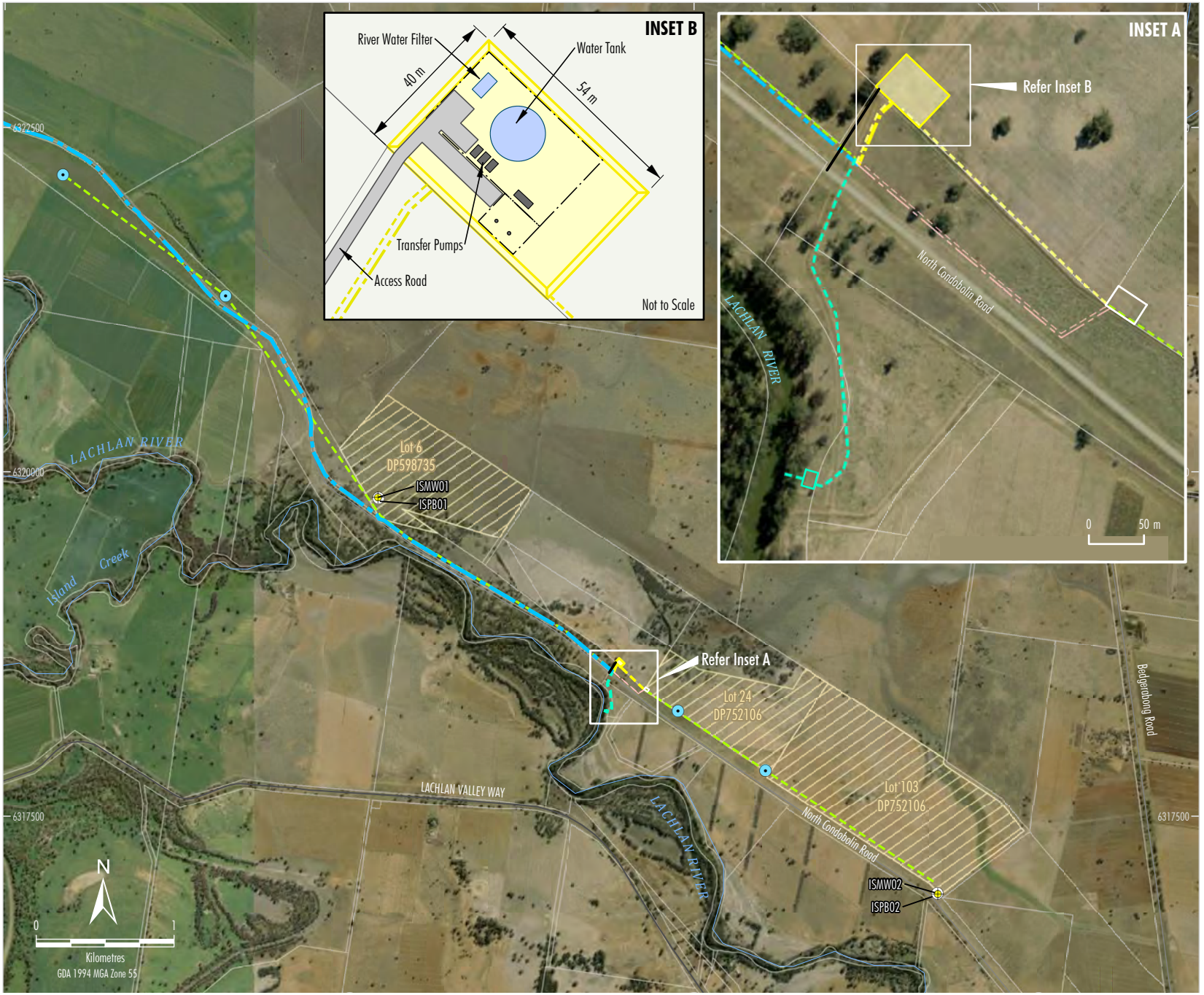


LEGEND

- 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.

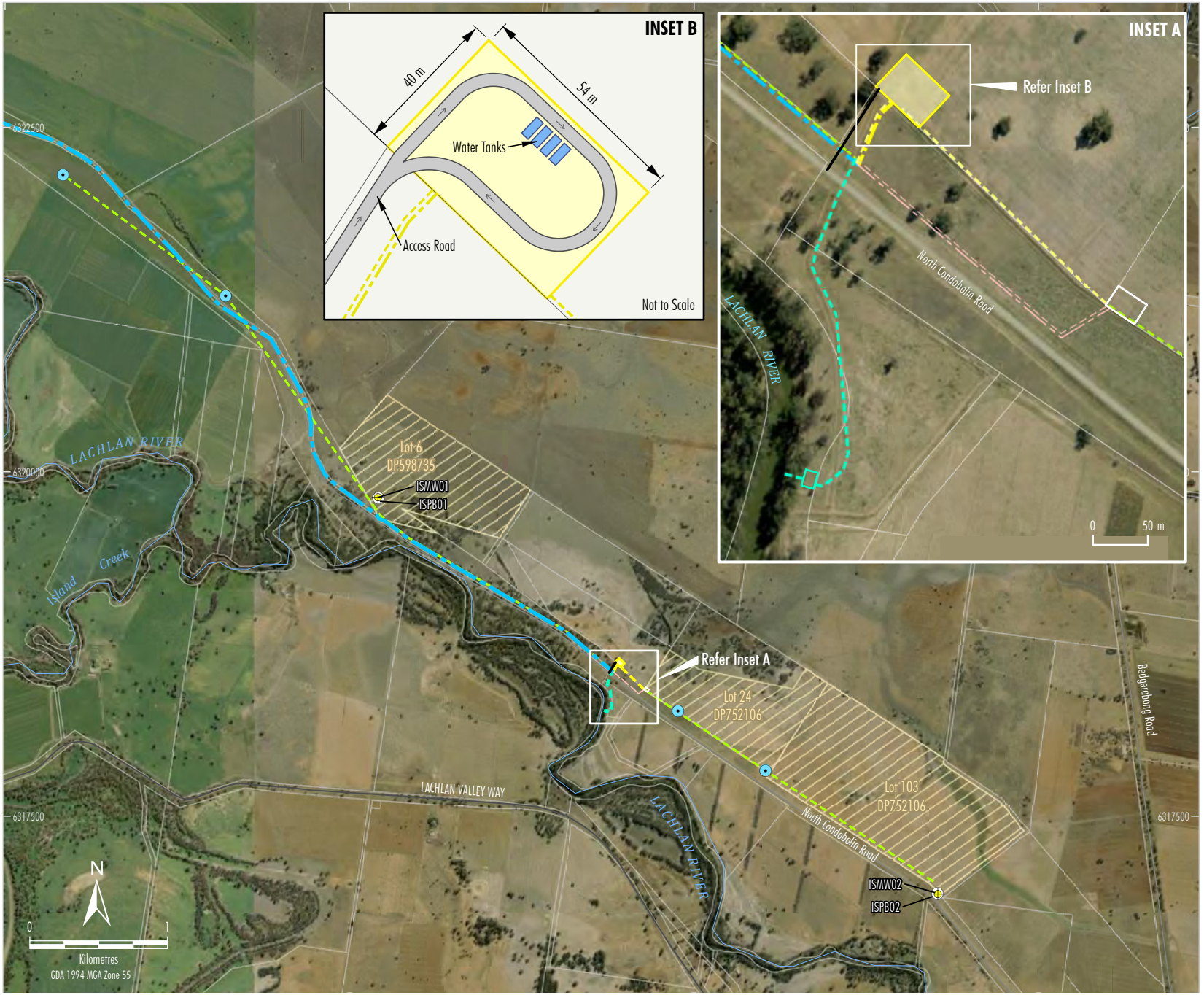
Source: NSW Land & Property Information (2017); Ivanplats Syerston (2005)

CLEAN TEQ
Powering innovation

SYERSTON PROJECT MODIFICATION 4

Modified Borefields and Surface Water Extraction - Post Water Pipeline Commissioning

Figure 16



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.

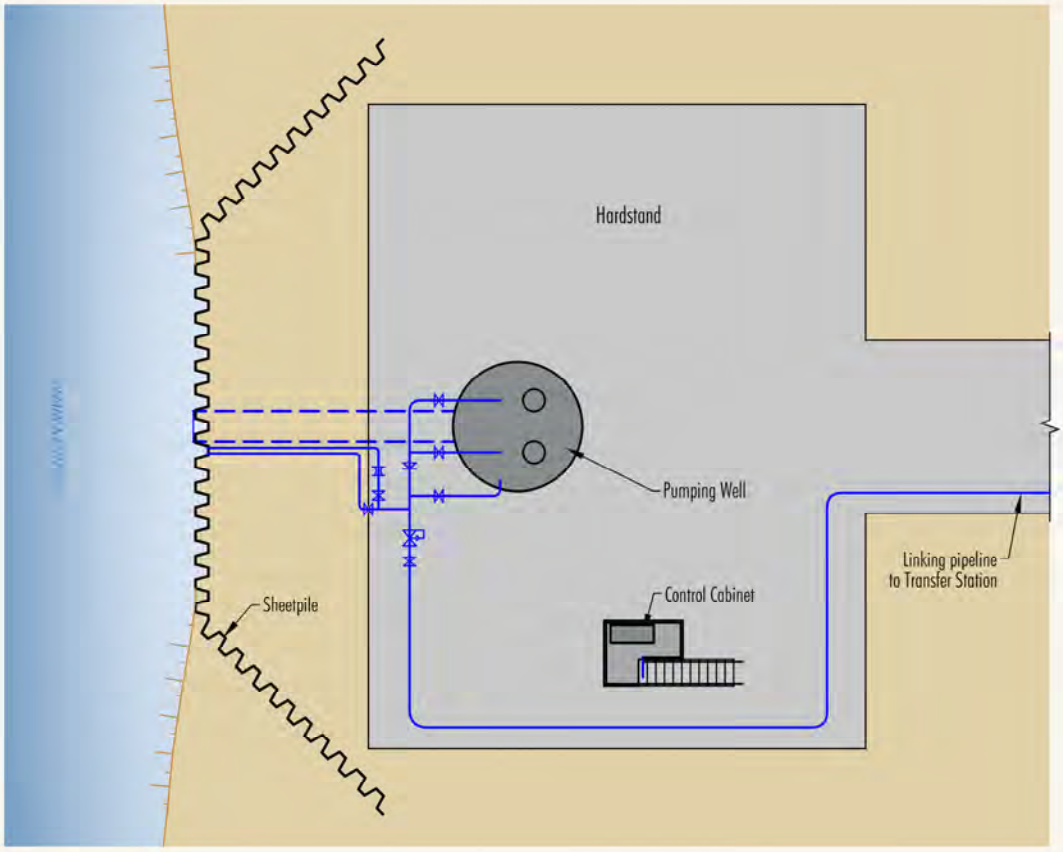
Source: NSW Land & Property Information (2016); Ivanplats Syerston (2005)

CLEAN TEQ
Powering innovation

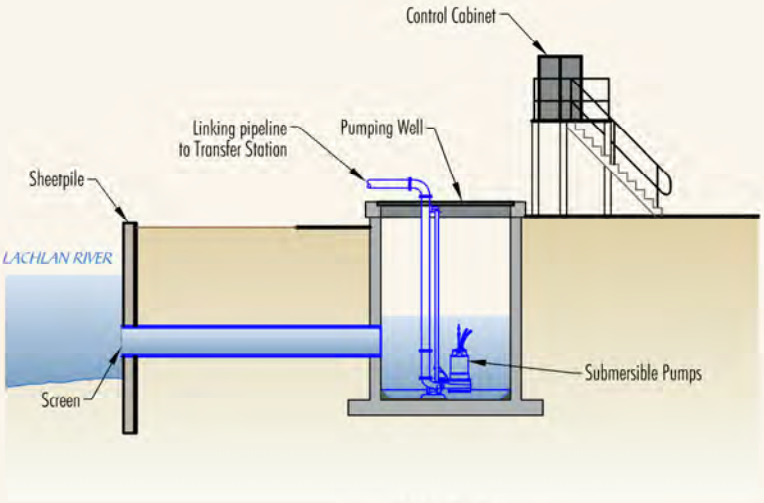
SYERSTON PROJECT MODIFICATION 4

Modified Borefields and Surface Water Extraction - Pre Water Pipeline Commissioning

Figure 17



PLAN



ELEVATION

Not to Scale

CTH-16-02 Mod4 EA 101B

Source: Clean TeQ (2017)

CLEAN TEQ
Powering Innovation

SYERSTON PROJECT MODIFICATION 4

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

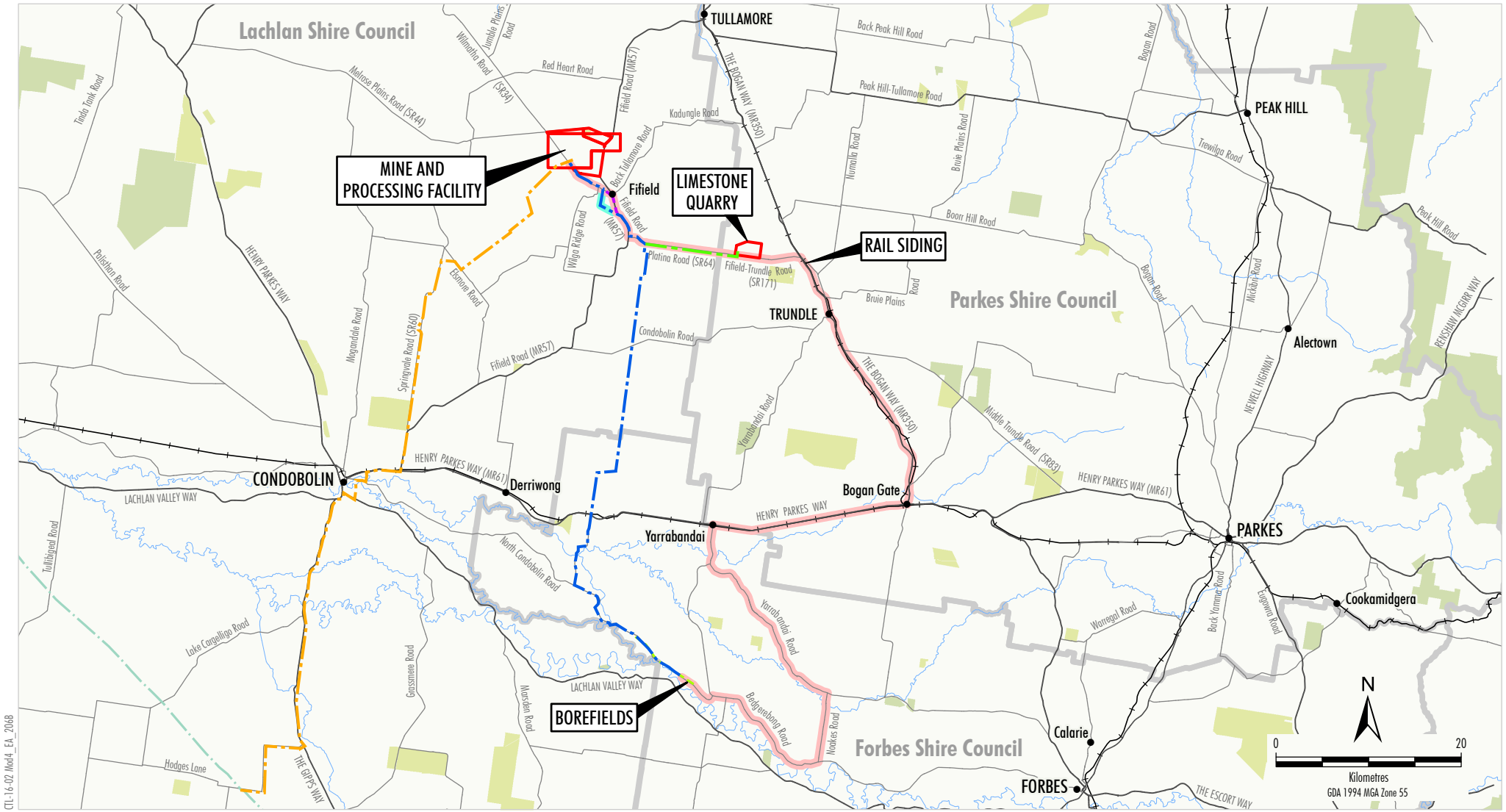
The Modification would not change the approved gas pipeline.

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

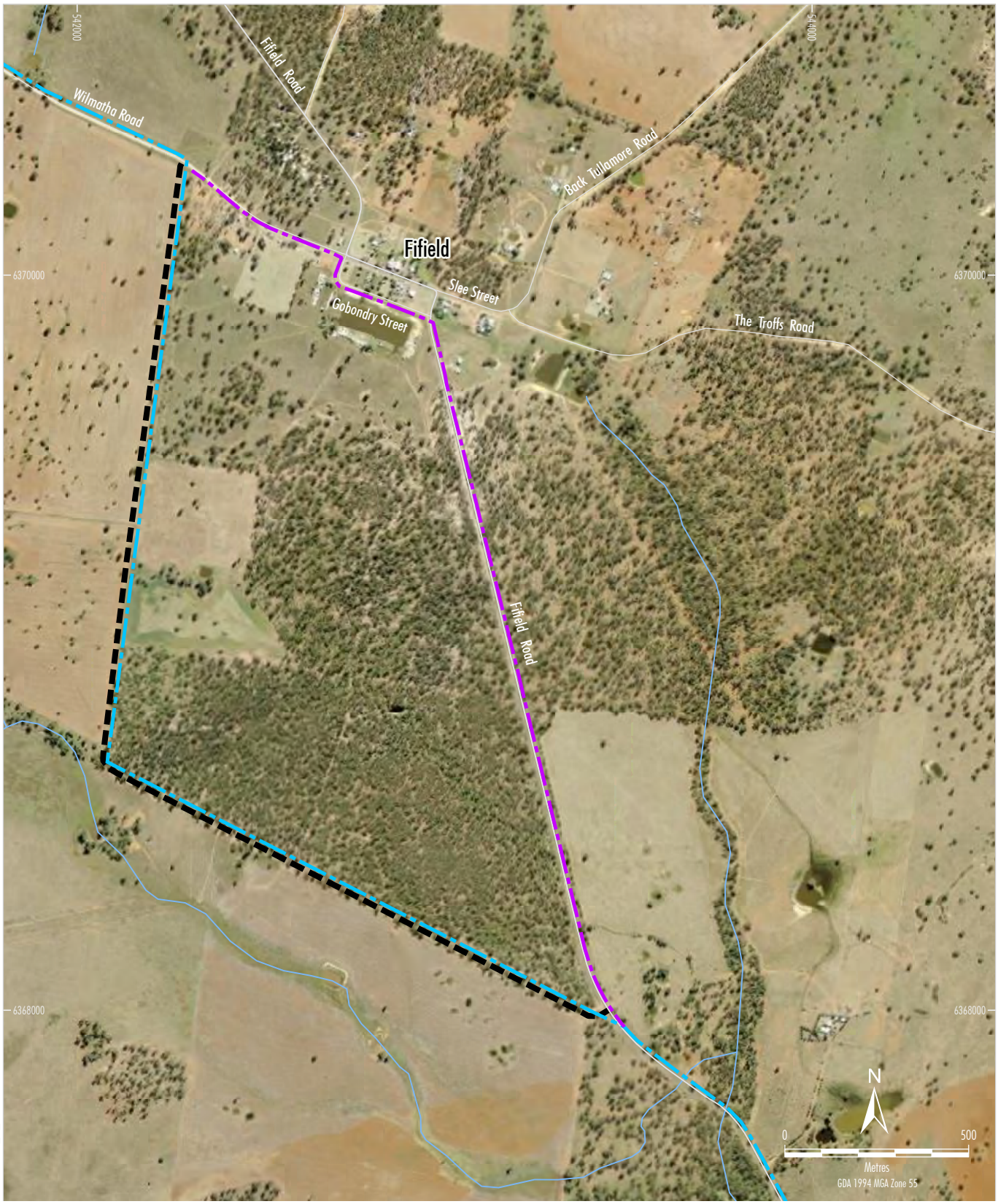
Source: Black Range Minerals (2000); NSW Department of Industry (2017); NSW Land & Property Information (2017); Office of Environment and Heritage NSW (2017)

CLEAN TEQ
Powering innovation

SYERSTON PROJECT MODIFICATION 4

Short Term Construction Phase
Water Transport Route

Figure 19



CTL 16-02 Mod4_EA_209C

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)

CLEAN TEQ
Powering innovation

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

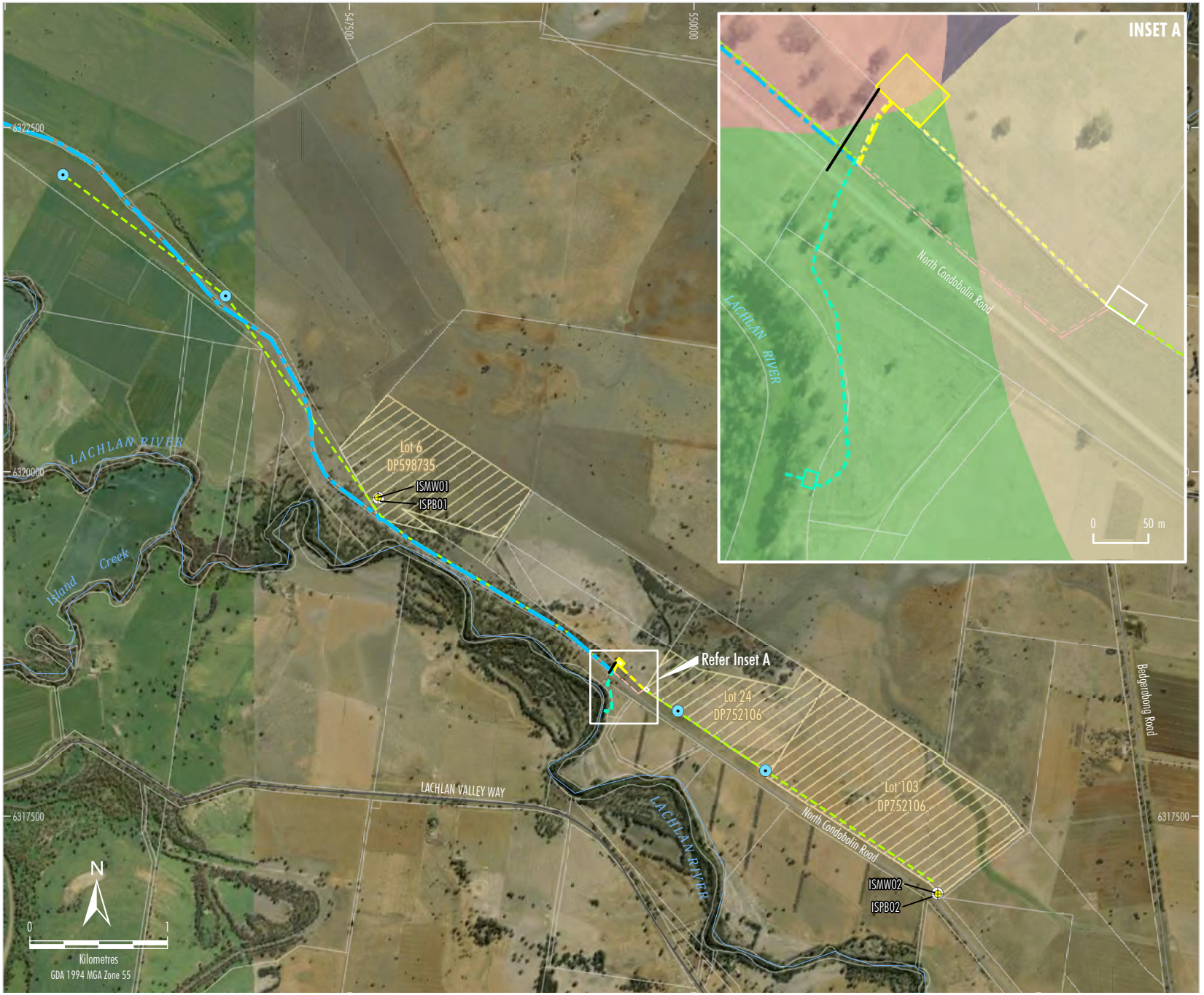
OEH's (2017) regional Australian Soil Classification mapping in the vicinity of the new surface water pump station and modified borefield transfer station is presented on Figure 21. The soils types mapped include Tenosols, Chromosols and Rudosols.

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)

CLEAN TEQ
Powering Innovation

SYERSTON PROJECT MODIFICATION 4

Modified Borefields and Surface Water Extraction - Regional Soil Mapping

Figure 21

CTL-16-02 Mod4_EA_223A

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)

CLEAN TEQ
Powering innovation

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 (µg/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: µg/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

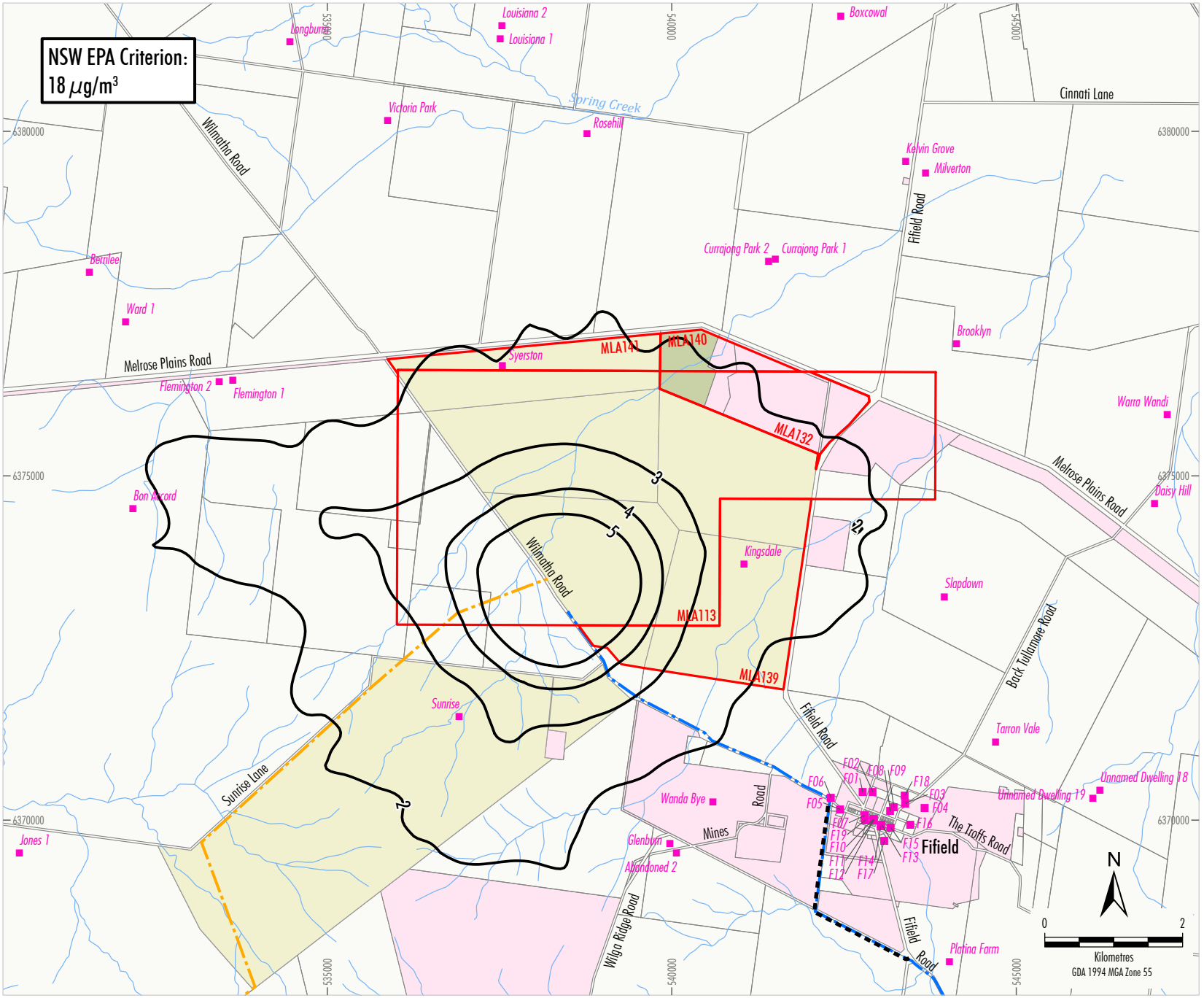
Ramboll Environ (2017) has conducted a vacant land assessment in accordance with contemporary policy and concluded that no additional properties are likely to exceed the criteria based on potential impacts on vacant land (Appendix A).

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.



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/m³)

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

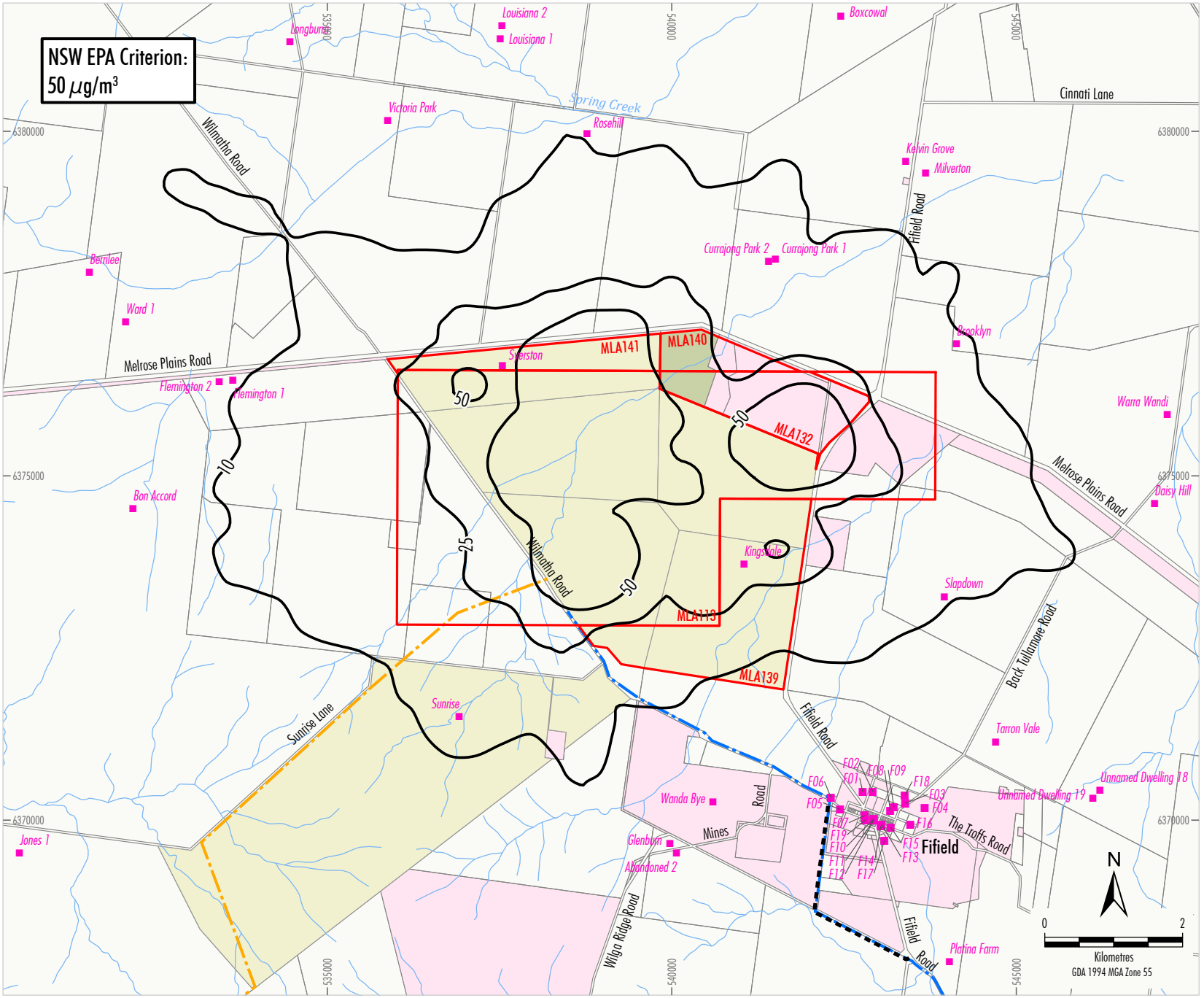
CLEAN TEQ
Powering Innovation

SYERSTON PROJECT MODIFICATION 4

1-hour Average
Sulphuric Acid Concentrations

Figure 23

CTL-16-02 Mod4_EA_225C



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)

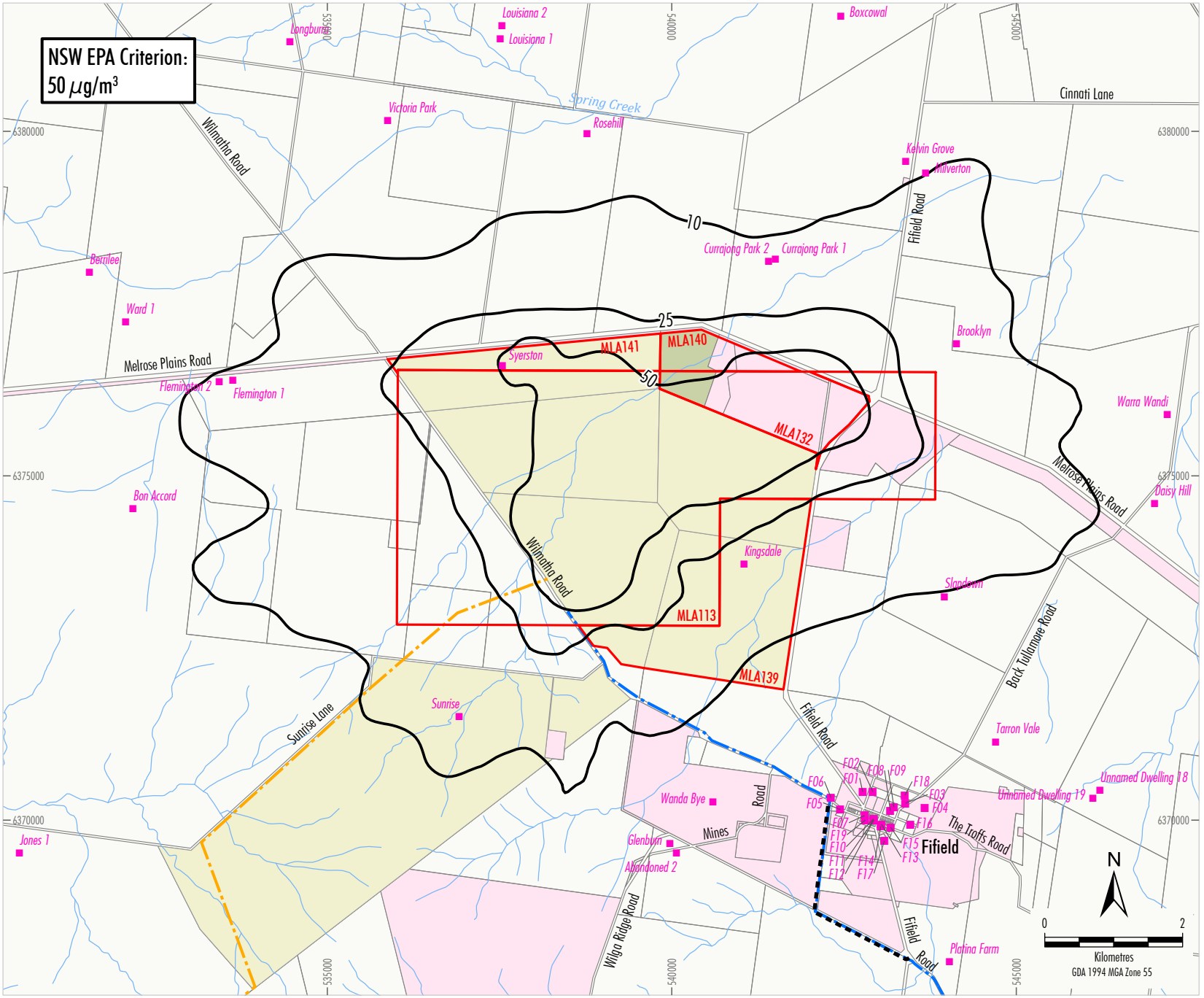
CLEAN TEQ
Powering Innovation

SYERSTON PROJECT MODIFICATION 4

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)

CLEAN TEQ
Powering Innovation

SYERSTON PROJECT MODIFICATION 4

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).

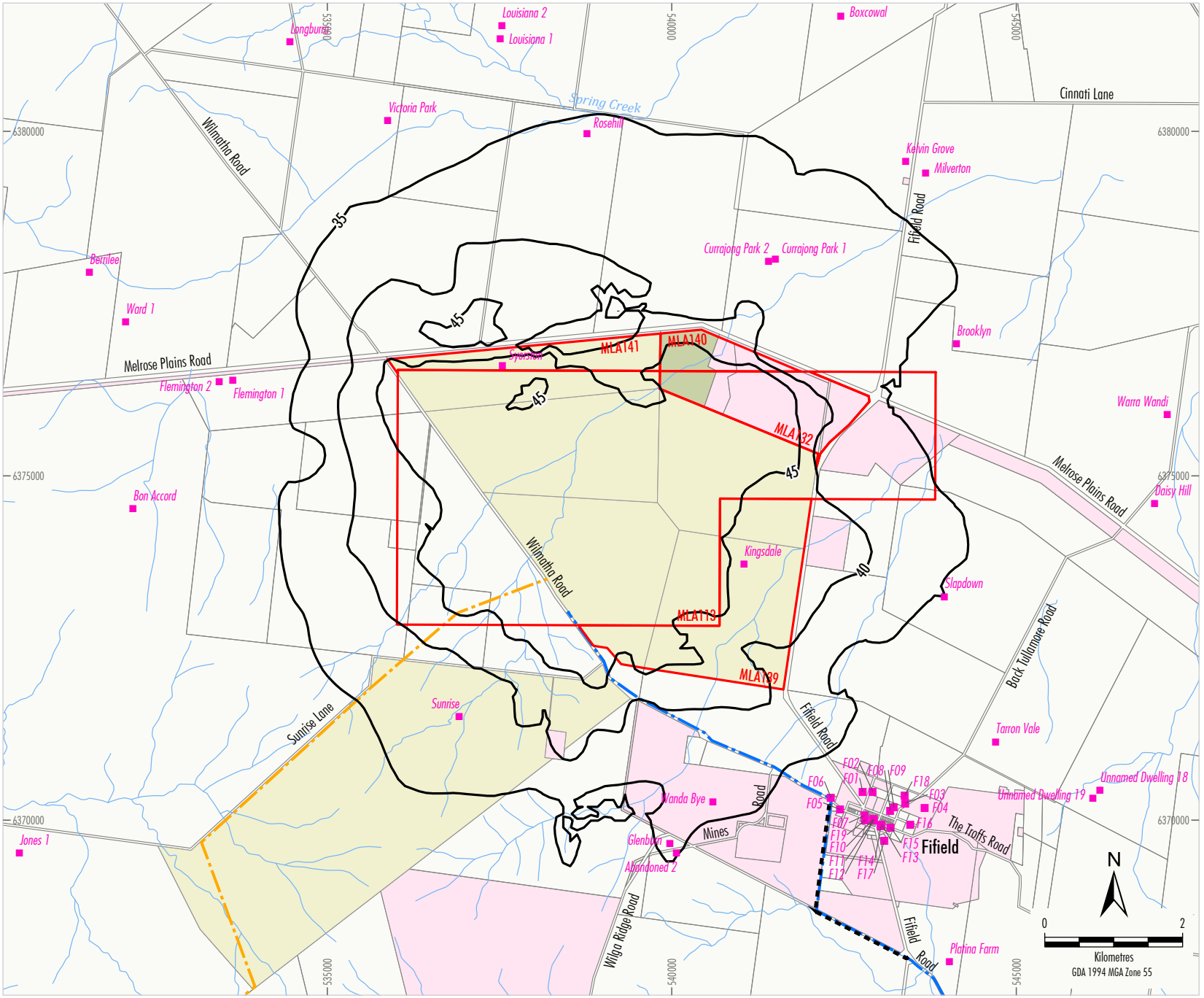
Land Assessment

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).



CLEAN TEQ
Powering innovation

SYERSTON PROJECT MODIFICATION 4

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.

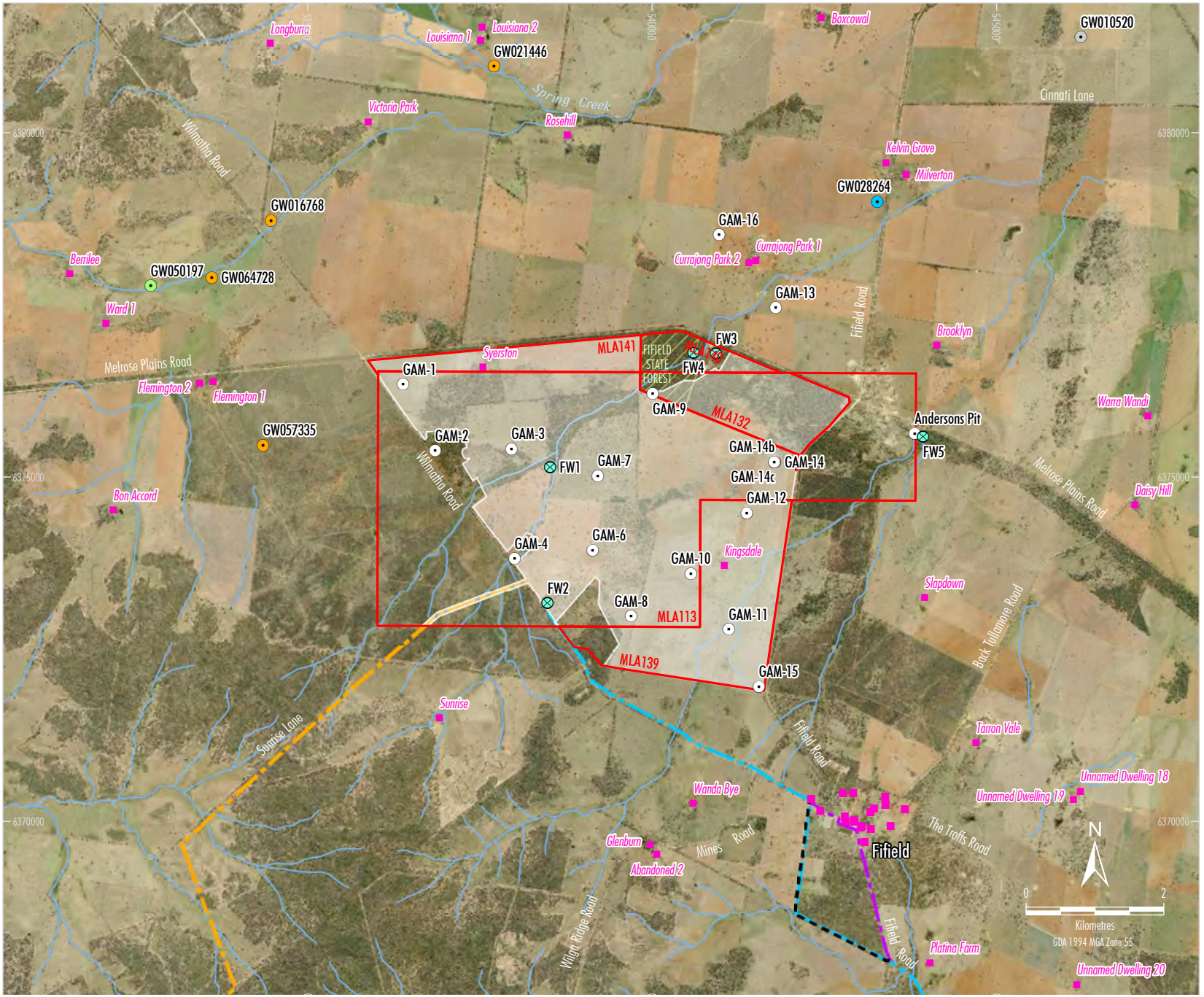
4.7.2 Potential Impacts

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.



CLEAN TEQ
Powering Innovation

SYERSTON PROJECT MODIFICATION 4

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

Figure 27

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 x 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.