening: 6:00 pm - 10:00 pm Monday to Sunday & Public Holidays.
3. Night: 10:00 pm - 7:00 am Monday to Saturday and 10:00 pm - 8:00 am Sundays & Public Holidays.
4. As required by the INP, the external ambient noise levels presented are free-field noise levels (ie. no façade reflection is incorporated).
5. There was presence of insect noise throughout the measurement duration.

The recorded RBLs for all seven (7) monitoring locations are approximately 30 A-weighted decibels (dB[A]) and below (with the exception of L7, which was affected by insect noise throughout the monitoring period), which is consistent with background noise levels expected for a rural region.

Background noise monitoring was previously conducted in 1999 as part of the original Syerston Project EIS. The recorded RBLs were found to be the same or lower than the previous monitoring results. Therefore, there have been no increases to background noise levels surrounding the Project since 1999.

For a conservative assessment of noise impacts from the Project, this assessment will adopt the minimum background noise levels nominated in the INP of 30 dB(A) for day, evening and night periods.

4.3 Short-term Noise Measurement Results

Short-term noise measurements were undertaken on Wednesday 14 December 2016 and Thursday 15 December 2016 during various day, evening and night periods, in order to supplement the long-term noise monitoring and provide a greater understanding of the surrounding noise environment.

The equipment used for noise measurements was a Brüel & Kjaer Type 2250 precision sound level analyser which is a Class 1 instrument having accuracy suitable for field and laboratory use. The instrument was calibrated prior and subsequent to measurements using a Brüel & Kjaer Type 4231 calibrator. No significant drift in calibration was observed. All instrumentation complies with AS IEC 61672.1 2004 *Electroacoustics - Sound Level Meters* and carries current National Association of Testing Authorities (NATA) certification (or if less than 2 years old, manufacturers certification).

Within Fifield, background noise was dominated by traffic on Wilmatha Fifield Road and environmental noise within the township. Background noise at other rural residences was dominated by environmental noise and distant traffic. A summary of the short-term measurement results is presented in Appendix D.

5 Meteorology

Certain meteorological conditions may increase noise levels by focusing sound-wave propagation paths at a single point. Such refraction of sound waves occur during temperature inversions (atmospheric conditions where temperatures increase with height above ground level) and where there is a wind gradient (that is, wind velocities increasing with height) with wind direction from the source to the receiver.

Temperature inversions occurring within the lowest 50 m to 100 m of atmosphere can affect noise levels measured on the ground. Temperature inversions are most commonly caused by radiative cooling of the ground at night leading to the cooling of the air in contact with the ground. This is especially prevalent on cloudless nights with little wind. Air that is somewhat removed from contact with the ground will not cool as much, resulting in warmer air aloft than nearer the ground.

Similarly, when significant wind exists, the conditions can significantly affect noise levels at receptor points downwind of a noise source. This would depend however, on the particular direction and the velocity of the wind at that time. It should also be noted that although wind can raise noise emission levels as perceived from a downstream assessment point, background noise also tends to increase as a result of increased wind activity. This often causes masking of potential increases in intrusive noise.

The NSW EPA's INP recommends that project noise criteria are to apply under weather conditions characteristic of an area. These conditions may include calm, wind and temperature inversions. In this regard, the increase in noise that results from atmospheric temperature inversions and wind effects may need to be assessed. The noise levels predicted under characteristic meteorological conditions for each receiver are then compared with the criteria, to establish whether the meteorological effect will cause a significant impact.

The NSW EPA's INP permits two approaches for assessing these effects: use of default parameters and use of site-specific parameters.

- With using default parameters, general meteorological values are used to predict noise levels, foregoing detailed analyses of site-specific meteorological data. This approach assumes that meteorological effects are conservative, in that it is likely to predict the upper range of increases in noise levels. Actual noise levels may be less than predicted.
- The use of site-specific parameters is a more detailed approach, which involves analysing site meteorological data to determine whether inversion and/or wind effects are significant features warranting assessment. Where assessment is warranted, default parameters are available for use in predicting noise or, where preferred, measured values may be used instead. The use of site-specific parameters provides a more accurate prediction of noise increases due to meteorological factors, however, is more costly especially if suitable site data is unavailable and long-term meteorological monitoring is required. Existing weather data may be used, provided the site is within a radius of 30 km of the collection point and in the same topographical basin.

For this assessment, the more detailed approach using site-specific meteorological parameters was conducted. Weather data, provided by Ramboll Environ, was taken from the Condobolin Airport Automatic Weather Station for the year 2015.

While this weather station is outside the radius provided in the INP (approximately 40 km southwest of the Project), this is the closest Bureau of Meteorology weather station to the Project. Given the relatively uncomplicated regional terrain, this weather station would be considered to be in the same topographical basin, and suitable for determining prevailing weather conditions for modelling purposes.

5.1 Temperature Inversions

Appendix C of the INP describes the following procedure for assessing the increase in noise caused by temperature inversions:

- Do an initial screening test to determine whether there is the potential for significant increases to noise levels due to inversions to warrant further assessment. That is, will the development operate during the night-time assessment period of 10:00 pm to 7:00 am, and if so, will the noise increase significantly (by more than 3 decibels [dB] as per Table D1 in Appendix D of INP)?
- Determine extent of impact in terms of percent (%) occurrence of inversions where there is the potential for inversions to increase noise levels for the locality being assessed. Where inversions are predicted for more than 30% of the total night-time (or approx. 2 nights per week) during winter (i.e. months of June, July and August), these are considered to be significant and should be accounted for in the noise assessment.
- Predict noise levels using default or site-specific parameters to determine the increase in noise levels expected due to inversions. The default parameters are:
  - non-arid areas (mean rainfall >500 millimetres per annum [mm pa]); 3 degrees Celsius (^{o}C)/100 m temperature inversion strength and 2 metres per second (m/s) at 10 m height drainage-flow wind from source to receiver where applicable.
  - arid and semi-arid areas (mean rainfall <500 mm pa); 8^{o}C/100 m temperature inversion strength and 1 m/s at 10 m height drainage-flow wind from source to receiver where applicable.
- Assess impact to determine whether the increased noise levels due to inversions will affect receivers in the vicinity of the development. The predicted increased noise levels are compared with the project's noise criteria to determine if any exceedances or noise impacts are expected.

Assessment of impacts from temperature inversions is confined to the night-time period of 10:00 pm to 7:00 am, as this is the time likely to have the greatest impact on amenity of nearby residences. As the Project operates at night-time, there is potential for noise impact due to inversions, and further consideration of these effects is required.

Following the procedure above, the likelihood of temperature inversion occurrence was determined based on Pasquill-Gifford stability classes for the winter night-time periods in the weather data. A summary of the likelihood of temperature inversions for night-time is presented in Table 5.1 below.

Table 5.1 – Winter Night-time Temperature Inversion (TI) Likelihood, %

Season	Pasquill-Gifford Stability Class							TI Likelihood (F+G)
	A	B	C	D	E	F	G	
Winter	0.0	0.0	0.0	16.2	44.2	33.3	6.3	39.6

The results above indicate that the F class temperature inversions are above the 30% occurrence threshold nominated in the INP for the night-time period, and therefore, temperature inversions will need to be considered in the assessment for the night-time period. In accordance with Section 5.2 of the INP, temperature inversions are only assessable during the night-time period.

5.2 Wind Effects

Gradient wind differs from the drainage-flow wind associated with temperature inversions. Drainage-flow wind is the localised drainage of cold air under the influence of the local topography, and travels in one direction only (direction of decreasing altitude). Gradient wind is the regional wind determined by synoptic factors (e.g. high and low-pressure systems).

Unlike temperature inversions, gradient winds may cause impacts during any assessment period, (day, evening and night), and not just the night period.

The INP specifies a procedure for assessing the significance of wind effects, and a default wind speed to be used in the assessment where these effects are found to be significant. The procedure requires that wind effects be assessed where wind is a feature of the area.

Wind is considered to be a feature where source-to-receiver wind speeds (at 10 m height) of 0.5 to 3 m/s occur for 30% of the time or more in any assessment period (day, evening and night) in any season. Winds with velocities less than 0.5 m/s (calm conditions) and greater than 3 m/s (at 10 m height), are not included in the calculations of wind occurrence.

Therefore, there are two ways to assess wind effects:

- Use available wind data or wind roses to determine the frequency of occurrence and wind speed, taking into account the various components of wind that are relevant.
- Simply assume that wind is a feature of the area (foregoing the need to use wind data or wind roses).

In accordance with the INP, where there is 30% or more occurrence of wind speeds between 0.5 m/s and 3 m/s (source-to-receiver component), then the highest wind speed is used (below 3 m/s) instead of the default. Where there is less than a 30% occurrence of wind between 0.5 m/s and 3 m/s (source-to-receiver component), wind is not included in the noise-prediction calculations.

Analysis of the wind data was undertaken using the EPA's Noise Enhancement Wind Analysis program to determine if wind is a 'feature' of the area as defined by the INP. The program determines whether there are prevailing source-to-receiver wind conditions. The results of the analysis are presented in Table 5.2 below.

Table 5.2 – Percentage of Wind Records (0.5 to 3 m/s) from Subject Site to Receiver, %

Direction	Summer			Autumn			Winter			Spring		
	Day	Eve	Night	Day	Eve	Night	Day	Eve	Night	Day	Eve	Night
N	5.9	6.9	7.8	3.9	6.0	5.0	4.8	11.4	5.1	5.0	9.6	7.3
NNE	7.2	10.0	10.7	4.7	8.7	6.4	6.1	14.7	6.6	4.9	12.4	9.6
NE	8.4	14.7	17.0	5.4	12.8	10.5	6.8	17.1	11.6	5.1	15.1	15.6
ENE	8.1	13.6	23.1	7.6	14.1	14.9	8.6	17.9	14.7	4.2	14.0	19.9
E	8.5	11.1	23.1	8.8	13.6	16.4	9.1	11.4	14.4	6.8	11.5	18.1
ESE	8.4	9.2	21.2	10.1	10.3	13.9	9.2	7.3	11.6	6.4	9.9	15.3
SE	6.9	7.8	14.4	11.1	7.1	10.0	11.0	5.7	7.7	7.2	8.0	9.8
SSE	5.7	6.7	7.0	7.1	4.9	4.7	7.2	3.0	3.9	6.1	7.4	5.0
S	8.6	10.6	7.8	12.5	10.1	6.8	14.1	10.3	4.2	9.4	14.8	6.6
SSW	6.6	11.1	7.6	11.7	14.9	11.7	16.1	14.9	5.2	10.7	14.6	7.9
SW	5.5	9.2	8.6	10.8	17.1	13.5	15.3	18.8	9.5	9.2	14.0	10.9
WSW	4.3	7.5	10.1	11.5	18.2	20.3	14.0	22.8	20.2	9.6	17.0	15.0
W	4.0	5.8	9.4	8.5	17.7	22.8	9.8	20.9	23.4	8.2	14.0	15.3
WNW	3.5	3.9	8.5	6.0	12.5	17.9	6.9	15.8	22.1	5.9	10.4	13.7
NW	3.9	3.1	6.7	5.6	8.2	15.8	5.6	10.9	18.2	4.7	8.5	10.6
NNW	4.3	4.4	4.8	3.8	6.0	8.0	4.8	7.9	8.6	5.2	6.3	7.0

Notes Bold denotes greater than 30% occurrence of wind scenario.

The results above indicate that there is no greater than 30% occurrence of winds between 0.5 m/s and 3 m/s (source-to-receiver component) for certain scenarios. Therefore, there are no prevailing wind conditions in accordance with the INP, and wind effects are not considered in this assessment.

5.3 Summary of Meteorological Assessment Conditions

Based on the findings in Section 5.1 and Section 5.2, Table 5.3 below presents a summary of the meteorological conditions considered for the operational noise computer modelling.

Table 5.3 – Summary of Meteorological Assessment Conditions

Period	Meteorological Assessment Condition
Day	Calm
Evening	Calm
Night	Calm
	F Class Inversion

6 Criteria

6.1 Construction Noise

The NSW ICNG provides guidelines for assessing noise generated during the construction phase of developments.

The key components of the guideline that are incorporated into this assessment include:

- Use of L_{Aeq} as the descriptor for measuring and assessing construction noise.

NSW noise policies, including the INP, RNP and Rail Infrastructure Noise Guideline (RING) (EPA, 2013a) have moved to the primary use of L_{Aeq} over any other descriptor. As an energy average, L_{Aeq} provides ease of use when measuring or calculating noise levels since a full statistical analysis is not required as when using, for example, the L_{A10} descriptor.

- Application of reasonable and feasible noise mitigation measures.
- As stated in the ICNG, a noise mitigation measure is feasible if it is capable of being put into practice, and is practical to build given the project constraints.
- Selecting reasonable mitigation measures from those that are feasible involves making a judgement to determine whether the overall noise benefit outweighs the overall social, economic and environmental effects.

The ICNG provides two methods for assessment of construction noise, being either a quantitative or a qualitative assessment. A quantitative assessment is recommended for major construction projects of significant duration, and involves the measurement and prediction of noise levels, and assessment against set criteria. A qualitative assessment is recommended for small projects with a duration of less than three weeks and focuses on minimising noise disturbance through the implementation of reasonable and feasible work practices, and community notification.

Given the scale and duration of the construction works proposed for the Project (i.e. greater than six months), a quantitative assessment is carried out herein, consistent with the ICNG.

Table 6.1, reproduced from the ICNG, sets out the Noise Management Levels (NMLs) and how they are to be applied for residential receivers.

Table 6.1 – Noise Management Levels at Residential Receivers

Time of Day	Management Level $L_{Aeq\ (15\ min)}$	How to Apply
Recommended standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays	Noise affected RBL + 10 dB(A)	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured LAeq (15 min) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: • times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences • if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5 dB(A)	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community. For guidance on negotiating agreements see section 7.2.2 of the ICNG.

Source: ICNG (Department of the Environment and Climate Change, 2009).

Based on the above ICNG requirements, Table 6.2 presents the construction NMLs established for the nearest noise sensitive residential receivers based upon the noise monitoring outlined in Section 4.

As described in Section 2.2, the construction activities relevant to the modified Project (i.e. at the mine and processing facility) would be conducted 24 hours per day, seven days per week. The construction activities would therefore be conducted both within and outside of the recommended standard construction hours.

Table 6.2 – Construction Noise Management Levels at Residential Receivers

Receiver Location	L_{A90} RBL[1]			NML $L_{Aeq(15min)}$		
	Day	Evening	Night	Day	Evening	Night
All Residential Receivers	30	30	30	40	35	35

Notes: 1. RBLs have adopted the minimum background noise levels nominated in the INP as long term background noise levels were recorded at approximately 30 dB(A) and below (refer to Section 4.2).

The Fifield Hotel (receiver M34) is assumed to have a permanent caretaker's residence on the property and is considered to be a residential receiver.

Table 6.3 sets out the ICNG NMLs for other noise sensitive receiver locations. As identified for residential receivers, a 'highly affected' noise objective of $L_{Aeq(15min)}$ 75 dB(A) is also adopted for all noise sensitive receivers, with exceedances addressed as described in Table 6.1.

Table 6.3 – Noise Management Levels at Other Noise Sensitive Land Uses

Land Use	Where Objective Applies	Management Level $L_{Aeq\ (15\ min)}$
Classrooms at schools and other educational institutions	Internal noise level	45 dB(A)
Hospital wards and operating theatres	Internal noise level	45 dB(A)
Places of worship	Internal noise level	45 dB(A)
Active recreation areas	External noise level	65 dB(A)
Passive recreation areas	External noise level	60 dB(A)
Community centres	Depends on the intended use of the centre.	Refer to the 'maximum' internal levels in AS2107 for specific uses.
Commercial premises	External noise level	70 dB(A)
Industrial premises	External noise level	75 dB(A)

Notes: NMLs apply when receiver areas are in use only.

It is noted that as a general rule, building structures would typically provide a minimum of 10 dB(A) reduction from external noise levels to internal noise levels, with windows opened sufficiently for fresh air ventilation. Therefore, the equivalent external management levels for the Fifield Town Hall (receiver M32) and St Dympna's Catholic Church are **55 dB(A)**.

The Fifield Fire Station (receiver M33) is considered to be a commercial premise.

6.2 Operational Noise

Operational noise from the Project is assessed in accordance with the INP. The INP is used as a guide by the EPA for setting statutory limits in licences for scheduled noise sources.

The INP has two components:

- Controlling intrusive noise impacts in the short term for residences.
- Maintaining noise level amenity for particular land uses for residences and other land uses.

6.2.1 Intrusive Noise Impacts

According to the INP, the intrusiveness of a noise source may generally be considered acceptable if the equivalent continuous (energy-average) A-weighted level of noise from the source (represented by the L_{Aeq} descriptor) does not exceed the background noise level measured in the absence of the source by more than 5 dB(A). The intrusiveness criterion is only applicable to residential type receivers and is summarised as follows:

- $L_{Aeq,15minute}$ **≤ RBL plus 5 dB(A).**

Table 6.4 presents the intrusiveness criteria established for the nearest noise sensitive residential receivers based upon the noise monitoring outlined in Section 4.

Table 6.4 – Intrusiveness Criteria

Receiver Location	L_{A90} RBL[1]			Intrusiveness Criteria $L_{Aeq(15min)}$		
	Day	Evening	Night	Day	Evening	Night
All Residential Receivers	30	30	30	35	35	35

Notes: RBL levels have adopted the minimum background noise levels nominated in the INP as long term background noise levels were recorded at approximately 30 dB(A) and below (refer to Section 4.2).

The Fifield Hotel (receiver M34) is assumed to have a permanent caretaker's residence on the property and is considered to be a residential receiver.

6.2.2 Protecting Noise Amenity

The amenity criteria are determined in accordance with Chapter 2 of the INP. The INP recommends base acceptable noise levels for various receivers, including residential, commercial, industrial receivers and sensitive receivers such as schools, hospitals, churches and parks. These base noise criteria are then lowered by up to 10 dB depending on the extent of existing industrial noise impact upon the receiver (if applicable). Higher levels of existing industrial noise therefore result in stricter amenity criteria applied to any new industrial development. In this way the cumulative impacts of existing and known future industrial noise sources are minimised.

To limit continuing increases in noise levels, the maximum ambient noise level within an area from industrial noise sources should not normally exceed the acceptable noise levels specified in Table 2.1 of the INP, the applicable parts of which are reproduced in Table 6.5 below.

It is noted that as a general rule, building structures would typically provide a minimum of 10 dB(A) reduction from external noise levels to internal noise levels, with windows opened sufficiently for fresh air ventilation. Therefore, the equivalent external management levels for the town hall and places of worship are **45 dB(A)** and **50 dB(A)**, respectively.

Table 6.5 – Amenity Criteria – Recommended L_{Aeq} Noise Levels from Industrial Sources

Type of Receiver	Indicative Noise Amenity Area	Time of Day	Recommended $L_{Aeq(Period)}$ Noise Level	
			Acceptable	Recommended Maximum
Residence	Rural	Day	50	55
		Evening	45	50
		Night	40	45
School classrooms – internal	All	Noisiest 1 hour period when in use	35	40
Hospital ward	All	Noisiest		

Type of Receiver	Indicative Noise Amenity Area	Time of Day	Recommended $L_{Aeq(Period)}$ Noise Level	
			Acceptable	Recommended Maximum
- internal		1 hour period	35	40
- external			50	55
Place of worship – internal	All	When in use	40	45
Area specifically reserved for passive recreation (e.g. National Park)	All	When in use	50	55
Active recreation area (e.g. school playground, golf course)	All	When in use	55	60
Commercial premises	All	When in use	65	70
Industrial premises	All	When in use	70	75

Notes:
1. Daytime 7.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm; Night-time 10.00 pm - 7.00 am.
2. On Sundays and Public Holidays, Daytime 8.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm; Night-time 10.00 pm - 8.00 am.
3. The L_{Aeq} index corresponds to the level of noise equivalent to the energy average of noise levels occurring over a measurement period.

6.2.3 Project Specific Noise Levels

In accordance with the INP, noise impact should be assessed in terms of both intrusiveness and amenity. Based on the background and ambient noise monitoring carried out at the nearest affected receiver locations, the Project Specific Noise Levels (PSNLs) are outlined in Table 6.6 below.

Table 6.6 – Project Specific Noise Levels

Locality	Land Use	Intrusiveness, $L_{Aeq,15min}$, dB(A)			Amenity, $L_{Aeq,period}$, dB(A)		
		Day	Evening	Night	Day	Evening	Night
Privately Owned Land	Rural Residential	35	35	35	50	45	40
Any	Fifield Town Hall	N/A	N/A	N/A	External 50 dB(A) when in use		
Any	St Dympna's Catholic Church	N/A	N/A	N/A	External 50 dB(A) when in use		
Any	Fifield Fire Station	N/A	N/A	N/A	External 65 dB(A) when in use		

Notes:
1. RBL levels have adopted the minimum background noise levels nominated in the INP as long term background noise levels were recorded at approximately 30 dB(A) and below.
2. Residential locations have been categorised as 'Rural'.

It is noted the PSNLs are consistent with the noise criteria present in Development Consent DA 374-11-00, with the exception of the Currajong Park property, which has criteria of 35 dB(A) during the day, 39 dB(A) during the evening and 40 dB(A) at night.

Once the Project is operational, monitoring results would be assessed against the INP, or policy that supersedes this policy (e.g. the finalised draft Industrial Noise Guideline), with respect to modifying factors (including for low frequency noise). If noise generated by the Project is found to contain annoying characteristics (such as dominant low frequency content), the appropriate modifying factor would be applied to measured Project noise levels and assessed against noise criteria.

6.2.4 Voluntary Land Acquisition and Mitigation Policy

The INP states that the intrusiveness and amenity criteria have been selected to protect at least 90% of the population living in the vicinity of industrial noise sources from the adverse effects of noise for at least 90% of the time. Provided the criteria in the INP are achieved, then it is unlikely that most people would consider the resultant noise levels excessive.

In those cases when the PSNLs are not, or cannot be achieved, then it does not automatically follow that those people affected by the noise would find the noise unacceptable. In subjective terms, exceedances of the PSNLs are described in the NSW Government's (2014) *Voluntary Land Acquisition and Mitigation Policy – SSD Mining* and reproduced in Table 6.7 below.

Table 6.7 – Characterisation of Noise Impacts & Potential Treatments

Residual Noise Exceeds INP Criteria By	Characterisation of Impacts	Potential Treatment
0-2 dB(A) above the PSNL	Impacts are considered to be **negligible**	The exceedances would not be discernible by the average listener and therefore would not warrant receiver based treatments or controls
3-5 dB(A) above the PSNL in the INP but the development would contribute less than 1 dB to the total industrial noise level	Impacts are considered to be **marginal**	Provide mechanical ventilation/comfort condition systems to enable windows to be closed without compromising internal air quality/amenity.
3-5 dB(A) above the PSNL in the INP and the development would contribute more than 1 dB to the total industrial noise level	Impacts are considered to be **moderate**	As for marginal impacts but also upgraded facade elements like windows, doors, roof insulation etc. to further increase the ability of the building façade to noise levels.
>5 dB(A) above the PSNL in the INP	Impacts are considered to be **significant**	Provide mitigation as for moderate impacts and see voluntary land acquisition provisions below.

Furthermore, the policy also presents information regarding the requirements for voluntary mitigation and voluntary acquisition. A consent authority can apply voluntary mitigation and voluntary land acquisition rights to reduce:

- *Operational noise impacts of a development on privately owned land; and*
- *Rail noise impacts of a development on privately owned land near non-network rail lines (private rail lines), on or exclusively servicing industrial sites (see Appendix 3 of the RING);*

But not:

- *Construction noise impacts, as these impacts are shorter term and can be controlled;*
- *Noise impacts on the public road or rail network; or*
- *Modifications of existing developments with legacy noise issues, where the modification would have beneficial or negligible noise impacts. In such cases, these legacy noise issues should be addressed through site-specific pollution reduction programs under the Protection of the Environment Operations Act 1997.*

Voluntary Mitigation Rights

A consent authority should only grant voluntary mitigation rights:

- *If the noise generated by the development would be equal to or greater than 3 dB(A) above the INP project-specific noise level at any residence on privately-owned land; or*
- *If the development would increase the total industrial noise level at any residence on privately-owned land by more than 1 dB(A), and noise levels at the residence are already above the recommended amenity criteria in Table 2.1 of the INP; or*
- *If the development includes a private rail line and the use of that private rail line would cause exceedances of the recommended acceptable levels in Table 6 of Appendix 3 of the RING by greater than or equal to 3 dB(A) at any residence on privately-owned land*

All noise levels must be calculated in accordance with the INP or RING (as applicable).

The selection of mitigation measures in cases when the PSNLs are not, or cannot be, achieved, should be guided by the potential treatments identified in Table 6.7.

Voluntary Land Acquisition Rights

A consent authority should only grant voluntary land acquisition rights where:

- *The noise generated by the development would be more than 5 dB(A) above the Project specific noise level at any residence on privately-owned land; or*
- *The noise generated by the development would contribute to exceedances of the recommended maximum noise levels in Table 2.1 of the INP on more than 25% of any privately owned land, and a dwelling could be built on that land under existing planning controls; or*
- *If the development includes a private rail line and the use of that private rail line would cause exceedances of the recommended maximum criteria in Table 6 of Appendix 3 of the RING at any residence on privately-owned land.*

All noise levels must be calculated in accordance with the INP or RING (as applicable).

6.2.5 Cumulative Noise Levels

For cumulative noise levels, the INP amenity criteria is applicable as it is intended to control the total noise level at a receiver location from all industrial or mining developments (Table 3.1). The cumulative noise levels are therefore assessed against the amenity criteria nominated in Table 6.5.

It is noted there are no other industrial noise sources in the vicinity of the Project that would contribute to cumulative noise levels.

6.2.6 Sleep Disturbance

Noise emanating from the Project has been assessed for its potential to disturb sleep at residential receivers. The NSW EPA (2013b) has made the following policy statement with respect to sleep disturbance:

> *"Peak noise level events, such as reversing beepers, noise from heavy items being dropped or other high noise level events, have the potential to cause sleep disturbance. The potential for high noise level events at night and effects on sleep should be addressed in noise assessments for both the construction and operational phases of a development. The INP does not specifically address sleep disturbance from high noise level events.*
>
> *Research on sleep disturbance is reviewed in the NSW Road Noise Policy. This review concluded that the range of results is sufficiently diverse that it was not reasonable to issue new noise criteria for sleep disturbance.*
>
> *From the research, the EPA recognised that current sleep disturbance criterion of an $L_{A1,\ (1\ minute)}$ not exceeding the $L_{A90,\ (15\ minute)}$ by more than 15 dB(A) is not ideal. Nevertheless, as there is insufficient evidence to determine what should replace it, the EPA will continue to use it as a guide to identify the likelihood of sleep disturbance. This means that where the criterion is met, sleep disturbance is not likely, but where it is not met, a more detailed analysis is required.*
>
> *The detailed analysis should cover the maximum noise level or $L_{A1,\ (1\ minute)}$, that is, the extent to which the maximum noise level exceeds the background level and the number of times this happens during the night-time period. Some guidance on possible impact is contained in the review of research results in the appendices to the NSW Road Noise Policy. Other factors that may be important in assessing the extent of impacts on sleep include:*
>
> - *how often high noise events will occur;*
> - *time of day (normally between 10:00 pm and 7:00 am); and*
> - *whether there are times of day when there is a clear change in the noise environment (such as during early morning shoulder periods).*
>
> *The $L_{A1,\ (1\ minute)}$ descriptor is meant to represent a maximum noise level measured under 'fast' time response. EPA will accept analysis based on either $L_{A1,\ (1\ minute)}$ or $L_{A,\ (Max)}$."*

The policy states that a sleep disturbance criterion of $L_{A1,\ (1\ minute)} \leq L_{A90,15minute}$ + 15 dB(A), should be used as a first step 'guide' as it is 'not ideal' and 'where it is not met, a more detailed analysis is required'. That detailed analysis includes a reference to the research material contained in the RNP in the assessment of the subject proposal.

The RNP contains a summary of the findings of world-wide research undertaken on sleep disturbance from noise up until the time when this publication was produced. It summarises all of the research with the following statement:

"From the research on sleep disturbance to date it can be concluded that:

- *maximum internal noise levels below 50-55 dB(A) are unlikely to awaken people from sleep*
- *one or two noise events per night, with maximum internal noise levels of 65-70 dB(A), are not likely to affect health and wellbeing significantly."*

Therefore, from the above research a 50-55 dB(A) maximum internal noise level would be equivalent to approximately 65-70 dB(A) maximum noise level outside a bedroom window. These external noise limits are in line with the noise limits described by Griefahn [Acoustics Australia vol 20 No 2 August 1992 pp 43-47] and the RNP which address sleep disturbance.

In summary, the sleep disturbance criteria described in policies described above are used for the purpose of noise impact assessment for this study, however due consideration is also given to the RNP research findings in setting an appropriate 'upper' limit.

The sleep disturbance criteria described in the NSW policies and research referred to above is used for the purpose of noise impact assessment for this study and is summarised in Table 6.8 below.

Table 6.8 – Sleep Disturbance Criteria

Receiver	Sleep disturbance criteria, 10:00 pm - 7:00 am, $L_{A1, (1\ minute)}$	
	$L_{A90(15min)}$ + 15	Upper limit
All residential	30 + 15 = **45 dB(A)**	**65 dB(A)**

6.3 Blasting

6.3.1 Residential Receivers

Blasting produces ground-borne vibration and air blast over pressure, both of which can cause discomfort, and at higher levels, damage to property.

The *ANZECC Technical Basis for Guidelines to Minimise Annoyance Due to Blasting Overpressure and Ground Vibration* (1990) have been adopted by the EPA and establish ground vibration and airblast overpressure criteria for potentially affected locations.

The blast charge configuration should be selected to ensure that EPA goals are not exceeded. Before blasting can commence at a site, critical locations should be identified and appropriate measures taken to limit over pressure and vibration to acceptable levels. Blasts should initially be monitored at these locations to ensure that predicted over pressure and vibration levels are not exceeded.

The recommended goals for blasting are based on NSW EPA's *Environmental Noise Control Manual* guidelines (EPA, 1994). These state that:

"Blasting operations should in most cases be confined to the periods Mondays to Saturdays, 9am to 3pm. Blasting outside of those times should be approved only where blasting during the preferred

times is clearly impracticable, and should then be limited in number. Blasting at night should be avoided unless it is absolutely necessary."

Table 6.9 presents the criteria for blast over pressure and ground vibration for the control of blasting impact on residential premises.

Table 6.9 – Criteria for the Control of Blasting Impact at Residences

Day	Time of Blasting	Blast Over Pressure Level, dB(Lin)	Ground Vibration, peak particle velocity, (mm/sec)
Monday to Saturday	9:00 am – 3:00 pm	115	5
Monday to Saturday	6:00 am – 9:00 am, 3:00 pm – 8:00 pm	105	2
Sunday, Public Holiday	6:00 am – 8:00 pm	95	1
Any day	8:00 pm – 6:00 am	95	1

Notes: mm/sec = millimetres per second.

In addition, any exceedance above a blast over pressure of 115 dB(Lin) should be limited to not more than 5% of the total number of blasts in a 12 month period. On these infrequent occasions a maximum limit of 120 dB(Lin) should not be exceeded at any time.

Ground vibration above 5 mm/sec should also be limited to not more than 5% of the total number of blasts in a 12 month period. On these infrequent occasions a maximum limit of 10 mm/sec should not be exceeded at any time.

For assessment of structural damage due to airblast over pressure, Australian Standard AS 2187.2-2006 *Explosives – Storage, Transport and Use – Part 2 Use of Explosive* recommends a 133 dB(Lin) level as a safe level that will prevent structural/architectural damage from airblast over pressure. The limiting criteria for the control of airblast over pressure impact at residences presented in Table 6.9 are more stringent than the AS 2187.2-2006 structural damage limits. If compliance with the limiting criteria is achieved then compliance with the structural damage criteria is also achieved. Therefore the structural criteria from airblast over pressure for residences are not considered further from herein.

For assessment of structural damage due to ground vibration, AS 2187.2-2006 recommends frequency dependent criteria taken from British Standard BS 7385-2 and the United States Bureau of Mines RI 8507. In practice, the limiting criteria for the control of ground vibration impact at residences presented in Table 6.9 are more stringent than the AS 2187.2-2006 structural damage limits.

If compliance with the limiting criteria is achieved then compliance with the structural damage criteria is also achieved. Therefore, the structural criteria from ground vibration for residences are not considered further from herein.

6.3.2 Development Consent Conditions for Blasting at Limestone Quarry

Development Consent DA 374-11-00 for the Project allows for blasting activities to be undertaken at the limestone quarry. Blasting at the limestone quarry is allowed between 9:00 am and 5:00 pm Monday to Saturday, inclusive, with the blasting criteria in Table 6.10 below.

Table 6.10 – Development Consent Blasting Criteria, dB(A)

Location	Airblast overpressure (dB(lin peak))	Ground vibration (mm/s)	Allowable exceedance
Residence on privately owned land	120	10	0%
	115	5	5% of total blasts over any 12 month period

It is noted that the Development Consent blasting criteria for the limestone quarry are similar to the nominated criteria in Table 6.9 for the period 9:00 am and 3:00 pm Monday to Saturday, except it allows an extension of the hours from 3:00 pm to 5:00 pm.

6.4 Road Traffic Noise

Noise impact from the potential increase in traffic on the surrounding road network due to construction and operational activities is assessed against the RNP. The RNP sets out criteria to be applied to particular types of road and land uses. These noise criteria are to be applied when assessing noise impact and determining mitigation measures for sensitive receivers that are potentially affected by road traffic noise associated with the construction and operation of the subject site, with the aim of preserving the amenity appropriate to the land use.

Table 6.11 sets out the assessment criteria for residences, to be applied to particular types of projects, road category and land use. These criteria are for assessment against facade corrected noise levels when measured in front of a building facade. The surrounding road network potentially impacted by the Project traffic consists of roads classified as sub-arterial roads.

GTA Consultants (author of the Syerston Project Modification 4 Road Transport Assessment [2017]) has concurred with the designation of these roads (i.e. as sub-arterial roads). In Table 6.11 below and in accordance with the RNP, freeways, arterial roads and sub-arterial roads are grouped together and attract the same criteria.

Table 6.11 – Road Traffic Noise Assessment Criteria for Residential Land Uses

Road Category	Type of Project/Land Use	Assessment Criteria, dB(A)	
		Day 7:00 am – 10:00 pm	Night 10:00 pm – 7:00 am
Freeway/arterial/sub-arterial roads	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	$L_{Aeq,(15 hour)}$ 60 (external)	$L_{Aeq,(9 hour)}$ 55 (external)

Where existing traffic noise levels are above the noise assessment criteria, the primary objective is to reduce these through feasible and reasonable measures to meet the assessment criteria.

As described in the RNP, in assessing feasible and reasonable mitigation measures, an increase of up to 2 dB represents a minor impact that is considered barely perceptible to the average person.

For existing residences and other sensitive land uses affected by *additional traffic on existing roads generated by land use developments*, any increase in the total traffic noise level should be limited to 2 dB above that of the corresponding 'no build option'.

The traffic noise impact from the 'land use development with potential to generate additional traffic on existing road' would need to also comply with the 'Relative Increase Criteria' as discussed in Section 2.4 of the RNP. The relative increase criteria are to be applied to the external areas of existing residential and sensitive land uses impacted upon by traffic noise.

The relative increase criteria as set out in the RNP applicable to the Project are reproduced in Table 6.12 below.

Table 6.12 – Relative Increase Criteria

Type of Development	Total Traffic Noise Level Increase, dB(A)
Land use development with the potential to generate additional traffic on existing road	Existing traffic $L_{Aeq(period)}$ + 12 dB (external)

7 Construction Noise Assessment

7.1 Construction Noise Modelling Scenario

The construction noise modelling scenario is based on the initial phase commencing in Year 1 of the Project.

In accordance with Condition 1, Schedule 3 of Development Consent DA 374-11-00, surface construction activities would occur 24 hours per day, seven days per week.

7.2 Construction Noise Sources

The Sound Power Levels (SWLs) of plant likely to be used during the construction activities have been determined based on manufacturer's specifications, or other available information including Renzo Tonin & Associates' database of noise levels and previous studies.

Modifying factor adjustments, as per Section 4 of the INP, has been considered for all proposed plant and equipment. Based on Renzo Tonin & Associates' experience, noise from all proposed plant and equipment, individually and in combination were determined not to exhibit tonal, low-frequency, impulsive, and/or intermittent characteristics. Therefore, no modifying factors corrections are required.

A summary of plant and equipment included in the noise modelling for the construction scenarios, and relevant SWLs, is provided in Table 7.1.

Table 7.1 – Indicative Construction Plant and Equipment Fleet List and SWLs

Plant Item	Specification	SWLs, dB(A) re. 1pW (per Item)	Number of Items
Grader	-	114	2
Front End Loader	966	112	3
Scraper	-	111	3
Franna Crane	-	110	1
Watercart	777F WT	110	2
Dozer	D10	109	1
Roller	-	109	2
Truck	20t	109	12
Small Excavator	-	107	2
Service Truck	-	105	1
Light Vehicle	-	88	20

The total SWL for the construction plant and equipment is 125 dB(A) and is the same as the total SWL used in the EIS assessment for construction noise.

7.3 Noise Modelling Methodology

Noise emissions from the various plant and equipment listed in Table 7.1 were calculated to the nearest and potentially most affected residential receiver locations identified in Section 3. Noise emissions were determined by modelling the noise sources, receiver locations, topographical features of the intervening area and recommended noise control treatments, using the Environmental Noise Model (ENM) computer program. ENM is a noise modelling program developed by Renzo Tonin which calculates the contribution of each noise source at each specified receptor point and allows for the prediction of the total noise from a site. ENM is endorsed by the EPA and its environmental noise predictions have been verified on many past occasions using noise monitoring measurements in the field.

Noise levels were calculated at the nearest affected residential locations considering the worst case scenario of all plant operating simultaneously.

7.4 Predicted Construction Noise Levels

Table 7.2 below presents predicted construction noise levels for Year 1 at the nearest potentially affected receivers. Construction noise contours are presented in Appendix E. With regard to noise contours, the calculation involves numerical interpolation from a series of calculations to specific points within a regular spaced grid, 1.5 m above ground level. The noise contours are estimates of the predicted noise levels, and the contour values may differ slightly from equivalent calculations at individual residences.

Table 7.2 – Predicted Construction Noise Levels at Nearest Potentially Affected Receivers ($L_{Aeq(15minute)}$)

ID	Description	Construction Noise Management Level, dB(A)		Predicted Construction Noise Levels for Year 1, dB(A)	
		Standard Hours	Outside Standard Hours	Day	Evening, Night
Privately-owned Dwellings					
M01	Longburra	40	35	<20	<20
M02	Victoria Park	40	35	<20	<20
M03	Ward 1	40	35	<20	<20
M04	Abandoned 2	40	35	23	26
M05	Berrilee	40	35	<20	<20
M06	Bon Accord	40	35	<20	<20
M07	Boxcowal	40	35	<20	<20
M08	Currajong Park 2	40	35	27	29
M09	Daisy Hill	40	35	<20	<20
M10	Glenburn	40	35	22	25
M12	Louisiana 1	40	35	<20	<20
M13	Louisiana 2	40	35	<20	<20
M14	Platina Farm	40	35	<20	<20
M16	Tarron Vale	40	35	<20	<20
M17	Jones 1	40	35	<20	<20
M18	-	40	35	<20	<20
M19	-	40	35	<20	<20
M20	-	40	35	<20	<20

ID	Description	Construction Noise Management Level, dB(A)		Predicted Construction Noise Levels for Year 1, dB(A)	
		Standard Hours	Outside Standard Hours	Day	Evening, Night
M21	Warra Wandi	40	35	<20	<20
M22	Brooklyn	40	35	20	22
M23	Currajong Park 1	40	35	26	29
M24	Flemington 1	40	35	<20	<20
M25	Flemington 2	40	35	<20	<20
M26	Kelvin Grove	40	35	<20	21
M27	Milverton	40	35	<20	<20
M28	Rosehill	40	35	20	22
M29	Slapdown	40	35	22	25
M31	Wanda Bye	40	35	27	30
M34	Fifield Hotel	40	35	<20	21
F01	Fifield residences	40	35	20	23
F02		40	35	<20	21
F03		40	35	<20	21
F04		40	35	<20	<20
F05		40	35	22	25
F06		40	35	21	24
F07		40	35	<20	21
F08		40	35	<20	<20
F09		40	35	<20	<20
F10		40	35	<20	21
F11		40	35	<20	<20
F13		40	35	<20	<20
F14		40	35	<20	<20
F15		40	35	<20	<20
F16		40	35	<20	<20
F17		40	35	<20	<20
F18		40	35	<20	<20
F19		40	35	<20	<20
Community Building					
M32	Fifield Town Hall	55[1]		<20	<20
M33	Fifield Fire Station	70[1]		<20	<20
M35	St Dympna's Catholic Church	55[1]		<20	21
Mine-owned Dwellings					
M15	Sunrise	40	35	21	23

Notes 1. When in use

From Table 7.2, it can be seen that predicted construction noise levels at all residential receivers were found to comply with the construction NMLs for all time periods. Construction noise levels at Fifield Town Hall (receiver M32), Fifield Fire Station (receiver M33) and St Dympna's Catholic Church (receiver M35) were also reviewed against the relevant ICNG NMLs. These predicted noise levels were found to comply with the ICNG NMLs.

8 Operational Noise Assessment

8.1 Operational Noise Modelling Scenarios

The Modification would consist of three distinct production phases and the scenarios selected for operational noise modelling were:

- Year 6 – the year of commencement of utilisation of maximum operational fleet.
- Year 11 – maximum operational fleet with the north-western waste emplacement at maximum height of 320 m Australian Datum Height (AHD) and the north-eastern waste emplacement at maximum height of 305 m AHD.
- Year 21 – maximum operational fleet with the north-western waste emplacement at maximum height of 330 m AHD and the north-eastern waste emplacement at maximum height of 315 m AHD.

8.2 Operational Noise Sources

The SWLs of plant likely to be used during the operation of the Project have been determined based on manufacturer's specifications, or other available information including Renzo Tonin & Associates database of noise levels and previous studies.

Modifying factor adjustments, as per Section 4 of the INP, have been considered for all proposed plant and equipment. Noise from all proposed plant and equipment, individually and in combination were determined not to exhibit tonal, low-frequency, impulsive, and/or intermittent characteristics. Therefore, no modifying factors corrections are required.

A summary of plant and equipment included in the operational noise modelling and relevant SWLs are provided in Table 8.1.

Table 8.1 – Indicative Operational Plant and Equipment List and SWLs

Plant Item	Specification	SWL dB(A) re. 1pW (per Item)	Number of Items			Period of Use
			Year 6	Year 11	Year 21	
Process Plant	-	124	1	1	1	Day, Evening, Night
Front End Loader	992K	117	1	1	1	Day, Evening, Night
Haul Truck	777D	117	7	7	7	Day, Evening, Night
Rockbreaker	CAT336DL	117	1	1	1	Day, Evening, Night
Tractor	773F	117	1	1	1	Day, Evening, Night
Excavator	EX1200	116	4	4	4	Day, Evening, Night
Drill Rig	M6290	114	2	2	2	Day, Evening, Night
Grader	16M	114	2	2	2	Day, Evening, Night
Compactor	CP64	110	1	1	1	Day, Evening, Night

Plant Item	Specification	SWL dB(A) re. 1pW (per Item)	Number of Items			Period of Use
			Year 6	Year 11	Year 21	
Franna Crane	-	110	1	1	1	Day, Evening, Night
Integrated Tool Carrier	950H	110	1	1	1	Day, Evening, Night
Integrated Tool Carrier	980H	110	1	1	1	Day, Evening, Night
Watercart	777F	110	2	2	2	Day, Evening, Night
Dozer	D10	109	4	4	4	Day, Evening, Night
Roller	825H	109	1	1	1	Day, Evening, Night
Service Truck	-	105	4	4	4	Day, Evening, Night
Forklift	MHT-X	103	1	1	1	Day, Evening, Night
Elevated Work Platform	-	98	1	1	1	Day, Evening, Night
Light Vehicle	-	88	20	20	20	Day, Evening, Night

The total SWL for the operational plant and equipment is 129 dB(A) and is 1 dB(A) lower than the total SWL used in the EIS assessment.

8.3 Noise Modelling Methodology

Noise emissions from the various plant and equipment listed in Table 8.1 were calculated to the nearest and potentially most affected residential receiver locations. Noise emissions were determined by modelling the noise sources, receiver locations, topographical features of the intervening area and recommended noise control treatments, using the ENM program.

Noise levels were calculated at the nearest affected residential locations considering the worst case scenario of all plant operating simultaneously. As a further exercise, the noise levels resulting from adverse meteorological conditions, potentially increasing noise emissions at the nearest residences, were computed using the ENM program. These occurrences are expected to be infrequent based on typical weather patterns for the study area and present extreme cases.

Where feasible and reasonable, mitigation measures have been introduced into the proposal to reduce potential noise emissions from the modified Project. The iterative steps undertaken are described below:

1. Preliminary noise modelling of scenarios representative of the maximum noise emissions from the modified Project to identify the potential for noise exceedances (Appendix F).

2. Evaluation of various combinations of noise management and mitigation measures to assess their relative effectiveness.

3. Review of the effectiveness of these measures and assessment of their feasibility by Clean TeQ.

4. Adoption of management and mitigation measures to appreciably reduce noise emissions associated with the Project.

The preliminary noise modelling indicated that in the absence of additional noise mitigation measures, intrusive noise levels at privately-owned dwellings could, with adverse meteorological conditions (i.e. Category F temperature inversion conditions at night), range up to 7 dB(A) above the PSNLs (Appendix F).

Privately-owned dwellings on four properties (M08 and M23 [Currajong Park], M22 [Brooklyn], M29 [Slapdown] and M31 [Wanda Bye]) were predicted to experience moderate or significant exceedances of the PSNLs (i.e. greater than or equal to 3 dB[A] above the PSNLs).

Potential noise management and mitigation measures that would achieve a reduction in Project noise levels under adverse meteorological conditions of up to 7 dB(A) were evaluated with respect to the feasibility of implementing the measures for the modified Project. These measures included significant operational shutdowns and attenuation of a number of major mobile equipment.

While technically feasible, measures to achieve up to a 7 dB(A) reduction at the most-affected receivers were then evaluated in light of the relative costs and benefits that would arise, including potential residential amenity benefits and corresponding capital and operating costs.

Modelling and evaluation of a range of potential noise mitigation benefits, capital and operating costs of mitigation and impacts on related modified Project metrics was undertaken. From this it was identified by Clean TeQ that an appreciable noise reduction of up to 5 dB(A) could be reasonably achieved *albeit* at significant operating cost to Clean TeQ, by modifying mining operations at night during Category F temperature inversion conditions.

To provide a noise reduction of up to 5 dB(A), significant modifications to mining operations at night during Category F temperature inversions would be required, such as ceasing overburden emplacement operations on the north-eastern waste emplacement as well as other constraints to mining operations.

The resulting achievable maximum intrusive noise levels of up to 37 dB(A) would be only marginally above the night-time PSNL of 35 dB(A), and well below the maximum consented noise limit previously approved (i.e. 40 dB[A] at night at the Currajong Park property).

Given the considerable operating costs associated with significantly modifying mining operations during adverse meteorological conditions, Clean TeQ will seek to enter into negotiated agreements with the owners of the four properties with predicted moderate and significant exceedances in accordance with the NSW Government's (2014) *Voluntary Land Acquisition and Mitigation Policy – SSD Mining*. Clean TeQ may also seek to purchase these properties.

If negotiated agreements were to be put in place with the owners of the four properties, or these properties were to become mine-owned, significant modifications to mining operations would not be considered reasonable, and modifications to mining operations would be less significant, with a noise reduction of less than 5 dB(A) (e.g. ceasing operation of a small number of noisy equipment such as drills, moving such equipment to more sheltered areas, or avoiding the use of intermittently operating auxiliary equipment).

However, if negotiated agreements (or purchase agreements) with the owners of the four properties are not achieved, or are only achieved for a subset of the four properties, Clean TeQ would significantly modify mining operations at night during Category F temperature inversions as required to reduce noise levels by up to 5 dB(A).

8.4 Predicted Operational Noise Levels

Table 8.2 below presents predicted operational noise levels for Year 6, Year 11 and Year 21, at the nearest potentially affected receivers.

The results presented in Table 8.2 assume that negotiated agreements (or purchase agreements) are not achieved with the owners of the four properties, and therefore significant modifications to mining operations are required at night during Category F temperature inversion conditions.

For the purposes of modelling, the following significant modifications to mining operations have been assumed during Category F temperature inversions conditions at night:

- Ceased overburden emplacement operations on the north-eastern waste emplacement.
- Ceased operation of a drill in the eastern pit.
- Ceased operation of an intermittently operated item of plant near the MIA (tractor).

A number of residential receivers were found to exceed the PSNL with the assumed mitigation measures in place, as shown in Table 8.2. All community/commercial receivers were found to comply with the PSNL. A summary of the properties with PSNL exceedances during the operational phase are presented in Table 8.3.

There are no privately-owned properties predicted to experience marginal, moderate or significant exceedances above the PSNL with the implementation of the assumed mitigation measures. Receivers M04 [Abandoned property], M08 and M23 [Currajong Park], M10 [Glenburn], M22 [Brooklyn], M28 [Rosehill], M29 [Slapdown] and M31 [Wanda Bye] are predicted to experience negligible exceedances above the PSNL with the assumed mitigation measures in place and are not considered further as per NSW Government (2014) policy.

Receiver M15 is a property that is owned by Clean TeQ with a moderate exceedance above the PSNL predicted in Year 21.

Mitigated operational noise contours, which incorporate the assumed mitigation measures described above, are presented in Appendix G.

With regards to noise contours, the calculation involves numerical interpolation from a series of calculations to specific points within a regular spaced grid, 1.5 m above ground level. It is noted that the noise contours are estimates of the predicted noise levels, and the contour values may differ slightly from equivalent calculations at individual residences.

Table 8.2 – Predicted Operational Noise Levels at Nearest Potentially Affected Receivers ($L_{Aeq(15minute)}$)

ID	Description	PSNL, dB(A)			Predicted Operational Noise Levels, dB(A)								
					Year 6			Year 11			Year 21		
		Day	Evening	Night	Day	Evening and Night		Day	Evening and Night		Day	Evening and Night	
					Calm	Calm	F-Class Inversion	Calm	Calm	F-Class Inversion	Calm	Calm	F-Class Inversion
	Privately-owned Dwellings												
M01	Longburra	*35*	*35*	*35*	<20	<20	28	21	21	29	22	22	30
M02	Victoria Park	*35*	*35*	*35*	21	21	32	25	25	33	25	25	34
M03	Ward 1	*35*	*35*	*35*	<20	<20	27	<20	20	26	22	22	30
M04	Abandoned 2	*35*	*35*	*35*	22	23	34	24	25	**36**	24	26	**36**
M05	Berrilee	*35*	*35*	*35*	<20	<20	26	<20	<20	26	20	20	29
M06	Bon Accord	*35*	*35*	*35*	<20	<20	24	20	21	27	21	21	30
M07	Boxcowal	*35*	*35*	*35*	<20	<20	24	24	24	30	26	25	28
M08	Currajong Park 2	*35*	*35*	*35*	32	34	**37**	34	34	**37**	**37**	**37**	**37**
M09	Daisy Hill	*35*	*35*	*35*	<20	<20	24	26	26	30	27	27	29
M10	Glenburn	*35*	*35*	*35*	21	23	34	24	25	**36**	25	25	**36**
M12	Louisiana 1	*35*	*35*	*35*	22	22	32	25	25	32	25	25	31
M13	Louisiana 2	*35*	*35*	*35*	21	22	32	25	25	32	26	25	31
M14	Platina Farm	*35*	*35*	*35*	<20	<20	23	<20	<20	21	<20	<20	22
M16	Tarron Vale	*35*	*35*	*35*	20	21	28	25	26	31	26	27	32
M17	Jones 1	*35*	*35*	*35*	<20	<20	<20	<20	<20	<20	<20	<20	21
M18	-	*35*	*35*	*35*	<20	<20	<20	<20	<20	<20	21	21	23
M19	-	*35*	*35*	*35*	<20	<20	20	<20	20	23	22	21	26
M20	-	*35*	*35*	*35*	<20	<20	<20	<20	<20	<20	<20	<20	<20
M21	Warra Wandi	*35*	*35*	*35*	<20	<20	24	26	26	29	27	26	28
M22	Brooklyn	*35*	*35*	*35*	27	28	34	35	35	34	**36**	35	33
M23	Currajong Park 1	*35*	*35*	*35*	32	33	**36**	34	34	**37**	**37**	**37**	**37**
M24	Flemington 1	*35*	*35*	*35*	20	20	28	23	25	31	25	25	32
M25	Flemington 2	*35*	*35*	*35*	<20	<20	28	23	24	30	24	24	32
M26	Kelvin Grove	*35*	*35*	*35*	23	25	29	29	29	33	29	29	31
M27	Milverton	*35*	*35*	*35*	23	25	29	30	29	34	32	31	32
M28	Rosehill	*35*	*35*	*35*	23	24	34	26	27	**36**	27	27	34
M29	Slapdown	*35*	*35*	*35*	25	27	33	32	33	**36**	32	33	**36**

ID	Description	PSNL, dB(A)			Predicted Operational Noise Levels, dB(A)								
					Year 6			Year 11			Year 21		
		Day	Evening	Night	Day	Evening and Night		Day	Evening and Night		Day	Evening and Night	
					Calm	Calm	F-Class Inversion	Calm	Calm	F-Class Inversion	Calm	Calm	F-Class Inversion
M31	Wanda Bye	35	35	35	24	26	**36**	26	28	**37**	27	28	**36**
M34	Fifield Hotel	35	35	35	20	22	27	22	24	28	24	25	26
F01	Fifield Residences	35	35	35	22	24	32	25	26	33	27	27	34
F02		35	35	35	22	24	31	24	25	30	26	27	33
F03		35	35	35	20	22	30	23	25	29	25	26	31
F04		35	35	35	<20	21	28	23	24	30	25	25	31
F05		35	35	35	22	25	33	26	27	34	26	27	33
F06		35	35	35	22	24	33	25	26	33	26	27	33
F07		35	35	35	20	22	27	23	24	28	24	25	26
F08		35	35	35	<20	21	27	22	24	28	25	25	29
F09		35	35	35	20	22	28	23	24	29	25	25	30
F10		35	35	35	20	22	27	23	24	29	25	25	29
F11		35	35	35	20	22	27	23	24	29	24	25	28
F13		35	35	35	20	22	27	22	23	27	24	24	27
F14		35	35	35	<20	21	26	22	23	27	23	24	26
F15		35	35	35	<20	20	25	21	22	26	23	23	24
F16		35	35	35	<20	20	26	22	22	25	23	24	28
F17		35	35	35	<20	21	28	22	23	26	23	23	27
F18		35	35	35	20	22	29	24	25	29	25	26	31
F19		35	35	35	20	21	27	23	23	27	24	24	27
Community Building													
M32	Fifield Town Hall	50 when in use			20	22	27	22	24	29	24	24	27
M33	Fifield Fire Station	65 when in use			20	22	27	23	24	28	24	25	28
M35	St Dympna's Catholic Church	50 when in use			20	22	27	23	24	28	24	25	28
Mine-owned Dwellings													
M15	Sunrise	35	35	35	28	30	**37**	29	31	**37**	30	31	**38**

Notes:
1. **Green** denotes a **negligible** exceedance of 0-2 dB(A) above the PSNL.
2. **Orange** denotes a **marginal** exceedance of 3-5 dB(A) above the PSNL.
3. **Red** denotes a **significant** exceedance of >5 dB(A) above the PSNL.

Table 8.3 – Summary of Privately-owned Dwellings with PSNL Exceedances

Zone	Exceedance Level	Maximum Predicted Noise Level		
		Year 6	Year 11	Year 21
Noise Management Zone	Negligible 0-2 dB(A) above PSNL	M08, M23, M31	M04, M08, M10, M23, M28, M29, M31	M04, M08, M10, M22 M23, M29, M31
	Moderate 3-5 dB(A) above PSNL	-	-	-
Noise Affectation Zone	Significant >5 dB(A) above PSNL	-	-	-

From review of the operational noise contours in Appendix G, it can be seen that no property experiences exceedance of the recommended maximum noise levels in Table 2.1 of the INP (Night - 45 dB[A]) on more than 25% of the property (i.e. any land where there is an existing dwelling or where a dwelling could be built under existing planning controls).

It should be noted that this assessment is conservative because the contours in Appendix G are $L_{Aeq(15minute)}$ noise levels, while the recommended maximum mine levels in the INP are averaged over the whole period.

8.5 Amenity Noise Levels

The following receivers were identified that require assessment against the INP Amenity criteria:

- Receiver M32 – Fifield Town Hall.
- Receiver M33 – Fifield Fire Station.
- Receiver M35 – St Dympna's Catholic Church.

Whilst the predicted operational noise levels presented in Section 8.4 for these receivers are $L_{Aeq(15\ minute)}$ noise levels as required by the intrusiveness criterion, rather than $L_{Aeq(period)}$ noise levels as required by the amenity criteria (Section 6.2.2), it is noted that an assessment against the intrusiveness criteria is more conservative than an assessment against the amenity criteria. Therefore, from a review of the predicted operational noise levels for the above receivers, it is evident that the relevant criteria in Section 6.2.2 would be met at these receiver locations.

8.6 Sleep Disturbance

The potential for sleep disturbance from the Project's night-time operations has been based on the noise modelling methodology described in Section 8.3. The proposed operational plant and equipment and their corresponding typical L_{Amax} SWLs used for the prediction of sleep disturbance are presented in Table 8.4.

Table 8.4 – Sleep Disturbance Sound Power Levels (L_{Amax})

Plant Item	Quantity	L_{Amax} SWL, dB(A)
Process Plant	1	124
Front End Loader	1	120
Haul Truck	7	120
Rockbreaker	1	125
Tractor	1	120
Excavator	4	119
Drill Rig	2	117
Grader	2	119
Compactor	1	116
Franna Crane	1	116
Integrated Tool Carrier	1	116
Integrated Tool Carrier	1	116
Watercart	2	116
Dozer	4	116
Roller	1	110
Service Truck	4	116

Based on the SWLs presented above, Table 8.5 presents the predicted night time L_{Amax} noise levels at the nearest affected residential receivers. The maximum noise level predictions take into account the meteorological assessment conditions nominated in Section 5.3 for the night-time period and presented values are the highest L_{Amax} noise levels predicted over all meteorological conditions.

Table 8.5 – Predicted Sleep Disturbance Noise Levels at Nearest Affected Residential Receivers (L_{Amax})

ID	Description	Sleep disturbance criteria (10:00 pm - 7:00 am)		Predicted Sleep Disturbance Level L_{Amax}		
		$L_{A90(15min)}$ + 15	Upper limit	Year 6	Year 11	Year 21
Privately-owned Dwellings						
M01	Longburra	*45*	*65*	32	33	34
M02	Victoria Park	*45*	*65*	35	37	38
M03	Ward 1	*45*	*65*	31	30	34
M04	Abandoned 2	*45*	*65*	36	38	38
M05	Berrilee	*45*	*65*	29	29	33
M06	Bon Accord	*45*	*65*	27	31	34
M07	Boxcowal	*45*	*65*	28	33	32
M08	Currajong Park 2	*45*	*65*	41	41	42
M09	Daisy Hill	*45*	*65*	27	33	32
M10	Glenburn	*45*	*65*	36	38	38
M12	Louisiana 1	*45*	*65*	36	36	35
M13	Louisiana 2	*45*	*65*	35	35	34
M14	Platina Farm	*45*	*65*	25	24	25

ID	Description	Sleep disturbance criteria (10:00 pm - 7:00 am)		Predicted Sleep Disturbance Level L_{Amax}		
		$L_{A90(15min)}$ + 15	Upper limit	Year 6	Year 11	Year 21
M16	Tarron Vale	*45*	*65*	31	34	35
M17	Jones 1	*45*	*65*	20	22	25
M18	-	*45*	*65*	22	23	26
M19	-	*45*	*65*	23	27	29
M20	-	*45*	*65*	21	20	23
M21	Warra Wandi	*45*	*65*	28	32	32
M22	Brooklyn	*45*	*65*	37	38	39
M23	Currajong Park 1	*45*	*65*	39	41	41
M24	Flemington 1	*45*	*65*	31	35	35
M25	Flemington 2	*45*	*65*	31	34	35
M26	Kelvin Grove	*45*	*65*	32	37	36
M27	Milverton	*45*	*65*	33	37	36
M28	Rosehill	*45*	*65*	38	39	38
M29	Slapdown	*45*	*65*	37	39	39
M31	Wanda Bye	*45*	*65*	38	40	39
M34	Fifield Hotel	*45*	*65*	30	30	30
F01	Fifield Residences	*45*	*65*	35	36	37
F02		*45*	*65*	33	34	36
F03		*45*	*65*	32	32	34
F04		*45*	*65*	32	34	34
F05		*45*	*65*	35	37	37
F06		*45*	*65*	35	37	37
F07		*45*	*65*	30	31	29
F08		*45*	*65*	29	31	32
F09		*45*	*65*	30	32	33
F10		*45*	*65*	30	32	32
F11		*45*	*65*	29	32	31
F13		*45*	*65*	29	29	30
F14		*45*	*65*	29	29	29
F15		*45*	*65*	28	28	28
F16		*45*	*65*	29	29	31
F17		*45*	*65*	30	29	30
F18		*45*	*65*	31	32	34
F19		*45*	*65*	30	30	30
Mine-owned Dwellings						
M15	Sunrise	*45*	*65*	39	40	41

From Table 8.5, predicted noise levels for all receivers were found to comply with the nominated criteria for all operational years.

9 Blasting

9.1 Proposed Blasting Activities

During operations, small blasts would be required to fracture the harder overburden material (i.e. typically at depths greater than 25 m) prior to its excavation and removal. Blast sizes with a maximum instantaneous charge (MIC) of approximately 380 kg Ammonium Nitrate Fuel Oil (ANFO) equivalent would be used as required.

9.2 Blasting Assessment Methodology

9.2.1 Air Blast Over Pressure

The distance limits relating to air blast over pressure have been determined using the following formula derived from blasting measurements undertaken by Renzo Tonin & Associates from previous projects in the Hunter Valley region.

$$P = 167 + 6.5 \log_{10} Q - 23 \log_{10} R$$

where

P = pressure, in kilopascals

Q = effective charge mass per delay or MIC in kilograms

R = distance between charge and point of measurement in metres

9.2.2 Ground Vibration

The distance limits relating to ground vibration have been determined using the formula in Australian Standard AS 2187.2-1993 *Explosives – Storage, Transport and Use – Part 2 Use of Explosive*. It is noted that although AS 2187.2-1993 has been superseded by AS 2187.2-2006, AS 2187.2-1993 presents information for estimating free face blasting in hard or highly structured rock in additional to the estimation method for free face blasting in 'average field conditions'. Therefore estimation of ground vibration is based upon AS 2187.2-1993, which states:

$$V = K\left(\frac{R}{Q^{1/2}}\right)^{-1.6}$$

where

V = ground vibration as peak particle velocity in mm/sec.

K = constant related to site and rock properties for estimation purposes. K = 500 for free face blasting in hard or highly structured rock and K = 1140 for free face blasting in 'average field conditions'.

R = distance between charge and point of measurement in metres.

Q = effective charge mass per delay or MIC in kilograms.

9.3 Blasting Impact Assessment

Based on the blasting assessment methodology in Section 9.2, the impacts from blasting activities to the nearest receivers are present in Table 9.1 below

Table 9.1 – Blasting Impact Assessment

ID	Description	Distance from Blasting Activity (m)	Blast Over Pressure Level, L_{peak} (dB(lin))	Ground Vibration, PPV (mm/sec)	
				Hard Rock	Average Rock
	Privately-owned Dwellings				
M01	Longburra	7,186	95	0.04	0.09
M02	Victoria Park	5,424	98	0.06	0.14
M03	Ward 1	7,036	95	0.04	0.09
M04	Abandoned 2	5,747	97	0.06	0.13
M05	Berrilee	7,730	94	0.03	0.08
M06	Bon Accord	6,856	96	0.04	0.10
M07	Boxcowal	6,669	96	0.04	0.10
M08	Currajong Park 2	2,969	104	0.16	0.37
M09	Daisy Hill	6,353	96	0.05	0.11
M10	Glenburn	5,621	98	0.06	0.13
M12	Louisiana 1	5,845	97	0.05	0.12
M13	Louisiana 2	6,025	97	0.05	0.12
M14	Platina Farm	8,019	94	0.03	0.07
M16	Tarron Vale	5,735	97	0.06	0.13
M17	Jones 1	10,418	91	0.02	0.05
M18	-	7,321	95	0.04	0.09
M19	-	7,323	95	0.04	0.09
M20	-	9,371	92	0.03	0.06
M21	Warra Wandi	6,540	96	0.05	0.10
M22	Brooklyn	3,834	101	0.11	0.24
M23	Currajong Park 1	3,023	104	0.16	0.36
M24	Flemington 1	5,354	98	0.06	0.14
M25	Flemington 2	5,547	98	0.06	0.13
M26	Kelvin Grove	5,108	98	0.07	0.15

ID	Description	Distance from Blasting Activity (m)	Blast Over Pressure Level, L_{peak} (dB(lin))	Ground Vibration, PPV (mm/sec)	
				Hard Rock	Average Rock
M27	Milverton	5,127	98	0.07	0.15
M28	Rosehill	4,292	100	0.09	0.20
M29	Slapdown	3,828	101	0.11	0.24
M31	Wanda Bye	4,972	99	0.07	0.16
F01	Fifield Residences	5,252	98	0.06	0.15
F02		5,312	98	0.06	0.14
F03		5,676	97	0.06	0.13
F04		5,875	97	0.05	0.12
F05		5,388	98	0.06	0.14
F06		5,171	98	0.07	0.15
F07		5,583	98	0.06	0.13
F08		5,670	97	0.06	0.13
F09		5,650	97	0.06	0.13
F10		5,681	97	0.06	0.13
F11		5,696	97	0.06	0.13
F13		5,696	97	0.06	0.13
F14		5,800	97	0.06	0.13
F15		5,819	97	0.05	0.13
F16		5,894	97	0.05	0.12
F17		5,985	97	0.05	0.12
F18		6,033	97	0.05	0.12
F19		5,570	98	0.06	0.13
	Community Building				
M34	Fifield Hotel	5,661	97	0.06	0.13
	Mine-owned Dwellings				
M15	Sunrise	4,639	99	0.08	0.18

From Table 9.1, the ground vibration impacts from blasting activities for all receivers will be within the nominated criteria for all time periods. The blast over pressure impacts from blasting activities for all receivers will be within the nominated criteria during the period from Monday to Saturday, between 6:00am and 8:00pm. Therefore, blasting activities should be limited to within these times.

9.4 Blasting Minimum Distance Limits

Based on the blasting assessment methodology in Section 9.2 the minimum distance limits, from blasting activities to the nearest receivers, to comply with blasting criteria for ground vibration are presented in Table 9.2 The minimum distance limits have been determined for both air blast over pressure and ground vibration (free face blasting in 'hard or highly structured rock' and free face blasting in 'average field conditions').

Table 9.2 - Minimum Distance Limits to Comply with Blasting Air Blast Over-Pressure and Ground Vibration Limits

Day	Time of Blasting	Minimum Distance Limits, m		
		MIC = 380 kg		
		Air Blast Over Pressure	Ground Vibration - Hard Rock	Ground Vibration - Average Conditions
Monday to Saturday	9:00 am – 3:00 pm	977	347	580
Monday to Saturday	6:00 am – 9:00 am, 3:00 pm – 8:00 pm	2,659	615	1,029
Sunday, Public Holiday	6:00 am – 8:00 pm	7,236	948	1,586
Any day	8:00 pm – 6:00 am	7,236	948	1,586

10 Road Traffic Noise Assessment

A Road Transport Assessment for the Modification was prepared by GTA Consultants (2017). The modified Project operational traffic would be consistent through the life of the modified Project and the year 2027 was selected as a future assessment scenario by GTA Consultants (2017).

The Road Transport Assessment (GTA Consultants, 2017) identified six road locations for forecasting future traffic volumes to determine the impact on the traffic volumes carried by the surrounding road network for the year 2027. Table 10.1 presents the future day (7:00 am to 10:00 pm) and night (10:00 pm to 7:00 am) total traffic for the Modification, the approved Initial Production Phase and the approved Full Production Phase on the six surrounding road locations, including a breakdown of light and heavy vehicles.

Table 10.1 – Traffic Volumes

Road	Total Traffic (vehicles per day)					
	Day (7:00 am – 10:00 pm)			Night (10:00 pm - 7:00 am)		
	Light	Heavy	Total	Light	Heavy	Total
Year 2027 Modification						
1. The Bogan Way north of Trundle	473	135	608	138	40	178
2. Fifield Road north of Platina Road	409	208	617	207	88	295
3. Fifield-Trundle Road west of The Bogan Way	207	108	316	126	52	178
4. Platina Road east of Fifield Road	207	145	353	126	71	197
5. Wilmatha Road west of Slee Street	236	139	375	207	77	284
6. Slee Street in Fifield	406	207	613	206	85	291
Year 2027 Approved Initial Production Phase						
1. The Bogan Way north of Trundle	393	105	498	33	15	48
2. Fifield Road north of Platina Road	269	100	370	50	24	73
3. Fifield-Trundle Road west of The Bogan Way	116	16	133	32	0	32
4. Platina Road east of Fifield Road	116	39	157	32	12	43
5. Wilmatha Road west of Slee Street	71	26	97	51	14	65
6. Slee Street in Fifield	266	100	366	49	20	69
Year 2027 Approved Full Production Phase						
1. The Bogan Way north of Trundle	420	92	512	123	27	150
2. Fifield Road north of Platina Road	315	207	522	159	88	247
3. Fifield-Trundle Road west of The Bogan Way	165	57	222	100	28	128
4. Platina Road east of Fifield Road	165	117	282	100	58	158
5. Wilmatha Road west of Slee Street	150	136	286	132	75	207
6. Slee Street in Fifield	312	206	518	158	85	243

Based on the traffic volumes in Table 10.1, and the nearest distance from each of the six road locations to residential receivers, the predicted traffic noise levels at the worst affected receiver locations are predicted for the year 2027 and compared against the approved Full Production Phase traffic in Table 10.2. If the predicted traffic noise levels at the closest residential receiver meets the proposed criteria then the criteria would be met at all other residential receivers along the same road.

Table 10.2 – Predicted Day $L_{Aeq, 15hour}$ and Night $L_{Aeq, 9hour}$ Traffic Noise Levels

Road	Distance to Nearest Receiver, m	Day $L_{Aeq, 15hour}$ (dB[A]) (7:00 am – 10:00 pm)			Night $L_{Aeq, 9hour}$ (dB[A]) (10:00 pm - 7:00 am)		
		Total Traffic	Approved Traffic[1]	Differ -ence	Total Traffic	Approved Traffic[1]	Differ -ence
1. The Bogan Way north of Trundle	22	56	54	1.2	53	51	1.2
2. Fifield Road north of Platina Road	35	54	54	0.3	53	53	0.3
3. Fifield-Trundle Road west of The Bogan Way	200	41	39	2.3	41	39	2.1
4. Platina Road east of Fifield Road	52	52	51	0.9	51	50	0.9
5. Wilmatha Road west of Slee Street	16	53	53	0.3	53	53	0.4
6. Slee Street in Fifield	11	57	57	0.2	55	55	0.2

Notes: 1. Full Production Phase traffic. A comparison against the approved Initial Production Phase traffic is provided in Appendix H.

From Table 10.2, the daytime $L_{Aeq\ 15hour}$ traffic noise levels predicted for receivers along all six road locations are within the RNP $L_{Aeq\ 15hour}$ noise criterion of 60 dB(A) for year 2027. The 2 dB(A) relative increase criteria is exceeded for receivers along road location '3. Fifield-Trundle Road west of The Bogan Way', however predicted $L_{Aeq\ 15hour}$ traffic noise levels for the Modification are 19 dB(A) below the RNP noise criterion of 60 dB(A).

From Table 10.2, the night time $L_{Aeq\ 9hour}$ traffic noise levels for receivers along all six road locations are within the RNP $L_{Aeq\ 9hour}$ noise criterion of 55 dB(A) for year 2027. The 2 dB(A) relative increase criteria is exceeded for receivers along road location '3. Fifield-Trundle Road west of The Bogan Way', however predicted $L_{Aeq\ 9hour}$ traffic noise levels for the Modification are 14 dB(A) below the RNP noise criterion of 55 dB(A).

From Table 10.2, the noise level change between the approved Project and the Modification scenarios are small at all receiver locations, well below 12 dB. There are no locations where the Modification would cause an increase of more than 12 dB over the approved scenario noise levels. The Modification therefore complies with the relative increase criteria.

11 Conclusion

11.1 General

- The Project includes an Initial Production Phase focussed on scandium oxide production prior to shifting to the Full Production Phase for scandium oxide and nickel and cobalt precipitate production. Clean TeQ has undertaken a Project Optimisation Study to identify opportunities to improve the overall efficiency of the Full Production Phase of the Project and the Modification involves the implementation of these opportunities.

- A background noise survey for the Project has been conducted and the RBLs, determined in accordance INP methodology, were found to be consistent with what is expected of a rural region. For day, evening and night periods the minimum RBL of 30 dB(A) as nominated in the INP has been adopted to allow for a conservative assessment.

- An analysis of noise enhancement from adverse meteorological conditions has been conducted in accordance with the INP based upon meteorological data collected at the nearby Condobolin meteorological station. Wind enhancement was not found to be a feature of the area but temperature inversions were included in the operational noise modelling. Noise modelling for the operational phase was undertaken under a varied set of adverse meteorological conditions.

11.2 Project Construction Noise

- Project construction activities at the surface would occur 24 hours per day, seven days per week.

- The construction scenario was assessed for Year 1 coinciding with the initial construction of the Project.

- All surrounding receivers were found to comply with the ICNG criteria.

11.3 Project Operational Noise

- Operational scenarios were considered for Year 6, Year 11 and Year 21 coinciding with the commencement of utilisation of maximum operational fleet and subsequent significant stages of development of the north-eastern and north-western emplacements.

- Following the implementation of feasible and reasonable mitigation measures, eight (8) privately owned receivers are predicted to experience negligible (i.e. 1 to 2 dB[A]) exceedances of the PSNL.

- In accordance with the NSW Government's *Voluntary Land Acquisition and Mitigation Policy – SSD Mining* (NSW Government, 2014), such exceedances would not be discernible by the average listener and would not warrant receiver based treatments or controls.

- All receivers are predicted to experience night-time L_{Amax} noise below the sleep disturbance screening criteria.

11.4 Project Blasting Activities

- Blasting activities are proposed for the operational phase of the Project. Blasting impacts from both blast over pressure and ground vibration have been assessed.
- Predicted ground vibration levels at all receivers are within the criteria for all time periods.
- Predicted blast over pressure levels at all receivers are within the criteria for the period from Monday to Saturday, between 6:00am and 8:00pm.
- Blasting activities should be limited to Monday to Saturday, between 6:00am and 8:00pm.

11.5 Project Road Traffic Noise

- Road traffic noise was assessed for the year 2027 and six major road locations of the surrounding road network, as determined by the Road Transport Assessment for the modified Project (GTA Consultants, 2017).
- Predicted road traffic noise at all locations for all periods were found to comply with the RNP criteria.

References

1. Australian and New Zealand Environment Conservation Council (1990) *Technical Basis for Guidelines to Minimise Annoyance Due to Blasting Overpressure and Ground Vibration*.

2. Australian Standard 2187.2-1993 (1993) *Explosives – Storage, Transport and Use – Part 2 Use of Explosives*.

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5. Department of Environment and Climate Change (2009) *NSW Interim Construction Noise Guideline.*

6. Environment Protection Authority (1994) *NSW Environmental Noise Control Manual*.

7. Environment Protection Authority (1999) *NSW Environmental Criteria for Road Traffic Noise*.

8. Environment Protection Authority (2000) *NSW Industrial Noise Policy*.

9. Environment Protection Authority (2013a) *NSW Rail Infrastructure Noise Guideline*.

10. Environment Protection Authority (2013b) *Application Notes – NSW Industrial Noise Policy*. Available at http://www.epa.nsw.gov.au/noise/applicnotesindustnoise.htm

11. Griefahn (1992) *Acoustics Australia vol 20 No 2 August 1992* pp 43-47.

12. GTA Consultants (2017) *Syerston Project Modification 4 Road Transport Assessment.*

13. New South Wales Government (2014) *Voluntary Land Acquisition and Mitigation Policy – SSD Mining.*

APPENDIX A Glossary of Terminology

The following is a brief description of the technical terms used to describe noise to assist in understanding the technical issues presented.

Adverse weather	Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).
Ambient noise	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
Assessment period	The period in a day over which assessments are made.
Assessment point	A point at which noise measurements are taken or estimated. A point at which noise measurements are taken or estimated.
Background noise	Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation, when extraneous noise is removed. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the L_{90} noise level (see below).
Decibel [dB]	The units that sound is measured in. The following are examples of the decibel readings of every day sounds: 0 dB The faintest sound we can hear 30 dB A quiet library or in a quiet location in the country 45 dB Typical office space. Ambience in the city at night 60 dB CBD mall at lunch time 70 dB The sound of a car passing on the street 80 dB Loud music played at home 90 dB The sound of a truck passing on the street 100 dB The sound of a rock band 115 dB Limit of sound permitted in industry 120 dB Deafening
dB(A)	A-weighted decibels. The A-weighting noise filter simulates the response of the human ear at relatively low levels, where the ear is not as effective in hearing low frequency sounds as it is in hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the "A" filter. A sound level measured with this filter switched on is denoted as dB(A). Practically all noise is measured using the A filter.
Frequency	Frequency is synonymous to pitch. Sounds have a pitch which is peculiar to the nature of the sound generator. For example, the sound of a tiny bell has a high pitch and the sound of a bass drum has a low pitch. Frequency or pitch can be measured on a scale in units of Hertz or Hz.
Impulsive noise	Having a high peak of short duration or a sequence of such peaks. A sequence of impulses in rapid succession is termed repetitive impulsive noise.
Intermittent noise	The level suddenly drops to that of the background noise several times during the period of observation. The time during which the noise remains at levels different from that of the ambient is one second or more.
L_{Max}	The maximum sound pressure level measured over a given period.
L_{Min}	The minimum sound pressure level measured over a given period.
L_1	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.
L_{10}	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.

L_{90}	The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L90 noise level expressed in units of dB(A).
L_{eq}	The "equivalent noise level" is the summation of noise events and integrated over a selected period of time.
Reflection	Sound wave changed in direction of propagation due to a solid object obscuring its path.
Sound	A fluctuation of air pressure which is propagated as a wave through air.
Sound absorption	The ability of a material to absorb sound energy through its conversion into thermal energy.
Sound level meter	An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels.
Sound pressure level	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone.
Sound power level	Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power.
Tonal noise	Containing a prominent frequency and characterised by a definite pitch.

APPENDIX B Long-term Noise Monitoring Methodology

B.1 Noise Monitoring Equipment

A long-term unattended noise monitor consists of a sound level meter housed inside a weather resistant enclosure. Noise levels are monitored continuously with statistical data stored in memory for every 15-minute period.

Long term noise monitoring was conducted using the instrumentation listed in Table B.1.

Table B.1 – Long Term Noise Monitoring Instrumentation

Description	Type	Octave band Data	Logger Location(s)
RTA05 (NTi Audio XL2)	Type 1	1/1 & 1/3	L1, L2, L3
RTA07 (NTi Audio XL2, with low noise microphone)	Type 1	1/1 & 1/3	L4, L5, L6, L7

Notes: All meters comply with AS IEC 61672.1 2004 "Electroacoustics - Sound Level Meters" and designated either Type 1 or Type 2 as per table, and are suitable for field use.

The equipment was calibrated prior and subsequent to the measurement period using a Brüel & Kjaer Type 4231 calibrator. No significant drift in calibration was observed.

B.2 Meteorology During Monitoring

Measurements affected by extraneous noise, wind (greater than 5 metres per second) or rain were excluded from the recorded data in accordance with the New South Wales Industrial Noise Policy. Determination of extraneous meteorological conditions was based on data from the Condobolin Airport Automatic Weather Station over the monitoring period.

B.3 Noise vs Time Graphs

Noise almost always varies with time. Noise environments can be described using various descriptors to show how a noise ranges about a level. In this report, noise values measured or referred to include the L_{10}, L_{90}, and L_{eq} levels. The statistical descriptors L_{10} and L_{90} measure the noise level exceeded for 10% and 90% of the sample measurement time. The L_{eq} level is the equivalent continuous noise level or the level averaged on an equal energy basis. Measurement sample periods are usually ten to fifteen minutes. The Noise -vs- Time graphs representing measured noise levels, as presented in this report, illustrate these concepts for the broadband dB(A) results.

APPENDIX C Long-term Noise Monitoring Results

APPENDIX D Short-term Noise Monitoring Results

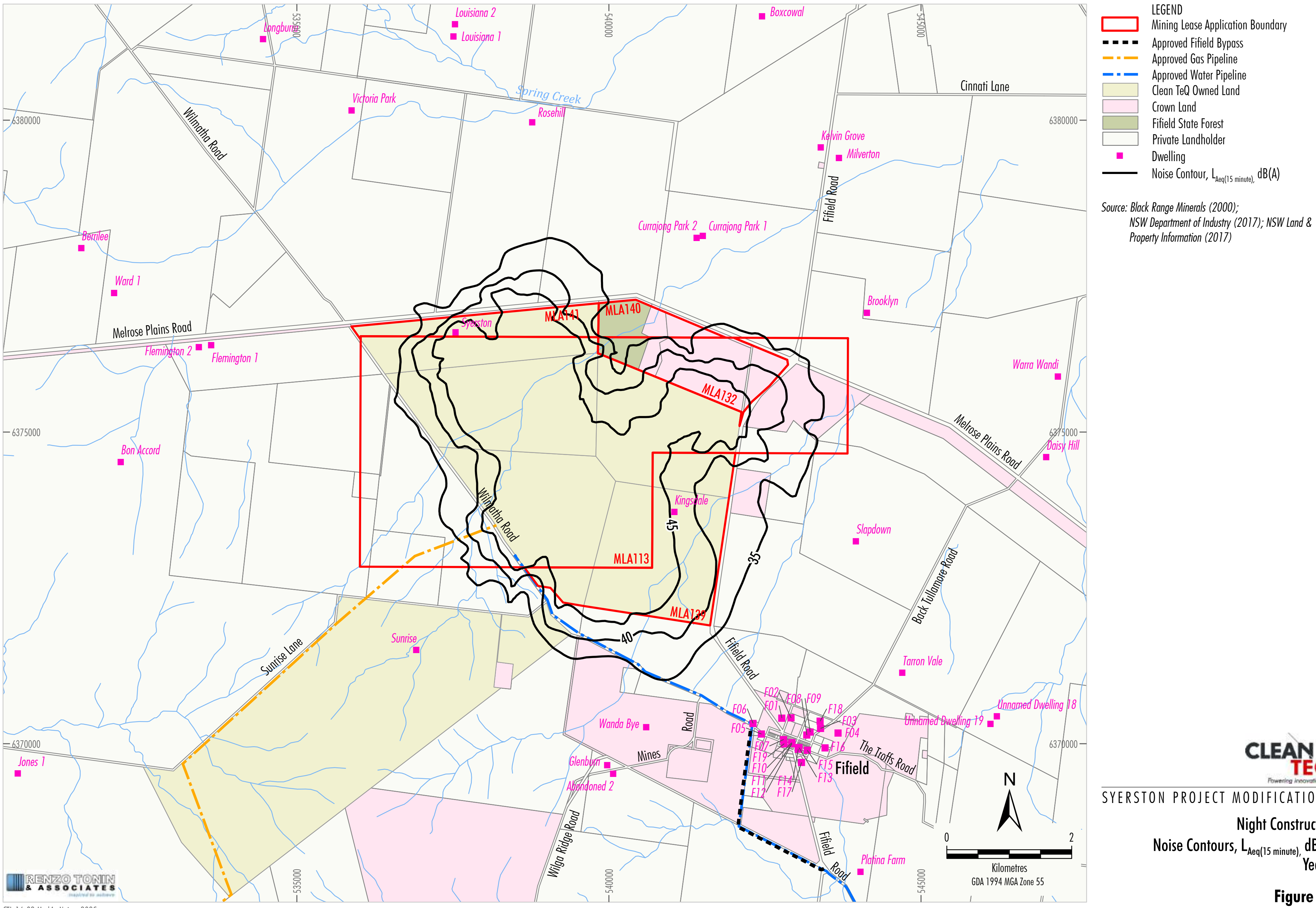
Table D.1 – Short-Term Noise Monitoring Results, dB(A)

Location	Period /Time	Measured noise level, dB(A)		Comments on measured noise levels
		L_{Aeq}	L_{A90}	
L1 – 9 Wilmatha Fifield Road	Day 14/12/2016 5:30 pm – 5:45 pm 5:45 pm – 6:00 pm	 39 39	 46 49	Background noise dominated by traffic on Wilmatha Fifield Road and environmental noise within the Township. Light rain during evening measurement period.
	Evening 14/12/2016 6:00 pm – 6:15 pm 6:15 pm – 6:30 pm	 34 35	 46 43	
	Night 15/12/2016 1:00 am – 1:15 am	 24	 42	
L2 – Slapdown	Day1 15/12/2016 11:00 am – 11:15 am 11:15 am – 11:30 am	 29 27	 37 39	Background noise dominated by environmental noise, distant harvesting activities and distant traffic.
	Evening 14/12/2016 9:45 pm – 10:00 pm	 34	 35	
	Night 14/12/2016 10:00 pm – 10:15 pm	 34	 35	
L3 – Wanda Bye	Day1 15/12/2016 11:00 am – 11:15 am 11:15 am – 11:30 am	 37 38	 42 42	Background noise dominated by environmental noise and distant traffic. On site sheep farming activities occur during the day time. Light rain during evening measurement period.
	Evening 14/12/2016 6:45 pm – 7:00 pm 7:15 pm – 7:30 pm	 32 32	 42 45	
	Night 15/12/2016 12:30 am – 12:45 am	 29	 34	
L4 – Warra Wandi	Day1 15/12/2016 11:00 am – 11:15 am 11:15 am – 11:30 am	 26 29	 43 46	Background noise dominated by environmental noise and traffic on Fifield Kadungle Road. Light rain during evening measurement period.
	Evening 14/12/2016 9:15 pm – 9:30 pm	 42	 44	
	Night 1/152/2016 10:30 pm – 10:45 pm	 43	 49	
L5 – Currajong Park	Day1 15/12/2016 11:00 am – 11:15 am 11:15 am – 11:30 am	 29 29	 38 38	Background noise dominated by environmental noise and distant traffic. On site sheep farming activities occur during the day time. Light rain during evening measurement period.

Location	Period /Time	Measured noise level, dB(A)		Comments on measured noise levels
		L_{Aeq}	L_{A90}	
	Evening 14/12/2016 8:45 pm – 9:00 pm	24	59	
	Night 14/12/2016 11:00 pm – 11:15 pm	22	45	
L6 - Sunrise	Day1 15/12/2016 11:00 am – 11:15 am 11:15 am – 11:30 am	28 34	44 51	Background noise dominated by environmental noise and distant traffic. Light rain during evening measurement period.
	Evening 14/12/2016 7:30 pm – 7:45 pm 7:45 pm – 8:00 pm	36 33	46 39	
	Night 15/12/2016 12:00 am – 12:15 am	35	37	
L7 - Flemington	Day1 15/12/2016 11:00 am – 11:15 am 11:15 am – 11:30 am	40 40	42 42	Background noise dominated by environmental noise and traffic on Melrose Gillenbine Road. Presence of insect noise throughout measurement periods. Light rain during evening measurement period.
	Evening 14/12/2016 8:15 pm – 8:30 pm	37	42	
	Night 14/12/2016 11:30 pm – 11:45 pm	40	44	

Notes: Due to inclement weather conditions, attended measurements could ne be conducted during the site visit. Presented results are based on the audio recording from the long term noise monitor for a period of clear weather.

APPENDIX E Construction Noise Contours



CTL-16-02 Mod4_Noise_208C

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Night Construction
Noise Contours, $L_{Aeq(15\ minute)}$, dB(A)
Year 1

Figure E.1

APPENDIX F Predicted Unmitigated Operational Noise Levels

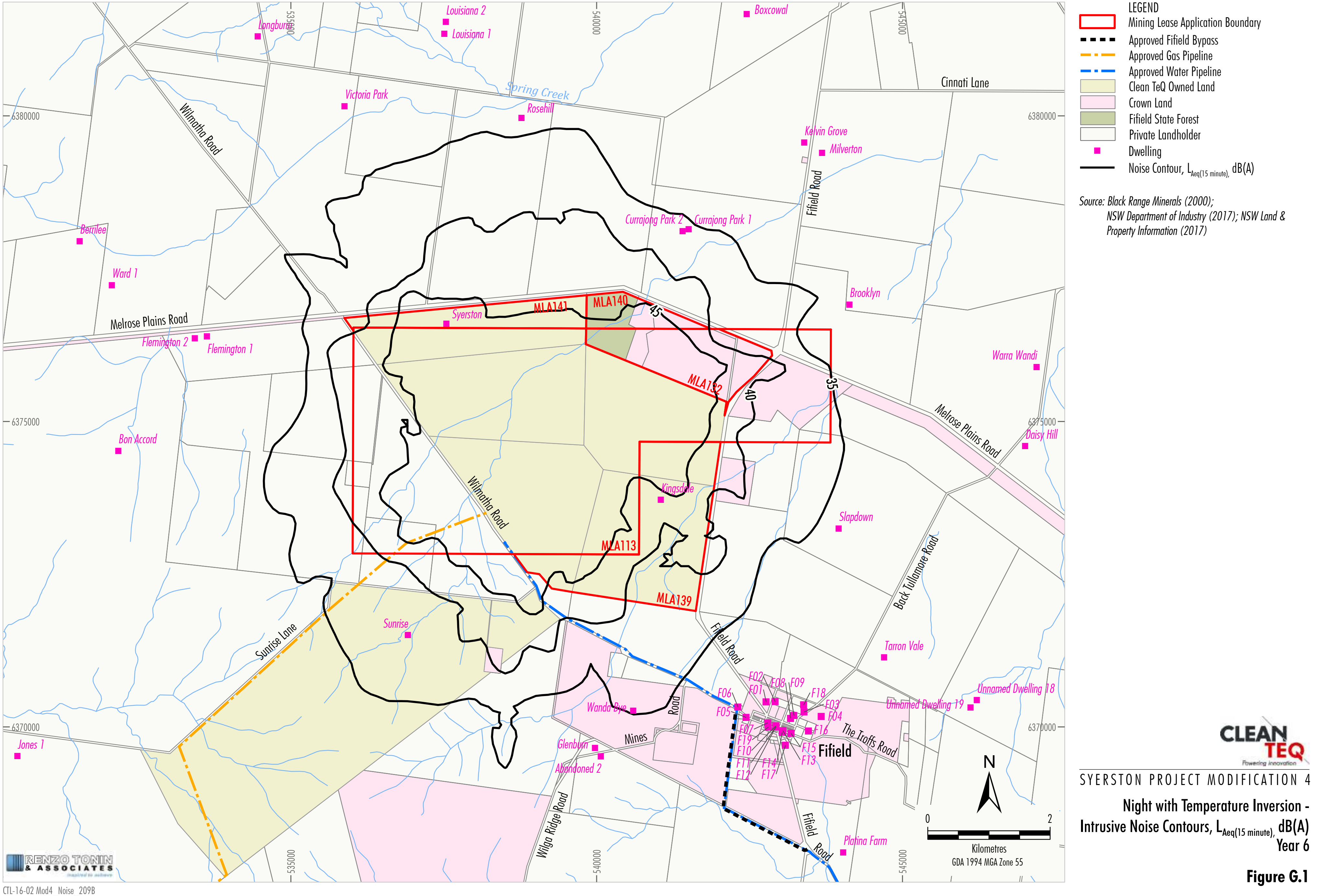
Table E.1 – Predicted Unmitigated Operational Noise Levels at Nearest Potentially Affected Receivers ($L_{Aeq(15minute)}$)

ID	Description	PSNL, dB(A)			Predicted Operational Noise Levels, dB(A)								
					Year 6			Year 11			Year 21		
		Day	Evening	Night	Day	Evening and Night		Day	Evening and Night		Day	Evening and Night	
					Calm	Calm	F-Class Inversion	Calm	Calm	F-Class Inversion	Calm	Calm	F-Class Inversion
Privately-owned Dwellings													
M01	Longburra	35	35	35	<20	<20	28	21	21	30	22	22	31
M02	Victoria Park	35	35	35	21	21	32	25	25	34	25	25	35
M03	Ward 1	35	35	35	<20	<20	27	<20	20	27	22	22	31
M04	Abandoned 2	35	35	35	22	23	35	24	25	**36**	24	26	**36**
M05	Berrilee	35	35	35	<20	<20	26	<20	<20	27	20	20	30
M06	Bon Accord	35	35	35	<20	<20	24	20	21	28	21	21	31
M07	Boxcowal	35	35	35	<20	<20	26	24	24	32	26	25	31
M08	Currajong Park 2	35	35	35	32	34	**40**	34	34	**42**	**37**	**37**	**42**
M09	Daisy Hill	35	35	35	<20	<20	26	26	26	33	27	27	33
M10	Glenburn	35	35	35	21	23	35	24	25	**37**	25	25	**36**
M12	Louisiana 1	35	35	35	22	22	33	25	25	33	25	25	32
M13	Louisiana 2	35	35	35	21	22	32	25	25	33	26	25	32
M14	Platina Farm	35	35	35	<20	<20	23	<20	<20	23	<20	<20	24
M16	Tarron Vale	35	35	35	20	21	29	25	26	33	26	27	34
M17	Jones 1	35	35	35	<20	<20	<20	<20	<20	<20	<20	<20	22
M18	-	35	35	35	<20	<20	21	<20	<20	25	21	21	27
M19	-	35	35	35	<20	<20	21	<20	20	27	22	21	28
M20	-	35	35	35	<20	<20	<20	<20	<20	20	<20	<20	22
M21	Warra Wandi	35	35	35	<20	<20	26	26	26	33	27	26	32
M22	Brooklyn	35	35	35	27	28	**36**	35	35	**42**	**36**	35	**42**
M23	Currajong Park 1	35	35	35	32	33	**40**	34	34	**42**	**37**	**37**	**41**
M24	Flemington 1	35	35	35	20	20	28	23	25	32	25	25	33
M25	Flemington 2	35	35	35	<20	<20	28	23	24	31	24	24	32
M26	Kelvin Grove	35	35	35	23	25	32	29	29	**36**	29	29	35
M27	Milverton	35	35	35	23	25	32	30	29	**37**	32	31	**36**
M28	Rosehill	35	35	35	23	24	34	26	27	**37**	27	27	35
M29	Slapdown	35	35	35	25	27	35	32	33	**39**	32	33	**39**

ID	Description	PSNL, dB(A)			Predicted Operational Noise Levels, dB(A)								
					Year 6			Year 11			Year 21		
		Day	Evening	Night	Day	Evening and Night		Day	Evening and Night		Day	Evening and Night	
					Calm	Calm	F-Class Inversion	Calm	Calm	F-Class Inversion	Calm	Calm	F-Class Inversion
M31	Wanda Bye	35	35	35	24	26	**36**	26	28	**38**	27	28	**37**
F01	Fifield Residences	35	35	35	22	24	32	25	26	35	27	27	**36**
F02		35	35	35	22	24	31	24	25	32	26	27	34
F03		35	35	35	20	22	30	23	25	31	25	26	33
F04		35	35	35	<20	21	29	23	24	32	25	25	33
F05		35	35	35	22	25	33	26	27	35	26	27	35
F06		35	35	35	22	24	33	25	26	35	26	27	35
F07		35	35	35	20	22	28	23	24	31	24	25	30
F08		35	35	35	<20	21	28	22	24	30	25	25	32
F09		35	35	35	20	22	29	23	24	31	25	25	32
F10		35	35	35	20	22	28	23	24	31	25	25	31
F11		35	35	35	20	22	28	23	24	31	24	25	31
F13		35	35	35	20	22	28	22	23	30	24	24	30
F14		35	35	35	<20	21	27	22	23	30	23	24	30
F15		35	35	35	<20	20	27	21	22	29	23	23	29
F16		35	35	35	<20	20	27	22	22	29	23	24	30
F17		35	35	35	<20	21	29	22	23	29	23	23	30
F18		35	35	35	20	22	30	24	25	31	25	26	33
F19		35	35	35	20	21	28	23	23	30	24	24	30
Community Building													
M32	Fifield Town Hall	50 when in use			20	22	28	22	24	31	24	24	30
M33	Fifield Fire Station	65 when in use			20	22	28	23	24	31	24	25	31
M34	Fifield Hotel	35	35	35	20	22	28	22	24	31	24	25	30
M35	St Dympna's Catholic Church	50 when in use			20	22	28	23	24	31	24	25	31
Mine-owned Dwellings													
M15	Sunrise	35	35	35	28	30	**37**	29	31	**38**	30	31	**38**

Notes:
1. **Green** denotes a **negligible** exceedance of 0-2 dB(A) above the PSNL.
2. **Orange** denotes a **marginal** exceedance of 3-5 dB(A) above the PSNL.
3. **Red** denotes a **significant** exceedance of >5 dB(A) above the PSNL.

APPENDIX G Mitigated Operational Noise Contours



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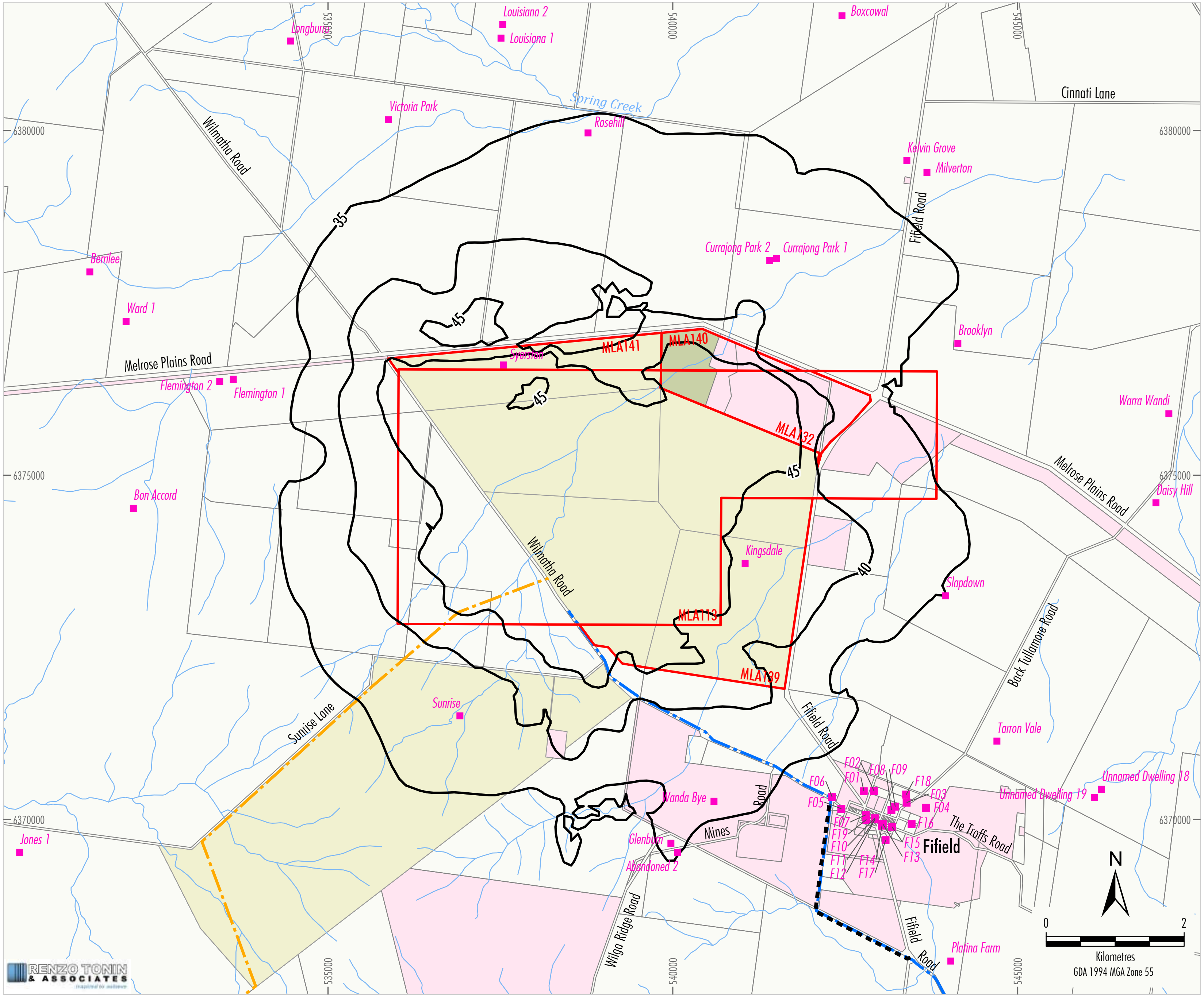
Night with Temperature Inversion - Intrusive Noise Contours, $L_{Aeq(15\ minute)}$, dB(A) Year 6

Figure G.1



LEGEND
- Mining Lease Application Boundary
- Approved Fifield Bypass
- Approved Gas Pipeline
- Approved Water Pipeline
- Clean TeQ Owned Land
- Crown Land
- Fifield State Forest
- Private Landholder
- Dwelling
- Noise Contour, $L_{Aeq(15\ minute)}$, dB(A)

Source: Black Range Minerals (2000); NSW Department of Industry (2017); NSW Land & Property Information (2017)

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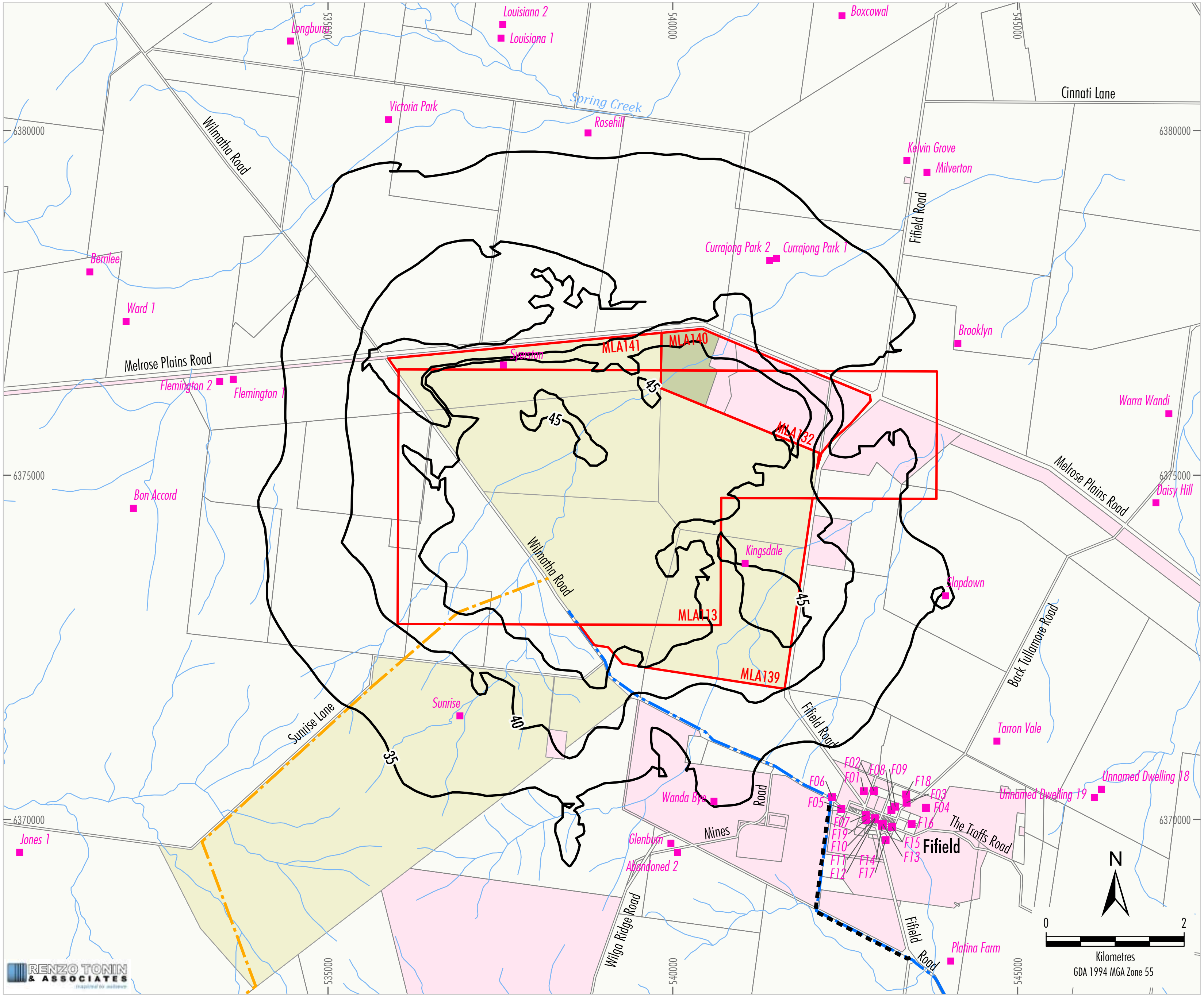
Night with Temperature Inversion - Intrusive Noise Contours, $L_{Aeq(15\ minute)}$, dB(A) Year 11

Figure G.2

CTL-16-02 Mod4_Noise_210B



CTL-16-02 Mod4_Noise_211B

LEGEND

- Mining Lease Application Boundary
- Approved Fifield Bypass
- Approved Gas Pipeline
- Approved Water Pipeline
- Clean TeQ Owned Land
- Crown Land
- Fifield State Forest
- Private Landholder
- Dwelling
- Noise Contour, $L_{Aeq(15\ minute)}$, dB(A)

Source: Black Range Minerals (2000); NSW Department of Industry (2017); NSW Land & Property Information (2017)

N

0 2
Kilometres
GDA 1994 MGA Zone 55

SYERSTON PROJECT MODIFICATION 4

Night with Temperature Inversion - Intrusive Noise Contours, $L_{Aeq(15\ minute)}$, dB(A)
Year 21

Figure G.3

APPENDIX H Road Traffic Noise Results

Table G.1 – Predicted Day $L_{Aeq, 15hour}$ and Night $L_{Aeq, 9hour}$ Traffic Noise Levels

Road	Distance to Nearest Receiver, m	Day $L_{Aeq, 15hour}$ (7:00 am – 10:00 pm)		Night $L_{Aeq, 9hour}$ (10:00 pm - 7:00 am)	
		Total Traffic	Approved Traffic[1]	Total Traffic	Approved Traffic[1]
1. The Bogan Way north of Trundle	22	56	55	53	48
2. Fifield Road north of Platina Road	35	54	51	53	47
3. Fifield-Trundle Road west of The Bogan Way	200	41	35	41	29
4. Platina Road east of Fifield Road	52	52	47	51	44
5. Wilmatha Road west of Slee Street	16	53	46	53	46
6. Slee Street in Fifield	11	57	54	55	49

Notes: 1. Initial Production Phase traffic. A comparison against the approved Full Production Phase traffic is provided in Section 10.

Syerston Project

MODIFICATION 4 ENVIRONMENTAL ASSESSMENT

Appendix C

Preliminary Hazard Analysis

PRELIMINARY HAZARD ANALYSIS FOR THE SYERSTON PROJECT MODIFICATION 4, FIFIELD, NSW

Prepared by: Dean Shewring

26 October 2017

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Preliminary Hazard Analysis for the Syerston Project

Modification 4

Disclaimer

This report was prepared by Pinnacle Risk Management Pty Limited (Pinnacle Risk Management) as an account of work for Clean TeQ Holdings Limited (Clean TeQ). The material in it reflects Pinnacle Risk Management's best judgement in the light of the information available to it at the time of preparation. However, as Pinnacle Risk Management cannot control the conditions under which this report may be used, Pinnacle Risk Management will not be responsible for damages of any nature resulting from use of or reliance upon this report. Pinnacle Risk Management's responsibility for advice given is subject to the terms of engagement with Clean TeQ.

Rev	Date	Description	Reviewed By
A	7/8/17	Draft for Comment	Resource Strategies / Clean TeQ
B	6/10/17	Final Issue	Resource Strategies / Clean TeQ
C	16/10/17	Minor Updates	Resource Strategies / Clean TeQ
D	26/10/17	Minor Updates	Resource Strategies / Clean TeQ

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EXECUTIVE SUMMARY

Scanium21 Pty Ltd owns the rights to develop the approved, but not yet developed, Syerston Project. Scandium21 Pty Ltd is a wholly owned subsidiary of Clean TeQ Holdings Limited (Clean TeQ). The Syerston Project is situated approximately 350 kilometres west-northwest of Sydney, near the village of Fifield, New South Wales (NSW), and was originally approved in 2001.

A Preliminary Hazard Analysis (PHA) was performed on the original design in 2000. This PHA was approved.

Clean TeQ are proposing to modify the original design. The proposed modifications are (the Modification):

- Mining in a more selective manner to initially increase the processing facility ore feed grade;
- Addition of drilling and blasting at the mine site;
- Adoption of the resin-in-pulp (RIP) processing method option (i.e. the counter current decantation processing method option is no longer proposed)[1];
- Increased sulphur and sulphuric acid demand to leach additional nickel, cobalt and scandium from the higher grade ore;
- Increased limestone demand to neutralise the additional acid required in the acid leach circuit;
- Addition of a crystalliser to the processing facility to extract ammonium sulphate from an existing waste stream for use as a fertiliser product;
- Changes to the process input and product road transport requirements;
- Addition of a water treatment plant to the processing facility to recycle process water and minimise make-up water demand;
- Increased tailings storage facility capacity to hold increased tailings volume due to the additional limestone required for acid neutralisation;
- Reduced evaporation pond capacity due to the recycling of process water;
- Relocation of mine infrastructure to avoid resource sterilisation and improve operational efficiency;
- Addition of surface water extraction from the Lachlan River to improve water supply security;
- Minor changes to the borefield transfer station layout and water pipeline alignment;
- Short-term road transport of water from the borefield to the mine site during the initial construction phase; and

---

[1] The Approved Project includes the option to use either the RIP or counter current decantation processing method.

- Reduced gas demand as the increased sulphuric acid production would generate additional steam for power generation.

The Modification would not involve changes to any aspects of the approved limestone quarry, rail siding or gas pipeline.

As part of the environmental assessment for the Modification, an updated PHA is required. This report details the results from the analysis.

The risks associated with the modified mine and processing facility have been assessed and compared against the NSW Department of Planning (now NSW Department of Planning and Environment) risk criteria.

The results are as follows and show compliance with all risk criteria.

Description	Risk Criteria	Risk Acceptable?
Fatality risk to sensitive uses, including hospitals, schools, aged care	0.5×10^{-6} per year	Y
Fatality risk to residential and hotels	1×10^{-6} per year	Y
Fatality risk to commercial areas, including offices, retail centres, warehouses	5×10^{-6} per year	Y
Fatality risk to sporting complexes and active open spaces	10×10^{-6} per year	Y
Fatality risk to be contained within the boundary of an industrial site	50×10^{-6} per year	Y
Injury risk – incident heat flux radiation at residential areas should not exceed 4.7 kW/m^2 at frequencies of more than 50 chances in a million per year or incident explosion overpressure at residential areas should not exceed 7 kPa at frequencies of more than 50 chances in a million per year	50×10^{-6} per year	Y
Toxic exposure - Toxic concentrations in residential areas which would be seriously injurious to sensitive members of the community following a relatively short period of exposure	10×10^{-6} per year	Y
Toxic exposure - Toxic concentrations in residential areas which should cause irritation to eyes or throat, coughing or other acute physiological responses in sensitive members of the community	50×10^{-6} per year	Y
Propagation due to Fire and Explosion – exceed radiant heat levels of 23 kW/m^2 or explosion overpressures of 14 kPa in adjacent industrial facilities	50×10^{-6} per year	Y

Societal risk, area cumulative risk, propagation risk, transport risk and environmental risk are also concluded to be acceptable.

The primary reason for the low risk levels from the modified site is the separation distances between the hazards and the nearest place of residence and site boundary.

The highest contributor to off-site risk is a release of ammonia, in particular, from transfer operations to the storage vessels. The second highest risk contributor involves generic release cases for holes in vessels and piping (typical for all processing facilities). It is expected that the design review process followed by the Hazard and Operability (HAZOP) study would mitigate the generic release cases to acceptable levels. This would include designing to Australian Standard AS2022 for the ammonia storage and handling systems.

The following recommendations are made to lower the off-site risk from the main contributor, i.e. releases of ammonia.

1. Ensure that the final design includes means to automatically isolate the ammonia road tanker (or container) and storage vessels should a release during a transfer occur (vapour and liquid lines). Actuation should be local as well as remote;
2. Provide Closed Circuit Television (CCTV) coverage of the ammonia transfer area to the plant's control room;
3. Provide means to isolate the ammonia flow to the plant should a release occur. This should be at each storage vessel;
4. Provide means to suppress an ammonia vapour plume. A plume could occur due to a release from the transfer system, the storage vessels or the plant supply lines. Options include spray deluge for the transfers bay and fire water monitors in the transfer and storage area. The latter can be operated remotely (preferable) or manually (may require the use of a full protective suit with self-contained breathing air). Monitors can be fixed or portable;
5. Provide means for road tanker driveaway protection. This could include interlocks on the vehicles brakes or self-sealing devices in the transfer lines;
6. Include the transfer hoses and couplings (dry-break preferred) in the preventative maintenance system. The transfer hoses would need to be regularly inspected, tested and replaced as per the manufacturer's recommendations;
7. Provide means for preventing stress corrosion cracking in the ammonia storage vessels and include the vessels in the preventative maintenance system for routine internal inspections;
8. Provide wind socks at appropriate locations to allow people to decide the best means of escape from an ammonia plume;
9. Provide alternate emergency assembly areas given that an ammonia plume can travel in any direction;
10. Provide means for protection for the ammonia road tanker / container driver should a release occur, e.g. safehouse;

11. Apply good practice for building design, e.g. design buildings as safehouses, should relevant guidelines recommend this. For example, design buildings as per the recommendations in the Chemical Industries Association guideline, "Guidance for the Location and Design of Occupied Buildings on Chemical Manufacturing Sites";
12. Provide overfill protection on the ammonia storage vessels. This system should be reviewed via a Safety Integrity Level (SIL) analysis; and
13. Provide means to prevent the vapour compressor from overpressuring the vapour return line and/or the road tanker / container.

GLOSSARY

ANE	Ammonium Nitrate Emulsion
ANSI	American National Standards Institute
API	American Petroleum Institute
AS	Australian Standard
CCPS	Centre for Chemical Process Safety
CCTV	Closed Circuit Television
cLX	Continuous Resin-In-Column
cRIP	Continuous Resin–in-Pulp
DG	Dangerous Good
DoP	NSW Department of Planning (now the Department of Planning and Environment)
ERPG	Emergency Response Planning Guidelines
EIV	Emergency Isolation Valve
HAZOP	Hazard and Operability Study
HIPAP	Hazardous Industry Planning Advisory Paper
HPAL	High Pressure Acid Leach
HSE	Health and Safety Executive (UK)
IBC	Intermediate Bulk Container
IDLH	Immediately Dangerous to Life and Health
LP	Low Pressure
MPF	Mine and Processing Facility
NiCo	Nickel Cobalt
NSW	New South Wales
PHA	Preliminary Hazard Analysis
PSV	Pressure Safety Valve
QRA	Quantitative Risk Analysis
RO	Reverse Osmosis

ROM	Run of Mine
Sc	Scandium
SEP	Surface Emissive Power
SEPP	State Environmental Planning Policy
SFARP	So Far As Reasonably Practicable
SIL	Safety Integrity Level
SMBS	Sodium Metabisulphate
SLOT	Specified Level of Toxicity
SSAN	Security Sensitive Ammonium Nitrate
STEL	Short Term Exposure Limit
SX	Solvent Extraction
TLV	Threshold Limit Value
TNT	Trinitrotoluene
TWA	Time Weighted Average

REPORT

1 INTRODUCTION

1.1 BACKGROUND

Scanium21 Pty Ltd owns the rights to develop the approved, but not yet developed, Syerston Project (the Project), an approved nickel cobalt scandium mining project. Scandium21 Pty Ltd is a wholly owned subsidiary of Clean TeQ Holdings Limited (Clean TeQ). The Project is situated approximately 350 kilometres (km) west-northwest of Sydney, near the village of Fifield, New South Wales (NSW), and was originally approved in 2001.

The Project includes the establishment and operation of the following:

- Mine (including processing facility);
- Limestone quarry;
- Rail siding;
- Gas pipeline;
- Borefields and water pipeline; and
- Associated transport activities and transport infrastructure (e.g. the Fifield Bypass, and road and intersection upgrades).

The Project includes an initial scandium oxide focussed production phase (the Initial Production Phase) prior to shifting to scandium oxide and nickel and cobalt precipitate production by developing the full Project (the Full Production Phase).

The Project would transition to the Full Production Phase once scandium-rich areas of the Syerston deposit are depleted or favourable market conditions prevail for larger scale nickel cobalt scandium production.

Construction of the Project commenced in 2006 with the construction of some components of the borefields, however, Project operations are yet to commence.

Clean TeQ has completed an optimisation study for the Project that has identified a number of opportunities to optimise the Full Production Phase of the Project, as well as increase the water supply security for the Project. These opportunities will be sought through a modification to the Development Consent for the Project (Development Consent DA 374-11-00) under section 75W of the NSW *Environmental Planning and Assessment Act, 1979*. This Preliminary Hazard Analysis (PHA) has been prepared to support the Environmental Assessment prepared for the Modification.

The Modification would include:

- Mining in a more selective manner to initially increase the processing facility ore feed grade;
- Addition of drilling and blasting at the mine site;
- Adoption of the resin-in-pulp (RIP) processing method option (i.e. the counter current decantation processing method option is no longer proposed)[2];
- Increased sulphur and sulphuric acid demand to leach additional nickel, cobalt and scandium from the higher grade ore;
- Increased limestone demand to neutralise the additional acid required in the acid leach circuit;
- Addition of a crystalliser to the processing facility to extract ammonium sulphate from an existing waste stream for use as a fertiliser product;
- Changes to the process input and product road transport requirements;
- Addition of a water treatment plant to the processing facility to recycle process water and minimise make-up water demand;
- Increased tailings storage facility capacity to hold increased tailings volume due to the additional limestone required for acid neutralisation;
- Reduced evaporation pond capacity due to the recycling of process water;
- Relocation of mine infrastructure to avoid resource sterilisation and improve operational efficiency;
- Addition of surface water extraction from the Lachlan River to improve water supply security;
- Minor changes to the borefield transfer station layout and water pipeline alignment;
- Short-term road transport of water from the borefield to the mine site during the initial construction phase; and
- Reduced gas demand as the increased sulphuric acid production would generate additional steam for power generation.

The Modification would not involve changes to any aspects of the approved limestone quarry, rail siding or gas pipeline.

[2] The Approved Project includes the option to use either the RIP or counter current decantation processing method.

The NSW Department of Planning and Environment has not issued formal Secretary's Environmental Assessment Requirements for the Modification, however, has provided some specific advice on key areas of consideration for the Department. This advice includes the following in relation to hazards:

- A detailed hazard and risk assessment should be undertaken in accordance with the State Environmental Planning Policy (SEPP) No. 33 – Hazardous and Offensive Development Application Guidelines (Ref 1); and
- The assessment should take into consideration the potential for higher grades of impurities (e.g. aluminium and manganese), and provide appropriate measures to manage, store and dispose of increased amounts of sulphuric acid and by-product ammonium sulphate.

The original, approved PHA for the Project was completed in 2000 (Ref 2). Clean TeQ has requested Pinnacle Risk Management Pty Limited revise the PHA to reflect the Modification. This PHA has been prepared in accordance with the guidelines published by the NSW Department of Planning (DoP) (now the NSW Department of Planning and Environment) Hazardous Industry Planning Advisory Paper (HIPAP) No 6 (Ref 3).

1.2 Objectives

The main aims of this PHA study are to:

- Identify the credible, potential hazardous events associated with the Modification (including the modified processing facility);
- Evaluate the level of risk associated with the identified potential hazardous events to surrounding land users and compare the calculated risk levels with the risk criteria published by the DoP in HIPAP No 4 (Ref 4);
- Review the adequacy of the proposed safeguards to prevent and mitigate the potential hazardous events; and
- Where necessary, submit recommendations to Clean TeQ to ensure that the modified Project is operated and maintained at acceptable levels of process safety and effective safety management systems are used.

1.3 Scope

This PHA assesses the credible, potential hazardous events and corresponding risks associated with the modified project with the potential for off-site impacts only.

Given the significant separation distances between the potentially hazardous materials and equipment at the processing facility to adjacent land users then only the events that have the potential for off-site impacts are analysed in detail in this PHA. This approach is consistent with the methodology used in the approved PHA from 2000 (Ref 2).

Off-site transport risks are separately assessed as part of this Project's environmental assessments. The transport of more hazardous materials, e.g. ammonia, are included in this PHA.

Given the Modification does not involve any changes to the limestone quarry, rail siding or gas pipeline, the risks associated with these components of the Project have not been reassessed. Notwithstanding, the potential risks of these components, as described in the original PHA, have been included for context.

1.4 METHODOLOGY

In accordance with the approach recommended by the DoP in HIPAP No 6 (Ref 3) the underlying methodology of the PHA is risk-based, that is, the risk of a particular potentially hazardous event is assessed as the outcome of its consequences and likelihood.

The PHA has been conducted as follows:

- Initially, the modified processing facility and its location were reviewed to identify credible, potential hazardous events, their causes and consequences. Proposed safeguards were also included in this review;
- As the potential hazardous events are located at a significant distance from other sensitive land users, the consequences of the potential hazardous events that could have off-site impact were estimated;
- Included in the analysis is the risk of propagation within the site; and
- If adverse off-site impacts could occur, assess the risk levels to check if they are within the criteria in HIPAP No 4 (Ref 4).

1.5 RISK CRITERIA

The assessment of risks to both the public as well as to operating personnel from a potentially hazardous development requires the application of the basic steps outlined above. As per SEPP 33 (Ref 1) and HIPAP No 6 (Ref 3), the chosen analysis technique should be commensurate with the nature of the risks involved.

The typical risk analysis methodology attempts to take account of all credible hazardous situations that may arise from the operation of processing plants etc. Specific incidents, identified by a variety of techniques, are assessed in terms of consequences and likelihood.

Having assembled data on the credible incidents, risk analysis requires the following general approach for individual incidents (which are then summated for all potential recognised incidents to get cumulative risk):

Risk = Likelihood x Consequence

For quantitative risk analysis (QRA) and hazard analysis, the consequences of an incident are calculated using standard correlations and probit-type methods which assess the effect of fire radiation, explosion overpressure and toxicity to an individual, depending on the type of hazard.

In this PHA, however, the approach adopted to assess the risk of the identified hazardous events is scenario based risk assessment. The reason for this approach is the limited hazardous events with the potential for off-site harm, i.e. there are generous separation distances involved to sensitive receptors.

Therefore, appropriate analysis of credible scenarios is performed in this PHA. Typically, the consequences of the potential events with off-site impact are assessed first. For the events which do not contribute to off-site risk (as determined by the risk criteria in HIPAP No 4 (Ref 4), no further risk analysis is warranted. When the consequence of an event does have the potential to impact people off-site, the likelihood and hence risk is then analysed as required.

The NSW DoP risk criteria applying to developments are summarised in Table 1 below (from Ref 4).

Table 1 – Risk Criteria, New Plants

Description	Risk Criteria
Fatality risk to sensitive uses, including hospitals, schools, aged care	0.5×10^{-6} per year
Fatality risk to residential and hotels	1×10^{-6} per year
Fatality risk to commercial areas, including offices, retail centres, warehouses	5×10^{-6} per year
Fatality risk to sporting complexes and active open spaces	10×10^{-6} per year
Fatality risk to be contained within the boundary of an industrial site	50×10^{-6} per year
Injury risk – incident heat flux radiation at residential areas should not exceed 4.7 kW/m^2 at frequencies of more than 50chances in a million per year or incident explosion overpressure at residential areas should not exceed 7 kPa at frequencies of more than 50chances in a million per year	50×10^{-6} per year
Toxic exposure - Toxic concentrations in residential areas which would be seriously injurious to sensitive members of the community following a relatively short period of exposure	10×10^{-6} per year
Toxic exposure - Toxic concentrations in residential areas which should cause irritation to eyes or throat, coughing or other acute physiological responses in sensitive members of the community	50×10^{-6} per year
Propagation due to Fire and Explosion – exceed radiant heat levels of 23 kW/m^2 or explosion overpressures of 14 kPa in adjacent industrial facilities	50×10^{-6} per year

2 SITE DESCRIPTION

The Project consists of the following main components:

- Mine site (including mining areas, nickel and cobalt extraction and refining plant, and power generation plant);
- Limestone quarry;
- Rail siding;
- Water pipeline and borefields;
- Natural gas pipeline; and
- Road upgrades.

Land use surrounding the mine site is largely agricultural and is dominated by sheep farming and cropping (generally wheat).

The mine site is located near the village of Fifield in the Lachlan Shire Local Government Area in the Central Western Region of NSW. The Project is located 45 km northeast of Condobolin. See Figure 1 for location details.

The mine site is accessible by road. The nearest rail station is Kadungle which is approximately 28 km away by road. There are no ecologically sensitive areas (e.g. National Parks or wetlands) in the immediate vicinity of the mine site.

The town of Fifield is located approximately 4.5 km southeast of the mine site. Locations of nearby privately-owned dwellings from the processing plant are (Figure 2):

- 'Sunrise' 2.4 km southwest;
- 'Wanda Bye' 4.6 km south;
- 'Slapdown' 5.6 km east;
- 'Currajong Park' 5.5 km northeast; and
- 'Flemington' 7.2 km northwest.

Adjacent properties are Kingsdale (owned by Clean TeQ) and Sunrise (this property was being purchased by Clean TeQ when revisions A and B of this PHA were being prepared). Therefore, the distance of impact to residential areas is taken as 2.4 km, i.e to 'Sunrise'. The PHA (revision C) results are now conservative as it is understood that the settlement for Sunrise has been concluded.

Security of the site would be achieved by a number of means. This includes site personnel and security patrols by an external security company (including weekends and night patrols). The site would operate 24 hours per day, 7 days per week. The processing plant and explosives storages would be fenced.

There would be approximately 180 people on site during day shifts and 60 people on site during night shifts.

There are no natural hazards for the site that are considered high risk.

Layout drawings showing the proposed location of the facilities are shown in Figure 3 and Figure 4.

Figure 1 - Site Location

Figure 2 – Land Ownership

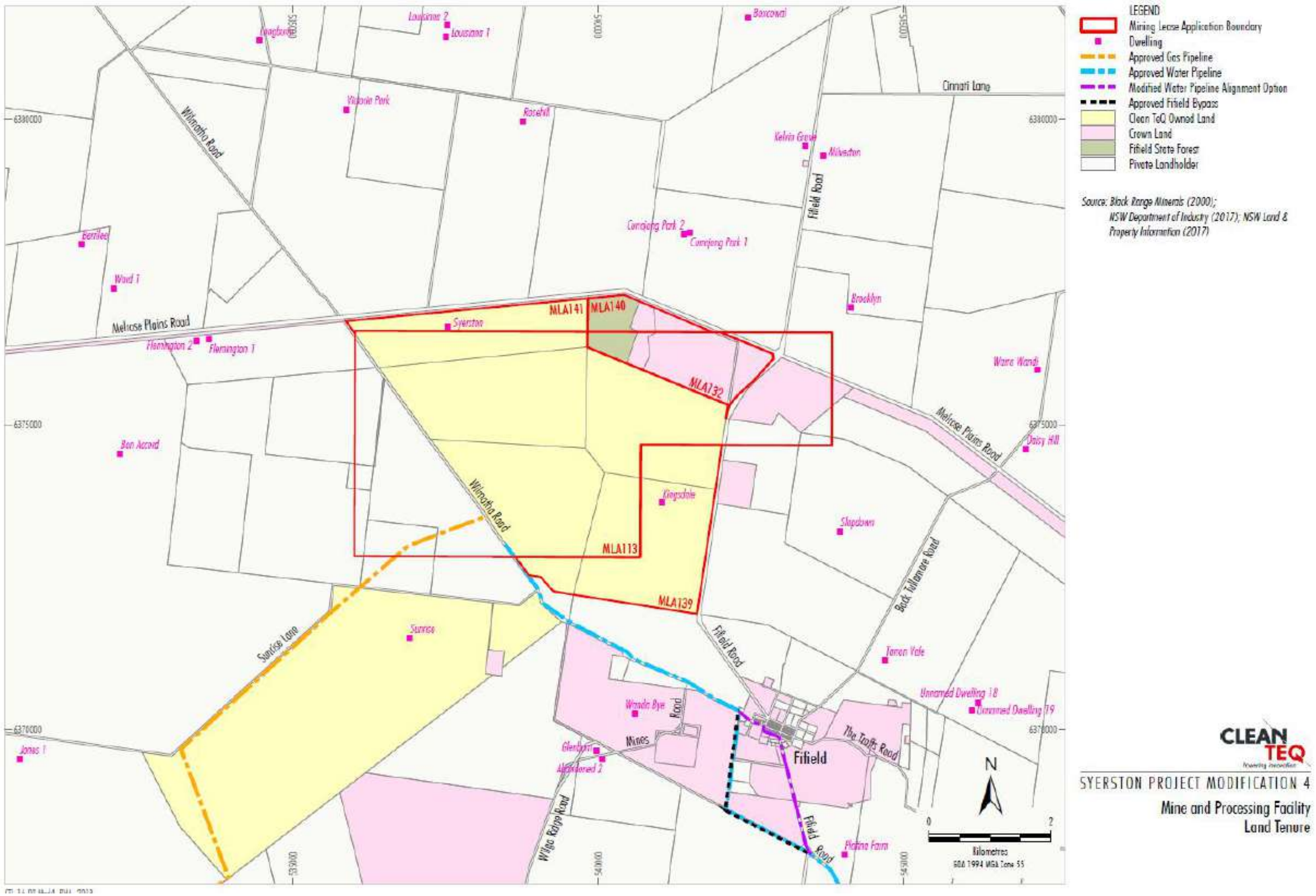


Figure 3 – Site Layout

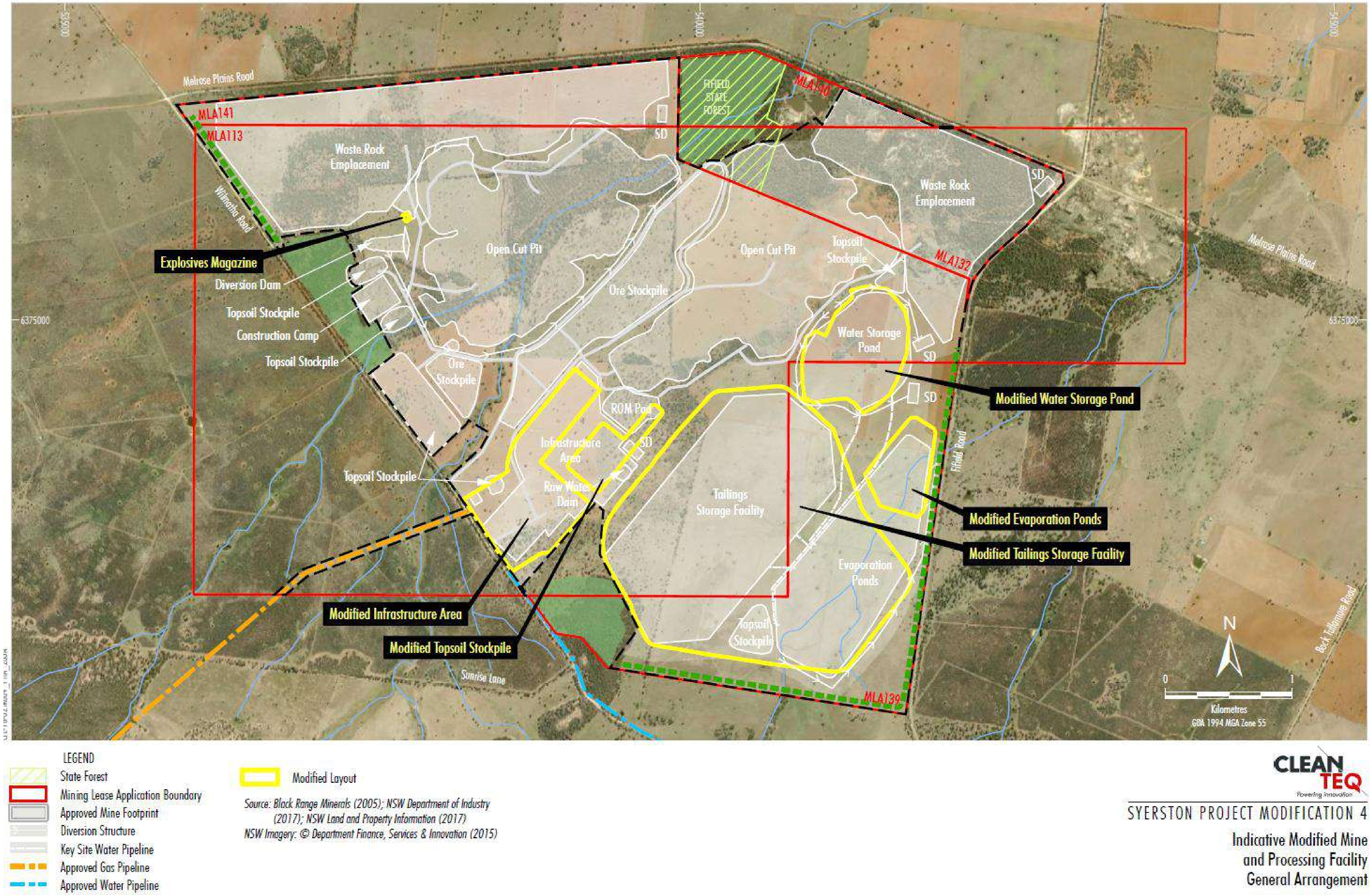
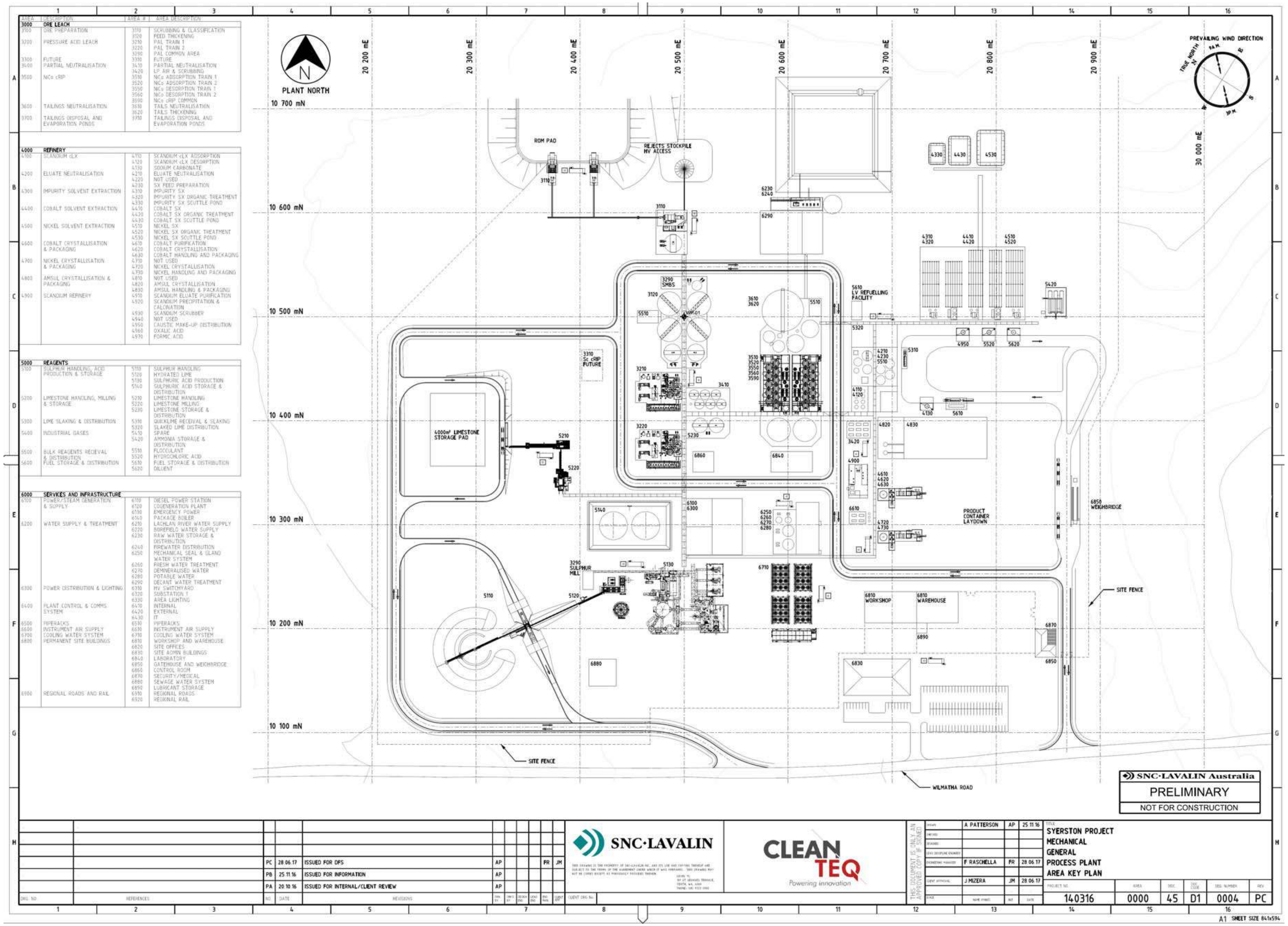


Figure 4 – Processing Plant Layout



3 PROCESS DESCRIPTION

The primary objective of the processing plant is to produce nickel sulphate and cobalt sulphate. Scandium oxide and Amsul (ammonium sulphate – a fertiliser) would also be produced. Proposed production rates are:

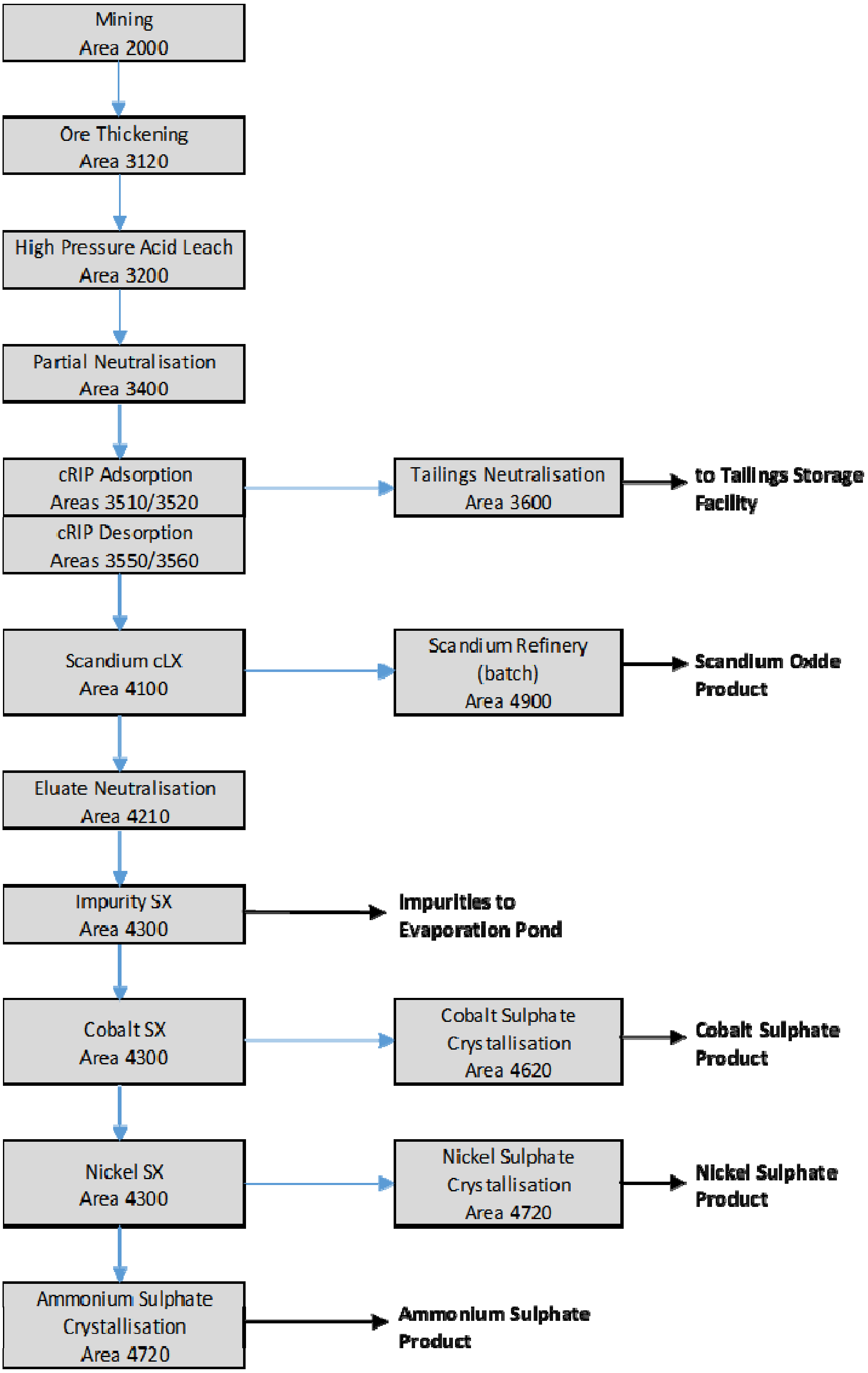
- Nickel and cobalt sulphates: 40,000 tonnes metal equivalents per year;
- Scandium Oxide: 180 tonnes per year; and
- Ammonium sulphate: 100,000 tonnes per year as $(NH_4)_2SO_4$.

The proposed processing plant would consist of the following major components:

- Ore Preparation (3100);
- High Pressure Acid Leaching (3200);
- Partial Neutralisation (3400);
- Nickel Cobalt Continuous Resin in Pulp (3500);
- Tailings Neutralisation (3600);
- Scandium Continuous Resin-in-Column (4100);
- Eluate Neutralisation (4200);
- Impurity, Cobalt, and Nickel Solvent Extraction (4300,4400,4500);
- Cobalt, Nickel and Amsul Crystallisation (4600,4700,4800); and
- Scandium Refinery (4900).

The process flow is summarised in Figure 5.

Figure 5 – Process Flow Schematic



3.1 ORE LEACH (3000)

3.1.1 Ore Preparation (3100)

Scrubbing and Classification (3110)

In the Ore Preparation Plant, the ore would be upgraded by rejecting oversize material enriched in silica. The circuit would be designed to produce a feed slurry thickened to an estimated 48w/w% solids. To achieve this density specification, the ore preparation plant requires feed that has been blended such that the slurry produced has properties that are amenable to thickening and pumping at this density.

The Ore Preparation Plant includes the following:

- The ore would be delivered to the Run of Mine (ROM) stockpile;
- Reclaim and transport via a truck to the process;
- Two crushing trains;
- Conveying, screening and magnetic separators (for tramp metal removal);
- Scrubbing (with water) to remove fines and oversized material (rejects); and
- The ore slurry from the scrubber passes through cyclones, a ball mill for further grinding and further screening.

Feed Thickening (3120)

The processes for feed thickening are as follows:

- The feed ore slurry would be stored in four Thickener Feed Tanks, i.e. each one feeds to a corresponding Feed Thickener;
- The ore feed would be thickened using coagulant and mixed with hot water and boiler blowdown;
- The thickened feed (48w/w% solids) would be stored in surge tanks which are designed to provide continuous feed to both High Pressure Acid Leach (HPAL) autoclaves for 12 hours at 100% production rates; and
- Sulphur slurry would be added to the HPAL feed surge tanks discharge and then pumped to Area 3200.

There are no significant potential fire, explosion or toxic hazardous events in this area that could impact people off-site.

3.1.2 High Pressure Acid Leach (3200)

HPAL Train 1 and 2 (3210/3220)

The function of the HPAL is to extract nickel, cobalt and scandium from the thickened slurry. The HPAL area consists of two separate operating trains. Each train comprises a two-stage direct contact heating system, a leach autoclave and three stages of flash pressure letdown and steam recovery.

The main unit operations in this area are:

- Steam heating of the feed with scrubbing of the vented gases;
- The autoclaves, which operate at a temperature of 250 degrees Celsius (°C) and pressure of 45 barg. The pressure leach process would be performed in an agitated, six compartment, horizontal, autoclave vessel;
- Sulphuric acid (98.5wt%) and supplementary steam are injected into the autoclaves;
- Because of the high working pressure of the autoclaves, it would be necessary to seal the agitator from the process. This would be accomplished with a high security, high-pressure seal system. Each agitator would have a double mechanical seal around the shaft that is attached to the autoclave agitator nozzle. This system effectively prevents depressurisation of the autoclave;
- Gases from the autoclave, e.g. carbon dioxide, are vented via the scrubber;
- The slurry from the autoclaves passes through a three-stage flash process where steam would be recovered for feed and water heating;
- Flashed slurry flows from the low pressure (LP) flash vessel to the HPAL Discharge Tank. The HPAL Discharge Tank would be fed SMBS (sodium metabisulphate) and would be capable of being fed raw water for emergency back-up/start-up; and
- Each of the three flash vessels are capable of discharging gas to a Safety Relief Blast Spool.

HPAL Common Area (3290)

SMBS would be made up in an agitated SMBS Mix Tank in which raw water would be mixed with SMBS from bulkabags.

Sulphuric acid would be pumped via the HPAL Sulphuric Acid Supply Pumps to the autoclaves.

The main process safety hazard in this area involves releases of high pressure acidic slurry. Historically, releases of corrosive material are a hazard to on-site personnel only. Large releases have caused damage to vegetation (i.e. burning) downwind, e.g. up to 100 m.

3.1.3 Partial Neutralisation (3400)

Partial Neutralisation (3410)

The slurry from the HPAL would be partially neutralised with limestone in six agitated tanks, and iron, aluminium and chromium are precipitated. Each tank has a vent that feeds to a ventilation stack for carbon dioxide release.

The partially neutralised slurry would be pumped to the Partial Neutralisation Trash Screens where oversize material would be rejected and sent to the coarse reject stockpile. The partially neutralised slurry would be pumped to the Nickel Cobalt (NiCo) Continuous Resin–in-Pulp (cRIP) Feed Tanks.

There are no significant potential fire, explosion or toxic hazardous events in this area that could impact people off-site.

3.1.4 NiCo Continuous Resin-in-Pulp (3500)

NiCo Adsorption Train 1 and 2 (3510 and 3520)

The cRIP (continuous resin in pulp) process comprises of two identical trains.

Partially neutralised slurry would be pumped to the first NiCo continuous adsorption units (known as Pachucas – air agitated reactors).

The adsorption circuit counter-currently contacts the partially neutralised slurry with resin which selectively adsorbs nickel, cobalt and scandium from the slurry.

Limestone slurry would be added to each of the 10 adsorption Pachucas for further neutralisation.

The resin would be transferred between stages using airlifts. The loaded resin discharges from Pachuca 1 onto the NiCo Loaded Resin Screen and then sent to Area 3550/3560 for desorption.

Gases are vented from all Pachucas and sent to the cRIP Scrubber.

NiCo Desorption Train 1 and 2 (3550/3560)

Loaded resin moves through the desorption process in a non-continuous manner. Small batches of resin are moved by airlifts between columns. The loaded resin would be fed to the top of the NiCo Loaded Resin Collection Column. Process water would be fed to the base and counter currently washes the resin to remove any waste pulp.

The loaded resin would then be airlifted to the NiCo Loaded Resin Wash Column where the resin would be washed to remove residual solids. The wash water would be added to the bottom of the column and moves counter currently to the loaded resin.

After passing through the NiCo Loaded Resin Wash Column, the resin would be airlifted to the NiCo Desorption U-Column where it would be fed to the top and moves counter-currently to the flow of the NiCo eluant. As the eluant flows down the resin filled column the nickel, cobalt and other elements are stripped off the resin into the eluant. The solution in the NiCo Desorption U-Columns forms two liquid products:

(1) NiCo eluate; and

(2) Desorption impurity liquor.

The desorption impurity liquor continues to rise through the column and would be removed through the inlet of the “U” column.

The NiCo eluate accumulates at the lower section of the Desorption Column and would be removed by the NiCo Eluate Extraction Pump to Area 4000, i.e. the refinery.

The barren resin would be removed from the NiCo Desorption U-Columns, washed and reused.

There are no significant potential fire, explosion or toxic hazardous events in this area that could impact people off-site.

3.1.5 Tailings Neutralisation (3600)

Tailings Neutralisation (3610)

Tailings are neutralised with slaked lime to remove free acid and precipitate the metal ions as stable hydroxides prior to being discharged to the tailings dam. The metals are thus captured in the solids, minimising any environmental impact through leaching from the tailings. Tails neutralisation involves tanks, pumps and a thickener (flocculant used - Magnafloc 1011 or equivalent).

The tailings thickener underflow would be combined with gland water and pumped to the tailings dam. The Tailings Thickener overflows into the Tailings Thickener Overflow Tank with the discharge being recycled back to the Tails Thickener and pumped to the Process Water Tank.

3.1.6 Tailings Disposal and Evaporation Ponds (3710)

The Tailings Dam would be fed underflow slurry from the tailings thickener. The Tailings Dam would also be used to store small amounts of waste material from other locations including waste carbon, solid effluent, impurity SX (solvent extraction) crud, cobalt SX crud, nickel SX crud and the tailings dam toe drain pump.

There are no significant potential fire, explosion or toxic hazardous events in this area that could impact people off-site.

3.2 REFINERY (4000)

3.2.1 Scandium Continuous Resin-in-Column (4100)

Scandium Continuous Resin-in-Column Adsorption (4110)

Continuous Resin-In-Column (cLX) is a continuous counter-current process that extracts metals from clarified leach solutions. This area of the process plant involves:

- The NiCo eluate from the NiCo Desorption Trains 1 and 2 flows through the Scandium (Sc) Adsorption Column where the scandium would be adsorbed onto resin;
- Screening (i.e. a Loaded Resin Trommel Screen);
- A Scandium Scrub Wash Column (water used);
- A Scandium Neutralisation Pachuca (caustic used); and
- The discharge of the Eluate Neutralisation Feed Tank would be the eluate neutralisation feed and would go to Area 4200 (eluate neutralisation). This stream contains the nickel and cobalt.

Scandium cLX Desorption (4120)

The desorption process involves four columns, i.e. the:

- Scandium Desorption Column (scandium eluant (sodium carbonate) would be used to desorb scandium from the resin);
- Scandium Desorption (Resin) Wash Column (reverse osmosis (RO) water used);
- Scandium Regeneration Column (regenerates the resin); and
- Scandium Regeneration (Resin) Wash Column.

Scandium eluate (containing the scandium) flows through the Scandium Desorption Column. The scandium eluate leaves from the top of the desorption column and would go to the Scandium Eluate Tank for subsequent purification (Area 4910).

The Scandium Regeneration Column would be fed resin regenerant from the Scandium Regenerant Tank which includes sulphuric acid.

The resin and scandium regenerant counter currently contact each other through the Scandium Regeneration Column. The aqueous discharge leaves the top of the column and would go to Areas 4110 and 3610 as scandium regeneration effluent. From the base of the Scandium Regeneration Column the resin would be airlifted to the Scandium Regeneration Wash Column.

The Scandium Regeneration Wash Column would be fed RO water to the base. The water and resin have counter current contact with the resin being discharged to the Barren Resin Trommel Screen with the overflow being barren resin which recycles to Area 4110. The wash water leaves the top of the Scandium Regeneration Wash Column and would go to the Scandium Regenerant Tank.

Sodium Carbonate (Scandium Eluant) (4130)

Sodium carbonate would be delivered by truck and stored in the Sodium Carbonate Silo. There are two Scandium Eluant Make Up Tanks, both of which are agitated and heated with low pressure steam. The Scandium Eluant Make Up Tanks are fed with scandium desorption wash water. The sodium carbonate feed addition would be controlled by rotary valves and screw feeders. Once leaving the Scandium Eluant Make Up Tanks the Scandium eluant would be pumped to the Scandium Eluant Storage Tank which would be agitated and heated with LP (low pressure) steam.

There are no significant potential fire, explosion or toxic hazardous events in this area that could impact people off-site.

3.2.2 Eluate Neutralisation (4200)

Eluate Neutralisation (4210)

The eluate (containing the nickel and cobalt) neutralisation circuit would reduce the excess acid concentration to a level that facilitates extraction of the valuable metals in a sulphate solution by solvent extraction. In this process, slaked lime would be used as the neutralising agent and some impurity elements (iron, aluminium and chromium) are precipitated out as hydroxides before they are filtered from the neutralised eluate stream.

The eluate neutralisation involves:

- Heating the Eluate Neutralisation Feed (this exchanger would be periodically cleaned with hydrochloric acid and raw water);
- Four agitated Eluate Neutralisation Tanks (fed slaked lime slurry and other process recycle streams);
- Discharge from the Eluate Neutralisation Tank 4 would be pumped to the Eluate Neutralisation Clarifier Feed Tank (flocculant used);
- Discharge from the Eluate Neutralisation Clarifier Feed Tank gravitates to the Eluate Neutralisation Clarifier. Part of the clarifier underflow would be recycled to Eluate Neutralisation Tank 1 and the remainder would be sent to the Eluate Neutralisation Filter Feed Tank. The overflow (containing the nickel and cobalt) flows into the Eluate Neutralisation Clarifier Overflow Tank and would be pumped to Area 4230; and
- The Eluate Neutralisation Filter Feed Tank discharge (i.e. the clarifier underflow) would be pumped to the Eluate Neutralisation Filter. The Filter Air Compressor provides pressure and RO water would be used for cake washing. The solids are periodically discharged into the Repulp Tank and are mixed with cobalt impurity ion exchange waste and process water. The eluate neutralisation repulp slurry would be recycled to Area 3410.

Solvent Extraction (SX) Feed Preparation (4230)

Nickel and cobalt are to be recovered by solvent extraction and then crystallised as high purity sulphates by evaporation and concentration.

The eluate overflow liquor from Eluate Neutralisation Clarifier feeds into the Eluate Polishing Filter. The Eluate Polishing Filter Air Compressor provides pressure and RO water would be used to wash the cake. The filtrate (containing the nickel and cobalt) would go to the SX Feed Heat Exchanger Feed Tank. The sludge discharges in a non-continuous manner to the Eluate Polishing Filter Dump Tank which would also be fed by the Eluate Polishing Filter Sump Pump. The polishing filter dump slurry would go to the Repulp Tank for recycling in the process.

Acid chloride waste and RO water are fed into the Filter Aid Tank, with filter aid also added by hand. This tank would be pumped to two locations; the Eluate Polishing Filter and the Eluate Neutralisation Filter Feed Tank, i.e. the filter aid enhances the performance of the two filters.

The discharge from SX Feed Heat Exchanger Feed Tank (containing the nickel and cobalt) flows through the SX Feed Heat Exchanger and then to the impurity SX feed (Area 4300).

There are no significant potential fire, explosion or toxic hazardous events in this area that could impact people off-site.

3.2.3 Impurity Solvent Extraction (4300)

Impurity SX (4310)

The Extract stage removes the zinc, manganese, cobalt, iron, calcium, 1% nickel and 60% of the magnesium from the aqueous phase (i.e. the eluate containing the nickel and cobalt) and converts them into an organic phase.

The organic phase would be a mixture of diluent and Di-(2-ethylhexyl) phosphate (DEHPA) extractant (a combustible liquid).

Ammonia would be added to control pH to 3.0 to 3.8.

Each Extract stage would be made up of a mixer and a settler.

After exiting the fourth and last Extract tank, the aqueous phase containing the nickel and cobalt would go to Diluent Wash tanks.

The loaded organic (i.e. with the abovementioned impurities) would then be scrubbed to remove the impurities.

The organic then moves into a stripping process which includes hydrochloric acid. The aqueous phase strips any nickel, cobalt, magnesium, manganese, copper, zinc, and calcium from the organic phase. The organic would be washed and recycled back to the extract phase.

Impurity SX Organic Treatment (4320)

In the course of the organic solvent and aqueous phase contacting and separating, an oily film of crud forms. Crud is an emulsion made up of grit, colloidal silica, denatured solvent and extractant. Crud would be treated by agitating with sulphuric acid and then passing to a settling cone. Recovered organic would be decanted off whilst the acidified residue would be returned to the process.

Various SX streams are combined and centrifuged. The solids go to the Crud Drum and are removed via a truck. The organic phase would go to the Impurity SX Recovered Organic Tank where it would be recycled back into the process. The aqueous phase from the centrifuge would also be recycled.

Impurity SX organic treatment also involves filtering and neutralisation with the clean aqueous phase being pumped to Area 4400.

The organic phase containing the impurities would be processed (i.e. extract, scrub and strip stages) and the waste sent to Area 4330.

Impurity SX Scuttle Pond (4330)

Impurity SX scuttled (waste) organic would be sent to the Impurity SX Scuttle Pond.

The significant potential off-site hazardous event from this area is a large release of anhydrous ammonia. It would be possible that the diluent can form a pool fire but the significant radiant heat levels would not travel far from the processing plant.

3.2.4 Cobalt SX (4400)

Cobalt SX (4410)

This stage removes zinc, manganese, cobalt, iron, aluminium, copper and 16% of the magnesium from the aqueous phase containing the nickel and cobalt and converts them into an organic phase in a similar process to Area 4310.

The organic phase, however, would be a mixture of diluent and Cyanex 272 extractant (a combustible liquid).

There are two aqueous phase discharge streams from Area 4400:

- The aqueous phase (containing the nickel) is called the Cobalt SX raffinate; and
- The other aqueous phase is the cobalt SX strip product which contains the cobalt, i.e. the cobalt has been stripped out of the water stream containing the nickel (see below).

Cobalt SX Organic Treatment (4420)

The Cobalt SX raffinate (i.e. the aqueous phase containing the nickel) would go to the Extract After Settler. The organic phase from the settler feeds into the Cobalt SX Crud Tank while the aqueous phase would go to the Cobalt SX Raffinate Filter. The aqueous filter discharge would go to the Cobalt SX Clean Raffinate Tank and would be pumped to Area 4500 for nickel recovery.

The backwash from the filter, with various other streams, would be centrifuged.

The solids go to the Crud Drum and are taken by truck to the Tailings Dam. The organic phase would go to the Cobalt SX Recovered Organic Tank where it would be recycled back into the process. The aqueous phase from the centrifuge would also be recycled.

The cobalt SX strip product (containing the cobalt) from Area 4410 would be further treated via filtering and carbon columns. Cobalt SX Clean Strip Product would then be pumped to the Cobalt Neutralisation Tank and then to Area 4600 for purification, crystallisation and packaging. Waste carbon would go to Area 3700.

Cobalt SX Scuttle Pond (4430)

Cobalt SX Scuttled (waste) Organic would sent to the Cobalt SX Scuttle Pond.

As with Area 4300, the significant potential off-site hazardous event from this area is a large release of anhydrous ammonia. It would be possible that the diluent can form a pool fire but the significant radiant heat levels would not travel far from the processing plant.

3.2.5 Nickel SX (4500)

Nickel SX (4510)

This stage removes the nickel, magnesium, zinc, chromium, manganese, cobalt, iron, aluminium, copper and 10% of the calcium from the aqueous phase and converts them into an organic phase in a similar process to Area 4310.

The organic phase, however, would be a mixture of 50% diluent and 50% versatic acid (not a scheduled hazardous material).

There are two aqueous phase discharge streams from Area 4500:

- The aqueous phase that has the nickel removed is called the Nickel SX raffinate; and
- The other aqueous phase is the nickel SX strip product which contains the nickel (see below).

Nickel SX Organic Treatment (4520)

The Nickel SX raffinate (containing the amsul) would go to the Extract After Settler. The organic phase feeds into the Nickel SX Crud Tank while the aqueous phase would go to the Nickel SX Raffinate Filter. The aqueous phase continues to the Nickel SX Clean Raffinate Tank for amsul production in Area 4800.

The backwash from the filter, with various other streams, would be centrifuged.

The solids go to the Crud Drum and are taken by truck to the Tailings Dam. The organic phase would go to the Nickel SX Recovered Organic Tank where it would be recycled back into the process. The aqueous phase from the centrifuge would also be recycled.

The nickel SX strip product (containing the nickel) would be further treated via filtering and carbon columns. Nickel SX Clean Strip Product would then be pumped to Area 4700 for crystallisation and packaging. Waste carbon would go to the tailings dam.

Nickel SX Organic Treatment (4530)

Nickel SX Scuttled (waste) Organic would be sent to the Nickel SX Scuttle Pond.

As with Area 4300, the significant potential off-site hazardous event from this area is a large release of anhydrous ammonia. It would be possible that the diluent can form a pool fire but the significant radiant heat levels would not travel far from the processing plant.

3.2.6 Cobalt Crystallisation and Packaging (4600)

Cobalt Purification (4610)

Cobalt purification from the cobalt SX clean strip product involves:

- Filtration;
- Copper removal in resin filled columns;
- Manganese precipitation in agitated tanks using Caro's acid (an acid that is formed when hydrogen peroxide and sulphuric acid are mixed); and
- Further filtration with the liquid discharge being purified cobalt sulphate.

Cobalt Crystallisation (4620)

Cobalt crystallisation involves:

- Heating the cobalt crystalliser feed liquor from Area 4610 to evaporate water;
- Once the cobalt solution becomes saturated, cobalt sulphate crystals start to form; and

- The crystals are put through a centrifuge and washed to remove mother liquor.

Cobalt Handling and Packaging (4630)

The cobalt sulphate crystals would be fed into three bins, each of which would have a load cell. The cobalt sulphate product would be packaged into 1 m^3 bags and placed in shipping containers for export. The off-spec cobalt sulphate would be recycled into Area 4620.

The main process safety hazards in Area 4600 involve hydrogen peroxide and sulphuric acid. These are local hazards only.

3.2.7 Nickel Crystallisation and Packaging (4700)

Nickel Crystallisation (4720)

Nickel crystallisation from the nickel SX clean strip product involves:

- Heating the nickel crystalliser feed liquor from Area 4520 to evaporate water;
- Once the nickel solution becomes saturated, nickel sulphate crystals start to form; and
- The crystals are put through a centrifuge and washed to remove mother liquor.

Nickel Handling and Packaging (4730)

The nickel sulphate crystals would be fed into three bins, each of which would have a load cell. The nickel sulphate product will be packaged into 1 m^3 bags and placed in shipping containers for export. The off-spec nickel sulphate would be recycled into Area 4720.

There are no significant potential fire, explosion or toxic hazardous events in this area that could impact people off-site.

3.2.8 Amsul Crystallisation and Packaging (4800)

Amsul Crystallisation (4820)

Amsul crystallisation from the nickel SX clean raffinate involves:

- Heating the raffinate from Area 4520 to evaporate water;
- Once the amsul solution becomes saturated, amsul crystals start to form; and
- The crystals are put through a centrifuge and washed to remove mother liquor.

Amsul Handling and Packaging (4830)

The amsul crystals are sorted into an on-spec and off-spec stockpile. A front-end loader would be used to move the crystals into amsul transport trucks which would move the product in bulk.

There are no significant potential fire, explosion or toxic hazardous events in this area that could impact people off-site.

3.2.9 Scandium Refinery (4900)

Scandium Eluate Purification (4910)

The Scandium Eluate from Area 4120 would be purified using following processes:

- Hydrolysis (chemical breakdown with water) in heated tanks;
- Filtration to remove waste solids;
- Caustic mixing and clarification;
- The clarifier underflow would be pumped to the Scandium Caustic Precipitate Centrifuge which produces scandium hydroxide;
- Washing of the scandium hydroxide with demineralised water;
- Acid (hydrochloric acid) leaching;
- The process liquid stream from leaching would be filtered and then ammonium hydroxide and oxalic acid are added; and
- The $Sc(C_2O_4)_3$ would go to an intermediate storage bin and then moved by hand to the Intermediate Sc_2O_3 Rotary Kiln. The kiln would also be fed diesel and air. Intermediate scandium oxide would go to the Intermediate Hopper.

Scandium Precipitation and Calcination (4920)

Scandium precipitation and calcination involves the following processes:

- Mixing the intermediate scandium oxide with demineralised water and hydrochloric acid;
- Filtration. The residual solids go to the scandium formic acid digestion area. The aqueous portion would go to the Scandium Ammonium Hydroxide Precipitation Tank (which would also be fed ammonia solution);
- The discharge from the Scandium Ammonium Hydroxide Precipitation Tank would be filtered;
- The hydroxide precipitate would be transferred by hand to the Product Sc_2O_3 Rotary Kiln; and
- The scandium oxide product from the kiln would be sent to the Scandium Oxide Drumming Plant.

Scandium Scrubber (4930)

The Scandium Refinery Scrubber would be fed intermediate kiln off gas, product kiln off gas and raw water.

Caustic Make-up and Distribution (4950)

Caustic would be delivered by road tanker and pumped into the Caustic Storage Tank.

Oxalic Acid (4960)

Oxalic acid would be fed out of the Oxalic Acid Hopper to the Oxalic Acid Make Up Tank where it would be mixed with demineralised water and pumped into the Oxalic Acid Storage Tank.

Formic Acid (4970)

Formic acid would be delivered in an IBC (intermediate bulk container) by truck and pumped into the Formic Acid Dosing Tank.

There are no significant potential fire, explosion or toxic hazardous events in this area that could impact people off-site.

3.3 REAGENTS (5000)

3.3.1 Sulphur Handling, Acid Production and Storage (5100)

Sulphur Handling (5110)

Sulphur would be delivered to the Port of Newcastle by ship, transported by rail to the rail siding and then transferred to the site by truck. The truck would enter the loading road and fill the Sulphur Receival Bin with the sulphur.

Sulphur demand would be up to 350,000 tonnes per annum.

The Sulphur Receival bin splits the sulphur into two feeds. One would be the sulphur melter feed which would go onto the Sulphur Melter Feed Conveyor (this would be sprayed with raw water for dust suppression). Hydrated lime would also be fed onto this conveyor and sent to Area 5130 for sulphuric acid production.

The second sulphur feed would go onto the sulphur stockpile for reclaim to the Sulphur Mill Feed Hopper.

The Sulphur Mill Feed Hopper would also be fed from the Lignosulphonate Dosing Pump and the underflow of the Sulphur Cyclone. The Feed Hopper discharges into the Sulphur Ball Mill. The mill discharge slurry would go to the Sulphur Cyclone Feed Hopper and would be pumped into the Sulphur Cyclone. The overflow of the Cyclone would go to the Sulphur Slurry Hopper where it would be pumped into Area 3120 as part of the ore feed thickening process prior to the HPAL autoclaves.

Hydrated Lime (5120)

Hydrated lime would be delivered by Pneumatic Tanker and fed into the Lime Silo. The hydrated lime would be fed to the Sulphur Melter Conveyor.

Sulphuric Acid Production (5130)

This plant would be vendor supplied. Typically, sulphuric acid would be produced by burning the sulphur and forming sulphur dioxide. This would be converted to sulphur trioxide (typically in the presence of vanadium pentoxide catalyst) and absorbed in weak acid to produce the required 98.5% sulphuric acid.

The sulphuric acid plant production rate would be approximately 1,050,000 tonnes per annum.

Sulphuric Acid Storage and Distribution (5140)

The sulphuric acid would be stored in two bunded Sulphuric Acid Storage Tanks (each tank being 12,000 tonne capacity). The acid from the storage tank would be discharged to multiple locations across the plant.

3.3.2 Limestone Handling, Milling and Storage (5200)

Limestone Handling (5210)

The limestone would be delivered to site by a truck and fed into the Limestone Feed Bin. This feeds into the Limestone Feeder which feeds the limestone to the milling circuit.

Limestone Milling (5220)

Limestone milling involves the following processes to make the slurry:

- Screening;
- Crushing;
- Milling in a ball mill; and
- Separation via cyclones.

Limestone Storage and Distribution (5230)

The limestone slurry would be pumped to the Limestone Slurry Storage Tanks 1 and 2 for storage and then distributed to Areas 3500, 3610 and 3410.

3.3.3 Lime Slaking and Distribution (5300)

Quicklime Receival and Slaking (5310)

Quicklime (CaO) would be delivered to site by tanker truck and transferred into the Quicklime Storage. The quicklime would be combined with raw water and fed to the Quicklime Slaking Mill. The mill discharge slurry would be screened and transferred to the Quicklime Slaking Mill Discharge Hopper.

Slaked Lime Distribution (5320)

The slaked lime slurry from the Quicklime Slaking Mill Discharge Hopper would be pumped to the two Slaked Lime Slurry Storage Tanks and distributed to Areas 3610, 4210, 4320 and 6290.

3.3.4 Industrial Gases (5400)

Ammonia Storage and Distribution (5420)

Anhydrous ammonia would be delivered by road tanker and is transferred to the two Anhydrous Ammonia Storage Bullets (100 te capacity each).

Vapour from the bullets passes through the Compressor Knockout Vessels, the Ammonia Unloading Compressors and then back into the ammonia road tanker, i.e. so that liquid ammonia can be transferred into the bullets.

The liquid discharge from the bullets passes through a vaporiser before being distributed to Areas 4310, 4410, 4510 and 4920.

3.3.5 Bulk Reagents Receival and Distribution (5500)

Coagulant and Flocculant (5510)

Solid coagulant would be delivered in a container by truck and transferred into the Coagulant Storage Silo. It would be mixed with raw water and distributed to Area 3120.

Solid flocculant from the warehouse would be stored in the Flocculant Storage Silo where it would be mixed with RO water and distributed to Area 4210.

Flocculant would also be delivered in a container by truck, mixed with water and pumped to the Tails Flocculant Storage Tank. This would be distributed to Areas 3610 and 6290.

Hydrochloric Acid (5520)

Hydrochloric acid would be delivered by tanker and pumped into the Hydrochloric Acid Storage Tank. It would be distributed to Areas 4210, 4310 and 4920.

3.3.6 Fuel Storage and Distribution (5600)

Fuel and diluent are brought to site by a tanker and transferred to the relevant tanks.

The fuel farm would consist of 3 x 60 m^3 self-bunded double walled diesel tanks. Diesel would be available via either high or low speed bowsers or pumped to the power station.

A storage tank for the solvent extraction diluent (similar to diesel) would be located in an earthen bund local to the solvent extraction plant. Diluent would be pumped to the solvent extraction area directly.

An additional two bunded 60 m^3 diesel tanks would be located at the mining contractor area.

An oil/water separator would be included to capture water and oil spillage from the diesel storage area. Water would be pumped to Area 3610. Waste oil would be collected and pumped to a tanker for disposal off-site.

The fuel storage and handling areas are to be designed to meet the requirements of AS1940.

The two potential hazardous events from the reagents area that can impact people off-site are releases of sulphur oxides from the sulphuric acid plant or burning sulphur and releases of anhydrous ammonia. These two events are analysed in this PHA.

3.4 SERVICES AND INFRASTRUCTURE (6000)

3.4.1 Power/Steam Generation and Supply (6100)

Diesel Power Station (6110)

Emergency backup power supply is proposed to be provided by diesel fuelled generators with a capacity of approximately 6 MW. Fuel for the diesel generators would be sourced from the 3 x 60 m^3 plant diesel tanks and stored locally in an above ground storage tank (nominal capacity of 5 m^3) in accordance with the relevant Australian Standards for storage of flammable and combustible liquids (e.g. AS1940) (Ref 5).

Steam would be raised by the sulphuric acid plant waste heat boilers, however, there would also be a small auxiliary boiler to cater for sulphur melting and heat tracing in the acid plant and warm-up of the autoclaves upon black-start conditions.

Included in the proposed design is an option for installing a natural gas pipeline to the site. If installed, the natural gas would be combusted (rather than diesel) to produce power and steam.

The natural gas would be supplied to the site from a lateral of the Moomba to Sydney gas pipeline approximately 75 km south-southwest of the mine site. The pipeline would be approximately 90 km long and buried as per AS2885 (Ref 6). The majority of the line would run within existing road reserves and would cross the Lachlan River near Condobolin.

Cogeneration Plant (6120)

Electricity would be generated by a 25 megawatt (MW) steam turbine High pressure steam feeding the turbine would be raised in the sulphuric acid plant boiler.

The power generation and distribution system would provide electricity for the plant power requirements for both normal and emergency operations. Maximum power demand requirements for the project are anticipated to be in the order of approximately 25 MW.

Package Boiler (6140)

Supplied by Vendor.

3.4.2 Water Supply and Treatment (6200)

Lachlan River Water Supply (6210)

The river water would go over a River Inlet Screen and pumped to the River Water Backwash Filter. It would then be transferred to Area 6220.

Borefield Water Supply (6220)

Six bore water pumps feed water to the Raw Water Break Tank. This water would be pumped to Area 6230 via a water pipeline.

Raw Water Storage and Distribution (6230)

The Raw Water Storage Tank overflows into the Raw Water Storage Pond. This pond would be filled with water. Fire water would be pumped out of both the Raw Water Storage Tank and the Raw Water Storage Pond to the fire water distribution system.

Water from the Raw Water Storage Pond would also be pumped to the Construction Accommodation Camp and to the Mine Utility Water Dam.

Water from the Raw Water Storage Tank and Raw Water Storage Pond are both distributed to numerous locations throughout the processing plant and facility.

Mechanical Seal and Gland Water System (6250)

Filtered water would be stored and used as seal and gland water for rotating equipment throughout the plant.

Fresh Water Treatment (6260)

The Water Treatment Plant would be fed raw water, sulphuric acid, hypochlorite, caustic and scale inhibitor. The plant would produce RO (reverse osmosis) water, filtered water, demineralised water, potable water and RO plant waste water for distribution to different areas of the plant.

Demineralised Water (6270)

Demineralised water leaves the Demineralised Water Column and would go to the Demineralised Water Storage Tank for use throughout the plant.

Potable Water (6280)

Potable water from the Water Treatment Plant would be stored in the Potable Water Break Tank and distributed to numerous areas within the plant and facility.

Decant Water Treatment (6290)

Supplied by Vendor.

3.4.3 Instrument Air Supply (6600)

Instrument Air Supply (6610)

Supplied by Vendor.

3.4.4 Cooling Water System (6700)

Cooling Water System (6710)

Supplied by Vendor.

3.4.5 Process Plant and Site Run-off

The plant site drainage system would be designed to catch all stormwater on the plant site outside the process areas. The system would comprise a network of open earthen drains and culverts which would gravitate to the settlement ponds. The settlement ponds would capture the sediment. The water would be pumped from the settlement ponds to the process raw water pond. The drains would be designed for a 1 in 100 year event and the settlement pond would be designed to contain the rainfall run-off for the 1 in 10 year, 24 hour storm event.

Spills and rain falling on the process areas would be contained within bunded areas (which include pumps and sumps) and would be pumped into the process.

3.4.6 Fire Protection System (6240)

The entire process plant area would be serviced by double head fire water hydrants in accordance with AS2419 – Fire Hydrant Installations (Ref 7).

In addition, the solvent extraction (SX) area would be serviced by a foam deluge system. The solvent extraction area processes an organic solution that consists predominantly of a diluent called Shellsol which is a type of kerosene which has a flash point of 78°C (i.e. a combustible liquid). The SX area consists of tanks, pulsed columns, filters, mixer/settler tanks and electrically powered centrifugal pumps. In the event of a spill, a concrete bund wall that surrounds the area contains all liquid. Within this bunded area there would be partition bund walls to separate the different stages of the SX process.

The foam deluge system for the SX area would consist of hydrant mounted foam monitors, fixed low-level foam-water discharge outlets and heat activated foam-water deluge sprinklers. The entire SX area would be serviced by infrared flame detectors which automatically activate the low-level foam-water discharge outlets in the event of a fire. The flame detectors would be failsafe including wiring and associated equipment. A bladder tank proportioning system would be used for foam addition.

The system would include fire protection equipment for the mine site's diesel fuel storage tanks to meet the relevant Australian Standards for storage of flammable liquids (e.g. AS1940).

The fire water pump set would be comprised of an electrically powered 100% duty pump, a diesel powered 100% standby pump and an electrically powered pressure maintaining 'jockey' pump. The jockey pump would be used to maintain system pressure in the ring main. This would be necessary because of pressure losses caused by normal system losses. The jockey pump prevents premature starting of the main fire service pumps. Large pressure drops in the ring main caused by a hydrant being used would cause the electric fire water pump to start automatically. In the event of a power failure or the electric powered pump fails to start then the diesel-powered pump would start automatically.

A fire suppression system would be installed in the plant's central control room and in each of the plant's electrical substations. Each fire suppression system would consist of a gas storage facility, dual risk detection system, warning and evacuation alarms and distribution piping and fittings.

The system would also include hand held, manually operated fire extinguishers throughout the processing plant, administration buildings, workshop, metallurgical lab and motor control centres for first aid firefighting.

The main potential hazardous event from these services (Area 6000) that could impact people off-site would be failure of the natural gas pipeline to the site.

3.5 Mining and Processing Waste Disposal Areas

The development of the Syerston deposit would involve conventional open pit mining methods at depths of generally 50 m below the surface. The mining method would comprise free digging by excavator. Some blasting may be required during mining. Ore and waste would be loaded directly to haul trucks for transfer to either the process, ROM pad, low grade stockpiles or the waste emplacements.

3.6 Limestone Quarry

There would be no change to the approved limestone quarry for the Modification.

3.7 Rail Siding

There would be no change to the approved rail siding for the Modification.

3.8 Transport

The various aspects of transport associated with the Project are:

- Rail transportation of bulk materials to, and from, the proposed rail siding using containers;
- Road transport of limestone from the limestone quarry or third party suppliers to the mine site;
- Road transport of bulk materials, chemicals, reagents and goods to the mine site;
- On-site transport and storage requirements; and
- Export of product from site.

The rail system would be used primarily for the receival of sulphur plus other reagents and supplies.

The bulk chemicals likely to be transported to the mine site by road tankers are Shellsol (the solvent extraction diluent), diesel, caustic soda (or rail), liquid nitrogen, quicklime, anhydrous ammonia, hydrated lime, sulphuric acid (for startup) and flocculant. Waste oil from the effluent separator would be transported from the mine site by road tanker. The majority of the packaged chemicals (e.g. acids, bases and reagents in bulkiboxes, and chemicals and catalysts supplied in drums, bulkabags or cylinders) are to be transported by road.

The mine site is accessible by the existing local road network. The local road network would be upgraded in accordance with the conditions of Development Consent DA 374-11-00 and Voluntary Planning Agreements with the Lachlan Shire Council, Parkes Shire Council and Forbes Shire Council. Nickel, cobalt and scandium product and Amsul by-product would be exported from the site in containers via road to the rail siding and via rail transport to a suitable port (e.g. Port Botany or Newcastle).

The sulphur transport would be a 350,000 tonne per annum operation involving bulk transport by ship to Newcastle and then by rail and road to the site.

Up to a total of 990,000 tonnes of limestone would be transported by road to the mine site, with up to 790,000 tonnes from the limestone quarry and up to 560,000 tonnes from a third party supplier.

4 HAZARD IDENTIFICATION

4.1 HAZARDOUS MATERIALS

The hazardous materials involved with the Modification are shown in Table 2. Given the large separation distances from the location of these materials to the nearest place of residence to the site (2.4 km) then the materials with the potential for off-site impact are:

- Natural gas due to failure of the natural gas supply pipeline with subsequent ignition. This can occur anywhere along the pipeline;
- Incident involving the explosives storages where the explosives detonate; and
- Ammonia and sulphur oxides due to a large release and dispersion downwind.

4.1.1 Natural Gas

Natural gas is a Class 2.1 Dangerous Good (DG) (flammable gas).

Natural gas is a colourless hydrocarbon fluid mainly composed of the following hydrocarbons:

- Methane (typically 88.5% or higher);
- Ethane (typically 8%);
- Propane (typically 0.2%);
- Carbon dioxide (typically 2%); and
- Nitrogen (typically 1.3%).

For a typical natural gas, the TLV (threshold limit value) is approximately 1,000 parts per million (ppm) and the STEL (short term exposure limit) is 30,000 ppm (i.e. approaching 5vol% which is the lower explosive limit).

The hydrocarbons are not considered to represent a significant environmental threat. Their hazard potential derives solely from the fact that they are flammable materials.

To enable ready leak detection, natural gas is normally odorised with mercaptans (sulphur containing hydrocarbons).

The flammability range is typically 5% to 15% by volume in air. The vapours are lighter than air and will normally disperse safely if not confined and/or ignited.

Natural gas ignition can lead to jet fires, flash fires or vapour cloud explosions.

Products of combustion include carbon monoxide and carbon dioxide.

Table 2 – Materials Summary

Material	Plant Area	Description	Annual Consumption	Storage Amount
Process Plant Raw Materials				
Sulphur Prills	5110	Prilled solids. Transported in closed containers by rail/road and unloaded to an open stockpile	350,000 te	30,000 te
98.5% Sulphuric Acid	5130 (Acid Plant) & 5140 (Acid Storage)	Produced on site in the acid plant and held in two acid storage tanks	1,050,000 te	2 x 12,000 te tanks
Hydrated Lime ($Ca(OH)_2$)	5120	Hydrated lime powder delivered by road tanker to a silo. Used to neutralise sulphur in the acid plant	1,500 te	1 x 25 te silo
Quicklime (CaO)	5310	Quicklime powder is delivered by road tanker to a silo	50,000 te	1 x 160 te silo
Anhydrous Ammonia	5420	Anhydrous ammonia transport bullets are delivered by rail and road, and the liquid ammonia is transferred into storage bullets on-site	28,000 te	2 x 100 te bullets
Flocculant (Ore prep) - BASF Magnafloc 1011 or equivalent)	5510 Flocc /3120 Ore Prep.	Powdered flocculant delivered by road tanker and unloaded to storage silo at site	300 te	1 x 30 te silo
Flocculant (Eluate Neutralisation) - BASF Magnafloc E10 or equivalent	5510 Flocc /4210 Eluate Neut.	Powdered flocculant delivered in 25 kg bags on a pallet. Pallet stored in warehouse and/or suitable storage shed local to the process area	2 te	1 pallet of 40 x 25 kg bags

Material	Plant Area	Description	Annual Consumption	Storage Amount
Flocculant (Tailings) -BASF Magnafloc 338 or equivalent	5510 Flocc /3620 Tails Thickening	Powdered flocculant delivered by road tanker and unloaded to storage silo at site	300 te	1 x 30 te silo
Flocculant (Process Water Treatment) SNF FLOPAM AN910 or equivalent	5510 Flocc /6290 Process Water Treatment	Powdered flocculant delivered by road tanker and unloaded to storage silo at site	300 te	1 x 30 te silo
Hydrochloric Acid (33%)	5520	33% hydrochloric acid is delivered by road in isotainers and unloaded to a storage tank on site	17,000 te	1 x 250 m^3 storage tank, + 1 x 50 m^3 day tank
Diluent -Shell Shellsol D70 or equivalent	5620		200 m^3	1 X 35 m^3 storage tank
Sodium Metabisulphate (SMBS)	3290	Powder SMBS delivered in either 1 te bulkabags or via truck	6,000 te	30 x 1 te bulkabags of powder 1 x 16 m^3 mix tank @ 350g/L 1 x 48 m^3 storage tank @ 350g/L
Oxalic Acid	4960	Powder delivered in 1 te bulkabags. 100 g/L oxalic acid solution is prepared on site in a mixing plant	200 te	20 x 1 te bulkabags of powder 1 x 16 m^3 mix tank @ 100g/L 1 x 48 m^3 storage tank @ 100g/L
Formic Acid	4970	99% solution delivered in either 1 m^3 IBCs or via tanker	3,500 te	1 x 50 m^3 storage tank
Resin, cRIP	3500	Resin delivered in 1 te bulkabags	800 te	30 x 1 te bulkabags

Material	Plant Area	Description	Annual Consumption	Storage Amount
Resin, Sc cLX	4100	Resin delivered in 25 kg bags and added to the process by hand via a hopper	15 te	2 pallets of 40 x 25 kg bags
Extractant - D2EHPA	4310	Solution delivered in 1 m^3 IBCs	15 m^3	2 x 1 m^3 IBCs
Extractant -Cytec Cyanex 272	4410	Solution delivered in 1 m^3 IBCs	15 m^3	2 x 1 m^3 IBCs
Extractant -Hexion Versatic Acid 10	4510	Solution delivered in 1 m^3 IBCs	60 m^3	6 x 1 m^3 IBCs
Caustic (NaOH)	4950	50%w/w caustic solution delivered in isotainers	400 te	1 x 35 m^3 storage tank
Soda Ash (Na_2CO_3)	4130	Bulk powder delivery by road tanker into a silo at site	8,000 te	1x110 te silo
Hydrogen Peroxide (70w/w%)	4610	Solution delivered in 1 m^3 IBCs or isotainer	70 te	8 x 1 m^3 IBCs or 2x20 m^3 isotainers
Sodium Hypochlorite (12.5% Av Chlorine)	6280	Solution delivered in 200 L drums	2 m^3	2 x 200 L drums
Diesel Fuel (excludes mine, refinery only)	5610	Delivered in tank trucks and stored in diesel storage tanks on site	6,500 m^3 (estimate only)	3 x 60 kL storage tanks
Mine				
Mining Diesel	Mining contractors yard	Delivered in tank trucks and stored in diesel storage tanks on site	3,700 m^3 (estimate only)	2x 60 kL storage tanks
Mining Explosives	Explosives magazine	-	-	Stored in secure magazine at site

Material	Plant Area	Description	Annual Consumption	Storage Amount
'In-Process' Fluids				**Estimates Only**
Molten Sulphur	5130	Sulphur is melted and burned in the acid plant to make sulphuric acid	-	1 x 1000 te dirty tank 1 x 2000 te clean tank
Sulphur dioxide and sulphur trioxide (SO_2/SO_3)	5130	SO_2 and SO_3 are intermediates in the production of sulphuric acid. SO_2 is produced by burning sulphur and is catalytically converted to SO_3. SO_3 is absorbed in acid to produce stronger acid. Low level SO_2/SO_3 atmospheric emissions (<250 ppm) leave the acid plant stack	-	No storage, however, large volumes exist within the acid plant
Slaked Lime Slurry	5210/5320	Quicklime is slaked on site to produce a hydrated lime slurry which used for neutralising process liquors. Slaked lime slurry is stored in the slaker and two storage tanks	-	2 x 135 m^3 slurry storage tanks (@ 30w/w% solids)
HPAL Process Slurry	3200	Acidic process slurry (40 g/L free acid) at high temperature (250°C) and pressure	-	2 x 718 m^3 autoclaves plus other piping, heaters and flash vessels
Partial Neutralisation Slurry	3410	Partially neutralised slurry (pH<4) at atmospheric temperature and pressure	-	6 x 0.5 ML tanks
Tailings Slurry	3600	Neutralised process slurry (pH ~6) at atmospheric temperature and pressure	-	Multiple large process tanks
cRIP Slurry	3500	Partially neutralised slurry (pH <4) at atmospheric temperature and pressure	-	Estimate ~20 ML of process tankage

Material	Plant Area	Description	Annual Consumption	Storage Amount
cRIP Eluate	4100	Partially neutralised pregnant liquor (pH ~2) at atmospheric temperature and pressure	-	Multiple large process tanks
Neutralised Eluate	4200	Neutralised pregnant liquor (pH ~6) at atmospheric temperature and pressure	-	Multiple large process tanks
Various Solvent Extraction Process Fluids	4300-4900	SX organic phases (combustible) SX aqueous phases (acidic)	-	Multiple large process tanks

4.1.2 Explosives (Ammonium Nitrate Emulsion)

Ammonium nitrate emulsion (ANE) is a Dangerous Good (DG) 5.1, Packing Group II, liquid (a creamy emulsion that supports combustion of other materials). A typical composition for ANE is:

- Ammonium nitrate > 60%;
- Fuels (diesel) < 10%;
- Mineral oil, hydrocarbon solvent, petroleum < 10%;
- Water 5 to 30%; and
- Non-hazardous materials < 30%.

ANE will support combustion of other materials and increase the intensity of a fire. It will decompose on heating emitting irritating white fumes (ammonium nitrate). Brown fumes indicate the presence of toxic oxides of nitrogen, e.g. nitrogen dioxide.

A major fire may involve a risk of explosion, in particular, if the ANE is confined and contaminated. An adjacent detonation may also involve the risk of explosion (i.e. sympathetic detonation). Heating can cause expansion or decomposition of the material which can lead to the containers exploding.

When molten, ANE may decompose violently due to shock or pressure.

ANE is insoluble in water, however, open fires can be fought by applying water spray.

This material is classified as Security Sensitive Ammonium Nitrate (SSAN). Within Australia, all persons who have unsupervised access to Security Sensitive Ammonium Nitrate require security clearances. The issuing of security clearances is controlled and issued through the local Government authorities. The checks include a criminal history check and a politically motivated violence check.

4.1.3 Ammonia

Anhydrous ammonia is toxic and flammable (DG Class 2.3 toxic gas). It is a gas at normal temperature and pressure but may be liquefied under moderate pressure (630 kPag at 15^{o}C) or at temperatures below -33^{o}C at atmospheric pressure.

At low concentrations in air, ammonia vapour irritates the eyes, nose and throat. Ammonia is very soluble in water, therefore as it enters the body, it is readily absorbed. Irritation is immediate and local to the point of entry. Inhalation of high concentrations produces a sensation of suffocation and quickly causes burning of the respiratory tract and may result in death.

Anhydrous liquid ammonia causes severe burns on contact with the skin and if swallowed, it will cause very severe corrosion in the mouth, throat and stomach. Severe eye damage may result from direct contact with the liquid or exposure to high gas concentrations. Long term disability is mainly due to corneal and respiratory injuries.

The exposure limits for ammonia are summarised in Table 3.

Table 3 – Ammonia Exposure Limits

Material	Odour Threshold	Exposure Limit (ppm)		IDLH (ppm)	Injury mechanism
		TWA	STEL		
Ammonia	5 to 53 ppm	25	35	300	Irritant

Ammonia is flammable in air in a concentration range of 16 - 25% by volume but it does not readily ignite (the minimum ignition energy is 100 mJ, compared with 0.29 mJ for methane). Ignition is therefore difficult and the probability of an explosion in the open air is low. The auto-ignition temperature of ammonia is 651°C (relatively high compared to hydrocarbon materials).

Ammonia decomposes into flammable hydrogen gas at approximately 450°C.

Given the difficulty of ignition, the relatively narrow flammability range and typical operating conditions, ammonia storage and distribution installations are not generally regarded as significant fire or unconfined explosion hazards.

Water spray can be used to absorb vapour releases but should not be sprayed on pools of liquid ammonia as this will cause the liquid to rapidly vaporise (ammonia dissolves exothermically in water). If water is used for vapour absorption, a minimum of 100 volumes of water must be available for each volume of ammonia.

The transport of liquefied ammonia in a tank or bulk container made of quenched and tempered steel is prohibited unless the liquefied ammonia contains not less than 0.2wt% water. Stress corrosion cracking can occur, e.g. due to the presence of oxygen in ppm, if water is not present for these materials of construction.

4.1.4 Sulphur Oxides

Sulphur dioxide and sulphur trioxide would be produced within the sulphuric acid plant at the mine site. In the sulphuric acid plant, sulphur dioxide is formed by the combustion of sulphur in a burner. The sulphur dioxide is catalytically converted to sulphur trioxide in a fixed bed reactor. The sulphur trioxide is absorbed in weak acid to produce sulphuric acid.

Both gases are toxic but non-combustible.

Sulphur dioxide is a colourless gas with a characteristic pungent and suffocating odour. The TWA (Time Weighted Average – concentration) is 2 ppm and the STEL is 5 ppm. Repeated exposure to the gas (>10 ppm) may cause lung effects including constriction and inflammation of the lungs and reduced lung function. The IDLH (immediately dangerous to life and health) is 100 ppm. Sulphur dioxide is an air contaminant and a constituent of smog. As the gas is heavier than air, it can accumulate in sumps, pits etc. In the presence of moisture, sulphur dioxide will form sulphurous acid (H_2SO_3) which is corrosive.

Sulphur trioxide, on release, will react with water in the atmosphere and form a dense cloud of visible (white) acid mist. The mist is likely to contain submicron droplets which remain airborne until they absorb additional water and rain out or are deposited onto surfaces. With regard to the effects of the acid mist formed, a LC_{50} (lethal concentration for 50% mortality) of 60 mg/m^3 for a 60 minute exposure is typical of most reported data.

4.2 Potential Hazardous Incidents Review

In accordance with the requirements of HIPAP No 6, (Ref 3), it is necessary to identify hazardous events associated with the facility's operations. As recommended in HIPAP No 6, the PHA focuses on "atypical and abnormal events and conditions. It is not intended to apply to continuous or normal operating emissions to air or water".

In keeping with the principles of risk assessments, credible hazardous events with ***the potential for off-site effects*** have been identified. That is, local events with limited impact or "slips, trips and falls" type events are not included nor are non-credible situations such as an aircraft crash occurring at the same time as an earthquake.

Given that the nearest place of residence is approximately 2.4 km away from the hazardous materials, only a limited number of potential hazardous events can have off-site impact. This was the basis for the original approved PHA in 2000 (Ref 2). As examples, large pool fires in the solvent extraction area have the following distances to various levels of radiant heat.

Table 4 – Pool Fire Scenarios

Pool Fire Scenario	SEP (kW/m^2)	Distance to Specified Radiant Heat Level (m)		
		23 kW/m^2	12.6 kW/m^2	4.7 kW/m^2
10 m diameter pool fire	56	4	9	19
50 m diameter pool fire	20		3	36

"SEP" is the surface emissive power (i.e. the radiant heat level of the flames).

From Table 4, there will be no adverse radiant heat impact from pool fires at the site's boundary. Therefore, these events do not contribute to the off-site risk criteria shown in Table 1 and can be ignored in this analysis (consistent with the methodology in the approved PHA from 2000, Ref 2).

Similarly for jet fires, Ref 2 included various jet fire scenarios with estimated flame lengths up to 30 m. As with pool fires, no adverse off-site impact is expected given the separation distance of greater than 1 km.

In preparation for the PHA conducted in 2000, a one day hazardous event identification exercise was conducted. For completeness, the results from this exercise are shown in Appendix 1. The events that are no longer relevant to the modified design have been removed.

The identified credible, significant incidents with the potential for off-site impacts for the proposed facility and modifications are summarised in the following Hazard Identification Word Diagram (Table 5). This diagram presents the causes and consequences of the events, together with major preventative and protective features that are to be included as part of the design.

Table 5 – Hazard Identification Word Diagram

Event Number	Hazardous Event	Causes	Consequences	Proposed Safeguards - Prevention Detection Mitigation
1	Loss of containment from the natural gas pipeline	External interference, e.g. pipe damaged by excavation activities. Corrosion. Exceeding the maximum allowable operating pressure. Weld failure. Ground movement or ground erosion by water	Potential for failure of the natural gas line and a jet fire, flash fire and/or explosion (if the gas is confined) if ignited. This can cause injury to people, and damage to property and the environment	Pipeline designed to AS2885 including signage along the pipeline route. This includes aspects associated with pipeline such as design and construction, welding, operation and maintenance, and field pressure testing. The pipeline would be buried deep to lower the risk of third party damage and recorded for Dial-Before-You-Dig purposes. Pressure monitoring for leak detection
2	Decomposition of the Ammonium Nitrate Emulsion (ANE)	ANE subjected to heat, confinement and impurities. Sympathetic detonation	Potential for the ANE to explode. This can cause injury to people, and damage to property and the environment	ANE would be delivered and stored in precursor form and only mixed at point of use. All explosives handling will be compliant to the relevant Australian Standards and by trained personnel
3	Large loss of containment of ammonia	Ammonia tank failure, e.g. due to stress corrosion cracking. Catastrophic failure of a large pipe or transfer hose conveying liquid ammonia	Release of ammonia which is both a toxic and flammable hazard. The ammonia would disperse downwind with the potential to impact people. At high concentrations, ammonia can also cause corrosive impact to vegetation	Tanks designed to AS2022. See the recommendations in this PHA for further safeguarding

Event Number	Hazardous Event	Causes	Consequences	Proposed Safeguards - Prevention Detection Mitigation
4	Release of sulphur dioxide or sulphur trioxide	Fugitive emissions from vessel holding hot molten sulphur. Leak or rupture at acid plant due to mechanical failure or impact, e.g. suction seals, valves, blower, piping, vessel or heat exchanger, transport or cranage accident. Loss of absorption in acid plant absorption tower, e.g. loss of reflux liquid	Release of sulphur dioxide or sulphur trioxide at ground level or through the stack. Toxic gases are dispersed downwind. Acute effects only (no long term effects). Corrosion of nearby structures	Regular maintenance. Computer control and monitoring of the acid plant. Stack emissions monitoring. Operator training and surveillance. Automatic shutdown of plant on upset conditions. Sulphur dioxide monitors located throughout the plant. Mechanical protection of the plant from traffic etc, e.g. bollards, walls. Appropriate materials of construction. Visual indication of release (white plume)

5 HAZARDOUS EVENTS ASSESSMENT

5.1 NATURAL GAS SUPPLY PIPELINE FAILURE

The natural gas pipeline was assessed in the 2000 PHA (Ref 2) and subsequently approved. The following is an update of the previously approved pipeline assessment.

Natural gas would be supplied to the site from a lateral of the Moomba to Sydney gas pipeline. The majority of the pipeline run would be within the road reserve. It would be laid underground and setback a minimum safety distance from all residences in accordance with Australian Standard AS2885 (Pipelines – Gas and Liquid Petroleum).

The pipe route has been selected to avoid sensitive areas, thereby taking public safety into consideration. This includes routing the pipe around the outskirts of Condobolin.

The major hazards associated with the pipe are loss of containment from leaks (e.g. due to mechanical damage) leading to fires (jet and flash) and explosions.

To reduce the likelihood of these events from occurring, the pipe is to be laid in accordance with the relevant standards and codes (e.g. AS2885). Measures recommended in this standard to reduce the likelihood of loss of containment include burial to avoid damage from hostile events (e.g. sabotage), corrosion protection features (e.g. corrosion allowance on wall thickness, approved material of construction and cathodic protection), flow monitoring (by computer controls) and fracture control plans (including means of isolation), signage, deep burial and large wall thickness to protect against common digging activities (e.g. ploughing, digging and fence post drilling), and minimisation of joints (and hence potential leak points and hazardous areas for electrical equipment selection).

Given that the natural gas pipe is to be run to avoid sensitive areas and would be installed with mitigation features as detailed in such standards as AS2885, acceptable levels of risk result would be attained.

Data for pipeline failure is available from a number of sources but one of the most recent, comparable data sets is from the United Kingdom's Health and Safety Executive (HSE) (Ref 8).

The HSE have researched pipeline releases in the United Kingdom over a 45 year period and determined a current failure rate of approximately 2.8×10^{-5}/year.km. This is for small, medium and large releases. Note the HSE data assumes the pipelines are in use 100% of the time.

The probability of ignition of flammable gas releases is dependent on the size of the release but is reported (Cox, Lees and Ang, Ref 9) as being from 1 to 30% depending on the size of the leak. As a conservative assumption, a 30% probability of ignition is taken for a leak of natural gas.

Therefore, the likelihood of a release and ignition is:

$$L = 2.8 \times 10^{-5}\text{/yr.km} \times 0.3 = 8.4 \times 10^{-6}\text{/yr.km or } 8.4 \times 10^{-9}\text{/yr.m}$$

The results from ignition include a jet fire, a flash fire and/or an explosion if the natural gas is confined.

The above low likelihood for a release and ignition supports the anecdotal evidence in Australia that gas and liquid lines built to the Australian Standards, e.g. AS2885, have a low failure rate. The low likelihood of releases and ignition plus construction to recognised codes confirms that the SFARP (So Far As Reasonably Practicable) principle is met.

5.2 EXPLOSIONS

5.2.1 Explosives

Explosives at the limestone quarry were assessed and approved in the 2000 PHA (Ref 2). The following assessment is from this report.

> *Explosives will be used at the limestone quarry. The use of explosives shall be as per standard mining and regulatory practice, e.g. detonators stored separately to explosive charges, purpose built storage facilities, static protection facilities and strict procedural control enacted by well trained personnel. Historically, these practices have proven to be adequate in avoiding unplanned explosions with off-site impacts. As such, the risk of a spurious explosion involving the explosives stored on the limestone quarry site is deemed to be acceptable. This judgement is based on the assumption that the quarry site will have a quality safety management system in place and in use for the life of the facility.*

As part of the Modification, explosives may be used at the mine site. Similarly to the limestone explosives, it would be stored and used as per the requirements of the Australian Standards.

If explosives are to be used at the mine site, initial information provides the following:

Type: Ammonium nitrate emulsion (ANE)

Quantity: Approximately 25 tes

Whilst storage and use as per the Australian Standards provides risk assurance for explosives, there are ways for it to decompose, e.g. impurities and heat whilst confined.

The TNT equivalence for ANE is approximately 0.8. For 25 tes ANE, the equivalent mass of TNT is 20 te. Using the TNT explosion model, the distances to selected explosion overpressures are shown in Table 6.

Given the distance to the nearest site boundary from the explosive storage area is approximately 920 m then the criteria shown in Table 6 are satisfied.

Table 6 – Explosive Overpressures

Explosion Scenario	Distance to Specified Overpressure Level, m		
	21 kPa	14 kPa	7 kPa
25 te ANE	206	265	410

The consequences of various levels of overpressure generated from vapour cloud explosions are shown in Table 7 (Ref 1).

Table 7 – Effects of Explosion Overpressures

Overpressure kPa	Effect
3.5	90% glass breakage No fatality and very low probability of injury
7	Damage to internal partitions and joinery but can be repaired Probability of injury is 10%. No fatality
14	Houses uninhabitable and badly cracked
21	Reinforced structures distort Storage tanks fail 20% chance of fatality to a person in a building
35	Houses uninhabitable Trucks and plant items overturned Threshold of eardrum damage 50% chance of fatality for a person in a building and 15% chance of fatality for a person in the open
70	Threshold of lung damage 100% chance of fatality for a person in a building or in the open Complete demolition of houses

5.2.2 Process Explosions

The 2000 PHA (Ref 2) reviewed the following potential process explosions (note that process explosions associated with the equipment that has now been removed from the design are not included):

1. Hydrogen explosions within sulphuric acid storage tanks (the tanks would be continuously vented to prevent this); and
2. Explosions within sulphur burner (or downstream equipment) in the sulphuric acid plant (robust burner management system used including trips).

As discussed in Ref 2, both these events have local impacts only and would not impact people (due to overpressures) at the nearest site boundary.

5.3 TOXIC GAS RELEASES

As identified in Section 4, large releases of sulphur oxides and ammonia have the potential to impact people off-site. The 2000 PHA (Ref 2) assessed releases of sulphur oxides and hydrogen sulphide. The latter is no longer part of the processing plant's design and hence is not included in this report.

The 2000 PHA toxic gas modelling basis is included in Appendix 2 for information.

The DoP risk criteria of importance for this rural site are:

- Irritation, injury and fatality risk at a place of residence. The nearest place of residence is the 'Sunrise' house located 2.4 km from the processing plant. Note that HIPAP No 4 defines the one in a million criterion assuming that residents would be at their place of residence (taken to be the house) and exposed to the risk 24 hours a day and continuously day after day for the whole year; and
- Fatality risk to be contained within the boundary of an industrial site, i.e. no more than 50x10-6/yr.

As the processing areas where the hazardous materials are stored and handled are a significant distance from the site's boundary and the nearest place of residence, e.g. the ammonia storage is approximately 420 m from the nearest site boundary, then only the releases that have the potential to cause irritation, injury and/or fatality at these locations are assessed (consistent with the 2000 PHA approach).

Meteorological Data

The meteorological data used in this PHA comprises an updated set of five dominant weather/wind combinations (Pasquill stability category / wind speed) for the area and has been used as the basis for all dispersion calculations. This is based on 2016 data with hourly measurements for 365 days.

The probability of the relevant combined weather/wind category and wind direction (data is split into 8 directions) is used in the calculation of toxic impact at the nearest place of residence ('Sunrise') and the nearest site boundary. Both these locations are to the southwest of the processing plant. The wind direction of interest is therefore northeast.

The meteorological data used for this risk assessment, sourced from the Condobolin Bureau of Meteorology weather station, is shown in Table 8.

Table 8 – Stability Class / Wind Speed

Wind Direction	Stability Class / Wind Speed (m/s)					
	Percentages:					
	D5.9	D2.4	E5.8	E2	F2	
N	4.5	3.1	2.4	2.9	5.0	
NE	2.7	2.4	2.5	2.7	2.9	
E	1.9	3.4	1.2	3.9	2.3	
SE	1.3	3.0	0.4	2.0	1.0	
S	1.6	3.2	0.8	1.8	1.0	
SW	5.5	3.9	2.8	3.1	2.7	
W	4.4	3.5	1.7	3.3	2.6	
NW	1.5	1.8	0.5	1.5	1.4	
Totals:	23.4	24.2	12.4	21.3	18.7	100

From a review of the data in Table 8, there is a slight bias for northern and southwestern winds.

5.3.1 Sulphur Oxides Releases

Releases of sulphur oxides were assessed in the 2000 PHA (Ref 2). The following is an update of this work, i.e. taking into consideration the 2016 atmospheric stability classes / wind speeds as well as the increased sulphuric acid plant rates.

Sulphuric acid would be produced in a conventional style, sulphur burning acid plant. After the burner, the sulphur dioxide is reacted over a fixed bed catalyst system to form sulphur trioxide. The sulphur trioxide is absorbed in acid to form the required 98 wt% sulphuric acid. Overhead gases from the absorber are vented to atmosphere.

These types of plants run at low pressure (typically 24 kPag after the burner) and hence there exists a low driving force for releases. Gas stream temperatures of 80°C or higher are normal.

Sulphur trioxide is present in the process from the reactor to the absorption tower. Any releases from these areas (including failure of absorption reflux flow) would immediately form white clouds as the sulphur trioxide readily forms sulphuric acid when combined with atmospheric moisture. The sulphuric acid mist generated becomes a dense cloud which partly rains out on to the ground and other surfaces.

This strong affinity of sulphur trioxide with water makes accurate modelling of sulphur trioxide clouds difficult, particularly over large distances such as that to the nearest place of residence. The approach taken in this analysis is to model releases of sulphur dioxide to determine the significant effects, if any, at the nearest place of residence and site boundary. Depending on these results, off-site effects of sulphur trioxide releases can be surmised. Whilst sulphur dioxide also reacts with atmospheric moisture, the reaction is not as fast as that of sulphur trioxide and is not taken into account in the modelling of releases.

The composition of the sulphur dioxide stream varies from plant to plant (e.g. depending on the sulphur sources), and, of course, within each plant. In this study, a composition of 18vol% sulphur dioxide in air is used (typical maximum value).

Release scenarios were only performed for the cases where the plant was kept operating. Once the plant is stopped, the low pressure in the equipment minimises the flowrate of further releases.

Release conditions are summarised as follows:

Plant rate (gas stream after burner)	65 kg/s
Sulphur dioxide rate	25 kg/s
Pressure	24 kPag
Temperature (approximate)	80°C
Release height (approximate pipe rack level)	5 m

Given this temperature, the density of the sulphur dioxide stream when it is released to atmospheric pressure was calculated to be 1.22 kg/m^3. As this is approximately the same as air at 15°C (1.23 kg/m^3), the plume is treated as having neutral buoyancy and it is modelled by using the Gaussian neutral gas dispersion correlations. The simulations involving large releases are based on a release duration of one minute (at full plant rate). Large releases would become known (visual, noise and smell as well as process monitoring alarms and trips) soon after the catastrophic failure, hence it is realistic to assume shutdown within one minute. For the smaller releases (from 50 mm holes or smaller), release durations of 15 minutes are modelled (to determine the worst case effect distances). This time allows for operator intervention to manually control and/or stop the leak.

Toxic Impact of Sulphur Dioxide

The toxicity effects of sulphur dioxide are summarised in Table 9.

Table 9 - Effects of Sulphur Dioxide

Exposure Level (ppm)	Duration (minutes)	Effects
0.3	60	ERPG 1
3		ERPG 2
25		ERPG 3

The three ERPG (emergency response planning guidelines) tiers are defined as follows:

- **ERPG-3** is the maximum airborne concentration below which nearly all individuals could be exposed for up to 1 hour without experiencing or developing life-threatening health effects.
- **ERPG-2** is the maximum airborne concentration below which nearly all individuals could be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms which could impair an individual's ability to take protective action.
- **ERPG-1** is the maximum airborne concentration below which nearly all individuals could be exposed for up to 1 hour without experiencing more than mild, transient adverse health effects or without perceiving a clearly defined objectionable odour.

Given the above definitions, ERPG 1 (0.3 ppm) and 2 (3 ppm) are taken as the limits for irritation and injury, respectively.

One level of fatal toxicity used by United Kingdom HSE (Health and Safety Executive) in relation to the provision of land use planning advice is termed the Specified Level of Toxicity (SLOT). The HSE has defined the SLOT as:

- Severe distress to almost everyone in the area;
- Substantial fraction of exposed population requiring medical attention;
- Some people seriously injured, requiring prolonged treatment; and
- Highly susceptible people possibly being killed.

The SLOT value for sulphur dioxide is 4.655×10^6 ppm^2.min. Hence, for a 1 minute exposure, the required average concentration is 2,160 ppm, or for a 15 minute exposure, the required average concentration is 560 ppm. The SLOT values are used to determine if fatality at the nearest place of residence and site boundary from a release is possible.

Sulphur Dioxide Release Cases Modelled

The following scenarios involving sulphur dioxide releases were modelled for the five dominant stability classes and wind speeds in Table 8. Concentrations at the nearest place of residence and site boundary are calculated.

1. Catastrophic vessel failures or full pipe fractures. The release rate is modelled as full plant rate for one minute.
2. Piping and vessels failures corresponding to the various hole sizes discussed in Appendix 2 (15 minutes duration).

The results for Scenario 1 above are shown in Table 10. Whilst there is a plantation across the road from the releases, the modelling is performed based on parkland and bushes given the land use beyond the plantation.

The distances used in the modelling have been measured from the sulphuric acid plant to the nearest residential dwelling (i.e. Sunrise) and the nearest property boundary.

Table 10 – Sulphur Dioxide Release Modelling – Catastrophic Failures

Stability Class / Wind Speed	Concentration (ppm) at Nearest Residence (2.4 km)	Concentration (ppm) at Nearest Boundary (75 m)
D5.9	18	8,600
D2.4	18	21,000
E5.8	39	13,000
E2	42	36,000
F2	123	39,600

Given the results in Table 10 then irritation and injury (but not fatality) are possible at the nearest place of residence and also fatality at the nearest site's boundary due to catastrophic equipment failures. The corresponding risks are analysed in Section 6 of this PHA.

The results for Scenario 2 above are shown in Table 11.

Table 11 – Sulphur Dioxide Hole Release Modelling

Stability Class / Wind Speed	50 mm Hole (0.2 kg/s)	
	Concentration (ppm) at Nearest Residence (2.4 km)	Concentration (ppm) at Nearest Boundary (75 m)
D5.9	0.32	70
D2.4	0.78	170
E5.8	0.73	105
E2	2	295
F2	6	310

The flowrates from 25 mm diameter or smaller holes are too low to impact people at the locations of interest.

Given the results in Table 11 then irritation and injury (but not fatality) are possible at the nearest place of residence due to releases through a 50 mm hole. The corresponding risks are analysed in Section 6 of this PHA.

The concentrations at the nearest site boundary are not expected to cause fatality.

From the 2000 PHA (Ref 2), with regard to sulphur trioxide releases, it was discussed previously that sulphur trioxide reacts readily with atmospheric moisture to form sulphuric acid which, being a dense mist, rains out significantly on to the ground and nearby structures. Given the predicted low sulphur dioxide levels from releases from 50 mm holes (or less) would only just cause impact at the nearest place of residence, it can be surmised that sulphur trioxide releases from these size holes are unlikely to have any significant off-site impacts. However, for a worst case release at full plant rates involving the sulphur trioxide steam, off-site effects can certainly be expected at the nearest site boundary. This is included in the risk analysis in Section 6 of this report.

5.3.2 Ammonia Releases

Releases of ammonia were not assessed in the 2000 PHA (Ref 2) as ammonia storage and handling was not part of the original design.

Anhydrous ammonia is to be delivered by road tanker and is transferred to the two anhydrous ammonia storage bullets (100 te capacity each).

Vapour from the bullets passes through the Compressor Knockout Vessels, the Ammonia Unloading Compressors and then back into the ammonia road tanker, i.e. so that liquid ammonia can be transferred into the bullets.

The liquid discharge from the bullets passes through a vaporiser before being distributed to the process at a rate of 1 kg/s (corresponds to approximately 31,500 te/year).

Losses of containment of ammonia can therefore be from:

- Container transfers;
- The storage bullets; and
- Piping including the vaporiser.

It is estimated that an average three ammonia deliveries per day would take place (1 container at 30 tonnes per container per delivery truck).

Ammonia is normally a heavy gas when modelled due to cooling when flashed and also absorption of water from the atmosphere. Therefore, it is modelled with the heavy gas model (SLAB) within Effects.

Toxic Impact of Ammonia

The toxicity effects of ammonia are summarised in Table 12.

Table 12 - Effects of Ammonia

Exposure Level (ppm)	Duration (minutes)	Effects
25	60	ERPG 1
150		ERPG 2
1,500		ERPG 3

The above exposure limits are quite conservative given the following information from the Australian Standard (AS2022) for ammonia (Ref 10):

Up to 100 ppm – no adverse effect for the average worker with no deliberate exposure for long periods permitted.

400 ppm – immediate nose and throat irritation with no serious effect after 30 minutes to one hour.

700 ppm – immediate eye irritation with no serious effect after 30 minutes to one hour.

1,700 ppm – convulsive coughing, severe eye, nose, and throat irritation; could be fatal after 30 minutes.

2,000-5,000 ppm – convulsive coughing, severe eye, nose, and throat irritation; could be fatal after 15 minutes.

Over 5,000 ppm – respiratory spasm, rapid asphyxia and fatal within minutes.

To be consistent with the sulphur oxides modelling, ERPG 1 (25 ppm) and 2 (150 ppm) are taken as the limits for irritation and injury.

The SLOT value for ammonia is 3.78×10^8 ppm^2.min. Hence, for a 1 minute exposure, the required average concentration is 19,440 ppm, or for a 15 minute exposure, the required average concentration is 5,020 ppm. The SLOT values are used to determine if fatality at the nearest place of residence and site boundary from a release is possible.

Ammonia Release Cases Modelled

The following scenarios involving ammonia releases were modelled for the five dominant stability classes and wind speeds in Table 8. Concentrations at the nearest place of residence and the site boundary are calculated. The location at the site boundary is adjacent to the sulphuric acid plant so that cumulative risk can be estimated.

1. Catastrophic storage bullet failures. The release quantity is taken as an average of 50 te per bullet.
2. Liquid releases from piping, transfer hose and vessel failures corresponding to the various hole sizes discussed in Appendix 2 (15 minutes duration).
3. Vapour releases from piping, transfer hose and vessel failures corresponding to the various hole sizes discussed in Appendix 2 (15 minutes duration).

Scenario 1 – Catastrophic Bullet Failure:

The results for Scenario 1 above are shown in Table 13. The modelling is performed based on regular large obstacles as the ammonia plume travels first through the plant and then through the plantation across the road.

Table 13 – Ammonia Release Modelling – Catastrophic Failures

Stability Class / Wind Speed	Concentration (ppm) at Nearest Residence (2.9 km)	Concentration (ppm) at the Boundary (510 m)
D5.9	1,230	25,900
D2.4	78	16,500
E5.8	1,920	30,600
E2	-	17,200
F2	-	21,000

Note: The distances used in the modelling have been measured from the ammonia storage and handling area to the nearest residential dwelling (i.e. Sunrise) and the nearest property boundary.

For the E2 and F2 conditions, the vapour would layer and be largely held by the plant structures and surrounding plantation without dispersing as far as the other weather / wind combinations. This has been observed with historical releases of liquid ammonia.

Given the results in Table 13 then irritation and injury (but not fatality) are possible at the nearest place of residence due to catastrophic storage bullet failures. Also, the concentrations predicted at the nearest site boundary are sufficiently high to cause fatality.

The corresponding risks are analysed in Section 6 of this PHA.

It is noted that historical releases of ammonia (including the 7,000 te release in Lithuania in 1989) have not resulted in fatalities beyond 200 m. Hence, the modelling results are very conservative.

Scenario 2 – Liquid Releases:

The results for Scenario 2 are shown in Table 14 and Table 15.

Table 14 – Ammonia (Liquid) 50 mm Hole Release Modelling

Stability Class (Wind Speed [m/s])	50 mm Hole (rate = 36 kg/s)	
	Concentration (ppm) at Nearest Residence (2.4 km)	Concentration (ppm) at the Boundary (420 m)
D (5.9)	160	2,600
D (2.4)	90	3,800
E (5.8)	350	4,300
E (2)	-	5,500
F (2)	-	9,700

This rate, i.e. 36 kg/s, is equivalent to 130 te/hr. Whilst this would exceed the transfer rate into the bullets, the results would be indicative for liquid releases from the transfer hose.

Table 15 – Ammonia (Liquid) 25 mm Hole Release Modelling

Stability Class / Wind Speed	25 mm Hole (rate = 9.3 kg/s)	
	Concentration (ppm) at Nearest Residence (2.9 km)	Concentration (ppm) at the Boundary (510 m)
D5.9	41	N/A
D2.4	28	N/A
E5.8	75	N/A
E2	-	N/A
F2	-	N/A

As above, for the E2 and F2 conditions, the vapour would layer and be largely held by the plant structures and surrounding plantation without dispersing as far as the other weather / wind combinations. This has been observed with historical releases of liquid ammonia.

Given the results shown in Table 14 and Table 15 then irritation and injury (but not fatality) are possible at the nearest place of residence due to liquid ammonia releases. There is a risk of fatality at the site boundary for some weather / wind combinations.

The corresponding risks are analysed in Section 6 of this PHA.

Scenario 3 – Vapour Releases:

The design plant vapour ammonia rate is 1 kg/s. This rate is modelled to determine the potential consequential impacts. This rate is also indicative of the vapour flow to the container when performing transfers.

The results for Scenario 3 are shown in Table 16.

Table 16 – Ammonia Vapour Release Modelling

Stability Class / Wind Speed	Rate = 1 kg/s	
	Concentration (ppm) at Nearest Residence (2.9 km)	Concentration (ppm) at the Boundary (510 m)
D5.9	4	70
D2.4	10	240
E5.8	10	210
E2	27	420
F2	82	1,600

The plant design ammonia vapour rate does not result in concentrations at the boundary sufficient to result in fatality. Irritation impact at the nearest place of residence is possible for the E2 and F2 conditions only.

The corresponding risks are analysed in Section 6 of this PHA.

5.4 Transport Incidents

5.4.1 Road

Road transport was assessed in the 2000 PHA (Ref 2). The following is an update of this assessment given the modifications.

Chemicals transported by road would, where relevant, be transported in accordance with the Australian Code for the Transport of Dangerous Goods by Road and Rail (Ref 11).

The expected frequency and quantity of deliveries of the bulk Dangerous Goods to the site is given in Table 17.

Hazardous materials that are less frequently delivered include flocculant, diluent, oxalic acid, extractant, caustic, hydrogen peroxide, sodium hypochlorite and explosives and are not included (typically one or less deliveries per week).

Table 17 – Bulk Chemicals Road Transport Frequencies

Material Transported	Approximate Number of Deliveries to Site	Approximate Annual Usage
Ammonia	3 single containers per day	31,500 te
Hydrochloric Acid	2 single containers per day	16,600 te
Formic Acid (IBCs)	1 every two days	3,500 te

Materials such as hydrated lime, soda ash, diesel, SMBS, the nickel, cobalt and scandium products, amsul and quicklime are not classified as dangerous goods for transport by road and rail and therefore are relatively safe to transport in bulk form (subject to road and rail usage regulations). Shellsol and diesel are both combustible liquids. The transport of these types of materials in approved road tankers throughout Australia is commonplace and of low risk.

The packaged chemicals delivered by road transport in IBCs (intermediate bulk containers), drums, bulk bags or cylinders, again, would be transported in accordance with the Australian Code for the Transport of Dangerous Goods by Road and Rail. The main usage of these chemicals is for dosing systems, shutdown replacements and topping up storages. The small packaged volumes with low usage rates pose minimal transport risks due to loss of containment. Mitigation of risks is also provided by the proposed use of approved transport companies through their safety management systems and emergency response plans.

Both hydrochloric acid and formic acid are corrosive liquids. Formic acid is also a subsidiary risk flammable liquid. If these materials are involved in a traffic accident, the primary risk to people, the environment and property is the corrosive nature of the fluids (including vapours). Formic acid could also combust if ignited.

The main new road transport hazard is ammonia. If a road tanker carrying ammonia is involved in an accident and the vessel integrity is lost then there is the potential for serious injury and fatality for people involved in the accident or those nearby.

Causes for road tanker accidents are summarised in Table 18 (Ref 12).

Table 18 – Causes for Road Tanker Accidents

Human Error	Equipment Failures	System or Procedural Failures	External Events
• driver impairment, eg. alcohol or drugs • speeding • driver overtired • driver exceeding safe working hours • en-route inspection • contamination • overfilling • other vehicle's driver • taking tight turns/ramps too quickly (overturns) • unsecured loads	• non-dedicated trailer • rail road crossing guard failure • leaking valve • leaking fitting • brake failure • relief device failure • tyre failure • soft shoulder • overpressure • material defect • steering failure • sloshing • high centre of gravity • corrosion • bad weld • excessive grade • poor intersection design • road chamber/width • suspension system • tyre fire caused by friction, brakes overheating or exploding tyres give sparks due to metal in the rubber) • fuel tank fire (diesel)	• driver incentives to work longer hours • driver training • carrier selection • container specification • route selection • emergency response training • speed enforcement • driver rest periods • maintenance • inspection • time of the day restrictions	• vandalism/sabotage • rain • fog/visibility • wind • flood/washout • fire at rest area/parking areas • earthquake • existing accident • animals on road

A detailed analysis of heavy vehicle risks in NSW was performed for the Cowal Gold Project (Ref 13). This study found the following typical heavy vehicle accident rates for similar road routes:

> 0.016 - 2.96 Heavy Vehicle Accidents/Annual Million km of Heavy Vehicle Travel

This data compares well with reported data, e.g. the Centre for Chemical Process Safety (CCPS) guidelines (Ref 12) quote a figure of approximately 2 accidents/year (for all causes) per 10^6 miles, i.e. $1.2\text{x}10^{-6}$ accidents per kilometre per year.

In the event of an accident involving a heavy vehicle, the carried goods may or may not be released. The probability of release is dependent on factors such as speed, shipping conditions (i.e. pressurised versus non-pressurised), inadequate load securing, and strength and integrity of the container.

Various studies of release probabilities from heavy vehicles involved in an accident have been undertaken. The Guidelines for Chemical Transportation Risk Analysis (CCPS, 1995, Ref 12) indicates that the release probability for various road types is between 5 and 10% (i.e. approximately one heavy vehicle accident in every 10 to 20 would result in a release of the material). The probability of fatality then has to be taken into account but this would depend on factors such as the leak size.

Given the history of road tanker transport in NSW, compliance with the Australian Dangerous Goods Code (an indicator of achieving SFARP (so far as reasonably practicable)) and the above representative data then the risk of an accident involving a vehicle transporting a hazardous material such as ammonia to the site resulting in a release of material is therefore relatively low.

5.4.2 Rail

The following is an update of the rail assessment from the 2000 PHA (Ref 2).

For this development, rail transport primarily concerns the movement of sulphur from the stockpile in Newcastle, NSW, to the proposed rail siding. The proposed number of return train trips per week is approximately three. To avoid congestion in the Sydney rail network as well as steep grades in the crossing of the Blue Mountains (i.e. minimise the likelihood of an accident), it is proposed that trains to and from the site use a route via Muswellbrook, Ulan, Dubbo, Narromine and Parkes to Bogan Gate.

The significant hazards are the potential for the sulphur to catch alight and emit toxic fumes (e.g. sulphur dioxide). The sulphur could catch alight due to ignition whilst in transit (e.g. arson, lightning strike or static) or due to an accident involving the train.

Radiant heat effects due to burning sulphur are localised only. Any loss of containment during transport would be responded to as per the proposed emergency response plans for the site to avoid contamination of waterways etc.

Sulphur is classified as a flammable solid (4.1), Packing Group III (minor danger only). It is routinely transported in bulk around the world. Separation from non-compatible materials and elimination of ignition sources are the major measures taken to avoid incident.

Protection features for the bulk transport of sulphur by rail to the proposed siding include minimal dust in the bulk sulphur (prilled form), proposed water sprays at all transfer points, local fire brigades (for water application), electrics (such as motors) rated for the hazardous area zones, separation from non-compatible materials and static protection. Small fires can be smothered with sand or even with additional sulphur. The sulphur remains within the shipping containers until it is taken to the site.

Given the proposed protective features associated with the rail transport of sulphur, the low likelihood of ignition of sulphur within the containers and the accepted risk of transport of bulk sulphur by road or rail throughout Australia and the world, the overall risk of an incident involving sulphur with significant consequences during rail transport is considered low. No further analysis (i.e. quantification of risks) of the transport of bulk sulphur to this site is deemed necessary.

The product metals are also likely to be transported from the site by rail. The nickel and cobalt sulphates and scandium oxide products would be stored and transported in bulkabags, not as a bulk concentrate.

5.5 NATURAL AND OTHER EXTERNAL HAZARDOUS EVENTS

The site has been assessed with regard to exposure to the following external hazards:

Subsidence	Landslide
Burst dam	Earthquake
Storm and high winds	Rising water courses
Flood	Storm water runoff
Lightning	Forest fire
Vermin/insect infestation	Security

Given the current proposed location of the project components, there are no obvious significant hazards amongst this list that could result in on-site events leading to serious off-site impacts.

6 RISK ANALYSIS

6.1 HIPAP 4 RISK CRITERIA

As discussed in Section 5.3, the DoP risk criteria of importance for this rural site are:

- Irritation, injury and fatality risk at a place of residence; and
- Fatality risk to be contained within the boundary of an industrial site, i.e. no more than $50x10^{-6}$/yr.

Given there are a minimal number of materials and events that can cause off-site impact, the updated analysis in this PHA was done on the same basis as the 2000 PHA (Ref 2). That is, model the sulphur dioxide and ammonia release cases for the five dominant stability class / wind directions to determine which events can contribute to off-site risk. The results are shown in Section 5.3.

These results are then analysed using event likelihoods (United Kingdom HSE 2012 data used, Ref 15), probits, the probability of use (e.g. transfer hoses) and the probability that the stability class / wind direction exists. The analysis is shown in Appendix 3 along with further explanation of the assumptions and data sources. The total estimated risks at the nearest place of residence and the site boundary are compared to the HIPAP 4 risk criteria (Ref 4) in Table 19.

Table 19 – Comparison to HIPAP 4 Risk Criteria

Risk Type	HIPAP No 4 Criteria	Estimated Risk or Likelihood	Comments
Irritation	$50x10^{-6}$/yr	$4.7x10^{-6}$/yr	Compliant
Injury	$10x10^{-6}$/yr	$2.1x10^{-6}$/yr	Compliant
Fatality	$50x10^{-6}$/yr	$9.3x10^{-7}$/yr	Compliant

The assessment was done on a conservative use of stability class / wind direction data. The above estimated risk values are likely to be conservatively high.

Given the separation distance between the processing plant and both the nearest place of residence and site boundary then all other risk criteria are satisfied. For example, it is not credible that radiant heat from a pool fire can travel over 2 km.

6.2 CUMULATIVE AND PROPAGATION RISK

Given the rural location, the generous separation distances and that significant consequential impacts largely remain on-site then it is reasonable to conclude that the modified development does not make a significant contribution to the existing cumulative risk in the area.

There is the potential for on-site propagation events, e.g. a diluent fire causing another loss of containment. However, as shown in the report, the separation distances mitigate the impacts from the potential hazardous events, either occurring in isolation or due to propagation from other events, and that the off-site risk is acceptable.

6.3 SOCIETAL RISK

Societal risk results are usually presented as F-N curves which show the frequency of events (F) resulting in N or more fatalities. To determine societal risk, it is necessary to quantify the population within each zone of risk surrounding a facility. By combining the results for different risk levels, a societal risk curve can be produced.

Societal risk is normally calculated where the 1 pmpy contour (or calculated risk level) approaches closely to residential areas or sensitive land uses or when events with very large consequence distances are being assessed. Hence, the potential exists for multiple fatalities as a result of a single accident.

In this study, there is a risk of fatality at the nearest site boundary, however, the surrounding area is rural with the nearest place of residence being 2.4 km from the processing plant. At this location, there is no estimated risk of fatality. Therefore, societal risk at residential and other types of land users is acceptable.

6.4 RISK TO THE BIOPHYSICAL ENVIRONMENT

The main concern for risk to the biophysical environment is generally with effects on whole systems or populations. Whereas any adverse effect on the environment is obviously undesirable, to have an incident with such consequences requires exposure of a sensitive area to either large effect, short term releases or smaller effect, long term releases. For this site, the latter includes seepage from the tailings storage facility and continuous gas emissions, e.g. from the stacks. These events are assessed separately within the Environmental Assessment for the Modification and are not included here.

Given the limited number of events (large effect, short term releases) that can occur at this site with off-site impacts and the rural nature of the surrounding area, the risk to people and other biological groups (animals and plants) is low. This has been shown by analysis in Section 6.1.

In summary, whilst off-site effects can be expected if a major release were to occur, there are no identified whole systems or populations which are at unacceptable levels of risk due to the potentially hazardous events reviewed in this PHA.

For completeness, risks to the biophysical environment due to significant loss of containment events are summarised below.

6.4.1 Escape of Materials to Atmosphere

The potential events that could lead to the escape of significant quantities of harmful materials to the atmosphere (and the effects / mitigation features available) are summarised as follows:

1. Dust release from stockpiles (water sprays and dust suppressant to be used);
2. Ammonia releases (analysis as per Section 5.3.2 of this PHA). See the recommendations in this study as the transfers to the storage vessels pose the highest off-site risk;
3. Products of combustion from fires (hydrocarbon fires typically generate carbon dioxide and water which readily disperse due to buoyancy of the plume);
4. Sulphur oxide releases (including sulphuric acid mist) from the sulphuric acid plant (generally, containment is within process piping and equipment and startup emissions etc are dispersed via the plant stack) or from sulphur fires (sulphur fires are slow burning, easy to detect and typically smothered to extinguish); and
5. Loss of containment of process gases, e.g. hydrogen and natural gas (if released, these types of gases readily disperse due to their low molecular weights).

6.4.2 Escape of Materials to Soil or Waterways

The potential events that could lead to the escape of significant quantities of harmful materials to the soil or waterways (and the effects / mitigation features available) are summarised as follows:

1. Loss of containment of acidic liquids or other hazardous liquid within the process or storage areas (all areas bunded to contain spills, disposal of spills on an as needs basis);
2. Loss of containment of hazardous liquids outside of bunded areas (site stormwater and effluent systems route all flows to the treatment plant area, thereby minimising the chance of harmful soil or waterways effects);
3. Rupture of tailings pipe (high integrity pipe design, instrumentation and visual inspection to be used to monitor flow problems); and
4. Loss of containment from the tailings storage facility, surge dam or evaporation pond (conformance to dam safety regulations including routine monitoring of dam’s structural condition).

6.5 Conclusion and Recommendations

The risks associated with the modified mine and processing facility have been assessed and compared against the DoP risk criteria.

The results are as follows and show compliance with all risk criteria.

Description	Risk Criteria	Risk Acceptable?
Fatality risk to sensitive uses, including hospitals, schools, aged care	0.5 x 10^{-6} per year	Y
Fatality risk to residential and hotels	1 x 10^{-6} per year	Y
Fatality risk to commercial areas, including offices, retail centres, warehouses	5 x 10^{-6} per year	Y
Fatality risk to sporting complexes and active open spaces	10 x 10^{-6} per year	Y
Fatality risk to be contained within the boundary of an industrial site	50 x 10^{-6} per year	Y
Injury risk – incident heat flux radiation at residential areas should not exceed 4.7 kW/m^2 at frequencies of more than 50 chances in a million per year or incident explosion overpressure at residential areas should not exceed 7 kPa at frequencies of more than 50 chances in a million per year	50 x 10^{-6} per year	Y
Toxic exposure - Toxic concentrations in residential areas which would be seriously injurious to sensitive members of the community following a relatively short period of exposure	10 x 10^{-6} per year	Y
Toxic exposure - Toxic concentrations in residential areas which should cause irritation to eyes or throat, coughing or other acute physiological responses in sensitive members of the community	50 x 10^{-6} per year	Y
Propagation due to Fire and Explosion – exceed radiant heat levels of 23 kW/m^2 or explosion overpressures of 14 kPa in adjacent industrial facilities	50 x 10^{-6} per year	Y

Societal risk, area cumulative risk, propagation risk, transport risk and environmental risk are also concluded to be acceptable.

The primary reason for the low risk levels from the modified site is the separation distances between the hazards the nearest place of residence and also the site boundary.

The highest contributor to off-site risk is a release of ammonia, in particular, from transfer operations to the storage vessels. The second highest risk contributor involves generic release cases for holes in vessels and piping (typical for all processing facilities). It is expected that the design review process followed by the Hazard and Operability (HAZOP) study would mitigate the generic release cases to acceptable levels. This would include designing to AS2022 for the ammonia storage and handling systems. The following recommendations are made to lower the off-site risk from the main contributor, i.e. releases of ammonia.

1. Ensure that the final design includes means to automatically isolate the ammonia road tanker (or container) and storage vessels should a release during a transfer occur (vapour and liquid lines). Actuation should be local as well as remote;
2. Provide closed circuit television (CCTV) coverage of the ammonia transfer area to the plant's control room;
3. Provide means to isolate the ammonia flow to the plant should a release occur. This should be at each storage vessel;
4. Provide means to suppress an ammonia vapour plume. A plume could occur due to a release from the transfer system, the storage vessels or the plant supply lines. Options include spray deluge for the transfers bay and fire water monitors in the transfer and storage area. The latter can be operated remotely (preferable) or manually (may require the use of a full protective suit with self-contained breathing air). Monitors can be fixed or portable;
5. Provide means for road tanker driveaway protection. This could include interlocks on the vehicles brakes or self-sealing devices in the transfer lines;
6. Include the transfer hoses and couplings (dry-break preferred) in the preventative maintenance system. The transfer hoses would need to be regularly inspected, tested and replaced as per the manufacturers recommendations;
7. Provide means for preventing stress corrosion cracking in the ammonia storage vessels and include the vessels in the preventative maintenance system for routine internal inspections;
8. Provide wind socks at appropriate locations to allow people to decide the best means of escape from an ammonia plume;
9. Provide alternate emergency assembly areas given that an ammonia plume can travel in any direction;
10. Provide means for protection for the ammonia road tanker / container driver should a release occur, e.g. safehouse;
11. Apply good practice for building design, e.g. design buildings as safehouses should relevant guidelines recommend this. For example, design buildings as per the recommendations in the Chemical Industries Association guideline, "Guidance for the Location and Design of Occupied Buildings on Chemical Manufacturing Sites";
12. Provide overfill protection on the ammonia storage vessels. This system should be reviewed via a Safety Integrity Level (SIL) analysis; and

13. Provide means to prevent the vapour compressor from overpressuring the vapour return line and/or the road tanker / container.

Appendix 1

Hazardous Events from the 2000 PHA

PPreliminary Hazard Analysis for the Syerston Project

Modification 4

Appendix 1 – Hazardous Events from the 2000 PHA.

Hazard Identification for the Main Ore Processing Plant

Possible Hazardous Event	Possible Initiating Events	Possible Consequences	Prevention / Protection Measures
Dust release from stockpiles	Wind blown	Siliceous geothite ore is 20-30% silicon (processed in plant after year 5) Dust release could lead to silicosis issues	Water sprays on stock piles and hoppers Dust suppressant used
Loss of process water to scrubber in high pressure acid leach (HPAL) area	Pump fails, closed valve etc	Acid mist, steam and particulates released "Red mud rain" Local effects only due to low flow and concentrations Operator exposure	Low velocity release (<2 m/s) Process alarms and trips Operation monitoring by operators
Release of sulphuric acid (either feed acid or an acidic ore solution)	Loss of autoclave seals due to corrosion, erosion (high acid velocities), weld / fabrication defect, loss of seal cooling water etc Pipe break or equipment failure due to corrosion etc Diaphragm pump failure (PAL feed pumps), eg corrosion in the casing Tanks or vessels overfilled	Loss of containment of sulphuric acid or acidic ore solution Possibility of local spraying of acid with acid mist generation (local event only) Operator exposure	Pressure vessels designed to AS 1210 Piping designed to relevant piping codes, eg ANSI B31.3 All plant areas processing sulphuric acid or acidic ore solution are bunded (either concrete or earth) Concrete bunded areas are lined (acid resistant) Bund volumes are sufficient to contain entire acid hold-up volumes within equipment and piping Pipes designed for low fluid velocities to avoid acid erosion problems Bund sump pumps installed to pump lost acid for neutralisation prior to delivery to tailings Acid supply can be stopped by closing double isolation valves Leaks from pipes carrying acid or acidic solutions outside of bunded areas flow to the dirty water pond

Possible Hazardous Event	Possible Initiating Events	Possible Consequences	Prevention / Protection Measures
			(lined) for treatment Correct materials of construction
Lifting PSV on PAL autoclave	Autoclave overfill	Pressurised release of steam and acid	PSV vented to a safe location Delivery pumps unable to achieve PSV set pressure Instrumentation monitoring, including alarms, warning operators of the likelihood of lifting the PSV Containment philosophy as above
Internal explosion in acid storage tanks	Build-up of hydrogen due to acid reacting with metals, ignition from static etc	Equipment damage Release of acid Operator exposure Possibility of “missiles”	Tanks and process vessels are continuously vented Containment philosophy as above
Carbon dioxide release from Leach Residue Neutralisation Tanks	Neutralisation with limestone generates carbon dioxide (a simple asphyxiant)	Carbon dioxide could fill sumps, pits etc, thereby reducing the oxygen concentration	Dispersion of carbon dioxide due to height of release Confined space entry procedures which include oxygen monitoring
Rupture of tailings pipe	Erosion Corrosion Water hammer	Spillage to ground leading to soil and groundwater pollution	High integrity pipe design Instrumentation to be installed to detect loss of flow (with automatic shutdown) On-site effect only due distance to boundary Spill response procedures
Loss of containment from tailings dam, surge dam or evaporation pond	Wall failure	Environmental effects (pollution off-site)	Conformance to dam safety regulations Dams and pond designed for minimal leakage rates Monitoring bores and toe drains used Can transfer between dams and pond

Possible Hazardous Event	Possible Initiating Events	Possible Consequences	Prevention / Protection Measures
Belt fire on conveyor	Overheating of belt at pulley	Belt fire only (eg the filter concentrate is too wet to burn)	Anti-slip protection on belts Routine maintenance and inspections Fire protection, eg hydrants (contaminated firewater contained on-site)
Loss of containment of the diluent in the solvent extraction or storage areas and subsequent fire	Pipe or vessel leaks Pipe breakage Flange failure Pump leaks (eg seal failures) Tanker transfer hose failure Tanker driveaway Vessel overflows Hot pump bearing	Pool fire if liquid is ignited Products of combustion (eg carbon oxides, water)	Hazardous area controls (eg minimisation of ignition sources) Fully bunded area (storage tanks to AS 1940) Fire protection and suppression systems (eg foam for pool fires and heat activated foam-water deluge system) Contaminated firewater contained on-site Routine maintenance to detect probable leak points Operator control and instrumentation monitoring
Carbon bed fire (solvent extraction area)	Organics absorbed onto the carbon with oxygen and a source of ignition present (eg maintenance activity)	Smouldering type fire, possibility to propagate to a diluent pool fire	Control over ignition sources during maintenance Routine operations unlikely to cause fires (no oxygen present in enclosed system) Infrared detection system (sprinkler system to deluge automatically) Foam fire suppression system

Possible Hazardous Event	Possible Initiating Events	Possible Consequences	Prevention / Protection Measures
Pool fire at API water-oil separator	Oil, diesel runoff to API separator is collected and a source of ignition is present	Pool fire involving oil etc	Only combustible materials are collected in separator (low ignition risk) Electrical hazardous area safeguards Control of ignition sources, e.g. permits to work API separator isolated from other plant items (no propagation risk) Local event only – no off-site fire effects

Hazard Identification for the Steam and Power Plants

Possible Hazardous Event	Possible Initiating Events	Possible Consequences	Prevention / Protection Measures
Natural gas release from pipe or fittings outside roofed areas	Leak or failure of pipe or fittings due to: • corrosion • impact • fire/explosion • earthquake • fabrication fault	Torch fire (resulting from immediate ignition) Flash fire or explosion (resulting from delayed ignition)	Piping design (material specification, fabrication testing) and inspection Painting Pipe located away from impact sources Control of ignition sources Isolation of supply
Natural gas release from pipe or fittings inside roofed area	As above	Fire (explosion possible if gas is trapped in confined space) Damage to building Possibility of “missiles”	As above, plus, where possible, plant design and layout will encourage the dispersion of gas leaks
Steam or condensate leak	Leak or failure of pipe or fittings due to: • corrosion • impact • fire/explosion • earthquake • fabrication fault • erosion • high temperature creep	Scalding, impact damage	Piping design (material specification, fabrication testing) and inspection Pipe sections buried, other sections to be located away from impact sources Isolation of supply Control of outlet steam quality Visible nature of small leaks (allowing corrective action for small leaks)
Turbine exhaust gas leak from casing	Leak or failure of pipe or fittings due to: • corrosion • impact • fire/explosion • earthquake • fabrication fault • erosion • high temperature creep	Burns Asphyxiation Fire	Materials specifications, design and construction codes, correct installation, post fabrication testing Location away from impact sources Routine inspection and maintenance Carbon dioxide extinguisher system Local effects only

Possible Hazardous Event	Possible Initiating Events	Possible Consequences	Prevention / Protection Measures
Mechanical failure of a gas turbine	• Overspeed • Corrosion • Erosion • Fatigue/creep • Impact • Bearing failure • Lubrication failure • Deposition • Fabrication failure • Combustion zone explosion • Earthquake • External fire	Impact damage, hot gas escape, fire, burns, hydraulic oil escape	Robust automatic control and trip system Materials specifications, design and construction codes, correct installation, post fabrication testing Air and gas filtration Robust, proven casing designs Gas purity control
Mechanical failure of the steam turbine	As above for gas turbines	Impact damage, scalding	As for gas turbine except, • Erosion prevented by steam quality control and trip system • Deposition: high quality demineralised water used
Mechanical failure of boilers (heat recovery steam generator or auxiliary boiler)	• Relief system failure • Corrosion • Erosion • Impact • Fabrication failure • Combustion zone explosion • Earthquake • External fire or explosion	Impact damage, burns scalding	Routine maintenance and testing Materials specifications, design and construction codes, and correct installation Demineralised water quality, air and gas filtration Location and guard rails Automatic control and trip system Firefighting systems
Mechanical failure of diesel generators	• Overspeed • Corrosion • Impact • Bearing failure • Lubrication failure • Fabrication failure • Earthquake • External fire or explosion	Impact damage, fire	Routine maintenance and testing Materials specifications, design and construction codes, and correct installation Location and guard rails Automatic control and trip system Firefighting systems

Possible Hazardous Event	Possible Initiating Events	Possible Consequences	Prevention / Protection Measures
Loss of containment of diesel fuel or lubricating oils	Impact Tanker, hose, or storage vessel failure Tanker driveaway Handling error Overfilling Corrosion Pipe leaks	Diesel contained by bunding Pool fire (if ignited) Oil mist fire could result if hot oil mist forms and is ignited	Inspection and maintenance procedures Materials specification Operator training Instrumentation monitoring of tank levels Control of ignition sources Firefighting systems
Loss of containment of transformer insulating oil	Impact Overpressure due to overheating (e.g. due to electrical problem) inside transformer casing External fire Transformer explosion due to major electrical fault or lightning strike	Pressure released via vent causing spillage (contained by bunding) Pool fire if ignition source present or ignited by or after an explosion	Guard rails, suitable location away from likely impacts Routine electrical maintenance Control of ignition sources Appropriate electrical design to minimise the effects of lightning and electrical disturbances Firefighting systems

Hazard Identification for the Sulphur Handling and Sulphuric Acid Plants

Possible Hazardous Event	Possible Initiating Events	Possible Consequences	Prevention / Protection Measures
Release of sulphur dioxide or sulphur trioxide	Fugitive emissions from vessel holding hot molten sulphur Failure of stack fan Leak or rupture at acid plant due to mechanical failure or impact, e.g. suction seals, valves, blower, piping, vessel or heat exchanger, transport or cranage accident Loss of absorption in acid plant absorption tower, e.g. loss of reflux liquid	Release of sulphur dioxide or sulphur trioxide at ground level or through the stack Toxic gases are dispersed Acute effects (no long term effects) Corrosion of nearby structures	Regular maintenance Computer control of the acid plant Operator training and surveillance Automatic shutdown of plant on upset conditions Sulphur dioxide monitors located throughout the plant Mechanical protection of the plant from traffic etc, eg bollards, walls Appropriate materials of construction Visual indication of release (white plume)
Release of sulphuric acid	Leak at piping, valves, pumps and associated equipment inside storage tanks bund or within the acid plant boundary (impact, mechanical damage, corrosion, erosion) Sample point left open Tank overfill Damage to pumps from running against a closed head Dry pump damage Loss at tanker unloading bay (used at initial plant startup and periods of high acid demand)	Release of acid forming pools inside bunds Personnel injury if in contact If water added, production of fumes and heat Explosive reactions with non-compatible materials	Bunds can contain volume of acid within plant equipment and tanks. Also, the tanker unloading bay is a contained area Spills can therefore be neutralised prior to pumping away Storage tanks to be fitted with high level instrumentation Operators will be trained in safe handling of products and use of protective equipment Periodic maintenance and control (manual and instrumented) of lines and pumps Emergency response procedures to be prepared for handing spills Safety showers and eye wash stations to be installed Segregation from non-compatible materials (e.g. natural gas)

Possible Hazardous Event	Possible Initiating Events	Possible Consequences	Prevention / Protection Measures
Development of hydrogen vapours in sulphuric acid pipeline or storage tanks	Corrosion of steel	Possibility of hydrogen embrittlement of the steel at high points Danger of ignition of hydrogen during maintenance etc	Protective coatings in tanks Acid strength is maintained (presence of water induces corrosion) Any hydrogen developed in the storage tanks will be vented away (via the tank vent) Hydrogen detection before maintenance Earthing of pipeline prevents excessive build-up of electrostatic charges
Natural gas fire (natural gas supplied to sulphur burner for startup purposes)	Leak from piping (hole or rupture), valves, flanges, etc. (impact, mechanical damage, corrosion, stress)	Immediate ignition – local torch fire Delayed ignition – flash fire or vapour cloud explosion (explosion overpressures generated) Equipment damage Injury to personnel	Piping design to appropriate codes and standards, e.g. ANSI B31.3 Routine maintenance and inspection procedures Fire protection system, e.g. hydrants
Explosion in sulphur burner or downstream equipment	Incorrect burner startup sequence Sulphur entrainment from the burner	Build-up of natural gas and/or sulphur in burner prior to ignition Explosion when ignition takes place Equipment damage Injury to personnel Possibility of missiles	Robust, proven burner management system to be used Operator training in startup procedures Purging cycles to avoid the build-up of flammable atmospheres Most likely outcome – energy of explosion damaging local equipment only

Possible Hazardous Event	Possible Initiating Events	Possible Consequences	Prevention / Protection Measures
Sulphur fires	Ignition source at stockpiles, e.g. front end loader, hot ash from diesel engines, or at the molten sulphur tank area	Sulphur fire evolving sulphur oxides. Potential to impact people, equipment and the environment	Stockpile wetting and control Small fires typically extinguished by smothering (in some cases by adding more sulphur on top to starve the fire of oxygen) Larger fires can be flooded with water Operator training and vigilance (smell is a very early indicator of sulphur fires) Front-end loaders safety features include spark arrestors on the exhausts and heat protection around the engines

Hazard Identification for the Fuel Farm and Reagents Storage Areas

Possible Hazardous Event	Possible Initiating Events	Possible Consequences	Prevention / Protection Measures
Loss of containment of diesel fuel from a 60 000 L tank (vehicle filling) Note: The diesel supply tank (5 000 L) for the emergency generator was included in the steam and power plants section. Loss of containment from the 1 000 L tank (firewater pump) as per the 5 000 L tank but with smaller effects	Impact Tanker, hose, pump, bowser or storage vessel failure Tanker driveaway Handling error Overfilling Corrosion Pipe leaks	Diesel contained by double lined tank or bund walls Pool fire (if ignited)	Inspection and maintenance procedures Materials specification Operator training Instrumentation monitoring of tank levels Control of ignition sources Firefighting systems
Loss of containment of reagents, e.g. caustic soda, hydrochloric acid, SMBS, oxalic acid, formic acid, hydrogen peroxide or sodium hypochlorite	Impact Tanker, hose, pump or storage vessel failure Tanker driveaway Handling error Overfilling Corrosion Pipe leaks	Release of corrosive and/or oxidising fluid (contained by bunding, including the tanker unloading area)	Inspection and maintenance procedures Materials specification Operator training Instrumentation monitoring of tank levels Spill response plans including neutralisation and disposal procedures

Appendix 2

2000 PHA Toxic Gas Modelling Basis

Preliminary Hazard Analysis for the Syerston Project

Modification 4

Appendix 2 – 2000 PHA Toxic Gas Modelling Basis

Given these large distances to the nearest place of residence, the assessment approach taken in this PHA is to analyse all incidents that may have an effect (e.g. irritation, injury and/or fatality) at this location as well as at the site's nearest boundary (for fatality risk). This approach is taken as the majority of identified incidents have no effect over such a large distance, e.g. a diluent pool fire would have no thermal effects at distances of approximately 500 metres and hence rigorous analysis is unnecessary. This approach would allow detailed assessment of, and hence draw attention to, the significant hazardous events. This approach would also aid in the determination of plant design requirements to mitigate the risks from these significant hazardous incidents as well as influence the plant's safety management systems and emergency response plans.

The consequence calculations in this PHA were carried out using commercially available risk assessment software, TNO's Effects (Ref 14). The consequence models used within Effects are well known and are fully documented in the TNO Yellow Book (Ref 14).

Essentially, for each scenario defined by the analyst (e.g. those events considered significant and likely to have an impact at the nearest place of residence and boundary), an appropriate release rate is calculated by using established equations within Effects. Data pertinent to the release conditions, including the initial state of the material, is included in the calculations.

Once the release conditions and rate have been determined, the likely outcomes (e.g. toxic gas release) are modelled. The results from these simulations (e.g. plume concentrations from toxic gas releases) are used to determine the effect on people, property and/or the environment.

The scenarios identified in Section 4 are the basis of the risk assessment. The significant events that involve fires, explosions and toxic gas releases are analysed further in this PHA. The basis for each analysis is given in the corresponding section to define the conditions of release for each event. This also includes assumptions made for each scenario.

Release Sources

For gas or liquid release scenarios, piping failures have been analysed using four failure cases. These are full pipe fracture, 50 mm, 13 mm, and 3 mm holes. Gasket failure is likely to result in a gap equivalent to the area between two flange bolts and is included in the analysis where relevant. This is considered equivalent to a 13 mm diameter hole size. Vessel failures have been analysed as catastrophic rupture and leaks of 50 mm, 25 mm, 13 mm and 6 mm. These generic failure cases are comparable to those used in a number of published risk assessment studies and described in Lees (Refs 15 and 16).

Release Rates

Release rates were calculated for each release scenario using standard equations based on hole size, pressure, temperature and material state (i.e. gas or liquid). Where the calculated release rate was greater than the maximum possible process rate (for example, if the flow was limited by the sulphur burning rate), the release rate was specified as equal to the limiting production rate. The maximum release inventory was also limited to the contents of the plant equipment plus the amount lost over the duration of the leak (variable depending on the leak rate).

Release Duration

The assumed time taken to stop and control a release is based on a credible estimate of a release scenario rather than always taking a worst case approach (in accordance with quantitative risk analysis principles).

For any scenarios where automatic shutdown of the plant occurs on detection of the hazardous event, a release duration of 1 minute has been chosen. This is consistent with the reported methodologies in Lees (Ref 16) and the approach taken within the Orica ISORIS risk assessment package (Ref 17). Also, if any worst case events occur (e.g. catastrophic rupture within the sulphuric acid plant where large visible clouds occur along with numerous alarms and trips) which are immediately obvious to the operators (24 hour manning), a release duration of one minute has been chosen.

For smaller leak scenarios which rely on manual response to stop and control the release (i.e. where operator intervention is required to stop the leak, usually by shutting down production or closing valves), release duration of between 6 and 30 minutes can be expected. The duration depends on the means to alert the operators of the release (e.g. process alarms) as well as the closeness of the release to the operators (i.e. smell, sight and/or noise may indicate a release if the operator is nearby). In this assessment, release duration for small leaks is assessed individually as described in the appropriate section.

Given that the plants are to be designed to the latest design standards which would include comprehensive monitoring via programmable electronic systems, it can be expected that sufficient alarms and trips would exist to warn the operators of significant abnormal plant behaviour. This expectation can be verified in the FHA and HAZOP studies if the project goes ahead. As such, the nominated release durations are judged to be achievable.

As a further means to mitigate the release duration (and hence release quantity), it is proposed to install emergency isolation valves (EIVs) on the inlets and outlets of all equipment processing the more hazardous materials (e.g. the ammonia storage vessels). Once a plant trip is initiated, these EIVs would shut, thereby boxing in sections of pipework and equipment. Hence, the amount released and the release duration are minimised.

For the sulphuric acid plant, shutting the plant down quickly stops releases as these plants run at low pressure (typically up to 24 kPag). Hence, there is little driving force for losses once the plant is stopped.

For any process plant, once the plant is stopped, the maximum amount released (and hence maximum duration) is limited by depressurising to atmospheric pressure if a pipe or vessel failure has occurred.

Appendix 3

Risk Analysis

Preliminary Hazard Analysis for the Syerston Project

Modification 4

Appendix 3 – Risk Analysis

The risk analysis performed for this PHA is shown on the table below (pages A3.4 and A3.5)

The notes associated with the calculations and shown in the table are:

1. Liquid ammonia lines estimated to be approximately 50 m, i.e. from containers to bullets and to the vaporiser.
2. Includes the ammonia vapour supply line as well as the vapour line back to the containers.
3. United Kingdom HSE data used for all likelihoods.

This failure rate includes catastrophic failures as well as 50 mm holes.

4. Same basis as the 2000 PHA (Ref 2).
5. Transfer failure rate is (United Kingdom HSE data):

$$0.2 \times 10^{-6}/\text{operation x 3 transfers per day x 340 days per year} = 2 \times 10^{-4}/\text{yr}$$

Note: Allowance for shutdowns and other periods taken to be 25 days.

6. Holes can occur in the pipework and vessels.
7. Holes and failures can occur in the pipework and vessels plus transfer hose failures.
8. Probits for sulphur dioxide and ammonia (from Ref 18):

$$Y = a + b\ln(tC^n)$$

where

- Y = probit value
- C = concentration of the toxic gas in ppm
- t = duration of exposure in minutes
- tC^n is referred to as the *Toxic Load*
- *a, b, n* are constants (unique for each gas)

Chemical	a	b	n
Ammonia	-9.82	0.71	2.0
Sulphur dioxide	-23.70	1.14	3.7

9. The widths of the plumes are estimated to be up to 70 m at the nearest place of residence. This results in a narrow angle for the plume (i.e. in the 'Y' direction) and hence the wind direction that can cause impact. The angle of the plume is increased to 5^o to allow for modelling inaccuracies. The probability that the wind is blowing towards the nearest residence is then taken to be (5/45) times the values for wind blowing from the northeast. Outside of this arc, the plume is not expected at the place of residence.

Risk Analysis:

Scenario	Stability Class Wind Speed	Pipe Length, m	Pipe Failure Likelihood, times/yr.m	Probability of System in Use	Vessels Failure Likelihood, times/yr	Number of Vessels	Transfer Hose Failure Likelihood, times/yr	Event Likelihood, times/yr	Probit Value	Probability of Fatality	Probability of Wind Direction	Contribution to the Following Risks: (times/yr)		
												Irritation	Injury	Fatality
						Note 4:			Note 8:		Note 9:			
Sulphur Dioxide - Catastrophic Failures	D5.9				4.00E-06	8		3.20E-05	15	1	0.003	9.60E-08	9.60E-08	9.60E-08
	D2.4				4.00E-06	8		3.20E-05	18	1	0.0027	8.64E-08	8.64E-08	8.64E-08
	E5.8				4.00E-06	8		3.20E-05	16	1	0.0028	8.96E-08	8.96E-08	8.96E-08
	E2				4.00E-06	8		3.20E-05	21	1	0.003	9.60E-08	9.60E-08	9.60E-08
	F2				4.00E-06	8		3.20E-05	21	1	0.0032	1.02E-07	1.02E-07	1.02E-07
		Note 4:	Note 3:					Note 6:						
Sulphur Dioxide - 50 mm Holes	D5.9	500	1.40E-07		5.00E-06	8		1.10E-04			0.003	3.30E-07		
	D2.4	500	1.40E-07		5.00E-06	8		1.10E-04			0.0027	2.97E-07		
	E5.8	500	1.40E-07		5.00E-06	8		1.10E-04			0.0028	3.08E-07		
	E2	500	1.40E-07		5.00E-06	8		1.10E-04			0.003	3.30E-07		
	F2	500	1.40E-07		5.00E-06	8		1.10E-04			0.0032	3.52E-07	3.52E-07	
Ammonia - Catastrophic Failures	D5.9				4.00E-06	2		8.00E-06	5	0.5	0.003	2.40E-08	2.40E-08	1.20E-08
	D2.4				4.00E-06	2		8.00E-06			0.0027	2.16E-08		
	E5.8				4.00E-06	2		8.00E-06	5	0.5	0.0028	2.24E-08	2.24E-08	1.12E-08
	F2				4.00E-06	2		8.00E-06	4	0.15	0.0032	2.56E-08		3.84E-09
		Note 1:					Note 5:	Note 7:						
Ammonia (liquid) - 50 mm Holes	D5.9	50	5.00E-07	0.08	5.00E-06	2	2.00E-04	2.12E-04			0.003	6.36E-07	6.36E-07	
	D2.4	50	5.00E-07	0.08	5.00E-06	2	2.00E-04	2.12E-04			0.0027	5.73E-07		
	E5.8	50	5.00E-07	0.08	5.00E-06	2	2.00E-04	2.12E-04			0.0028	5.94E-07	5.94E-07	
	E2	50	5.00E-07	0.08	5.00E-06	2	2.00E-04	2.12E-04	4	0.15	0.003			9.54E-08
	F2	50	5.00E-07	0.08	5.00E-06	2	2.00E-04	2.12E-04	5	0.5	0.0032			3.39E-07
		Note 1:												
Ammonia (liquid) - 25 mm Holes	D5.9	50	5.00E-07	0.08	5.00E-06	2		1.21E-05			0.003	3.63E-08		
	D2.4	50	5.00E-07	0.08	5.00E-06	2		1.21E-05			0.0027	3.26E-08		
	E5.8	50	5.00E-07	0.08	5.00E-06	2		1.21E-05			0.0028	3.38E-08		

Scenario	Stability Class Wind Speed	Pipe Length, m	Pipe Failure Likelihood, times/yr.m	Probability of System in Use	Vessels Failure Likelihood, times/yr	Number of Vessels	Transfer Hose Failure Likelihood, times/yr	Event Likelihood, times/yr	Probit Value	Probability of Fatality	Probability of Wind Direction	Contribution to the Following Risks: (times/yr)		
												Irritation	Injury	Fatality
		Note 2:	Note 3:				Note 5:							
Ammonia Vapour Releases	E2	150	6.00E-07		5.00E-06	2	2.00E-04	1.00E-04			0.003	3.00E-07		
	F2	150	6.00E-07		5.00E-06	2	2.00E-04	1.00E-04			0.0032	3.20E-07		
TOTALS												4.71E-06	2.10E-06	9.32E-07

7 REFERENCES

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Syerston Project

MODIFICATION 4 ENVIRONMENTAL ASSESSMENT

Appendix D

Water Management Assessment

10 November 2017

SYERSTON PROJECT

MODIFICATION 4 WATER MANAGEMENT ASSESSMENT

Submitted to:
Adam Hall
Clean TeQ Holdings Limited
Level 17
191 St Georges Terrace
Perth WA

Report Number. 039-1524361 Rev 2

REPORT

Golder Associates

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1.0 INTRODUCTION

Scandium21 Pty Ltd owns the rights to develop the Syerston Project (the Project). Scandium21 Pty Ltd is a wholly owned subsidiary of Clean TeQ Holdings Limited (Clean TeQ). Development Consent DA 374-11-00 for the Project was issued in 2001.

Clean TeQ has applied to the NSW Department of Planning and Environment to modify the Development Consent DA 374-11-00 for the Project.

The approved Project (Figure 1) includes the establishment and operation of the:

- Mine (including the processing facility)
- Limestone quarry
- Rail siding
- Gas pipeline
- Borefield and water pipeline
- Associated transport and infrastructure.

Since Development Consent DA 374-11-00 was issued under Part 4 of the New South Wales (NSW) *Environmental Planning and Assessment Act 1979* (EP&A Act) in 2001, three modifications to Development Consent DA 374-11-00 have been granted under the EP&A Act:

- Modification 1 in 2005 – to allow for the increase of the run-of-mine (ROM) ore processing rate, limestone quarry extraction rate and adjustments to ore procession operations
- Modification 2 in 2006 – to allow for the reconfiguration of the water supply borefield
- Modification 3 in 2017 – to allow for the production of scandium oxide.

This modification, referred to as Modification 4, has been proposed following completion of an optimisation study for the Project. The optimisation study identified potential opportunities in relation to water management including:

- Increasing the efficiency of mining and processing operations
- Increasing water recycling and as a result minimising water demand from external water supply sources
- Increasing water supply security by diversifying the approved water supply sources to include surface water from the Lachlan River.

This report details the modification to the approved water management system, describes current knowledge of the hydrological and hydrogeological setting, and addresses contemporary planning requirements relevant to water management for the Project. The modification is described in further detail in Section 2.0.

1.1 Background

The Project is located approximately 350 kilometres (km) north-west of Sydney, near Fifield, NSW (Figure 1). The major town centres of Parkes and Dubbo are located within 100 km of the Project area. The mine (including processing facility) is located within Exploration Licence (EL) EL4563.

The Project allows for mining and processing of a high grade nickel, cobalt and scandium resource. A feasibility study was completed in 2000 for a nickel/laterite operation. A change in ownership occurred in 2004, and a revised feasibility study was completed in 2005. The Project did not proceed to full development due to the prevailing base metal prices at that time.

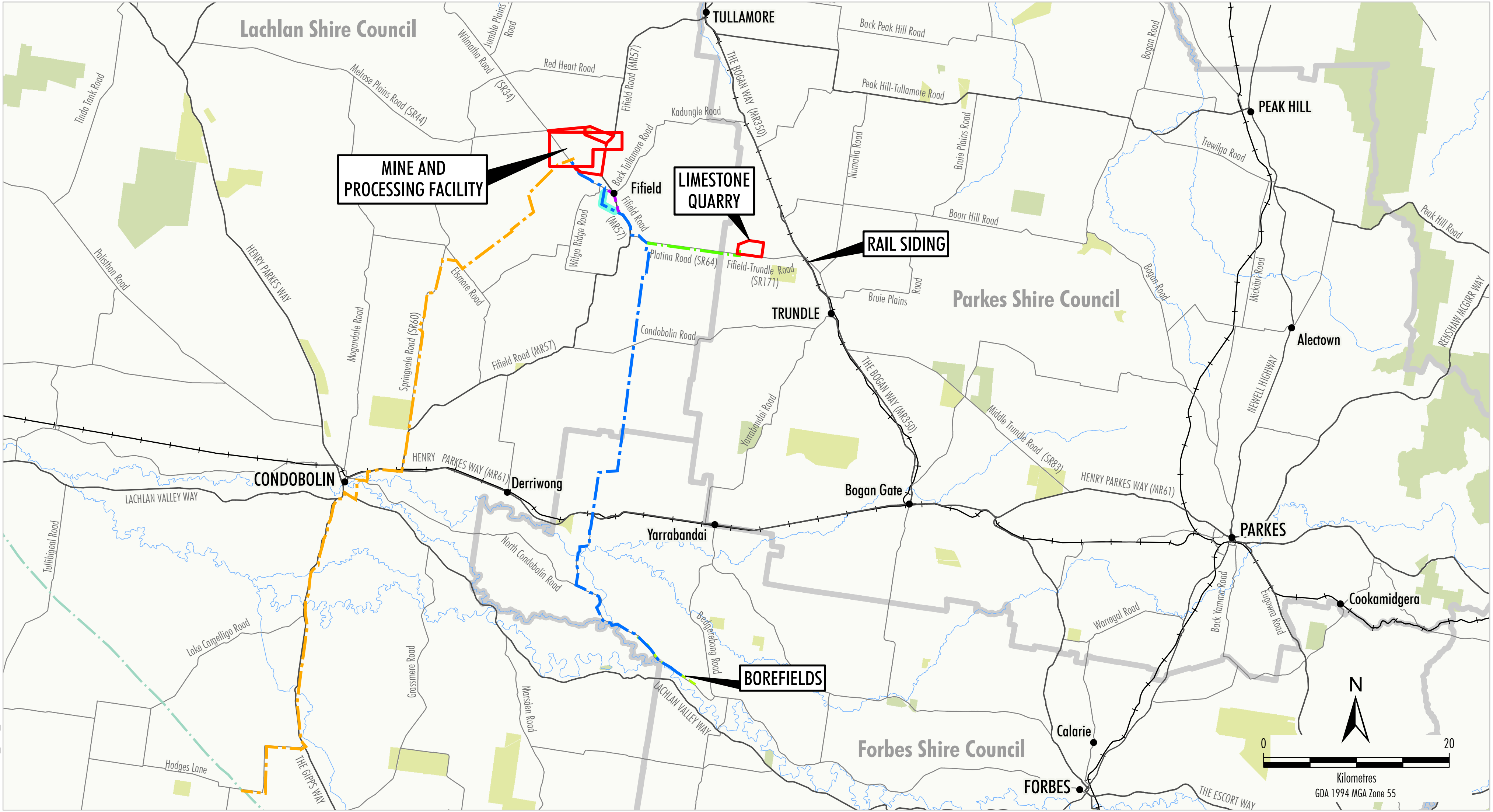
Clean TeQ acquired the Project in 2014. Clean TeQ completed a feasibility study for a small-scale scandium project to produce scandium oxide and is currently undertaking a bankable feasibility study for an expanded nickel/cobalt/scandium project. Modification 3 to DA 374-11-00, to allow for the production of scandium oxide, was approved in May 2017.

1.2 Previous studies

Golder Associates Pty Ltd (Golder) has conducted a number of surface water, groundwater and geotechnical studies within the Project area between 1999 and 2016 (listed in Table 1).

Table 1: Previous Golder reports

Year	Report	Title	Submitted to
March 2000	99631001-A	Regional Hydrogeology	Black Range Minerals (BRM)
	99631001-B	TSF Geotechnical Investigations	BRM
	99631001-C	Surface Hydrology	BRM
	99631001-D	Plant Site and Mine Geotechnical Investigations	BRM
	99631001-E	TSF Water balance	BRM
	99631001-F	TSF Design	BRM
	99631001-G	TSF Seepage	BRM
June 2005	011-04631030	RSF Design	Ivanplats
April 2015	004-1524361	Ground and Other Water Supply Review	Clean TeQ Metals
June 2015	011-1524361	Update Geotechnical and Residue Disposal Designs	Clean TeQ Metals
December 2016	021-1524361	Groundwater Monitoring Bore Assessment	Clean TeQ Metals



CTL-16-02 Mod4_WMA_2018B

LEGEND

- National Park/Conservation Area
- State Forest
- Local Government Boundary
- Existing Gas Pipeline
- Mining Lease Application Boundary
- Approved Water Pipeline
- Approved Limestone Quarry Water Pipeline
- Approved Gas Pipeline
- Approved Borefield Infrastructure Corridor
- Modified Water Pipeline Alignment Option
- Approved Fifield Bypass

Source: Black Range Minerals (2000); NSW Department of Industry (2017); NSW Land & Property Information (2017); Office of Environment and Heritage NSW (2017)

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SYERSTON PROJECT MODIFICATION 4

Regional Location

Figure 1

2.0 DESCRIPTION OF THE MODIFICATION

2.1 Modification overview

The Modification involves the implementation of the opportunities identified following completion of an optimisation study and would include:

- Mining in a more selective manner to initially increase the processing facility ore feed grade
- Addition of drilling and blasting at the mine site
- Adoption of the resin-in-pulp (RIP) processing method option (i.e. the counter current decantation processing method option is no longer proposed)[1]
- Increased sulphur and sulphuric acid demand to leach additional nickel, cobalt and scandium from the higher grade ore
- Increased limestone demand to neutralise the additional acid required in the acid leach circuit
- Addition of a crystalliser to the processing facility to extract ammonium sulphate from an existing waste stream for use as a fertiliser product
- Changes to process input and product road transport requirements
- Addition of a water treatment plant to the processing facility to recycle process water and minimise make-up water demand
- Increased tailings storage facility capacity to hold increased tailings volume due to the additional limestone required for acid neutralisation
- Reduced evaporation pond capacity due to the recycling of process water
- Relocation of mine infrastructure to avoid resource sterilisation and improve operational efficiency
- Addition of surface water extraction from the Lachlan River to improve water supply security
- Minor changes to borefield transfer station layout and water pipeline alignment
- Short-term road transport of water from the borefield to the mine site during the initial construction phase
- Reduced gas demand as the increased sulphuric acid production would generate additional steam for power generation.

The Modification would not involve changes to any aspects of the approved limestone quarry, rail siding or gas pipeline.

A detailed description of the Modification is provided in the Environmental Assessment main text. A summary of the key water-related Project changes is provided in the remainder of this section.

2.2 Mine site general arrangement

The following components of the approved mine site would be modified:

- Mine infrastructure area components would be relocated to avoid potential resource sterilisation and improve operational efficiency

[1] The approved Project includes the option to use either the RIP or counter current decantation processing method.

- Increased tailings storage facility footprint (capacity) to hold increased tailings volume due to the additional limestone required for acid neutralisation
- Reduced evaporation pond footprint (capacity) due to the recycling of process water
- An explosives magazine would be constructed north of the diversion dam
- Minor alterations would be made to on-site water management infrastructure (e.g. sediment dams, pipelines, diversions) to account for the modified layout and increased water recycle on-site.

The general arrangement of the modified mine and processing facility is provided in Figure 2.

Progressive general arrangements of the modified mine and processing facility are provided in Figure 3 to Figure 6.

2.3 Mining operations

The Modification would include mining in a more selective manner to initially increase the processing facility ore feed grade.

The Modification would not however change the approved mining areas (i.e. open cut pit extents), mining method or mining rate.

2.4 Processing operations

The Modification would include the adoption of the RIP processing method (i.e. the counter current decantation processing method option is no longer proposed).

Other changes to the mine processing facility would include:

- Increased sulphur and sulphuric acid demand to leach additional nickel, cobalt and scandium from the higher grade ore
- Increased limestone demand to neutralise the additional acid required in the acid leach circuit
- Addition of a crystalliser to the processing facility to extract ammonium sulphate from an existing waste stream for use as a fertiliser product
- Addition of a water treatment plant to the processing facility to recycle process water and minimise make-up water demand (Section 2.5).

The processing facility would continue to operate with an autoclave feed rate of 2.5 million tonnes per annum (Mtpa) to produce up to 40 000 tonnes per annum (tpa) of nickel and cobalt metal equivalents, as sulphate precipitate products and up to 180 tpa of scandium oxide.

2.5 Water treatment plant

The water treatment plant would allow process water to be recycled from the tailings storage facility and final neutralisation thickener for use in the processing facility.

Process water would first be treated in a high-density sludge (HDS) process to remove magnesium and manganese. This would involve using lime to raise the pH sufficiently to precipitate magnesium and manganese. The precipitate solids would be concentrated in a thickener and transferred to the tailings storage facility.

Process water treated in the HDS process would then be advanced to an ammonia membrane. The microporous membrane uses sulphuric acid to strip gaseous ammonia from the process water. This creates a by-product of ammonium sulphate which would be combined with the ammonium sulphate produced elsewhere in the processing facility.

Finally, the process water proceeds to an ion exchange process, which uses two circuits to remove calcium, magnesium, sulphate and other impurities from the process water via a resin. The resin would be washed with sulphuric acid and lime respectively for each circuit and recycled back to the start of the ion exchange process. The wash liquors would be recycled back to the HDS process, eliminating any waste streams.

The treated process water would then be transferred to the start of the processing facility and used as a substitute for raw water.

2.6 Tailings management

2.6.1 Tailings storage facility

The capacity of the tailings storage facility would be increased to hold increased tailings volume due to the additional limestone required for acid neutralisation. To increase the tailings storage facility capacity, the footprint would be increased and the construction methodology would change from upstream to downstream. The final elevation of the tailings storage facility remains essentially the same, increasing from approximately 310 metres Australian Height Datum (m AHD) to 314 m AHD.

Other components of the tailings storage facility, such as tailings delivery, underdrainage, seepage collection and decant systems would be generally unchanged. Decant water would however be pumped to the water storage dam rather than the evaporation ponds.

The design of the modified tailings storage facility would conform to the relevant guidelines and requirements described in Condition 29, Schedule 3 of Development Consent DA 374-11-00. This includes the requirements for permeability of liners, storage capacity and DSC design requirements. Further details of the tailings storage facility are provided in Section 6.1.

2.7 Tailings storage facility water management

The tailings storage facility would continue to only receive water inflows from the tailings slurry and incident rainfall, as the tailings storage facility would be a ‘turkeys nest’ arrangement with a fully encompassing raised perimeter embankment.

Supernatant waters (including incident rainfall) decanted from the tailings storage cells would be pumped to the water storage dam for reuse in the processing facility. Prior to reuse, a portion of the returned water would be directed to the water treatment plant at the processing facility (Section 2.5) for treatment.

An approved liquid waste stream from the processing facility containing high concentrations of chloride would be separated from other processing facility waste streams and pumped to the evaporation pond. This would prevent the build-up of chloride in the process water as the water in the evaporation pond would be evaporated rather than be recycled in the site water management system for reuse in the processing facility.

Due to the reduction in water volume reporting to the evaporation pond, the footprint of the ponds would be reduced.

The tailings storage facility and water storage dam would be operated to maintain a freeboard storage, above the level of the decant pond, in excess of that required to store the volume of runoff generated from a 1 in 100 year ARI rain event of 72 hours duration, in accordance with Condition 29, Schedule 3 of Development Consent DA 374-11-00. The tailings storage facility decant system would be designed to remove the quantity of water generated by a storm of this magnitude within a reasonable timeframe of the event occurring, with water sent directly to the water storage dam.

In accordance with Condition 29, Schedule 3 of Development Consent DA 374-11-00, the floor and side walls of the evaporation ponds and water storage dam would be designed to the same standard as the tailings storage facility.

2.8 Site water management

The overall objective of the water management system is to control runoff from the development/construction areas and the operation areas, while diverting upstream water around these areas.

The water management system would include both permanent features that would continue to operate post-closure (e.g. diversion dam, northern and southern diversion channels) and temporary structures during mining operations.

The water management system would be progressively developed during the construction and operation of the mine as diversion and containment requirements change.

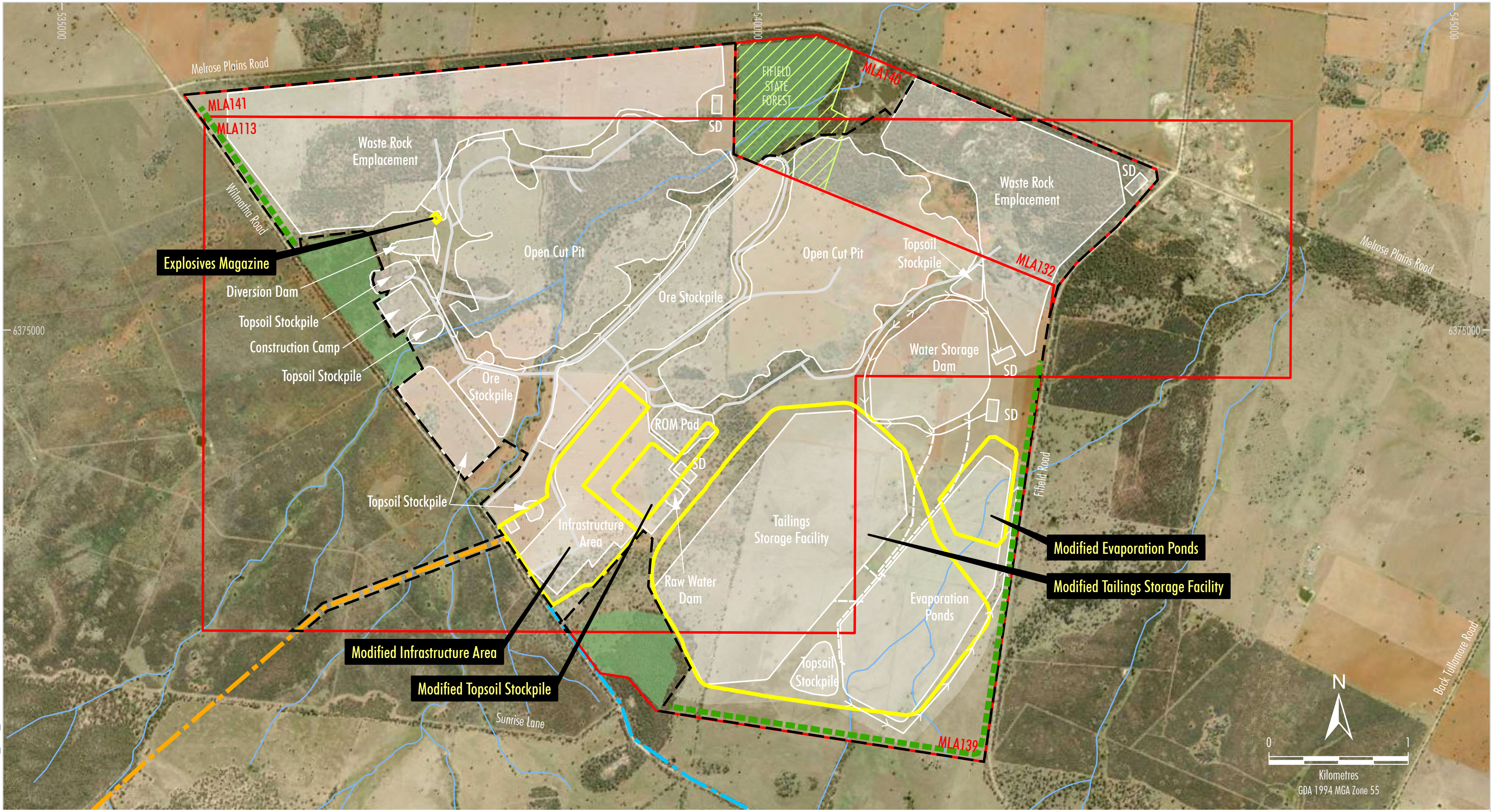
Some existing drainage paths will require diversion around the northern open cut pit and evaporation ponds into exiting drainage lines by development of the northern and southern diversion structures, respectively. The design would consider long term stability and compatibility with existing hydrological features, landforms and vegetation. A detailed description of the clean water diversion systems would be included in the Surface Water Management Plan in accordance with Condition 30, Schedule 3 of Development Consent DA 374-11-00.

An internal drainage system would be constructed to collect and contain water generated within the development/construction areas and operation areas.

Sediment control structures such as sediment dams and sediment fences would be employed where necessary within and downstream of disturbance areas.

Sediment control structures would be designed, installed and maintained in accordance with *Managing Urban Stormwater: Soils and Construction* in accordance with Condition 29, Schedule 3 of Development Consent DA 374-11-00.

The site water management system for the modified Project would be generally unchanged. The southern diversion alignment would be revised to reflect the modified tailings storage facility and evaporation ponds (Figures 3 to 6).



LEGEND

- State Forest
- Mining Lease Application Boundary
- Approved Surface Development Area
- Approved Mine Footprint
- Diversion Structure
- Key Site Water Pipeline
- Approved Gas Pipeline
- Approved Water Pipeline
- Vegetation Screening
- Existing Open Woodland
- Modified Layout

Source: Black Range Minerals (2005); NSW Department of Industry (2017); NSW Land and Property Information (2017)
NSW Imagery: © Department of Finance, Services & Innovation (2017)

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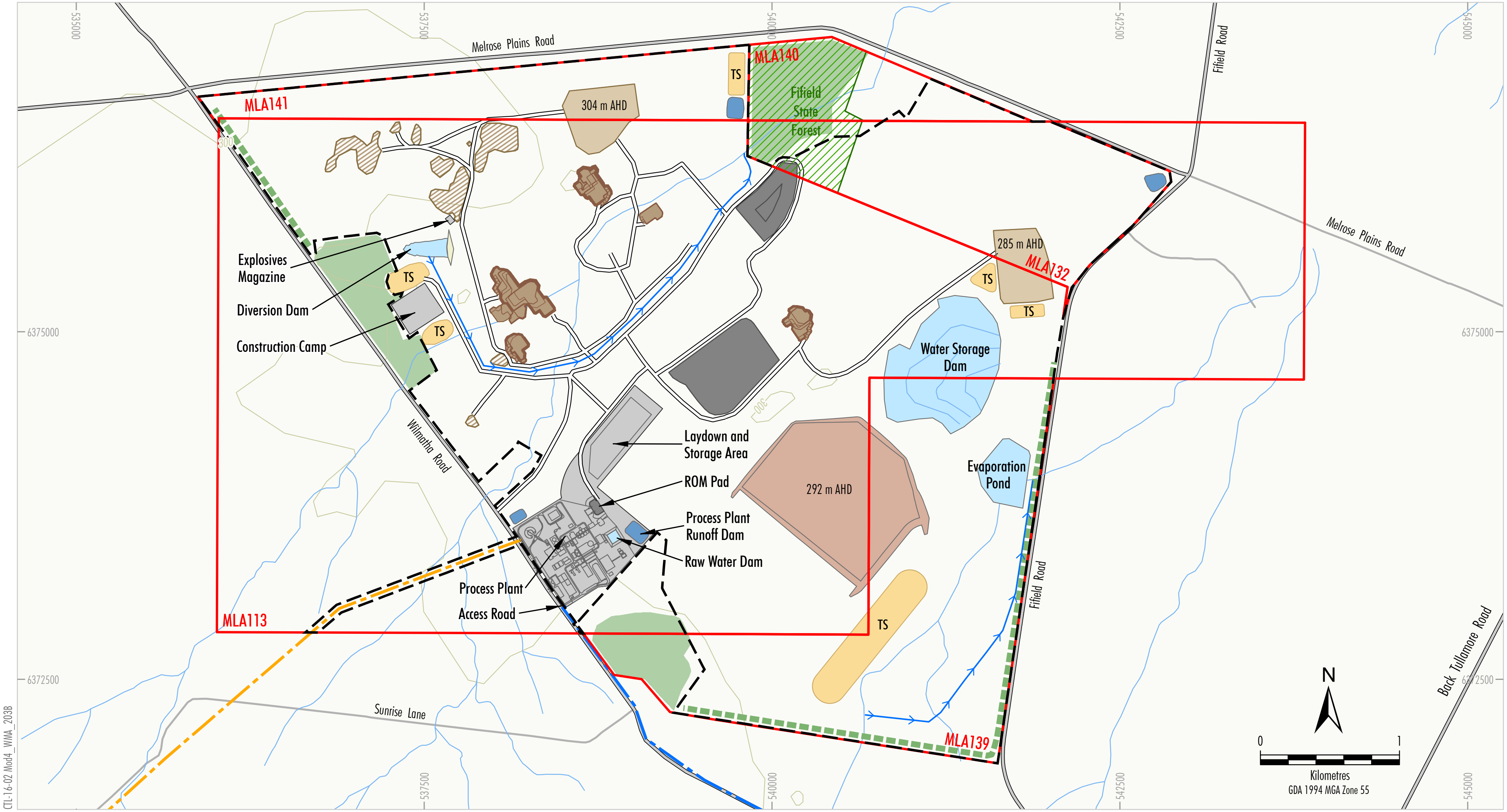
SYERSTON PROJECT MODIFICATION 4

Indicative Modified Mine and Processing Facility General Arrangement

Figure 2



LEGEND

- Mining Lease Application Boundary
- Approved Surface Development Area
- Open Cut Pit (Scandium Oxide)
- Open Cut Pit
- Waste Rock Emplacement
- Tailings Storage Facility
- TS Topsoil Stockpile
- Ore Stockpile
- Mine Infrastructure Area
- Sediment Dam
- Diversion Structure
- Gas Pipeline
- Water Pipeline
- Vegetation Screening
- Existing Open Woodland to be Maintained
- State Forest

Source: Black Range Minerals (2000); NSW Department of Industry (2017); NSW Land & Property Information (2017)

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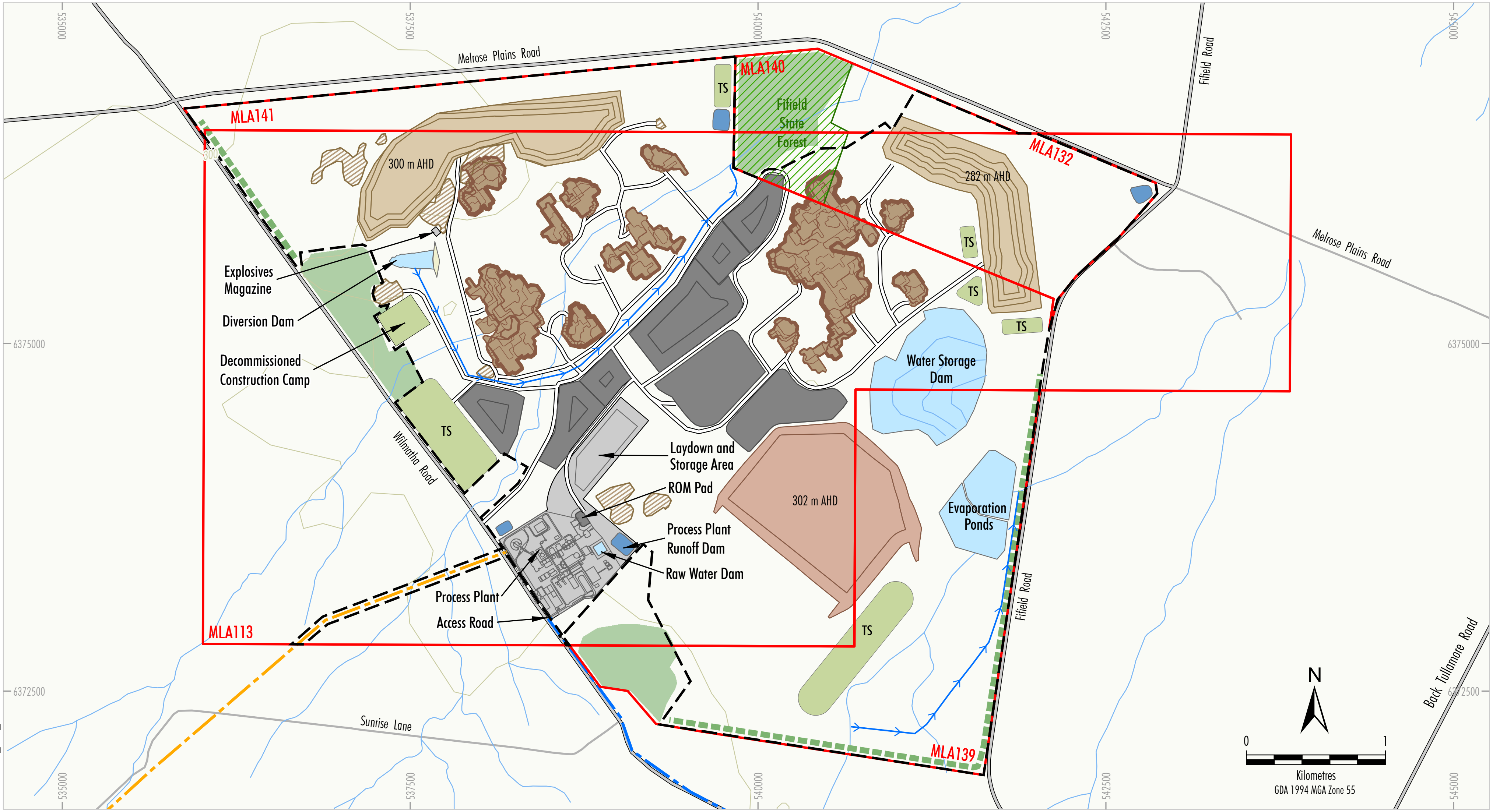
SYERSTON PROJECT MODIFICATION 4

Modified Mine and Processing Facility Conceptual General Arrangement Year 1

Figure 3



LEGEND

- Mining Lease Application Boundary
- Approved Surface Development Area
- Open Cut Pit (Scandium Oxide)
- Open Cut Pit
- Waste Rock Emplacement
- Tailings Storage Facility
- TS Topsoil Stockpile
- Ore Stockpile
- Mine Infrastructure Area
- Sediment Dam
- Initial Rehabilitation
- Diversion Structure
- Gas Pipeline
- Water Pipeline
- Vegetation Screening
- Existing Open Woodland to be Maintained
- State Forest

Source: Black Range Minerals (2000); NSW Department of Industry (2017); NSW Land & Property Information (2017)

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SYERSTON PROJECT MODIFICATION 4

Modified Mine and Processing Facility Conceptual General Arrangement Year 6

Figure 4

LEGEND

- Mining Lease Application Boundary
- Approved Surface Development Area
- Open Cut Pit (Scandium Oxide)
- Open Cut Pit
- Waste Rock Emplacement
- Tailings Storage Facility
- TS Topsoil Stockpile
- Ore Stockpile
- Mine Infrastructure Area
- Sediment Dam
- Initial Rehabilitation
- Intermediate/Advanced Rehabilitation
- Diversion Structure
- Gas Pipeline
- Water Pipeline
- Vegetation Screening
- Existing Open Woodland to be Maintained
- State Forest

Source: Black Range Minerals (2000); NSW Department of Industry (2017); NSW Land & Property Information (2017)

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SYERSTON PROJECT MODIFICATION 4

Modified Mine and Processing Facility Conceptual General Arrangement Year 11

Figure 5

LEGEND

- Mining Lease Application Boundary
- Approved Surface Development Area
- Open Cut Pit (Scandium Oxide)
- Open Cut Pit
- Waste Rock Emplacement
- Tailings Storage Facility
- TS Topsoil Stockpile
- Ore Stockpile
- Mine Infrastructure Area
- Sediment Dam
- Initial Rehabilitation
- Intermediate/Advanced Rehabilitation
- Diversion Structure
- Gas Pipeline
- Water Pipeline
- Vegetation Screening
- Existing Open Woodland to be Maintained
- State Forest

Source: Black Range Minerals (2000); NSW Department of Industry (2017); NSW Land & Property Information (2017)

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SYERSTON PROJECT MODIFICATION 4

Modified Mine and Processing Facility
Conceptual General Arrangement
Year 21

Figure 6

2.9 Borefield transfer station

The Modification would not change the location of the existing/approved bores in the borefields. However, the transfer station location would be relocated approximately 300 m to the north-west. The relocation of the transfer station would require the realignment of the associated borefield infrastructure corridor, transfer station access road and water pipeline. The layout of the modified transfer station once the water pipeline has been commissioned is shown in Figure 8.

During construction and prior to commissioning of the water pipeline, water would be transported from the borefields to the mine site by road. During this period, the layout of the transfer station would include water tanks, a truck filling pump and a turning circle to allow water trucks to enter and leave the transfer station easily. The layout of the modified borefields and transfer station prior to commissioning of the water pipeline is shown on Figure 7.

2.10 Lachlan River surface water extraction

To improve the water supply security of the Project, it is proposed to diversify supply sources by including extraction of surface water from the Lachlan River.

A pump station would be constructed near the Lachlan River to extract surface water and pump it to the approved water pipeline. An underground pipeline would connect the pump station to the river.

The indicative location of the pump station is shown on Figure 7 and the conceptual design of the pump station is shown on Figure 9.

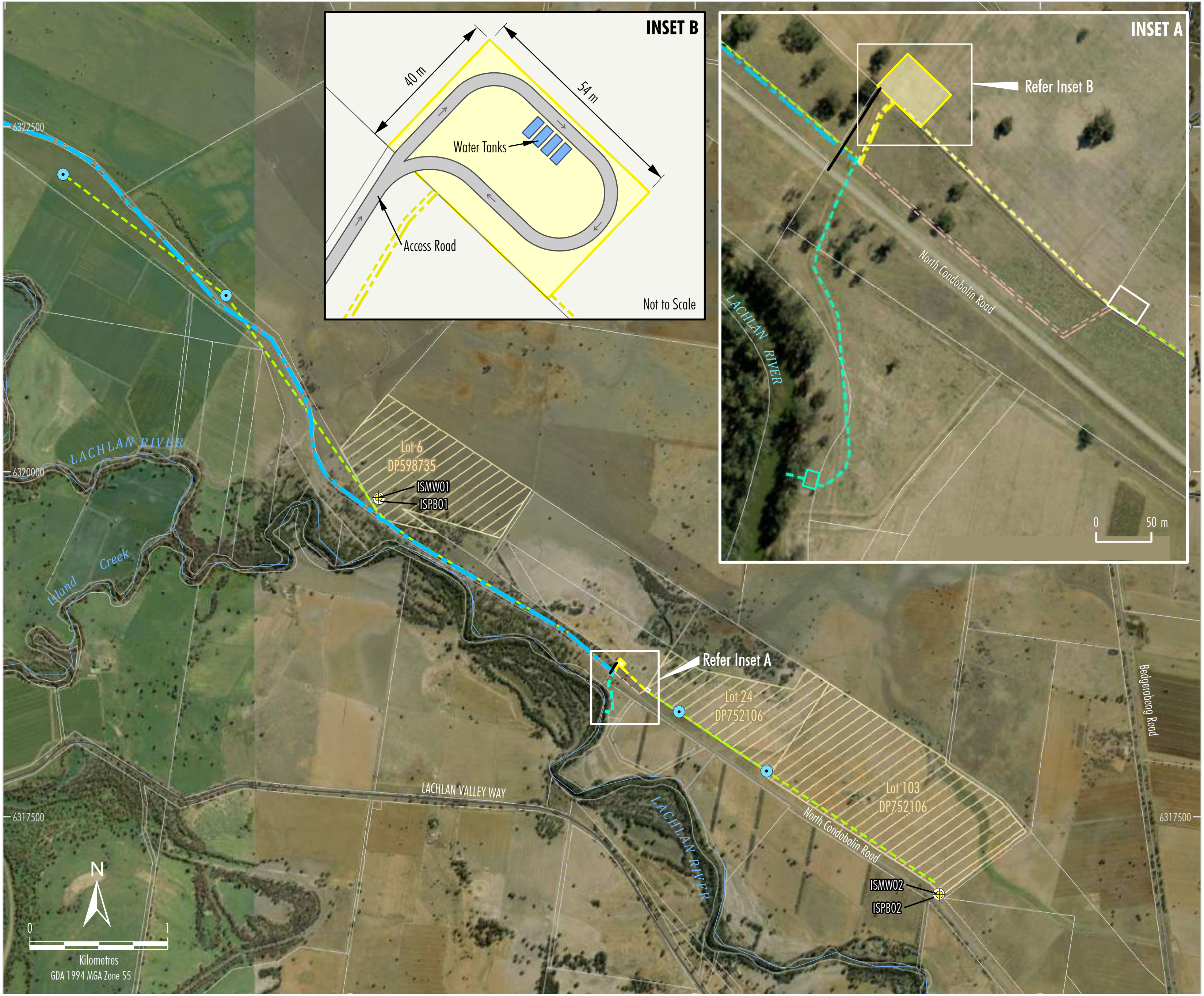
The pump station would be connected to the transfer station via a linking pipeline. The indicative alignment of the linking pipeline (within the surface water extraction infrastructure corridor) is shown on Figure 7.

Relevant water licences to allow for the extraction of surface water from the Lachlan River would be obtained, as described in Section 3.3.1.

2.11 Water pipeline

A road safety audit would be conducted to determine road upgrades required for the modified Project. If the road safety audit determines that the approved Fifield Bypass is not required, an alternative transport route may be selected. In the event this occurs, the approved water pipeline alignment may be modified to follow existing road reserves rather than following the alignment of the approved Fifield Bypass.

The capacity of the water reticulation system would be unchanged.



LEGEND

Property Boundary

Approved Project

- Transfer Station
- Water Pipeline
- Borefield Infrastructure Corridor *
- Potential Borefield Location
- Approximate Location of Production Bore (not constructed)
- Production Bore (constructed)
- Monitoring Bore

Modified Project

- Transfer Station
- Pump Station
- Access Road
- Water Pipeline
- Borefield Infrastructure Corridor *
- Surface Water Infrastructure Corridor *
- Approved Water Pipeline Section no longer required
- Approved Borefield Infrastructure Corridor section no longer required

* Infrastructure Corridor includes linking pipline, access road and electricity transmission line.

Source: NSW Land & Property Information (2016); Ivanplats Syerston (2005)

NSW Imagery: © Department of Finance, Services & Innovation (2017)

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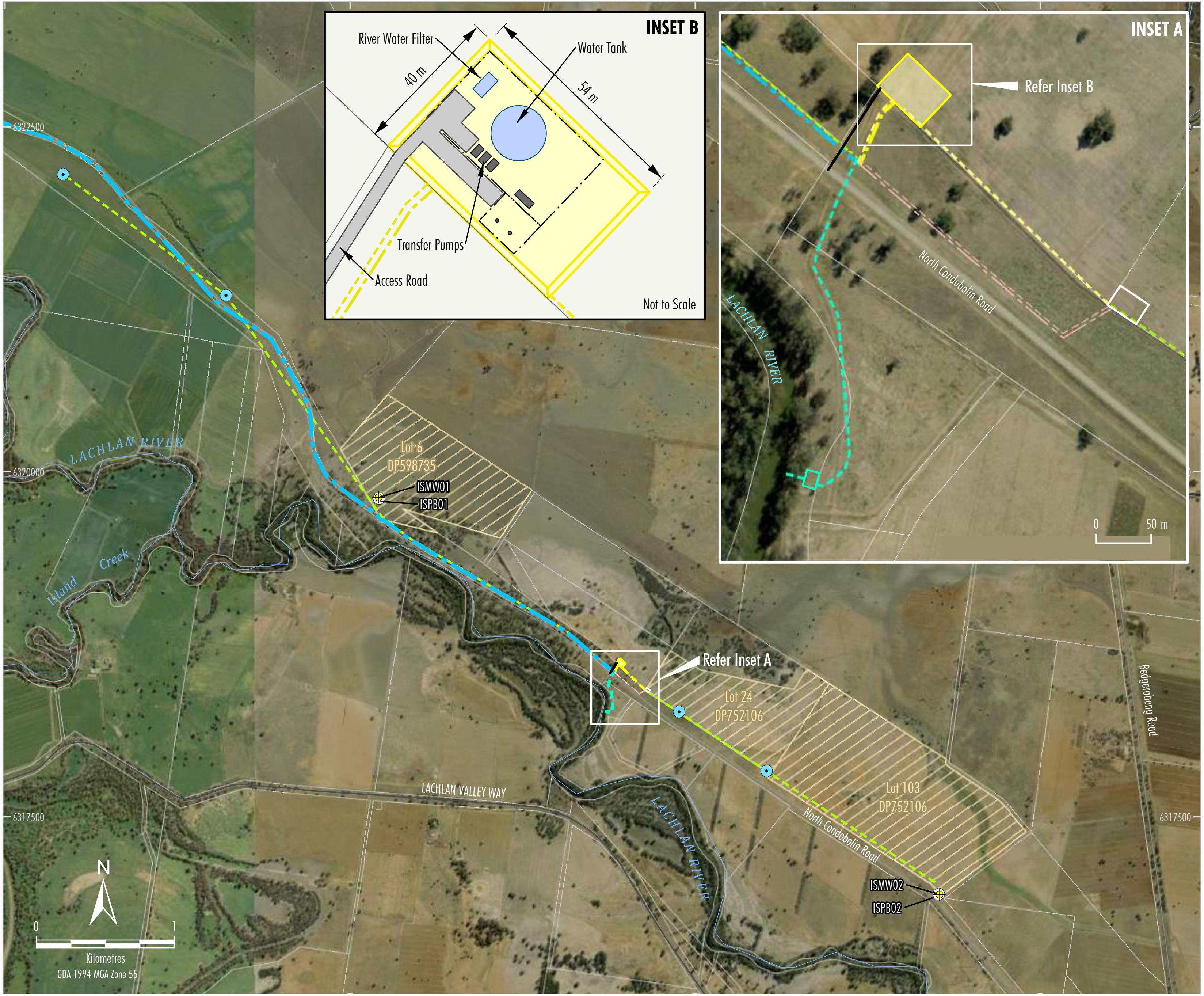
SYERSTON PROJECT MODIFICATION 4

Modified Borefields and Surface Water Extraction - Pre Water Pipeline Commissioning

Figure 7

CTL-16-02 Mod4_WMA_207A



LEGEND

Property Boundary

Approved Project

Transfer Station

Water Pipeline

Borefield Infrastructure Corridor *

Potential Borefield Location

Approximate Location of Production Bore (not constructed)

Production Bore (constructed)

Monitoring Bore

Modified Project

Transfer Station

Pump Station

Access Road

Water Pipeline

Borefield Infrastructure Corridor *

Surface Water Infrastructure Corridor *

Approved Water Pipeline Section no longer required

Approved Borefield Infrastructure Corridor section no longer required

* Infrastructure Corridor includes linking pipline, access road and electricity transmission line.

Source: NSW Land & Property Information (2017); Ivanplats Syerston (2005)
NSW Imagery: © Department of Finance, Services & Innovation (2017)

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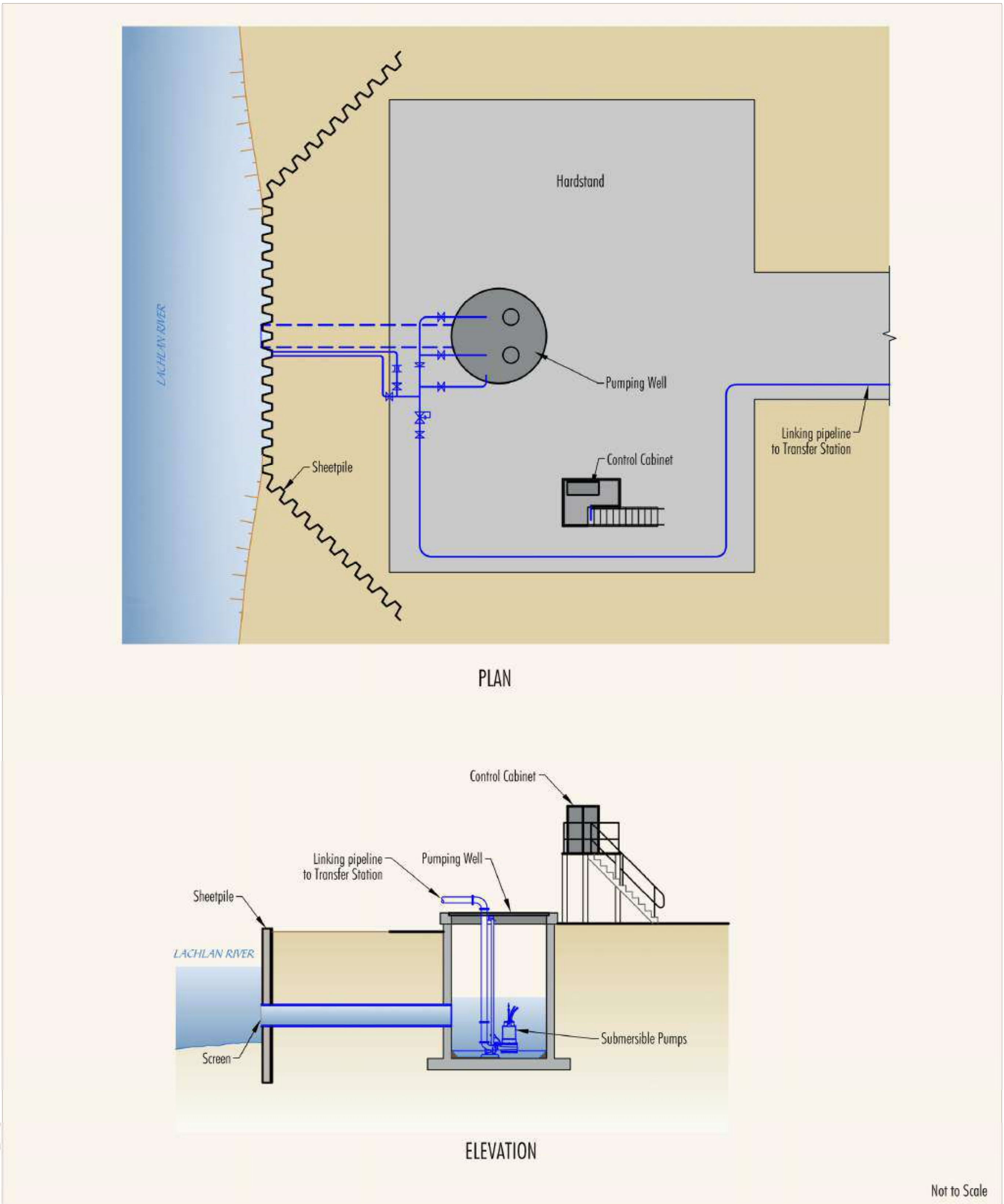
SYERSTON PROJECT MODIFICATION 4

Modified Borefields and Surface Water Extraction - Post Water Pipeline Commissioning

Figure 8

CTL-16-02 Mod4_WMA_208A



Source: Clean TeQ (2017)

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SYERSTON PROJECT MODIFICATION 4

Surface Water Extraction Layout

Figure 9

3.0 REGULATORY FRAMEWORK

3.1 NSW Legislation that applies to Syerston Project Modification 4

The EP&A Act is administered by the NSW Department of Planning and Environment and is the principal piece of legislation regulating land use in NSW. The EP&A Act institutes a system of environmental planning and assessment for developments in NSW.

Some types of development, such as mining and extraction operations, are determined to be State Significant Development (SSD) due to their size, economic values or potential impacts. These types of development are assessed by the NSW Department of Planning and Environment. A request to the Minister to modify an SSD approval can be sought for development where approval has been granted. The Project was approved under Part 4 of the EP&A Act in 2001 by development consent under Division 4 of Part 4 of the EP&A Act, which relates to SSD.

3.2 Local government regulatory provisions

Environmental Planning Instruments (EPIs) collectively refers to Local Environmental Plans (LEPs), State Environmental Planning Policies (SEPPs), and Regional Environmental Plans (REPs). The provisions of the EPIs are legally binding on both government and developers.

3.2.1 Lachlan local environmental plan 2013

The mine and processing facility, Fifield bypass, natural gas pipeline and parts of the water supply pipeline components of the Project fall within the boundary of the Lachlan local government area (LGA).

The proposed changes to the water management system at the mine and processing facility are described in Section 2.0.

No changes to the Fifield bypass, natural gas pipeline the parts of the water supply pipeline within Lachlan LGA are proposed for Modification 4.

3.2.2 Forbes local environmental plan 2013

The water supply borefields and parts of the water supply pipeline components of the approved Syerston Project are located in the Forbes LGA.

The proposed changes to the borefield infrastructure layout (i.e. transfer station and surface water extraction point) are described in Section 2.0.

3.3 Management of water resources for mining projects in NSW

The *Water Management Act 2000* provides for managing the state's water resources through water sharing plans (WSPs). These are used to set out the rules for the sharing of water in a particular water source between water users and the environment and facilitate water trading in a particular water source.

Water sharing plans have commenced under the *Water Management Act 2000* for all groundwater and surface water systems within which the Project lies. Accordingly, the *Water Act 1912* is not relevant to licensing considerations for the Project and WSPs are in place for all water sources within the Project area.

The following WSPs are applicable to the mine (including processing facility) area:

- Water Sharing Plan for the Macquarie Bogan Unregulated and Alluvial Water Sources 2012
- Water Sharing Plan for the NSW Murray Darling Basin Fractured Rock Groundwater Sources 2011.

While these WSPs are applicable to the borefield and surface water extraction point:

- Water Sharing Plan for the Lachlan Regulated River Water Source 2016
- Water Sharing Plan for the Lachlan Unregulated and Alluvial Water Sources 2012.

Water extraction requires an authorisation under a water access licence (WAL) which contains an associated water allocation account. The primary regulatory instruments of the *Water Management Act 2000* are the WALs, water use approvals, water management use approvals, controlled activity approvals and aquifer interference activity approvals.

Further details for each of the WSPs applicable to the Project are provided in Section 3.3.1.

3.3.1 Water sharing plans applicable to the Project

The WSPs will be the key documents to manage water extraction, use and trading because it sets a limit on long-term average annual diversions and governs how water is managed (DPI Water, 2016). Water sharing plans manage the extractions within the long-term average annual extraction limit (LTAAEL), thereby maintaining all water in excess of the LTAAEL for the environment. In doing so, it aims to support viable and sustainable water dependent industries over the long-term.

3.3.1.1 Water sharing plan for the Macquarie Bogan Unregulated and Alluvial Water Sources, 2012

The WSP for the Macquarie Bogan Unregulated and Alluvial Water Sources 2012 covers 30 unregulated surface water sources that are grouped into one EMU and four alluvial groundwater sources (DPI Water, 2012b).

The mine and processing facility is located within the mapped extent of the Upper Bogan River Water Source, within the Macquarie Bogan Unregulated Rivers EMU. The Project is not located within nor proximal to the four alluvial groundwater sources and therefore they are not discussed any further in this report.

Water source extraction limits and licensing

As discussed in Sections 3.3.2 and 3.3.4, Clean TeQ would not require licensing for surface waters at the mine as:

1) Exemptions under the *Water Management (General) Regulation 2011* would apply; and

2) The runoff water captured by undisturbed areas between the proposed up-catchment diversion structures and the ultimate extent of the Project disturbance boundary would be within the estimated Harvestable Right available to Clean TeQ (based on total contiguous landholdings).

Notwithstanding, it is noted that there are currently 26 WALs issued in the Upper Bogan River Water Source. A total of 14 WALs relate to unregulated river access licences (including one special additional high flow) with a total share component of 1 645 shares (or MLs, based on an AWD of 1).

Water trading records on the NSW Water Register for unregulated river access licences in the Upper Bogan River Water Source show that trades (up to 309 unit shares) have occurred in the past within the Upper Bogan River Water Source.

3.3.1.2 Water sharing plan for the NSW Murray Darling Basin Fractured Rock Groundwater Sources 2011

Fractured rock and porous rock groundwater sources for the mine are covered by the WSP for the NSW Murray Darling Basin Fractured Rock Groundwater Sources 2011, which commenced on 16 January 2012.

The WSP for the NSW Murray-Darling Basin Fractured Rock Groundwater Sources 2011 covers 10 groundwater sources that make up an area of approximately 24 404 000 ha, and includes the Lachlan Fold Belt MDB Groundwater Source (DPI Water, 2012c).

Water source extraction limits and licensing

The Lachlan Fold Belt MDB Groundwater Source covers a large area of 16 722 000 ha. The LTAAEL for the Lachlan Fold Belt MDB Groundwater Source is 875 652 ML/year.

Groundwater extracted by in-pit (or advance) dewatering from the mine pit (and immediate surrounds) is located in the Lachlan Fold Belt MDB Groundwater Source. As described in Section 8.1.2, in-pit dewatering is expected to be negligible over the life of the Project.

Notwithstanding, Clean TeQ currently holds WAL 28681 in the Lachlan Fold Belt MDB Groundwater Source (Lachlan Fold Belt MDB [Other] Management Zone), for 243 share components under the WSP for the NSW Murray Darling Basin Fractured Rock Groundwater Sources 2011 for the mine pit should the deepest areas intercept any groundwater. Under this WAL water may be extracted at any time and at any rate subject to a number of conditions relating to the "taking of water" specified in Table 2.

Table 2: WAL Conditions for WAL28681

Condition	Take of Water
MW0716-00001	The maximum volume of water that may be taken under this licence in any water year must not exceed a volume equal to: a) the sum of water allocations accrued to the water allocation account for this licence from available water determinations in that year; plus b) the water allocations carried over from the water year prior to that water year; plus c) the net amount of any water allocations assigned to or from the water allocation account for this licence under section 71T of the Act; plus d) any water allocations re-credited to the water allocation account for this licence in accordance with section 76 of the Act in that water year.
MW0631-00001	Water must not be taken under this access licence otherwise than in compliance with the conditions of the nominated water supply work approval.
Additional Condition	
MW0718-00001	The maximum water allocation that may be carried over in the water allocation account for this access licence from one water year to the next is either: a) 10 % of the access licence share component for access licences with share components expressed as ML/year; or b) 0.1 ML per unit share of access licence share component for access licences with share components expressed as a number of unit shares.

3.3.1.3 Water sharing plan for the Lachlan Unregulated and Alluvial Water Sources 2012

The WSP for the Lachlan Unregulated and Alluvial Water Sources 2012 (the Lachlan Unregulated WSP) covers 23 unregulated surface water sources that are grouped into one extraction management unit (EMU), and two alluvial groundwater sources (Upper Lachlan and Belubula Valley) (DPI Water, 2012a).

Water source extraction limits and licensing

The LTAAEL for the Upper Lachlan Alluvial Groundwater Source is 94 168 ML/year.

The approved water supply borefield would extract groundwater from within Zone 5 of the Upper Lachlan Alluvial Groundwater Source.

Clean TeQ currently hold a WAL (Number: 32068) for the Upper Lachlan Alluvial Groundwater Source (Upper Lachlan Alluvial Zone 5 Management Zone), with a maximum share component of 3 154 units (ML).

Under this WAL water may be extracted at any time and at any rate subject to a number of conditions relating to the “taking of water” specified in Table 3.

Table 3: WAL Conditions for WAL32068

Condition	Take of Water
MW0010-00006	The maximum water allocation that may be carried over in the account for this access licence from one water year to the next water year is 0.2 ML/unit share of the share component of the licence.
MW0605-00001	Water must be taken in compliance with the conditions of the approval for the nominated work on this access licence through which water is to be taken.
MW0547-00001	The total volume of water taken under this licence in any water year must not exceed a volume equal to: a) the sum of water in the account from the available water determination for the current year, plus b) the water carried over in the account from the previous water year, plus c) the net amount of water assigned to or from the account under a water allocation assignment, plus d) any water re-credited by the Minister to the account.

There are currently 371 WALs issued for aquifer access licences in the Upper Lachlan Alluvial Groundwater Source, with a total share component of 172,722.5 shares (or MLs, based on an AWD of 1).

Water trading records on the NSW Water Register for aquifer access licences in the Upper Lachlan Alluvial Groundwater Source in the past water year show that trades (up to 2,000 unit shares) have occurred.

3.3.1.4 Water sharing plan for the Lachlan Regulated River Water Source 2016

The *Water Sharing Plan for the Lachlan Regulated River Water Source 2016* (NSW) (the LRRWS WSP) was made under section 50 of the *Water Management Act 2000* and commenced on 1 July 2016.

Water source extraction limits and licensing

The LTAAEL stated in the LRRWS WSP is estimated to be 305 000 ML/year. By limiting long-term average annual extractions to an estimated 305 000 ML/year, the LRRWS WSP ensures that approximately 75% of the long-term average annual flow in this water source (estimated to be 1 212 000 ML/year) will be preserved and will contribute to the maintenance of basic ecosystem health.

The LRRWS WSP establishes a bulk access regime which determines how much water will be available for extraction by all licensed water users within the plan. Generally, new WALs for mining and other commercial purposes are no longer being granted. Instead, operators need to purchase an existing licence on the water market. However, the LRRWS WSP allows for an application to be made for a new specific purpose WAL or a zero share component WAL, if required. The water access licence must hold sufficient share component and water allocation to account for the take of water from the relevant water source at all times.

Any surface water extraction from the Lachlan River resulting from Modification 4 will need to hold sufficient water allocation via WALs.

As demonstrated below in Section 3.3.1.5 by the available share components in the Lachlan Regulated River Water Source, history of available water determinations orders and recent water trading statistics, while the water market is variable (availability subject to significant rainfall events), it is mature (administered since 2004) and has significant depth of available shares for trading.

3.3.1.5 Water trading market

Water markets are able to ensure the efficient allocation of water resources to the benefit of end users. Water trading provides the flexibility necessary to adapt to changeable conditions by providing a critical tool for the management of water supply, production, and risk. The Lachlan River forms part of the Northern Murray-Darling Basin that also includes the Macquarie, Namoi, Peel, Gwydir, and Border-Rivers Systems. Hydrologically isolated from each other, these systems vary in the extent of their development and how active the water markets are in each individual system. They also experience differences in water availability such that allocation prices can differ substantially between systems. Some northern systems also have differences in their storage capacity, which can further influence prices (Aither, 2017).

Surface water allocation markets have been well developed in the northern systems with trade having been observed since 2004–05. Significant volumes were traded in 2005-06, before declining through to 2009–10. Allocation trade volumes increased substantially to the highest observed volumes in 2012–13, before declining to 2015–16. By volume, the Macquarie and Lachlan systems tended to experience the most trade. Groundwater allocation markets are also active, with trade observed since 2006–07. Groundwater trade levels were at their lowest in 2011–12 but increased to among the highest overall levels during 2015–16. The Lachlan has tended to display the greatest volume of groundwater allocation trade to date (Aither, 2017).

For example, it was estimated at the time of commencement of the WSP for the Lachlan Regulated River Source 2016, the share components of regulated river (high security) access licences authorised to take water from the Lachlan Regulated River Water Source totalled 27 680 unit shares. It was estimated at the time of commencement of the WSP for the Lachlan Regulated River Source 2016, the share components of regulated river (general security) access licences authorised to take water from the Lachlan Regulated River Water Source total 592 801 unit shares.

It is noted that available water determination (AWD) orders are regularly made and applied to water sources to which the WSP for the Lachlan Regulated River Source 2016 applies. Records of past orders made under the *Water Management Act 2000* for regulated river (general security) and regulated river (high security) access licences since replacement of the *Water Sharing Plan for the Lachlan Regulated River Source 2016* on 1 July 2016 are summarised in Table 4. Review of these records show that high security access licences have been at 100% utilisation, whereas general security access licences are variable (i.e. subject to significant rainfall events). Water trading in this WSP area occurred regularly with eight trades for regulated river (high security) access licences comprising of 1 113 share components and 61 trades for regulated river (general security) access licences comprising of 35 738 share components since 1 July 2016.

Table 4: AWD orders for the Lachlan River Regulated Water Source since 1 July 2016

<table>
<tr><th>AWD Order</th><th>Commenced</th><th>Category of Access Licence</th><th>Volume per Unit of Access Licence Share Component</th></tr>
<tr><td>Lachlan Regulated River Water Source 2017-2018</td><td>14 August 2017</td><td>Regulated River (General Security)</td><td>0.02 ML</td></tr>
<tr><td rowspan="2">Various NSW Regulated River Water Sources (No. 2) 2017</td><td rowspan="2">27June 2017</td><td>Regulated River (High Security)</td><td>1.0 ML</td></tr>
<tr><td>Regulated River (General Security)</td><td>0.0 ML</td></tr>
<tr><td rowspan="4">Lachlan Regulated River Water Source 2016-2017</td><td>15 June 2017</td><td>Regulated River (General Security)</td><td>0.02 ML</td></tr>
<tr><td>10 April 2017</td><td>Regulated River (General Security)</td><td>0.05 ML</td></tr>
<tr><td>5 September 2016</td><td>Regulated River (General Security)</td><td>0.09 ML</td></tr>
<tr><td>5 August 2016</td><td>Regulated River (General Security)</td><td>1.15 ML</td></tr>
</table>

AWD Order	Commenced	Category of Access Licence	Volume per Unit of Access Licence Share Component
	15 July 2016	Regulated River (General Security)	0.25 ML
Various NSW Regulated River Water Sources (No. 2) 2016	29 June 2016	Regulated River (High Security)	1.0 ML
		Regulated River (General Security)	0.18 ML

Water within the Lachlan River catchment is mostly issued to General Security[2] water entitlement licence[3] holders, which comprise 89 per cent (592 801 ML) of the total amount of available entitlement. High Security[4] water entitlement licence holders form 4 per cent of the total resource on issue. Due to hydrological isolation, water entitlements are infrequently traded. However, there is comparatively more activity in the WAL market, which displays good trade volumes and prices throughout most years. Groundwater trade markets display only modest activity (Aither, 2017; DPI Water, 2016b). A summary of the entitlements for the 2016–2017 year for the Lachlan River catchment is given in Table 5.

Table 5: Entitlements on issue for Lachlan Catchment Water Systems, 2016-17 (Aither, 2017)

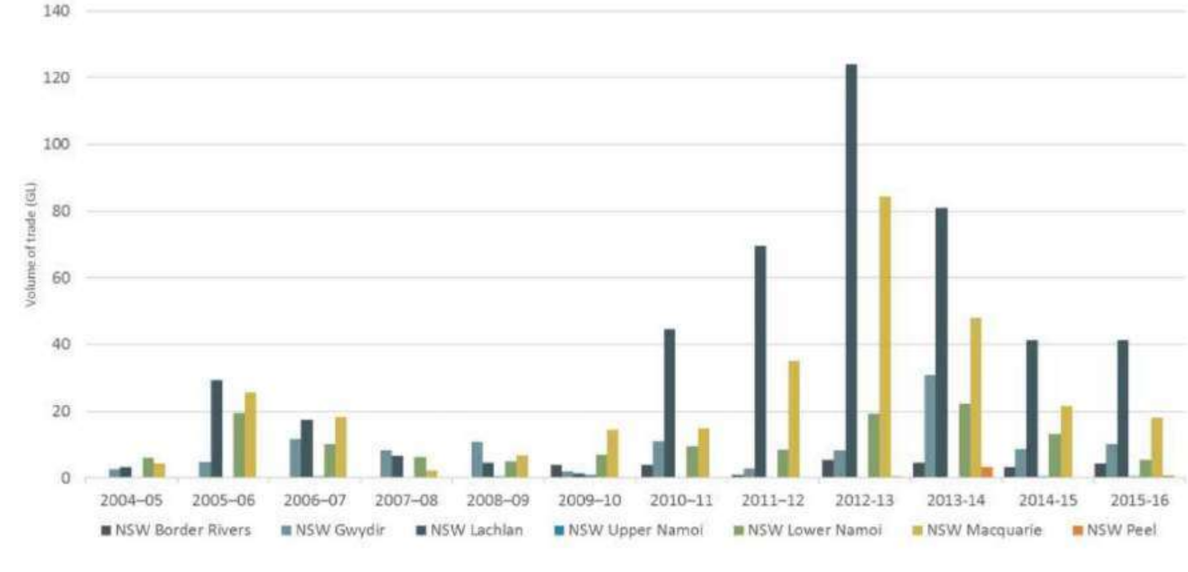
Entitlement Type	Number of Entitlements	Total Volume of Entitlement (ML)	Proportion of Total Entitlement on Issue (%)	Environmental Water Holdings (ML)	Proportion of Total Entitlement held by Environment (%)
Lachlan Regulated River Water Source					
General Security	823	592 801	89%	124 518	21%
High Security	175	27 680	4%	2 638	10%
Local Water Utility	9	15 545	2%	0	0%
Domestic & Stock	584	12 762	2%	0	0%
Conveyance	1	17 911	3%	0	0%
Total	1 592	666 700	100%	127 156	19%
Lower Lachlan Groundwater Source					
Aquifer	91	105 680	81%	0	0%
Local Water Supply	5	2 922	2%	0	0%
Supplementary	44	21 237	16%	0	0%
Total	140	129 839	100%	0	0%

[2] General Security licences are the last to receive allocations and are therefore the least secure licence category. They can start the year with low or zero allocation and typically receive incremental improvement as the year unfolds commensurate with rainfall and runoff. General security licences are the most susceptible to seasonal climatic variations (DPI Water, 2016b).

[3] Main licence categories in approximate order of priority are: Domestic & Stock, Town Water Supply, High Security, Conveyance, General Security (DPI Water, 2016b).

[4] Full or near full High Security allocations are made at the start of all but the very dry years and Conveyance allocation is made commensurate with other allocations (DPI Water, 2016b).

Northern Murray-Darling Basin surface water allocation trade volumes are depicted in Figure 10. There is an apparent trend showing the volume of trade being somewhat correlated to water allocations, but the inverse is not true (i.e. the volume of trade is high when allocation levels are high – such as the wetter period observed from 2010). This trend does not necessarily reflect a greater trade intensity (i.e. the amount of water traded, over the amount that was available) but may simply be due to the fact that there was a greater volume of water available in those years. For example, in years of drought, there is less water available to be transferred, despite there being a high demand for trade (and a corresponding high price). It may be that a greater proportion of water available is traded in drought, but the absolute volume transferred is much smaller than in a year with greater water availability (Aither, 2017).



Source: Aither 2016. Based on information provided by NSW DPI Water.

Note: All $0 trades are removed from calculation of prices and volumes. Total volume of trade in a zone is defined as all trades within that zone, plus all trades into that zone, but excluding trades out of the zone (to avoid double counting). Interstate trade volumes to Queensland are not included.

Figure 10: Northern Murray-Darling Basin surface water allocation trade volumes, 2004-05 to 2015-16 (Aither, 2017)

Table 6 outlines the number of discrete WALs in the northern Murray-Darling systems. While a single entity or user can hold several WALs (and WALs can also be combined or split) this table provides a wide indication of the relative potential size of a market within each of the listed systems. A greater number of WALs can potentially support a larger market as there are more counterparties (Aither, 2017).

Table 6: Number of separate WALs involved in allocation trades from 2004-05 to 2015-16 (Aither, 2017)

Region	Number of Separate WALs Involved in Trade 2004-05 to 2015-16[5]
Lachlan	900
Macquarie	689
Namoi	393
Peel	144
Gwydir	187
Border Rivers	219
Hunter	462
Barwon-Darling	59

[5] Based only on surface water allocation trades and excludes within irrigation corporation trades (Aither, 2017).

In summary, the surface water allocation market in the Lachlan River catchment is currently active and relatively mature. Trade is not possible between the Lachlan and other Murray-Darling systems. There have been substantial volumes of annual trade in most of the past ten years (see Figure 10). Prices for allocation water have varied considerably, from record highs in 2007 to record lows in 2010–11 to 2012– 13. This price partly reflects the availability of water for trade (due to climatic variation) rather than trade intensity (Aither, 2017).

3.3.2 Project exemptions from water licensing

The *Water Management (General) Regulation 2011* commenced on 1 September 2011, superseding and consolidating the provisions of two former Regulations; the *Water Management (General) Regulation 2004* and the *Water Management (Water Supply Authorities) Regulation 2004,* with some amendments.

Exemptions that are provided for by the regulation, and may apply to the Project include:

1) Exempt monitoring bores – Allows any person to take water from, or by means of, an exempt monitoring bore for the purposes of measuring water levels, water pressure or water quality. The exemption is given on the basis that these bores take only very minimal amounts of water (if any) for monitoring purposes. The exemption also applies to water supply work approvals in that a water supply work approval is not a requirement for the construction and use of an exempt monitoring bore for measuring level, pressure or water quality purposes.

2) Water bore testing – Exempts any person engaged in the testing of a water bore by means of a pump test if carried out in accordance with either an aquifer interference approval, water supply work approval, or the conditions of an approved project. Testing can take place during the week following completion of the water bore's installation, or during any other period for which such testing is required to be carried out by the relevant approval (NSW Government, 2015).

3) Dams solely for the capture, containment and recirculation of drainage and/or effluent, consistent with best management practice or required by a public authority (other than Landcom or the Superannuation Administration Corporation or any of their subsidiaries) to prevent the contamination of a water source, that are located on a minor stream.

3.3.3 Managing the impacts of extracting water from aquifers

The Water Management (General) Amendment (Aquifer Interference) Regulation 2011 requires mining exploration and petroleum (including coal seam gas) exploration activities that take more than 3 ML of water per year, to hold a WAL. Prior to that, these activities were exempt from needing a WAL (DPI Water, 2012d).

As the Project will interfere with water in an aquifer (e.g. in-pit dewatering, albeit negligible), the Aquifer Interference Policy (AIP) applies. The AIP was developed particularly to address high risk aquifer interference activities such as mining activities and is discussed further in Section 3.3.3.1.

3.3.3.1 Aquifer interference requirements in relation to Modification 4

The AIP requires all water taken by aquifer interference activities to be accounted for within the extraction limits set by the relevant WSP.

The AIP contains two main parts:

i) Licensing the water taken through aquifer interference

ii) The assessment process for aquifer interference activities.

It is a requirement for any mining company to obtain WALs in accordance with the WSP framework to account for the water they take from NSW water resources, including all water taken by aquifer interference activities exceeding 3 ML/year (DPI Water, 2012d).

Aquifer licensing and impact considerations

Water access licences under the *Water Management Act 2000* are not to be granted unless the NSW Minister for Primary Industries is satisfied that adequate arrangements are in place to ensure that the consequences of taking the water will not result in any further than minimal harm to any water.

In the event that there is unassigned water within a water source, an aquifer access licence may be acquired by auction, tender or other means. However unassigned water can only occur where total water requirements within a water source are less than the LTAAEL specified in the relevant WSP.

Aquifer interference approvals are not required under the AIP. Instead, mining projects must take a risk management approach to assessing the potential impacts of an aquifer interference activity. The Policy also details the data and modelling requirements to quantify the impacts associated with an aquifer interference activity. These impacts are assessed by the NSW Office of Water (NOW) by defining minimal impact considerations. Any predicted impact to the water source must be managed through an adaptive management process. If the predicted impact cannot meet specific conditions set by the minimal impact considerations, then further studies are required.

This assessment focuses on the criteria specified by the minimal impact considerations of the AIP, and considers (Section 8.0):

- Licensable takes of water (and their partitioning)
- Intersection of, or proximity to, alluvial deposits
- Water table drawdown
- Pressure head drawdown
- Groundwater quality impacts.

NOW classify groundwater systems as ‘Highly Productive’ and ‘Less Productive’. The AIP (NSW DPI, 2012) states that a groundwater source will be defined as Highly Productive based on the following criteria:

> *a) has total dissolved solids of less than 1 500 mg/L, and*
>
> *b) contains water supply works that can yield water at a rate greater than 5 L/sec.*

The fractured rock aquifers associated with the mine site are considered to be Less Productive as testing of groundwater monitoring bores indicate the yield is less than 5 L/sec. Therefore, the following AIP minimal impact considerations apply for groundwater quality at the mine site:

> *1. Any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40 m from the activity.*
>
> *2. If condition 1 is not met then appropriate studies will need to demonstrate to the Minister’s satisfaction that the change in groundwater quality will not prevent the long-term viability of the dependent ecosystem, significant site or affected water supply works.*

While the AIP requires ‘cumulative assessment’ of groundwater impacts, there are no other known or planned future aquifer interference activities proximal to the mine.

As no changes are proposed for the borefield extraction activities as part of Modification 4, no further consideration of the AIP is made in this report.

3.3.4 Harvestable rights – collecting overland flow

Under the *Water Management Act 2000*, landholders in most rural areas are permitted to collect a proportion of the runoff on their property and store it in one or more dams up to a certain size. This is known as a 'harvestable right'. A dam can capture up to 10 percent of the average regional runoff for their landholding without requiring a licence. The harvestable rights provisions are based on the assumption that the dam capacity is the same as this portion of the annual runoff.

Considering Clean TeQ's total contiguous landholdings of 1 901 ha (Table 7), the DPI Water Harvestable Rights calculator estimates the maximum harvestable right dam capacity (MHRDC) available to Clean TeQ at the Project site as 104.6 ML (Appendix A).

Clean TeQ's landholding includes approximately 12 existing farm dams with an estimated combined total surface area of 1.4 ha. Based on an average depth of 1.5 m, the total capacity of existing farm dams is conservatively estimated at 21 ML. The entire 21ML capacity is held in dams within the proposed mining and mine infrastructure area. Subtracting the capacity of farm dams (21 ML) from the harvestable right (104.6 ML) leaves an available harvestable rights volume of 83.6 ML.

Any runoff from disturbed mine areas that is captured is not required to be considered under harvestable rights. Water that falls on undisturbed areas of the site and is not diverted around the site water management system but captured and used for operational purposes, cannot cumulatively exceed the available harvestable rights volume of 83.6 ML.

Table 7: Maximum Harvestable Right Dam Capacity for Clean TeQ contiguous landholdings

Lot/Plan Number	Tenure	Area (ha)
6 DP745021	Freehold	423.998
7 DP745021	Freehold	377.407
8 DP745021	Freehold	403.310
9 DP745021	Freehold	400.117
10 DP745021	Freehold	296.188
	Total Area	1 901.02

3.3.5 Water resources within the Murray-Darling Basin

Water resource plans (WRPs) are to be developed in NSW as a key commitment under the Commonwealth Murray-Darling Basin Plan (Basin Plan 2012). The WRPs will be a package of documents that will govern how water is managed in each water resource and how compliance with the Basin Plan 2012 is achieved. These documents will include a Water Sharing Plan, Water Quality Management Plan, Risk Assessment and a Long-term Environmental Watering Plan.

A total of 22 WRPs are to be developed for NSW by 2019 as part of the Basin Plan 2012, covering surface and groundwater resources.

Relevant to the Project, there will be one surface water WRP for the Lachlan that covers the Lachlan Regulated River, Belubula Regulated River and Lachlan Unregulated Streams. There will also be one groundwater WRP for the Lachlan that covers the Upper Lachlan Alluvial, Belubula Alluvial and Lower Lachlan Alluvial Groundwater areas.

The Macquarie-Castlereagh WRP and Macquarie-Castlereagh Alluvium WRP will cover the surface and groundwater administered by the current Macquarie Bogan Unregulated and Alluvial Water Sources WSP (Section 3.3.1.1).

4.0 HYDROLOGICAL AND HYDROGEOLOGICAL SETTING

4.1 Hydrology

4.1.1 Climate

The mine (and processing facility) is located in the central southern region of the Macquarie-Bogan Catchment with an average annual rainfall of approximately 500 mm (Figure 11).

Pan evaporation in the Macquarie-Bogan catchment has a strong east-westerly gradient and varies from 900 mm/year in the south-east to 2 200 mm/year in the north-east (refer to Figure 12). The Project location is in the region of 1 800 mm/year pan evaporation.

The closest rainfall gauging station maintained by the Bureau of Meteorology is located at Murrumbogie (#050028), approximately 17 km south-east of the mine site. This station has 134 years of near complete rainfall records between the years 1883 and 2017 with few data gaps (Figure 13).

The nearest pan evaporation station is located at the Condobolin Agricultural Research Station (#050052), 40 km to the south-west of the mine site with evaporation data from 1975 to present.

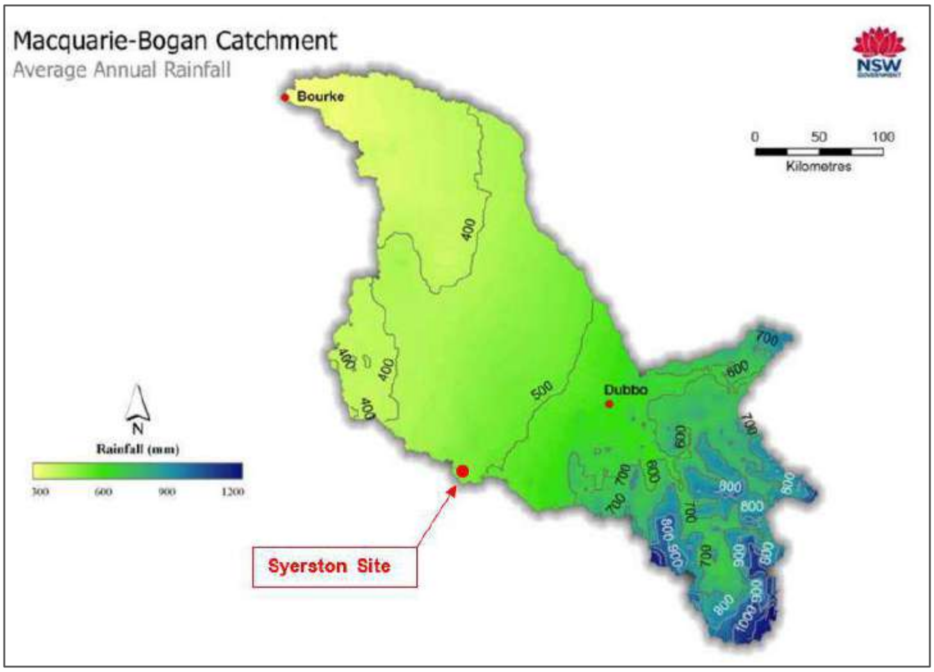


Figure 11: Average annual rainfall distribution in the Macquarie-Bogan catchment (Source: Hutchinson and Kesteven, 1998; via Green et al., 2011[6])

[6] Green D., Petrovic J., Moss P., Burrell M. (2011) Water resources and management overview: Macquarie-Bogan catchment, NSW Office of Water, Sydney

Hutchinson M and Kesteven J. 1998. Monthly mean climate surfaces for Australia. Australian National University. December.

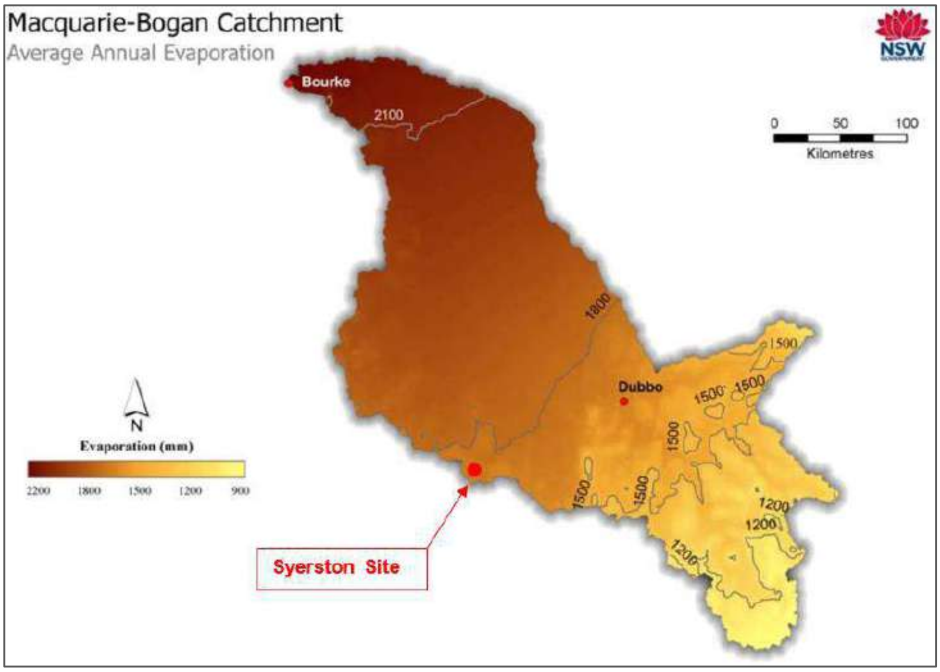


Figure 12: Average annual pan evaporation in the Macquarie-Bogan catchment (Source: Hutchinson and Kesteven, 1998; via Green et al., 2011)

A rainfall and evaporation data record for was obtained from the Department of Science, Information Technology and Innovation's (DSITI) SILO Data Drill (SILO) for the Project location (32.5° S, 147.5° E). SILO accesses grids of data interpolated from point observations by the Australian Bureau of Meteorology (BoM). SILO data formats are available for any location in Australia and are suitable for statistical and modelling applications as data records are long (from 1889 to current) and continuous (without data gaps).

The Project SILO rainfall and class A pan evaporation records have been compared to the gauged sites at Murrumbogie and the Carnarvon Agricultural Research Centre respectively (Figure 13 and Figure 14). In both cases the SILO datasets show exhibit minimal variation from gauged datasets which suggests the SILO dataset is reliable for site climate analysis.

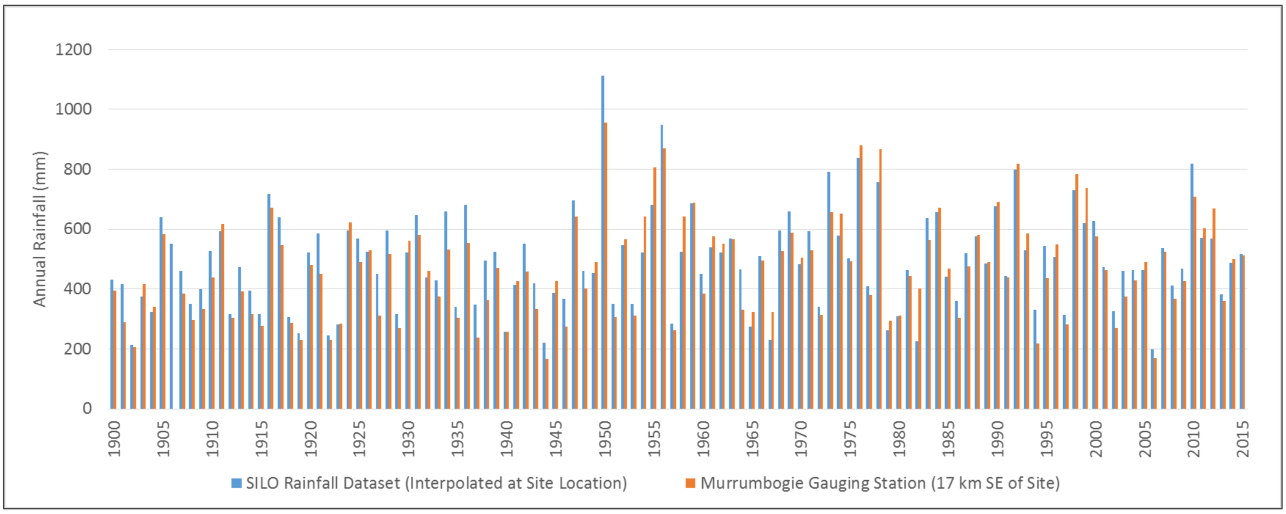


Figure 13: Comparison of Project SILO rainfall and Murrumbogie rainfall gauging station

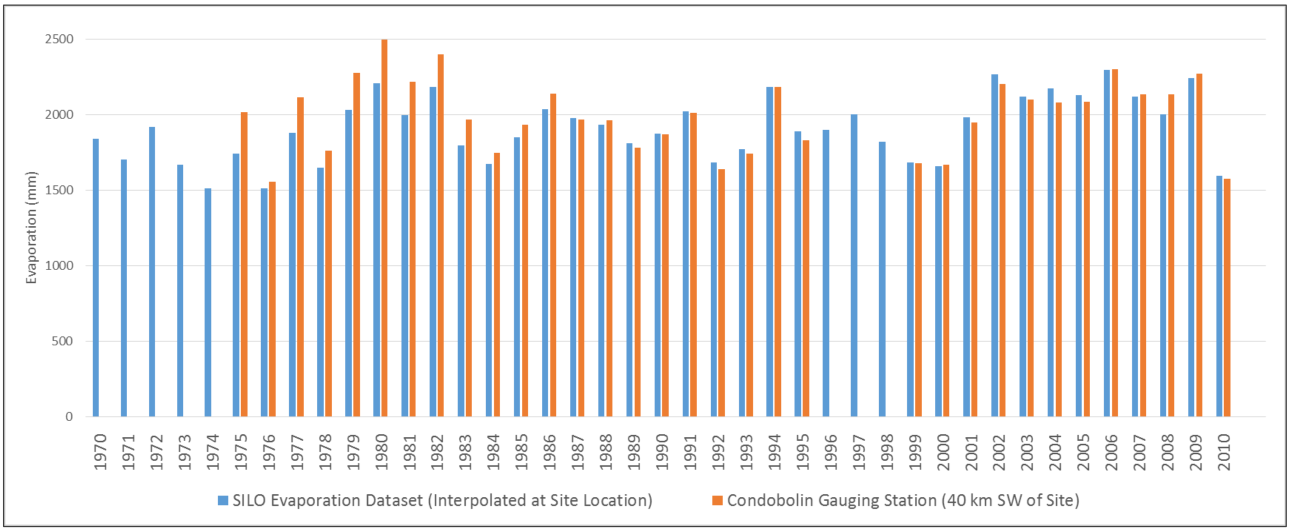


Figure 14: Class A Pan Evaporation: Syerston SILO and Condobolin Agricultural Research Centre

Rainfall records are indicative of a dry (borderline semi-arid) climate which is confirmed by the location of the Project on the Köppen climate classification system as borderline semi-arid with a hot summer (classification: BSh).

Seasonal rainfall and evaporation variation throughout the year is displayed in Table 8 and Table 9 respectively. This variation can be visualised in Figure 15, which outlines monthly statistical totals including a boxplot indicating the 10th, 25th, 50th (median), 75th, and 90th percentiles. The average monthly rainfall indicates rainfall is distributed evenly throughout the year with a slight summer maximum and higher rainfall variability between the months of December and February.

Pan evaporation is seasonally dependent, with average annual variations from 48 mm/month in the winter months to 295 mm/month in summer months.

The Project location has an average annual rainfall of 488 mm/year, annual evaporation of 1 978 mm/year and therefore an annual excess of evaporation over rainfall of 1 490 mm/year.

Table 8: Syerston SILO rainfall (mm) statistics (1900 – 2016)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Max	293	244	184	405	151	139	102	152	120	198	215	200	**1 111**
Median	36	27	27	23	31	33	32	34	25	36	33	32	**482**
Min	1	0	0	0	0	0	0	0	0	0	0	0	**93**

Table 9: Syerston SILO pan evaporation (mm) statistics (1975 – 2016)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Median	295	236	204	125	74	46	50	77	116	179	228	295	**1 908**

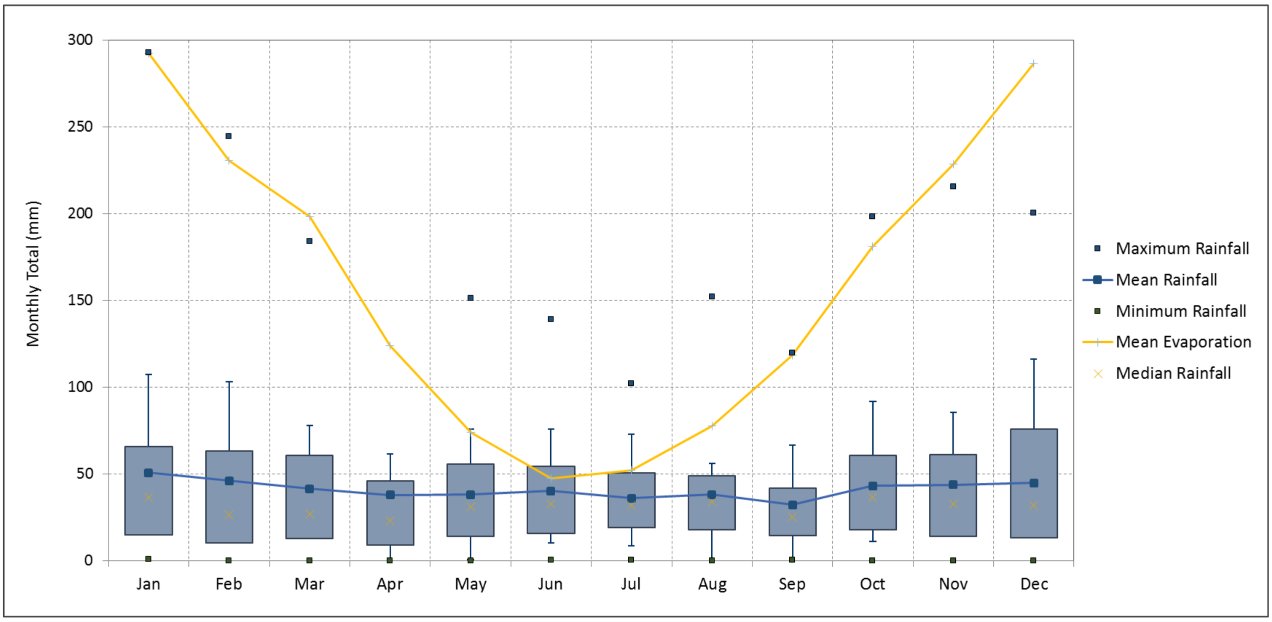


Figure 15: Syerston monthly rainfall and evaporation statistics (SILO)

4.1.2 Topography

Elevations across the Macquarie-Bogan catchment varies from 1 300 mRL in the south-east in the Great Dividing Range down to less than 100 mRL in the north-west of the catchment (Figure 16). The area downstream of Dubbo is predominantly flat alluvial plains with elevations generally less than 300 m.

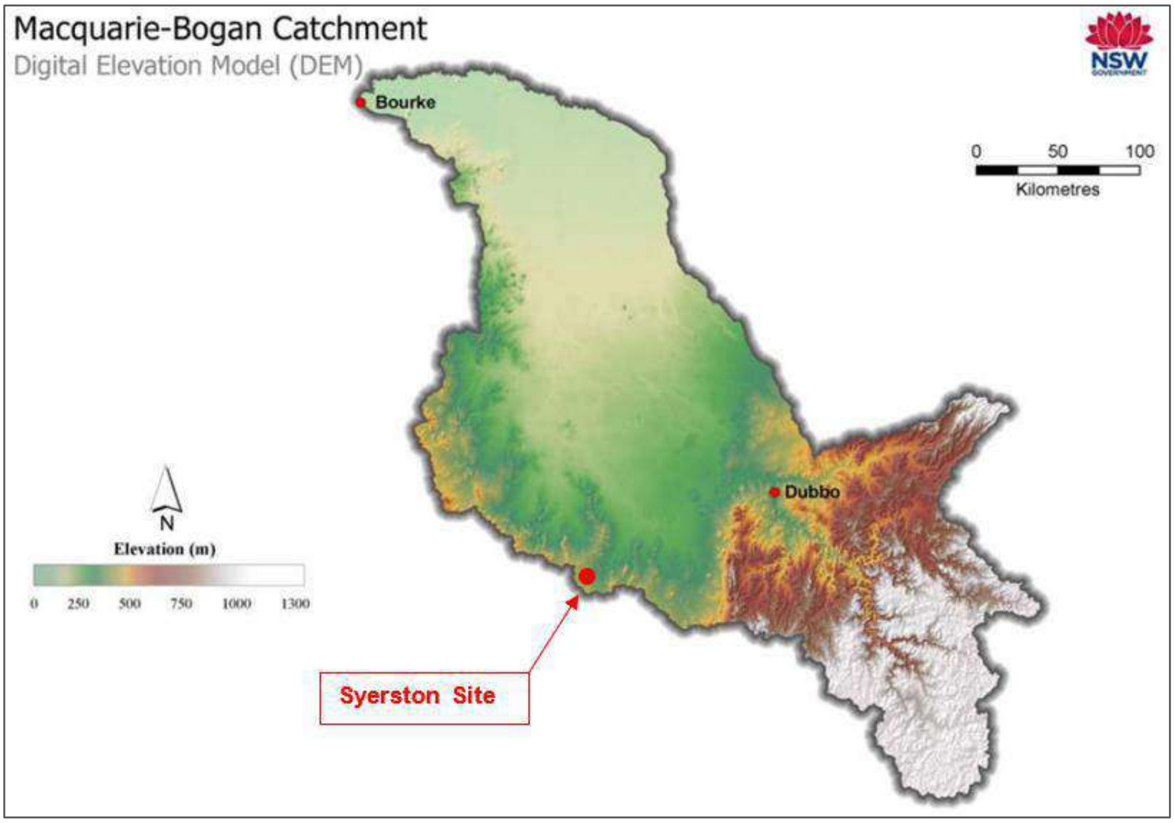


Figure 16: Topography and elevation of the Macquarie-Bogan catchment (Source: Hutchinson and Kesteven, 1998; via Green et al., 2011)

The mine (and processing facility) is situated to the northern side of low lying ridgeline which separates the Macquarie-Bogan catchment from the Lachlan catchment to the south. The topography of the proposed mining lease area consists of gentle to moderate sloping grazing and farming land which generally slopes towards the north-east. Elevations across the mine (and processing facility) area vary from 326 mRL in the south to 274 mRL to the north-east.

Remnant magnesite mining features are present in the north-east corner of the mine site, altering the natural topography with spoil piles and shallow pits.

4.1.3 Streamflow

4.1.3.1 Macquarie-Bogan catchment

The mine (and processing facility) is located within the Macquarie-Bogan catchment which covers an area of approximately 74 800 km^2 within the Murray-Darling Basin. Regional north-west-flowing rivers (Bogan, Macquarie, Castlereagh, Namoi and Barwon) drain an extensive floodplain north of the site. The mine is situated in the upper headwaters of Bullock Creek in proximity to the township of Tullamore to the north-east and the headwaters of the Lachlan catchment to the south.

The NSW Office of Water operates 91 river flow gauging stations within the Macquarie-Bogan catchment recording flows on a continuous basis, with 6 stations located along the Bogan River. Flows along the Bogan River generally increase with distance downstream as a result of regulated water supplies entering from Albert Priest Canal, Gunningbar Creek and Duck Creek.

There are no gauging stations in close proximity to the Project. Peak Hill gauging station is located on the Bogan River 60 km upstream of the confluence of Bullock Creek and Dandaloo gauging station located on the Bogan River 20 km downstream of the confluence of Bullock Creek. Mean daily flow records for gauging stations along the Bogan River are provided as an indication of regional measured river flow relative to catchment area (refer to Table 10).

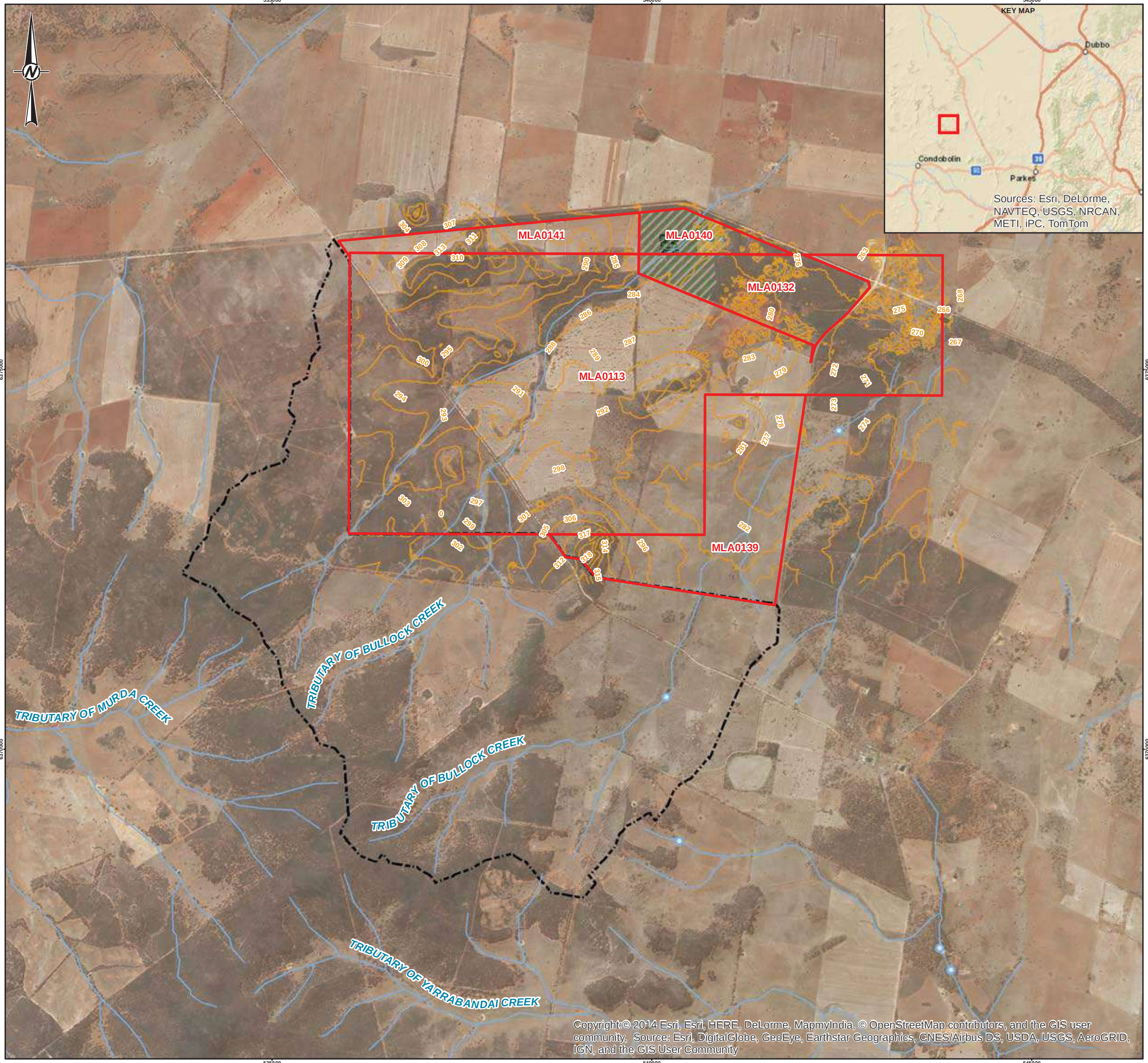
Table 10: Mean daily flow for selected Bogan River gauges

Gauging Station	Catchment Area (km^2)	Mean Daily Flow (ML)	Distance from Bullock Creek Confluence (km)	Period of Record
Upstream of Bullock Creek Confluence				
Peak Hill	1 036	57	60	1967 - 2017
Downstream of Bullock Creek Confluence				
Dandaloo	5 440	174	20	1971 - 2017
Neurie Plain	14 760	221	100	1959 - 2017
Gongolgon	27 970	532	280	1945 - 2017

Two small catchment areas (approximately 2 700 ha and 1 950 ha, respectively) to the south-west, contribute to two ephemeral watercourses which cross the mine area as shown in Figure 17.

The northern watercourse discharges into Bullock Creek to the north-east which flows north-easterly and then discharges to the Bogan River (Figure 1). The southern watercourse loses definition north-east of the site due to a combination of flat terrain and interruption by remnant mining operations in the area.

Watercourses in the location of the mine (and process facility) are shallow broad vegetated ephemeral channels and as such are not suitable for flow monitoring. There are also no gauging stations maintained on Bullock Creek.



LEGEND

- Mining Lease Application Boundary
- Syerston catchment upgradient of mining lease boundary
- Fifield State Forest
- Waterhole
- Mapped Stream
- Major Elevation Conour

0 1,000 2,000

Meters

1:50,000 METRES

NOTE(S)

REFERENCE(S)

CLIENT

SYERSTON NICKEL COBALT PROJECT
SCANDIUM OXIDE MODIFICATION

PROJECT

PHASE 5000 MOD EA AMMENDMENT

TITLE

TOPOGRAPHY AND HYDROLOGY

CONSULTANT

Golder Associates

YYYY-MM-DD	1/08/2017
DESIGNED	TR
PREPARED	KS
REVIEWED	MH
APPROVED	MH

PROJECT NO.	CONTROL	REV.	FIGURE
1524361	039	2	17

4.1.3.2 Lachlan River catchment

The proposed water supply intake is to be located at approximately 33.27°S and 147.53°E consisting of a combined southern borefield and Lachlan River surface water intake; drawing water from the Lachlan Formation groundwater system and Lachlan River.

The Lachlan River catchment occupies an area of around 90 000 km^2 within the Murray-Darling Basin and flows from the Great Dividing Range in the east and terminating at the Great Cumbung Swamp in the west. Water in the catchment is regulated by Wyangala Dam located in the upper headwaters of the Lachlan River (approximately 150 km upstream from the proposed water supply offtake). The Lachlan River flows north-west from Wyangala Dam towards the town of Forbes where it reaches its maximum capacity due to several tributaries entering the Lachlan River within this reach. The proposed bore intake is located approximately 50 km west of Forbes. Downstream of Forbes, the river divides into a number of meandering creeks across a flood plain, reforming as a single continuous river channel downstream of Condobolin.

The NSW Office of Water operates around 100 flow gauging stations within the Lachlan River catchment which record flows on a continuous basis. Due to the complex stream system along the reach between Forbes and Condobolin (downstream of the proposed water supply offtake), there is a lack of continuous and real-time flow gauging station data. Mean daily flow records for selected gauging stations along the Lachlan River are provided in Table 11.

Table 11: Mean daily flow for selected Lachlan River gauges

Gauging Station	Catchment Area (km^2)	Mean Daily Flow (ML)	Distance from Water Supply Intake (km)	Period of Record
Upstream of Intake				
Forbes Cottons Weir	19 000	3 176	40	1892 - 2017
Jemalong Weir	19 400	2 915	20	1941 - 2017
Downstream of Intake				
Condobolin Bridge	25 200	1 640	50	1896 - 2017
Lake Cargelligo Weir	45 800	2 041	130	1910 - 2017

4.1.4 Surface water quality

4.1.4.1 Macquarie-Bogan catchment

The mine site is located within the Upper Bogan River Water Region that is administered by the Macquarie Bogan Unregulated and Alluvial Water Sources WSP. Environmental flows and water quality targets in this river system are regulated. Cease to pump rules apply when the river flow falls below a designated level.

Water Quality Objectives (WQOs) have been developed for NSW rivers and estuaries which provide guideline levels to assist water quality planning and management (NSW Government, 2006). WQOs with accompanying trigger values apply to the following objectives: aquatic ecosystems, visual amenity, recreation, livestock and irrigation, drinking water, and aquatic foods.

Surface water quality data is available for the three proximate NSW Office of Water gauging stations downstream of the mine (and processing facility) site along the Bogan River. The most complete (1970 to present) and regular (monthly) monitoring occurs at Gongolgon gauging station (421023), with only limited data available for remaining sites.

Regularly recorded parameters include: anions and cations, acidity and alkalinity, nutrients, total suspended solids (TSS) and total dissolved solids (TDS). Background TSS levels are shown in Figure 18 and do not exceed 100 mg/L at this location for the sampling events.

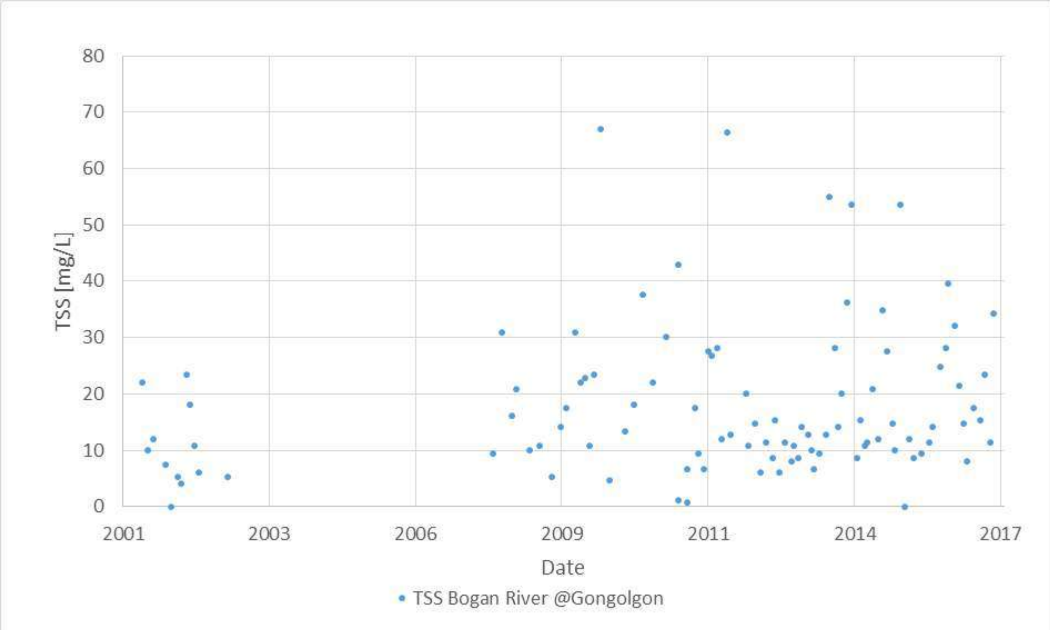


Figure 18: Background total suspended solids (at 105°C) at Gongolgon

Figure 19 shows historical TDS levels at Gongolgon gauging station alongside the Australian Drinking Water Guidelines (ADWG) relevant guideline recommended TDS for 'good palatability'. No specific health guideline value is provided for TDS under the ADWG, as there are no health effects directly attributable to TDS. For rural industries, ANZECC/ARMCANZ guidelines recommend TDS concentration tolerance levels for livestock ranging from 2 000-5 000 mg/L, and NSW Government recommendations state that salinity levels greater than 670 mg/L can cause problems for the irrigation of some crops and can damage aquatic ecosystems at higher concentrations. Recorded TDS levels generally fall below all relevant recommended levels.

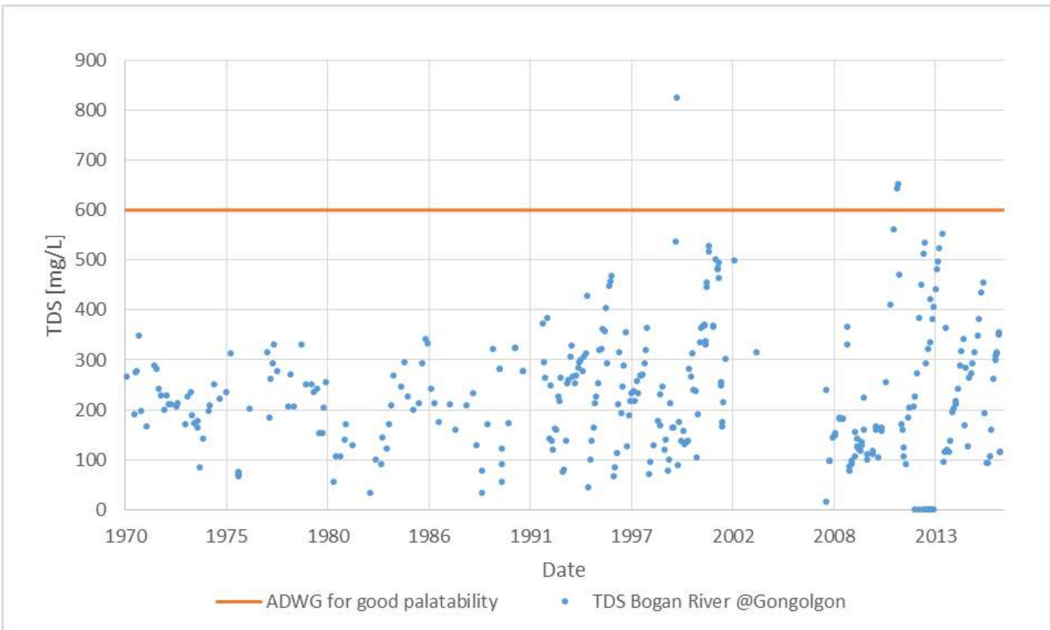


Figure 19: Historical total dissolved solids at Gongolgon versus relevant guidelines

Surface water quality data is not available in the vicinity of Bullock Creek or in close proximity to the mine site (that is the ephemeral watercourses). Accordingly, the Project will reference the low-risk default trigger values applicable to slightly disturbed upland river ecosystems in NSW from the ANZECC/ARMCANZ guidelines, as shown in Table 12 and Table 13. These values are derived from using the 80th and/or 20th percentile of the reference data.

Table 12: ANZECC/ARMCANZ default trigger levels for slightly disturbed aquatic ecosystems in NSW

Ecosystem type	Chlorophyll a	Total Phosphorus	FRP	Total Nitrogen	NOx	Ammonium	Dissolved Oxygen		pH	
Units	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	% saturation			
							Lower Limit	Upper Limit	Lower Limit	Upper Limit
Upland River	N/A	20	15	250	15	13	90	110	6.5	7.5

Trigger values for toxicants at alternative levels of protection are also specified in the ANZECC/ARMCANZ guidelines. Using the 95% level of protection to derive trigger levels for these toxicants is considered to be a conservative approach. Table 13 lists the default trigger values for chemical toxicants at the 95% level of protection in slightly to moderately disturbed ecosystems.

Table 13: ANZECC/ARMCANZ default trigger levels for toxicants at alternative levels of protection

Chemical	Trigger values for freshwater (µg/L)
	95% Level of protection
Aluminium	55
Arsenic (III)	24
Arsenic (V)	13
Boron	370
Cadmium	0.2
Chromium (III)	3.3
Chromium (VI)	1.0
Cobalt	1.4
Copper	1.4
Iron	300
Lead	3.4
Manganese	1 900
Mercury (inorganic)	0.06[1]
Nickel	11.0
Silver	0.05
Vanadium	6.0
Zinc	8.0

[1] This values is derived from the 99% level of protection which correlates to slightly to moderately disturbed ecosystems.

4.1.4.2 Lachlan River catchment

Surface water sampling was undertaken by Coffey Geosciences Pty Ltd (Coffey) on 27 November 1999 and 15 August 2017 (see Appendix B) at sampling locations indicated in Table 14. Samples were tested at NATA accredited laboratories and results presented in reports Coffey (2000 and 2017).

Table 14: Surface water sample coordinates

Date of Sample	Surface Water ID	Latitude	Longitude	Distance from Intake
27 November 1999	RIVER	33.33 S	147.58 E	8 km upstream
15 August 2017	LR1	33.27 S	147.53 E	0 m (at proposed intake)

Reported concentrations are compared to Australian drinking water guidelines (2011) and trigger values for 95% protection of freshwater ecosystems (ANZECC, 2000). The following analytes were found to exceed defined trigger values:

- 1999: Copper, gold, manganese and total phosphorus.
- 2017: EC, aluminium, copper, iron and total phosphorus.

4.1.5 Surface water users

4.1.5.1 Macquarie-Bogan catchment

The extraction of surface and groundwater within the Macquarie-Bogan catchment is controlled by the Water Sharing Plan for the Macquarie-Bogan Unregulated and Alluvial Water Sources, as discussed in Section 3.3.1.1. The Syerston site falls within the Upper Bogan River water source of the catchment. The total extraction entitlements for surface water users within the Upper Bogan water source under various access licence types is provided in Table 15.

Table 15: Upper Bogan water extraction entitlements (WSP July 2016)

Access licence type	Total Upper Bogan share component	Total Macquarie-Bogan share component
Domestic and stock	155 ML/year	1 952 ML/year
Local water utility	32 ML/year	40 327 ML/year
Unregulated river	1 553 unit shares	113 358 unit shares
Unregulated river (special additional high flow)	1 082 unit shares	44 501 unit shares

Local surface water user data was sourced from the NSW Office of Water (September, 2017). At the time of this information request, there are no licenced surface water users within 10 km radius of the mine area. As noted in Section 3.3.4, landholders in most NSW rural areas are allowed to collect a proportion of the rainfall runoff on their property without requiring a licence. There are a number of small farm dams to the north of the Project site.

4.1.5.2 Lachlan River catchment

The extraction of surface water within the Lachlan River catchment is controlled by the Water Sharing Plan for the Lachlan Regulated River Water Source, as discussed in Section 3.3.1.4. The Project proposes to extract water from the Lachlan River. The total extraction entitlements for surface water users within the Lachlan Regulated River water source under various access licence types is provided in Table 16.

Table 16: Lachlan River water extraction entitlement (WSP, July 2016)

Access licence type	Total Lachlan Regulated River Water Source share component
Domestic and stock	12 502 ML/year
Local water utility	15 545 ML/year
Regulated river (high security)	27 680 unit shares
Regulated river (general security)	592 801 unit shares
Regulated river (conveyance)	17 911 unit shares
Supplementary	N/A

4.2 Hydrogeology

4.2.1 Local geology

Previous hydrogeological investigations have encountered the following geological formations within the Project site: Laterite, Ultrabasic intrusive rocks (pyroxenite, gabbro, diorite), and residual soils/alluvial (Golder, 2000a). Figure 20 shows a typical hydrogeological cross section AA' (refer to Figure 21 for location).

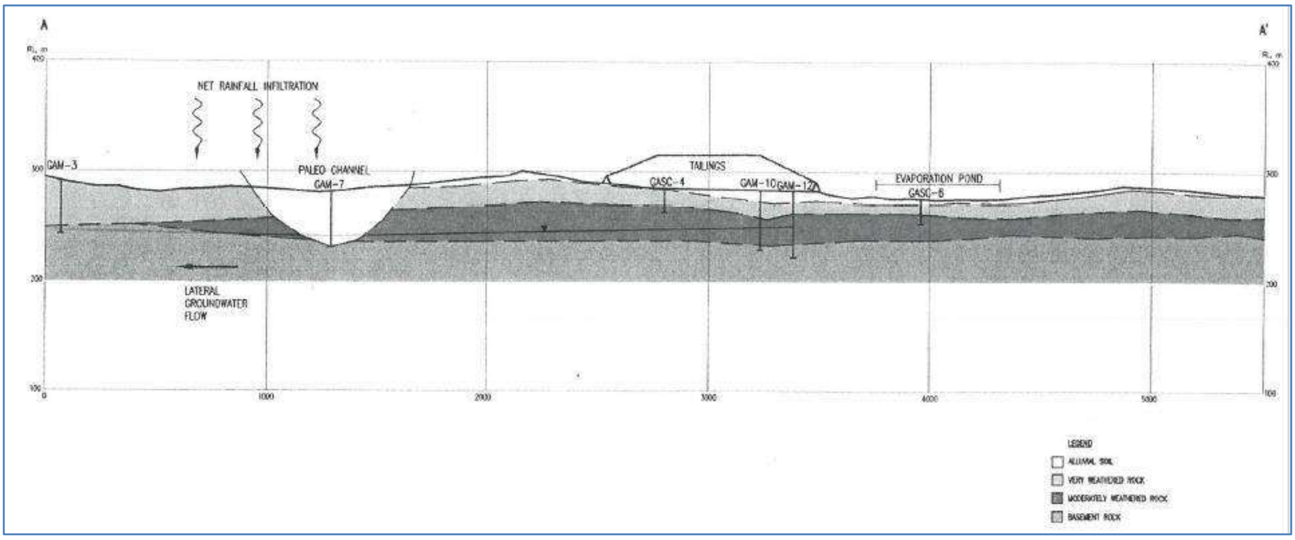


Figure 20: Representative hydrogeological cross section (EIS, 2000, Volume 2)

The mine site comprises generally the Cowra Formation which disconformably overlies the Lachlan Formation. Cowra formation comprises clay, silt and gravel. The Lachlan Formation consists of sand, fine to medium gravel, with minor silt and clay unit (Coffey, 2016).

The Girilambone group forms the basement rock of the mine site and surroundings. The bedrock is mostly dominated by fine quartz sandstone, siltstones and shale, mostly metamorphoses to quartzite, phyllite and schist (EIS, 2000, Volume 1).

The mine site is formed predominantly of an oblate Dunite core intrusion approximately 2 km north-south by 3 km east-west which is surrounded by ultramafic and mafic rocks (gabbro, diorite and olivine pyroxenite) and laterite (EIS, 2000, Volume 1). Residual soil/alluvials covers up to 2 m of low lying area of the Project site (Golder, 2000g). The paleochannel passes through the mine site in a north-easterly direction, encountered in boreholes GAM7, GAM9, GAM13 and GAM16 (refer to Figure 20 and Figure 21). The paleochannel is up to 1 500 m wide and 35 m below ground level and comprises silts, clays, gravels, quartz and rock fragments (Golder, 2000g). The channel materials appear to have hydraulic parameters similar to the surrounding subsurface and can therefore be represented by the same materials – surface alluvium, highly weathered rock, and slightly weathered rock.

Syerston is a Type C nickel laterite deposit classified as oxide deposits dominated by iron-hydroxides. The deposit contains resource grade nickel and cobalt mineralisation within the Laterite profile overlying the Dunite core intrusion (EIS, 2000, Volume 1).

4.2.2 Local hydrogeology

Three aquifers have been encountered on the Syerston site (Golder, 2000a):

- In the more fractured basement rocks
- Where saturated gravel/sand was encountered in the paleochannel (one monitoring bore only)
- In the siliceous cap-rock over the dunite intrusion.

Two recent surveys of the monitoring bores on site have been conducted (December 2016 and June 2017) to measure groundwater levels at the groundwater monitoring bores on site (Table 17) and to install groundwater level data loggers in those bores. Site monitoring bore locations are displayed in Figure 21.

Both periods showed similar interpreted groundwater contours and groundwater flow directions as shown in Figure 22 and Figure 23. Generally, groundwater levels are 30 to 60 m below ground level and follow surface topography, being highest in the western area of the site. It is inferred that groundwater flow enters the site from the west and then flows either south-east towards the paleochannel or north-east following the drop in topography. A groundwater divide is interpreted to exist beneath the topographical ridge in the (centre) eastern area of the site.

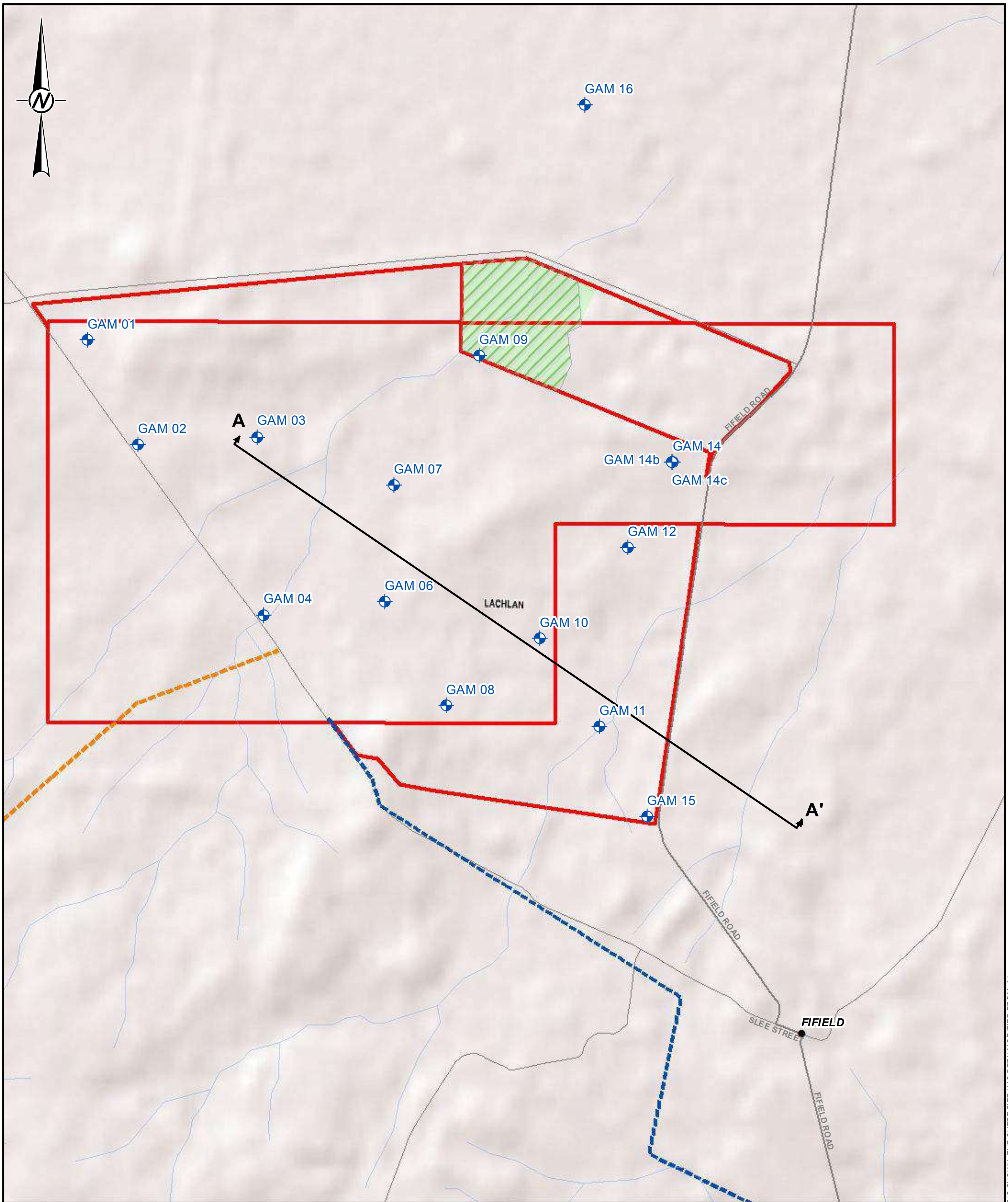
Water samples were not collected during the recent surveys. As such, the understanding of groundwater salinity across the site is based on the water quality data analysis from Golder (2000a) which shows that groundwater is fresh in the north-west area of the site, brackish in and near the centre of the site and saline in the south-east area of the site. Anderson's Pit is located outside the north-east corner of the site and contains fresh water due to surface water runoff.

Table 17: Standing water levels - December 2016 and June 2017

Bore ID	Easting (m) GDA 94	Northing (m) GDA 94	SWL-Dec 2016 (m AHD*)	SWL-Dec 2016 (m BGL**)	SWL-Jun 2017 (m AHD)	SWL-Jun 2017 (m BGL)	SWL Change (m)
GAM 01	536 383	6 376 352	272.87	27.70	276.38	24.19	3.51
GAM 02	536 851	6 375 388	268.64	31.02	268.97	30.69	0.33
GAM 03	537 953	6 375 460	247.28	45.39	247.73	44.94	0.45
GAM 04	538 007	6 373 817	263.73	28.34	264.13	27.94	0.40
GAM 06	539 132	6 373 939	249.14	44.90	249.67	44.37	0.53
GAM 07	539 211	6 375 016	-	-	242.55	46.02	N/A
GAM 08	539 695	6 372 982	244.38	48.68	248.58	44.48	4.20
GAM 09	540 003	6 376 210	237.98	40.97	238.69	40.26	0.71
GAM 10	540 563	6 373 602	249.53	32.93	249.82	32.64	0.29
GAM 11	541 109	6 372 792	241.86	39.30	242.32	38.84	0.46
GAM 12	541 376	6 374 443	250.31	29.46	251.99	27.78	1.68
GAM 14	541 787	6 375 224	243.8	38.38	244.59	37.59	0.79
GAM 14b	541 782	6 375 225	231.28	51.01	232.3	49.99	1.02
GAM 14c	541 776	6 375 225	250.88	31.60	250.63	31.85	-0.25
GAM 15	541 551	6 371 961	239.12	54.45	239.68	53.89	0.56
GAM 16	540 976	6 378 523	216.19	55.96	216.79	55.36	0.60

*Note: * m AHD refers to metres Australian Height Datum*

*** mBGL refers to metres below ground level*



LEGEND

- GAM Monitoring Bores
- Hydrogeological Cross Section
- Approved Gas Supply Pipeline
- Approved Water Supply Pipeline
- Limestone Quarry
- Mining Lease Application Boundary

REFERENCE

Basemaps sourced from Esri Online Basemaps.
Road & Property © New South Wales, Spatial Services, 2015.
Water © Commonwealth of Australia, Bureau of Meteorology, 2014.

0 250 500 1,000 1,500 2,000 Metres

REFERENCE SCALE: 1:50,000 (at A4)
PROJECTION: GDA 1994 MGA Zone 55

CLIENT
SYERSTON NICKEL COBALT PROJECT
SCANDIUM OXIDE MODIFICATION

PROJECT
PHASE 5000 MOD EA AMENDMENT

TITLE
MPF MONITORING BORE LOCATIONS

CONSULTANT
Golder Associates

YYYY-MM-DD	2017-09-28
PREPARED	KS / AFE
DESIGN	-
REVIEW	MH
APPROVED	MH

PROJECT	CONTROL	REV.	FIGURE
1524361	039-R	2	21

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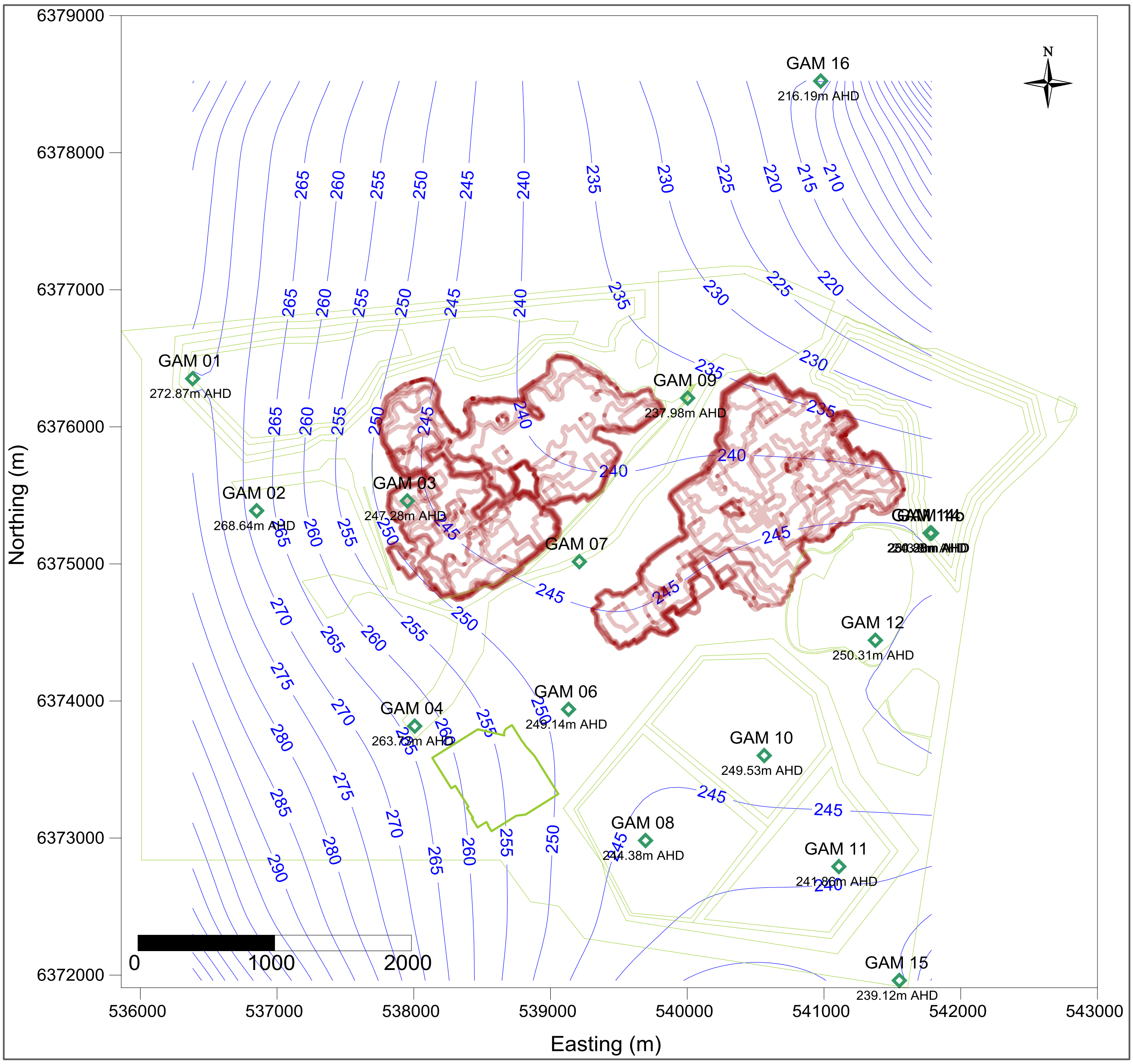


Figure 22: Groundwater level contours December 2016

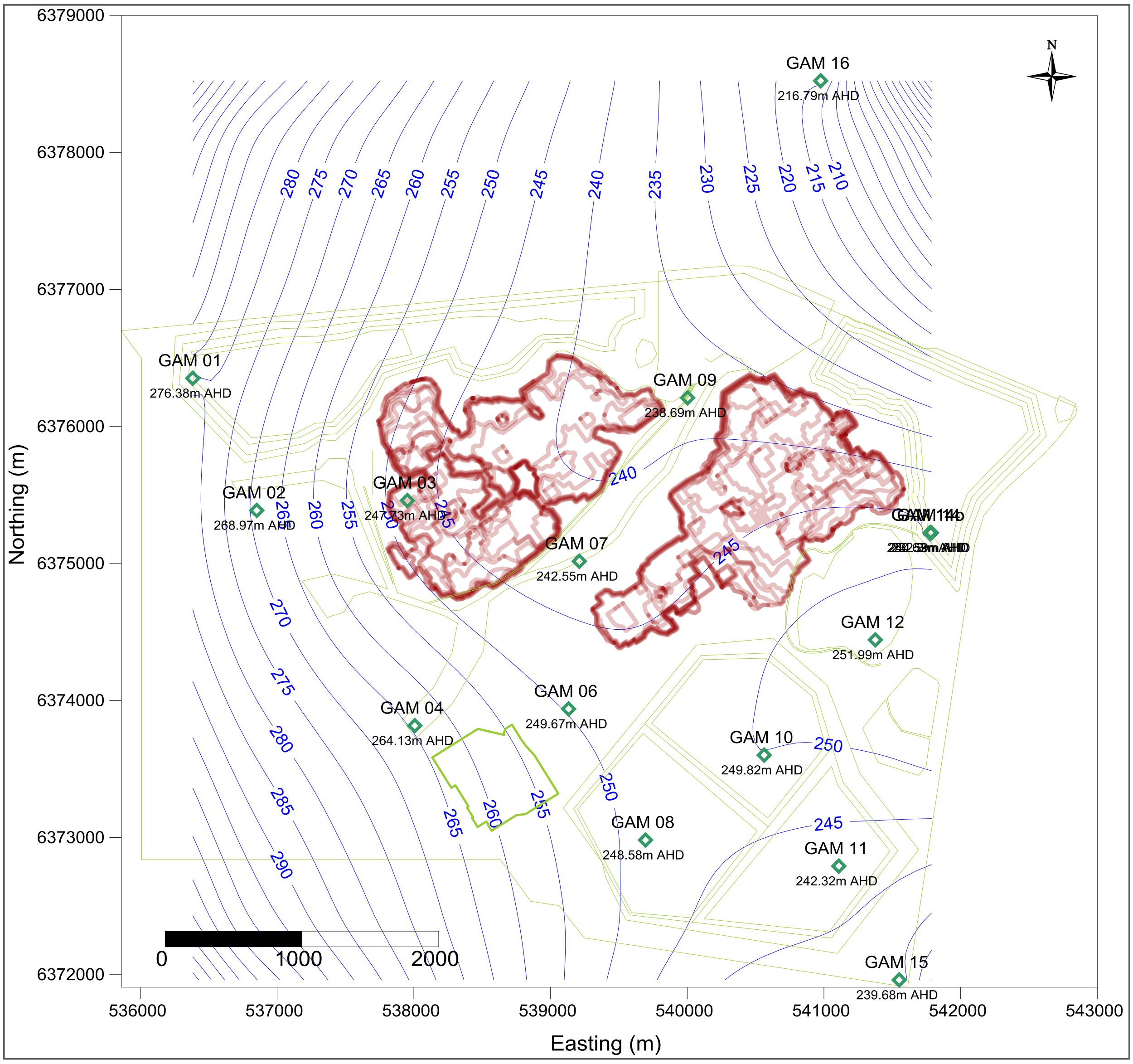


Figure 23: Groundwater level contours June 2017

The installation of automated data loggers (insitu, Rugged TROLL 100 series) for long-term groundwater monitoring was conducted in sixteen bores in June, 2017. A summary of logger installation is provided in Table 18.

Table 18: Summary of automated data logger installation – June, 2017

Bore ID	Installation Date	Data Logger Serial Number	SWL (mBTOC[1])	Approximate Logger Installation Depth (mBTOC)
GAM01	15/06/2017	S/N 449457	24.82	30.20
GAM02	15/06/2017	S/N 538811	31.33	36.00
GAM03	15/06/2017	S/N 518769	45.57	47.50
GAM04	14/06/2017	S/N 519089	28.57	33.00
GAM06	14/06/2017	S/N 518517	44.93	50.00
GAM07	15/06/2017	S/N 516190	46.65	51.00
GAM08	13/06/2017	S/N 518772	45.12	50.00
GAM09[1]	13/06/2017	S/N 518774	40.91	47.00
GAM10	13/06/2017	S/N 518511	33.28	38.00
GAM11	13/06/2017	S/N 516183	39.48	44.00
GAM12	13/06/2017	S/N 518509	28.41	33.50
GAM14A	13/06/2017	S/N 516182	38.21	43.00
GAM14B	13/06/2017	S/N 518528	50.60	55.50
GAM14C	13/06/2017	S/N 518762	32.47	37.00
GAM15	13/06/2017	S/N 515821	54.52	56.50
GAM16	13/06/2017	S/N 518756	56.01	61.00

Note: - 1 –mBTOC- meters below top of casing,
Baro troll (S/N 519712) was installed at GAM09

Hydraulic testing (falling head) was undertaken to estimate the hydraulic conductivity of the subsurface profile at six existing monitoring bores (GAM06, GAM07, GAM09, GAM11, GAM12 and GAM15) from 13th June 2017 to 15th June 2017. Data obtained through the falling head tests was analysed using AQTESOLV. Saturated hydraulic conductivities were calculated from the falling head test data for each bore (Table 19).

Table 19: Summary of estimated saturated hydraulic conductivity from falling head tests

Bore ID	Estimated K (m/s) & Solution Method				Average K (m/s)	Test Interval (mbGL)	Aquifer Thickness (m)	Formation Tested
	Bouwer-Rice	Hvorslev	KGS	Barker-Black				
GAM06	$1.8x10^{-6}$	$2.3x10^{-6}$	$2.2x10^{-6}$	$1.4x10^{-6}$	$1.9x10^{-6}$	51.4 to 57.4	13.14	Pyroxenite, fesh rock, some veining
GAM07	$5.6x10^{-7}$	$7.4x10^{-7}$	$9.6x10^{-7}$	$3.6x10^{-7}$	$6.6x10^{-7}$	51.0 to 57.0	10.27	Pyroxenite, slightly weathered
GAM09	Not analysable (high K)							Pyroxenite, extremely to slightly weathered
GAM11	$2.4x10^{-7}$	$2.9x10^{-7}$	$2.7x10^{-7}$	$1.5x10^{-7}$	$2.4x10^{-7}$	54.0 to 60.0	22.10	Pyroxenite, slightly weathered
GAM12	$9.8x10^{-9}$	$1.1x10^{-8}$	$1.1x10^{-8}$	$5.5x10^{-9}$	$9.3x10^{-9}$	50.8 to 56.8	29.59	Gabbro fresh rock
GAM15	$1.6x10^{-6}$	$1.8x10^{-6}$	$1.8x10^{-6}$	$5.2x10^{-7}$	$1.4x10^{-6}$	64.7 to 70.7	16.85	Pyroxenite, slightly weathered

4.2.3 Groundwater resources

Previous hydrogeological desktop studies identified potential local groundwater resources available within the Syerston site and the area within approximately 3 km of the Syerston site, and regional groundwater resources within 20 km of the Syerston site (Golder, 2015).

With the exceptions of GAM01 and possibly GAM09, hydraulic testing of groundwater monitoring bores suggested that hydraulic conductivities are very low and the potential yield of the fractured rock aquifer may be minimum (on the order of 0.1 L/s or less). GAM1 had a reported airlift yield of 1.3 L/s (Golder, 2000g). Yield testing of GAM9 is being undertaken in late 2017.

Regionally, nine bores are reported (NSW Groundwater Database) within the region yield exceeding about 1 L/s, with most from 1-2 L/s. The relatively high-yield bores are located approximately 10 to 20 km from the mine site, with groundwater being sourced primarily from fractured rock aquifers.

4.2.4 Groundwater users near the mine site

The following land use has been identified between the mine (including processing facility) and the borefield location (Australian Government National Map, 2016):

- Production Forestry
- Cropping
- Grazing modified pasture
- Other minimal use
- Land in transition.

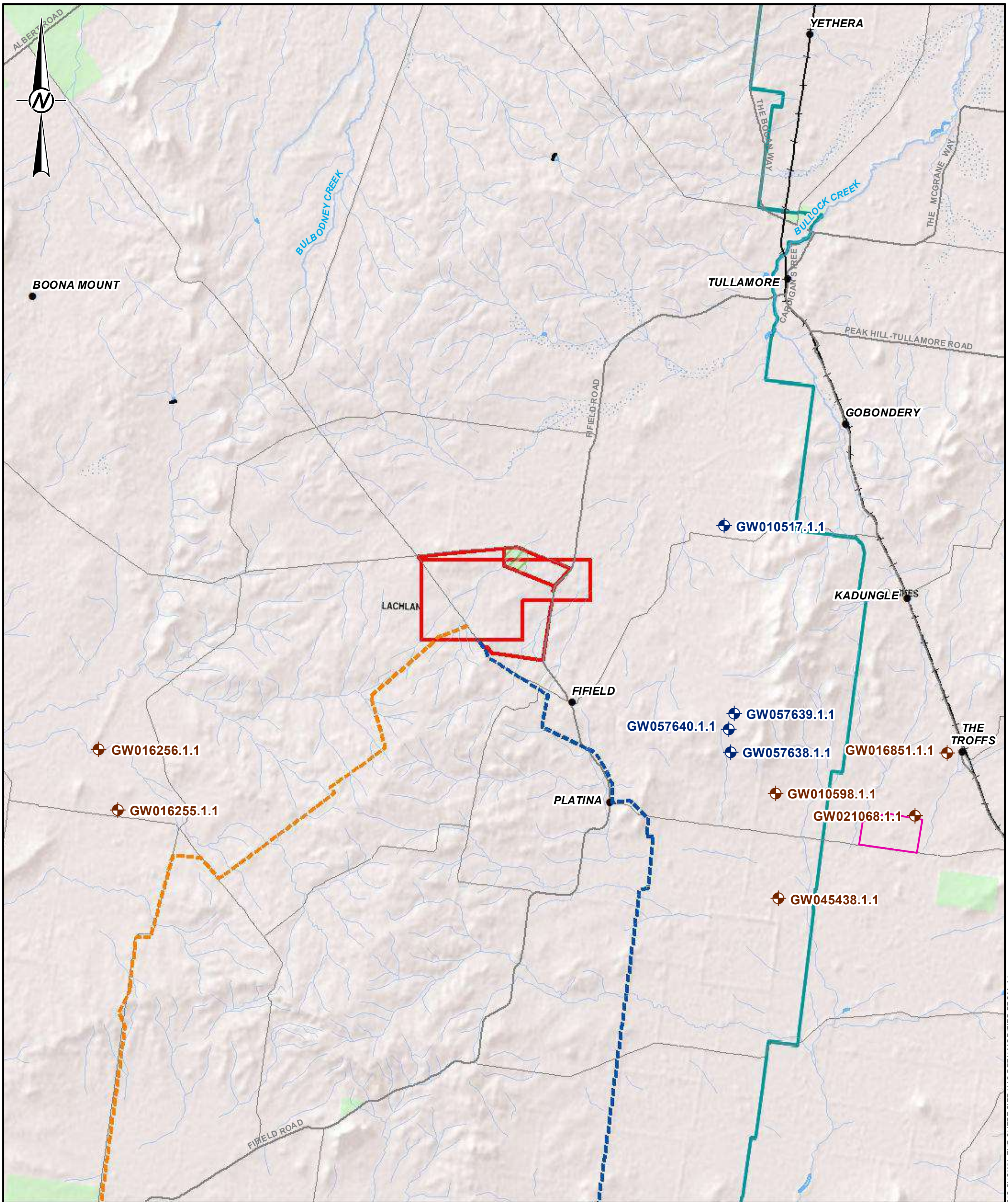
Farmers are likely to use some groundwater for irrigation and/or water supply purpose for their agricultural activities; mainly cropping and grazing. The registered bores usage is outlined in Section 4.2.5.

4.2.5 Registered groundwater bores near the Syerston site

Details of registered groundwater bores, including coordinates, purpose, usage, geology, water levels and salinity measurements, were extracted from the BoM groundwater database. There are 16 registered groundwater bores around the mine (including processing facility) and 177 registered groundwater bores around the borefield, with purpose and usage information including:

- Monitoring
- Stock and domestic
- Water supply
- Irrigation.

Monitoring bores which have recorded information concerning water levels and salinity are shown on Figure 24 (within 20 km of the mine (including processing facility)) and Figure 25 (within 20 km of the borefield). The registered bore closest to the mine (including processing facility), GW010517.1.1, is located approximately 7 km east of site and there are a further three bores within 10 km. There are 32 monitoring bores with recorded information within 10 km of the borefield.



LEGEND

Registered Bores with Water Level or Salinity Information

- Within 10 km of MPF
- Within 20 km of MPF
- Approved Gas Supply Pipeline
- Approved Water Supply Pipeline
- Limestone Quarry
- Mining Lease Application Boundary

REFERENCE

Basemaps sourced from Esri Online Basemaps.
Road & Property © New South Wales, Spatial Services, 2015.
Water © Commonwealth of Australia, Bureau of Meteorology, 2014.

0 1 2 4 6 8 10 Km

REFERENCE SCALE: 1:250,000 (at A4)
PROJECTION: GDA 1994 MGA Zone 55

CLIENT
SYERSTON NICKEL COBALT PROJECT
SCANDIUM OXIDE MODIFICATION

PROJECT
PHASE 5000 MOD EA AMENDMENT

TITLE
REGISTERED BORES WITH WATER LEVELS AND SALINITY INFORMATION

CONSULTANT
Golder Associates

YYYY-MM-DD	2017-09-28
PREPARED	KS / AFE
DESIGN	-
REVIEW	MH
APPROVED	MH

PROJECT	CONTROL	REV.	FIGURE
1524361	039-R	2	24

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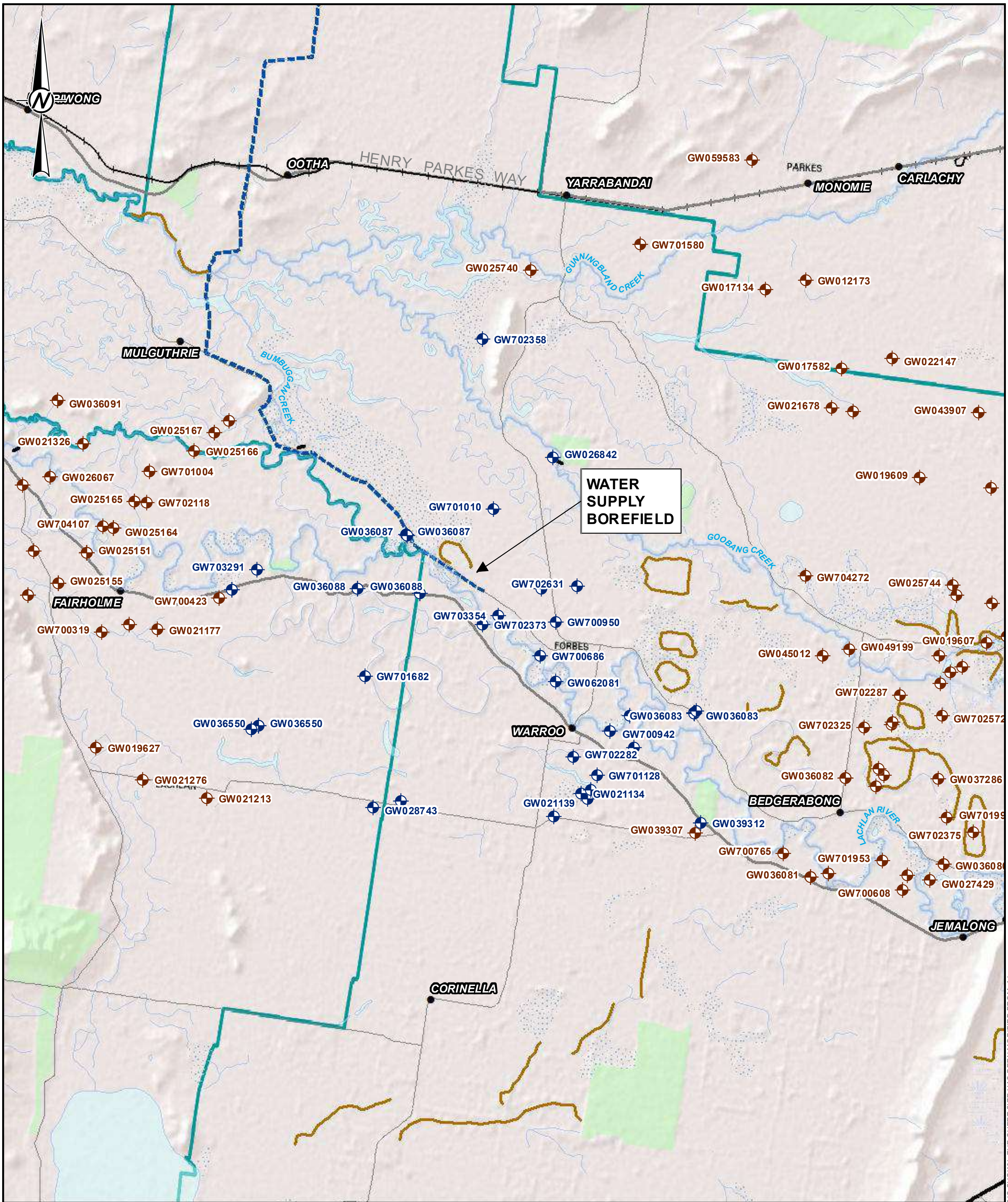

LEGEND

Registered Bores with Water Level or Salinity Information

- Within 10 km of Borefield
- Within 20 km of Borefield
- DamWall
- Levee
- Approved Water Supply Pipeline

REFERENCE

Basemaps sourced from Esri Online Basemaps.
Road & Property © New South Wales, Spatial Services, 2015.
Water © Commonwealth of Australia, Bureau of Meteorology, 2014.

0 1 2 4 6 8 10 Km

REFERENCE SCALE: 1:225,000 (at A4)
PROJECTION: GDA 1994 MGA Zone 55

CLIENT
SYERSTON NICKEL COBALT PROJECT
SCANDIUM OXIDE MODIFICATION

PROJECT
PHASE 5000 MOD EA AMENDMENT

TITLE
REGISTERED BORES WITH WATER LEVELS AND SALINITY INFORMATION

CONSULTANT
Golder Associates

YYYY-MM-DD	2017-09-28
PREPARED	KS / AFE
DESIGN	-
REVIEW	MH
APPROVED	MH

PROJECT	CONTROL	REV.	FIGURE
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5.0 OVERVIEW OF THE APPROVED WATER MANAGEMENT SYSTEM

The purpose of the mine water management system is to control water generated within the Syerston site development and operational areas, as well as divert ephemeral streamflow around these areas. The water management system consists of both temporary structures which will operate during mining operations only and permanent features which will continue to operate post-closure. An overview of the approved management system is provided in Figure 26.

The summary details of the components of the approved water management system are provided in Table 20.

Table 20: Approved water management system components

FACILITY	DETAILS			
Storage facilities	**No. Cells**	**Capacity**	**Unit**	**Area (ha)**
Tailings storage facility	2	46.4	Mm^3	217
Evaporation pond	7	2 420	ML	121
Surge dam	1	1 500	ML	56
Surface water diversions	**Catchment Area (ha)**	**Depth (m)**	**Width (m)**	**Length (m)**
Northern diversion	2 700	1.5 to 1.7	10 to 15	3 500
Southern diversion	1 950	1.5	10	2 450

5.1 Summary of the Approved Water Management System

5.1.1 Tailings storage facility

All mine tailings generated as a result of ore processing were to be stored in a Tailings Storage Facility (TSF) located east of the process plant. The TSF comprised of two cells, a northern and southern cell of total area 217 ha. Tailings were to be pumped to the TSF as a slurry with a solids concentration of approximately 48%. Slurry was to be deposited through a series of spigots located at the perimeter of the cells and a decant pond was to be maintained in the centre of each cell. The TSF design employed an underdrain system which would collect seepage and control the phreatic surface within the cells. Decant water would be piped to sumps outside the perimeter of the TSF embankment which would be pumped back to the TSF or to the evaporation ponds for evaporative disposal.

5.1.2 Evaporation pond

The evaporation pond design consisted of seven contour pond cells contained by 2.5 m high earth embankments located to the immediately east of the TSF. The evaporation pond cells had a combined surface area of 121 ha. Decant water from the TSF cells would be pumped to a sump at the evaporation ponds, from where it would then be distributed to the various evaporation pond cells. When the evaporation pond cells have reached capacity, excess water would be redirected to the surge dam. When the evaporation ponds have spare capacity, stored surge dam water would be pumped back into the evaporation pond cells from the surge dam.

5.1.3 Surge dam

The surge dam was to be located to the immediate north of the TSF with the operational objective to keep the water level as low as possible to ensure available surge capacity for runoff generated from large rainfall events. The base of the surge dam was to be terraced to form four evaporation ponds confined within an 8 m high embankment on the downslope of the dam. The surge dam would provide an approximate storage capacity of 1 500 ML with a 1 m freeboard and a combined surface area of 56 ha. The evaporation pond cells and the surge dam were designed to operate with sufficient freeboard to account for a runoff generated from a 72 hour 0.01% AEP rainfall event.

5.1.4 Surface water diversions

5.1.4.1 Drainage path diversions

Three ephemeral drainage lines which cross the Syerston mine lease area, described in Section 4.1.3, were to be permanently diverted through the site around planned Syerston infrastructure.

The two western drainage lines (on MLA0113 in Figure 17) were to be captured and diverted around the southern and eastern perimeter of the western open cut pit by the Northern Diversion channel, as shown in Figure 26. This diversion was planned to connect back into the natural drainage path downstream of the open cut pit.

The eastern drainage line (on MLA0139 in Figure 17) was to be captured and diverted around the eastern perimeter of the evaporation ponds by the Southern Diversion channel, as shown in Figure 26, and connect back into the existing drainage path before exiting the eastern site boundary.

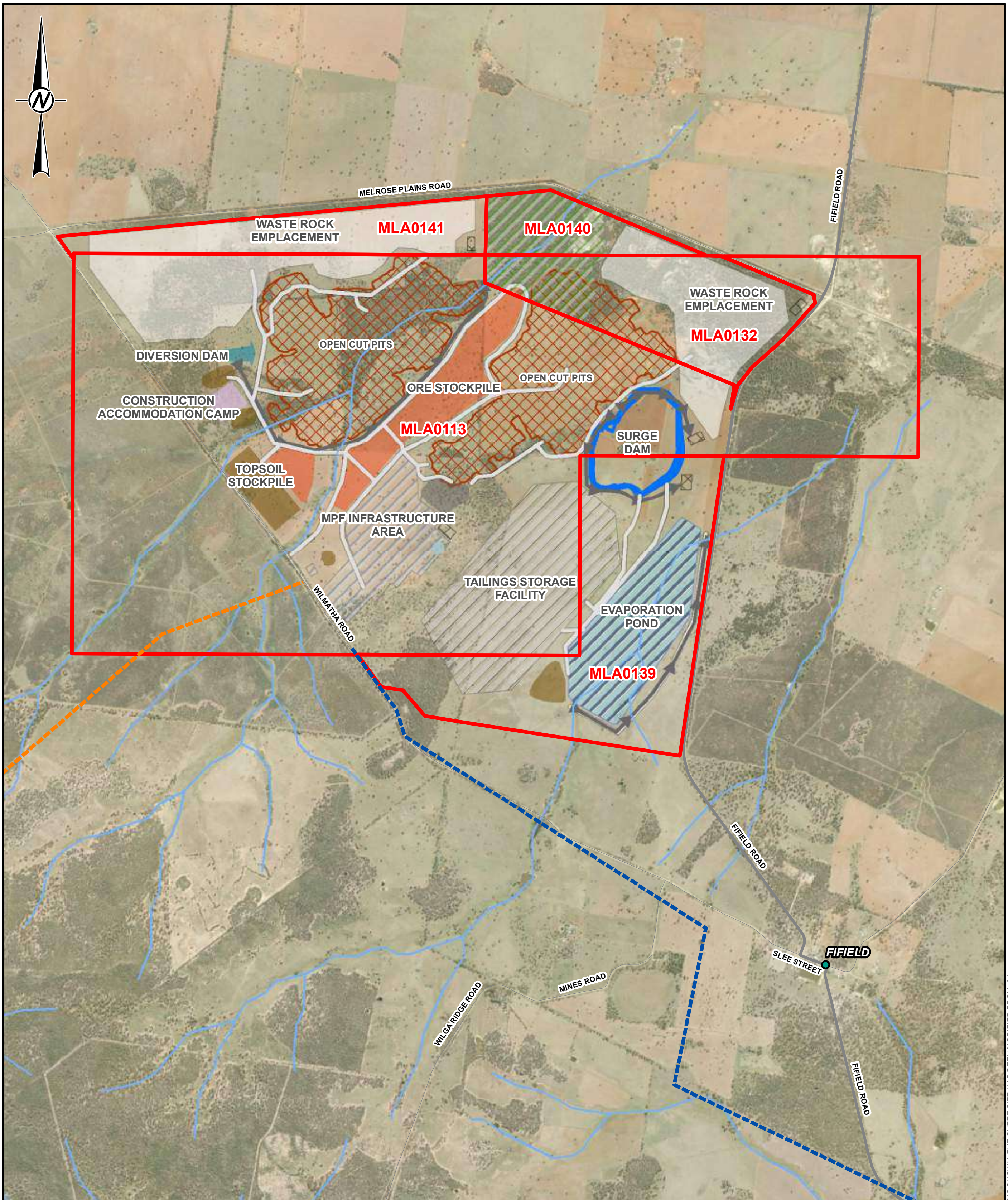
5.1.4.2 Surge dam diversion

The surge dam diversion was located in the east of the Syerston site and was designed to divert water originating within the site upstream of the surge dam around its perimeter to minimise the upslope inflows, as shown in Figure 26.

5.2 Water supply

The main water demand (usage) for the mine (including processing facility) will be associated with the process plant. Other water demand requirements include dust suppression, cooling water and potable and non-potable uses in the mine infrastructure area.

At full production (that is 2.5 Mtpa autoclave feed rate), the total raw water demand for the processing facility was originally estimated and approved to be up to approximately 17.5 ML/d, or an annualised basis, up to 6 387 ML/year. An optimisation study has since been completed by Clean TeQ resulting in the opportunity to increase the efficiency of mining and processing operations, as well as increasing the recycling of water on-site and therefore reducing the water demand from external water supply sources (as discussed in Section 6.2.



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LEGEND

- Approved Gas Supply Pipeline
- Approved Water Supply Pipeline
- Diversion Structure
- Key Site Water Pipeline
- MPF Infrastructure Area
- Diversion Dam
- Raw Water
- Evaporation Ponds
- Topsoil Stockpile
- Tailings Storage Facility
- Waste Rock Emplacement
- Ore Stockpile
- ROM Pad
- SD
- Construction Accommodation Camp
- Mining Lease Application Boundary

REFERENCE

Basemaps sourced from Esri Online Basemaps.
Road & Property © New South Wales, Spatial Services, 2015.
Water © Commonwealth of Australia, Bureau of Meteorology, 2014.

0 250 500 1,000 1,500 2,000 Metres

REFERENCE SCALE: 1:50,000 (at A4)
PROJECTION: GDA 1994 MGA Zone 55

CLIENT
SYERSTON NICKEL COBALT PROJECT
SCANDIUM OXIDE MODIFICATION

PROJECT
PHASE 5000 MOD EA AMENDMENT

TITLE
APPROVED MINE LAYOUT

CONSULTANT
Golder Associates

YYYY-MM-DD	2017-11-01
PREPARED	KS / AFE
DESIGN	-
REVIEW	MH
APPROVED	MH

PROJECT	CONTROL	REV.	FIGURE
1524361	039-R	2	26

6.0 MODIFICATION 4 WATER MANAGEMENT SYSTEM

6.1 Summary Modification 4 water management system

The Modification 4 Water Management System is shown in Figure 6.

The components of the approved water management system are provided in Table 21.

Table 21: Water management system components

FACILITY	DETAILS			
Storage facilities	**No. Cells**	**Capacity**	**Unit**	**Area (ha)**
Tailings Storage Facility	3	62.7	Mm^3	310
Evaporation pond	2	185	ML	27
Water storage dam	1	1 720	ML	58
Surface water diversions	**Catchment Area (ha)**	**Depth (m)**	**Width (m)**	**Length (m)**
Northern diversion	2 700	1.0 to 2.4	12 to 16	3 600
Southern diversion	1 950	2.0 to 2.7	15	3 000

6.1.1 Tailings storage facility

All tailings generated in the process plant will be pumped to and stored in the TSF located north east of the process plant. The TSF comprised of three cells, northern, southern and eastern, with total footprint area of 380 ha. Tailings will be pumped to the TSF as a slurry with a solids concentration of approximately 42%. The tailings slurry will be deposited through a series of spigots located at the perimeter of the cells and a decant pond will be maintained in the centre of each cell. Decant water will be piped to the water storage dam (WSD) for reuse in the process plant.

The tailings are at a pH of above 6, and consist of Gypsum from the neutralisation process (calcium, manganese and sulphate ions) and goethite (precipitated iron oxide).

The NSW Dams Safety committee (DSC) sets out the requirements relating to the safety management of dams in NSW. The DSC has adopted, with qualifications, the Australian National Committee on Large Dams (ANCOLD) Guidelines on Assessment of the Consequences of Dam Failure. The operational flood criteria and overall flood capacity of the TSF will be based on an assessment of the facilities consequence category. The TSF is designed to operate with sufficient flood storage capacity to meet the DSC and ANCOLD requirements.

6.1.2 Water storage dam

The water storage dam (WSD) is located to the immediate north of the TSF with the operational objective to store excess water contained in the TSF for reuse in the process plant. This is located at the site that was previously to be used for the surge pond. The water storage dam will be lined with a High Density Polyethylene (HDPE) liner to limit seepage losses.

As is the case for the TSF, the WSD is designed to operate with sufficient flood storage capacity to account for the required rainfall event. A spillway will be provided and sized consistent with the requirements of the DSC and ANCOLD.

6.1.3 Evaporation pond

An evaporation pond has been retained in the Modification 4 water management system to manage a minor stream of high chloride process water. To prevent chloride build-up in process water, this outflow from the process plant is separated from the TSF and WSD system and retained and evaporated in an evaporation pond.

The evaporation pond has been reduced to 2 contour pond cells contained by 2.5 m high earth embankments located immediately north east of the TSF. The cells will be lined with a low permeability clay to minimise seepage. The high chloride process water will be pumped from the plant to a sump at the evaporation pond, from where it would then be distributed to the two evaporation pond cells.

6.1.4 Surface water diversions

There is no substantial change to the surface water diversions for the ephemeral drainage lines from the approved project general arrangement. The drain depth and width have been adjusted slightly as the design has been updated. The existing drainage paths described in Section 4.1.3, were designed to be permanently diverted through the site around planned site infrastructure as shown in Figure 6.

The diversions that were around the surge dam have been eliminated as the current water storage dam is designed to collect and store water, rather than evaporate it.

Relevant proposed modifications to the water management system are provided in Section 2.0.

6.2 Water supply

6.2.1 Demand

The processing facility raw water demand is 2,960 ML/yr.

The raw water for the processing facility would be supplied from the borefield adjacent the Lachlan River, and would be supplemented by licenced surface water extraction from the Lachlan River. The raw water demand would be minimised by utilising recycled and treated process water and other water collected on site (e.g. internal runoff collection at the mine site [including harvestable rights] and mine dewatering [in-pit and advance]).

6.2.2 Recycled water supply

A water balance model was developed using GoldSim model software to size critical components of water infrastructure and better define the available recycled water supply from the WSD. The WSD receives supernatant decant from the TSF, direct rainfall to the WSD and rainfall runoff from active and newly rehabilitated cells of the TSF. The water process flow for the GoldSim model simulations is shown in Figure 27.

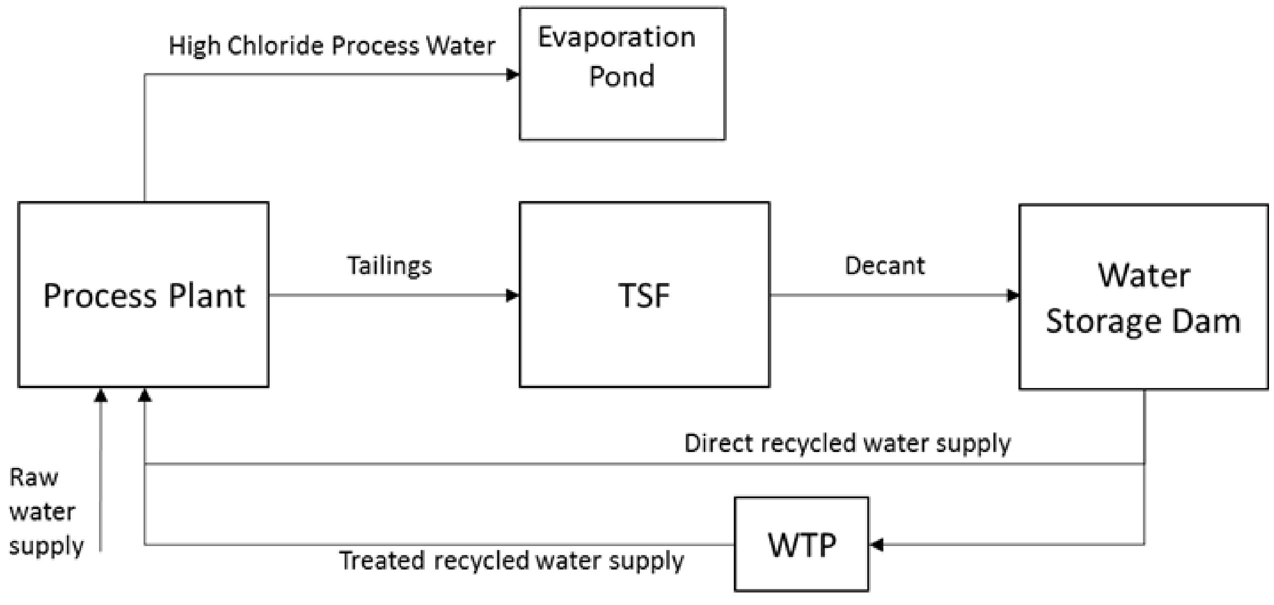


Figure 27: Modelled water flow diagram

The model was simulated for a period of 20 years using daily timesteps. Three scenarios were simulated using SILO rainfall data (discussed in Section 4.1.1):

- Scenario 1 - the driest sequential 20 years.
- Scenario 2 - the average sequential 20 years.
- Scenario 3 - the wettest sequential 20 years.

The model simulated return water from the WSD, including direct recycled water supply, and treated recycled water supply treated through the Water Treatment Plant (WTP).

For this assessment the slurry density was set at 42% and initial tailings dry density at 0.8 t/m^3, resulting in a supernatant flow of 161.7 m^3/hr.

The water balance results for the three rainfall scenarios are summarised in Table 22. The majority of recycled supply is supernatant water from the TSF. The remainder is direct rainfall to the WSD or runoff from active and rehabilitated TSF.

As expected, evaporation exceeds direct rainfall. Overflow is possible from the WSD spillway during extreme rainfall events, however, no overflow occurred during dry or average conditions.

In all scenarios (dry, average and wet climate conditions) and with the exception of a short start up period, 90 m^3/hr (789 ML/yr) and 76 m^3/hr (662 ML/yr) was able to be reliably supplied via direct recycled water supply and treated recycled water supply respectively.

Table 22: WSD balance (at end of 20 year simulation)

	Dry Climate Volume (ML)	Average Climate Volume (ML)	Wet Climate Volume (ML)
Inflow to WSD			
Direct Rainfall to WSD Pond	3 989	4 298	4 853
Decant	32 784	32 995	33 739
Active Cell Overflow	101	0	77
Runoff from the Rehabilitated Cell	1 923	1 830	2 750
Outflow from WSD			
Evaporation	9 243	9 519	10 650
Direct Supply to Process	15 753	15 746	15 749
Supply to WTP	13 302	13 297	13 299
Overflow	0	0	895
Remaining in Storage WSD	**499**	**562**	**826**

6.2.3 Raw water supply

In 2006, the Project was issued a licence under the Water Management Act, 2000 for an extraction rate of 3 154 ML/yr from the water supply borefield located near the Lachlan River, about 65 km south southeast of the Project area (Coffey, 2016).

A long term trial of a pumping rate equivalent to 6 308 ML/yr undertaken by Coffey (Coffey, 2000) has assessed that pumping at this rate in alternating six month cycles between the eastern and western borefields has a limited impact on the aquifer. Groundwater drawdowns recover rapidly following the end of the extraction program. Within the first year following cessation of groundwater extraction, drawdowns are less than 10% of the peak drawdowns with full recovery within 10 years (Coffey, 2000).

This modification proposes to diversify supply sources by including extraction of surface water from the Lachlan River as an alternative to borefield extraction.

A pump station would be constructed near the Lachlan River to extract surface water and pump it to the approved water pipeline.

For the purposes of assessment, Clean TeQ is seeking approval for up to approximately 350 ML/annum surface water extraction from the Lachlan River. When compared to the total share components of general security access licences traded since 1 July 2016, this is less than 1% based on an AWD of 1. As noted in Section 3.3.1.5, if the volume per unit of access licence share component was as low as 0.02 (based on previous AWD orders), then this volume would be approximately half of the total volumetric allocation of general security access licences traded since 1 July 2016, and consequently groundwater use in accordance with the existing (and/or future) WAL would be preferentially utilised for make-up raw water supply during such times.

It is however noted, that if opportunities were to arise (e.g. during wet climate scenarios) to obtain additional access licences for surface water extraction beyond 350 ML/annum, Clean TeQ would obtain the necessary water licences in accordance with Condition 26, Schedule 3 of the Development Consent.

6.3 Evaporation pond

A GoldSim water balance model was developed to simulate the fluctuation of storage in response to high chloride process water inflow, incidental rainfall and evaporation. The evaporation pond has been sized to contain all water from the waste inflow and rainfall during a 20 year simulation using the cumulative wettest sequential 20 years of rainfall data from the SILO rainfall data record.

A minimum evaporation pond area of 7.8 ha (185 ML) with a depth of 2.5 m (not including freeboard) was determined from the water model simulation.

7.0 ASSESSMENT OF POTENTIAL SURFACE WATER IMPACTS

7.1 Potential surface water quantity impacts

The TSF, water storage dam and evaporation pond are designed to contain and manage process water. All of these structures are without external catchments and as such do not collect rainfall runoff.

Water collected in mining pits and runoff from waste dumps will be temporarily contained in sediment basins and recycled, evaporated or assessed to meet surface water discharge requirements prior to discharge to the environment. Sediment basins will be sized according to the guidance provided in the NSW Government document Soils and Construction (Volume 1) (NSW, 2004) and the International Erosion and Sediment Control Guideline, Best Practice Erosion and Sediment Control (IECA, 2008).

None of the storages on-site are used to harvest runoff from land and all storages are used to contain potential contaminated drainage, mine water or effluent in accordance with best management practice or are used to control soil erosion. It is concluded therefore that all of these storages should be excluded from consideration as a component of the harvestable right calculation.

The ephemeral watercourses that enter the mine lease areas at the southern boundary of the mine site are diverted around mining infrastructure, discharging to the northern and eastern boundary of the mine lease area. There is no change to the diversion channel concept design in the Modification 4 water management network.

The pump station at the Lachlan River and all associated infrastructure would be constructed to be at an elevation higher than the 1:25 year flood (Golder, 2017). Water from the river will be filtered prior to transfer to site. A small amount of filter back wash will be generated and would be disposed of to an evaporation pond. As the flow in the Lachlan River is managed by the Wyangala Dam, the impact of the pump station on the quantity of water in the Lachlan River is expected to be minimal.

7.2 Potential surface water quality impacts

There are no changes to potential surface water quality impacts as a result of the Modification 4.

As discussed in Section 6.1, the TSF, water storage dam and evaporation pond have been designed to retain process water without release to the environment. The capacity of these storage facilities have been modelled to assess the water management system during both extended dry and extended wet periods using site based historical climate records.

Extraction of water by the Lachlan River pump station will not alter the quality of the river water.

8.0 ASSESSMENT OF POTENTIAL GROUNDWATER IMPACTS

8.1 Potential groundwater quantity impacts

8.1.1 Groundwater model

Two-dimensional (2D) finite element cross-sectional groundwater models were developed to estimate groundwater inflows to mine pits, seepages from the TSF and water storage dam, and potential groundwater drawdown. The 2D modelling was conducted using industry standard software Seep/W version 8.16, developed by Geo Slope International Ltd. The 2D modelling results are conservative (i.e., likely to over-estimate changes in groundwater levels and flow directions) as it represents maximum disturbance, that is, the mine pits are modelled as being instantaneously excavated to maximum depth, and the TSF is modelled as being instantaneously filled to capacity prior to transient simulation commencing. This approach will maximise mine pit inflows and seepage estimates.

Three (3) 2D cross-sectional models were developed across the project area as follows:

- Model section AB – Runs north-east to south-west direction through deepest final mine pit level. The model will estimate groundwater inflows into final pit void and potential groundwater drawdown
- Model section CD – Runs north-east to south-west direction across the proposed tailing storage facility and water storage dam. Model estimate potential seepage from the proposed TSF and water storage dam
- Model section EF - Runs north-west to south-east direction through proposed TSF and mine pits. The model estimates potential seepages from TSF.

The alignments of the cross-sections modelled are shown in Figure 28.

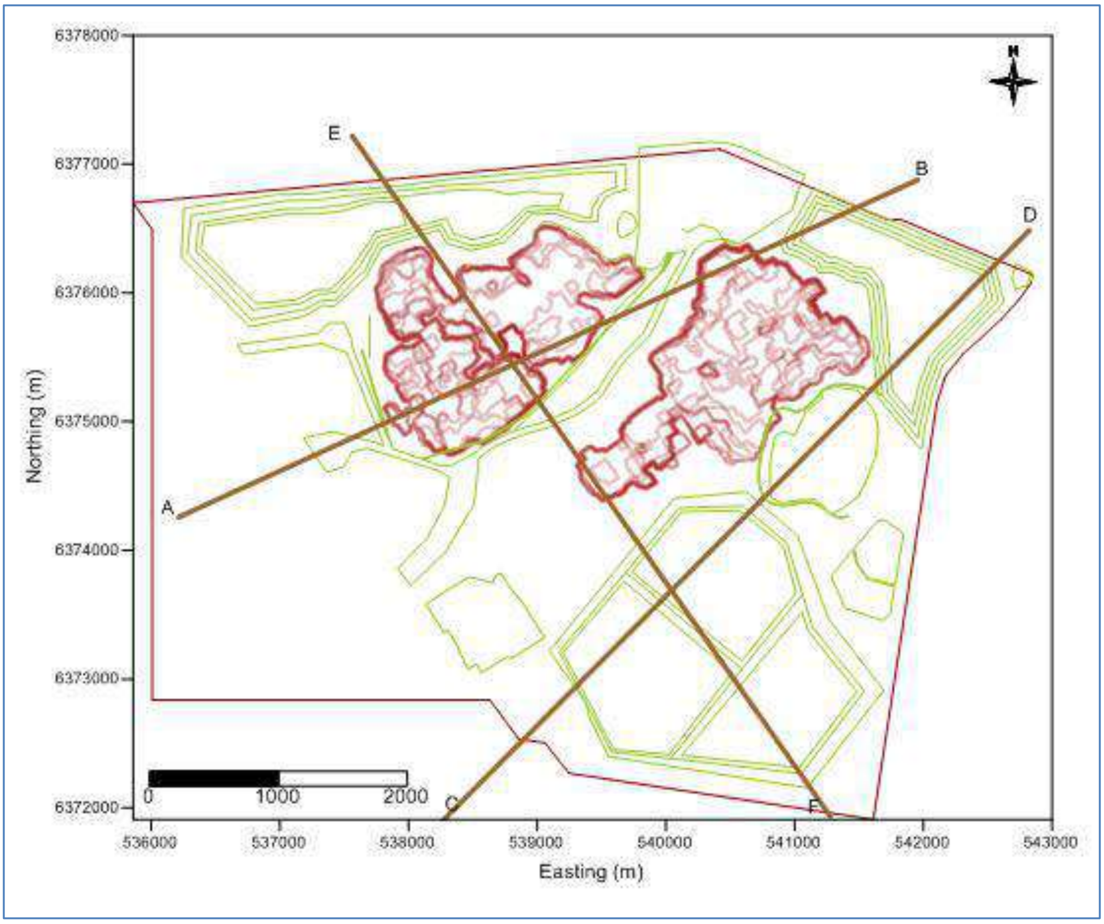


Figure 28: Alignments of cross-sectional groundwater models

8.1.1.1 Hydrogeological conceptual model and calibration

The layering of the models is based on the subsurface conditions interpreted from the results of site investigations (Golder, 2000a, 2000g) and recent hydraulic testing (Golder, 2016, 2017). Four distinct hydrogeological formations were identified across the project area and summary of conceptual hydrogeological units are shown in Table 23. The values for hydraulic conductivity are based on field data obtained from hydraulic testing and calibration to observed groundwater levels. The TSF and water storage dam are modelled as having a low permeability liner.

Table 23: Summary of model hydrogeological units

Layer	Description	Approximate Thickness (m)	Saturated Hydraulic Conductivity K (m/s)[1]
Layer 1	Alluvial soil, mainly sand	3	3.2×10^{-06}
Layer 2	Highly weathered rock	11	1.0×10^{-06}
Layer 3	Slightly weathered rock	13	1.0×10^{-07}
Layer 4	Basement fresh rock	>100	9.0×10^{-09}

The model hydraulic conductivities adopted for tailings is 1×10^{-7} m/s and for the liners (for the base of the TSF and base of the WSD) is 1×10^{-9} m/s.

8.1.1.2 Model boundary conditions

Boundary conditions applied in the models are:

- Constant head boundaries at the right and left hand extremities of the model
- The constant head values defined for these boundaries are based on groundwater contours generated by groundwater level measurements from Dec-2016 and June-2017 and are assumed to be sufficiently distant as to not significantly influence groundwater behaviour near key features (mine pits, TSF and water storage dam)
- A constant head boundary at the final elevation of the water storage dam
- Minimal rainfall recharge (0.01%) applied along the ground surface of the model
- The tailings in the TSF are initially fully saturated.

The hydrogeology, extent and boundary conditions of the three cross-sectional models are presented in Figure 29, Figure 30 and Figure 31.

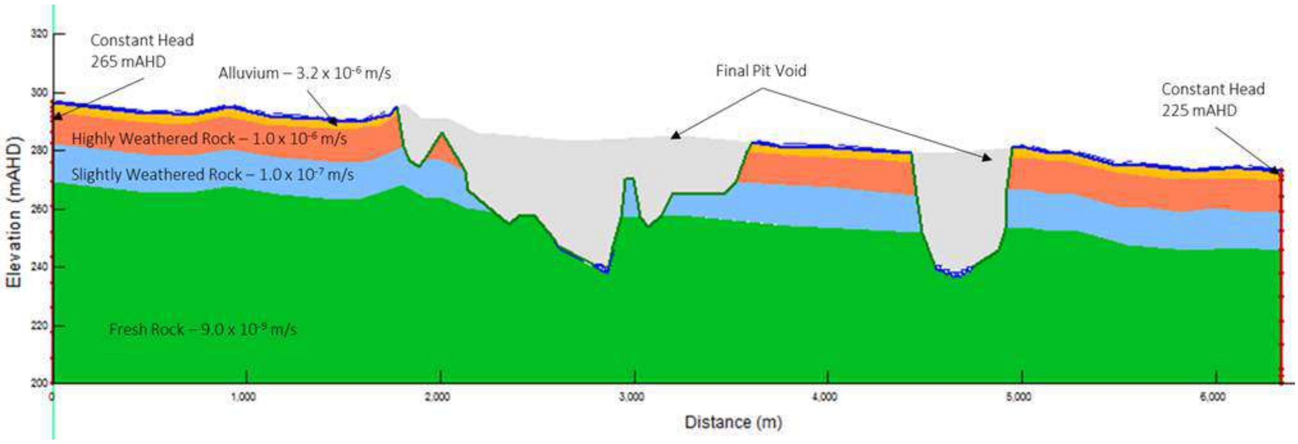


Figure 29: Section AB - Conceptual model showing associated hydraulic conductivity values

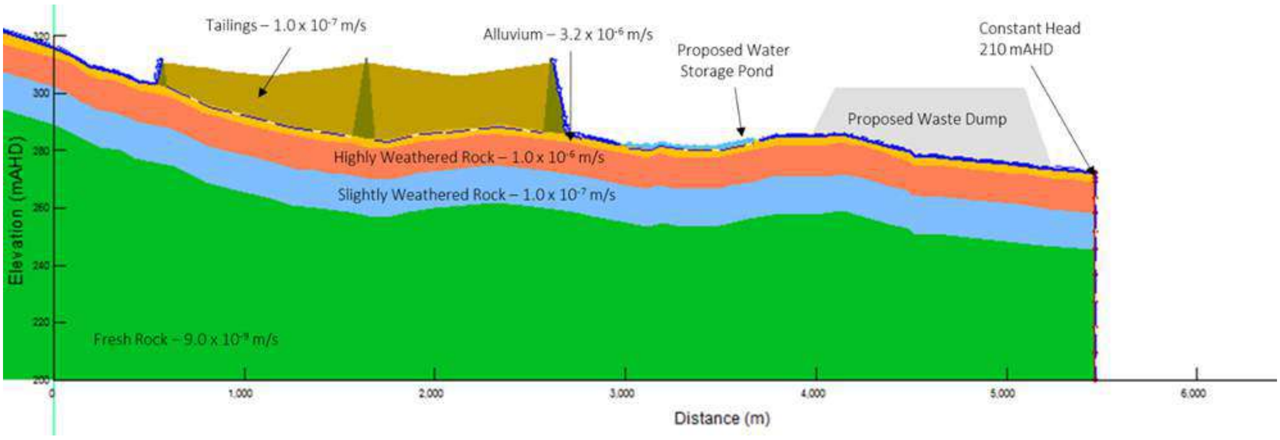


Figure 30: Section CD - Conceptual model showing associated hydraulic conductivity values

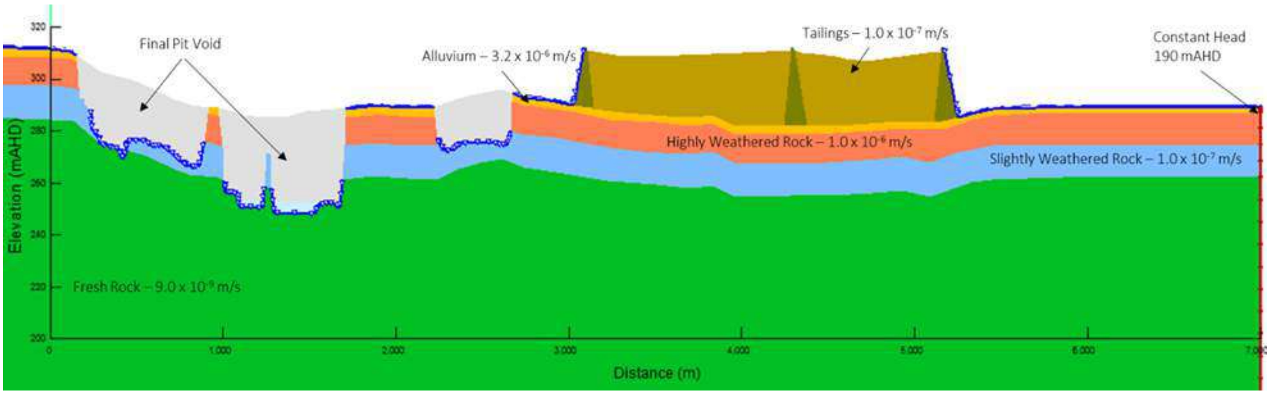


Figure 31: Section EF - Conceptual model showing associated hydraulic conductivity values

8.1.1.3 Groundwater flow simulation scenarios

Each cross-sectional model has been used to simulate groundwater flow behaviour for two scenarios:

- Base Case – each model is run using the calibrated hydraulic conductivities (Table 23)
- Sensitivity Case – each model is run with increased hydraulic conductivity (half order of magnitude).

8.1.2 Groundwater inflows to mine pits (aquifer take)

The mine pit through which the AB cross-sectional model is aligned has the potential to intersect groundwater at the maximum proposed depth of this pit (all other mine pits are not predicted to intersect groundwater). Groundwater entering this pit will be removed from the pit and therefore represents water taken from the aquifer. Estimates of potential groundwater inflows for the Base Case and Sensitivity Case are presented in Table 24. Long-term groundwater inflow to the pit is estimated to be less than 0.002 L/s (for both Base and Sensitivity Cases).

Table 24: Predicted groundwater inflows to mine pits - Section AB

Year	Annual Inflow - Base Case ML/Year	Annual Inflow - Sensitivity Case ML/Year
1	0.071	0.153
2	0.058	0.113
3	0.052	0.098
4 (onwards)	0.046	0.084

8.1.3 Drawdown

Interception of groundwater by the deepest area of the mine pit means there is the potential for a drawdown in the groundwater levels to occur in the vicinity of the interception. The extent of drawdown is estimated using cross-section model AB. The estimated maximum extent of groundwater drawdown of 1 m after 20 years (assuming no backfilling of pits occurs) is shown in Figure 32 and is estimated not to extend beyond the mine site boundaries.

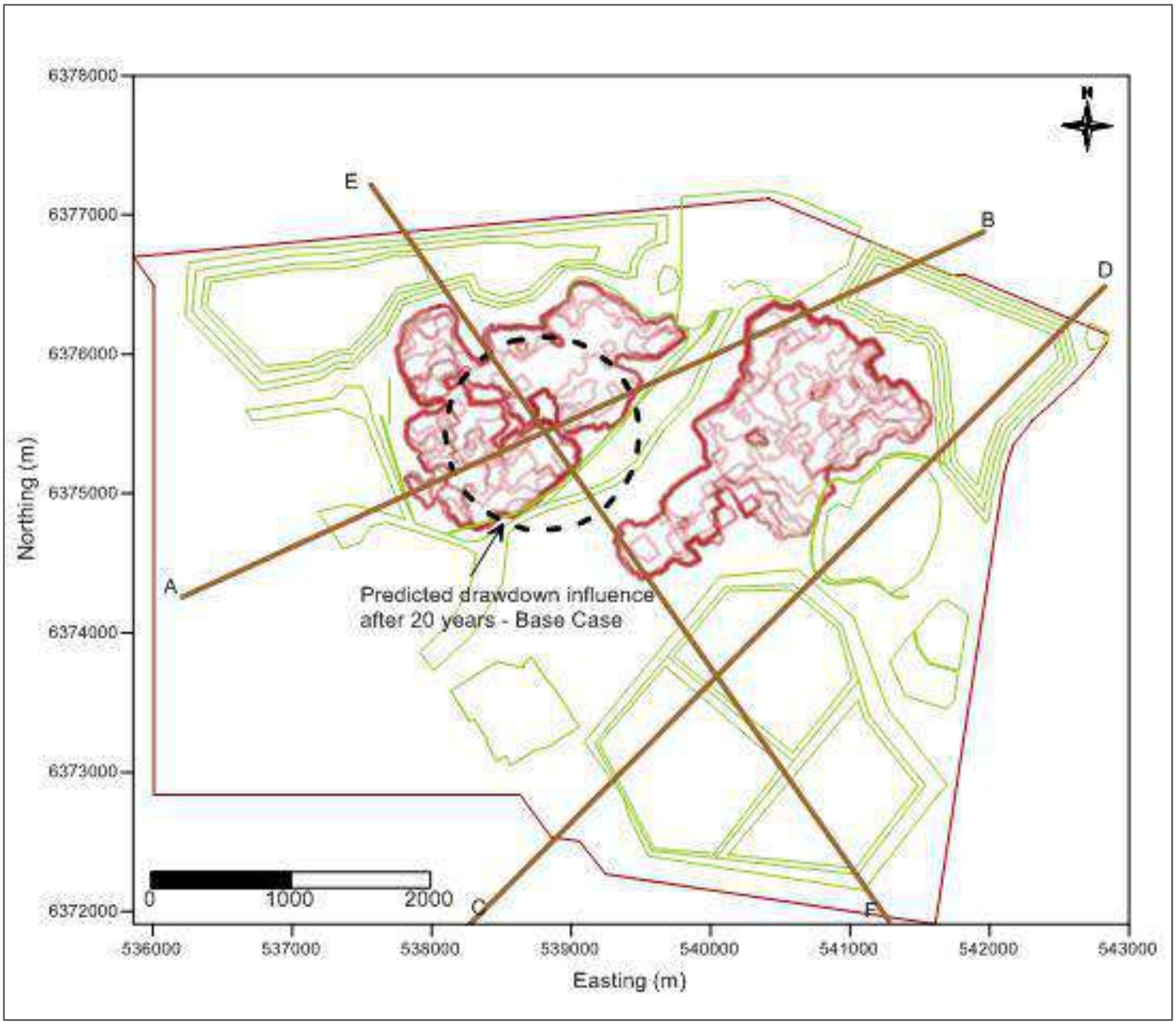


Figure 32: Estimated 1 m drawdown extent after 20 years - Base Case

8.1.4 Seepage

Potential seepage rates (flows) from the storage dam and the TSF into the underlying groundwater system were estimated using cross-sectional models CD and EF respectively.

The TSF and the WSD are modelled as including a lined base with a hydraulic conductivity of 1 x 10^{-9} m/s. This will be a clay liner for the TSF and a HDPE liner for the WSD. The estimated seepage rates from the WSD for Base and Sensitivity Cases are presented in Table 25. The estimated seepage rates from the TSF for Base and Sensitivity Cases are presented in Table 26.

Long-term seepage rates are estimated to be less than 2.4 L/s (Base Case) for the TSF and less than 0.1 L/s (Base Case) for the water storage dam. Initial instantaneous seepage rates appear high due to the simplification of tailings deposition rates used in the model, as described in Section 8.1.1.

Groundwater mounding can be expected to develop below the TSF and water storage dam due to the low permeability of the underlying ground, with slow migration away from the footprints of the TSF and water storage dam. The cross-sectional model EF (Base Case) estimates that no change in groundwater flow rates across the site boundaries occurs during the first 20 years. The cross-sectional model CD (Base Case) estimates that groundwater flow rates across the site boundaries may increase by <1% during the first 20 years.

Table 25: Estimated Water Storage Dam seepage rates - Section CD

Time (Years)	Total Seepage Storage Dam Base Case		Total Seepage Storage Dam Sensitivity Case 1	
	m^3/day	L/s	m^3/day	L/s
0.7	1.5	0.01	1.9	0.02
1.8	1.6	0.02	23.2	0.3
3.9	12.9	0.2	316.3	3.7
6.3	304.8	3.5	74.0	0.9
7.6	110.8	1.3	47.7	0.6
12.3	30.5	0.4	40.2	0.5
20.0	12.8	0.1	20.0	0.2

Table 26: Estimated TSF seepage rates - Section EF

Time (Years)	Total Seepage TSF - Base Case		Total Seepage TSF - Sensitivity Case 1	
	m^3/day	L/s	m^3/day	L/s
0.2	4 436	51	88 504	1 024
0.3	19 015	220	21 982	254
0.7	2 857	33	1 570	18
1.8	493	5.7	910	11
4.7	288	3.3	742	8.6
7.6	269	3.1	622	7.2
12.3	243	2.8	508	5.9
20.0	207	2.4	397	4.6

8.1.5 Mitigation measures

The proposed control measures for the TSF include the installation of underdrainage and a seepage interception drain at the downstream toe. These drains would intercept any seepage flowing horizontally through the upper layers of the underlying soils. Existing monitoring wells are to be used as sentinel wells.

8.2 Potential groundwater quality impacts

8.2.1 Groundwater Dependent Ecosystems (GDE)

Groundwater Dependent Ecosystems (GDE) are defined as ecosystems whose ecological processes and biodiversity are wholly, or partially, reliant on groundwater. Information on potential groundwater dependent ecosystems at the mine site has been extracted from the National Atlas of Groundwater Dependent Ecosystems (Bureau of Meteorology). Based on information from this atlas, there are no identified aquatic GDEs at the mine site, and only a low potential vegetation (terrestrial) GDE in the vicinity of the mine site (Figure 33).

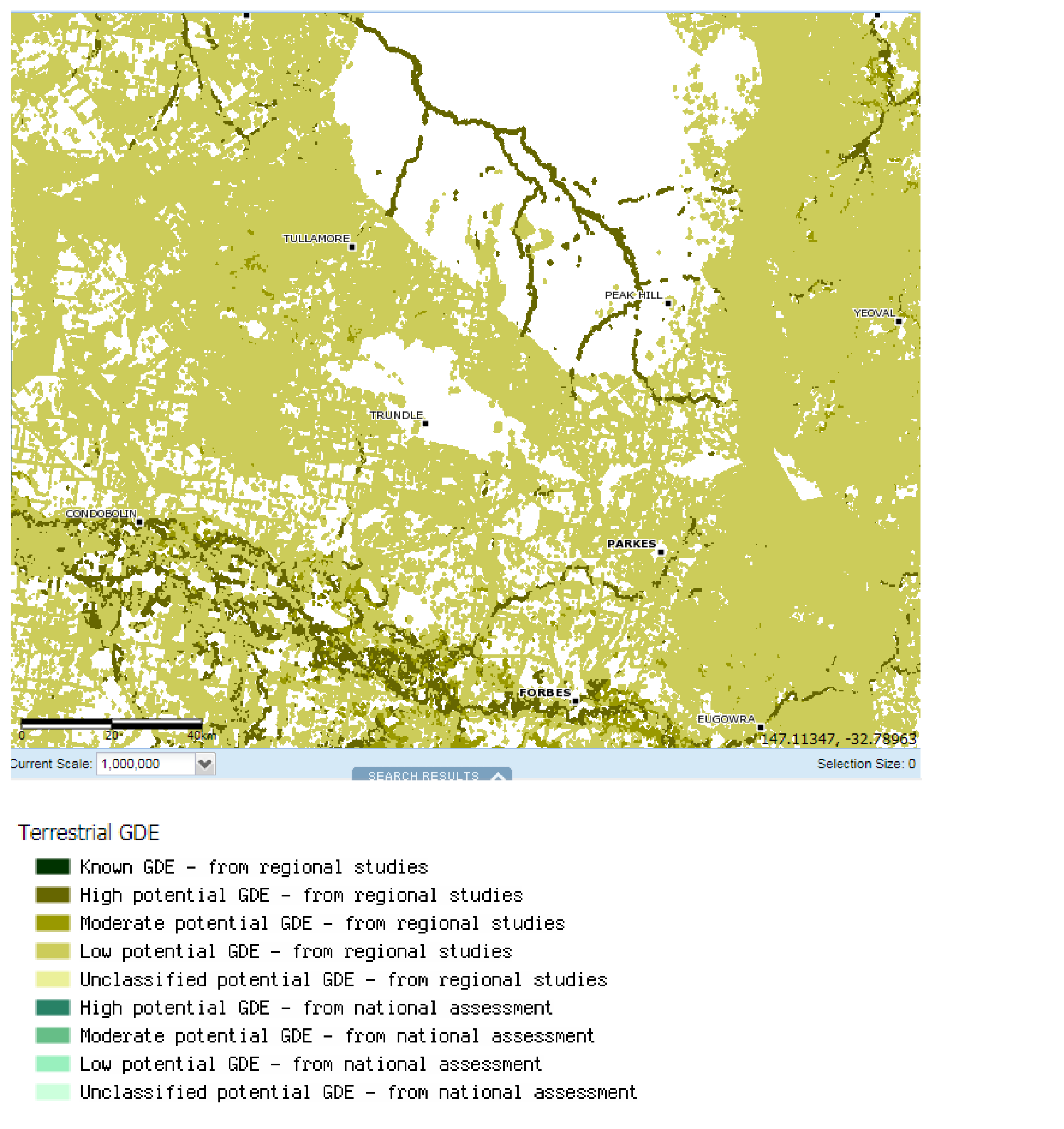


Figure 33: Terrestrial GDE (BOM)

The potential for seepage from the TSF and water storage dam is constrained by the low permeability of the underlying and adjacent soil and rock, with estimated total groundwater flow velocities across the model boundary (Base Case) being of the order of 0.1 m/year. These low flow velocities retard the migration of seepage and are estimated to have no significant water quality impact on the low potential GDE.

8.2.2 Other groundwater quality impacts

The estimated distance of saline migration beyond the site boundary is based on long term seepage rates and changes in horizontal flow velocities estimated by the numerical model. After commencing operations, saline migration is estimated to extend up to 400 m from the site boundaries (following general groundwater flow directions across the site). Extent of the seepage front may increase where the rock permeability is higher or where fractures occur. As groundwater quality is brackish in the vicinity of the TSF, and seepage is constrained by the low permeability of the underlying and adjacent soil and rock, the impact to groundwater quality is estimated to be very low. As the nearest downgradient registered groundwater user is approximately 2.8 km from the site, modelling results estimate that there would be no groundwater quality impacts on groundwater users.

Monitoring of groundwater quality downgradient of the TSF is recommended (as discussed in Section 10.2).

8.2.3 Mitigation measures

The proposed control measures for the TSF include the installation of underdrainage and a seepage interception drain at the downstream toe. These drains would intercept any seepage flowing horizontally through the upper layers of the underlying soils. Existing monitoring wells will be used as sentinel wells.

9.0 POST CLOSURE WATER MANAGEMENT CONCEPTS

The objective of mine closure management will be to ensure, where possible, that rehabilitation achieves a safe, stable and functioning landform which is consistent with the surrounding landscape and post-closure mining activities.

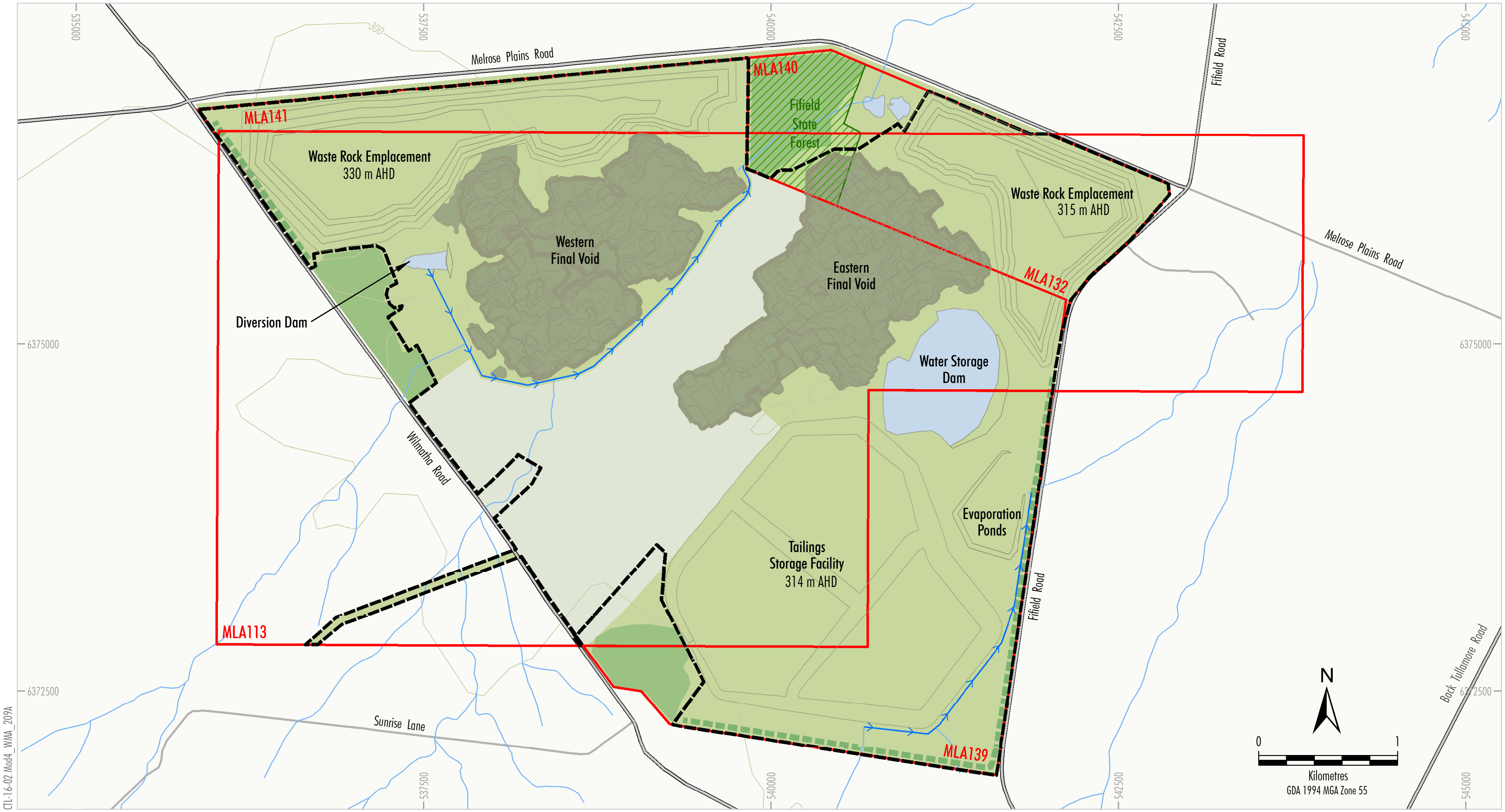
The following concepts have been developed for the water management infrastructure at closure and are illustrated in Figure 34.

The TSF will be progressively rehabilitated during operations with final rehabilitation completed at closure. The TSF surface will be profiled, covered, topsoiled and vegetated to provide a stable land surface that sheds runoff and maintains a vegetated cover. The WSD will remain in place as a water storage resource for post-mining activities.

Evaporation and sediment ponds will be removed and the landform re-profiled and revegetated. Where possible the final landform will be consistent with pre-mining landform and aim to maintain watershed boundaries consistent with the pre-mining watershed.

The clean water diversion channel will be left in place and riparian zone revegetated.

The Modification would not significantly change the rehabilitation strategy for infrastructure, waste rock emplacements, final voids or mine water infrastructure.



LEGEND
- Mining Lease Application Boundary
- Approved Surface Development Area
- Void
- Rehabilitated/Revegetated Endemic Woodland
- Rehabilitated/Revegetated Pasture
- Water Storage
- Existing Open Woodland to be Maintained
- State Forest
- Vegetation Screening
- Diversion Structure

Source: Black Range Minerals (2000); NSW Department of Industry (2017); NSW Land & Property Information (2017)

CLEAN TEQ
Powering innovation

SYERSTON PROJECT MODIFICATION 4

Modified Mine and Processing Facility Conceptual Final Landform and Land Uses

Figure 34

10.0 SURFACE WATER AND GROUNDWATER MONITORING PLAN

10.1 Surface water

The environmental management and monitoring program proposed for the mine (including processing facility) is provided in the Syerston Nickel Cobalt Project EIS (Resource Strategies, 2000). Changes in the water management system as a result of the Modification 4 will not change the surface water monitoring requirement.

In summary, upon completion of construction and commissioning of water management infrastructure, Clean TeQ will monitor the following aspects of the water management system:

- Mine water storage and raw water dam levels and volumes (stored and freeboard), including development of storage curves
- Mine pit inflows/dewatering (where measurable from pumping records)
- Metered water quantity from the borefield and/or surface water extraction
- Potable water supply
- Dust suppression water demands
- Processing water inputs and outputs including:
  - feed tonnage and moisture contents
  - product tonnages and moisture contents
  - tailings tonnages and solid:water ratios
  - deposited tailings *in situ* moisture contents (including determining TSF return water efficiencies)
- Any discharges (volume, rate and quality) licensed by an EPL.

The appropriate monitoring frequencies and methods will be determined by Clean TeQ as required.

10.2 Groundwater

The groundwater monitoring bores listed in Table 17 form a groundwater monitoring network that can be utilised throughout the life and after closure of Syerston as an active mining operation to monitor potential impacts of the TSF, water storage dam and mine pits. Some existing monitoring bores may be destroyed due to mining activities and additional monitoring bores will be installed to meet any changes in operational monitoring requirements.

Baseline groundwater level and quality data has already been collected.

Groundwater levels would be monitored continuously using automatic data loggers with the data to be downloaded and reviewed on a quarterly basis.

Groundwater samples would be collected quarterly for the first two years of operation and analysed for a suite of parameters (EC, pH, major cations, major anions, selected metals and total dissolved solids). Thereafter, and depending on measured variability, sampling would be reduced to annually.

Groundwater inflow rates into the open pits would also be monitored.

Groundwater monitoring at the borefields would be conducted in accordance with the requirements of the WAL and relevant management plan.

11.0 IMPORTANT INFORMATION

Your attention is drawn to the document titled - “Important Information Relating to this Report”, which is included in Appendix C 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 Important Information document does not alter the obligations Golder Associates has under the contract between it and its client.

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Report Signature Page

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APPENDIX A

Maximum Harvestable Right Dam Calculator Result

NSW GOVERNMENT | Department of Primary Industries Office of Water

Maximum Harvestable Right Dam Capacity

Information provided by the user

1. The location of the proposed dam is:

- Latitude: **-32.754679**
- Longitude: **147.409186**

2. Total property area to use for calculating the size of the dam is **1901.02 Hectares**

Result

The maximum Harvestable right dam capacity for your property is **104.5561** ML (Megalitres)

Date

18/10/2017

Name

Sarah Duarte

Limitations of the calculator

a) Where to site a dam

You can only construct a harvestable rights dam where the Harvestable Rights Orders apply, refer to NSW Government Gazette 40 dated 31 March 2006 (pages 1628 to 1631).

b) First and Second order streams

The maximum harvestable right calculator does not verify that the location of the proposed dam sits on a first or second order stream. A factsheet : "Where can they be built without a licence?" is available on the DPI Water website to help you work out the stream orders.

You will need to use the legislated topographic map for your area to identify the stream order. This map is the gazetted map as per NSW Government Gazette 57 dated 23 March 2001 (pages 1481-1489).

c) Size of property and dam

The calculator does not take into account other dams already on your property. If you have existing harvestable rights dams on your property, you must take the capacity of these dams into account when constructing a new dam. In the Eastern and Central Divisions other dams must also be taken into account, as described in the NSW Government Gazette 40 dated 31 March 2006 (pages 1628 to 1631).

d) Protected wetlands

The Harvestable Rights Orders specify that you are not allowed to build a dam on or within 3 km of a RAMSAR wetland site. There are 12 RAMSAR wetlands in NSW. Further information on the location of those 12 RAMSAR sites in NSW can be found on the NSW Environment and Heritage government website.

APPENDIX B

Lachlan River Water Quality

Table A1 - Syerston Water Quality - Groundwater and Surface Water Data - November 1999 and August 2017

Analytes	Units	Laboratory Limit of Reporting (LOR)	Drinking Water Guideline [A] (Health)	Aesthetic Water Guideline [A]	ANZECC 95% Protection for Freshwater Ecosystems [B]	Syerston Bore Groundwater	Surface Water Lachlan River	Surface Water Lachlan River
						15/08/2017	15/08/2017	27/11/1999
						ISPB01	LR1	RIVER
Physiochemical Parameters								
pH (field)	pH unit	0.01		6.5 to 8.5	6.5 to 8.0[1]	7.1	7.2	8
Turbidity (field)	NTU	0.1				4.2	53	22
Electrical Conductivity (field)	µS/cm	1			30 to 350[2]	1238	469	
Electrical Conductivity (lab)	µS/cm	1			30 to 350[2]	1350	484	
Total Dissolved Solids (lab)	mg/L	10	*	600		669	262	200
Total Suspended Solids (lab)	mg/L	1				8	94	35
Chemical Oxygen Demand	mg/L	10				<10	22	19
Biochemical Oxygen Demand	mg/L	2				<2	3	<2
Specific Gravity		0.01				1	1	
Reactive Silica	mg/L	0.05		80		13.3	8.04	
Total Hardness as CaCO3	mg/L	1				146	130	
Major Cations								
Calcium	mg/L	1				24	24	25
Magnesium	mg/L	1				21	17	19
Potassium	mg/L	1				3	2	2.8
Sodium	mg/L	1	*	180		188	35	23
Major Anions								
Hydroxide Alkalinity as CaCO3	mg/L	1				<1	<1	
Carbonate Alkalinity as CaCO3	mg/L	1				<1	<1	
Bicarbonate Alkalinity as CaCO3	mg/L	1				193	93	120
Total Alkalinity as CaCO3	mg/L	1				193	93	
Chloride	mg/L	1	*	250		235	61	54
Sulphate as SO4	mg/L	1	500	250		52	26	14
Fluoride	mg/L	0.1	1.5			0.5	0.2	0.14
Metals								
Aluminium	mg/L	0.01		0.2	0.055	0.03	1.25	
Arsenic	mg/L	0.001	0.01		0.013	<0.001	0.001	<0.01
Barium	mg/L	0.001	2			0.034	0.044	<0.1
Bismuth	mg/L	0.001			0.7[4]	<0.001	<0.001	
Boron	mg/L	0.05	4		0.37	0.07	<0.05	
Cadmium	mg/L	0.0001	0.002		0.0002[3]	<0.0001	<0.0001	
Chromium	mg/L	0.001			0.0033[4,5]	<0.001	0.002	
Cobalt	mg/L	0.001			0.0014	<0.001	<0.001	
Copper	mg/L	0.001	2	1	0.0014[3]	<0.001	0.003	0.002
Gold	mg/L	0.001				<0.001	<0.001	
Iron	mg/L	0.05		0.3	0.3[4]	0.92	1.92	0.47
Iron Ferric	mg/L	0.05				<0.05	<0.05	
Iron Ferrous	mg/L	0.05				1	0.23	0.43
Lead	mg/L	0.001	0.01		0.0034[3]	<0.001	0.001	<0.001
Lithium	mg/L	0.001				0.006	0.001	
Manganese	mg/L	0.001	0.5	0.1	1.9	0.051	0.07	0.11
Mercury	mg/L	0.0001	0.001		0.0006	<0.0001	<0.0001	
Molybdenum	mg/L	0.001	0.05		0.034[4]	<0.001	<0.001	
Nickel	mg/L	0.001	0.02		0.011	<0.001	0.002	
Selenium	mg/L	0.01	0.01		0.011	<0.01	<0.01	<0.01
Silver	mg/L	0.001	0.1		0.00005	<0.001	<0.001	
Strontium	mg/L	0.001				0.543	0.17	0.18
Titanium	mg/L	0.01				<0.01	<0.01	
Vanadium	mg/L	0.01				<0.01	<0.01	
Yttrium	mg/L	0.001				<0.001	<0.001	
Zinc	mg/L	0.005		3	0.008[3]	<0.005	<0.005	0.005
Zirconium	mg/L	0.005				<0.005	<0.005	
Nutrients								
Ammonia as N	mg/L	0.01		0.5	0.9[6]	0.06	0.04	<0.01
Nitrite as N	mg/L	0.01	3			<0.01	<0.01	
Nitrate as N	mg/L	0.01	50		0.7	<0.01	0.42	0.49
Nitrite + Nitrate as N	mg/L	0.01				<0.01	0.42	
Total Phosphorus as P	mg/L	0.01			0.02[2]	0.06	0.06	0.15

A. National Water Quality Management Strategy. 2011 Australian Drinking Water Guidelines. Version 3.3 updated November 2016.
B. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. 2000.
Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Management Council of Australia and New Zealand (ARMCANZ)
* No health-based value considered necessary
1. Range of values are for NSW upland rivers
2. Default trigger values for upland streams in southeastern Australia (NSW upland rivers EC generally near the high end of this range).
3. Dependent on water hardness
4. Indicative Interim Working Level (IIWL) - low reliability trigger value based on limited data
5. Chromium trigger level listed is for Cr III
6. Ammonia trigger level is pH dependent. Value for pH 8.0 listed.

APPENDIX C

Important Information about this Report

IMPORTANT INFORMATION RELATING TO THIS REPORT

The document ("Report") to which this page is attached and which this page forms a part of, has been issued by Golder Associates Pty Ltd ("Golder") subject to the important limitations and other qualifications set out below.

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CLEAN TEQ
Powering innovation

Syerston Project

MODIFICATION 4 ENVIRONMENTAL ASSESSMENT

Appendix E

Road Transport Assessment

Syerston Project Modification 4
Fifield, NSW
Road Transport Assessment

Client // Clean TeQ Holdings Limited
Office // NSW
Reference // N108040
Date // 10/11/17

Syerston Project Modification 4

Fifield, NSW

Road Transport Assessment

Issue: B 10/11/17

Client: Clean TeQ Holdings Limited
Reference: N108040
GTA Consultants Office: NSW

Quality Record

Issue	Date	Description	Prepared By	Checked By	Approved By	Signed
A	27/10/17	Final	Penny Dalton	Penny Dalton	Penny Dalton	Penny Dalton
B	10/11/17	Final	Penny Dalton	Penny Dalton	Penny Dalton	PDalton

171025rep N108040 Syerston Project Modification 4 (2) (160805 v1.8)

GTAconsultants
Melbourne | Sydney | Brisbane
Canberra | Adelaide | Perth
Gold Coast | Townsville

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1. Introduction

The Syerston Project (the Project) is situated approximately 350 kilometres (km) west-northwest of Sydney, near the village of Fifield, New South Wales (NSW). Scandium21 Pty Ltd owns the rights to develop the Project. Scandium21 Pty Ltd is a wholly owned subsidiary of Clean TeQ Holdings Limited (Clean TeQ). Development Consent DA 374-11-00 for the Project was issued in 2001.

This report has been prepared on behalf of Clean TeQ to present the findings of an assessment of the road transport implications of the proposed modification to Development Consent DA 374-11-00 (Modification 4 or the Modification).

The approved Project includes the establishment and operation of:

- a mine and processing facility (MPF);
- a limestone quarry;
- a rail siding;
- a natural gas pipeline;
- borefields and water pipeline; and
- associated transport and infrastructure.

Construction of the Project substantially commenced in 2006 with the construction of the borefields, however Project operations are yet to commence.

The approved Project involves an Initial Production Phase focussed on scandium oxide production, transitioning to the Full Production Phase of scandium oxide, nickel and cobalt precipitate production when market conditions are favourable. The Initial Production Phase will be a smaller scale operation, with a significantly lower level of activity, and will not include construction of the limestone quarry and rail siding.

The Modification involves the implementation of a number of opportunities to optimise the Full Production Phase of the Project, with some associated amendments to approved transport sources and methods, and no change to the workforce compared with the approved Project.

This study has considered the implications of the modified Project on the operation of the road network.

2. Existing Road Transport Environment

2.1 Site Location

The Project will be located near Fifield, approximately 80 km northwest of Parkes in Central NSW (Figure 2-1). The approved locations of the limestone quarry, rail siding, natural gas pipeline, borefields, water pipeline and associated infrastructure are shown on Figure 2-1.

2.2 Road Network

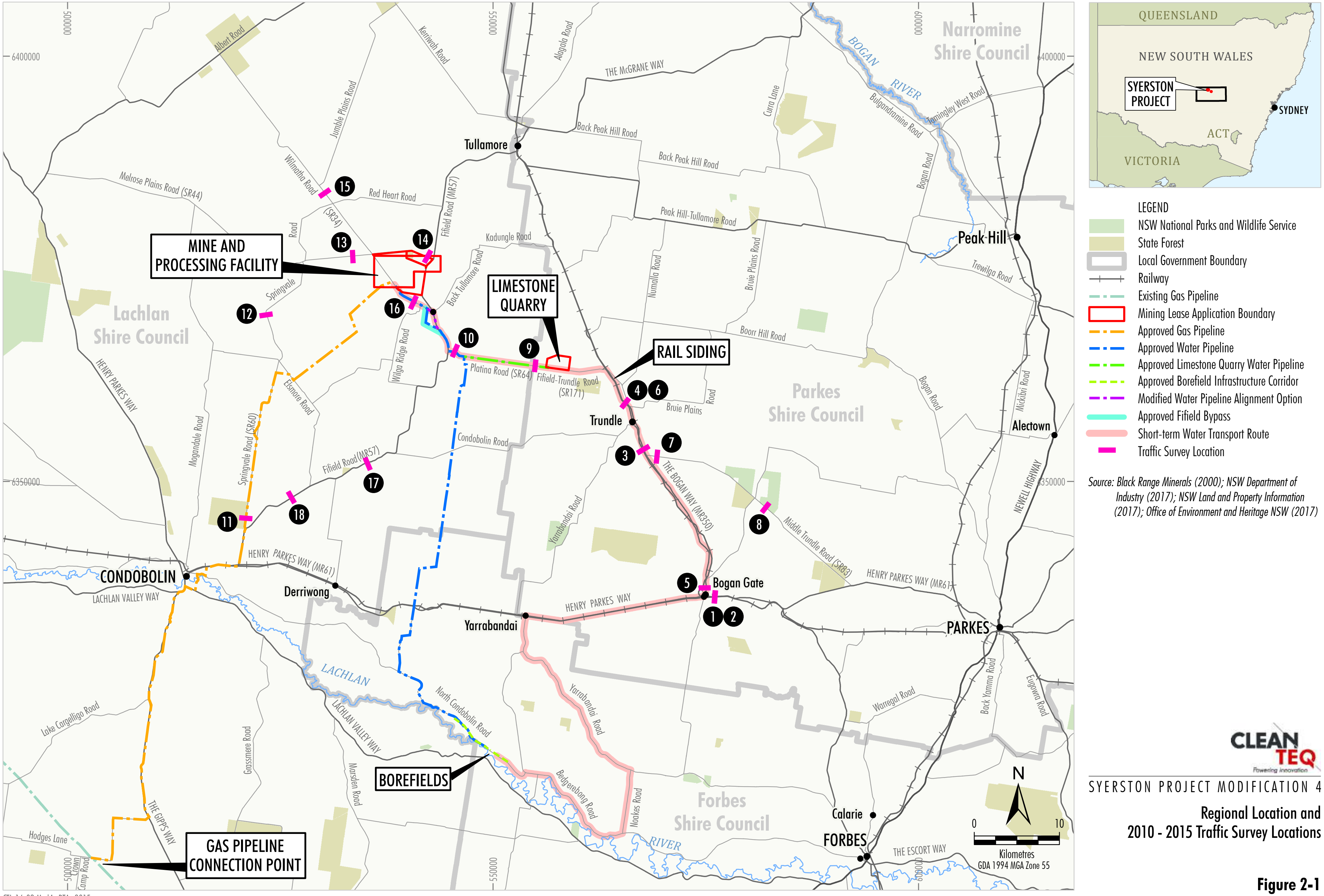
The road system in the region is presented in Figure 2-1 and briefly described below.

Henry Parkes Way (MR61E) forms part of Main Road 61 East, which provides an east-west link between Orange and Condoblin. It connects Parkes and Condobolin through Bogan Gate and Ootha, and is also known as Parkes-Condobolin Road. Henry Parkes Way typically has a single travel lane in each direction with gravel or grassed shoulders, and a speed limit of 100 kilometres per hour (km/h). Through Bogan Gate, the speed limit is reduced to 50 km/h. It has centre and edge line marking and guidance posts. It is crossed by the Bogan Gate Tottenham Railway at a passive level crossing at Bogan Gate, and by the Parkes Narromine Railway at an active level crossing approximately 5 km west of Parkes.

The Bogan Way (MR350) is a Regional Road and forms part of Main Road 350, which extends from the Newell Highway at Forbes to Henry Parkes Way near Bogan Gate thence via Trundle and Kadungle to the Peak Hill-Tullamore Road (MR348) near Tullamore. The Bogan Way has a two lane sealed carriageway, with centre line marking and guidance posts. The road shoulder is unpaved and varies in width from 0 to 2 metres (m), with no edge line marking. The speed limit is generally 100 km/h, and 50 km/h through Trundle and at the southern end in Bogan Gate. There is a 40 km/h school zone at the southern end of Trundle. The Bogan Way is crossed by the Bogan Gate Tottenham Railway at three passive control level crossings between Trundle and Bogan Gate. As a Regional Road, the NSW Roads and Maritime Services (RMS) provides financial assistance to the Parkes Shire Council for its management.

Middle Trundle Road (SR83) runs northwest from Henry Parkes Way approximately midway between Parkes and Bogan Gate to The Bogan Way approximately 4 km south of Trundle. It is also known as Shire Road 83. The route between Parkes and Trundle along Middle Trundle Road is some 10 km shorter than via Bogan Gate. The intersections at each end of Middle Trundle Road are basic rural road T-intersections, without auxiliary lane treatments or channelisation. Condition 43, Schedule 3 of Development Consent DA 374-11-00 requires Clean TeQ to upgrade the intersection of Henry Parkes Way and Middle Trundle Road prior to commissioning of the MPF. The intersection of Middle Trundle Road with The Bogan Way was constructed in 2013 and has some turning path deficiences relating to B-doubles and B-triples, but is deemed suitable due to low volumes (Crossroads Civil Design, 2014). A central portion of Middle Trundle Road approximately 16 km long remains unsealed.

The McGrane Way (MR354) is a Regional road which extends from the Nyngan-Condobolin Road (MR57) at Tullamore to the Tomingley-Narromine Road (MR89) at Narromine. It is typically a sealed road with a speed limit of 100 km/h, a single travel lane in each direction and centre and edge line marking.



CLEAN TEQ

SYERSTON PROJECT MODIFICATION 4

Regional Location and 2010 - 2015 Traffic Survey Locations

Figure 2-1

CTL-16-02 Mod4_RTA_201E

Fifield Road (MR57N) is a Regional Road also known as Main Road 57 North, which runs northwards from Henry Parkes Way approximately 6 km east of Condobolin, through Fifield to Tullamore. In Fifield, it is known as **Slee Street**. It is crossed by the Parkes Narromine Railway just to the north of its intersection with Henry Parkes Way at an active level crossing, and by the Bogan Gate Tottenham Railway at a passive level crossing at Tullamore. It is a two lane sealed road with centre line marking. The speed limit on Fifield Road is typically 100 km/h, and reduced to 50 km/h at Fifield. This portion of MR57 is a Regional Road, thus RMS provides financial assistance to the Lachlan Shire Council for its management.

Fifield-Trundle Road (SR171)/Platina Road (SR64) is also known as Shire Road 171/Shire Road 64, and extends west from The Bogan Way approximately 6 km north of Trundle to Fifeld Road approximately 5 km south of Fifield. The section of road in the Parkes Shire is Fifield-Trundle Road and the section of road in the Lachlan Shire is Platina Road. Fifield-Trundle Road typically has a 6.5 m wide formation with 6.0 m wide seal. Platina Road typically has a sealed surface approximately 4 m wide, with 1 m gravel shoulders. There is limited line marking. The intersections at the ends of Fifield-Trundle Road and Platina Road are basic rural T-intersections, without auxiliary lane treatments or channelisation.

Wilmatha Road (SR34), also known as Shire Road 34, runs northwest from Fifield past the MPF site, and crosses Melrose Plains Road at the northwestern boundary of the MPF. It has an unsealed surface approximately 8 to 12 m wide and a speed limit of 100 km/h. The MPF access road will intersect with Wilmatha Road at an Austroads Type C intersection.

Melrose Plains Road (SR44) runs east-west along the northern boundary of the MPF and is also known as Shire Road 44. It intersects with Fifield Road northeast of the MPF at a four way intersection. At the northwestern boundary of the MPF, Melrose Plains Road intersects with Wilmatha Road (Shire Road 34) at a four way intersection, and farther to the west, it intersects with Springvale Road (Shire Road 60) at two offset T-intersections, at which Melrose Plains Road traffic has priority. Melrose Plains Road is unsealed, and approximately 8 to 12 m wide, through flat terrain and has a speed limit of 100 km/h.

Springvale Road (SR60), or Shire Road 60, extends in a northerly direction from Fifield Road north of Henry Parkes Way, crossing Melrose Plains Road some 8 km west of the MPF. It has a speed limit of 100 km/h, and follows a generally straight alignment through flat terrain. It is a sealed road approximately 6 m wide with limited line marking.

Yarrabandai Road provides a link between The Bogan Way northwest of Forbes and The Bogan Way at Trundle, crossing Henry Parkes Way at staggered T-intersections approximately 22 km west of Bogan Gate. Approximately 24 km south of Henry Parkes Way, Yarrabandai Road intersects with **Noakes Road** which provides a 7 km long link to **Bedgerabong Road** at Bedgerabong. Approximately 15 km west of Bedgerabong, Bedgerabong intersects with **North Condobolin Road**, which is the access road for the Project borefields. South of Henry Parkes Way, this route is typically constructed with a narrow sealed surface.

2.3 Heavy Vehicle Routes

The RMS website provides information on the enforceable network for all Restricted Access Vehicles (RAV) operating at General Mass Limits and Concessional Mass Limits. An interactive map provides the following information about use of the roads in the vicinity of the Project by heavy vehicles:

- Lachlan Shire is an approved area for road trains and B-doubles.
- Lachlan Shire, Parkes Shire and Forbes Shire are approved areas for travel by vehicles up to 4.6 m high.
- Road trains and B-doubles up to 25 m long are permitted without specific conditions on Henry Parkes Way and Fifield Road.
- B-doubles up to 25 m long are permitted on The Bogan Way, and road trains are permitted at a maximum speed of 80 km/h.
- Road trains and B-doubles up to 25 m long are permitted on Middle Trundle Road at a maximum of 80 km/h, with some additional conditions as follows:
    - No road train access between sunset and sunrise.
    - No road train travel permitted between 7.30am and 9.00am, and between 3.00pm and 4.30pm on school days.
    - No B-double travel permitted between Henry Parkes Way and Five Chain Lane between 7.30am and 9.00am, and between 3.00pm and 4.30pm on school days.
    - During periods of wet weather, Parkes Shire Council is to be consulted regarding possible road closures.
    - Road trains and B-doubles are permitted on The McGrane Way at a maximum of 80 km/h within Parkes Shire.

2.4 Historic Traffic Conditions

Traffic survey data has been collated from data available from Lachlan Shire Council and Parkes Shire Council, covering data collected since 2010 on roads of relevance to the Project. It is noted that Parkes Shire Council provided GTA Consultants with additional data from early 2016 on Middle Trundle Road and The Bogan Way (Sites 3, 7 and 8 in Figure 2-1). Due to inconsistencies between the counting methods used for these and earlier surveys, the possible impacts of road works during the surveys, and in consultation with Parkes Shire Council, the results of these later surveys have not been relied upon for this assessment.

Table 2.4 summarises average daily traffic volumes on routes in the Project region, which includes the average over all surveyed days at each location. The locations of the traffic count sites are shown on Figure 2-1.

Table 2.1: Daily Traffic Volumes 2010 to 2015 (vehicles per day)

Site[A]	Road	Location	Date	Average Daily Traffic
1	Henry Parkes Way	East of Bogan Gate	Dec 2014	986
2	Henry Parkes Way	East of Bogan Gate	Nov 2014	1,024
3	The Bogan Way	North of Middle Trundle Road	Aug 2015	376
4	The Bogan Way	North of Trundle (South of Numulla Road)	Dec 2014	506
5	The Bogan Way	North of Henry Parkes Way	Nov 2014	467
6	The Bogan Way	North of Trundle	Oct 2014	479
7	Middle Trundle Road	East of The Bogan Way	Oct 2014	98
8	Middle Trundle Road	13 km Northwest of Henry Parkes Way	Sep 2014	93
9	Fifield-Trundle Road	At Parkes Shire Boundary	Sep-Nov 2015	85
10	Platina Road	East of Fifield Road	Jul 2010	54
11	Springvale Road	300 m North of Fifield Road	Jul 2010	26
12	Springvale Road	27 km North of Fifield Road	Feb-Mar 2014	21
13	Melrose Plains Road	2 km West of Wilmatha Road	Dec 2010-Jan 2011	21
14	Melrose Plains Road	West of Fifield Road	May-Jun 2010	8
15	Wilmatha Road	North of Red Heart Road	Dec 2010-Jan 2011	17
16	Wilmatha Road	West of Wilga Ridge Road	Nov 2010	26
17	Fifield Road	22 km North of Henry Parkes Way	May-Jun 2013	123
18	Fifield Road	North of Raynella Road	Feb-Apr 2014	234

Data source: Lachlan Shire Council and Parkes Shire Council.
[A] Refer to Figure 2-1.

Table 2.5 summarises the peak volumes recorded in any one hour over the average weekdays, noting that the data indicates that weekdays are typically busier than weekend days.

Table 2.2: Average Weekday Peak Hourly Traffic Volumes 2010 to 2015 (vehicles per hour)

Site[A]	Road	Location	Date	Peak Hour Start	Peak Hour Volume
1	Henry Parkes Way	East of Bogan Gate	Dec 2014	15:00	88
2	Henry Parkes Way	East of Bogan Gate	Nov 2014	14:00	90
3	The Bogan Way	North of Middle Trundle Road	Aug 2015	15:00	35
4	The Bogan Way	North of Trundle (South of Numulla Road)	Dec 2014	16:00	47
5	The Bogan Way	North of Henry Parkes Way	Nov 2014	14:00	44
6	The Bogan Way	North of Trundle	Oct 2014	9:00	48
7	Middle Trundle Road	East of The Bogan Way	Oct 2014	15:00	11
8	Middle Trundle Road	13 km Northwest of Henry Parkes Way	Sep 2014	16:00	8
9	Fifield-Trundle Road	At Parkes Shire Boundary	Sep-Nov 2015	16:00	7
10	Platina Road	East of Fifield Road	Jul 2010	17:00	6
11	Springvale Road	300 m North of Fifield Road	Jul 2010	17:00	3
12	Springvale Road	27 km North of Fifield Road	Feb-Mar 2014	8:00	3
13	Melrose Plains Road	2 km West of Wilmatha Road	Dec 2010-Jan 2011	13:00	2
14	Melrose Plains Road	West of Fifield Road	May-Jun 2010	10:00	1
15	Wilmatha Road	North of Red Heart Road	Dec 2010-Jan 2011	17:00	2
16	Wilmatha Road	West of Wilga Ridge Road	Nov 2010	11:00	3
17	Fifield Road	22 km North of Henry Parkes Way	May-Jun 2013	16:00	12
18	Fifield Road	North of Raynella Road	Feb-Apr 2014	16:00	19

Data source: Lachlan Shire Council and Parkes Shire Council.
[A] Refer to Figure 2-1.

The data indicates that at most locations, the busiest period occurs in the mid to late afternoon, and that peak hourly volumes are generally low on the relevant roads. Henry Parkes Way is the busiest road, with a peak volume of 90 vehicles per hour, while The Bogan Way carries around 35 to 48 vehicles per hour, and Fifield Road fewer than 20 vehicles per hour.

The traffic volume data provided by Parkes Shire Council and Lachlan Shire Council also provides information on the types of vehicles using each of the routes. Table 2.6 presents the proportions of light and heavy vehicles at each of the surveyed locations. Light vehicles include motorcycles, cars, vans, four wheel drives (4WDs), and utes (including those towing a trailer). Heavy vehicles includes single unit trucks and buses with two to four axles, semi-trailers, rigid trucks with trailers, B-doubles and road trains (where permissible).

Table 2.3: Traffic Composition 2010 to 2015 (percent of total traffic)

Site[A]	Road	Location	Date	Percent Light	Percent Heavy
1	Henry Parkes Way	East of Bogan Gate	Dec 2014	80.0	20.0
2	Henry Parkes Way	East of Bogan Gate	Nov 2014	79.6	20.4
3	The Bogan Way	North of Middle Trundle Road	Aug 2015	85.6	14.4
4	The Bogan Way	North of Trundle (South of Numulla Road)	Dec 2014	83.9	16.1
5	The Bogan Way	North of Henry Parkes Way	Nov 2014	80.0	20.0
6	The Bogan Way	North of Trundle	Oct 2014	67.1	32.9
7	Middle Trundle Road	East of The Bogan Way	Oct 2014	93.2	6.8
8	Middle Trundle Road	13 km Northwest of Henry Parkes Way	Sep 2014	90.9	9.1
9	Fifield-Trundle Road	At Parkes Shire Boundary	Sep-Nov 2015	72.7	27.3
10	Platina Road	East of Fifield Road	Jul 2010	81.3	18.7
11	Springvale Road	300 m North of Fifield Road	Jul 2010	94.3	5.7
12	Springvale Road	27 km North of Fifield Road	Feb-Mar 2014	55.6	44.4
13	Melrose Plains Road	2 km West of Wilmatha Road	Dec 2010-Jan 2011	60.9	39.1
14	Melrose Plains Road	West of Fifield Road	May-Jun 2010	85.6	14.4
15	Wilmatha Road	North of Red Heart Road	Dec 2010-Jan 2011	78.2	21.8
16	Wilmatha Road	West of Wilga Ridge Road	Nov 2010	68.7	31.3
17	Fifield Road	22 km North of Henry Parkes Way	May-Jun 2013	72.3	27.7
18	Fifield Road	North of Raynella Road	Feb-Apr 2014	61.1	38.9

Data source: Lachlan Shire Council and Parkes Shire Council.
Note totals may not add to 100% due to rounding.
[A] Refer to Figure 2-1.

Table 2.6 demonstrates that the proportional contribution of heavy vehicles to total traffic varies significantly on the surveyed roads, and even along a single road. The lowest recorded proportion of heavy vehicles occurred on Springvale Road 300 m north of Fifield Road (5.7 percent [%]) and the highest proportion also occurred on Springvale Road, 27 km north of Fifield Road (44.4% of total traffic). It is noted however that where background traffic volumes were low, small variations in the number of heavy vehicles on an average day can result in erratic results when considering the contribution of heavy vehicles to the total traffic.

2.5 Traffic Surveys

The traffic data from Lachlan Shire Council and Parkes Shire Council has been supplemented with data collected at locations specific to the Project during November 2016:

- Fifield Road between Tullamore and Fifield;
- Slee Street in Fifield;
- Melrose Plains Road east of Wilmatha Road;
- Wilmatha Road south of Melrose Plains Road; and
- The McGrane Way north of Back Peak Hill Road.

Over the November 2016 survey period, Newell Highway was closed between Forbes and West Wyalong due to flooding, with the small possibility that travel patterns in the Fifield region may be atypical. The advertised diversion suggested a route farther to the south and west, via Temora, Stockinbingal, Young, and Cowra, so impacts within the Fifield region were likely to be low.

The original one week survey period was however extended to include several days after the reopening of Newell Highway on 11 November, so that any impact of the road closure could be determined. Review of the data however indicates that there was no significant difference between volumes during and after the closure, thus the results of the full survey period have been included in this assessment.

Ongoing surveys have also been undertaken during 2017 at the following locations relevant to the Project (Figure 2-1):

- The Bogan Way between Trundle and Fifield-Trundle Road;
- The Bogan Way between Bogan Gate and Middle Trundle Road;
- Middle Trundle Road between The Bogan Way and Henry Parkes Way;
- Platina Road/Fifield-Trundle Road between The Bogan Way and Fifield Road;
- Fifield Road between Slee Street and Platina Road;
- Fifield Road between Fifield-Trundle Road and Springvale Road;
- Wilmatha Road north of Sunrise Lane; and
- Melrose Plains Road between Fifield Road and Wilmatha Road.

During the ongoing surveys during 2017, roadworks on The Bogan Way south of its intersection with Middle Trundle Road resulted in atypical conditions for a period, with a detour via Middle Trundle Road in place. Some loss of data also occurred due to damage to the tube on The Bogan Way south of Middle Trundle Road. Information collected during those periods has been excluded from the results used in this assessment. The data used covers the first quarter of 2017, i.e. between 1 January and 31 March 2017.

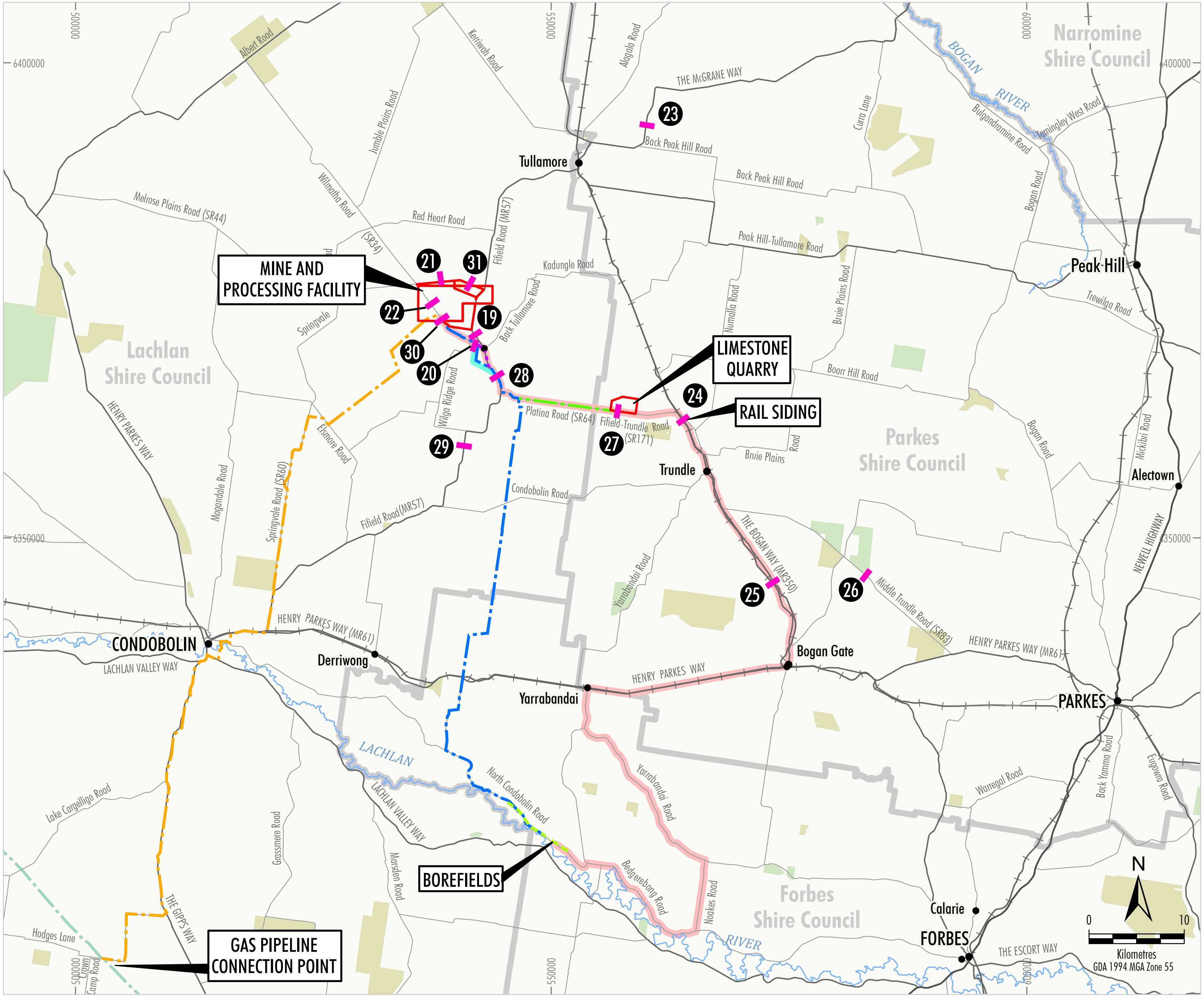
Table 2.4 presents the average daily traffic volumes at the locations surveyed in 2016 and 2017.

Table 2.4: Daily Traffic Volumes 2016 and 2017 (vehicles per day)

Site[A]	Road	Location	Average Daily Traffic
November 2016 Surveys			
19	Fifield Road	Between Tullamore and Fifield	185
20	Slee Street	In Fifield	246
21	Melrose Plains Road	East of Wilmatha Road	13
22	Wilmatha Road	South of Melrose Plains Road	21
23	The McGrane Way	North of Back Peak Hill Road	124
1 January to 31 March 2017 Surveys			
24	The Bogan Way	between Trundle and Fifield-Trundle Road	367
25	The Bogan Way	between Bogan Gate and Middle Trundle Road	388
26	Middle Trundle Road	between The Bogan Way and Henry Parkes Way	118
27	Fifield-Trundle Road	between The Bogan Way and Platina Road	78
28	Fifield Road	between Slee Street and Platina Road	253
29	Fifield Road	between Platina Road and Springvale Road	198
30	Wilmatha Road	North of Sunrise Lane	19
31	Melrose Plains Road	between Fifield Road and Wilmatha Road	11

[A] Refer to Figure 2-2.

Table 2.5 summarises the peak volumes recorded in any one hour over the average weekdays during the 2016 and 2017 surveys, noting that the data indicates that weekdays are busier than weekend days. The 2017 data is based on the last week of March 2017, with the exception of the survey location on The Bogan Way between Bogan Gate and Middle Trundle Road. The volume for that location is from the latest available week during the first quarter of 2017, being 27-31 March.



Source: Black Range Minerals (2000); NSW Department of Industry (2017); NSW Land and Property Information (2017); Office of Environment and Heritage NSW (2017)

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2016 - 2017 Traffic Survey Sites

Figure 2-2

CTL-16-02 Mod4_RTA_202G

Table 2.5: **Average Weekday Peak Hourly Traffic Volumes 2016 and 2017 (vehicles per hour)**

Site [A]	Road	Location	Peak Hour Start	Peak Hour Volume
November 2016 Surveys				
19	Fifield Road	Between Tullamore and Fifield	16:00	21
20	Slee Street	In Fifield	16:00	26
21	Melrose Plains Road	East of Wilmatha Road	various	2
22	Wilmatha Road	South of Melrose Plains Road	various	2
23	The McGrane Way	North of Back Peak Hill Road	15:00	14
1 January to 31 March 2017 Surveys[B]				
24	The Bogan Way	between Trundle and Fifield-Trundle Road	8:00	43
25	The Bogan Way[C]	between Bogan Gate and Middle Trundle Road	8:00	41
26	Middle Trundle Road	between The Bogan Way and Henry Parkes Way	8:00	17
27	Fifield-Trundle Road	between The Bogan Way and Platina Road	8:00	11
28	Fifield Road	between Slee Street and Fifield-Trundle Road	various	28
29	Fifield Road	between Fifield-Trundle Road and Springvale Road	12:00	20
30	Wilmatha Road	North of Sunrise Lane	various	2
31	Melrose Plains Road	between Fifield Road and Wilmatha Road	15:00	4

[A] Refer to Figure 2-2.
[B] Average weekday 27-31 March 2017.
[C] Average weekday 6-10 March 2017.

The data indicates that the busiest period during those surveys occurred at various times of the day, with some being in the morning and others in the mid to late afternoon. The average weekday peak hourly volumes are generally low on the surveyed roads. Of the roads surveyed during 2016 and 2017, The Bogan Way north of Trundle is the busiest road, with a peak volume of 43 vehicles per hour.

Table 2.6 summarises the proportional contribution of heavy vehicles to total traffic during the 2016 and 2017 surveys.

Table 2.6: **Traffic Composition 2016 to 2017 (percent of total traffic)**

Site[A]	Road	Location	Light	Heavy
November 2016 Surveys				
19	Fifield Road	Between Tullamore and Fifield	70.4	9.5
20	Slee Street	In Fifield	71.4	28.5
21	Melrose Plains Road	East of Wilmatha Road	50.6	49.4
22	Wilmatha Road	South of Melrose Plains Road	61.9	38.1
23	The McGrane Way	North of Back Peak Hill Road	75.9	24.1
1 January to 31 March 2017 Surveys				
24	The Bogan Way	between Trundle and Fifield-Trundle Road	80.7	19.3
25	The Bogan Way	between Bogan Gate and Middle Trundle Road	76.0	24.0
26	Middle Trundle Road	between The Bogan Way and Henry Parkes Way	78.0	22.0
27	Fifield-Trundle Road	between The Bogan Way and Platina Road	82.1	17.9
28	Fifield Road	between Slee Street and Fifield-Trundle Road	71.1	28.9
29	Fifield Road	between Fifield-Trundle Road and Springvale Road	64.6	35.4
30	Wilmatha Road	North of Sunrise Lane	84.2	15.8
31	Melrose Plains Road	between Fifield Road and Wilmatha Road	72.7	27.3

[A] Refer to Figure 2-2.
Note: Totals may not add to 100% due to rounding.

During the 2016 and 2017 surveys, the lowest recorded heavy vehicle contribution was on Fifield Road north of Fifield, where 9.5% of total vehicles were heavy vehicles, while the highest recorded contribution was 49.4% of total vehicles on Melrose Plains Road east of Wilmatha Road. As noted previously, the high proportion of heavy vehicles on roads such as Melrose Plains Road should be considered in the context of the total volumes, which are very low.

2.6 Road Safety

Road crash data was obtained from RMS for the most recent five year period available on the main Project access routes. The data covers finalised data for the period from 1 January 2011 to 31 December 2015, and provisional data for the period to 14 November 2016. Data during the provisional period may be incomplete and subject to change, noting that the provisional data includes three crashes in the assessment which follows. The data includes those crashes which conform to the national guidelines for reporting and classifying road vehicle crashes based on the following criteria:

- The crash was reported to the police.
- The crash occurred on a road open to the public.
- The crash involved at least one moving vehicle.
- The crash involved at least one person being killed or injured or at least one motor vehicle being towed away.

Crash data was obtained and reviewed for the following roads:

- Henry Parkes Way (MR61) between Condobolin and Parkes;
- The Bogan Way (MR350) between Bogan Gate and The McGrane Way (MR354) north of Tullamore;
- Fifield Road (MR57 North) between Henry Parkes Way and Tullamore;
- Middle Trundle Road (SR83) between The Bogan Way and Henry Parkes Way;
- Springvale Road (SR60) between Fifield Road and Wilmatha Road;
- Wilmatha Road (SR34) between Fifield and Springvale Road/Red Heart Road;
- Platina Road (SR64)/Fifield-Trundle Road (SR171) between Fifield Road and The Bogan Way;
- Melrose Plains Road (SR44) between Springvale Road and The Bogan Way;
- The McGrane Way (MR354) between The Bogan Way (MR350) north of Tullamore and Narromine; and
- The component of the proposed water transport route south of the Henry Parkes Way (Section 4.5.1) including North Condobolin Road, Bedgerabong Road, Noakes Road and Yarrabandai Road (for the period from 1 January 2012 to 31 March 2017).

Table 2.7 summarises the number and general types of crashes which occurred on the sections of road under consideration.

Table 2.7: Reported General Crash Types on Project Access Routes (January 2011 to November 2016)

Road	Pedestrian	Multiple Vehicles					Single Vehicle			Other
		Adjacent Approaches	Opposing Directions	Same Direction	U-turn/Parking	Overtaking	On Path	Off Path on Straight	Off Path on Curve	
Henry Parkes Way Condobolin to Parkes	-	-	-	-	-	-	4	15[A]	8	1
The Bogan Way Bogan Gate to The McGrane Way	-	1	-	-	-	2	2	6	2	-
Fifield Road Henry Parkes Way to Tullamore	-	-	-	-	-	-	-	2	2	-
Middle Trundle Road The Bogan Way to Henry Parkes Way	-	-	-	-	-	-	1	9[B]	2[B]	-
Springvale Road Fifield Road to Wilmatha Road	-	-	-	-	-	-	-	-	-	-
Wilmatha Road Springvale Road to Fifield Road	-	-	-	-	-	-	-	-	-	-
Platina Road/Fifield-Trundle Road Fifield Road to The Bogan Way	-	-	-	-	-	-	-	-	-	-
Melrose Plains Road Springvale Road to The Bogan Way	-	-	-	-	-	-	-	-	-	-
The McGrane Way Tullamore to Narromine	-	-	-	-	-	-	-	-	-	1[B]
Water Transport Route Henry Parkes Way to Borefields[C]	-	-	-	-	-	-	1	-	-	-
Total Crashes by Type	**-**	**1**	**-**	**-**	**-**	**2**	**8**	**32**	**14**	**2**
Total People Injured	**-**	**1**	**-**	**-**	**-**	**1**	**5**	**17**	**15**	**2**
Total People Killed	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**1**	**1**

[A] Includes two fatal crashes. [B] Includes one fatal crash. [C] Data from 1 January 2012 to 31 March 2017.

Over the five years and routes reviewed, a total of 59 crashes occurred on the main Project access routes, resulting in five fatalities and 41 people being injured. No reported crashes occurred on Springvale Road, Wilmatha Road, Platina Road, Fifield-Trundle Road, or Melrose Plains Road.

Table 2.7 demonstrates that over all the roads investigated, the most common types of crashes involved single vehicles leaving the carriageway, known as run-off-road (ROR) crashes, which made up 79% of the reported crashes in Table 2.7, 80% of people killed, and 78% of injured people. This is consistent with Austroads (2015), which found that in rural road environments in Australia, off-path crashes were the most likely. They were also associated with the greatest numbers of fatalities, which is consistent with the routes investigated here. ARRB (2011) states that known causes of ROR crashes include:

- driver behaviours such as speed, inattention, avoidance manoeuvres, errant vehicles;
- driver impairment including fatigue, alcohol, drugs, mood state;
- road conditions such as horizontal alignment, shoulder deficiencies, slippery surface, poor delineation, damaged surfaces;
- vehicle failure; and
- environmental conditions such as rain, fog, snow, livestock or native fauna.

The road safety history of the various roads has been reviewed with regard to each road's crash exposure, which considers the rate at which crashes occur in crashes per vehicle kilometres travelled (VKT). One VKT is equivalent to one vehicle travelling a distance of 1 km, or alternatively two vehicles travelling for a distance of half a kilometre (and so on). The crash exposure increases as the length of a trip increases, and as traffic volumes increase. This is a general measure of the performance of the roads, and enables a comparison to be made between the relative safety of roads.

Table 2.8 presents the estimated average daily traffic (ADT) for each of the route sections described in Table 2.7, and the calculated crash rates for those routes. For Middle Trundle Road, the calculation is based only on those crashes which occurred on the sealed length of the route.

Table 2.8: Crash Rates on Project Access Routes January 2011 to November 2016

	Distance (km)	Estimated ADT	MVKT	Number of Crashes	Crashes per 100 MVKT
Henry Parkes Way Condobolin to Parkes	100	1,000	213.5	28	13.1
The Bogan Way Bogan Gate to Tullamore	59	500	63.0	13	20.6
Fifield Road Henry Parkes Way to Tullamore	73	230	35.8	4	11.2
Middle Trundle Road The Bogan Way to Henry Parkes Way	13	100	2.8	3	108.1
The McGrane Way Tullamore to Narromine	85	130	23.6	1	4.2
Water Transport Route Henry Parkes Way to Borefields[A]	54	100	10.3	1	0.1

ADT is based on seven day average volumes from recent surveys (Section 2.4).
MVKT = million vehicle kilometres travelled.
[A] 1 January 2012 to 31 March 2017

RTA (2004) indicates that based on a review of data on 36 classified roads in NSW, undivided two lane rural roads have an average crash rate of 32.8 crashes per 100 million VKT, of which 28.6 crashes per 100 million VKT were non-intersection crashes, and 4.2 crashes per 100 million VKT were intersection crashes. The overall crash rate was higher where sealed shoulders of less than 1.0 m width were provided, at 38.1 crashes per 100 million VKT, and lower where sealed shoulders greater than 1.0 m width were provided, at 28.5 crashes per million VKT. That study was based on crash data from 1997 to 2001, noting that changes have occurred in the crash reporting protocols over that time and in general crash trends. Between 2000 and 2014, the VKT in NSW increased by 27%, while the number of casualty crashes decreased by 13% (Centre for Road Safety, 2015). Thus direct comparison with the RTA (2004) data is considered to have limited relevance, however as a general guide, comparison with the average crash rate of 32.8 crashes per 100 million VKT on two lane rural classified roads indicates that the overall crash rate on Henry Parkes Way, The Bogan Way, Fifield Road and The McGrane Way are below that average.

The rate on the sealed length of Middle Trundle Road is well above that average, however the combination of a low number of crashes and low traffic volumes over a relatively short road length exaggerates the calculated crash rate. The routes included in the RMS (2004) study were classified roads varying between 39 km and 1,059 km in length (average 273 km) and carrying significantly higher volumes than that of Middle Trundle Road. The higher than average rate calculated for the sealed portion of Middle Trundle Road is not considered to reflect any particular issue with that road, rather that it is not indicative of the routes used in the calculation of average crash rates.

A detailed review of the crashes on each of these roads is provided in the following sections.

2.6.1 Middle Trundle Road

The details of the crash history of Middle Trundle Road between January 2011 and November 2016 are summarised in Table 2.9.

Table 2.9: Middle Trundle Road Crash Summary January 2011 to November 2016

	Pedestrian	Multiple Vehicles					Single Vehicle			Other
		Adjacent Approaches	Opposing Directions	Same Direction	U-turn/Parking	Overtaking	On Path	Off Path on Straight	Off Path on Curve	
Total Crashes	-	-	-	-	-	-	1	9	2	-
Road Surface Condition										
Dry Road	-	-	-	-	-	-	1	8	2	-
Wet Road	-	-	-	-	-	-	-	1	-	-
Weather Conditions										
Fine	-	-	-	-	-	-	1	9	2	-
Overcast	-	-	-	-	-	-	-	-	-	-
Raining	-		-	-	-	-	-	-	-	-
Vehicle Type										
Motorcycle	-	-	-	-	-	-	1	1	-	-
Car, Station Wagon, 4WD, Van	-	-	-	-	-	-	-	6	2	-
Light or Large Truck or Bus	-	-	-	-	-	-	-	2	-	-
Articulated Vehicle	-	-	-	-	-	-	-	-	-	-
Other	-	-	-	-	-	-	-	-	-	-
Severity of Crash										
Fatal	-	-	-	-	-	-	-	1	1	-
Injury	-	-	-	-	-	-	1	4	1	-
Non-injury	-	-	-	-	-	-	-	4	-	-
People Killed or Injured[A]										
Killed	-	-	-	-	-	-	-	1	1	-
Injured	-	-	-	-	-	-	-	3	-	-
Factors[B]										
Alcohol	-	-	-	-	-	-	-	-	1	-
Fatigue	-	-	-	-	-	-	-	4	-	-
Speed	-	-	-	-	-	-	-	-	2	-
None	-	-	-	-	-	-	1	5	-	-

[A] Note this reports the number of people injured or killed not the number of accidents resulting in injury or fatalities.
[B] Factors considered to have contributed to the crash, more than one factor can be nominated for a single crash.

Two fatal crashes occurred along Middle Trundle Road, both of which occurred in 2011 and involved loss of control of a single vehicle in fine weather on a dry road surface. One occurred in darkness at 12:30am and speed and alcohol were nominated as contributing factors. The other occurred in the late afternoon at 4:20pm and fatigue was nominated as a contributing factor. Both fatal crashes occurred on the sealed length of Middle Trundle Road.

2.6.2 Henry Parkes Way

The details of the crash history of Henry Parkes Way between Condobolin and Parkes between January 2011 and November 2016 are summarised in Table 2.10.

Table 2.10: Henry Parkes Way Crash Summary January 2011 to November 2016

		Multiple Vehicles					Single Vehicle			
	Pedestrian	Adjacent Approaches	Opposing Directions	Same Direction	U-turn/Parking	Overtaking	On Path	Off Path on Straight	Off Path on Curve	Other
Total Crashes	-	-	-	-	-	-	4	15	8	1
Road Surface Condition										
Dry Road	-	-	-	-	-	-	3	11	8	1
Wet Road	-	-	-	-	-	-	1	4	-	-
Weather Conditions										
Fine	-	-	-	-	-	-	3	12	8	1
Overcast	-	-	-	-	-	-	-	2	-	-
Raining	-		-	-	-	-	1	1	-	-
Vehicle Type										
Motorcycle	-	-	-	-	-	-	-	1	1	-
Car, Station Wagon, 4WD, Van	-	-	-	-	-	-	2	9	3	1
Light or Large Truck or Bus	-	-	-	-	-	-	-	4	4	-
Articulated Vehicle	-	-	-	-	-	-	-	1	-	1
Other	-	-	-	-	-	-	2	-	-	-
Severity of Crash										
Fatal	-	-	-	-	-	-	-	2	-	-
Injury	-	-	-	-	-	-	2	8	6	1
Non-injury	-	-	-	-	-	-	2	5	2	-
People Killed or Injured[A]										
Killed	-	-	-	-	-	-	-	2	-	-
Injured	-	-	-	-	-	-	3	8	7	1
Factors[B]										
Alcohol	-	-	-	-	-	-	-	3	3	-
Fatigue	-	-	-	-	-	-	-	6	1	-
Speed	-	-	-	-	-	-	-	-	5	-
None	-	-	-	-	-	-	4	7	2	1

[A] Note this reports the number of people injured or killed not the number of accidents resulting in injury or fatalities.
[B] Factors considered to have contributed to the crash, more than one factor can be nominated for a single crash.

Two fatal crashes occurred along this section of Henry Parkes Way, one between Fifield Road and Condobolin, and the other to the west of Bogan Gate. Both were single vehicle crashes involving a light truck in fine weather on a dry road, and alcohol was nominated as a factor in both. Fatigue was nominated as a factor in one.

2.6.3 The Bogan Way

The details of the crash history of The Bogan Way between Bogan Gate and The McGrane Way north of Tullamore between January 2011 and November 2016 are summarised in Table 2.11.

Table 2.11: The Bogan Way Crash Summary January 2011 to November 2016

		Multiple Vehicles					Single Vehicle			
	Pedestrian	Adjacent Approaches	Opposing Directions	Same Direction	U-turn/Parking	Overtaking	On Path	Off Path on Straight	Off Path on Curve	Other
Total Crashes	-	1	-	-	-	2	2	6	2	-
Road Surface Condition										
Dry Road	-	1	-	-	-	1	1	4	2	-
Wet Road	-	-	-	-	-	1	1	2	-	-
Weather Conditions										
Fine	-	1	-	-	-	1	1	4	2	-
Overcast	-	-	-	-	-	1	1	2	-	-
Raining	-	-	-	-	-	-	-	-	-	-
Vehicle Type										
Motorcycle	-	-	-	-	-	-	-	-	-	-
Car, Station Wagon, 4WD, Van	-	-	-	-	-	2	-	2	-	-
Light or Large Truck or Bus	-	2	-	-	-	2	2	-	1	-
Articulated Vehicle	-	-	-	-	-	-	-	3	1	-
Other	-	-	-	-	-	-	-	1	-	-
Severity of Crash										
Fatal	-	-	-	-	-	-	-	-	-	-
Injury	-	1	-	-	-	1	1	4	2	-
Non-injury	-	-	-	-	-	1	1	2	-	-
People Killed or Injured[A]										
Killed	-	-	-	-	-	-	-	-	-	-
Injured	-	1	-	-	-	1	1	4	3	-
Factors[B]										
Alcohol	-	-	-	-	-	-	-	-	-	-
Fatigue	-	-	-	-	-	-	-	1	1	-
Speed	-	-	-	-	-	-	-	-	2	-
None	-	1	-	-	-	2	2	5	-	-

[A] Note this reports the number of people injured or killed not the number of accidents resulting in injury or fatalities.
[B] Factors considered to have contributed to the crash, more than one factor can be nominated for a single crash.

No fatal crashes occurred along this section of The Bogan Way over the period investigated.

2.6.4 Fifield Road

The details of the crash history of Fifield Road between Henry Parkes Way and Tullamore between January 2011 and November 2016 are summarised in Table 2.12.

Table 2.12: Fifield Road Crash Summary January 2011 to November 2016

	Pedestrian	Multiple Vehicles					Single Vehicle			Other
		Adjacent Approaches	Opposing Directions	Same Direction	U-turn/Parking	Overtaking	On Path	Off Path on Straight	Off Path on Curve	
Total Crashes	-	-	-	-	-	-	-	2	2	-
Road Surface Condition										
Dry Road	-	-	-	-	-	-	-	2	2	-
Wet Road	-	-	-	-	-	-	-	-	-	-
Weather Conditions										
Fine	-	-	-	-	-	-	-	1	2	-
Overcast	-	-	-	-	-	-	-	1	-	-
Raining	-	-	-	-	-	-	-	-	-	-
Vehicle Type										
Motorcycle	-	-	-	-	-	-	-	-	-	-
Car, Station Wagon, 4WD, Van	-	-	-	-	-	-	-	1	1	-
Light or Large Truck or Bus	-	-	-	-	-	-	-	1	1	-
Articulated Vehicle	-	-	-	-	-	-	-	-	-	-
Other	-	-	-	-	-	-	-	-	-	-
Severity of Crash										
Fatal	-	-	-	-	-	-	-	-	-	-
Injury	-	-	-	-	-	-	-	-	2	-
Non-injury	-	-	-	-	-	-	-	2	-	-
People Killed or Injured[A]										
Killed	-	-	-	-	-	-	-	-	-	-
Injured	-	-	-	-	-	-	-	-	2	-
Factors[B]										
Alcohol	-	-	-	-	-	-	-	-	-	-
Fatigue	-	-	-	-	-	-	-	-	1	-
Speed	-	-	-	-	-	-	-	-	1	-
None	-	-	-	-	-	-	-	2	-	-

[A] Note this reports the number of people injured or killed not the number of accidents resulting in injury or fatalities.
[B] Factors considered to have contributed to the crash, more than one factor can be nominated for a single crash.

No fatal crashes occurred along this section of Fifield Road over the period investigated.

2.6.5 The McGrane Way

One crash occurred on The McGrane Way between Tullamore and Narromine between 1 January 2011 and November 2016. It was a fatal crash, in which an eastbound B-double struck a southbound train at the railway level crossing just out of Narromine. Speed was identified as a contributing factor. The crash occurred in fine weather on a dry road surface at 5.15pm on Wednesday 23 September 2015. One person was killed and one person injured.

2.6.6 Water Transport Route

One crash occurred on the proposed water transport route south of Henry Parkes Way between 1 January 2012 and 31 March 2017. It was a non-injury crash, in which an eastbound car in Yarrabandai Road struck straying stock 100m east of Bollingers Lane. The crash occurred in fine weather on a dry road surface at 9.30pm on Monday 20 May 2013.

Provisional data for the period from 1 April 2017 to 9 November 2017 identified a crash at the intersection of Henry Parkes Way and Yarrabandai Road, in which a northbound utility in Yarrabandai Road struck an eastbound truck on Henry Parkes Way. The crash description suggests the utility was crossing Henry Parkes Way into the loop road opposite Yarrabandai Road which serves the Yarrabandai coach stop, rather than turning left or right into Henry Parkes Way. The crash occurred in fine weather on a dry road surface on Tuesday 20 June 2017. As the data is provisional, and therefore subject to change, this crash is not included in Table 2.7.

2.6.7 Other Routes

No crashes were reported on the following routes included in the review:

- Springvale Road between Fifield Road and Wilmatha Road;
- Wilmatha Road between Springvale Road and Fifield Road;
- Platina Road/Fifield Trundle Road between Fifield Road and The Bogan Way;
- Melrose Plains Road between Springvale Road and The Bogan Way; and
- The McGrane Way between Tullamore and Narromine.

2.7 Road Network Operations

2.7.1 Road Capacity

The theoretical capacity of a two way two lane road under ideal conditions is 3,200 passenger cars per hour (Austroads, 2013). A two lane two way road is the most basic road with a single stream of traffic travelling in each direction, such that vehicles are required to cross to the opposing carriageway to overtake. The capacity of the sealed two lane two way roads in the vicinity of the Project would be expected to be somewhat less than the theoretical ideal, as the latter assumes no restrictive roadway, terrain or traffic conditions. Taking into account the proportion of heavy vehicles (Table 2.6), the peak hourly flows on the road network (Table 2.5) are very low in comparison to the theoretical capacity. A detailed assessment of midblock roadway capacity of the roads in the vicinity of the Project is therefore not warranted (i.e. there is no capacity concerns on roads in the vicinity of the Project).

The ideal road conditions assumed for general road capacity above assume that the road is sealed. The capacity or desirable traffic range carried on unsealed roads differs from that of sealed roads, as the quality of the road surface can vary significantly, and the type of surface can have a major influence on the speed at which drivers travel and how close behind another vehicle that drivers will choose to travel. The desirable traffic range can also vary according to the weather conditions.

Wilmatha Road is unsealed and carries some 21 vehicles per day, which is consistent with the volume range for Class U3 unsealed roads (Austroads, 2009), which carry between 20 and 100 vehicles per day with a travel speed of 80 km/h (not necessarily equivalent to the posted speed limit).

Middle Trundle Road contains a length of gravel roadway, and currently carries some 118 vehicles per day, which is the lower threshold for Class U2 unsealed roads (Austroads, 2009). Austroads (2009) suggests that for a Class U2 road, a mostly all-weather formed pavement with some drainage, made up of two pavement layers over subgrade is appropriate, with granular or modified materials adopted in the wearing course. Dust suppressants may be incorporated in maintenance strategies of such roads. Class U2 roads carry volumes between 100 and 200 vehicles per day and between 10% and 20% heavy vehicles (heavy being Class 4 and above), with a traffic speed of 100 km/h on two travel lanes with shoulders. Typical Class U2 roads are main links between communities, national parks, recreation areas, and haul roads.

Nevertheless, the existing volumes on the unsealed portion of Middle Trundle Road and Wilmatha Road remain very low, with the road surface and weather conditions having a greater impact on travel behaviour than the potential for being delayed by other vehicles.

2.7.2 Intersection Operation

At unsignalised intersections with minor roads, where there are relatively low volumes of through and turning vehicles, capacity considerations are usually not significant, and detailed analysis of capacity is not warranted. As a guide, at volumes below the following combinations of maximum hourly volumes at a cross intersection with a two lane two way road, capacity analysis is not warranted:

- major road 400 vehicles per hour, minor road 250 vehicles per hour;
- major road 500 vehicles per hour, minor road 200 vehicles per hour; and
- major road 650 vehicles per hour, minor road 100 vehicles per hour.

The majority of intersections in the vicinity of the Project are T-intersections and so have fewer potentially conflicting movements than a cross intersection. Comparison between these threshold volumes and the peak hourly volumes on the key roads (Table 2.5) indicates that the existing traffic volumes on all roads are well below the threshold volumes above, and as such, there is no capacity concerns regarding the operation of intersections in the vicinity of the Project.

3. Approved Project

3

3.1 Project Description

The Project includes the establishment and operation of:

- a MPF;
- a limestone quarry;
- a rail siding;
- a natural gas pipeline;
- borefields and water pipeline; and
- associated transport and infrastructure.

Construction of the Project substantially commenced in 2006 with the construction of the borefields, however Project operations are yet to commence.

The approved Project involves an Initial Production Phase focussed on scandium oxide production, transitioning to the Full Production Phase of scandium oxide, nickel and cobalt precipitate production when market conditions are favourable. The Initial Production Phase will be a smaller scale operation, with a significantly lower level of activity, and will not include construction of the limestone quarry and rail siding.

The Project is approved to operate 24 hours per day (the limestone quarry may operate from 7:00am to 5:00pm, with truck loading permitted 24 hours), seven days per week for a period of 21 years after commencement of mining operations.

3.2 Road Transport Trip Generation

A Road Transport Assessment was prepared by Masson Wilson Twiney (MWT) (2000) for the Environmental Impact Statement (EIS) for the Project. The study assessed the road transport implications of the Approved Project during both operational and construction phases. A Traffic Report was later prepared (MWT, 2005) which assessed the traffic and transport implications of Modification 1. Those road transport assessments assumed that construction of the Fifield Bypass would occur, which would allow traffic travelling to and from the MPF to bypass the village of Fifield. A Road Transport Assessment was prepared by GTA Consultants (2016) for Modification 3, which assessed the traffic and transport implciations of the small-scale Initial Production Phase. That modification assumes construction of the Fifield Bypass will not occur during the Initial Production Phase. Modification 3 did not change traffic associated with the Project at full development (the Full Production Phase).

The approved Project road transport trip generation and distribution outlined by GTA Consultants (2016) for the Initial Production Phase and by MWT (2005) for the Full Production Phase are described below.

3.2.1 Deliveries and Product Transport

Table 3.1 summarises the approved Project deliveries and product transport demands.

Table 3.1: Approved Project Deliveries and Product Transport

Project Component	Initial Production Phase	Full Production Phase
Hours of Operation	24 hours per day 7 days per week	24 hours per day 7 days per week
Autoclave Feed Rate	100,000 tonnes per annum (tpa)	2.5 million tonnes per annum (Mtpa)
Product	Up to 80 tpa scandium oxide Up to 1,000 tpa of nickel and cobalt metal equivalents as either sulphide or sulphate precipitate products	Up to 80 tpa scandium oxide Up to 40,000 tpa of nickel and cobalt metal equivalents as either sulphide or sulphate precipitate products
Key Process Consumables	30,000 tpa sulphuric acid up to 25,000 tpa limestone minor reagents	260,000 tpa sulphur 790,000 tpa limestone 1,100 tpa flocculant 100 tpa caustic soda minor reagents
Employees	45	300

Initial Production Phase

For the Initial Production Phase, raw materials would be transported to the Project by road using a range of vehicles types, including rigid trucks, B-doubles and pneumatic tippers. Trucks from Sydney, Port Kembla, Newcastle and Parkes would approach along Henry Parkes Way, The Bogan Way, Fifield-Trundle Road, Platina Road, Fifield Road, Slee Street and Wilmatha Road to the MPF Access Road. Trucks transporting miscellaneous items between local retailers at Condobolin and the MPF will use Henry Parkes Way, Fifield Road, Slee Street and Wilmatha Road to the MPF Access Road. The Fifield Bypass will not be constructed for the Initial Production Phase.

The transport of raw materials and product associated with the Initial Production Phase will generate an average of fewer than 24 vehicle trips per day.

Full Production Phase

For the Full Production Phase, the rail loading and unloading facility north of Trundle will allow for the transport of various raw materials and products to and from the Project by rail, with back loading of products from the MPF by rail. From the rail siding, road trains and B-doubles will transport containers of raw materials and nickel-cobalt sulphide precipitate to and from the MPF, travelling along Fifield-Trundle Road, Platina Road, Fifield Road, the Fifield Bypass[1], and Wilmatha Road. Trucks transporting limestone from the quarry on Fifield-Trundle Road will use the same road trains and B-doubles used for sulphur transport, and will travel along Fifield-Trundle Road, Platina Road, Fifield Road, the Fifield Bypass and Wilmatha Road.

Trucks transporting miscellaneous items between local retailers in Condobolin and the MPF will use Henry Parkes Way, Fifield Road, the Fifield Bypass[1] (or Slee Street) and Wilmatha Road. Magnesia will be sourced from Young, and transported in bulk pressure B-doubles, travelling from Young via Grenfell, Forbes, Parkes, Bogan Gate, and Trundle. Fuel and lubricants will be transported by 19 m long B-double tankers from Sydney, or smaller tankers from Parkes. Nickel and cobalt product will be transported by backloading the containers bringing sulphur to the MPF.

The transport of raw materials and product associated with the Full Production Phase will generate an average of 169 vehicle trips per day.

1 In accordance with the proposed Voluntary Planning Agreement terms included in Appendix 3 of Development Consent 374-11-00, a road safety audit will be undertaken in consultation with the Lachlan Shire Council to assist in determining if the Fifield Bypass is required (Section 7.1.4). If it is determined that the Fifield Bypass is not required, Project traffic would approach the site via Slee Street.

3.2.2 Employee Traffic

The Initial Production Phase workforce will generate 90 vehicle trips per day (GTA Consultants, 2016) and the Full Production Phase will generate 225 vehicle trips per day (MWT, 2005). Taking into account the residential distribution of the workforce, Table 3.2 summarises the daily vehicle trips generated by the workforce during the Initial and Full Production Phases.

Table 3.2: Daily Employee Trip Generation (vehicle trips per day)

Location	Initial Production Phase	Full Production Phase
Parkes	60	147
Condobolin	30	65
Trundle	-	6
Tullamore	-	5
Ootha	-	1
Bogan Gate	-	1
Total	**90**	**225**

Employee traffic from Trundle, Tullamore and Bogan Gate will use The Bogan Way, Fifield-Trundle Road, Platina Road, Fifield Road, the Fifield Bypass[2] (or Slee Street) and Wilmatha Road to the MPF Access Road. Employee traffic from Parkes will use Henry Parkes Way, Middle Trundle Road, The Bogan Way, Fifield-Trundle Road, Platina Road, Fifield Road, the Fifield Bypass[2] (or Slee Street) and Wilmatha Road to the MPF Access Road. Employee traffic from Condoblin and Ootha will use Henry Parkes Way, Fifield Road, Slee Street and Wilmatha Road to the MPF Access Road.

3.2.3 Other Project Traffic

Other traffic visiting the MPF during its operational phases will include deliveries of daily consumables, locally sourced spare parts and equipment, maintenance contractors, MPF staff visiting off-site facilities, regulating inspectors and general visitors. This traffic would occur mainly between 7:00am and 6:00pm. Approximately 90% of the other Project traffic would travel to and from the Parkes region, and 10% towards the Condobolin region.

For the Initial Production Phase, this will generate some 25 vehicle movements per day (GTA Consultants, 2016). Vehicles travelling to and from Parkes will use Henry Parkes Way, Middle Trundle Road (light vehicles only), The Bogan Way, Fifield-Trundle Road, Platina Road, Fifield Road, Slee Street and Wilmatha Road to the MPF Access Road. Vehicles travelling to and from Condobolin will use Henry Parkes Way, Fifield Road, Slee Street and Wilmatha Road.

For the Full Production Phase, this will generate some 75 vehicle movements per day (MWT, 2005). Vehicles travelling to and from Parkes will use Henry Parkes Way, The Bogan Way, Fifield-Trundle Road, Platina Road, Fifield Road, the Fifield Bypass[2] (or Slee Street) and Wilmatha Road to the MPF Access Road. Vehicles travelling to and from Condobolin will use Fifield Road, the Fifield Bypass[2] (or Slee Street) and Wilmatha Road.

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2 In accordance with the proposed Voluntary Planning Agreement terms included in Appendix 3 of Development Consent 374-11-00, a road safety audit will be undertaken in consultation with the Lachlan Shire Council to assist in determining if the Fifield Bypass is required (Section 7.1.4). If it is determined that the Fifield Bypass is not required, Project traffic would approach the site via Slee Street.

3.2.4 Total Traffic

Table 3.3 summarises the average daily traffic volumes anticipated to be generated by the Initial Production Phase and Full Production Phase of the approved Project, based on the assessments undertaken by GTA Consultants (2016) and MWT (2005) respectively.

Table 3.3: Approved Project Average Daily Traffic (vehicles per day)

Site[A]	Road	Location	Initial Production Phase			Full Production Phase		
			Light	Heavy	Total	Light	Heavy	Total
A	Henry Parkes Way	East of Bogan Gate	0	35	35	0	34	34
B		East of Middle Trundle Road	71	35	106	181	34	215
C	The Bogan Way	North of Henry Parkes Way	0	35	35	1	34	35
D		North of Middle Trundle Road	71	35	106	182	34	216
E		North of Trundle	71	35	106	188	68	256
F	Fifield Road	North of Henry Parkes Way	32	1	33	69	49	118
G		North of Fifield-Trundle Road[B]	103	36	139	258	207	465
H		North of Wilmatha Road	0	0	0	5	0	5
I	Middle Trundle Road	East of The Bogan Way	71	0	71	181	0	181
J	Fifield-Trundle Road	West of The Bogan Way	71	35	106	188	68	256
K	Platina Road	East of Fifield Road	71	35	106	189	158	347
M	Wilmatha Road	North of Sunrise Lane	103	36	139	263	207	470
N	MPF Access Road	East of Wilmatha Road	103	36	139	263	207	470

[A] Refer to Figure 5-1.
[B] Including Slee Street for Initial Production Phase, and Fifield Bypass[3] for Full Production Phase.
Source: MWT (2005) and GTA Consultants (2016).

Table 3.3 demonstrates that for the approved Full Production Phase, the Syerston Project can be expected to generate some 470 vehicles trips per day, of which 263 trips would be by light vehicles and 207 trips per day would be by heavy vehicles.

3.2.5 Rail Movements

Up to three trains per week will be required for the Project. A maximum of two trains per day will be required.

[3] In accordance with the proposed Voluntary Planning Agreement terms included in Appendix 3 of Development Consent 374-11-00, a road safety audit will be undertaken in consultation with the Lachlan Shire Council to assist in determining if the Fifield Bypass is required (Section 7.1.4). If it is determined that the Fifield Bypass is not required, Project traffic would approach the site via Slee Street.

4. Modified Project (Modification 4)

4

4.1 Modification 4 Description

The Modification involves the implementation of a number of opportunities to optimise the Full Production Phase of the Project, including:

- mining in a more selective manner to initially increase the processing facility ore feed grade;
- addition of drilling and blasting at the mine site;
- adoption of the resin-in-pulp (RIP) processing method option (i.e. the counter current decantation processing method option is no longer proposed)[4];
- increased sulphur and sulphuric acid demand to leach additional nickel, cobalt and scandium from the higher grade ore;
- increased limestone demand to neutralise the additional acid required in the acid leach circuit;
- addition of a crystalliser to the processing facility to extract ammonium sulphate from an existing waste stream for use as a fertiliser product;
- changes to process input and product road transport requirements;
- addition of a water treatment plant to the processing facility to recycle process water and minimise make-up water demand;
- increased tailings storage facility capacity to hold increased tailings volume due to the additional limestone required for acid neutralisation;
- reduced evaporation pond capacity due to the recycling of process water;
- relocation of mine infrastructure to avoid resource sterilisation and improve operational efficiency;
- addition of surface water extraction from the Lachlan River to improve water supply security;
- minor changes to borefield transfer station layout and water pipeline alignment;
- short-term road transport of water from the borefield to the mine site during the initial construction phase; and
- reduced gas demand as the increased sulphuric acid production would generate additional steam for power generation.

The Modification would not involve changes to any aspects of the approved limestone quarry, rail siding or gas pipeline.

4.2 Road Transport Trip Generation

Table 4.1 summarises a comparison between road transport-related aspects of the Full Production Phase as approved and with the Modification. The Modification would not alter the approved Initial Production Phase activity assessed by GTA Consultants (2016).

[4] The Approved Project includes the option to use either the RIP or counter current decantation processing method.

Table 4.1: Comparison of Road Transport Related Aspects of Approved Project and Modification

Project Component	Approved Project	Modification
Hours of Operation	24 hours per day 7 days per week	24 hours per day 7 days per week
Autoclave Feed Rate	2.5 Mtpa	2.5 Mtpa
Product	180 tpa scandium oxide 40,000 tpa of nickel and cobalt metal equivalents as either sulphide or sulphate precipitate products	180 tpa scandium oxide 40,000 tpa of nickel and cobalt metal equivalents as sulphate precipitate products 100,000 tpa of ammonium sulphate
Key Process Consumables	260,000 tpa sulphur 790,000 tpa limestone 1,100 tpa flocculant 100 tpa caustic soda minor reagents	350,000 tpa sulphur 990,000 tpa limestone 3,000 tpa caustic soda 50,000 tpa lime minor reagents
Employees	300	300

Similar to the approved Full Production Phase of the Project, the Modification would generate road traffic associated with the movement of the workforce to and from the MPF, the delivery of raw materials and transport of product to and from the site, and other miscellaneous vehicle traffic associated with the mining activity. The main differences would result from changes to the transport demands. The anticipated number of trips generated with the Modification is determined in this section.

For the purposes of this assessment, it has been assumed that the road safety audit undertaken in consultation with the Lachlan Shire Council in accordance with the proposed Voluntary Planning Agreement (VPA) terms included in Appendix 3 of Development Consent 374-11-00 and other assessments of operational conditions will determine that the Fifield Bypass is not required. Project traffic has therefore been assumed to approach the site via Slee Street rather than the Fifield Bypass. This assessment approach is expected to capture the maximum case road transport impacts on the road network.

4.2.1 Employees

A workforce of 300 employees would be required, with rostered shifts resulting in 180 employees on day shift and 60 employees on night shift. This assessment conservatively assumes that all employee travel would be by private vehicles, which would generate a higher number of vehicle trips on the road network. GTA Consultant's experience with employee transport to and from regional mining projects is that some level of car pooling occurs, with a typical average car occupancy of 1.2 people per vehicle, and hence this rate has been adopted for this assessment. On this basis, the 240 employees present each day would generate 400 vehicle trips on the surrounding road network each day. Clean TeQ intends to investigate operating shuttle bus services for employees to and from the Project. Details of such a scheme have not yet been determined, however it is likely that buses would operate to and from Parkes and Condobolin.

It is anticipated that half the employees would reside in Parkes, one-third would reside in Condobolin, and the remainder in regional locations including Trundle, Tullamore, Ootha and Bogan Gate. The resulting vehicle trips generated by the workforce are summarised in Table 4.2.

Table 4.2: Daily Employee Trip Distribution

Location	Percent of Employees	Employees Present at MPF	Daily Vehicle Trips
Parkes	50	120	200
Condobolin	33	80	134
Trundle	17	40	30
Tullamore			24
Ootha			6
Bogan Gate			6
Total	**100**	**240**	**400**

The workforce would work two 12-hour shifts per day, and so the generated traffic would be on the road network around the shift changeover times as follows:

- AM 150 vehicles arriving prior to start of day shift, 50 vehicles departing after end of night shift; and
- PM 50 vehicles arriving prior to start of night shift, 150 vehicles departing after end of day shift.

By way of comparison, should buses be used to transport employees between the Project and Parkes and Condobolin, up to 200 employees may travel by bus rather than private vehicle, removing up to 334 private vehicle trips per day from the road network. The extent to which employees would use the service would depend on a number of factors. The number of bus trips generated in place of the private vehicles would depend on the size of buses being operated and the management of the routes. As a guide, and assuming larger coaches are used with a capacity of 60 people per bus, two buses would operate between the Project and Parkes, and two buses would operate between the Project and Condobolin. These would generate eight vehicle trips per day on the road network, an overall reduction of up to 326 vehicle trips per day.

4.2.2 Materials and Product Transport

Raw materials would be transported to the Project using a range of vehicle types, including rigid trucks, B-doubles, and pneumatic bulk tippers. The typical types of trucks used for each material or product are described below, noting that actual vehicle types used may vary. Clean TeQ would minimise the number of heavy vehicles movements by maximising the use of rail transport and consolidating materials and product transport where practicable.

Sulphur

Sulphur would be transported by rail from Newcastle to the Project rail siding north of Trundle. The containers would be transported from the storage area near the road siding to the MPF using a shuttle fleet of five trucks, likely to include road trains and/or B-doubles. Transport of the total annual load of 350,000 tpa would generate an average of 21 deliveries per day and three rail trips from Newcastle per week. Clean TeQ is considering the use of larger capacity trucks (e.g. AB-triples) subject to approval from the relevant roads authority. The use of larger trucks would reduce the number of deliveries required to transport 350,000 tpa of sulphur from the rail siding. For the purposes of this assessment, the smaller trucks generating the larger number of movements has been assessed.

Caustic Soda

Caustic soda would be transported in containers by rail or road, with transport by rail from Sydney assumed for this assessment. Caustic soda containers would be unloaded at the Project rail siding and trucked to the MPF in containers using B-doubles. Transport of the total annual load of 3,000 tpa would generate five deliveries per month.

Limestone

Up to 990,000 tpa of limestone would be required at the MPF. This would be sourced from the limestone quarry (up to 790,000 tpa) and from other local quarries (up to 560,000 tpa).

Limestone would be transported from the quarry to the MPF using a dedicated fleet of trucks with a 48 tonne capacity. The processing plant would be available for an average of 46 weeks per year, operating seven days per week. The maximum annual load of 790,000 tpa of limestone from the limestone quarry would generate an average of 51 deliveries per day over the 46 operating weeks. Clean TeQ is considering the use of larger trucks (90 tonne capacity) subject to approval from the relevant roads authority. The use of larger trucks would reduce the number of deliveries required to transport 790,000 tpa of limestone from the limestone quarry to an average of 27 deliveries per day over the 46 operating weeks. For the purposes of this assessment, the smaller trucks generating the larger number of movements has been assessed.

As above, up to 560,000 tpa of limestone may be procured from local quarries and transported to the MPF using similar vehicles to those above. The maximum annual load of 560,000 tpa of limestone from local quarries would generate an average of 36 deliveries per day over the 46 operating weeks. A supplier has not yet been identified, however it is noted that local quarries include WestLime Quarry off The Bogan Way and EzyLime on Lynton Lane off Henry Parkes Way. For the purpose of this assessment, it is assumed that these delivery trips would follow a similar route to those vehicles approaching from Parkes.

The combined total requirement for 990,000 tpa of limestone would generate an average of 64 deliveries per day over the 46 operating weeks.

Limestone sourced from the quarry would be transported on the heavy vehicle route only between the quarry and the MPF. Limestone transported from local quarries is assumed to be transported on the heavy vehicle route from Henry Parkes Way (east) to the MPF. To account for the variations which may occur in the routes used for limestone deliveries, this assessment assumes that 560,000 tpa limestone is transported on the heavy vehicle route between Henry Parkes Way (east) and the quarry, and 990,000 tpa limestone is transported on the heavy vehicle route between the quarry and the MPF. This represents the conditions under which the transport of limestone would have its greatest impact on each part of the road network.

Lime

Up to 50,000 tpa of lime may be sourced from external suppliers and transported to the MPF by trucks with an average capacity of 40 tonnes. Assuming this would occur over some 46 operating weeks per year and seven days per week, this would generate an average of four deliveries per day during the operating weeks. A supplier has not yet been identified, and for the purpose of this assessment, it is assumed that the lime delivery trucks would follow a similar route to those vehicles approaching from Parkes.

Fuel and Lubricants

Fuel would be transported to the MPF using 19 m B-double tankers from Parkes. Lubricants would be sourced from Parkes. Fuel and lubricant would generate an average of three deliveries per week.

Miscellaneous Bulk Materials

Miscellaneous bulk materials would be transported from Newcastle by rail and transported from the Project rail siding to the MPF. Transport of these materials would generate an average of two deliveries per day.

Other Materials and Equipment

Supplies and equipment are expected to generate two deliveries per day from local sources and two deliveries per day from Sydney. Half of these would be by heavy vehicles, and half by light trucks and vans, however for the purpose of this assessment, it is conservatively assumed that all such deliveries would be by heavy vehicles.

Ammonia

Ammonia would be transported by rail then by truck from the rail siding to the MPF in containers, with each truck carrying one container with a 30 tonne capacity. Transport of 35,000 tpa of ammonia would generate an average of three deliveries per day, occurring over 52 weeks of the year, seven days per week.

Hydrochloric Acid

Hydrochloric acid would be transported from Newcastle to the MPF using B-doubles. Transport of 13,000 tpa would generate an average of two deliveries per day, occurring over 52 weeks of the year, seven days per week.

Soda Ash

Soda ash would be transported by rail to the Project siding, and then transported by road using the same truck fleet as would be used to transport sulphur. The transport of 7,000 tpa of soda ash would generate an average of three deliveries per week.

Other Reagents

Other reagents would be typically transported by rail then by truck from the rail siding to the MPF in containers. Transport of 8,000 tpa of other reagents would generate an average of three to four deliveries per week.

MPF Product

Nickel and cobalt metal equivalents (as sulphate precipitate products) and scandium oxide would be transported from the MPF to the rail siding by backloading the sulphur containers. Due to this backloading, transport of up to 40,000 tpa of nickel and cobalt metal equivalents as sulphate precipitate products and 180 tpa of scandium oxide would generate no additional vehicle trips.

Similarly, the transport of 100,000 tpa of ammonium sulphate extracted for sale as fertiliser would be backloaded in the sulphur containers to the rail siding, and would generate no additional vehicle trips.

Total Materials and Product Transport

Table 4.3 summarises the total transport demand generated by the movement of raw materials and product to and from the modified Project during the Full Production Phase.

Table 4.3: **Modification Raw Materials and Product Delivery Summary**

Product	Rail Siding	Quarry	Parkes/ Sydney	Newcastle	Condobolin	Total
Sulphur	21 / day	-	-	-	-	-
Caustic Soda	5 / month	-	-	-	-	-
Limestone - Quarry	-	51 / day[A] 28 / day[B]	-	-	-	-
Limestone (Local Sources)	-	-	13 / day[A] 36 / day[B]	-	-	-
Lime	-	-	4 / day	-	-	-
Fuel and Lubricants	-	-	3 / week	-	-	-
Miscellaneous Bulk Materials	2 / day	-	-	-	-	-
Other Materials and Equipment	-	-	2 / day	-	2 / day	-
Ammonia	3 / day	-	-	-	-	-
Hydrochloric Acid	-	-	-	2 / day	-	-
Soda Ash	3 / week	-	-	-	-	-
Other Reagents	4 / week	-	-	-	-	-
MPF Product	-	-	-	-	-	-
Ammonium Sulphate	-	-	-	-	-	-
Average Day Total (rounded)[B]	**27**	**28**	**43**	**2**	**2**	**102**
Average Day Two Way Trips[B]	**54**	**56**	**86**	**4**	**4**	**204**

[A] 790,000 tpa limestone sourced from the limestone quarry, and 200,000 tpa limestone sourced from local quarries
[B] 560,000 tpa limestone sourced from local quarries, and 430,000 tpa limestone sourced from the limestone quarry

The transport of raw materials and product associated with the modified Project would generate an average of approximately 102 deliveries per day (or 204 vehicle trips per day).

4.2.3 Other Traffic

Other traffic visiting the MPF during its operational phase would include deliveries of daily consumables, locally sourced spare parts and equipment, maintenance contractors, MPF staff visiting off-site facilities, regulating inspectors and general visitors. These activities would generate an average of approximately 16 deliveries or visits per day:

- 2 heavy vehicle deliveries per weekday (only) from Parkes;
- 2 heavy vehicle deliveries per weekday (only) from Condobolin;
- 10 light vehicles deliveries per day from Parkes; and
- 2 light vehicle deliveries per day from Condobolin.

4.3 Traffic Travel Routes

The routes used by vehicles travelling to and from the modified Project would vary according to the origin/destination. The following routes have been adopted for the modified Project traffic for this assessment:

- rail siding – Scotson Lane, Fifield-Trundle Road, Platina Road, Fifield Road, Slee Street, Wilmatha Road, and the MPF Access Road;
- limestone quarry – Quarry Access Road, Fifield-Trundle Road, Platina Road, Fifield Road, Slee Street, Wilmatha Road, and MPF Access Road;
- Sydney/Parkes – Henry Parkes Way, The Bogan Way, Fifield-Trundle Road, Platina Road, Fifield Road, Slee Street, Wilmatha Road, and MPF Access Road (external limestone supply and lime deliveries (Table 4.3) would adopt this route);

- Sydney/Parkes – Henry Parkes Way, Middle Trundle Road, The Bogan Way, Fifield-Trundle Road, Platina Road, Fifield Road, Slee Street, Wilmatha Road, and MPF Access Road (this route would be adopted for deliveries of fuel and lubricants (Table 4.3), other materials and equipment (Table 4.3), and other consumables and equipment from Parkes (Section 4.2.3);
- Newcastle – Mitchell Highway, The McGrane Way, The Bogan Way, Fifield Road, Wilmatha Road, and MPF Access Road;
- Condobolin, Ootha and local sources – Henry Parkes Way, Fifield Road, Slee Street, Wilmatha Road, and MPF Access Road;
- Trundle and Bogan Gate – The Bogan Way, Fifield-Trundle Road, Platina Road, Fifield Road, Slee Street, Wilmatha Road, and MPF Access Road; and
- Tullamore – Fifield Road, Wilmatha Road, and MPF Access Road.

4.4 Total Traffic

4.4.1 Daily Traffic

Table 4.4 summarises the average daily traffic volumes on the road network anticipated to be generated by the modified Project.

Table 4.4: Modified Project Average Daily Traffic (vehicles per day)

Road	Section	Light Vehicles	Heavy Vehicles	Total Vehicles
Mitchell Highway	Narromine to Dubbo	0	4	4
The McGrane Way	Tullamore to Narromine	0	4	4
Scotson Lane	Rail Siding to The Bogan Way	0	54	54
Henry Parkes Way	Condobolin to Fifield Road	138	8	146
	Parkes to Middle Trundle Road	220	90	310
	Middle Trundle Road to The Bogan Way	0	82	82
	Ootha to Fifield Road	6	0	6
Middle Trundle Road	Henry Parkes Way to The Bogan Way	220	8	228
The Bogan Way	Henry Parkes Way to Middle Trundle Road	6	82	88
	Middle Trundle Road to Trundle	226	90	316
	Trundle to Fifield-Trundle Road	256	90	346
Quarry Access Road	Off Fifield-Trundle Road	0	56	56
Fifield-Trundle Road	The Bogan Way to Quarry Access Road	256	144	400
	Quarry Access Road to Platina Road	256	200	456
Platina Road	Fifield-Trundle Road to Fifield Road	256	200	456
Fifield Road	Tullamore to Wilmatha Road	24	4	28
	Henry Parkes Way to Platina Road	144	8	152
	Platina Road to Slee Street	400	208	608
Slee Street	Fifield Road to Wilmatha Road	400	208	608
Wilmatha Road	Slee Street to MPF Access Road	424	212	636
MPF Access Road	Off Wilmatha Road	424	212	636

A Assumes 430,000 tpa limestone sourced from the limestone quarry. If 790,000 tpa limestone is sourced from the limestone quarry, average daily traffic on the Quarry Access Road would be 102 heavy vehicles per day.

The modified Project is expected to generate an average of 636 vehicle trips per day, of which 424 vehicle trips would be light vehicles (noting that this assumes private vehicle travel by the workforce), and 212 vehicle trips would be heavy vehicles.

4.4.2 Peak Hourly Traffic

Employee traffic would tend to be concentrated at the shift change times, with employees arriving just prior to the start of their shift followed by employees leaving at the end of their shift. Transport of materials and product, and other Project traffic would tend to be more spread throughout the day and night. For the purpose of this assessment, it is assumed that the employee traffic occurs in two distinct hours in the day at shift change times, and that approximately 10% of the materials and other transport activity occurs during each of the same hours as the employee traffic.

On this basis, Table 4.5 summarises the peak hourly traffic volumes on the average day anticipated to be generated by the modified Project.

Table 4.5: Modification Peak Hourly Traffic (vehicles per hour)

Road	Section	Light Vehicles	Heavy Vehicles	Total Vehicles
Mitchell Highway	Narromine to Dubbo	0	2	2
The McGrane Way	Tullamore to Narromine	0	2	2
Scotson Lane	Rail Siding to The Bogan Way	0	6	6
Henry Parkes Way	Condobolin to Fifield Road	69	4	73
	Parkes to Middle Trundle Road	102	12	114
	Middle Trundle Road to The Bogan Way	0	9	9
	Ootha to Fifield Road	3	0	3
Middle Trundle Road	Henry Parkes Way to The Bogan Way	102	3	105
The Bogan Way	Henry Parkes Way to Middle Trundle Road	3	9	12
	Middle Trundle Road to Trundle	105	12	117
	Trundle to Fifield-Trundle Road	120	12	132
Quarry Access Road	Off Fifield-Trundle Road	0	6[A]	6
Fifield-Trundle Road	The Bogan Way to Quarry Access Road	120	18	138
	Quarry Access Road to Platina Road	120	24	144
Platina Road	Fifield-Trundle Road to Fifield Road	120	24	144
Fifield Road	Tullamore to Wilmatha Road	12	2	14
	Henry Parkes Way to Platina Road	72	4	76
	Platina Road to Slee Street	192	28	220
Slee Street	Fifield Road to Wilmatha Road	192	28	220
Wilmatha Road	Slee Street to MPF Access Road	204	30	234
MPF Access Road	Off Wilmatha Road	204	30	234

[A] Assumes 430,000 tpa limestone sourced from the limestone quarry. If 790,000 tpa limestone is sourced from the limestone quarry, average day peak hourly traffic on the Quarry Access Road would be 10 to 12 heavy vehicles per hour.

The modified Project is expected to generate an average of 234 vehicle trips per hour during the peak hours at shift change times, of which 204 vehicle trips would be light vehicles (noting that this assumes private vehicle travel by the workforce), and 30 vehicle trips would be heavy vehicles.

4.5 Construction Traffic

Construction aspects of the Project were assessed by MWT (2000), and the modified Project construction activity is expected to remain generally consistent with those findings, with some exceptions which are discussed in this section.

4.5.1 Water Transport

It is proposed to transport water to the MPF from the borefield by road for a short period (approximately six months) during the initial construction phase while the water supply pipeline is being constructed, which was not previously considered by MWT (2000) as part of the construction activity.

The water trucks are proposed to operate six days per week during daylight hours only, with between 23 and 35 deliveries per day. This would generate between 46 and 70 vehicle trips per day when operating. The proposed route for the water trucks is shown in Figure 2-1 and includes:

- North Condobolin Road;
- Bedgerabong Road;
- Noakes Road;
- Yarrabandai Road;
- Henry Parkes Way;
- The Bogan Way;
- Fifield-Trundle Road;
- Platina Road;
- Fifield Road;
- Slee Street; and
- Wilmatha Road.

Clean TeQ would continue to consult with the Forbes Shire Council (FSC) and the final short-term construction phase water transport route would be determined in consultation with the FSC.

Between Bogan Gate and the MPF, the route proposed to be used by the water trucks is the same as that expected to be used by other construction vehicles. The road transport of water would occur when other construction activity is relatively low, and so would not coincide with the peak activity forecast in MWT (2000). The southern part of the route from North Condobolin Road to The Bogan Way is a "new" route with regard to Project construction traffic. Yarrabandai Road, Noakes Road and Henry Parkes Way are approved for use by B-Doubles, with a restriction of 80 km/h on Yarrabandai Road south of Henry Parkes Way where school buses operate. The review of the crash history of the route found that one crash occurred along the route south of Henry Parkes Way between 1 January 2012 and 31 March 2017, and provisional data (subject to change) found one crash occurred at the intersection of Henry Parkes Way and Yarrabandai Road. The crash data indicates no particular crash causal factors exist along the route. The short-term road transport of water would therefore not exacerbate any existing safety concerns along the route.

The overall impacts of the proposed short-term road transport of water are considered to be small, and well within the capacity of the existing roads. This minor short-term increase in construction traffic during the initial construction phase would not overlap with peak construction activity and has therefore not been assessed in further detail in this study.

4.5.2 Accommodation Camp

MWT (2000) assessed the construction period implications of the Project on the basis that a temporary accommodation camp for the construction workforce would be provided within the MPF site. Clean TeQ is separately seeking approval for an accommodation camp on the "Sunrise" property off Sunrise Lane (Figure 5-1). If separate approval for the "Sunrise" accommodation camp is obtained, the approved accommodation camp at the MPF site would not be constructed.

This would require the construction workforce to travel on public roads between the camp and the MPF each day, and other vehicle trips associated with the construction camp would be to and from "Sunrise" rather than the MPF access road. These trips were not previously accounted for by MWT (2000). The access road to "Sunrise" is located off Sunrise Lane.

Traffic generated to and from the "Sunrise" accommodation camp is expected to include:

- Travel by resident employees to and from the MPF;
- Recreational travel by resident employees;
- Bus trips to and from Parkes Airport;
- Delivery trips of consumables and supplies.

Resident Employee Travel to/from MPF

MWT (2000) found that the average construction workforce would be approximately 540 employees, with a peak of 962 employees. Ninety percent of the workforce was assumed to be accommodated in the temporary accommodation camp, i.e. an average of approximately 486 and peak of 866 workers would be accommodated at the camp. With the modified Project, those workers residing in the accommodation camp would travel to and from the MPF each day, using Sunrise Lane and Wilmatha Road.

Assuming that those workers travel by private vehicle, car pooling would be convenient, and an average vehicle occupancy of three persons per vehicle has been assumed. On this basis, the workforce would generate an average of 162 and peak of 289 vehicle trips each day from the camp to the MPF, and the same number of trips each day from the MPF to the camp. This is a conservatively high estimate which does not take into account absenteeism due to roster arrangements or the like. Should Clean TeQ implement a shuttle bus system between the camp and the MPF, the number of vehicle trips would be significantly reduced. The vehicles would turn left from Sunrise Lane to Wilmatha Road in the morning, and right from Wilmatha Road to Sunrise Lane in the evening.

Construction activity would occur on a continuous 24 hour basis. Assuming that the construction employees work two 12-hour shifts per day, the trips would occur during two hours of the day around the shift change times. With 70 percent of the workforce on day shift and 30 percent on night shift, the workforce would generate:

AM Peak Hour

- Average 113 and peak 202 vehicle trips from the camp to the MPF
- Average 49 and peak 87 vehicle trips from the MPF to the camp

PM Peak Hour

- Average 49 and 87 vehicle trips from the camp to the MPF
- Average 113 and peak 202 vehicle trips from the MPF to the camp.

Camp Resident Recreational Travel

MWT (2000) found that non-work trips by the employee residents of the camp would generate an average of 34 vehicle trips per day and a peak of 68 vehicle trips per day. Relocation of the accommodation camp to Sunrise Lane would not alter the number of non-work vehicle trips made by the camp residents, but would divert those trips to Sunrise Lane. The vehicles would therefore turn left from Wilmatha Road to Sunrise Lane when arriving, and turn right from Sunrise Lane to Wilmatha Road when departing.

Airport-Camp Bus Travel

MWT (2000) found that buses to and from Parkes Airport would generate an average of two vehicle trips per day and a peak of four vehicle trips per day. Relocation of the accommodation camp to Sunrise Lane would not alter the number of bus trips between the camp and Parkes Airport, but would divert those trips to Sunrise Lane. The buses would therefore turn left from Wilmatha Road to Sunrise Lane when arriving, and turn right from Sunrise Lane to Wilmatha Road when departing.

Camp Deliveries

MWT (2000) found that delivery trips to the camp would generate an average of 20 vehicle trips per day and a peak of 30 vehicle trips per day. Relocation of the accommodation camp to Sunrise Lane would not alter the number of delivery trips to and from the camp, but would divert those trips to Sunrise Lane. The delivery vehicles would therefore turn left from Wilmatha Road to Sunrise Lane when arriving, and turn right from Sunrise Lane to Wilmatha Road when departing.

4.6 Rail Movements

The Modification would not result in any change to the average number of train movements (i.e. three trains per week) or the approved maximum number of trains per day (i.e. two trains per day).

5. Future Traffic Conditions

The timing of the modified Project would be dependent upon market conditions. For the purpose of this assessment, a ten-year (2027) horizon has been adopted as a suitable basis for assessing the impacts of the modified Project together with other changes to traffic conditions which may occur over time. Should the modified Project commence operations before 2027, the combined impacts of the Project with other traffic changes would be less than assessed here.

Other developments in the region and general background growth in traffic may impact on traffic conditions on those roads serving the Project. Recent approvals and applications made to the NSW Department of Planning and Environment for major projects in the region have been reviewed and are described below, in the context of the potential road transport implications on roads of relevance to the modified Project.

5.1 Parkes Solar Farm

A commercial scale solar photovoltaic site, known as the Parkes Solar Farm, located to the south of Henry Parkes Way, some 10 km west-northwest of Parkes has recently been approved. The Environmental Impact Statement (NGH Environmental, 2016) indicates that construction of the Parkes Solar Farm is expected to take nine months, and would employ approximately 100 people at peak construction. The operational workforce would be very low, at 0.5 full time equivalent operational staff for the life of the Parkes Solar Farm. The operational life would be approximately 30 years.

Vehicular access would be via an access road from Pat Meredith Drive, which extends southwards from Henry Parkes Way. It is not expected that the construction phase of the Parkes Solar Farm would coincide with the Full Production Phase of the Project as construction of the Parkes Solar Farm is scheduled for 2017 (NGH Environmental, 2016). Given the very low number of operational workers, the ongoing increase in traffic as a result of the Parkes Solar Farm would be negligible, and well within the day-to-day variations in traffic.

This assessment therefore does not include forecasts of traffic specifically to and from the Parkes Solar Farm, as background traffic growth (Section 5.3) is considered to adequately address the potential traffic generation of the Parkes Solar Farm.

5.2 North Parkes Mine

The North Parkes Mine is a copper-gold mine located approximately 27 km northwest of Parkes via the Newell Highway and Bogan Road. It has been operating since 1993, and the North Parkes Step Change Project allows for continued mining operations until 2032. Transport & Urban Planning (2013) assessed the traffic implications of the Step Change Project, which included the relocation of the North Parkes Mine vehicle access to McClintocks Lane. That assessment found that the Step Change Project would result in some construction traffic activity, assumed to occur during 2015, while ongoing operational traffic generation would remain unchanged, as the employment and production levels would remain unchanged. Localised changes in traffic distribution would result from the relocation of the North Parkes Mine vehicle access.

The contribution of the North Parkes Mine on traffic conditions in the vicinity of the Project would be negligible, noting that less than 5% of the workforce is assumed to travel to and from Trundle and Bogan Gate. As the traffic survey data (Section 2.4) captures that contribution, and no change to operational traffic generation is expected from the North Parkes Mine, no changes to future traffic conditions as a result of activity at North Parkes Mine are anticipated in the assessment which follows.

5.3 Background Traffic Growth

The survey data supplied by Parkes Shire Council and Lachlan Shire Council was collated over the period from May 2010 to November 2015, while additional data was collected at some locations during November 2016 and continually over the first quarter of 2017. For the purpose of this assessment, it has been assumed that traffic growth on the roads of relevance to the Project has occurred at a rate of 2% per year between the date that survey data was collected and 2017, and will continue to grow at that same rate until 2027. This is considered to be a conservatively high estimate of future traffic growth over that period, noting that the State Infrastructure Strategy forecasts assume that the population of regional NSW will grow by 0.7% per year, with employment growth of 0.86% per year over the period from 2011 to 2031.

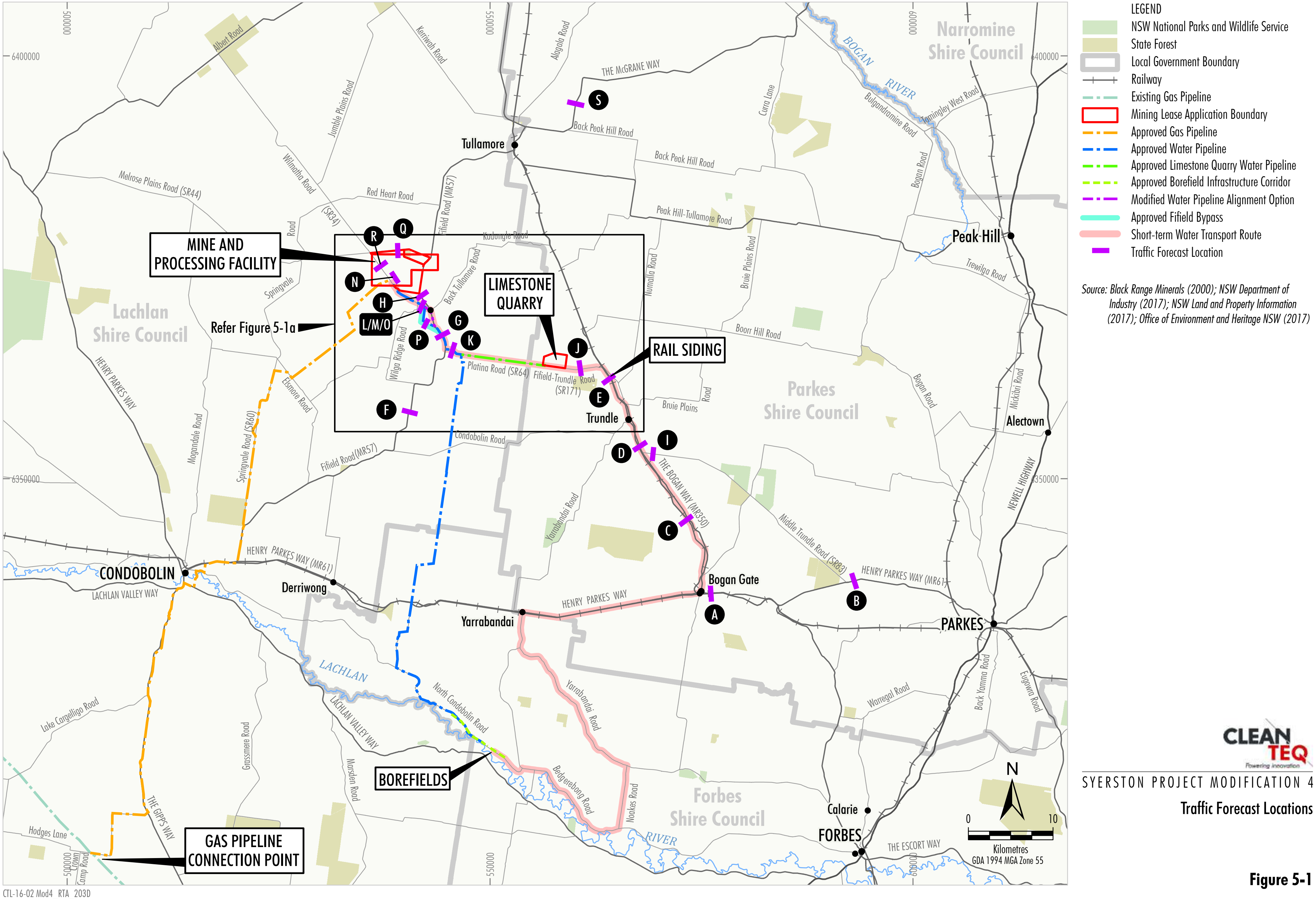
This rate of growth has been applied over the surveyed conditions from the survey date at each location (Table 2.4). Wherever possible, the most recent survey data has been used as the basis of the forecast. The resulting baseline average daily traffic volumes are presented for 2017 and 2027 conditions in Table 5.1 at the locations shown on Figure 5-1. These results exclude any traffic associated with the approved Project.

Table 5.1: Background Average Daily Traffic 2017 and 2027 No Syerston Project (vehicles per day)

Site[A]	Road	Location	Year 2017			Year 2027		
			Light	Heavy	Total	Light	Heavy	Total
A	Henry Parkes Way	East of Bogan Gate	853	219	1,072	1,024	263	1,287
B		East of Middle Trundle Road[B]	927	874	1,801	941	878	1,819
C	The Bogan Way	North of Henry Parkes Way	295	93	388	354	112	466
D		North of Middle Trundle Road[B]	369	114	483	442	137	579
E		North of Trundle	296	71	367	355	85	440
F	Fifield Road	North of Henry Parkes Way	128	70	198	154	84	238
G		North of Platina Road[B]	180	73	253	216	88	304
H		North of Wilmatha Road	132	54	186	158	65	223
I	Middle Trundle Road	East of The Bogan Way	92	26	118	110	31	141
J	Fifield-Trundle Road	West of The Bogan Way	64	14	78	77	17	94
K	Platina Road	East of Fifield Road	64	14	78	77	17	94
L/M	Wilmatha Road	West of Fifield Road	16	3	19	19	4	23
N	MPF Access Road	East of Wilmatha Road	0	0	0	0	0	0
O	Slee Street	in Fifield	177	70	247	212	84	296
Q	Melrose Plains Road	East of Wilmatha Road	8	3	11	10	4	14
R	Wilmatha Road	South of Melrose Plains Road	13	8	21	16	10	26
S	The McGrane Way	North of Black Peak Hill Road	95	30	125	114	36	150

[A] Refer to Figure 5-1.

[B] Assumes 80% of traffic on Middle Trundle Road uses Henry Parkes Way (east) and The Bogan Way (north).

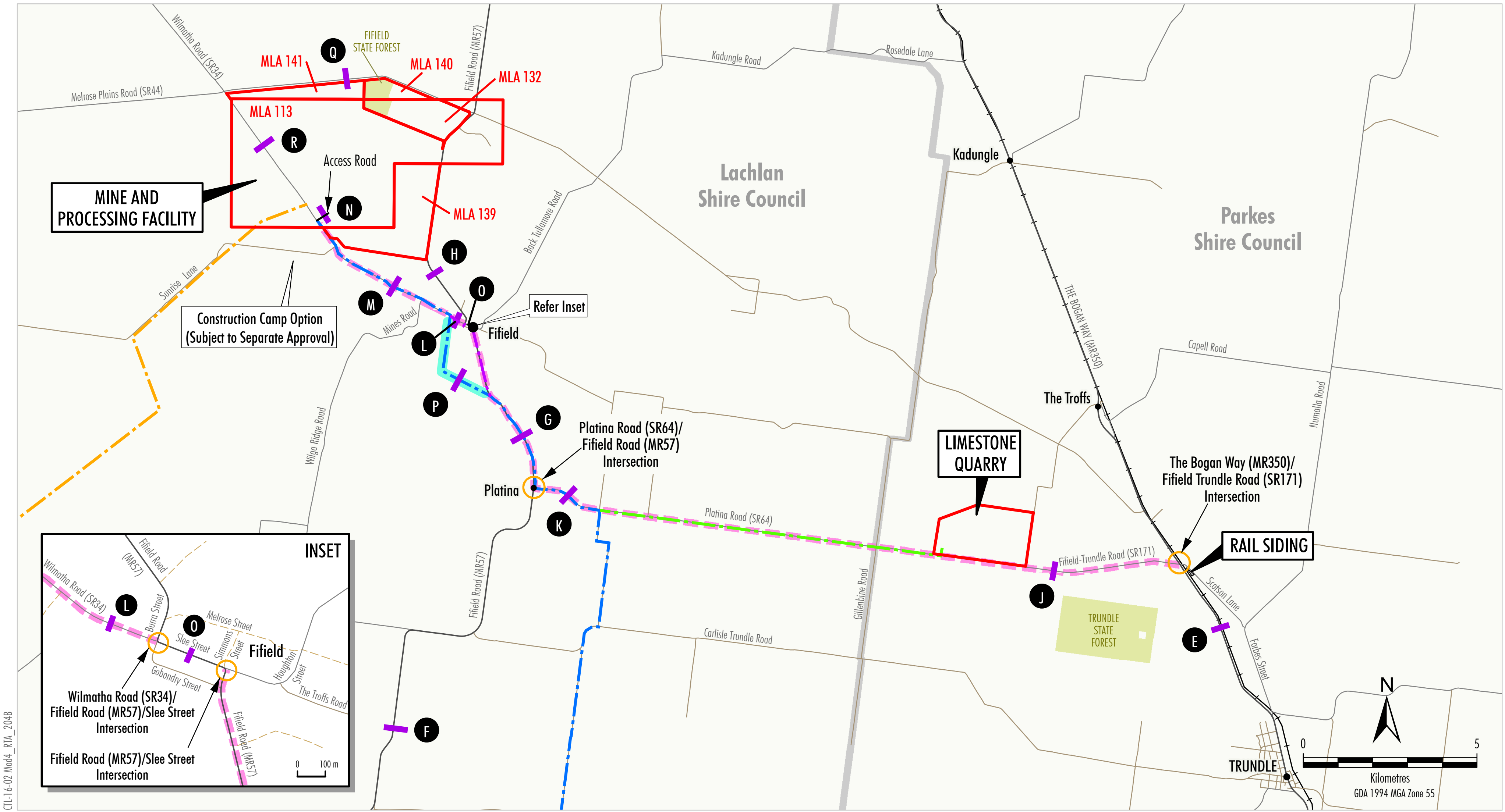


CLEAN TEQ

SYERSTON PROJECT MODIFICATION 4

Traffic Forecast Locations

Figure 5-1



LEGEND
State Forest
Local Government Boundary
Mining Lease Application Boundary
Approved Gas Pipeline
Approved Water Pipeline
Approved Limestone Quarry Water Pipeline
Extent of Road Upgrade (Condition 3 of VPA)
Approved Fifield Bypass
Traffic Forecast Location

Source: Black Range Minerals (2000); NSW Department of Industry (2017); NSW Land & Property Information (2017); Office of Environment and Heritage NSW (2017)

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SYERSTON PROJECT MODIFICATION 4

Road Upgrades Inset

Figure 5-1a

The resulting baseline average weekday peak hourly traffic volumes are presented for 2017 and 2027 conditions in Table 5.2 at the locations shown on Figure 5-1. These results exclude any traffic associated with the approved Project.

Table 5.2: Average Weekday Peak Hour Traffic 2017 and 2027 No Syerston Project (vehicles per hour)

Site[A]	Road	Location	Year 2017			Year 2027		
			Light	Heavy	Total	Light	Heavy	Total
A	Henry Parkes Way	East of Bogan Gate	75	19	94	90	23	113
B		East of Middle Trundle Road[B]	55	52	107	67	62	129
C	The Bogan Way	North of Henry Parkes Way	31	10	41	37	12	49
D		North of Middle Trundle Road[B]	42	13	55	50	15	65
E		North of Trundle	35	8	43	42	10	52
F	Fifield Road	North of Henry Parkes Way	13	7	20	16	8	24
G		North of Platina Road[B]	20	8	28	25	9	34
H		North of Wilmatha Road	15	6	21	18	7	25
I	Middle Trundle Road	East of The Bogan Way	13	4	17	15	5	20
J	Fifield-Trundle Road	West of The Bogan Way	9	2	11	11	2	13
K	Platina Road	East of Fifield Road	9	2	11	11	2	13
L/M	Wilmatha Road	West of Fifield Road	2	0	2	2	0	2
N	MPF Access Road	East of Wilmatha Road	0	0	0	0	0	0
O	Slee Street	in Fifield	19	7	26	22	9	31
Q	Melrose Plains Road	East of Wilmatha Road	3	1	4	4	1	5
R	Wilmatha Road	South of Melrose Plains Road	1	1	2	1	1	2
S	The McGrane Way	North of Black Peak Hill Road	11	3	14	13	4	17

[A] Refer to Figure 5-1.
[B] Assumes 80% of traffic on Middle Trundle Road uses Henry Parkes Way (east) and The Bogan Way (north).

6. Impact of the Modification

6.1 Comparison with Approved Project

Table 6.1 compares the assumed traffic generation of the approved Full Production Phase of the Project (MWT, 2005) with that of the modified Project. This demonstrates that the estimated heavy vehicle trip generation of the modified Project is similar to that of the approved Project. The increase in trips generated by the transport of higher volumes of limestone and sulphur with the modified Project compared with the approved Project would be partly offset by a reduction in other heavy vehicle delivery trips, and changes to some of the transport characteristics from those assumed in MWT (2005).

The estimated light vehicle generation of the modified Project is higher than that of the approved Project, primarily as a result of changes in the assumptions regarding the workforce present on site and its travel characteristics. The total workforce remains unchanged. As noted (Section 4.2.1), the forecasts for the modified Project assume private vehicle travel, while Clean TeQ proposes to implement shuttle bus services between the mine and Condobolin and Parkes. The modified Project forecasts also assume a flat level of car pooling throughout the day and night, while the approved Project forecasts (MWT, 2005) assumed higher levels of car pooling for night shift works, based on surveys undertaken at the Cadia Gold Operations.

Table 6.1: Approved Project and Modified Project Traffic Generation Forecasts (vehicle trips)

	Approved Full Production Phase			Modified Full Production Phase		
	Light	Heavy	Total	Light	Heavy	Total
Average Day						
Employees	225	0	225	400	0	400
Materials	0	169	169	0	204	204
Other	38	38	76	24	8	32
Total	263	207	470	424	212	636
Weekday Peak Hour						
Employees	113	0	113	200	0	200
Materials	0	20	20	0	26	26
Other	6	6	12	4	4	8
Total	119	26	145	204	30	234

6.2 Future Daily Traffic Volumes

As described in Section 4.2, it has been assumed that the road safety audit undertaken in consultation with the Lachlan Shire Council in accordance with the proposed VPA terms included in Appendix 3 of Development Consent 374-11-00 and other assessments of operational conditions will determine that the Fifield Bypass is not required. Project traffic has therefore been assumed to approach the site via Slee Street rather than the Fifield Bypass.

Table 6.2 presents the estimated average daily light and heavy vehicle traffic volumes on the surrounding roads with 10 years of growth in background non-Project traffic and the modified Project. Table 6.2 compares these volumes with those assuming the Project is constructed as approved and operating in its Full Production Phase. For ease of comparison, Table 6.2 assumes that the Fifield Bypass is not constructed for either the approved Project or modified Project.

Table 6.2: Year 2027 Average Daily Traffic with Approved and Modified Project (vehicles per day)

Site[A]	Road	Location	Approved Project[B]			Modified Project		
			Light	Heavy	Total	Light	Heavy	Total
A	Henry Parkes Way	East of Bogan Gate	1,024	297	1,321	1,024	345	1,369
B		East of Middle Trundle Road	1,122	912	2,034	1,161	968	2,129
C	The Bogan Way	North of Henry Parkes Way	355	146	501	360	194	554
D		North of Middle Trundle Road	624	171	795	668	227	895
E		North of Trundle	543	119	662	611	175	786
F	Fifield Road	North of Henry Parkes Way	224	133	357	298	92	390
G		North of Platina Road	474	295	769	616	296	912
H		North of Wilmatha Road	163	65	228	182	69	251
I	Middle Trundle Road	East of The Bogan Way	291	31	322	330	39	369
J	Fifield-Trundle Road	West of The Bogan Way	265	85	350	333	161	494
K	Platina Road	East of Fifield Road	265	175	440	333	217	550
L	Wilmatha Road	West of Slee Street	282	211	493	443	216	659
N	MPF Access Road	East of Wilmatha Road	263	207	470	424	212	636
O	Slee Street	in Fifield	470	291	761	612	292	904
Q	Melrose Plains Road	East of Wilmatha Road	10	4	14	10	4	14
S	The McGrane Way	North of Black Peak Hill Road	114	36	150	114	40	154

[A] Refer to Figure 5-1
[B] Full Production Phase

Table 6.2 demonstrates that on the average day, the total future daily traffic volumes with the modified Project would be higher than with the approved Project, with the most significant differences related to the light vehicle movements. As above, should Clean TeQ implement shuttle bus services between the mine and Condobolin and Parkes, the number of light vehicle trips would be significantly reduced from those forecast in Table 6.2.

6.3 Future Peak Hourly Traffic Volumes

Table 6.3 presents the estimated average weekday peak hourly light and heavy vehicle traffic volumes on the routes to and from the Project with 10 years of growth in background non-Project traffic, and with the Modification operational. As for the daily traffic forecasts, this assumes growth at a rate of 2% per year over the previously surveyed conditions between the survey date and 2027. These are conservatively high estimates of peak hourly traffic, as they assume that the peak hour for traffic generated by the modified Project would coincide with the peak hour recorded in the background traffic. Table 2.5 indicates that the time of the peak hour for background traffic varies significantly, thus the modified Project peak cannot coincide with the background peak at all locations.

For ease of comparison, Table 6.3 assumes that the Fifield Bypass is not constructed for either the approved Project or modified Project.

Table 6.3: **Year 2027 Peak Hourly Traffic with Approved and Modified Project (vehicles per hour)**

Site[A]	Road	Location	Approved Project[B]			Modified Project		
			Light	Heavy	Total	Light	Heavy	Total
A	Henry Parkes Way	East of Bogan Gate	90	27	117	90	32	122
B		East of Middle Trundle Road	145	66	211	169	74	243
C	The Bogan Way	North of Henry Parkes Way	38	16	54	40	21	61
D		North of Middle Trundle Road	129	19	148	155	27	182
E		North of Trundle	124	14	138	162	22	184
F	Fifield Road	North of Henry Parkes Way	51	16	67	88	12	100
G		North of Platina Road	142	35	177	217	37	254
H		North of Wilmatha Road	20	7	27	30	9	39
I	Middle Trundle Road	East of The Bogan Way	93	5	98	117	8	125
J	Fifield-Trundle Road	West of The Bogan Way	93	10	103	131	20	151
K	Platina Road	East of Fifield Road	93	20	113	131	26	157
L	Wilmatha Road	West of Fifield Road	121	26	147	206	30	236
N	MPF Access Road	East of Wilmatha Road	119	26	145	204	30	234
O	Slee Street	in Fifield	139	35	174	214	37	251
Q	Melrose Plains Road	East of Wilmatha Road	4	1	5	4	1	5
S	The McGrane Way	North of Black Peak Hill Road	13	4	17	13	6	19

[A] Refer to Figure 5-1
[B] Full Production Phase

Table 6.3 indicates that with the Modification, peak hourly traffic volumes on the part of the access route closest to the Project can be expected to reach approximately 230 to 250 vehicles per hour. This is a conservatively high estimate, noting that the main component of generated traffic during the peak hours is employees travelling to and from the Project. The forecasts assume that all employees travel by private vehicle. Clean TeQ plans to investigate providing a shuttle bus service at shift change times, possibly between the Project and Parkes and Condobolin. To the extent that such a service is used by employees, the total traffic would be reduced below those presented in Table 6.3.

6.4 Future Road Capacity

As noted (Section 2.7.1), the theoretical capacity of a two way two lane road under ideal conditions is 3,200 passenger cars per hour (Austroads, 2013a). Considering the future traffic peak hour volume forecasts (Table 6.3) the peak hourly flows on the road network would remain very low in comparison to the theoretical capacity, and a detailed assessment of midblock roadway capacity is not warranted.

The forecast increase in peak hourly traffic volumes may however impact the driver's experience on some of the key routes. To assess the change in conditions, the forecast traffic volumes on the roads which would experience the greatest increases in traffic as a result of the Project have been reviewed with regard to the Level of Service experienced along those routes.

Austroads (2013a) provides guidelines for the capacity and performance of two lane, two way rural roads, which in turn, refers to the *Highway Capacity Manual* (HCM) (Transportation Research Board, 2010). Level of Service (LOS) is defined as a qualitative measure describing the operational conditions within a traffic stream as perceived by drivers and/or passengers. A LOS definition generally describes these conditions in terms of factors such as speed and travel time, freedom to manoeuvre, traffic interruptions, comfort, convenience and safety. LOS A provides the best traffic conditions, with no restriction on desired travel speed or overtaking. LOS B to D describes progressively worse traffic conditions. LOS E occurs when traffic conditions are at or close to capacity, and there is virtually no freedom to select desired speeds or to manoeuvre in the traffic stream. The service flow rate for LOS E is taken as the capacity of a lane or roadway. In rural situations, LOS C is generally considered to be acceptable. At LOS C, most vehicles are travelling in platoons, and travel speeds are curtailed. At LOS D, platooning increases significantly, and the demand for passing is high, but the capacity to do so is low.

The LOS experienced by drivers on two way rural roads is dependent on the drivers' expectations regarding the road, and three classes of road are defined in the HCM. Class I roads are those on which motorists expect to travel at relatively high speeds. They most often serve long-distance trips or provide connecting links between facilities that serve long-distance trips. Class II roads are those on which motorists do not necessarily expect to travel at high speeds, and may function as access routes to Class I facilities, serve as scenic or recreational routes or pass through rugged terrain. Class III roads serve moderately developed areas, and may be portions of a Class I or Class II highway that pass through small towns or developed recreational areas, where local traffic mixes with through traffic, and the density of unsignalised roadside access points increases.

The roads with the highest forecasts of peak hourly traffic associated with the Modification are Wilmatha Road, Slee Street and Fifield Road (between Slee Street and Platina Road). These roads would generally be considered as Class II roads under the HCM descriptions, as drivers would expect some level of restriction to their freedom of movement along the routes as a result of characteristics of the route such as limits on the opportunities for overtaking (e.g. centre line marking, sight distances, lack of overtaking lanes). On Class II LOS is defined in terms of Percent Time Spent Following (PTSF). The PTSF is a measure of the level of opportunities to overtake, and is estimated from the demand traffic volumes, the directional distribution of that traffic, and the opportunities that drivers have to overtake. The LOS criteria for Class II two lane roads are as shown in Table 6.4.

Table 6.4: Level of Service Criteria for Class II Two Lane Roads

Level of Service	Class II PTSF (%)
A	≤ 40
B	> 40 – 55
C	> 55 – 70
D	> 70 – 85
E	≥ 85

Table 6.5 presents estimated PTSF and LOS results for these busiest routes with the modified Project, considering each as a Class II road. The HCM model is not valid for the existing posted speed limit of 50 km/h on Slee Street, thus as a general examination of capacity, the calculation is based on a speed limit of 60 km/h.

Table 6.5: **Indicative Peak Hour Midblock Road Performance 2027 with Modification**

Traffic Volume Scenario	Peak	Contrapeak Direction		Peak Direction	
		PTSF	LOS	PTSF	LOS
Slee Street	AM PM	17.2 17.2	A A	40.9 49.0	B B
Fifield Road between Slee Street and Platina Road	AM PM	17.2 18.8	A A	40.4 40.6	B B
Wilmatha Road between Slee Street and MPF Access	AM PM	17.4 17.5	A A	41.4 41.3	B B

Table 6.5 indicates that good Levels of Service can be expected on the busiest part of the routes accessing the Project with the modified Project traffic, with Level of Service B forecast for travel in the peak direction with the combined effects of background growth over ten years and the modified Project traffic. Level of Service B represents good operating conditions.

6.5 Intersection Operation

Formal assessment of intersection capacity is not warranted at low traffic volumes (Section 2.7.2). Comparison between these threshold volumes and the expected peak hourly volumes on the key roads indicates that the future traffic volumes on all roads are well below the threshold volumes, and as such, there is no capacity concerns regarding the operation of intersections in the vicinity of the modified Project.

Two new intersections are required as part of the approved and modified Project:

- Fifield-Trundle Road and the Limestone Quarry access road;
- Wilmatha Road and the MPF Access Road.

If the Fifield Bypass is to be constructed, new intersections would also be required at:

- Fifield Bypass and Wilmatha Road; and
- Fifield Bypass and Fifield Road.

If required, the new intersections would be designed in accordance with RMS and Austroads guidelines, including intersection geometry, sight distances, lane width, shoulder widths, signage and line marking.

6.6 Construction Phase

As described in Section 4.5.1, it is proposed to transport water to the MPF from the borefield by road for a short period (approximately six months) during the initial construction phase while the water supply pipeline is being constructed, which was not previously considered by MWT (2000) as part of the construction activity.

The water trucks are proposed to operate six days per week during daylight hours only, with between 23 and 35 deliveries per day. This would generate between 46 and 70 vehicle trips per day when operating.

The road transport of water would occur when other construction activity is relatively low, and so would not coincide with the peak activity forecast in MWT (2000). The review of the crash history of the route found that no crashes were reported along the component of the route south of Henry Parkes Way between 1 January 2012 and 31 March 2017, indicating no particular crash causal factors exist along the route. The short-term road transport of water would therefore not exacerbate any existing safety concerns along the route.

The overall impacts of the proposed short-term road transport of water are considered to be small, and well within the capacity of the existing roads. This minor short-term increase in construction traffic during the initial construction phase would not overlap with peak construction activity and has therefore not been assessed in further detail in this study.

As described in Section 4.5.2, Clean TeQ is separately seeking approval to relocate the construction accommodation camp to the “Sunrise” property off Sunrise Lane (Figure 5-1). With regard to the wider road network in the region, the relocation of the accommodation camp to Sunrise Lane would have negligible effect on the impacts of the modified Project on the operation of the key access routes. The main implications of the relocation of the camp on the road network compared with that assessed by MWT (2000) would be limited to:

- Sunrise Lane between Wilmatha Road and the access to “Sunrise” with an additional 218 vehicles per day on average during the construction period, and 391 vehicles per day during the peak construction period;
- Wilmatha Road between Sunrise Lane and the MPF access road with an additional 162 vehicles per day on average during the construction period, and 289 vehicles per day during the peak construction period; and
- the MPF access road, with an additional 162 vehicles per day on average during the construction period, and 289 vehicles per day during the peak construction period.

Based on the forecast of approximately 400 vehicles per day on Sunrise Lane, including buses and heavy vehicles, if the separate application is approved, it is recommended that Sunrise Lane be upgraded to be consistent with a Class 4A unsealed road (ARRB, 2010). On this basis, Sunrise Lane between Wilmatha Road and the access to “Sunrise” would be upgraded and maintained for the duration of the construction accommodation camp to a minimum of an all weather road standard with an operating speed standard of 80 km/h and carriageway width of 9 m (equivalent to two 3.5 m lanes and two 1.0 m wide shoulders). ARRB (2010) indicates that Class 4A roads may be sealed, depending on economic justification. As Sunrise Lane would only carry these higher volumes during the construction phase of the modified Project, it is unlikely to be economically justifiable to seal Sunrise Lane due to the relatively short duration of construction.

The separately proposed relocation of the construction accommodation camp would result in increased turning movements at the intersection of Wilmatha Road and Sunrise Lane. With upgrading of Sunrise Lane as above, the intersection would be improved to remove the current transition between the dirt surface of Sunrise Lane and the gravel surface of Wilmatha Road. If Wilmatha Road is sealed while the temporary accommodation camp is in use, a minimum of 30 m of Sunrise Lane should also be sealed on the approach to the intersection to provide a transition between the two surfaces separated from the intersection, and to prevent gravel drifting from Sunrise Lane onto the sealed surface of Wilmatha Road. The intersection would be designed to meet Austroads requirements with regard to geometry, signage and line marking where appropriate, and to ensure sight distances are adequate for the speed environment.

As noted above, the proposed relocation of the construction accommodation camp to the “Sunrise” property off Sunrise Lane (Figure 5-1) is subject to separate approval (i.e. not part of the Modification).

6.7 The McGrane Way

Condition 43 of Development Consent DA 374-11-00 requires that MR354 The McGrane Way not be used by heavy vehicles travelling to and from the MPF, unless otherwise agreed by the Secretary. The Modification proposes the limited use of The McGrane Way by heavy vehicles travelling to and from Newcastle, via Dubbo on the Mitchell Highway, The McGrane Way, The Bogan Way, Fifield Road, Wilmatha Road, and the MPF Access Road. As demonstrated in Table 4.3, this amounts to an average of two deliveries per day, or four heavy vehicles trips per day on The McGrane Way. The alternative route for these vehicles to avoid use The McGrane Way is to travel via Parkes, a significantly longer route.

It is considered that the modified Project would have acceptable impacts on the operation of The McGrane Way with no significant impacts on its performance, capacity, efficiency and safety. This very low level of additional traffic would not warrant any upgrading of The McGrane Way.

6.8 Road Safety

The review of the crash history of the surrounding road network (Section 2.6) does not reveal any specific concerns with the safety of the key routes and accesses used by Project traffic. A number of road upgrades, intersection upgrades and contributions to road maintenance are proposed with the Project, which are discussed in Section 7. All road works would be designed and constructed in accordance with Austroads and RMS requirements to provide a safe road environment for all road users.

6.9 Car Parking

Car parking for employees and visitors during operational stages would be located within the MPF site to meet the expected demands. The peak demand for employee parking would occur at the shift change over time, when those who are ending a shift are still present while those who are starting a shift are arriving. Based on the travel and shift assumptions, this would generate a peak demand for 200 employee parking spaces. Should a shuttle bus service be implemented, the employee parking demand would decrease, and provision for parking of buses would need to be made.

The quantity of parking required would be reviewed as part of the investigation into provision of an employee shuttle bus service.

7. Mitigation Measures

7.1 Development Consent Conditions

7.1.1 Traffic Management Plan

Condition 46, Schedule 3 of Development Consent DA 374-11-00 requires that a Traffic Management Plan be developed, including a Road Transport Protocol for haulage vehicles travelling to and from the MPF.

It is recommended that a Traffic Management Plan be prepared for the modified Project.

7.1.2 Voluntary Planning Agreements

Condition 17 of Schedule 2 of Development Consent DA 374-11-00 requires that:

Prior to carrying out any development under this consent after 6 May 2017, unless otherwise agreed by the Secretary, the Applicant must enter into a VPA with each of the relevant Councils, consistent with the offers summarised in Appendix 3. The VPA must include the provision of funding for:

- *a) the road upgrades required for the development;*
- *b) ongoing road maintenance for the development; and*
- *c) community enhancement initiatives in the locality.*

Table 7.1 summarises the relevant Lachlan Shire Council proposed VPA requirements contained within Appendix 3 of Development Consent DA 374-11-00 with respect to condition 17.

Table 7.1: Summary of Development Consent DA 374-11-00 Lachlan Shire Council Requirements

Location	Requirements and Timing
Lachlan Shire Council VPA Road Upgrades[A]	
Platina Road between Lachlan Shire boundary and Fifield Road	Prior to commissioning of the Mine and processing facility, 8.0 m sealed pavement and 1.0 m gravel shoulders, 3.5 m sealed private access road approach and 3.0 m gravel shoulders 30 m on either side of all private access roads.
Fifield Road between Platina Road and Slee Street in Fifield Village	Prior to commissioning of the Mine and processing facility, 8.0 m sealed pavement and 1.0 m gravel shoulders, 3.5 m sealed private access road approach and 3.0 m gravel shoulders 30 m on either side of all private access roads.
Wilmatha Road between Slee Street and the MPF access road	Prior to commissioning of the Mine and processing facility, 8.0 m sealed pavement and 1.0 m gravel shoulders, 3.5 m sealed private access road approach and 3.0 m gravel shoulders 30 m on either side of all private access roads.
Lachlan Shire Council VPA Intersection Upgrades[A]	
Platina Road and Fifield Road	Prior to commissioning of the Mine and processing facility, upgrade signage and line marking in accordance with relevant Austroads requirements.

Location	Requirements and Timing
Fifield Road and Slee Street	Prior to commissioning of the Mine and processing facility, upgrade signage and line marking in accordance with relevant Austroads requirements.
Slee Street, Wilmatha Road and Fifield Road	Prior to commissioning of the Mine and processing facility, upgrade signage and line marking in accordance with relevant Austroads requirements, including installation of advance warning signs on Slee Street, Fifield Road and Wilmatha Road approaches.
Lachlan Shire Council VPA Road Safety Audit	
Henry Parkes Way between Jones Lane and Fifield Road; Fifield Road between Henry Parkes Way and Slee Street; Fifield Road between Slee Street and Red Heart Road; Platina Road between Lachlan Shire boundary and Fifield Road; Slee Street between Fifield Road and Wilmatha Road; Wilmatha Road between Slee Street and Melrose Plains Road; Springvale Road between Fifield Road and Melrose Plains Road; Melrose Plains Road between Springvale Road and 4.65km after the Melrose Plains Road/Back Tullamore Road intersection.	Prior to commissioning of the limestone quarry and/or rail siding, the owner shall pay for a road safety audit to determine road upgrade requirements on specified roads, including intersections and rail crossings. The road safety audit must also determine if the Fifield Bypass is required. Prior to commissioning of the limestone quarry and/or rail siding, the owner shall pay for the road upgrades identified in the road safety audit and agreed with the LSC. The road safety audit must also determine if the Fifield Bypass is required.
Lachlan Shire Council VPA Road Maintenance	
Platina Road between Lachlan Shire boundary and Fifield Road; Fifield Road between Platina Road and Slee Street; Slee Street between Fifield Road and Wilmatha Road; and Wilmatha Road between Slee Street and MPF access road.	The owner shall make annual contributions to LSC towards the maintenance of the specified roads associated with the heavy vehicle transport route.
Fifield Road between Henry Parkes Way and Platina Road; and Henry Parkes Way between Jones Lane and Fifield Road.	The owner shall make annual contributions to LSC towards the maintenance of the specified roads that are likely to experience additional light vehicle traffic.

^ A road construction programme detailing timing and scheduling of these upgrades to be prepared in consultation with Lachlan Shire Council prior to commencement of construction

Table 7.2 summarises the relevant Parkes Shire Council proposed VPA requirements contained within Appendix 3 of Development Consent DA 374-11-00 with respect to Condition 17.

Table 7.2: Summary of Development Consent DA 374-11-00 Parkes Shire Council Requirements

Parkes Shire Council VPA Road Upgrades[A]	
Fifield-Trundle Road between The Bogan Way and the Parkes Shire boundary	Prior to commissioning of the Mine and processing facility, 8.0 m sealed pavement and 1.0 m gravel shoulders, 3.5 m sealed private access road approach and 3.0 m gravel shoulders 30 m on either side of all private access roads.
Parkes Shire Council VPA Intersection Upgrades[A]	
The Bogan Way and Fifield-Trundle Road	Prior to commissioning of the Mine and processing facility, upgrade signage and line marking in accordance with Austroads requirements including installation of "give way" signs on Fifield-Trundle Road.
Parkes Shire Council VPA Road Safety Audit	
Henry Parkes Way between Westlime Road and The Bogan Way; Middle Trundle Road between Henry Parkes Way and The Bogan Way; The Bogan Way between Henry Parkes Way and Fifield Road; and Fifield-Trundle Road between The Bogan Way and the Parkes Shire boundary.	Prior to commissioning of the limestone quarry and/or rail siding, the owner shall pay for a road safety audit to determine road upgrade requirements on the specified roads, including intersections and rail crossings. The owner shall pay for the road upgrades identified in the road safety audit and agreed with PSC.
Parkes Shire Council VPA Road Maintenance	
Henry Parkes Way between Westlime Road and The Bogan Way; Middle Trundle Road between Henry Parkes Way and The Bogan Way; The Bogan Way between Henry Parkes Way and Fifield-Trundle Road; and Fifield-Trundle Road between The Bogan Way and the Parkes Shire boundary	The owner shall make annual contributions to PSC towards the maintenance of the specified roads associated with the heavy vehicle transport route.

[A] A road construction programme detailing timing and scheduling of these upgrades to be prepared in consultation with Parkes Shire Council prior to commencement of construction

7.1.3 Road Upgrade and Maintenance Strategy

Condition 44 of Schedule 3 of Development Consent DA 374-11-00 requires that:

Prior to carrying out any development under this consent after 6 May 2017, the Applicant must prepare a Road Upgrade and Maintenance Strategy for the development, in consultation with RMS and Council, and to the satisfaction of the Secretary. This strategy must:

- a) *identify the road and intersection upgrades required for the project, including all those outlined in Appendix 5; and*
- b) *include a program for:*
  - *the implementation of the road upgrades in accordance with the timing outlined in Appendix 5; and*
  - *the maintenance of the relevant sections of the road network following the upgrades.*

Table 7.3 summarises the relevant timing requirements contained within Appendix 5 of Development Consent DA 374-11-00 with respect to condition 44. It is noted that these requirements are generally consistent with the requirements of Appendix 3 of the Development Consent DA 374-11-00.

Table 7.3: **Summary of Development Consent DA 374-11-00 Appendix 5 Timing Requirements**

Location	Timing
Road Upgrades	
Platina Road between the Lachlan Shire boundary and Fifield Road; Fifield Road between Platina Road and Slee Street; Wilmatha Road between Slee Street and the MPF; and Fifield-Trundle Road between The Bogan Way and the Parkes Shire boundary.	Prior to commissioning of the MPF
Intersection Upgrades	
Platina Road and Fifield Road; Fifield Road and Slee Street; Slee Street, Wilmatha Road and Fifield Road; The Bogan Way and Fifield-Trundle Road; Henry Parkes Way and Middle Trundle Road; and Henry Parkes Way and The Bogan Way.	Prior to commissioning of the MPF
Further Road and Intersection Upgrades	
Henry Parkes Way between Jones Lane and Fifield Road; Fifield Road between Henry Parkes Way and Slee Street; Fifield Road between Slee Street and Red Heart Road; Platina Road between Lachlan Shire boundary and Fifield Road; Slee Street between Fifield Road and Wilmatha Road; Wilmatha Road between Slee Street and Melrose Plains Road; Springvale Road between Fifield Road and Melrose Plains Road; Henry Parkes Way between Westlime Road and The Bogan Way; Middle Trundle Road between Henry Parkes Way and The Bogan Way; The Bogan Way between Henry Parkes Way and Fifield-Trundle Road; Fifield-Trundle Road between The Bogan Way and the Parkes Shire boundary; and Melrose Plains Road between Springvale Road and 4.65km after the Melrose Plains Road/Back Tullamore Road intersection.	Prior to development of the limestone quarry or rail siding

7.1.4 Road Safety Audit Requirements

The VPAs with both Lachlan Shire Council and Parkes Shire Council require that road safety audits be conducted on a number of specific routes, with the aim of determining road upgrade requirements along those routes, including intersections and rail crossings. The proposed VPA with Lachlan Shire Council also requires that the road safety audit must determine if the Fifield Bypass is required.

Road safety audits have been conducted in November 2015 and August 2017 along many of the routes specified in the VPAs, and the results of those audits have been taken into account in this assessment of road and intersection upgrade requirements (Sections 7.2 and 7.3). With the modified Project, some parts of the routes specified for upgrades and/or audit in the VPAs would not be used by traffic travelling to and from the MPF, and so should not be included in the VPA requirements. These include:

- Wilmatha Road between the MPF access and Melrose Plains Road;
- Springvale Road between Fifield Road and Melrose Plains Road; and
- Melrose Plains Road between Springvale Road and 4.65km after the Melrose Plains Road/Back Tullamore Road intersection.

The requirements for road safety audits should therefore be amended to include only those routes that would be used by Project traffic and exclude those roads listed above. This assessment assumes that Project-generated light vehicle traffic to and from the east on Henry Parkes Way would use Middle Trundle Road, and the alternative route via Bogan Gate (using Henry Parkes Way and The Bogan Way) would be used by the majority of Project-generated heavy vehicles. Both routes are therefore recommended to be retained in the VPA requirements.

As included in the Lachlan Shire Council VPA, a road safety audit of the existing roads in conjunction with forecast traffic volumes may be used as part of the determination of whether or not the Fifield Bypass should be constructed. Similarly, the Parkes Shire Council VPA requires that the owner shall pay for the road upgrades identified in the road safety audit. An audit identifies potential safety risks to road users, including identifying deficiencies or non-conformances along a route. The non-conformances are allocated a risk rating based on the likelihood and severity of a poor safety outcome. Treatment of non-conformances can then be identified and prioritised, although this is not part of the audit itself. A road safety audit in itself will not determine the need for the Fifield Bypass, nor identify road upgrades.

To determine the need for the Fifield Bypass, consideration would however also need to be given to comparing the forecast traffic conditions on the Bypass (if constructed) with those of the alternative route (if the Bypass is not constructed), and identifying which option is preferred based on established performance guidelines or other considerations such as residential amenity along one route or another. This would take into account what standards of roads would be required under both options, and the potential works required to achieve those standards. The works required for the option without the Bypass would then consider the difference between the existing road standards and the required road standards. The findings of an audit of the existing roads, particularly those which form the alternative route to the Fifield Bypass, may therefore inform the decision, but would form only part of that determination.

7.2 Road Upgrades

All road upgrades would be designed in accordance with Austroads requirements, including any relevant RMS supplementary requirements, relating to lane widths, shoulder widths, horizontal and vertical alignments, sight distances, clear zones, line marking and signage.

7.2.1 Project Heavy Vehicle Route

The Lachlan Shire Council proposed VPA specifies upgrading requirements of that part of the heavy vehicle route within the Lachlan Shire, and the Parkes Shire Council proposed VPA specifies upgrading requirements for that part of the heavy vehicle route within the Parkes Shire. The suggested road standard in the VPAs allows for:

- two travel lanes of 3.5 m width;
- 0.5 m sealed shoulders on each side; and
- 1.0 m gravel shoulders on each side.

This road standard is sufficient to allow heavy vehicles to pass or overtake without either vehicle having to move sideways towards the outer edge of the lane. It is consistent with Austroads (2010) desirable standard for a rural road carrying up to 1,000 vehicles per day, noting that Table 6.2 indicates that Fifield Road between Platina Road and Slee Street would be expected to carry 912 vehicles per day with the modified Project and background traffic growth. This is the highest forecast volume along the heavy vehicle route, which suggests that the nominated road standard is appropriate.

Table 6.2 indicates that Fifield-Trundle Road would be expected to carry 494 vehicles per day with the modified Project and background traffic growth. This is the lowest forecast volume along the heavy vehicle route. At less than 500 vehicles per day, Austroads (2010) suggests that the traffic lanes may be reduced from 3.5 m each to 3.1 m each, however recommends a minimum seal width of 7.0 m on designated heavy vehicle routes or where the average daily traffic is more than 15% heavy vehicles. Considering that heavy vehicles travelling to and from the rail siding would use this route, the standard suggested in the proposed VPAs is appropriate for the entire heavy vehicle route between the MPF and the rail siding.

The treatment of the private access roads, with a 3.5 m wide sealed approach is consistent with Austroads (2010) for rural roads carrying up to 150 vehicles per day. The suggested treatment with 3.0 m wide gravel shoulders on the main road for a minimum of 30 m on either side of minor accesses is consistent with the basic intersection treatments under Austroads guidelines.

These general requirements are considered appropriate for the heavy vehicle route for the modified Project, which is made up of:

- Fifield-Trundle Road between The Bogan Way and the Parkes Shire boundary;
- Platina Road between the Lachlan Shire boundary and Fifield Road;
- Fifield Road between Platina Road and Slee Street;
- Slee Street; and
- Wilmatha Road between Slee Street and the MPF access road.

These routes were included in the road safety audits, and based on the existing road conditions, this would require sealing and/or widening of:

- Fifield-Trundle Road between The Bogan Way and the Parkes Shire boundary;
- Platina Road between the Lachlan Shire boundary and Fifield Road;
- Fifield Road between Platina Road and Slee Street; and
- Wilmatha Road between Slee Street and the MPF access.

7.2.2 Fifield Road

With the modified Project, traffic travelling to and from the MPF would use parts of Fifield Road outside of the heavy vehicle route discussed in Section 7.2.1. These are discussed below.

Fifield Road South of Platina Road

The section of Fifield Road between Henry Parkes Way and Platina Road is included in the Development Consent requirement for a road safety audit (Section 7.1.4) to identify non-conformances and for maintenance contributions (Section 7.4). This section of Fifield Road was included in the 2017 road safety audit.

The surveys indicate that Fifield Road south of Platina Road presently carries an average of 198 vehicles per day, of which 70 vehicles (35 per cent) are heavy vehicles. With the modified Project traffic and background growth, Fifield Road would carry 390 vehicles per day, of which 92 vehicles (24 per cent) would be heavy vehicles. At less than 500 vehicles per day, Austroads (2010) suggests that the traffic lanes may be reduced from 3.5 m each to 3.1 m each, however recommends a minimum seal width of 7.0 m on designated heavy vehicle routes or where the average daily traffic is more than 15% heavy vehicles. It is therefore considered that the desirable minimum seal width on Fifield Road between Henry Parkes Way and Platina Road is 7.0 m for existing and forecast conditions, due to the background proportion of heavy vehicles. The existing pavement width is approximately 7.6 m, thus meets the desirable minimum standard. The Project's contribution to traffic on Fifield Road south of Platina Road is expected to be predominantly light vehicles.

Fifield Road North of Fifield

The section of Fifield Road between Slee Street and Red Heart Road is included in the requirement for a road safety audit (Section 7.1.4) to identify non-conformances and upgrade requirements. This section of Fifield Road was included in the 2017 road safety audit.

The surveys indicate that Fifield Road north of Fifield presently carries an average of 186 vehicles per day, of which 54 vehicles (29%) are heavy vehicles. With the modified Project traffic and background growth, Fifield Road north of Fifield would carry 251 vehicles per day, of which 69 vehicles (27%) would be heavy vehicles. As above, comparing with Austroads (2010). It is considered that the desirable seal width on Fifield Road north of Fifield is 7.0 m for existing and forecast conditions due to the background proportion of heavy vehicles. The existing pavement width is approximately 7.2 m, thus meets the desirable minimum standard. The Project's contribution to traffic on Fifield Road south of Platina Road is expected to be predominantly light vehicles.

7.2.3 Henry Parkes Way

Henry Parkes Way between Jones Lane and Fifield Road

The modified Project traffic travelling between the MPF and Condobolin would travel on Henry Parkes Way between Jones Lane (on the outskirts of Condobolin) and Fifield Road. The modified Project is forecast to contribute 138 light and 8 heavy vehicles per day on this section of Henry Parkes Way.

This section of road is included in the requirement for a road safety audit (Section 7.1.4) to identify non-conformances and for maintenance contributions (Section 7.4). It was included in the 2017 road safety audit.

Henry Parkes Way between Westlime Road and The Bogan Way

Westlime Road lies on the western outskirts of Parkes. Light vehicles associated with the modified Project would use Middle Trundle Road as the route for travel between Parkes and the MPF, and so would not contribute any additional traffic to Henry Parkes Way between The Bogan Way and Middle Trundle Road. The majority of heavy vehicles associated with the modified Project would travel via Bogan Gate, and so would contribute additional traffic to Henry Parkes Way between The Bogan Way and Middle Trundle Road. The modified Project is forecast to contribute up to 220 light and 90 heavy vehicles per day on Henry Parkes Way east of Middle Trundle Road, and 82 heavy vehicles per day on Henry Parkes Way between Middle Trundle Road and The Bogan Way. This assumes up to 560,000 tpa limestone would be sourced from local quarries located to the east of Middle Trundle Road such that limestone transport trucks would use all or part of this section of Henry Parkes Way. If the maximum amount of limestone is sourced from the limestone quarry (790,000 tpa), up to 200,000 tpa limestone would be sourced from local quarries, and the heavy vehicle contribution of the modified Project on Henry Parkes Way would be reduced to 44 heavy vehicles per day east of Middle Trundle Road, and to 36 heavy vehicles per day between The Bogan Way and Middle Trundle Road.

Henry Parkes Way between The Bogan Way and Westlime Road was included in the 2017 road safety audit. It is recommended that contributions towards maintenance of Henry Parkes Way between The Bogan Way and Westlime Road would be appropriate with the modified Project traffic. Details of the Project's contribution to traffic on this route would be determined once the local sources of limestone are known, and should take into consideration the potential variability of use of the route by limestone trucks.

7.2.4 The Bogan Way

With the modified Project, The Bogan Way would be used by Project-generated light and heavy vehicle traffic between Henry Parkes Way and Fifield-Trundle Road. Only a small number of light vehicle trips would be generated by the Project on The Bogan Way south of Middle Trundle Road travelling to and from Bogan Gate. Table 4.4 demonstrates that the modified Project would contribute 6 light vehicle and 82 heavy vehicles per day on The Bogan Way between Henry Parkes Way and Middle Trundle Road, and 226 to 256 light vehicle trips per day and 90 heavy vehicles per day on The Bogan Way between Middle Trundle Road and Fifield-Trundle Road. These forecasts assume that up to 560,000 tpa limestone is sourced from local quarries located to the east such that the limestone transport trucks use The Bogan Way between Fifield-Trundle Road and Henry Parkes Way. If the maximum amount of limestone is sourced from the limestone quarry (790,000 tpa), up to 200,000 tpa limestone would be sourced from local quarries, and the heavy vehicle contribution of the modified Project on The Bogan Way would be reduced to 44 heavy vehicles per day on The Bogan Way between Fifield-Trundle Road and Middle Trundle Road, and 36 heavy vehicles per day on The Bogan Way between Middle Trundle Road and Henry Parkes Way.

The Bogan Way between Henry Parkes Way and Fifield-Trundle Road was included in the 2015 road safety audit. It is understood that Parkes Shire Council has been undertaking seal works on The Bogan Way, and it is recommended that Clean TeQ make contributions to the maintenance of The Bogan Way.

The need for upgrading of the rail level crossings of The Bogan Way with the Bogan Gate Tottenham Railway would be considered in consultation with the rail authority. Austroads (2017b) sets out a range of treatment options that may be considered, with their implementation requiring coordination between the road and rail authorities. It is recommended that all signage and line marking at the rail level crossings be upgraded to meet authority requirements, and to be consistent along the route.

7.2.5 Melrose Plains Road

Melrose Plains Road would not be used by MPF-related traffic and upgrading would not be required by the modified Project.

7.2.6 Middle Trundle Road

Middle Trundle Road between Henry Parkes Way and The Bogan Way was included in the 2015 road safety audit. It is understood that the remaining unsealed length of Middle Trundle Road between Henry Parkes Way and The Bogan Way is to be sealed, and the resulting road standard would be suitable for use by heavy vehicles. On that basis, no further upgrading of the road is warranted, noting the recommended upgrading of the Middle Trundle Road intersections are discussed in Sections 7.3.5 and 7.3.7.

The proposed VPA with Parkes Shire Council requires contributions to the maintenance of Middle Trundle Road, which is considered to be appropriate.

7.2.7 Springvale Road

Springvale Road would not be used by MPF-related traffic (which would use Fifield Road) and upgrading would not be required by the modified Project.

7.2.8 Wilmatha Road

Between Slee Street and the MPF access road, Wilmatha Road is recommended to be upgraded as part of the heavy vehicle route for the Project (Section 7.2.1). Between the MPF access road and Melrose Plains Road, Wilmatha Road would not be used by MPF-related traffic and so does not warrant upgrading as a result of the modified Project.

7.3 Intersection Upgrades

All intersection upgrades would be designed in accordance with Austroads requirements, including any relevant RMS supplementary requirements, relating to lane widths, shoulder widths, horizontal and vertical alignments, sight distances, clear zones, line marking and signage.

7.3.1 Intersection Treatments

The current Austroads (2017b) rural intersection designs are described in this subsection.

Basic Intersection Treatment

The general minimum preferred treatment at rural road intersections are Basic Auxiliary Left (BAL) and Basic Auxiliary Right (BAR) treatments. The rural BAL treatment on the major road has a widened shoulder, which assists turning vehicles to move further off the through carriageway, making it easier for through vehicles to pass. The rural BAR treatment features a widened shoulder on the major road that allows through vehicles, having slowed, to pass to the left of turning vehicles. The BAL treatment on the minor road allows turning movements to occur from a single lane, with a shoulder that is too narrow to be used by left-tuning vehicles, so as to prevent vehicles from standing two abreast at the holding line. These design features are preferred to safely manage the movement of vehicles in the high speed rural environment.

Auxiliary Lane Treatment

Auxiliary lane turn treatments have short lengths of auxiliary lane provided to improve safety, especially on high speed roads. The Auxiliary Right-turn treatment (AUR) on the major road is created by the use of a short lane with standard painted stripes, where the median lane is shared between through and right turning vehicles, and the auxiliary kerbside lane allows through vehicles to pass a vehicle which has slowed to turn right. AUR treatments are not used in NSW, rather a channelised right turn treatment with a short turn bay known as a CHR(S) treatment is used. This is a modification of the channelised treatment described below.

Auxiliary Left-turn (AUL) treatments on the major and minor road are normal indented turn lanes, used only by vehicles turning left. The auxiliary lane treatment on the major road is safer than a basic treatment, however the channelised treatment described below is preferred where practicable, as the risk of collisions is lower. Consequently, Austroads (2017b) indicates that a channelised left turn (CHL) treatment should be used wherever practicable. The AUL treatment on the minor road is less safe than a basic or channelised treatment, and is therefore while it is included in the warrants, it is not recommended, and Austroads (2017b) indicates that a BAL or CHL treatment should be used wherever practicable.

Channelised Treatment

Channelised treatments at the intersections are CHR and channelised left turn (CHL) treatments for right and left turns respectively. The channelised "CH" treatments separate conflicting vehicle paths by raised or painted medians and/or islands, and often use auxiliary lanes in conjunction with channelisation. The CHR treatment on the major road provides a continuous lane for through vehicles only, and an auxiliary turn lane for right turning vehicles only. CHL treatments on the major or minor road provide a separate left turn "slip" lane, separated from the adjacent lane by a painted or raised island.

Channelised treatments are preferred over auxiliary lane treatments where practicable, as the risk of collisions is lower.

Platina Road and Fifield Road

At the intersection of Platina Road and Fifield Road, the modified Project is forecast to contribute the following peak hourly vehicle movements:

AM Peak Hour

- Fifield Road southbound: 18 light and 2 heavy vehicles
- Left turn from Fifield Road to Platina Road: 31 light and 12 heavy vehicles
- Right turn from Platina Road to Fifield Road: 90 light and 12 heavy vehicles
- Fifield Road northbound: 53 light and 2 heavy vehicles.

PM Peak Hour

- Fifield Road southbound: 53 light and 2 heavy vehicles
- Left turn from Fifield Road to Platina Road: 90 light and 12 heavy vehicles
- Right turn from Platina Road to Fifield Road: 31 light and 12 heavy vehicles
- Fifield Road northbound:18 light and 2 heavy vehicles.

The baseline background traffic in 2027 is forecast at 13 vehicles per hour on Platina Road and 34 vehicles per hour on Fifield Road north of Platina Road (both two way volumes during the busiest hour of the day). With the modified Project, the forecast number of vehicles turning to and from Platina Road and Fifield Road north is likely to be significantly greater than the number travelling through on Fifield Road. Under these conditions, it may be prudent to consider altering the priority of the intersection, such that the southern approach of Fifield Road becomes the minor leg of the intersection, with appropriate design to ensure the priority is clear, and with the relevant signage and line marking. It should be noted though that should Clean TeQ implement a shuttle bus system for employees, the volumes would not increase so greatly and the change of priority may not then be warranted.

The details of the required intersection treatment would be dependent upon the traffic demands. Should the existing priority remain, signage and line marking at the intersection should be upgraded to meet Austroads requirements. Should the priority be altered, the design of the intersection should be in accordance with Austroads guidelines, including intersection geometry, sight distances, lane width, shoulder widths, signage and line marking.

7.3.2 Fifield Road and Slee Street (East)

At the intersection of Fifield Road and Slee Street, the modified Project is forecast to contribute the following peak hourly vehicle movements:

AM Peak Hour

- Left turn from Fifield Road to Slee Street: 143 light and 14 heavy vehicles
- Right turn from Slee Street to Fifield Road: 49 light and 14 heavy vehicles.

PM Peak Hour

- Left turn from Fifield Road to Slee Street: 49 light and 14 heavy vehicles
- Right turn from Slee Street to Fifield Road: 143 light and 14 heavy vehicles.

These left and right turn movements have priority at the intersection, and the movements to and from the minor road would remain very low and would not be increased by the modified Project. No specific upgrading of the intersection is required to accommodate the additional demand resulting from the Modification. It is recommended that the signage and line marking at the intersection of Fifield Road and Slee Street be upgraded to meet Austroads requirements.

7.3.3 Fifield Road, Slee Street (West) and Wilmatha Road

The baseline background traffic in 2027 is forecast at peak hourly volumes of 25 vehicles per hour on Fifield Road, 31 vehicles per hour on Slee Street, and 2 vehicles per hour on Wilmatha Road. The modified Project is forecast to contribute the following peak hourly vehicle movements at the intersection of Slee Street, Wilmatha Road and Fifield Road:

AM Peak Hour

- Wilmatha Road eastbound to Slee Street: 49 light and 14 heavy vehicles
- Left turn from Wilmatha Road to Fifield Road: 3 light and 1 heavy vehicle
- Right turn from Fifield Road to Wilmatha Road: 9 light and 1 heavy vehicles
- Slee Street westbound to Wilmatha Road: 143 light and 14 heavy vehicles.

PM Peak Hour

- Wilmatha Road eastbound to Slee Street: 143 light and 14 heavy vehicles
- Left turn from Wilmatha Road to Fifield Road: 9 light and 1 heavy vehicle
- Right turn from Fifield Road to Wilmatha Road: 3 light and 1 heavy vehicles
- Slee Street westbound to Wilmatha Road: 49 light and 14 heavy vehicles.

The most significant increases in traffic generated by the modified Project would therefore be the movements between Slee Street and Wilmatha Road. Priority at the intersection lies along Slee Street (east) and Fifield Road (north). Inbound traffic from Slee Street to Wilmatha Road would have right of way at the intersection, and so would not be delayed by any opposing traffic, thus upgrading to separate the "turning" traffic from the "through" traffic would not be warranted. Outbound traffic from Wilmatha Road to Slee Street would be required to give way to the "through" traffic on Fifield Road-Slee Street. During the peak hours, this volume of traffic would exceed the through traffic, however it is recommended that Slee Street – Fifield Road remain the major road at this intersection.

As described in Section 7.2.1, Wilmatha Road would be widened and sealed as part of the Project heavy vehicle route. Upgrading of signage and line marking to Austroads standards would be undertaken as part of that upgrading, and it is recommended that this include advance warning signs for the intersection and its priority for drivers approaching on Slee Street (W9-2L) and Fifield Road (W9-2L) and advance warning of the Give Way signs (W3-2) on Wilmatha Road. This would encourage outbound drivers from the MPF to slow before entering Slee Street, which has a speed limit of 50 km/h.

7.3.4 The Bogan Way and Fifield-Trundle Road

With the modified Project, the intersection of The Bogan Way and Fifield-Trundle Road should be considered together with Scotson Lane, which would provide access to the rail siding. The modified Project is forecast to contribute the following peak hourly vehicle movements:

AM Peak Hour

- Left turn from The Bogan Way to Fifield-Trundle Road: 90 light and 6 heavy vehicles
- Westbound through Scotson Lane to Fifield-Trundle Road: 3 heavy vehicles
- Eastbound through Fifield-Trundle Road to Scotson Lane: 3 heavy vehicles
- Right turn Fifield-Trundle Road to The Bogan Way: 31 light and 6 heavy vehicles.

PM Peak Hour

- Left turn from The Bogan Way to Fifield-Trundle Road: 31 light and 6 heavy vehicles
- Westbound through Scotson Lane to Fifield-Trundle Road: 3 heavy vehicles
- Eastbound through Fifield-Trundle Road to Scotson Lane: 3 heavy vehicles
- Right turn Fifield-Trundle Road to The Bogan Way: 90 light and 6 heavy vehicles.

Baseline traffic volumes in 2027 are forecast at 13 vehicles per hour on Fifield-Trundle Road and 52 vehicles per hour on The Bogan Way.

The Austroads (2017b) warrants for unsignalised intersection turn treatments do not apply to four way intersections, however it is noted that the volumes using Scotson Lane are expected to be very low, with the Modification generating six heavy vehicle movements in an hour. As a guide to considering the need for treatment of this intersection, the volumes excluding Scotson Lane are considered below.

Comparison with the Austroads (2017b) warrants indicates that the peak hourly volumes resulting from the combination of baseline and Modification traffic would remain well below the volumes at which a additional treatment (AUL, CHL or CHR) in The Bogan Way would be warranted. The existing flared layout of The Bogan Way at the intersection is therefore considered sufficient with regard to left turns from The Bogan Way to Fifield-Trundle Road. With the modified Project traffic and assuming private vehicle travel by employees, the dominant movements at the intersection would be the turns between The Bogan Way south and Fifield-Trundle Road, which may suggest altering the priority of the intersection. However, this intersection should be considered together with Scotson Lane, discussed below.

Notwithstanding the above, with the modified Project, there would be a demand for vehicle movements across The Bogan Way between Fifield-Trundle Road and Scotson Lane. Scotson Lane is presently unsealed and slightly offset from Fifield-Trundle Road, and crosses the railway line at a passive level crossing approximately 30m east of the eastern edge of The Bogan Way. The intersection design may either aim to better align Scotson Lane with Fifield-Trundle Road, resulting in a four way intersection, however it is noted that such intersections, with one road having priority, record high crash rates for the through movements from the minor road. The alternative is to form a staggered T-intersection.

The current layout of Scotson Lane and Fifield-Trundle Road suggests that a right-left stagger may be suitable, i.e., vehicles approaching from Scotson Lane and Fifield-Trundle Road must turn right onto The Bogan Way before turning left onto the opposing side road. This type of staggered arrangement is suitable where capacity is not a concern, and may be provided with a basic or channelised right turn treatment in the major road (The Bogan Way). The stagger distance for a right-left stagger on a two lane two way road such as The Bogan Way is important in that it should be small enough to enable an efficient crossing manoeuvre in a single movement (i.e., not staged), yet great enough to eliminate the possibility of high speed crossing manoeuvres from the minor roads (Austroads, 2017a).

In addition to considering the intersection design, the adjacent level crossing would require upgrading to meet current signage and line marking requirements of Australian Standard 1742.7 (2016). The design of the level crossing and intersection of The Bogan Way with Scotson Lane and Fifield-Trundle Road would also need to take into consideration other potential risks including:

- queuing of vehicles from the intersection back across the crossing;
- short stacking, i.e. ensuring the distance between the crossing and the adjacent road interection is long enough to accommodate the largest stationary gazetted vehicles without the rear of the vehicle fouling the track; and
- proximity of the level crossing to the siding, and whether a train in the siding could block the crossing.

To eliminate short stacking risks, a storage length of 25 m would need to be provided in Scotson Lane between The Bogan Way and the level crossing.

7.3.5 Henry Parkes Way and Middle Trundle Road

The modified Project is forecast to contribute the following peak hourly vehicle turning movements at the intersection:

AM Peak Hour

- Left turn from Middle Trundle Road to Henry Parkes Way: 26 light and 1 heavy vehicle
- Right turn from Henry Parkes Way to Middle Trundle Road: 76 light and 2 heavy vehicles
- Westbound on Henry Parkes Way: 4 heavy vehicles
- Eastbound on Henry Parkes Way: 4 heavy vehicles.

PM Peak Hour

- Left turn from Middle Trundle Road to Henry Parkes Way: 76 light and 2 heavy vehicles
- Right turn from Henry Parkes Way to Middle Trundle Road: 26 light and 1 heavy vehicle
- Westbound on Henry Parkes Way: 4 heavy vehicles
- Eastbound on Henry Parkes Way: 4 heavy vehicles.

Henry Parkes Way is forecast to carry 129 vehicles per hour (two way) east of Middle Trundle Road during the busiest hour of the day, excluding Project traffic.

Comparison with the Austroads (2017b) warrants for intersection treatments indicates that basic right turn treatment of Henry Parkes Way would be warranted, which is consistent with its current layout. It is recommended that the shoulder widening required for BAL/BAR treatments be constructed to a sealed surface in place of the existing unsealed shoulders. It is also recommended that signage and line marking at the intersection be upgraded to meet Austroads requirements, including advance warning of the give way signs (W3-2) to encourage lower vehicle speeds due to the angle at which Middle Trundle Road meets Henry Parkes Way.

7.3.6 Henry Parkes Way and The Bogan Way

The modified Project is forecast to contribute the following peak hourly vehicle turning movements at the intersection:

AM Peak Hour

- Left turn from The Bogan Way to Henry Parkes Way: 4 heavy vehicles
- Right turn from Henry Parkes Way to Middle Trundle Road: 4 heavy vehicles.

PM Peak Hour

- Left turn from The Bogan Way to Henry Parkes Way: 4 heavy vehicles
- Right turn from Henry Parkes Way to Middle Trundle Road: 4 heavy vehicles.

Henry Parkes Way is forecast to carry 113 vehicles per hour (two way) east of Bogan Gate during the busiest hour of the day, excluding Project traffic.

The existing intersection of The Bogan Way and Henry Parkes Way has BAL and BAR treatments on Henry Parkes Way, with a wide sealed shoulder for vehicles turning left into The Bogan Way, and a wide unsealed shoulder for westbound vehicles to pass vehicles turning right into The Bogan Way. Comparison with the Austroads (2017b) warrants indicates that the peak hourly volumes resulting from the combination of baseline and Project traffic would remain well below the volumes at which any additional treatment (AUL, CHL or CHR) in Henry Parkes Way would be warranted.

It is recommended that linemarking and signage be improved to meet Austroads requirements as part of ongoing maintenance activities.

7.3.7 The Bogan Way and Middle Trundle Road

The intersection of Middle Trundle Road with The Bogan Way was upgraded in 2013 to cater for access by low volumes of road trains, but did not include any auxiliary lanes. The upgraded intersection was reviewed by Crossroads Civil Design (2014) and deemed suitable due to low volumes. Line marking of the existing intersection has been worn by the movement of heavy vehicles, which means that drivers in Middle Trundle Road have only a limited indication of where to position their vehicle to stop.

The baseline background traffic in 2027 is forecast at peak hourly volumes of 65 vehicles per hour on The Bogan Way (south of Middle Trundle Road) and 20 vehicles per hour on Middle Trundle Road. The modified Project is forecast to contribute the following peak hourly vehicle turning movements at the intersection:

AM Peak Hour

- Southbound on The Bogan Way: 1 light and 4 heavy vehicles
- Left turn from The Bogan Way to Middle Trundle Road: 26 light and 1 heavy vehicle
- Right turn from Middle Trundle Road to The Bogan Way: 76 light and 2 heavy vehicles
- Northbound on The Bogan Way: 2 light and 4 heavy vehicles.

PM Peak Hour

- Southbound on The Bogan Way: 2 light and 4 heavy vehicles
- Left turn from The Bogan Way to Middle Trundle Road: 76 light and 2 heavy vehicles
- Right turn from Middle Trundle Road to The Bogan Way: 26 light and 1 heavy vehicle
- Northbound on The Bogan Way: 1 light and 4 heavy vehicles.

Comparison with the Austroads (2017b) warrants for intersection treatments indicates that further upgrading of the intersection to provide auxiliary lanes would not be warranted with the modified Project traffic. It is recommended that signage and line marking be improved to meet Austroads requirements, including give way signs (R1-2) and advance warning of the give way signs (W3-2) for drivers approaching on Middle Trundle Road.

7.3.8 New Intersections

Two new intersections are required as part of the modified Project:

- Fifield-Trundle Road and the Limestone Quarry access road; and
- Wilmatha Road and the MPF Access Road.

The new intersections would be designed in accordance with Austroads guidelines, including intersection geometry, sight distances, lane width, shoulder widths, signage and line marking.

The forecast movements at the intersection of Fifield-Trundle Road and the Limestone Quarry access road would warrant a basic intersection treatment, with suitable geometry to accommodate the swept path of the trucks which would be used to transport the limestone.

The forecast movements at the intersection of Wilmatha Road and the MPF access road suggest that this intersection may be appropriately designed with Wilmatha Road south and the MPF access road being the main road, and Wilmatha Road north as the minor road. With this layout, a basic rural intersection treatment would be required, with appropriate signage and line marking to clarify the priority.

7.4 Road Maintenance Contributions

The proposed VPA with Lachlan Shire Council requires annual contributions by the owner towards the maintenance of specific routes, including the heavy vehicle transport route, as well as roads which are expected to experience additional light traffic as a result of the Project. Those requirements assume that the Fifield Bypass is not constructed. With the modified Project, the Fifield Bypass would result in changes to the routes used, and it is recommended that the road maintenance requirements be amended accordingly.

It is recommended that the road maintenance contributions be required for the following routes, with the average daily traffic contributed by the modified Project set out in Table 4.4:

- Henry Parkes Way between Jones Lane and Fifield Road;
- Henry Parkes Way between Westlime Road and The Bogan Way;
- Middle Trundle Road between Henry Parkes Way and The Bogan Way;
- The Bogan Way between Henry Parkes Way and Fifield-Trundle Road;
- Fifield-Trundle Road between The Bogan Way and Parkes Shire boundary;
- Platina Road between Lachlan Shire boundary and Fifield Road;
- Fifield Road between Henry Parkes Way and Slee Street (noting that the Project's contribution to future traffic volumes differs north and south of Platina Road);
- Slee Street; and
- Wilmatha Road between Slee Street and MPF access road.

In addition to the above, Clean TeQ would contribute to the maintenance of the proposed water transport route south of the Henry Parkes Way including North Condobolin Road (approximately 8 km), Bedgerabong Road (approximately 15 km), Noakes Road (approximately 7 km) and Yarrabandai Road (approximately 24 km) (the other sections of the proposed water transport route are addressed above) during the short-term road transport of water from the borefield to the mine site. As noted in Section 4.5.1, Clean TeQ would continue to consult with the FSC and the final short-term construction phase water transport route would be determined in consultation with the FSC.

It is proposed that prior to the recommencement of construction of the Project, Clean TeQ would commission a condition assessment of this section of the proposed water transport route in consultation with the FSC. A follow-up condition assessment would be undertaken in consultation with the FSC after the water transport has ceased, to identify sections of the road requiring maintenance works as a result of the short-term road transport of water. Clean TeQ would then undertake these required maintenance works in consultation with the FSC.

7.5 Review of Voluntary Planning Agreement Requirements

Table 7.4 summaries recommended changes to the proposed VPA requirements contained within Appendix 3 of Development Consent DA 374-11-00 as a result of the Modification.

Table 7.4: Summary of Modifications to Development Consent DA 374-11-00 Lachlan Shire Council Requirements

Location	Existing Requirements and Timing	Modified Requirements and Timing
Lachlan Shire Council VPA Road Upgrades[A]		
Platina Road between Lachlan Shire boundary and Fifield Road	Prior to commissioning of the MPF, 8.0 m sealed pavement and 1.0 m gravel shoulders, 3.5 m sealed private access road approach and 3.0 m gravel shoulders 30 m on either side of all private access roads.	No change.
Fifield Road between Platina Road and Slee Street in Fifield Village	Prior to commissioning of the MPF, 8.0 m sealed pavement and 1.0 m gravel shoulders, 3.5 m sealed private access road approach and 3.0 m gravel shoulders 30 m on either side of all private access roads.	No change.
Wilmatha Road between Slee Street and the MPF access road	Prior to commissioning of the MPF, 8.0 m sealed pavement and 1.0 m gravel shoulders, 3.5 m sealed private access road approach and 3.0 m gravel shoulders 30 m on either side of all private access roads.	No change.
Slee Street between Fifield Road and Wilmatha Road	-	It is recommended that a review of the need for upgrading of street lighting and pedestrian facilities on Slee Street in Fifield Village be included.
Sunrise Lane between Wilmatha Road and "Sunrise" access road	-	It is recommended that should the temporary accommodation camp be located at "Sunrise" (subject to separate approval), this road be upgraded. It is recommended that the road be upgraded and maintained for the duration of the construction accommodation camp with a minimum all weather standard for an operating speed standard of 80 km/h and carriageway width of 9 m (equivalent to two 3.5 m lanes and two 1.0 m wide shoulders).
Lachlan Shire Council VPA Intersection Upgrades[A]		
Platina Road and Fifield Road	Prior to commissioning of the MPF, upgrade signage and line marking in accordance with relevant Austroads requirements.	No change.
Fifield Road and Slee Street	Prior to commissioning of the MPF, upgrade signage and line marking in accordance with relevant Austroads requirements.	No change.
Slee Street, Wilmatha Road and Fifield Road	Prior to commissioning of the MPF, upgrade signage and line marking in accordance with relevant Austroads requirements, including installation of advance warning signs on Slee Street, Fifield Road and Wilmatha Road approaches.	No change.

Location	Existing Requirements and Timing	Modified Requirements and Timing
Wilmatha Road and Sunrise Lane	-	It is recommended that should the temporary accommodation camp be located at "Sunrise" (subject to separate approval), this intersection be upgraded. It is recommended that the intersection of Wilmatha Road and Sunrise Lane be upgraded as part of upgrading of Sunrise Lane to remove the transition between the gravel and dirt surfaces while Wilmatha Road remains unsealed, and by sealing a minimum of 30 m of Sunrise Lane on the approach to the intersection when Wilmatha Road is sealed.
Lachlan Shire Council VPA Road Safety Audit		
Henry Parkes Way between Jones Lane and Fifield Road; Fifield Road between Henry Parkes Way and Slee Street; Fifield Road between Slee Street and Red Heart Road; Platina Road between Lachlan Shire boundary and Fifield Road; Slee Street between Fifield Road and Wilmatha Road; Wilmatha Road between Slee Street and Melrose Plains Road; Springvale Road between Fifield Road and Melrose Plains Road; Melrose Plains Road between Springvale Road and 4.65km after the Melrose Plains Road/Back Tullamore Road intersection.	Prior to commissioning of the limestone quarry and/or rail siding, the owner shall pay for a road safety audit to determine road upgrade requirements on specified roads, including intersections and rail crossings. The road safety audit must also determine if the Fifield Bypass is required. Prior to commissioning of the limestone quarry and/or rail siding, the owner shall pay for the road upgrades identified in the road safety audit and agreed with the LSC. The road safety audit must also determine if the Fifield Bypass is required.	It is recommended that the following road be added as it is expected to be used by modified Project traffic: o Fifield Road between Red Heart Road and the Lachlan Shire Boundary. It is recommended that the following roads be removed as they are not expected to be impacted by the modified Project: o Wilmatha Road between the MPF access and Melrose Plains Road; o Springvale Road between Fifield Road and Melrose Plains Road; and o Melrose Plains Road between Springvale Road and 4.65km after the Melrose Plains Road/Back Tullamore Road intersection.
Lachlan Shire Council VPA Road Maintenance		
Platina Road between Lachlan Shire boundary and Fifield Road; Fifield Road between Platina Road and Slee Street; Slee Street between Fifield Road and Wilmatha Road; and Wilmatha Road between Slee Street and MPF access road.	The owner shall make annual contributions to LSC towards the maintenance of the specified roads associated with the heavy vehicle transport route.	It is recommended that the following road be added as it is expected to be used by modified Project heavy vehicle traffic: o Fifield Road between Slee Street and the Lachlan Shire Boundary.
Fifield Road between Henry Parkes Way and Platina Road; and Henry Parkes Way between Jones Lane and Fifield Road.	The owner shall make annual contributions to LSC towards the maintenance of the specified roads that are likely to experience additional light vehicle traffic.	No change.

^ A road construction programme detailing timing and scheduling of these upgrades to be prepared in consultation with Lachlan Shire Council prior to commencement of construction

Table 7.5 summaries recommended changes to the proposed Parkes Shire Council VPA requirements contained within Appendix 3 of Development Consent DA 374-11-00.

Table 7.5: Summary of Modifications to Development Consent DA 374-11-00 Parkes Shire Council Requirements

Location	Existing Requirements and Timing	Modified Requirements and Timing
Parkes Shire Council VPA Road Upgrades[A]		
Fifield-Trundle Road between The Bogan Way and the Parkes Shire boundary	Prior to commissioning of the Mine and processing facility, 8.0 m sealed pavement and 1.0 m gravel shoulders, 3.5 m sealed private access road approach and 3.0 m gravel shoulders 30 m on either side of all private access roads.	No change.
Parkes Shire Council VPA Intersection Upgrades[A]		
The Bogan Way and Fifield-Trundle Road	Prior to commissioning of the Mine and processing facility, upgrade signage and line marking in accordance with Austroads requirements including installation of "give way" signs on Fifield-Trundle Road.	No change.
Parkes Shire Council VPA Road Safety Audit		
Henry Parkes Way between Westlime Road and The Bogan Way; Middle Trundle Road between Henry Parkes Way and The Bogan Way; The Bogan Way between Henry Parkes Way and Fifield Road; and Fifield-Trundle Road between The Bogan Way and the Parkes Shire boundary.	Prior to commissioning of the limestone quarry and/or rail siding, the owner shall pay for a road safety audit to determine road upgrade requirements on the specified roads, including intersections and rail crossings. The owner shall pay for the road upgrades identified in the road safety audit and agreed with PSC.	It is recommended that the following roads be added as they are expected to be used by modified Project traffic: o Fifield Road between the Parkes Shire Boundary and The Bogan Way; o The Bogan Way (Cardigan Street) between Fifield Road and The McGrane Way; and o The McGrane Way between The Bogan Way and the Parkes Shire Boundary.
Parkes Shire Council VPA Road Maintenance		
Henry Parkes Way between Westlime Road and The Bogan Way; Middle Trundle Road between Henry Parkes Way and The Bogan Way; The Bogan Way between Henry Parkes Way and Fifield-Trundle Road; and Fifield-Trundle Road between The Bogan Way and the Parkes Shire boundary	The owner shall make annual contributions to PSC towards the maintenance of the specified roads associated with the heavy vehicle transport route.	It is recommended that the following roads be added as they are expected to be used by modified Project heavy vehicle traffic: o Fifield Road between the Parkes Shire Boundary and The Bogan Way; o The Bogan Way (Cardigan Street) between Fifield Road and The McGrane Way; and o The McGrane Way between The Bogan Way and the Parkes Shire Boundary.

[A] A road construction programme detailing timing and scheduling of these upgrades to be prepared in consultation with Parkes Shire Council prior to commencement of construction

8. Conclusions

This study has found that the Modification would have acceptable impacts on the operation of the surrounding road system. No significant impacts on the performance, capacity, efficiency and safety of the road network is expected to arise as a result of the traffic associated with the Modification, with the implementation of the following management or mitigation measures:

- Consistent with the Lachlan Shire Council VPA terms in Appendix 3 of Development Consent DA 374-11-00, upgrading of the heavy vehicle access route between the MPF and the rail siding to 8.0 m sealed pavement with 1.0 m unsealed shoulders on each side. Private access roads to be upgraded to 3.5 m wide sealed approach with 3.0 m wide gravel shoulders on the main road for a minimum of 30 m each side of the minor access. The heavy vehicle access route for the modified Project includes:
  - MPF Access Road;
  - Wilmatha Road between MPF Access Road and Slee Street;
  - Slee Street;
  - Fifield Road between Slee Street and Platina Road;
  - Platina Road between Fifield Road and Lachlan Shire boundary;
  - Fifield-Trundle Road between Parkes Shire boundary and The Bogan Way;
  - The Bogan Way between Fifield-Trundle Road and Scotson Lane; and
  - Scotson Lane between The Bogan Way and the rail siding.
- Consistent with the VPA terms in Appendix 3 and Appendix 5 of Development Consent DA 374-11-00, the following upgrades to intersections are recommended:
  - Platina Road and Fifield Road – upgrade requirements subject to provision of shuttle bus service for employees, to Austroads standards;
  - Fifield Road and Slee Street (East) – signage and line marking to Austroads standards, as part of heavy vehicle route upgrade;
  - Fifield Road, Slee Street (West) and Wilmatha Road – signage and line marking to Austroads standards as part of heavy vehicle route upgrade;
  - The Bogan Way, Fifield-Trundle Road and Scotson Lane – right-left staggered T-intersections with signage and line marking to Austroads standards, prior to commissioning of the rail siding;
  - Henry Parkes Way and Middle Trundle Road – signage and line marking, upgrade shoulders on Henry Parkes Way to sealed surface in accordance with Austroads guidelines for basic rural intersection treatments;
  - Henry Parkes Way and The Bogan Way– signage and line marking to Austroads standards;
  - The Bogan Way and Middle Trundle Road – signage and line marking to Austroads standards;
  - Fifield-Trundle Road and Limestone Quarry access – basic rural intersection treatment; and
  - Wilmatha Road and MPF access road – basic rural intersection treatment with priority between MPF access and Wilmatha Road south.
- Consistent with the VPA terms in Appendix 3 of Development Consent DA 374-11-00, road maintenance contributions to be agreed for:
  - Henry Parkes Way between Jones Lane and Fifield Road;
  - Henry Parkes Way between Westlime Road and The Bogan Way;

- Middle Trundle Road between Henry Parkes Way and The Bogan Way;
  - The Bogan Way between Henry Parkes Way and Fifield-Trundle Road;
  - Fifield-Trundle Road between The Bogan Way and Parkes Shire boundary;
  - Platina Road between Lachlan Shire boundary and Fifield Road;
  - Fifield Road between Henry Parkes Way and Slee Street;
  - Slee Street; and
  - Wilmatha Road between Slee Street and MPF access road.
- Consistent with Condition 44, Schedule 3 of Development Consent DA 374-11-00, development of a Road Upgrade and Maintenance Strategy.
- Consistent with Condition 46, Schedule 3 of Development Consent DA 374-11-00, development of a Traffic Management Plan.
- In addition to the VPA terms in Appendix 3 and Appendix 5 of Development Consent DA 374-11-00, the following measures are recommended:
  - road maintenance contributions to be agreed for Fifield Road between Slee Street and the Lachlan Shire boundary; Fifield Road between Parkes Shire boundary and The Bogan Way, The Bogan Way (Cardigan Street) between Fifield Road and The McGrane Way, and The McGrane Way between The Bogan Way and the Parkes Shire boundary;
  - the need for upgrading of street lighting and pedestrian facilities on Slee Street in Fifield by reviewed, and upgrades undertaken as required;
  - road maintenance contribution to the proposed water transport route south of the Henry Parkes Way including North Condobolin Road, Bedgerabong Road, Noakes Road and Yarrabandai Road during the short-term road transport of water from the borefield to the mine site;
  - Sunrise Lane between Wilmatha Road and the access to "Sunrise" be upgraded and maintained for the duration of the construction accommodation camp at "Sunrise" (subject to separate approval), consistent with a Class 4A unsealed road, with a minimum all weather standard for an operating speed standard of 80 km/h and carriageway width of 9 m (equivalent to two 3.5 m lanes and two 1.0 m wide shoulders); and
  - the intersection of Wilmatha Road and Sunrise Lane be upgraded (subject to the separate approval of the Sunrise accommodation camp) as part of upgrading of Sunrise Lane (above) to remove the transition between the gravel and dirt surfaces while Wilmatha Road remains unsealed, and by sealing a minimum of 30 m of Sunrise Lane on the approach to the intersection when Wilmatha Road is sealed.

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CLEAN TEQ
Powering innovation

Syerston Project

MODIFICATION 4 ENVIRONMENTAL ASSESSMENT

Appendix F

Aboriginal Cultural Heritage Assessment

Syerston Project – Modification 4

Aboriginal Cultural Heritage Assessment

Report to Clean TeQ Holdings Limited
26 October 2017

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Clean TeQ Holdings Limited

Syerston Project – Modification 4

Aboriginal Cultural Heritage Assessment

Local Government Area: Lachlan

Nearest Town: Fifield

Landskape

Natural and Cultural Heritage Management

a division of M.L. Cupper Pty Ltd

ABN: 48 107 932 918

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EXECUTIVE SUMMARY

Scandium21 Pty Ltd is the proponent of the approved (but yet to be developed) Syerston Project (the Project), near Fifield, approximately 60 kilometres north of Condobolin in central western New South Wales (**Figures 1** and **2**). Scandium21 Pty Ltd is a wholly owned subsidiary of Clean TeQ Holdings Limited ("Clean TeQ"). The Project is a greenfield site with the capacity to sustain a 2.5 million tonnes per annum autoclave feed rate over a minimum 21 year mine life. The Project is contained largely within Exploration Licence 4573 and Mining Lease Applications 113, 132, 139, 140, 141.

The approved Project includes the establishment and operation of the nickel cobalt scandium mine and processing facility, limestone quarry and processing facility, rail loading and unloading facility, natural gas pipeline, borefields and water pipeline, and associated road infrastructure upgrades. Open cut mining and processing of ore to produce up to 180 tonnes per annum (tpa) of scandium oxide and 40,000 tpa of nickel and cobalt metal equivalents (as either sulphide or sulphate precipitate products) are approved at the mine processing facility.

An Environmental Impact Statement (EIS) was prepared in late 2000 by then-proponent Black Range Minerals, as a requirement to apply for Development Consent for the Project. The existing environment, potential environmental impacts, mitigation measures and environmental management, rehabilitation and monitoring strategies associated with the approved Project are documented in the EIS. An archaeological investigation (Appleton, 2000) was prepared as part of the EIS. The Project was granted Development Consent (DA 374-11-00) in May 2001, with several modifications since that time.

Clean TeQ is seeking to modify the existing Development Consent (DA 374-11-00) to (amongst other elements) reconfigure the approved borefield arrangement and to supplement the water supply for the approved Syerston Project by extracting surface water from the Lachlan River. As part of this development proposal, Clean TeQ is also seeking approval for a modified pipeline arrangement through the town of Fifield. This proposal is herein referred to as "the Modification". To this end, Clean TeQ commissioned Landskape Natural and Cultural Heritage Management to undertake an Aboriginal Cultural Heritage Assessment of the Modification.

This report presents an assessment of the Aboriginal cultural heritage related issues for the Modification in accordance with the relevant requirements of the various advisory documents and guidelines.

No Aboriginal cultural heritage sites have previously been recorded in or near the Modification area and the present survey did not encounter any additional items or sites of Aboriginal cultural heritage significance.

Based on the results of this cultural heritage investigation and consultation with representatives of the Registered Aboriginal Parties (RAPs) the following is recommended:

- The Modification be allowed to proceed because the areas proposed for development are located in areas where harm to Aboriginal cultural heritage will be avoided.
- The wider landscape setting of the Modification presents a low risk of activities harming previously unidentified Aboriginal cultural heritage, but any future variations to the footprint of the Modification should be preceded by an appropriate level of assessment/investigation.
- In the unlikely event that human skeletal remains are encountered during the course of activities associated with the Modification, all work in that area must cease. Remains must not be handled or otherwise disturbed except to prevent further disturbance. If the remains are thought to be less than 100 years old, the Police or the State Coroner's Office (tel: 02 9552 4066) must be notified. If there is reason to suspect that the skeletal remains are more than 100 years old and of Aboriginal origin, Clean TeQ should contact the Office of Environment and Heritage's (OEH's) Environmental Line (tel: 131 555) for advice. In the unlikely event that an Aboriginal burial is encountered, strategies for its management would need to be developed with the involvement of the local Aboriginal community.

- A Heritage Management Plan (HMP), which outlines the management and mitigation measures for Aboriginal cultural heritage, should be prepared for the Syerston Project in consultation with the Aboriginal community and the OEH and should incorporate the Modification and the recommendations of this assessment. The HMP should continue to remain active for the life of the Modification and define the tasks, scope and conduct of all Aboriginal cultural heritage management activities.
- Clean TeQ should continue to provide training to all on-site personnel regarding the HMP strategies relevant to their employment tasks.
- Clean TeQ should continue to involve the RAPs and any other relevant Aboriginal community groups or members in matters pertaining to the Modification.

1 INTRODUCTION

Scandium21 Pty Ltd is the proponent of the approved (but yet to be developed) Syerston Project (the Project), near Fifield, approximately 60 kilometres (km) north of Condobolin in central western New South Wales (NSW) (**Figures 1** and **2**). Scandium21 Pty Ltd is a wholly owned subsidiary of Clean TeQ Holdings Limited ("Clean TeQ"). The Project is a greenfield site with the capacity to sustain a 2.5 million tonnes per annum (Mtpa) autoclave feed rate over a minimum 21 year mine life. The Project is contained largely within Exploration Licence (EL) 4573 and Mining Lease Applications (MLA) 113, 132, 139, 140, 141.

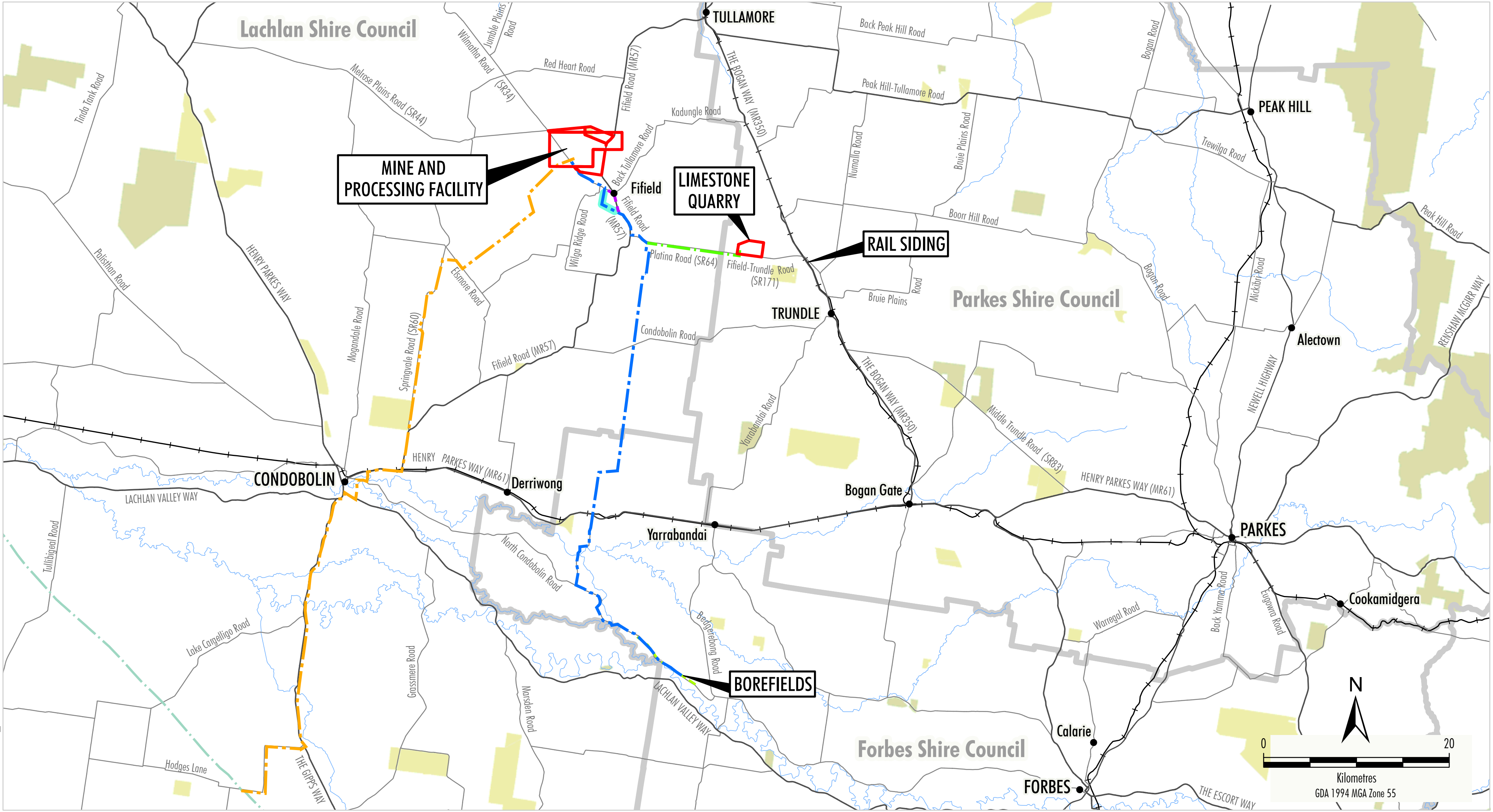
The approved Project includes the establishment and operation of the nickel cobalt scandium mine and processing facility, limestone quarry and processing facility, rail loading and unloading facility, natural gas pipeline, borefields and water pipeline, and associated road infrastructure upgrades. Open cut mining and processing of ore to produce up to 180 tonnes per annum (tpa) of scandium oxide and 40,000 tpa of nickel and cobalt metal equivalents (as either sulphide or sulphate precipitate products) are approved at the mine processing facility.

An Environmental Impact Statement (EIS) was prepared in late 2000 by then-proponent Black Range Minerals, as a requirement to apply for Development Consent for the Project. The existing environment, potential environmental impacts, mitigation measures and environmental management, rehabilitation and monitoring strategies associated with the approved Project are documented in the EIS. An archaeological investigation (Appleton, 2000) was prepared as part of the EIS. The Project was granted Development Consent (DA 374-11-00) in May 2001, with several modifications since that time.

Clean TeQ is seeking to modify the existing Development Consent (DA 374-11-00) to (amongst other elements) reconfigure the approved borefield arrangement and to supplement the water supply for the approved Syerston Project by extracting surface water from the Lachlan River. As part of this development proposal, Clean TeQ is also seeking approval for a modified pipeline arrangement through the town of Fifield. This proposal is herein referred to as "the Modification". To this end, Clean TeQ commissioned Landskape Natural and Cultural Heritage Management (Landskape) to undertake an Aboriginal Cultural Heritage Assessment (ACHA) of the Modification.

This report presents an assessment of the Aboriginal cultural heritage related issues for the Modification in accordance with the relevant requirements of the various advisory documents and guidelines. These guidelines and documents include (but are not limited to):

- *Aboriginal cultural heritage consultation requirements for proponents 2010* (Part 6 *National Parks and Wildlife Act, 1974* [NP&W Act]) (Consultation Guidelines) (NSW Department of Environment, Climate Change and Water [DECCW], 2010a).
- *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCW, 2010b).
- *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (NSW Office of Environment and Heritage [OEH], 2011).
- *The Burra Charter: The Australia ICOMOS Charter for the Conservation of Places of Cultural Significance* (Australia International Council on Monuments and Sites [ICOMOS], 2013).
- *Aboriginal Cultural Heritage: Standards and Guidelines Kit* (NSW National Parks and Wildlife Service, 1997).
- *Ask First: A Guide to Respecting Indigenous Heritage Places and Values* (Australian Heritage Commission, 2002).
- *NSW Minerals Industry Due Diligence Code of Practice for the Protection of Aboriginal Objects* (NSW Minerals Council, 2010).



LEGEND

- National Park/Conservation Area
- State Forest
- Local Government Boundary
- Existing Gas Pipeline
- Mining Lease Application Boundary
- Approved Water Pipeline
- Approved Limestone Quarry Water Pipeline
- Approved Gas Pipeline
- Approved Borefield Infrastructure Corridor
- Modified Water Pipeline Alignment Option
- Approved Fifield Bypass

Source: Black Range Minerals (2000); NSW Department of Industry (2017); NSW Land & Property Information (2017); Office of Environment and Heritage NSW (2107)

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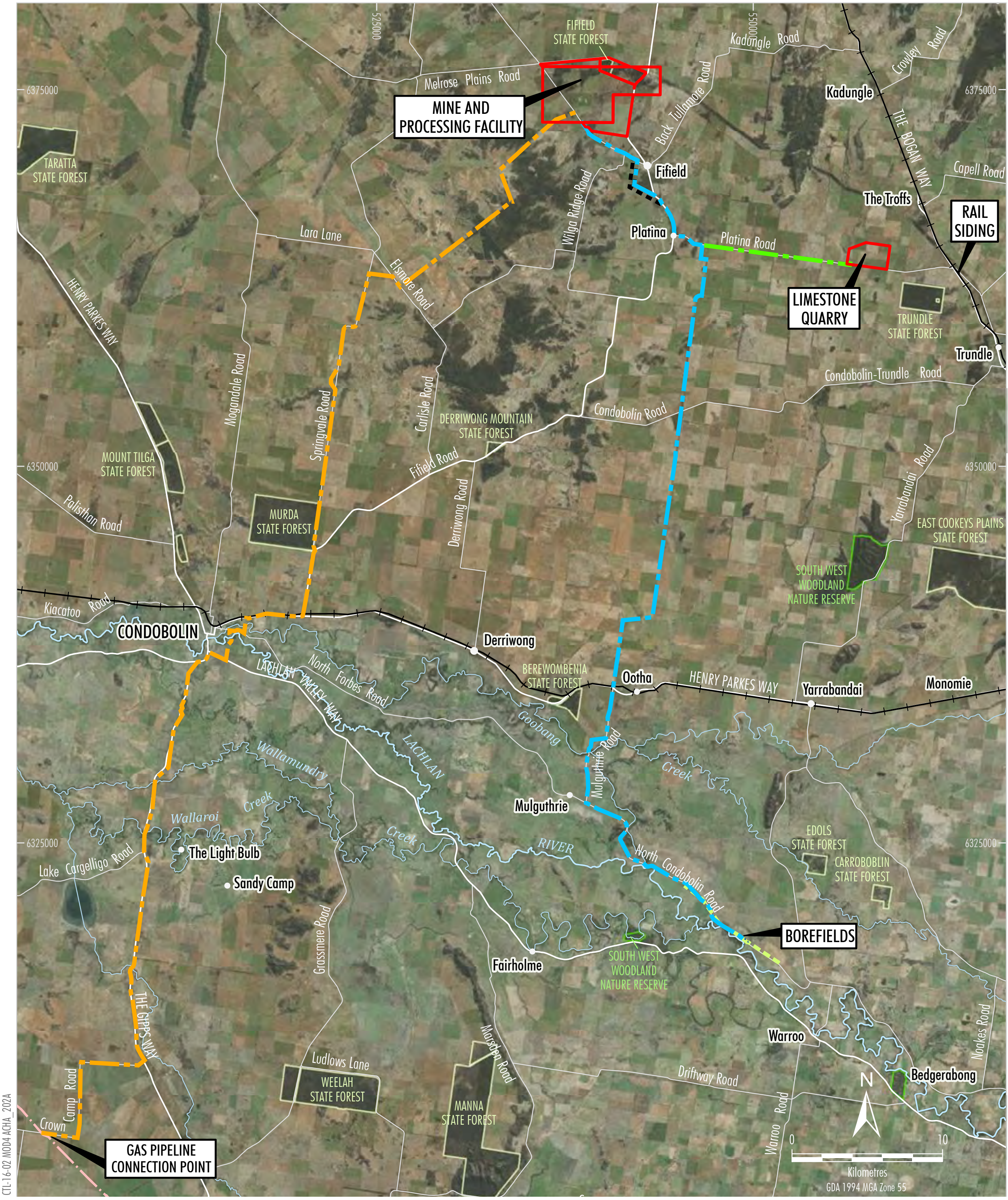
SYERSTON PROJECT MODIFICATION 4

Regional Location

Figure 1



LEGEND

- NSW National Parks and Wildlife Service
- State Forest
- Railway
- Existing Gas Pipeline
- Mining Lease Application Boundary
- Approved Gas Pipeline
- Approved Water Pipeline
- Approved Limestone Quarry Water Pipeline
- Approved Borefield Infrastructure Corridor
- Fifield Bypass

Source: Black Range Minerals (2000); NSW Department of Industry (2017); NSW Land and Property Information (2017); Office of Environment and Heritage NSW (2017) World Imagery: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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SYERSTON PROJECT MODIFICATION 4

Approved Syerston Project

Figure 2

- *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (DECCW, 2010c).

This ACHA would be used to support an application for an Aboriginal Heritage Impact Permit (AHIP) under section 90 of the NP&W Act (and/or a variation application to the existing approved AHIP #C0003049).

1.1 OBJECTIVES OF STUDY

The specific objectives of the ACHA were to:

- consult the local Aboriginal community to identify any concerns they may have (consultation with the Aboriginal community followed the requirements of the Consultation Guidelines [DECCW, 2010a]);
- conduct a desktop assessment (including heritage register searches) to delineate areas of known and predicted Aboriginal cultural heritage within the Modification area;
- undertake a stratified archaeological survey of known and predicted Aboriginal cultural heritage identified in the desktop assessment with representatives of the local Aboriginal community;
- record any Aboriginal cultural heritage sites within the Modification area and assess their significance;
- identify the nature and extent of approved impacts of the Modification on Aboriginal cultural heritage; and
- develop measures in consultation with the Aboriginal community to avoid or mitigate potential impacts of the approved Modification on Aboriginal cultural heritage places and objects.

Preparation of this report involved collation of relevant archival, archaeological, historical and environmental information and the use of aerial photographs and topographic and geomorphic maps to identify areas likely to contain Aboriginal cultural heritage sites.

1.2 STRUCTURE OF THIS REPORT

This ACHA has been prepared in consideration of the requirements of the *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCW, 2010b) and as such includes the following specific information:

Section 1: Outlines the Modification and the objectives and structure of this report.

Section 2: Lists the investigators and contributors involved with this report.

Section 3: Provides a summary description of the Modification and the Modification area being considered in this ACHA.

Section 4: Details the consultation and partnership with the Aboriginal community.

Section 5: Outlines the landscape context and includes descriptions of land use history, geology and vegetation within the Modification area.

Section 6: Provides background information and a description of previous archaeological works, including relevant ethno-history, the regional archaeological context and previous predictive models developed for the Modification area.

Section 7:	Describes the current predictive model for the Modification area including archaeological survey and data collection, information regarding the method of the survey and a description of the areas surveyed. The results of the survey area are presented in this section. Also provides a consideration of cultural values/significance.
Section 8:	Assesses the impact of the approved Modification on Aboriginal cultural heritage.
Section 9:	Describes the management, mitigation measures and recommendations.
Section 10:	Provides a summary of the recommendations.
Section 11:	Lists the references cited in this report.
Appendix 1:	Provides a glossary of commonly used terms in this report.
Appendix 2:	Provides a log of consultation carried out for the Modification relevant to Aboriginal cultural heritage.
Appendix 3:	Provides a summary of correspondence to Aboriginal community stakeholders.
Appendix 4:	Provides a summary of correspondence from Aboriginal community stakeholders.
Appendix 5:	Provides the Aboriginal Heritage Information Management System (AHIMS) Register search results.
Appendix 6:	Provides relevant cadastre information and survey unit mapping.

2 INVESTIGATORS AND CONTRIBUTORS

Landskape was commissioned by Clean TeQ to complete the ACHA for the Modification and to prepare this report.

Dr Matt Cupper, a qualified archaeologist and geoscientist with 18 years' experience as a cultural heritage advisor, was Landskape's project archaeologist for the Modification.

The field investigation for the modification was undertaken in two campaigns. The first archaeological field investigation for the Modification was completed on 23 February 2016 by the project archaeologist Dr Matt Cupper. This inspection focused on the proposed modified pipeline corridor through the village of Fifield.

The second archaeological field investigation for the Modification was completed over one day on 22 March 2017 by project archaeologist Dr Matt Cupper, with the assistance of the following Aboriginal community representatives: Rebecca Shepherd and Adam Dargin (Murie Elders Group) and Cecil Coe and Eugene Coe (Wiradjuri Condobolin Corporation). The field surveys were completed as part of a broader survey program being undertaken for the approved Project.

Community consultation pursuant to the Consultation Guidelines (DECCW, 2010a) was managed by Clean TeQ.

3 DESCRIPTION OF THE MODIFICATION

3.1 THE APPROVED PROJECT

Development Consent (DA 374-11-00) for the Syerston Project was issued under Part 4 of NSW *Environmental Planning and Assessment Act, 1979* (EP&A Act) in 2001. The Development Consent (DA 374-11-00) has been modified on three occasions since it was issued:

- 2005 – to allow for the increase of run-of-mine ore processing rate, limestone quarry extraction rate and adjustments to ore procession operations.
- 2006 – to allow for the reconfiguration of the water supply borefield.
- 2017 – to allow for an initial scandium oxide focused production phase prior to refocusing on nickel and cobalt precipitate production by developing the full Project with additional scandium oxide production.

The approved Project is presented on **Figure 2** and includes the establishment and operation of the following:

- nickel cobalt scandium mine and processing facility;
- limestone quarry and processing facility;
- rail loading and unloading facility;
- natural gas pipeline;
- borefields and water pipeline; and
- associated transport and infrastructure (including the approved Fifield Bypass and materials transport route upgrades).

3.2 THE MODIFICATION

The approved Project includes (among other elements) the establishment and operation of borefields and a water pipeline. Clean TeQ is seeking modification of the development consent to supplement the water supply for the Syerston Project by extracting surface water via a pump station on the Lachlan River. Associated infrastructure includes a transfer station and connecting pipelines totalling approximately 400 metres (m) in length (**Figure 2**).

As part of the modification, Clean TeQ will also be seeking approval for a modified water pipeline alignment. In the event that Clean TeQ elects not to develop the currently approved Fifield Bypass, the water pipeline would require realignment through the Fifield township.

Clean TeQ are seeking to engage with the Aboriginal community as part of the preparation of an ACHA. This ACHA would be used to support an application for an AHIP under section 90 of the NP&W Act (and/or a variation application to the existing approved AHIP #C0003049). Consultation with Aboriginal people and communities will be guided by the Consultation Guidelines (DECCW, 2010a).

The Modification is proposed to commence as soon as practicable after all necessary approvals have been obtained and any pre-requisite conditions filled.

3.3 THE MODIFICATION AREA

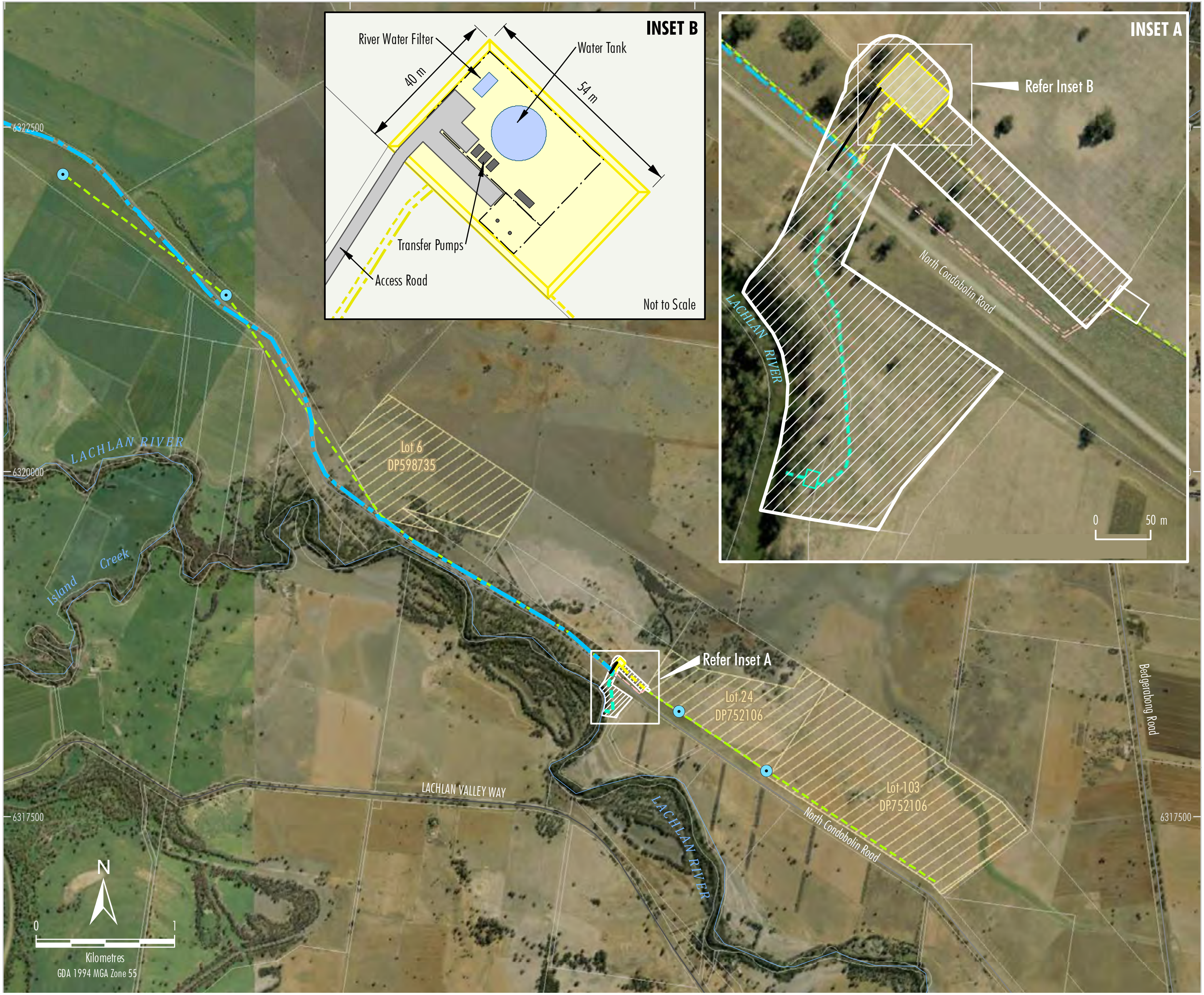
For assessment purposes, the Modification area has been separated into two key components, including the following:

- Modified borefield area (**Figure 3**).
- Modified Fifield pipeline realignment area (**Figure 4**).

In relation to the modified borefield area, Clean TeQ is seeking to modify the location of the approved transfer station (and augmentations to the water pipeline and linking pipeline) and to install new infrastructure to allow for surface water extraction from the Lachlan River (including a pump station, access road and pump station pipeline). The exact locations of the infrastructure will be flexible, and may be located anywhere within the zone indicated on **Figure 4**. Although disturbance will be limited where possible, it has been conservatively assumed in this assessment that disturbance may occur anywhere within the extent of the areas shown (presented on **Figure 4**) and hence the AHIP application (and/or variation application) would be made to allow for the entire extent of this area.

In relation to the modified Fifield pipeline realignment, it is noted that disturbance would be limited to within the extent of the existing road reserves.

As described above, Clean TeQ will seek an application for an AHIP for the Modification area (and/or a variation application to the existing approved AHIP #C0003049), including all portions of land described above and affected by the components of the Modification.



LEGEND

Property Boundary

Approved Project

- Transfer Station
- Water Pipeline
- Borefield Infrastructure Corridor *
- Potential Borefield Location
- Approximate Location of Production Bore (not constructed)

Modified Project

- Transfer Station
- Pump Station
- Access Road
- Water Pipeline
- Borefield Infrastructure Corridor *
- Surface Water Infrastructure Corridor *
- Approved Water Pipeline Section no longer required
- Approved Borefield Infrastructure Corridor section no longer required
- Study Area

* Infrastructure Corridor includes linking pipline, access road and electricity transmission line.

Source: NSW Land & Property Information (2017); Ivanplats Syerston (2005)
NSW Imagery: © Department of Finance, Services & Innovation (2017)

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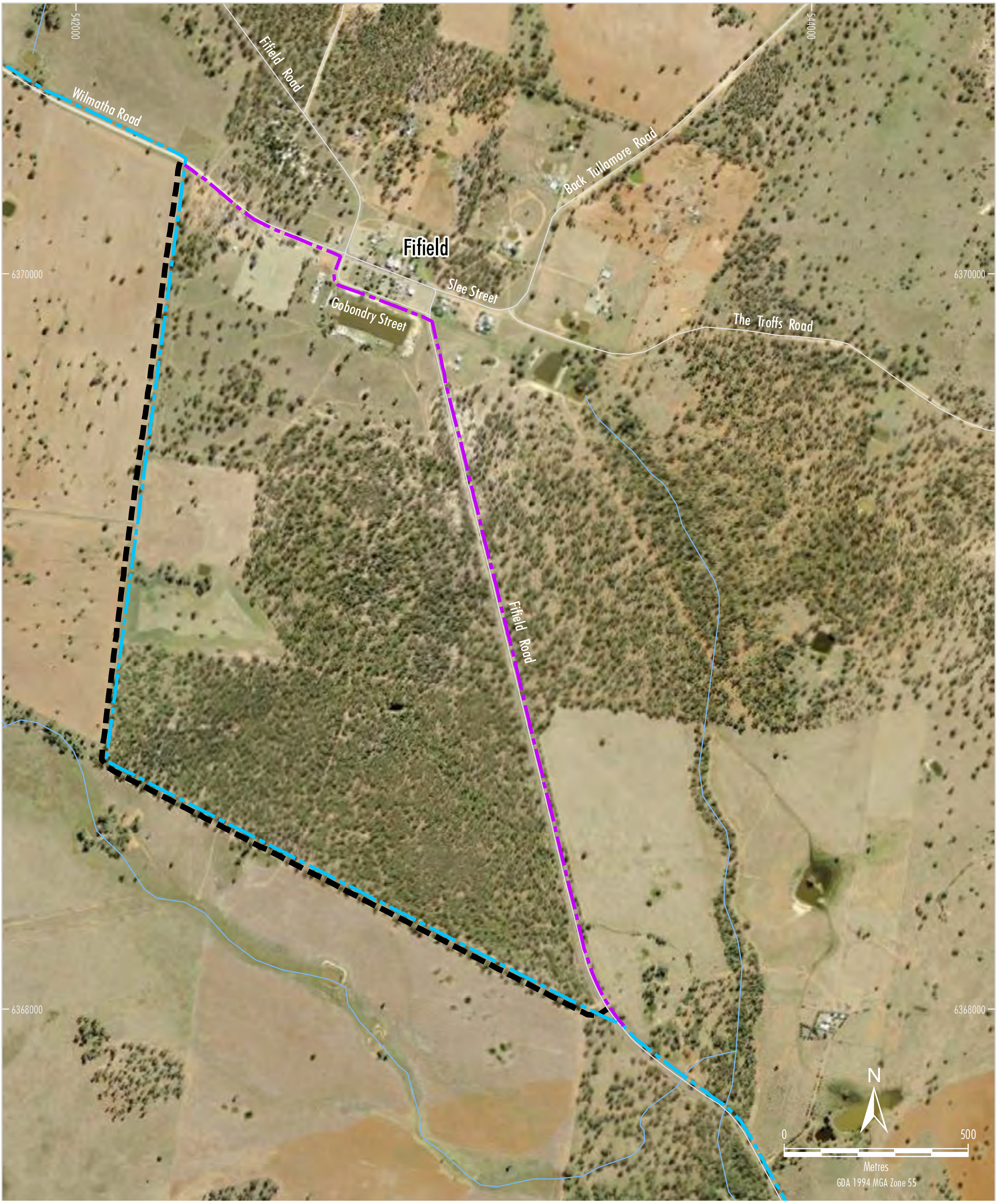
SYERSTON PROJECT MODIFICATION 4

Modified Borefields General Arrangement

Figure 3

CTL-16-02 MOD4 ACHA_203C



LEGEND
- Approved Fifield Bypass
- Approved Water Pipeline
- Modified Water Pipeline

Source: Black Range Minerals (2000); NSW Land & Property Information (2015)
NSW Imagery: © Department of Finance, Services & Innovation (2017)

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SYERSTON PROJECT

Modified Water Pipeline Alignment

Figure 4

4 ABORIGINAL COMMUNITY CONSULTATION

4.1 INTRODUCTION

Consultation with the Aboriginal community for the Modification was undertaken in accordance with the Consultation Guidelines (DECCW, 2010a), and the NSW *National Parks and Wildlife Regulation, 2009* (NP&W Regulation).

Accordingly, this assessment has involved the appropriate representatives of the local Aboriginal community and considered their cultural values and concerns. The following sections describe consultation undertaken with the Aboriginal community and demonstrate that the input of the involved Aboriginal community representatives has been considered.

The Consultation Guidelines (DECCW, 2010a) outline a four stage consultation process that includes detailed guidance as to the aim of each consultation stage and what actions are necessary for it to be successfully completed. These four stages include the following:

- Stage 1 – Notification of Modification proposal and registration of interest.
- Stage 2 – Presentation of information about the proposed Modification.
- Stage 3 – Gathering information about the cultural significance.
- Stage 4 – Review of draft ACHA report.

It is noted that community consultation was undertaken previously as part of the archaeological investigation prepared to support the original EIS for the approved Project (Appleton, 2000) and as part of the Modification to the borefield (Modification 2) (Appleton, 2005). Notwithstanding, this consultation was undertaken prior to the implementation of relevant guidelines and regulations, and hence, Clean TeQ has commissioned Landskape to prepare a contemporary assessment including consultation with the local Aboriginal community in accordance with the Consultation Guidelines (DECCW, 2010a) and the NP&W Regulation.

4.2 REGISTRATION PROCESS

In accordance with section 4.1.2 of the Consultation Guidelines (DECCW, 2010a), Modification notifications (**Appendix 3**) were sent on 2 December 2016 to the following organisations:

- Central West Local Land Services;
- Condobolin Local Aboriginal Land Council (LALC);
- Lachlan Shire Council
- National Native Title Tribunal;
- Native Title Services Corporation Limited (NTSCORP);
- OEH;
- Office of the Registrar, NSW *Aboriginal Land Rights Act, 1983; and*
- Peak Hill LALC.

Responses to the Modification notifications were received from the following organisations (**Appendix 4**):

- Office of the Registrar, of the NSW *Aboriginal Land Rights Act, 1983* (6 December 2016);
- OEH (9 December 2016);
- National Native Title Tribunal (14 December 2016); and
- Lachlan Shire Council (18 January 2017).

As a result of contacting the relevant organisations, a number of individuals and groups were identified as potentially having an interest in the Modification. An invitation was sent out to each individual/group inviting Aboriginal persons or groups who hold cultural knowledge relevant to, or who have right or interest in, determining the cultural heritage significance of Aboriginal object(s) and/or place(s) in the “Area of Interest” to register an interest in the Modification on 6 January and 18 January 2017 (**Appendix 3**).

In addition, public notices inviting the registration of Aboriginal persons or groups who hold cultural knowledge relevant to, or who have a right or interest in, determining the cultural heritage significance of Aboriginal object(s) and/or place(s) in the “Area of Interest” were published in the Condobolin Argus on 18 January 2017 and the Koori Mail on 11 January 2017 (**Appendix 3**).

A copy of the list of the Registered Aboriginal Parties (RAPs) for the Modification, along with a copy of the written notifications and the public notice, were provided to the OEH, the Condobolin LALC and the West Wyalong LALC on 22 February 2017, in accordance with section 4.1.6 of the Consultation Guidelines (DECCW, 2010a).

As a result of the registration process undertaken for the Modification, a total of seven RAPs have registered an interest in the Modification[1], including:

- Wiradjuri Condobolin Corporation.
- Murie Elders Group.
- Binjang Wellington Wiradjuri Aboriginal Heritage Survey.
- West Wyalong LALC.
- Condobolin LALC.
- Louise Davis.
- Peter Peckham.

A consultation log detailing all Aboriginal community consultation undertaken for the Modification is provided in **Appendix 2**. A copy of relevant written correspondence sent to and received from the RAPs is provided in **Appendices 3** and **4**.

[1] The Forbes Aboriginal & Community Working Party were originally registered as stakeholders for the consultation process, however at a later date they advised Clean TeQ that they did not wish to be included in the Aboriginal consultation process going forward, and hence have not been described further in this report.

4.3 PROPOSED METHODOLOGY AND INFORMATION SESSION

Information regarding the Modification was provided in writing to all RAPs on 14 February 2017. A copy of the Proposed Methodology was provided for review and comment (**Appendix 3**).

A minimum of 28 days was allowed for the RAPs to provide input in regards to the following aspects:

- The nature of the Proposed Methodology.
- Any Aboriginal objects or places of cultural value within the Modification area, or issues of cultural significance.
- Any restrictions or protocols considered necessary in relation to any information of sensitivity that may be provided.
- Any other factors considered to be relevant to the ACHA.

Correspondence that included an invitation to attend an information session regarding the ACHA for the Modification was provided in writing to all RAPs on 20 February 2017. The information session was held at the Condobolin RSL Club on 8 March 2017. The purpose of the information session was to provide RAPs with an additional opportunity to raise any cultural issues or comments/perspectives regarding the Modification or the Proposed Methodology.

The information session supported the information previously provided in writing and included a presentation on the nature and scale of the Modification, an overview of the impact assessment process, a discussion of the roles, functions and responsibilities of participants and protocols for the management of any sensitive cultural heritage information.

Three representatives of the Murie Elders Group and two representatives of the Wiradjuri Condobolin Corporation attended the information session on 8 March 2017. Copies of the attendance records for the information sessions and a copy of the Proposed Methodology are provided in **Appendix 3**.

4.4 COMMENTS ON PROPOSED METHODOLOGY

At the close of the Proposed Methodology review period, the comments and feedback on the Proposed Methodology received by Clean TeQ were recorded in the consultation log in **Appendix 2** (if verbal) or **Appendix 4** (if written/email) and are recorded and considered below.

A consultation log detailing all Aboriginal community consultation undertaken for the Modification is provided in **Appendix 2**. A copy of relevant written correspondence sent to and received from the RAPs is provided in **Appendices 3** and **4**.

Responses to each of the relevant submissions received from the RAPs at the closing date for comments and feedback on the Proposed Methodology are provided in **Table 1**.

Table 1. Responses to Submissions from RAPs on Proposed Methodology.

Date, Registered Aboriginal Party	Comment on the Proposed Methodology	Clean TeQ Response
16 March 2017, Murie Elders Group	*"Following an archaeological survey by John Appleton, between 1998 and 2000, which was not made available either prior to or at the meeting, 14 archaeological sites were observed and recorded, including "six isolated artefacts, six scarred trees, an open scatter and an extensive campsite" (page 3 of methodology document). A satellite map of the proposed "sites of disturbance" was also provided at the consultation meeting. Unfortunately, neither John Appleton nor Dr Cupper was present at this meeting to answer any questions about the methodology, the proposed field surveys or the past field survey. We find it inappropriate that an archaeologist was not present at a meeting about the proposed methodology to answer our questions about the methodology. The focus group meeting and proposed methodology document did not provide satisfactory information about how the archaeological survey would be conducted... Regarding the methodology at the consultation Meeting, RAPS were informed that the purpose of the field survey with Dr Cupper was to re-record "the sites previously visited", with additional recordings to be made as they were identified during the proposed surveys however no methodology was put forward regarding a broader survey of the proposed impact area which was not sufficiently surveyed by Appleton in the 1998/2000 survey. There was some discussion regarding the 14 sites recorded, in that there were so few identified and documented, and the RAPs were informed that the "Consultation back then doesn't meet the standards now, and the survey is to document any new sites'. As a method has not being put forward to tell us how the new sites will be documented and recorded we cannot provide specific comment, we hope that the survey covers enough of the proposed impact area to locate all evidence of Aboriginal occupation in the area."*	The Proposed Methodology is an assessment methodology, rather than a methodology regarding the survey techniques or sampling approach. In this regard, it was not considered necessary for the archaeologist to be present at this time. In the event that any RAPs had queries that were unable to be answered by the Modification team and Clean TeQ representatives at the meeting, these questions were taken on notice and provided to the archaeologist for a response. Detailed survey methodology is outlined in Section 7 of this assessment, including the re-documentation of relevant sites within the Modification area and the recording and identification of new Aboriginal heritage sites.
16 March 2017, Murie Elders Group	*It is noted that the "recent AHIMS recordings" for the areas concerned, now appears to have been reduced from 14 sites to 5 sites. Archaeological work around the area has recorded significantly more sites in the area over the past 20 years which area not shown on the map provided on 16 March."*	Noted. For clarity on the maps and for the purposes of the information session, the focus was on the AHIMS sites recorded within and immediately adjacent to the Modification. However, AHIMS records as well as previous archaeological investigations in the Modification area and wider surrounds have been considered as part of this assessment. Further details regarding previous works are summarised in Section 6.
16 March 2017, Murie Elders Group	*"Finally, as this survey was conducted prior to 2010, when significant legislative changes were made, along with the probability that there have been many changes to landforms over the past 20 year period (as the result of both man made changes and environmental factors including drought, floods), as well as recent site identification (both on AHIMS & from local knowledge), it is respectfully suggested that the previous survey cannot be relied upon to any degree, and that the field survey needs to be conducted in line with current legislative requirements to ensure that no significant sites or places are mistakenly impacted, thus ensuring that the AHIP (Aboriginal heritage Impact Permit) now being sought by the Syerston Modification, can be properly considered and supported by all stakeholders in this process, in a proper and timely manner."*	Noted. As described in Section 7, field surveys for the purposes of this assessment have been undertaken, including a re-survey and assessment of areas considered during the previous archaeological investigation (Appleton, 2000, 2005).

4.5 ABORIGINAL CULTURAL HERITAGE FIELD SURVEYS

The field investigation for the modification was undertaken in two campaigns. The first campaign of the archaeological field investigation for the Modification was completed on 23 February 2016 by the project archaeologist Dr Matt Cupper. This inspection focused on the proposed modified pipeline corridor through the village of Fifield.

The second campaign of the archaeological field investigation for the Modification was completed over one day on 22 March 2017 by project archaeologist Dr Matt Cupper, with the assistance of the following Aboriginal community representatives: Rebecca Shepherd and Adam Dargin (Murie Elders Group) and Cecil Coe and Eugene Coe (Wiradjuri Condobolin Corporation). The field surveys were completed as part of a broader survey program being undertaken for the approved Project.

During the field surveys, attending RAPs were invited to provide any cultural information or values associated with the Modification area. For example, the archaeologists encouraged participants to provide input on bush food resources, fauna and cultural associations/knowledge of the Modification area.

4.6 REVIEW OF DRAFT ACHA REPORT

In accordance with the Consultation Guidelines (DECCW, 2010a), an initial draft of this ACHA was provided to all RAPs listed in Section 4.2 for review and comment on 9 June 2017. As part of the draft ACHA review process, Clean TeQ invited all RAPs and other community stakeholders and Elders to attend an information session regarding the draft ACHA at the Condobolin RSL Club on 22 June 2017. The purpose of the information session was to provide an opportunity for RAPs to discuss, ask questions and/or provide comment on the draft ACHA, particularly the cultural significance and proposed management measures. Dr Matt Cupper and representatives from Clean TeQ attended the information session. The information session also included an opportunity to attend a site inspection (i.e. in addition to the field surveys) to view the Project Area and a selection of the recorded Aboriginal heritage sites.

A total of eight RAPs attended the information and site inspection (Appendix 3). No comments were received in relation to the Modification or the draft ACHA.

5 LANDSCAPE CONTEXT

5.1 CONTEXT OF MODIFIED BOREFIELD AREA

In relation to the modified borefield area, the Modification area is located on the edge of the riverine channel in the Lachlan River valley. The climate is semi-arid, receiving approximately 420 millimetres of rainfall per annum (Bureau of Meteorology, 2017).

Geologically, the area is Quaternary alluvium within the Lachlan River trench, which comprises channel and overbank deposits of clay and silt.

Remnant and regrowth Grey Box (*Eucalyptus microcarpa*) and Black Box (*E. largiflorens*) with a substorey of Myall (*Acacia pendula*) grow on the alluvial plains, with River Red Gum (*E. camaldulensis*) trees lining the river channel. Extensive cleared areas primarily have a vegetation cover of native and introduced pasture grasses.

Overall, the area has been extensively modified by past European land use practices. The alluvial plains had largely been cleared for agricultural cropping and sheep and cattle grazing following European settlement in the second half of the nineteenth century. Road and channel construction has disturbed parts of the Modification area. Remnant vegetation occurs in the North Condobolin Road and travelling stock reserves to be traversed by the proposed water pipelines, but these are degraded by past earthworks and grazing (see **Figures 5 – 8**).

Figure 5. Cleared paddock in the eastern portion of the Modification area.

Figure 6. Lachlan River channel in the central portion of the Modification area.

Figure 7. Cleared paddock in the eastern portion of the Modification area.

Figure 8. Travelling stock reserve in the western portion of the Modification area.

5.2 CONTEXT OF MODIFIED FIFIELD PIPELINE REALIGNMENT AREA

In relation to the modified Fifield pipeline realignment area, the Modification area comprises low footslopes of the Lachlan Fold Belt that fringes the plains of the Murray-Darling Basin (Brown and Stephenson 1991, Sherwin 1997). The area is underlain by deeply weathered schist and quartzite bedrock of the early Ordovician (474-484 million year old) Girilambone Group (Sherwin 1997). Stony, dark reddish brown clay loam soil derived from these weathered basement rocks forms the surface of the proposed disturbance area.

As described in Section 3, the modified Fifield pipeline realignment would occupy the road reserves of Fifield Road, Wilmatha Fifield Road, Burra Street and Gobondry Street over a distance of approximately 3 km west and south of the town of Fifield. The Fifield Road reserve retains degraded patches of Red Box (*Eucalyptus polyanthemus*), Poplar Box (*Eucalyptus populnea*) and White Cypress Pine (*Callitris glaucophylla*) woodland vegetation, but most of the proposed corridor has been disturbed by past European land use. This has included clearing of almost all of the original vegetation along Wilmatha Road, Burra Street and Gobondry Street, land levelling and installation of road, fences and utilities (**Figures 9 - 14**).

Figure 9. Wilmatha Fifield Road reserve.

Figure 10. Gobondry Road reserve.

Figure 11. Gobondry Road reserve.

Figure 12. Condobolin Tullamore Road reserve.

Figure 13. Condobolin Tullamore Road reserve.

Figure 14. Condobolin Tullamore Road reserve.

6 ABORIGINAL CULTURAL HERITAGE CONTEXT

6.1 ETHNO-HISTORICAL CONTEXT

Aboriginal people of the Wiradjuri language group occupied the southwest slopes of central western NSW at the time of first contact with Europeans (Sturt, 1833; Hovell and Hume, 1837; Mitchell, 1839; Tindale, 1974). The Wiradjuri were traditionally associated with the region encompassing the Macquarie, Lachlan and Murrumbidgee Rivers.

There may have been around 60 different dialects of Wiradjuri, whose speakers shared similar material culture and social organisation (Howitt, 1904; White, 1986). Perhaps the greatest regional variation was between speakers of the northern dialect (*Wirraaydhuurray*) and those of the south (speakers of the *Wirraayjuurray* dialect) (White, 1986). For example, the practice of carving zigzag motifs into tree trunks appears to have been particular to the Wiradjuri of the Macquarie and Lachlan River valleys, but is absent from the Murrumbidgee (Etheridge, 1918; Bell, 1982). Such carved trees are thought to have perhaps marked ceremonial areas and burial grounds. The *Burbung* ceremony was another of the Wiradjuri customs and traditions (Howitt, 1904). This ceremony was associated with male initiation and involved the preparation of special earth mounds and usually the application of red ochre.

The Wiradjuri were hunter-fisher-gatherers and appear to have had a semi-sedentary lifestyle. They caught fish including eels, freshwater crayfish, yabbies, tortoises and freshwater mussels in the Lachlan, Macquarie and Murrumbidgee Rivers and other streams and wetlands in the region (Howitt, 1904). Watercraft were manufactured from large slabs of bark cut from River Red Gum trees. Fish were caught using fishing lines and nets made from reed fibre.

Nets were used to catch waterbirds, whose eggs were also collected. Some of the other animals that the Wiradjuri hunted include kangaroos, wallabies, emus, possums, echidnas, lizards, snakes and frogs (Howitt, 1904). In summer, some Wiradjuri journeyed southeast to the high plains of the Great Dividing Range, where bogong moths were collected in large quantities (Flood, 1980). Plant foods included Native Millet, Panic Grass, Pigface fruits, Wild Cherries, Kangaroo Apple, tubers, yams, roots and other grass grains (Howitt, 1904; Gott, 1983).

Aspects of the initial interaction between Europeans and the Wiradjuri led to violent conflict. Aboriginal people were shot, poisoned and displaced from their land by pastoral settlers and, in retaliation, cattle, sheep, stockmen and shepherds were speared (Pearson, 1984).

Explorer and Surveyor-General of NSW Lieutenant John Joseph William Molesworth Oxley had led an expedition down the Lachlan River in 1817 (Johnson, 2001). At Goobothery upstream of Condobolin he exhumed the burial mound of a Wiradjuri leader that has been marked by two carved trees. Oxley's party was eventually forced to divert north by the Great Cumbungi Swamp in the lower reaches of the Lachlan (Johnson, 2001). He struck the Macquarie River and encountered favourable land for pasture, further surveying the region the following year and opening up the southwest slopes to pastoral settlement (Pearson, 1984). Over the next few years pastoral runs were taken up along the Macquarie in the Wellington area approximately 140 km northeast of the Modification area.

Expanding European settlement led to conflict with the Wiradjuri. Intense fighting occurred between 1822 and 1824 in what were termed the Bathurst Wars (Pearson, 1984). In 1824, Governor Brisbane instituted a period of martial law over the region between Bathurst and Wellington. There was considerable resistance by local Aboriginal people led by Windradyne, a senior Wiradjuri guerrilla leader, but by the end of the year the violence had been quashed. Martial law was repealed on 11 December 1824, and on 28 December 1824 Windradyne travelled to Parramatta, where he was pardoned by Governor Brisbane (Pearson, 1984).

The first pastoral runs were taken up on the Lachlan in the 1830s and within a decade of the first contact with Europeans many of the Wiradjuri were living adjacent to pastoral homesteads, often working as shepherds or engaged in other labouring activities (Günther, 1837-1842). Those Aboriginal people who resided on pastoral holdings in central western NSW continued to live a semi-traditional existence into the second half of the nineteenth century (Pearson, 1984). This included collecting plant and animal foods to supplement station rations. Historical sources record a rapid decline in Wiradjuri numbers, caused by dispossession of land and the consequent destruction of habitat and social networks (Günther, 1837-1842; Pearson, 1984). Diseases including smallpox and malnutrition also took their toll (Günther, 1837-1842; Pearson, 1984). Traditional social networks collapsed. Other social structures, such as marriage laws, were also abandoned.

Grants of land were set aside for church and government Aboriginal reserves from the 1830s. One of the earliest was Wellington Mission operated by the Church Missionary Society for Africa and the Far East between 1832 and 1844 on the Macquarie River at Wellington (Günther, 1837-1842). One of the ministers, Reverend Watson, had a policy of removing Aboriginal children from their families, which led to bitter confrontations between Watson and other missionaries. The Church Missionary Society dismissed Watson in 1839 (Pearson, 1984). Watson and his wife left the mission along with a small group of Wiradjuri People and established a private mission, known as Apsley Mission, just outside the boundary of the Wellington Mission. Approximately eight years after establishing Apsley Mission, Watson, his wife Ann and their small Aboriginal community of about thirty people moved to a new site on the bank of the Macquarie River, known as the Blake's Fall Mission (Pearson, 1984).

An Aboriginal Reserve (reserve number R32512) was gazetted for Aboriginal people on the south bank of the Lachlan River at Condobolin on 13 April 1901 (Department of Lands, 1900). Known as the Condobolin Mission, and later the Willow Bend Mission, the reserve was originally run by the Aborigines Protection Board (later Aborigines Welfare Board). Aboriginal people also resided at a self-managed “fringe camp” at the Murie Reserve, approximately 4 km south of Condobolin, between approximately 1900 and 1970.

Many of the contemporary Aboriginal people of central western NSW live in regional centres such as Condobolin, and the region has a population of around 13,600 Aboriginal people, or some 6 % of the total population (Australian Bureau of Statistics, 2016).

6.2 PREHISTORIC CONTEXT

Accounts of Aboriginal land use of central western NSW during the nineteenth century provide an insight into possible settlement patterns in the prehistoric period. Pearson (1984) concluded that, prior to European settlement, large localised clans of Aboriginal people inhabited the southwest slopes encompassing the Modification area.

During normal conditions, clans divided into bands of up to 20 people, who may have used a territory with a radius of 20 km to 30 km. These bands coalesced relatively quickly into groups of 80 to 150 people to take advantage of a guaranteed or desirable resource, such as seasonal food resources (Pearson, 1984).

The material record of this occupation is preserved in the archaeological sites of central western NSW, most of which probably date to the period since the last Ice Age (after around 18,000 years ago). All that remains at many of these sites are flakes of stone debris from the making and resharpening of stone tools. These were made both at Aboriginal open and closed habitation areas (campsites and rockshelters) or special activity areas such as axe grinding groove sites.

As well as being the sites of manufacture and maintenance of stone implements, habitation areas usually contain evidence of domestic and other activities such as cooking and food preparation. Campfires or oven hearths are common, marked by charcoal and heat retaining stones or hearthstones. Organic remains consist of marsupial, rodent, bird, lizard, snake and fish bones, eggshell and freshwater mussel shell. Modified trees show where bark may have been removed by Aboriginal people to manufacture canoes, shelters and dishes, or carved to mark burial grounds and ceremonial sites.

6.3 TYPES OF ABORIGINAL CULTURAL HERITAGE SITES IN THE REGION

Based on the results and analytical conclusions of previous archaeological surveys in similar landscape contexts on the southwest slopes of central western NSW, it is possible to predict the types and topographic contexts of Aboriginal cultural heritage sites in the Modification area. The occurrence and survival of archaeological sites is, however, dependent on many factors including micro-topography and the degree of land surface disturbance.

The types of Aboriginal cultural heritage sites previously recorded on the southwest slopes of central western NSW are described in Sections 6.3.1-6.3.11.

6.3.1 Stone Artefact Scatters

Scatters of stone artefacts exposed at the ground surface are one of the most commonly occurring types of archaeological site in the region. The remains of fire hearths may also be associated with the artefacts. In rare instances, sites that were used over a long period of time may accumulate sediments and become stratified. That is, there may be several layers of occupation buried one on top of another.

Stone artefact scatters are almost invariably located near permanent or semi-permanent water sources. Local topography is also important in that open campsites tend to occur on level, well drained ground elevated above the local water source. In central western NSW they are commonly located on river terraces and along creek-lines and also around the margins of lakes and swamps.

6.3.2 Modified Trees

Slabs of bark were cut from trees by Aboriginal people and used for a variety of purposes including roofing shelters and constructing canoes, shields and containers. Scars also resulted from the cutting of toeholds for climbing trees to obtain honey or to capture animals such as possums. Some trees were carved, whereby Aboriginal people cut designs through the bark onto the wood beneath. Ethno-historic records indicate that some carved trees were associated with burials whilst others may have been sacred or totemic sites.

In central western NSW, River Red Gums and Box are the most commonly scarred species. Carvings are often on Box or Cypress Pine. The classification of scarred trees as natural, European or Aboriginal is often problematic. However, if the scar is associated with Aboriginal activity the tree must now be more than ~150 years old (Long, 2005).

6.3.3 Hearths

Hearths consist of lumps of burnt clay or stone cobble hearthstones. Sometimes ash and charcoal are preserved. Other materials found in hearths include animal bone, freshwater mussel shell, emu eggshell and stone artefacts. Hearths probably represent the remains of cooking ovens, similar to those described in ethnographic accounts by Major Thomas Mitchell (1839). These were lined with baked clay nodules and stone cobbles, possibly to retain heat. Hearths may be isolated or occur in clusters and may be associated with open campsites or middens. They are sometimes located on floodplain terraces of central western NSW.

6.3.4 Stone Quarries

These are locations where Aboriginal people obtained raw material for their stone tools or ochre for their art and decoration. Materials commonly used for making flaked stone tools include chert, silcrete, quartz and quartzite. These materials were obtained from exposed sedimentary formations or picked up as loose rock on the surface. Stone quarries may also be associated with volcanic rock outcrops, which provided the raw material for ground stone tools such as stone axes. Gobondery Mountains to the northeast of Fifield has one such axe quarry (Beuzeville, 1917).

6.3.5 Stone Arrangements, Ceremonial Rings and Ceremony and Dreaming Sites

Stone arrangements range from cairns or piles of rock to more elaborate arrangements such as stone circles or standing slabs of rock held upright by stones around the base. Beuzeville (1917) describes concentric stone circles measuring 4 m to 5 m in diameter near The Troffs, east of Fifield. Some stone arrangements were used in ceremonial activities whilst others may represent sacred or totemic sites. Other features associated with the spiritual aspects of Aboriginal life are those now called ‘ceremony and dreaming’ sites. These can be either stone arrangements or natural features such as rock outcrops, waterholes or mountains, which may be associated with initiation ceremonies or the activities of ancestral creators.

6.3.6 Water Holes

These result from Aboriginal people modifying rock outcrops to collect or trap surface or groundwater. Water holes may be in the beds of creeks or hill slopes where sheets of rock may have been hollowed out to pool water. In most instances, soft stone such as limestone or sandstone outcrops provided the most suitable surface for excavating water holes. A notable example in the Fifield area was a stone trough cut by Aboriginal people at a spring, which gave its name to the locality “The Troffs” (Beuzeville, 1917; this site has subsequently been destroyed by railway construction).

6.3.7 Freshwater Shell Middens

Shell middens are deposits of shell and other food remains accumulated by Aboriginal people as food refuse. In inland NSW these middens typically comprise shells of the freshwater lacustrine mussel (*Velesunio ambiguous*) or the freshwater riverine mussel (*Alathyria jacksoni*). Freshwater middens are most frequently found as thin layers or small patches of shell and often contain stone or bone artefacts and evidence of cooking. Such sites are relatively common along the watercourses of central western NSW and their associated wetlands.

6.3.8 Earth Mounds

Earth mounds may have been used by Aboriginal people as cooking ovens or as campsites. Originally they appear to have ranged from 3 m to 35 m in diameter and from 0.5 m to 2 m in height. Today, however, they may be difficult to recognise because of the effects of ploughing, grazing and burrowing rabbits. Earth oven material, stone artefacts, food refuse and the remains of hut foundations have been exposed in excavated earth mounds.

6.3.9 Rockshelter Sites

Caves or shelters in cliff lines and beneath boulder overhangs were often used by Aboriginal people as campsites. Because of the confined area in these shelters and because of repeated Aboriginal occupation of such sites, the occupation deposits that they contain are often richer than open campsites and are usually stratified. Rockshelters will only be found where suitable geological formations are present. They may occur as sandstone overhangs, shelters beneath granite tors or as limestone caves.

6.3.10 Rock Art Sites

Rock art consists of paintings, drawings and/or engravings on rock surfaces. In most instances in the wider region, rock art is related to the distribution of rockshelters but it may also be found on freestanding rocks.

6.3.11 Burials

Aboriginal burial grounds may consist of a single interment or a suite of burials. In the drier parts of the Murray-Darling Basin, skeletal material is regularly found eroding from sand deposits (Bonhomme, 1990; Hope, 1993). In the higher southwest slopes burial sites are rarely found because conditions for the preservation of bone are poor. Knowledge of Aboriginal burial grounds is best sought from local Aboriginal communities.

6.4 PREVIOUS ABORIGINAL CULTURAL HERITAGE INVESTIGATIONS

An understanding of the past Aboriginal occupation of central western NSW has begun to emerge from a number of studies including some undertaken within and in proximity to the Modification area. However, there have been few systematic regional investigations, with most undertaken in discrete areas including management studies of conservation reserves in the region and for mining and infrastructure developments. These include surveys of the Cowal Gold Operations near West Wyalong (south of the Modification area) (Paton, 1989; Cane, 1995, 1996, 1997; Huys and Johnston, 1995; Nicholson, 1997; Stone, 2002; Pardoe, 2009, 2011, 2013) and the approved Syerston Project (Appleton, 2000; Cupper and Stone, 2017). Also relevant is Flood's (1980) broad-scale study of the uplands further east, which identified general features of the regional archaeological record of the southwest slopes of central western NSW.

Surface scatters of flaked stone artefacts are the most common site type in central western NSW. These stone assemblages are dominated by flakes and flaked pieces mostly struck from quartz, and less commonly, silcrete, chert and quartzite. Few formalised tool types have been recorded, but include ground-edged axes and grinding dishes. Eucalypt trees modified by Aboriginal people are also well represented along creeklines of central western NSW and are particularly abundant on the adjacent plains. Other site types on the plains include earthen features such as hearths and mounds. Rockshelters, rock art sites, axe-head grinding grooves, waterholes, stone sources and stone arrangements also occur in the foothills of the southwest slope.

Aboriginal occupation of central western NSW is known to date from at least 29,000 to 34,000 years ago. The oldest ages have been obtained from the Pleistocene (Ice Age) sites of Cuddie Springs and Tambar Springs at the downstream end of the Macquarie River catchment some 300 km north of the Modification area (e.g. Field and Dodson, 1999). Closer to the Modification area, a burial of a very tall and robust Aboriginal male, Kiacatoo Man, from Kiacatoo some 30 km downstream on the Lachlan River from Condobolin, has been dated to 17,000 years ago (Kemp *et al.*, 2014).

The Lachlan River was a particular focus of past Aboriginal occupation. Trees carved by Aboriginal people are a prominent site type along the river. Carved trees had designs cut into their trunks, commonly a type of zigzag motif, and marked ceremonial areas and burial grounds (Etheridge, 1918; Bell, 1982). This practice appears to have been peculiar to the central part of western NSW. Bell (1982) located a total of 205 carved trees in this region. Most were concentrated along the Bogan and Macquarie Rivers and the middle reaches of the Lachlan River.

The distribution of modified trees probably reflects wider Aboriginal settlement patterns of the southwest slopes. People seem to have spent much of their time near the more reliable water sources. Paton and Hughes (1984), who examined areas near Condobolin, recorded that stone artefact densities drop from one artefact per square metre (m^2) close to the Lachlan River, to as little as one artefact per 400 m^2 away from the river. These stone artefact assemblages are dominated by quartz (77 %) with the remainder comprising chert.

Similar stone artefact scatters close to water sources in the Lachlan River valley have been described by Silcox (1986) at West Wyalong and Paton (1989), Cane (1995, 1996, 1997), Huys and Johnston (1995), Nicholson (1997), Stone (2002) and Pardoe (2009, 2011, 2013) at Lake Cowal. These studies found that quartz, silcrete and chert were prevalent in lithic assemblages, the latter often used to manufacture backed blades. Other formal artefact types such as modified flakes, scrapers, adze slugs and seed grinding implements were less abundant.

Rock art sites tend to occur in the bedrock ranges of the southwest slopes, mainly to the northeast of the Modification area. Paintings include both figurative and non-figurative motifs. Lines, dots, tracks, hand stencils and depictions of humans, emus and kangaroos are represented (Gunn, 1983; Martin, 1991).

Flood's (1980) investigation of the higher uplands of central western NSW to the east of the Modification area provides insights into possible regional patterns of past Aboriginal land use. Flood (1980) found that lowland sites often either comprised large base camps, open occupation areas covering two or three square kilometres (km^2) found on sand dunes and near lakes and rivers, or smaller camps distributed along river banks in a lineal pattern.

Flood (1980) noted typical landscape settings of Aboriginal campsites. All sites are within 1 km and most within 100 m of a river, creek, lake or spring. However, no sites are located right at the water's edge. All sites are located on well-drained ground with a reasonably good view of the approaches. When sites occur on the side of a mountain range or valley their aspect is usually east or north thus obtaining shelter from the prevailing westerly winds (Flood, 1980).

6.5 PREVIOUSLY RECORDED ABORIGINAL CULTURAL HERITAGE IN THE MODIFICATION AREA

The most recent archaeological investigations pertinent to the Modification area are Appleton’s (2000, 2005) and Landskape’s (2017) previous assessments undertaken for the approved Syerston Project (and subsequent modifications).

Appleton (2000, 2005) identified 14 Aboriginal cultural heritage sites in or near the Syerston Project area. These comprised one stone artefact scatter (AHIMS site number 35-4-0015), eight isolated finds of stone artefacts (AHIMS site numbers 35-4-0010, 35-4-0011, 35-4-0012, 35-4-0013, 35-4-0014, 35-4-0016, 43-2-0049, 43-2-0050), four scarred trees (AHIMS site numbers 43-4-0009, 43-4-00010, 43-4-0011, 35-4-0017) and a site complex with stone artefacts, hearths, a scarred tree and hundreds of flaked lithics (AHIMS site number 43-4-0014).

A more recent assessment undertaken by Landskape (2017) identified an additional 13 Aboriginal cultural heritage sites in or near the Syerston Project area, including two stone artefact scatters (AHIMS site numbers 35-4-0024, 36-4-0132), eight isolated finds of stone artefacts (AHIMS site numbers 35-4-0027, 35-4-0028, 35-4-0030, 35-4-0031, 35-4-0032, 35-4-0033, 35-5-0170, 35-5-0171), two stone quarries (AHIMS site numbers 35-4-0025, 35-4-0026) and a scarred tree (AHIMS site number 35-4-0029).

The closest of these Aboriginal cultural heritage sites are two isolated finds of stone artefacts (AHIMS site numbers 43-2-0049, 43-2-0050) north of the North Condobolin Road reserve approximately 1 km east of the Modification area (Appleton, 2005; AHIMS search number 266797 accessed 15 February 2017). **Table 2** provides a summary of Aboriginal cultural heritage sites previously identified proximal to the Modification area.

Table 2. Previously Identified Aboriginal Cultural Heritage Sites Proximal to the Modification Area.

AHIMS Site Number	Site Name	Site Type	Eastings GDA94 mE (Zone 55)	Northings GDA94 mN (Zone 55)
43-2-0050	North Condobolin Road ISO2	Isolated find of a stone artefact	550643	6317884
43-2-0049	North Condobolin Road ISO1	Isolated find of a stone artefact	550673	6317994

7 CULTURAL HERITAGE FIELD INVESTIGATION

In accordance with the *Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in New South Wales* (OEH, 2011) and the *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCW, 2010b), an archaeological design and survey methodology was prepared as a key component of the cultural heritage field assessment. Details of the archaeological design and survey methodology are presented in the following sections.

7.1 CULTURAL HERITAGE SITE PREDICTIVE MODEL

Previous archaeological studies indicate that the most frequently recorded Aboriginal cultural heritage places in central western NSW are open occupation areas represented by scatters of stone artefacts and culturally modified trees (NSW OEH AHIMS site database). Burials, earthen features including mounds and hearths and stone features including stone quarries, ceremonial rings, water holes, rockshelters and rock art sites are also represented in the archaeological record.

The potential for encountering Aboriginal cultural heritage in the Modification area is mitigated to some extent by the high degree of previous disturbance. For example, the extent of tree clearance from past agricultural land use reduces the probability of encountering scarred and carved trees. Similarly, modification of the original land surface during past agricultural land use and road and channel construction could have destroyed earthen features such as mounds and stone features such as arrangements and ceremonial rings, had they previously existed in this area. Stone artefacts, alternatively, are more likely to survive in the cultivated soil.

Based on past observations of archaeological site types and their distribution and landscape setting, the following predictive model of Aboriginal cultural heritage site locations for the activity can be proposed:

- **Trees scarred or carved by Aboriginal people** may occur wherever mature Eucalypt trees grow. However, given the extent of vegetation clearance the probability of encountering culturally modified trees is not particularly high.
- **Stone artefact scatters** and **isolated finds** of stone artefacts are possible at the Modification area. They are typically found within 200 m of water sources, so are most likely to be encountered on the margins of the Lachlan River. They are also possible around natural depressions such as ephemeral swamps.
- **Burial sites** are possible, particularly in sandy deposits elevated above waterways. However, there is a low likelihood of occurrence within the Modification area.
- **Freshwater shell middens** may occur on the margins of the Lachlan River.
- **Earthen features** including **mounds**, **ovens** and **hearths, stone arrangements** and **ceremonial rings** are normally restricted to level ground, the former usually adjacent to water sources. They are possible near waterways in the study area, but their likelihood is lessened because previous land disturbance such as earthworks associated with grading roads and fence lines, constructing channels and ploughed cultivation during agricultural cropping is likely to have destroyed earthen and stone features, had these site types originally occurred in the Modification area.
- **Rockshelters, grinding grooves, water holes, stone quarries** and **rock art sites** are not likely to occur, given the absence of suitable rock outcrops in the Modification area.

While predictive studies such as this can be expected to identify areas in which sites associated with subsistence activities may be present, notably open habitation areas, other sites may fall outside such a predictive framework. For example, places associated with spiritual aspects of traditional Aboriginal society such as ceremony and dreaming sites are often located at topographically distinct or unique features, which cannot be identified from an examination of maps or other records. For this reason, it was essential that local Aboriginal communities be consulted so that sites of significance to them can be identified.

7.2 FIELD METHODOLOGY

7.2.1 Logistics

The field investigation for the modification was undertaken in two campaigns. The first archaeological field investigation for the Modification was completed on 23 February 2016 by the project archaeologist Dr Matt Cupper. This inspection focused on the proposed modified pipeline corridor through the village of Fifield.

The second archaeological field investigation for the Modification was completed over one day on 22 March 2017 by project archaeologist Dr Matt Cupper, with the assistance of the following Aboriginal community representatives: Rebecca Shepherd and Adam Dargin (Murie Elders Group) and Cecil Coe and Eugene Coe (Wiradjuri Condobolin Corporation). The field surveys were completed as part of a broader survey program being undertaken for the approved Project.

7.2.2 Survey Methods

The Modification area was inspected on foot by the project archaeologist and Aboriginal community representatives (in portions of the area) (**Figures 15** and **16**). The field teams examined the ground surface for any archaeological traces such as stone artefacts, hearths, hearthstones, shells, bones and mounds. All mature trees in the areas of proposed disturbance were inspected for scarring or carving by Aboriginal people.

Particular attention was paid to areas with high ground surface visibility such as along stock and vehicle tracks and in scalds, gullies and other eroded areas.

The team members walked abreast across the surveyed areas in a series of closely spaced transects. These were evenly distributed over the areas of proposed disturbance and approximately 5 m apart. Due to the general openness of the landscape, it was usually possible to identify likely site locations from at least 5 m and deviate from the transects to make closer inspections.

Indicative survey unit mapping is presented in **Appendix 6**.

7.2.3 Access to Survey Areas and Weather Conditions

Access was available to all of the Modification area and weather conditions were good during the survey.

Figure 15. Survey team members inspecting the Modification area.

Figure 16. Survey team members inspecting the Modification area.

7.3 SURVEY COVERAGE DATA

7.3.1 Conditions of Visibility

Conditions of ground surface visibility affect how many sites are located. Visibility may also skew the results of a survey. If, for example, conditions of ground surface visibility vary dramatically between different environments, then this would be reflected in the numbers of sites reported for each area. The area with the best visibility may be reported as having the most sites (because they are visible on the ground) while another area with less visibility but perhaps more sites would be reported as having very little occupation. It is important therefore to consider the nature of ground surface visibility as part of any archaeological investigation.

Conditions of ground surface visibility typically ranged from approximately 5 % to 60 % across the Modification area (**Table 3**, **Figures 17** and **18**). Grass and herbaceous plant growth was generally moderate to dense, with areas of the ground surface exposed by erosion from scalding and gullying and stock and vehicular traffic.

Figure 17. Moderate visibility conditions within the Modification area.

Figure 18. Moderate visibility conditions within the Modification area.

7.3.2 Coverage Analysis

Coverage analysis is a useful measurement to allow cultural resource managers to assess surveys from adjacent areas and it also allows some meaningful calculation of the actual sample size surveyed. The *actual* or *effective* area surveyed by a study depends on the conditions of ground surface visibility. Conditions of surface visibility are affected by vegetation cover, geomorphic processes such as sedimentation and erosion rates, and the abundance of natural rock that may obscure the remains of cultural activities.

Approximately 56 % of the surface of the Modification area was inspected on foot (**Tables 3** and **4**)[2]. This is a relatively high coverage and was a result of the generally intensive nature of the survey and the typically fair conditions of surface visibility.

Table 3. Effective Survey Coverage of the Modification Area.

Survey Unit	Landform	Survey Unit Area (m^2)	Visibility (%)	Exposure (%)	Effective Cover (m^2)	Effective Cover (%)	No. of Sites
Pipeline	Lower terrace	40,000	60	60	24,000	60	-
Pump station	Lower terrace	500	10	10	50	10	-
Transfer station	Lower terrace	2500	5	5	125	5	-
Total		**43,000**			**24,175**	**56**	**-**

m^2 – square metres.

Table 4. Landform Summary of Sampled Areas of the Modification Area.

Landform	Landform Area (m^2)	Area Effectively Covered (m^2)	Landform Effectively Surveyed (%)	No. of Sites
Lower terrace	43,000	24,175	56	-
Total	**43,000**	**24,175**	**56**	**-**

7.4 SURVEY RESULTS

No Aboriginal cultural heritage sites were identified in the Modification area, despite the intensive nature of the survey. This negative result is despite the generally fair conditions of surface visibility and high survey coverage. It is largely attributable to past land use of the Modification area, including pastoralism, agriculture and channel and road construction, as such previous land clearing and earthworks are likely to have destroyed Aboriginal cultural heritage sites, had they previously existed in this area.

Quarry sites are also definitely not represented in the Modification area as rock outcrop is lacking. Landforms such as lunettes or source-bordering sand dunes that might contain sensitive sub-surface archaeological material such as burials do not occur in the Modification area. The sediments of the Modification area had been well enough exposed by pastoral and agricultural activities, road and channel construction, vehicular traffic and wind and water erosion to determine that no archaeological material was present on the surface nor is likely to be buried beneath the soil.

[2] The results presented in **Tables 3** and **4** allow for a correction for transect spacing (i.e. the calculations allow for the areas between survey team members [who are assumed to be able to view a maximum 8-m-wide strip of the ground surface] are deducted).

In relation to the proposed Fifield pipeline realignment area, it was observed that much of the original vegetation had been removed and the land levelled. Extensive earthen embankments have been constructed on the south side of Gobondry Street for the Fifield township water reservoir. The verges of Fifield Road, Wilmatha Road, Burra Street and Gobondry Street have been graded by heavy machinery, and the topsoil and subsoil within the proposed pipeline corridor have been substantially disturbed during past excavations for the roads. Additionally, trenches have been excavated across the corridor to install utilities including water and telecommunications cables. This extensive previous ground disturbance means that little of the original land surfaces for the entire length of the proposed pipeline corridor remains intact.

7.5 IDENTIFIED ABORIGINAL CULTURAL VALUES

As described in earlier sections, this assessment has been prepared in accordance with the Consultation Guidelines (DECCW, 2010a) and the NP&W Regulation.

The cultural values assessment undertaken to date has been based on the following:

- Review of background resources including previous archaeological investigations for the surrounding region and the approved Syerston Project (Appleton, 2000; Landskape, 2017).
- Historical research.
- Discussions with RAPs during field survey.
- Discussions with RAPs during community information sessions.
- Requests for comments during the review period for the Proposed Methodology.
- Specific meetings with RAPs upon request.

These points of consultation provided the opportunity for the Aboriginal community to have direct input into the management of Aboriginal cultural heritage values – both tangible and intangible – in the Modification area.

During the archaeological surveys the attending RAPs did not identify any specific locations within the Modification area as being of high or specific cultural significance. However a number of sites were identified in the surrounding areas (e.g. Mulgutherie Mountain) as being of specific value to the Aboriginal community. These sites are outside of the Modification area and hence would not be subject to impacts by the Modification.

RAPs identified the Modification area as a place that Aboriginal people had occupied in the past. Generally, the Aboriginal representatives viewed all the Aboriginal cultural heritage sites as significant because they preserve a record of how and where people lived in the past.

The Lachlan River and its adjacent plains are considered to be of particular cultural significance to the Aboriginal community. Several of the RAPs involved in the assessment advised that the river areas have special significance to the Aboriginal community. Local Aboriginal people previously and still visit the Lachlan River for significant social events including meetings, fishing, mussel collecting and family outings.

8 POTENTIAL IMPACTS OF THE MODIFICATION ON ABORIGINAL CULTURAL HERITAGE

In accordance with the *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (OEH, 2011), the principles of ecologically sustainable development were considered in assessing the likely harm of the Modification to Aboriginal cultural heritage sites.

No Aboriginal cultural heritage was identified within the Modification area, so no known Aboriginal cultural heritage sites, items or values would be potentially impacted by the Modification. The potential for previously unidentified Aboriginal cultural heritage to occur in the Modification area is however considered in Section 8.1.

8.1 POTENTIAL FOR PREVIOUSLY UNIDENTIFIED ABORIGINAL CULTURAL HERITAGE TO OCCUR IN THE MODIFICATION AREA

Although the Modification area was sufficiently surveyed (both previously and during this assessment), there remains the potential for Aboriginal cultural heritage sites to be located within this area (e.g. sites that may have been obscured by grass or soil at the time of survey). Such previously unidentified features, should they occur, would probably be isolated finds or low-density concentrations of stone artefacts (based on the predictive model outlined in Section 7.1 and informed by the results of the current survey, summarised in Section 7.4).

The shallow soils of the Modification area, coupled with past disturbance from pastoralism, agriculture and road and channel construction, means that significant *in situ* subsurface cultural deposits are highly improbable.

The Modification area does not contain culturally sensitive landforms such as lunettes or source-bordering sand dunes where subsurface Aboriginal cultural deposits (e.g. burials) have been recorded previously.

A strategy for managing any newly identified Aboriginal objects during the life of the Modification is outlined in Section 9.

8.2 POTENTIAL CUMULATIVE IMPACTS OF THE MODIFICATION

Given that no Aboriginal cultural heritage has been identified in the Modification area, coupled with the low potential for such heritage to occur, the Modification would not increase cumulative impacts to Aboriginal cultural heritage in the region.

8.3 FLEXIBILITY OF THE DESIGN OF THE MODIFICATION

The locations of the proposed components associated with the Modification are currently within their optimum design locations, but could potentially be modified to avoid harm to Aboriginal cultural heritage.

9 MANAGEMENT STRATEGIES FOR CULTURAL HERITAGE

9.1 INTRODUCTION

This section presents proposed strategies for the management of cultural heritage values within the Modification area that may be subject to direct impacts by the Modification.

Based on the known and predicted Aboriginal cultural heritage values within the Modification area, it is concluded that impacts to any Aboriginal cultural heritage (should it occur) as a result of the Modification can be effectively managed or mitigated through the following actions and strategies.

A Heritage Management Plan (HMP), which outlines the management and mitigation measures for Aboriginal cultural heritage, should be prepared for the Syerston Project in consultation with the Aboriginal community and the OEH and should incorporate the Modification and the recommendations of this assessment. The HMP should continue to remain active for the life of the Modification and define the tasks, scope and conduct of all Aboriginal cultural heritage management activities.

The effective application of the HMP and its strategies is dependent on an appreciation of its content and function by on-site staff and employees. It is recommended that training is provided to all on-site personnel regarding the HMP strategies relevant to their employment tasks.

The measures presented below are considered best practice in the mining industry. Their effectiveness and reliability is demonstrated by their continued use and inclusion in management plans and strategies developed in consultation with the RAPs and to the satisfaction of OEH.

9.2 GENERAL RECOMMENDATIONS

It is recommended that the following general approach be taken to manage Aboriginal cultural heritage during the life of the Modification:

- Ongoing consultation with the Aboriginal community throughout the life of the Modification.
- Erosion and sediment control works be undertaken in accordance with the requirements of the development consent and in consideration of other Aboriginal cultural heritage management measures.
- The wider landscape setting of the Modification presents a low risk of activities harming previously unidentified Aboriginal cultural heritage, but any future variations to the footprint of the Modification should be preceded by (at a minimum, and dependent on the nature of the proposed variations) an Aboriginal cultural heritage due diligence assessment.

10 SUMMARY RECOMMENDATIONS

Based on the results of this cultural heritage investigation and consultation with representatives of the RAPs the following is recommended:

- The Modification be allowed to proceed because the areas proposed for development are located in areas where harm to Aboriginal cultural heritage will be avoided.
- The wider landscape setting of the Modification presents a low risk of activities harming previously unidentified Aboriginal cultural heritage, but any future variations to the footprint of the Modification should be preceded by an appropriate level of assessment/investigation.
- In the unlikely event that human skeletal remains are encountered during the course of activities associated with the Modification, all work in that area must cease. Remains must not be handled or otherwise disturbed except to prevent further disturbance. If the remains are thought to be less than 100 years old, the Police or the State Coroner's Office (tel: 02 9552 4066) must be notified. If there is reason to suspect that the skeletal remains are more than 100 years old and of Aboriginal origin, Clean TeQ should contact the OEH's Environmental Line (tel: 131 555) for advice. In the unlikely event that an Aboriginal burial is encountered, strategies for its management would need to be developed with the involvement of the local Aboriginal community.
- A HMP, which outlines the management and mitigation measures for Aboriginal cultural heritage, should be prepared for the Syerston Project in consultation with the Aboriginal community and the OEH and should incorporate the Modification and the recommendations of this assessment. The HMP should continue to remain active for the life of the Modification and define the tasks, scope and conduct of all Aboriginal cultural heritage management activities.
- Clean TeQ should continue to provide training to all on-site personnel regarding the HMP strategies relevant to their employment tasks.
- Clean TeQ should continue to involve the RAPs and any other relevant Aboriginal community groups or members in matters pertaining to the Modification.

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APPENDICES

APPENDIX 1. GLOSSARY

Archaeological site - A place with evidence of past human activity. This evidence may include Aboriginal and/or historic artefacts, features, structures or organic traces.

Artefact scatter - A surface scatter of Aboriginal or historic cultural material. Scatters of stone artefacts are a common archaeological site type. These scatters may also contain charcoal, discarded animal bones, shell and ochre.

Assemblage - A collection of artefacts from a single archaeological site.

Burial site - A place with a concentration of human remains. Ochre, stone tools, charcoal and grave goods may be associated with burials. Most burial sites are found in sand dunes but dead trees, caves and rock shelters were also used.

Ceremonial ring - Place that may be associated with initiation ceremonies, meetings or sacred rituals. Stone arrangements may be present, including cairns, stone circles or standing slabs of rock.

Chert - A fine-grained opaline rock ranging in colour from white to black, but most often grey, brown, grayish brown and light green to rusty red.

Core - A piece of stone from which flakes have been removed. They usually have negative flake scares that have resulted from the removal of flakes.

Cultural material - Any material remains or objects resulting from human activity.

Flake - A piece of stone detached from a core that typically displays a striking platform, bulb of percussion and flake scars on the ventral surface.

Flaked piece - Small fragments of stone resulting from the manufacture of stone tools. A striking platform or bulb of percussion may not be evident.

Ground surface visibility - The amount of bare ground exposed, usually expressed as a percentage.

Hearth - The remains of a campfire containing charcoal, discoloured soil, and possibly, hearthstones, heat retainers or the remains of animals or shellfish cooked and consumed at the campsite.

Hearthstone – Stone cobble placed in a campfire to retain heat for cooking. The types of stone used as hearthstones in western Victoria includes calcrete and sandstone.

Heat retainer - Nodule of baked clay, thought to have been placed in campfires to retain heat for cooking.

in situ - An artefact or other feature that has not been disturbed from its original position.

Mound - Raised areas of earth ranging from 3 m to 35 m in diameter and from 0.5 m to 2 m in height. Earth oven material, stone artefacts, food refuse and the remains of hut foundations have been recovered from excavated earth mounds in the central and western parts of Victoria.

Ochre - Soft varieties of the iron oxides goethite, limonite or haematite usually coloured red or yellow and used as pigment for painting.

Quarry - An outcrop of stone or ochre where Aboriginal people have extracted the raw material for use or trade. Stone quarries are identifiable by a dense scatter of broken stone and flakes or consist of pits or hollows where material has been dug out of the ground.

Quartz – A silica mineral resistant to weathering because of its hardness. It is commonplace in the landscape as a consequence.

Quartzite - A metamorphic rock formed by the re-crystallization of quartz.

Scarred tree - A tree with a scar on its trunk caused by bark removal.

Shell midden - A surface scatter or heap of discarded shell often with charcoal, animal bones and stone artefacts. Middens may be found near coastlines, rivers, creeks, swamps and ancient lakes.

Silcrete - A hard, fine-grained rock composed of silica cement.

Stone feature - Cairns, rock wells, grinding groves, stone structures, fish traps and stone arrangements are examples of stone features.

Survey - An inspection of land either by foot or vehicle for the purpose of identifying archaeological sites.

Transect - A predetermined area or a path that directs the course of a survey.

APPENDIX 2. CONSULTATION LOG

Syerston Project - Consultation Log

DATE	ORGANISATION CONTACTED	HOW CONTACTED	CONTACTED BY	NATURE OF CONSULTATION
2/12/2016	Office of Environment and Heritage, Condobolin Local Aboriginal Land Council, Peak Hill Local Aboriginal Land Council, Lachlan Shire Council, Forbes Shire Council, Parkes Shire Council, Native Title Services Corporation Limited, National Native Title Tribunal, Office of the Registrar Aboriginal Land Rights Act 1983, Central West Local Land Services	Post	Mick Ryan, Scandium21	Step 1 letters sent out to relevant organisation requesting details of Aboriginal persons or groups who hold cultural knowledge relevant to, or who have a right or interest in, determining the cultural heritage significance of Aboriginal object(s) and/or place(s) in the Area of Interest for the Modification.
7/12/2016	Scandium21	Email	Office of the Registrar Aboriginal Land Rights Act 1983	Provided a response to the Step 1 letter.
9/12/2016	Scandium21	Email	Kylie Rowe, Office of Environment and Heritage	Provided a response to the Step 1 letter.
14/12/2016	Scandium21	Email	Irene Assumpter, National Native Title Tribunal	Provided a response to the Step 1 letter.
19/12/2016	Scandium21	Email	Paul Bennet, Forbes Shire Council	Provided a registration on behalf of the Forbes Aboriginal & Community Working Party
6/01/2017	Interested Aboriginal Stakeholders	Post/Email	Mick Ryan, Scandium21	Step 2 letters sent out to groups/individual identified during Step 1, inviting Aboriginal persons or groups who hold cultural knowledge relevant to, or who have a right or interest in, determining the cultural heritage significance of Aboriginal object(s) and/or place(s) in the Area of Interest to register an interest in the Project.
6/01/2017	Scandium21	Email	Return Email Service	Returned email received from Joy Russell (copy of Step 2 letter). Unable to be delivered. No alternative contact details on file.
11/01/2017	Scandium21	Telephone	George, NTSCORP	Left message requesting a call back in relation to the Syerston Extension Modification Project.
11/01/2017	Interested Aboriginal Stakeholders	Public Notice	Scandium21	A public notice was published in the Koori Mail on 11 January 2017, inviting Aboriginal persons or groups who hold cultural knowledge relevant to, or who have a right or interest in, determining the cultural heritage significance of Aboriginal object(s) and/or place(s) in the Area of Interest to register an interest in the Project.
12/01/2017	George, NTSCORP	Telephone	Scandium21	Called George, returning his call. Left message with contact details and advising that would try and call again on Monday.
16/01/2017	Scandium21	Post	Australia Post	Returned mail received from Bogan River Peak Hill Wiradjuri Aboriginal Corporation (copy of Step 2 letter). The correspondence was marked "return to sender". No alternative contact details on file.
16/01/2017	George, NTSCORP	Telephone	Scandium21	Called George, returning his call. George advised that the Ngemba, Ngiyampaa, Wangaaypuwan and Wayilwan Native Title Claimants boundary was outside of the Project area and that they claimants were unlikely to register an interest.
18/01/2017	Scandium21	Post	Lachlan Shire Council	Provided a response to the Step 1 letter.
18/01/2017	Scandium21	Post	Australia Post	Returned mail received from Trevor Robinson (copy of Step 2 letter). The correspondence was marked "return to sender". No alternative contact details on file.
18/01/2017	Scandium21	Post	Australia Post	Returned mail received from Bulgandramine Youth Development Aboriginal Corporation (copy of Step 2 letter). The correspondence was marked "return to sender". No alternative contact details on file.
18/01/2017	Scandium21	Post	Australia Post	Returned mail received from Little Burning Mountain Aboriginal Corporation (copy of Step 2 letter). The correspondence was marked "return to sender".
18/01/2017	Little Burning Mountain Aboriginal Corporation	Post	Scandium21	Posted additional copy of Step 2 letter to alternative contact details (as per registered company address available on website).

18/01/2017	Interested Aboriginal Stakeholders	Public Notice	Scandium21	A public notice was published in the Condobolin Argus on 18 January 2017, inviting Aboriginal persons or groups who hold cultural knowledge relevant to, or who have a right or interest in, determining the cultural heritage significance of Aboriginal object(s) and/or place(s) in the Area of Interest to register an interest in the Project.
19/01/2017	Interested Aboriginal Stakeholders	Post/Email	John Hanrahan, Clean TeQ	Additional step 2 letters sent out to groups/individual identified during Step 1, inviting Aboriginal persons or groups who hold cultural knowledge relevant to, or who have a right or interest in, determining the cultural heritage significance of Aboriginal object(s) and/or place(s) in the Area of Interest to register an interest in the Project. Additional letters due to late response to Step 1 correspondence.
23/01/2017	Clean TeQ	Email	Laurie Hutchison, Wiradjuri Condobolin Corporation	Registered an interested in the Project.
1/02/2017	Clean TeQ	Email	Lois Goolagong, Murie Elders Group	Registered an interested in the Project.
1/02/2017	Clean TeQ	Email	Jamie Gray, Binjang Wellington Wiradjuri Aboriginal Heritage Surveys	Registered an interested in the Project.
3/02/2017	Clean TeQ	Telephone	Lois Goolagong, Murie Elders Group	Called to confirm receipt of registration. Provided telephone contact details.
8/02/2017	West Wyalong Local Aboriginal Land Council	Post	Clean TeQ	Step 1 letters sent out to relevant organisation requesting details of Aboriginal persons or groups who hold cultural knowledge relevant to, or who have a right or interest in, determining the cultural heritage significance of Aboriginal object(s) and/or
14/02/2017	Registered Aboriginal Parties	Email/Post	Clean TeQ	Copies of Proposed Methodology were distributed for review and comment. Feedback on the Proposed Methodology was requested by Friday 17 March 2017.
15/02/2017	Clean TeQ	Telephone	Louise Davis	Registered an interested in the Project.
16/02/2017	Louise Davis	Email	Clean TeQ	Copy of Proposed Methodology distributed for review and comment. Feedback on the Proposed Methodology was requested by Friday 17 March 2017.
17/02/2017	Clean TeQ	Email	Laurie Hutchison, Wiradjuri Condobolin Corporation	Provided response to Proposed Methodology.
21/02/2017	Registered Aboriginal Parties	Email/Post	Clean TeQ	Copies of invitations to information session were distributed to all Registered Aboriginal Parties.
22/02/2017	West Wyalong Local Aboriginal Land Council, Condobolin Local Aboriginal Land Council, OEH	Post	Clean TeQ	Copies of OEH and LALC letters distributed.
23/02/2017	Clean TeQ	Telephone	Rebecca Shepherd, Murie Elders Group	Rebecca called on behalf of Lois Goolagong to confirm that the group was registered for consultation associated with the Project. Confirmed registration. Rebecca advised that the Murie Elders Group would be attending the information session on 8 March 2017.
27/02/2017	Clean TeQ	Telephone	Leeanne Hampton, West Wyalong Local Aboriginal Land Council	Called to confirm registration of West Wyalong Local Aboriginal Land Council. Also indicated that representatives of the land council will be attending the information session.
1/03/2017	Clean TeQ	Telephone	Rebecca Shepherd, Murie Elders Group	Rebecca called to request an additional copy of the Proposed Methodology be emailed through.
1/03/2017	Rebecca Shepherd, Murie Elders Group	Email	Clean TeQ	Emailed through an additional copy of the Proposed Methodology as requested.
1/03/2017	Clean TeQ	Email	Rebecca Shepherd, Murie Elders Group	Rebecca emailed to confirm receipt of additional copy of the Proposed Methodology. Also confirmed that she would extend the meeting invitation to Elders within their RAP group.
3/03/2017	Registered Aboriginal Parties	Email/Post	Clean TeQ	Copies of invitations to attend field surveys were distributed to all Registered Aboriginal Parties.
3/03/2017	Clean TeQ	Telephone	Rebecca Shepherd, Murie Elders Group	Rebecca called to advised that it was their understand that the Murie Elders were exempt from paying for workers compensation insurance. She also raised concerns with the requirements for steel capped boots for the field surveys. The need for no prior medicals was clarified.
6/03/2017	Clean TeQ	Email	Ally Coe	Emailed to advised that all emails in relation to Lois Goolagong should be directed to Rebecca Shepherd.
6/03/2017	Laurie Hutchison, Wiradjuri Condobolin Corporation	Telephone	Clean TeQ	Discussion with Ally Coe, who advised that the WCC would be providing a representative for the information session.

6/03/2017	David Acheson, Forbes Aboriginal & Community Working Party	Telephone	Clean TeQ	David advised that the Forbes Aboriginal & Community Working Party no longer wished to be consulted in relation to the Syerston Project, and that they did not wish to receive any further correspondence.
6/03/2017	David Acheson, Forbes Aboriginal & Community Working Party	Email	Clean TeQ	Provided email correspondence to advise that as requested, Clean TeQ will no longer provide correspondence to the Forbes Aboriginal & Community Working Party in relation to the Syerston Project.
8/03/2017	Registered Aboriginal Parties	Information Session	Clean TeQ	An information session was held to discuss the Project, the Proposed Methodology and the AHIP application. All RAPs were invited to attend. Representatives from the Murie Elders Group and the Wiradjuri Condobolin Corporation attended. Representatives from the Murie Elders Group and the Wiradjuri Condobolin Corporation requested the provision of several documents relating to the approved Syerston Project.
8/03/2017	Clean TeQ	Telephone	Louise Davis	Called to advise that she would be unable to attend the information session.
9/03/2017	Clean TeQ	Telephone	Leeanne Hampton, West Wyalong Local Aboriginal Land Council	Called to confirm that a representative from the West Wyalong Local Aboriginal Land Council would be attending the surveys.
9/03/2017	Clean TeQ	Telephone	Louise Davis	Called to confirm that she would be attending the surveys.
10/03/2017	Clean TeQ	Telephone	Rebecca Shepherd, Murie Elders Group	Called to advise that she would be attending the surveys as the representative of the Murie Elders. Also confirmed the updated postal address for the group.
10/03/2017	Clean TeQ	Email	Rebecca Shepherd, Murie Elders Group	Rebecca emailed through a copy of the insurances for the Murie Elders Group, and confirmed that she would be attending the surveys as the representative. Also requested a copy of several documents that were discussed during the information session on 8 March 2017.
13/03/2017	Rebecca Shepherd, Murie Elders Group	Telephone	Clean TeQ	Called to discuss the management plan for The Murie (registered Aboriginal place). Rebecca advised that she would discuss with the Elders the possibility of providing a copy of the management plan to Clean TeQ.
14/03/2017	Rebecca Shepherd, Murie Elders Group	Post	Clean TeQ	Provided hard copies of the 2000 Archaeological Assessment prepared for the approved Syerston Project, as requested.
14/03/2017	Phil Purcell, Office of Environment and Heritage	Telephone	Clean TeQ	Called to advise of an additional interested stakeholder for the Syerston Project. Provided relevant contact details.
14/03/2017	Peter Peckham	Telephone	Clean TeQ	Called to discuss the Syerston Project and confirm that will now be included as a RAP going forward.
15/03/2017	Peter Peckham	Email	Clean TeQ	Provided Peter with a copy of the Proposed Methodology and an invitation to attend the field surveys.
15/03/2017	Rebecca Shepherd, Murie Elders Group	Telephone	Clean TeQ	Returned Rebecca's call regarding the management plan for The Murie, confirmed that plan could be provided directly during the field surveys.
15/03/2017	Jamie Gray, Binjang Wellington Wiradjuri Heritage Survey	Telephone	Clean TeQ	Called to confirm availability for the field surveys. Phone disconnected.
15/03/2017	Condobolin Local Aboriginal Land Council	Telephone	Clean TeQ	Called to confirm availability for the field surveys. Phone disconnected.
15/03/2017	Louise Davis	Telephone	Clean TeQ	Called to confirm availability for the field surveys. Louise confirmed her attendance and advised that insurances would be sent through.
15/03/2017	Clean TeQ	Telephone	Laurie Hutchison, Wiradjuri Condobolin Corporation	Called to confirm that at a representative of the WCC would be attending the field surveys and that insurances would be provided via email.
15/03/2017	Rebecca Shepherd, Murie Elders Group	Email	Clean TeQ	Provided copies documents, as per request made at the information session.
15/03/2017	Ally Coe, Wiradjuri Condobolin Corporation	Email	Clean TeQ	Provided copies documents, as per request made at the information session.
16/03/2017	Clean TeQ	Telephone	Laurie Hutchison, Wiradjuri Condobolin Corporation	Called regarding insurances and to advise that Eugene Coe would be the representative attending the surveys and would provide a copy of the insurances in the field (internet was down).
16/03/2017	Clean TeQ	Telephone	Louise Davis	Called regarding insurances and to advise that she would be relying on the West Wyalong Local Aboriginal Land Council insurances.
16/03/2017	Clean TeQ	Email	Rebecca Shepherd, Murie Elders Group	Emailed to advise that the Murie Elders Group would be providing a submission on the Proposed Methodology by COB tomorrow.

17/03/2017	Rebecca Shepherd, Murie Elders Group	Telephone	Clean TeQ	Called to invite second representative from Murie Elders Group to attend second week of surveys. Rebecca confirmed that the additional representative in the second week would be Adam Dhaagans. Rebecca also discussed possibility of sending a junior for free during the first week to observe (as Murie Elders Group internal cost). Was advised that this would be dependent on availability each day.
17/03/2017	Laurie Hutchison, Wiradjuri Condobolin Corporation	Telephone	Clean TeQ	Called to invite second representative from WCC to attend first week of surveys. Left message on land line.
17/03/2017	Laurie Hutchison, Wiradjuri Condobolin Corporation	Telephone	Clean TeQ	Called to invite second representative from WCC to attend first week of surveys. Left message on mobile.
17/03/2017	Laurie Hutchison, Wiradjuri Condobolin Corporation	Telephone	Clean TeQ	Called to invite second representative from WCC to attend first week of surveys. Left message on land line.
17/03/2017	Clean TeQ	Email	Rebecca Shepherd, Murie Elders Group	Provided comments on the Proposed Methodology.
20/03/2017	Laurie Hutchison, Wiradjuri Condobolin Corporation	Telephone	Clean TeQ	Called to invite second representative from WCC to attend first week of surveys. Left message with Kristie.
21/03/2017	Peter Peckham	Telephone	Clean TeQ	Left message regarding survey commencement and to confirm whether a representative would be attending.
21/03/2017	Peter Peckham	Telephone	Clean TeQ	Returned call. Peter advised that a representative was not available, but that if one was he would give me a call.
21/03/2017	Clean TeQ	Surveys	Louise Davis	Queried whether her brother could also attend the insurances. Louise was informed that she had only been allocated one paid position and that if he attended he would not be paid. Louise agreed. She also advised that he would be coming under the West Wyalong LALC insurances.
1/05/2017	Clean TeQ	Telephone	Dave Carter, Condobolin Local Aboriginal Land Council	Called to discuss the status of the Project and AHIP application. Indicated that the Condobolin LALC would like to be involved in the project going forward.
6/06/2017	Registered Aboriginal Parties	Post/Email	Clean TeQ	Copies of the draft ACHA were provided to the RAPs for review and commnet. Comments on the report were requested by Friday 7 July 2017.
9/06/2017	Registered Aboriginal Parties	Post	Clean TeQ	Copies of the draft ACHA for MOD4 were provided to the RAPs for review and commnet. Comments on the report were requested by Wednesday 12 July 2017.
10/06/2017	Registered Aboriginal Parties	Email	Clean TeQ	Copies of the draft ACHA for MOD4 were provided to the RAPs for review and commnet. Comments on the report were requested by Wednesday 12 July 2017.
13/06/2017 and 14/06/2017	Registered Aboriginal Parties	Post/Email	Clean TeQ	Invitations to an information session and site inspection on 22 June 2017 were distributed to all Registered Aboriginal Parties via email and post.
14/06/2017	Clean TeQ	Email	Peter Peckham	Advised that he was unable to attend the information session and site inspection.
18/06/2017	Clean TeQ	Email	Rebecca Shepherd, Murie Elders Group	Emailed to confirm attendance at information session. Requested opportunity to visit one of the stone quarry sites recorded, during the site inspection.
19/06/2017	Wiradjuri Condoblin Corporation	Telephone	Clean TeQ	Called to confirm attendance at information session. Vicky confirmed that she would be attending and possibly two other representatives.
19/06/2017	Leeanne Hampton, West Wyalong LALC	Telephone	Clean TeQ	Called to confirm attendance at information session. Leanne confirmed that she would be attending.
19/06/2017	Dave Carter, Condobolin LALC	Telephone	Clean TeQ	Called to confirm attendance at information session. Left message.
19/06/2017	Louise Davis	Telephone	Clean TeQ	Called to confirm attendance at information session. Rang out.
5/07/2017	Registered Aboriginal Parties	Post/Email	Clean TeQ	Correspondence providing an extension of the review period for the draft reports was sent to all Registered Aboriginal Parties.
17/07/2017	Rebecca Shepherd, Murie Elders Group	Telephone	Clean TeQ	Called to confirm whether submitting any written comments on the draft ACHA.
17/07/2017	Leeanne Hampton, West Wyalong LALC	Telephone	Clean TeQ	Called to confirm whether submitting any written comments on the draft ACHA.
21/07/2017	Rebecca Shepherd, Murie Elders Group	Telephone	Clean TeQ	Called to follow up on any written comments on the draft ACHA report. Rebecca advised that the Murie Elders Group did not have any comments on the draft ACHA.

APPENDIX 3. CORRESPONDENCE TO ABORIGINAL COMMUNITY STAKEHOLDERS

STEP 1 CORRESPONDENCE

2 December 2016

Office of Environment and Heritage
PO Box 2111
DUBBO NSW 2830

Syerston Project Extension Modification – Aboriginal Cultural Heritage Assessment

Dear Sir/Madam,

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12/21 Howleys Rd
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PO Box 227
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t: +61 3 9797 6700
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e: info@cleanteq.com

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Kind Regards,

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MICK RYAN
PROJECT MANAGER – SYERSTON

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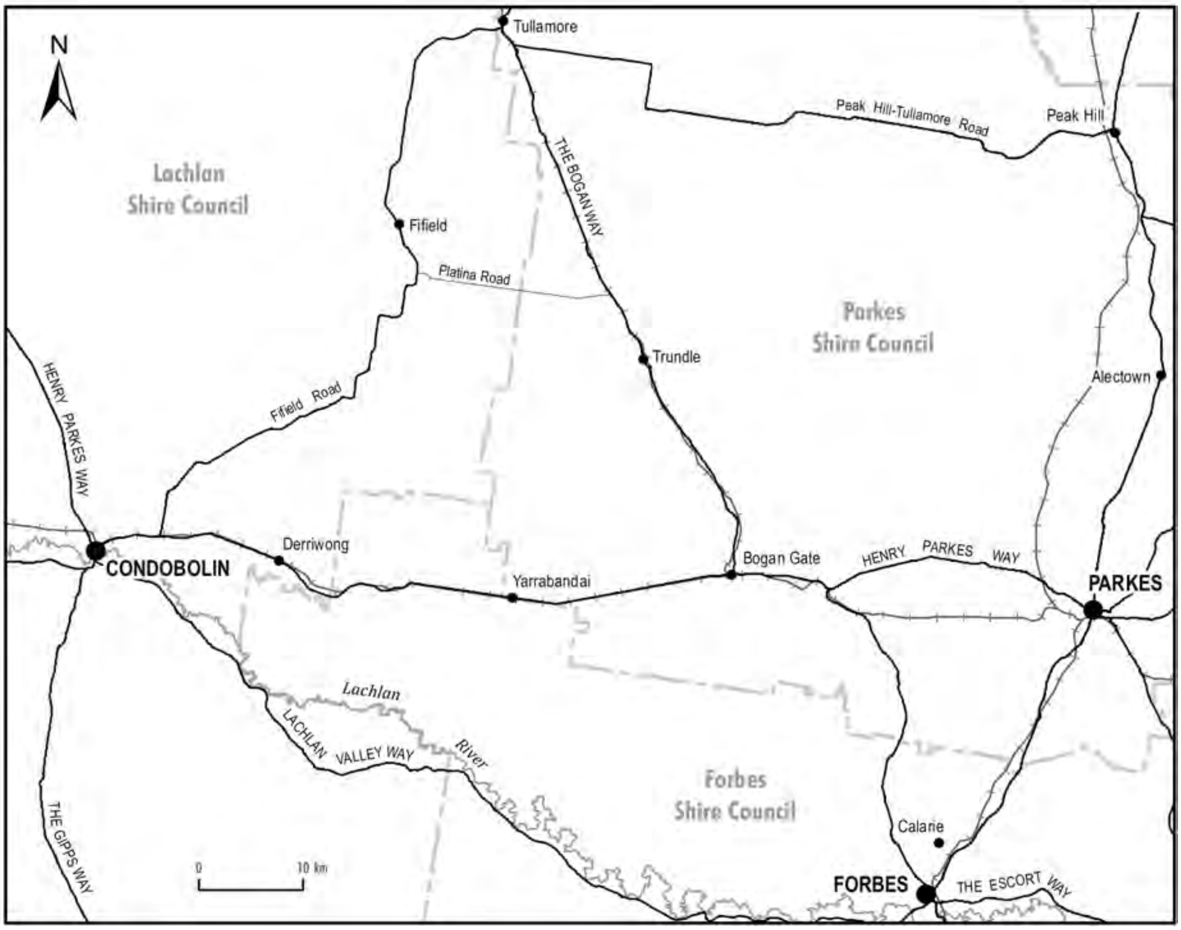

2 December 2016

Condobolin Local Aboriginal Land Council
PO Box 114
CONDOBOLIN NSW 2877

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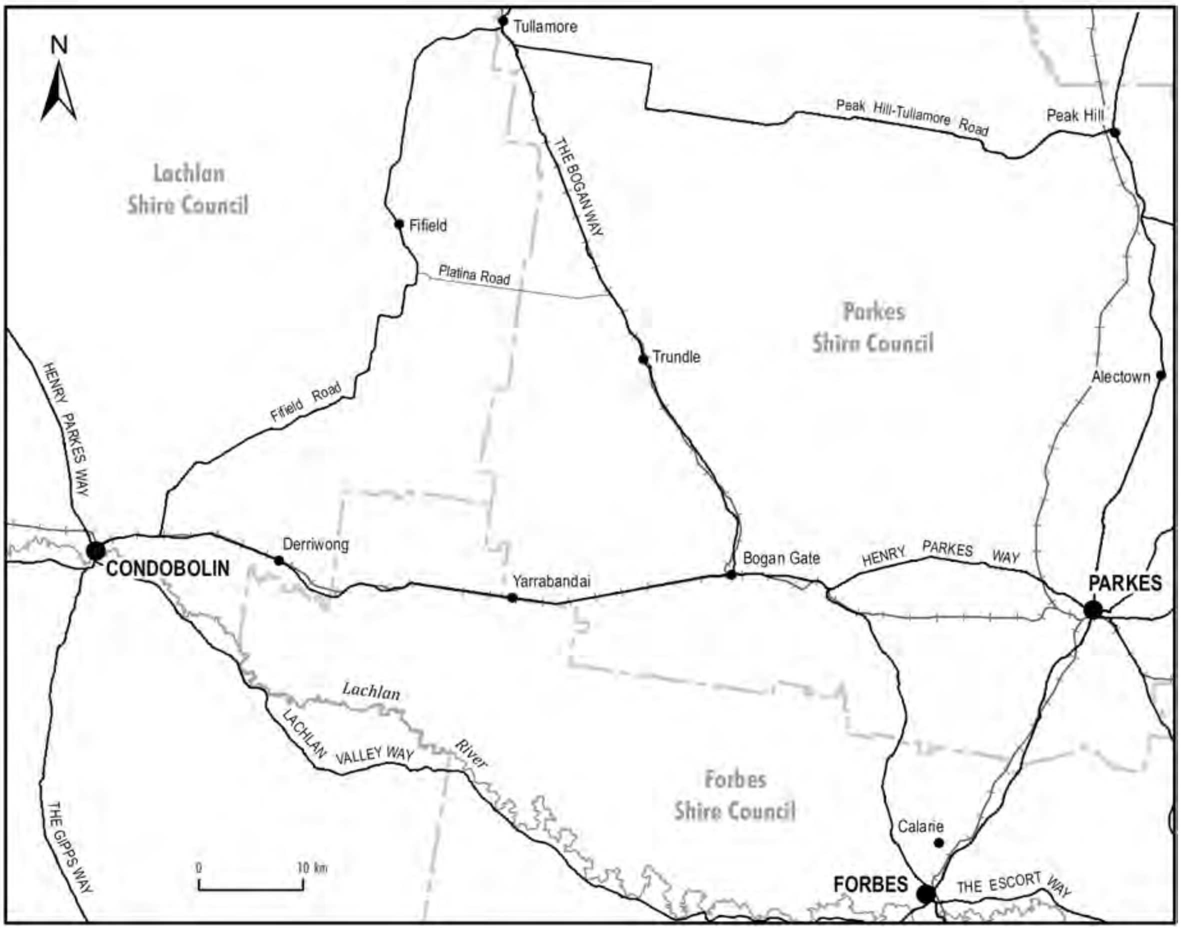

2 December 2016

Peak Hill Local Aboriginal Land Council
PO Box 63
PEAK HILL   NSW   2869

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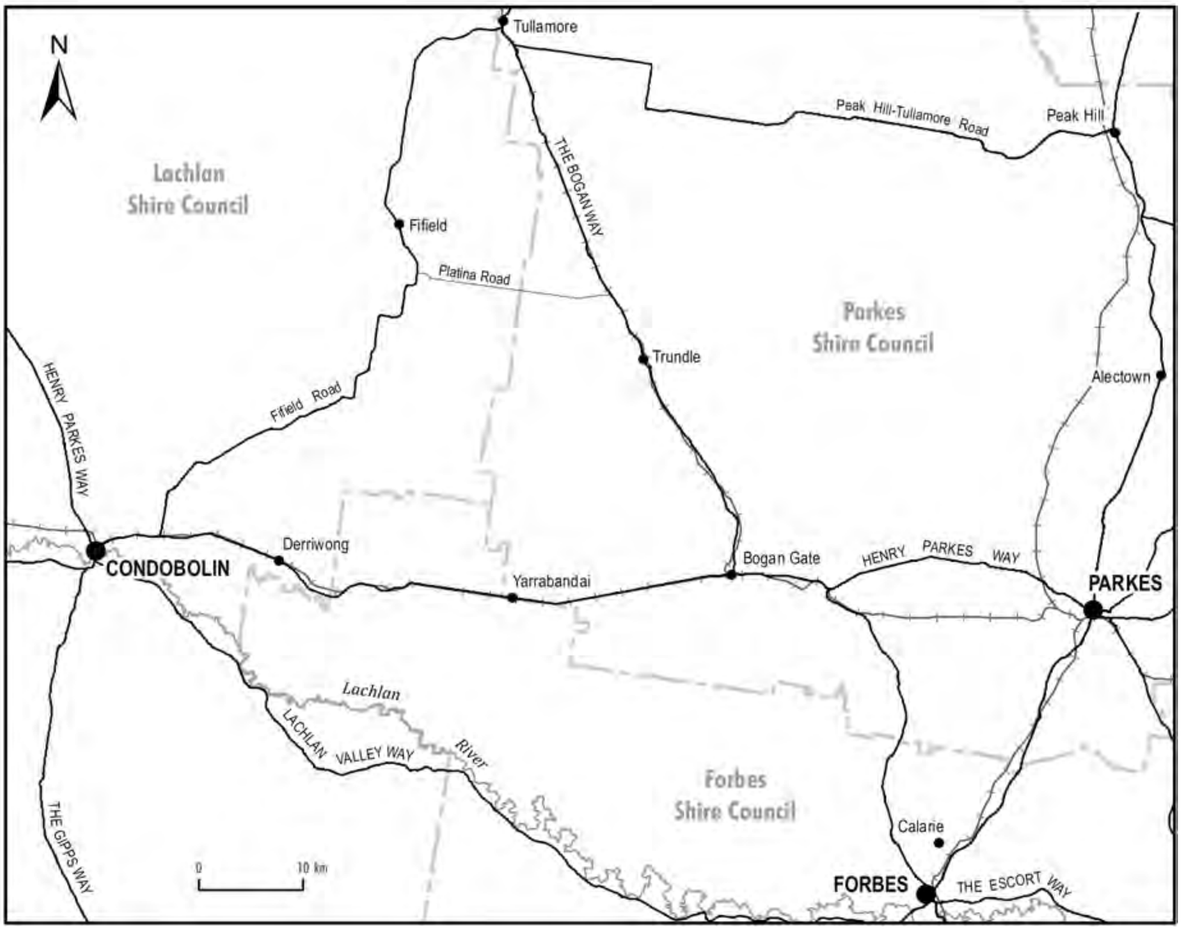

ScANDIUM21

2 December 2016

Lachlan Shire Council
Attention: Robert Hunt, General Manager
PO Box 216
CONDOBOLIN NSW 2877

Syerston Project Extension Modification – Aboriginal Cultural Heritage Assessment

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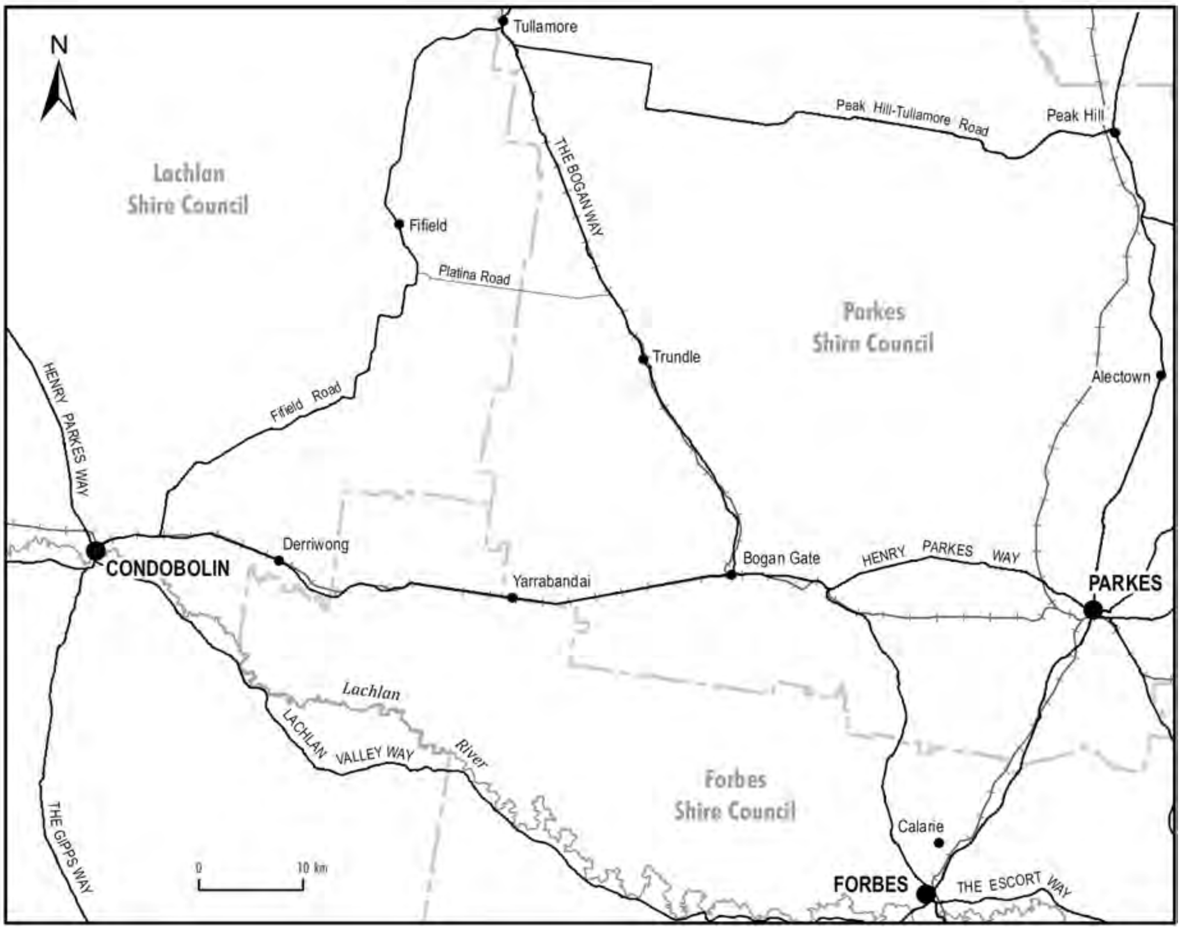

2 December 2016

Forbes Shire Council
Attention: Danny Green, General Manager
PO Box 333
FORBES NSW 2871

Syerston Project Extension Modification – Aboriginal Cultural Heritage Assessment

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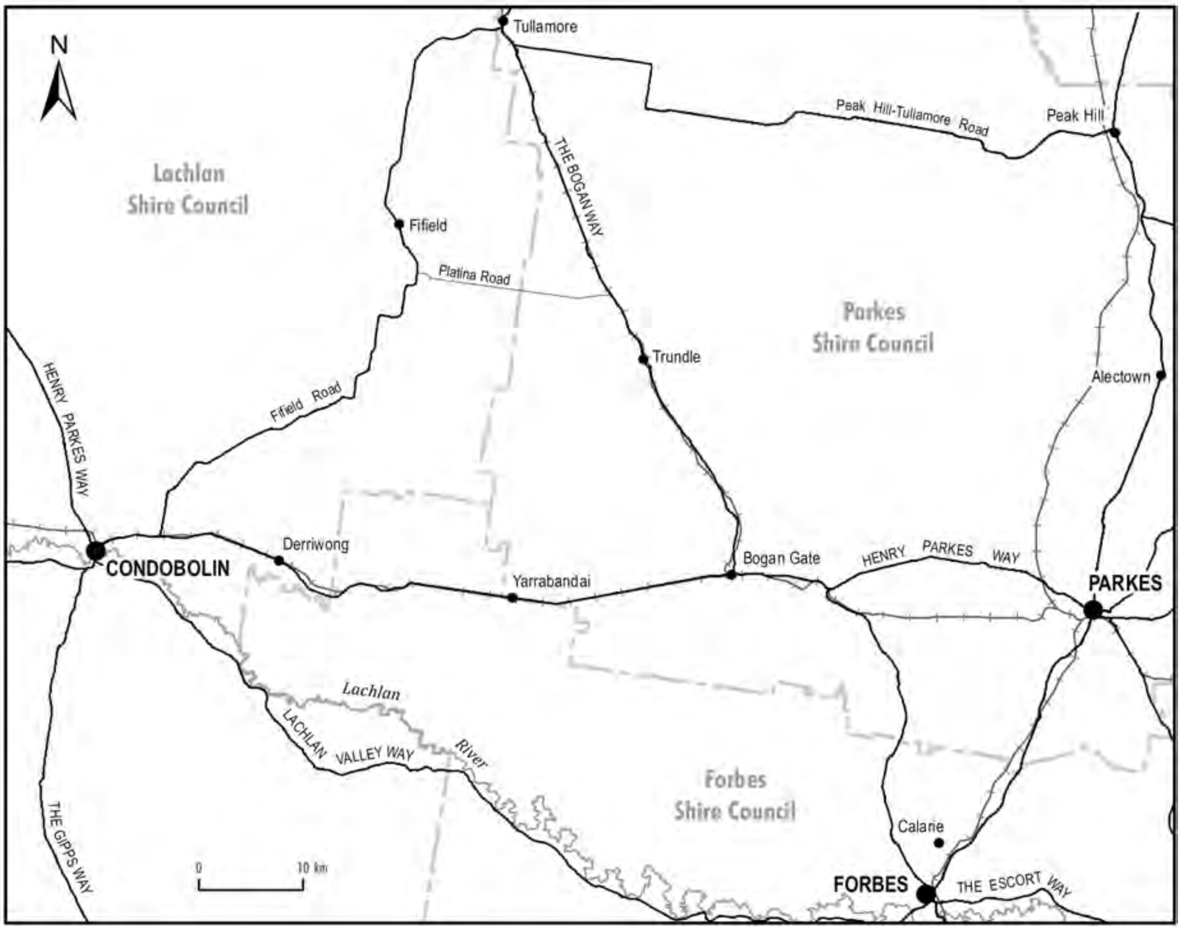

2 December 2016

Parkes Shire Council
Attention: Kent Boyd, General Manager
PO Box 337
PARKES NSW 2870

Syerston Project Extension Modification – Aboriginal Cultural Heritage Assessment

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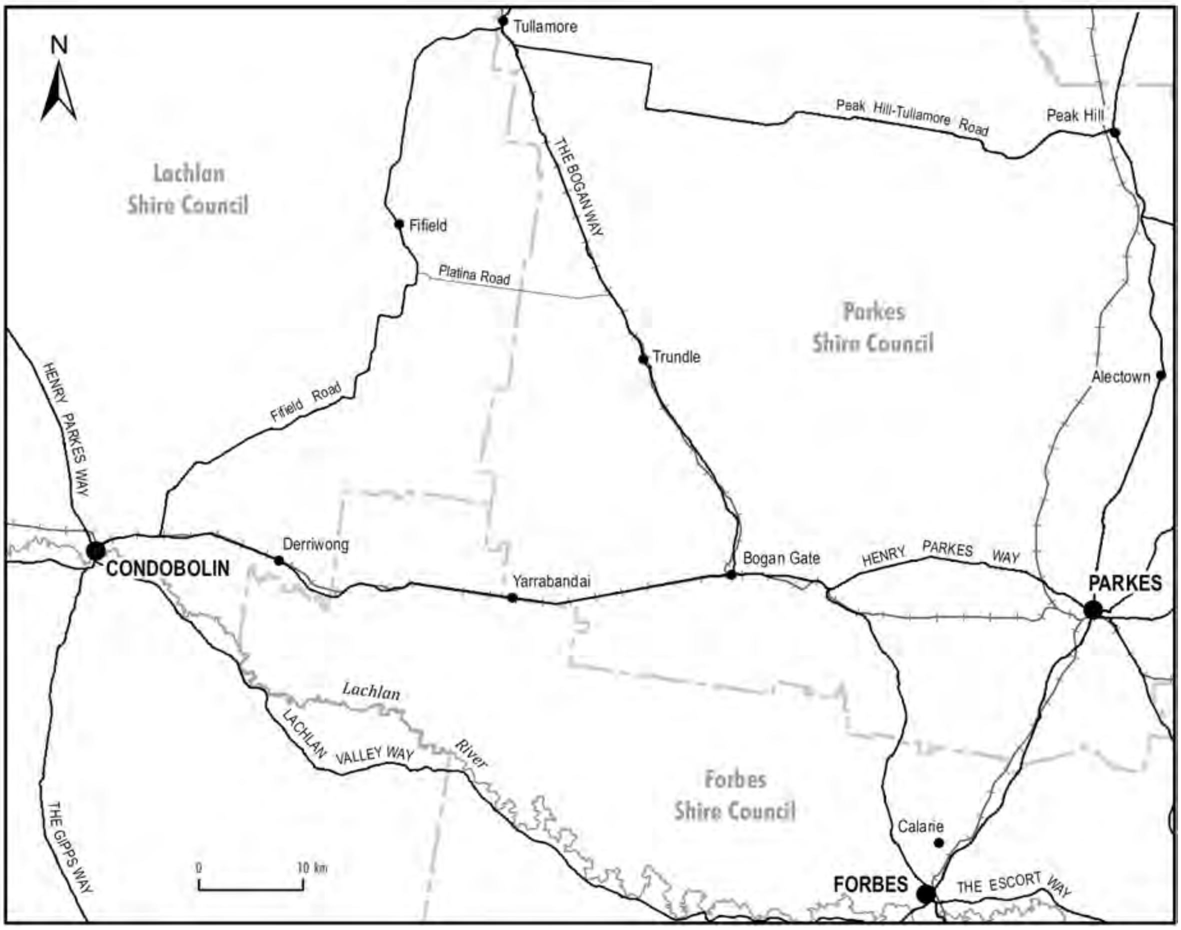

SCANDIUM 21

2 December 2016

Native Title Services Corporation Limited
PO Box 2105
STRAWBERRY HILLS NSW 2012

Syerston Project Extension Modification – Aboriginal Cultural Heritage Assessment

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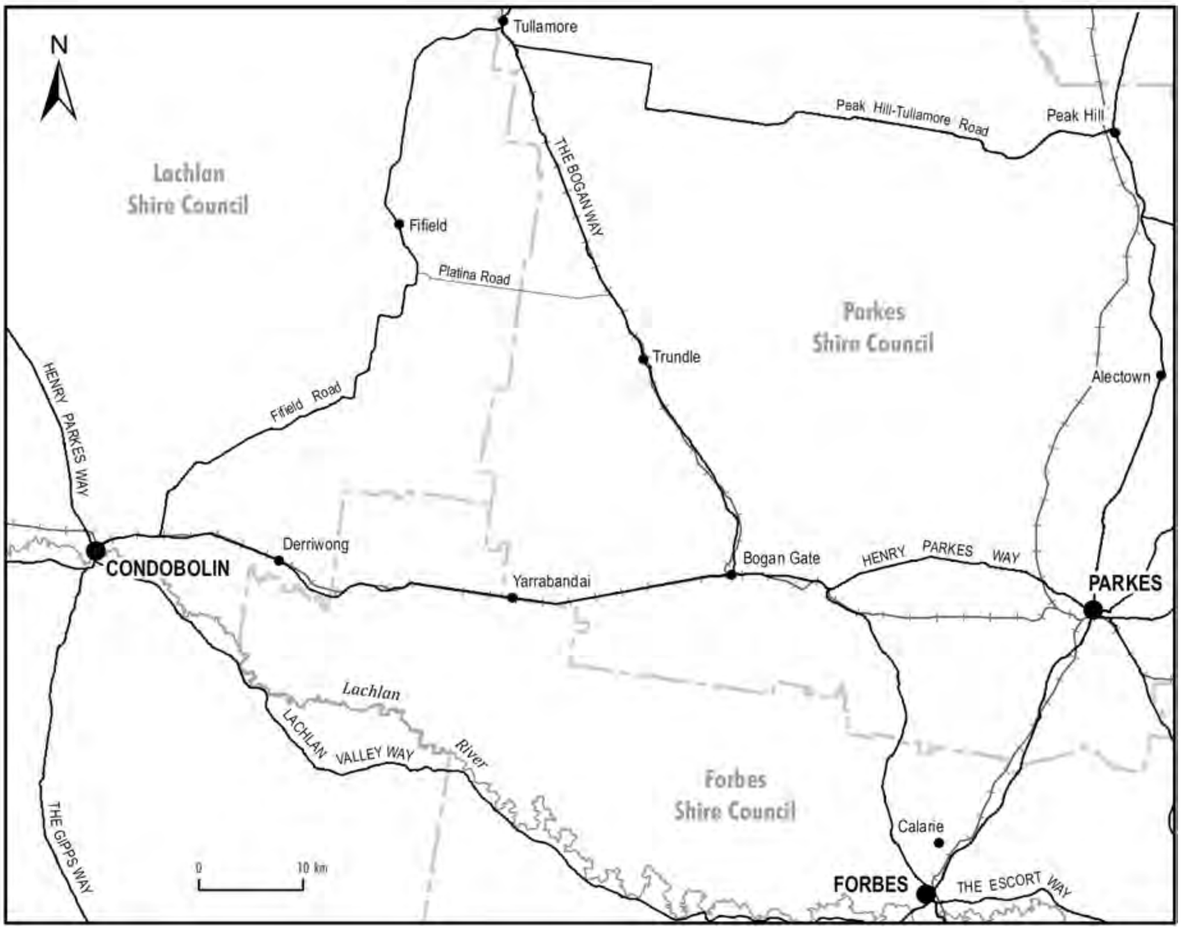
Kind Regards,

pp

MICK RYAN
PROJECT MANAGER – SYERSTON

PLAN SHOWING "AREA OF INTEREST"



2 December 2016

National Native Title Tribunal
NSW & ACT Registry
GPO Box 9973
SYDNEY NSW 2001

Syerston Project Extension Modification – Aboriginal Cultural Heritage Assessment

Dear Sir/Madam,

Scandium21 Pty Ltd (Scandium21), a wholly owned subsidiary of Clean TeQ Limited, owns the rights to develop the approved, but not yet developed, Syerston Project. The Syerston Project is situated approximately 350 km west-northwest of Sydney, near the village of Fifield, New South Wales (NSW).

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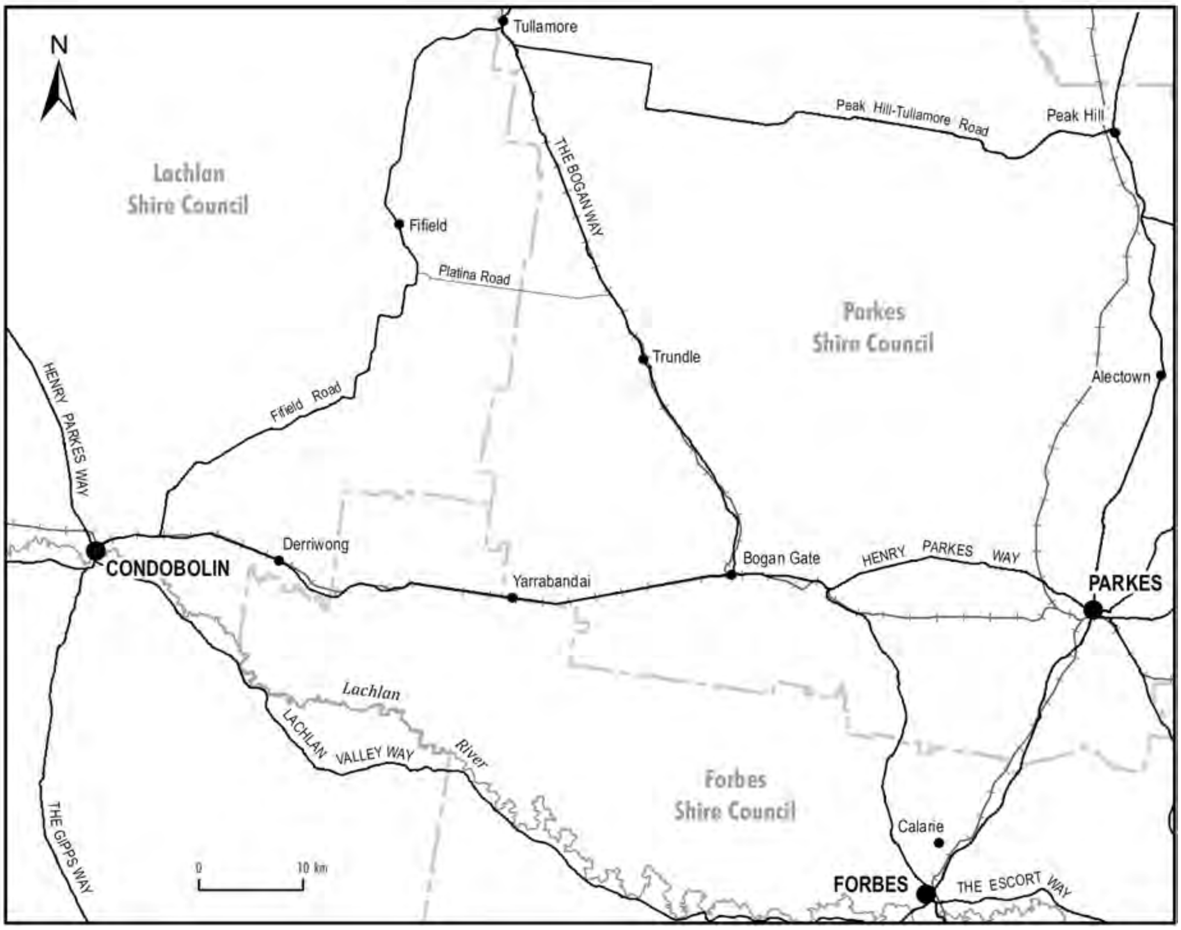

2 December 2016

The Registrar
Office of the Registrar, Aboriginal Land Rights Act 1983
PO Box 112
GLEBE NSW 2037

Syerston Project Extension Modification – Aboriginal Cultural Heritage Assessment

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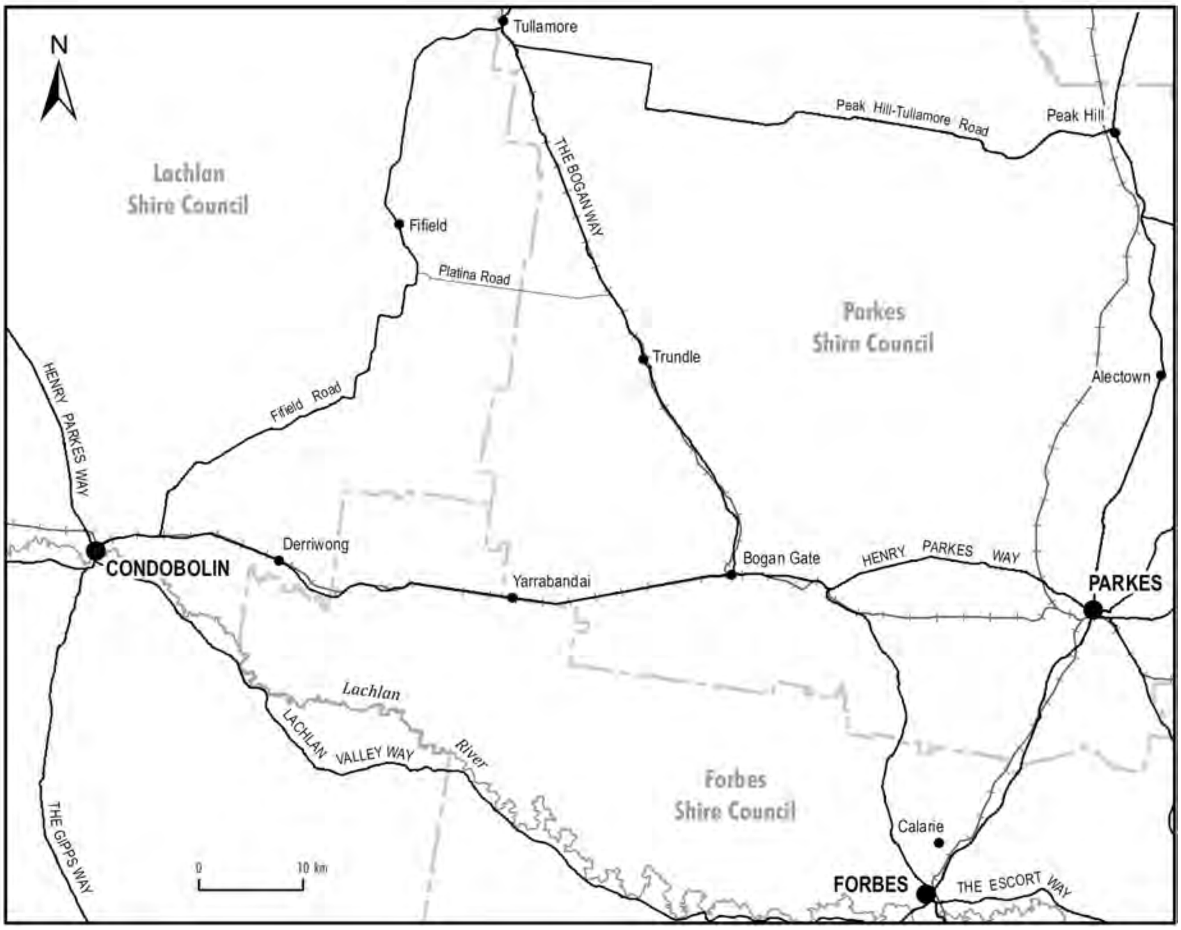

2 December 2016

Central West Local Land Services
PO Box 100
CONDOBOLIN NSW 2877

Syerston Project Extension Modification – Aboriginal Cultural Heritage Assessment

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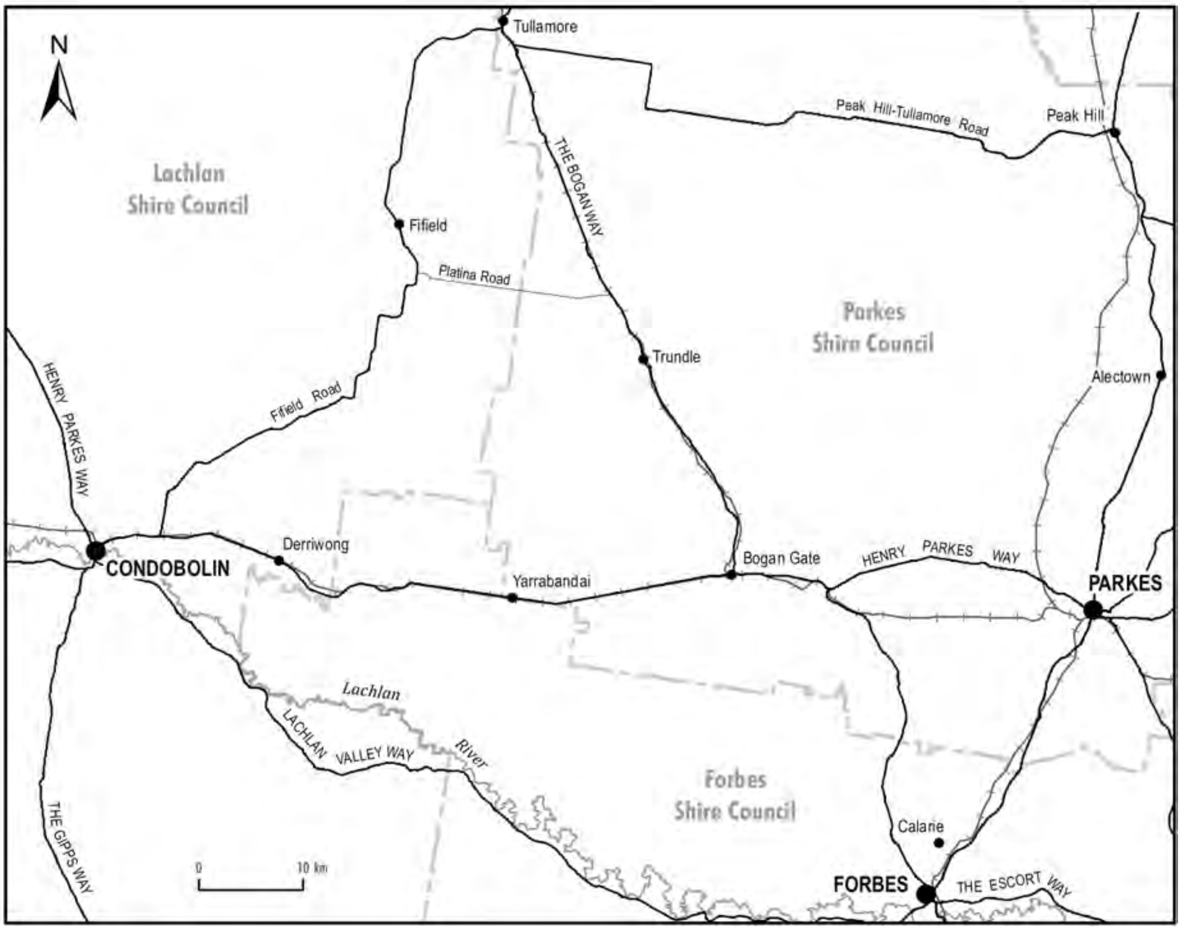

3 February 2017

West Wyalong Local Aboriginal Land Council
PO Box 332
WEST WYALONG NSW 2671

Syerston Project Extension Modification – Aboriginal Cultural Heritage Assessment

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JOHN HANRAHAN
APPROVALS LEAD – THE SYERSTON PROJECT

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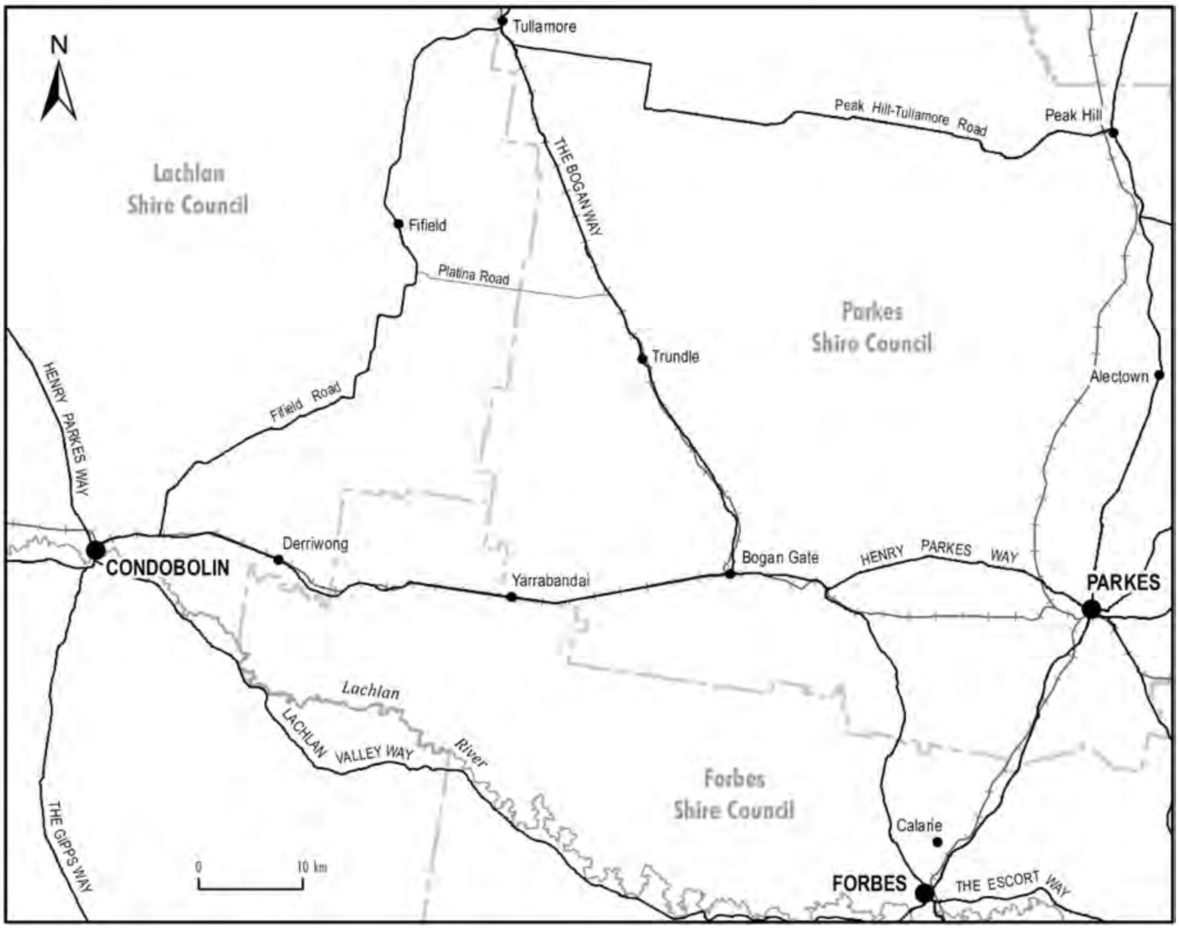

STEP 2 CORRESPONDENCE

6 January 2017

Condobolin Local Aboriginal Land Council
Chairperson
PO Box 114
CONDOBOLIN NSW 2877

Syerston Project Extension Modification – Aboriginal Cultural Heritage Assessment

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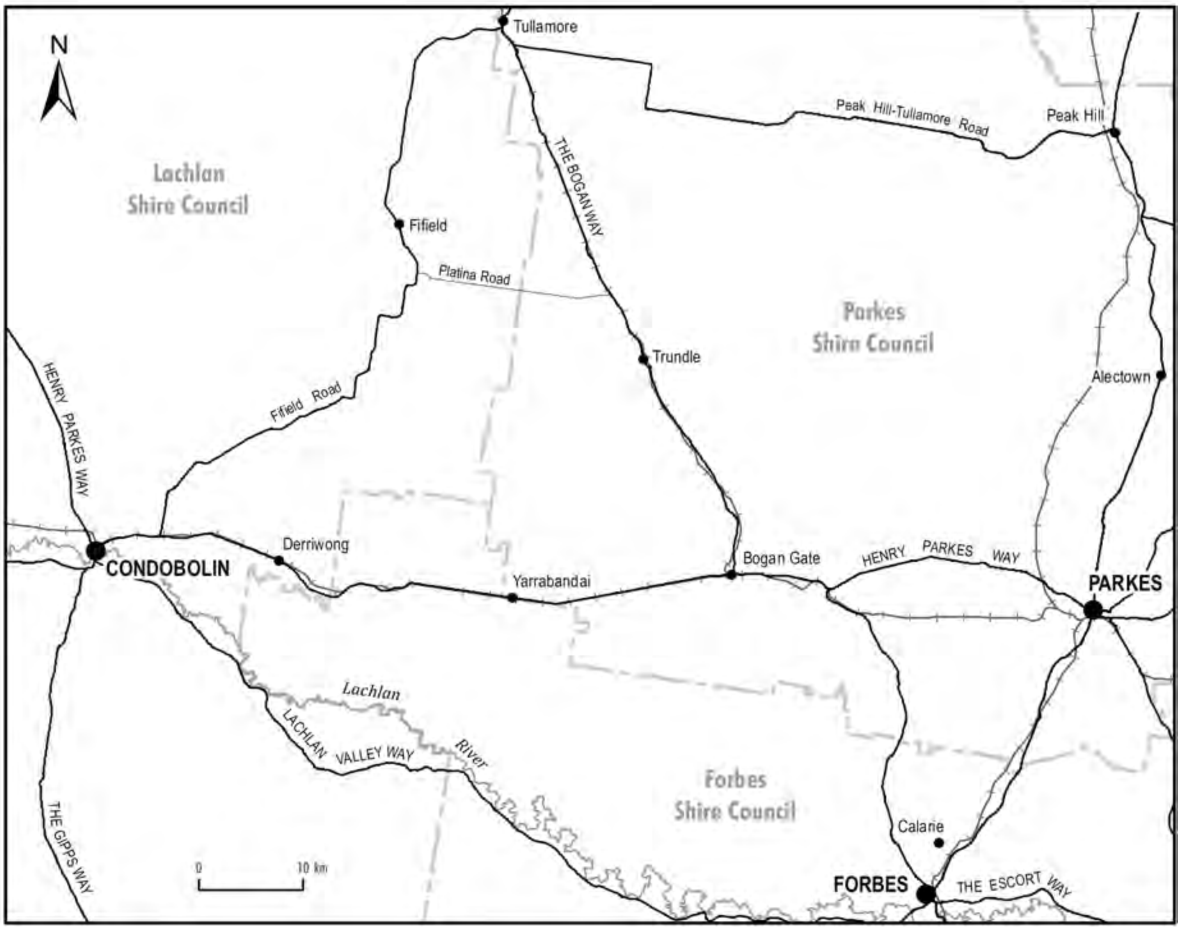

6 January 2017

Hunter Central Rivers Catchment Management Authority
Aboriginal Reference Group
Private Bag 2010
PATERSON NSW 2421

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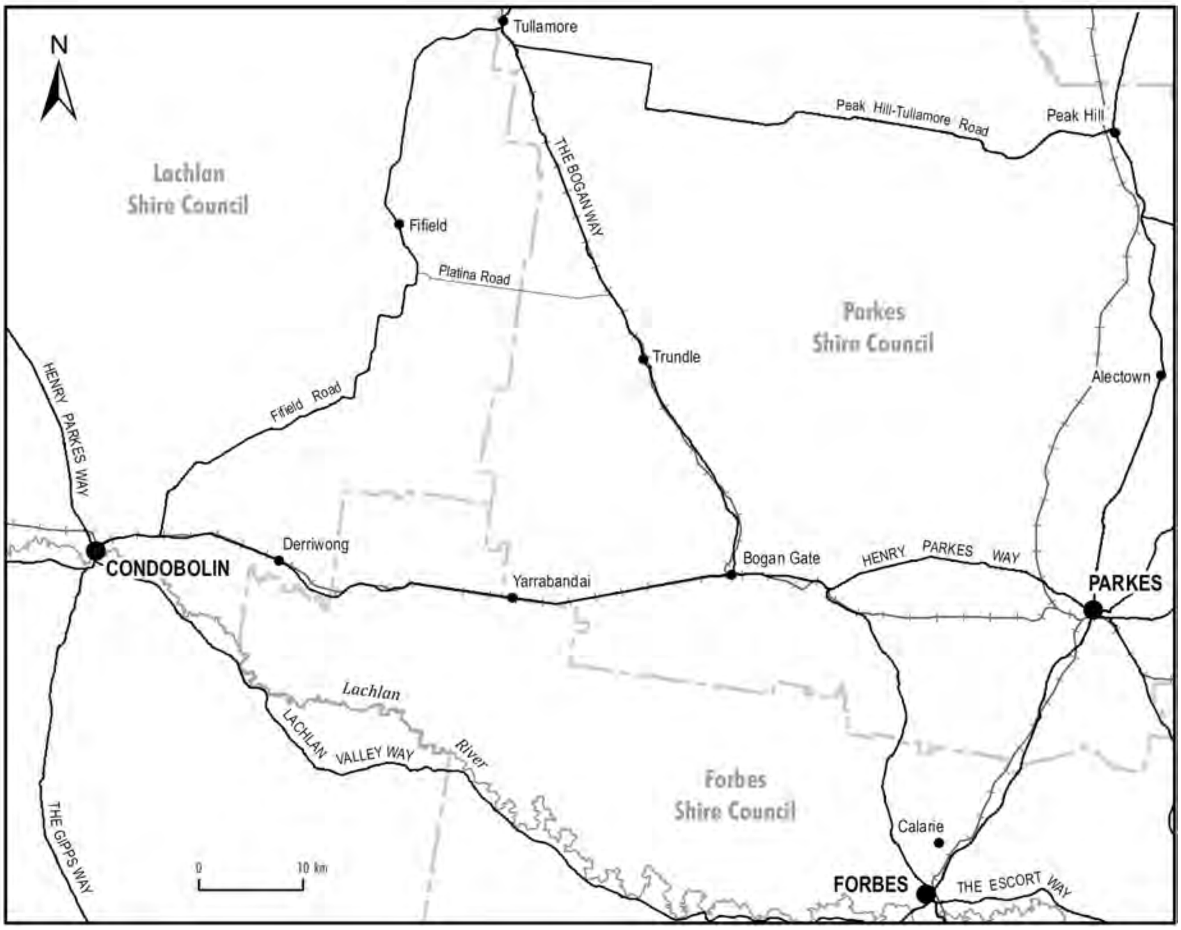

6 January 2017

Lachlan Catchment Management Authority
Aboriginal Reference Group
2 Sheriff Street
FORBES NSW 2871

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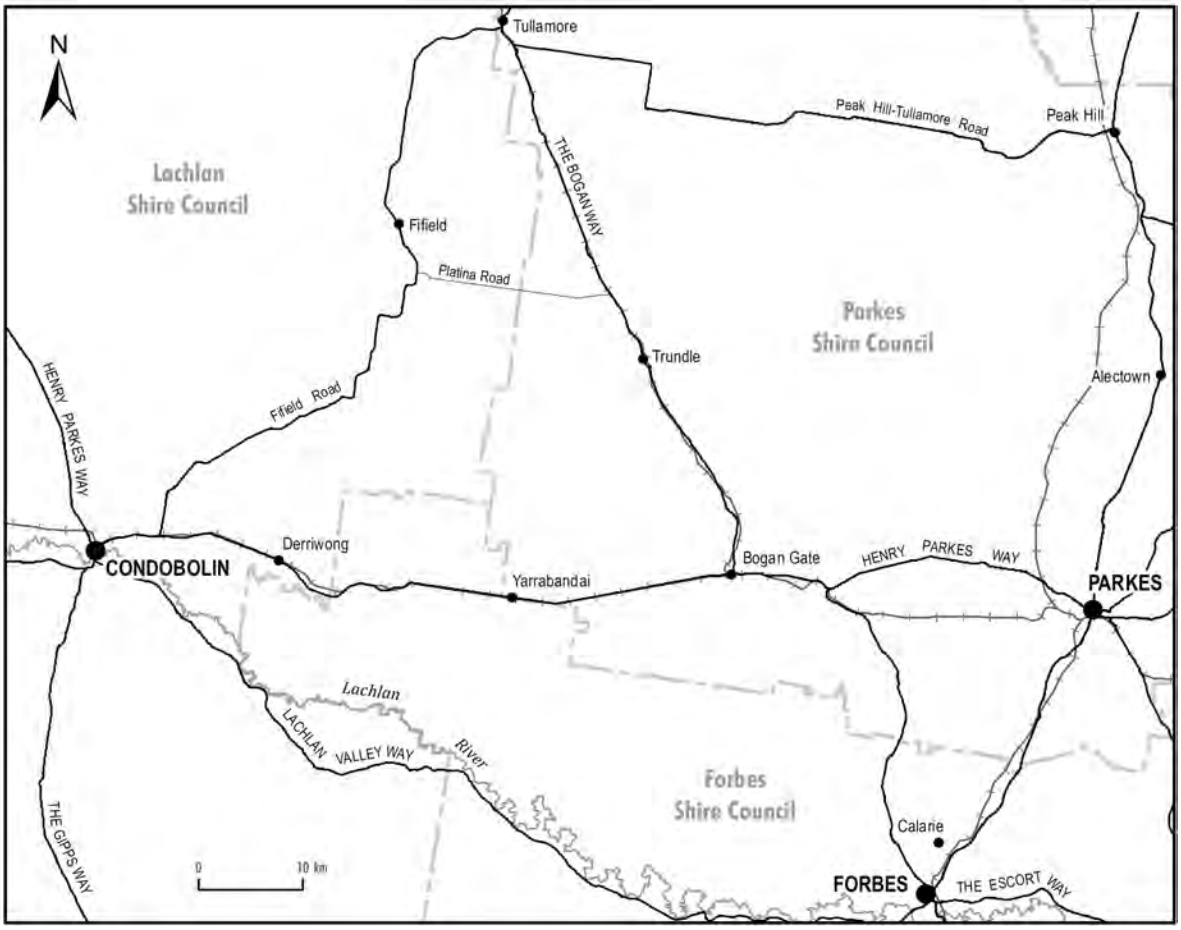
Kind Regards,

PP

MICK RYAN
PROJECT MANAGER – SYERSTON

PLAN SHOWING "AREA OF INTEREST"



6 January 2017

Mooka
Neville Williams
PO Box 70
COWRA NSW 2794

Syerston Project Extension Modification – Aboriginal Cultural Heritage Assessment

Dear Neville,

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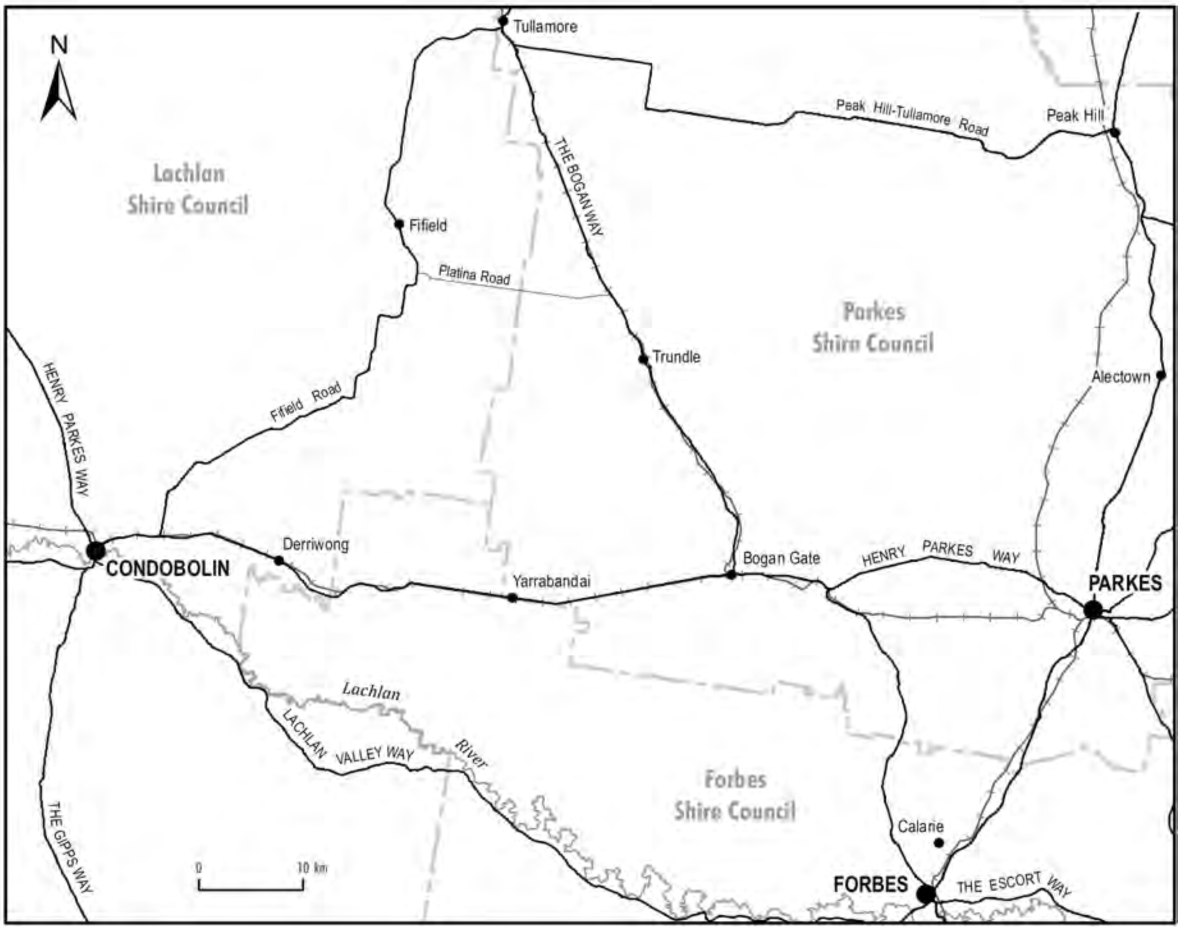

6 January 2017

Peak Hill Bogan River Traditional Owner
C/- Sylvana Keating, A/Area Manager
NPWS Lachlan Area, PO Box 774
FORBES NSW 2871

Syerston Project Extension Modification – Aboriginal Cultural Heritage Assessment

Dear Sylvana,

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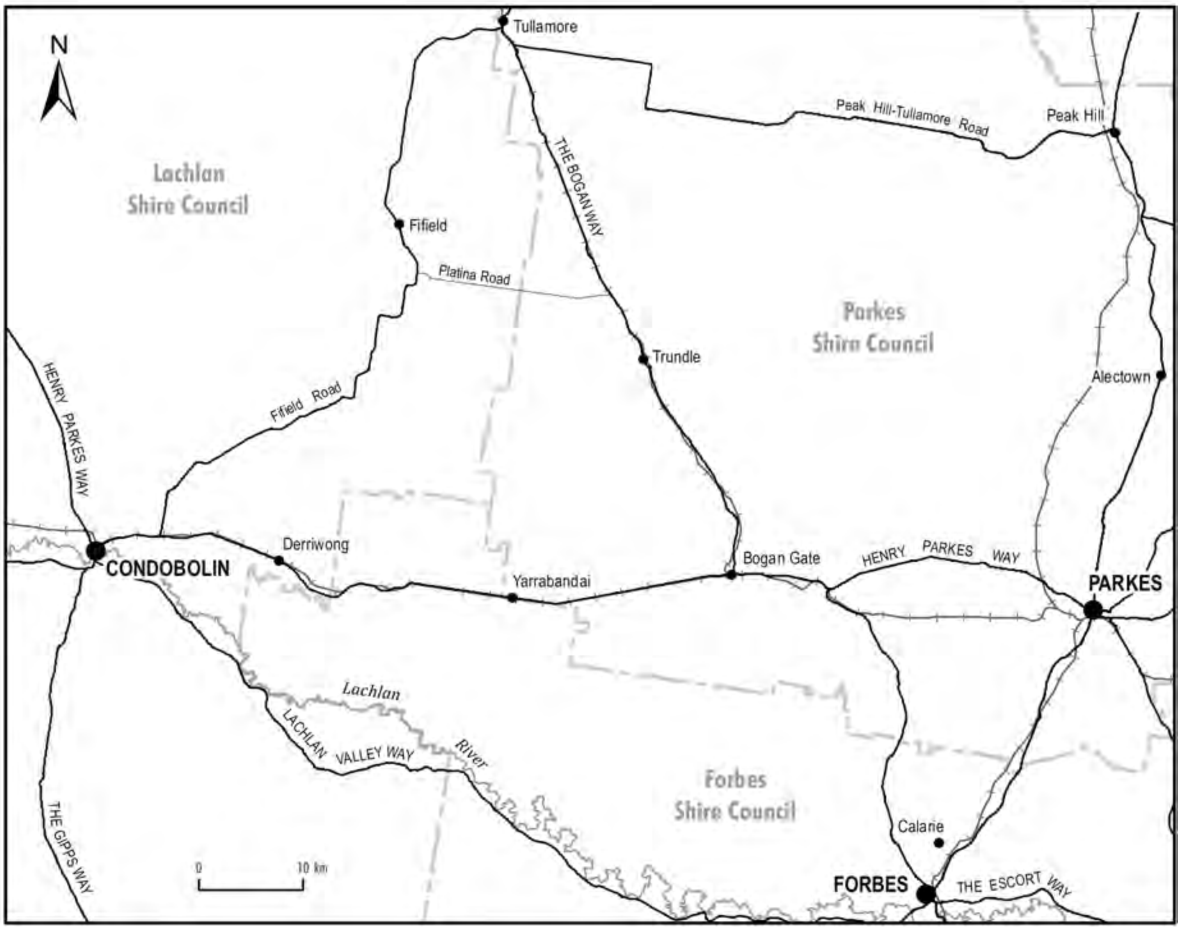

SCANDIUM21

6 January 2017

Trevor Robinson
PO Box 73
PEAK HILL NSW 2869

Syerston Project Extension Modification – Aboriginal Cultural Heritage Assessment

Dear Trevor,

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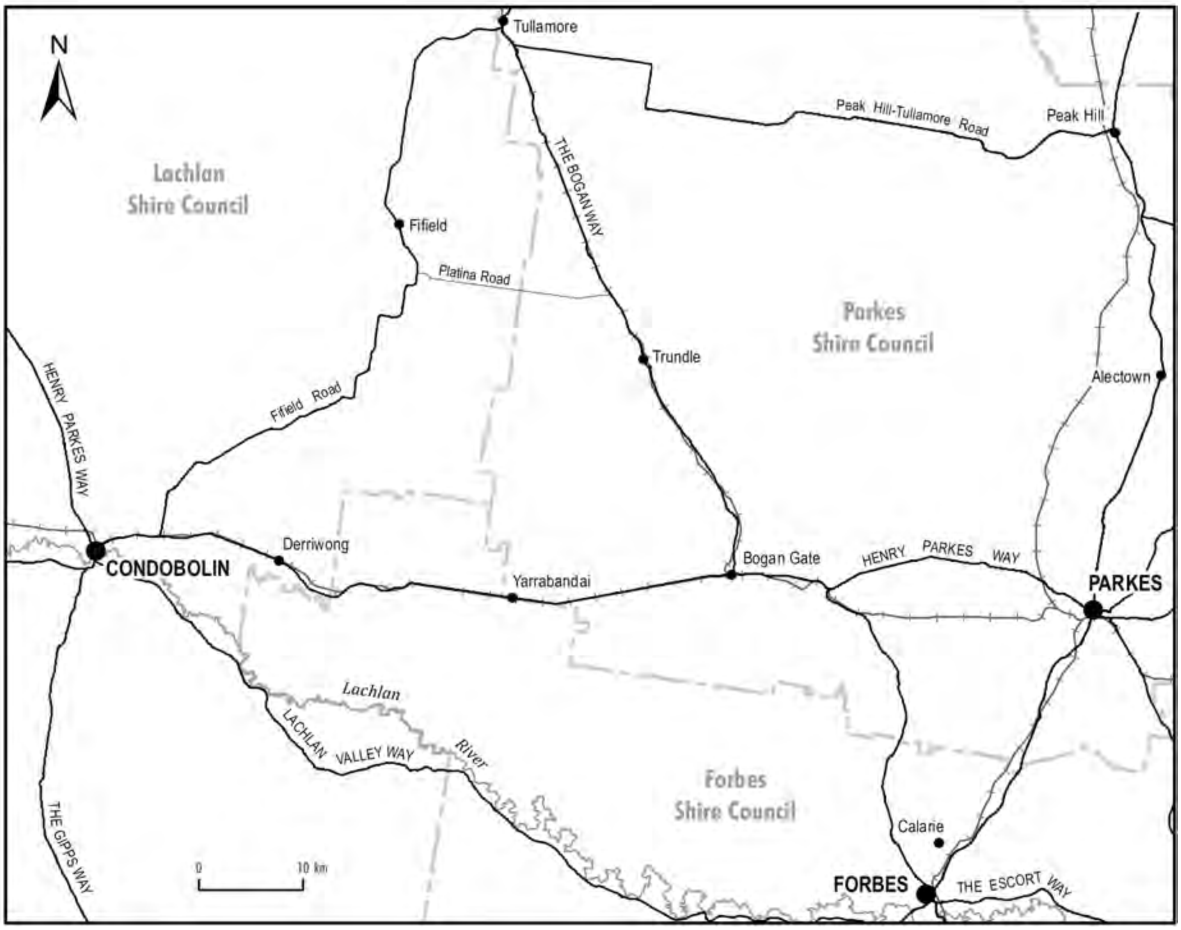

SCANDIUM 21

6 January 2017

Kullila Site Consultants
Paul Charles
14 Werrang Road
PRIMBEE NSW 2502

Syerston Project Extension Modification – Aboriginal Cultural Heritage Assessment

Dear Paul,

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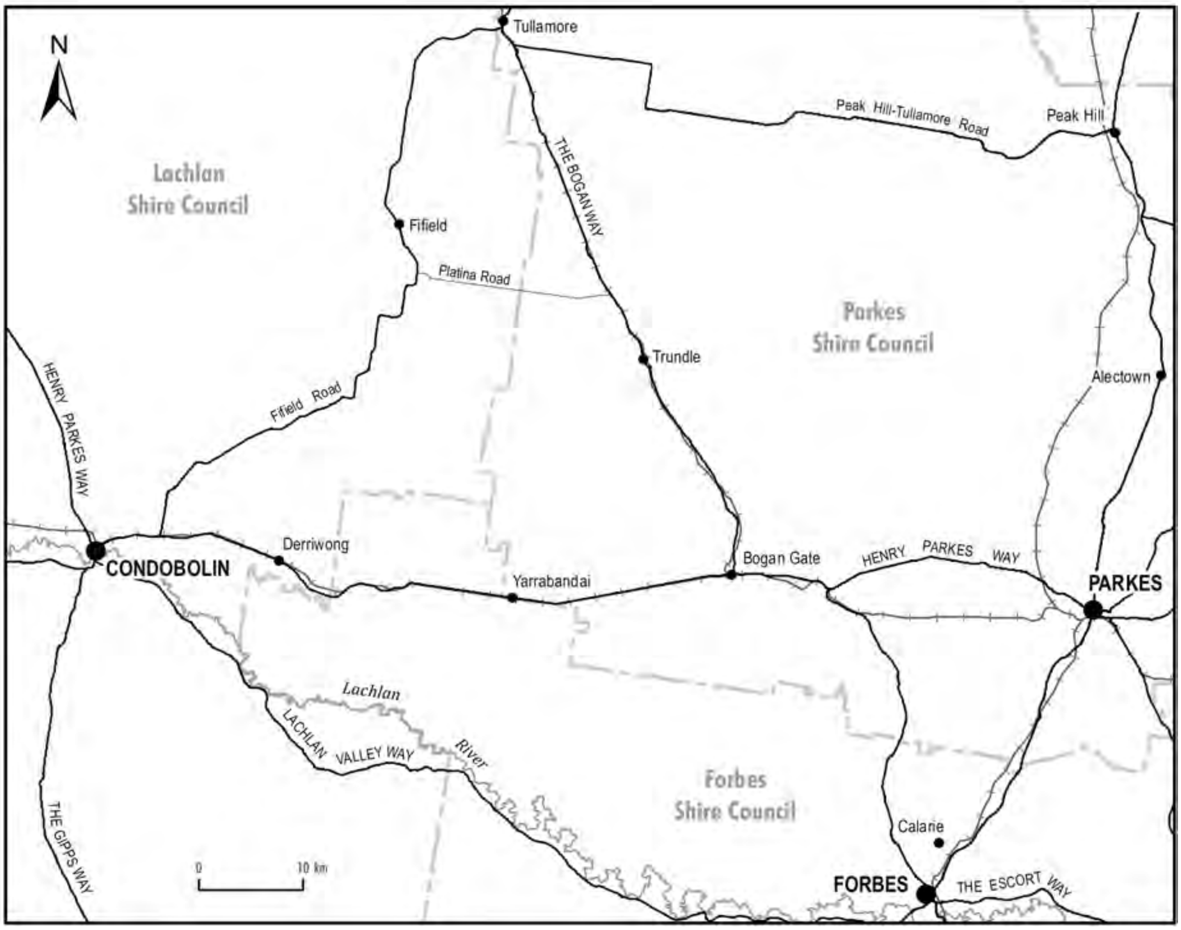

6 January 2017

Mulli Mulli Local Aboriginal Land Council
Chairperson
PO Box 68
WOODENBONG NSW 2476

Syerston Project Extension Modification – Aboriginal Cultural Heritage Assessment

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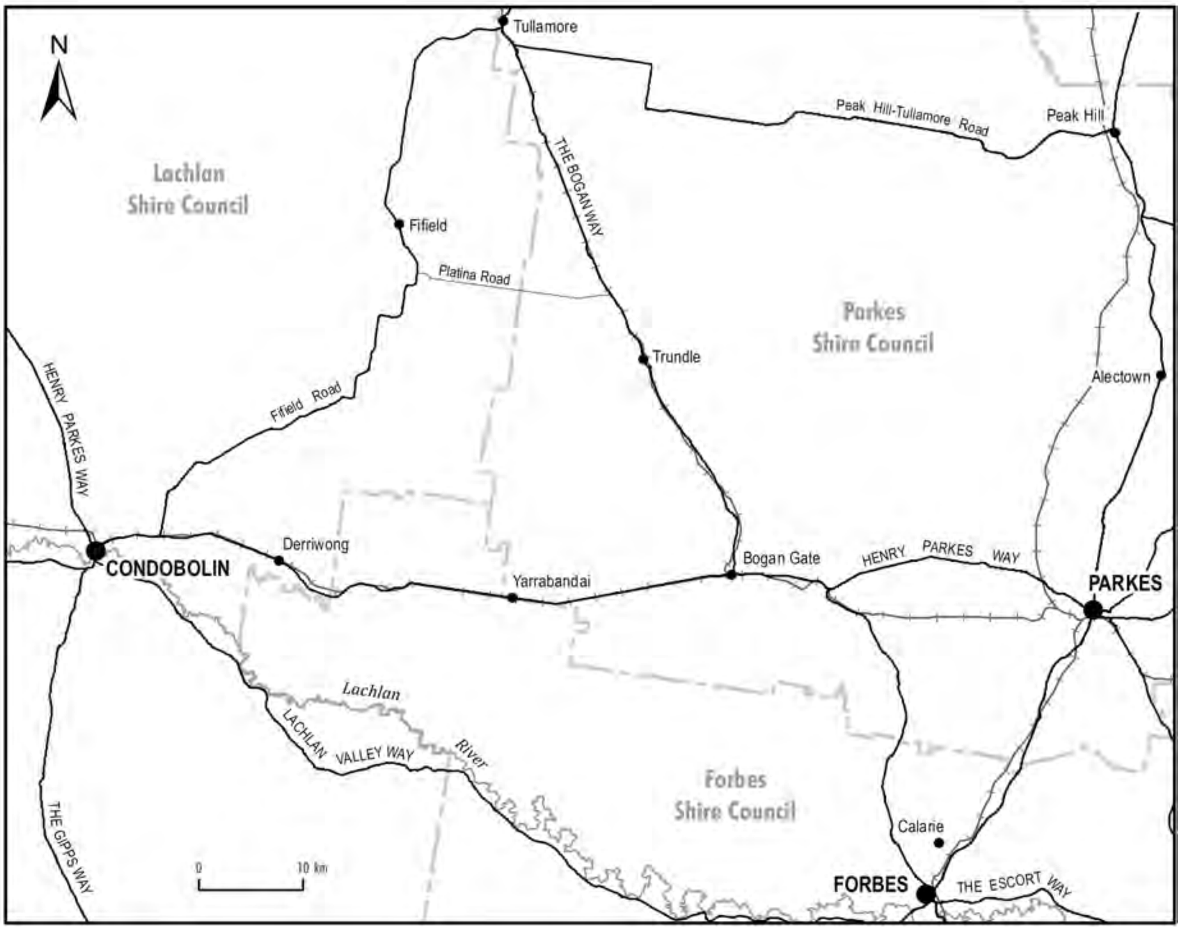

6 January 2017

Murie Elders Group
Chairperson
161 Bathurst Street
CONDOBOLIN NSW 2877

Syerston Project Extension Modification – Aboriginal Cultural Heritage Assessment

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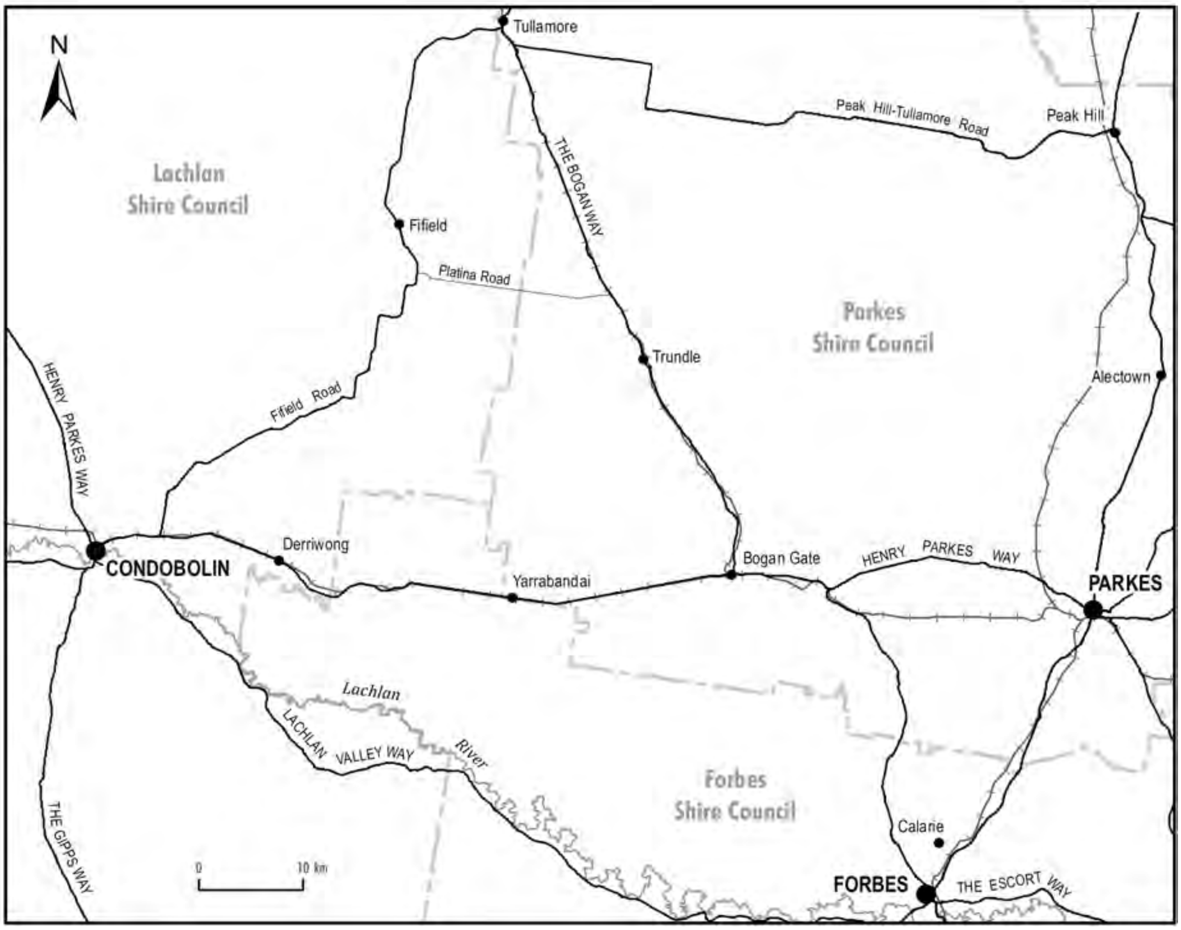

6 January 2017

Murrin Bridge Local Aboriginal Land Council
Chairperson
PO Box 157
LAKE CARGELLIGO NSW 2672

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MICK RYAN
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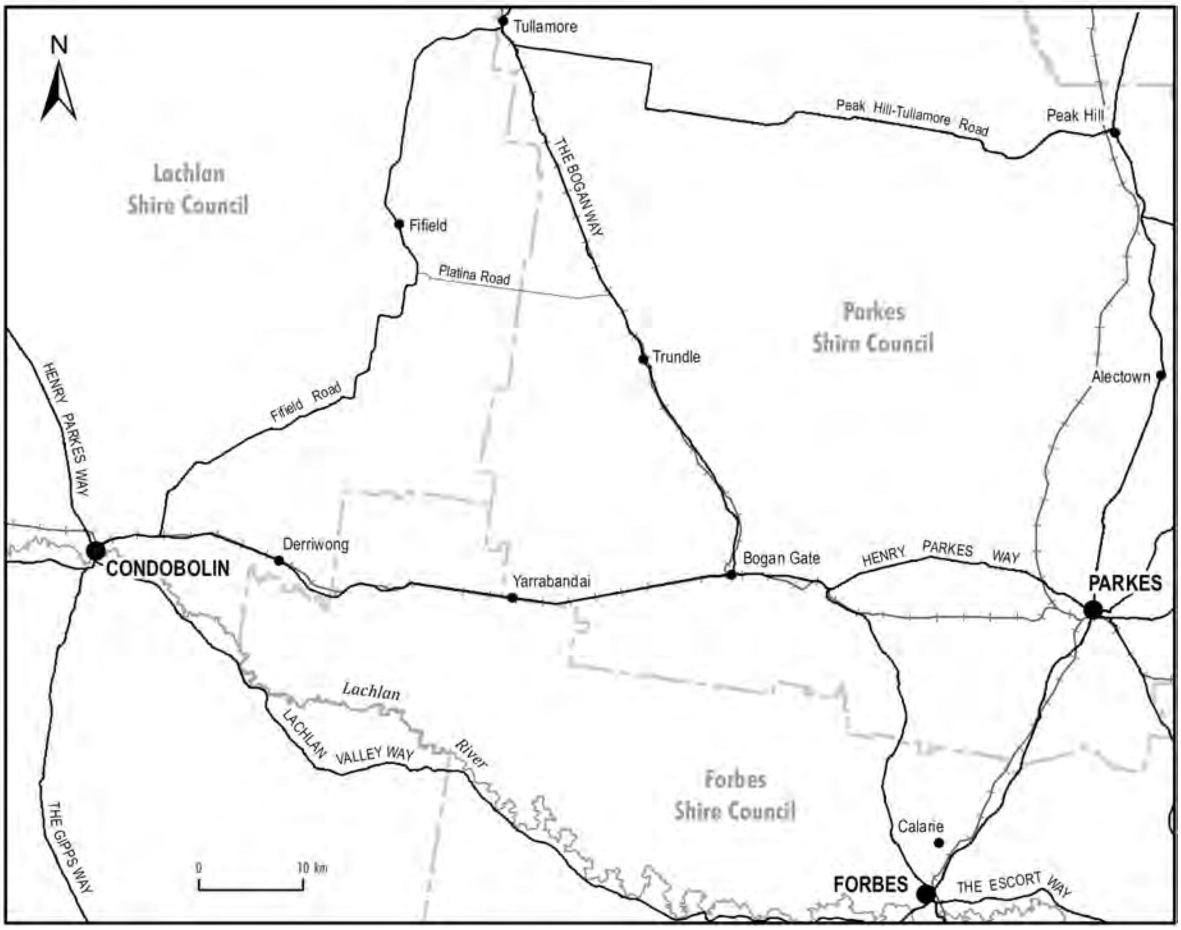
PLAN SHOWING "AREA OF INTEREST"



6 January 2017

Peter Peckham
27 Jennings Street
GEURIE NSW 2831

Syerston Project Extension Modification – Aboriginal Cultural Heritage Assessment

Dear Peter,

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Kind Regards,

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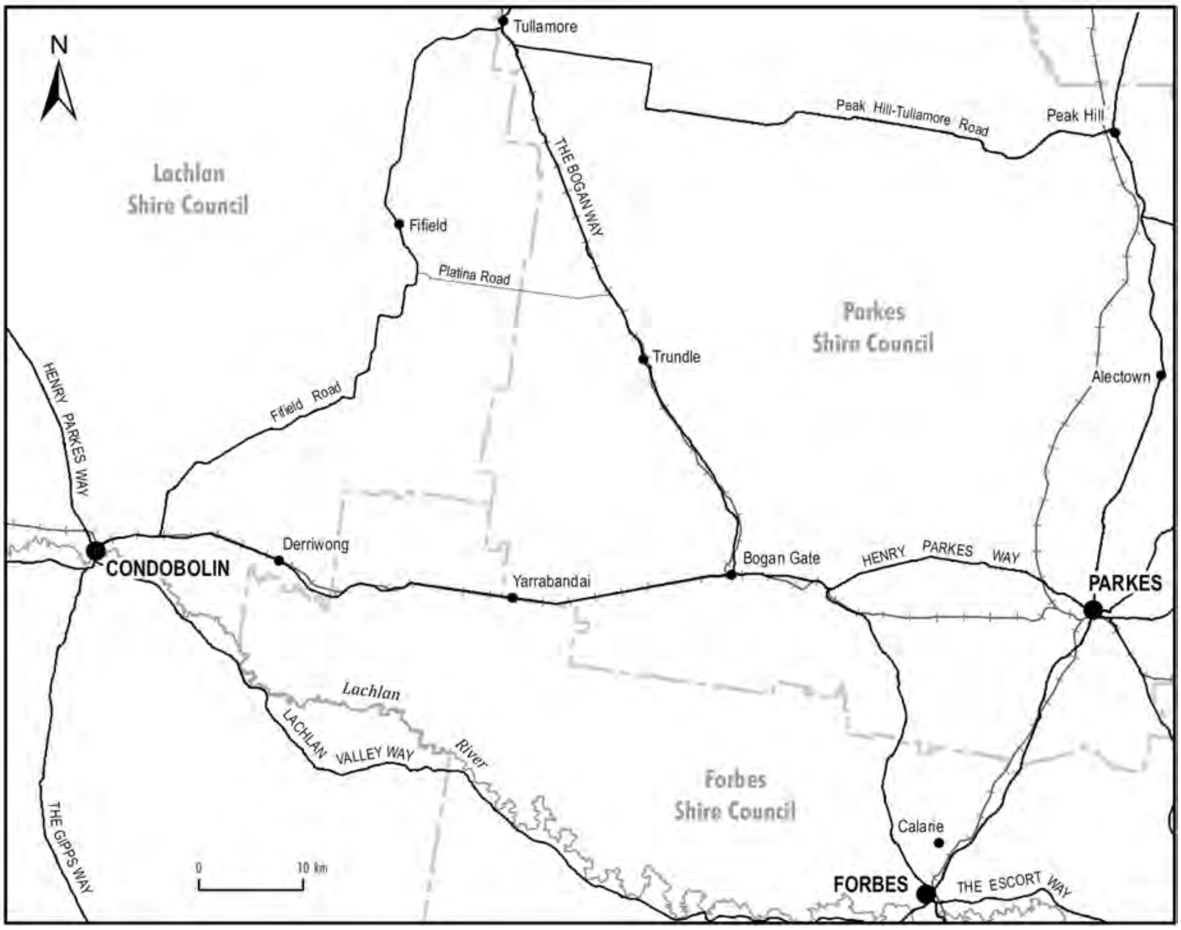

6 January 2017

Trevor Robinson
PO Box 73
PEAK HILL NSW 2869

Syerston Project Extension Modification – Aboriginal Cultural Heritage Assessment

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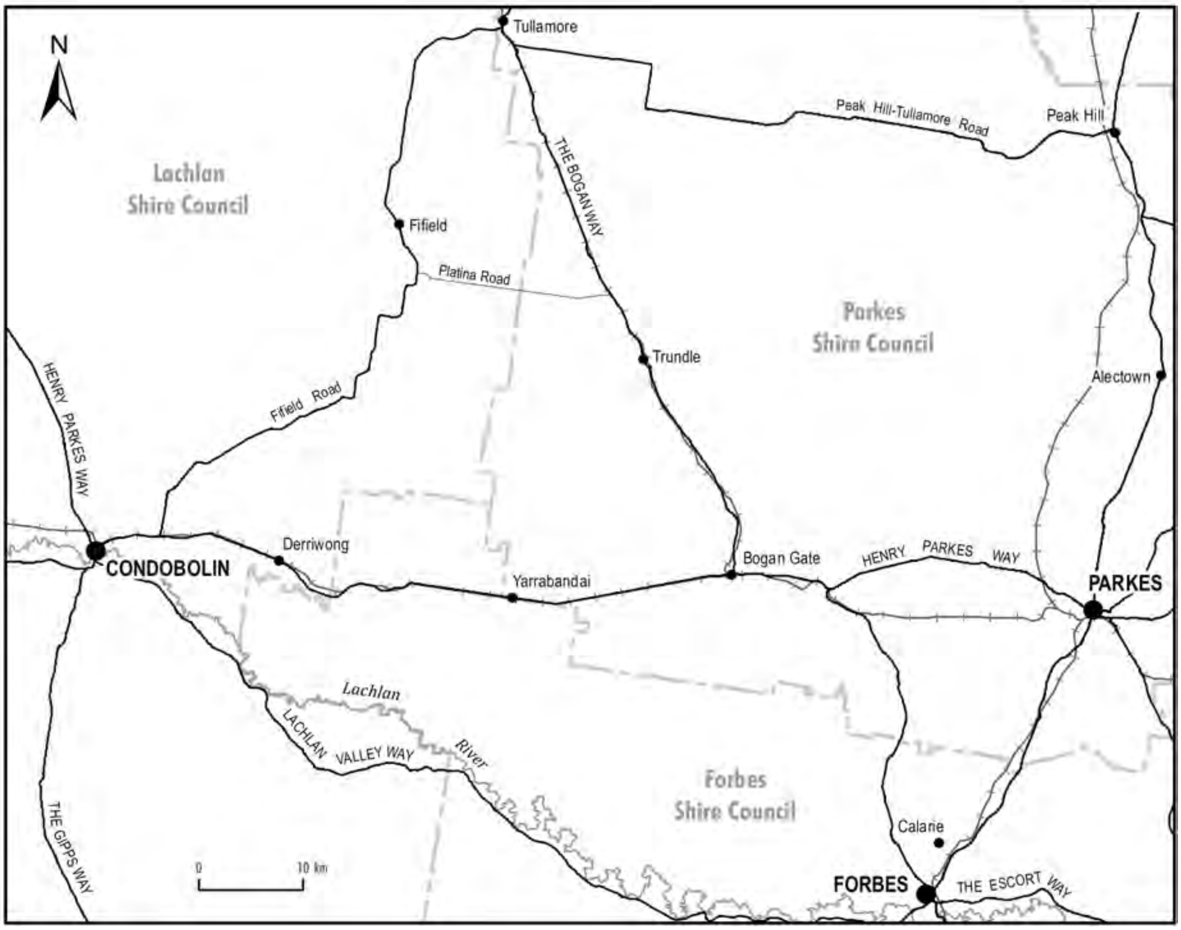

ScANDIUM 21

6 January 2017

Wiradjuri Condobolin Corporation
PO Box 194
CONDOBOLIN NSW 2877

Syerston Project Extension Modification – Aboriginal Cultural Heritage Assessment

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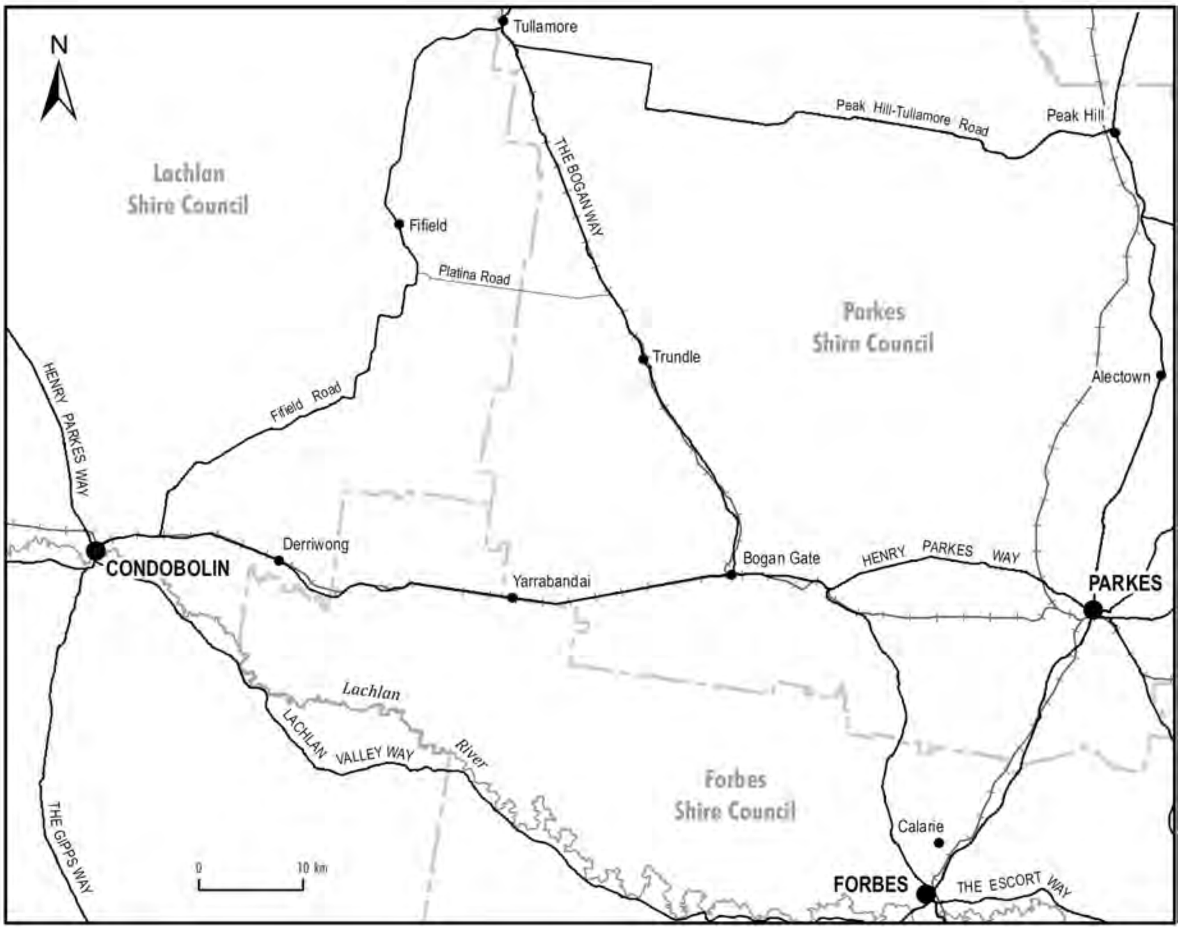

6 January 2017

Wiradjuri Council of Elders
Robert Clegg
7 Keast Street
PARKES NSW 2870

Syerston Project Extension Modification – Aboriginal Cultural Heritage Assessment

Dear Robert,

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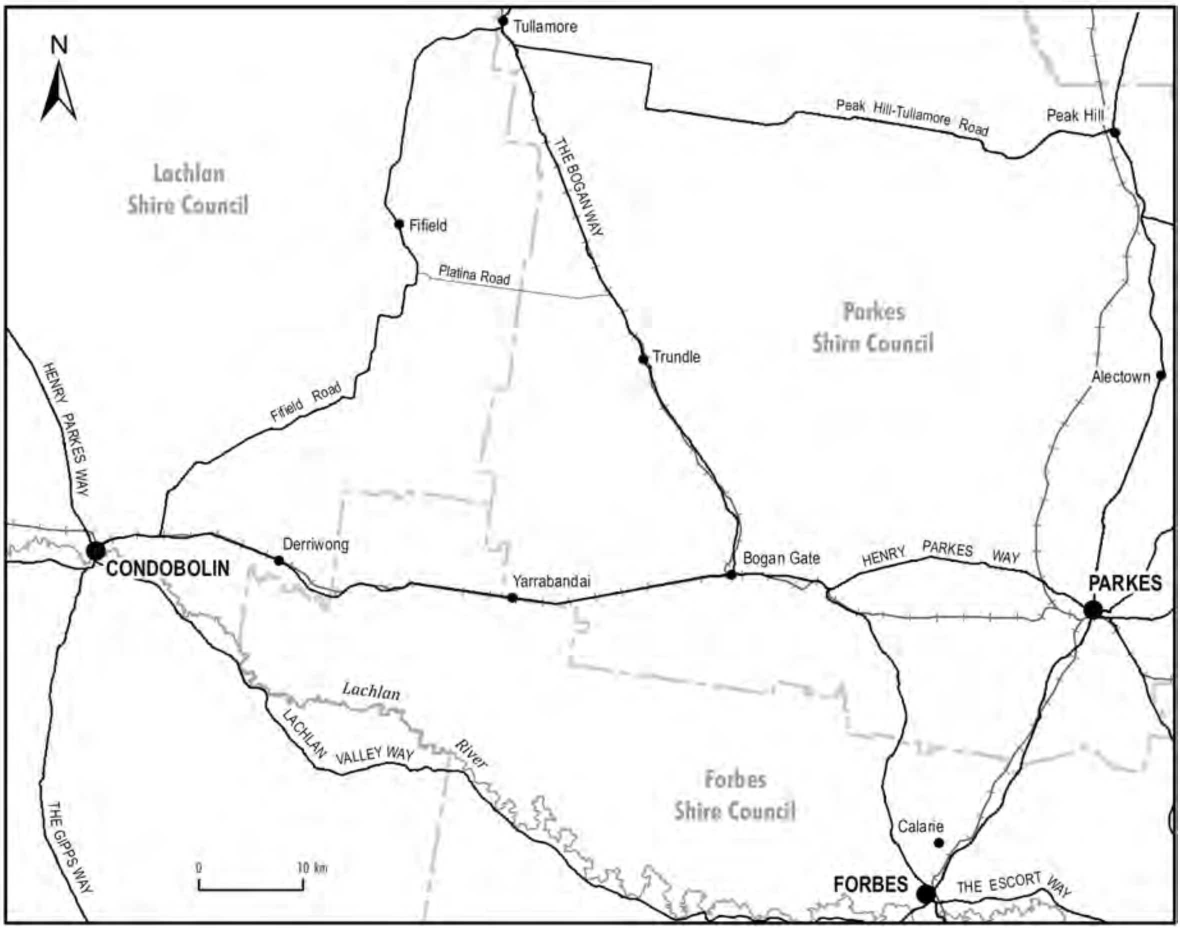

6 January 2017

Binjang Wellington Wiradjuri Heritage Survey
Dorothy Stewart
260 Myall Street
DUBBO NSW 2830

Syerston Project Extension Modification – Aboriginal Cultural Heritage Assessment

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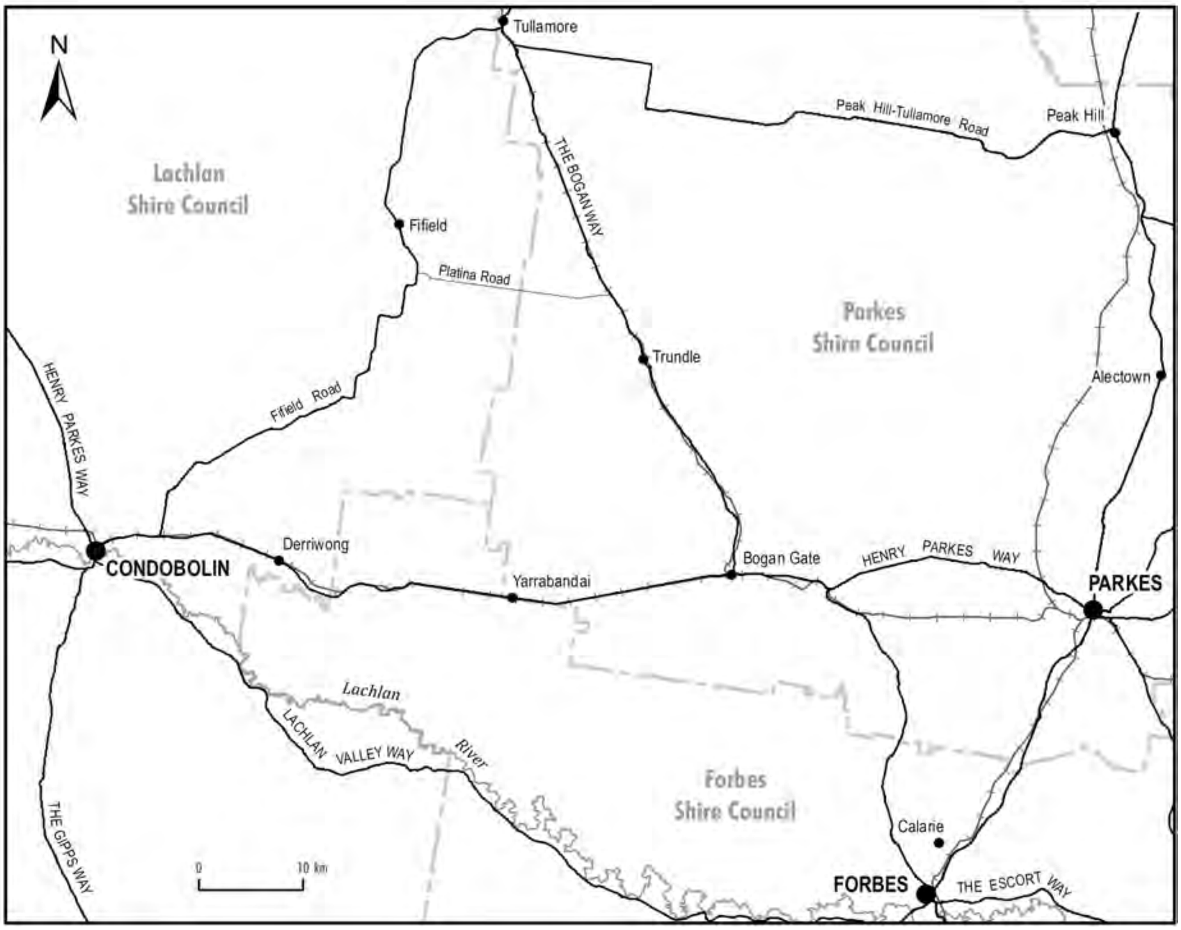

6 January 2017

Bogan River Peak Hill Wiradjuri Aboriginal Corporation
Chairperson
PO Box 42
PEAK HILL NSW 2869

Syerston Project Extension Modification – Aboriginal Cultural Heritage Assessment

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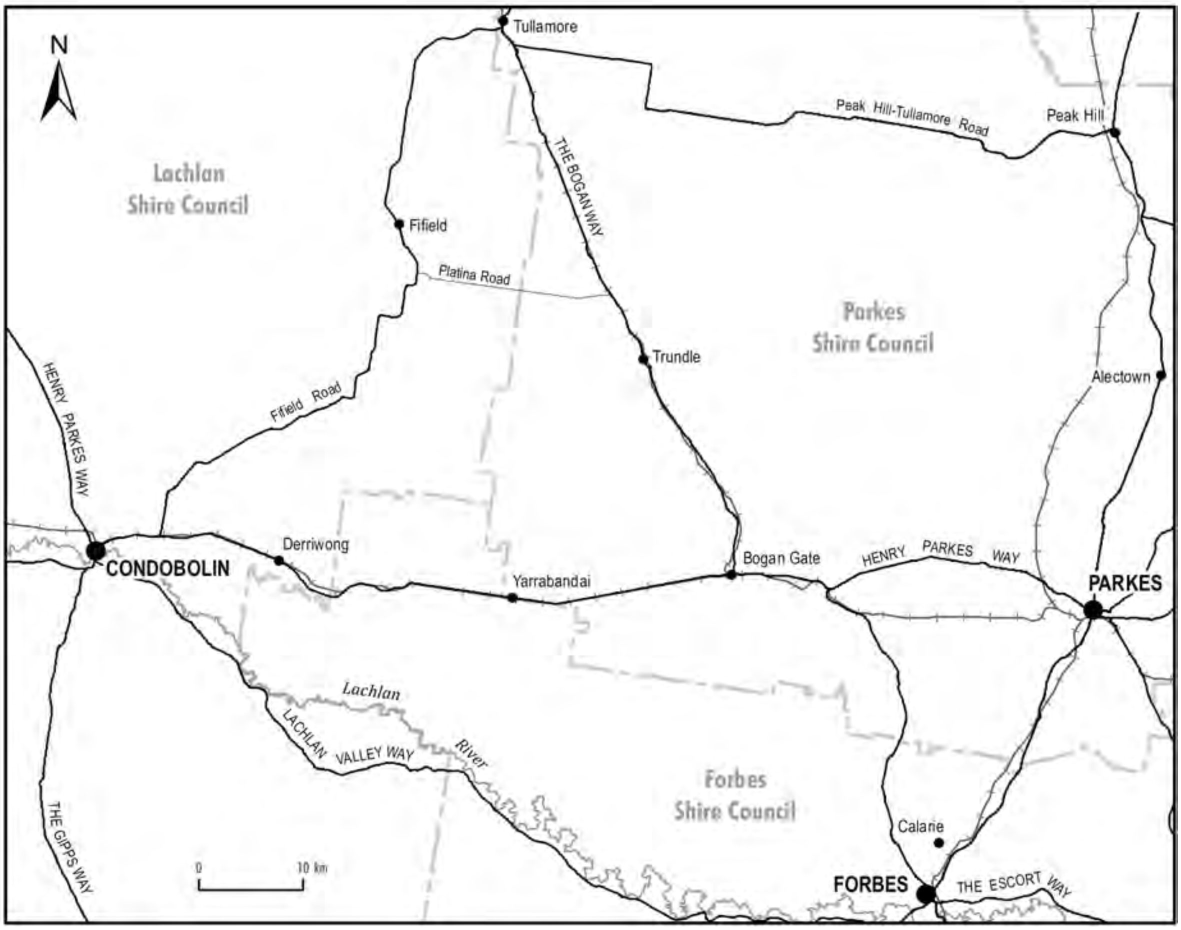

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Bulgandramine Youth Development Aboriginal Corporation
Chairperson
PO Box 119
PEAK HILL NSW 2869

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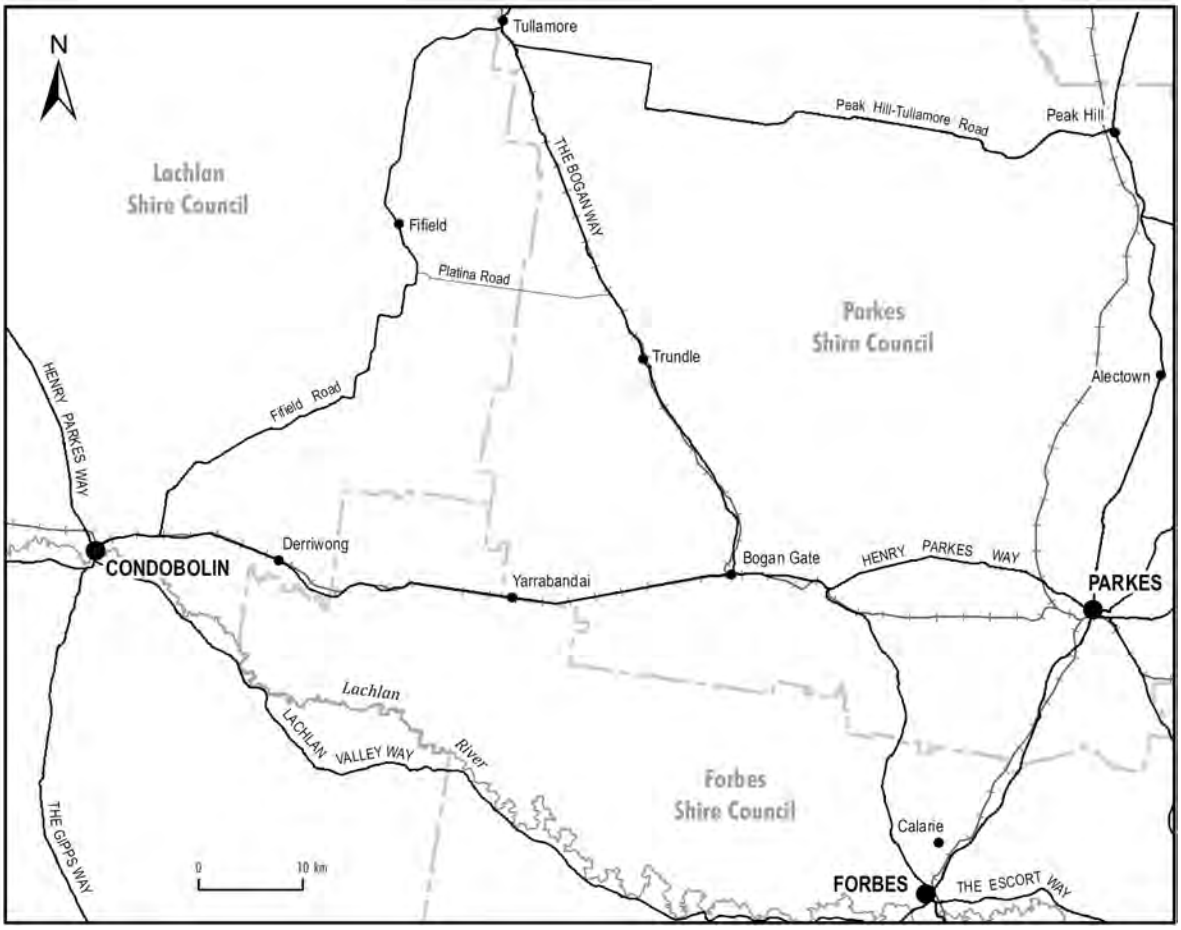

6 January 2017

Eva Coe
3 Yarnbildine Place
COWRA NSW 2794

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Kind Regards,

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MICK RYAN
PROJECT MANAGER – SYERSTON

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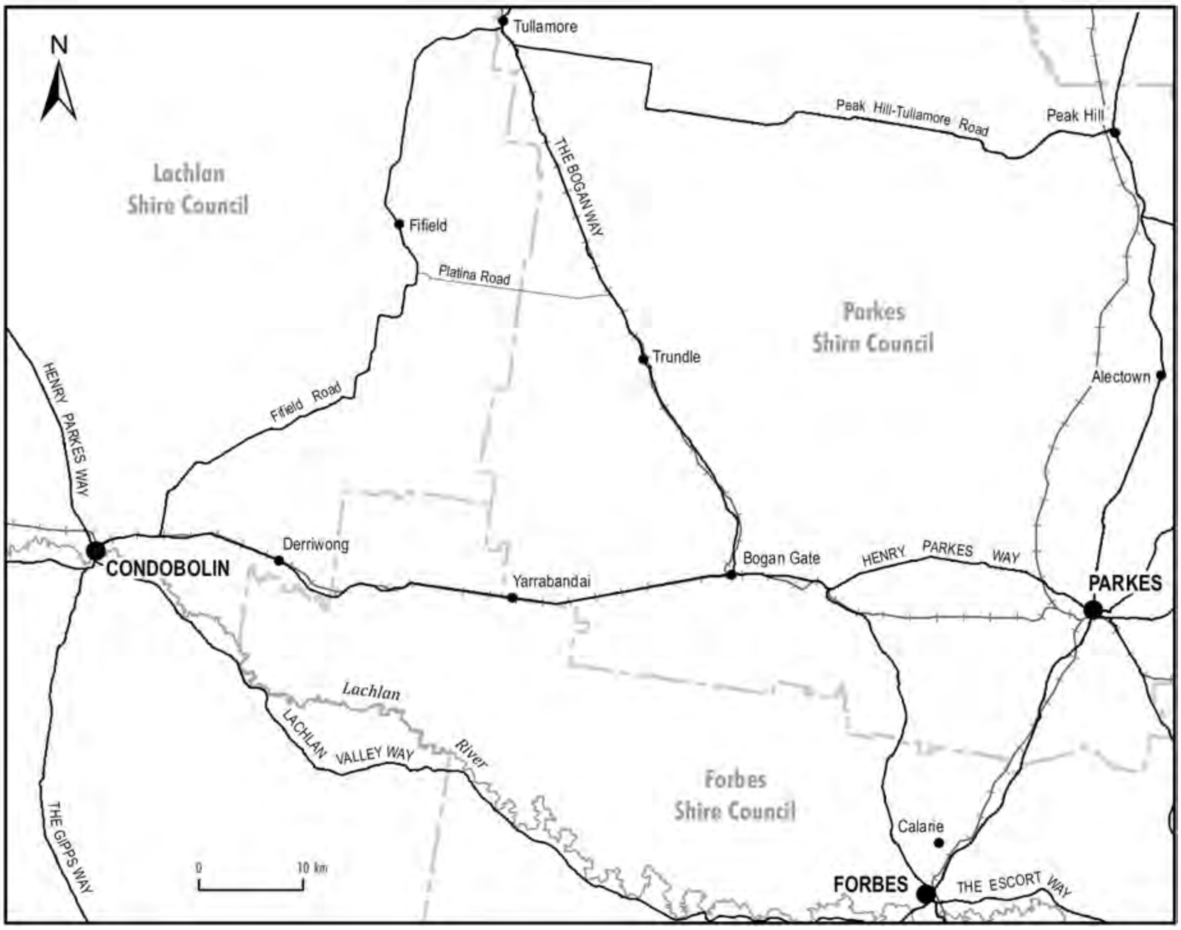

6 January 2017

Cowra Local Aboriginal Land Council
Chairperson
PO Box 769
COWRA NSW 2794

Syerston Project Extension Modification – Aboriginal Cultural Heritage Assessment

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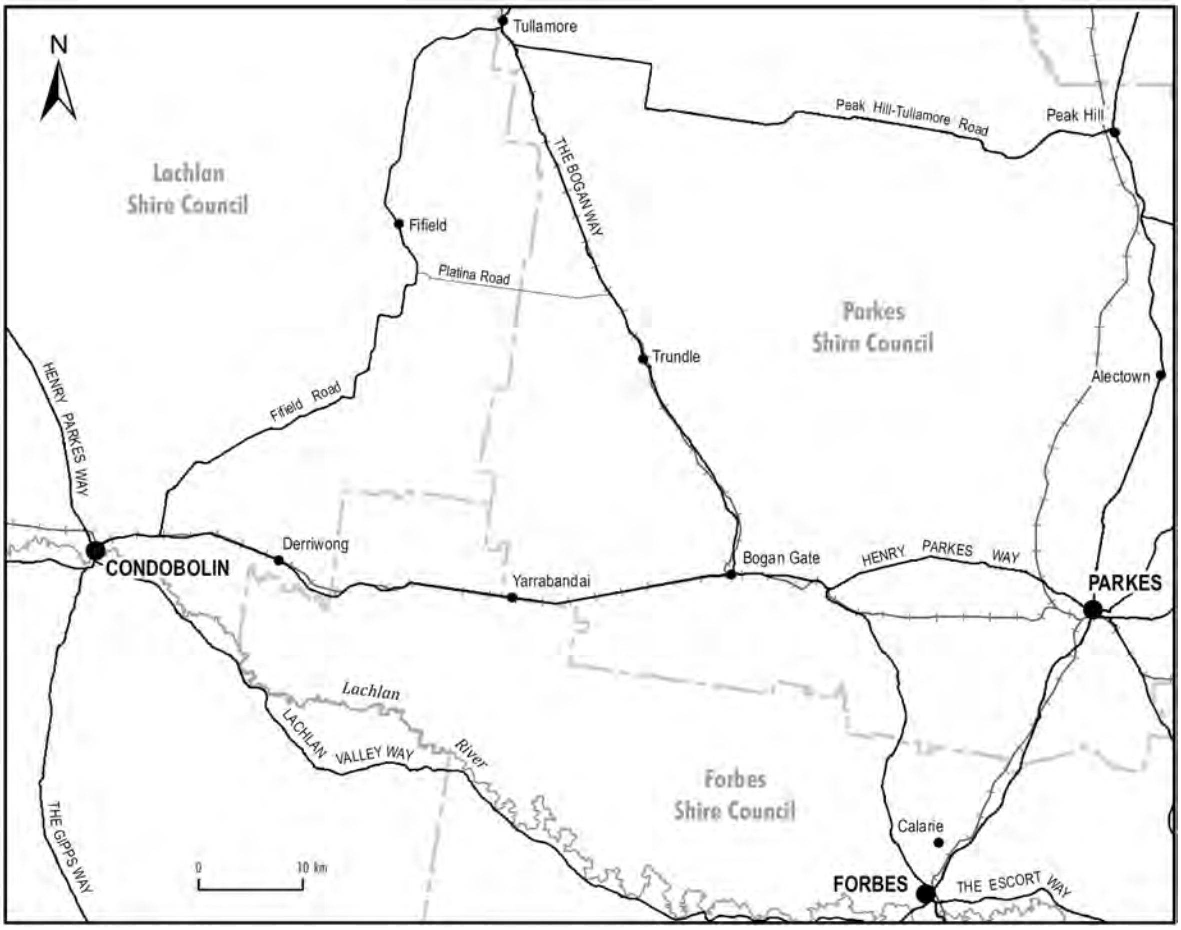

SCANDIUM21

6 January 2017

Little Burning Mountain Aboriginal Corporation
Chairperson
PO Box 152
PEAK HILL NSW 2869

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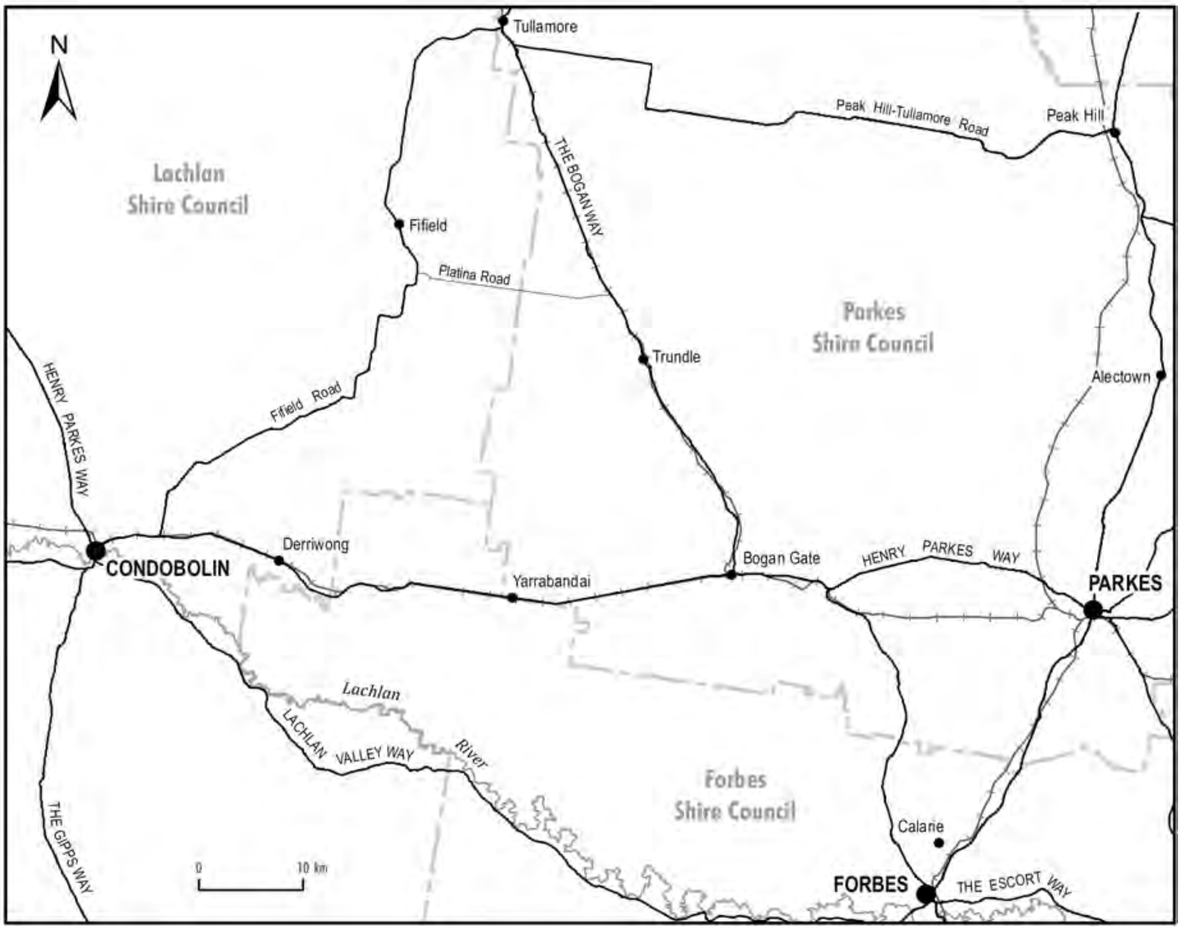

6 January 2017

Peak Hill Local Aboriginal Land Council
Chairperson
PO Box 63
PEAK HILL NSW 2869

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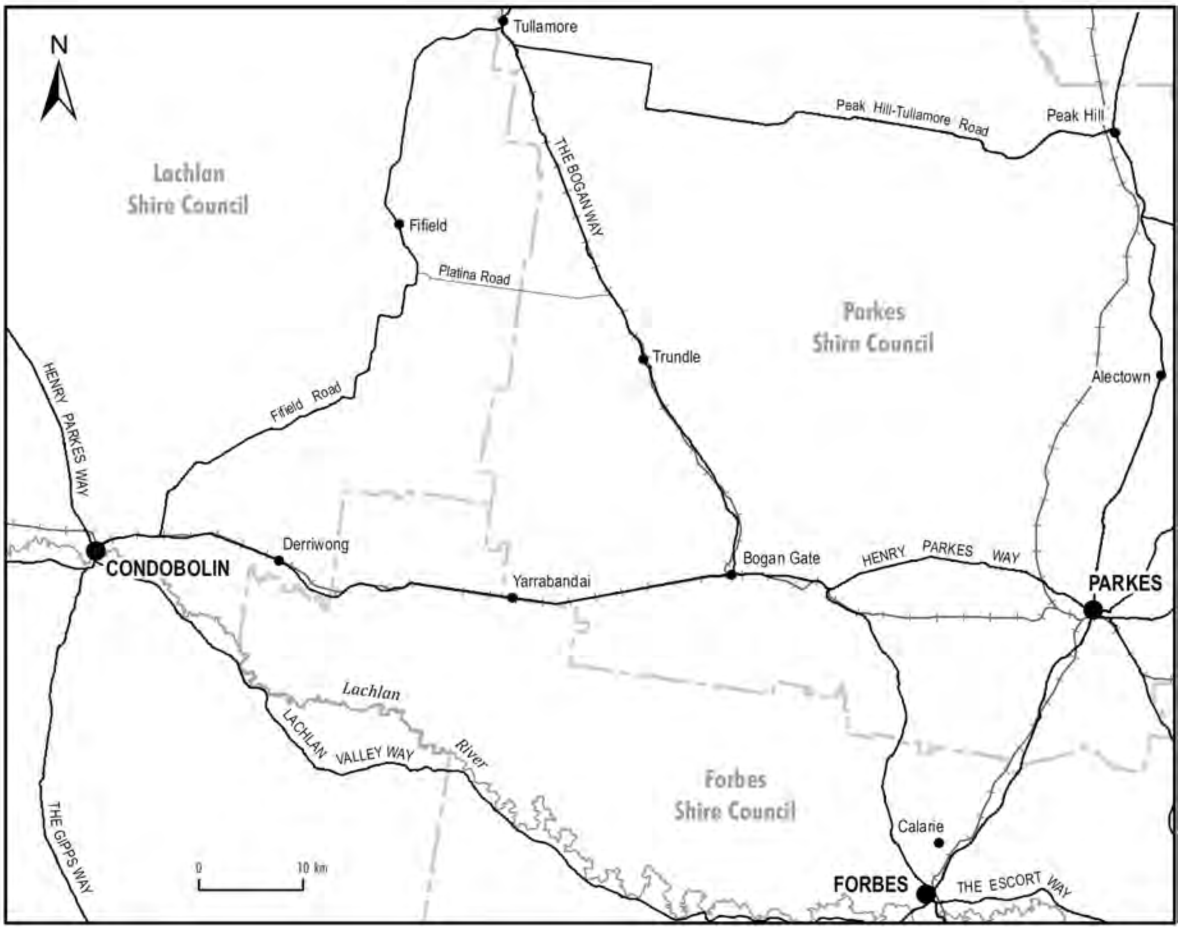

6 January 2017

Warramunga Community Advancement Co-operative Society Ltd
Chairperson
79 Caswell Street
PEAK HILL NSW 2869

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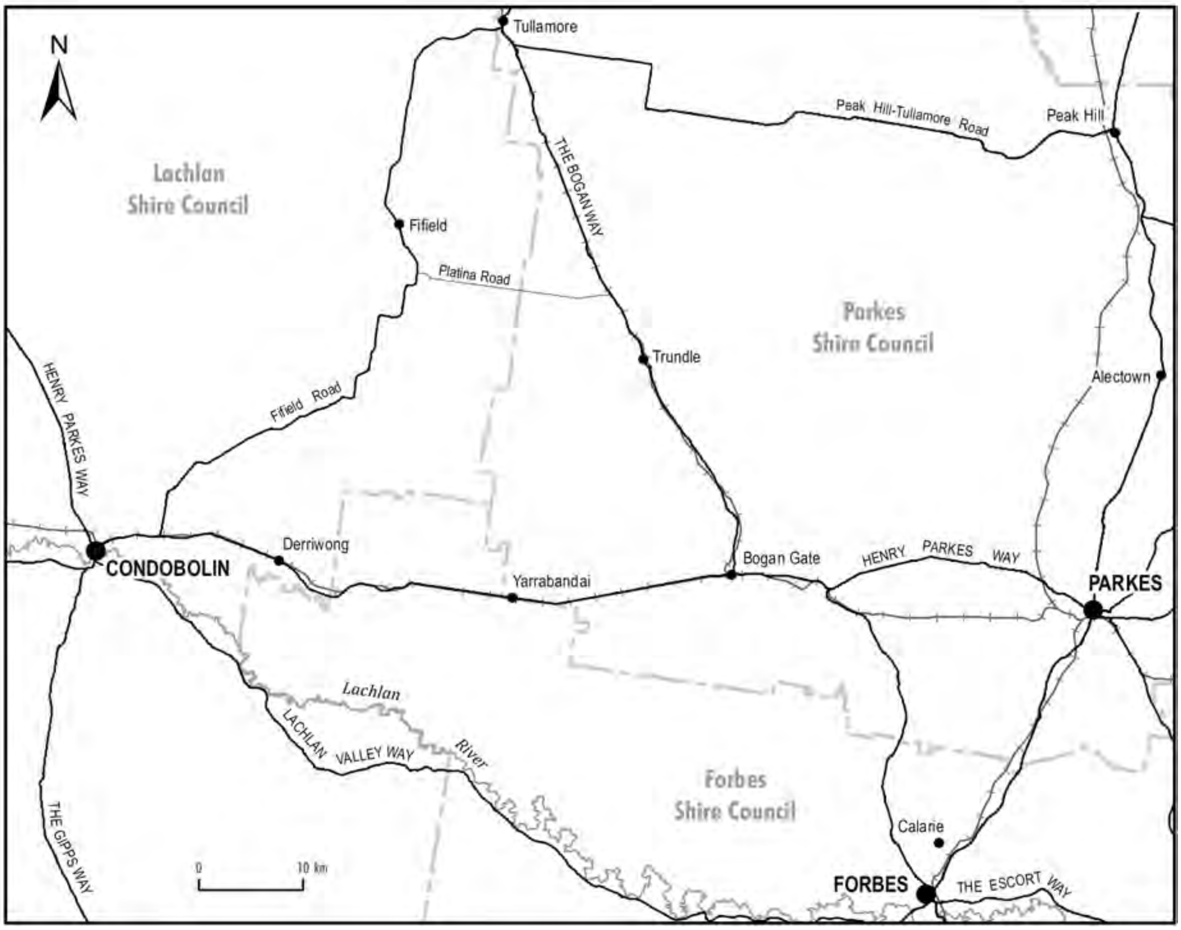

6 January 2017

Ngemba, Ngiyampaa, Wangaaypuwan and Wayilwan Native Title Claimants
Native Title Services Corporation Limited
Principal Solicitor
Unit 1a Suite 2.02, 44-70 Rosehill Street
REDFERN NSW 2016

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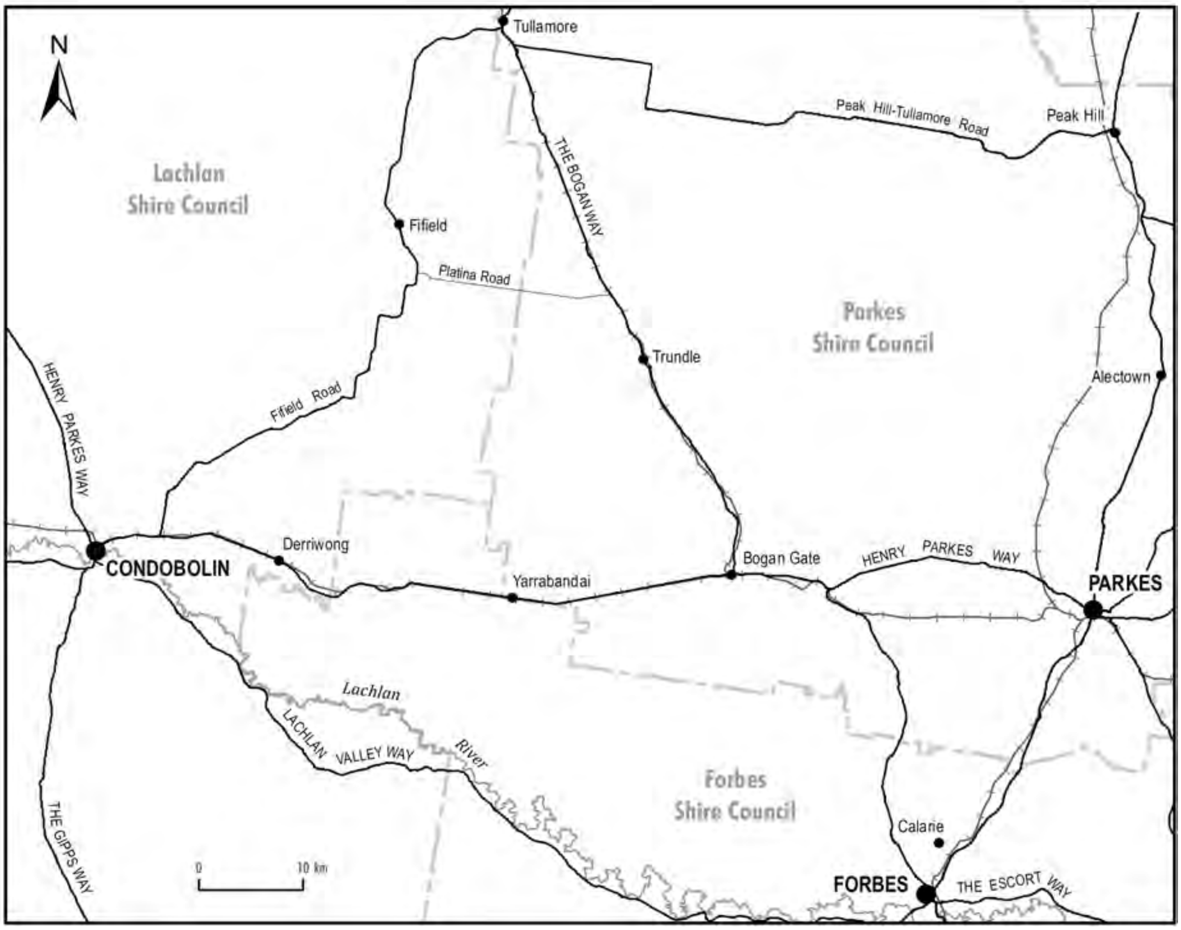

SCANDIUM 21

6 January 2017

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Syerston Project Extension Modification – Aboriginal Cultural Heritage Assessment

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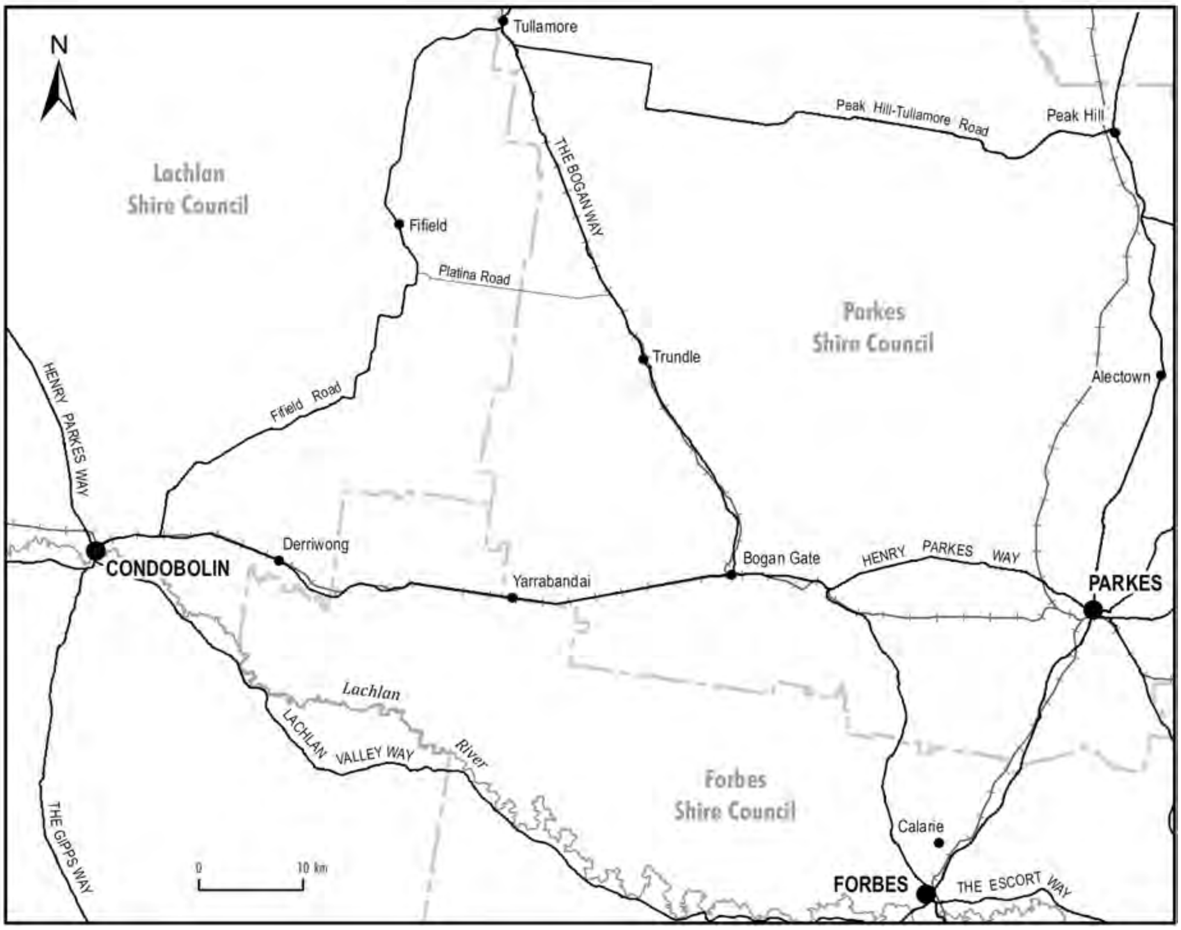

From: Danielle Wallace
Sent: Friday, 6 January 2017 9:35 AM
Subject: Syerston Project - Proposed Modification
Attachments: ltr - Scandium21 Correspondence.pdf

Dear Sir/Madam,

Please find attached correspondence from Scandium21 Pty Ltd regarding the Aboriginal community consultation process for a proposed modification to the Syerston Project.

Please don't hesitate to call should you wish to discuss.

Regards

Danielle Wallace
Environmental Project Manager
e dwallace@resourcestrategies.com.au
m 0414 833 397

Resource Strategies Pty Ltd
Suite 2 Level 3, 24 McDougall Street
PO Box 1842
Milton Qld 4064
t 07 3367 0055 f 07 3367 0053
www.resourcestrategies.com.au

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f: +61 3 9706 8304
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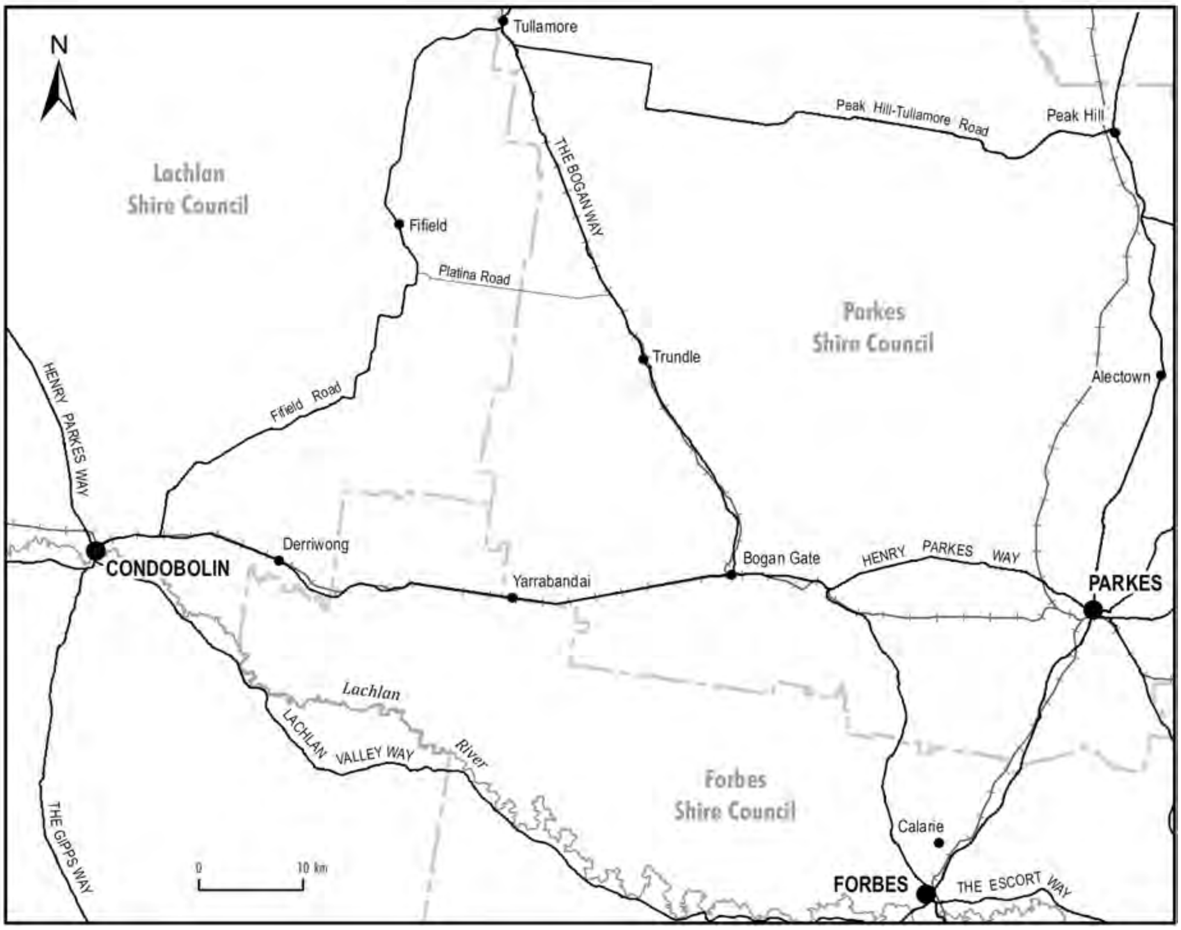
Kind Regards,

pp

MICK RYAN
PROJECT MANAGER – SYERSTON

PLAN SHOWING "AREA OF INTEREST"



Contact Name	Email Address
David Acheson	dgajp@hotmail.com
Delma Butler	delmabutler@bigpond.com
Jacqueline Flannery	jacqueline.hodges@det.nsw.edu.au
Jodie Markwort	jodie.markwort1@det.nsw.edu.au
Joy Russell	Joy.Russell@det.nsw.edu.au
Kelly Bowden	kelly@binaalbilla.com.au
Larry Towney	larry.towney@lls.nsw.gov.au
Mary Hodge	marytommy27@hotmail.com

18 January 2017

Condobolin Aboriginal Health Service
PO Box 321
CONDOBOLIN NSW 2877

Syerston Project Extension Modification – Aboriginal Cultural Heritage Assessment

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JOHN HANRAHAN
APPROVALS LEAD – THE SYERSTON PROJECT

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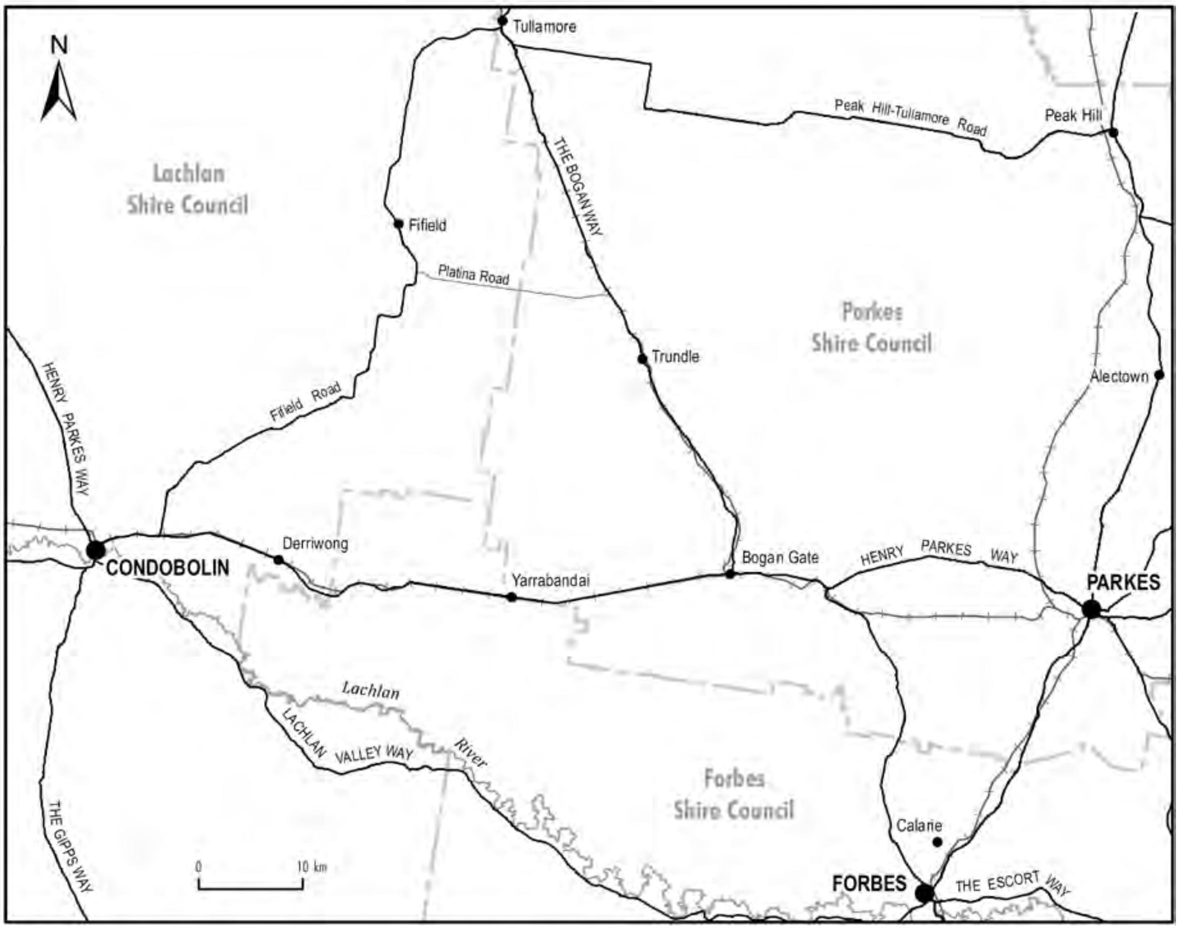

18 January 2017

Trangie Local Aboriginal Land Council
48 Dandaloo Street
TRANGIE NSW 2823

Syerston Project Extension Modification – Aboriginal Cultural Heritage Assessment

Dear Sir/Madam,

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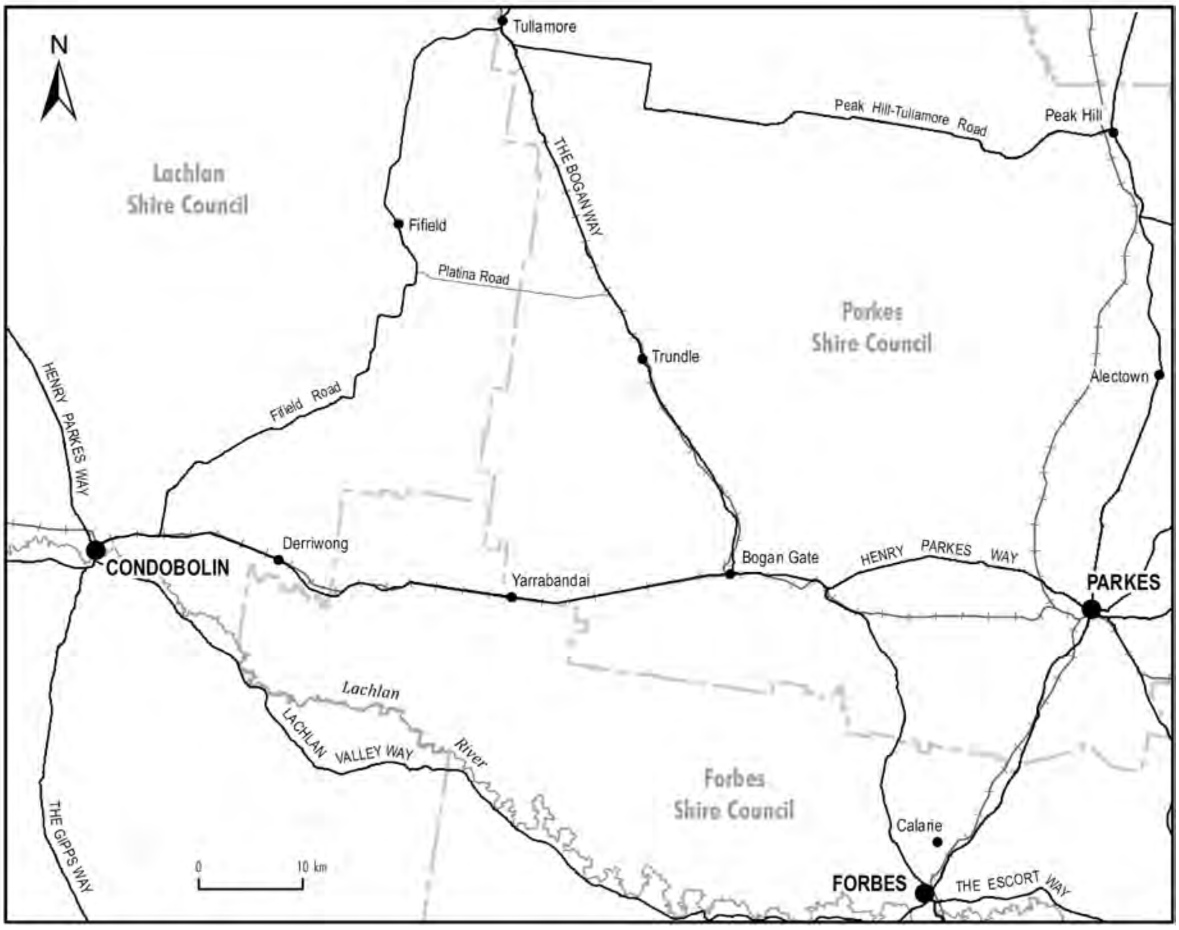

18 January 2017

Yawarra Aboriginal Corporation
15 Molong Street
CONDOBOLIN NSW 2877

Syerston Project Extension Modification – Aboriginal Cultural Heritage Assessment

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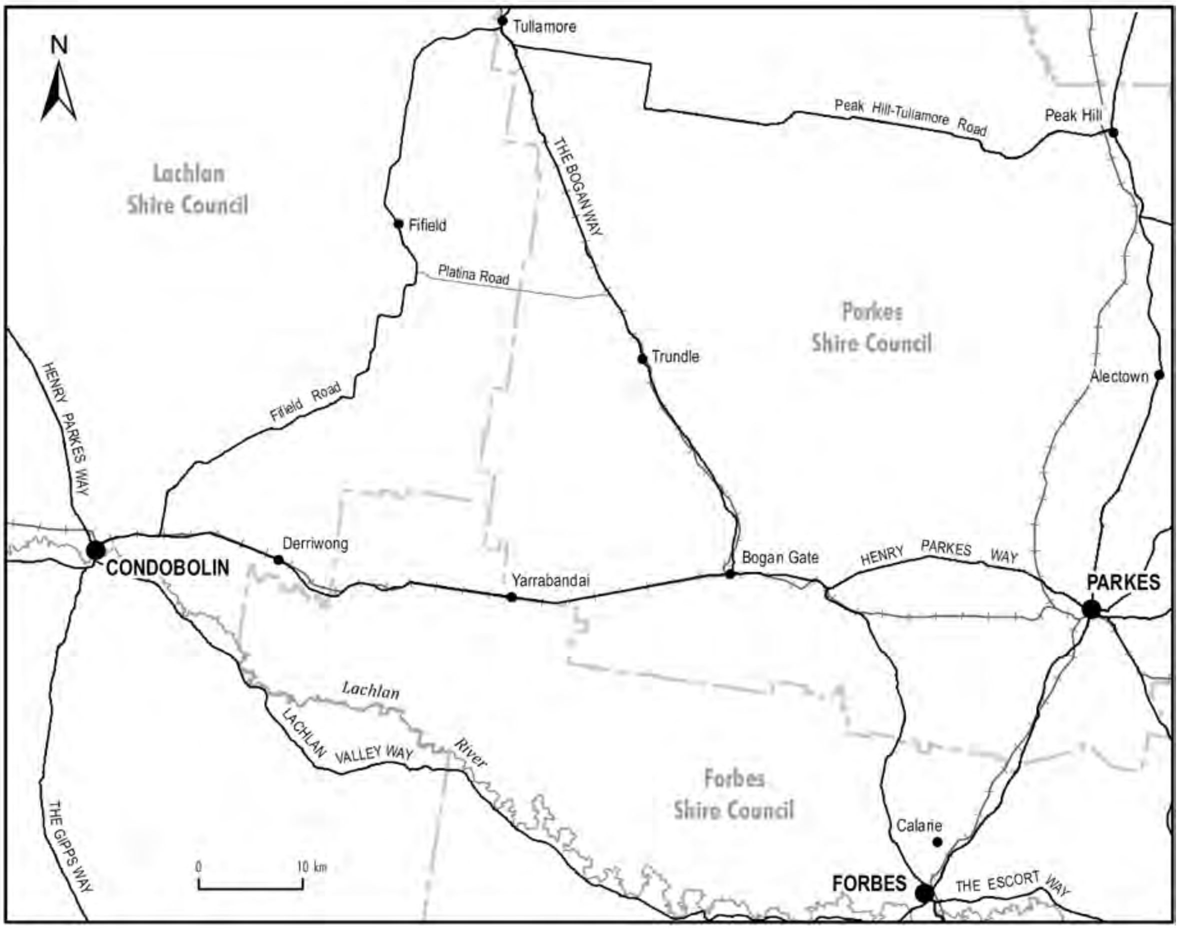

POSITION VACANT

MOSES & SON
Innovative Wool Marketing, Traditional Service

WAREHOUSE ALL ROUNDER CONDOBOLIN

Full time permanent position.

Moses & Son are currently seeking a motivated person to join our team in the Condobolin warehouse. Working alongside a close knit team, the storeperson's primary focus will be to manage inbound and outbound wool as well as maintaining the warehouse and its equipment.

Your job will be varied with your main responsibilities including:

- Manage the receiving, shipping, handling, distribution, input and storage of all wool, product, and supplies that come in and out of the warehouse.
- Rural merchandise sales and inventory maintenance including stocktake.
- Maintain a safe and tidy warehouse.

The position would ideally suit someone with a rural background and holds the following licences & qualifications:

- Forklift Licence (or willing to obtain)
- Drivers Licence
- Average computer skills
- Registered Wool Classer (not essential)

For full position description visit mosesandson.com.au or for further information contact Tim Foster on 0428 952 851

Applications with references to be sent to Liz Oliver, PO Box 85 Temora NSW 2666 or emailed to liz@mosesandson.com.au

Applications close: 30 January 2017

Condobolin
Preschool and Childcare Centre

Our service is based on our high quality, play-based learning philosophy, delivered in a fun, caring, supportive, learning environment that exceeds the National Quality Standard.

We are seeking a highly motivated person or persons to join our dedicated team suitable for;

CHILDCARE EDUCATOR
PERMANENT POSITION
4 DAYS (32 hours)
or Job Share 2 Days (16 hours)

ESSENTIAL skills include:

- Certificate 111 or Diploma in Children's Services
- Current First Aid Certificate or the ability to obtain these
- Experience working in a centre based children's service
- Knowledge of the National Quality Standard

CHILDCARE TRAINEE
12 month Contract

This position is for a one year contract with ongoing employment possibilities once the traineeship is completed. Successful applicants will complete a Certificate III in Children's Services whilst they gain hands on practical experience and mentoring by our existing team of educators.

ESSENTIAL skills include:

- To be enthusiastic and be willing to learn
- To show a passion for working with children and catering for their needs
- Show a strong sense of initiative
- Work well in a team
- Be friendly, punctual and energetic

Indigenous Applications are encouraged to apply

Any offer of employment will be conditional upon a satisfactory Working-with-Children Check.

Applications Close: Wednesday 25th January 2017

Enquires Phone: 02 6895 2784

The Director
Condobolin Preschool and Childcare Centre. PO Box 135. Condobolin NSW 2877

SENIOR FARM HAND

Senior Farm Hand wanted for busy mixed farming property at Condobolin. Must be experienced with farming and stock and have own dog(s) and tools.
Heavy vehicle licence and chemical card preferred or prepared to train.
This is a career position with above award wage for the first 6 months with progression to overseer with lucrative package negotiated for the right person.
Apply for full Job description or express your interest and send your resume with two recent work references to condofarmer@gmail.com. Immediate start available.

PUBLIC NOTICES

Central West Family Support

Central West Family Support

Group activities 2016
Activities include sport, handball, arts & craft, cooking, swimming or whatever the group decides on the day.

Monday
Boys Group (all ages)
3.30 - 5pm
Tuesday
Kids in Care (specific children)
3.30 – 5pm
Wednesday
Youth afternoon (all age groups)
3.30 – 5pm
Thursday
Girls group (yr5 to high school)
3.30 – 5pm
Country kids and Wiradjuri playgroups
0 – 5yrs
Mondays and Tuesdays from 11.00am
Afternoon/morning tea is provided.
Please advise of any food allergies.
For more information call:
02 6895 2533

Find us on: facebook

ALL SAINTS ANGLICAN CHURCH SERVICES
Sunday 22nd January 9am Morning Prayer.
Saturday 28th January 4pm Holy Communion
Sunday 29th January NO SERVICE

NAME BADGES NOW AVAILABLE
Only $8.00 each- full colour
Bulk discounts available
Phone your order to 68 953301
Email condoctc@qualitel.com.au
CTC@Condobolin
18 William Street, Condobolin.

PUBLIC NOTICES

Syerston Project Extension Modification Aboriginal Cultural Heritage Assessment

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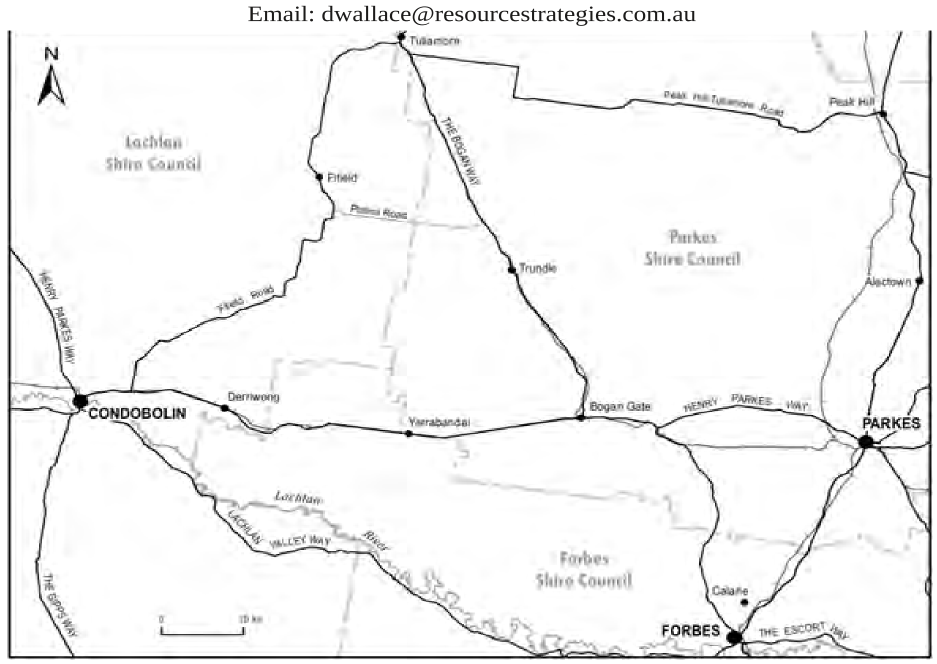

Boating Licence Course

Boating licence course in Condobolin. Saturday 22nd of January 2017. For bookings call 0422 438 733.

GET YOUR PRECIOUS PHOTOS PRINTED

Professional quality photo printer
Great for family history, family albums, wedding and special occassions.
Bulk deals available.

Western Plains Regional Development Inc
18 William Street, Condobolin.
NSW. ph: 68953301

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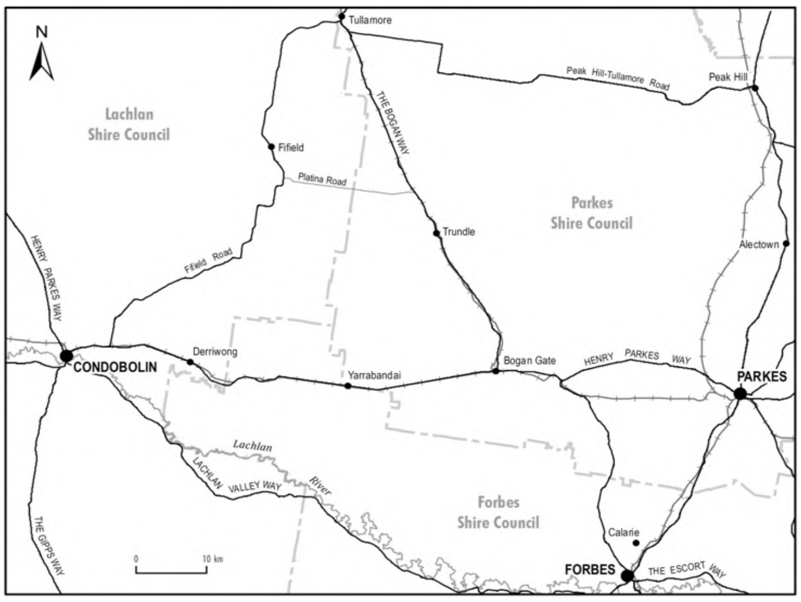

WATERNSW

MURRUMBIDGEE UNREGULATED & ALLUVIAL WATER SOURCE

An application for a new WATER SUPPLY WORK AND USE APPROVAL has been received from **ROBERT WILLIAM BEEGLING** for a 65 mm pump on Little Gilmore Creek, 300/1222752 for irrigation on 210/1183335, Parish of Selwyn, County of Wynard.

Objections to the granting of this approval must be registered in writing to WaterNSW, PO Box 156, Leeton NSW 2705 within 28 days of this notice. The objection must include your name and address to specify the grounds of the objection. (A9186)

Any queries please call (02) 6951 2711 Sarah O'Brien, Water Regulation Officer.

A04560

WATERNSW

UPPER MURRAY GROUNDWATER WATER SOURCE

An application to AMEND A COMBINED WORK APPROVAL has been received from **PACE LAND HOLDING PTY LTD** for an additional bore proposed to be on Lot 160 DP753754 for irrigation purposes.

Objections to the granting of this approval must be registered in writing to WaterNSW, PO Box 829, Albury NSW 2640, within 28 days of this notice. The objection must include your name and address to specify the grounds of objection. (A009145).

Any queries please call (02) 6024 8852, David Finnimore, Water Regulation Officer.

A04564

WATERNSW

LACHLAN FOLD BELT MDB GROUNDWATER SOURCE

An application for a new WATER SUPPLY WORKS APPROVAL has been received from **ANNIE LEE** for a new bore proposed to be on Lot 2 DP1131729 for commercial purposes.

Objections to the granting of this approval must be registered in writing to WaterNSW, PO Box 829, Albury NSW 2640, within 28 days of this notice. The objection must include your name and address to specify the grounds of objection. (A009185).

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A04562

WATERNSW

WOOLGOOLGA CREEK WATER SOURCE

An application to amend a WATER SUPPLY WORKS AND USE APPROVAL section has been received from **SWARAN SINGH DHALIWAL AND MANJIT KAUR DHALIWAL** for a dam and a pump on an Unnamed Watercourse, on Lot 8, DP 787536 Parish Woolgoolga, County Fitzroy, for conservation of water and irrigation purposes.

Objections to the granting of this approval must be registered in writing to WaterNSW, Locked Bag 10, Grafton NSW 2460 within 28 days of this notice. The objection must include your name and address to specify the grounds of objection. (A009132)

Any queries please phone (02) 6641 6500, Mark Bonner, Water Regulation Officer.

A04563

WATERNSW

BARWON-DARLING UNREGULATED RIVER WATER SOURCE

An application for an amended COMBINED WATER SUPPLY WORK AND USE APPROVAL has been received from **SALTO (NSW) PTY LTD** for one 660mm axial flow pump (to replace an existing currently authorised 400mm axial flow pump at Lot 19 DP 752692, Parish of Euminbah, County of Finch.

Objections to the granting of this approval must be registered in writing to WaterNSW, PO Box 717, Dubbo NSW 2830 within 28 days of this notice. The objection must include your name and address to specify the grounds of objection. (A009109)

Any queries please call (02) 6841 7414, Richard Wheatley, Senior Water Regulation Officer.

A04558

WATERNSW

BILLABONG FLOODPLAIN MANAGEMENT PLAN AREA

An application for a Flood Work Approval has been received from **GREGORY ALLAN, ROBERT ORMOND AND SELWYN LESLIE FERGUSON** for three levees within the Billabong Floodplain on Lot 5 DP 706153 and Lot 100 DP 800050, Parish of North Gunambill, County of Urana.

Objections to the granting of this Approval must be registered in writing to WaterNSW, PO Box 829, ALBURY NSW 2640, within 28 days of this notice. Any objection must include your name and address to specify the grounds of objection.

Any queries please call (02) 6024 8859, Clare Purtle, Senior Water Regulation Officer.

A04561

WATERNSW

LACHLAN REGULATED RIVER WATER SHARING PLAN

THAT PART OF THE WATER SOURCE DOWNSTREAM OF LAKE CARGELLIGO WEIR

An application for an amended WATER SUPPLY WORKS and/or WATER USE APPROVAL has been received from **ROSELLA SUB TC PTY LTD** for 4 x 450mm pumps, total capacity 121 ML/day, on Lot 1 DP 1180971, Parish Huntawong, County Nicholson, for Irrigation purposes.

Objections to the granting of this approval must be registered in writing to WaterNSW, PO Box 291, Forbes NSW 2871 within 28 days of this notice. The objection must include your name and address to specify the grounds of objection (A009100)

Any queries please call (02) 6850 2808, Andrew Glasson, Senior Water Regulation Officer.

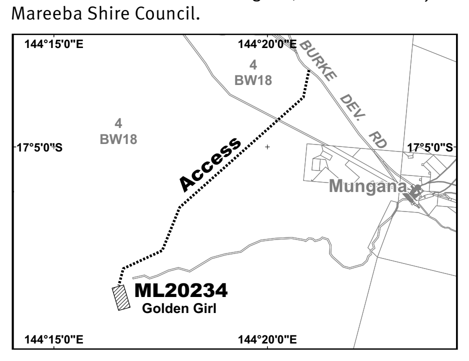
A04559

NOTICE OF PROPOSED RENEWAL OF A MINING LEASE

NATIVE TITLE ACT 1993 (CTH) SECTION 29

The Queensland Minister for Natural Resources and Mines, PO Box 15216, City East, Queensland, 4002, hereby gives notice in accordance with section 29 of the *Native Title Act 1993* (Cth) of the proposed renewal of the Mining Lease shown below under the *Mineral Resources Act 1989* (Qld).

Mining Lease 20234 sought by Wandoo Tenements Pty Ltd, over an area of 50 ha, centred approximately 13 km South West of Mungana, in the locality of Mareeba Shire Council.



Nature of Act(s): The renewal of the Mining Lease under the *Mineral Resources Act 1989* (Qld), authorises the holder to mine and carry out associated activities subject to the *Mineral Resources Act 1989* (Qld), for a term not exceeding six (6) years, with the possibility of renewal for a term not exceeding six (6) years.

Name and address of person doing acts: It is proposed that the Mining Lease be renewed by the Queensland Minister for Natural Resources and Mines, PO Box 15216, City East, Queensland, 4002.

Further Information: Further information about the proposed renewal of the Mining Lease, including extract of plans showing the boundaries of the Mining Lease may be obtained from the Department of Natural Resources and Mines, Principal Mining Registrar, Mineral Hub, Level 9, Verde Tower, 445 Flinders Street, Townsville, Queensland 4810, Telephone: (07) 4447 9230, or email MineralHub@dnrm.qld.gov.au

Native Title Parties: Under the *Native Title Act 1993* (Cth) any person who is a "native title party" is entitled to certain rights in relation to the proposed renewal of the Mining Lease. Under section 30 of the *Native Title Act 1993* (Cth), persons have until three (3) months after Notification Day to take certain steps to become native title parties in relation to this notice. Enquiries in relation to filing a native title determination application may be directed to the Federal Court, Brisbane Registry, Level 6, Commonwealth Law Courts, 119 North Quay, Brisbane, Queensland 4000. Telephone: (07) 3248 1100 or Email: qldreg@fedcourt.gov.au

Enquiries in relation to the registration of a native title determination application may be directed to the National Native Title Tribunal, Brisbane Registry, Level 5, 119 North Quay, Brisbane, Queensland 4000, Telephone: (07) 3307 5000 or 1800 640 501.

Notification Day: 1 February 2017

Queensland Government

From: Danielle Wallace
Sent: Monday, 6 March 2017 4:43 PM
To: 'facp2014@gmail.com'
Subject: Syerston Project and Syerston Project Modification 4 - Registration

Hi David,

As discussed and as requested, Clean TeQ will remove the Forbes Aboriginal & Community Working Party from the list of Registered Aboriginal Parties for the Syerston Project and will not provide any further correspondence in relation to this project.

Please don't hesitate to call should you wish to discuss.

Regards
Danielle Wallace
Environmental Project Manager
e dwallace@resourcestrategies.com.au
m 0414 833 397

Resource Strategies Pty Ltd
Suite 2 Level 3, 24 McDougall Street
PO Box 1842
Milton Qld 4064
t 07 3367 0055 f 07 3367 0053
www.resourcestrategies.com.au

PROPOSED METHODOLOGY AND CORRESPONDENCE

SYERSTON PROJECT
AND
SYERSTON PROJECT MODIFICATION 4

PROPOSED METHODOLOGY
FOR THE
ABORIGINAL CULTURAL HERITAGE ASSESSMENTS

February 2017
Project No. CTL-16-02
Document No. 00822893

1 INTRODUCTION

Clean TeQ Holdings Limited (Clean TeQ) owns the rights to develop the approved, but yet to be developed, Syerston Project. The Syerston Project is situated approximately 350 kilometers west-northwest of Sydney, near the village of Fifield, New South Wales (NSW) (Figure 1).

Development Consent (DA 374-11-00) for the Syerston Project was issued under Part 4 of NSW *Environmental Planning and Assessment Act, 1979* (EP&A Act) in 2001. The Development Consent (DA 374-11-00) has been modified on two occasions since it was issued:

- 2005 – to allow for the increase of run-of-mine (ROM) ore processing rate, limestone quarry extraction rate and adjustments to ore procession operations.
- 2006 – to allow for the reconfiguration of the water supply borefield.

The Syerston Project Scandium Oxide Modification was submitted in late 2016 and is currently being assessed by the NSW Department of Planning and Environment.

1.1 Approved Syerston Project

The approved Syerston Project includes the establishment and operation of the following:

- nickel cobalt mine and processing facility;
- limestone quarry and processing facility;
- rail loading and unloading facility;
- natural gas pipeline;
- two water supply borefields and pipelines; and
- associated transport and infrastructure.

The approved Syerston Project is presented on Figure 1.

Clean TeQ are seeking to engage with the Aboriginal community as part of the preparation of an Aboriginal Cultural Heritage Assessment (ACHA), which will be used to support an application for an Aboriginal Heritage Impact Permit (AHIP) under section 90 of the NSW *National Parks and Wildlife Act, 1974* (NP&W Act) for all components of the approved Syerston Project. Consultation with Aboriginal people and communities will be guided by the NSW Office of Environment and Heritage's (OEH) *Aboriginal cultural heritage consultation requirements for proponents 2010* (NSW Department of Environment, Climate Change and Water [DECCW], 2010).

1.2 Syerston Project Modification 4

Separate to the application for an AHIP for the approved Syerston Project described in Section 1.1, Clean TeQ also proposes to separately modify Development Consent (DA 374-11-00) to allow for the extraction of surface water from the Lachlan River and potential changes to the approved mine surface development area (herein referred to as the 'Syerston Project Modification 4').

It is proposed that the Syerston Project Modification 4 will be sought under section 75W of the NSW EP&A Act.

The indicative locations of the Syerston Project Modification 4 areas are presented on Figure 2.

Detailed design and mine planning is ongoing, however it is anticipated that the Syerston Project Modification 4 may include the following:

- an extension to the currently approved water supply pipeline and supporting infrastructure to provide for the extraction of surface water from the Lachlan River;
- changes to the approved mine surface development area (within Mining Lease Application Area [MLA] 141, MLA 113, MLA 139, MLA 132 and MLA 140); and/or
- possible road closures and/or road upgrades.

Similar to the AHIP application for the approved Syerston Project, Clean TeQ are seeking to engage with the Aboriginal community as part of the preparation of an ACHA, which will be used to support an application for an AHIP under section 90 of the NSW NP&W Act for all components of the proposed Syerston Project Modification 4. Consultation with Aboriginal people and communities will be guided by the OEH *Aboriginal cultural heritage consultation requirements for proponents 2010* (DECCW, 2010).

1.3 Structure of this Document

Section 2 of this document describes the previous archaeological investigations undertaken for the approved Syerston Project, while Section 3 outlines the Proposed Methodology for the cultural and archaeological assessment of Aboriginal objects, places and/or Aboriginal cultural heritage values within the approved Syerston Project area and the Syerston Project Modification 4 area.

Section 4 outlines the sensitive cultural information management protocol and Section 5 provides further information on the preparation of the ACHA report(s). Relevant personnel and critical timeframes for the assessment(s) are outlined in Sections 6 and 7, respectively.

2 PREVIOUS ARCHAEOLOGICAL INVESTIGATIONS

A previous archaeological survey and assessment was conducted in 2000 by Archaeological Surveys and Reports on behalf of Black Range Minerals Ltd, for the (now) approved Syerston Project.

The surveys undertaken by Archaeological Surveys and Reports in 2000 resulted in the recording of 14 Aboriginal heritage sites, comprising of six isolated artefacts, six scarred trees, an open artefact scatter and an extensive camp site. Three carved tree sites previously listed on the Aboriginal Heritage Information Management Sysytem (AHIMS) register were also inspected during the survey and assessment.

In addition to several site specific management measures, the assessment prepared for the approved Syerston Project recommended that an AHIP be sought over the now approved Syerston Project area (Archaeological Surveys and Reports, 2000).

3 PROPOSED ASSESSMENT METHODOLOGY

The Proposed Methodology for the cultural and archaeological assessment for the ACHA(s) is as follows, and will apply to both the approved Syerston Project and the Syerston Project Modification 4:

- Conduct a desktop assessment to delineate areas of known and predicted Aboriginal objects, places and/or Aboriginal cultural heritage values, including a detailed review of the previous assessment prepared by Archaeological Surveys and Reports (2000).
- Identify the Aboriginal cultural heritage values associated with the relevant area through consulting with Aboriginal people with cultural knowledge or responsibilities for Country in which the approved Syerston Project and/or the Syerston Project Modification 4 occurs, utilising written, oral research and field investigations.
- The conduct of a cultural and archaeological assessment with representatives of local Aboriginal community, to identify Aboriginal objects, places and/or Aboriginal cultural heritage values. The field investigation(s) would be carried out by the project archaeologist with the assistance of Aboriginal representatives.
- Record/document any Aboriginal objects, places and/or Aboriginal cultural heritage values within the relevant area and assessment of their significance with representatives of the Registered Aboriginal Parties (RAPs).
- In consultation with the RAPs, develop recommended management and mitigation measures for Aboriginal objects, places and/or Aboriginal cultural heritage values, including documentation (where relevant) of previous management and mitigation measures described for the approved Syerston Project (Archaeological Surveys and Reports, 2000).
- Provide a consideration of the aproved impact of the Syerston Project on Aboriginal objects, places and/or Aboriginal cultural heritage values within the approved Syerston Project area.
- Provide a consideration of the potential impacts of the Syerston Project Modification 4 on Aboriginal objects, places and/or Aboriginal cultural heritage values within the Syerston Project Modification 4 area.
- Describe and justify the outcomes and alternatives.
- Document the Aboriginal cultural heritage impact assessment and the recommendations to minimise potential impacts on Aboriginal cultural heritage.
- Provide a copy of the draft ACHA(s) to the RAPs for their review and feedback.
- Documentation of feedback received as part of the cultural assessment from RAPs for presentation in the final ACHA report(s) (subject to the sensitivity of the information provided).
- As part of the process, Clean TeQ will seek an AHIP (or a variation to an existing AHIP) under section 90 of the NSW NP&W Act.

In accordance with the *Aboriginal cultural heritage consultation requirements for proponents 2010* (DECCW, 2010) Clean TeQ requests that RAPs provide, where relevant during the conduct of the ACHA(s), cultural information regarding:

- whether there are any Aboriginal sites/objects of cultural value to Aboriginal people in the relevant area or surrounds; and
- whether there are any places of cultural value to Aboriginal people in the relevant area or surrounds.

This may include places of social, spiritual and cultural value, historic places with cultural significance, and potential places/areas of historic, social, spiritual and/or cultural significance.

4 SENSITIVE CULTURAL INFORMATION – MANAGEMENT PROTOCOL

In the event that a RAP has sensitive or restricted public access information, it is proposed that Clean TeQ would manage this information (if provided by the Aboriginal community) in accordance with a sensitive cultural information management protocol.

It is anticipated that the protocol would include making note of and managing the material in accordance with the following key limitations/requirements as advised by the relevant RAP at the time of the information being provided:

- any restrictions on access to the material;
- any restrictions on communication of the material;
- any restrictions on the location/storage of the material;
- any cultural recommendations on handling the material;
- any contextual information;
- any names and contact details of persons authorised by the relevant Aboriginal party to make decisions concerning the Aboriginal material and the degree of authorisation;
- any details of any consent given in accordance with customary law;
- the level of confidentiality to be accorded to the material; and
- any access and use by the RAP, of the cultural information in the material.

All RAPs should be aware of the mandatory OEH requirement that all feedback provided must be documented in the final ACHA(s), including copies of any submissions received and the proponents response to the issues raised.

5 ABORIGINAL CULTURAL HERITAGE ASSESSMENT

Following consultation on the Proposed Methodology of the cultural and archaeological assessment, and undertaking any required field components, a draft ACHA report(s) will be prepared. The draft ACHA(s) will be provided to all RAPs for their review and comment, and will include:

- details of the Aboriginal objects, places and/or Aboriginal cultural heritage values within the approved Syerston Project area and how they will be impacted by the approved Syerston Project;
- details of the Aboriginal objects, places and/or Aboriginal cultural heritage values within the Syerston Project Modification 4 area and how they will be impacted by the Syerston Project Modification 4;
- details of the consultation undertaken and how comments received at various times were considered; and
- management and mitigation recommendations drawing on information provided by RAPs and the results of the cultural and archaeological assessments.

6 PERSONNEL

Project Archaeologist: Dr Matt Cupper would be the project archaeologist. Matt has a wide range of experience in cultural and natural heritage management and an academic background in archaeology, geology and botany, including a PhD in the palaeoecology and early Aboriginal occupation of the Darling River. His particular area of expertise is the interaction of Aboriginal people and arid ecosystems in the interior of Australia. As a consultant archaeologist he has been engaged in many management and research-oriented studies of the Murray Darling Basin for industry and government. These have included investigation of the cultural heritage of the dunefields of western NSW for petroleum and mineral sands developments, and archaeological surveys of water supply and irrigation infrastructure along the Lachlan, Murray and Darling Rivers.

Aboriginal Field Representatives: It is anticiapted that a minimum of three Aboriginal field representatives would be engaged by Clean TeQ for the duration of the cultural heritage field survey (although this number may be subject to change based on the extent of the area requiring survey or due to workplace health and safety constraints). Aboriginal field representatives (including community leaders and Elders attending community consultation meetings) would invoice and, where appropriate, negotiate with Clean TeQ directly in relation to engagement for the field surveys. Aboriginal field personnel may be engaged on a rotational basis (e.g. a different team of representatives each day) as required.

7 CRITICAL TIMEFRAMES

Critical timeframes for the ACHA(s) are outlined below:

1. Collation of cultural significant information – ongoing throughout process until the end of the draft ACHA review period(s).
2. Provision of comments on the Proposed Methodology to Clean TeQ – March 2017.
3. Field survey(s) – anticipated to occur March-June 2017 (noting that survey dates will be confirmed with relevant representatives of the RAPs as required).
4. Provision of a draft ACHA(s) (including proposed management and mitigation measures) to RAPs for review and comment – anticipated to occur May-July 2017 (following field survey)[1].
5. Provision of comments from RAPs on draft ACHA(s) to Clean TeQ – anticipated to occur May-July 2017.
6. Finalise ACHA(s) in consideration of comments received – July/August 2017.
7. As part of the process, Clean TeQ will seek an AHIP (or a variation to an existing AHIP) under section 90 of the NSW NP&W Act. This would occur following finalisation of the ACHA(s).

[1] The ACHA for the approved Syerston Project AHIP application may be prepared seperated to the Syerston Project Modification 4 ACHA. Where this occurs, revised timing will be provided to the RAPs as required.

8 REFERENCES

Archaeological Surveys and Reports (2000) *The report of the archaeological investigation of the Mine site and sites of Associated Ancillary Infrastructure for the Syerston Nickel-Cobalt Project.* Report prepared for Black Range Minerals Ltd.

Department of Environment, Climate Change and Water (2010) *Aboriginal cultural heritage consultation requirements for proponents 2010*.

FIGURES

LEGEND

- NSW National Parks and Wildlife Service
- State Forest
- Railway
- Existing Gas Pipeline
- Mining Lease Application Boundary
- Approved Fifield Bypass
- Approved Gas Pipeline
- Approved Water Pipeline
- Approved Limestone Quarry Water Pipeline

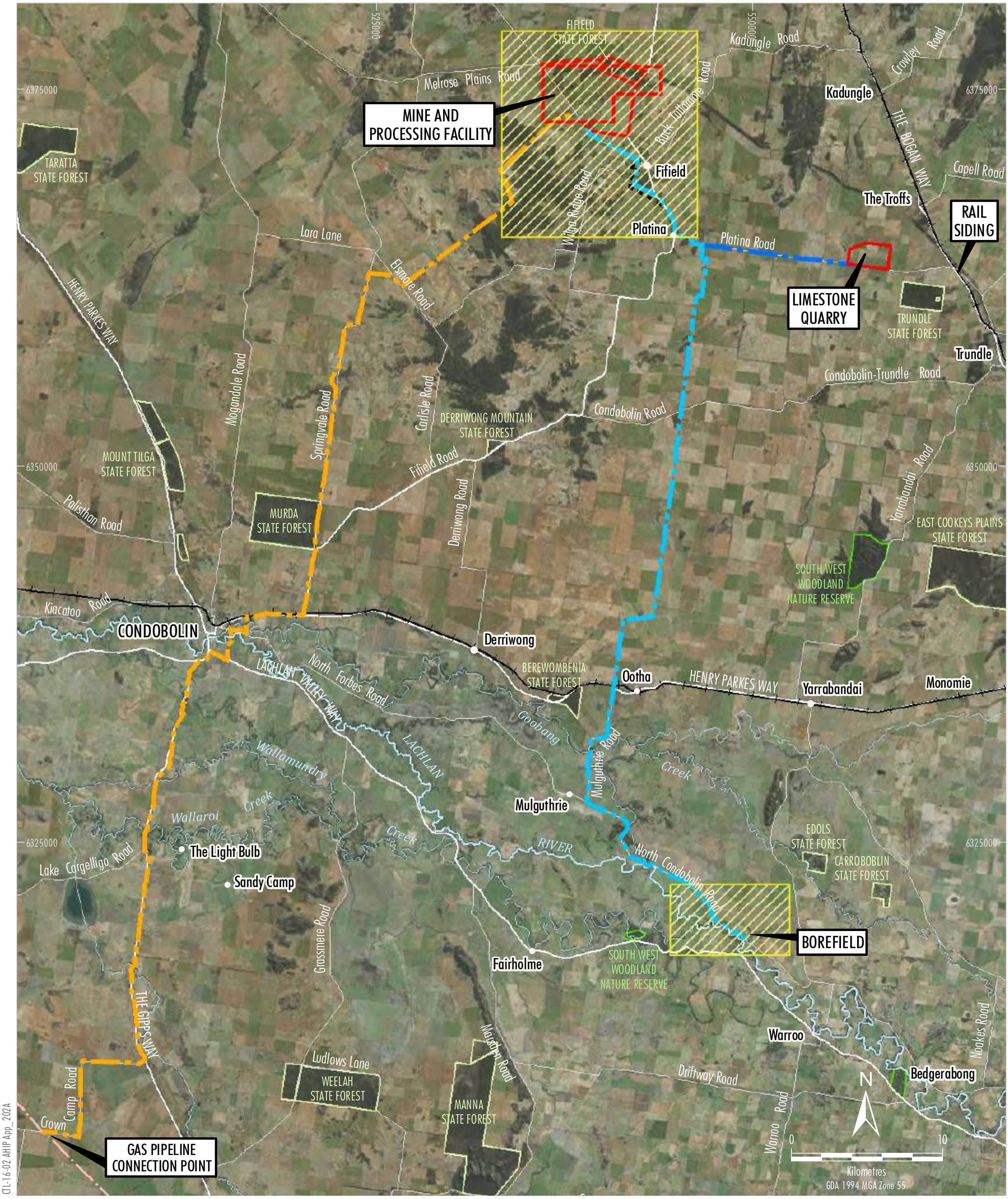
Source: Black Range Minerals (2000); NSW Department of Industry (2016); NSW Land and Property Information (2016); Office of Environment and Heritage NSW (2016) World Imagery: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

CLEAN TEQ

S Y E R S T O N   P R O J E C T

Regional Location and Approved Syerston Project

Figure 1



LEGEND

- NSW National Parks and Wildlife Service
- State Forest
- Railway
- Existing Gas Pipeline
- Mining Lease Application Boundary
- Approved Fifield Bypass
- Approved Gas Pipeline
- Approved Water Pipeline
- Approved Limestone Quarry Water Pipeline
- Indicative Location of Modification

Source: Black Range Minerals (2000); NSW Department of Industry (2016); NSW Land and Property Information (2016); Office of Environment and Heritage NSW (2016) World Imagery: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

CLEAN TEQ

S Y E R S T O N   P R O J E C T

Regional Location and Indicative Location of Syerston Project Modification 4

Figure 2

14 February 2017

West Wyalong Local Aboriginal Land Council
PO Box 332
WEST WYALONG NSW 2671

Dear Sir/Madam,

RE: ABORIGINAL CULTURAL HERITAGE ASSESSMENT PROPOSED METHODOLOGY FOR THE SYERSTON PROJECT AND SYERSTON PROJECT MODIFICATION 4

As you are aware, Clean TeQ Holdings Limited (Clean TeQ) owns the rights to develop the approved, but yet to be developed, Syerston Project which is situated approximately 350 kilometres west-northwest of Sydney, near the village of Fifield, New South Wales (NSW).

Proposed Methodology

Please find enclosed for your review, a copy of the Proposed Methodology for the Aboriginal Cultural Heritage Assessment(s) for the Syerston Project and the Syerston Project Modification 4.

In accordance with the *Aboriginal cultural heritage consultation requirements for proponents 2010* (New South Wales [NSW] Department of Environment, Climate Change and Water, 2010) issued by the NSW Office of Environment and Heritage, we have provided the Proposed Methodology for your review and feedback. Your feedback may include the identification of issues or areas of cultural significance that may be used to affect, inform or refine the Proposed Methodology.

If you wish to provide input on the following, please make a submission to Clean TeQ Holdings Limited (via the contact details provided at the end of this letter) by **5:00pm Friday 17 March 2017**:

- The nature of the Proposed Methodology.
- Any Aboriginal objects or places of cultural value within the investigation area, or issues of cultural significance, that you are aware of.
- Any restrictions or protocols you may consider necessary in relation to any information of sensitivity that you may provide.
- Any other factors you consider to be relevant to the heritage assessment.

All comments received will be taken into consideration as the Methodology is finalised.

An information session with all Registered Aboriginal Parties and Clean TeQ representatives will be held to provide further information on the Syerston Project and to allow for additional comment on the Proposed Methodology. Details regarding the information session will be provided separately.

Contact Details

Any feedback with respect to the Proposed Methodology can be provided to Clean TeQ via the following contact details:

Clean TeQ
C/- Danielle Wallace
PO Box 379, WEST RYDE, NSW 2114
Mobile: 0414 833 397
Email: dwallace@resourcestrategies.com.au

Yours sincerely,
CLEAN TEQ HOLDINGS LIMITED

JOHN HANRAHAN
APPROVALS LEAD – THE SYERSTON PROJECT

14 February 2017

Condobolin Local Aboriginal Land Council
PO Box 114
CONDOBOLIN NSW 2877

Dear Sir/Madam,

RE: ABORIGINAL CULTURAL HERITAGE ASSESSMENT PROPOSED METHODOLOGY FOR THE SYERSTON PROJECT AND SYERSTON PROJECT MODIFICATION 4

As you are aware, Clean TeQ Holdings Limited (Clean TeQ) owns the rights to develop the approved, but yet to be developed, Syerston Project which is situated approximately 350 kilometres west-northwest of Sydney, near the village of Fifield, New South Wales (NSW).

Proposed Methodology

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PO Box 379, WEST RYDE, NSW 2114
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Yours sincerely,
CLEAN TEQ HOLDINGS LIMITED

JOHN HANRAHAN
APPROVALS LEAD – THE SYERSTON PROJECT

14 February 2017

Forbes Aboriginal & Community Working Party
Attention: David Acheson
Via email: facp2014@gmail.com

Dear David,

RE: ABORIGINAL CULTURAL HERITAGE ASSESSMENT PROPOSED METHODOLOGY FOR THE SYERSTON PROJECT AND SYERSTON PROJECT MODIFICATION 4

Thank you for registering an interest in the Aboriginal consultation process for the Syerston Project.

As you are aware, Clean TeQ Holdings Limited (Clean TeQ) owns the rights to develop the approved, but yet to be developed, Syerston Project which is situated approximately 350 kilometres west-northwest of Sydney, near the village of Fifield, New South Wales (NSW).

Proposed Methodology

Please find enclosed for your review, a copy of the Proposed Methodology for the Aboriginal Cultural Heritage Assessment(s) for the Syerston Project and the Syerston Project Modification 4.

In accordance with the *Aboriginal cultural heritage consultation requirements for proponents 2010* (New South Wales [NSW] Department of Environment, Climate Change and Water, 2010) issued by the NSW Office of Environment and Heritage, we have provided the Proposed Methodology for your review and feedback. Your feedback may include the identification of issues or areas of cultural significance that may be used to affect, inform or refine the Proposed Methodology.

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Clean TeQ
C/- Danielle Wallace
PO Box 379, WEST RYDE, NSW 2114
Mobile: 0414 833 397
Email: dwallace@resourcestrategies.com.au

Yours sincerely,
CLEAN TEQ HOLDINGS LIMITED

JOHN HANRAHAN
APPROVALS LEAD – THE SYERSTON PROJECT

CLEAN TEQ
Powering innovation

14 February 2017

Wiradjuri Condobolin Corporation
Attention: Laurie Hutchison
Via email: laurie@wiradjuricondocorp.com

Dear Laurie,

RE: ABORIGINAL CULTURAL HERITAGE ASSESSMENT PROPOSED METHODOLOGY FOR THE SYERSTON PROJECT AND SYERSTON PROJECT MODIFICATION 4

Thank you for registering an interest in the Aboriginal consultation process for the Syerston Project.

As you are aware, Clean TeQ Holdings Limited (Clean TeQ) owns the rights to develop the approved, but yet to be developed, Syerston Project which is situated approximately 350 kilometres west-northwest of Sydney, near the village of Fifield, New South Wales (NSW).

Proposed Methodology

Please find enclosed for your review, a copy of the Proposed Methodology for the Aboriginal Cultural Heritage Assessment(s) for the Syerston Project and the Syerston Project Modification 4.

In accordance with the *Aboriginal cultural heritage consultation requirements for proponents 2010* (New South Wales [NSW] Department of Environment, Climate Change and Water, 2010) issued by the NSW Office of Environment and Heritage, we have provided the Proposed Methodology for your review and feedback. Your feedback may include the identification of issues or areas of cultural significance that may be used to affect, inform or refine the Proposed Methodology.

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Clean TeQ
C/- Danielle Wallace
PO Box 379, WEST RYDE, NSW 2114
Mobile: 0414 833 397
Email: dwallace@resourcestrategies.com.au

Yours sincerely,
CLEAN TEQ HOLDINGS LIMITED

JOHN HANRAHAN
APPROVALS LEAD – THE SYERSTON PROJECT

14 February 2017

Murie Elders Group
Attention: Lois Goolagong
161 Bathurst Street
CONDOBOLIN NSW 2877

Dear Lois,

RE: ABORIGINAL CULTURAL HERITAGE ASSESSMENT PROPOSED METHODOLOGY FOR THE SYERSTON PROJECT AND SYERSTON PROJECT MODIFICATION 4

Thank you for registering an interest in the Aboriginal consultation process for the Syerston Project.

As you are aware, Clean TeQ Holdings Limited (Clean TeQ) owns the rights to develop the approved, but yet to be developed, Syerston Project which is situated approximately 350 kilometres west-northwest of Sydney, near the village of Fifield, New South Wales (NSW).

Proposed Methodology

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- Any Aboriginal objects or places of cultural value within the investigation area, or issues of cultural significance, that you are aware of.
- Any restrictions or protocols you may consider necessary in relation to any information of sensitivity that you may provide.
- Any other factors you consider to be relevant to the heritage assessment.

All comments received will be taken into consideration as the Methodology is finalised.

An information session with all Registered Aboriginal Parties and Clean TeQ representatives will be held to provide further information on the Syerston Project and to allow for additional comment on the Proposed Methodology. Details regarding the information session will be provided separately.

Contact Details

Any feedback with respect to the Proposed Methodology can be provided to Clean TeQ via the following contact details:

Clean TeQ
C/- Danielle Wallace
PO Box 379, WEST RYDE, NSW 2114
Mobile: 0414 833 397
Email: dwallace@resourcestrategies.com.au

Yours sincerely,
CLEAN TEQ HOLDINGS LIMITED

JOHN HANRAHAN
APPROVALS LEAD – THE SYERSTON PROJECT

14 February 2017

Binjang Wellington Wiradjuri Aboriginal Heritage Survey
Attention: Jamie Gray
Via email: jamiegray66@gmail.com

Dear Jamie,

RE: ABORIGINAL CULTURAL HERITAGE ASSESSMENT PROPOSED METHODOLOGY FOR THE SYERSTON PROJECT AND SYERSTON PROJECT MODIFICATION 4

Thank you for registering an interest in the Aboriginal consultation process for the Syerston Project.

As you are aware, Clean TeQ Holdings Limited (Clean TeQ) owns the rights to develop the approved, but yet to be developed, Syerston Project which is situated approximately 350 kilometres west-northwest of Sydney, near the village of Fifield, New South Wales (NSW).

Proposed Methodology

Please find enclosed for your review, a copy of the Proposed Methodology for the Aboriginal Cultural Heritage Assessment(s) for the Syerston Project and the Syerston Project Modification 4.

In accordance with the *Aboriginal cultural heritage consultation requirements for proponents 2010* (New South Wales [NSW] Department of Environment, Climate Change and Water, 2010) issued by the NSW Office of Environment and Heritage, we have provided the Proposed Methodology for your review and feedback. Your feedback may include the identification of issues or areas of cultural significance that may be used to affect, inform or refine the Proposed Methodology.

If you wish to provide input on the following, please make a submission to Clean TeQ Holdings Limited (via the contact details provided at the end of this letter) by **5:00pm Friday 17 March 2017**:

- The nature of the Proposed Methodology.
- Any Aboriginal objects or places of cultural value within the investigation area, or issues of cultural significance, that you are aware of.
- Any restrictions or protocols you may consider necessary in relation to any information of sensitivity that you may provide.
- Any other factors you consider to be relevant to the heritage assessment.

All comments received will be taken into consideration as the Methodology is finalised.

An information session with all Registered Aboriginal Parties and Clean TeQ representatives will be held to provide further information on the Syerston Project and to allow for additional comment on the Proposed Methodology. Details regarding the information session will be provided separately.

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Clean TeQ
C/- Danielle Wallace
PO Box 379, WEST RYDE, NSW 2114
Mobile: 0414 833 397
Email: dwallace@resourcestrategies.com.au

Yours sincerely,
CLEAN TEQ HOLDINGS LIMITED

JOHN HANRAHAN
APPROVALS LEAD – THE SYERSTON PROJECT

15 February 2017

Louise Davis
Via email: louise.davis28@hotmail.com

Dear Louise,

RE: ABORIGINAL CULTURAL HERITAGE ASSESSMENT PROPOSED METHODOLOGY FOR THE SYERSTON PROJECT AND SYERSTON PROJECT MODIFICATION 4

As you are aware, Clean TeQ Holdings Limited (Clean TeQ) owns the rights to develop the approved, but yet to be developed, Syerston Project which is situated approximately 350 kilometres west-northwest of Sydney, near the village of Fifield, New South Wales (NSW).

Proposed Methodology

Please find enclosed for your review, a copy of the Proposed Methodology for the Aboriginal Cultural Heritage Assessment(s) for the Syerston Project and the Syerston Project Modification 4.

In accordance with the *Aboriginal cultural heritage consultation requirements for proponents 2010* (New South Wales [NSW] Department of Environment, Climate Change and Water, 2010) issued by the NSW Office of Environment and Heritage, we have provided the Proposed Methodology for your review and feedback. Your feedback may include the identification of issues or areas of cultural significance that may be used to affect, inform or refine the Proposed Methodology.

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Email: dwallace@resourcestrategies.com.au

Yours sincerely,
CLEAN TEQ HOLDINGS LIMITED

JOHN HANRAHAN
APPROVALS LEAD – THE SYERSTON PROJECT

From: Danielle Wallace
Sent: Wednesday, 15 March 2017 11:35 AM
To: 'peterpeckham53@gmail.com'
Subject: Syerston Project - Aboriginal Cultural Heritage Assessment
Attachments: ltr - Peter Peckham - 6 January 2017.pdf; Syerston - Proposed Methodology.pdf; ltr - RAPs - Field Survey Invitations - Peter Peckham (RES00840006).pdf

Hi Peter,

As discussed yesterday, please find attached the following correspondence from Clean TeQ Holdings Limited, in relation to the Syerston Project:

- A letter sent to you via post on 6 January 2017 inviting you to register for the community consultation process. Note that this letter was sent to the address provided by the Office of Environment and Heritage. Could you please advise whether the postal address is correct?
- A copy of the Proposed Methodology that was distributed to Registered Aboriginal Parties on 14 February 2017. Note that comments on the Proposed Methodology have been requested by COB Friday 17 March 2017.
- An invitation to attend the Aboriginal cultural heritage field surveys scheduled from Tuesday 21 March to Friday 24 March, and Monday 27 March to Friday 31 March 2017.

Please advise if you require hard copies of the attached correspondence.

Please don't hesitate to call should you wish to discuss further – 0414 833 397.

Thanks,
Danielle

Name	Registered Aboriginal Group	Signature
Lois Goolagong	Murie Elders Ab Corp'n	L Goolagong
Rebecca Shepherd	" " " "	[illegible]
Evelyn Coe	" " "	
Ally COE	WCC	A Coe
LAURIE HUTCHISON	WCC	[illegible]

CORRESPONDENCE TO NSW OFFICE OF ENVIRONMENT AND HERITAGE AND RELEVANT LOCAL ABORIGINAL LAND COUNCILS

22 February 2017

Condobolin Local Aboriginal Land Council
PO Box 114
CONDOBOLIN NSW 2877

Dear Sir/Madam,

RE: SYERSTON PROJECT AND SYERSTON PROJECT MODIFICATION 4 – ABORIGINAL CULTURAL HERITAGE ASSESSMENT

In accordance with the New South Wales (NSW) Office of Environment and Heritage (OEH) policy *Aboriginal cultural heritage consultation requirements for proponents 2010* (NSW Department of Environment, Climate Change and Water [DECCW], 2010), a list of the Registered Aboriginal Parties that registered an interest in the community consultation process with Clean TeQ Holdings Limited for the Syerston Project and the Syerston Project Modification 4 is provided below:

- Forbes Aboriginal & Community Working Party.
- Wiradjuri Condobolin Corporation.
- Murie Elders Group.
- Binjang Wellington Wiradjuri Aboriginal Heritage Survey.
- Louise Davis.

Copies of the notification letters sent to the Aboriginal stakeholders and the public notice published in accordance with Section 4.1.6 of the OEH policy *Aboriginal cultural heritage consultation requirements for proponents 2010* (DECCW, 2010) are provided in Enclosures A and B respectively.

Kind Regards,
CLEAN TEQ HOLDINGS LIMITED

JOHN HANRAHAN
APPROVALS LEAD – SYERSTON PROJECT

Enclosure A: Correspondence sent to Aboriginal Stakeholders
Enclosure B: Public Notice

22 February 2017

Office of Environment and Heritage
PO Box 2111
DUBBO NSW 2830

Dear Sir/Madam,

RE: SYERSTON PROJECT AND SYERSTON PROJECT MODIFICATION 4 – ABORIGINAL CULTURAL HERITAGE ASSESSMENT

In accordance with the New South Wales (NSW) Office of Environment and Heritage (OEH) policy *Aboriginal cultural heritage consultation requirements for proponents 2010* (NSW Department of Environment, Climate Change and Water [DECCW], 2010), a list of the Registered Aboriginal Parties that registered an interest in the community consultation process with Clean TeQ Holdings Limited for the Syerston Project and the Syerston Project Modification 4 is provided below:

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Kind Regards,
CLEAN TEQ HOLDINGS LIMITED

JOHN HANRAHAN
APPROVALS LEAD – SYERSTON PROJECT

Enclosure A: Correspondence sent to Aboriginal Stakeholders
Enclosure B: Public Notice

22 February 2017

West Wyalong Local Aboriginal Land Council
PO Box 332
WEST WYALONG NSW 2671

Dear Sir/Madam,

RE: SYERSTON PROJECT AND SYERSTON PROJECT MODIFICATION 4 – ABORIGINAL CULTURAL HERITAGE ASSESSMENT

In accordance with the New South Wales (NSW) Office of Environment and Heritage (OEH) policy *Aboriginal cultural heritage consultation requirements for proponents 2010* (NSW Department of Environment, Climate Change and Water [DECCW], 2010), a list of the Registered Aboriginal Parties that registered an interest in the community consultation process with Clean TeQ Holdings Limited for the Syerston Project and the Syerston Project Modification 4 is provided below:

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Copies of the notification letters sent to the Aboriginal stakeholders and the public notice published in accordance with Section 4.1.6 of the OEH policy *Aboriginal cultural heritage consultation requirements for proponents 2010* (DECCW, 2010) are provided in Enclosures A and B respectively.

Kind Regards,
CLEAN TEQ HOLDINGS LIMITED

JOHN HANRAHAN
APPROVALS LEAD – SYERSTON PROJECT

Enclosure A: Correspondence sent to Aboriginal Stakeholders
Enclosure B: Public Notice

DRAFT ACHA CORRESPONDENCE

9 June 2017

Wiradjuri Condobolin Corporation
Attention: Laurie Hutchison and Ally Coe
PO Box 194
CONDOBOLIN NSW 2877

Dear Laurie and Ally,

RE: SYERSTON PROJECT MODIFICATION 4 - DRAFT ABORIGINAL CULTURAL HERITAGE ASSESSMENT

Clean TeQ Holdings Limited (Clean TeQ) owns the rights to develop the approved, but yet to be developed, Syerston Project which is situated approximately 350 kilometres west-northwest of Sydney, near the village of Fifield, New South Wales (NSW).

Modification 4

As you are aware, Clean TeQ recently provided a draft Aboriginal Cultural Heritage Assessment (ACHA) for your review and comment in relation to the approved Syerston Project. In addition to this, Clean TeQ is seeking to modify the existing Development Consent (DA 374-11-00) to reconfigure the approved borefield arrangement and to supplement the water supply for the approved Syerston Project by extracting surface water from the Lachlan River. As part of this development proposal, Clean TeQ is also seeking approval for a modified pipeline arrangement through the town of Fifield.

Draft Aboriginal Cultural Heritage Assessment

Please find enclosed for your review, a copy of the draft ACHA for Modification 4. In accordance with the *Aboriginal cultural heritage consultation requirements for proponents 2010* (NSW Department of Environment, Climate Change and Water, 2010), we have provided the draft ACHA for your review and feedback. Your feedback may include the identification of issues or areas of cultural significance that may be used to affect, inform or refine the draft ACHA.

If you wish to provide input on the following, please make a submission to Clean TeQ by **5.00 pm Wednesday 12 July 2017** (via the contact details provided below):

- Identification of issues.
- Any Aboriginal objects or places of cultural value within the investigation area, or issues of cultural significance, that you are aware of.

- Any restrictions or protocols you may consider necessary in relation to any information of sensitivity that you may provide.
- Any other factors you consider to be relevant to the heritage assessment.

All comments received will be taken into consideration as the draft ACHA is finalised. The ACHA, following further consultation and subject to discussions with the NSW Office of Environment and Heritage, will form the basis of an application for an Aboriginal Heritage Impact Permit (and/or a variation application).

Note that all Registered Aboriginal Parties will be invited by Clean TeQ to attend an information session and site inspection of a selection of recorded sites, during the draft ACHA review period. Details regarding the information and site inspection will be provided to you in separate correspondence.

Please submit any feedback regarding the draft ACHA to Clean TeQ via the following contact details by 5.00pm Wednesday 12 July 2017:

Clean TeQ
C/- Danielle Wallace
PO Box 379, WEST RYDE, NSW 2114
Mobile: 0414 833 397
Email: dwallace@resourcestrategies.com.au

Yours sincerely,
CLEAN TEQ HOLDINGS LIMITED

JOHN HANRAHAN
APPROVALS LEAD – SYERSTON PROJECT

9 June 2017

Murie Elders Group
Attention: Lois Goolagong
C/- Rebecca Shepherd
18 William Street
CONDOBOLIN NSW 2877

Dear Lois,

RE: SYERSTON PROJECT MODIFICATION 4 - DRAFT ABORIGINAL CULTURAL HERITAGE ASSESSMENT

Clean TeQ Holdings Limited (Clean TeQ) owns the rights to develop the approved, but yet to be developed, Syerston Project which is situated approximately 350 kilometres west-northwest of Sydney, near the village of Fifield, New South Wales (NSW).

Modification 4

As you are aware, Clean TeQ recently provided a draft Aboriginal Cultural Heritage Assessment (ACHA) for your review and comment in relation to the approved Syerston Project. In addition to this, Clean TeQ is seeking to modify the existing Development Consent (DA 374-11-00) to reconfigure the approved borefield arrangement and to supplement the water supply for the approved Syerston Project by extracting surface water from the Lachlan River. As part of this development proposal, Clean TeQ is also seeking approval for a modified pipeline arrangement through the town of Fifield.

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- Any Aboriginal objects or places of cultural value within the investigation area, or issues of cultural significance, that you are aware of.

Clean TeQ Holdings Limited ABN 34 127 457 916
12/21 Howleys Rd, Notting Hill VIC 3168 Australia I PO Box 227, Mulgrave VIC 3170 Australia
T: +61 3 9797 6700 F: +61 3 9706 8344 E: info@cleanteq.com

- Any restrictions or protocols you may consider necessary in relation to any information of sensitivity that you may provide.
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All comments received will be taken into consideration as the draft ACHA is finalised. The ACHA, following further consultation and subject to discussions with the NSW Office of Environment and Heritage, will form the basis of an application for an Aboriginal Heritage Impact Permit (and/or a variation application).

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Clean TeQ
C/- Danielle Wallace
PO Box 379, WEST RYDE, NSW 2114
Mobile: 0414 833 397
Email: dwallace@resourcestrategies.com.au

Yours sincerely,
CLEAN TEQ HOLDINGS LIMITED

JOHN HANRAHAN
APPROVALS LEAD – SYERSTON PROJECT

9 June 2017

Binjang Wellington Wiradjuri Aboriginal Heritage Survey
Attention: Jamie Gray
260 Myall Street
DUBBO NSW 2830

Dear Jamie,

RE: SYERSTON PROJECT MODIFICATION 4 - DRAFT ABORIGINAL CULTURAL HERITAGE ASSESSMENT

Clean TeQ Holdings Limited (Clean TeQ) owns the rights to develop the approved, but yet to be developed, Syerston Project which is situated approximately 350 kilometres west-northwest of Sydney, near the village of Fifield, New South Wales (NSW).

Modification 4

As you are aware, Clean TeQ recently provided a draft Aboriginal Cultural Heritage Assessment (ACHA) for your review and comment in relation to the approved Syerston Project. In addition to this, Clean TeQ is seeking to modify the existing Development Consent (DA 374-11-00) to reconfigure the approved borefield arrangement and to supplement the water supply for the approved Syerston Project by extracting surface water from the Lachlan River. As part of this development proposal, Clean TeQ is also seeking approval for a modified pipeline arrangement through the town of Fifield.

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PO Box 379, WEST RYDE, NSW 2114
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Email: dwallace@resourcestrategies.com.au

Yours sincerely,
CLEAN TEQ HOLDINGS LIMITED

JOHN HANRAHAN
APPROVALS LEAD – SYERSTON PROJECT

9 June 2017

West Wyalong Local Aboriginal Land Council
Attention: Leeanne Hampton
PO Box 332
WEST WYALONG NSW 2671

Dear Leeanne,

RE: SYERSTON PROJECT - DRAFT ABORIGINAL CULTURAL HERITAGE ASSESSMENT

RE: SYERSTON PROJECT MODIFICATION 4 - DRAFT ABORIGINAL CULTURAL HERITAGE ASSESSMENT

Clean TeQ Holdings Limited (Clean TeQ) owns the rights to develop the approved, but yet to be developed, Syerston Project which is situated approximately 350 kilometres west-northwest of Sydney, near the village of Fifield, New South Wales (NSW).

Modification 4

As you are aware, Clean TeQ recently provided a draft Aboriginal Cultural Heritage Assessment (ACHA) for your review and comment in relation to the approved Syerston Project. In addition to this, Clean TeQ is seeking to modify the existing Development Consent (DA 374-11-00) to reconfigure the approved borefield arrangement and to supplement the water supply for the approved Syerston Project by extracting surface water from the Lachlan River. As part of this development proposal, Clean TeQ is also seeking approval for a modified pipeline arrangement through the town of Fifield.

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Yours sincerely,
CLEAN TEQ HOLDINGS LIMITED

JOHN HANRAHAN
APPROVALS LEAD – SYERSTON PROJECT

9 June 2017

Condobolin Local Aboriginal Land Council
Attention: Dave Carter
PO Box 114
CONDOBOLIN NSW 2877

Dear Dave,

RE: SYERSTON PROJECT MODIFICATION 4 - DRAFT ABORIGINAL CULTURAL HERITAGE ASSESSMENT

Clean TeQ Holdings Limited (Clean TeQ) owns the rights to develop the approved, but yet to be developed, Syerston Project which is situated approximately 350 kilometres west-northwest of Sydney, near the village of Fifield, New South Wales (NSW).

Modification 4

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Email: dwallace@resourcestrategies.com.au

Yours sincerely,
CLEAN TEQ HOLDINGS LIMITED

JOHN HANRAHAN
APPROVALS LEAD – SYERSTON PROJECT

9 June 2017

Attention: Louise Davis
Via email: louise.davis28@hotmail.com

Dear Louise,

RE: SYERSTON PROJECT MODIFICATION 4 - DRAFT ABORIGINAL CULTURAL HERITAGE ASSESSMENT

Clean TeQ Holdings Limited (Clean TeQ) owns the rights to develop the approved, but yet to be developed, Syerston Project which is situated approximately 350 kilometres west-northwest of Sydney, near the village of Fifield, New South Wales (NSW).

Modification 4

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Yours sincerely,
CLEAN TEQ HOLDINGS LIMITED

JOHN HANRAHAN
APPROVALS LEAD – SYERSTON PROJECT

9 June 2017

Attention: Peter Peckham
Via email: peterpeckham53@gmail.com

Dear Peter,

RE: SYERSTON PROJECT MODIFICATION 4 - DRAFT ABORIGINAL CULTURAL HERITAGE ASSESSMENT

Clean TeQ Holdings Limited (Clean TeQ) owns the rights to develop the approved, but yet to be developed, Syerston Project which is situated approximately 350 kilometres west-northwest of Sydney, near the village of Fifield, New South Wales (NSW).

Modification 4

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> Clean TeQ
> C/- Danielle Wallace
> PO Box 379, WEST RYDE, NSW 2114
> Mobile: 0414 833 397
> Email: dwallace@resourcestrategies.com.au

Yours sincerely,
CLEAN TEQ HOLDINGS LIMITED

JOHN HANRAHAN
APPROVALS LEAD – SYERSTON PROJECT

13 June 2017

Wiradjuri Condobolin Corporation
Attention: Laurie Hutchison and Ally Coe
PO Box 194
CONDOBOLIN NSW 2877

Dear Laurie,

RE: SYERSTON PROJECT– INVITATION TO INFORMATION SESSION AND SITE INSPECTION

As you would be aware, Clean TeQ Holdings Limited (Clean TeQ) owns the rights to develop the approved, but yet to be developed, Syerston Project which is situated approximately 350 kilometres west-northwest of Sydney, near the village of Fifield, New South Wales (NSW).

Information Session and Site Inspection

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Should you have any queries regarding the Syerston Project (or Modification 4), or to indicate your interest in attending the information session and site inspection please advise Clean TeQ via the following contact details by 5.00pm Monday 19 June 2017:

Clean TeQ
C/- Danielle Wallace
PO Box 379, WEST RYDE, NSW 2114
Mobile: 0414 833 397
Email: dwallace@resourcestrategies.com.au

Yours sincerely,
CLEAN TEQ HOLDINGS LIMITED

JOHN HANRAHAN
APPROVALS LEAD – SYERSTON PROJECT

13 June 2017

Murie Elders Group
Attention: Lois Goolagong
C/- Rebecca Shepherd
18 William Street
CONDOBOLIN NSW 2877

Dear Lois,

RE: SYERSTON PROJECT– INVITATION TO INFORMATION SESSION AND SITE INSPECTION

As you would be aware, Clean TeQ Holdings Limited (Clean TeQ) owns the rights to develop the approved, but yet to be developed, Syerston Project which is situated approximately 350 kilometres west-northwest of Sydney, near the village of Fifield, New South Wales (NSW).

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Yours sincerely,
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JOHN HANRAHAN
APPROVALS LEAD – SYERSTON PROJECT

13 June 2017

Binjang Wellington Wiradjuri Aboriginal Heritage Survey
Attention: Jamie Gray
260 Myall Street
DUBBO NSW 2830

Dear Jamie,

RE: SYERSTON PROJECT– INVITATION TO INFORMATION SESSION AND SITE INSPECTION

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JOHN HANRAHAN
APPROVALS LEAD – SYERSTON PROJECT

13 June 2017

West Wyalong Local Aboriginal Land Council
Attention: Leeanne Hampton
PO Box 332
WEST WYALONG NSW 2671

Dear Leeanne,

RE: SYERSTON PROJECT– INVITATION TO INFORMATION SESSION AND SITE INSPECTION

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JOHN HANRAHAN
APPROVALS LEAD – SYERSTON PROJECT

13 June 2017

Condobolin Local Aboriginal Land Council
Attention: Dave Carter
PO Box 114
CONDOBOLIN NSW 2877

Dear Sir/Madam,

RE: SYERSTON PROJECT– INVITATION TO INFORMATION SESSION AND SITE INSPECTION

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Yours sincerely,
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JOHN HANRAHAN
APPROVALS LEAD – SYERSTON PROJECT

13 June 2017

Attention: Louise Davis

Via email: louise.davis28@hotmail.com

Dear Louise,

RE: SYERSTON PROJECT– INVITATION TO INFORMATION SESSION AND SITE INSPECTION

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Yours sincerely,
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JOHN HANRAHAN
APPROVALS LEAD – SYERSTON PROJECT

13 June 2017

Attention: Peter Peckham

Via email: peterpeckham53@gmail.com

Dear Peter,

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APPROVALS LEAD – SYERSTON PROJECT

Name	Registered Aboriginal Group	Signature
Walter Coe	~~Ind~~ Murie Elders	W alter Coe
LOUISE DAVIS	~~[illegible]~~ Independant	LD.
Leeanne Hampton	WWLALC	L. Hampton.
EVELYN COE	MURIE Elders	E Coe

Name	Registered Aboriginal Group	Signature
George Coe	W.C.C	G Coe
Mervyn Coe (Joe)	W C C	M Coe (Joe)
Rebecca Shepherd	Murie Elders	R.
Bonnie Merritt	Murra Elders	

4 July 2017

Binjang Wellington Wiradjuri Aboriginal Heritage Survey
Attention: Jamie Gray
260 Myall Street
DUBBO NSW 2830

Dear Jamie,

RE: DRAFT ABORIGINAL CULTURAL HERITAGE ASSESSMENTS FOR THE SYERSTON PROJECT AND SYERSTON PROJECT MODIFICATION 4 – EXTENSION OF REVIEW PERIOD

Clean TeQ Holdings Limited (Clean TeQ) has decided to extend the consultation period for the draft Aboriginal Cultural Heritage Assessment for the approved Syerston Project and the draft Aboriginal Cultural Heritage Assessment for the Syerston Project Modification 4.

On this basis, if you wish to provide comment on either of the draft Aboriginal Cultural Heritage Assessments, please ensure you do so (either in writing or verbally) by **5.00 pm on Friday 14 July 2017**.

All comments received by that date will be taken into consideration as the Aboriginal Cultural Heritage Assessments are finalised. A copy of the final Aboriginal Cultural Heritage Assessments will be made available to you after completion.

The Aboriginal Cultural Heritage Assessments, following further consultation and subject to discussions with the NSW Office of Environment and Heritage, will form the basis of applications for Aboriginal Heritage Impact Permits (and/or variation applications).

Please submit any feedback regarding the draft Aboriginal Cultural Heritage Assessments to Clean TeQ via the following contact details:

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APPROVALS LEAD – SYERSTON PROJECT

4 July 2017

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JOHN HANRAHAN

APPROVALS LEAD – SYERSTON PROJECT

4 July 2017

Louise Davis

Via email: louise.davis28@hotmail.com

Dear Louise,

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The Aboriginal Cultural Heritage Assessments, following further consultation and subject to discussions with the NSW Office of Environment and Heritage, will form the basis of applications for Aboriginal Heritage Impact Permits (and/or variation applications).

Please submit any feedback regarding the draft Aboriginal Cultural Heritage Assessments to Clean TeQ via the following contact details:

Clean TeQ
C/- Danielle Wallace
PO Box 379, WEST RYDE, NSW 2114
Mobile: 0414 833 397
Email: dwallace@resourcestrategies.com.au

Yours sincerely,

CLEAN TEQ HOLDINGS LIMITED

JOHN HANRAHAN

APPROVALS LEAD – SYERSTON PROJECT

4 July 2017

West Wyalong Local Aboriginal Land Council
Attention: Leeanne Hampton
PO Box 332
WEST WYALONG NSW 2671

Dear Leeanne,

RE: DRAFT ABORIGINAL CULTURAL HERITAGE ASSESSMENTS FOR THE SYERSTON PROJECT AND SYERSTON PROJECT MODIFICATION 4 – EXTENSION OF REVIEW PERIOD

Clean TeQ Holdings Limited (Clean TeQ) has decided to extend the consultation period for the draft Aboriginal Cultural Heritage Assessment for the approved Syerston Project and the draft Aboriginal Cultural Heritage Assessment for the Syerston Project Modification 4.

On this basis, if you wish to provide comment on either of the draft Aboriginal Cultural Heritage Assessments, please ensure you do so (either in writing or verbally) by **5.00 pm on Friday 14 July 2017**.

All comments received by that date will be taken into consideration as the Aboriginal Cultural Heritage Assessments are finalised. A copy of the final Aboriginal Cultural Heritage Assessments will be made available to you after completion.

The Aboriginal Cultural Heritage Assessments, following further consultation and subject to discussions with the NSW Office of Environment and Heritage, will form the basis of applications for Aboriginal Heritage Impact Permits (and/or variation applications).

Please submit any feedback regarding the draft Aboriginal Cultural Heritage Assessments to Clean TeQ via the following contact details:

Clean TeQ
C/- Danielle Wallace
PO Box 379, WEST RYDE, NSW 2114
Mobile: 0414 833 397
Email: dwallace@resourcestrategies.com.au

Yours sincerely,

CLEAN TEQ HOLDINGS LIMITED

JOHN HANRAHAN

APPROVALS LEAD – SYERSTON PROJECT

4 July 2017

Wiradjuri Condobolin Corporation
Attention: Laurie Hutchinson and Ally Coe
PO Box 194
CONDOBOLIN NSW 2877

Dear Laurie and Ally,

RE: DRAFT ABORIGINAL CULTURAL HERITAGE ASSESSMENTS FOR THE SYERSTON PROJECT AND SYERSTON PROJECT MODIFICATION 4 – EXTENSION OF REVIEW PERIOD

Clean TeQ Holdings Limited (Clean TeQ) has decided to extend the consultation period for the draft Aboriginal Cultural Heritage Assessment for the approved Syerston Project and the draft Aboriginal Cultural Heritage Assessment for the Syerston Project Modification 4.

On this basis, if you wish to provide comment on either of the draft Aboriginal Cultural Heritage Assessments, please ensure you do so (either in writing or verbally) by **5.00 pm on Friday 14 July 2017**.

All comments received by that date will be taken into consideration as the Aboriginal Cultural Heritage Assessments are finalised. A copy of the final Aboriginal Cultural Heritage Assessments will be made available to you after completion.

The Aboriginal Cultural Heritage Assessments, following further consultation and subject to discussions with the NSW Office of Environment and Heritage, will form the basis of applications for Aboriginal Heritage Impact Permits (and/or variation applications).

Please submit any feedback regarding the draft Aboriginal Cultural Heritage Assessments to Clean TeQ via the following contact details:

Clean TeQ
C/- Danielle Wallace
PO Box 379, WEST RYDE, NSW 2114
Mobile: 0414 833 397
Email: dwallace@resourcestrategies.com.au

Yours sincerely,
CLEAN TEQ HOLDINGS LIMITED

JOHN HANRAHAN
APPROVALS LEAD – SYERSTON PROJECT

APPENDIX 4. CORRESPONDENCE FROM ABORIGINAL COMMUNITY STAKEHOLDERS

STEP 1 CORRESPONDENCE

OFFICE OF THE REGISTRAR
ABORIGINAL LAND RIGHTS ACT 1983 (NSW)

11-13 Mansfield Street
Glebe NSW 2037
PO Box 112, Glebe NSW 2037
P. 02 9562 6327 F. 02 9562 6350

7 December 2016

Danielle Wallace
Scandium21
PO Box 379
WEST RYDE NSW 2114

Dear Danielle

Re: Request - Search for Registered Aboriginal Owners

I refer to your letter dated 2 December 2016 regarding Aboriginal Cultural Heritage Assessment within Fifield NSW.

I have searched the Register of Aboriginal Owners and the project area described *does not appear* to have Registered Aboriginal Owners pursuant to Division 3 of the *Aboriginal Land Rights Act* 1983 (NSW).

I suggest that you contact the Condobolin Local Aboriginal Land Council on 02 6895 2377. They will be able to assist you in identifying other Aboriginal stakeholders for this project.

Yours sincerely

Tabatha Dantoine
Directorate Support Officer
Office of the Registrar, *Aboriginal Land Rights Act 1983*

Our Ref: DOC16/623324

Ms Danielle Wallace
Scandium21
PO Box 379
WEST RYDE NSW 2114
dwallace@resourcestrategies.com.au

Dear Danielle,

Written Notification as Required under the Office of Environment and Heritage Aboriginal Cultural Heritage Requirements for Proponents 2010: Syerston Project Extension Modification

I refer to your letter dated 2 December 2016 to the Office of Environment and Heritage (OEH) regarding the above matter.

A list of known Aboriginal parties that OEH considers is likely to have an interest in this development is listed in **Attachment 1**. Please note this list is not necessarily an exhaustive list of all interested Aboriginal parties and receipt of this list does not remove the requirement for a proponent/consultant to advertise in local print media and contact other bodies seeking interested Aboriginal parties, in accordance with the requirements.

Should you require further information regarding issues that are the responsibility of OEH, please contact Phil Purcell, Archaeologist, on 6883 5341.

Yours faithfully,

STEVEN COX
Senior Team Leader - Planning
North West Region

Contact officer: PHIL PURCELL
(02) 6883 5341

09 December 2016

ATTACHMENT 1

Table 1: List of aboriginal stakeholder groups within the Forbes, Lachlan and Parkes local government areas that may have an interest in the project, provided as per OEH aboriginal cultural heritage requirements for proponents (2010).

Forbes LGA		
Organisation/Association	**Name/Title**	**Address**
Condobolin LALC	Chairperson	PO Box 114, Condobolin NSW
	Danny Molloy	*No known contact details available*
	David Acheson	dgajp@hotmail.com
	Delma Butler	delmabutler@bigpond.com
Hunter Central Rivers Catchment Management Authority	Aboriginal Reference Group	Private Bag 2010, Paterson NSW 2421
	Jacqueline Flannery	jacqueline.hodges@det.nsw.edu.au
	Jodie Markwort	jodie.markwort1@det.nsw.edu.au
	Joy Russell	Joy.Russell@det.nsw.edu.au
	Karen Howell	*No known contact details available*
	Kelly Bowden	kelly@binaalbilla.com.au
	Kerry Stirling	*No known contact details available*
Lachlan Catchment Management Authority	Aboriginal Reference Group	2 Sheriff Street, Forbes NSW 2871
	Larry Towney	larry.towney@lls.nsw.gov.au
	Mary Hodge	marytommy27@hotmail.com
Mooka	Neville Williams	PO Box 70, Cowra NSW 2794
	Nichole Back	*No known contact details available*
Peak Hill Bogan River Traditional Owner	C/- Sylvana Keating, A/Area Manager	NPWS Lachlan Area PO Box 774, Forbes NSW 2871
	Trevor Robinson	PO Box 73, Peak Hill NSW 2869
	Wayne Markwort	*No known contact details available*
Lachlan LGA		
Organisation/Association	**Name/Title**	**Address**
Condobolin LALC	Chairperson	PO Box 114, Condobolin NSW
Kullila Site Consultants	Paul Charles	14 Werrang Road, Primbee NSW 2502
Mooka	Neville Williams	PO Box 70, Cowra NSW 2794
Mulli Mulli LALC	Chairperson	PO Box 68, Woodenbong NSW 2476
Murie Elders Group	Chairperson	161 Bathurst Street, Condobolin NSW 2877
Murrin bridge LALC	Chairperson	PO Box 157, Lake Cargelligo NSW 2672
	Peter Peckham	27 Jennings Street, Geurie, NSW 2831
	Trevor Robinson	PO Box 73, Peak Hill NSW 2869
Wiradjuri Condobolin Corporation		PO Box 194, Condobolin NSW 2877
Wiradjuri Council of Elders	Robert Clegg	7 Keast Street, Parkes NSW 2870

Parkes LGA		
Organisation/Association	**Name/Title**	**Address**
Binjang Wellington Wiradjuri Heritage Survey	Dorothy Stewart	260 Myall St, Dubbo NSW 2830
Bogan River Peak Hill Wiradjuri Aboriginal Corporation	Chairperson	PO Box 42, Peak Hill NSW 2869
Bulgandramine Youth Development Aboriginal Corporation	Chairperson	PO Box 119, Peak Hill NSW 28369
Condobolin LALC	Chairperson	PO Box 114, Condobolin NSW
Cowra LALC	Chairperson	PO Box 769, Cowra NSW 2794
	Eva Coe	3 Yarnbildine Place, Cowra NSW 2794
Little Burning Mountain Aboriginal Corporation	Chairperson	PO Box 152, Peak Hill NSW 2869
Mooka	Neville Williams	PO Box 70, Cowra NSW 2794
Peak Hill LALC	Chairperson	PO Box 63, Peak Hill NSW 2869
	Peter Peckham	27 Jennings Street, Geurie, NSW 2831
	Trevor Robinson	PO Box 73, Peak Hill NSW 2869
Warramunga Community Advancement Co-operative Society Ltd	Chairperson	79 Caswell Street, Peak Hill NSW 2869
Wiradjuri Council of Elders	Robert Clegg	7 Keast Street, Parkes NSW 2870

From:	Irene Assumpter [Irene.Assumpter@nntt.gov.au]
Sent:	Wednesday, 14 December 2016 1:50 PM
To:	info@cleanteq.com; Danielle Wallace
Cc:	Enquiries
Subject:	RE: NSW Native Title Search over Fifield - Lachlan Shire Council LGA
Attachments:	20161214_sr2004_LachlanLGA_Overlap_Reports.xls; 20161214_sr2004 _ParkesLGA_Overlap_Reports.xls; 20161214_sr2004_ForbesLGA_Overlap_Reports.xls

UNCLASSIFIED

Native title search –*NSW: Fifield, NSW, within Lachlan Shire Council LGA*
Your ref: *N/A* - **Our ref:** *SR2004*

Att: Mick Ryan
Project Manager - Syerston
c/-Scandium21 Pty Ltd

Dear Sir/Madam,

Thank you for your search request received on 12 December 2016 in relation to the above area, please find your results attached. The proposed project location identified in your correspondence dated 2 December 2016 appears to be located within the Lachlan Shire Council Local Government Area ('Lachlan LGA'), and by extension, Parkes Shire Council and Forbes Shire Council Local Government Areas ('Parkes and Forbes LGAs'). On this basis the National Native Title Tribunal has provided native title overlap results for Lachlan LGA as well as Parkes and Forbes LGAs. All overlaps shown within Lachlan LGA have been verified as real.

Based on the records held by the National Native Title Tribunal as at 14 December 2016, it would appear that there are no Indigenous Land Use Agreements, Scheduled or Registered Native Title Claims or Determined Claims over Parkes and Forbes LGAs.

If you would like more specific information regarding the proposed project location, please provide identifiers such as lot numbers and Deposit Plan IDs. Please note that the relevant parcel/parcels may or may not be freehold. For confirmation of freehold data, please contact NSW's Land and Property Information office.

Search Results
The results provided are based on the information you supplied and are derived from a search of the following Tribunal databases:

- Schedule of Applications
- Register of Native Title Claims
- National Native Title Register
- Register of Indigenous Land Use Agreements
- Notified Indigenous Land Use Agreements

Copies of the relevant register extracts are now available on our website here.

Please note: There may be a delay between a native title determination application being lodged in the Federal Court and its transfer to the Tribunal. As a result, some native title determination applications recently filed with the Federal Court may not appear on the Tribunal's databases.

The search results are based on analysis against external boundaries of applications only. Native title applications commonly contain exclusions clauses which remove areas from within the external boundary. To determine whether the areas described are in fact subject to claim, you need to refer to the "Area covered by claim" section of the relevant Register Extract or Schedule Extract and any maps attached.

Search results and the existence of native title
Please note that the enclosed information from the Register of Native Title Claims and/or the Schedule of Applications is **not** confirmation of the existence of native title in this area. This cannot be confirmed until the Federal Court makes a determination that native title does or does not exist in relation to the area. Such determinations are registered on the National Native Title Register.

Tribunal accepts no liability for reliance placed on enclosed information
The enclosed information has been provided in good faith. Use of this information is at your sole risk. The National Native Title Tribunal makes no representation, either express or implied, as to the accuracy or suitability of the information enclosed for any particular purpose and accepts no liability for use of the information or reliance placed on it.

If you have any further queries, please do not hesitate to contact me on the number below or on the free call number 1800 640 501.

Regards,
Enquiries
National Native Title Tribunal
Freecall 1800 640 501
Email enquiries@nntt.gov.au
Website **www.nntt.gov.au**
Shared country, shared future.

National Native Title Tribunal

Overlap Analysis Report

Disclaimer
This information product has been created to assist in understanding the spatial characteristics and relationships of this native title matter and is intended as a guide only. Spatial data used has been sourced from the relevant custodians in each jurisdiction, and/or the Tribunal, and is referenced to the GDA94 datum.

While the Native Title Registrar **(Registrar)** has exercised due care in ensuring the accuracy of the information provided, it is provided for general information only and on the understanding that neither the Native Title Registrar nor the Commonwealth of Australia (Commonwealth) is providing professional advice. Appropriate professional advice relevant to your circumstances should be sought rather than relying on the information provided. In addition, you must exercise your own judgment and carefully evaluate the information provided for accuracy, currency, completeness and relevance for the purpose for which it is to be used.
As the interpretation of any particular native title determination area provided is based upon the best information available to the Registrar at the time of creation, any effective analysis must include reference to **both** the relevant determination of native title made by the Federal Court of Australia and the entry made in relation to that determination on the National Native Title Register maintained by the Registrar.

Please note:
- Calculated areas may not be the same as the legal area of a parcel.
- Where shown, NNTT Tenure Class for a non freehold parcel refers to a tenure grouping derived for the purposes of the Tribunal, and does not necessarily represent the jurisdictional tenure type.
- Overlap results are returned only for the currently active jurisdiction.

Selected feature

Name	Lachlan
Full name	Lachlan Shire Council
As at	1/08/2016
Calculated area SqKm	14,966.7120

Selected feature

Overlap details

Schedule of Native Title Determination Applications

Overlap Tribunal ID	Name	FC No	Date Lodged	RT Status	Area sq km(calculated)	Overlap Area sq km (calculated)
NC2012/001	Ngemba, Ngiyampaa, Wangaaypuwan and	NSD415/2012	14/03/2012	Accepted for registration	95,059.4626	2,455.4380

Register of Native Title Claims

Overlap Tribunal ID	Name	FC No	Date Lodged	RT Status	Combined	Area sq km(calculated)	Overlap Area sq km (calculated)
NC2012/001	Ngemba, Ngiyampaa, Wangaaypuwan and Wayilwan native title determination	NSD415/2012	14/03/2012	Accepted for registration	N	95,059.4626	2,455.4380

Native Title Determinations

No overlap found

Native Title Determination Outcomes

No overlap found

Indigenous Land Use Agreements

No overlap found

RATSIB areas

Name	Organisation	RATSIB Status	Area sq km(calculated)	Overlap Area sq km (calculated)
New South Wales	NTSCORP Limited	NTSP	1,723,577.6084	14,966.7118

National Native Title Tribunal

Overlap Analysis Report

Disclaimer
This information product has been created to assist in understanding the spatial characteristics and relationships of this native title matter and is intended as a guide only. Spatial data used has been sourced from the relevant custodians in each jurisdiction, and/or the Tribunal, and is referenced to the GDA94 datum.

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As the interpretation of any particular native title determination area provided is based upon the best information available to the Registrar at the time of creation, any effective analysis must include reference to **both** the relevant determination of native title made by the Federal Court of Australia and the entry made in relation to that determination on the National Native Title Register maintained by the Registrar.

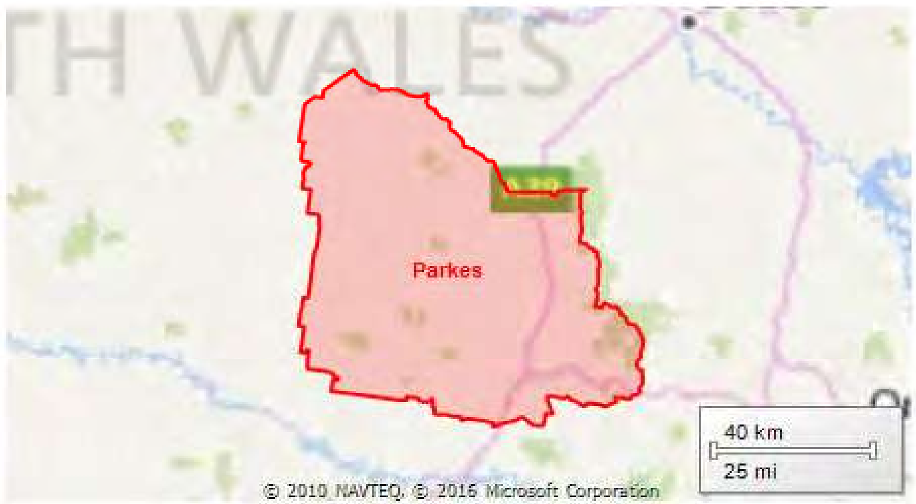
Please note:

- Calculated areas may not be the same as the legal area of a parcel.
- Where shown, NNTT Tenure Class for a non freehold parcel refers to a tenure grouping derived for the purposes of the Tribunal, and does not necessarily represent the jurisdictional tenure type.
- Overlap results are returned only for the currently active jurisdiction.

Selected feature

Name	Parkes
Full name	Parkes Shire Council
As at	1/08/2016
Calculated area SqKm	5,956.7546

Selected feature



Overlap details

Schedule of Native Title Determination Applications

No overlap found

Register of Native Title Claims

No overlap found

Native Title Determinations

No overlap found

Native Title Determination Outcomes

No overlap found

Indigenous Land Use Agreements

No overlap found

RATSIB areas

Name	Organisation	RATSIB Status	Area sq km(calculated)	Overlap Area sq km (calculated)
New South Wales	NTSCORP Limited	NTSP	1,723,577.6084	5,956.7547

National Native Title Tribunal

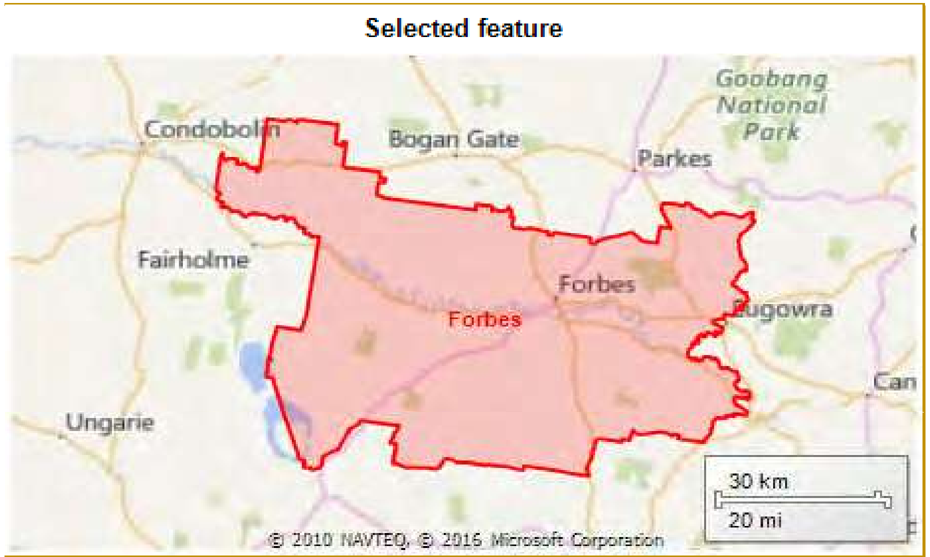
Overlap Analysis Report

Please note:

- Calculated areas may not be the same as the legal area of a parcel.
- Where shown, NNTT Tenure Class for a non freehold parcel refers to a tenure grouping derived for the purposes of the Tribunal, and does not necessarily represent the jurisdictional tenure type.
- Overlap results are returned only for the currently active jurisdiction.

Selected feature

Name	Forbes
Full name	Forbes Shire Council
As at	1/08/2016
Calculated area SqKm	4,710.5405



Overlap details

Schedule of Native Title Determination Applications

No overlap found

Register of Native Title Claims

No overlap found

Native Title Determinations

No overlap found

Native Title Determination Outcomes

No overlap found

Indigenous Land Use Agreements

No overlap found

RATSIB areas

Name	Organisation	RATSIB Status	Area sq km(calculated)	Overlap Area sq km (calculated)
New South Wales	NTSCORP Limited	NTSP	1,723,577.6084	4,710.5403

LACHLAN SHIRE
COUNCIL

Contact Person: G Wilcox

Lachlan Shire Council
58-64 Molong Street
PO Box 216
CONDOBOLIN NSW 2877
P: 02 6895 1900
F: 02 6895 3478
E: council@lachlan.nsw.gov.au

7 December 2016

Scandium 21
C/- Danielle Wallace
PO Box 379
WEST WYDE NSW 2221

Dear Ms Wallace

Syerston Project Extension Modification – Aboriginal Cultural Heritage Assessment

Reference is made to your letter of 2nd December 2016 requesting advice from Council as to any Aboriginal groups that should be consulted as part of the modification of this project.

Council would like to advise that the following organisations should be contacted for advice;

- Condobolin Aboriginal Health Service
  99 Bathurst Street PO Box 321Condobolin NSW 2877
  Phone: (02) 6895 4311Fax: (02) 6895 4322
- Wiradjuri Condobolin Corporation Ltd
  Cnr Cunningham & McDonnell Street Condobolin NSW 2877
  t (02) 6895 4664f (02) 6895 3663
  PO Box 194 Condobolin NSW 2877
- Aboriginal Lands Council
  18 William St, Condobolin, NSW, 2877
  Phone: 02 6895 3639
- Yawarra Aboriginal Corporation
  15 Molong St, Condobolin NSW 2877
- Trangie Local Aboriginal Lands Council
  48 Dandaloo St, Trangie NSW 2823

Council would like to advise you that this may not be all groups that represent Aboriginal people in the locality of the project proposal and you should seek your own advice as to people, families and groups that may have an interest within the project area and the regional impact of this development.

Should you require further advice on this matter please contact me.

Yours faithfully

Glenn Wilcox
Director Environment and Planning

From: Paul Bennett [Paul.Bennett@forbes.nsw.gov.au]
Sent: Monday, 19 December 2016 3:49 PM
To: Danielle Wallace
Subject: Syerston Project - Aboriginal Cultural Assessment

Danielle
Could you please include the Forbes Aboriginal & Community Working Party in your consultation.
David Acheson is the convener and can be contacted on 0429 007 129 or facwp2014@gmail.com

Paul Bennett | Director| Environmental Services & Planning

Forbes Shire Council | Court Street | PO Box 333 Forbes NSW 2871
P: 02 6850 2344 | F: 02 6850 2399 | E: PaulBe@forbes.nsw.gov.au
Please consider the environment before printing this email.

STEP 2 CORRESPONDENCE

From: Laurie Hutchison [laurie@wiradjuricondocorp.com]
Sent: Monday, 23 January 2017 10:19 AM
To: Danielle Wallace
Subject: Registration of Interest - Syerston Project Extension Modification - Fifield NSW

Dear Danielle,

Wiradjuri Condobolin Corporation is an Aboriginal organisation who holds significant cultural knowledge and a right in determining the cultural significance of Aboriginal objects and/or places in the "Area of Interest" and therefore formally wishes to register our interest in the process of community consultation with Scandium21.

Assuring you that we are at the forefront of participating with those seeking to develop our country for the benefit of all communities in the Lachlan Shire Council region.

Warm regards,

Laurie Hutchison
Chief Executive Officer
Wiradjuri Condobolin Corporation
Tel: (02) 6895 4664

From: Ally Coe [ally.coe@wiradjuricondocorp.com]
Sent: Wednesday, 1 February 2017 3:08 PM
To: Danielle Wallace
Subject: Register of Interest in Community Consultation Process

Please register our organisation in the community consultation process please
Name : Murie Elders Group
Contact: Lois Goolagong
Address: 161 Bathurst St Condobolin NSW 2877
Thank You
Lois Goolagong

From: Jamie Gray [jamiegray66@gmail.com]
Sent: Wednesday, 1 February 2017 5:52 PM
To: Danielle Wallace
Subject: Syerston Project Extension Modification-Aboriginal Cultural Heritage Assessment

Dear Mick Ryan

Binjang Wellington Wiradjuri Aboriginal Heritage Surveys,(B.W.W.A.H.S) would like to register our interest as stakeholders to above project.

As per the required information in your email dated 6th January 2017

Thanks you
Jamie Gray

Sent from my iPhone

PROPOSED METHODOLOGY AND CORRESPONDENCE

From: Laurie Hutchison [laurie@wiradjuricondocorp.com]
Sent: Friday, 17 February 2017 12:01 PM
To: Danielle Wallace
Subject: RE: Syerston Project and Syerston Project Modification 4 - Aboriginal Cultural Heritage Assessment Proposed Methodology

Danielle

Many thanks for the information.

I can assure you that we are keen to work with you and not against your organisation. Hopefully we can work collaboratively for the benefit of all and not just the disingenuous few who seek financial rewards rather than meaningful opportunities.

Sincerest regards,

Laurie Hutchison
Chief Executive Officer
The Wiradjuri Centre
Tel: (02) 6895 4664

SYERSTON PROJECT: Proposed Methodology

Submission from Murie Elders Aboriginal Corporation 16/3/1017

This report has been prepared at the request of the Syerston Mine Project regarding Aboriginal cultural heritage within the proposed impact area.

Information regarding the proposed methodology was received in a document entitled "Syerston Project & Syerston Project Modification 4: Proposed Methodology for the Aboriginal Cultural heritage Assessments".

In addition, a Community Consultation meeting was conducted for the RAPS (Registered Aboriginal Parties) at Condobolin on Wednesday 8th March 2017, which was attended by Lois Goolagong, Evelyn Coe & Rebecca Shepherd, on behalf of the Murie Elders Group.

At this meeting information was provided regarding 5 discrete areas which had been the subject of an Archaeological Field Assessment in 1998 which formed part of the approved EIS (Environmental Impact Statement), which was approved by the NSW State Government in 2000, and that the Syerston Project now plans to conduct further field assessments of these 5 areas in March 2017 in order to obtain an AHIP.

The 5 areas which are the subject of this field survey are:

- Mine & processing plant northwest of Fifield,
- Limestone Quarry site on Platina Rd, southeast of Fifield,
- Rail siding at trundle & associated access road upgrades
- Water borefield on the Lachlan River
- Gas pipeline connecting to the Moomba to Sydney gaspipeline.

Background:

Following an archaeological survey by John Appleton, between 1998 and 2000, which was not made available either prior to or at the meeting, 14 archaeological sites were observed and recorded, including "six isolated artefacts, six scarred trees, an open scatter and an extensive campsite" (page 3 of methodology document). A satellite map of the proposed "sites of disturbance" was also provided at the consultation meeting. Unfortunately, neither John Appleton nor Dr Cupper was present at this meeting to answer any questions about the methodology, the proposed field surveys or the past field survey. We find it inappropriate that an archaeologist was not present at a meeting about the proposed methodology to answer our questions about the methodology. The focus group meeting and proposed methodology document did not provide satisfactory information about how the archaeological survey would be conducted.

NOTE: a copy of Appleton's assessment report, along with a recent detailed listing of all AHIMS sites along with a map showing these sites locations was requested at the 8th March meeting.

The 1998/2000 Archaeological Report was provided on 15th March & the recent AHIMS search (which comprised 5 site recordings only) & a map of the AHIMS sites within the proposed impact area was provided on 16th March, one day before the submissions for comment on the proposed methodology closed. It is noted that the "recent AHIMS recordings" for the areas concerned, now appears to have been reduced from 14 sites to 5 sites. Archaeological work around the area has recorded significantly more sites in the area over the past 20 years which area not shown on the map provided on 16 March.

Regarding the methodology at the consultation Meeting, RAPS were informed that the purpose of the field survey with Dr Cupper was to re-record "the sites previously visited", with additional recordings to be made as they were identified during the proposed surveys however no methodology was put forward regarding a broader survey of the proposed impact area which was not sufficiently surveyed by Appleton in the 1998/2000 survey. There was some discussion regarding the 14 sites recorded, in that there were so few identified and documented, and the RAPs were informed that the "Consultation back then doesn't meet the standards now, and the survey is to document any new sites'. As a method has not being put forward to tell us how the new sites will be documented and recorded we cannot provide specific comment, we hope that the survey covers enough of the proposed impact area to locate all evidence of Aboriginal occupation in the area.

Lois Goolagong stated, "That's good, there has to be something there, it's impossible to go over this land and not see anything". This was clarified somewhat with the response that "99% of the pipeline route is along already disturbed road reserve, and that there is only one scar tree within the proposed mine site, which can ideally be avoided". Evelyn Coe asked what would happen to the trees if they were cut down as "White people take our trees and put them in museums, some of those trees marked their old territories or boundaries". The group was advised that this would be discussed later should the need arise. Lois Goolagong stated that "Burial trees should be left where they are, they should never be destroyed or moved and that years ago we travelled from here to the Bogan River and Peak Hill, it's all a pretty important place, like Lake Cowal was, and even today we have an important relationship with the Peak Hill and Bogan mob." It is important to retain these few remaining items which represent our connection to neighbouring mobs. It should also be noted that an archaeological assessment near Lake Cargelligo found a site with over a million surface artefacts (and 7000 artefacts recovered from excavation) in a disturbed road reserve. This assessment also identified 12 scar trees in the disturbed road reserve.

There was some discussion regarding the fact that not all sites or artefacts are found on the ground surface, and visibility can also effect the process. It was also noted that there are special places for men or women, and places of high cultural significance to the community, such as the Murie reserve (Aboriginal Place) and the associated bunyip hole located close by on the Lachlan River near the town of Condobolin, and all were cautioned by the Elders representatives about “going into wrong areas or touching the wrong things’. It is important that our cultural wishes are adhered to for our own health.

The Syerston representatives were informed that recent excavations at the nearby Mineral Hill mine site, produced 3,000 plus subsurface artefacts from 6 small sample excavation sites, some of high cultural & scientific significance. Also that recent dates from two sites along the mid to lower Lachlan, were producing findings up to 50,000 years bp, which were highly significant both culturally and scientifically, and that should the opportunity eventuate, both onsite excavations & dating should be conducted prior to any disturbance of the sites.

The group was advised that “If there is potential for subsurface deposits, or dating, that this would be discussed at a later date, but only as part of the AHIP process”. The Murie elders group understand that excavation and dating can be undertaken as part of an AHIP but also under the Code of Practice prior to an AHIP being issued. Depending on the findings of the survey, we believe that excavation and dating should be discussed as soon as possible if required.

It was also noted by RAPS that not all Aboriginal“sites” or “places” are recorded on the Government AHIMS register, and the group was assured that should there be any “sensitive or restricted information provided, it must be identified by the RAPs as such, or it will be included in the ACHA report.”

Comments regarding the planned methodology:

Despite repeated requests from 8 March to 15 March, the Appleton report and AHIMS results were sent the day before the submission period closed. Due to the delay in obtaining John Appleton’s report & the surprising recent AHIMS search results, with far less than the anticipated information, a comprehensive response from the Murie Elders Group will have to await the outcomes of the field surveys and the findings which eventuate from these. It is noted however that the original survey has some surprising and clearly incorrect flaws.

In particular, it is noted that not all of the areas to be directly impacted by this project were surveyed on foot and many areas were surveyed by vehicle.

A further concern is the incorrect assumptions made, apparently based upon a predictive model which did not rely on any cultural local knowledge or historical research, that certain sites/places or objects such as stone arrangements, middens, carved trees, “mythological” sites, or materials suitable for stone tool manufacture, would not be present or found in the survey areas. This model appears to be founded on the identification of discrete archaeological surface remains, rather than viewing the country as a culturally connected and significant landscape. The reference list does not provide any evidence that this predictive model was researched or substantiated in any way.

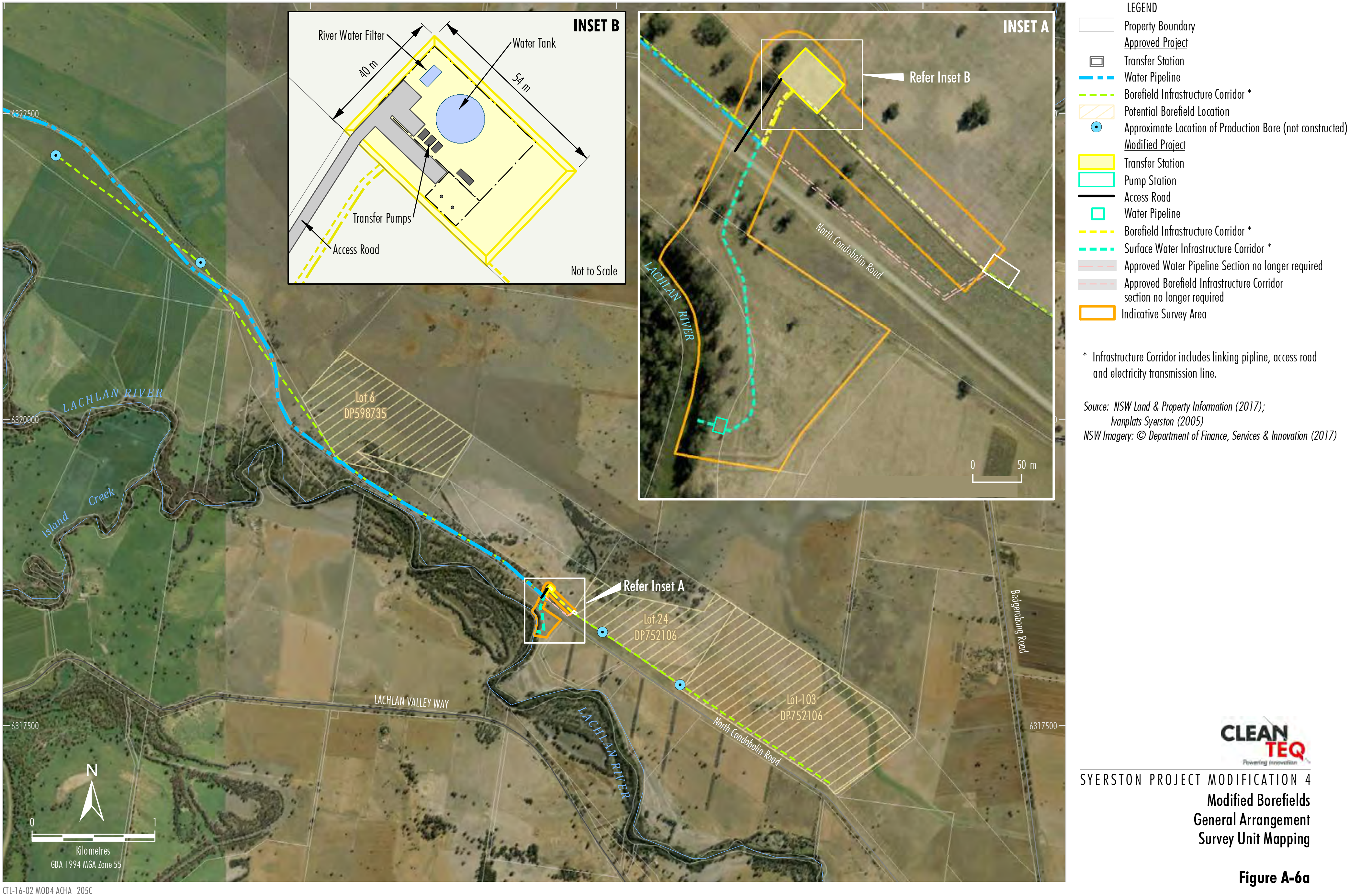
Finally, as this survey was conducted prior to 2010, when significant legislative changes were made, along with the probability that there have been many changes to landforms over the past 20 year period (as the result of both man made changes and environmental factors including drought, floods), as well as recent site identification (both on AHIMS &

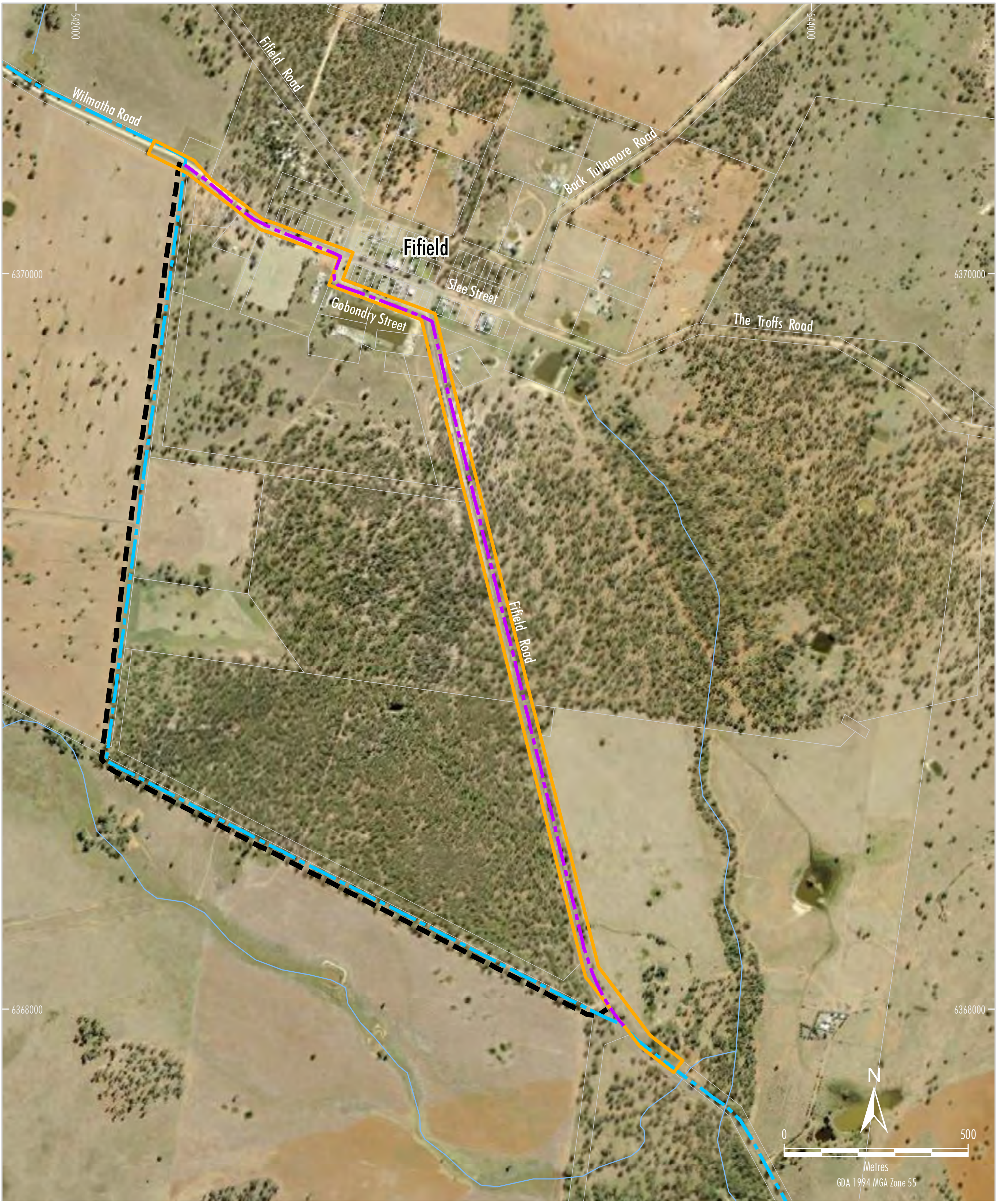
from local knowledge), it is respectfully suggested that the previous survey cannot be relied upon to any degree, and that the field survey needs to be conducted in line with current legislative requirements to ensure that no significant sites or places are mistakenly impacted, thus ensuring that the AHIP (Aboriginal heritage Impact Permit) now being sought by the Syerston Project, can be properly considered and supported by all stakeholders in this process, in a proper and timely manner.

APPENDIX 5. AHIMS REGISTER SEARCH

Note: This appendix contains culturally sensitive material and is available upon request and subject to approval by the NSW Office of Environment and Heritage.

APPENDIX 6. CADASTRE INFORMATION AND SURVEY UNIT MAPPING


INSET B
River Water Filter
Water Tank
40 m
54 m
Transfer Pumps
Access Road
Not to Scale
INSET A
Refer Inset B
North Condobolin Road
LACHLAN RIVER
0
50 m
6322500
6320000
6317500
LACHLAN RIVER
Island Creek
Lot 6
DP598735
Refer Inset A
Lot 24
DP752106
Lot 103
DP752106
LACHLAN VALLEY WAY
North Condobolin Road
Bedgerabong Road
N
0
1
Kilometres
GDA 1994 MGA Zone 55
LEGEND
Property Boundary
Approved Project
Transfer Station
Water Pipeline
Borefield Infrastructure Corridor *
Potential Borefield Location
Approximate Location of Production Bore (not constructed)
Modified Project
Transfer Station
Pump Station
Access Road
Water Pipeline
Borefield Infrastructure Corridor *
Surface Water Infrastructure Corridor *
Approved Water Pipeline Section no longer required
Approved Borefield Infrastructure Corridor section no longer required
Indicative Survey Area
* Infrastructure Corridor includes linking pipline, access road and electricity transmission line.
Source: NSW Land & Property Information (2017);
Ivanplats Syerston (2005)
NSW Imagery: © Department of Finance, Services & Innovation (2017)
CLEAN TEQ
Powering innovation
SYERSTON PROJECT MODIFICATION 4
Modified Borefields
General Arrangement
Survey Unit Mapping
Figure A-6a
CTL-16-02 MOD4 ACHA_205C



LEGEND
- Property Boundary
- Approved Fifield Bypass
- Approved Water Pipeline
- Modified Water Pipeline
- Indicative Survey Area

Source: Black Range Minerals (2000);
NSW Land & Property Information (2015)
NSW Imagery: © Department of Finance, Services & Innovation (2017)

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S Y E R S T O N   P R O J E C T

Modified Water Pipeline Alignment
Survey Unit Mapping

Figure A-6b

CLEAN TEQ
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Syerston Project

MODIFICATION 4 ENVIRONMENTAL ASSESSMENT

Appendix G

Surface Water Extraction
Baseline Flora and Fauna Habitat Report

Syerston Project Modification 4 – Surface Water Extraction Baseline Flora and Fauna Habitat Report

Prepared by AMBS Ecology & Heritage Pty Ltd
for Clean TeQ Holdings Limited

Final

October 2017

AMBS Reference: 16225

Document Information

Citation:	AMBS Ecology & Heritage 2017. *Syerston Project Modification – Surface Water Extraction Baseline Flora and Fauna Habitat Report* Consultancy report to Clean TeQ Holdings Limited
AMBS Ref:	16225
Versions:	Version 1: Draft Report issued 16 June 2017 Version 2: Draft Report issued 26 June 2017 Version 3: Final Report issued 4 July 2017 Version 4: Revised Final Report issued 11 September 2017 Version 5: Revised Final Report issued 26 October 2017
Recipient:	John Hanrahan
Authors:	Belinda Pellow; Mark Semeniuk
Approved by:	Glenn Muir

Executive Summary

Scandium 21 Pty Ltd owns the rights to develop the approved "Syerston Project". The Syerston Project is situated approximately 350 kilometres (km) west-northwest of Sydney, near the village of Fifield, New South Wales (NSW), and includes the establishment and operation of a nickel, cobalt, scandium mine and the development of associated infrastructure (quarry, rail facilities, natural gas and water pipelines). Scandium 21 Pty Ltd is a wholly owned subsidiary of Clean TeQ Holdings Limited. AMBS Ecology & Heritage Pty Ltd was commissioned to prepare a baseline flora, and fauna habitat report for the proposed surface water extraction site (the study area) located 40 km east of Condobolin on the Lachlan River and approximately 50 km south of the Syerston Mine Site.

The study area is 6.2 hectares in size, accessed via North Condobolin Road, and located on the northern side of the Lachlan River 4.5 km north-west of the town of Warroo.

The scope and objectives of this study were to undertake:

- flora surveys in the study area;
- fauna habitat surveys in the study area;
- map and describe plant communities and their condition;
- map and describe threatened ecological communities (if present) according to the relevant State and Commonwealth listings;
- describe how targeted surveys were undertaken for threatened flora species in consideration of the relevant State and Commonwealth guidelines;
- review the vegetation against relevant tree species listed in the *State Environment Planning Policy 44 - Koala Habitat Protection* and *Recovery Plan for the Koala (Phascolarctos cinereus)*; and
- prepare a survey report documenting the survey methods and findings and how surveys were adequate in consideration of the relevant State and Commonwealth guidelines.

Two vegetation types were mapped within the study area:

- River Red Gum - Lignum very tall open forest or woodland wetland on floodplains of semi-arid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion); and
- Cultivated land.

Neither vegetation type forms part of any threatened ecological communities listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999* or the NSW *Threatened Species Conservation Act, 1995*. No native plants listed as threatened or potential habitat for threatened plants, were located in the study area.

Three exotic species listed as noxious in the Lachlan Local Government Area were recorded:

- *Lycium ferocissimum*;
- *Phyla canescens*; and
- *Xanthium spinosum*.

Potential habitat exists for a variety of threatened fauna, including threatened birds, arboreal mammals and microbats. The most notable habitat features for threatened fauna occur in *Eucalyptus camaldulensis* (River Red Gum) trees, which contain a source of nectar, foraging substrates, and tree cavities. Similar habitat occurs more widely along the Lachlan River.

Contents

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1 Introduction

1.1 Background

Scandium 21 Pty Ltd owns the rights to develop the approved "Syerston Project". The Syerston Project is situated approximately 350 kilometres (km) west-northwest of Sydney, near the village of Fifield, New South Wales (NSW), and includes the establishment and operation of a nickel, cobalt, scandium mine and the development of associated infrastructure (quarry, rail facilities, natural gas and water pipelines). Scandium 21 Pty Ltd is a wholly owned subsidiary of Clean TeQ Holdings Limited (CTQ). In the year 2000, a flora assessment was undertaken as part of the *Syerston Nickel Cobalt Project – Environmental Impact Statement* (Bower & Kenna 2000). Development Consent DA 374-11-00 for the Syerston Project was subsequently issued under Part 4 of the NSW *Environmental Planning and Assessment Act, 1979* (EP&A Act) in 2001 and has been modified on three occasions since consent was issued.

CTQ have identified potential opportunities to optimise the Syerston Project, and are proposing to incorporate these opportunities through Modification of DA 374-11-00 under section 75W of the EP&A Act. Components of the Syerston Project Modification relevant to this report includes the addition of surface water extraction from the Lachlan River, and associated infrastructure (e.g. pipeline, pump station, transfer station and access road).

AMBS Ecology & Heritage Pty Ltd (AMBS) was commissioned to prepare a baseline flora and fauna habitat report for the proposed surface water extraction site (the study area) located 40 km east of Condobolin on the Lachlan River and approximately 50 km south of the Syerston Mine site.

1.2 Study area

The location of the study area is shown on Figure 1.1 and in detail on Figure 1.2. Major towns in the region include Condobolin to the west, Parkes to the north-east, and Forbes to the south-east. The study area is 6.2 hectares (ha) in size, accessed via North Condobolin Road, and located on the northern side of the Lachlan River 4.5 km north-west of the town of Warroo.

The study area is in the Local Land Service (LLS) area of Lachlan and the Local Government Area (LGA) of Lachlan. It falls within the Interim Biogeographic Regionalisation for Australia Version 7 (IBRA7) bioregion of NSW South Western Slopes.

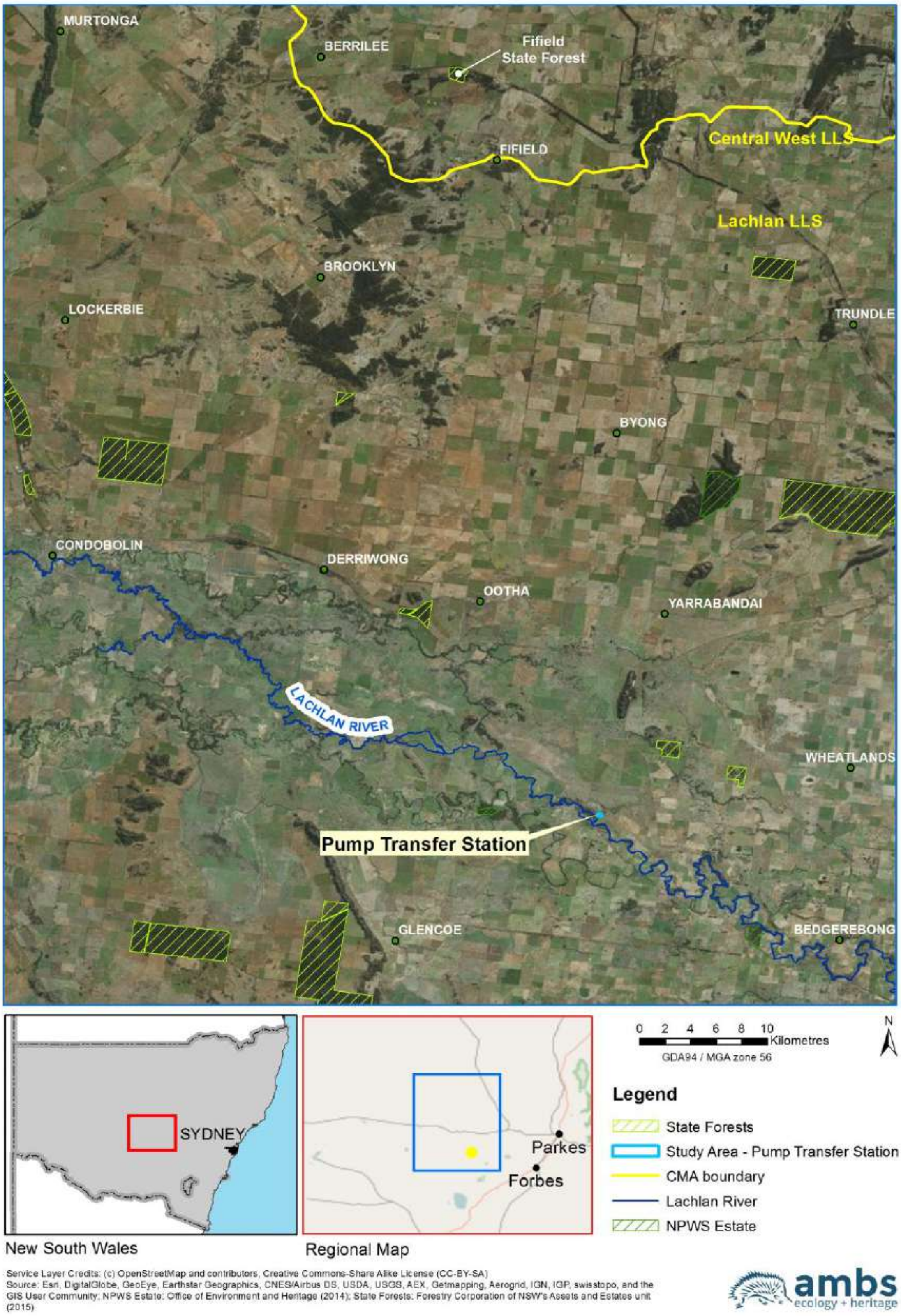

Figure 1.1 Location of the study area in the region

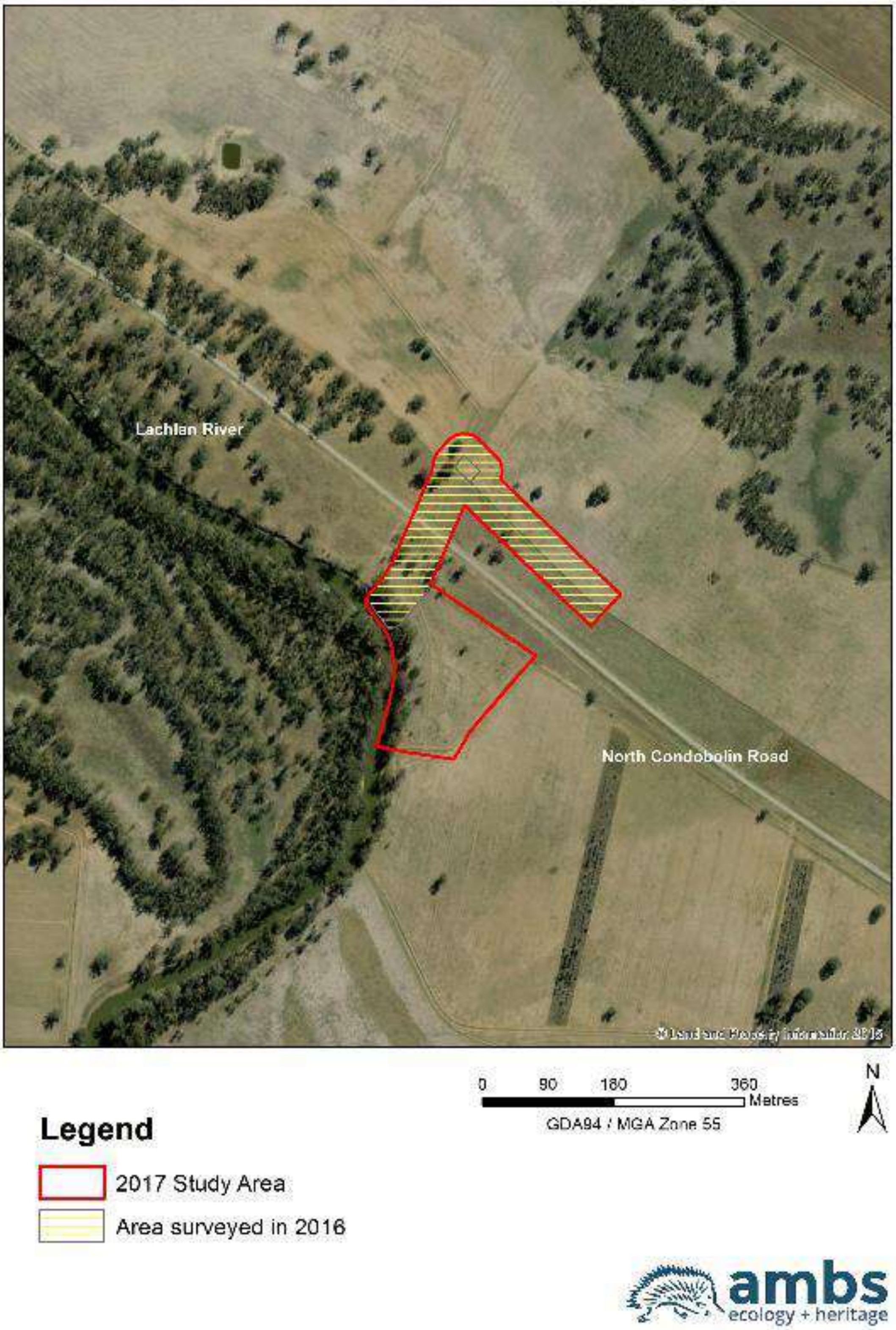

Figure 1.2 Study area - proposed pump transfer station site

1.3 Scope and objectives

The study area was partly surveyed in 2016 by AMBS (flora) and by Future Ecology (fauna). Since that time an additional area has been added for assessment (Figure 1.2). AMBS surveyed the additional area and incorporated results from 2016 and 2017 to prepare this report documenting the flora and fauna habitat of the study area.

The scope and objectives of this assessment were to undertake:

- flora surveys in the study area;
- fauna habitat assessment in the study area;
- map and describe plant communities and their condition (with a reconciliation against Biometric Vegetation Types [BVTs] and Plant Community Types [PCTs]);
- map and describe threatened ecological communities (TECs) (if present) according to the relevant State and Commonwealth listings;
- describe how targeted surveys were undertaken for threatened flora species in consideration of the relevant State and Commonwealth guidelines;
- review the vegetation against relevant tree species listed in the *State Environment Planning Policy (SEPP) 44 - Koala Habitat Protection* (SEPP 44) and *Recovery Plan for the Koala (Phascolarctos cinereus)* (NSW Department of Environment and Climate Change [DECC] 2008); and
- prepare a survey report documenting the survey methods and findings and how surveys were adequate in consideration of the relevant State and Commonwealth guidelines.

2 Methods

2.1 Literature and database review

A 'desktop' study of threatened species information and local reports was conducted prior to undertaking field surveys. This included:

- database searches for threatened plant records in the region using the Australian Virtual Herbarium (AVH) (AVH 2017), Atlas of Living Australia (ALA) (ALA 2017), the Department of the Environment and Energy (DEE) Protected Matters Search Tool (DEE 2017) and BioNet (NSW Office of Environment and Heritage [OEH] 2017a);
- review of data from flora surveys undertaken in 2016 (AMBS 2016);
- familiarisation with fauna data supplied by Future Ecology;
- interpretation of Map 8431 - Bogan Gate, Boona Mount, Condobolin, Dandaloo, Tottenham and Tullamore 1: 100 000 Map Sheets (NSW Department of Water and Land Conservation [DLWC] 2002); and
- review of tree species listed in SEPP 44 and the *Recovery Plan for the Koala (Phascolarctos cinereus)* (DECC 2008).

Prior to the field surveys, potential habitat for threatened flora was reviewed using aerial imagery (NSW Department of Finance, Services and Innovation [DFSI] 2017) and topographic features.

2.2 Flora surveys

2.2.1 Overview

Flora surveys were undertaken on 30 August 2016 by botanist Belinda Pellow and 4 November 2016 and 6 June 2017 by ecologist James Schlunke. Fauna surveys were undertaken by Future Ecology between 24 – 31 October 2016 and fauna habitat surveys by ecologist James Schlunke on 6 June 2017.

Surveys undertaken were designed to detect threatened species that could occur in the study area. They were developed, as required, in accordance with the following guidelines:

- the *Draft Survey Guidelines for Australia's Threatened Orchids* (Department of the Environment [DotE] 2013);
- *Threatened Biodiversity Survey and Assessment Guidelines for Developments and Activities Working Draft* (NSW Department of Environment and Conservation [DEC] 2004);
- *NSW Guide to Surveying Threatened Plants* (OEH 2016);
- *Field Survey Methods* (OEH 2017d); and
- *Native Vegetation Interim Type Standard* (Sivertsen 2009).

2.2.2 Plant communities

The field survey for plant community definition and mapping used rapid data points (RDPs) and opportunistic observations. Photographs were taken at each point and the location of the point was recorded using a Global Positioning System (GPS).

RDPs were used to collect data for the purpose of refining the vegetation mapping. At each RDP site, the dominant species in the canopy layer, the shrub layer and ground layer were recorded. Notes were made on the percentage cover of each structural layer and the general condition/disturbance issues of the vegetation at each site. Utilising the information collected and photographic images, each RDP was used to assist in interpreting aerial imagery and assigning boundaries for vegetation map units.

Plant species were identified in the field or collected and identified in the laboratory. If specimens required further identification or confirmation they were sent to the National Herbarium of NSW.

The NSW Vegetation Information System (VIS) Classification 2.1 (OEH 2017c) was used to test the similarity of vegetation descriptions to PCTs so that each vegetation type could be assigned a BVT and PCT number. Where an exact match was not possible the best fit was determined.

2.2.3 Threatened flora surveys

The NSW BioNet (OEH 2017a) was used to determine threatened plant species known or predicted for the Lachlan LLS Lower slopes subregion (Table 2.1). One species *Austrostipa wakoolica* has been recorded within a 10 km radius of the study area (OEH 2017a). Candidate species were further assessed by referring to the *Threatened Species Profile Database* (OEH 2017d) to determine if they were likely to occur in the study area (Table 2.1).

Searches for threatened plant species were undertaken using techniques outlined in the *NSW Guide to Surveying Threatened Plants* (OEH 2016) and Cropper (1993). In this small and degraded study area, one parallel field traverse was used in a linear patch of woodland vegetation that covered 1.8 ha of the study area. The aim of this technique is to maximise the likelihood of detecting the target species. If a threatened plant species is found the following information is recorded:

- location coordinates (using a hand-held GPS);
- extent of each occurrence;
- population counts or population estimates; and
- detailed habitat and condition description including native species lists and weed occurrences.

Table 2.1 Threatened plant species known or predicted to occur in the Lachlan LLS, Lower Slopes Subregion (OEH 2017a)

Scientific name	Common name	NSW status	Commonwealth status	Occurrence	Vegetation class	Survey time	Likely to occur
Austrostipa metatoris	A spear-grass	Vulnerable	Vulnerable	Known	Floodplain Transition Woodlands	All year	No, study area degraded
Austrostipa wakoolica	A spear-grass	Endangered	Endangered	Known	Floodplain Transition Woodlands	Sept-Dec	Unlikely, study area degraded
Acacia ausfeldii	Ausfeld's Wattle	Vulnerable	n/a	Known	Western Slopes Grassy Woodlands	Sept-Oct	No, study area degraded
Eleocharis obicis	Spike-Rush	Vulnerable	Vulnerable	Known	Forested Wetland and Freshwater Wetlands	All year	No, Habitat not present
Diuris tricolor	Pine Donkey Orchid	Vulnerable	n/a	Known	Floodplain Transition Woodlands and Western Slopes Grassy Woodlands	Aug-Sept	No, Habitat not present

Scientific name	Common name	NSW status	Commonwealth status	Occurrence	Vegetation class	Survey time	Likely to occur
Kippistia suaedifolia	Fleshy Minuria	Endangered	n/a	Known	Arid shrublands and Saline wetlands	Sept-Nov	No, Habitat not present
Lepidium aschersonii	Spiny Peppercress	Vulnerable	Vulnerable	Known	Floodplain Transition Woodlands	Aug-May	No, Habitat not present
Lepidium monoplocoides	Winged Peppercress	Endangered	Endangered	Known	Floodplain Transition Woodlands	Nov-Feb	No, Habitat not present
Pilularia novae-hollandiae	Austral Pillwort	Endangered	n/a	Known	Floodplain Transition Woodlands	All year	No, Habitat not present
Senecio garlandii	Woolly Ragwort	Vulnerable	n/a	Predicted	Western Slopes Dry Sclerophyll Forests and Western Slopes Grassy Woodlands	All year	No, Habitat not present
Swainsona murrayana	Slender Darling Pea	Vulnerable	Vulnerable	Known	Floodplain Transition Woodlands	Sept-Feb	No, study area degraded
Swainsona sericea	Silky Swainson-pea	Vulnerable	n/a	Known	Floodplain Transition Woodlands and Western Slopes Grassy Woodlands	Sept-Dec	No, study area degraded
Tylophora linearis		Vulnerable	Endangered	Known	Floodplain Transition Woodlands	Sept-May	No, Habitat not present

2.3 Fauna surveys

2.3.1 Previous fauna surveys

Results from the previous fauna surveys undertaken by Future Ecology in the study area were reviewed for relevant data and results used to inform surveys undertaken in 2017.

2.3.2 Fauna habitat survey

Fauna habitat features were recorded to provide observations of habitat features for threatened fauna. A proforma developed using OEH *Field Survey Methods* (OEH 2017b) was used to record habitat features across the area. Features assessed are listed in Table 2.2.

Table 2.2 Fauna habitat features assessed

Feature
BVTs
Other vegetation native and introduced
Hollow-bearing trees, including dead stags
Bush rock and rocky outcrops
Natural burrows
Large trees with basal cavities
Logs
Wetlands, streams, rivers, dams and other water bodies
Nests and roosts
Wombat burrows
Dens used by Yellow-bellied Gliders (*Petaurus australis*), Squirrel Gliders (*Petaurus norfolcensis*) and Brush-tailed Phascogales (*Phascogale tapoatafa*)
Sap feed trees for the Yellow-bellied Glider and Squirrel Glider
Distinctive scats (e.g. those of the Spotted-tailed Quoll [*Dasyurus maculatus*] or Koala)
Latrine and den sites of the Spotted-tailed Quoll
Allocasuarina spp.
Flying-fox camps
Microchiropteran bat tree roosts
Microchiropteran bat subterranean roosts (caves, culverts, tunnels and disused mine shafts)
Swift Parrot (*Lathamus discolor*) and Regent Honeyeater (*Anthochaera phrygia*) feed or nest trees
Winter-flowering eucalypts
Permanent soaks and seepages in potential habitat for *Philoria* spp.
Areas that can act as corridors for plant or animal species
Connectivity value of the site

2.3.3 Koala habitat tree assessment

A list of potential food trees is provided in SEPP 44 and the *Recovery Plan for the Koala (Phascolarctos cinereus)* (DECC 2008). During field surveys the presence of tree species known to provide food for the Koala in the central west region was recorded.

2.4 Data interpretation and mapping

Plant species identifications were checked against descriptions and distribution information provided by PlantNet (PlantNet 2012) to confirm that the species identified were known for the region and the habitat they were located in. If a species was considered unusual for the location its identification was confirmed at the National Herbarium of NSW.

RDP information was used to establish the vegetation type present. The OEH vegetation map 8431 (DLWC 2002), which provides broad scale vegetation covering the study area, was reviewed. As well, the NSW VIS Classification 2.1 (OEH 2017c) was accessed for descriptions of relevant PCTs. To determine if communities conformed to a relevant TEC under the Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act) and/or the NSW *Threatened Species Conservation Act, 1995* (TSC Act) relevant listing advice/final determinations were reviewed.

3 Results

3.1 Flora

3.1.1 Plant communities

The determination of plant communities and their boundaries was based on rapid assessment site data, interpretation of PCT descriptions (OEH 2017c) and previous mapping (DLWC 2002). A full list of species recorded across the study areas can be found in Appendix A. A total of 44 species were recorded, of which 17 were natives.

The native vegetation in the study area consisted of River Red Gum - Lignum very tall open forest or woodland wetland on floodplains of semi-arid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion). Other portions of the study area were land that has been cultivated and North Condobolin Road (Figure 3.1 and Table 3.1).

Table 3.1 Plant Community Types in the study area

BVT	BVT Number	PCT Number	Keith Formation	Total Area Mapped (ha)
River Red Gum - Lignum very tall open forest or woodland wetland on floodplains of semi-arid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion	LA190	11	Forested Wetland	1.8
Cultivated	n/a	n/a	n/a	4.4

The location of the plant communities is shown in Figure 3.1 and descriptions of each are provided below.

River Red Gum - Lignum very tall open forest or woodland wetland on floodplains of semi-arid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion).

Plate 1 River Red Gum vegetation adjecent to the Lachlan River

The River Red Gum community adjacent to the Lachlan River had recently been flooded (Plate 1). The canopy was dominated by *Eucalyptus camaldulensis* (River Red Gum) with *Eucalyptus populnea* (Poplar Box) occurring on the outer edge of the wooded area. A smaller tree layer of *Eucalyptus camaldulensis* also occurred. Shrubs were sparse and were primarily *Duma florulenta* and *Maireana microphylla.* The ground layer was also sparse, primarily due to the recent flooding. Native ground layer species recorded included *Marsilea drummondii, Lythrum hyssopifolia, Rumex brownii, Eleocharis pallens, Paspalidium jubiflorum* and *Austrostipa verticillata.*

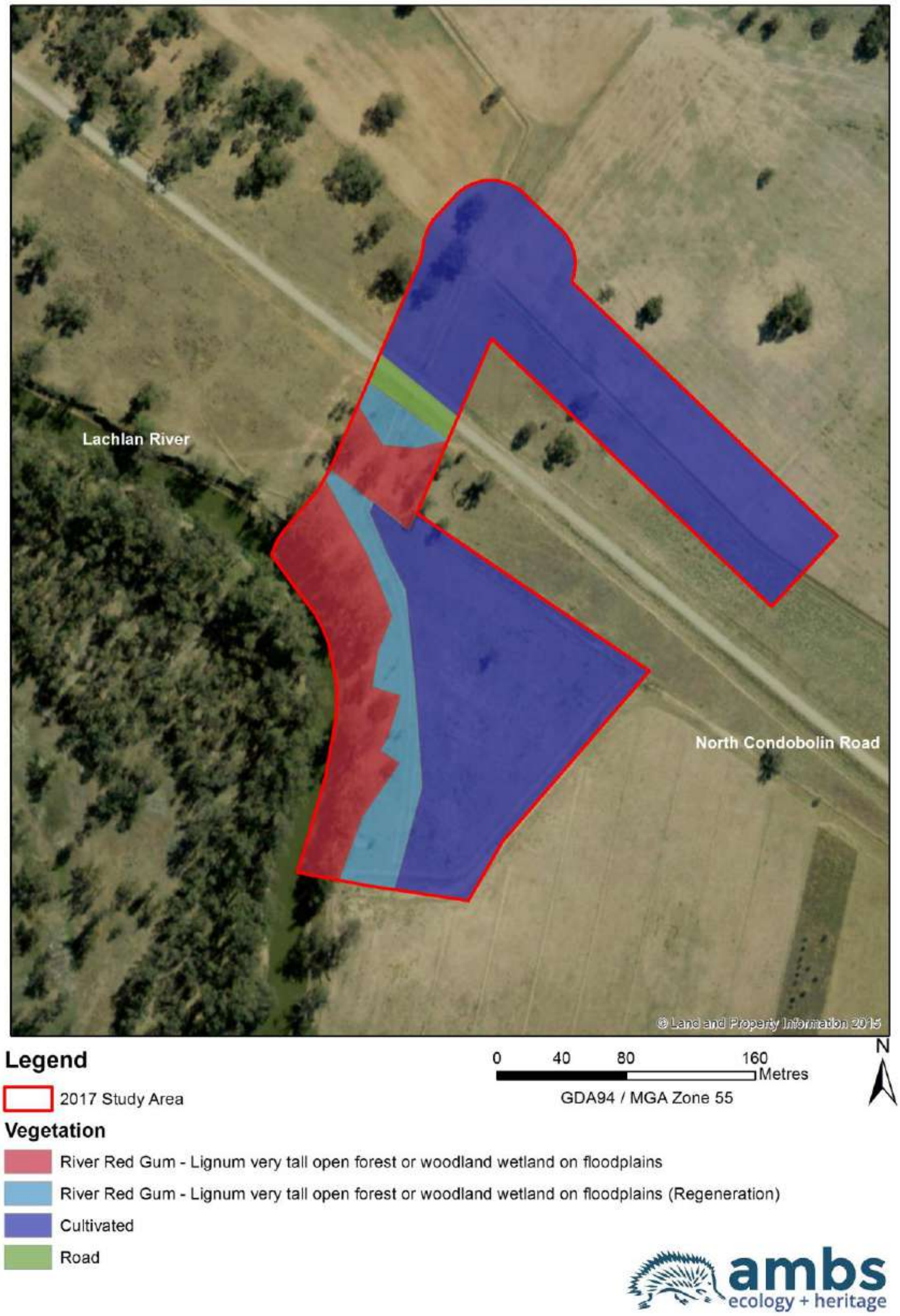

Figure 3.1 Plant communities within the study area

The vegetation in this plant community was in poor condition, being disturbed by grazing and recreational activities such as camping. The ground cover was dominated by exotic species including *Phyla canescens, Lolium perenne, Hordeum marinum, Echium plantagineum, Sonchus oleraceus, Xanthium spinosum, Malva parviflora, Polygonum aviculare* and *Lycium ferocissimum.*

Soils were deep, dark brown alluvial silts and the ground surface was relatively flat, with little or no slope.

This plant community is not listed as a TEC.

Full floristic survey sites: Rapid assessment sites only.

Cultivated

Plate 2 Typical cultivated area

A large portion of the study area was cleared and cultivated agricultural land (Plate 2) with a few remnant shrubs and trees including *Eucalyptus microcarpa* (Grey Box), *Eucalyptus populnea* (Poplar Box), *Eucalyptus camaldulensis* (River Red Gum) and *Geijera parviflora* are sparsely dotted across the landscape. The ground layer had few native species and was dominated by exotic species.

This plant community is not listed as a TEC.

3.1.2 Threatened Ecological Communities

River Red Gum - Lignum very tall open forest or woodland wetland on floodplains of semi-arid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion does not represent a threatened ecological community relevant to State or Commonwealth listings.

3.1.3 Threatened plant species

No threatened plant species were likely to occur within this disturbed study area. Searches in the linear woodland vegetation adjacent to the Lachlan River and the cultivated land did not locate any threatened flora species. Potential habitat for threatened flora was not located in the study area.

3.1.4 Weed species

Field surveys recorded 27 exotic species across the study areas (Appendix A). Of these, three are recorded as noxious weeds in the Lachlan LGA (DPI 2017) (Table 3.2).

Table 3.2 Noxious weeds recorded within the study areas

Scientific Name	Common Name	Noxious Class
Lycium ferocissimum	African Boxthorn	4
Phyla canescens	Lippia	4
Xanthium spinosum	Bathurst Burr	4

3.2 Fauna

3.2.1 Previous fauna surveys

Surveys of a portion of the study area were undertaken by Future Ecology in 2016. During those surveys one Brown Treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*) was recorded (Future Ecology 2016). This species is listed as Vulnerable under the TSC Act.

3.2.2 Fauna habitat description

Woodland on Alluvial Plain / Riparian Woodland

This habitat occurred adjacent to the Lachlan River. It was a mixed aged stand including mature and medium-aged trees, as well as young regenerating eucalypts. The woodland has been subject to various disturbances, including historical clearing and recent grazing, which has impacted mid-storey development and encouraged exotic plant cover in ground layers. The woodland is continuous along both sides of the Lachlan River within the study area and beyond, however is sparsely wooded in some adjacent areas.

The canopy was moderately dense and composed entirely of *Eucalyptus camaldulensis* (River Red Gum). The shrub layer was almost absent, with the exception of a few areas with *Lycium ferocissimum* (African Boxthorn). Groundcover was in moderate density composed of mostly exotic species, including *Phyla canescens* and *Xanthium spinosum* (Bathurst burr).

Small and large tree hollows were common in mature *Eucalyptus camaldulensis* (River Red Gums) within the study area and are likely to be widespread along the Lachlan River. Standing dead timber and large trees with basal cavities were also observed in smaller numbers. Logs were relatively common, consisting mostly of fallen hollow branches from *Eucalyptus camaldulensis* (River Red Gum). Other habitat resources such as decorticating bark and mistletoe were considered sparse. Leaf litter was sparse, although likely dependent on time since flooding. No bush rock was observed. Signs of feral species included sheep and rabbits.

Open Grassland / Pasture

This habitat occurred adjacent to the Riparian Woodland. It consisted of an open grassland that has been previously cultivated, and is currently dominated by exotic species. A few remnant shrubs and trees are sparsely dotted across the area, including *Eucalyptus microcarpa* (Grey Box), *Eucalyptus populnea* (Poplar Box) and *Geijera parviflora* (Wilga). One *Eucalyptus camaldulensis* (River Red Gum) occurred as a paddock tree and contained small tree hollows. Evidence of previous disturbance (e.g. clearing, grazing) was obvious due to the lack of any structural vegetation layers. Connectivity with other areas of habitat, apart from the adjacent Riparian Woodland, was non-existent. Habitat resources such as decorticating bark, mistletoe, logs and bush rock were not observed. Leaf litter was sparse. Signs of feral species included sheep and rabbits were observed.

3.2.3 Threatened fauna habitat

The *Eucalyptus camaldulensis* (River Red Gum) woodland in the study area occurs more extensively along the Lachlan River. A variety of threatened fauna species have potential to use the woodland habitat within the study area. Mature trees with cavities provide potential roosting locations for threatened microbats such Southern Myotis (*Myotis macropus*) (Vulnerable TSC Act), as well as the Brown Treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*) (Vulnerable TSC Act). Other threatened species such as the Grey-crowned Babbler (*Pomatostomus temporalis temporalis*) (Vulnerable TSC Act), Diamond Firetail (*Stagonopleura guttata*) (Vulnerable TSC Act) and Spotted Harrier (*Circus assimilis*) (Vulnerable TSC Act), have potential to also utilise the Red Gum woodland, as well as the lightly treed and grassland areas. No threatened species under the EPBC Act have been recorded within 15 km of the study area (OEH, 2017a).

3.2.4 Koala food trees

Trees listed as food trees for the Koala in the central west region (DECC 2008) were located across the study area. No Koalas have been recorded within 15 km of the study area (OEH, 2017a).

Primary food tree species: *Eucalyptus camaldulensis* (River Red Gum) was adjacent to the Lachlan River in River Red Gum - Lignum very tall open forest or woodland wetland on floodplains of semi-arid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion).

Secondary food tree species: *Eucalyptus populnea* (Poplar Box) and *Eucalyptus microcarpa* (Western Grey Box), were recorded as isolated individuals adjacent to the River Red Gum community.

Stringybarks/supplementary species: None were recorded.

Please note that Western Grey box has been incorrectly named in the Recovery Plan for the Koala (*Phascolarctos cinereus*) (DECC 2008). In Appendix 2 Management Area 6: Western Slopes and Plains, it states the species is *Eucalyptus macrocarpa* (it should say *Eucalyptus microcarpa*).

4 Conclusion

Two vegetation types were mapped within the study area:
- River Red Gum - Lignum very tall open forest or woodland wetland on floodplains of semi-arid (warm) climate zone (mainly Riverina Bioregion and Murray Darling Depression Bioregion); and
- Cultivated land.

Neither vegetation type forms part of any TEC communities listed under the EPBC Act or the TSC Act. No native plants listed as threatened or potential habitat for threatened plants, were located in the study area.

Three exotic species listed as noxious in the Lachlan LGA were recorded:
- *Lycium ferocissimum*;
- *Phyla canescens*; and
- *Xanthium spinosum*.

Potential habitat exists for a variety of threatened fauna, including threatened birds, arboreal mammals and microbats. The most notable habitat features for threatened fauna occur in *Eucalyptus camaldulensis* (River Red Gum) trees, which contain a source of nectar, foraging substrates, and tree cavities. Similar habitat occurs more widely along the Lachlan River.

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Appendix A: List of all species recorded across the study areas

Family	Scientific name	Common name	Exotic
Amaranthaceae	*Alternanthera sp.*		
Asteraceae	*Arctotheca calendula*	Capeweed	X
Poaceae	*Austrostipa aristiglumis*	Plains Grass	
Poaceae	*Austrostipa verticillata*		
Poaceae	*Bromus diandrus*	Great Brome	X
Poaceae	*Bromus sp.*		X
Brassicaceae	*Capsella bursa-pastoris*	Shepherd's Purse	X
Poaceae	*Chloris truncata*	Windmill Grass	
Asteraceae	*Cirsium vulgare*	Spear Thistle	
Polygonaceae	*Duma florulenta*	Lignum	
Boraginaceae	*Echium plantagineum*	Paterson's Curse	X
Cyperaceae	*Eleocharis pallens*		
Poaceae	*Eragrostis cilianensis*	Stinkgrass	X
Myrtaceae	*Eucalyptus camaldulensis*	River red gum	
Myrtaceae	*Eucalyptus microcarpa*	Grey Box	
Myrtaceae	*Eucalyptus populnea*	Bimble Box, Poplar Box	
Rutaceae	*Geijera parviflora*	Wilga	
Amaranthaceae	*Gomphrena celosioides*	Gomphrena weed	X
Poaceae	*Hordeum leporinum*	Barley grass	X
Poaceae	*Hordeum marinum*	Barley grasses	X
Brassicaceae	*Lepidium africanum*		X
Poaceae	*Lolium perenne*	Perennial Ryegrass	X
Poaceae	*Lolium rigidum*	Wimmera ryegrass	X
Onagraceae	*Ludwigia peploides*	Primrose	
Solanaceae	*Lycium ferocissimum*	African Boxthorn	X
Lythraceae	*Lythrum hyssopifolia*	Hyssop Loosestrife	
Chenopodiaceae	*Maireana microphylla*	Small-leaf bluebush	
Malvaceae	*Malva parviflora*	Small-flowered mallow	X
Marsileaceae	*Marsilea drummondii*	Common nardoo	
Fabaceae	*Medicago polymorpha*	Burr Medic	X
Fabaceae	*Medicago sp.*	Medics	X
Poaceae	*Paspalidium jubiflorum*	Warrego Grass	
Poaceae	*Phalaris sp.*	Canary grasses	X
Verbenaceae	*Phyla canescens*		X
Polygonaceae	*Polygonum aviculare*	Wireweed	X
Polygonaceae	*Rumex brownii*	Swamp Dock	
Chenopodiaceae	*Sclerolaena muricata var. semiglabra*	Black rolypoly	
Brassicaceae	*Sisymbrium sp.*	Mustards	X
Asteraceae	*Soliva stolonifera*	Carpet Burweed	X
Asteraceae	*Sonchus oleraceus*	Common Sowthistle	X
Fabaceae	*Trifolium angustifolium*	Narrow-leaved clover	X
Fabaceae	*Trifolium repens*	White clover	X
Fabaceae	*Trifolium sp.*	Clover	X
Poaceae	*Vulpia sp.*	Fescue grasses	X
Asteraceae	*Xanthium spinosum*	Bathurst Burr	X

CLEAN TEQ
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MODIFICATION 4 ENVIRONMENTAL ASSESSMENT

Appendix H

Alternative Water Pipeline Alignment Baseline Flora Report

Clean TeQ Holdings Limited

SYERSTON PROJECT MODIFICATION 4
ALTERNATIVE WATER PIPELINE ALIGNMENT
BASELINE FLORA REPORT

October 2017

PREPARED BY DR COLIN DRISCOLL

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TABLES

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EXECUTIVE SUMMARY

Scandium21 Pty Ltd (a wholly owned subsidiary of Clean TeQ Holdings Limited) proposes to seek a realignment of an approximately three kilometre section of the currently approved water pipeline associated with the approved Syerston Project. This realignment will form part of a Section 75W Modification to Development Consent (DA 374-11-00) for the Syerston Project, issued under Part 4 of the New South Wales *Environmental Planning and Assessment Act 1979* in 2001.

This is a report on the flora and vegetation communities in and around the proposed realignment.

The study area consisted of just over three kilometres of approximately 60 metres wide road easement, both sides of the road, starting to the west of Fifield and through Fifield by way of side streets then along Fifield Road to the south. The section of the study area from the west and through Fifield was not vegetated, consisting of maintained and disturbed areas. The vegetated areas of interest started just under 200m south down Fifield Road. In the vegetated areas the overall arrangement from the outer edge of the study area was vegetation (woodland/grassland) for approximately two thirds of the road easement width, then a grassy verge between the wooded areas and the edge of the sealed road.

Within the study area, the disturbance area in which the pipeline would be laid lies within 5 m from the edge of the sealed road (either side), an area consisting of native grasses, exotic plants and bare gravel. The disturbance area is not part of the original landform having been part of the initial road construction.

Three threatened flora species were recorded in the wider study area by AMBS Ecology and Heritage, *Tylophora linearis*, *Lepidium monoplocoides* (Winged Peppercress) and *Austrostipa wakoolica*. One endangered ecological community, a Western Grey Box community, was recorded within the study area but is located outside the extent of disturbance associated with the Modification.

1 INTRODUCTION

1.1 Background

The Syerston Project is situated approximately 350 kilometres (km) west-northwest of Sydney, near the village of Fifield, New South Wales (NSW). Scandium21 Pty Ltd owns the rights to develop the Project. Scandium21 Pty Ltd is a wholly owned subsidiary of Clean TeQ Holdings Limited (Clean TeQ). Development Consent (DA 374-11-00) for the Project was issued under Part 4 of the New South Wales (NSW) *Environmental Planning and Assessment Act 1979* (EP&A Act) in 2001.

Clean TeQ proposes to realign approximately 3 km section of the currently approved 60 km water pipeline associated with the approved Syerston Project (Figure 1). This realignment will form part of a Section 75W Modification to Development Consent (DA 374-11-00) under the EP&A Act. The realignment is located in and near the town of Fifield in central western NSW, just over 40 km north east of Condobolin.

1.2 Flora and Vegetation Survey Objectives

Objectives of the flora and fauna surveys were to:

- document plant species growing across the study area by drawing on the results of past surveys and augmenting this information with that from the current survey;
- classify and map the distribution of vegetation communities across the study area; and
- target species, communities and populations listed as threatened both in the *NSW Threatened Species Conservation Act 1995* (TSC Act) and the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The following guidelines and policies were used to inform the methodology and outcomes of the surveys:

- *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities - Working Draft* (Department of Environment and Conservation [DEC], 2004).
- *NSW Guide to Surveying Threatened Pants* (State of NSW and NSW Office of Environment and Heritage [OEH], 2016).
- *Survey Guidelines for Australia's Threatened Orchids* (Commonwealth of Australia, 2013).
- Profiles and guidelines specific to threatened species and communities (e.g. BioNet [OEH, 2016a] and the Vegetation Information System Classification 2.1 [OEH, 2015a]).
- *Threatened Species Survey and Assessment Guidelines* (OEH, 2015b).
- *Matters of National Environmental Significance Significant Impact Guidelines 1.1* (Department of Environment, Water Heritage and the Arts, 2009).

- *Guidelines for Threatened Species Assessment* (DEC and Department of Primary Industries [DPI], 2005).

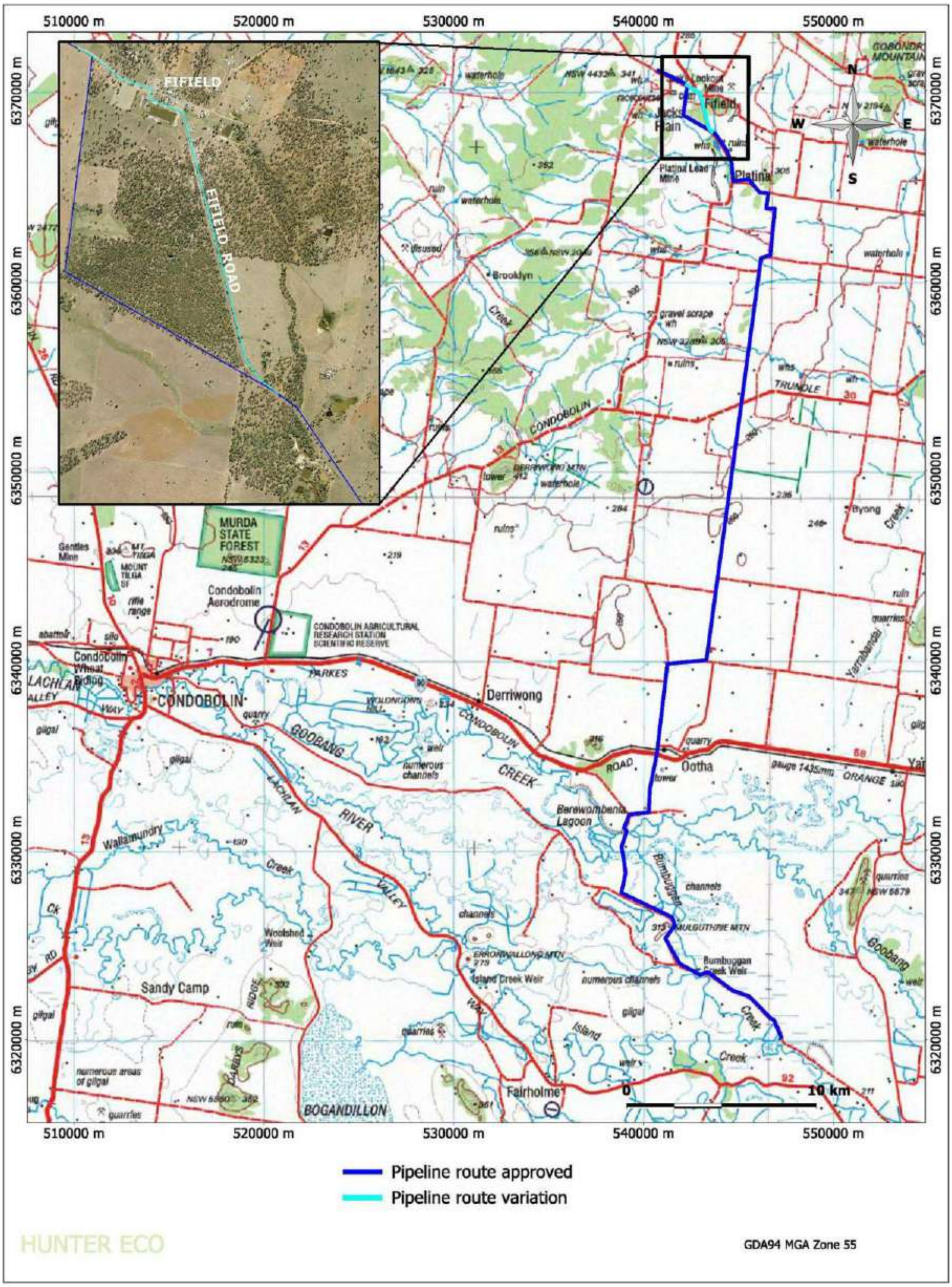

Figure 1 Regional Location

2 THE STUDY AREA REGION

2.1 Regional Setting

The study area is located in:

- Cobar Peneplain IBRA Region, Lachlan Plains subregion;
- Central West Local Land Services, Nymagee Rankins Springs subregion;
- Central Western Slopes Botanical Division; and
- Lachlan Local Government Area.

2.2 Mitchell Landscapes

Mitchell landscapes are areas of land with relatively homogenous geomorphology, soils and broad vegetation types which have been mapped at 1:250,000 scale. Each Mitchell landscape includes an estimate of the percent of native vegetation that has been cleared within the landscape (OEH 2016b).

The majority of the study area (central 2.4 km) is located in the 82% cleared Fifield Intrusives Mitchell Landscape. A small section (0.7 km) at the southern end is located in the 71% cleared Belmont Hills landscape and a smaller section (0.2 km) at the northern end is located in the Bogan Alluvial Plains landscape.

2.3 Topography and Drainage

The study area is located in a low relief widely undulating landscape with elevation from 208 to 300 m.

2.4 Geology and Soils

Geology across the study area is from the Ordovican period Palaeozoic era, Girilambone Group. The lithology is described as variously deformed and metamorphosed, micaceous, quartzose and quartz-lithic sandstone, pelite, chert; minor intercalations of polymictic conglomerate, siltstone, quartzite, and mafic and intermediate volcanics; black shale (Geoscience Australia 2015).

From the Australian Soil Classification (http://www.clw.csiro.au/aclep/asc/), soils in the study area are predominantly Rudosols and Tenosols along with Chromosols.

2.5 Climate

Climate data were extracted from the Australian Bureau of Meteorology (BoM) website (http://www.bom.gov.au/climate/data/), with weather stations nearest to Fifield being selected.

Rainfall data were obtained from the Trundle (Murrumbogie) weather station which shows that the area has mean annual rainfall of 477 mm with late Autumn to early Spring being slightly drier than late Spring and Summer (Figure 2) (BoM, 2016).

Temperature data were obtained from Condobolin Ag Research Station which shows an average annual mean temperature of 24.5 °C, with a range of 12.8 °C in July to 37.8 °C in January (Figure 3) (BoM, 2016).

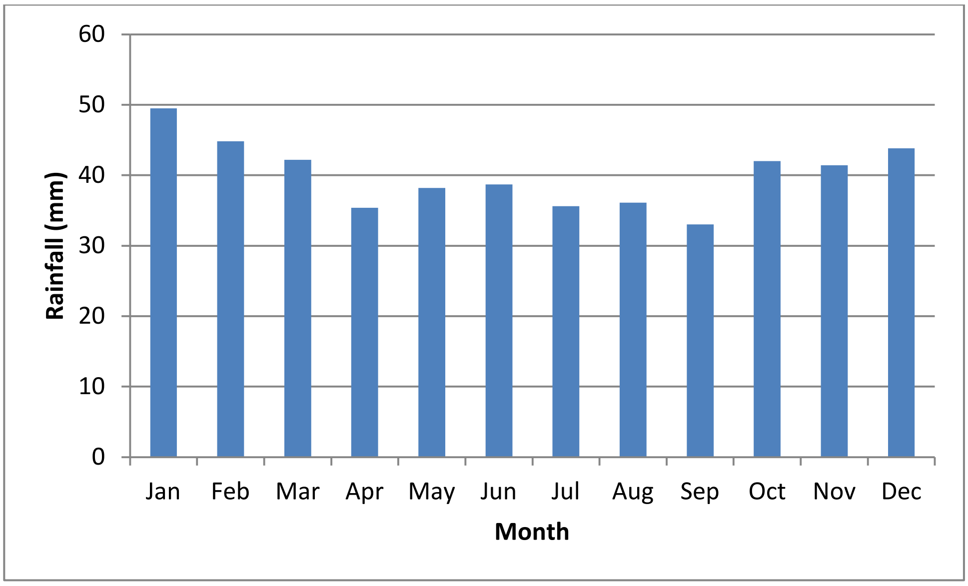

Figure 2 Average monthly rainfall at Trundle (Murrumbogie)

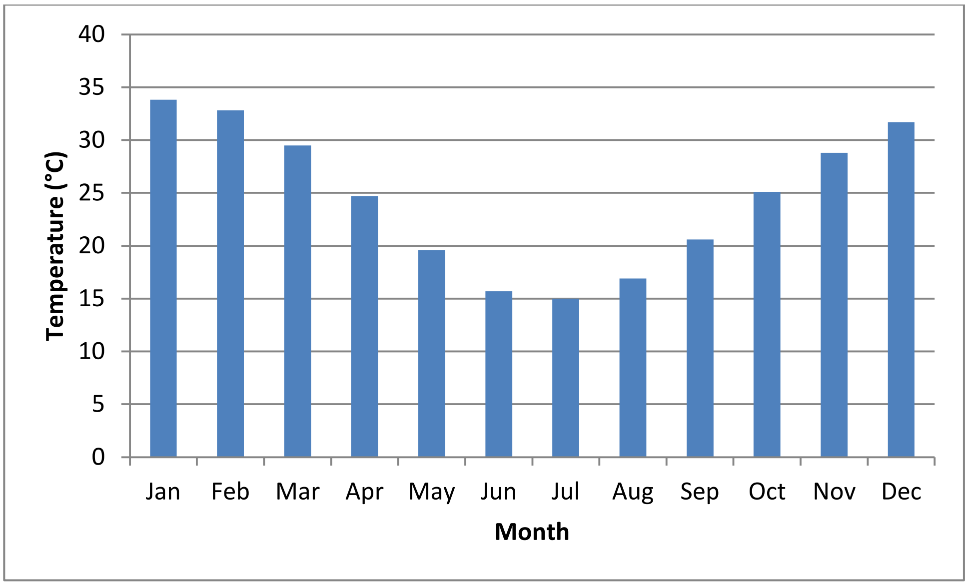

Figure 3 Average monthly temperatures at Condobolin Ag. Research Station

3 THE STUDY AREA AND DISTURBANCE AREA

The study area consisted of just over 3 km of approximately 60 m wide road easement, both sides of the road, starting to the west of Fifield, through Fifield by way of side streets then along Fifield Road to the south. The section of the study area from the west and through Fifield was not vegetated, consisting of maintained and disturbed areas. The vegetated areas of interest started just under 200 m down Fifield Road. Appendix 1 provides photographs of the study area.

Within the study area, the disturbance area in which the pipeline would be laid lies within 5 m from the edge of the sealed road (either side), an area consisting of native grasses, exotic plants and bare gravel. The disturbance area is not part of the original landform having been part of the initial road construction.

4 METHODS

4.1 Vegetation Classification and Mapping

The shape of the study area was a long narrow strip so the entire length of each side of the road was inspected. The vegetation communities were broadly defined according to the dominant canopy species

Using the floristic composition of these communities, they were then matched to the NSW vegetation classification hierarchy as follows:

1. Local Classification.
2. NSW BioMetric Vegetation Types (BVTs).
3. NSW Plant Community Types (PCTs).
4. NSW Vegetation Class (Keith, 2004).
5. NSW Vegetation Formation (Keith, 2004).

Where appropriate, classified communities were further stratified into condition classes.

Data from each community were collected from standard 20 m x 20 m floristic plots, from which each species was recorded and its cover/abundance scored using the Braun-Blanquet cover scale: 1 = <1%, 2 = 1 – 5%, 3 = 5 – 25%, 4 = 25 – 50%, 5 = 50 – 75% and 6 = 75 – 100%.

4.1.1 BioMetric Data

In addition to collecting floristic cover abundance data, BioMetric data were collected at each plot location in accordance with the NSW Biodiversity Offsets Policy for Major Projects (OEH, 2014a) and the OEH policy Framework for Biodiversity Assessment (OEH, 2014b). BioMetric data provides input into the NSW BioBanking credit calculator (Department of Environment and Climate Change (DECC), 2008; Department of Environment, Climate Change and Water (DECCW), 2009). Collecting BioMetric data includes an extension to the 20 m x 20 m floristic plot to form a 20 m x 50 m plot. Data collected are:

• Total number of native plant species	20 m x 20 m plot
• Native overstorey cover %	50 m transect
• Native mid-storey cover %	50 m transect
• Native ground cover grasses %	50 m transect
• Native ground cover shrubs %	50 m transect
• Native ground cover other %	50 m transect
• Exotic plant cover %	50 m transect
• Number of trees with hollows	20 m x 50 m plot
• Overstorey regeneration %	entire stratified unit
• Length of fallen logs	20 m x 50 m plot

4.2 Threatened Ecological Communities

Threatened ecological communities (TECs), both State and Commonwealth, likely to occur in the region were extracted from BioNet (OEH 2016a) and the EPBC Protected Matters search (Department of the Environment (DotE), 2016) site. Following vegetation community classification and mapping from field survey results, the floristic content of communities was compared with descriptions in the listed community determinations.

Three TECs (protected at the State and Commonwealth levels) were predicted to occur within the study area:

- NSW endangered ecological community *Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions.*
- Commonwealth endangered ecological community *Grey Box* (Eucalyptus microcarpa) *Grassy Woodlands and Derived Native Grasslands of South-eastern Australia*.
- NSW endangered ecological community *Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South western Slopes bioregions.*
- Commonwealth endangered ecological community *Weeping Myall Woodlands.*
- NSW endangered ecological community *White Box Yellow Box Blakely's Red Gum Woodland*.
- Commonwealth critically endangered *White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland, to be known informally as Box – Gum Grassy Woodland and Derived Grassland*.

4.3 Endangered Populations

No endangered populations were known or predicted for the Nymagee Rankins Springs subzone (OEH 2016a) or were predicted to occur within or in proximity to the study area based on the EPBC Protected Matters Search tool (DotE, 2016).

4.4 Targeted Searches for Threatened Species and Communities

Known and predicted threatened species were extracted from BioNet (OEH 2016a) for the Lachlan – Nymagee Rankins Springs IBRA subzone and from the EPBC Protected Matters Search tool (DotE, 2016). Following initial field habitat assessment these species were evaluated for their likelihood of occurring based on known habitat preferences (Appendix 2). Targeted surveys were conducted for those species for which suitable habitat was considered to be present. However, surveys were also conducted with the possibility in mind of previously unrecorded threatened species being present.

4.5 Survey Effort

Field surveys were conducted over three days from 4 – 6 April 2016. Weather conditions were fine, warm and clear with a moderate to strong breeze. Leading up to the survey, drying winds had resulted in some grasses and small herbs dying.

5 RESULTS

5.1 Vegetation Communities/Vegetation Types

Two woodland vegetation communities were present within the study area (Figure 4), one dominated by Mugga Ironbark (*Eucalyptus sideroxylon*) (Figure 5) and the other by Western or Inland Grey Box (*Eucalyptus microcarpa*) (Figure 6). The Mugga Ironbark community was in moderate/good condition, and the Western Grey Box community was stratified as moderate/good woodland and moderate/good predominantly derived native grassland.

The remaining land within the study area was mapped as cleared or low condition land (including maintained and disturbed areas) (Section 6.1.3) (OEH, 2014a, 2014b).

Table 1 provides the community classification hierarchy for the vegetation communities mapped within the extent of the study area.

No vegetation communities were recorded within the proposed disturbance area where it is classed as cleared land.

5.2 Threatened Ecological Communities

The Western Grey Box community identified within the study area is consistent with the following TECs:

- NSW endangered ecological community *Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions;* and
- Commonwealth endangered ecological community *Grey Box* (*Eucalyptus microcarpa*) *Grassy Woodlands and Derived Native Grasslands of South-eastern Australia*.

The two other TECs listed as possibly occurring in Section 5.2 were not present within the study area. There were no *Acacia pendula* or Box-Gum species, primarily *Eucalyptus albens, Eucalyptus blakelyi* or *Eucalyptus melliodora*.

Table 1 Vegetation Community Hierarchy within the extent of the study area

Local Community	PCT	BVT	PCT Name	Formation	Class	TEC NSW	TEC Commonwealth
Western Grey Box DNG	82	LA152	Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion	Grassy Woodlands	Floodplain Transition Woodlands	Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions	Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia
Western Grey Box Woodland	82	LA152	Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion	Grassy Woodlands	Floodplain Transition Woodlands	Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions	Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia
Mugga Ironbark Woodland	243	LA168	Mugga Ironbark - White Cypress Pine woodland on low rises mainly in the Cobar Peneplain Bioregion	Dry Sclerophyll Forests (Shrubby sub-formation)	Western Slopes Dry Sclerophyll Forests	None	None

DNG – derived native grassland.

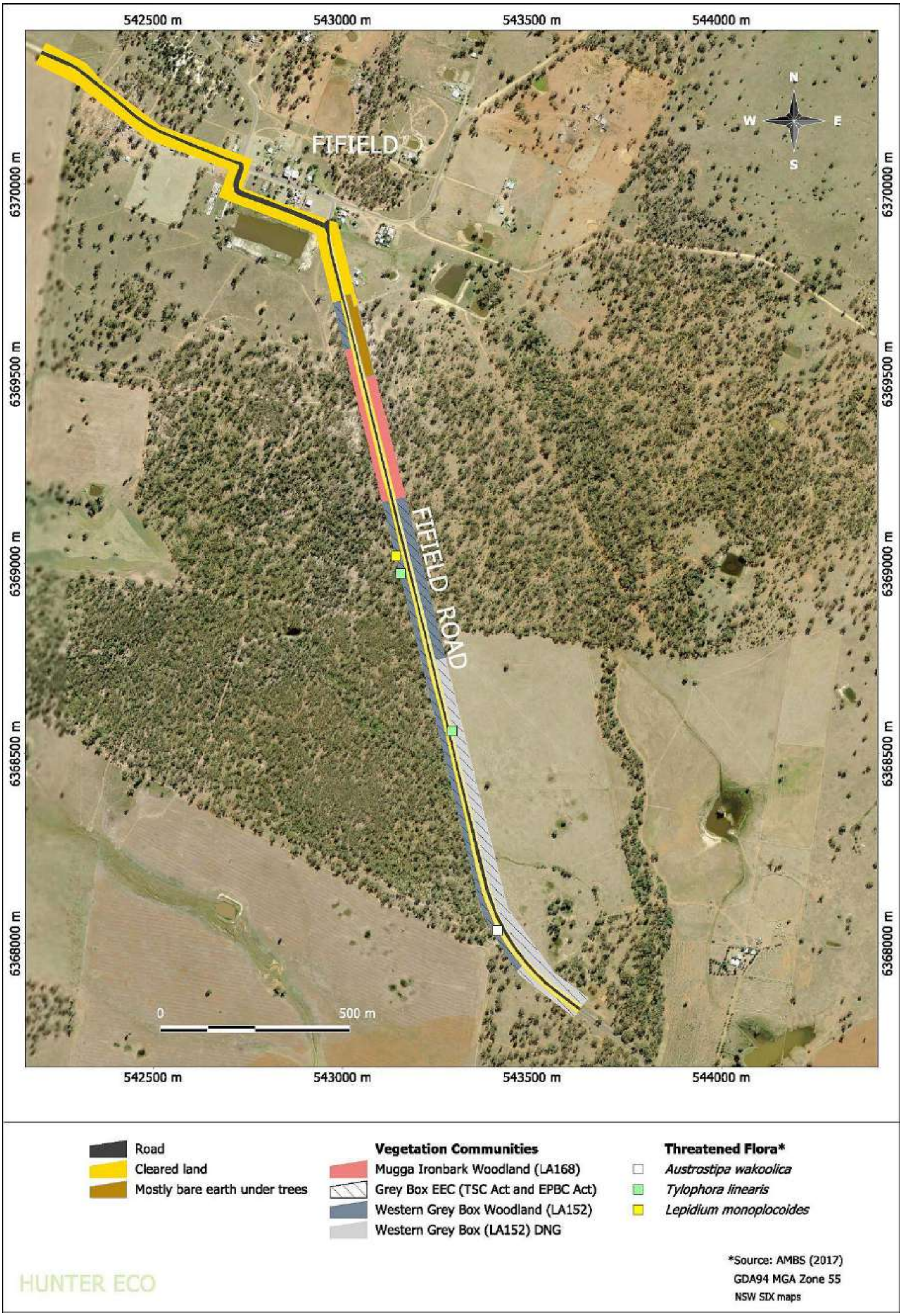

Figure 4 the study area, threatened flora and vegetation communitites

5.2.1 Mugga Ironbark Woodland

Figure 5 Mugga Ironbark Woodland

The Woodland is dominated by Mugga Ironbark (*Eucalyptus sideroxylon*) along with Dwyer's Red Gum (*Eucalyptus dwyeri*). Shrubs were *Acacia amblygona*, *Geijera parviflora, Dodonaea viscosa*, and *Pultenaea microphylla*. The ground was dominated by a variety of grass species such as *Austrostipa scabra subsp. falcata*, *Aristida ramosa, Enteropogon acicular*is and *Eragrostis elongata.*

The Mugga Ironbark Woodland is located outside of the proposed disturbance area.

5.2.2 Western Grey Box Woodland and Derived Native Grassland

Figure 6 Western Grey Box Woodland

Woodland dominated by Western Grey Box (*Eucalyptus microcarpa*). Southern portions of this community were predominantly cleared and have been stratified as native grass land derived from the original community (DNG). Shrubs included *Callitris glaucophylla, Eremophila mitchellii, Myoporum montanum, Dodonaea viscosa, Acacia dawsonii, Acacia hakeoides, Acacia oswaldii* and *Senna artemisioides.* Ground cover was predominantly grasses *Aristida leptopoda, Austrostipa blackii, Dichanthium sericeum, Echinochloa colona, Enteropogon acicularis* and *Sporobolus caroli*.

The Western Grey Box Woodland and Derived Native Grassland Communities are located outside of the proposed disturbance area.

5.2.3 Vegetation within the Disturbance Area

The vegetation within the proposed disturbance area (i.e. within 5 m of the sealed road) consisted almost entirely of native and exotic grasses, herbs and small shrubs. There were no canopy trees in this area.

Grasses: several *Aristida species, Austrostipa blackii, Austrostipa scabra subsp. scabra, Dichanthium sericeum, Echinochloa colona, Enteropogon acicularis, Eriochloa pseudoacrotricha* and *Sporobolus caroli*. Exotics: *Chloris virgata, Panicum miliaceum, Eragrostis curvula* and *Phalaris paradoxa.*

Herbs and small shrubs: *Calocephalus citreus, Calocephalus sonderi,* several *Calotis* species*, Leiocarpa panaetioides, Wahlenbergia communis, Enchylaena tomentosa, Salsola kali, Sclerolaena bicornis* var. *horrida, Sclerolaena birchii, Sclerolaena muricata, Senna artemisioides, Mentha satureioides* and *Solanum coactiliferum*. Exotics: *Bidens subalternans, Dittrichia graveolens* and *Lactuca saligna*.

5.3 Flora Species

Appendix 2 provides a list of all flora species recorded within the study area. In summary, 113 species were recorded which included 13 weed species. There were 75 genera from 33 families.

Three threatened flora species were recorded in the wider study area by AMBS Ecology and Heritage, *Tylophora linearis*, *Lepidium monoplocoides* (Winged Peppercress) and *Austrostipa wakoolica* (Figure 4) (Appendix 3). These plants were all within Western Grey Box Woodland. No threatened flora species were recorded in the cleared road verge where the proposed alternative water pipeline alignment would be located.

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APPENDIX 1 Site Photographs


Leading into Fifield from the north west


A disturbed work area at the northern end of Fifield road

The vegetation distribution on the western side of Fifield Road

The vegetation distribution on the eastern side of Fifield Road showing predominantly derived native grassland

APPENDIX 2 Flora Species Recorded

Family and Species	Mugga Ironbark	Western Grey Box
Acanthaceae		
Rostellularia adscendens		✓
Adiantaceae		
Cheilanthes sieberi	✓	✓
Amaranthaceae		
**Gomphrena celosioides*		✓
Alternanthera denticulata		✓
Ptilotus atriplicifolius		✓
Ptilotus obovatus var. *parviflorus*		✓
Asclepiadaceae		
Rhyncharrhena linearis		✓
Asteraceae		
**Bidens subalternans*		✓
**Conyza albida*		✓
**Conyza bonariensis*		✓
**Dittrichia graveolens*		✓
**Lactuca saligna*		✓
Calocephalus citreus		✓
Calocephalus sonderi		✓
Calotis cuneifolia		✓
Calotis hispidula		✓
Calotis lappulacea		✓
Cassinia aculeata	✓	
Cassinia laevis	✓	
Chrysocephalum apiculatum	✓	
Cotula australis		✓
Leiocarpa panaetioides		✓
Ozothamnus obcordatus		✓
Rhodanthe floribunda	✓	✓
Vittadinia cervicularis var. *subcervicularis*		✓
Vittadinia pterochaeta		✓
Vittadinia sp.		✓
Xerochrysum bracteatum		✓
Brassicaceae		
Lepidium pseudohyssopifolium		✓
Campanulaceae		
Wahlenbergia communis	✓	✓
Capparaceae		
Apophyllum anomalum		✓

Casuarinaceae		
Allocasuarina luehmannii	✓	✓
Chenopodiaceae		
Chenopodium glaucum	✓	
Einadia hastata	✓	
Einadia nutans		✓
Einadia nutans subsp. *linifolia*		✓
Einadia polygonoides		✓
Enchylaena tomentosa		✓
Salsola kali		✓
Sclerolaena bicornis var. *horrida*		✓
Sclerolaena birchii		✓
Sclerolaena muricata		✓
Convolvulaceae		
Convolvulus erubescens		✓
Cupressaceae		
Callitris glaucophylla		✓
Cyperaceae		
Carex inversa		✓
Cyperus fulvus		✓
Eleocharis acuta		✓
Fimbristylis dichotoma		✓
Euphorbiaceae		
Chamaesyce drummondii		✓
Fabaceae (Caesalpinioideae)		
Senna artemisioides subsp. *filifolia*		✓
Senna artemisioides subsp. *zygophylla*		✓
Fabaceae (Faboideae)		
Glycine clandestina		✓
Glycine tabacina		✓
Pultenaea microphylla	✓	
Fabaceae (Mimosoideae)		
Acacia amblygona	✓	
Acacia dawsonii		✓
Acacia deanei	✓	
Acacia doratoxylon	✓	
Acacia hakeoides	✓	✓
Acacia oswaldii		✓
Juncaceae		
Juncus flavidus		✓
Juncus remotiflorus		✓
Lamiaceae		
Mentha satureioides		✓

Lomandraceae		
Lomandra effusa		✓
Lomandra multiflora	✓	
Malvaceae		
Sida corrugata		✓
Myrtaceae		
Eucalyptus dwyeri	✓	
Eucalyptus microcarpa	✓	✓
Eucalyptus sideroxylon	✓	
Nyctaginaceae		
Boerhavia dominii		✓
Phormiaceae		
Dianella longifolia	✓	✓
Poaceae		
**Chloris virgata*		✓
**Eragrostis curvula*		✓
**Panicum miliaceum*		✓
**Paspalum dilatatum*		✓
**Phalaris paradoxa*		✓
Aristida calycina var. *calycina*	✓	
Aristida leichhardtiana	✓	
Aristida leptopoda		✓
Aristida ramosa	✓	
Austrostipa blackii		✓
Austrostipa scabra subsp. *falcata*	✓	✓
Chloris virgata		✓
Dichanthium sericeum		✓
Echinochloa colona		✓
Elymus scaber		✓
Enneapogon gracilis		✓
Enteropogon acicularis	✓	✓
Eragrostis alveiformis		✓
Eragrostis elongata	✓	
Eragrostis lacunaria		✓
Eriochloa pseudoacrotricha		✓
Panicum effusum	✓	
Panicum queenslandicum		✓
Paspalidium constrictum		✓
Poa tenera		✓
Rytidosperma bipartitum		✓
Rytidosperma caespitosum	✓	✓
Rytidosperma sp.		✓
Sporobolus caroli		✓

Polygonaceae		
**Polygonum aviculare*		✓
Rumex brownii		✓
Portulacaceae		
Portulaca oleracea		✓
Rubiaceae		
Asperula cunninghamii		✓
Rutaceae		
Geijera parviflora	✓	✓
Sapindaceae		
Dodonaea viscosa subsp. *angustifolia*		✓
Dodonaea viscosa subsp. *angustissima*	✓	
Dodonaea viscosa subsp. *cuneata*	✓	✓
Scrophulariaceae		
Eremophila mitchellii		✓
Myoporum montanum		✓
Solanaceae		
**Lycium ferocissimum*		✓
Solanum coactiliferum		✓
Stackhousiaceae		
Stackhousia muricata	✓	✓

APPENDIX 3 Syerston Project Modification 4 – Water Supply Pipeline Realignment Threatened Flora Searches

18 August 2017

John Hanrahan
Clean TeQ Holdings Limited – Syerston Project
PO Box 227
Mulgrave Victoria 3170

Dear John,

Syerston Project Modification 4 – Water Supply Pipeline Realignment Threatened Flora Searches

Scandium21 Pty Ltd (a wholly owned subsidiary of Clean TeQ Ltd) proposes to seek a realignment of the currently approved water pipeline associated with the approved Syerston Project.

Between 30 October and 4 November 2016, botanists Belinda Pellow and Ryan Sims from AMBS Ecology & Heritage Pty Ltd (AMBS) undertook targeted searches for threatened flora species listed under the New South Wales (NSW) *Threatened Species Conservation Act, 1995* (TSC Act) and Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act) within a study area covering the proposed water supply pipeline realignment and surrounding vegetation. The study area followed Fifield Road and was approximately 20 metres (m) wide (including the hard road surface) and 3 km long (approximately 6 ha in total) (Figure 1).

Searches for threatened plant species were undertaken using techniques outlined in the NSW *Guide to Surveying Threatened Plants* (Office of Environment and Heritage [OEH] 2016a) and Cropper (1993).

No threatened flora species were recorded in the cleared road verge where the proposed water supply pipeline realignment would be located. Three threatened plant species were recorded within the study area in native woodland vegetation; *Tylophora linearis*, *Lepidium monoplocoides* (Winged Peppercress) and *Austrostipa wakoolica* (Figure 1). Confirmation of the identity of these species was made by the National Herbarium of NSW.

Tylophora linearis

Tylophora linearis is a slender twiner to herbaceous or woody small bush with rhizomatous roots. It has clear sap, cylindrical stems up to 3 millimetre (mm) diameter and opposite, dark green, linear leaves, 1-5 cm long and 0.5-3 mm wide. The stems and leaves are glabrous to sparsely haired, often with long white hairs on the bracts. The flowers which occur in Spring are 6-7 mm in diameter and are formed in umbels of between 2-8 (PlantNET 2016). They are often olive on the outside and purple to dark purple inside with dense to sparse hairs. The fruit is hairless, cigar shaped and approximately 100 mm long by 5 mm wide (PlantNET 2016).

Classified as Vulnerable in NSW (TSC Act) and Endangered Federally (EPBC Act), *Tylophora linearis* occurs on the western slopes of NSW in dry scrub and open forest on sedimentary flats (OEH 2016b).

Tylophora linearis were recorded in two locations in the study area. The first location (-32.8163, 147.4609) had 50 individuals and the second location (-32.8201, 147.4625) had 10 individuals. *Tylophora linearis* was found in Western Grey Box Woodland and was well shaded. The Western Grey Box Woodland was in moderate to good condition, being dominated by native species in all structural layers.

<u>*Lepidium monoplocoides*</u>

Lepidium monoplocoides is an erect, annual herb between 15-20 cm in height and varies between glabrous to scabrous. Leaves are also variable being 2-7 cm long and pinnatisect to entire. The inflorescence occurs in late winter to spring (OEH 2016b) and is borne on an elongated raceme and the petals are rudimentary to absent. Fruit or silicula is broad ovate to circular approximately 5 mm long and 4 mm wide, has an acute wing spreading the entire circumference and is notched at the apex (PlantNET 2016).

Classified as Endangered (TSC Act, EPBC Act), *Lepidium monoplocoides* is found in scattered locations on seasonally inundated heavy fertile soils of the western NSW plains. An ephemeral species, it is reliant on seasonal conditions of flooding or waterlogging and is often recorded periodically in concentrated local populations (OEH 2016b).

Lepidium monoplocoides was recorded in one location in native woodland (-32.8159, 147.4608). It was growing in Western Grey Box Woodland along the edge of a shallow drainage depression. Soils were brown clay and gravelly. Approximately 50 individuals were recorded in an area 20 m^2.

The condition of the vegetation at the population site was moderate to poor.

<u>*Austrostipa wakoolica*</u>

Austrostipa wakoolica is a perennial tussock grass. Growing to 1 m in height the leaves are 1.5-2.5 mm wide and densely hairy. Flowering occurs in Spring to Summer, but this varies in response to rain. The inflorescence is a spreading to moderately dense panicle up to 36 cm in length. Spikelets are 11-15 mm long excluding the awn and gaping, the lemma is 5.5-6.5 mm long and deep brown at maturity with a coma of erect hairs 2-2.5 mm long. Awns are 3.6-6 cm long and twice bent (PlantNET 2016).

Classified as Endangered (TSC Act, EPBC Act), this grass occurs in open woodland, swamp edges and flood plains associated with the Murray River tributaries in Central West and South West NSW (OEH 2016b).

Austrostipa wakoolica was recorded in one location in Western Grey Box Woodland (-32.8248, 147.4637). The condition of the vegetation at the population site was moderate to poor.

One individual was noted among several other species of the *Austrostipa* genus. It is likely that more individuals of this species occur in Western Grey Box Woodland; however, confirmation of the identification of this species from the others present is difficult in the field without a light source and microscope to examine the seed.

Yours sincerely

B.Pellow

Belinda Pellow
Senior Botanist
AMBS Ecology & Heritage

References

Cropper, S.C. (1993). *Management of Endangered Plants*. CSIRO Publications Victoria.

Office of Environment and Heritage (2016a) *NSW Guide to Surveying Threatened Plants*. Office of Environment and Heritage, Hurstville, NSW

Office of Environment and Heritage (2016b) *NSW Vegetation Information System: Classification*. NSW Office of Environment and Heritage. http://www.environment.nsw.gov.au/NSWVCA20PRapp/default.aspx [accessed December 2016]

PlantNET (2016). *The NSW Plant Information Network System*. Royal Botanic Gardens and Domain Trust, Sydney. http://plantnet.rbgsyd.nsw.gov.au [accessed November 2016]

Figure 1 Location of threatened plants, pipeline variation site

Syerston

MODIFICATION 4 ENVIRONMENTAL ASSESSMENT

Project

Attachment 1

Syerston Project
Consolidated Development Consent
DA 374-11-00

ENVIRONMENTAL PLANNING AND ASSESSMENT ACT, 1979

INTEGRATED STATE SIGNIFICANT DEVELOPMENT

DETERMINATION OF DEVELOPMENT APPLICATION PURSUANT TO SECTIONS 76(A)9 & 80

I, the Minister for Urban Affairs and Planning, pursuant to Sections 76(A)9 & 80 of the Environmental Planning and Assessment Act, 1979 determine the development application ("the application") referred to in Schedule 1 by granting consent to the application subject to the conditions set out in Schedules 2 to 5.

The reasons for the imposition of the conditions are to:

(i) minimise the adverse impact the development may cause through water, noise and air pollution, and disturbance to archaeological sites, flora and fauna and the visual environment;

(ii) provide for environmental monitoring and reporting; and

(iii) set requirements for development infrastructure provision.

Andrew Refshauge MP

Minister for Urban Affairs and Planning,

SYDNEY, **2001** **FILE NO.S98/01078**

SCHEDULE 1

Applicant:	CleanTeq Holdings Limited
Consent Authority:	The Minister for Urban Affairs and Planning
Land:	See Appendix 1
Development:	Syerston Mine Project

TABLE OF CONTENTS

DEFINITIONS

Applicant	CleanTeq Holdings Limited, or any other person/s who rely on this consent to carry out the development that is subject to this consent
ARI	Average Recurrence Interval
BCA	Building Code of Australia
Borefields	The Borefields located on the land listed in Appendix 1 and shown in Figure 6 of Appendix 2
CCC	Community Consultative Committee
Clean water	Water not in contact with mine water
Construction	All site activities associated with the development, including clearing, trenching, earthworks, road works, development of borrow pits and tailings dams; or the location of earthmoving plant or buildings (portable or fixed) onto the site
Conditions of this consent	Conditions contained in Schedules 2 to 5 inclusive
Councils	Lachlan Shire Council, Parkes Shire Council, Forbes Shire Council
Day	The period from 7.00 am to 6.00 pm on Monday to Saturday, and 8.00 am to 6.00 pm on Sundays and Public Holidays
Department	Department of Planning & Environment
Development	The development as described in the EIS and comprising the: • mine including mine processing facility; • mining operations; • limestone quarry including limestone processing facility; • quarrying operations; • rail siding; • borefields; • water pipeline; and • gas pipeline
DPI	Department of Primary Industries
DPI Water	The Division of Water within DPI
DSC	Dams Safety Committee
EIS	Environmental Impact Statement prepared by Resource Strategies Pty Ltd dated October 2000 and supplemented by letters dated 3 December 2000 and 12 January 2001. Statement of Environmental Effects prepared by Resource Strategies Pty Ltd dated May 2005. Letter prepared by Ivanplats Syerston Pty Ltd dated 22 December 2005. Environmental Assessment titled "Syerston Project Scandium Oxide Modification Environmental Assessment" dated May 2016 and Response to Submissions.
EP&A Act	*Environmental Planning and Assessment Act 1979*
EP&A Regulation	*Environmental Planning and Assessment Regulation 2000*
EPA	Environment Protection Authority
EPL	Environment Protection Licence issued under the POEO Act
Evening	The period from 6.00 pm to 10.00 pm
Feasible	Feasible relates to engineering considerations and what is practical to build or to implement
Gas pipeline	The gas pipeline located on the land listed in Appendix 1 and shown in Figure 1 of Appendix 2
Ha	Hectare
Heritage item	An item as defined under the *Heritage Act 1977* and/or an Aboriginal object or Aboriginal place as defined under the *National Parks and Wildlife Act 1974*
Incident	A set of circumstances that: a) causes or threatens to cause material harm to the environment; and/or b) breaches or exceeds the limits or performance measures/criteria in this consent
LAeq	Equivalent continuous sound pressure level with "A" weighted scale
Land	In general, the definition of land is consistent with the definition in the EP&A Act. However, in relation to acquisition it means the whole of a lot, or contiguous lots owned by the same landowner, in a current plan registered at the Land Titles Office at the date of this consent
Limestone processing facility	Infrastructure and plant associated with crushing operations for the preparation of limestone at the limestone quarry, exclusive of all quarrying

	activities
Limestone product	Limestone produced at the limestone quarry
Limestone quarry	Limestone quarry including the limestone processing facility, located on the land listed in Appendix 1 and shown in Figures 1 and 4 of Appendix 2
Limestone quarry water	Water that accumulates within active quarrying and infrastructure areas
Material harm to the environment	Actual or potential harm to the health or safety of human beings or to ecosystems that is not trivial
Mine	The mine including the mine processing facility, located on the land listed in Appendix 1 and shown in Figures 1, 2 and 3 of Appendix 2
Mine processing facility	Infrastructure and plant associated with the processing of ore at the Mine
Mine water	Water that accumulates within active mining and infrastructure areas
Mining operations	Includes the removal of overburden and extraction, processing, handling, storage and transportation of ore
Minor	Not very large, important or serious
Mitigation	Activities associated with reducing the impacts of the development prior to or during those impacts occurring
Night	The period from 10pm each night to 7.00 am on Mondays to Saturdays and to 8.00 am on Sundays and Public Holidays
NP&W Act	*National Parks & Wildlife Act 1974*
OEH	Office of Environment and Heritage
POEO Act	*Protection of the Environment Operations Act 1997*
Privately-owned land	Land that is not owned or leased by a public agency, or a mining company (or its subsidiary)
Public infrastructure	Infrastructure that provides services to the general public, such as roads, railways, water supply, drainage, sewerage, gas supply, electricity, telephone, telecommunications, etc
Quarrying operations	The extraction, processing, stockpiling and transportation of limestone product and the associated removal of vegetation, topsoil and overburden
Rail siding	The rail siding located on the land listed in Appendix 1 and shown in Figures 1 and 5 of Appendix 2
Reasonable	Reasonable relates to the application of judgement in arriving at a decision, taking into account: mitigation benefits, cost of mitigation versus benefits provided, community views and the nature and extent of potential improvements
Rehabilitation	The restoration of land disturbed by the development to a good condition to ensure it is safe, stable and non-polluting
RFS	Rural Fire Service
RMS	Roads and Maritime Services
Secretary	The Secretary of the Department, or nominee and/or delegate
Site	The land listed in Appendix 1
Transport route	Routes SR171, SR64, MR57 and SR34 between the rail siding and the mine, as shown in Figure 7 in Appendix 2
TSP	Total Suspended Particulate
VPA	Voluntary Planning Agreement
Water pipeline	The water pipeline located on the land listed in Appendix 1 and shown in Figure 1 of Appendix 2

SCHEDULE 2

ADMINISTRATIVE CONDITIONS

OBLIGATION TO MINIMISE HARM TO THE ENVIRONMENT

1. In addition to meeting the specific performance measures and criteria established under this consent, the Applicant must implement all reasonable and feasible measures to prevent and/or minimise any harm to the environment that may result from the construction, operation, or rehabilitation of the development.

TERMS OF CONSENT

2. The Applicant must carry out the development:
   (a) generally in accordance with the EIS; and
   (b) in accordance with the conditions of this consent.

   Note: The general layout of the development is shown in the figures in Appendix 2.

3. If there is any inconsistency between the documents referred to in condition 2 above, the most recent document must prevail to the extent of the inconsistency.

4. The Applicant must comply with any reasonable requirements of the Secretary arising from the Department's assessment of:
   (a) any strategies, plans, programs, reviews, audits, reports or correspondence that are submitted in accordance with this consent (including any stages of these documents);
   (b) any reports, reviews or audits commissioned by the Department regarding compliance with this consent; and
   (c) the implementation of any actions or measures contained in these documents.

LIMITS ON MINING OPERATIONS

Mining Operations

5. The Applicant may carry out mining operations at the mine for 21 years from the day upon which mining operations start.

Ore Processing

6. In any calendar year, the Applicant must not exceed an autoclave feed rate of 2.5 million tonnes of ore at the mine .

Off-site Product Transport

7. In any calendar year, the Applicant must not transport more than 180 tonnes of scandium oxide and 40,000 tonnes of nickel and cobalt metal equivalents (as either sulphide or sulphate precipitate products) from the mine.

LIMITS ON QUARRYING OPERATIONS

Extraction

8. In any calendar year, the Applicant must not extract more than 790,000 tonnes of limestone from the limestone quarry.

Restriction on Use of Extracted Limestone

9. Limestone extracted from the limestone quarry may only be sent to the mine for use in mining operations, and may not be sold or used for any other purpose.

NOTIFICATION OF DEPARTMENT

10. The Applicant must notify the Department and the relevant Councils in writing of the day upon which the:
    (a) development of the mine starts;
    (b) commissioning of the mine processing facility starts;
    (c) development of the limestone quarry starts;
    (d) development of the gas pipeline starts;
    (e) commissioning of the gas pipeline starts;
    (f) development of the borefields starts;

(g) development of the water pipeline starts;
(h) commissioning of the water pipeline starts;
(i) development of the rail siding starts;
(j) rail siding operations start;
(k) road or intersection upgrades start; and
(l) road or intersection upgrades are completed.

11. If the carrying out of the development is to be staged, then the Applicant must notify the Department and relevant Councils in writing prior to the commencement of the relevant stage, and clearly identify the development that would be carried out in the relevant stage.

UPDATING & STAGING OF STRATEGIES, PLANS OR PROGRAMS

12. With the approval of the Secretary, the Applicant may submit any strategy, plan or program required by this consent on a progressive basis.

    To ensure these strategies, plans or programs are updated on a regular basis, the Applicant may at any time submit revised strategies, plans or programs to the Secretary for approval.

    With the agreement of the Secretary, the Applicant may prepare any revised strategy, plan or program without undertaking consultation with all the parties referred to under the relevant condition of this consent.

    Notes:
    - *While any strategy, plan or program may be submitted on a progressive basis, the Applicant must ensure that all development being carried out on site is covered by suitable strategies, plans or programs at all times.*
    - *If the submission of any strategy, plan or program is to be staged, then the relevant strategy, plan or program must clearly describe the specific stage to which the strategy, plan or program applies, the relationship of this stage to any future stages, and the trigger for updating the strategy, plan or program.*

STRUCTURAL ADEQUACY

Building and Structures

13. The Applicant must ensure that all new buildings and structures, and any alterations or additions to existing buildings and structures, are constructed in accordance with the relevant requirements of the BCA.

    Notes:
    - *Under Part 4A of the EP&A Act, the Applicant is required to obtain construction and occupation certificates for the proposed building works.*
    - *Part 8 of the EP&A Regulation sets out the requirements for the certification of the development.*

Pipeline Construction and Operation

14. The Applicant must design and construct the gas pipeline in accordance with the relevant Australian Standards, in particular *AS2885 Pipelines – Gas and Liquid Petroleum*, or its latest version.

    Note: All utility crossings of Henry Parkes Way require concurrence from RMS in accordance with Section 138(2) of the Roads Act 1993*.*

DEMOLITION

15. The Applicant must ensure that all demolition work is carried out in accordance with *Australian Standard AS 2601-2001: The Demolition of Structures*, or its latest version.

OPERATION OF PLANT AND EQUIPMENT

16. The Applicant must ensure that all plant and equipment used on site, or in connection with the development, is:
    (a) maintained in a proper and efficient condition; and
    (b) operated in a proper and efficient manner.

PLANNING AGREEMENTS

17. Prior to carrying out any development under this consent after 6 May 2017, unless otherwise agreed by the Secretary, the Applicant must enter into a VPA with each of the relevant Councils, consistent with the offers summarised in Appendix 3. The VPA must include the provision of funding for:
    (a) the road upgrades required for the development;
    (b) ongoing road maintenance for the development; and
    (c) community enhancement initiatives in the locality.

SCHEDULE 3

ENVIRONMENTAL PERFORMANCE CONDITIONS

NOISE

Hours of Construction/Operation

1. The Applicant must comply with the restrictions in Table 1, unless otherwise agreed by the Secretary.

Table 1: Restriction on Hours of Construction/Operation

Activity	*Operating Hours*
• Construction of the: - gas pipeline; - water pipeline and borefields; - rail siding; and - road upgrades. • Construction materials haulage along the transport route	• 7 am to 6 pm, Monday to Sunday
• All quarrying operations (excluding truck loading on the limestone quarry site)	• 7 am to 5 pm, Monday to Sunday

Note: All other operations are permitted 24 hours per day, seven days per week.

Construction Noise

2. The Applicant must minimise the noise generated during construction of the development in accordance with the best practice requirements outlined in the *Interim Construction Noise Guideline (DECC, 2009),* or its latest version.

Operational Noise Criteria - Mine

3. The Applicant must ensure that the noise generated by development at the mine does not exceed the criteria in Table 2.

Table 2: Noise Criteria (dB(A)) - Mine

Location	*Day* $L_{aeq\ (15\ minute)}$	*Evening* $L_{aeq\ (15\ minute)}$	*Night* $L_{aeq\ (15\ minute)}$
Currajong Park	35	39	40
Al other privately-owned residences	35	35	35

Note: To identify the residence referred to in Table 2, see Figure 8 in Appendix 4.

Operational Noise Criteria – Limestone Quarry

4. The Applicant must ensure that the noise generated by development at the limestone quarry does not exceed the criteria in Table 3.

Table 3: Noise Criteria (dB(A)) – Limestone Quarry

Location	*Day* $L_{aeq\ (15\ minute)}$	*Evening* $L_{aeq\ (15\ minute)}$	*Night* $L_{aeq\ (15\ minute)}$
Moorelands	42	35	35
Lesbina Eastbourne	38	35	35
Gillenbine	37	35	35
All other privately-owned residences	35	35	35

Note: To identify the residences referred to in Table 3, see Figure 8 in Appendix 4.

Operational Noise Criteria – Rail Siding

5. The Applicant must ensure that the noise emissions from the development at the rail siding do not exceed the noise limits in Table 4 at all non-development related residences.

Table 4: Noise Criteria (dB(A)) – Rail Siding

Location	Day $L_{aeq\ (15\ minute)}$	Evening $L_{aeq\ (15\ minute)}$	Night $L_{aeq\ (15\ minute)}$
Glen Rock Ballanrae Spring Park	37	35	35

Note: To identify the residences referred to in Table 4, see Figure 8 in Appendix 4.

Noise Management Requirements

6. Noise generated by the development is to be measured in accordance with the relevant requirements of the *NSW Industrial Noise Policy* (EPA, 1999), or its latest version. Appendix 4 sets out the meteorological conditions under which the criteria in conditions 3 – 5 above apply, and the requirements for evaluating compliance with these criteria.

Noise Agreements

7. However, the noise criteria in conditions 3 – 5 above do not apply if the Applicant has an agreement with the owner/s or leaseholders of the residence to generate higher noise levels, and the Applicant has advised the Department in writing of the terms of this agreement.

Operating Conditions

8. The Applicant must:
   (a) minimise the noise impacts of the development during meteorological conditions under which the noise limits in this consent do not apply; and
   (b) undertake regular attended monitoring of the noise of the development, to ensure compliance with the relevant conditions of this consent.

Noise Management Plan

9. Prior to carrying out any development under this consent after 6 May 2017, the Applicant must prepare a Noise Management Plan for the development to the satisfaction of the Secretary. This plan must:
   (a) be prepared in consultation with the EPA;
   (b) include management of construction, traffic and operational noise;
   (c) describe the measures that would be implemented to ensure compliance with the noise criteria and operating conditions of this consent;
   (d) include a noise monitoring program for evaluating and reporting on:
      - compliance against the noise criteria in this consent;
      - compliance against the noise operating conditions; and
   (e) defines what constitutes a noise incident, and includes a protocol for identifying and notifying the Department and relevant stakeholders of any noise incidents.

10. The Applicant must implement the approved Noise Management Plan for the development.

BLASTING

11. Blasting may only be undertaken at the limestone quarry.

Blasting Criteria

12. The Applicant must ensure that blasting at the limestone quarry does not cause exceedances of the criteria in Table 5.

Table 5: Blasting Criteria (dB(A))

Location	Airblast overpressure (db(lin peak))	Ground vibration (mm/s)	Allowable exceedance
Residence on privately-owned land	120	10	0%
	115	5	5% of total blasts over any 12 month period

13. However, these criteria do not apply if the Applicant has a written agreement with the relevant landowner, and has advised the Department in writing of the terms of this agreement.

Blasting Hours

14. The Applicant may only carry out blasting at the limestone quarry between 9:00am and 5:00pm Monday to Saturday, inclusive. No blasting is allowed on Sundays, public holidays or at any other time without the written approval of the Secretary.

Operating Conditions

15. The Applicant must:
    (a) implement best management practice to:
    - protect the safety of people and livestock in the surrounding area;
    - protect public or private infrastructure/ property in the surrounding area from damage from blasting operations; and
    - minimise the dust and fume emissions from any blasting; and

    (b) monitor and report on compliance with the relevant blasting conditions in this consent,

    to the satisfaction of the Secretary.

Blast Management Plan

16. Prior to carrying out any blasting at the limestone quarry, the Applicant must prepare a Blast Management Plan for the development to the satisfaction of the Secretary. This plan must:
    (a) describe the measures that would be implemented to ensure compliance with the blasting criteria and operating conditions of this consent;
    (b) propose and justify any alternative ground vibration limits for any public infrastructure in the vicinity of the site (if relevant); and
    (c) include a monitoring program for evaluating and reporting on compliance with the blasting criteria and operating conditions.

17. The Applicant must implement the approved Blast Management Plan for the development.

AIR QUALITY

Odour

18. The Applicant must ensure that no offensive odours are emitted from the development, as defined under the POEO Act.

Air Quality – Mine

19. The Applicant must ensure that gaseous emissions from the development at the mine comply with the requirements of any EPL or the relevant requirements of the *Protection of the Environment Operations (Clean Air) Regulation 2010* and the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (2016) (*or its latest version).

20. On submission of an application for an Environment Protection Licence, the Applicant must provide a revised air quality impact assessment to ensure the impacts of the proposal are appropriately assessed and demonstrate compliance with the relevant requirements of the Protection of the Environment Operations (Clean Air) Regulation 2010, to the satisfaction of the EPA.

Air Quality Criteria - Development

21. The Applicant must ensure that all reasonable and feasible avoidance and mitigation measures are employed so that particulate matter emissions generated by the development do not cause exceedances of the criteria listed in Tables 6, 7 and 8 at any residence on privately owned land.

Table 6: Long term impact assessment criteria for particulate matter

Pollutant	***Averaging period***	***d Criterion***
TSP matter	Annual	a 90 µg/m³
Particulate matter < 10 µm (PM10)	Annual	a 30 µg/m³

Table 7: Short term impact assessment criterion for particulate matter

Pollutant	***Averaging period***	***d Criterion***
Particulate matter < 10 µm (PM10)	24 hour	a 50 µg/m³

Table 8: Long term impact assessment criteria for deposited dust

Pollutant	***Averaging period***	***Maximum increase in deposited dust level***	***Maximum total deposited dust level***
c Deposited dust	Annual	b 2 g/m²/month	a 4 g/m²/month

Notes to Tables 6-8:

a. *Total impact (i.e. incremental increase in concentrations due to the development plus background concentrations due to all other sources).*
b. *Incremental impact (i.e. incremental increase in concentrations due to the development on its own).*
c. *Deposited dust is to be assessed as insoluble solids as defined by Standards Australia, AS/NZS 3580.10.1:2003: Methods for Sampling and Analysis of Ambient Air - Determination of Particulate Matter - Deposited Matter - Gravimetric Method.*
d. *Excludes extraordinary events such as bushfires, prescribed burning, dust storms, sea fog, fire incidents or any other activity agreed by the Secretary.*

Operating Conditions

22. The Applicant must:
    (a) minimise:
    - dust emissions from the development;
    - the surface disturbance of the development, including implementing interim rehabilitation strategies to stabilise areas prone to dust generation that cannot be permanently rehabilitated; and
    - the greenhouse gas emissions of the development; and

    (b) carry out any monitoring required by the EPA, and publish the results of this monitoring on its website.

Air Quality Management Plan

23. On submission of an application for an Environment Protection Licence, unless otherwise agreed by the Secretary and the EPA, the Applicant must prepare an Air Quality Management Plan for the development to the satisfaction of the Secretary and the EPA. This plan must:
    (a) Be prepared in consultation with the EPA;
    (b) outline the procedure for notifying property owners and occupiers likely to be affected by dust from the operations;
    (c) describe the measures that would be implemented to ensure compliance with the relevant air quality criteria and operating conditions of this consent;
    (d) include an air quality monitoring program for evaluating and reporting on:
    - baseline monitoring undertaken prior to development consent;
    - compliance against the air quality criteria in this consent;
    - compliance against the air quality operating conditions; and

    (e) defines what constitutes an air quality incident, and includes a protocol for identifying and notifying the Department and relevant stakeholders of any air quality incidents.

24. The Applicant must implement the approved Air Quality Management Plan for the development.

METEOROLOGICAL MONITORING

25. During the life of the development, the Applicant must ensure that there is a suitable meteorological station operating in the vicinity of the mine that complies with the requirements in the *Approved Methods for Sampling of Air Pollutants in New South Wales* guideline.

WATER

Water Supply

26. The Applicant must ensure that it has sufficient water for all stages of the development, and if necessary, adjust the scale of development on site to match its available water supply.

    Note: Under the Water Act 1912 *and/or the* Water Management Act 2000*, the Applicant is required to obtain the necessary water licences for the development.*

Water Pollution

27. Unless an EPL authorises otherwise, the Applicant must comply with Section 120 of the POEO Act.

Compensatory Water Supply

28. The Applicant must provide a compensatory water supply to anyone whose basic landholder water rights (as defined in the *Water Management Act 2000*) are adversely and directly impacted as a result of the development. This supply must be provided in consultation with DPI Water, and to the satisfaction of the Secretary.

    The compensatory water supply measures must provide an alternative long-term supply of water that is equivalent to the loss attributable to the development. Equivalent water supply must be provided (at least on an interim basis) as soon as possible after the loss is identified, unless otherwise agreed with the landowner.

If the Applicant and the landowner cannot agree on the measures to be implemented, or there is a dispute about the implementation of these measures, then either party may refer the matter to the Secretary for resolution.

If the Applicant is unable to provide an alternative long-term supply of water, then the Applicant must provide alternative compensation to the satisfaction of the Secretary.

Water Management Performance Measures

29. The Applicant must ensure the development on site complies with the performance measures in Table 9, to the satisfaction of the Secretary.

Table 9: Water Management Performance Measures

Feature	***Performance Measure***
Water management – General	• Maintain separation between clean and mine water management systems • Minimise the use of clean water on site
Construction and operation of infrastructure	• Design, install and maintain erosion and sediment controls generally in accordance with the series *Managing Urban Stormwater: Soils and Construction including Volume 1, Volume 2A – Installation of Services and Volume 2C – Unsealed Roads* • Design, install and maintain infrastructure within 40 m of watercourses generally in accordance with the *Guidelines for Controlled Activities on Waterfront Land (DPI 2012*), or its latest version • Design, install and maintain any creek crossings generally in accordance with the *Policy and Guidelines for Fish Habitat Conservation and Management (DPI, 2013)* and *Why Do Fish Need To Cross The Road? Fish Passage Requirements for Waterway Crossings (NSW Fisheries 2003)*, or their latest versions
Clean water diversion infrastructure	• Maximise the diversion of clean water around disturbed areas on site
Sediment dams (mine and limestone quarry)	• Design, install and/or maintain the dams generally in accordance with the series *Managing Urban Stormwater: Soils and Construction – Volume 1 and Volume 2E Mines and Quarries*
Mine and limestone quarry water storages	• Design, install and/or maintain mine and limestone water storage infrastructure to ensure no discharge of mine or limestone quarry water off-site (except in accordance with an EPL) • On-site storages (including mine infrastructure dams, groundwater storage and treatment dams) are suitably designed, installed and/or maintained to minimise permeability • Ensure that the floor and side walls of the Tailings Storage Facility, Evaporation Basin and Surge Dam are designed with a minimum of a 900 mm clay or modified soil liner with a permeability of no more than 1 x 10^{-9} m/s, or a synthetic (plastic) liner of 1.5 mm minimum thickness with a permeability of no more than 1 x 10^{-14} m/s (or equivalent) • Design, install and maintain the water storages to capture and convey the 100 year, 72-hour ARI rainfall event • Design, install and/or maintain the facilities to meet the requirements of the DSC • The design of the Tailings Storage Facility should conform to: - DSC3A – Consequence Categories for Dams (DSC); and - DSC3F – Tailings Dams (DSC)
Chemical and hydrocarbon storage	• Chemical and hydrocarbon products to be stored in bunded areas in accordance with the relevant Australian Standards

Water Management Plan

30. Prior to carrying out any development after 6 May 2017, the Applicant must prepare a Water Management Plan for the development in consultation with DPI Water and the EPA, and to the satisfaction of the Secretary. This plan must include:
    (a) a Water Balance that:
    - includes details of:
        - sources and security of water supply, including contingency planning for future reporting periods;
        - water use and management on site;
        - reporting procedures, including the preparation of a site water balance for each calendar

year; and
- describes the reasonable and feasible measures that would be implemented to minimise clean water use on site and maximise the reuse of recovered tailings water at the facility;

(b) a Surface Water Management Plan, that includes:
- baseline data on water flows and quality in the watercourses that could be affected by the development (if available);
- a detailed description of the water management system on-site, including the:
  - clean water diversion systems;
  - erosion and sediment controls; and
  - water storages;
- objectives and performance criteria, including trigger levels for investigating any potential or actual adverse impacts associated with the development, including the:
  - surface water flows and quality;
  - downstream flooding;
- a program to monitor and report on:
  - the effectiveness of the water management system and tailings storage facility; and
  - surface water flows and water quality;
  - the performance measures listed in Table 9;
  - impacts on water users;
  - downstream flooding;
- a plan to respond to any exceedances of the trigger levels and/or performance criteria, and minimise and/or offset any adverse surface water impacts of the development;

(c) a Groundwater Management Plan, that includes:
- baseline data on groundwater levels, yield and quality in the region and privately-owned groundwater bores that could be affected by the development in the vicinity of the borefields;
- groundwater assessment criteria, including trigger levels for investigating any potentially adverse groundwater impacts associated with the development in the vicinity of the borefields;
- a program to monitor and report on:
  - groundwater inflows into the open cut pits, if relevant;
  - the seepage/leachate from the tailings storage facility and evaporation [onds; and
  - the impacts of the development on:
    - o groundwater supply of any potentially affected landholders, particularly around the borefields;
    - o regional and local aquifers; and
    - o post-mining groundwater recovery;
- a plan to respond to any exceedances of the groundwater assessment criteria, and mitigate any adverse impacts of the development;

31. The Applicant must implement the approved Water Management Plan for the development.

BIODIVERSITY

Revegetation

32. For every 1 ha of native woodland vegetation cleared for the mine or limestone quarry, a minimum of 2 ha must be revegetated as native woodland.

Revegetation Strategy

33. Prior to carrying out any development under this consent after 6 May 2017, the Applicant must prepare a Revegetation Strategy for the development, in consultation with OEH, to the satisfaction of the Secretary. This strategy must:
   (a) include updated estimates of the likely clearing of native vegetation required over the life of the development;
   (b) identify areas on or off site that will be available for revegetation over the life of the development;
   (c) propose a strategy for progressive rehabilitation and revegetation for the development and which reflects the requirements of condition 32 (for the mine and limestone quarry); and
   (d) include a program to monitor and review the effectiveness of the strategy over the life of the development.

34. The Applicant must implement the approved Revegetation Strategy for the development.

Biodiversity Management Plan

35. Prior to carrying out any development under this consent after 6 May 2017, the Applicant must prepare a Biodiversity Management Plan for the development in consultation with OEH, and to the satisfaction of the Secretary. This plan must:
   (a) describe the short, medium, and long term measures that would be implemented to:

- manage and enhance the quality of remnant vegetation and fauna habitat on site, with specific emphasis on the preservation of remnant Box woodland; and
- ensure that the Revegetation Strategy is effectively implemented over the life of the development;

(b) include detailed performance and completion criteria for evaluating the performance of the revegetation area identified in the approved Revegetation Strategy, and triggering remedial action (if necessary);

(c) include a detailed description of the measures that would be implemented for:
- protecting vegetation and fauna habitat outside the approved disturbance area on-site;
- enhancing the quality of existing vegetation and fauna habitat in the revegetation area identified in the approved Revegetation Strategy;
- minimising, clearing and avoiding unnecessary disturbance within the approved development footprint;
- recording the details of any vegetation clearing that is undertaken for the development;
- progressively rehabilitating and revegetating the site, particularly in temporary disturbance areas;
- maximising the salvage of resources within the approved disturbance area - including vegetative and soil resources – for beneficial reuse in the rehabilitation of the site;
- collecting and propagating seed;
- identifying and managing significant impacts on any threatened fauna species not identified in the EIS, (particularly the Yellow-bellied Sheathtail Bat, Little Pied Bat, Greater Long eared bat, Barking Owl, Pied Honey eater, Major Mitchell's Cockatoo and Superb Parrot);
- minimising the impacts on threatened fauna on site, including pre-clearance surveys (with an emphasis on tree hollows, stags and roosting bats);
- seasonally adjusting activities to minimise disturbance of potential breeding activities;
- minimising potential exposure to tailings;
- implementing a fauna rescue strategy (including provision of artificial roosts);
- controlling weeds and feral pests;
- managing bushfire risk;
- controlling erosion;

(d) include a seasonally-based program to monitor and report on the effectiveness of these measures;

(e) identify the potential risks to the successful implementation of the Biodiversity Management Plan, and include a description of the contingency measures that would be implemented to mitigate against these risks; and

(f) include details of who would be responsible for monitoring, reviewing, and implementing the plan.

36. The Applicant must implement the approved Biodiversity Management Plan for the development.

HERITAGE

Protection of Aboriginal Sites

37. Unless otherwise authorised under the NP&W Act, the Applicant must ensure that the development does not cause any direct or indirect impact on any Aboriginal heritage items located outside the approved disturbance area of the development.

38. Prior to any disturbance of the artefacts identified as Syerston 1 in the EIS, the Condobolin Local Aboriginal Council or the Wiradjuri Branch of the NSW Aboriginal Land Council must be invited to collect the artefacts.

39. The pastoral out station on the western boundary of the mine site (illustrated in Figure 5 in Appendix M of the EIS) should be retained if practical and feasible.

Heritage Management Plan

40. Prior to carrying out any development under this consent after 6 May 2017, the Applicant must prepare a Heritage Management Plan for the development to the satisfaction of the Secretary. This plan must:

(a) be prepared by a suitably qualified and experienced person(s) whose appointment has been endorsed by the Secretary;

(b) be prepared in consultation with OEH and the Condobolin Local Aboriginal Land Council, Wiradjuri Branch of the NSW Aboriginal Land Council (in relation to the management of Aboriginal heritage values);

(c) include a description of the measures that would be implemented for:
- managing the discovery of any human remains or previously unidentified heritage objects on site; and
- ensuring workers on-site receive suitable heritage inductions prior to carrying out works on the site, and that suitable records are kept of these inductions;

(d) include a description of the measures that would be implemented for:
- protecting, monitoring and/ or managing Aboriginal heritage items on site, , paying particular attention to the following sites as identified in the EIS:
  - Syerston 2 – open scatter and possible knapping floor;
  - Syerston 3 – isolated flake of brown/red vitreous volcanic material; and

    - Scarred tree beside the Fifield to Wilmatha Road;
- implementing archaeological investigations and/ or salvage measures for Aboriginal heritage items on site;
- maintaining and managing reasonable access for Aboriginal stakeholders to heritage items on site;
- on-going consultation with the Aboriginal stakeholders in the conservation and management of Aboriginal cultural heritage on site; and
- protecting Aboriginal sites and items outside the development disturbance area from the development; and

(e) include the following for the management of non-Aboriginal heritage:
- a description of the measures that would be implemented for:
    - protecting, monitoring and/or managing heritage objects on site (particularly the pastoral out station referred to in condition 39 of this consent);
    - recording, prior to disturbance, any heritage areas or structures that will be impacted by the development, and making these records publically available;
    - managing the discovery of any previously unidentified heritage objects on site; and
    - implementing archaeological investigations and/ or salvage measures for heritage items on site;

41. The Applicant must implement the approved Heritage Management Plan for the development.

TRANSPORT

Restriction on Transport Routes

42. The Applicant must ensure route MR 354 is not used for heavy vehicles travelling to and from the development, unless otherwise agreed by the Secretary.

Road Upgrade and Maintenance Strategy

43. Prior to carrying out any development under this consent after 6 May 2017, the Applicant must prepare a Road Upgrade and Maintenance Strategy for the development, in consultation with RMS and Council, and to the satisfaction of the Secretary. This strategy must:

(a) identify the road and intersection upgrades required for the project, including all those outlined in Appendix 5; and

(b) include a program for:
- the implementation of the road upgrades in accordance with the timing outlined in Appendix 5; and
- the maintenance of the relevant sections of the road network following the upgrades.

44. The Applicant must implement the approved Road Upgrade and Maintenance Strategy for the development.

Traffic Management Plan

45. Prior to carrying out any development under this consent after 6 May 2017, the Applicant must prepare a Traffic Management Plan for the development in consultation with the relevant road authority, and to the satisfaction of the Secretary. This plan must include:

(a) details of all transport routes and traffic types to be used for development-related traffic;

(b) a program to monitor and report on the amount of metal sulphide/sulphate precipitate and scandium oxide transported from the mine;

(c) a program to monitor and report on the amount of limestone transported from the limestone quarry;

(d) the measures that would be implemented to:
- minimise traffic safety issues and disruption to local users of the transport route/s during construction and decommissioning of the development, including:
    - temporary traffic controls, including detours and signage;
    - notifying the local community about development-related traffic impacts; and
    - a traffic management system for managing over-dimensional vehicles; and

(e) a Road Transport Protocol for all drivers transporting materials to and from the site with measures to:
- ensure drivers adhere to the designated transport routes;
- verify that these heavy vehicles are completely covered whilst in transit;
- co-ordinate the staggering of heavy vehicle departures to minimise impacts on the road network, where practicable;
- minimise disruption to school bus timetables and rail services;
- ensure travelling stock access and right of way to the adjacent travelling stock route;
- maintain radio communications between all school buses and heavy vehicle operators operating on the transport route between the rail siding and mine;
- manage worker fatigue during trips to and from the site;
- manage appropriate driver behaviour including adherence to speed limits, safe overtaking and maintaining appropriate distances between vehicles (i.e. a Driver Code of Conduct);
- inform drivers of relevant drug and alcohol policies;

- regularly inspect vehicles maintenance and safety records;
- implement contingency procedures when the transport route is disrupted;
- respond to emergencies;
- transport processing reagents safely; and
- ensure compliance with and enforcement of the protocol.

46. The Applicant must implement the approved Traffic Management Plan for the development.

CONSTRUCTION ACCOMMODATION CAMP

47. Prior to carrying out any development at the mine, unless otherwise agreed by the Secretary, the Applicant must prepare a final layout for the accommodation camp in consultation with Lachlan Shire Council, and to the satisfaction of the Secretary.

VISUAL

Operating Conditions

48. The Applicant must:
    (a) implement all reasonable and feasible measures to minimise the visual and off-site lighting impacts of the development;
    (b) ensure that all external lighting associated with the development complies with *Australian Standard AS4282 (INT) 1995 - Control of Obtrusive Effects of Outdoor Lighting*, or its latest version;
    (c) take all practical measures to shield views of the development from users of public roads and privately-owned residences; and
    (d) ensure the visual appearance of all ancillary infrastructure (including paint colours, specifications and screening) blends in as far as possible with the surrounding landscape,

    to the satisfaction of the Secretary.

BUSHFIRE MANAGEMENT

49. The Applicant must:
    (a) ensure that the development:
        - provides for asset protection in accordance with the RFS's *Planning for Bushfire Protection 2006* (or equivalent); and
        - is suitably equipped to respond to any fires on site;
    (b) develop procedures to manage potential fires on site an in the vicinity of the site, in consultation with the RFS; and
    (c) assist the RFS and emergency services as much as possible if there is a fire in the vicinity of the site.

DANGEROUS GOODS

50. The Applicant must ensure that the storage, handling, and transport of dangerous goods is done in accordance with:
    (a) the relevant Australian Standards, particularly AS1940 and AS1596;
    (b) the *Australian Code for the Transport of Dangerous Goods by Road and Rail*; and
    (c) *Hazardous Industry Planning Advisory Paper No 11 'Route Selection'*.

51. Bulk storage of hydrogen sulphide (H_2S) and sulphur dioxide (SO_2) is not permitted at the mine, other than to ensure process continuity in the event of a process upset, start-up or shut-down.

HAZARDS AND RISK

Pre-Construction Hazard Studies

52. Prior to carrying out any development under this consent after 6 May 2017, the Applicant must prepare and submit for approval a:
    (a) Fire Safety Study for the development, covering all relevant aspects of the Department's publication *Hazardous Industry Planning Advisory paper No. 2, 'Fire Safety Study'* and the *New South Wales Government's Best Practice Guidelines for Contaminated Water Retention and Treatment Systems*.
    (b) Final Hazard Analysis for the development, prepared by a suitably qualified and experienced person(s) approved by the Secretary, consistent with the Department's publication *Hazardous Industry Planning Advisory Paper No. 6 , 'Guidelines for Hazard Analysis'*. The Final Hazard Analysis must report on the implementation of the recommendation made by the Preliminary Hazard Assessment, within the EIS.
    (c) Construction Safety Study for the mine processing facility and Gas Pipeline, prepared in accordance with *Hazardous Industry Planning Advisory Paper No. 7, 'Construction Safety Study Guidelines'*.

(d) Hazard and Operability Study for the mine processing facility and Limestone processing facility, to be conducted by a suitably qualified and experienced team and chaired by a suitably qualified and independent, whose appointments have been endorsed by the Secretary. The study shall be consistent with the Department's *Hazardous Industry Planning Advisory Paper No. 8, 'HAZOP Guidelines'*. The final report for the study must be accompanied by a program for the implementation of all recommendations made within the report. If the Applicant intends to defer the implementation of a recommendation, reasons must be documented;

Pre-Commissioning Hazard Studies

53. Prior to commissioning of the mine processing facility and gas pipeline, the Applicant must prepare and submit for approval a:
    (a) Transport of Hazardous Materials Study for the development, covering the transport of hazardous materials including details of routes to be used for the movement of vehicles carrying hazardous materials to or from the development. The Study must be carried out in accordance with the Department's publication *Hazardous Industry Planning Advisory Paper No. 11, 'Route Selection'*. Suitable routes identified in the Study must be used except where departures are necessary for local deliveries or emergencies.
    (b) Emergency Plan for the development, prepared by suitably qualified person(s) approved by the Secretary, that is consistent with the Department's publication *Hazardous Industry Planning Advisory Paper No. 1, 'Industry Emergency Planning Guidelines'*. The Plan must be developed in consultation with the State Emergency Services, RFS and Fire & Rescue NSW, and include detailed procedures for the development and include consideration of the safety of all people outside the development who may be at risk from the development.
    (c) Safety Management System for the development, prepared in accordance with the Department's publication *Hazardous Industry Planning Advisory Paper No. 9, 'Safety Management'*. The System must cover all operations on-site and associated transport activities involving hazardous materials. All safety-related procedures, responsibilities and policies, along with details of mechanisms for ensuring adherence to procedures, must be clearly specified in the System. Records must be kept on-site and must be available for inspection by the Secretary upon request.

WASTE

54. The Applicant must:
    (a) implement all reasonable and feasible measures to minimise the waste generated by the development;
    (b) classify all waste in accordance with the EPA's *Waste Classification Guidelines 2014 (*or its latest version);
    (c) store and handle all waste generated on site in accordance with its classification;
    (d) not receive or dispose of any waste on site;
    (e) ensure that waste is disposed of at appropriately licensed waste facilities; and
    (f) manage on-site sewage treatment and disposal in accordance with the requirements of the relevant Councils and EPA.

REHABILITATION

Rehabilitation Objectives

55. The Applicant must rehabilitate the site to the satisfaction of the Secretary. This rehabilitation must be generally consistent with the proposed rehabilitation strategy described in the EIS, and comply with the objectives in Table 10.

Table 10: Rehabilitation Objectives

Feature	***Objective***
Site (as a whole)	• Safe, stable & non-polluting • Materials (including topsoils, substrates and seeds of the disturbed areas) are recovered, appropriately managed and used effectively as resources in the rehabilitation of the site • Final landforms to: - restore native vegetation communities and ecosystem function (in the applicable domains); - sustain the intended land use for the post-mining domains; - minimise visual impacts - be generally in keeping with the natural terrain features of the area; - incorporate micro-relief • incorporate drainage lines consistent with topography and natural drainage where reasonable and feasible

Final voids	• Minimise: - the size and depth of the final void/s - the drainage catchment of the final voids - risk of flood interaction for all flood events up to and including a 1 in 100 year or 1% annual exceedance probability storm event
Surface infrastructure	• To be decommissioned and removed, unless agreed otherwise by the Secretary
Agriculture	• Land capability classification for the relevant nominated agricultural pursuit for each domain is established and self-sustaining within a reasonable timeframe
Community	• Ensure public safety • Minimise the adverse socio-economic effects of mine closure

Progressive Rehabilitation

56. The Applicant must rehabilitate the site progressively, that is, as soon as is practicable following disturbance, to the satisfaction of the Secretary Industry.

Rehabilitation Management Plan

57. Prior to carrying out any development under this consent after 6 May 2017, the Applicant must prepare a Rehabilitation Management Plan for the development to the satisfaction of the Secretary. This plan must:
    (a) be prepared in consultation with the Department, OEH, DPI and relevant Councils;
    (b) be prepared in accordance with relevant guidelines and consistent with the rehabilitation objectives in the EIS and in Table 10;
    (c) include detailed performance and completion criteria for evaluating the performance of the rehabilitation of the site, and triggering remedial action (if necessary);
    (d) describe the measures that would be implemented to ensure compliance with the relevant conditions of this consent, and address all aspects of rehabilitation including timeframes for achieving specified rehabilitation objectives;
    (e) review the final land use options, including the use of void water at the mine and limestone quarry;
    (f) include a mine closure strategy that details measures to minimise the long term impacts associated with mine closure, including final landform and the final voids, final land use and socio-economic issues;
    (g) include interim rehabilitation where necessary to minimise the area exposed for dust generation;
    (h) include a strategy for the preparation of the site for habitat rehabilitation as part of the revegetation program, including the exclusion of stock feeding on bushland reconstruction areas;
    (i) include a program to monitor, independently audit and report on the effectiveness of the measures, and progress against the detailed performance and completion criteria; and
    (j) build to the maximum extent practicable on the other management plans required under this consent.

58. The Applicant must implement the approved Rehabilitation Management Plan for the development.

SCHEDULE 4

ADDITIONAL PROCEDURES

INDEPENDENT REVIEW

1. If an owner of privately-owned land considers the development to be exceeding the relevant criteria in schedule 3, then he/she may ask the Secretary in writing for an independent review of the impacts of the development on his/her land.

   If the Secretary is satisfied that an independent review is warranted, then within 2 months of the Secretary's decision the Applicant must:
   (a) commission a suitably qualified, experienced and independent person, whose appointment has been approved by the Secretary, to:
   - consult with the landowner to determine his/her concerns;
   - conduct monitoring to determine whether the development is complying with the relevant criteria in schedule 3; and
   - if the development is not complying with these criteria, then identify the measures that could be implemented to ensure compliance with the relevant criteria; and

   (b) give the Secretary and landowner a copy of the independent review.

   Note: Where the independent review finds that the development is not complying with applicable criteria, the Department may take enforcement action under the EP&A Act to ensure compliance with the consent.

SCHEDULE 5

ENVIRONMENTAL MANAGEMENT, REPORTING AND AUDITING

ENVIRONMENTAL MANAGEMENT

Environmental Management Strategy

1. Prior to carrying out any development under this consent after 6 May 2017, the Applicant must prepare an Environmental Management Strategy for the development in consultation with the relevant authorities and the CCC and to the satisfaction of the Secretary. This strategy must:
   (a) provide the strategic framework for environmental management of the development;
   (b) identify the statutory approvals that apply to the development;
   (c) describe the role, responsibility, authority and accountability of all key personnel involved in the environmental management of the development;
   (d) include overall ecological and community objectives for the development, and a strategy for the restoration and management of the areas affected by operations, including elements such as creek lines and drainage channels, within the context of those objectives;
   (e) identify cumulative environmental impacts and procedures for dealing with these at each stage of the development;
   (f) describe the procedures that would be implemented to:
      - keep the local community and relevant agencies informed about the operation and environmental performance of the development;
      - receive, handle, respond to, and record complaints;
      - resolve any disputes that may arise;
      - respond to any non-compliance; and
      - respond to emergencies; and
   (g) include:
      - copies of any strategies, plans and programs approved under the conditions of this consent; and
      - a clear plan depicting all the monitoring to be carried out in relation to the development.

2. Following approval, the Applicant must carry out the development in accordance with this strategy.

Adaptive Management

3. The Applicant must assess and manage development-related risks to ensure that there are no exceedances of the criteria and/or performance measures in Schedule 3. Any exceedance of these criteria and/or performance measures constitutes a breach of this consent and may be subject to penalty or offence provisions under the EP&A Act or EP&A Regulation.

   Where any exceedance of these criteria and/or performance measures has occurred, the Applicant must, at the earliest opportunity:
   (a) take all reasonable and feasible steps to ensure that the exceedance ceases and does not recur;
   (b) consider all reasonable and feasible options for remediation (where relevant) and submit a report to the Department describing those options and any preferred remediation measures or other course of action; and
   (c) implement remediation measures as directed by the Secretary,
   to the satisfaction of the Secretary.

Management Plan Requirements

4. The Applicant must ensure that the management plans required under this consent are prepared in accordance with any relevant guidelines, are consistent with other plans prepared for other stakeholders, and include:
   (a) detailed baseline data;
   (b) a description of:
      - the relevant statutory requirements (including any relevant approval, licence or lease conditions);
      - any relevant limits or performance measures/criteria;
      - the specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, the development or any management measures;
   (c) a description of the measures that would be implemented to comply with the relevant statutory requirements, limits, or performance measures/criteria;
   (d) a program to monitor and report on the:
      - impacts and environmental performance of the development;
      - effectiveness of any management measures (see c above);
   (e) a contingency plan to manage any unpredicted impacts and their consequences;

(f) a program to investigate and implement ways to improve the environmental performance of the development over time;

(g) a protocol for managing and reporting any:
- incidents;
- complaints;
- non-compliances with statutory requirements; and
- exceedances of the impact assessment criteria and/or performance criteria; and

(h) a protocol for periodic review of the plan.

Note: The Secretary may waive some of these requirements if they are unnecessary or unwarranted for particular management plans.

Annual Review

5. By the end of March each year, the Applicant must review the environmental performance of the development for the previous calendar year to the satisfaction of the Secretary. This review must:

(a) describe the development (including any rehabilitation) that was carried out in the past calendar year, and the development that is proposed to be carried out over the current calendar year;

(b) include a comprehensive review of the monitoring results and complaints records of the development over the past year, which includes a comparison of these results against the:
- relevant statutory requirements, limits or performance measures/criteria;
- monitoring results of previous years; and
- relevant predictions in the EIS;

(c) identify any non-compliance over the last year, and describe what actions were (or are being) taken to ensure compliance;

(d) identify any trends in the monitoring data over the life of the development;

(e) identify any discrepancies between the predicted and actual impacts of the development, and analyse the potential cause of any significant discrepancies; and

(f) describe what measures will be implemented over the next year to improve the environmental performance of the development.

Revision of Strategies, Plans and Programs

6. Within 3 months of the submission of:

(a) annual review under condition 4 above;

(b) incident report under condition 8 below;

(c) audit under condition 10 below; or

(d) any modification to the conditions of this consent (unless the conditions require otherwise),

the Applicant must review and, if necessary, revise the strategies, plans, and programs required under this consent to the satisfaction of the Secretary.

Where this review leads to revisions in any such document, then within 4 weeks of the review the revised document must be submitted to the Secretary for approval.

Note: This is to ensure the strategies, plans and programs are updated on a regular basis, and incorporate any recommended measures to improve the environmental performance of the development.

Community Consultative Committee

7. The Applicant must establish and operate a CCC for the development to the satisfaction of the Secretary, in accordance with the *Community Consultative Committee Guidelines for State Significant Project (2016)*, or its latest version. The Applicant must ensure at least one CCC meeting is held prior to any development at the mine, unless the Secretary agrees otherwise.

Notes:
- *The CCC is an advisory committee. The Department and other relevant agencies are responsible for ensuring that the Applicant complies with this consent.*
- *In accordance with the guideline, the Committee should be comprised of an independent chair and appropriate representation from the Applicant, Councils, and the local community.*

REPORTING

Incident Reporting

8. The Applicant must immediately notify the Secretary and any other relevant agencies of any incident that has caused, or threatens to cause, material harm to the environment. For any other incident associated with the development, the Applicant must notify the Secretary and any other relevant agencies as soon as practicable after the Applicant becomes aware of the incident. Within 7 days of the date of the incident, the Applicant must provide the Secretary and any relevant agencies with a detailed report on the incident, and such further reports as may be requested.

Regular Reporting

9. The Applicant must provide regular reporting on the environmental performance of the development on its website, in accordance with the reporting arrangements in any plans or programs approved under the conditions of this consent.

AUDITING

10. Within 1 year of the commencement of the development, and every 3 years thereafter, unless the Secretary directs otherwise, the Applicant must commission and pay the full cost of an Independent Environmental Audit of the development. This audit must:
    (a) be conducted by a suitably qualified, experienced and independent team of experts whose appointment has been endorsed by the Secretary;
    (b) include consultation with the relevant agencies;
    (c) assess the environmental performance of the development and assess whether it is complying with the requirements in this consent, and any other relevant approvals, EPL/s; and/or mining lease/s;
    (d) include a comprehensive Hazard Audit of the development in accordance with the Department's publication *Hazardous Industry Planning Advisory paper No. 5 - Hazard Audit Guidelines*, including a review of the Site Safety Management System and all entries made in the incident register since the previous Audit.
    (e) review the adequacy of any approved strategy, plan or program required under the abovementioned approvals; and
    (f) recommend measures or actions to improve the environmental performance of the development, and/or any strategy, plan or program required under these approvals.

    Note: This audit team must be led by a suitably qualified auditor, and include experts in water resources, noise, air quality, ecology, and any other fields specified by the Secretary.

11. Within 3 months of commissioning this audit, or as otherwise agreed by the Secretary, the Applicant must submit a copy of the audit report to the Secretary, together with its response to any recommendations contained in the audit report.

ACCESS TO INFORMATION

12. The Applicant must:
    (a) make the following information publicly available on its website as relevant to the stage of the development:
        - the EIS;
        - current statutory approvals for the development;
        - approved strategies, plans or programs required under the conditions of this consent;
        - a comprehensive summary of the monitoring results of the development, which have been reported in accordance with the various plans and programs approved under the conditions of this consent;
        - a complaints register, which is to be updated on a monthly basis;
        - any independent environmental audit, and the Applicant's response to the recommendations in any audit; and
        - any other matter required by the Secretary; and
    (b) keep this information up to date,

    to the satisfaction of the Secretary.

APPENDIX 1

SCHEDULE OF LAND

Site	*Land Description*
Mine	Lots 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 and 11 DP 754021 Lot 7001 DP 1028245 Lots 7301 and 7302 DP 1148734 Lot 7303 DP 1148889 Lot 1 DP 652705
Fifield Bypass Road	Lots 8 and 28 DP 752111 Crown Road
Limestone quarry	Lots 11, 12 and 24 DP 752089 Lot 352 DP 629402 Lot 281 DP 610057
Rail siding	Part Lot 39 DP 752117
Gas pipeline	Lots 10 and 17 DP 752086 Lots 4, 5, 27 and 28 DP 752087 Lots 1 and 2 DP 580284
Borefields/water pipeline	Lot 6 DP 598735 Lots 24 and 103 DP 752106

And all Crown road reserves, crown land, road reserves, main roads, rail corridors, and travelling stock routes within the development application area, as modified.

APPENDIX 2

DEVELOPMENT LAYOUT PLANS

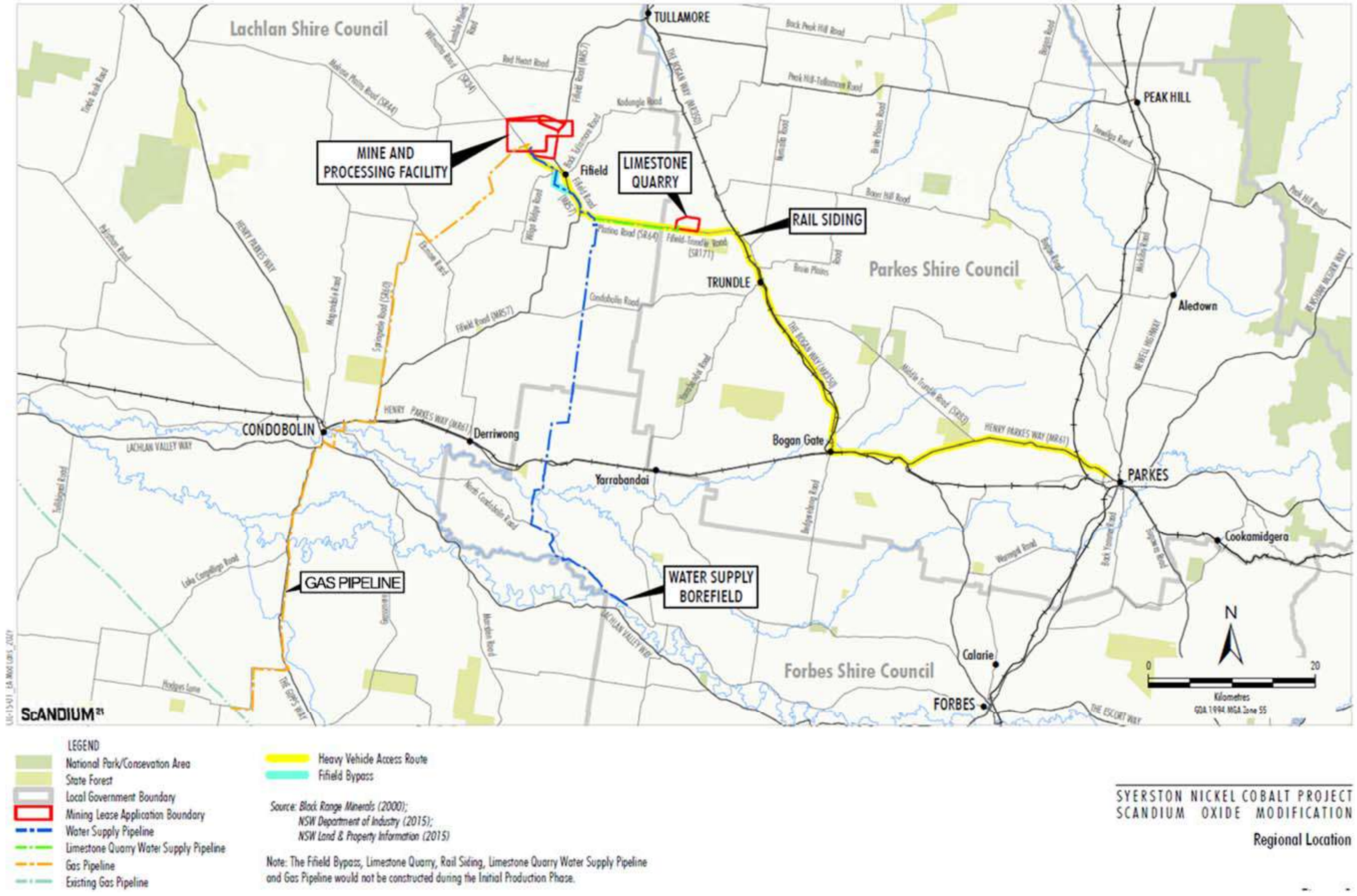


***Figure 1**: Development Components*

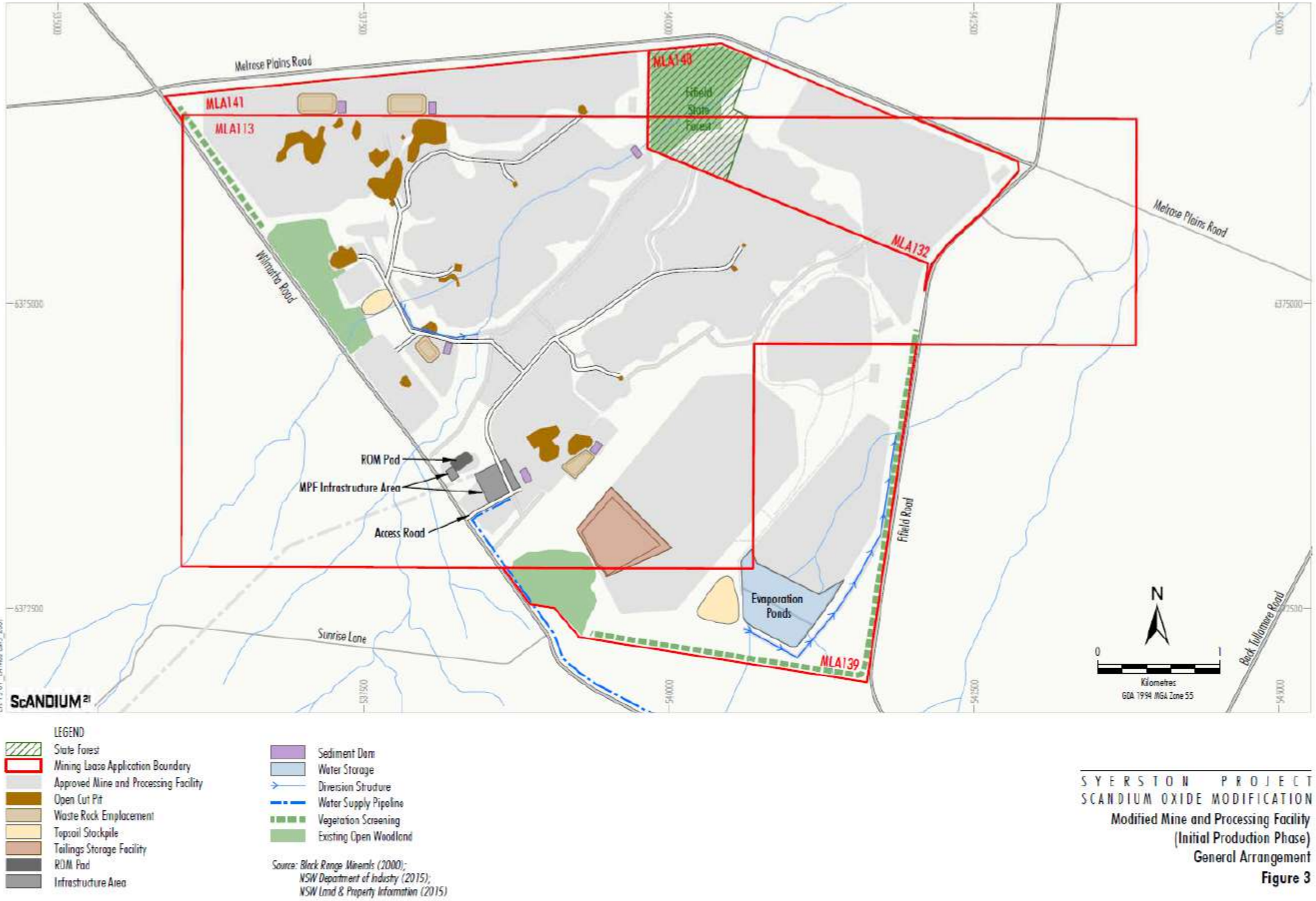


***Figure 2**: Mine Layout - stage 1*

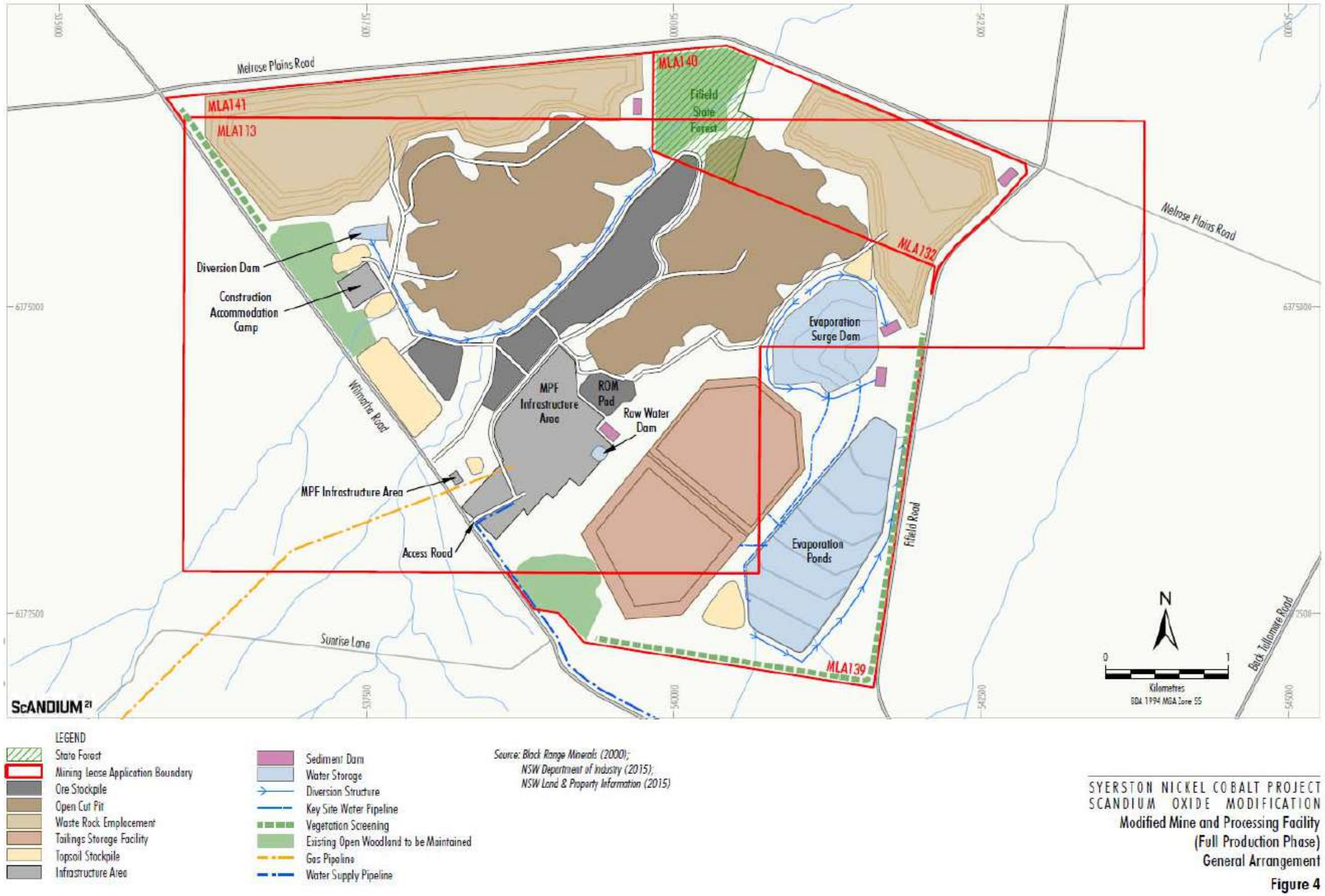


***Figure 3**: Mine Layout - stage 2*

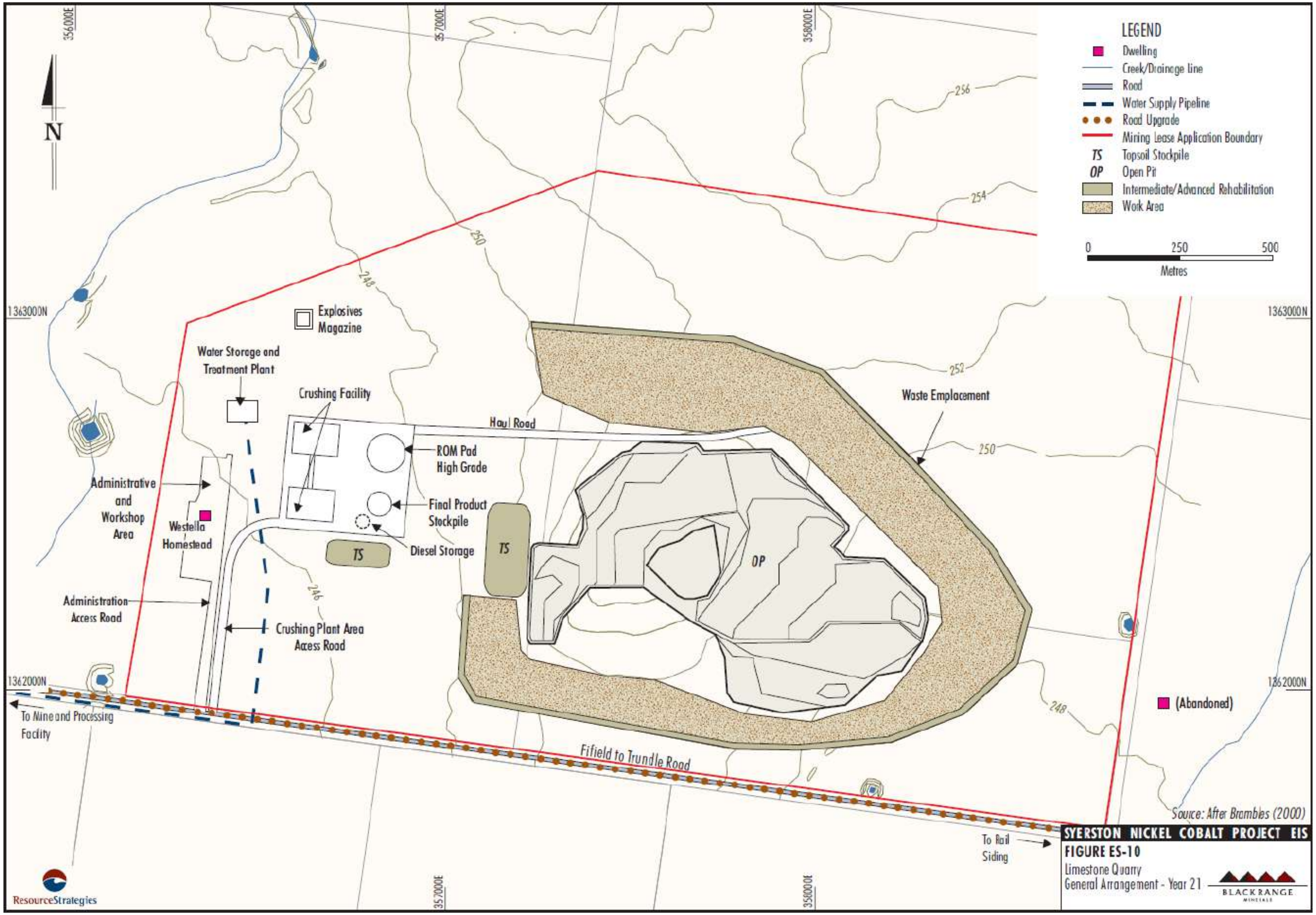


***Figure 4**: Limestone Quarry Layout*

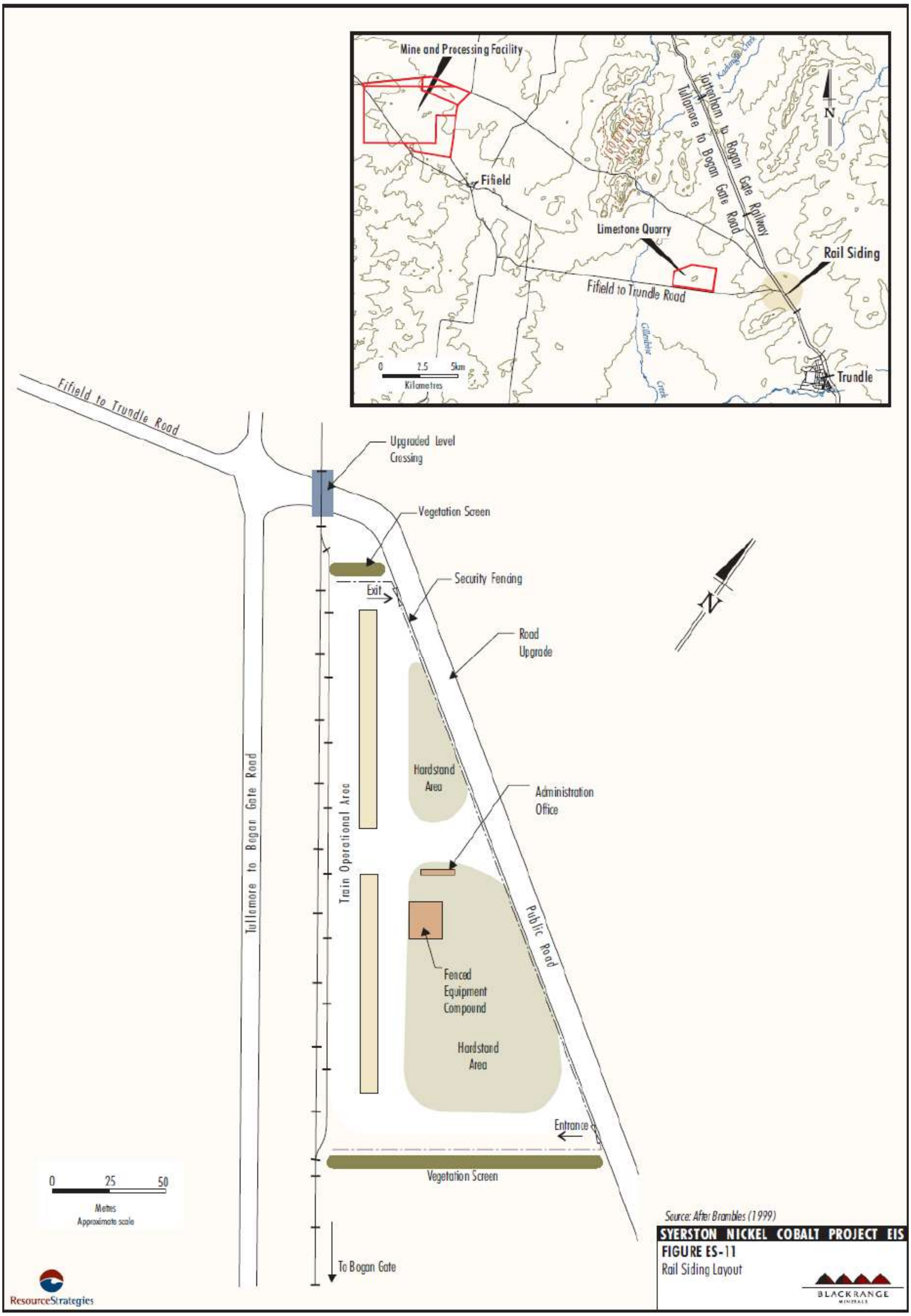


***Figure 5**: Rail Siding Layout*

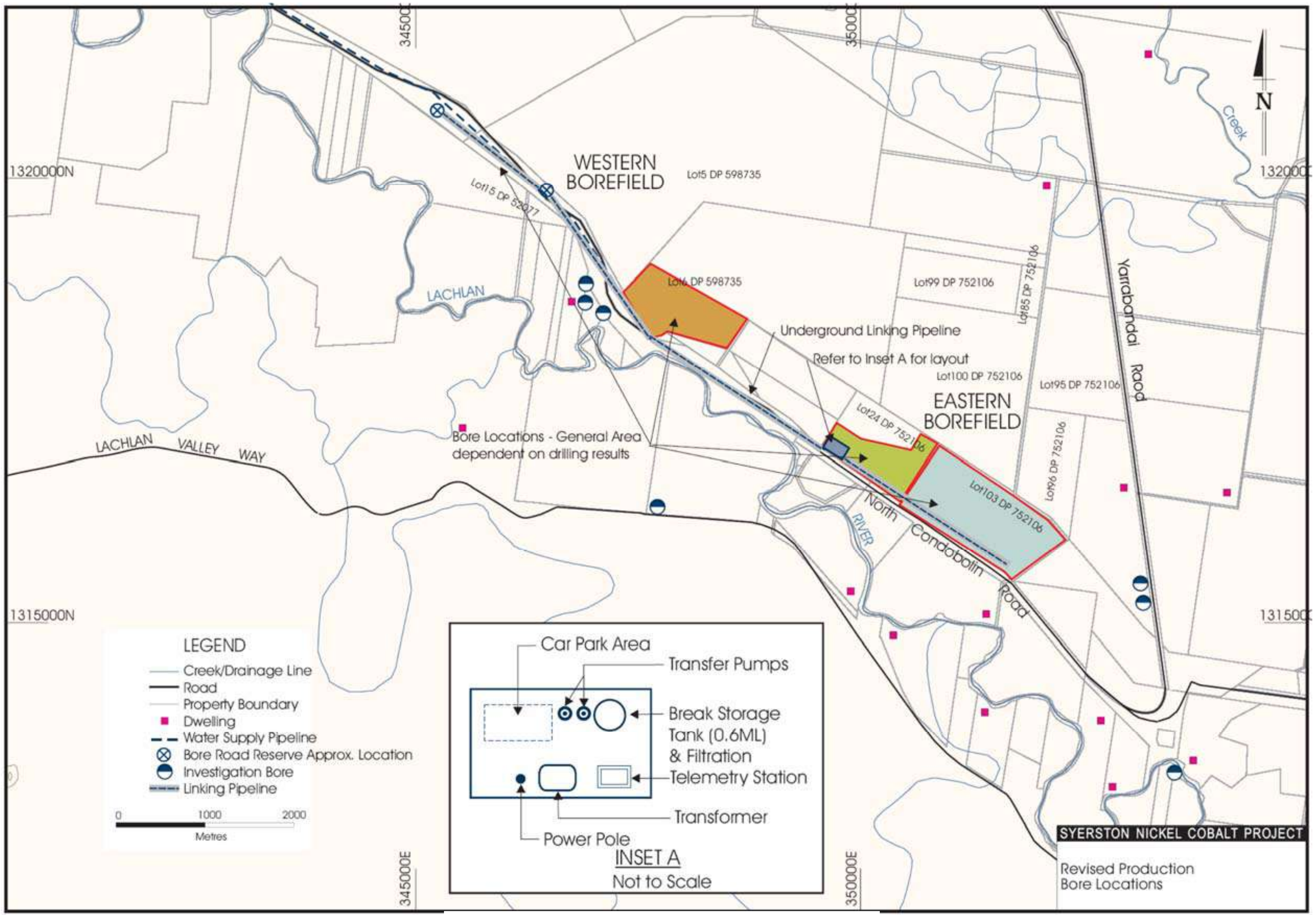
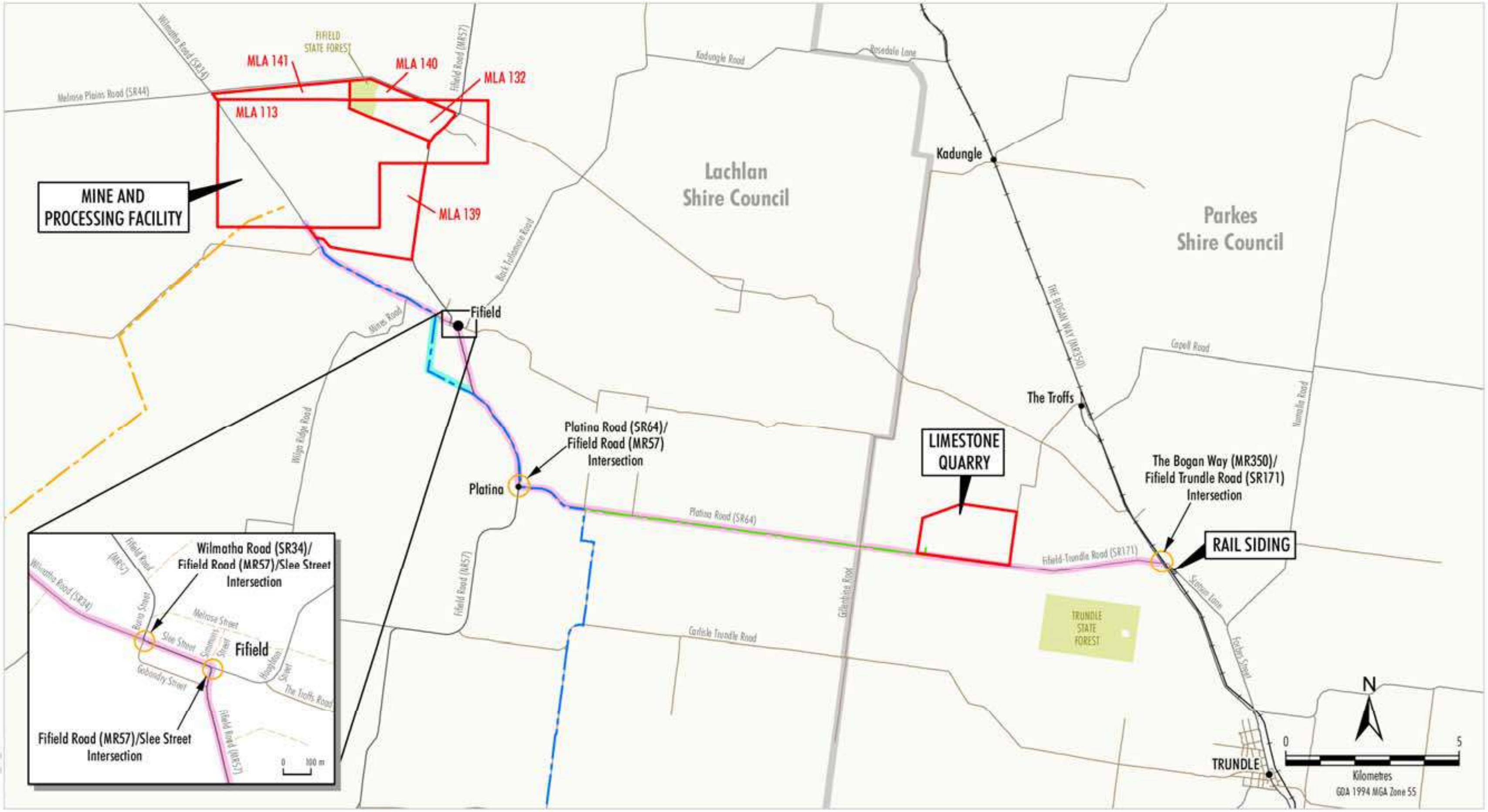


***Figure 6**: Borefields Layout*



LEGEND

- State Forest
- Local Government Boundary
- Mining Tenement
- Approved Gas Pipeline
- Approved Water Supply Pipeline
- Limestone Quarry Water Supply Pipeline
- Transport Route
- Fifield Bypass

Source: Black Range Minerals (2000);
NSW Department of Industry (2015);
NSW Land & Property Information (2015)

Note: The Limstone Quarry, Rail Siding, Limestone Quarry Water Supply Pipeline and Gas Pipeline would not be constructed during the Initial Production Phase.

SYERSTON PROJECT
SCANDIUM OXIDE MODIFICATION

***Figure 7**: Transport Route*

APPENDIX 3

TERMS OF VOLUNTARY PLANNING AGREEMENTS

Proposed Voluntary Planning Agreement Framework Syerston Nickel Cobalt Project Lachlan Shire Council

COMMUNITY ENHANCEMENT

1. The owner of the Syerston Mine (the owner) shall pay the following construction community enhancement contribution to the Lachlan Shire Council (LSC) for the provision of infrastructure and services generated by the development within six months of the commencement of construction of the Mine and processing facility.

Construction Community Enhancement Contribution ($) = $200,000

2. From the commencement of operation of the processing facility until mining operations cease on the site, the owner shall pay the following annual contribution to the LSC for the provision of infrastructure and services generated by the development.

Annual Operations Community Enhancement Contribution ($) =
$100,000 +
$300,000 × Em ÷ 335 × WF_{LSC}

Notes:

- *Em = the number of full-time equivalent employees/contractors at the Project.*
- *WF_{LSC} = the percentage of the workforce residing in Forbes Shire, Lachlan Shire and Parkes Shire that resides in Lachlan Shire as determined by employment records held by the owner.*
- *Em and WF_{LSC} are to be calculated for the first time within three months of the commencement of operation of the processing facility, and then recalculated on the same date each following year.*
- *The $100,000 and $300,000 shall be indexed according to the CPI at the time of payments after the initial payment.*
- *The fixed $100,000 component shall be reviewed between the owner and LSC every 5 years from the date of commencement of operation of the processing facility.*

The owner shall pay the first annual operations community enhancement contribution within six months of the commencement of operation of the processing facility, and then paid on the same date each following year until mining operations cease on the site.
Recognition of the owner's contribution to the potential supply of borefield water to the Fifield township will be discussed and agreed between the owner and LSC.

ROAD UPGRADES

3. Prior to the commissioning of the Mine and processing facility, the owner shall pay for the following upgrades:

- road pavement (8.0 m sealed pavement and 1.0 m gravel shoulders); and
- all private access roads (3.5 m sealed private access road approach and 3.0 m gravel shoulders along road 30 m either side of all private access roads).

to the following roads (Figures 1a and 1b):

- **Platina Road [SR64]** (between the Lachlan Shire boundary and Fifield Road [MR57]);
- **Fifield Road [MR57]** (between Platina Road [SR64] and Slee St [in Fifield Village]); and
- **Wilmatha Road [SR34]** (between Slee St [in Fifield Village] and the Mine and processing facility access road).

In addition, prior to the commissioning of the Mine and processing facility, the owner shall pay for the following intersection upgrades (Figure 1b):

- **Platina Road [SR64] /Fifield Road [MR57] Intersection** – upgrade signage and line marking in accordance with relevant Austroads requirements.

• **Fifield Road [MR57] /Slee Street [in Fifield Village] Intersection** – upgrade signage and line marking in accordance with relevant Austroads requirements.
• **Slee Street [in Fifield Village]/Wilmatha Road [SR34]/Fifield Road Intersection** – upgrade signage and line marking in accordance with relevant Austroads requirements (including installation of advance warning signs on the Slee Street [in Fifield Village], Fifield Road [MR57] and Wilmatha Road [SR34] approaches).

4. The owner shall prepare a road construction programme detailing the timing and scheduling of road upgrades required by Condition 3 above. The programme shall be prepared by the owner in consultation with LSC, prior to commencement of construction of the Mine and processing facility. The road upgrades described in Condition 3 above shall be undertaken in accordance with the road construction programme unless otherwise agreed with LSC. The road upgrades can be undertaken by the LSC or an alternative appropriately qualified contractor.

Prior to the commissioning of the limestone quarry and/or Rail Siding, the owner shall pay for a road safety audit to determine road upgrade requirements on the following roads (including intersections and rail crossings) (Figures 1a and 1b):
• **Henry Parkes Way [MR61]** (between Jones Lane [eastern outskirts of Condobolin] and Fifield Road [MR57]);
• **Fifield Road [MR57]** (between Henry Parkes Way [MR61] and Slee St [in Fifield Village] and between Slee St [in Fifield Village] and Red Heart Road [SR41]);
• **Platina Road [SR64]** (between the Lachlan Shire Boundary and Fifield Road [MR57]);
• **Slee St [in Fifield Village]** (between Fifield Road [MR57] and Wilmatha Road [SR34]); and
• **Wilmatha Road [SR34]** (between Slee St [in Fifield Village] and Melrose Plains Road [SR44]);
• **Springvale Road [SR60]** (between Fifield Road [MR57] and Melrose Plains Road [SR44]);
• **Melrose Plains Road [SR44]** (between Springvale Road [SR60] and 4.65 km after the Melrose Plains Road [SR44]/Back Tullamore Road [SR1151] Intersection).
The road safety audit must also determine if the Fifield Bypass is required.
6. Prior to the commissioning of the limestone quarry and/or Rail Siding, the owner shall pay for the road upgrades identified in the road safety audit and agreed with the LSC, described in Condition 5 above.
ROAD MAINTENANCE
7. The owner shall make annual contributions to LSC towards the maintenance of the following roads associated with the heavy vehicle transport route (Figures 2a and 2b):
• **Platina Road [SR64]** (between the Lachlan Shire boundary and Fifield Road [MR57]); and
• **Fifield Road [MR57]** (between Platina Road [SR64] and Slee St [in Fifield Village]);
• **Slee St [in Fifield Village]** (between Fifield Road [MR57] and Wilmatha Road [SR34]); and
• **Wilmatha Road [SR34]** (between Slee St [in Fifield Village] and the Mine and processing facility access road).

The owner shall also make annual contributions to LSC towards the maintenance of the following roads that are likely to experience additional light vehicle traffic (Figures 2a and 2b):
• **Fifield Road [MR57**] (between Henry Parkes Way [MR61] and Platina Road [SR64]); and
• **Henry Parkes Way [MR61]** (between Jones Lane [eastern outskirts of Condobolin] and Fifield Road [MR57]).

The first annual contribution is to be made within 12 months of the commencement of construction of the Mine and processing facility, and then paid on the same date each following year until mining operations cease on the site.

The owner and LSC are to agree on the annual maintenance monitoring programme for the above listed roads prior to implementation and review this programme every year.

Each contribution is to be calculated as follows:

Annual ongoing maintenance contribution ($) = $VM\%_{SR64} \times$ Annual $Expenditure_{SR64} + VM\%_{MR57} \times$ Annual $Expenditure_{MR57}$ $VM\%_{Slee\ St} \times$ Annual $Expenditure_{Slee\ St} +$
$VM\%_{SR34} \times$ Annual $Expenditure_{SR34} + VM\%_{MR57} \times$ Annual $Expenditure_{MR57} + VM\%_{MR61} \times$ Annual $Expenditure_{MR61}$

Notes:

• Annual Expenditure is the total annual standard road maintenance expenditure carried out by LSC on the above listed sections of road as evidenced by LSC records. Standard road maintenance expenditure must be associated with maintenance activities required to maintain the roads at the Levels as defined in the latest approved version of Lachlan Shire Council's Transport Services – Roads Asset Management Plan (unless otherwise agreed between the owner and the LSC).

• VM% = percentage of Syerston Mine vehicle axle counts to the total number of vehicle axle counts on the relevant sections of road listed above in the relevant 12 month period.

• The owner shall prepare and implement a Traffic Monitoring Programme in consultation with LSC, which contains suitable monitoring measures to accurately determine both the annual VM% and total annual vehicle axle counts on the above listed roads.

Proposed Voluntary Planning Agreement Syerston Nickel Cobalt Project Forbes Shire Council

COMMUNITY ENHANCEMENT

1. The owner of the Syerston Mine (the owner) shall pay the following construction community enhancement contribution to the Forbes Shire Council (FSC) for the provision of infrastructure and services generated by the development within six months of the commencement of construction of the Mine and processing facility.

Construction Community Enhancement Contribution ($) = $100,000

2. From the commencement of operation of the processing facility until mining operations cease on the site, the owner shall pay the following annual contribution to the FSC for the provision of infrastructure and services generated by the development.

Annual Operations Community Enhancement Contribution ($) = $\$300,000 \times Em \div 335 \times WF_{FSC}$

Notes:

- *Em = the number of full-time equivalent employees/contractors at the Project.*
- *WF_{FSC} = the percentage of the workforce residing in FSC, LSC and PSC that resides in FSC as determined by employment records held by the owner.*
- *Em and WF_{FSC} are to be calculated for the first time within three months of the commencement of run-of-Mine ore processing, and then recalculated on the same date each following year.*
- *$300,000 shall be indexed according to the CPI at the time of payments after the initial payment.*

The owner shall pay the first annual operations community enhancement contribution within six months of the commencement of operation of the processing facility, and then paid on the same date each following year until mining operations cease on the site.
Recognition of the owner’s contribution to the potential supply of borefield water to the Ootha township will be discussed and agreed between the owner and FSC.

Proposed Voluntary Planning Agreement Syerston Nickel Cobalt Project Parkes Shire Council

COMMUNITY ENHANCEMENT

1. The owner of the Syerston Mine (the owner) shall pay the following construction community enhancement contribution to the Parkes Shire Council (PSC) for the provision of infrastructure and services generated by the development within six months of the commencement of construction of the Mine and processing facility.

Construction Community Enhancement Contribution ($) = $100,000

2. From the commencement of operation of the processing facility until mining operations cease on the site, the owner shall pay the following annual contribution to the PSC for the provision of infrastructure and services generated by the development.

Annual Operations Community Enhancement Contribution ($) = $\$300,000 \times Em \div 335 \times WF_{PSC}$

Notes:

- *Em = the number of full-time equivalent employees/contractors at the Project.*
- *WF_{PSC} = the percentage of the workforce residing in Forbes Shire, Lachlan Shire and Parkes Shire that resides in Parkes Shire as determined by employment records held by the owner.*
- *Em and WF_{PSC} are to be calculated for the first time within three months of the commencement of run-of-Mine ore processing, and then recalculated on the same date each following year.*
- *$300,000 shall be indexed according to the CPI at the time of payments after the initial payment.*

The owner shall pay the first annual operations community enhancement contribution within six months of the commencement of operation of the processing facility, and then paid on the same date each following year until mining operations cease on the site.

APPENDIX 4

NOISE COMPLIANCE ASSESSMENT

Applicable Meteorological Conditions

13. The noise criteria in conditions 1 - 3 of Schedule 3 apply under all meteorological conditions except the following:
    (a) wind speeds greater than 3 m/s at 10 metres above ground level; or
    (b) stability category F temperature inversion conditions and wind speeds greater than 2 m/s at 10 m above ground level; or
    (c) Pascall stability classes G temperature inversion conditions

Determination of Meteorological Conditions

14. Except for wind speed at microphone height, the data to be used for determining meteorological conditions must be that recorded by the meteorological station on or in the vicinity of the Mine.

Compliance Monitoring

15. Unless directed otherwise by the Secretary, attended monitoring is to be used to evaluate compliance with the relevant conditions of consent.

    Note: The Noise Management Plan (see condition 7 of Schedule 3) is required to include a noise monitoring program for the development, which will include details of the frequency of monitoring. The Secretary may direct that the frequency of monitoring increase or decrease at any time during the life of the development.

16. Unless otherwise agreed with the Secretary, this monitoring is to be carried out in accordance with the relevant requirements for reviewing performance set out in the NSW Industrial Noise Policy (as amended or replaced from time to time), in particular the requirements relating to:
    (a) monitoring locations for the collection of representative noise data;
    (b) meteorological conditions during which collection of noise data is not appropriate;
    (c) equipment used to collect noise date, and conformity with Australian Standards relevant to such equipment; and
    (d) modifications to noise data collected including for the exclusion of extraneous noise and/or penalties for modifying factors apart from adjustments for duration.

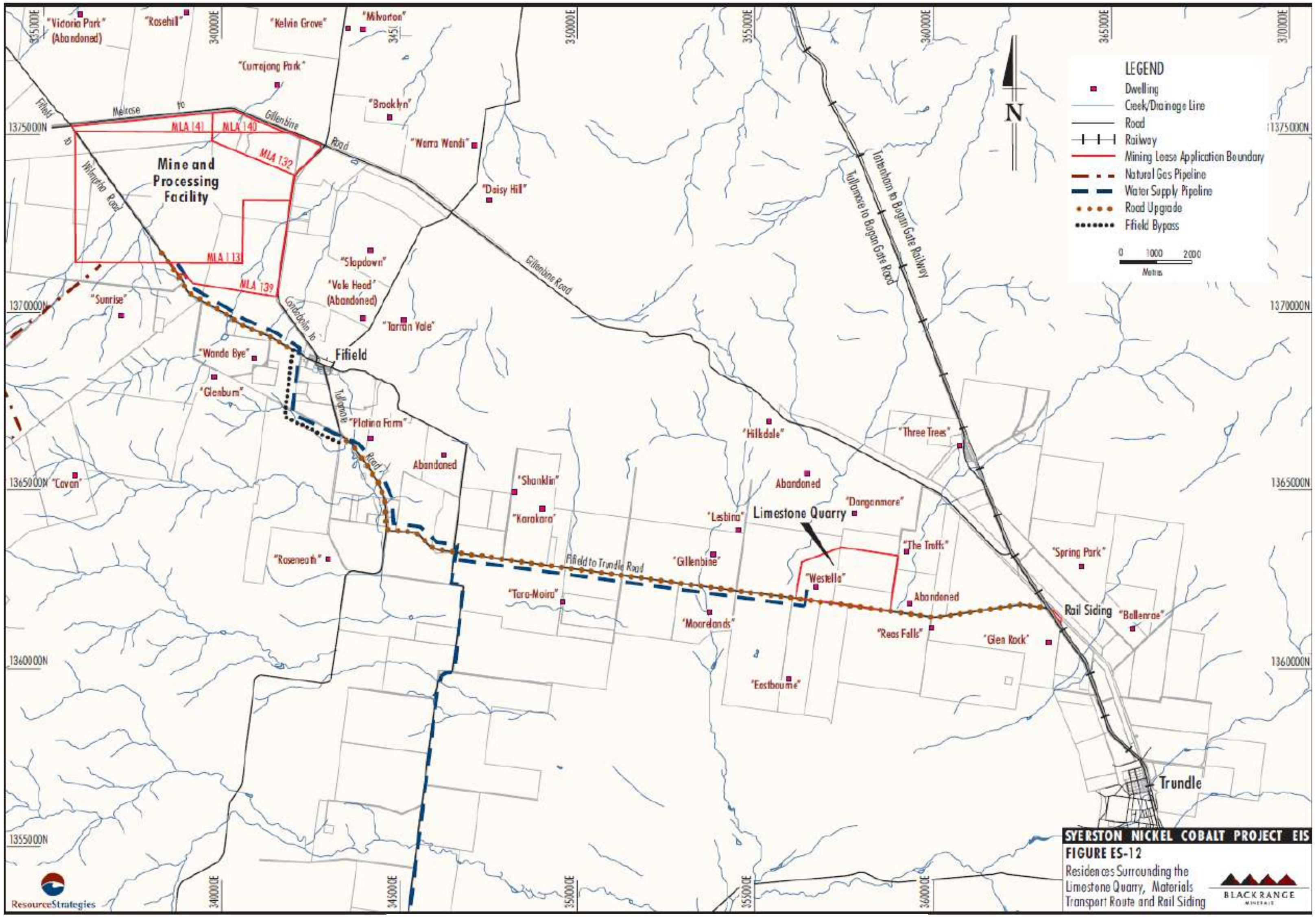


***Figure 8**: Residences surrounding the development*

APPENDIX 5

ROAD AND INTERSECTION UPGRADES

1. Road upgrades – prior to commissioning of the mine processing facility	(a) Platina Road [SR64] (between the Lachlan Shire boundary and Fifield Road [MR57]); (b) Fifield Road [MR57] (between Platina Road [SR64] and Slee St [in Fifield Village]); (c) Wilmatha Road [SR34] (between Slee St [in Fifield Village] and the mine; and (d) Fifield Trundle Road [SR171] (between The Bogan Way [MR350] and the Parkes Shire boundary)
2. Intersection upgrades – prior to commissioning of the mine processing facility	(a) Platina Road [SR64] / Fifield Road [MR57]; (b) Fifield Road [MR57] / Slee Street [In Fifield Village]; (c) Slee Street [In Fifield Village] / Wilmatha Road [SR34] / Fifield Road; (d) The Bogan Way [MR350] /Fifield Trundle Road [SR171] ; (e) Henry Parkes Way and Middle Trundle Road; and (f) Henry Parkes Way and The Bogan Way.
3. Further road and intersection upgrades – prior to the development of the limestone quarry or rail siding	(a) Henry Parkes Way [SR61] (between Jones Lane and Fifield Road [MR57]); (b) Fifield Road [MR57] (between Henry Parkes Way [MR61] and Slee St [In Fifield Village] and between Slee St [in Fifield Village] and Red Heart Road [SR41]; (c) Platina Road [SR64] (between Lachlan Shire boundary and Fifield Road [MR57] ; (d) Slee St [in Fifield Village] (between Fifield Road [MR57] and Wilmatha Road [SR34]; (e) Wilmatha Road [SR34] (between Slee St [in Fifield Village] and Melrose Plains Road [SR44]); (f) Springvale Road [SR60] (between Fifield Road [MR57] and Melrose Plains Road [SR44]); (g) Henry Parkes Way [MR61] (between Westlime Road [western outskirts of Parkes] and The Bogan Way [MR350]) ; (h) Middle Trundle Road [SR83] (between Henry Parkes Way [MR61] and The Bogan Way [MR350]); (i) The Bogan Way [MR350] (between Henry Parkes Way [MR61] and Fifield Trundle Road [SR171]); (j) Fifield Trundle Road [SR171] (between The Bogan Way [MR350] and the Parkes Shire boundary); and (k) Melrose Plains Road [SR44) (between Springvale Road [SR60] and 4.65 km after the Melrose Plains Road [SR44] / Back Tullamore Road [SR1151] intersection).