CLEANTEQ
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Syerston

MODIFICATION 4 ENVIRONMENTAL ASSESSMENT

Project

Appendix D

Water Management Assessment

10 November 2017

SYERSTON PROJECT

MODIFICATION 4 WATER MANAGEMENT ASSESSMENT

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REPORT

Report Number. 039-1524361 Rev 2

Golder Associates

Table of Contents

TABLES

FIGURES

APPENDICES

1.0 INTRODUCTION

Scandium21 Pty Ltd owns the rights to develop the Syerston Project (the Project). Scandium21 Pty Ltd is a wholly owned subsidiary of Clean TeQ Holdings Limited (Clean TeQ). Development Consent DA 374-11-00 for the Project was issued in 2001.

Clean TeQ has applied to the NSW Department of Planning and Environment to modify the Development Consent DA 374-11-00 for the Project.

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

- Mine (including the processing facility)
- Limestone quarry
- Rail siding
- Gas pipeline
- Borefield and water pipeline
- Associated transport and infrastructure.

Since Development Consent DA 374-11-00 was issued under Part 4 of the New South Wales (NSW) *Environmental Planning and Assessment Act 1979* (EP&A Act) in 2001, three modifications to Development Consent DA 374-11-00 have been granted under the EP&A Act:

- Modification 1 in 2005 – to allow for the increase of the run-of-mine (ROM) ore processing rate, limestone quarry extraction rate and adjustments to ore procession operations
- Modification 2 in 2006 – to allow for the reconfiguration of the water supply borefield
- Modification 3 in 2017 – to allow for the production of scandium oxide.

This modification, referred to as Modification 4, has been proposed following completion of an optimisation study for the Project. The optimisation study identified potential opportunities in relation to water management including:

- Increasing the efficiency of mining and processing operations
- Increasing water recycling and as a result minimising water demand from external water supply sources
- Increasing water supply security by diversifying the approved water supply sources to include surface water from the Lachlan River.

This report details the modification to the approved water management system, describes current knowledge of the hydrological and hydrogeological setting, and addresses contemporary planning requirements relevant to water management for the Project. The modification is described in further detail in Section 2.0.

1.1 Background

The Project is located approximately 350 kilometres (km) north-west of Sydney, near Fifield, NSW (Figure 1). The major town centres of Parkes and Dubbo are located within 100 km of the Project area. The mine (including processing facility) is located within Exploration Licence (EL) EL4563.

The Project allows for mining and processing of a high grade nickel, cobalt and scandium resource. A feasibility study was completed in 2000 for a nickel/laterite operation. A change in ownership occurred in 2004, and a revised feasibility study was completed in 2005. The Project did not proceed to full development due to the prevailing base metal prices at that time.

Clean TeQ acquired the Project in 2014. Clean TeQ completed a feasibility study for a small-scale scandium project to produce scandium oxide and is currently undertaking a bankable feasibility study for an expanded

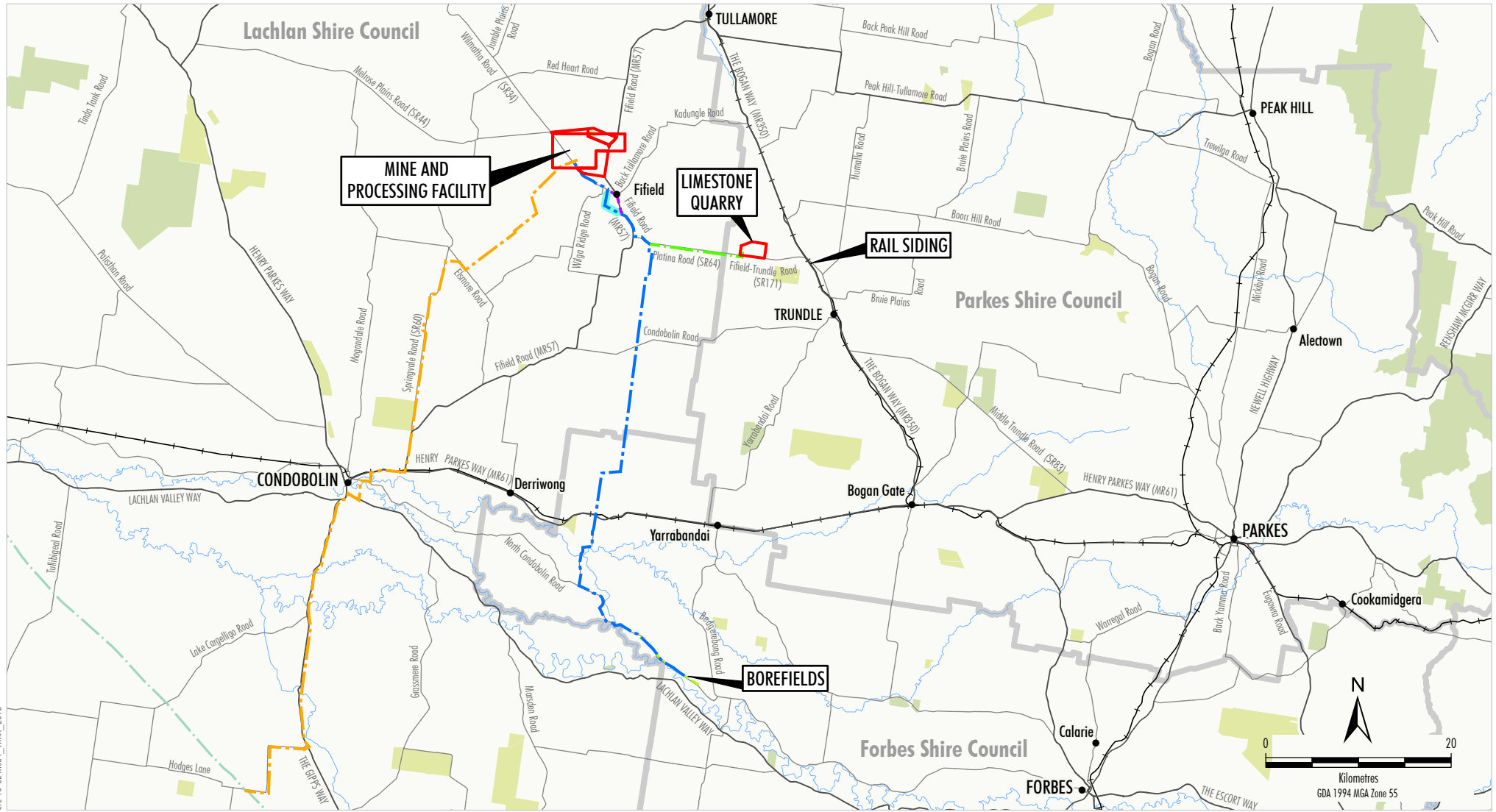
nickel/cobalt/scandium project. Modification 3 to DA 374-11-00, to allow for the production of scandium oxide, was approved in May 2017.

1.2 Previous studies

Golder Associates Pty Ltd (Golder) has conducted a number of surface water, groundwater and geotechnical studies within the Project area between 1999 and 2016 (listed in Table 1).

Table 1: Previous Golder reports

Year	Report	Title	Submitted to
March 2000	99631001-A	Regional Hydrogeology	Black Range Minerals (BRM)
	99631001-B	TSF Geotechnical Investigations	BRM
	99631001-C	Surface Hydrology	BRM
	99631001-D	Plant Site and Mine Geotechnical Investigations	BRM
	99631001-E	TSF Water balance	BRM
	99631001-F	TSF Design	BRM
	99631001-G	TSF Seepage	BRM
June 2005	011-04631030	RSF Design	Ivanplats
April 2015	004-1524361	Ground and Other Water Supply Review	Clean TeQ Metals
June 2015	011-1524361	Update Geotechnical and Residue Disposal Designs	Clean TeQ Metals
December 2016	021-1524361	Groundwater Monitoring Bore Assessment	Clean TeQ Metals



LEGEND

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

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

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SYERSTON PROJECT MODIFICATION 4

Regional Location

Figure 1

2.0 DESCRIPTION OF THE MODIFICATION

2.1 Modification overview

The Modification involves the implementation of the opportunities identified following completion of an optimisation study and would include:

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

The Modification would not involve changes to any aspects of the approved limestone quarry, rail siding or gas pipeline.

A detailed description of the Modification is provided in the Environmental Assessment main text. A summary of the key water-related Project changes is provided in the remainder of this section.

2.2 Mine site general arrangement

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

- Mine infrastructure area components would be relocated to avoid potential resource sterilisation and improve operational efficiency

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

- Increased tailings storage facility footprint (capacity) to hold increased tailings volume due to the additional limestone required for acid neutralisation
- Reduced evaporation pond footprint (capacity) due to the recycling of process water
- An explosives magazine would be constructed north of the diversion dam
- Minor alterations would be made to on-site water management infrastructure (e.g. sediment dams, pipelines, diversions) to account for the modified layout and increased water recycle on-site.

The general arrangement of the modified mine and processing facility is provided in Figure 2.

Progressive general arrangements of the modified mine and processing facility are provided in Figure 3 to Figure 6.

2.3 Mining operations

The Modification would include mining in a more selective manner to initially increase the processing facility ore feed grade.

The Modification would not however change the approved mining areas (i.e. open cut pit extents), mining method or mining rate.

2.4 Processing operations

The Modification would include the adoption of the RIP processing method (i.e. the counter current decantation processing method option is no longer proposed).

Other changes to the mine processing facility would include:

- Increased sulphur and sulphuric acid demand to leach additional nickel, cobalt and scandium from the higher grade ore
- Increased limestone demand to neutralise the additional acid required in the acid leach circuit
- Addition of a crystalliser to the processing facility to extract ammonium sulphate from an existing waste stream for use as a fertiliser product
- Addition of a water treatment plant to the processing facility to recycle process water and minimise make-up water demand (Section 2.5).

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

2.5 Water treatment plant

The water treatment plant would allow process water to be recycled from the tailings storage facility and final neutralisation thickener for use in the processing facility.

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

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

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

The treated process water would then be transferred to the start of the processing facility and used as a substitute for raw water.

2.6 Tailings management

2.6.1 Tailings storage facility

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

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

The design of the modified tailings storage facility would conform to the relevant guidelines and requirements described in Condition 29, Schedule 3 of Development Consent DA 374-11-00. This includes the requirements for permeability of liners, storage capacity and DSC design requirements. Further details of the tailings storage facility are provided in Section 6.1.

2.7 Tailings storage facility water management

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

Supernatant waters (including incident rainfall) decanted from the tailings storage cells would be pumped to the water storage dam for reuse in the processing facility. Prior to reuse, a portion of the returned water would be directed to the water treatment plant at the processing facility (Section 2.5) for treatment.

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

Due to the reduction in water volume reporting to the evaporation pond, the footprint of the ponds would be reduced.

The tailings storage facility and water storage dam would be operated to maintain a freeboard storage, above the level of the decant pond, in excess of that required to store the volume of runoff generated from a 1 in 100 year ARI rain event of 72 hours duration, in accordance with Condition 29, Schedule 3 of Development Consent DA 374-11-00. The tailings storage facility decant system would be designed to remove the quantity of water generated by a storm of this magnitude within a reasonable timeframe of the event occurring, with water sent directly to the water storage dam.

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

2.8 Site water management

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

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

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

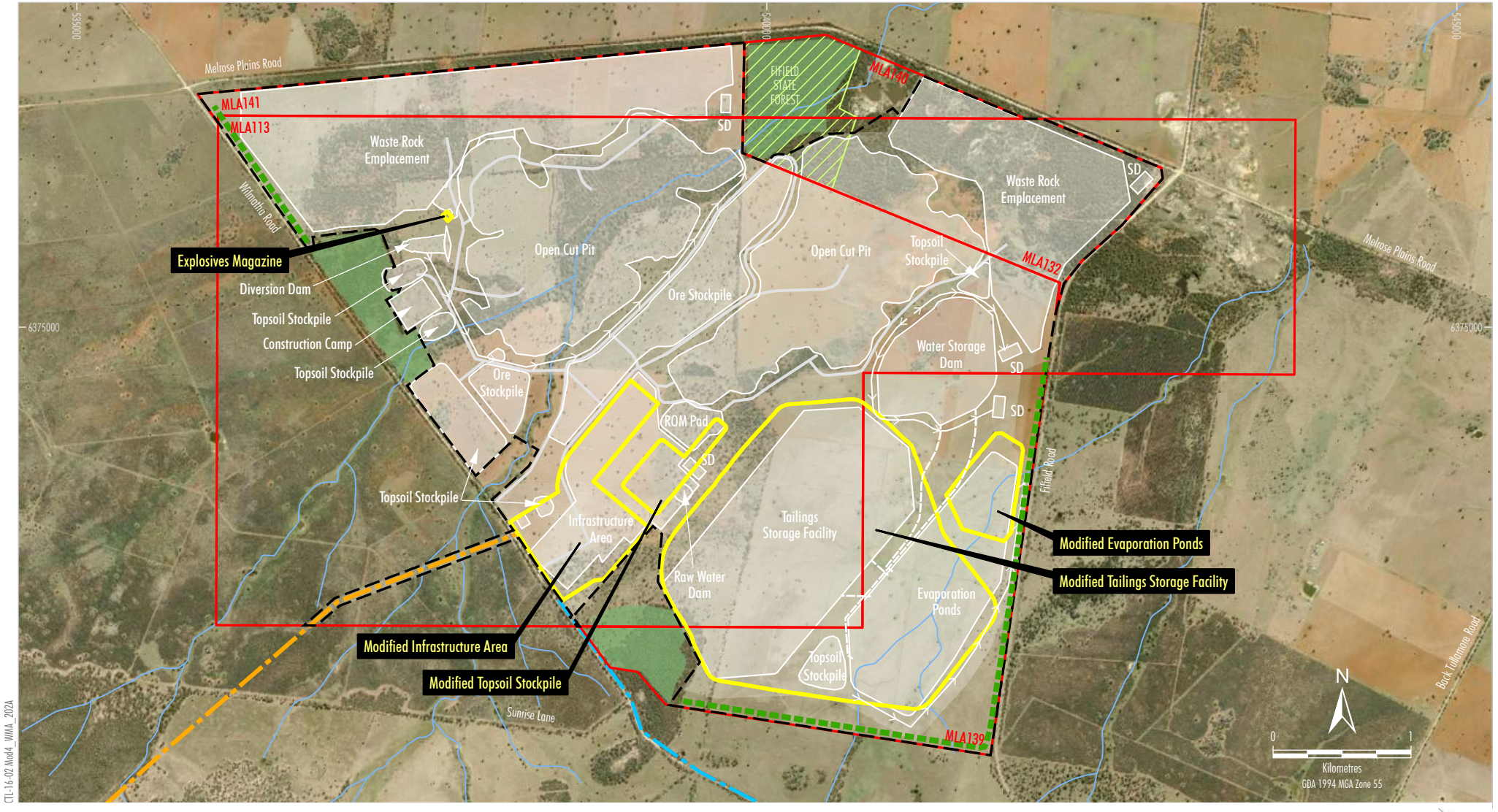
Some existing drainage paths will require diversion around the northern open cut pit and evaporation ponds into exiting drainage lines by development of the northern and southern diversion structures, respectively. The design would consider long term stability and compatibility with existing hydrological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

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

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

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

The site water management system for the modified Project would be generally unchanged. The southern diversion alignment would be revised to reflect the modified tailings storage facility and evaporation ponds (Figures 3 to 6).



CTL-16-02 Mod4_WMA_202A

LEGEND

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

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

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

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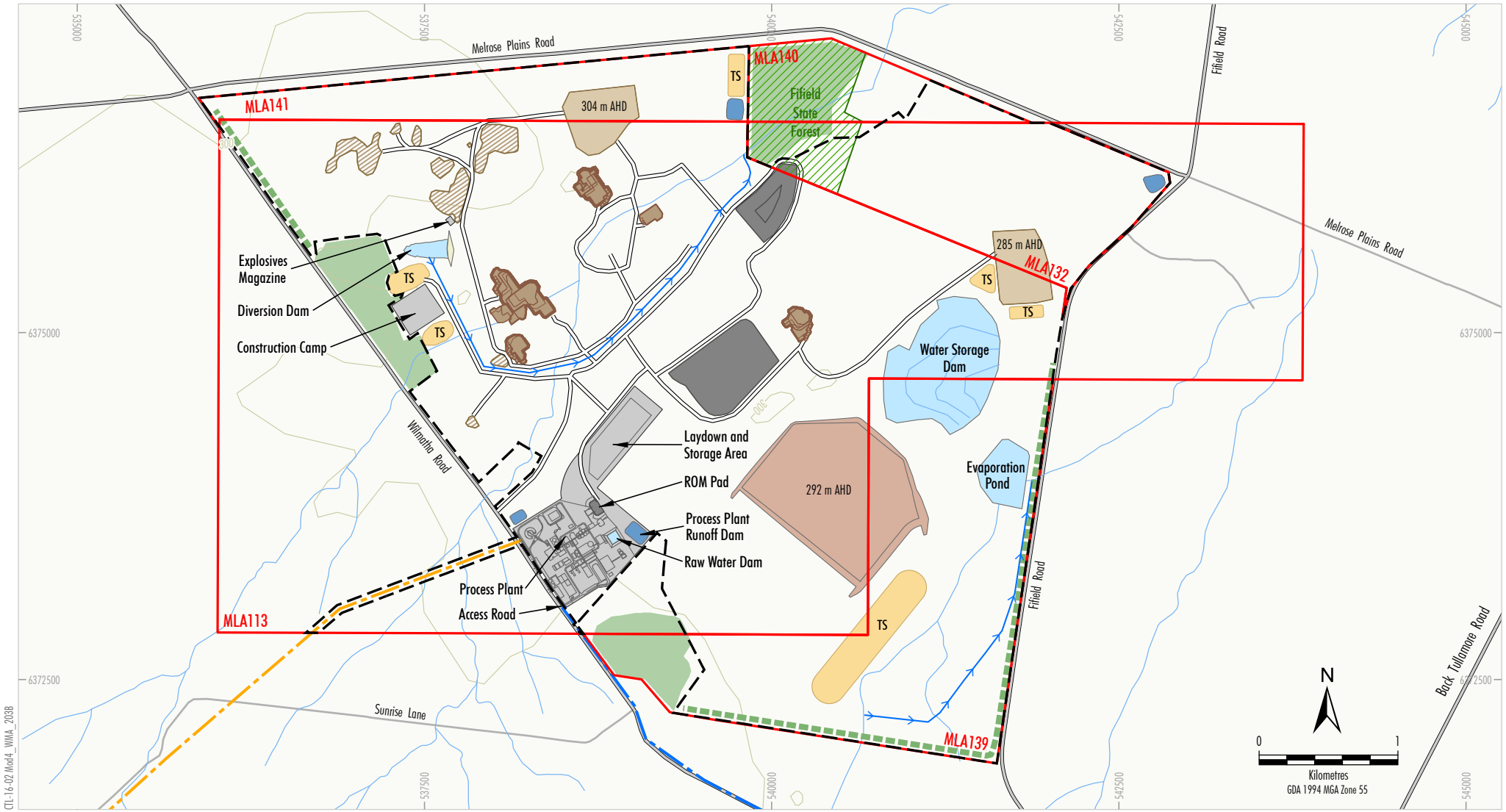
SYERSTON PROJECT MODIFICATION 4

Indicative Modified Mine and Processing Facility General Arrangement

Figure 2



CTL-16-02 Mod4_WMA_203B

LEGEND

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

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

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SYERSTON PROJECT MODIFICATION 4

Modified Mine and Processing Facility Conceptual General Arrangement Year 1

Figure 3

CTL-16-02 Mod4_WMA_205B

LEGEND

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

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

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SYERSTON PROJECT MODIFICATION 4

Modified Mine and Processing Facility Conceptual General Arrangement Year 6

Figure 4

LEGEND

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

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

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SYERSTON PROJECT MODIFICATION 4

Modified Mine and Processing Facility Conceptual General Arrangement Year 11

Figure 5

CTL-16-02 Mod4_WMA_206C

LEGEND

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

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

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SYERSTON PROJECT MODIFICATION 4

Modified Mine and Processing Facility Conceptual General Arrangement Year 21

Figure 6

2.9 Borefield transfer station

The Modification would not change the location of the existing/approved bores in the borefields. However, the transfer station location would be relocated approximately 300 m to the north-west. The relocation of the transfer station would require the realignment of the associated borefield infrastructure corridor, transfer station access road and water pipeline. The layout of the modified transfer station once the water pipeline has been commissioned is shown in Figure 8.

During construction and prior to commissioning of the water pipeline, water would be transported from the borefields to the mine site by road. During this period, the layout of the transfer station would include water tanks, a truck filling pump and a turning circle to allow water trucks to enter and leave the transfer station easily. The layout of the modified borefields and transfer station prior to commissioning of the water pipeline is shown on Figure 7.

2.10 Lachlan River surface water extraction

To improve the water supply security of the Project, it is proposed to diversify supply sources by including extraction of surface water from the Lachlan River.

A pump station would be constructed near the Lachlan River to extract surface water and pump it to the approved water pipeline. An underground pipeline would connect the pump station to the river.

The indicative location of the pump station is shown on Figure 7 and the conceptual design of the pump station is shown on Figure 9.

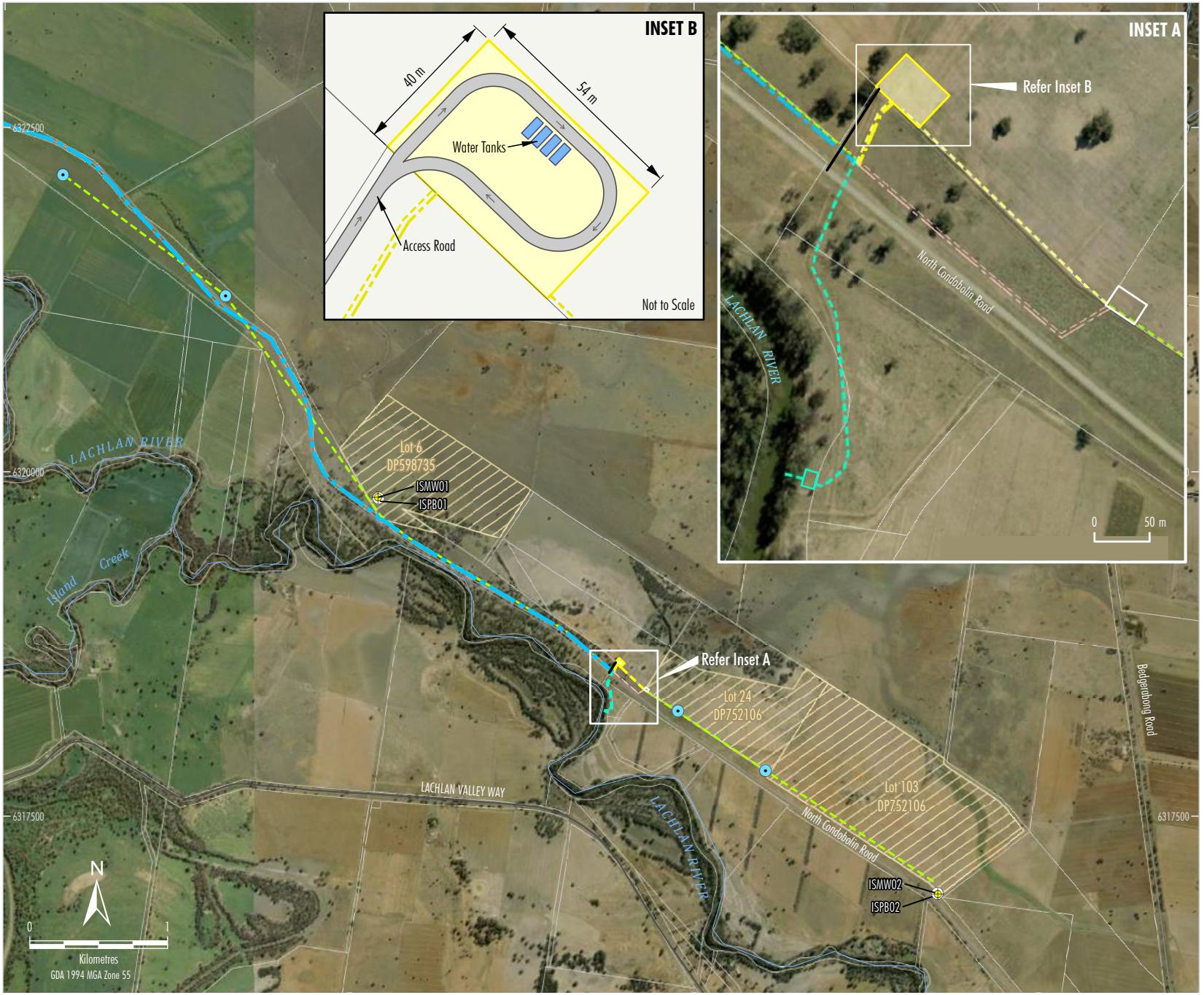
The pump station would be connected to the transfer station via a linking pipeline. The indicative alignment of the linking pipeline (within the surface water extraction infrastructure corridor) is shown on Figure 7.

Relevant water licences to allow for the extraction of surface water from the Lachlan River would be obtained, as described in Section 3.3.1.

2.11 Water pipeline

A road safety audit would be conducted to determine road upgrades required for the modified Project. If the road safety audit determines that the approved Fifield Bypass is not required, an alternative transport route may be selected. In the event this occurs, the approved water pipeline alignment may be modified to follow existing road reserves rather than following the alignment of the approved Fifield Bypass.

The capacity of the water reticulation system would be unchanged.



LEGEND

- Property Boundary
- Approved Project
- Transfer Station
- Water Pipeline
- Borefield Infrastructure Corridor *
- Potential Borefield Location
- Approximate Location of Production Bore (not constructed)
- Production Bore (constructed)
- Monitoring Bore
- Modified Project
- Transfer Station
- Pump Station
- Access Road
- Water Pipeline
- Borefield Infrastructure Corridor *
- Surface Water Infrastructure Corridor *
- Approved Water Pipeline Section no longer required
- Approved Borefield Infrastructure Corridor section no longer required

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

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

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

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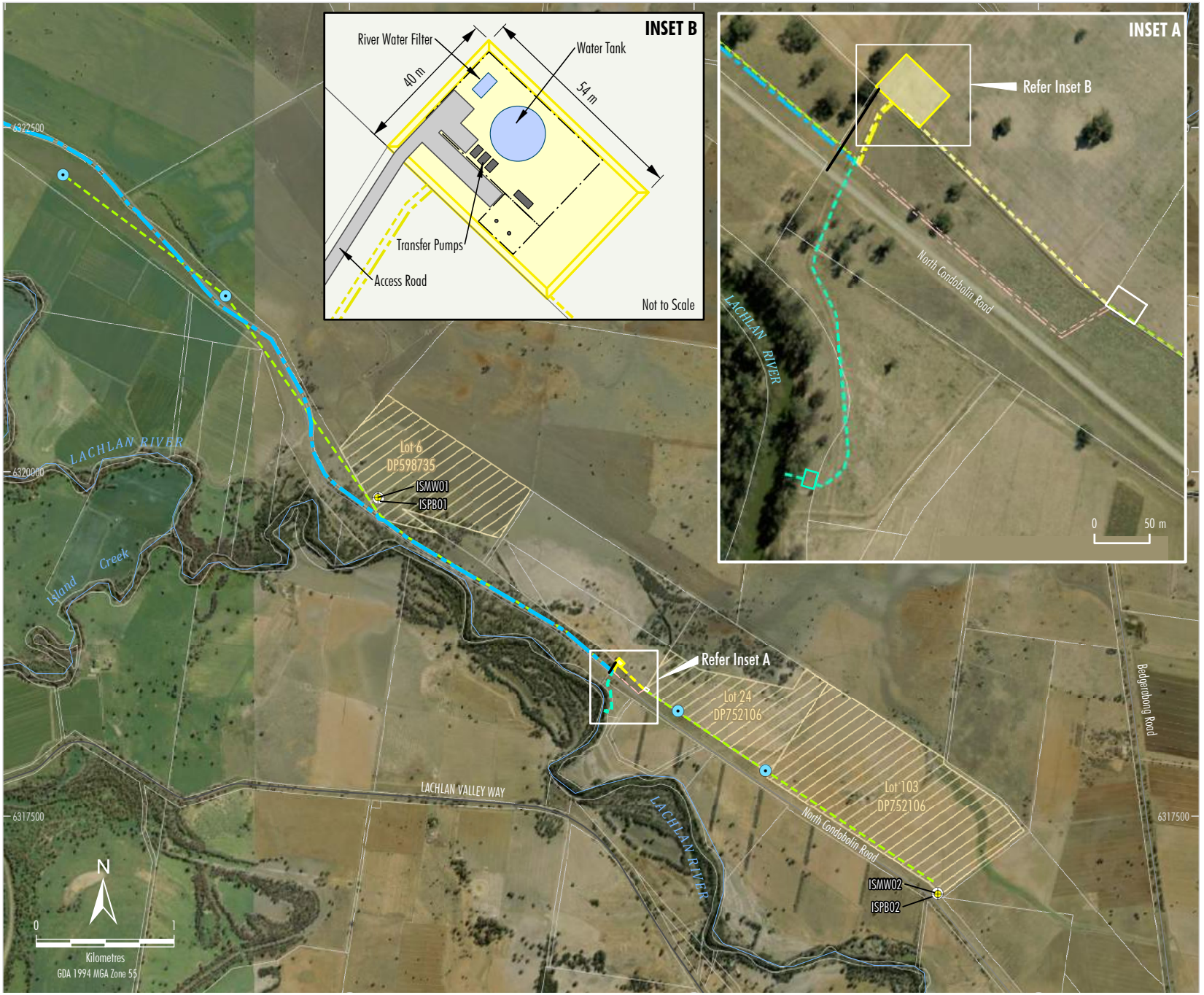
SYERSTON PROJECT MODIFICATION 4

Modified Borefields and Surface Water Extraction - Pre Water Pipeline Commissioning

Figure 7

CTL-16-02 Mod4_WMA_207A



LEGEND

- Property Boundary
- Approved Project
- Transfer Station
- Water Pipeline
- Borefield Infrastructure Corridor *
- Potential Borefield Location
- Approximate Location of Production Bore (not constructed)
- Production Bore (constructed)
- Monitoring Bore
- Modified Project
- Transfer Station
- Pump Station
- Access Road
- Water Pipeline
- Borefield Infrastructure Corridor *
- Surface Water Infrastructure Corridor *
- Approved Water Pipeline Section no longer required
- Approved Borefield Infrastructure Corridor section no longer required

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

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

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

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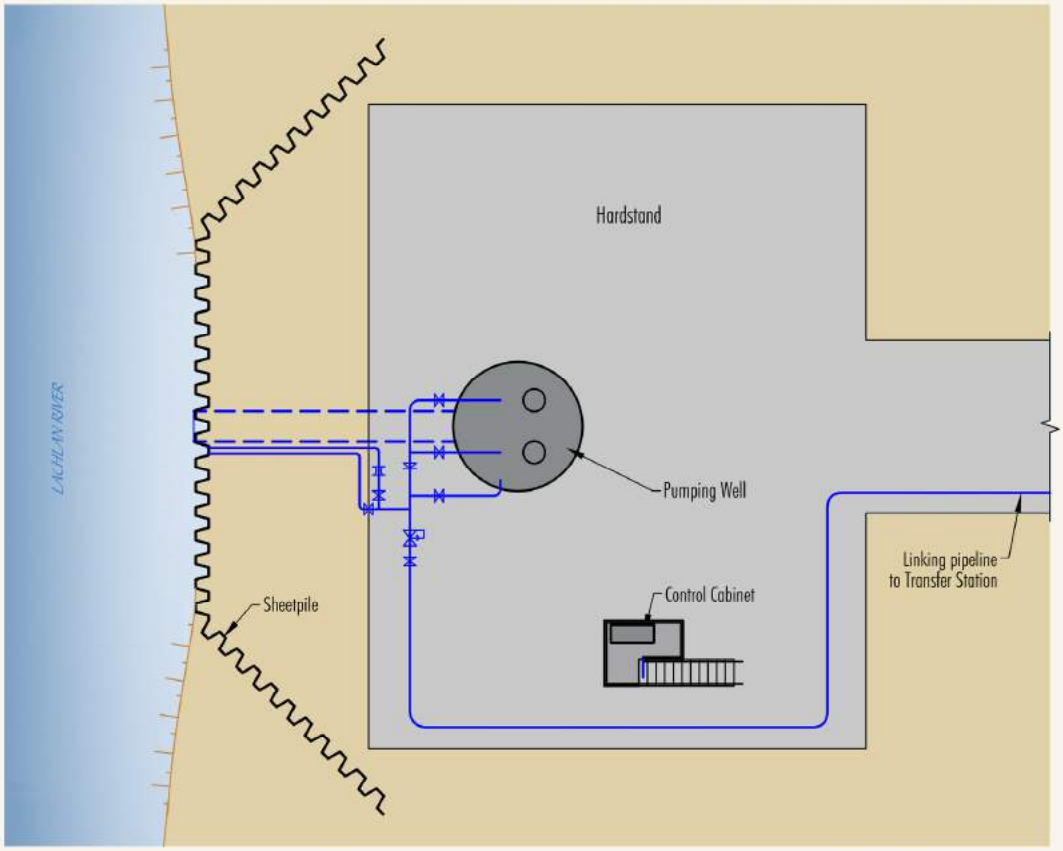
SYERSTON PROJECT MODIFICATION 4

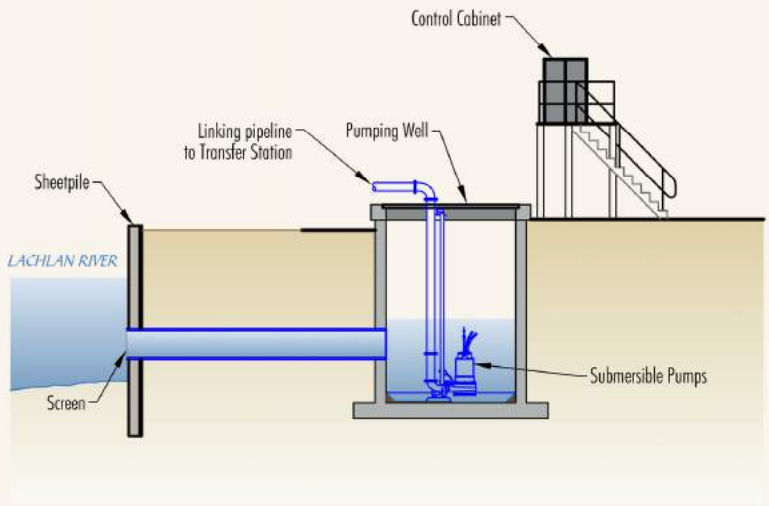
Modified Borefields and Surface Water Extraction - Post Water Pipeline Commissioning

Figure 8

CTL-16-02 Mod4_WMA_208A



PLAN



ELEVATION

Not to Scale

CTL-16-02 Mod4 MWA_101A

Source: Clean TeQ (2017)

SYERSTON PROJECT MODIFICATION 4

Surface Water Extraction Layout

Figure 9

3.0 REGULATORY FRAMEWORK

3.1 NSW Legislation that applies to Syerston Project Modification 4

The EP&A Act is administered by the NSW Department of Planning and Environment and is the principal piece of legislation regulating land use in NSW. The EP&A Act institutes a system of environmental planning and assessment for developments in NSW.

Some types of development, such as mining and extraction operations, are determined to be State Significant Development (SSD) due to their size, economic values or potential impacts. These types of development are assessed by the NSW Department of Planning and Environment. A request to the Minister to modify an SSD approval can be sought for development where approval has been granted. The Project was approved under Part 4 of the EP&A Act in 2001 by development consent under Division 4 of Part 4 of the EP&A Act, which relates to SSD.

3.2 Local government regulatory provisions

Environmental Planning Instruments (EPIs) collectively refers to Local Environmental Plans (LEPs), State Environmental Planning Policies (SEPPs), and Regional Environmental Plans (REPs). The provisions of the EPIs are legally binding on both government and developers.

3.2.1 Lachlan local environmental plan 2013

The mine and processing facility, Fifield bypass, natural gas pipeline and parts of the water supply pipeline components of the Project fall within the boundary of the Lachlan local government area (LGA).

The proposed changes to the water management system at the mine and processing facility are described in Section 2.0.

No changes to the Fifield bypass, natural gas pipeline the parts of the water supply pipeline within Lachlan LGA are proposed for Modification 4.

3.2.2 Forbes local environmental plan 2013

The water supply borefields and parts of the water supply pipeline components of the approved Syerston Project are located in the Forbes LGA.

The proposed changes to the borefield infrastructure layout (i.e. transfer station and surface water extraction point) are described in Section 2.0.

3.3 Management of water resources for mining projects in NSW

The *Water Management Act 2000* provides for managing the state's water resources through water sharing plans (WSPs). These are used to set out the rules for the sharing of water in a particular water source between water users and the environment and facilitate water trading in a particular water source.

Water sharing plans have commenced under the *Water Management Act 2000* for all groundwater and surface water systems within which the Project lies. Accordingly, the *Water Act 1912* is not relevant to licensing considerations for the Project and WSPs are in place for all water sources within the Project area.

The following WSPs are applicable to the mine (including processing facility) area:

- Water Sharing Plan for the Macquarie Bogan Unregulated and Alluvial Water Sources 2012
- Water Sharing Plan for the NSW Murray Darling Basin Fractured Rock Groundwater Sources 2011.

While these WSPs are applicable to the borefield and surface water extraction point:

- Water Sharing Plan for the Lachlan Regulated River Water Source 2016
- Water Sharing Plan for the Lachlan Unregulated and Alluvial Water Sources 2012.

Water extraction requires an authorisation under a water access licence (WAL) which contains an associated water allocation account. The primary regulatory instruments of the *Water Management Act 2000* are the WALs, water use approvals, water management use approvals, controlled activity approvals and aquifer interference activity approvals.

Further details for each of the WSPs applicable to the Project are provided in Section 3.3.1.

3.3.1 Water sharing plans applicable to the Project

The WSPs will be the key documents to manage water extraction, use and trading because it sets a limit on long-term average annual diversions and governs how water is managed (DPI Water, 2016). Water sharing plans manage the extractions within the long-term average annual extraction limit (LTAAEL), thereby maintaining all water in excess of the LTAAEL for the environment. In doing so, it aims to support viable and sustainable water dependent industries over the long-term.

3.3.1.1 Water sharing plan for the Macquarie Bogan Unregulated and Alluvial Water Sources, 2012

The WSP for the Macquarie Bogan Unregulated and Alluvial Water Sources 2012 covers 30 unregulated surface water sources that are grouped into one EMU and four alluvial groundwater sources (DPI Water, 2012b).

The mine and processing facility is located within the mapped extent of the Upper Bogan River Water Source, within the Macquarie Bogan Unregulated Rivers EMU. The Project is not located within nor proximal to the four alluvial groundwater sources and therefore they are not discussed any further in this report.

Water source extraction limits and licensing

As discussed in Sections 3.3.2 and 3.3.4, Clean TeQ would not require licensing for surface waters at the mine as:

1) Exemptions under the *Water Management (General) Regulation 2011* would apply; and

2) The runoff water captured by undisturbed areas between the proposed up-catchment diversion structures and the ultimate extent of the Project disturbance boundary would be within the estimated Harvestable Right available to Clean TeQ (based on total contiguous landholdings).

Notwithstanding, it is noted that there are currently 26 WALs issued in the Upper Bogan River Water Source. A total of 14 WALs relate to unregulated river access licences (including one special additional high flow) with a total share component of 1 645 shares (or MLs, based on an AWD of 1).

Water trading records on the NSW Water Register for unregulated river access licences in the Upper Bogan River Water Source show that trades (up to 309 unit shares) have occurred in the past within the Upper Bogan River Water Source.

3.3.1.2 Water sharing plan for the NSW Murray Darling Basin Fractured Rock Groundwater Sources 2011

Fractured rock and porous rock groundwater sources for the mine are covered by the WSP for the NSW Murray Darling Basin Fractured Rock Groundwater Sources 2011, which commenced on 16 January 2012.

The WSP for the NSW Murray-Darling Basin Fractured Rock Groundwater Sources 2011 covers 10 groundwater sources that make up an area of approximately 24 404 000 ha, and includes the Lachlan Fold Belt MDB Groundwater Source (DPI Water, 2012c).

Water source extraction limits and licensing

The Lachlan Fold Belt MDB Groundwater Source covers a large area of 16 722 000 ha. The LTAAEL for the Lachlan Fold Belt MDB Groundwater Source is 875 652 ML/year.

Groundwater extracted by in-pit (or advance) dewatering from the mine pit (and immediate surrounds) is located in the Lachlan Fold Belt MDB Groundwater Source. As described in Section 8.1.2, in-pit dewatering is expected to be negligible over the life of the Project.

Notwithstanding, Clean TeQ currently holds WAL 28681 in the Lachlan Fold Belt MDB Groundwater Source (Lachlan Fold Belt MDB [Other] Management Zone), for 243 share components under the WSP for the NSW Murray Darling Basin Fractured Rock Groundwater Sources 2011 for the mine pit should the deepest areas intercept any groundwater. Under this WAL water may be extracted at any time and at any rate subject to a number of conditions relating to the "taking of water" specified in Table 2.

Table 2: WAL Conditions for WAL28681

Condition	Take of Water
MW0716-00001	The maximum volume of water that may be taken under this licence in any water year must not exceed a volume equal to: a) the sum of water allocations accrued to the water allocation account for this licence from available water determinations in that year; plus b) the water allocations carried over from the water year prior to that water year; plus c) the net amount of any water allocations assigned to or from the water allocation account for this licence under section 71T of the Act; plus d) any water allocations re-credited to the water allocation account for this licence in accordance with section 76 of the Act in that water year.
MW0631-00001	Water must not be taken under this access licence otherwise than in compliance with the conditions of the nominated water supply work approval.
Additional Condition	
MW0718-00001	The maximum water allocation that may be carried over in the water allocation account for this access licence from one water year to the next is either: a) 10 % of the access licence share component for access licences with share components expressed as ML/year; or b) 0.1 ML per unit share of access licence share component for access licences with share components expressed as a number of unit shares.

3.3.1.3 Water sharing plan for the Lachlan Unregulated and Alluvial Water Sources 2012

The WSP for the Lachlan Unregulated and Alluvial Water Sources 2012 (the Lachlan Unregulated WSP) covers 23 unregulated surface water sources that are grouped into one extraction management unit (EMU), and two alluvial groundwater sources (Upper Lachlan and Belubula Valley) (DPI Water, 2012a).

Water source extraction limits and licensing

The LTAAEL for the Upper Lachlan Alluvial Groundwater Source is 94 168 ML/year.

The approved water supply borefield would extract groundwater from within Zone 5 of the Upper Lachlan Alluvial Groundwater Source.

Clean TeQ currently hold a WAL (Number: 32068) for the Upper Lachlan Alluvial Groundwater Source (Upper Lachlan Alluvial Zone 5 Management Zone), with a maximum share component of 3 154 units (ML).

Under this WAL water may be extracted at any time and at any rate subject to a number of conditions relating to the "taking of water" specified in Table 3.

Table 3: WAL Conditions for WAL32068

Condition	Take of Water
MW0010-00006	The maximum water allocation that may be carried over in the account for this access licence from one water year to the next water year is 0.2 ML/unit share of the share component of the licence.
MW0605-00001	Water must be taken in compliance with the conditions of the approval for the nominated work on this access licence through which water is to be taken.
MW0547-00001	The total volume of water taken under this licence in any water year must not exceed a volume equal to: a) the sum of water in the account from the available water determination for the current year, plus b) the water carried over in the account from the previous water year, plus c) the net amount of water assigned to or from the account under a water allocation assignment, plus d) any water re-credited by the Minister to the account.

There are currently 371 WALs issued for aquifer access licences in the Upper Lachlan Alluvial Groundwater Source, with a total share component of 172,722.5 shares (or MLs, based on an AWD of 1).

Water trading records on the NSW Water Register for aquifer access licences in the Upper Lachlan Alluvial Groundwater Source in the past water year show that trades (up to 2,000 unit shares) have occurred.

3.3.1.4 Water sharing plan for the Lachlan Regulated River Water Source 2016

The *Water Sharing Plan for the Lachlan Regulated River Water Source 2016* (NSW) (the LRRWS WSP) was made under section 50 of the *Water Management Act 2000* and commenced on 1 July 2016.

Water source extraction limits and licensing

The LTAAEL stated in the LRRWS WSP is estimated to be 305 000 ML/year. By limiting long-term average annual extractions to an estimated 305 000 ML/year, the LRRWS WSP ensures that approximately 75% of the long-term average annual flow in this water source (estimated to be 1 212 000 ML/year) will be preserved and will contribute to the maintenance of basic ecosystem health.

The LRRWS WSP establishes a bulk access regime which determines how much water will be available for extraction by all licensed water users within the plan. Generally, new WALs for mining and other commercial purposes are no longer being granted. Instead, operators need to purchase an existing licence on the water market. However, the LRRWS WSP allows for an application to be made for a new specific purpose WAL or a zero share component WAL, if required. The water access licence must hold sufficient share component and water allocation to account for the take of water from the relevant water source at all times.

Any surface water extraction from the Lachlan River resulting from Modification 4 will need to hold sufficient water allocation via WALs.

As demonstrated below in Section 3.3.1.5 by the available share components in the Lachlan Regulated River Water Source, history of available water determinations orders and recent water trading statistics, while the water market is variable (availability subject to significant rainfall events), it is mature (administered since 2004) and has significant depth of available shares for trading.

3.3.1.5 Water trading market

Water markets are able to ensure the efficient allocation of water resources to the benefit of end users. Water trading provides the flexibility necessary to adapt to changeable conditions by providing a critical tool for the management of water supply, production, and risk. The Lachlan River forms part of the Northern Murray-Darling Basin that also includes the Macquarie, Namoi, Peel, Gwydir, and Border-Rivers Systems. Hydrologically isolated from each other, these systems vary in the extent of their development and how active the water markets are in each individual system. They also experience differences in water availability such that allocation prices can differ substantially between systems. Some northern systems also have differences in their storage capacity, which can further influence prices (Aither, 2017).

Surface water allocation markets have been well developed in the northern systems with trade having been observed since 2004–05. Significant volumes were traded in 2005-06, before declining through to 2009–10. Allocation trade volumes increased substantially to the highest observed volumes in 2012–13, before declining to 2015–16. By volume, the Macquarie and Lachlan systems tended to experience the most trade. Groundwater allocation markets are also active, with trade observed since 2006–07. Groundwater trade levels were at their lowest in 2011–12 but increased to among the highest overall levels during 2015–16. The Lachlan has tended to display the greatest volume of groundwater allocation trade to date (Aither, 2017).

For example, it was estimated at the time of commencement of the WSP for the Lachlan Regulated River Source 2016, the share components of regulated river (high security) access licences authorised to take water from the Lachlan Regulated River Water Source totalled 27 680 unit shares. It was estimated at the time of commencement of the WSP for the Lachlan Regulated River Source 2016, the share components of regulated river (general security) access licences authorised to take water from the Lachlan Regulated River Water Source total 592 801 unit shares.

It is noted that available water determination (AWD) orders are regularly made and applied to water sources to which the WSP for the Lachlan Regulated River Source 2016 applies. Records of past orders made under the *Water Management Act 2000* for regulated river (general security) and regulated river (high security) access licences since replacement of the *Water Sharing Plan for the Lachlan Regulated River Source 2016* on 1 July 2016 are summarised in Table 4. Review of these records show that high security access licences have been at 100% utilisation, whereas general security access licences are variable (i.e. subject to significant rainfall events). Water trading in this WSP area occurred regularly with eight trades for regulated river (high security) access licences comprising of 1 113 share components and 61 trades for regulated river (general security) access licences comprising of 35 738 share components since 1 July 2016.

Table 4: AWD orders for the Lachlan River Regulated Water Source since 1 July 2016

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)	0.02 ML
Various NSW Regulated River Water Sources (No. 2) 2017	27June 2017	Regulated River (High Security)	1.0 ML
		Regulated River (General Security)	0.0 ML
Lachlan Regulated River Water Source 2016-2017	15 June 2017	Regulated River (General Security)	0.02 ML
	10 April 2017	Regulated River (General Security)	0.05 ML
	5 September 2016	Regulated River (General Security)	0.09 ML
	5 August 2016	Regulated River (General Security)	1.15 ML

AWD Order	Commenced	Category of Access Licence	Volume per Unit of Access Licence Share Component
	15 July 2016	Regulated River (General Security)	0.25 ML
Various NSW Regulated River Water Sources (No. 2) 2016	29 June 2016	Regulated River (High Security)	1.0 ML
		Regulated River (General Security)	0.18 ML

Water within the Lachlan River catchment is mostly issued to General Security[2] water entitlement licence[3] holders, which comprise 89 per cent (592 801 ML) of the total amount of available entitlement. High Security[4] water entitlement licence holders form 4 per cent of the total resource on issue. Due to hydrological isolation, water entitlements are infrequently traded. However, there is comparatively more activity in the WAL market, which displays good trade volumes and prices throughout most years. Groundwater trade markets display only modest activity (Aither, 2017; DPI Water, 2016b). A summary of the entitlements for the 2016–2017 year for the Lachlan River catchment is given in Table 5.

Table 5: Entitlements on issue for Lachlan Catchment Water Systems, 2016-17 (Aither, 2017)

Entitlement Type	Number of Entitlements	Total Volume of Entitlement (ML)	Proportion of Total Entitlement on Issue (%)	Environmental Water Holdings (ML)	Proportion of Total Entitlement held by Environment (%)
Lachlan Regulated River Water Source					
General Security	823	592 801	89%	124 518	21%
High Security	175	27 680	4%	2 638	10%
Local Water Utility	9	15 545	2%	0	0%
Domestic & Stock	584	12 762	2%	0	0%
Conveyance	1	17 911	3%	0	0%
Total	1 592	666 700	100%	127 156	19%
Lower Lachlan Groundwater Source					
Aquifer	91	105 680	81%	0	0%
Local Water Supply	5	2 922	2%	0	0%
Supplementary	44	21 237	16%	0	0%
Total	140	129 839	100%	0	0%

[2] General Security licences are the last to receive allocations and are therefore the least secure licence category. They can start the year with low or zero allocation and typically receive incremental improvement as the year unfolds commensurate with rainfall and runoff. General security licences are the most susceptible to seasonal climatic variations (DPI Water, 2016b).

[3] Main licence categories in approximate order of priority are: Domestic & Stock, Town Water Supply, High Security, Conveyance, General Security (DPI Water, 2016b).

[4] Full or near full High Security allocations are made at the start of all but the very dry years and Conveyance allocation is made commensurate with other allocations (DPI Water, 2016b).

Northern Murray-Darling Basin surface water allocation trade volumes are depicted in Figure 10. There is an apparent trend showing the volume of trade being somewhat correlated to water allocations, but the inverse is not true (i.e. the volume of trade is high when allocation levels are high – such as the wetter period observed from 2010). This trend does not necessarily reflect a greater trade intensity (i.e. the amount of water traded, over the amount that was available) but may simply be due to the fact that there was a greater volume of water available in those years. For example, in years of drought, there is less water available to be transferred, despite there being a high demand for trade (and a corresponding high price). It may be that a greater proportion of water available is traded in drought, but the absolute volume transferred is much smaller than in a year with greater water availability (Aither, 2017).

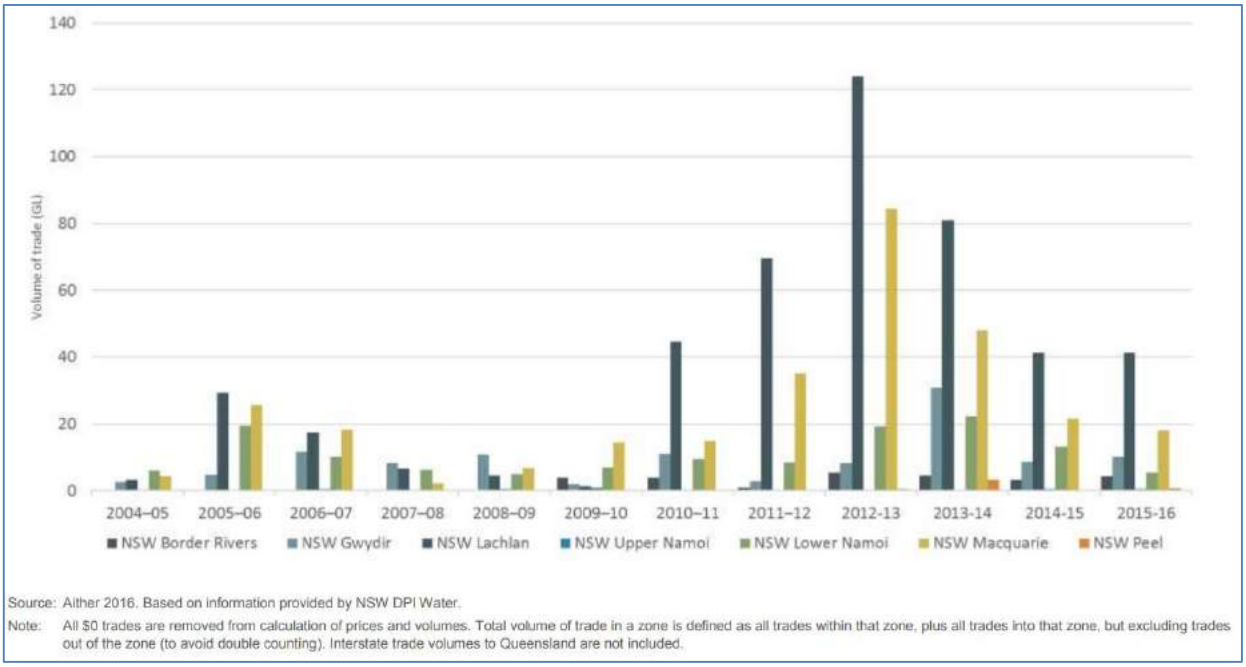


Figure 10: Northern Murray-Darling Basin surface water allocation trade volumes, 2004-05 to 2015-16 (Aither, 2017)

Table 6 outlines the number of discrete WALs in the northern Murray-Darling systems. While a single entity or user can hold several WALs (and WALs can also be combined or split) this table provides a wide indication of the relative potential size of a market within each of the listed systems. A greater number of WALs can potentially support a larger market as there are more counterparties (Aither, 2017).

Table 6: Number of separate WALs involved in allocation trades from 2004-05 to 2015-16 (Aither, 2017)

Region	Number of Separate WALs Involved in Trade 2004-05 to 2015-16[5]
Lachlan	900
Macquarie	689
Namoi	393
Peel	144
Gwydir	187
Border Rivers	219
Hunter	462
Barwon-Darling	59

[5] Based only on surface water allocation trades and excludes within irrigation corporation trades (Aither, 2017).

In summary, the surface water allocation market in the Lachlan River catchment is currently active and relatively mature. Trade is not possible between the Lachlan and other Murray-Darling systems. There have been substantial volumes of annual trade in most of the past ten years (see Figure 10). Prices for allocation water have varied considerably, from record highs in 2007 to record lows in 2010–11 to 2012– 13. This price partly reflects the availability of water for trade (due to climatic variation) rather than trade intensity (Aither, 2017).

3.3.2 Project exemptions from water licensing

The *Water Management (General) Regulation 2011* commenced on 1 September 2011, superseding and consolidating the provisions of two former Regulations; the *Water Management (General) Regulation 2004* and the *Water Management (Water Supply Authorities) Regulation 2004,* with some amendments.

Exemptions that are provided for by the regulation, and may apply to the Project include:

1) Exempt monitoring bores – Allows any person to take water from, or by means of, an exempt monitoring bore for the purposes of measuring water levels, water pressure or water quality. The exemption is given on the basis that these bores take only very minimal amounts of water (if any) for monitoring purposes. The exemption also applies to water supply work approvals in that a water supply work approval is not a requirement for the construction and use of an exempt monitoring bore for measuring level, pressure or water quality purposes.

2) Water bore testing – Exempts any person engaged in the testing of a water bore by means of a pump test if carried out in accordance with either an aquifer interference approval, water supply work approval, or the conditions of an approved project. Testing can take place during the week following completion of the water bore's installation, or during any other period for which such testing is required to be carried out by the relevant approval (NSW Government, 2015).

3) Dams solely for the capture, containment and recirculation of drainage and/or effluent, consistent with best management practice or required by a public authority (other than Landcom or the Superannuation Administration Corporation or any of their subsidiaries) to prevent the contamination of a water source, that are located on a minor stream.

3.3.3 Managing the impacts of extracting water from aquifers

The Water Management (General) Amendment (Aquifer Interference) Regulation 2011 requires mining exploration and petroleum (including coal seam gas) exploration activities that take more than 3 ML of water per year, to hold a WAL. Prior to that, these activities were exempt from needing a WAL (DPI Water, 2012d).

As the Project will interfere with water in an aquifer (e.g. in-pit dewatering, albeit negligible), the Aquifer Interference Policy (AIP) applies. The AIP was developed particularly to address high risk aquifer interference activities such as mining activities and is discussed further in Section 3.3.3.1.

3.3.3.1 Aquifer interference requirements in relation to Modification 4

The AIP requires all water taken by aquifer interference activities to be accounted for within the extraction limits set by the relevant WSP.

The AIP contains two main parts:

i) Licensing the water taken through aquifer interference

ii) The assessment process for aquifer interference activities.

It is a requirement for any mining company to obtain WALs in accordance with the WSP framework to account for the water they take from NSW water resources, including all water taken by aquifer interference activities exceeding 3 ML/year (DPI Water, 2012d).

Aquifer licensing and impact considerations

Water access licences under the *Water Management Act 2000* are not to be granted unless the NSW Minister for Primary Industries is satisfied that adequate arrangements are in place to ensure that the consequences of taking the water will not result in any further than minimal harm to any water.

In the event that there is unassigned water within a water source, an aquifer access licence may be acquired by auction, tender or other means. However unassigned water can only occur where total water requirements within a water source are less than the LTAAEL specified in the relevant WSP.

Aquifer interference approvals are not required under the AIP. Instead, mining projects must take a risk management approach to assessing the potential impacts of an aquifer interference activity. The Policy also details the data and modelling requirements to quantify the impacts associated with an aquifer interference activity. These impacts are assessed by the NSW Office of Water (NOW) by defining minimal impact considerations. Any predicted impact to the water source must be managed through an adaptive management process. If the predicted impact cannot meet specific conditions set by the minimal impact considerations, then further studies are required.

This assessment focuses on the criteria specified by the minimal impact considerations of the AIP, and considers (Section 8.0):

- Licensable takes of water (and their partitioning)
- Intersection of, or proximity to, alluvial deposits
- Water table drawdown
- Pressure head drawdown
- Groundwater quality impacts.

NOW classify groundwater systems as ‘Highly Productive’ and ‘Less Productive’. The AIP (NSW DPI, 2012) states that a groundwater source will be defined as Highly Productive based on the following criteria:

> *a) has total dissolved solids of less than 1 500 mg/L, and*
>
> *b) contains water supply works that can yield water at a rate greater than 5 L/sec.*

The fractured rock aquifers associated with the mine site are considered to be Less Productive as testing of groundwater monitoring bores indicate the yield is less than 5 L/sec. Therefore, the following AIP minimal impact considerations apply for groundwater quality at the mine site:

> *1. Any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40 m from the activity.*
>
> *2. If condition 1 is not met then appropriate studies will need to demonstrate to the Minister’s satisfaction that the change in groundwater quality will not prevent the long-term viability of the dependent ecosystem, significant site or affected water supply works.*

While the AIP requires ‘cumulative assessment’ of groundwater impacts, there are no other known or planned future aquifer interference activities proximal to the mine.

As no changes are proposed for the borefield extraction activities as part of Modification 4, no further consideration of the AIP is made in this report.

3.3.4 Harvestable rights – collecting overland flow

Under the *Water Management Act 2000*, landholders in most rural areas are permitted to collect a proportion of the runoff on their property and store it in one or more dams up to a certain size. This is known as a 'harvestable right'. A dam can capture up to 10 percent of the average regional runoff for their landholding without requiring a licence. The harvestable rights provisions are based on the assumption that the dam capacity is the same as this portion of the annual runoff.

Considering Clean TeQ's total contiguous landholdings of 1 901 ha (Table 7), the DPI Water Harvestable Rights calculator estimates the maximum harvestable right dam capacity (MHRDC) available to Clean TeQ at the Project site as 104.6 ML (Appendix A).

Clean TeQ's landholding includes approximately 12 existing farm dams with an estimated combined total surface area of 1.4 ha. Based on an average depth of 1.5 m, the total capacity of existing farm dams is conservatively estimated at 21 ML. The entire 21ML capacity is held in dams within the proposed mining and mine infrastructure area. Subtracting the capacity of farm dams (21 ML) from the harvestable right (104.6 ML) leaves an available harvestable rights volume of 83.6 ML.

Any runoff from disturbed mine areas that is captured is not required to be considered under harvestable rights. Water that falls on undisturbed areas of the site and is not diverted around the site water management system but captured and used for operational purposes, cannot cumulatively exceed the available harvestable rights volume of 83.6 ML.

Table 7: Maximum Harvestable Right Dam Capacity for Clean TeQ contiguous landholdings

Lot/Plan Number	Tenure	Area (ha)
6 DP745021	Freehold	423.998
7 DP745021	Freehold	377.407
8 DP745021	Freehold	403.310
9 DP745021	Freehold	400.117
10 DP745021	Freehold	296.188
	Total Area	1 901.02

3.3.5 Water resources within the Murray-Darling Basin

Water resource plans (WRPs) are to be developed in NSW as a key commitment under the Commonwealth Murray-Darling Basin Plan (Basin Plan 2012). The WRPs will be a package of documents that will govern how water is managed in each water resource and how compliance with the Basin Plan 2012 is achieved. These documents will include a Water Sharing Plan, Water Quality Management Plan, Risk Assessment and a Long-term Environmental Watering Plan.

A total of 22 WRPs are to be developed for NSW by 2019 as part of the Basin Plan 2012, covering surface and groundwater resources.

Relevant to the Project, there will be one surface water WRP for the Lachlan that covers the Lachlan Regulated River, Belubula Regulated River and Lachlan Unregulated Streams. There will also be one groundwater WRP for the Lachlan that covers the Upper Lachlan Alluvial, Belubula Alluvial and Lower Lachlan Alluvial Groundwater areas.

The Macquarie-Castlereagh WRP and Macquarie-Castlereagh Alluvium WRP will cover the surface and groundwater administered by the current Macquarie Bogan Unregulated and Alluvial Water Sources WSP (Section 3.3.1.1).