BLACK RANGE MINERALS

SYERSTON NICKEL COBALT PROJECT

ENVIRONMENTAL IMPACT STATEMENT

VOLUME 1 – MAIN REPORT

October 2000

ResourceStrategies

ENVIRONMENTAL IMPACT STATEMENT

CONTENTS OVERVIEW

EXECUTIVE SUMMARY

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ES1 INTRODUCTION

The Syerston Nickel Cobalt Project Environmental Impact Statement (EIS) assesses the proposed development of the Syerston nickel cobalt deposit located 4.5 km north-west of the village of Fifield and approximately 45 km north-east of Condobolin in the Central West Region of New South Wales (NSW) (Figure ES-1). The proponent is an Australian publicly listed company, Black Range Minerals Ltd (BRM).

Mineral exploration and mining have been conducted in the Fifield area since the 1860s with gold, platinum, tin and magnesite mining. The development of modern exploration techniques led to regional aeromagnetic survey data being published in 1984, indicating a series of unusual intrusive complexes in the Fifield area. A number of exploration companies identified the complexes as a possible source of the alluvial platinum previously mined in the region. The exploration focus shifted in the late 1980s to concentrate on enriched elements including nickel, cobalt and chromium.

Subsequent developments in pressure acid leach nickel and cobalt extraction methods and on-going exploration has resulted in the identification of a resource at Syerston with significant economic nickel and cobalt mineralisation. In-fill drilling and testwork conducted by BRM has identified a mining reserve at Syerston of 76.8 million tonnes (Mt) graded at 0.73% nickel, and 0.13% cobalt. The Syerston Nickel Cobalt Project was subsequently proposed.

The Project includes the construction, operation and rehabilitation of a nickel cobalt mine, processing facility and related infrastructure. The Project components, associated development application (DA) area and Mining Lease Application (MLA) areas are shown on Figure ES-2 and comprise:

Mine and Processing Facility (MPF)

The MPF site would comprise the majority of the infrastructure and operations associated with the Project. These include:

- the development of an open pit mine, producing an average of 2 million tonnes per annum (Mtpa) of nickel cobalt ore;
- processing ore at an average of some 2 Mtpa, to produce up to 42,000 t of mixed sulphide precipitate or up to 20,000 t of nickel and 5,000 t cobalt metal per annum;
- production of reagents including sulphuric acid, hydrogen sulphide, hydrogen, oxygen and nitrogen for process requirements at the MPF site;
- electricity and steam generation in a gas fired co-generation plant;
- disposal of overburden, process tailings and process water in specifically designed waste emplacements, dams and evaporation ponds; and
- water treatment facilities, administration offices and workshop/maintenance facilities.

Ancillary Components Located Outside the MPF Site

These would comprise:

- a limestone quarry and crushing plant some 20 kilometres (km) south-east of the MPF site, to provide approximately 560,000 tpa of crushed limestone for process neutralisation requirements;
- upgrades of road and rail transport facilities to accommodate transport movements associated with the Project in the vicinity of the mine, including the provision of a dedicated rail siding located some 25 km south-east of the MPF site and a materials transport route between the limestone quarry, rail siding and the MPF;
- provision of up to 6,300 megalitres (ML) per annum of process water from two borefields to the south in the Lachlan Valley Palaeochannel, and an associated water supply pipeline; and
- provision of natural gas for electricity, steam and hydrogen generation via a buried pipeline from the existing Moomba to Sydney Gas Pipeline located south of Condobolin.

A summary of key Project information is provided in Table ES-1.

SYERSTON NICKEL COBALT PROJECT EIS

FIGURE ES-1
Regional Location

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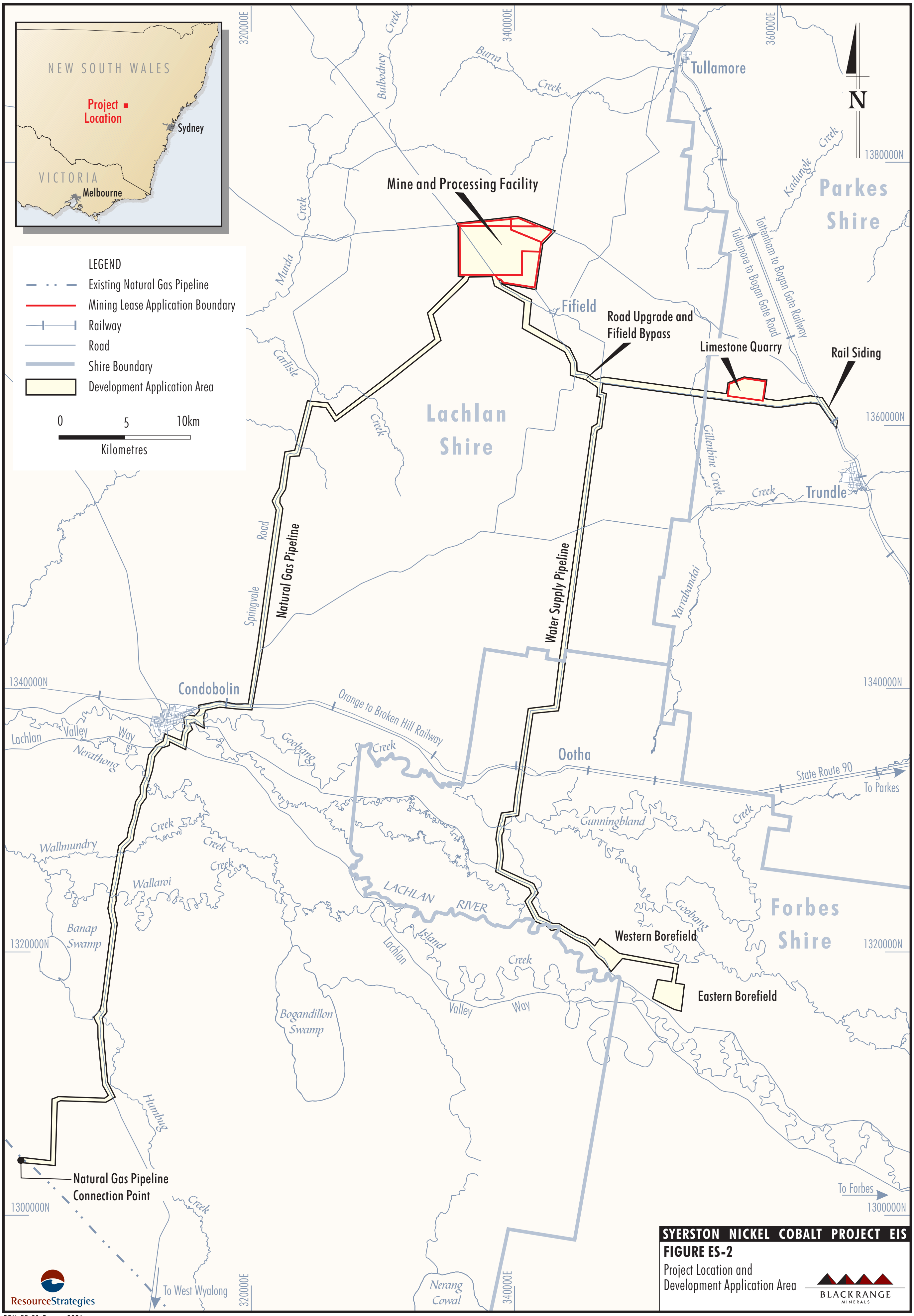

SYERSTON NICKEL COBALT PROJECT EIS

FIGURE ES-2

Project Location and Development Application Area

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Table ES-1
Project Snapshot

Project Development Component	Summary
General	An open pit, nickel cobalt mine employing some 1,000 construction and 400 operational staff.
Proponent	Black Range Minerals Ltd, ACN 009 079 047, Level 10, 17 Castlereagh Street, SYDNEY NSW 2000.
Tenement Status	Exploration tenements for the deposit (EL 4573) and the limestone quarry (EL 5586) held by BRM, who have applied for 4 mining leases at the MPF site and one mining lease at the limestone quarry site, covering a combined area of approximately 3,000 ha.
Mining	Open pit mining operation producing up to 3 Mtpa of ore (average 2 Mtpa). Limestone quarry to provide about 560,000 t of crushed limestone for process requirements.
Processing	Processing via acid leach and ancillary processes to produce up to 20,000 t of nickel and 5,000 t of cobalt per annum or 42,000 t of mixed nickel/cobalt sulphides.
Life of Mine	The current Development Application is for 21 years, however, the size of the mining reserve (approximately 75 million tonnes (Mt)) indicates a mine life of greater than 30 years.
Mine Waste Management	Approximately 125 Mt of mine waste (in the form of overburden) would be deposited in two progressively rehabilitated waste emplacements at the MPF site and one perimeter waste emplacement at the limestone quarry.
Tailings Disposal	Tailings from the Project are to be thickened and deposited in two adjoining specifically designed tailings cells at the MPF site.
Evaporation Ponds and Dams	Non-recyclable process waters to be evaporated from approximately 180 ha of purpose built evaporative ponds and dams at the MPF site.
Power Supply	2.6 petajoules of natural gas per annum to be piped to the MPF site for the production of approximately 34 megawatts (MW) of electricity at an on site power generation facility.
Water Supply	The water demand for the Project of up to 6,300 ML per annum, to be provided by the Lachlan Valley Palaeochannel borefield and pipeline (approximately 65 km).
Transport	Materials for consumption to be either railed to a dedicated rail siding and trucked along the materials transport route to the MPF site or trucked to the MPF site. Limestone from the limestone quarry to be trucked to the MPF site along the materials transport route.
Hours of Operation	Project components would operate 24 hours a day, 7 days per week except mining at the limestone quarry (daytime operation).
Employment	Approximately 300 full time company personnel and 100 permanent contractors during operations.

ES1.1 ENVIRONMENTAL APPROVAL PROCESS

The EIS has been prepared in accordance with the provisions of Part 4 of the *NSW Environmental Planning and Assessment Act, 1979* (EP&A Act) to accompany the development application for the Project. By operation of State Environmental Planning Policy No. 34 (Major Employment Generating Industrial Development) (SEPP 34) the consent authority for the Project is the Minister for Urban Affairs and Planning. The Project is classified as "State Significant Development".

Under the provisions of the EP&A Act, the Director-General of the Department of Urban Affairs and Planning (DUAP) prepared "Director General's Requirements" for the Project EIS.

A summary table of these requirements noting where the requirements are addressed in the EIS is presented in Table ES-2.

Mineral reserve estimates indicate that the life of the Project may extend to more than 30 years. In accordance with regulatory requirements, the EIS describes the Project for a term of 21 years.

Table ES-2
Summary of Director-General's Requirements for the EIS

Specific Issues to be Addressed	Main Text Reference	Appendix Reference
Planning and Environmental Context		
• Planning information and permissibility – description of the planning framework and statutory requirements of other regulatory agencies required for integrated development;	Section I	-
• Site description and locality information; and	Sections I, A1, B1 and C1	-
• Overview of the affected environment in the vicinity of the development, including baseline information.	Sections A3, B3 and C3	Appendices A to O
Full Description of the Development		
• describe the characteristics and economic significance of the resource;	Section A2, B2	Appendix H
• describe the proposed mining method and processing plant;	Section A2, B2	-
• identify if the water and gas pipelines will be addressed in the EIS, and the nature, extent and potential impacts of the proposed locations of additional off site infrastructure necessary to meet the construction and operational requirements of the Project;	Section I, B2, C2, B3, C3, B4, C4	-
• provide plans clearly indicating the location and layout of the disturbance area and all major infrastructure, mine landforms and buildings on the site; and	Sections A2, B2 and C2	-
• consideration of alternatives and justification for the preferred proposal including assessments of the consequences of adopting alternatives.	Section I and C2	-
Analysis of Environmental Impacts and Mitigation Measures		
Potential impacts of the proposal on the environment for the following issues should be addressed in satisfactory detail and suitably quantified.	Sections A4, B4, C4	
• air quality;		Appendix A
• water quality;		Appendices D and E
• noise and vibration impacts;		Appendix K
• transportation impacts;		Appendix C
• visual impact;		Appendix N
• hazard assessment;		Appendix B
• agricultural viability;		Appendix O
• flora and fauna;		Appendices I, JA to JD
• heritage aspects;		Appendices L and M
• economic and social environment; and		Appendices G and H
• rehabilitation.		Appendices A to O
In addition an assessment of the proposed mitigation and management strategies and their effectiveness to mitigate potential impacts during and after the operation should be made.	Sections A5, B5, C5 Sections A4, B4, C4	
Consultation		
The EIS should include details of any consultation with the local community undertaken to date – consideration and review of key issues discerned by the community.	Section I	Appendix C

ES1.2 EIS STRUCTURE

The structure of the EIS reflects the geographical separation of a number of Project elements and is divided into the following parts:

Part A	Mine and Processing Facility;
Part B	Limestone Quarry, Rail Siding and Materials Transport Route; and
Part C	Natural Gas Pipeline, Borefields and Water Supply Pipeline.

Table ES-3 outlines the sections of this Executive Summary which specifically relate to the EIS Parts.

Table ES-3
EIS Parts and Executive Summary Sections

Project Component	EIS Part	Executive Summary Section
MPF	A	ES2
Limestone Quarry, Rail Siding and Materials Transport Route	B	ES3
Natural Gas Pipeline, Borefields and Water Supply Pipeline	C	ES4

ES2 MINE AND PROCESSING FACILITY

ES2.1 PROJECT DESCRIPTION

The major infrastructure components of the MPF include:

- open pits;
- waste emplacements;
- run of mine (ROM) ore and limestone pads;
- ore stockpiles;
- process plant area;
- tailings storage facility;
- evaporation ponds;
- evaporation surge dam;
- topsoil stockpiles; and
- internal roads and haul roads.

Figure ES-3 shows the layout of these components at Year 20 of the Project life.

ES2.1.1 Mining

The development of the Syerston deposit would involve conventional open pit mining methods.

The proposed mine plan includes development of multiple open pits to access areas of shallow high grade ore in the initial stages of the Project. The mineralised zones have been highly weathered and it is expected that the ore would be free dug by excavator. Ore and waste would be loaded directly to haul trucks for transfer to the ROM pad, ore stockpiles or the waste emplacements. Ore would be stockpiled as high and low grade while the open pits are further developed and expanded. Up to 11 open pits would be developed and these would be expanded to form two open pits by Year 20. The ore production rate would be adjusted as necessary to maintain a process plant feed rate of approximately 2.0 Mtpa.

ES2.1.2 Mine Waste Management

Waste material removed from the open pits during mining would be trucked to and stored in two waste emplacements. The emplacements (a western and eastern waste emplacement) would be adjacent to the open pits and located along the north-eastern and north-western MLA boundaries (Figure ES-3). After 21 years the waste emplacements would contain approximately 125 Mt of waste. Waste material would consist predominantly of alluvium.

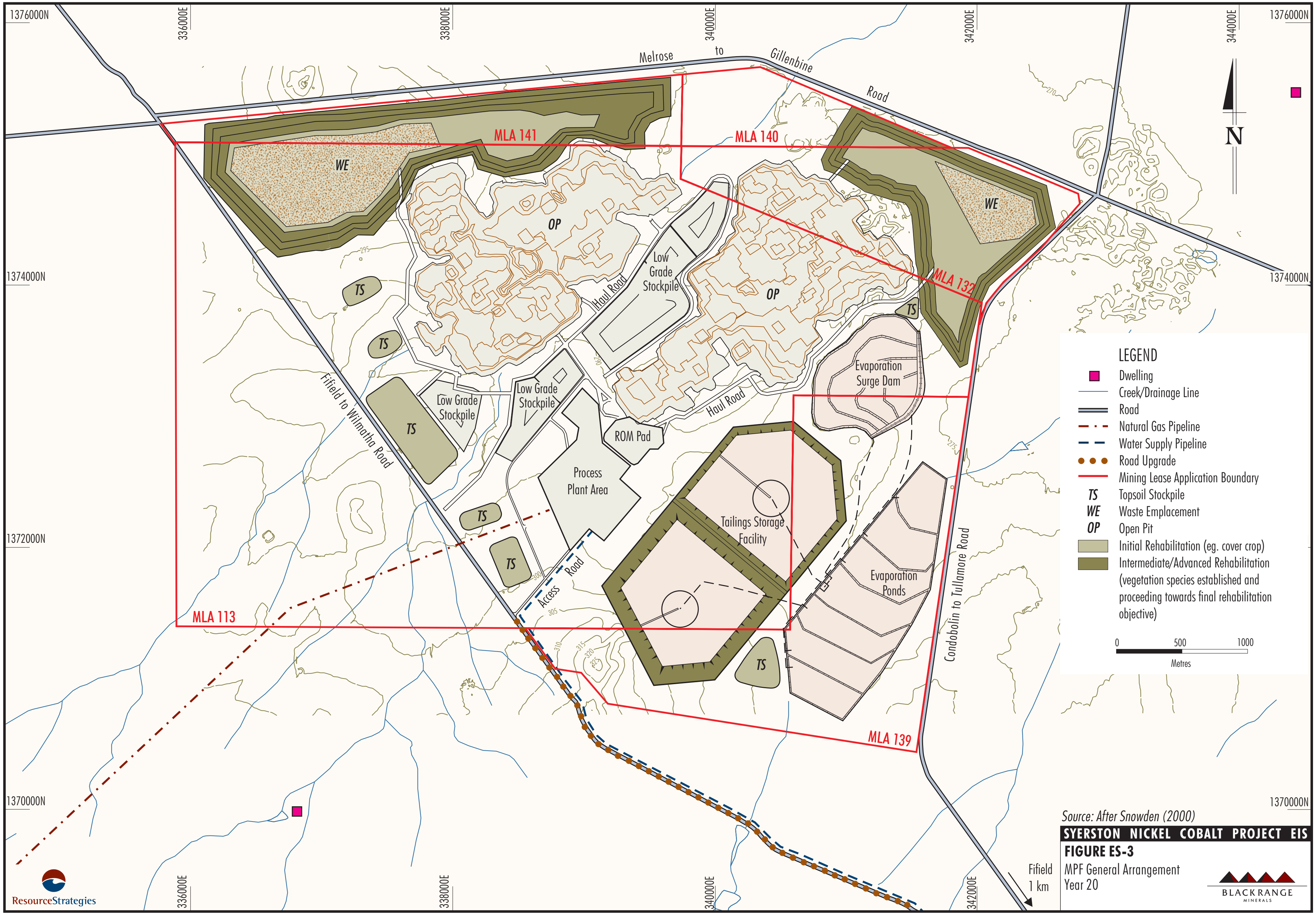
Prior to the commencement of mining, soil would be stripped from disturbance areas and selectively stockpiled for use during rehabilitation. Rehabilitation using stabilising cover crops and native endemic vegetation species would be conducted as waste emplacement surfaces and faces are progressively finalised.

Geochemical assessment of waste material has been undertaken to identify waste types and develop suitable waste handling and disposal strategies. Mine waste material is highly weathered, oxidised and is non-acid forming.

ES2.1.3 Ore Processing

Ore processing would involve the following eight stages:

- ore preparation;
- acid leaching;



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- thickening and tailings neutralisation;
- solution neutralisation;
- sulphide precipitation;
- sulphide leaching and removal of impurities;
- solvent extraction; and
- electrowinning to produce metal product.

Figure ES-4 describes the ore processing circuit.

ES2.1.4 Reagent Production

The ore processing system would require chemicals as inputs to various stages. The MPF design allows for the site production of some of these inputs. These would require their own on-site infrastructure and processes. They include production plants for the following:

- oxygen;
- sulphuric acid;
- hydrogen;
- hydrogen sulphide;
- nitrogen; and
- lime slurry.

The locations of these production plants are shown on Figure ES-5.

ES2.1.5 Tailings Management and Evaporation System

Barren residue (tailings) from the mineral processing circuit would be deposited in the Tailings Storage Facility (TSF).

Approximately 50 Mt of tailings would be produced over the term of the EIS with a tailings production rate of approximately 2.55 Mtpa at 48% solids. Two adjoining tailings storage cells would be constructed in the south-east of the MPF site with sufficient capacity to contain tailings for more than 20 years.

The saline nature of tailings water (principally magnesium sulphate or epsom salts) prevents reuse within the ore processing system and an evaporation system is required to remove excess supernatant water from the tailings storage facility. The evaporation system would comprise seven adjoining evaporation ponds and an evaporation surge dam.

The evaporation ponds and evaporation surge dam provide the appropriate storage capacity for the TSF rainfall event design criteria, hence providing the ability to provide evaporative losses and storage of rainfall events (up to 1 in 100 Annual Recurrence Interval).

ES2.1.6 Water Supply

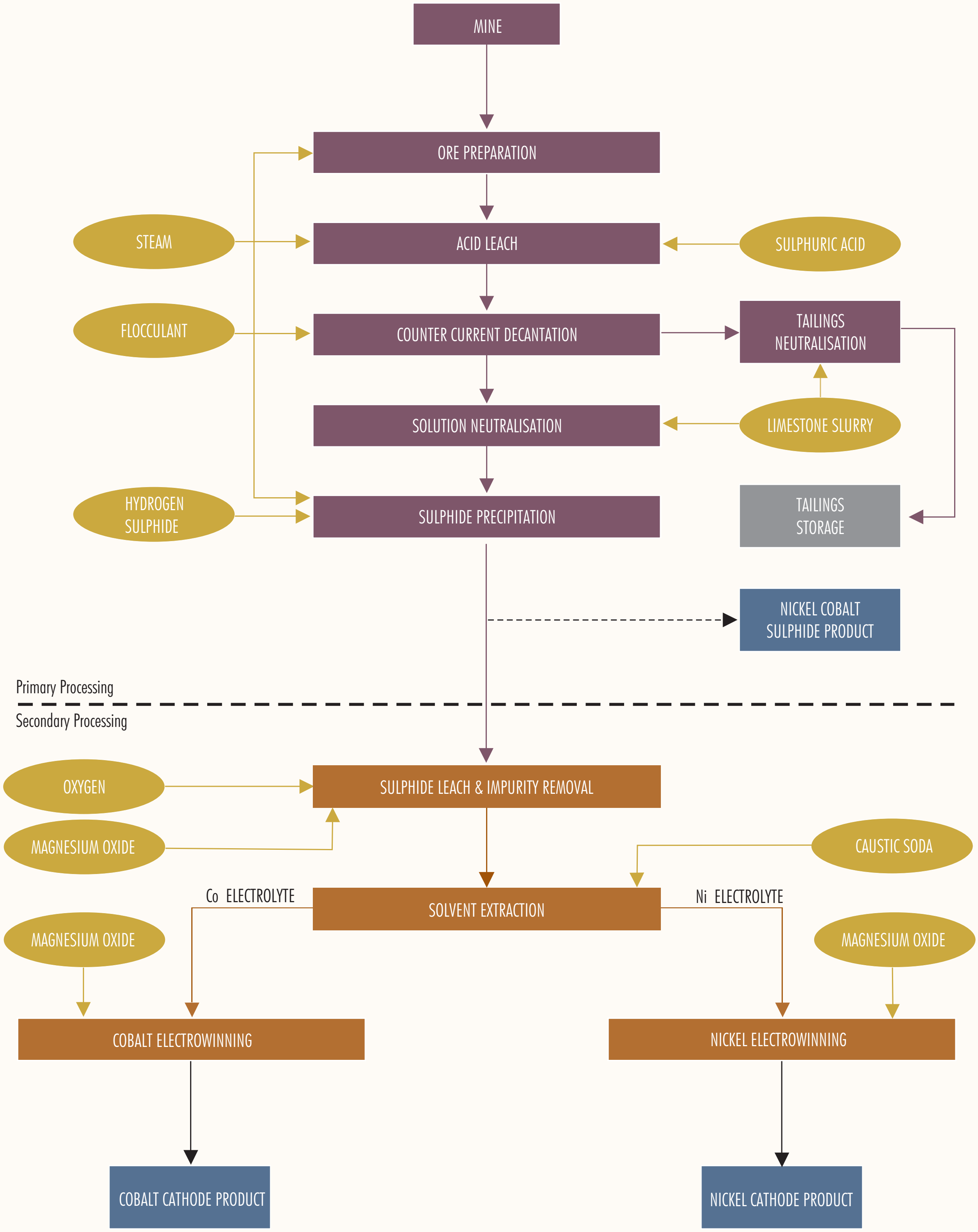
Water required for the operation of the MPF would be supplied by two borefields located to the south in the Lachlan Valley Palaeochannel. Up to 6,300 megalitres (ML) per annum would be supplied from the borefields and associated water supply pipeline. The proposed bore locations and water supply pipeline route are discussed in Section ES4.

ES2.1.7 Water Management

The overall objective of the MPF water management system is to control runoff from MPF development/construction areas and operation areas, while diverting upstream water around such areas. The water management system would include both permanent features that would continue to operate post-closure and temporary structures servicing life of Project requirements only. The water management system would be progressively developed during the construction and operation of the MPF as diversion and containment requirements change.

The water management system requires alteration of some existing ephemeral drainage paths by the development of two diversion channels. The northern diversion channel would allow upper catchment surface runoff to flow around the southern and eastern limits of open pits in the west of the MPF site and back into an existing drainage line. Similarly, the southern diversion channel would allow upper catchment surface runoff to flow around the southern and eastern perimeter of the evaporation ponds and back to an existing drainage path. These diversion system features would be designed to ensure long term stability as well as compatibility with existing hydrological features, landforms and vegetation.

An internal drainage system would be constructed to ensure waters generated within development/construction areas and operation areas are controlled. This system would consist of a series of permanent small drains designed to act as internal catchment divides and deliver water from disturbed areas to sediment dams.



Source: After SNC-Lavalin (2000) & BRM (2000)

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FIGURE ES-4

Ore Processing Block Diagram

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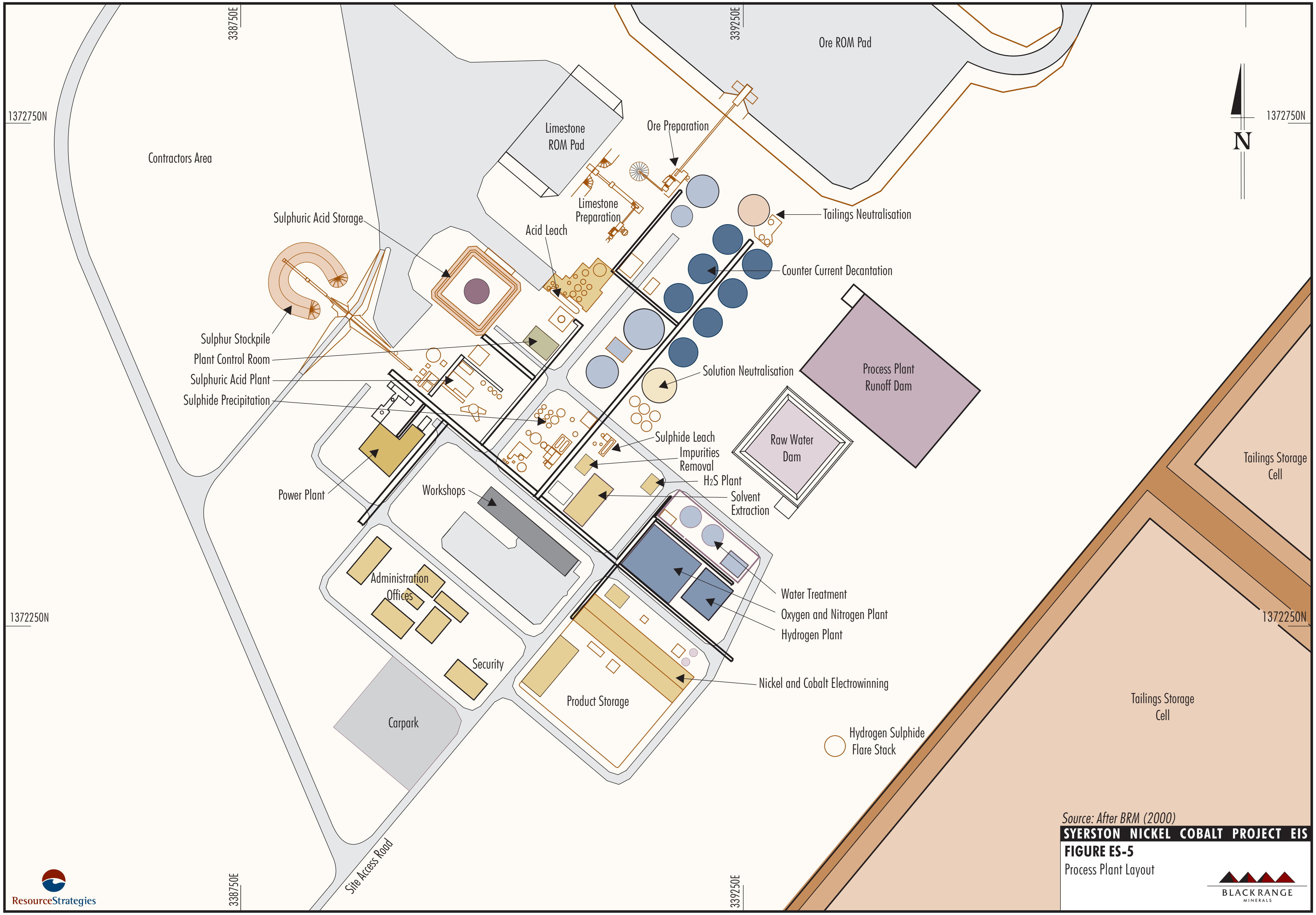

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Sediment control structures such as sediment dams and sediment fences would be employed where necessary within and downstream of individual areas of disturbance and infrastructure. These sediment control structures and associated drainage systems form the Integrated Erosion and Sediment Control System during the life of the MPF. These structures would be constructed in a staged manner as the MPF is developed.

ES2.1.8 Associated Infrastructure

Infrastructure which is external to the MPF site would include the water supply pipeline, borefields, natural gas pipeline, limestone quarry, materials transport route and rail siding. This infrastructure is described in Sections ES3 and 4. Section ES3 provides a detailed description of the limestone quarry, materials transport route and the dedicated rail siding. Section ES4 provides a description of the natural gas pipeline to the MPF site and the water supply borefields and associated pipelines.

The on-site natural gas fired power station would supply the MPF electrical demand. Gas for the power station would be provided by a spurline from the existing Moomba to Sydney natural gas pipeline that runs south of Condobolin (Section ES4).

Infrastructure adjacent to the process plant area includes an on-site power station, water treatment plant, sulphuric acid plant and other plants listed in Section ES2.1.4, construction camp and internal road.

ES2.1.9 Transport

Process consumables, and nickel-cobalt sulphide and metal products would be transported to and from the MPF site. Incoming freight would be transported by a combination of rail and road transport. A large proportion of consumables including sulphur would be transported by rail to a dedicated rail siding, located some 25 km south-east of the MPF site (Section ES3). Once unloaded, the materials would be transported by road from the rail siding to the MPF site.

Nickel and cobalt metal product or mixed nickel-cobalt sulphide would be trucked to the rail siding and then back-loaded in general goods rail wagons for transport to Newcastle.

The majority of heavy vehicle road transport would approach the MPF site via Parkes on State Route 90 and the Tullamore to Bogan Gate Road (Figure ES-6) and then via the materials transport route (Section ES3).

ES2.2 POTENTIAL IMPACTS ON EXISTING ENVIRONMENT AND PROPOSED MITIGATION MEASURES

The potential impacts and proposed mitigation measures associated with the MPF are summarised in this section.

ES2.2.1 Air Quality

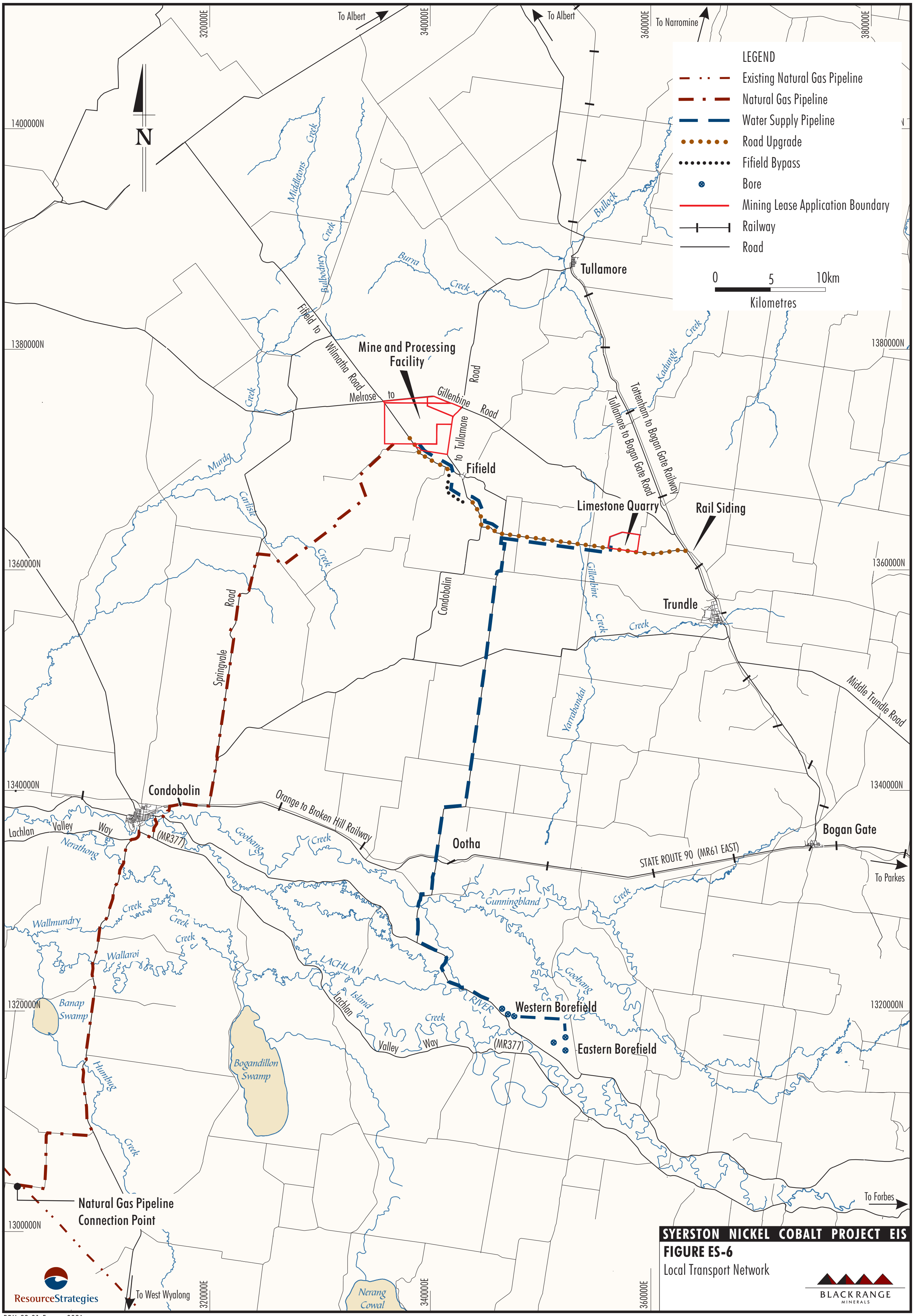
Potential air quality impacts associated with the MPF site are assessed in terms of gaseous emissions, dust deposition and total suspended particulates.

Gaseous Emissions

The existing levels of oxides of sulphur and nitrogen and the criteria air pollutants of gaseous origin are expected to be low in the Project area.

During normal operations the potential gaseous emissions of the processing facility would comprise:

- low pressure steam from the acid leach flash vessel scrubber;
- water vapour (as evaporation) from open tanks, the TSF, evaporation ponds and surge dam;
- mist and water vapour from the main cooling tower;
- sulphur dioxide from the sulphuric acid plant and hydrogen sulphide flare;
- nitrogen oxides from the co-generation plant turbines, boilers and intermittent emissions from the nitric vent fan;
- oxygen, hydrogen and water vapour from the electrowinning processes;
- carbon dioxide from the neutralisation circuits where limestone is consumed and from the co-generation and hydrogen plants;
- trace emissions of hydrogen sulphide from the hydrogen sulphide plant and process circuits; and



SYERSTON NICKEL COBALT PROJECT EIS

FIGURE ES-6

Local Transport Network

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- process steam releases.

These emissions would be released in a controlled manner either from stacks or vents at the processing plant.

NSW Environment Protection Authority (EPA) has established goals for gaseous emissions. The relevant goals include concentrations for sulphur dioxide (SO_2), nitrogen dioxide (NO_2) and hydrogen sulphide (H_2S). These concentrations are assumed over relevant averaging periods including three minutes, one hour, 24 hours and one year.

Emissions data for the MPF and relevant meteorological data were used to calculate ground level concentrations of SO_2, oxides of nitrogen (NO_x) and H_2S in the ambient air surrounding the processing facility. Ground level concentrations were calculated over three minute, one hour, 24 hour and one year intervals using a standard Gaussian plume model (AUSPLUME) for comparison with relevant air quality goals.

The predicted SO_2 concentrations at the MPF site remained below the EPA's and National Environment Protection Council's (NEPC) National Environment Protection Measure (NEPM) goals.

It is possible that emissions from the MPF could include a variety of oxides of nitrogen. For assessment purposes, 100% conversion of these oxides to NO_2 was assumed. Modelling over a one hour period assuming the full conversion to NO_2 at the point of emission indicated there would be exceedance of the EPA and NEPM NO_2 goal at the MPF site boundaries. The main contributor to the predicted highest concentrations of NO_X would be emissions from the nitric vent fan. At the nitric vent fan, additional testing is proposed during the detailed design phase to evaluate the actual proportion of NO_x and NO_2 emissions. Emission engineering controls at the vent would be implemented to achieve compliance in the event that testwork indicates potential non-compliance with the relevant goals.

Modelling results for H_2S indicated compliance with the goal at the MPF site boundary

Mitigation and control measures to limit gaseous emissions or to aid dispersion have been incorporated in the design of the processing facility and ancillary plants.

These measures include the following:

- Excess or waste hydrogen sulphide gas would be converted to SO_2, NO_2 and carbon dioxide (CO_2) at the hydrogen sulphide flare stack by combustion with natural gas at a height of up to 80 m.
- SO_2 emissions of the sulphuric acid plant would be released from a stack up to 80 m in height.
- Combustion gases of the hydrogen plant including CO_2 and NO_2, would be released from a 36 m high reformer stack.
- Entrained traces of sulphuric acid in uncondensed steam would be removed by a scrubber with 99% efficiency and the steam released from a 40 m high stack.
- CO_2 emissions from the tailings neutralisation circuit and leach liquor neutralisation tanks would be vented from a 16 m high stack and a vent above the tanks respectively.
- Combustion gases at the co-generation power plant including SO_2, CO_2 and NO_2 would be vented from a 25 m high stack.

In addition to the proposed emission mitigation measures included in the plant design a comprehensive gaseous emissions monitoring programme is proposed (as a component of the Air Quality Management Plan) to provide on-going assessment of compliance.

Dust Deposition

A dust monitoring network was established to characterise the background air quality in the MPF area. The mean deposition rates for the monitoring sites over a period of 32 months ranged from 1.01 g/m^2/month to 1.35 g/m^2/month. The results are reviewed in the context of the NSW EPA which has adopted amenity-based criteria for dust deposition of an increase of 2 grams per square metre per month (g/m^2/month).

Off-site dust deposition rates are predicted to remain below the EPA amenity criteria during MPF operations and construction at all nearby residences.

Notwithstanding the predicted low impact of dust generating activities, a range of air quality safeguards would be employed to reduce emissions of atmospheric dust from the MPF site.

These safeguards are based on current control techniques as recommended by the EPA. The main components of these controls include watering of disturbed areas, road maintenance, prevention of truck overloading and the resulting spillage during loading and hauling, use of dust suppressants or cover crops on stockpiles, and progressive rehabilitation of disturbed areas.

Total Suspended Particulates

The National Health and Medical Research Council of Australia (NHMRC, 1985) recommend an annual concentration of 90 $\mu g/m^3$ as the maximum permissible level of total suspended particulates (TSP) in the air to protect public health in residential environments.

The existing TSP environment at the MPF site is anticipated to range from 20 $\mu g/m^3$ to 30 $\mu g/m^3$. An increase of 60 $\mu g/m^3$ would therefore be required to reach the NHMRC guideline of 90 $\mu g/m^3$.

Modelling indicates that the annual mean levels of TSP would comply with the 90 $\mu g/m^3$ NHMRC guideline at the MPF site boundary and all nearby residences during the Project's initial years after which TSP levels outside the MPF boundaries would be slightly higher but would comply at all nearby residences.

Dust control measures outlined above would also provide control of TSP (including PM_{10} fraction) emissions.

ES2.2.2 Risk Assessment

A Preliminary Hazard Assessment was conducted to obtain a comprehensive understanding of the hazards and risks associated with the Project and to identify relevant mitigation measures. The assessment was conducted in accordance with DUAP criteria published in the department's Hazardous Industry Planning Advisory Paper No. 4.

Potential hazards related to the MPF are discussed in this section while those hazards pertaining to the limestone quarry, rail siding and materials transport route are discussed in Section ES3, and those associated with the natural gas pipeline, borefield and water supply pipeline are discussed in Section ES4.

A hazard identification procedure was conducted and included assessment of hazardous materials to be processed or stored on the MPF site. Potential hazardous incidents were then identified for discrete areas within the MPF site.

Possible initiating events, consequences and prevention/protection measures were identified for the potential hazardous incidents. The large distances from the processing plant to MPF site boundaries, and to the nearest residences, were found to control the significance of the incidents and their potential impacts. The consequences of those events considered significant and with potential to impact at distances beyond the MPF site boundary were then assessed (consequence analysis). Gaseous releases, fires and explosions were identified as the most significant hazardous incidents at the MPF.

Along with the consequence analysis, frequencies of these significant hazardous incidents were combined to assess risk. No mitigation measures were included in the risk assessment, therefore giving a conservative assessment. Different types of risk were assessed and the results presented below.

A major release of sulphur dioxide was the only potential hazardous incident which was found to contribute to the risk of a fatality at or outside the MPF site boundary. The level of risk compared favourably with DUAP target criteria, although indicated further control measures may be required. This would be the subject of more detailed assessment during the detailed design phase and incorporated within a Final Hazard Analysis prior to Project commencement.

The toxic injury and irritation risk levels (ie. risk levels associated with non-fatal events which cause injury or irritation to the public) were found to be low due to the large distance from the MPF to the site boundaries, surrounding low population density and conservative modelling approach.

Fire and explosion risk levels were found to be low and it was determined that there was no credible likelihood of exceeding the associated DUAP target criteria for risk at any site boundaries.

Given the limited number of incidents that can occur at the MPF site with off-site impacts (due to the large distance to the nearest site boundary) and the rural nature of the surrounding area, the risk to people and other biological groups (animals, plants etc.) was found to be low.

Whilst off-site effects can be expected if a major release were to occur, there were no identified whole systems or populations at unacceptable levels of risk due to the potentially hazardous events reviewed in the PHA.

In addition to the low level of risk assessed to be associated with the MPF, mitigation measures/factors which would be included in the MPF design would further reduce the potential hazardous risk imposed by the MPF. These measures include, storage, handling and design in accordance with recognised standards (eg Australian Standards), operator training programmes, implementation of safety and security systems, implementation of an Emergency Response Plan and preparation of a Final Hazards Analysis.

ES2.2.3 Transport

Daily traffic volumes on roads most likely to be affected by the Project were measured. The traffic counts are generally very low and characteristic of local rural access roads. The local roads likely to be used during the Project include two-lane unsealed roads as well as sealed dual carriageways.

The potential impacts of Project generated traffic on local roads were assessed based on AUSTROADS level of service classification. The impacts of traffic associated with the MPF are summarised in this section.

During the MPF construction phase, it is expected that on average there would be a total of some 420 vehicle trips generated per day by the MPF. These movements would primarily include deliveries of plant equipment to the MPF site.

During the MPF operation phase approximately 550 vehicle movements are forecast. This traffic would include the movements (to and from the site) of raw materials (excluding traffic associated with the rail siding and limestone quarry which is described in Section ES3), employee traffic and other traffic (eg local deliveries and visitors).

The quality of service on most roads serving the MPF would remain satisfactory. A reduction in the quality of service of three local roads is predicted.

In addition to the proposed roadworks associated with the materials transport route, the following mitigating measures would be undertaken where necessary to improve the transport network affected by the MPF (Figure ES-6).

- Sealing appropriate sections of the Middle Trundle Road the Melrose to Gillenbine Road and the Fifield to Wilmatha Road between the Springvale Road and the MPF site.
- Nomination of a heavy vehicle route through Bogan Gate on State Route 90 and the Tullamore to Bogan Gate Road.
- Intersection upgrades to provide sheltered right turn bays and appropriate truck turning radii at the State Route 90/Tullamore to Bogan Gate Road, State Route 90/Condobolin to Tullamore Road and Springvale Road/Condobolin to Tullamore Road intersections. Appropriate lighting and signage would also be provided at these intersections.

The configuration of intersections, upgrades and other modifications would be formulated in consultation with relevant Shire Councils and NSW Roads and Transport Authority (RTA).

Further mitigation measures associated with the potential impacts of the Project on the transport system, specifically those related to the transportation of materials from the rail siding and limestone quarry, are presented in Section ES3.

ES2.2.4 Water Resources

Surface Water

The potential surface water impacts of the MPF include impacts on surface water quality from runoff, seepage or the uncontrolled release of water from construction or operation areas.

Surface water runoff from MPF landforms, disturbed areas and infrastructure areas could potentially contain contaminants such as sediments, dissolved solids, oil, grease, process reagents and by-products (eg. tailings).

A water management system has been developed for the MPF site to manage and minimise any potential surface water quality impacts. The overall objective of the MPF site water management system is to contain any potentially contaminated water generated within development/construction and operational areas while diverting all other water around these areas. This includes minimising disturbance areas, containment and recycling (including an evaporative process water disposal system and prioritised reuse system), a seepage control system for the TSF (including underdrainage and bunding) and progressive stabilisation and revegetation of disturbed areas.

Erosion and sediment control measures would be designed in accordance with the above water management principles and would be based on design criteria to be developed in an Integrated Erosion and Sediment Control Plan (IESCP).

Groundwater

Investigations undertaken at the MPF site indicate that one local fractured rock aquifer occurs in the north-west of the site and that there are no perched aquifers. A groundwater recharge zone was also identified in the north-west of the MPF site. No major groundwater discharge areas occur in the MPF site or surrounds.

Groundwater generally flows slowly to the north-east, following the direction of the fall in the topography.

Regional surveys did not locate any groundwater use within 5 km down-gradient of the TSF site. Local groundwater quality in the vicinity of the MPF site has been assessed as saline with limited beneficial use.

Potential impacts of the MPF on local groundwater systems are assessed in the vicinity of the TSF, evaporation ponds and surge dam. These potential impacts are associated with seepage from the storages and include rises in water table around the storages and impacts on groundwater quality.

The quality of potential seepage is expected to reflect the quality of solution stored in the TSF, evaporation ponds and evaporation surge dam.

Supernatant solution within the TSF is predicted to be near neutral pH with elevated total dissolved solids (TDS).

Solution stored in the evaporation ponds and surge dam is expected to contain elevated TDS concentrations (predominately magnesium sulphate – epsom salts) due to evapo-concentration effects. The quality of any limited seepage from these storages would reflect these elevated concentrations.

Seepage from the TSF and evaporation ponds and surge dam is likely to have negligible impact on existing groundwater levels or quality. Low permeabilities in the underlying and adjacent soil and rock, the low height of saturated tailings, the shallow depth of water in the evaporation ponds and low regional groundwater velocities control these potential impacts. In addition, the construction of low permeability clay liners under the storages and installation of an underdrainage and seepage interception drain would provide a physical control barrier to limit seepage.

Further control for seepage effects would result from consolidation of tailings materials to reduce permeability and adsorption of tailings chemicals onto clay colloids within subsoils beneath the storage.

ES2.2.5 Land Resources

The general landscape of the MPF site is flat to very gently undulating and is bisected by a shallow drainage line running diagonally across the site to the north-east. Several areas of low hills occur across the site with broad shallow valleys between. Surface elevations in the MPF site vary from approximately 325 m Australian Height Datum (AHD) in the south, down to approximately 275 m AHD in the north-eastern section.

The majority of the vegetation in the area has been heavily cleared for grazing and cropping. Remnant and regrowth native vegetation is generally restricted to elevated areas and along drainage lines. Less disturbed areas of remnant vegetation occur in the north of the MPF site within the Fifield State Forest (Figure ES-7) and on the western extremity of MLA 139.

The site is bounded by the Condobolin to Tullamore Road to the east and the Melrose to Gillenbine Road to the north (Figure ES-6). The Fifield to Wilmatha Road bisects MLA 113 in the west.

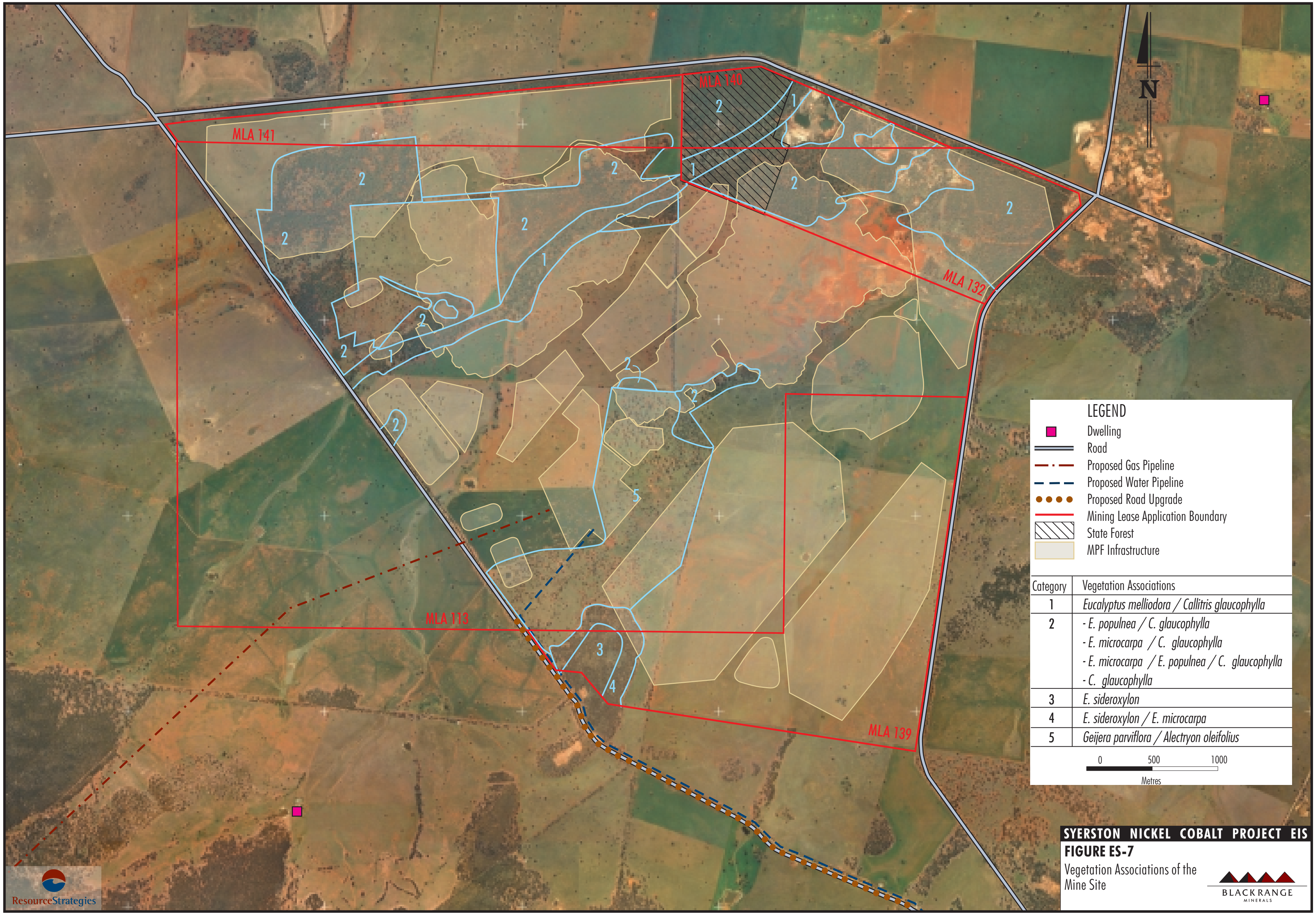

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FIGURE ES-7

Vegetation Associations of the Mine Site

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Source: © The Land Information Centre
Panorama Avenue Bathurst 2795

There are several small old mine workings and mullock heaps scattered in the north-eastern corner of the MPF site.

Potential topographical impacts would be related to the construction of permanent mine landform features (eg waste emplacements and open pits). Progressive rehabilitation would aim to integrate constructed landforms with the surrounding landscape.

A number of soil resource management strategies have been developed for the Project including formulation of soil stripping guidelines and nomination of appropriate depths, locating areas to be stripped and stockpiling of soil. Topsoil stockpiles would be managed to ensure long term viability through implementation of appropriate management practices, in consultation with relevant regulatory authorities. An IESCP would be developed for the construction and operational phases of the MPF to provide for the control of further impacts on soil resources through erosion.

To prevent or reduce the potential for contamination of land from process reagents, fuels and oils, measures would include use of appropriately licensed carriers, communications systems to allow for prompt notification in the event of an accident, construction of bunds along internal transport routes and around storage areas and operation of storage areas in compliance with the requirements of Australian Standards.

The extensive areas of managed pasture land surrounding the MPF site are expected to restrict the movement and magnitude of any bushfire. Bushfire management procedures would be developed for the MPF site as part of the Site Management Plan (SMP), in consultation with local bushfire brigades and the Lachlan Shire Council. These procedures would include consideration for the use of an on-site fire tender and mine water trucks. All MPF workers would undergo training in bushfire prevention and management strategies.

ES2.2.6 Community Infrastructure

A community infrastructure and social assessment has been prepared for the Project. The aim of the study was to assess sub-regional housing and infrastructure issues associated with the proposed workforce.

The findings of the study are relevant to the whole Project, therefore including the MPF as well as related infrastructure. The findings are summarised in this section.

A peak construction workforce of approximately 1000 workers is anticipated. A construction camp would be built to accommodate the proposed workforce due to the limited available accommodation services in the vicinity of the Project. It is estimated that there would be a proportionally large non-local component of the direct workforce. Approximately 20% of available jobs would be filled by residents from the local area (within 100 km of the Project) and the majority of skilled labour (and other skill categories) would be drawn from outside the region. Indirect and direct flow-on employment of approximately 220 jobs would be created for short periods in the region during the construction period.

Increases in population and housing requirements during the operational phase are expected based on the decommissioning of the construction camp, projected direct workforce and flow-on employment multipliers. Indirect and direct flow-on employment would lead to some 530 additional jobs and a total population increase of about 1000 for the region. It is anticipated that the associated increase in demand for housing in Parkes could be accommodated, however the housing sector in Condobolin would need to improve to accommodate increased activity.

In terms of health services and facilities no significant impact on the delivery of health care is anticipated during the construction phase at the Parkes district hospital, Parkes community health centre and the Condobolin hospital. Community health services may experience some increase in demand during the construction phase due to the presence of a large construction workforce and the relatively remote location of the construction camp.

No significant impacts on hospital services or community health services are anticipated during the operational phase.

No significant capacity problems in any one school in the area (including Condobolin, Parkes and Forbes) would be anticipated as a result of the Project.

It is anticipated that the Project may lead to a gradual additional demand being placed on community support services and facilities, particularly in the Condobolin area as the level and range of services is not as broad as those offered in Parkes.

It was concluded that on-going liaison with the NSW Departments of Health and Community Services would be appropriate to ensure appropriate services are provided for the incoming population.

ES2.2.7 Benefit Cost Analysis and Regional Economics

A benefit cost analysis and regional economic impact assessment was prepared for the Project and provides a regional economic impact analysis considering the likely economic contribution of the Project to the region and a benefit cost analysis of the economic efficiency of the Project. The findings of the study are relevant to the whole Project, therefore including the MPF as well as related infrastructure. The findings are summarised in this section.

The establishment and operation of the Project would stimulate demand in the local and regional economy leading to increased business turnover in a range of sectors and increased employment opportunities. Towns that can provide the inputs to the Project and/or the products and services required by employees would benefit from the proposal by way of an increase in economic activity.

During the construction phase it is estimated that the peak year of the construction phase of the Project is likely to contribute in the order of $67 million (M) in annual direct and indirect regional output or business turnover, $35M in annual direct and indirect regional value added, including $25M in annual household income. These particular impacts on the regional economy are only likely to be experienced for a period of around one year with lesser construction impacts felt over a further one to two years.

The operation of the Project is likely to contribute in the order of $351M in annual direct and indirect regional output or business turnover, $190M in direct and indirect regional value added including $41M in household income. Of production costs, 20% would be expended within the Central West region.

These impacts would be built up over a number of years as scheduled production rates increase over time and may then continue for a number of years while the Project operates at full production levels.

Cessation of the Project would lead to a reduction in economic activity. Minimisation of the impacts on the regional economy associated with Project cessation can occur through retention of displaced workers within the region, even if they remain unemployed. This is because even expenditure by the unemployed in the regional economy (albeit at reduced levels) contributes to final demand.

Given the long term nature of the Project it is not possible to foresee the likely circumstances within which Project cessation would occur, however impacts associated with the cessation of the Project may be absorbed by the region's broadened economic base resulting from the Project.

A benefit cost analysis of the proposal identified a range of potential economic costs and benefits of the proposal and placed indicative values on most of the production costs and benefits including identification of possible environmental externalities of the proposal. The main economic costs of the Project relate to opportunity costs of land, existing plant, Project capital, annual operating costs and rehabilitation. In total these costs have been estimated to be in the vicinity of $629 M.

The analysis indicated that the total net quantified production benefits of the Project are likely to have a net present value in the order of $1,176M, with $762M of these benefits accruing to Australia. The figure of $762M represents the minimum opportunity cost to Australian society of not proceeding with the proposal. Alternatively stated, any environmental externalities from the Project, after mitigation by BRM, would need to be valued at greater than $762M to make the proposal questionable from an economic efficiency perspective.

To put this threshold value in some context, every household in the region of Forbes, Lachlan and Parkes would need to be willing to pay in order of $71,969 to avoid the identified potential environmental impacts of the Project, to make the proposal undesirable from an Australian economic efficiency perspective. The equivalent figure for NSW households is $337.

ES2.2.8 Flora

Historical activities on the MPF site have resulted in the clearance of native vegetation for grazing, cropping and historic mining activities. The vegetation of the MPF site can be described in four categories based on levels of disturbance. Endemic woodland comprises areas of relatively undisturbed woodland with native species comprising associations of White Cypress Pine and Box Woodland associations while cleared land with Wilga/Rosewood patches covers a relatively small area of the MPF that has been thinned for cropping and grazing. The majority of the MPF site is classified as land cleared for agricultural purposes while the north-eastern portion of the MPF site has been disturbed by previous mining and has regenerating Cypress Pine and weeds. The Fifield State Forest (Figure ES-7) supports the best-preserved natural plant communities and the majority would not be disturbed by the MPF. The vegetation associations of the MPF site are shown on Figure ES-7.

Construction and operation of the MPF would disturb approximately 55% of the total MPF site. Significant portions of this area would be rehabilitated with pasture or endemic woodland. Portions of the final voids would be selectively rehabilitated to grassland or endemic vegetation. Following rehabilitation there would be a net increase in endemic woodland areas and a net decrease in pasture/cropping land when compared to the existing condition.

No significant species listed as threatened under the NSW *Threatened Species Conservation Act, 1995* or the Commonwealth *Protection of the Environment Biodiversity Conservation Act, 1999* were found within the MPF site. In accordance with the provisions of Section 5A of the EP&A Act (8 Part Test of Significance) 18 species were assessed and it is considered that the proposed MPF site would not have a significant effect on these threatened plant species, populations, ecological communities or habitats.

A number of measures/principles have been incorporated into the design, development and operation of the Project to assist in the mitigation of potential impacts on flora. Measures include the retention, wherever feasible, of mature remnant trees within the Project area to be a high priority in formulating detailed layout of the mine and related infrastructure.

Remnant patches of native vegetation immediately adjoining the proposed MPF disturbance areas are to be delineated and clearly marked or fenced to prevent accidental damage during construction works.

Any disturbance to stream bank and aquatic vegetation is to be conducted in accordance with integrated erosion and sediment control initiatives and relevant statutory conditions.

Clearance areas would be minimised with soil resources stripped and timber resources either harvested or recycled or effectively disposed from cleared areas.

A weed control programme would be coordinated with surrounding landholder programmes.

ES2.2.9 Fauna

Fauna surveys of the MPF site recorded 81 species comprising 54 birds, 22 mammals, four reptiles and one amphibian.

Six species listed as vulnerable in the *Threatened Species Conservation Act 1995* were recorded from or within the vicinity of the MPF site during the surveys, these being the Barking Owl, Pied Honeyeater, Major Mitchell's Cockatoo, Yellow-bellied Sheathtail Bat, Little Pied Bat and the Greater Longeared Bat. The Yellow-bellied Sheathtail Bat and Little Pied Bat were the only threatened fauna species recorded at the MPF site. It was determined that no threatened species would be significantly affected by the Project to the extent of undermining the viability of a local population of that species.

The potential impacts of the Project on fauna relate to habitat disturbance, feral species, noise and air emissions, road traffic, artificial lighting, human intrusion and the water storage structures (ie. TSF, evaporation ponds and surge dam).

In recognition of the habitat value of extant areas of native vegetation, the removal of native vegetation would be undertaken, where possible, in late autumn or winter to minimise disturbance to potential breeding activities.

Prior to ground disturbance works, mature trees with hollows would be identified, marked and retained wherever feasible. Where feasible, mature, hollow-bearing trees within the proposed clearance zone could be used in the rehabilitation programme.

Pre-clearance surveys would be undertaken to establish bat roosts in trees which require removal and relocation of the roosts away from the impact areas.

Artificial roosts (bat houses) would be provided at strategic locations in the MPF site and surrounds to replace any roosts that would be lost.

Rehabilitation concepts for the MPF site aim to maximise opportunities for the creation of habitat continuous with existing preserved woodland and giving consideration to the installation of nest/roost boxes and exclusion of grazing in selected areas.

In addition to revegetation of the MPF site, areas of existing native habitat would, where possible, be preserved. A primary aim of preserving such areas would be to maintain biodiversity and to facilitate the potential for linking these areas to rehabilitation areas. Management activities could include exclusion of grazing, weed and feral species control, fertilising, supplementary planting and provision of habitat features (eg. hollows, ground shelter).

A clean, rubbish-free environment would be maintained across the MPF site, particularly around administration and contractor areas. This would discourage scavenging and reduce the potential for colonisation of these areas by non-endemic fauna (eg. introduced rodents, birds).

To reduce the potential for vehicle strike, speed limits would be imposed on vehicles using roads and tracks in the MPF site and signposting installed. In addition, employees would be informed about flora and fauna resources of the MPF site and surrounds.

Feral animal control programs and site management strategies developed for the MPF site would be co-ordinated with adjacent landholders.

The TSF, evaporation ponds and surge dam would be inspected daily for fauna, as a precautionary measure, during the course of normal daily maintenance inspections.

In the unlikely event that the storages become a focus for avifauna, the use of hazing techniques (as adopted in the mining industry elsewhere) could be considered to minimise bird usage of the storages.

ES2.2.10 Acoustics

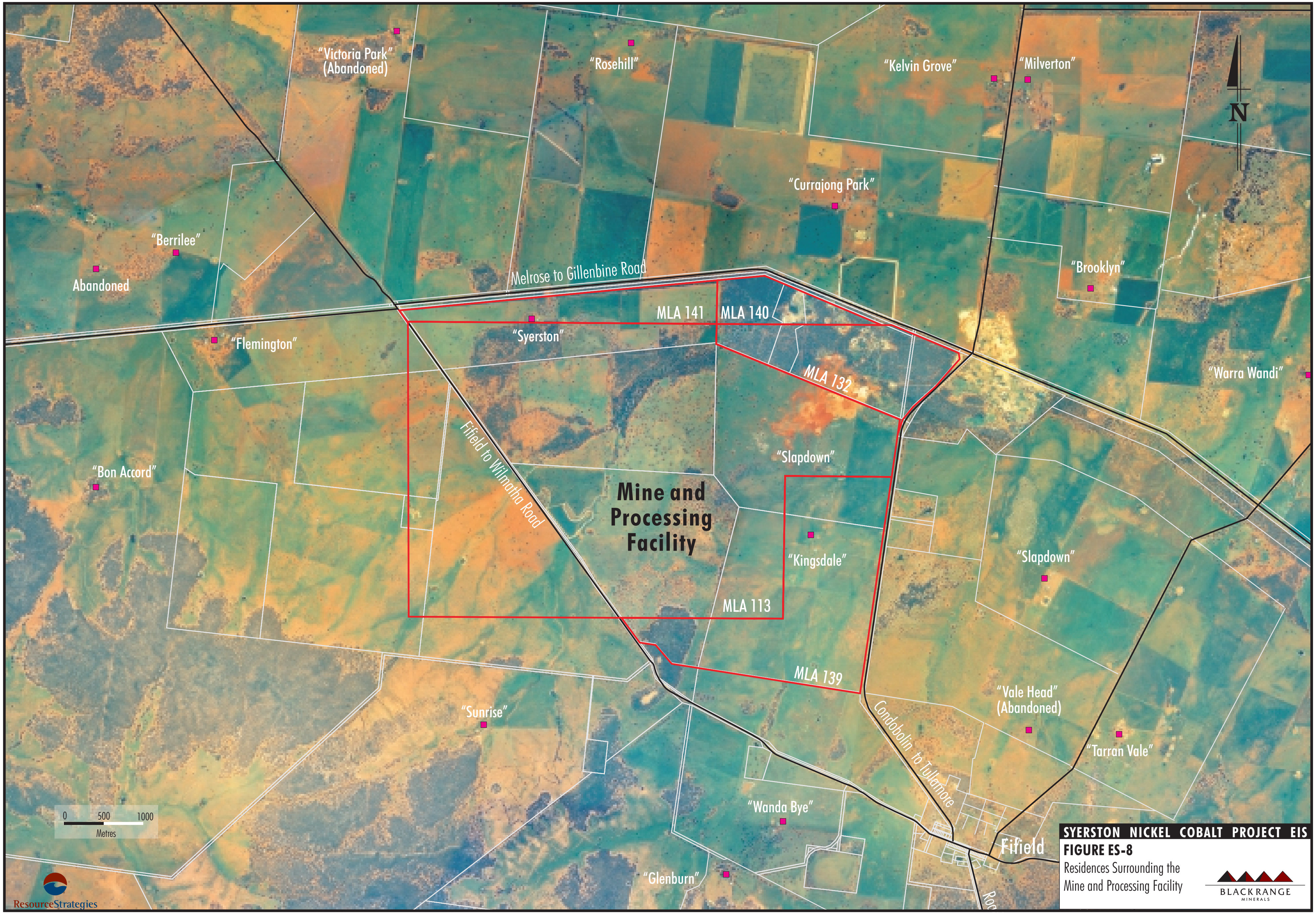
The noise impact assessment completed for the MPF site assessed noise emissions associated with Project construction and operations. A number of residential localities beyond the Project area nominated to be representative of the local noise environment, formed the basis for assessing noise emissions. Residences surrounding the MPF site are shown on Figure ES-8.

The noise impact assessment found that noise emissions during construction are below the recommended criteria (determined in accordance with EPA requirements) at all locations and under all of the meteorological conditions modelled. During operations, noise emissions are below the recommended criteria at all locations except for “Currajong Park” during the evening and night time. Exceedances at “Currajong Park” were assessed as marginal exceedances in the initial phases of operation up to moderate exceedances during later stages of operation.

Confirmatory monitoring is proposed throughout operations, notably later during the MPF life, when exceedances of up to 5 dBA at “Currajong Park” are predicted. This would be followed by actions such as the attenuation of noise at the source or at the receiver. Attenuation may take the form of earthen bunds on the MPF site or noise controls on mobile equipment. Property acquisition could also be undertaken.

ES2.2.11 Aboriginal Heritage

A survey and assessment of Aboriginal artefacts associated with the MPF site was undertaken in consultation with the Condobolin LALC (Local Aboriginal Land Council) in September 1997 and in consultation with the Wiradjuri RALC (Regional Aboriginal Land Council) in 1999 and 2000. Four Aboriginal sites were identified within the MPF site including a scarred tree, two isolated flakes and an open scatter and possible knapping floor of seven flakes.



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Source: © The Land Information Centre
Panorama Avenue Bathurst 2795

One of the isolated flake sites would be disturbed by MPF works while the remaining sites would be demarcated to avoid disturbance.

Site recording forms would be completed for each of the four sites and lodged with NPWS for listing on the Aboriginal Sites Register. Where disturbance of any of the sites is proposed, written consent would be obtained from the Condobolin LALC or the Wiradjuri RALC and a "Consent to Destroy" from the NPWS.

In accordance with the *National Parks and Wildlife Act, 1974,* all artefacts, bone or discrete shell distributions uncovered during earthmoving operations would be reported to the Condobolin LALC, Wiradjuri RALC and NPWS prior to further disturbance. Work in such an area would not recommence without approval from these councils/authorities.

ES2.2.12 European Heritage

Survey and assessment of European heritage at the MPF site was undertaken and the remains of a pastoral outstation were assessed as a heritage site of local significance on the MPF site.

Where possible, disturbance to this site would be avoided (eg. during construction of the construction camp). If disturbance is unavoidable, the site would be recorded for archival purposes.

ES2.3 REHABILITATION

In general, the Project rehabilitation concepts are described for a Project life of 21 years. Notwithstanding this, the concepts presented remain applicable to Project closure after more than 30 or more years of operation.

The finalisation of rehabilitation concepts would require design studies throughout the Project life which would be reported in the Mining Operations Plan (MOP). Rehabilitation trials would be undertaken over the life of the mine to refine the designs and confirm performance.

The proposed concepts for the rehabilitation of the MPF site are summarised below.

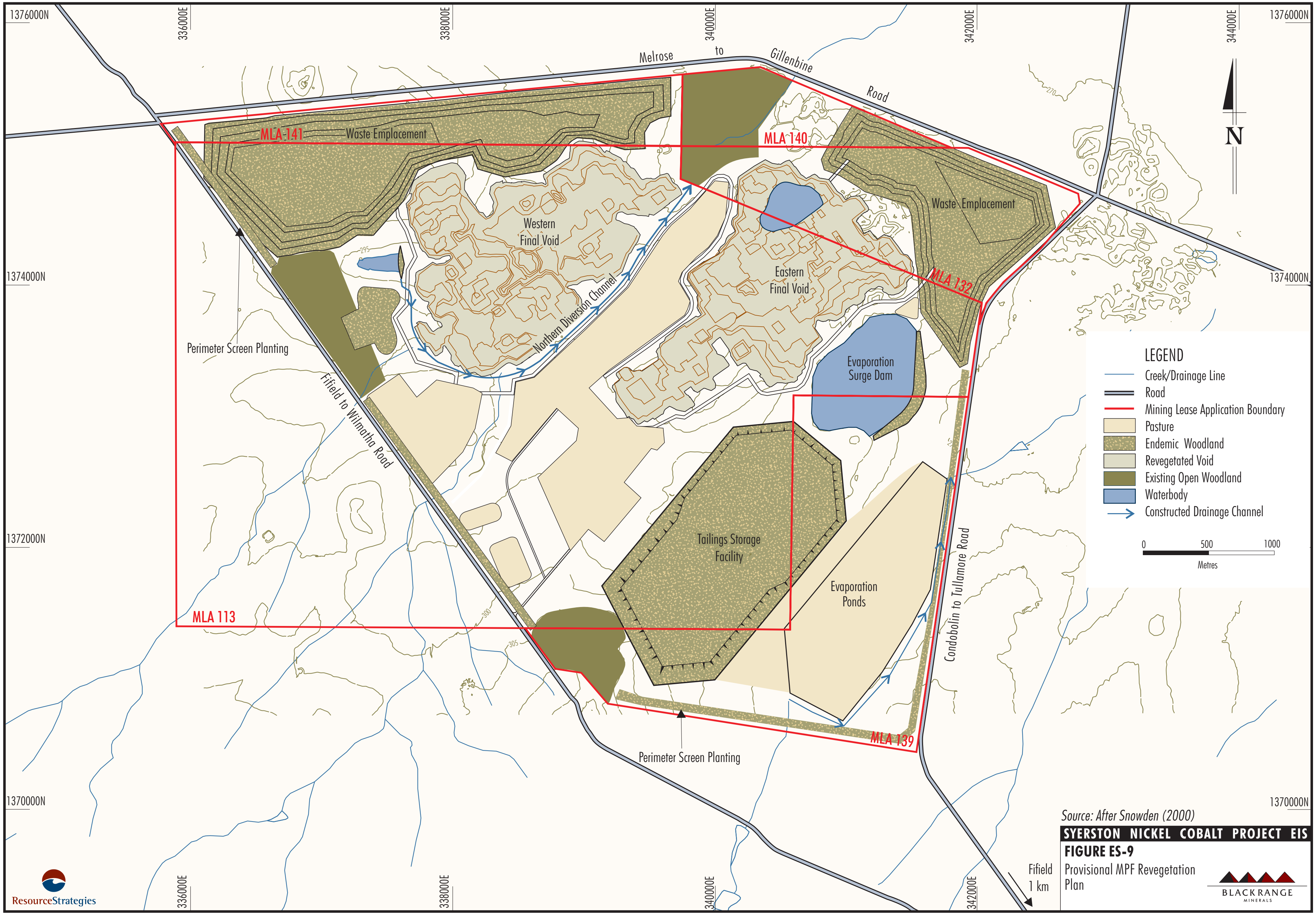
Rehabilitation objectives and principles for the MPF include construction of a stable landform, progressive rehabilitation as mining proceeds, integration of revegetation areas with existing woodland areas, preservation of areas of existing vegetation where possible and establishment of areas of endemic woodland and, where appropriate, pasture.

The key activities of the MPF rehabilitation programme include planning and scheduling, progressive land clearance, soil handling, erosion and sediment control works as well as rehabilitation trials and studies. Planning encompasses preparation of detailed rehabilitation plans, budgets and monitoring requirements. Soil handling activities include adoption of procedures for soil stripping, stockpiling and re-application. Erosion and sediment control works would be incorporated into programming via adoption of an IESCP. Rehabilitation trials undertaken over the life of the mine would include revegetation, geochemical analysis of tailings material as well as seeding, planting and, where appropriate, harvesting techniques.

The key areas of focus for final rehabilitation planning include infrastructure areas, final voids, the tailings storage facility, waste emplacements and the evaporation ponds and surge dam. Figure ES-9 presents a provisional revegetation plan for MPF landforms.

Concepts for the infrastructure areas would include removal of equipment following the completion of mining, testing foundation soils for residual contamination (and removal or treatment in accordance with EPA requirements if necessary), contour ripping, topsoiling and revegetation.

Concepts for the final voids include topsoiling and revegetation of selected areas on the void floors, flattening and rehabilitation of pit slopes, direct revegetation of accessible pit benches and utilisation of the voids as backfill areas for mine waste. Future consideration could also include the possible use of mine voids for tailings containment. Two water management options which would be investigated further include maximisation of surface water runoff into the final voids by breaching upslope diversions or minimisation of surface water runoff into the final voids by maintaining stabilised/revegetated upslope surface water diversions.



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Rehabilitation concepts for the batters and top surface of the TSF include progressive rehabilitation, enhanced water absorption through reverse graded berms on batters, surface swale drains on the top surface and creation of a "rough" surface, topsoiling and revegetation comprising the use of native species to re-establish endemic woodland with shrub and grassland communities.

Concepts for the evaporation ponds and surge dam include the removal of any salt deposits from the base of the ponds and surge dam to the TSF at the end of processing and two end use options (including retention of the storages as water storage infrastructure for future landuse opportunities or revegetation to pastures).

Concepts for the waste emplacements include enhanced surface "roughness", wide reverse-graded berms on batters, a series of small shallow basins (depressions) on the surface, and woodland vegetation with a high water demand.

The management and monitoring of rehabilitation progression would be detailed in various management plans (eg. MOP) and updated periodically.

ES2.4 ENVIRONMENTAL MONITORING AND MANAGEMENT

The environmental management and monitoring programmes proposed for the MPF are summarised below.

The proposed programmes have been formulated from the results of the environmental baseline studies and Project impact assessment.

Environmental management at the MPF would include the development and implementation of an Environmental Management System (EMS), numerous environmental management plans, manuals, procedures and environmental initiatives. Plans which would be prepared include:

- Construction Environmental Management Plan;
- Mining Operations Plan;
- Site Management Plan (this would include the management of topsoil, vegetation, bushfires, weeds, pests and native fauna);
- Integrated Erosion and Sediment Control Plan;
- Air Quality Management Plan;
- Waste Management Plan;
- Hazardous Waste and Chemical Management Plan;
- Emergency Response Plan; and
- Closure Plan.

Key environmental issues for the MPF have been identified through specific issues investigations, mine planning and consultation with the government and community. Proposed MPF monitoring would cover a suite of environmental factors with specific focus on the following:

- meteorology (temperature, rainfall, evaporation, wind direction and wind speed);
- air quality (dust deposition, total suspended particulates and gaseous emissions);
- noise (operator attended and unattended);
- surface water (quality);
- groundwater (level, quality and use);
- erosion and sediment control (structural integrity and effectiveness);
- weed and animal pest control;
- rehabilitation performance;
- tailings geochemistry; and
- landholder and community consultation.

Results from the monitoring programmes would be reported annually in an Annual Environmental Management Report as part of regulatory requirements.

ES3 LIMESTONE QUARRY, MATERIALS TRANSPORT ROUTE AND RAIL SIDING

ES3.1 PROJECT DESCRIPTION

Details relevant to the operation of the limestone quarry (Figure ES-10), rail siding (Figure ES-11) and materials transport route (Figure ES-12 including sections of the Fifield to Wilmatha and Condobolin to Tullamore Roads, the Fifield bypass and the Fifield to Trundle Road) are summarised in this section.

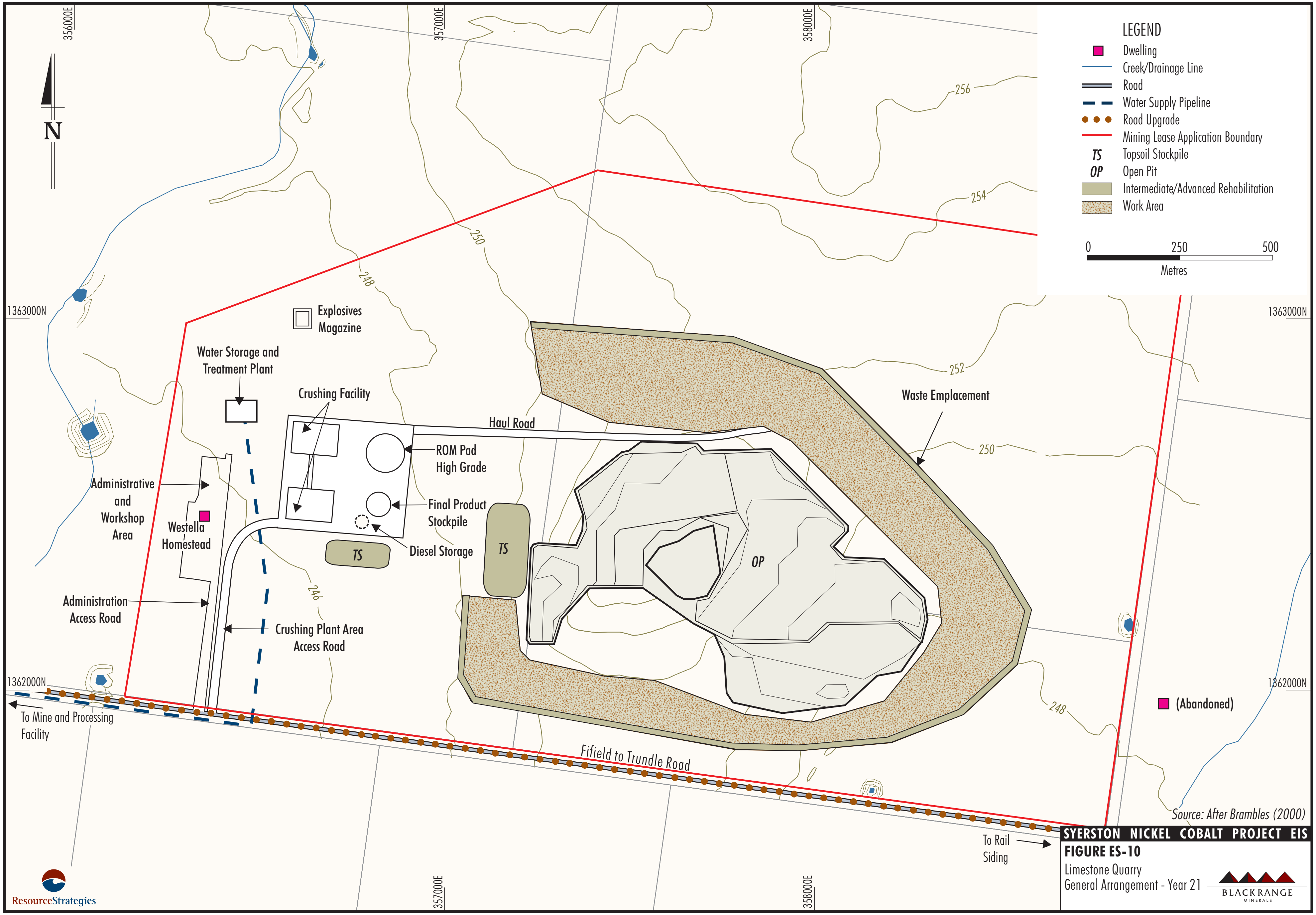

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FIGURE ES-10

Limestone Quarry
General Arrangement - Year 21

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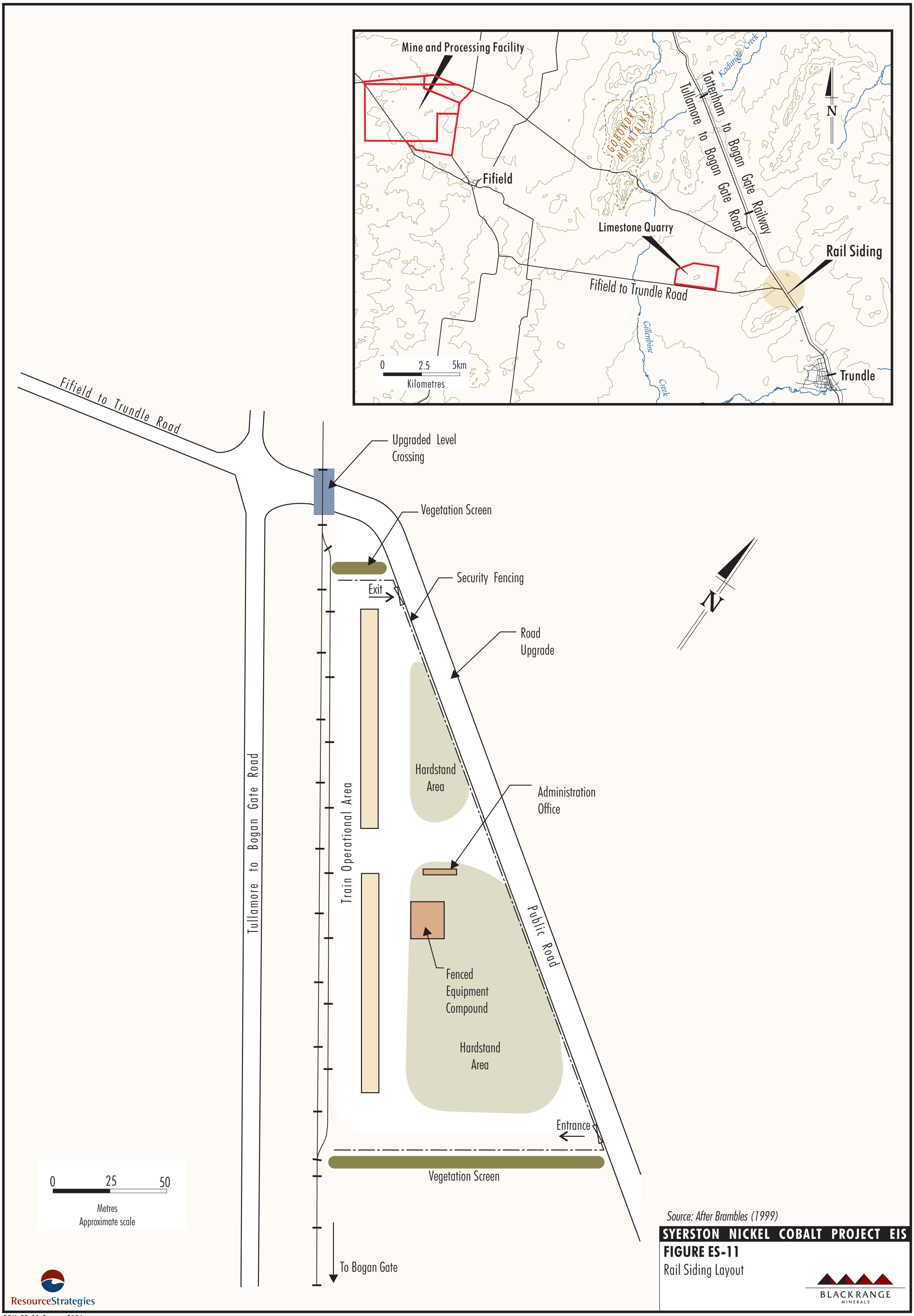

Source: After Brambles (1999)

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FIGURE ES-11

Rail Siding Layout

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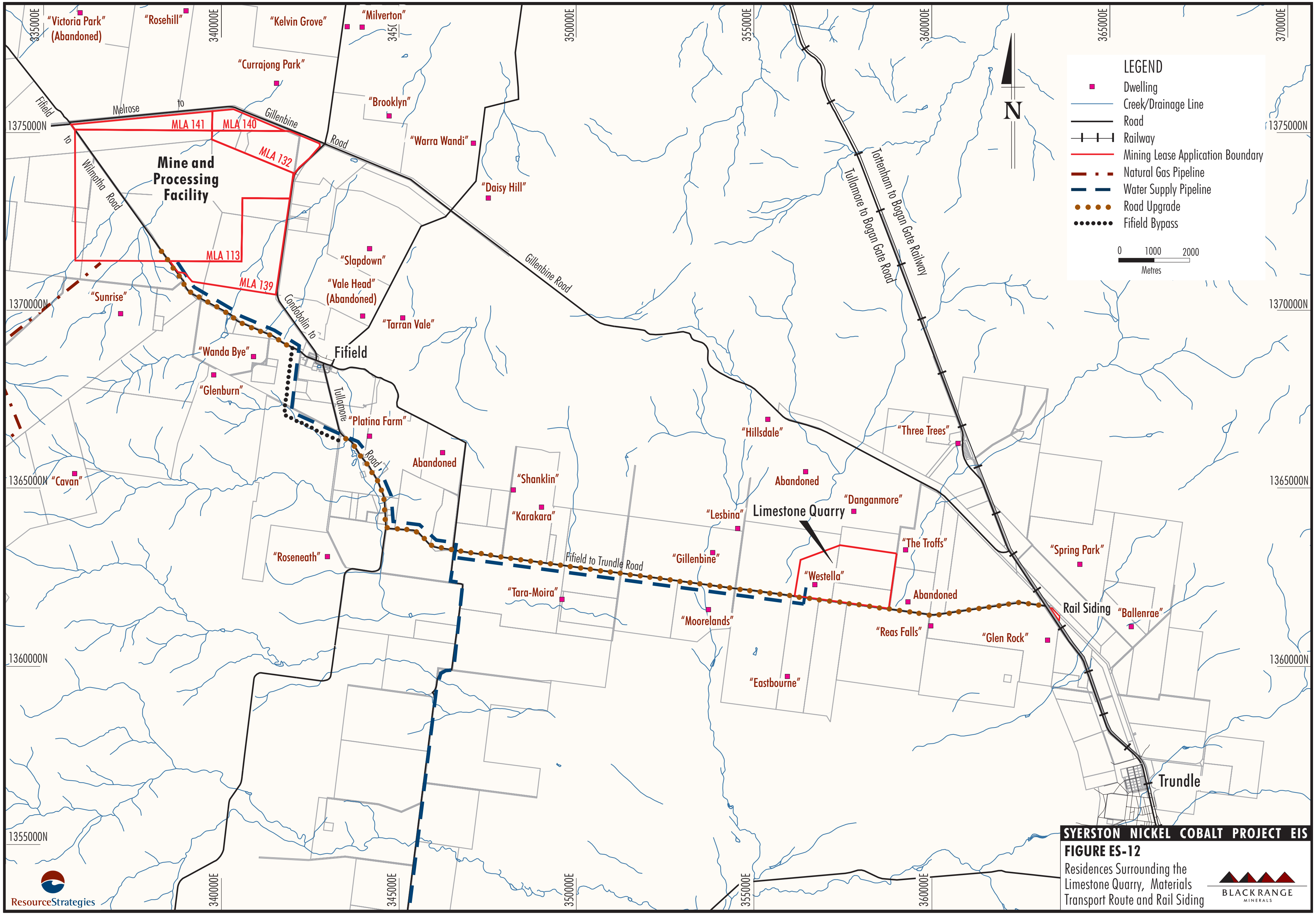

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FIGURE ES-12

Residences Surrounding the Limestone Quarry, Materials Transport Route and Rail Siding

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ES3.1.1 Limestone Quarry

The Project requires approximately 560,000 tpa of limestone. The limestone would predominantly be used to neutralise process liquids and slurries at the MPF, following acid leaching. In order to meet this demand, BRM is proposing to mine the Gillenbine limestone deposit, located approximately 20 km south-east of the MPF (Figure ES-2).

The deposit is located adjacent to the Fifield to Trundle Road. Access to the limestone quarry from the Fifield to Trundle Road would be adjacent to the existing entrance to the "Westella" homestead (Figure ES-10). The proposed layout of the limestone quarry is also shown on Figure ES-10.

Quarrying would utilise conventional open pit drill and blast methods. The limestone would be crushed to a particle size less than 100 mm before being trucked to the MPF. Waste rock and low grade limestone would be deposited in an emplacement surrounding the open pit.

ES3.1.2 Rail Siding

A rail siding would be constructed on the Tottenham to Bogan Gate Railway and would be used in the delivery of consumables and product to and from the Project. The proposed siding site is located some 25 km south-east of the MPF site (Figure ES-11). The rail siding would be located on privately owned property adjoining the eastern side of the rail line and would include container loading and unloading facilities, administration office, equipment compound, fuel storage, and short term container storage facilities (Figure ES-11). Vehicular access to the siding would be provided by upgrading an existing road located to the north and east of the siding.

ES3.1.3 Materials Transport Route

Access to the MPF site from the rail siding, limestone quarry and the Tullamore to Bogan Gate Road would be provided by construction of a Fifield bypass and upgrades of the Fifield to Trundle Road, and sections of the Condobolin to Tullamore Road and the Fifield to Wilmatha Road (Figure ES-6).

The proposed Fifield bypass would link the Fifield to Wilmatha Road with the Condobolin to Tullamore Road, allowing traffic to bypass the village of Fifield (Figure ES-6).

ES3.2 POTENTIAL IMPACTS ON EXISTING ENVIRONMENT AND PROPOSED MITIGATION MEASURES

The potential impacts on the existing environment along the materials transport route, at the limestone quarry and rail siding and related mitigation measures are summarised in this section.

ES3.2.1 Transport

As discussed in Section ES2.2.3, daily traffic volumes on roads most likely to be affected by the Project were measured and predicted increases in traffic volumes were assessed. Traffic volumes in the vicinity of the Project area were very low and characteristic of local rural access roads.

The potential impacts of traffic associated with the limestone quarry, rail siding and materials transport route are summarised in this section.

Over the construction period at the rail siding and limestone quarry (ie. some six months) an average of approximately 30 vehicle movements per day is predicted. In addition, a large proportion of general construction traffic for the MPF site including workforce, equipment and supply deliveries, and other traffic would use the materials transport route. This would include some traffic transporting oversize or overweight loads. These loads would be transported in accordance with the relevant permits and licences as required by the regulatory authorities (eg RTA).

Predicted traffic on the materials transport route during the Project operational phase include an increase of approximately 449 vehicles comprising approximately 196 trucks and 253 light vehicles (measured at the Fifield bypass). These movements include employee and general transport movements and road haulage of consumables and products.

Transport of consumables from the rail siding and limestone from the quarry to the MPF site would contribute approximately 100 truck movements per day (50 round trips). Nickel and cobalt products would be back-loaded on incoming general goods containers and therefore would not contribute any additional truck movements.

Approximately six rail movements on the Tottenham to Bogan Gate Railway would be required each week for the transport of sulphur, other consumables and cobalt and nickel products. Increased road traffic accessing the rail siding via the existing level crossing adjacent the site has the potential to interrupt rail traffic.

Mitigation measures proposed to minimise the potential impact of the Project on the local transport network include road upgrade of the Fifield to Trundle Road and sections of the Fifield to Wilmatha Road and the Condobolin to Tullamore Road, construction of the Fifield bypass, traffic flow prioritisation, intersection upgrades, a level crossing upgrade (in accordance with road and rail authorities requirements) and scheduling Project traffic movements. Locations of those roads mentioned above are shown on Figure ES-6.

ES3.2.2 Acoustics

Potential noise and vibration impacts at the limestone quarry and noise impacts from the rail siding and materials transport route are discussed in this section along with related mitigation measures.

A number of residential localities beyond the Project area nominated to be representative of the local noise environment formed the basis for assessing noise emissions. The locations of residences surrounding the limestone quarry, rail siding and along the materials transport route are shown on Figure ES-12.

At the limestone quarry, noise modelling predicted that during quarry operations the daytime noise emissions would be below the recommended criteria during prevailing meteorological conditions except at "Moorelands", "Lesbina" and "Eastbourne" (Figure ES-12). The predicted noise emissions at "Lesbina" and "Eastbourne" would be marginally (2 dBA) above the criteria and at "Moorelands" moderately (5 dBA) above the criteria under prevailing meteorological conditions. The limestone quarry waste emplacement would progressively encircle the open pit on the southern, eastern and northern sides to provide noise screening of in-pit activities. Noise monitoring would be undertaken around the limestone quarry (including the above residences) and if necessary, property owner discussions and consideration of mitigating measures (eg. point source attenuation, acoustic barriers or dwelling treatments) would be undertaken.

For the limestone quarry, predicted levels of ground vibration and airblast at the three nearest potentially affected residential dwellings complied with relevant ground vibration and airblast criteria.

For the rail siding, predicted noise levels from train movements at the closest potentially affected residences (Figure ES-12) are well below the EPA criteria. This was based on a maximum of six train movements (ie. three return trips) per week required to transport sulphur and other materials to the rail siding.

Noise levels from use of the materials transport route during both construction and operation of the Project were predicted to be lower than both the relevant EPA daytime and night-time traffic noise criteria.

Construction noise associated with roadworks to upgrade the materials transport route would be audible at the nearest residences for a limited duration (ie. as the roadworks occur on the section of road immediately adjacent to the residence) during daylight hours only.

Noise monitoring in the vicinity of the quarry, rail siding and materials transport route would be undertaken on an on-going basis.

ES3.2.3 Air Quality

Emissions relevant to the quarry, rail siding and materials transport route are restricted to the generation and dispersion of atmospheric dust from the limestone quarry and limestone crushing operations. The materials transport route and rail siding are not considered to be dust generating activities as the majority of vehicle movements will be on sealed road surfaces.

Modelling predictions indicate that the EPA amenity criteria for dust deposition would be met for all non-Company owned or optioned residences surrounding the limestone quarry. Exceedance of the criteria is predicted during operations for a small area of farmland to the south and to the west of the MLA.

Limestone haulage to the MPF site would be in covered containers or trucks. No significant dust emissions are anticipated from haulage operations on the materials transport route.

Measures such as watering of disturbed areas, prevention of truck overloading and spillage during loading and hauling, use of dust suppressants or cover crops on stockpiles, installation of fogging water sprays on crushing and screening operations and progressive rehabilitation of disturbed areas would be employed at the limestone quarry to further mitigate potential air quality impacts.

Assessment of potential impacts associated with TSP was also undertaken. Results indicate compliance with the NHMRC guideline at all non-company owned or optioned residences. The guideline may be exceeded on occasion in a small area of farmland to the west of the MLA boundary within the "Westella" property (BRM optioned) during the later stages of operation.

Dust control measures outlined above would also provide control of TSP (including PM_{10} fraction) emissions.

ES3.2.4 Risk Assessment

As discussed in Section ES2.2.2, a Preliminary Hazard Assessment was conducted to obtain a comprehensive understanding of the hazards and risks associated with the Project and to identify relevant mitigation measures.

Potential hazards identified at the limestone quarry, rail siding or materials transport route included those associated with on-site storage of diesel (loss of containment and fire), transport of materials (loss of containment, explosion and fire), explosives (accidental explosion, fire and uncontrolled flyrock) and breaches of security (sabotage and vandalism).

Mitigation measures/factors would include transport, storage, handling and design in accordance with recognised standards (eg Australian Standards), operator training programmes, implementation of safety and security systems, minimisation of rehandling during loading and unloading and implementation of an Emergency Response Plan.

ES3.2.5 Land Resources

The limestone deposit occurs as a low hill (approximately 10 m high) in the middle of the Gillenbine Creek plain. The limestone quarry area consists of cleared land currently used for grazing and occasional cropping.

The rail siding site is located in predominantly cleared dry sclerophyll woodland country and is on the broad level summit of a low rise. From the top of the rise the land falls gently away to the east and west. The rail siding area is currently used for occasional grazing.

The materials transport route follows the existing Fifield to Trundle and Tullamore to Bogan Gate Roads except in the vicinity of Fifield village where the Fifield bypass would be constructed (Figure ES-12). The bypass route crosses gently undulating grazing and fodder-crop pastoral country.

Of these three Project components only the limestone quarry has the potential to appreciably impact on the topography and landscape of the area primarily through excavation of the open pit and construction of the waste emplacement. Both the rail siding and upgrades to the materials transport route would require minimal alteration of the existing topography.

The limestone quarry waste emplacement has been designed to progressively encircle the open pit and would act as a visual screen between activities in the open pit and traffic travelling along the Fifield to Trundle Road. The final shape of the waste emplacement would resemble a low mesa-shaped hill with a crest slightly lower than the original limestone hill. Progressive rehabilitation would further integrate constructed landforms with the surrounding landscape. The rehabilitation strategies for the limestone quarry, rail siding and materials transport route are detailed in Section ES3.3.

An IESCP for the limestone quarry (incorporating construction phase controls for the rail siding and materials transport route) prepared in consultation with relevant government would aim to minimise potential impacts on the soil resources and runoff water quality of the sites.

Soil resource management strategies developed for the Project would be implemented for the limestone quarry. These include formulation of topsoil stripping guidelines and nomination of appropriate depths, locating areas to be stripped and stockpiling of soil. Topsoil stockpiles would be managed to ensure long term viability through implementation of appropriate management practices, in consultation with relevant regulatory authorities.

Measures similar to those to be adopted for the MPF site to prevent or reduce the potential for contamination of land from process reagents, fuels and oils would be implemented at the limestone quarry, rail siding and along the materials transport route.

The extensive areas of managed pasture land surrounding the limestone quarry, rail siding and materials transport route are expected to restrict the movement and magnitude of any bushfire. Bushfire management procedures would be developed as part of the Environmental Management Plan.

ES3.2.6 Water Resources

Surface Water

Surface water runoff from disturbed areas associated with the limestone quarry, rail siding and materials transport route could potentially contain sediments, dissolved solids, oil, grease and other spilt consumables (eg. sulphur, limestone) being transported to or from the MPF area.

The overall objective of the water management system for the limestone quarry, rail siding and materials transport route is consistent with that proposed for the MPF area. In summary, all potentially contaminated water generated within construction and operational areas would be controlled via drainage channels and dams, while all other water would be diverted around these areas.

As discussed in Section ES3.2.5, an IESCP would be prepared for the limestone quarry (incorporating construction phase erosion and sedimentation controls for the rail siding and materials transport route) in consultation with relevant government agencies prior to the commencement of construction activities. The IESCP would detail specific mitigation measures to control soil erosion and sediment migration and therefore protect downstream surface water resources.

Groundwater

The activities proposed at the rail siding and materials transport route are not predicted to create any impact on groundwater resources in the area. Limited groundwater resources encountered during exploratory drilling at the limestone quarry would suggest that localised drawdown effects resulting from the excavation of the limestone quarry open pit would be minimal.

In addition, there are no registered groundwater extraction licences or users in the immediate vicinity of the limestone quarry. No specific measures to reduce the groundwater effects of the open pit are therefore proposed. Groundwater level monitoring in the limestone quarry area and the measurement of underground inflow rates would be used to evaluate the drawdown effects of the quarry open pit.

ES3.3 REHABILITATION

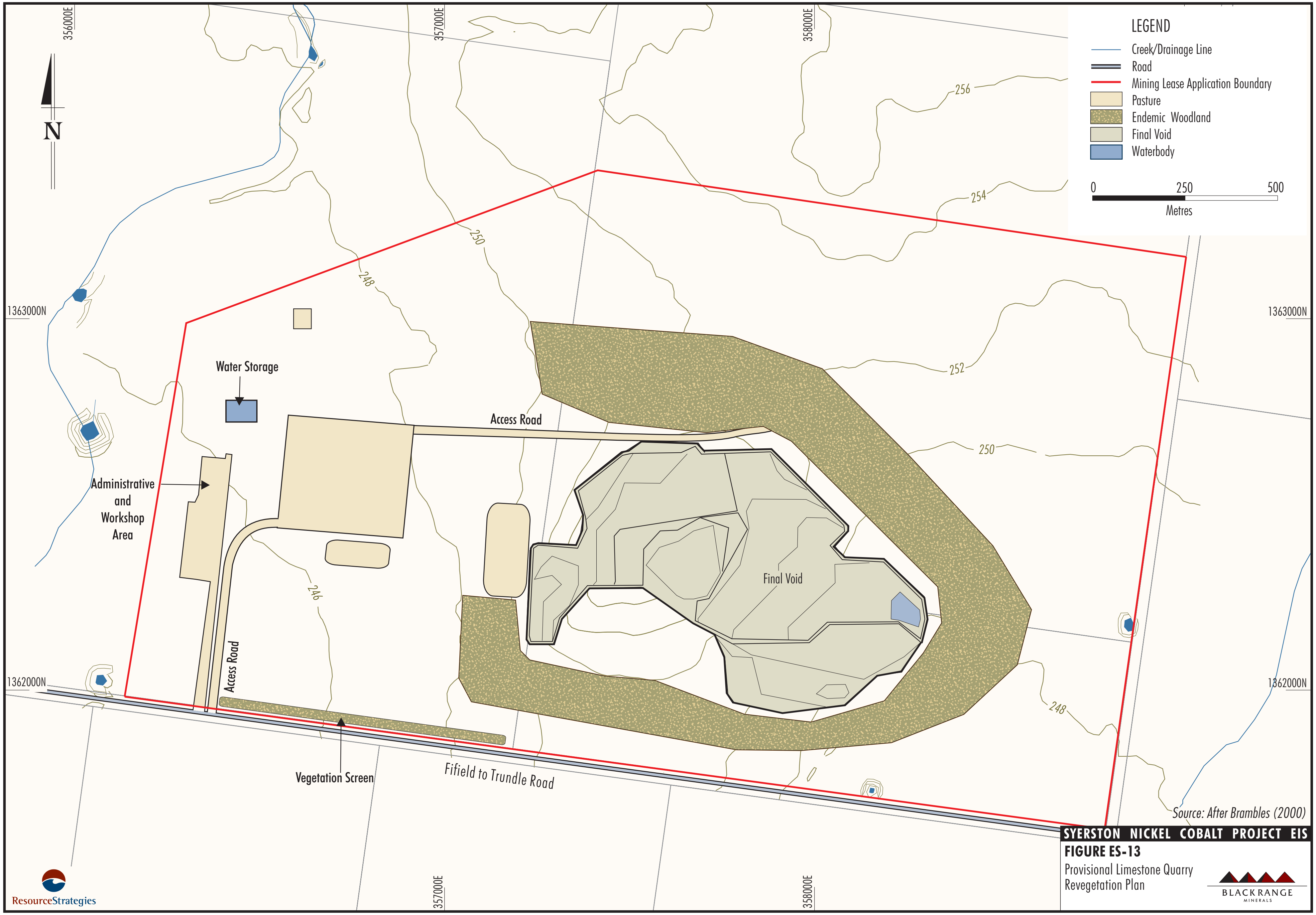
The proposed concepts for the rehabilitation of the limestone quarry, rail siding and materials transport route are summarised below.

Rehabilitation objectives for the limestone quarry, rail siding and materials transport route include the provision of acceptable post-mine landforms suitable for the proposed final landuses including roads, grazing, cropping and/or woodland/pasture habitat.

The key rehabilitation activities for these areas include planning and scheduling, progressive land clearance, soil handling and erosion and sediment control works. Planning and scheduling would include preparation of relevant pre-mining plans/commitments (eg. soil conservation and erosion control plans). Land clearance would include the same vegetation clearance protocols adopted for the MPF. Soil handling would include stripping and stockpiling procedures while erosion and sediment control works would include the preparation of an IESCP which would detail erosion and sediment controls for the construction and operation phases.

The key areas for focus for final rehabilitation planning include infrastructure areas, final void (limestone quarry) and waste emplacement (limestone quarry). Figure ES-13 presents a provisional revegetation plan for the limestone quarry landforms.

Concepts for the infrastructure areas at the limestone quarry and rail siding include decommissioning and rehabilitation to pastures where practical or retention as required in consultation with Department of Mineral Resources (DMR) and relevant stakeholders.



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Concepts for the limestone quarry final void include leaving the void to fill with water to an equilibrium level and to leave its surrounds safe (for humans and stock) and revegetated in a manner consistent with the overall Project rehabilitation objectives. Batter and berm surfaces above the final water level in the void would be left in a roughened state to encourage natural succession. The berms would be topsoiled and planted with a mixture of endemic woodland and grass species where practical.

Concepts for the waste emplacement include placement of a soil layer and the progressive rehabilitation of outer batters with grass cover, tubestock and seeds of native woodland species. The surface of the waste emplacement would be rehabilitated in the same manner as the batters once mining operations had ceased.

The final landform concept of the materials transport route (including the Fifield bypass) is to retain the road for future use. The rehabilitation concepts are to provide a safe and stable embankment and verge.

An on-going monitoring and research programme would be developed for the limestone quarry and would be used to assess the appropriateness of the rehabilitation strategy

ES3.4 ENVIRONMENTAL MONITORING AND MANAGEMENT

The environmental management and monitoring programmes proposed for the limestone quarry, rail siding and materials transport route are summarised below.

The EMS developed and implemented for the MPF would also encompass environmental management of the limestone quarry, rail siding and materials transport route. Environmental management and monitoring of the limestone quarry, rail siding and materials transport route would be facilitated by a variety of management plans and monitoring programmes.

These plans would include:

- Construction Environmental Management Plan;
- Mining Operations Plan (for the limestone quarry);
- Operations Environmental Management Plans (including management procedures for land resources, water resources, noise and blasting, air quality, flora and fauna, weed control, bushfires, visual aspects and transport and procedures for environmental monitoring); and
- Closure Plan.

Environmental monitoring programmes for the limestone quarry, rail siding and materials transport route (including parameters, frequencies and analytical procedures) would be specified in the Construction and Operation Environmental Management Plans and the Closure Plans (for post-closure), in consultation with regulators and other stakeholders.

Proposed environmental monitoring programmes for the limestone quarry, rail siding and materials transport route would cover a suite of environmental factors with specific focus on the following:

- groundwater (at the limestone quarry);
- surface water (at the limestone quarry and rail siding);
- erosion and sediment control;
- noise;
- blast (at the limestone quarry);
- air quality;
- rehabilitation performance; and
- community consultation.

The parameters and frequency of all monitoring activities would be reviewed through the Mining Rehabilitation and Environmental Management Process (MREMP) associated with the MPF. The Annual Environmental Management Report prepared for the MPF would present the results and findings of the above monitoring programmes and would be subject to annual review and continuous improvement as a result of stakeholder input.

ES4 NATURAL GAS PIPELINE, WATER SUPPLY PIPELINE AND BOREFIELDS

ES4.1 PROJECT DESCRIPTION

Details relevant to the operation of the natural gas pipeline, borefields and water supply pipeline (Figure ES-14) are summarised in this section.

ES4.1.1 Natural Gas Pipeline

The MPF electricity demand (an average of approximately 34MW) would be supplied by an on-site natural gas fired power station. Natural gas would be supplied to the power station via a pipeline from south of Condobolin to the MPF site (Figure ES-14).

The natural gas pipeline would be approximately 90 km long, and would connect the MPF site with the existing Moomba to Sydney natural gas pipeline (Figure ES-14).

It would be buried and located within road reserves, for the majority of its length. The alignment has been selected in consultation with Lachlan Shire Council (including the section around Condobolin).

The infrastructure associated with the natural gas pipeline is likely to include:

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

At major watercourse crossings, the natural gas pipeline would be bored under the stream channel.

ES4.1.2 Water Supply Borefields

The proposed raw water supply scheme would predominantly comprise the development of two borefields (eastern and western). The borefields, each comprising three bores (two production and one standby) are proposed to be developed within the Lachlan River Palaeochannel, at the intersection with the Bland Creek Palaeochannel, located south of the MPF site.

The reticulation system from the borefields to the MPF site would be constructed with a capacity of approximately 17.5 ML/day and is expected to provide water to the Project at a rate of 10.5 ML/day.

ES4.1.3 Water Supply Pipeline

The water supply pipeline would be approximately 65 km long, and would connect the MPF site with the eastern and western borefields adjacent to the Lachlan River. The pipeline would be laid below ground within existing road reserves. A smaller size, 12 km spur line would also be constructed from the main pipeline to the limestone quarry.

It is proposed to bury the pipeline, where possible, along its route. However, at river and major tributary crossings the pipeline would cross watercourses on a raised structure.

ES4.2 POTENTIAL IMPACTS ON EXISTING ENVIRONMENT AND PROPOSED MITIGATION MEASURES

The potential impacts on the existing environment along the natural gas pipeline, at the borefields and along the water supply pipeline and related mitigation measures are summarised in this section.

ES4.2.1 Water Resources

Surface Water

During construction surface water runoff from disturbed areas could potentially contain sediments or traces of contaminants (eg. diesel). In addition, where pipelines cross watercourses, there is increased potential for erosion, sedimentation or contamination.

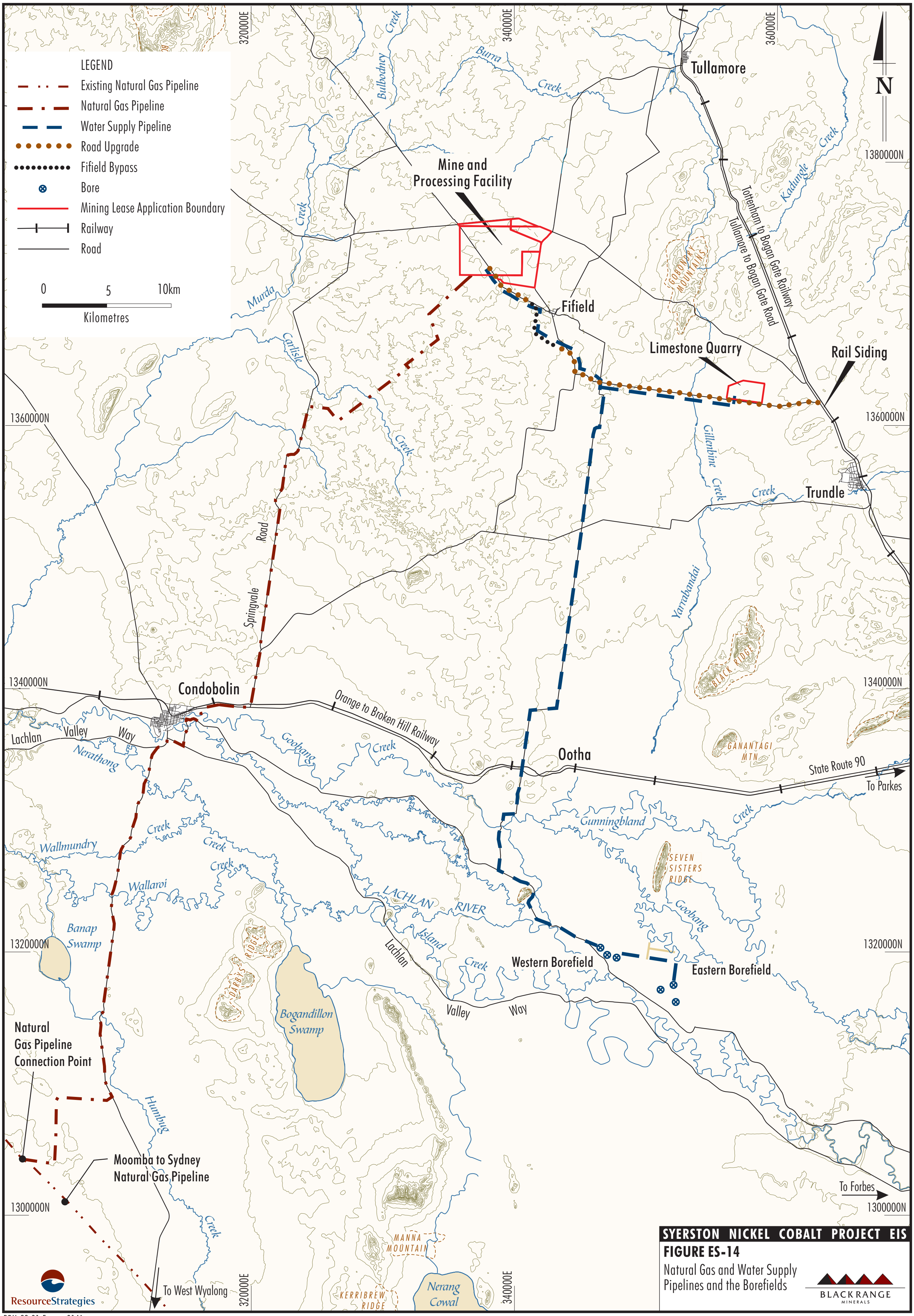

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FIGURE ES-14

Natural Gas and Water Supply Pipelines and the Borefields

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During the operation phase, potential surface water impacts include sedimentation or water quality impacts upon surface waters associated with rupture of the water pipeline and the loss of contained groundwater to watercourses.

The sediment and erosion control measures and contamination control measures outlined in Section ES4.2.2 would be employed to minimise impacts associated with disturbance area runoff, erosion and sedimentation.

At major watercourse crossings, the natural gas pipeline would be bored under the stream channel and water supply pipeline would be suspended above streams on elevated structures. These construction methods would minimise disturbance to the stream banks and channels.

During operation, the water supply pump system would be fitted with an automatic, pressure sensitive shutdown system to rapidly cease pumping in the event of pipeline rupture. Loss of contained water during a potential pipeline rupture would be unlikely to have a significant impact on surface water quality.

Groundwater

The proposed western and eastern borefields for the Project are located within the central southern section of the Department of Land and Water Conservation's (DLWC's) Zone 5 of Groundwater Management Area 11.

The DLWC manage groundwater use within this zone in accordance with the objectives of NSW's State Groundwater Management Policy. For management purposes, the DLWC have estimated the total amount of groundwater that could be extracted from Zone 5. The proposal to extract groundwater for Project water supply has been assessed by the DLWC under the management scenario described above.

Authority to grant licences for extraction of groundwater rests with the DLWC under Part 5 of the *NSW Water Act, 1912*. Applications for production bore licenses were made by BRM in July 1998.

A hydrogeological assessment conducted in consultation with DLWC investigated potential drawdown effects using two different modelling methods. The methods produced both a "worst case" (Model 1) and "best case" (Model 2) scenario.

The potential impacts of the borefields on local and regional groundwater regimes include:

- a depletion of the aquifer during the extraction period;
- water level drawdown after 30 years of extraction of approximately 3.5 m to 14 m in the vicinity of the production borefields and about 3 to 4 m in Model 1 and up to 0.5 m in Model 2 around the aquifer boundaries;
- variable impacts on surrounding shallow bores dependent on the depth of bore screens and their proximity to the Syerston borefields;
- increased recharge from the Lachlan River to the groundwater system;
- a lowering of the groundwater mound beneath Jemalong-Wyldes Plains;
- a reversal of groundwater flow direction near the groundwater mound beneath Jemalong-Wyldes Plains, resulting in restoration of the original groundwater flow path northwards from the Bland Creek Palaeochannel to the Lachlan River Palaeochannel; and
- a decrease in groundwater levels in deeper aquifers of the Lachlan River valley resulting in induced vertical infiltration from shallow aquifers.

Hydrogeological conditions would be monitored at the borefields as part of a proposed Borefields Management Plan. Monitoring piezometers would be installed, the number and location of which would be determined in consultation with the relevant government authorities. Ameliorative measures such as bore reconditioning, lowering existing pump sets and/or refitting would be undertaken should disruption to surrounding bores occur.

Six month sequential pumping of each alternate borefield is proposed to minimise impacts on groundwater reserves and surrounding bores. This is expected to reduce the impact on groundwater levels at each extraction area.

ES4.2.2 Land Resources

The pipelines would be established in existing road reserves beside public roads for the majority of their lengths. Land adjacent to the road corridors is characterised by cleared agricultural land.

Both the eastern and western borefields would be located in previously cleared and cultivated agricultural areas.

There is potential for erosion downslope of and in disturbance areas during the construction phase.

Construction activities would be designed to minimise disturbance areas and the potential for erosion and sediment movement with rehabilitation being undertaken as soon as practicable following completion of construction. Sediment and runoff controls such as silt fences and hay-bale baffles would be installed in road verges and downslope of disturbance areas prior to construction works commencing. Disturbance areas would be stick-raked, slashed or otherwise cleared such that seed/root stock is left in the ground and surface soils are disturbed as little as possible.

Spillage of hazardous substances such as diesel, paints and herbicides could potentially result in localised environmental impacts along the pipeline corridors or at the borefields. Hazardous substances would be stored and handled in accordance with Australian Standards where applicable and all waste generated by construction works would be removed from site to authorised facilities. Relevant control and clean-up procedures for potential spills and other incidents would be outlined in a Construction Environmental Management Plan (CEMP).

The extensive areas of managed pasture land surrounding the pipelines and borefields are expected to restrict the movement and magnitude of any bushfire. Bushfire management procedures would be developed as part of the CEMP.

ES4.2.3 Flora

Service corridors for the pipelines would be established in existing easements beside public roads for the majority of their length. The density of native vegetation currently remaining in the easements varies considerably along the corridors and depends on the width of the easement and degree of past disturbance.

The wider corridors are Travelling Stock Routes subject to periodic grazing during droughts. These generally retain more or less intact samples of the original vegetation.

Seven vegetation alliances were identified along the natural gas pipeline route, comprising 17 vegetation associations. To the north of Condobolin, the natural gas pipeline route is vegetated mainly by remnants of box-pine woodlands. To the south of Condobolin, remnant vegetation predominantly consists of acacia shrublands dominated by Myall and Black Box.

Five vegetation alliances were identified along the water supply pipeline comprising seven vegetation associations. The River Red Gum is the dominant tree species forming monospecific forest stands along creeks and rivers and across associated floodplains from the borefields to Goobang Creek (approximately 15 km west of the borefields). North of this the water supply pipeline predominantly traverse box-pine woodlands all the way to the MPF and limestone quarry sites.

The borefields are situated in cleared agricultural land.

While no threatened flora species listed in the *Threatened Species Conservation Act, 1995* were identified during the surveys of the natural gas pipeline, water supply pipeline and borefields, the Austral Pillwort has previously been recorded in the vicinity of a small section of the natural gas pipeline.

Although not threatened under the *Threatened Species Conservation Act, 1995*, the Club-leaved Phebalium considered to be rare by Briggs and Leigh (1996) (*Rare or Threatened Australian Plants)* was recorded at one site on the natural gas pipeline route.

Areas of significant roadside vegetation were recorded along the natural gas pipeline route on roadsides along the West Wyalong to Condobolin Road and as well as along the water supply pipeline on roadsides along the Ootha to Fifield road.

Construction of the natural gas pipeline (northern section), water supply pipeline (northern section) and borefields located on private property would require minimal vegetation clearance due to their placement in previously cleared areas. The remainder of the pipelines would be situated within predominantly cleared existing road corridors, although some clearance of remnant vegetation may be required.

Strategies to minimise clearance would be implemented and clearance protocols would be adopted to include maximum harvesting of cleared timber resources, recycling or disposal of other non-harvestable parts and delineation of "management zones". These zones would include gilgai areas along the natural gas pipeline in the vicinity of the Austral Pillwort recording, areas in the vicinity of the Club-leaved Phebalium recording, and areas of significant roadside vegetation along the West Wyalong to Condobolin Road and the Ootha to Fifield Road.

ES4.2.4 Fauna

Twenty-one mammals, twenty-one bird species, seven reptiles and five amphibian species were recorded in the vicinity of the natural gas pipeline, water supply pipeline and borefields.

Six fauna species listed as threatened under the NSW *Threatened Species Conservation Act, 1995* were recorded during the surveys, *viz*. the Pied Honeyeater, Barking Owl, Major Mitchell's Cockatoo, Yellow-bellied Sheathtail Bat, Little Pied Bat and Greater Longeared Bat in or in the vicinity of the pipelines.

It was determined that no threatened fauna species would be significantly affected by the construction of the natural gas pipeline, water supply pipeline or borefields to the extent of undermining the viability of a local population of that species.

Survey suggested that cropland, pasture land and habitat with few scattered trees were of low habitat value to threatened bat species.

Disturbance areas would be restricted to pre-cleared areas where possible and trees of high habitat value would be avoided where practicable. Such trees would be identified during a pre-construction survey of the pipelines. Clearance activities would be carefully managed in the areas considered to be of high habitat value. Potential impacts during clearance would be further minimised through the inspection of large trees for fauna prior to removal and the relocation of any animals (and bat colonies) found to alternative suitable habitat. Following construction, the disturbance areas would be rehabilitated with native grasses and forbs, creating ground cover for small fauna, and shrub and tree planting. The pipeline trenches would be left exposed for as short a period as possible, inspected daily and their ends ramped to allow larger sized fauna to escape.

ES4.2.5 Aboriginal Heritage

An Aboriginal heritage assessment was undertaken with the assistance of a representative of the Condobolin LALC and the Wiradjuri RALC. Thirteen sites were recorded within the area during survey.

Two sites are located within the proposed natural gas pipeline corridor, *viz.* an isolated artefact and a camp site on Humbug Creek. The isolated artefact is likely to be destroyed through construction of the pipeline. The camp site on Humbug Creek is of high cultural significance and research potential. It is located within the pipeline corridor and could potentially be disturbed.

A written agreement would be obtained from the Condobolin LALC or the Wiradjuri RALC for the destruction of the artefact and an application for a Consent to Destroy lodged with NPWS. Disturbance of the Humbug Creek site is largely avoidable by locating the natural gas pipeline in the area already disturbed between an existing bridge and side track. A representative of the Condobolin LALC or Wiradjuri RALC would be in attendance to monitor any earthworks for the pipeline within the vicinity of the area.

No sites of archaeological significance were located within water supply pipeline corridors or the vicinity of the borefields.

ES4.2.6 European Heritage

A pine log structure of local heritage significance and a series of telephone poles of local historical interest are located within the natural gas pipeline corridor. These sites may potentially be disturbed during pipeline construction works.

The old telephone poles would be avoided and left undisturbed wherever possible.

It is proposed that the pipeline be placed no nearer than 15 m from the pine log site, as there is evidence that artefacts may be spread around the site. If it is not possible to keep construction works at least 15 m from the site, the immediate surrounds of the site (ie. 5 m from its centre) would be fenced to protect the site.

No sites of European heritage significance were recorded within water supply pipeline corridors or the vicinity of the borefields.

ES4.2.7 Risk Assessment

The major hazards associated with the proposed pipeline infrastructure are loss of containment from the natural gas pipeline (eg. leaks due to corrosion, mechanical damage) leading to fires or explosions.

This includes the possibility of a vapour cloud explosion resulting from a large leak of natural gas (although such clouds are typically difficult to ignite).

Diesel spills and fires also present a potential on-site risk during construction.

The natural gas pipeline has been routed to avoid sensitive areas, where possible. This includes routing the pipeline around the outskirts of Condobolin.

The natural gas pipeline would be laid in accordance with relevant standards and codes (eg. AS 2885, *Pipelines – Gas and Liquid Petroleum*) and an efficient fire alarm and fire suppression system for the natural gas pipeline infrastructure would be implemented. An automatic monitoring and shut-down facility would be installed, a detailed emergency response plan prepared and operator training provided to minimise the risk associated with the natural gas pipeline.

ES4.3 REHABILITATION

The proposed concepts for the rehabilitation of the natural gas pipeline, water supply pipeline and borefields sites are summarised below.

The main rehabilitation objectives for the natural gas pipeline, water supply pipeline and borefields would include the provision of acceptable post-mine landforms suitable for the proposed final landuses. The rehabilitation strategy for the pipelines include replacement of soil and revegetation, weed management and erosion and sediment control. The strategy for the borefields would include weed management and erosion and sediment control.

Post closure strategies would depend on the decommissioning options for the pipelines and borefields. Various decommissioning options exist for the pipelines and borefields which include retention for future use by others and dismantling.

Decommissioning options would be determined in consultation with landowners and relevant authorities. Should the pipelines and borefields be dismantled, rehabilitation would include removal of infrastructure, rehabilitation of disturbed areas, provisions for stock, native fauna and human safety and amendment of titles information and dissolution of agreements with affected landowners.

Rehabilitation would be undertaken in accordance with Construction Environmental Management Plans and a Closure Plan developed in consultation with relevant authorities.

ES4.4 ENVIRONMENTAL MONITORING AND MANAGEMENT

The environmental management and monitoring programmes proposed for the natural gas pipeline, borefields and water supply pipeline are summarised below.

The EMS developed and implemented for the MPF would also encompass environmental management of the natural gas pipeline, water supply pipeline and borefields. The results of the management and monitoring programmes for the pipelines and borefields would be reported within the MPF Annual Environmental Management Report.

Environmental management and monitoring of the natural gas pipeline, water supply pipeline and borefields would be facilitated by a variety of management plans and monitoring programmes.

These plans would include:

- Construction Environmental Management Plan;
- Natural Gas Pipeline Safety and Operating Plan;
- Water Supply Pipeline Safety and Operating Plan;
- Borefields Management Plan; and
- Closure Plan.

Monitoring of the natural gas pipeline, water supply pipeline and borefields would be carried out in accordance with the natural gas and water supply pipeline Safety Operating Plans and Borefields Management Plan, respectively.

Monitoring of the pipelines would include maintenance inspections while a more detailed monitoring programme would be implemented for the borefields.

Proposed environmental monitoring programmes for the borefields would cover a suite of environmental factors with specific focus on the following:

- a bore census of all bores within a 10 km radius of the Project borefields prior to commencement of groundwater extractions;
- daily rainfall at the borefields;
- groundwater levels and quality in bores in the borefields, observation piezometers surrounding the borefields and in selected regional bores; and
- annual groundwater usage in selected regional bores.

The continuation of relevant monitoring programmes would be determined in consultation with relevant agencies and stakeholders.

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OCTOBER 2000
Project No. BRM-01\2.9
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SYERSTON NICKEL COBALT PROJECT ENVIRONMENTAL IMPACT STATEMENT

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RESOURCE STRATEGIES PTY LTD

OCTOBER 2000
Project No. BRM-01\1\2.9
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I1 GENERAL

I1.1 PROJECT OVERVIEW

This Environmental Impact Statement (EIS) is produced in three Parts (Section I1.3) and assesses the proposed development of the Syerston nickel-cobalt lateritic deposit located approximately 4.5 km north-west of the village of Fifield and some 45 km north-east of Condobolin in the Central West Region of New South Wales (NSW) (Figures I-1 and I-2). The proponent is an Australian publicly listed company, Black Range Minerals Ltd (BRM).

The lateritic deposit is dominated by non-oxide minerals developed over a dunite intrusive. The laterite occurs up to 40 metres (m) thick, overlain by approximately 15-20 m of tertiary clays/gravels and pisolitic lateritic and siliceous ironstone overburden. Potentially economic mineralisation identified within the deposit includes nickel, cobalt and platinum.

The Syerston Nickel Cobalt Project (herein referred to as the Project) includes the construction, operation and rehabilitation of a nickel-cobalt mine, processing facility and ancillary infrastructure. The Project components are summarised below.

Mine and Processing Facility (MPF)

The MPF site would comprise the majority of the infrastructure and operations associated with the Project and include:

- the development of an open pit mine comprising up to 11 pits and producing an average of 2 million tonnes per annum (Mtpa) of nickel-cobalt ore;
- transfer of ore by haul road to a processing facility with an average milled ore consumption rate of some 2 Mtpa, to produce up to 42,000 tonnes (t) of mixed sulphide precipitate or up to 20,000 t of nickel metal and 5,000 t of cobalt metal per annum;
- production of reagents including sulphuric acid, hydrogen sulphide, hydrogen, oxygen and nitrogen for process requirements at the MPF site;
- electricity and steam generation at the MPF site in a natural gas fired co-generation plant;
- disposal of overburden, process tailings and process water in specifically designed mine waste emplacements, dams and evaporative ponds; and
- water treatment facilities, administration offices and workshop/maintenance facilities.

The components located at the MPF site are described in Part A of the EIS.

Ancillary Components Located Outside the MPF Site

The following components are located outside the MPF site:

- a limestone quarry and crushing plant some 20 km south-east of the MPF site, to provide approximately 560,000 tonnes per annum (tpa) of crushed limestone for process neutralisation requirements;
- upgrades of road and rail transport facilities to accommodate transport movements associated with the Project in the vicinity of the MPF site, including the provision of a dedicated rail siding located some 25 km south-east of the MPF site and a materials transport route between the limestone quarry, rail siding and the MPF;
- provision of up to 6,300 megalitres (ML) per annum of process water from two borefields in the Lachlan Valley Palaeochannel, and an associated water supply pipeline; and
- provision of natural gas for electricity and steam generation and hydrogen production via a predominantly buried pipeline from the existing Moomba to Sydney natural gas pipeline located south of Condobolin.

These items are addressed in Part B and Part C of the EIS.

The relative locations of the above listed features, associated Development Application (DA) area and Mining Lease Application (MLA) areas are shown on Figure I-2. An overview of the EIS structure is provided in Section I1.3.

Table I-1 provides a summary of key Project information.

SYERSTON NICKEL COBALT PROJECT EIS

FIGURE I-1

Regional Location

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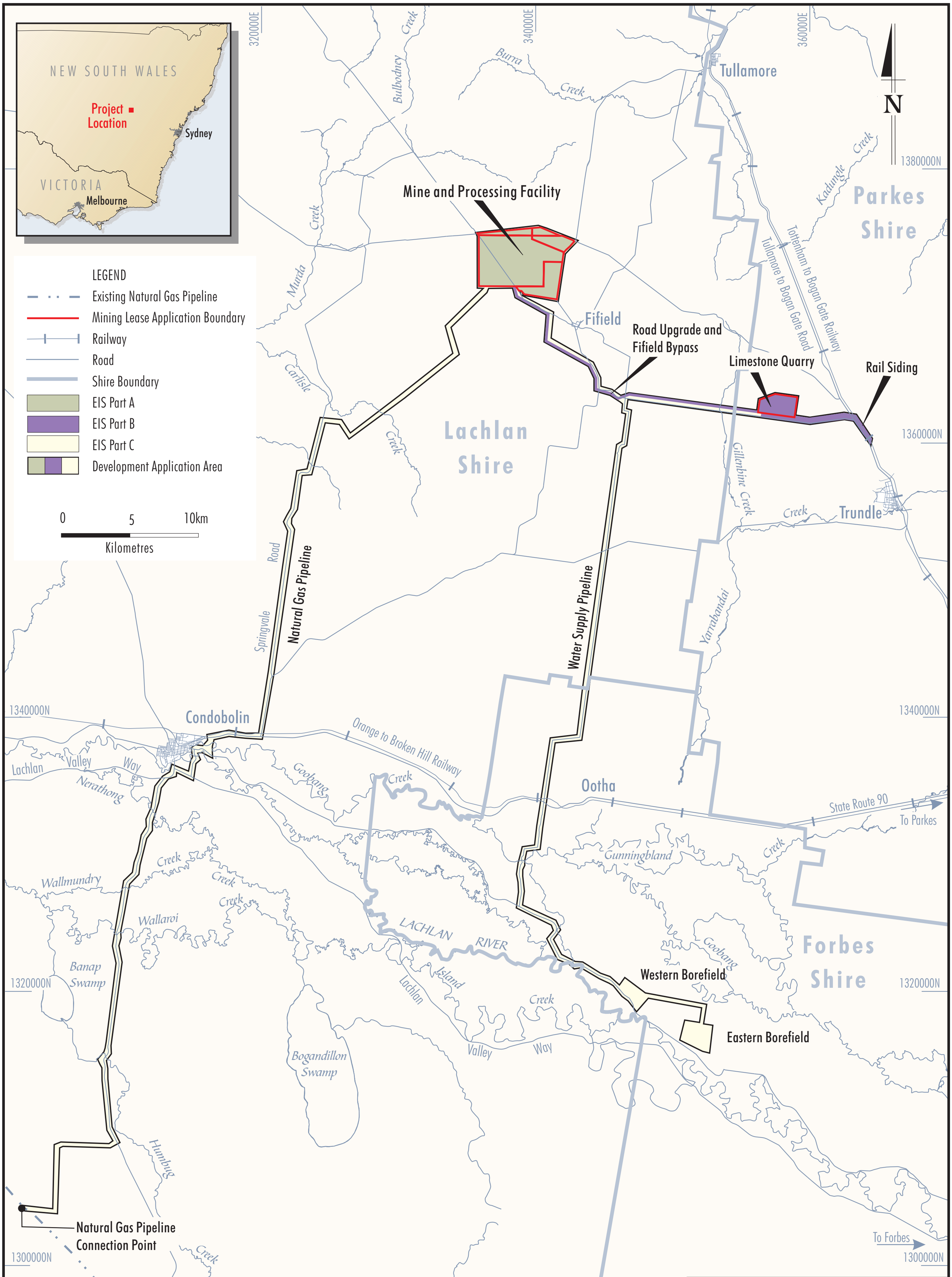

SYERSTON NICKEL COBALT PROJECT EIS

FIGURE I-2

Project Location and Development Application Area

ResourceStrategies

BLACK RANGE MINERALS

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Table I-1
Project Snapshot

Project Development Component	Summary
General	An open pit, nickel-cobalt mine employing some 1,000 construction and 400 operational staff.
Proponent	Black Range Minerals Ltd, ACN 009 079 047, Level 10, 17 Castlereagh Street, SYDNEY NSW 2000.
Tenement Status	Exploration tenements for the deposit (EL 4573) and the limestone quarry (EL 5586) held by UAL Pty Ltd (a 100% owned subsidiary of BRM), who have applied for 4 mining leases at the MPF site and one mining lease at the limestone quarry site, covering a combined area of approximately 3,000 ha.
Mining	Open pit mining operation producing up to 3 Mtpa of ore (average 2 Mtpa). Limestone quarry to provide about 560,000 tpa of crushed limestone for process neutralisation requirements.
Processing	Processing via acid leach and ancillary processes to produce 42,000 t of mixed nickel/cobalt sulphides or up to 20,000 t of nickel and 5,000 t of cobalt per annum.
Life of Mine	The current Development Application is for 21 years, however, the size of the mining ore reserve (76.8 million tonnes [Mt]) indicates a mine life of greater than 30 years.
Mine Waste Management	Approximately 125 Mt of mine waste (in the form of overburden) would be deposited in two progressively rehabilitated waste emplacements.
Tailings Disposal	Tailings from the Project are to be thickened and deposited in two adjoining specifically designed subaerial tailings cells.
Evaporative Ponds	Non-recyclable process waters to be evaporated from approximately 180 ha of evaporative ponds and dams.
Power Supply	2.6 petajoules of natural gas per annum to be piped to the site for the production of approximately 34 megawatts (MW) of electricity at an on-site power generation facility.
Water Supply	The water demand for the Project of up to 6,300 ML per annum, to be provided by the Lachlan Valley Palaeochannel borefield and pipeline (approximately 65 km).
Hours of Operation	24 hours a day, 7 days per week except mining at the limestone quarry (daytime operation).
Employment	Approximately 300 full time company personnel and 100 permanent contractors during operations.

I1.2 EXPLORATION AND MINING HISTORY

Mineral exploration and small scale alluvial gold mining commenced in the Fifield area in the 1860s. In 1893 a buried palaeochannel bearing platinum and gold was discovered near the present location of the village of Fifield and was developed into the Platina deep lead mine. The Platina mine and two additional deep lead mines in the Fifield area went on to produce some 640 kilograms (kg) of platinum and 180 kg of gold by the time mining ceased in the 1960s.

In addition to gold and platinum, the Fifield area has also been subject to tin and magnesite mining. Tin was discovered 12-16 km north-west of Fifield in 1874 and mined intermittently until 1980. Magnesite was discovered in the early 1900s and mined for use in steel manufacturing from 1915 until the 1980s.

Magnesite mining within and north-east of the MPF area was undertaken from the 1950s and a series of open pits and other remnants of past mining operations can be found in the north-east of the MPF area (Appendix M).

The development of modern exploration techniques led to regional aeromagnetic survey data being published in 1984, indicating a series of unusual intrusive complexes occurring in a north-northwest trend in the Fifield area. A number of exploration companies identified the intrusive complexes as a possible source of the alluvial platinum previously mined in the region. Noble Resources NL (later Black Range Minerals Ltd) applied for tenements within the Flemington/Tout intrusive complex and commenced exploration in 1986. In 1988 Noble Resources formed a joint venture with Poseidon Limited who then managed exploration of the venture, with effort primarily focussed on platinum.

The exploration focus shifted in the late 1980s to concentrate on other element enrichment including nickel, cobalt and chromium. In 1989 Poseidon commissioned initial metallurgical testing on samples from the Syerston area, however extractive technologies were not sufficiently advanced at the time to further develop the identified mineralisation.

Subsequent developments in pressure acid leach nickel and cobalt extraction methods and on-going exploration has resulted in the identification of a resource at Syerston with significant economic nickel and cobalt mineralisation. In-fill drilling and testwork conducted by BRM between 1997 and 2000 has identified a mining ore reserve at Syerston of 76.8 Mt graded at 0.73% nickel, and 0.13% cobalt.

Additional prospective nickel-cobalt lateritic targets have been identified within BRM's joint venture and exploration leases to the north and south of the Syerston deposit (Figure I-3).

I1.3 STRUCTURE OF THE EIS

This EIS has been prepared in accordance with the provisions of Part 4 of the NSW *Environmental Planning and Assessment Act*, *1979* (EP&A Act), to accompany the DA submitted by BRM for the Project. The approximate DA areas are shown on Figure I-2.

The EIS is presented as two components, the first being the main text and the second being the supporting study appendices. The document is presented in four volumes:

- EIS Volume 1 - Main Text (Parts A, B and C)
- EIS Volume 2 - Appendices A-F
- EIS Volume 3 - Appendices G-JD
- EIS Volume 4 – Appendices K-O.

This introduction to the EIS provides background information on the Project including consultation undertaken in preparing the EIS, alternative development scenarios considered, DA requirements and ecologically sustainable development considerations.

Due to the geographical separation of a number of Project elements, Volume 1 has been broken into the following parts (Figure I-2):

Part A	Mine and Processing Facility
Part B	Limestone Quarry, Rail Siding and Materials Transport Route
Part C	Natural Gas Pipeline, Borefields and Water Supply Pipeline

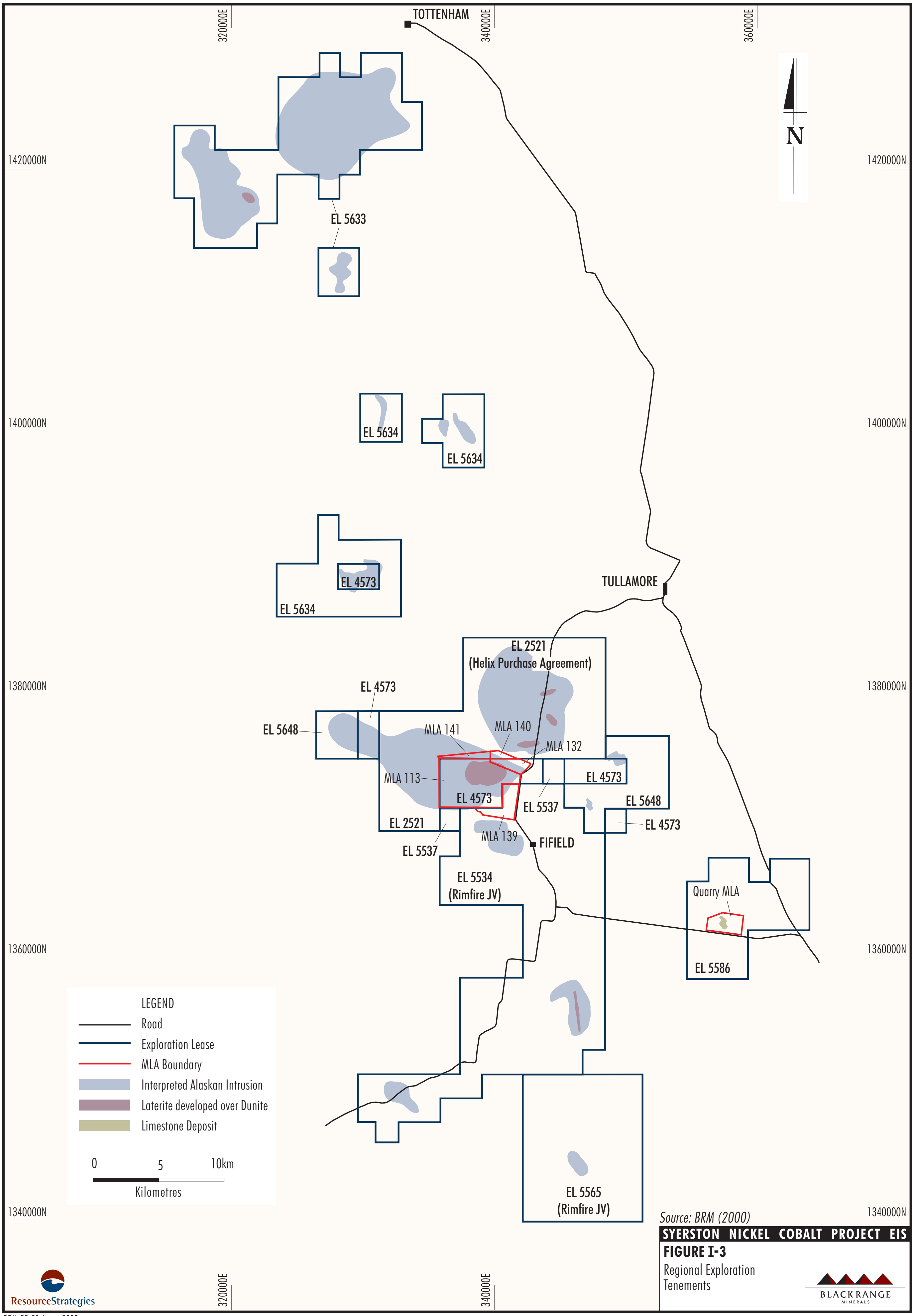
Each of Parts A, B and C contain the following sections (eg. Part A contains Sections A1 to A6):

Section 1	Provides a brief introduction to the Part.
Section 2	Provides a description of the proposed developments.
Section 3	Describes the existing environment of the relevant area and surrounds.
Section 4	Describes the potential impacts of the developments and associated mitigation measures.
Section 5	Outlines rehabilitation concepts for the components, both operational and post-mining.
Section 6	Summarises proposed environmental management and monitoring provisions.

Sections 7, 8 and 9 provide a combined list of reports, scientific papers and guidelines referenced, a list of abbreviations/acronyms and a glossary of terms, for Parts A, B and C of the EIS main text.

Appendices A to O provide supporting documentation for the EIS, including a number of independent specialist reports, as follows:

Appendix A	Assessment of Air Quality
Appendix B	Preliminary Hazard Assessment
Appendix C	Transport Assessment
Appendix D	Tailings and Site Water Management
Appendix E	Water Supply Borefield – Hydrogeological Investigation
Appendix F	Environmental Geochemical Assessment of Waste Rock and Tailings
Appendix G	Community Infrastructure Assessment
Appendix H	Benefit Cost Analysis and Regional Economic Impact Assessment



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Appendix I	Flora Report
Appendix J	Fauna Studies
Appendix K	Construction, Operation and Transportation Noise and Blasting Impact Assessment
Appendix L	Archaeological Investigation
Appendix M	European Heritage Survey and Assessment
Appendix N	Visual Assessment
Appendix O	Soil, Land Capability and Agricultural Suitability Assessment

Where applicable, each of the appendices listed above addresses the three parts of the Project.

I1.4 THE PROPONENT

The proponent, BRM, is a publicly listed company with interests in the Syerston Nickel Cobalt Project and a number of other exploration ventures in Queensland.

The registered and principal office of BRM is:

Black Range Minerals Ltd
Level 10
17 Castlereagh Street
SYDNEY NSW 2000

I2 CONSULTATION

I2.1 OBJECTIVES

BRM is committed to an on-going and open consultation policy. The key objectives of the consultation programme developed by BRM are to:

- inform government and public stakeholders about the progress and nature of the Project;
- present information to stakeholders to permit an informed assessment of the proposal;
- recognise local concerns or interests in the Project; and
- establish dialogue between BRM and stakeholders which would then be on-going if the Project is approved.

A summary of the consultation undertaken to date for the Project is presented in the following sections.

I2.2 COMMUNITY CONSULTATION

Following initial and on-going contact with local landholders during exploration and Project baseline activities, formal public consultation meetings commenced in October 1999. The following public consultation activities have been undertaken:

- initial public consultation meetings in Fifield, Tullamore, Trundle, Condobolin and Parkes on the 5 and 6 October 1999;
- meeting with local landholders in Fifield on the 6 October 1999;
- Project status updates provided in response to public telephone inquiries during the EIS and feasibility study preparation period;
- second round public consultation meetings in Fifield, Tullamore, Trundle, Condobolin and Parkes on the 6, 7 and 8 September 2000; and
- meeting with local landholders in Fifield on the 6 September 2000.

In addition, BRM have appointed a property agent to liaise directly with local landholders with regard to property negotiations such as easement agreements, purchase option agreements and purchases.

I2.3 ABORIGINAL GROUPS

Contact with Aboriginal Land Councils was initiated in 1997 when a representative of the Condobolin Local Aboriginal Land Council (LALC) attended a preliminary archaeological survey of the MPF site. A representative from the Wiradjuri Regional Aboriginal Land Council (RALC) accompanied the archaeological consultant during the field assessments of additional Project areas and ancillary infrastructure corridors in 1999 and 2000.

Management measures for identified archaeological sites have been developed in consultation with the Condobolin LALC and Wiradjuri RALC (Appendix L).

I2.4 STATE AND LOCAL GOVERNMENT AGENCIES

Initial consultation with the Department of Urban Affairs and Planning regarding the Project commenced in mid 1998. The Project planning focus meeting was held in September 1998 and was attended by representatives from various State and local government agencies including:

- Department of Urban Affairs and Planning (DUAP);
- Environment Protection Authority (EPA);
- NSW Agriculture (NSW Ag);
- National Parks and Wildlife Service (NPWS);
- Lachlan Shire Council;
- Parkes Shire Council;
- Forbes Shire Council;
- Department of Mineral Resources (DMR);
- Department of Land and Water Conservation (DLWC);
- State Forests;
- Advance Energy; and
- Roads and Traffic Authority (RTA).

The EIS requirements of NPWS, DLWC and EPA were issued in October and November 1998 and the Director-General's requirements for the EIS were issued by the DUAP in December 1998 (Attachment 1).

An EIS/DA process steering committee involving BRM and key members from the DUAP, DMR and Lachlan, Parkes and Forbes Shire Councils was set up in July 1999 and has met on several occasions to steer the DA process and resolve any Project issues. In addition, a specialist transport sub-committee was set up to scope, produce, review and finalise the EIS transport study. This involved BRM, shire councils and RTA technical representatives. The EIS transport study was accepted in July 2000.

Regular meetings with the DUAP and other regulatory bodies have been undertaken during the Project and EIS development period, including steering committee meetings, informal and formal progress meetings and input from regulatory agencies on the assessment process. These also included formal Project information presentations made to the Lachlan, Parkes and Forbes Shire Councils in December 1999.

From July to September 2000, key government agencies were given opportunities to review draft sections of the EIS and selected specialist reports including air quality, water supply, acoustics, risk and hazard, Aboriginal heritage, European heritage and flora and fauna studies.

I3 DEVELOPMENT APPROVAL PROCESS

I3.1 DEVELOPMENT CONSENT REQUIREMENTS

The Project is located within three local government areas *viz.* Lachlan, Forbes and Parkes.

The majority of the Project is located within the Lachlan local government area and the land is zoned 1 (a) Rural Agricultural Zone under the Lachlan Local Environmental Plan 1991 (Lachlan LEP). Within this zone, the development of the proposed works is permissible with development consent from the consenting authority.

A portion of the Project (notably the limestone quarry and rail siding) is located within the Parkes local government area where the land is zoned 1 (a) (Rural "A" Zone) under the Parkes Local Environmental Plan 1990 (Parkes LEP). Within this zone, the development of the proposed works is permissible with development consent from the consenting authority.

The water supply borefields and the southern section of the water supply pipeline are located within the Forbes local government area and the land is zoned 1 (a) (Rural Zone) under the Forbes Local Environmental Plan 1986 (Forbes LEP). Within this zone, the development of the proposed works is permissible with development consent from the consenting authority.

The development application for the Project will be assessed and processed in accordance with Part 4 of the EP&A Act. By operation of State Environmental Planning Policy No. 34 (Major Employment Generating Industrial Development) (SEPP 34):

(a) the consent authority for the Project is the Minister for Urban Affairs and Planning; and

(b) the Project is classified as "State Significant Development" (pursuant to a declaration of the Minister for Urban Affairs and Planning dated 30 June 1998).

As a consequence of the Project being classified as State Significant Development, any components of the Project which would otherwise fail to be assessed under Part 5 of the EP&A Act will be assessed with the remainder of the Project under Part 4. In this respect Section 76A (8) of the EP&A Act (within Part 4) provides:

If:

(a) a project comprises development part of which is State significant development, all other development comprised in the project is taken to be State significant development, and

(b) but for this provision, part of State significant development would be subject to Part 5, this Part applies to the exclusion of Part 5.

I3.2 ENVIRONMENTAL IMPACT STATEMENT

As required by Section 78A (8) of the EP&A Act, the development application for the Project is accompanied by an EIS. This subsection provides:

A development application must be accompanied by:

(a) if the application is in respect of designated development – an environmental impact statement prepared by or on behalf of the applicant in the form prescribed by the regulations... .

"Designated development" is defined in the EP&A Act as development that is declared to be designated by an environmental planning instrument or the regulations. The *Environmental Planning and Assessment Regulation, 1994* includes a schedule listing categories of designated development. This schedule includes the categories of "mines" and "mineral processing works". Based on these definitions, the Project is designated development.

A summary table of the Director-General's requirements for the Syerston Nickel Cobalt Project EIS, noting where the requirements are addressed in the EIS, is presented in Table I-2.

In addition to the requirements in Table I-2 a number of local and State regulatory authorities have requested that certain issues be addressed in the EIS (Attachment 1).

I3.3 ENVIRONMENTAL PLANNING INSTRUMENTS

Environmental planning instruments relevant to the Project are outlined below.

Local Environmental Plans

The majority of the Project is located within the Lachlan local government area with ancillary components located in Parkes and Forbes local government areas. These areas are addressed in the Lachlan LEP, Forbes LEP and Parkes LEP. The Project is located within zone 1 (a) (rural) under these plans and within this zone the development of the proposed works is permissible with development consent from the consenting authority.

State Environmental Planning Policy No. 11 (Traffic Generating Developments)

SEPP 11 requires the consent authority to refer a copy of the development application for the Project to the RTA.

State Environmental Planning Policy No. 33 (Hazardous and Offensive Development)

SEPP 33 requires the consent authority, in considering a development application for a potentially hazardous or a potentially offensive industry, to take into account:

- current guidelines or circulars published by the DUAP;
- consultations with public authorities;
- any preliminary hazard analysis;
- any feasible alternatives to the carrying out of the development and the reasons for choosing the development;
- the subject of the application; and
- any likely future use of the land surrounding the development.

Table I-2
Summary of Director-General's Requirements for the EIS – Reference Summary

Specific Issues to be Addressed	Main Text Reference	Appendix Reference
Planning and Environmental Context		
• planning information and permissibility – description of the planning framework and statutory requirements of other regulatory agencies required for integrated development;	Section I	-
• site description and locality information; and	Sections I, A1, B1 and C1	-
• overview of the affected environment in the vicinity of the development, including baseline information.	Sections A3, B3 and C3	Appendices A to O
Full Description of the Development		
• describe the characteristics and economic significance of the resource;	Section A2, B2	Appendix H
• describe the proposed mining method and processing plant;	Section A2, B2	-
• identify if the water and natural gas pipelines will be addressed in the EIS, and the nature, extent and potential impacts of the proposed locations of additional off site infrastructure necessary to meet the construction and operational requirements of the Project;	Section I	-
• provide plans clearly indicating the location and layout of the disturbance area and all major infrastructure, mine landforms and buildings on the site; and	Sections A2, B2 and C2	-
• consideration of alternatives and justification for the preferred proposal including assessments of the consequences of adopting alternatives.	Sections I and C1	-
Analysis of Environmental Impacts and Mitigation Measures		
Potential impacts of the proposal on the environment for the following issues should be addressed in satisfactory detail and suitably quantified.	Sections A4, B4, C4	
• air quality;		Appendix A
• water quality;		Appendices D and E
• noise and vibration impacts;		Appendix K
• transportation impacts;		Appendix C
• visual impact;		Appendix N
• hazard assessment;		Appendix B
• agricultural viability;		Appendix O
• flora and fauna;		Appendices JA to JD
• heritage aspects;		Appendices L and M
• economic and social environment; and		Appendices G and H
• rehabilitation.		Appendices A to O
In addition an assessment of the proposed mitigation and management strategies and their effectiveness to mitigate potential impacts during and after the operation should be made.	Sections A5, B5, C5 Sections A4, B4, C4	
Consultation		
The EIS should include:		
• details of any consultation with the local community undertaken to date – consideration and review of key issues discerned by the community.	Section I	Appendix C

For potentially hazardous development, SEPP 33 requires a preliminary hazard analysis to be prepared (Appendix B).

State Environmental Planning Policy No. 34 (Major Employment Generating Industrial Development)

SEPP 34 is discussed in Section I3.1.

State Environmental Planning Policy No. 44 (Koala Habitat Protection)

SEPP 44 requires the consent authority for any development application in certain local government areas (including Forbes and Parkes) to consider whether the land which is the subject of the development application is "*potential koala habitat*" or "*core koala habitat*". Assessment of flora and fauna information presented in Appendices I and J indicates that the lands are not potential or core Koala habitat.

State Environmental Planning Policy No. 45 (Permissibility of Mining)

State Environmental Planning Policy 45 (Permissibility of Mining) (SEPP 45) Clause 5 (2) states:

> *... if mining is permissible on land with development consent in accordance with an environmental planning instrument if the consent authority is satisfied as to certain matters specified in the instrument, mining is permissible on that land with development consent without the consent authority having to be satisfied as to those specified matters.*

The effect of SEPP 45 therefore negates certain clauses regarding landuse in the applicable Local Environmental Plans.

I3.4 OTHER STATUTORY APPROVALS

BRM's legal advisors Harris Wheeler Lawyers have advised that the following Acts may be applicable to the Project:

- *Environmental Planning and Assessment Act, 1979;*
- *Local Government Act, 1993;*
- *Heritage Act, 1977;*
- *National Parks and Wildlife Act, 1974;*
- *Protection of the Environment Operations Act, 1997;*
- *Roads Act, 1993;*
- *Water Act, 1912;*
- *The Fisheries Management Act, 1994;*
- *Rivers and Foreshores Improvement Act, 1948;*
- *Mining Act, 1992;*
- *Mines Inspection Act, 1901;*
- *Dams Safety Act, 1978;*
- *Pipelines Act, 1967;*
- *Gas Supply Act, 1996;*
- *Dangerous Goods Act, 1975;*
- *Roads and Rail Transport (Dangerous Goods) Act, 1997;*
- *Soil Conservation Act, 1938;*
- *Threatened Species Conservation Act, 1995;*
- *Wilderness Act, 1987;*
- *Environmentally Hazardous Chemicals Act, 1985; and*
- *Native Vegetation Conservation Act, 1997.*

In addition, the Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act) may be applicable to the Project (Section I3.6).

I3.5 INTEGRATED DEVELOPMENT

The Project is integrated development under Division 5 of Part 4 of the EP&A Act. Table I-3 lists the licences and approvals that BRM's lawyers have advised may be required in accordance with the EP&A Act provisions for integrated development.

The EP&A Act provides that on receipt of a development application for integrated development, copies of the application must be forwarded by the consent authority to each "*approval body*" (in the present case the NSW EPA, DLWC and NSW Fisheries will be approval bodies).

Table I-3
List of Integrated Development Approvals Potentially Required

Act	Provision	Requirement
Fisheries Management Act, 1994	s. 201	Permits are required for any aspect of the Project that requires the carrying out of dredging or reclamation work in any water.
Heritage Act, 1977	s. 58	If any item subject of an Interim Heritage Order or listed in the State Heritage Register will be demolished, moved, altered or damaged in the course of construction or operational phases of the Project, the proponent must obtain approval under Section 58 of this Act.
National Parks and Wildlife Act, 1974	s. 90	If Aboriginal artefacts will be destroyed, defaced or damaged as a result of the Project, the proponent must obtain a consent pursuant to Section 90 of this Act.
Protection of the Environment Operations Act, 1997	ss. 47 and 48	The proponent must obtain an Environmental Protection Licence ("EPL") from the NSW EPA pursuant to this Act.
Rivers and Foreshores Improvement Act, 1948	Part 3A	The proponent must obtain a permit under Section 22C of the Act to excavate or remove material from "protected land" or do anything that obstructs or detrimentally affects the flow of "protected waters".
Roads Act, 1993	s. 138	The proponent requires the following from the appropriate "roads authority" to undertake road works and to install water pipelines under various roads or reserves: 1. consent to undertake works in a road, pursuant to Section 138 of this Act; and 2. consent, in the roads authority's capacity as owner of the road, for the purposes of making an application for development consent under the *Environmental Planning and Assessment Act, 1979*.
Water Act, 1912	s. 10 and s. 116	A licence is required under Section 116 of this Act to sink a bore and to take or use water obtained from any such bore. The proponent must also obtain licences under Section 10 of this Act to divert any stream of water, whether permanent or intermittent, which flows in a natural or artificial channel.

Source: Harris Wheeler Lawyers (2000)

Before granting development consent to integrated development, the Minister for Urban Affairs and Planning must obtain from each approval body the general terms of any approval proposed to be granted by the approval body in relation to the development.

I3.6 ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT, 1999

The Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act) commenced operation on the 16 July 2000 and repealed a number of existing Commonwealth environmental laws.

The primary objective of the EPBC Act is to provide for the protection of the environment, particularly those aspects of the environment that are of *"national environmental significance"*.

The EPBC Act establishes a scheme requiring environmental assessment and approval of proposals likely to impact significantly upon such matters, which in the Act are termed *"protected matters"*.

The EPBC Act specifies a number of categories of protected matters. These include:

- World Heritage properties;
- Ramsar wetlands of international importance;
- listed threatened species and communities;
- migratory species protected under international agreements;
- nuclear actions; and
- the Commonwealth marine environment.

A proposal that is likely to have a significant impact on a matter of environmental significance is described in the EPBC Act as a *"controlled action"*.

A person proposing to take an action that may be a controlled action is required by the EPBC Act to refer the proposal to the Commonwealth Minister for the Environment. The Minister then decides whether or not the action is a controlled action.

In the event that the Minister finds that an action is a controlled action a number of options are available under the EPBC Act for assessing the environmental impact of the action.

The Minister selects one of the following five assessment pathways:

- an accredited assessment process;
- an assessment based on preliminary documentation;
- a public environment report;
- an environmental impact statement; or
- a public inquiry.

The ultimate result of the assessment process is the granting or refusing of approval by the Minister to undertake the controlled action.

BRM will refer the Project to the Commonwealth Minister for the Environment for an assessment of whether it includes a controlled action under the EPBC Act.

I4 PROJECT ALTERNATIVES

I4.1 PROJECT SCALE

On a world scale, the Project would be a medium sized nickel producer and large cobalt producer operating a medium scale open pit mining operation.

The scale of a mining development is dictated by ore grades, efficiencies of mining, the relative cost of ore treatment and the calculated payback period for a return on capital investment. These characteristics are used to calculate a mineralisation cut-off grade, which then defines the mining reserve of the operation. BRM has estimated a mining ore reserve of 76.8 Mt for the Project.

BRM have analysed a range of Project scales from small (ie. 1 Mtpa) to medium/large scale (ie. greater than 4 Mtpa). The results indicated an optimum Project scale of approximately 2 Mtpa.

The environmental effects of the Project are not materially altered by the selection of a smaller or larger mine. The period of mining and processing would vary, but the potential environmental and or socio-economic impacts of the Project would not alter significantly.

I4.2 WATER SUPPLY

The milling and processing of nickel-cobalt lateritic ores typically requires water to process the ore as a slurry. In addition, water is also used in the production and use of reagents in various stages of the extraction and refining of nickel and cobalt and to convey tailings from the processing plant to the tailings storage facility (TSF).

A feature of the proposed process for the recovery of nickel and cobalt from lateritic ore is that a proportion of the process water cannot be recycled as it becomes saturated with calcium and magnesium salts that cannot be economically removed. Consequently, while some water is recycled the majority of water used in the process must predominantly be ‘new’ water. The Project therefore includes an up to 6,300 ML per annum water supply system.

A number of options were considered for water supply for the Project within the existing regulatory framework existing in the Murray Darling Catchment:

- application for bore licences to pump from the Lachlan Palaeochannel;
- upgrading and use of existing town water supply infrastructure from Forbes to Tottenham;
- purchase of surface water allocations on regional drainage systems such as the Lachlan River and extraction within the regulated water allocation system; and
- the use of a combination of surface and groundwater sources.

Following consideration of the economic and regulatory restrictions and advantages of the above options the water supply scheme adopted comprises two borefields within the Lachlan River Palaeochannel, at the intersection with the Bland Creek Palaeochannel, located some 65 km south-east of the MPF site.

The reticulation of the extracted water would be constructed with a capacity of 17.5 ML per day and would comprise a buried pipeline, balancing tanks and pump infrastructure. Sections A2 and C2 provide detailed descriptions of the water supply system.

I4.3 POWER SUPPLY

The Project has an approximate electricity demand of 34 MW (Section A2). Alternatives considered to supply this capacity include:

- on-site power station powered by natural gas supplied by a spurline from the Moomba to Sydney natural gas pipeline; or
- connection to the nearest electrical grid with substantial upgrades of existing substations and installation of some 85 km of transmission line, transformers and switchgear.

Following a review of capital and operating costs it was concluded that a gas powered on-site power generation facility was optimal due to cost and the requirement of natural gas for steam and hydrogen production. In addition, a heat recovery steam generator and condensing steam turbine in the generation plant could produce steam as a by-product of power generation for use in ore processing, and the electricity supply would be independent of the public grid.

I4.4 LIMESTONE SUPPLY

Approximately 560,000 tpa of crushed limestone is required for the neutralisation of acid slurries in the processing facility. A number of sources of limestone are available within the region and the following alternative sources of limestone were considered:

- development of a greenfield limestone quarry some 20 km from the MPF site; or
- supply of limestone from an alternative existing regional source of limestone products and road or rail transportation to the MPF site.

Following consideration of the relative costs and transport requirements of the two options, development of the new limestone quarry was selected.

I4.5 TRANSPORT

Combinations of road and rail transport options have been considered for transport of major consumables and metal products to and from the MPF site.

Following a review of the Tottenham to Bogan Gate Railway line located some 25 km east of the MPF site, the following options for the location of a rail siding were examined:

- upgrading existing rail facilities at Trundle;
- upgrading existing rail facilities at The Troffs; or
- construction of a dedicated siding adjacent to the intersection of the Fifield to Trundle Road and the Condobolin to Tullamore Road.

Following a review of transport alternatives, the requirements of the Project would be met with a combination of road and rail transport and a dedicated rail siding would be constructed adjacent to the Fifield to Trundle Road. Road upgrades and construction of the Fifield bypass road are proposed to provide a materials transport route from the rail siding and limestone quarry to the MPF site.

Rail transport to and from the dedicated siding would carry more than 30% of the incoming consumables. All nickel and cobalt products from the MPF site would be backloaded on trucks returning to the rail siding, reducing total road movements on the material transport route. At the rail siding, products would be backloaded on consumable rail wagons, minimising total movements on the rail network.

I5 ECOLOGICALLY SUSTAINABLE DEVELOPMENT

I5.1 CONCEPTS

Ecologically sustainable development is the use, conservation and enhancement of resources so that ecological processes on which life depends are maintained, while increasing the quality of life for both present and future generations.

The main objective underpinning sustainable development is the maximisation of human welfare. In 1987 the World Commission on Environment and Development (the Brundtland Commission) articulated what has become a commonly used definition of sustainable development:

> "*Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.*"

The Agenda 21 agreement at the Rio Earth Summit in 1992 provided further guidance on the broad scope of policy issues surrounding sustainable development. This agreement classified sustainable development activities in six broad themes:

1. Quality of life.
2. Efficient use of natural resources.
3. Protection of the global commons.
4. Management of human settlements.
5. Waste management.
6. Sustainable economic growth (World Bank, 1997).

In Australia the term ecologically sustainable development (ESD) has been adopted to address these considerations. In 1992, in releasing the National Strategy for Ecologically Sustainable Development (NSESD), the Council of Australian Government considered that ESD:

> "*Aims to meet the needs of Australians today, while conserving our ecosystems for the benefit of future generations.*"

Three core objectives are presented in the NSESD:

- enhance individual and community wellbeing and welfare by following a path of economic development that safeguards the welfare of future generations;
- provide for equity within and between generations; and
- protect biological diversity and maintain essential processes and life-support systems.

The NSESD states that the challenge for the mining industry in Australia with regards to sustainable development is:

> *"To further develop the mining industry in a way which manages the renewable and non-renewable resources on which it depends in an efficient manner which is also consistent with the principles of ESD."*

Following the implementation of ESD by Commonwealth departments and agencies, the Australian Commonwealth Government has prepared an Act relating to the protection of the environment and the conservation of biodiversity and for related purposes.

The objectives of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) are:

(a) to provide for the protection of the environment, especially those aspects of the environment that are matters of national environmental significance;

(b) to promote ecologically sustainable development through the conservation and ecologically sustainable use of natural resources;

(c) to promote the conservation of biodiversity;

(d) to promote a co-operative approach to the protection and management of the environment involving governments, the community, landholders and indigenous peoples;

(e) to assist in the co-operative implementation of Australia's international environmental responsibilities;

(f) to recognise the role of indigenous people in the conservation and ecologically sustainable use of Australia's biodiversity; and

(g) to promote the use of indigenous peoples' knowledge of biodiversity with the involvement of, and in co-operation with, the owners of the knowledge.

In order to achieve these objectives the EPBC Act:

(a) recognises an appropriate role for the Commonwealth in relation to the environment by focussing Commonwealth involvement on matters of national environmental significance and on Commonwealth actions and Commonwealth areas;

(b) strengthens inter-governmental co-operation, and minimises duplication, through bilateral agreements;

(c) provides for the inter-governmental accreditation of environmental assessment and approval processes;

(d) adopts an efficient and timely Commonwealth environmental assessment and approval process that will ensure activities that are likely to have significant impacts on the environment are properly assessed;

(e) enhances Australia's capacity to ensure the conservation of its biodiversity by including provisions to:

  (i) protect native species (and in particular prevent the extinction, and promote the recovery, of threatened species) and ensure the conservation of migratory species;

  (ii) establish an Australian Whale Sanctuary to ensure the conservation of whales and other cetaceans;

  (iii) protect ecosystems by means that include the establishment and management of reserves, the recognition and protection of ecological communities and the promotion of off-reserve conservation measures; and

  (iv) identify processes that threaten all levels of biodiversity and implement plans to address these processes;

(f) includes provisions to enhance the protection, conservation and presentation of world heritage properties and the conservation and wise use of Ramsar wetlands of international importance; and

(g) promotes a partnership approach to environmental protection and biodiversity conservation through:

  (i) bilateral agreements with States and Territories;

  (ii) conservation agreements with land holders;

  (iii) recognising and promoting indigenous peoples' role in, and knowledge of, the conservation and ecologically sustainable use of biodiversity; and

  (iv) the involvement of the community in management planning.

I5.2 ECOLOGICALLY SUSTAINABLE USE OF NATURAL RESOURCES

The EPBC Act defines ecologically sustainable use of natural resources as:

> *Use of natural resources within their capacity to sustain natural processes while maintaining the life-support systems of nature and ensuring that the benefit of the use to the present generation does not diminish the potential to meet the needs and aspirations of future generations.*

Central to using natural resources in this manner are the principles of ESD.

In accordance with the EPBC Act these principles are:

> *(a) decision-making processes should effectively integrate both long term and short term economic, environmental, social and equitable considerations;*
>
> *(b) if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation;*
>
> *(c) the principle of inter-generation equity – that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations;*
>
> *(d) the conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making; and*
>
> *(e) improved valuation, pricing and incentive mechanisms should be promoted.*

Measures adopted to align the Project with the above principles and conventions, where appropriate, are contained throughout this EIS and are summarised below.

I5.3 ESD FOR THE PROJECT

BRM's role in supporting the concept of ESD is focused on achieving ecological sustainability throughout the Project's life cycle, by combining good planning with an effective and environmentally sound approach to the design, operation and management of the Project. This is achieved through:

- enhanced decision-making based on full risk assessment;
- achieving a high standard of environmental and occupational health and safety performance;
- improving consultative mechanisms; and
- optimising the economic return to the community from mining.

The long term and cumulative impacts of the Project on the environment were assessed during the preparation of specialist reports on aspects including air quality, noise emissions, groundwater, tailings storage design, socio-economic issues, ecology (flora and fauna), landscape assessment and rehabilitation planning.

The principles of ESD have been applied to all aspects of the Project, evidenced by the implementation of cleaner production principles within the process, including the minimisation of waste outputs and where possible, recycling or alternative use of process waters. Throughout the EIS document, ESD has been incorporated in the overall development description and documented in relevant sections.

Precautionary Principle

The EPBC Act defines the precautionary principle as the concept that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing a measure to prevent degradation of the environment.

Adoption and where appropriate adaptation, of external and internal codes of practice, guidelines, standards and principles for exploration, environmental management, rehabilitation and community relations typify the application of the precautionary principle to the Project. Examples of such codes, guidelines, etc. include:

- Environment Protection Authority Best Practice Environmental Management in Mining;
- Environmental Management Plan (EMP);
- Mining Operations Plan (MOP);
- Annual Environmental Management Report (AEMR);
- Construction Environmental Management Plan (CEMP);
- Site Management Plan (SMP);
- Integrated Erosion and Sediment Control Plan (IESCP);
- Waste Management Plan (WMP);
- Hazardous Waste and Chemical Management Plan (HWCMP); and
- Emergency Response Plan (ERP).

Section A6 provides further details on the proposed Project environmental and operational plans.

In addition to the range of management plans and environmental documentation to be developed for the Project, consultation with government, local landholders and community groups has been undertaken (Section I2). During the consultation programme, information was gathered from stakeholders to prepare an environmental risk and hazard assessment for the Project (Appendix B).

A key objective of the risk and hazard assessment was to identify and rank the risks associated with the Project and to develop mitigation measures and strategies, typically based on 'worst' or 'maximum' case scenarios. This process is considered to epitomise the precautionary principle.

Social Equity

Social equity is defined by inter and intra-generational equity. Inter-generational equity is the concept that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations, while intra-generational equity is a similar concept but applied within the same generation.

The Project aims to meet the principles of social equity by implementing management strategies that mitigate risks of environmental degradation to negligible levels, thus retaining for future generations a number of options with regard to the use of natural resources. The mitigation measures outlined in Sections A4, B4 and C4 of this EIS, aim to ensure that natural resource values including biodiversity and ecological integrity are not undermined.

Further consideration of inter-generational equity issues associated with the Project is evidenced by the adherence to various resource use and allocation policies. Relevant examples of such policies include:

- water sharing principles outlined in *Water Sharing in New South Wales – Access and Use* (DLWC, 1998); and
- national principles for the provision of water for ecosystems, as prepared by the Agriculture and Resource Management Council of Australia and New Zealand and the Australian and New Zealand Environment Conservation Council (ANZECC).

Based on the effects of similar projects in the region, the Syerston Nickel Cobalt Project would stimulate local and regional economies and provide export earnings, thus contributing to future generations through amenity, infrastructure provisions and positive social development.

Biodiversity and Ecological Integrity

Biodiversity is defined in the EPBC Act as the variability among living organisms from all sources (including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part) and includes diversity within species and between species; and diversity of ecosystems.

The proposed development meets biodiversity and ecological integrity principles by operating under a Site Management Plan designed to conserve any critical conservation values of the Project area and immediate surrounds, and long term species diversity and abundance. This is to be achieved via measures such as:

- adoption of MPF site and associated infrastructure layout design to minimise clearance of areas of native vegetation (remnant and regenerating);
- incorporation of a range of operating constraints and ameliorative measures to ensure, as a minimum, compliance with statutory conditions and guidelines;
- rehabilitation and revegetation programmes designed to augment the range and extent of native vegetation and fauna habitat resources in the region; and
- commitment to on-going environmental monitoring to assess impacts of the MPF operation.

Greenhouse Emissions

Australia is a signatory to the Kyoto Protocol, which will establish provisions to limit emissions of six greenhouse gases or groups of gases. These are:

- carbon dioxide (CO_2);
- methane (CH_4);
- nitrous oxide (N_2O);
- hydroflurocarbons (HFCs);
- perflurocarbons (PFCs); and
- sulphur hexafluoride (SF_6).

Once enacted, the Protocol would limit the emissions of greenhouse gases in Australia to no more than 108% of 1990 levels.

The Environmental Management Statement prepared for the Project (SNC Lavalin, 2000a), indicates that significant emissions of greenhouse gases at the Project would be restricted to CO_2. The estimated CO_2 emissions of the Project are approximately 305,000 tpa, which represents around 0.05% of the national greenhouse gas emission rate[1].

The MPF and limestone quarry sites are currently used for cropping and grazing. Rehabilitation of these sites would see a combination of woodland and pasture established at these sites which would include the provision of habitat for wildlife. Rehabilitation of the MPF and quarry sites would include revegetation of approximately 700 ha of woodland (a potential gain of approximately 390 ha). The additional area of woodland would yield a CO_2 absorption capacity in the order of 39,000 t (where 1 ha of woodland has the capacity to absorb 100 t of CO_2)[2].

1 Based on 1996 estimate of 600 Mt

2 Calculation based on Minerals Industry Greenhouse Challenge Workbook, Australian Greenhouse Office (1996)

The gain in woodland on the site would therefore provide some contribution towards sinks or offsets against the CO_2 emitted.

The proposed natural gas fired co-generation plant for provision of Project electrical (and steam) requirements (Section I4.3) represents current industry best practice for electrical power generation and provides considerable savings in greenhouse emissions over coal fired sources.
In addition, the proposed high pressure acid leach process for extraction of nickel from laterite ore would produce significantly lower CO_2 emissions than the following alternative nickel metal production methodologies:

- ferrous nickel processing and metal production;
- nickel sulphide processing and metal production; and
- Caron nickel production processes.

Cleaner Production

Cleaner production involves the application of an integrated preventative strategy to processes and products to reduce risks to humans and the environment (UNEP, 1995). Adopting cleaner production and waste reduction strategies involves managing the environmental impacts of production of a product. Typically cleaner production provides benefits through reductions in the consumption of energy through improved efficiency, and a reduction of waste outputs.

Through the implementation of the Waste Management Plan (WMP) and Hazardous Waste and Chemical Management Plan (HWCMP) (Section A6) BRM would document waste management practices, including the nature, generation and destination of wastes generated by the Project. The Plans would be utilised to investigate all avenues and potential methods of waste reduction and cleaner production consistent with the NSW Government's Waste Reduction Goals.

As a component of the WMP, BRM would examine the potential for further recycling of tailings decant waters, in preference to evaporative disposal of waste water (Section A2.10). If significant further recycling was feasible, a reduction in the total raw water demand from the water supply borefields may also be feasible.

I6 EIS PROJECT TEAM

Resource Strategies Pty Ltd prepared the Project EIS with additional specialist input from the following organisations, institutes and individuals:

- Air Quality (*P. Zib and Associates*)
- Risk and Hazard (*SHE Pacific*)
- Transport (*Masson Wilson Twiney*)
- Tailings Disposal and Water Management *(Golder Associates*)
- Water Supply (*Coffey Geosciences*)
- Social (*Martin and Associates*)
- Economics (*Gillespie Economics*)
- Flora (*Bower and Kenna*)
- Fauna - Bats (*Greg Richards and Associates*)
- Fauna - Terrestrial (*Mount King Ecological Surveys*)
- Acoustics (*Richard Heggie Associates*)
- Aboriginal Heritage (*Archaeological Surveys and Reports*)
- European Heritage (*Heritage Management Consultants*)

SECTION A1 - INTRODUCTION

MINE AND PROCESSING FACILITY

PREPARED BY
RESOURCE STRATEGIES PTY LTD

SEPTEMBER 2000
Project No. BRM-01\2.0
Document No. PART A - SECTION 1-G.DOC

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A1 INTRODUCTION

A1.1 OVERVIEW

Section I establishes that the main text sections of this EIS are presented as three Parts (Parts A to C). Part A addresses the main components of the Project which are located at the MPF site within MLAs 141, 140, 132, 113 and 139 (Figure A1-1). These main components include:

- up to 11 open pits, two waste emplacements and temporary ore and topsoil stockpiles;
- haul roads, ore and limestone run-of-mine (ROM) pads;
- processing plant and metals refinery;
- electricity and steam co-generation plant;
- sulphuric acid and industrial gas plants;
- administration and maintenance facilities;
- fuel and reagent storage, preparation and distribution systems;
- tailings storage facilities and evaporative structures;
- potable and raw water supply treatment and distribution facilities; and
- MPF site water management structures.

Locations of these components throughout the mine life and a detailed description of them are provided in Section A2.

The ancillary infrastructure associated with the Project and located outside the MPF site are addressed in Part B (limestone quarry, rail siding and materials transport route) and Part C (natural gas pipeline, borefields and water supply pipeline).

A1.2 LAND TENURE

Land tenure within the five proposed MLA areas for the MPF site is a combination of privately owned land, State Forest, Crown reserve and Crown land. Land tenure of the MPF site and surrounds is shown on Figure A1-1.

The majority of the proposed MPF infrastructure is located on “Syerston” held by Messrs K. & Q. Williams, “Slapdown” held by Mr B. Strudwick and “Kingsdale” held by UAL Pty Ltd (a 100% owned subsidiary of BRM) (Figure A1-1). BRM holds options to purchase the above listed properties as well as a portion of “Flemington” (Mr A. Ward), located immediately to the west of the MPF site.

MLA 140 and MLA 132 also encompass a portion of Fifield State Forest, Crown land and Crown reserve areas adjoining “Slapdown” (Figure A1-1).

Land Tenure Schedule

Map Key	Landowner	Property Name
1	KR Williams	"Syerston"
2	AJ Ward	"Flemington"
3	AJ Ward	-
4	AJ Ward	-
5	AJ Ward	-
6	AJ Ward	-
7	QC & KR Williams	-
8	State Forest	-
9	Native Flora Fauna Reserve	-
10	Crown Land	-
11	Crown Land	-
12	Crown Land	-
13	LW & GB Strudwick	"Slapdown"
14	QC & KR Williams	-
15	UAL Pty Ltd	"Kingsdale"
16	TP Galvin	-
17	TP Galvin	-
18	TP Galvin	"Wanda Bye"
62	WB Quade	-

Map Key	Landowner	Property Name
63	Crown Land	Reserve for Racecourse and Cemetery
65	TE & MM Hall	"Victoria Park"
66	WJ & WM Artery	"Rosehill"
67	AJ Sunderland	"Currajong Park"
68	Helix Resources NL	"Kelvin Grove"
69	GJ McAneney	"Malroobie"
70	JF McAneney	"Brooklyn"
71	Crown Land	Travelling stock reserve
72	KW & GB Strudwick	-
73	KW & GB Strudwick	"Slapdown"
74	JF McAneney	-
75	Crown Land	Travelling stock reserve
76	JF McAneney	"Vale Head"
77	Crown Land	Trigonometry Station
78	BC & WJ Nelson	"Sunrise"
79	AJ Ward	-
80	DJ Ward	-
81	CI Laing	"Bon Accord"
82	CI Laing	-

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SYERSTON NICKEL COBALT PROJECT EIS

FIGURE A1-1

Land Tenure for the Mine and Processing Facility

BLACK RANGE MINERALS

BRM-98-01-Pt A-S1_002E

Source: © The Land Information Centre
Panorama Avenue Bathurst 2795

SECTION A2
PROJECT DESCRIPTION
MINE AND PROCESSING FACILITY

PREPARED BY
RESOURCE STRATEGIES PTY LTD

OCTOBER 2000
Project No. BRM-01\2.1
Document No. PART A - SECTION 2-H.DOC

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A2 PROJECT DESCRIPTION

A2.1 MINERAL RESOURCE

Exploration drilling for the evaluation of laterite mineralisation was commenced by Noble Resources NL (later Black Range Minerals Ltd) on EL 4573 in 1993 (Figure I-3). This evaluation continued to 1996 and in 1997 further investigations including 344 drill holes formed the basis for a pre-feasibility study. This study was completed in 1998 and recommended a bankable feasibility study be prepared. In 1999 BRM conducted an extensive drilling programme to form the basis of a bankable feasibility study. This programme included a further 730 exploration drill holes to support the feasibility study which was completed by BRM and SNC-Lavalin Australia in July 2000 (SNC-Lavalin, 2000b). The BRM mineral resource estimate is made up of measured, indicated and inferred components and is defined as 96 Mt graded at 0.69% nickel, and 0.12% cobalt. Further assessment of the mineral resource was conducted during the feasibility study which resulted in an ore reserve estimate in accordance with the Australian Code for Reporting of Mineral Resources and Ore Reserves (the JORC Code – September 1999). The ore reserve is estimated at 76.8 Mt graded at 0.73% nickel and 0.13% cobalt.

The nickel-cobalt lateritic mineralisation is largely confined within goethite and siliceous goethite zones at depths of 10 m to 60 m from the surface in deposits up to 40 m in thickness. Figure A2-1 provides an illustration of a typical geological section of the Syerston deposit.

The ore reserve has been estimated to provide a mine life of more than 30 years. The following sections describe the proposed construction and operation of the MPF for the term of the EIS which is 21 years.

A2.2 MPF OVERVIEW

The components of the MPF at four stages are shown on general arrangement Figures A2-2 to A2-5.

The general arrangements show construction (Year -1) and operational Years 5, 10 and 20 and include the progressive rehabilitation strategy (which is discussed further in Section A5). The major infrastructure components of the MPF shown on the figures include:

- open pits;
- waste emplacements;
- run of mine (ROM) ore pad;
- ore stockpiles;
- process plant area;
- tailings storage facility;
- evaporation ponds;
- evaporation surge dam;
- topsoil stockpiles; and
- internal roads and haul roads.

Water management structures associated with erosion and sediment control are not shown on these figures. Water management including erosion and sediment control is discussed in Section A2.11.

Location and design of the MPF layout incorporates the following key attributes:

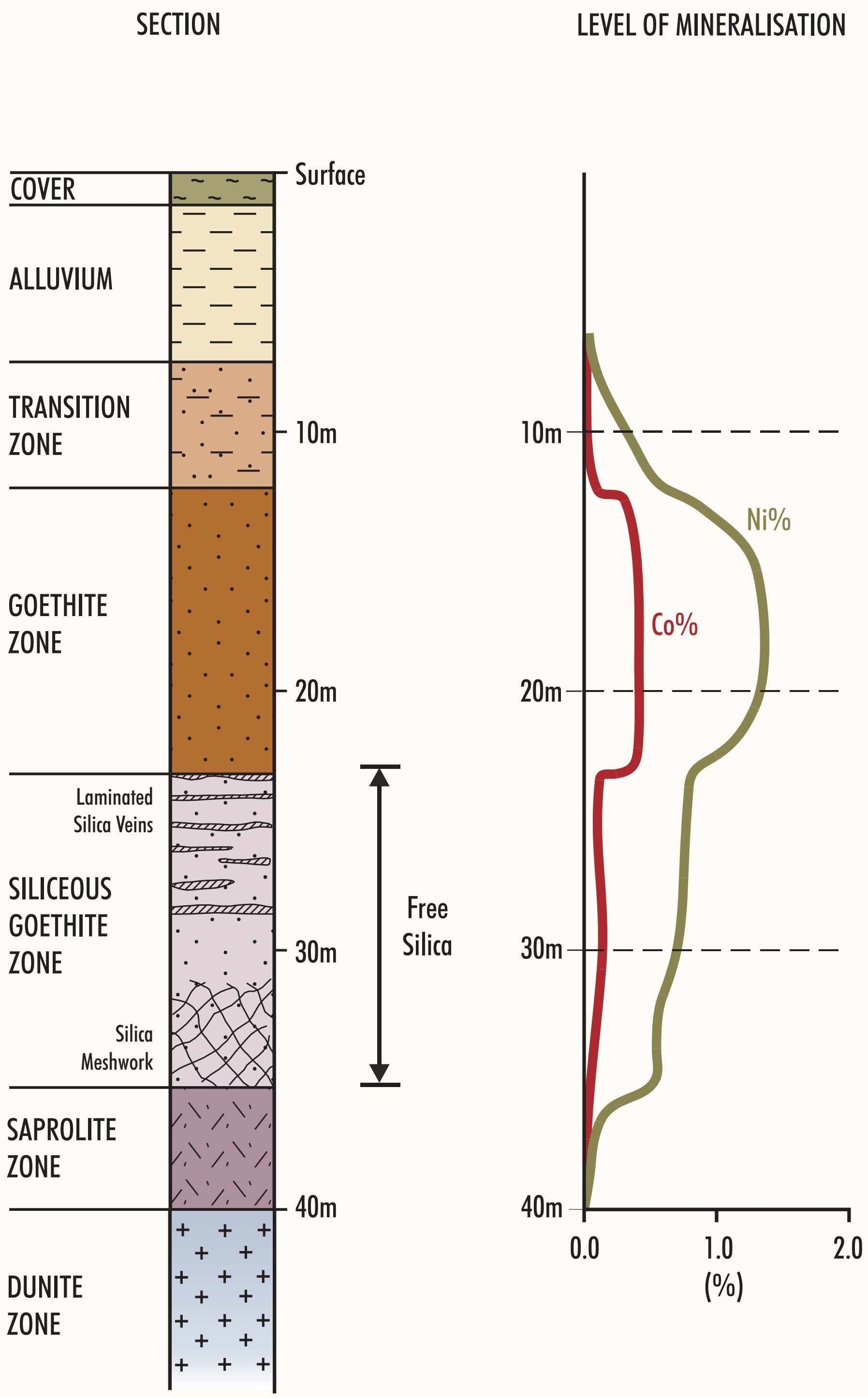
- location of the process plant within a relatively small area adjacent to the tailings storage facility;
- location of the ROM ore stockpile adjacent to the plant;
- location of waste emplacements in close proximity to open pits and around the perimeter of the MPF site; and
- location of the evaporation ponds and evaporation surge dam immediately adjacent to the tailings storage.

An overview of the proposed MPF development is provided below.

A2.2.1 Mining Method

The development of the Syerston deposit would involve conventional open pit mining methods to an average depth of 35 m (SNC-Lavalin, 2000b) with localised deeper areas up to approximately 55 m below the surface.

The proposed mine plan includes development of multiple open pits to access areas of shallow, high grade ore in the initial stages of the Project. Ore would be stockpiled as high and low grade while the open pits are further developed and expanded.



Source: BRM (2000)

SYERSTON NICKEL COBALT PROJECT EIS

FIGURE A2-1

Typical Geological Section of the Syerston Deposit and Corresponding Mineralisation

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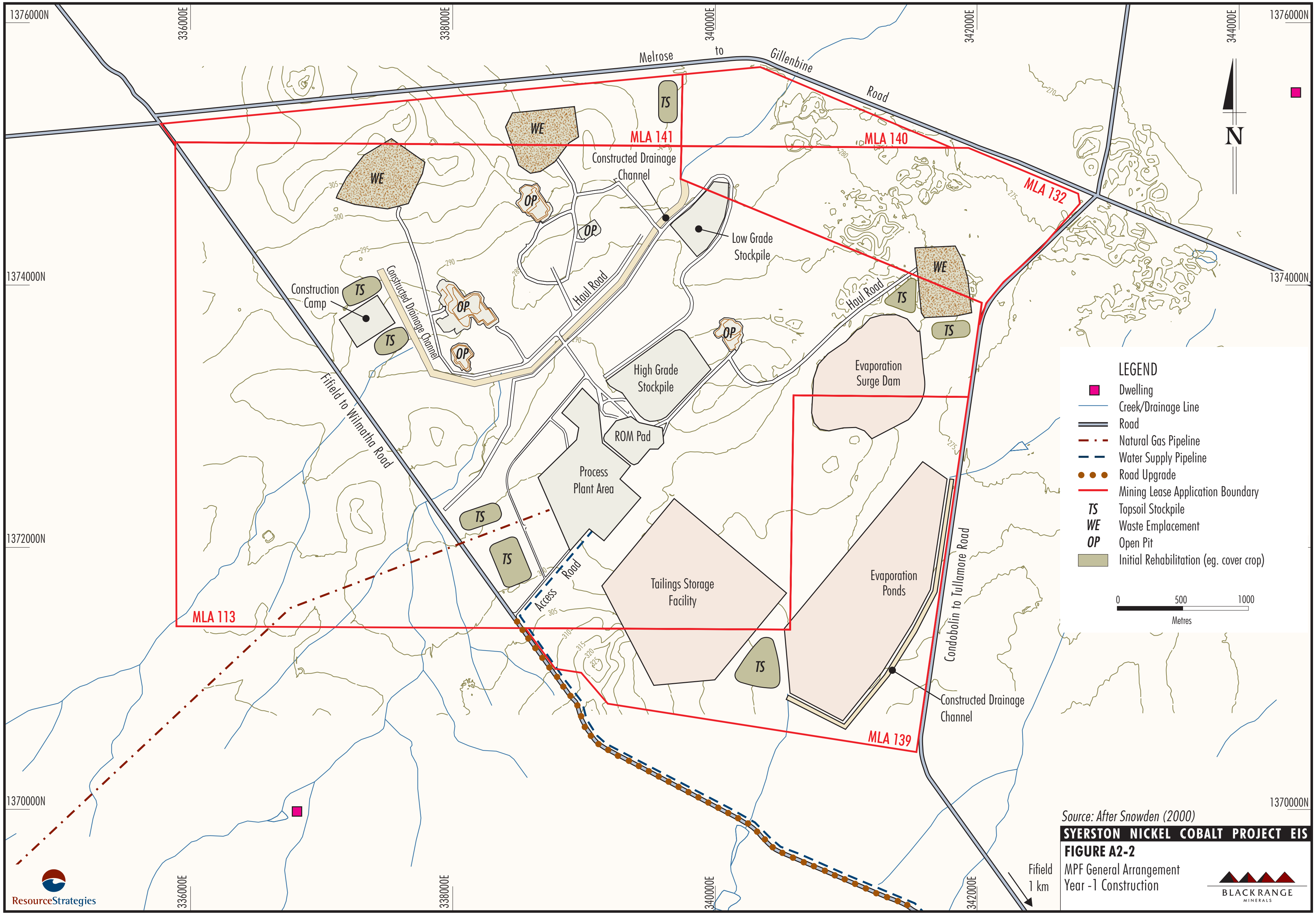

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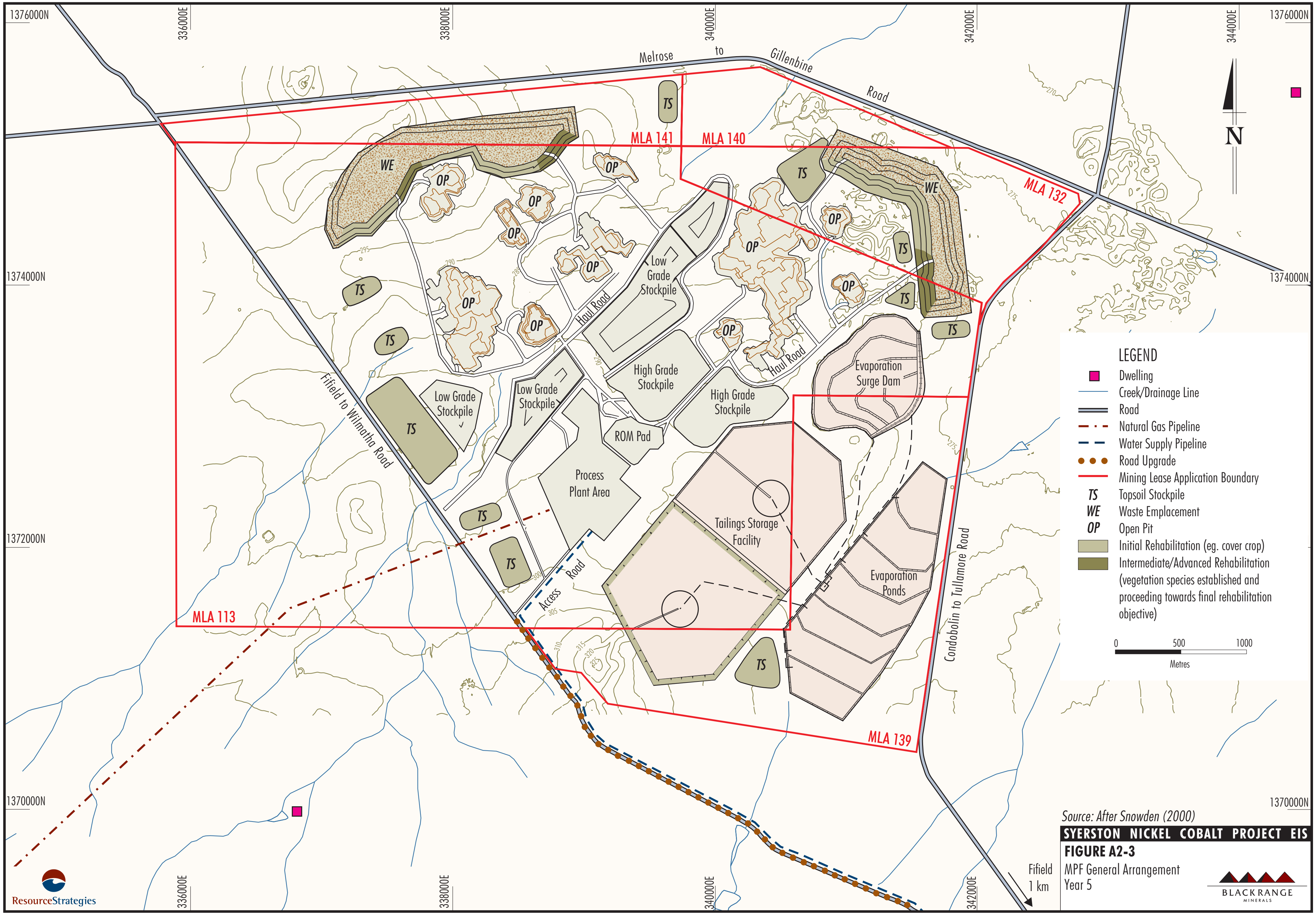

FIGURE A2-3

MPF General Arrangement Year 5

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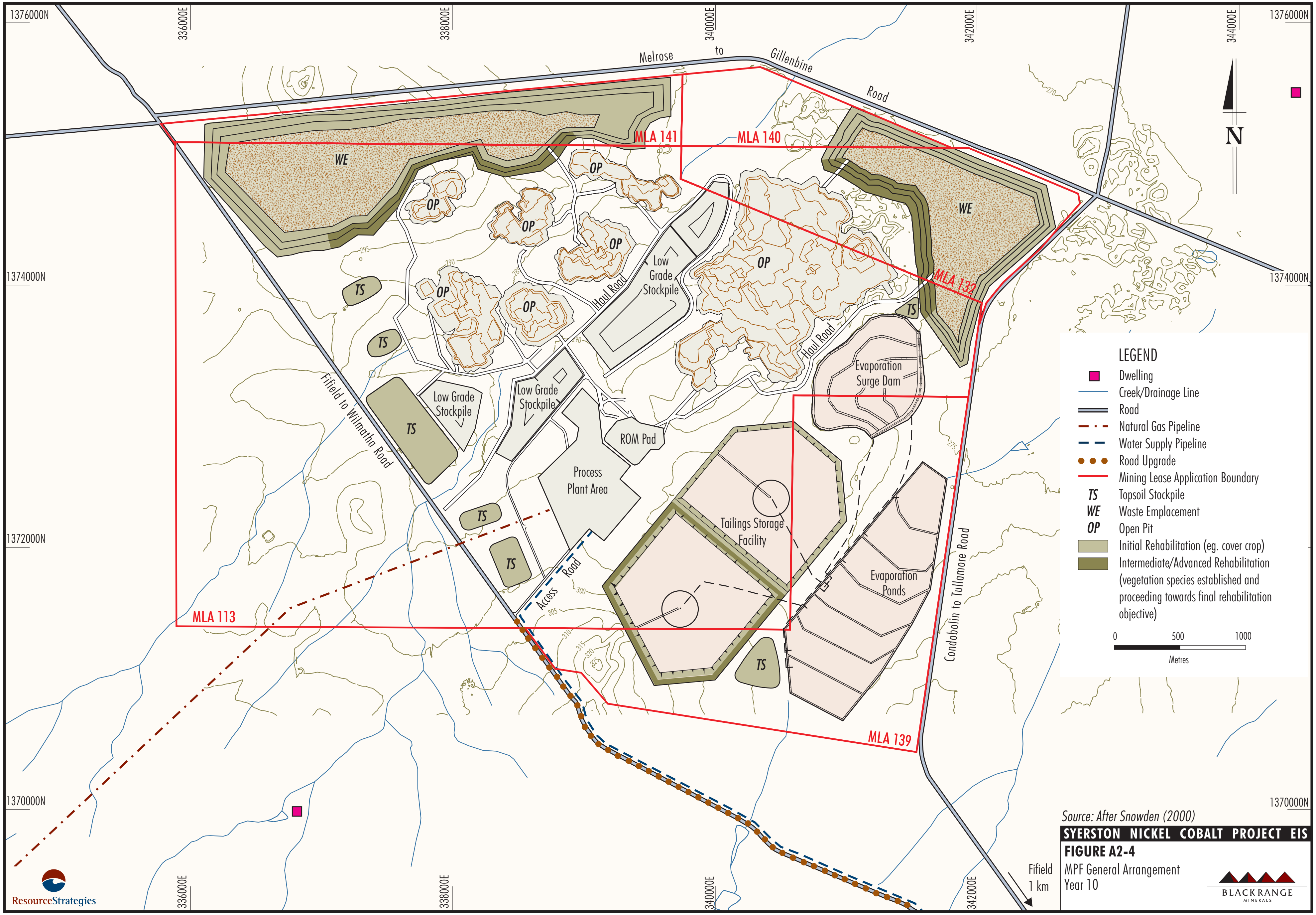

Source: After Snowden (2000)

SYERSTON NICKEL COBALT PROJECT EIS

FIGURE A2-4

MPF General Arrangement
Year 10

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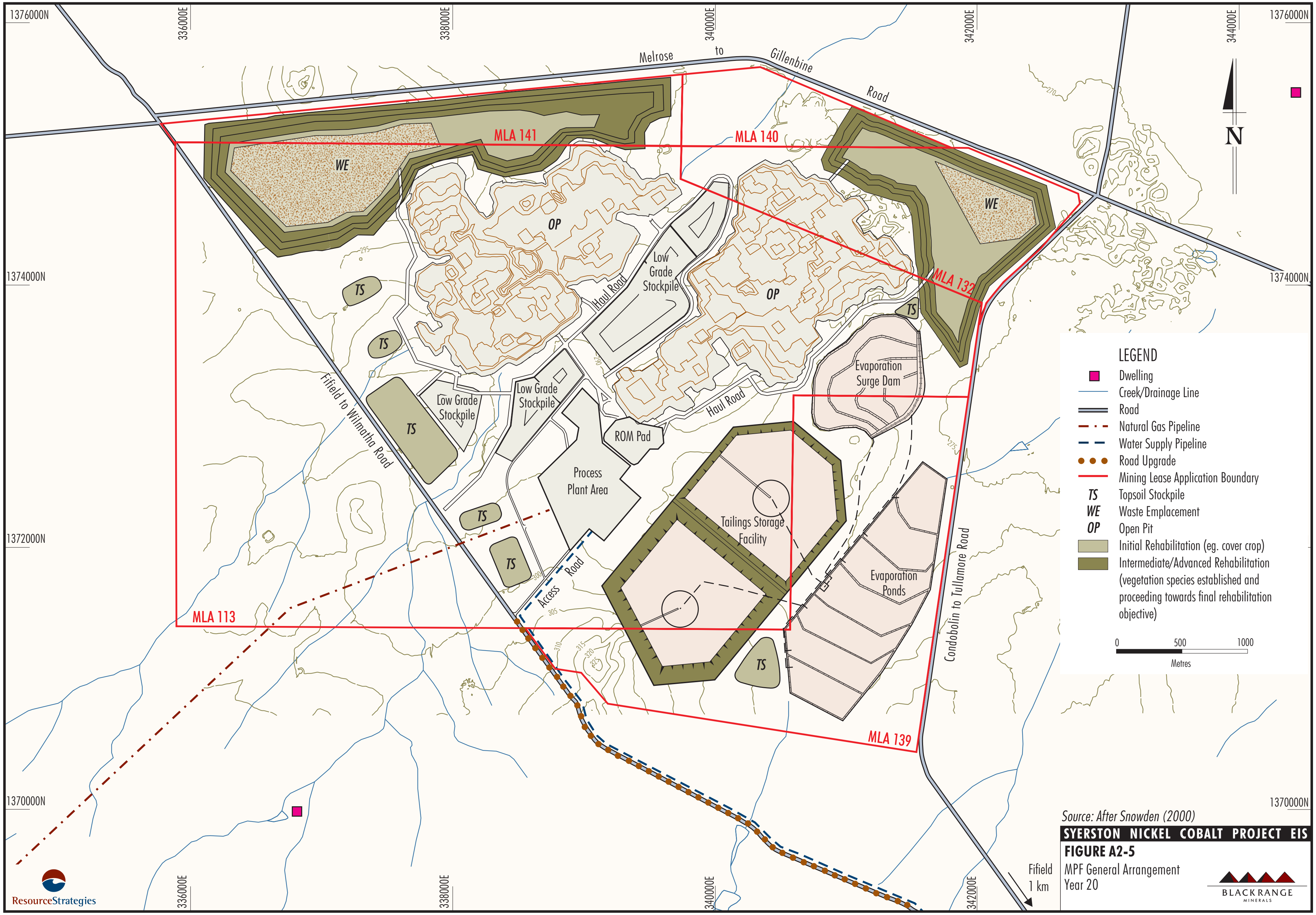
BRM-98-01-Pt A-S2_003G



Source: After Snowden (2000)

SYERSTON NICKEL COBALT PROJECT EIS

FIGURE A2-5

MPF General Arrangement
Year 20

BRM-98-01-Pt A-S2_004F

Up to 11 open pits would be developed and these would be expanded to form two open pits by Year 20. The ore production rate would be adjusted as necessary to maintain a process plant feed rate of approximately 2 Mtpa following the removal of reject ore material (silica fines) which would range from 5% to 40%, depending upon ore type.

The goethite and siliceous goethite zones have been highly weathered and as such the majority of the ore would be free dug by excavator. Ore and mine waste would be loaded directly to haul trucks for transfer to the ROM pad, ore stockpiles or the waste emplacements.

A2.2.2 Mine Waste Management

Mine waste material (material excavated during open pit mining which does not contain economical mineral quantities) removed from the open pits during mining would be stored in two waste emplacements. The emplacements (a western and eastern waste emplacement) would be adjacent to the open pits and located along the north-eastern and north-western MLA boundaries (Figures A2-2 to A2-5). After 21 years the waste emplacements would contain approximately 125 Mt of mine waste. Mine waste material would consist predominantly of alluvium.

Prior to the commencement of mining, topsoil would be stripped from disturbance areas and selectively stockpiled for use during rehabilitation. Rehabilitation using stabilising cover crops and native endemic vegetation species would be conducted as waste emplacement surfaces and faces are progressively finalised. Figure A2-6 shows the conceptual waste emplacement construction methodology that is discussed further in Section A2.5.2.

A2.2.3 Ore Processing

The process plant would process 2 Mtpa of ore to produce saleable nickel and cobalt products. In summary the process involves the following eight stages:

- ore preparation;
- acid leaching;
- thickening and tailings neutralisation;
- solution neutralisation;
- sulphide precipitation;
- sulphide leaching and removal of impurities;
- solvent extraction; and
- electrowinning to produce metal product.

Figure A2-7 provides a block diagram of the ore processing circuit and the process is further discussed in Section A2.6.

The ore processing circuit would require chemicals as inputs to various stages throughout the circuit. The MPF design allows for the site production of some of these inputs. These would require their own on-site infrastructure and processes. They include the following production plants:

- oxygen;
- sulphuric acid;
- hydrogen;
- hydrogen sulphide;
- nitrogen; and
- lime slurry.

The locations of these production plants are shown on Figure A2-8.

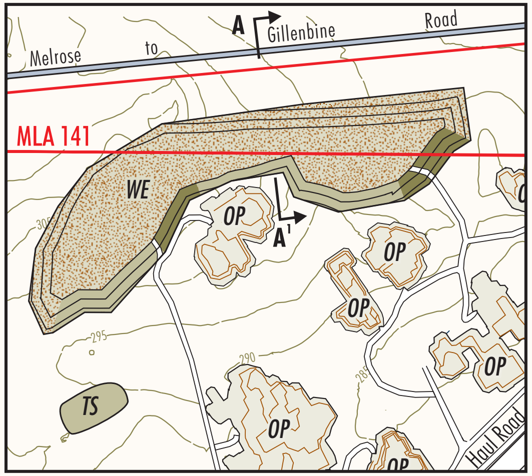
Production and storage of these chemicals is described in Sections A2.7 and A2.14.

A2.2.4 Tailings Disposal and Evaporation Ponds

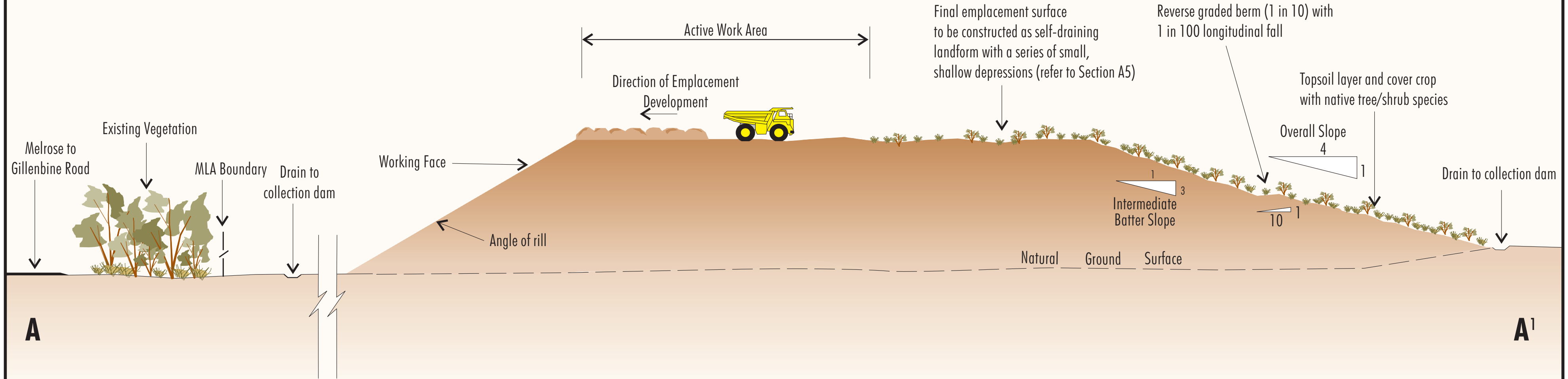
Barren residue (tailings) from the mineral processing circuit would be deposited in the tailings storage facility (TSF) (Section A2.8).

Approximately 50 Mt of tailings would be produced over the term of the EIS with a tailings production rate of approximately 2.55 Mtpa at 48% solids. Two adjoining tailings storage cells would be constructed in the south-east of the MPF site with a combined area of approximately 220 hectares (ha). The TSF would have sufficient capacity to contain tailings for more than 20 years and would be of conventional subaerial design.

Not to scale



Plan



Section A

SYERSTON NICKEL COBALT PROJECT EIS

FIGURE A2-6

Year 5
Conceptual Waste Emplacement
Construction Detail

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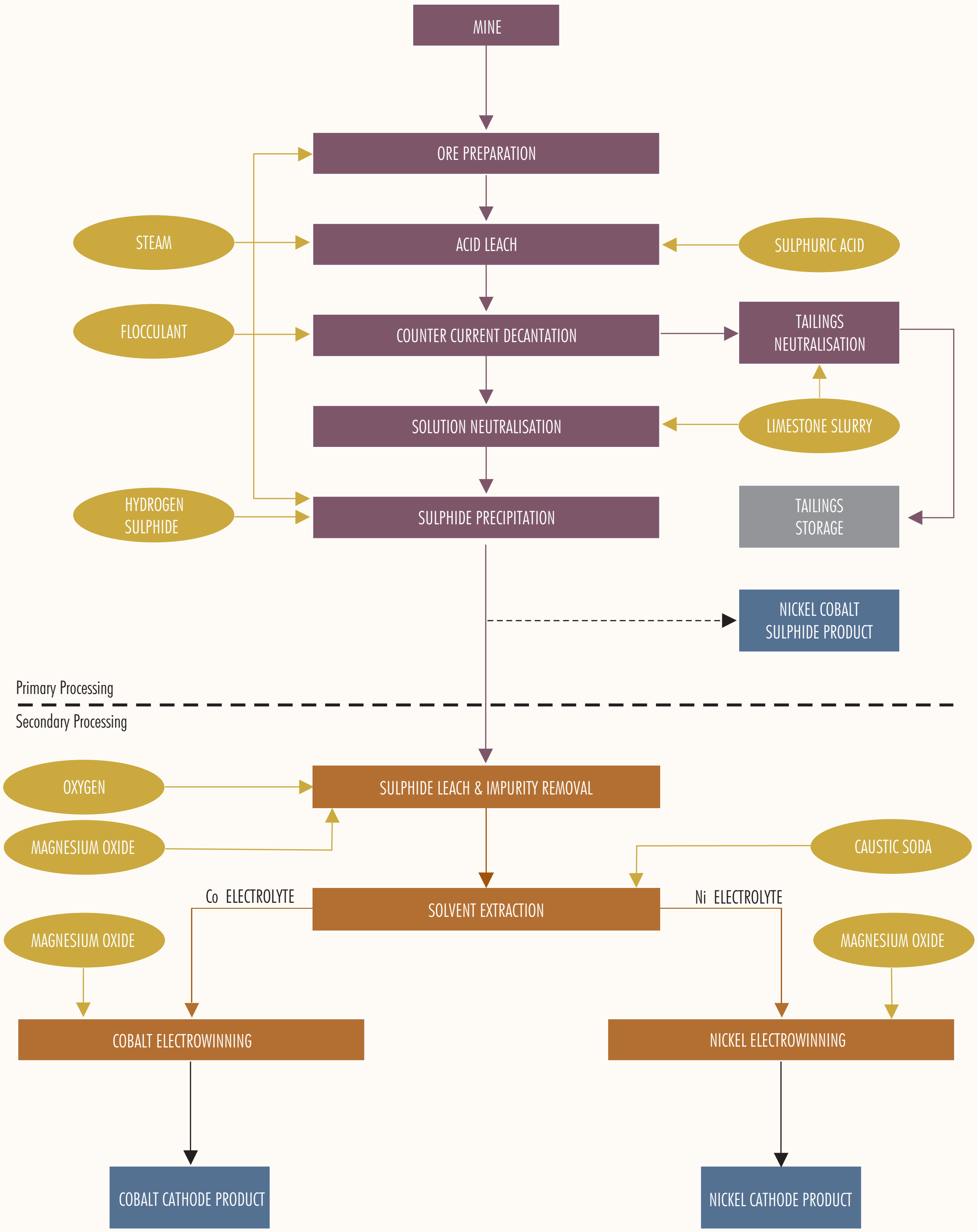

Source: After SNC-Lavalin (2000) & BRM (2000)

SYERSTON NICKEL COBALT PROJECT EIS

FIGURE A2-7

Ore Processing Block Diagram

BLACK RANGE MINERALS

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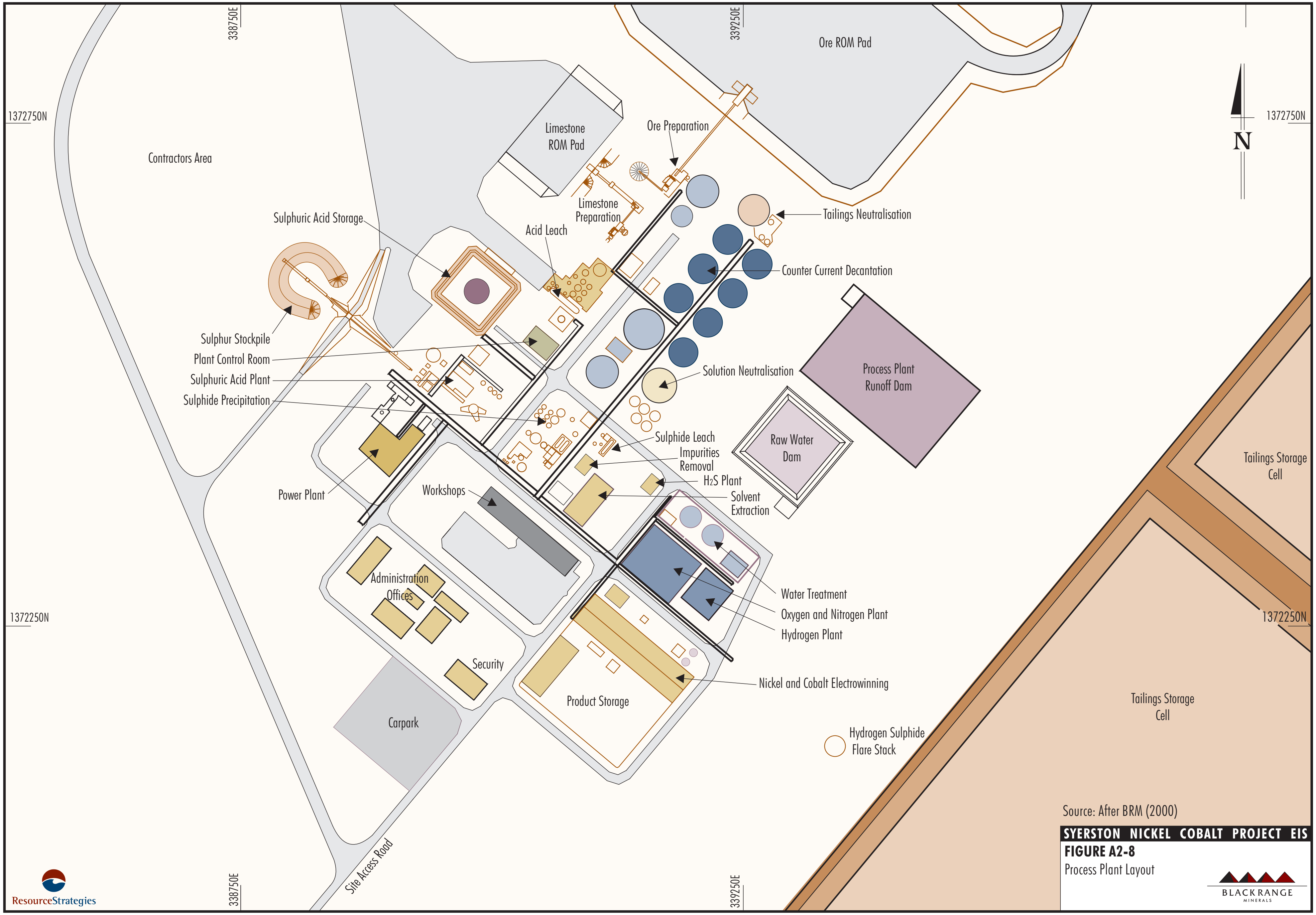
BRM-98-01-Pt A-S2_007D



BRM-98-01-Pt A-S2_013C

The saline nature of tailings water (principally magnesium sulphate or Epsom salts) prevents reuse within the ore processing system and an evaporation system is required to remove excess supernatant water from the tailings storage facility. The evaporation system would comprise seven adjoining evaporation ponds and an evaporation surge dam. The evaporation ponds and evaporation surge dam provide the appropriate storage capacity for the TSF rainfall event design criteria, hence providing the ability to provide evaporative losses and storage of rainfall events (up to 1 in 100) at the same time. The evaporative system would have a combined capacity of some 3,900 ML and combined surface area of approximately 180 ha.

A2.2.5 Associated Infrastructure

Infrastructure which is external to the MPF site would include the water supply pipeline, borefields, natural gas pipeline, limestone quarry, materials transport route and rail siding. This infrastructure is described in Part B and Part C of this EIS. Part B provides a detailed description of the limestone quarry, materials transport route and the dedicated rail siding. Part C provides a description of the natural gas pipeline to the MPF site and the water supply borefields and associated pipelines.

The on-site natural gas fired power station would supply the MPF's electrical demand which is estimated at approximately 34 MW. Approximately 2.6 petajoules of natural gas for the power station would be provided by a spurline from the existing Moomba to Sydney natural gas pipeline that runs south of Condobolin (EIS Part C). The power station would comprise two gas turbine power generators, with two heat recovery steam generators (HRSG) and a condensing steam turbine. Power would be reticulated around the site at 11 kilovolts (kV) (high voltage) and 415 volts (V) (low voltage) power lines.

Infrastructure adjacent to the process plant area includes an on-site power station, water treatment plant, sulphuric acid plant and other plants listed in Section 2.2.3, construction camp and internal road system (including haul and access roads) (Figure A2-8).

A2.2.6 Transport

Process consumables and sulphide and metal products would be transported to and from the MPF site. Incoming freight would be transported by a combination of rail and road transport. A large proportion of consumables including sulphur (210,000 tpa) would be transported by rail to a dedicated rail siding, located some 25 km south-east of the MPF site. Once unloaded, the materials would be transported by road from the rail siding to the MPF site.

Approximately 25,000 tpa of nickel and cobalt metal product or 42,000 tpa of mixed nickel-cobalt sulphides would be trucked to the rail siding and then back-loaded in general goods rail wagons for transport to Newcastle.

The majority of heavy vehicle road transport would approach the MPF site via Parkes on State Route 90 and the Tullamore to Bogan Gate Road and then via the materials transport route. Internal transport within the site would be provided by construction of unsealed haul and access roads to provide transport links between the process plant, open pits, tailings and evaporative storages and waste emplacements.

Employee generated traffic would approach the MPF site via local roads.

A2.3 MPF CONSTRUCTION

The MPF construction phase comprises both on-site and off-site activities. The pre-construction phase includes off-site activities which precede on-site construction activities (ie. the general construction phase).

A2.3.1 Pre-Construction Phase

Prior to on-site construction or earthworks commencing, a number of pre-construction activities would be completed. These would include:

- ordering large process plant and infrastructure components such as autoclaves and power station components which require a long lead time for delivery;

- development of site management protocols for control of erosion and sedimentation and stripping procedures for topsoil management;
- detailed design of all facilities; and
- tendering for construction and operating contracts.

The pre-construction phase is estimated to take approximately 6 months.

A2.3.2 Construction Schedule

Table A2-1 provides a provisional schedule of construction activities including construction of the temporary workforce accommodation camp, processing plant and on-site ancillary infrastructure, development of water control structures and tailings and evaporative storages, and commencement of mine waste removal. The general construction phase would comprise approximately 24 months.

A2.3.3 General Construction Phase

The general construction phase would involve the construction of all the components of the development within the MPF site, prior to commencement of ore processing.

Construction Camp

The construction workforce accommodation camp would be located adjacent to the Wilmatha to Fifield Road in the west of the MPF area (Figure A2-2) and would house approximately 1,000 persons during the height of the construction period. The majority of construction works would be completed in 6 months and it would be one of the first construction activities to occur on the MPF site.

The buildings and infrastructure at the construction camp would be constructed using conventional demountable components. All items would be constructed in accordance with local government requirements, including sewerage and other waste disposal systems. Potable water would be supplied by a package water treatment plant utilising borewater from the production borefield and water supply pipeline (Part C). The camp would be removed following completion of processing facility construction and commissioning.

MPF Site and Ancillary Infrastructure

General on-site construction activities would include the development of tailings storage facilities and evaporative storages, installation of power generation and water treatment plants, as well as construction of the ore processing facilities, ROM pad and haul roads.

Prior to commencement of construction activities, site management procedures and protocols for land disturbance would be formulated in consultation with relevant government agencies. Protocols and procedures would be formulated for vegetation clearance, soil stripping and stockpiling from disturbance areas and the installation of appropriate erosion and sedimentation control structures (Section A6).

Contractors and employees working on the MPF site would be required to operate in accordance with a BRM and the DUAP approved Construction Environmental Management Plan.

Ore Processing and On-site Reagent Production Plants

In comparison with the development of tailings storages, haul roads and other major earthworks, the construction of the processing and ancillary plants is a labour intensive component of construction.

Activities associated with this component of the MPF construction include the construction of the eight major parts of the processing plant and the ancillary reagent production plants described in Section A2.2.3.

This component of the construction phase is the most labour intensive and would involve a workforce of skilled specialist contractors.

A2.3.4 Construction Earthworks

Borrow pits

The main access roads, haul roads and other internal roads to the site would be constructed using *in situ* rock and soil materials. Borrow pits would be excavated to provide the necessary gravel and clay materials. Local clay material would be utilised for tailings and evaporative storage liners. Borrow pits would be located within the proposed tailings storage or open pit areas.

Table A2-1
Provisional Construction Schedule

Construction Phase Activity (On-Site)	Construction								Operations Year 1	
	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	5th Qtr	6th Qtr	7th Qtr	8th Qtr	1st Qtr	2nd Qtr
Water Supply and Natural Gas Pipelines										
Access Roads										
Construction Camp Development										
Construction Camp Operation										
Soil Stripping										
Drainage Structures										
Process Plant Construction										
Initial Borrow Pit Stripping										
Waste Emplacement Construction										
Southern Tailings Storage Starter Embankments and Earthworks										
Evaporation Ponds Embankments and Earthworks										
Evaporation Surge Dam Embankments and Earthworks										
Process Plant and Services/Infrastructure Pre-Commissioning										
Acid Leach Testing										
Construction Camp Decomissioning										
Mining of Ore										
Acid Leach Commissioning and Ramp Up										
Refinery Commissioning and Ramp Up										

Geochemically benign mine waste material from the open pits would be used preferentially as a construction material (Appendix F) (Resource Strategies, 2000a) for the evaporative storages, surge dam and initial tailings embankments.

Soil Stripping

A strategy for soil management would be incorporated in the Integrated Erosion and Sediment Control Plan (IESCP). In summary the soil resources from beneath all the proposed MPF disturbance areas in the MLA would be stripped and stockpiled for use in rehabilitation (Section A5). Areas proposed for stripping during construction would include:

- processing facility areas;
- ore stockpile areas;
- haul and access roads;
- waste emplacements;
- TSF;
- evaporation ponds;
- evaporation surge dam;
- open pits; and
- erosion and sediment control works.

Proposed locations of topsoil stockpiles during construction are shown on Figure A2-2.

Concrete Batch Plant

All concrete requirements for the MPF during construction would be supplied from an appropriately licensed temporary batch plant located on-site.

A2.3.5 Construction Transport

An assessment of existing traffic and estimated increase resulting from the construction and operation of the Project is presented in Appendix C (Masson Wilson Twiney, 2000). Significant variation in traffic movement during the construction period would be associated with scheduled deliveries of construction material requirements. Employee traffic during this period would be limited, as the construction workforce would be accommodated in the on-site camp.

Light Traffic

During the construction phase light traffic would consist of cars and buses/minibuses carrying employees to and from the MPF site and light vehicle traffic associated with contractor movements. It is anticipated that average light vehicle movements over the period would be approximately 290 per day.

Heavy Traffic

Heavy vehicle traffic would vary considerably over the construction period according to construction scheduling. An average of 130 heavy vehicle movements per day would be expected over the construction period. Heavy vehicles would be required to deliver construction materials, process components, mine equipment, MPF consumables and consumables for the construction camp.

Oversize Traffic

During the construction period, there would be a proportion of heavy vehicles that are oversize. These vehicles would be carrying process components or mine equipment which are not easily dismantled for transport. The number of oversize loads would be small and would be transported in accordance with relevant licences and regulations. This EIS does not assess the transport of the acid leach autoclave. This would be addressed separately by the autoclave supplier and/or transport contractor.

A2.4 MINING

A2.4.1 Mining Schedule

The proposed mining method is conventional open pit mining. The mining schedule is presented in Table A2-2.

In the initial five years of the mine life, areas of the resource which are accessible (ie. relatively shallow) with high nickel and cobalt grades and low percentage of silica reject material would be preferentially mined to maximise capital return. Goethite ore contains minimal reject and siliceous goethite ore contains 20% to 40% reject. The number of open pits would increase to approximately 11 by Year 5 and after which they would be progressively expanded into two by Year 20.

Table A2-2
Provisional Mining and Processing Schedule

Phase	Year	Mined Ore (t)	Mined Waste (t)	Mined Total (t)	Total Metal Produced (t)	
					Nickel	Cobalt
Construction/ Pre-Production	-1	0	1,185,000	1,185,000	0	0
Operation	1	866,000	4,125,256	4,991,256	4,339	1,739
	2	1,657,000	4,438,078	6,095,078	15,810	4,352
	3	1,999,999	3,782,276	5,782,276	20,574	4,638
	4	2,000,000	6,594,940	8,594,940	18,460	4,647
	5	1,999,999	7,035,462	9,035,461	16,368	4,259
	6	2,102,460	5,229,895	7,332,355	17,550	3,776
	7	2,071,659	5,160,624	7,232,283	16,690	3,652
	8	2,144,458	5,146,554	7,291,012	18,061	3,161
	9	2,133,445	4,975,046	7,108,491	21,553	2,485
	10	2,172,645	4,677,363	6,850,008	18,042	2,868
	11	2,078,460	4,947,054	7,025,514	15,872	3,644
	12	2,098,250	5,020,205	7,118,455	17,559	3,348
	13	2,049,485	4,960,584	7,010,069	13,208	3,693
	14	2,149,074	8,309,680	10,458,754	14,184	3,129
	15	2,067,918	8,432,092	10,500,010	15,117	2,799
	16	2,155,716	8,230,202	10,385,918	16,638	2,680
	17	2,113,759	8,142,285	10,256,044	12,843	3,177
	18	2,236,445	8,263,560	10,500,005	16,762	2,124
	19	2,223,975	8,276,028	10,500,003	13,453	1,895
	20	2,004,820	8,476,790	10,481,610	12,569	1,314
Total		40,325,568	125,408,974	165,734,542	315,653	63,382
Yearly Average*		2,016,278	5,971,856	7,892,121	15,783	3,169

* averaged for Years 1-20 for mined ore and processing
Source: BRM (2000)

It is proposed to maintain an annual average ore feed to the process plant of 2 Mtpa.

In order to maximise mining efficiency and provide for ore grade control, a series of ore stockpiles would be located adjacent to the open pits and ROM pad. In the construction period, initial high grade and low grade stockpiles would be established (Figure A2-2). In the period up to Year 5 ore stockpiles would increase in size and capacity to cover an area of approximately 150 ha (Figure A2-3). From Year 5 until the end of mine life the low grade stockpiles would fluctuate in capacity according to mining and processing requirements.

A2.4.2 Mined Waste Material

Annual quantities of mine waste removed would vary over the mine life. Initial quantities would be low, as high grade areas are preferentially mined. Over the term of the EIS, mine waste quantities would generally increase from approximately 4.1 Mt in Year 1 to approximately 8.5 Mt in Year 20. Mine waste management is discussed in Section A2.5.

A2.4.3 Soil

Soil resources stripped from open pits and waste emplacement areas to be developed during the operations phase would either be placed directly on completed landforms as part of the progressive rehabilitation programme or stored in existing or new topsoil stockpiles. Proposed topsoil stockpile locations for the operation phase and the progressive rehabilitation strategy are shown on Figures A2-3 to A2-5.

A2.4.4 Mine Fleet

Equipment required during mining operations includes hydraulic excavators, haul trucks, dozers, graders and front-end loaders. The estimated number of each equipment type during each year of mining is presented in Table A2-3.

The trend of increased mine waste production over the mine life would result in accelerating development of the waste emplacements and a general increase of earthmoving equipment over time.

A2.4.5 Mine Life

An ore reserve estimation model was used to quantify economically mineable open pit ore which conformed to the Australian Code for reporting Mineral Resources and Ore Reserves (the JORC Code – September 1999). This model estimates mining to extend beyond 30 years with the inferred resources excluded from the ore reserve estimate and therefore classified as mine waste material. Accordingly, the actual mine life would depend on a number of factors including metal prices and would continue to be defined as mining proceeds. The current mining ore reserve has been identified as 76.8 Mt graded at 0.73% nickel, and 0.13% cobalt.

A2.5 MINE WASTE MANAGEMENT

Approximately 125 Mt of mine waste material would be generated from mining over the EIS term. Quantities of mine waste material would increase during the mine life as the open pits deepen. The maximum annual quantity of mine waste material produced during the EIS period would be approximately 8.5 Mt in Year 20.

A2.5.1 Geochemical Characteristics of Mine Waste Material

Geochemical assessment of mine waste material has been undertaken to identify mine waste types and develop suitable mine waste handling and disposal strategies. Detailed mine waste characterisation information is provided in Appendix F and is summarised below. Mine waste material is highly weathered, oxidised and is non-acid forming.

A2.5.2 Waste Emplacement Construction

Mine waste and ore reject material would be deposited in two main waste emplacements (eastern and western waste emplacements) located along the north-eastern and north-western perimeters of the MPF site. The progressive development of the waste emplacements during mine life is shown on Figures A2-2 to A2-5.

Western Waste Emplacement

The western waste emplacement has been designed to contain the majority of mine waste generated during the EIS term. The emplacement would be located adjacent to the Melrose to Gillenbine and the Fifield to Wilmatha Roads and to the north and west of the western open pits.

Initial construction of the emplacement would commence in Year -1 with two small emplacements located in close proximity to the initial open pits. The emplacement would then continue to be developed for the remainder of mine life. At Year 20 the dump would reach a height of approximately 30 m and would contain approximately 80 Mt of mine waste.

Eastern Waste Emplacement

The eastern waste emplacement would be smaller in area than the western waste emplacement as it is constrained by the Melrose to Gillenbine Road to the north and the Condobolin to Tullamore Road to the east as well as by the location of the eastern open pits.

Initial construction of the emplacement would commence in Year -1 and would continue to Year 20. At Year 20 the dump would reach a height of approximately 30 m and would contain approximately 45 Mt of mine waste.

Table A2-3
Provisional Mining Equipment Schedule

Year	**-1**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Item	**Typical Number Required in Each Year of Operation**																				
DC 1000 Excavator	0	2	2	2	3	3	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3
CAT 777 Haul Truck	0	8	8	8	12	12	8	8	8	8	8	8	8	8	12	12	12	12	12	12	12
Water Cart	2	2	2	3	4	4	3	3	3	3	3	3	3	3	4	4	4	4	4	4	4
D10 Dozer	1	2	2	2	3	3	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3
140G Grader	2	2	2	3	4	4	3	3	3	3	3	3	3	3	4	4	4	4	4	4	4
992D Front End Loader	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
966 Front End Loader	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Scraper	3	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Roller	2	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Trucks (20 t)	12	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Excavator	2	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Source: BRM (2000)

Waste Emplacement Construction

Construction of the waste emplacements would entail progressive pre-stripping of the emplacement footprint and systematic development by truck dumping and dozer pushing. The emplacements would be initially developed on areas close to the open pits and would progress out toward the MLA boundaries. These initial areas would be revegetated as soon as final landforms are completed as shown in Figures A2-2 to A2-5.

The overall batter slopes of the emplacements would be 1V:4H with reverse graded berms at approximately 10 m vertical intervals. Intermediate batter slopes would be constructed to 1V:3H grades. Section A2.11 discusses water management strategies for waste emplacement runoff. Figure A2-6 provides a cross section of progressive waste emplacement development.

A2.6 ORE PROCESSING

A2.6.1 Overview

Ore processing incorporates ore preparation, leaching, neutralisation and precipitation of nickel-cobalt sulphides, nickel-cobalt refining and product and waste (tailings) handling. The process is complex and requires a series of discrete steps to produce intermediate (nickel-cobalt sulphides) or final products (nickel and cobalt metals). A block flow diagram summarising the process is shown on Figure A2-7 and a plan of the processing plant is shown in Figure A2-8.

Ore processing steps consist of:

- ore preparation;
- acid leach;
- counter current decantation;
- tailings neutralisation;
- solution neutralisation;
- sulphide precipitation;
- sulphide leaching and impurity removal;
- solvent extraction; and
- electrowinning and metal product handling.

The following section provides a brief summary of each of these steps.

A2.6.2 Process Description

Ore Preparation

The ore preparation circuit includes selective ore reclaim from the ROM pad, removal of oversize material and production of ore to a water based slurry suitable for acid leaching.

The major component of the circuit is the rotating ball mill with additional significant components including the ROM bin and primary crushing facilities, crushed ore conveyor, cyclone cluster, ore slurry feed thickener and coarse rejects stockpile conveyor.

Ore from the mining operation would be delivered to the ROM pad and dumped according to ore type and grade. A front end loader would then selectively reclaim ore to the ROM bin and primary sizer, thereby controlling plant feed ore grades. Primary sized ore is then conveyed to the ball mill where the ore is broken down in the presence of heated process water and grinding media (steel balls) to produce a slurry. The mill discharge would be screened and oversize material (>1 mm) would be conveyed to the coarse rejects stockpile for disposal.

The remaining ore slurry is separated in the cyclone cluster according to particle size with larger particles returned to the ball mill for further breakdown and smaller particles directed to the feed thickener. The feed thickener recycles process water and thickens the ore slurry to a suitable consistency for the **acid leach circuit**.

Acid Leaching

Nickel and cobalt is leached from the ore slurry with the application of sulphuric acid in a high pressure and high temperature vessel (autoclave) to produce an autoclave slurry containing dissolved nickel and cobalt, and leach residue.

The autoclave is the major component of the stage comprising a cylindrical steel shell approximately 36 m long and 5.8 m in diameter. The autoclave is lined with titanium and internally divided into six compartments, each equipped with an agitator. Additional components of the circuit include an ore slurry feed tank, autoclave feed pumps, pre-heaters and flash vessels.

Feed slurry from the ore preparation circuit is fed to the autoclave at high pressure after being pumped through three stages of preheating using recycled and new process steam. The feed slurry is pumped into the autoclave at approximately 250°C and 4,300 kilopascals (kPa) pressure. Sulphuric acid at an average rate of 250 kg of acid per tonne of dry ore is added from the sulphuric acid feed tank. Extraction of nickel and cobalt in the acid leach circuit would be approximately 95%.

Having passed through the autoclave, the autoclave slurry discharge passes through three flash vessels, where the pressure and temperature of the slurry is reduced, and steam recovered for reuse, to pre-heat incoming ore. The autoclave slurry is reduced to atmospheric pressure and cooled to 99°C in the flash vessels prior to being pumped to the **counter current decantation** circuit.

Counter Current Decantation

Acid and soluble nickel and cobalt sulphates produced in the acid leach circuit are removed from the thickened residue solids (tailings) in the counter current decantation (CCD) circuit.

The CCD circuit would consist of a leach liquor storage tank, a number of wash thickeners approximately 30 m in diameter and 8 m high, and associated slurry re-pulp tanks and slurry pumps.

The CCD circuit would operate via several stages of re-pulping (or "washing") of the pressure leach slurry on a counter current principle, where thickened slurry and separated solution move in opposite directions through the circuit.

Separated solution from the first stage wash thickener (containing free acid and nickel and cobalt sulphates) is delivered to the **solution neutralisation circuit**. In the last stage wash thickener the slurry (tailings) produced is delivered to the **tailings neutralisation circuit.**

Tailings Neutralisation

Limestone slurry is used to neutralise the residual free acid in the residue slurry prior to disposal in the tailings storage facility (TSF). The circuit comprises two leach residue neutralisation tanks, a tailings thickener and a tailings disposal surge tank.

The slurry (tailings) from the last stage CCD thickener is mixed with limestone slurry in two neutralisation tanks and then pumped to a tailings thickener.

The underflow from the thickener is pumped to a tailings disposal surge tank at approximately 48% solids for disposal in the TSF, while the separated solution is recycled for use within the process plant.

Solution Neutralisation Circuit

The purpose of the solution neutralisation circuit is to reduce ferric iron in the CCD solution with hydrogen sulphide (H_2S), and to neutralise free acid in the CCD solution using limestone slurry.

Major components of the circuit comprise a H_2S pre-reduction mixer, reduction degassing tank, three leach liquor neutralisation tanks and two limestone slurry tanks, a gypsum thickener and neutralised liquor clarifiers and storage tank.

Solution from the CCD circuit is pumped through the hydrogen sulphide (H_2S) pre-reduction mixer, where hydrogen sulphide gas and vent H_2S from sulphide precipitation is mixed with the solution to reduce ferric iron to ferrous iron, consuming all of the H_2S. The solution is then delivered to a series of leach liquor neutralisation tanks where limestone slurry is added until the solution is neutralised.

The neutralised solution enters the gypsum thickener for removal of the gypsum formed during neutralisation of the residual acid. Thickener solution (neutralised leach liquor) passes through clarifiers to a storage tank, before being delivered to the **sulphide precipitation circuit**.

Sulphide Precipitation and Grinding

The purpose of the sulphide precipitation circuit is to precipitate a high grade nickel and cobalt sulphide product from the neutralised leach liquor.

The major components of the circuit are two sulphide precipitation autoclaves approximately 15 m long and 3.5 m in diameter. Secondary components include a sulphide precipitation feed tank, feed heaters, flash vessels, sulphide thickener and overflow tank, barren liquor clarifiers and neutralisation tanks, sulphide cyclones and sulphide filters. In addition, the circuit is also linked to the H_2S flare drum and flare stack.

From the solution neutralisation circuit, the solution is delivered to a feed heater where low pressure steam is used to heat the solution before the sulphide precipitation autoclaves. Hydrogen sulphide gas is fed to the autoclaves, where the precipitation of the nickel and cobalt sulphides occurs.

Excess H_2S gas is removed from the discharge sulphide precipitation autoclave slurry and the slurry temperature is reduced in two flash vessels. The flash condenser vacuum pumps convey the flashed gases back to the H_2S autoclaves. Hydrogen sulphide vented from the H_2S autoclaves is first used in pre-reduction to consume H_2S and the residual gas is delivered to the H_2S flare drum and then to the H_2S flare stack.

The H_2S autoclave slurry is delivered from the flash vessels to the sulphide precipitation thickener. The thickener solution is delivered to the barren liquor neutralisation circuit, while the underflow is pumped to a cyclone cluster. The neutralised barren liquor is recycled to the CCD circuit as wash water. Cyclone overflow is recycled as seed in the precipitation process, and the underflow is screened and filtered before being either bagged as intermediate nickel-cobalt sulphide product or repulped for grinding.

In the sulphide grinding circuit, the repulped slurry is pumped to a cyclone cluster where it is separated according to particle size. The oversize particles are delivered to a regrind mill for size reduction. The undersize particles are delivered to the **sulphide leach circuit**.

Sulphide Leaching and Impurity Removal

The purpose of the sulphide leaching and impurity removal circuit is to oxidise the nickel and cobalt sulphides to produce a nickel and cobalt sulphate solution with low acidity and impurity content.

The major component of the sulphide leach circuit is the sulphide autoclave which is approximately 18 m long and 1.5 m in diameter and internally divided into five compartments, each equipped with an agitator. Ancillary components of the leach circuit include feed and discharge tanks, flash vessel, flash vessel vent condenser and associated pumps. Impurity removal components include three iron removal tanks, iron removal thickener, iron precipitate press and associated tanks and filter.

The sulphide slurry from the grinding circuit is pumped to the sulphide leach autoclave. The autoclave operates at 165°C and 1,200 kPa, with oxygen added to affect the leach reaction. The reaction is exothermic and the temperature in the autoclave is controlled using cooling water.

The discharge from the autoclave enters a flash vessel from which steam is recovered. This steam is combined with the vent from the autoclave, condensed, and recycled to the sulphide autoclave feed tank. The leach solution from the flash vessel is pumped to the impurity removal circuit.

The purpose of the impurity removal circuit is to remove residual solids, iron and any other elements that would either contaminate the final nickel and cobalt products or foul the solvent extraction circuit.

Sulphide leach solution is delivered to a series of iron removal tanks. The solution is neutralised in these tanks by the addition of magnesium oxide. This precipitates most of the ferric iron present in the solution. The discharge slurry is pumped to the iron removal thickener. The overflow is filtered and then fed to the **solvent extraction circuit**. Thickener underflow is filtered, and the solution is recovered. The filter cake is returned to the **ore preparation circuit**.

Solvent Extraction

In the solvent extraction circuit, the solution is separated into nickel sulphate and cobalt sulphate for downstream metals recovery and zinc contaminants are removed.

Major components of the circuit include cobalt extraction and cobalt strip columns, zinc extraction and zinc strip columns, nickel raffinate (product of extraction of liquid from solvent) filter, nickel raffinate carbon columns, and a series of organic treatment tanks.

From the impurity removal circuit, the pregnant leach solution is delivered to the cobalt extraction column. An organic chemical flowing countercurrent to the flow of leach solution extracts cobalt and zinc sulphates.

The nickel-rich raffinate from the column is filtered to remove residual organic chemical, and is delivered to the **nickel electrowinning circuit.**

The organic chemical flowing from the cobalt extraction column enters the cobalt strip column, where high quality water flowing countercurrent to the organic chemical removes the cobalt and zinc.

The strip solution containing cobalt and zinc is filtered to remove organic chemical and is then delivered to the zinc solvent extraction circuit. In the zinc solvent extraction circuit, the cobalt strip liquor is pumped through the zinc extraction column, counter current to organic chemical flow. The organic chemical removes the zinc from the liquor. The cobalt-rich raffinate flowing from the column is filtered and delivered to the **cobalt electrowinning circuit**.

Cobalt Electrowinning

In the cobalt electrowinning circuit, the cobalt rich solution from the solvent extraction circuit is treated and cobalt is recovered as cathode metal.

The major component of the circuit is cobalt electrowinning cells. Ancillary components include cobalt precipitate tanks and filter press, cobalt precipitate re-dissolution tanks and electrolyte clarifiers, lead removal tank and press, feed and surge tanks, and cathode and anode preparation facilities.

To control solution pH, magnesium oxide is added to the cobalt rich solution and mixed in a series of cobalt precipitate tanks. Precipitate formed is removed from the solution using a filter press. The solution which is principally magnesium and sodium sulphate is evaporated while the precipitate is combined with recycled cobalt anolyte and is delivered to the electrolyte storage tank via clarifiers. The solution is then pumped through the agitated lead removal tank where lead is precipitated. The electrolyte is again filtered, and then pumped through a heat exchanger to raise the temperature before feeding into the electrowinning cells where cobalt metal is produced by electrolysis.

Magnesium sodium sulphate solution is processed through a brine evaporator with solution from nickel electrowinning to recover water for reuse within the refinery. The solid magnesium and sodium sulphate salt is combined with neutralised leach residue in the tailings storage facility.

Nickel Electrowinning

In the nickel electrowinning circuit, the nickel rich solution from the solvent extraction circuit is treated and the nickel is recovered as cathode metal.

The major components of the circuit would be nickel electrowinning starter cells and nickel electrowinning commercial cells. Additional components of the circuit would include nickel precipitation tanks and precipitate filter press, precipitate re-dissolution tanks and catholyte clarifiers, lead removal tank and press, feed and surge tanks, and cathode and anode preparation facilities.

To control solution sulphate levels, magnesium oxide is added to the nickel rich solution and mixed in a series of tanks. Precipitate formed is removed from the solution using a filter press. The solution which is principally magnesium and sodium sulphate is evaporated.

The precipitate combines with recycled nickel anolyte and is delivered to the catholyte storage tank via clarifiers. The solution is then pumped through the agitated lead removal tank where lead is precipitated. The electrolyte is again filtered, and then pumped from a reagent make-up tank to a heat exchanger to raise the temperature before feeding into the electrowinning cells for production of nickel metal by electrolysis.

Magnesium sodium sulphate solution is processed through a brine evaporator with solution from cobalt electrowinning to recover water for reuse within the refinery. The solid magnesium and sodium sulphate salt is combined with neutralised leach residue in the tailings storage facility.

Cobalt Metal Preparation

The cobalt cathode is stripped from the blanks and the sheets are fed through a crusher to break the cobalt into small pieces. The cobalt metal is then loaded in batches into the vacuum degassing furnace where it is heated for approximately four hours under vacuum. The degassing step is mainly aimed at the removal of hydrogen. The degassed cathode pieces are then drummed and weighed for shipment.

Nickel Product Preparation

The nickel cathode would be automatically stripped from the cathode blanks and packaged on pallets and weighed for shipment.

A2.6.3 Process Consumables

Typical annual consumption and transport quantities of major process consumables for ore processing are summarised in Table A2-4.

Process consumables used during ore processing are discussed in the same general order of the ore processing description (Section A2.6.1).

Sulphuric acid would be used for ore leaching in the acid leach autoclave at a rate of approximately 250 kg per dry tonne of ore. Acid would be produced on-site in a double adsorption contact plant from elemental sulphur. In times of high demand, additional acid supplies would be transported by road. On-site storage of sulphuric acid would be provided by a 10,000 t storage tank located within an impervious, high density polyethylene (HDPE) lined and bunded area within the processing plant area.

Limestone would be used in the processing plant as a neutralising agent in the form of limestone slurry. Approximately 560,000 tpa would be transported to the MPF site from the limestone quarry (Part B) and stored on-site in a limestone stockpile located at the processing plant.

Elemental sulphur would be used for sulphuric acid production and in the hydrogen sulphide plant. Prilled elemental sulphur would be imported from North America, railed via Newcastle, to the siding in covered containers and transferred by truck to site.

On-site storage would be on a bunded pad in an open stockpile, adjacent to the processing plant. The stockpile would be treated with a dust suppressant.

Magnesium oxide and caustic soda would be utilised in the refinery sections of the plant for control of solution pH. In addition caustic soda would also be used in the water treatment facility. Caustic soda would be railed or trucked from Sydney and magnesium oxide would be trucked in sealed B-Double trucks from Young.

Organic chemicals such as diluent, extractant and modifiers would be used in the solvent extraction circuits and would be trucked to site and stored in bunded storage tanks.

Flocculant for use in the ore preparation CCD and sulphide precipitation thickeners would be transported from Newcastle or similar by either road or road/rail to site.

Hydrogen would be produced in an on-site facility for use in the hydrogen sulphide plant. Hydrogen sulphide would be used primarily in the sulphide precipitation circuit.

Oxygen would be used for sulphide leaching and nitrogen for plant purge gas. Both oxygen and nitrogen would be produced on-site.

Table A2-4
Consumables - Transport and Storage

Consumable	Annual Consumption	Transport Shipment	On-Site Storage	Transport Mode
Sulphur	210,000 tpa	1,500-2,000 t (rail) 60 t (road)	10,000 t	rail, road
Oxygen	44,000 tpa	n/a	120 t liquid	n/a
Hydrogen	1,500 tpa	n/a	no storage	n/a
Hydrogen Sulphide	26,500 tpa	n/a	no storage	n/a
Sulphuric Acid	620,500 tpa	on-site production or 42 t by road	10,000 t	road if required from Newcastle
Caustic Soda	10,000 tpa	40 t @ 50% solution	302 t	rail, road
Magnesia	21,000 tpa	25 t	500 t	road
Limestone	560,000 tpa	60-100 t	20,000 t	road
Extractant	3,000 Lpa	-	250 L	road
Modifier	1,500 Lpa	-	125 L	road
Diluent	15,000 Lpa	-	20,000 L	road
Flocculant	900 tpa	-	75 t	road

Source: BRM (2000) and SNC-Lavalin (2000)

In addition to the major consumables described above, the processing plant would also utilise minor quantities of a number of other consumables including:

- mill balls (steel);
- hydrated lime;
- sodium sulphate;
- coagulant;
- barium hydroxide;
- boric acid;
- nitric acid;
- diatomaceous earth;
- gelatine; and
- hydrochloric acid.

These consumables would be transported by road or rail/road from Newcastle or Sydney, and would be handled and stored in accordance with relevant regulations and standards.

A2.6.4 Product Storage and Transport

Up to 42,000 t of nickel-cobalt sulphides or 20,000 tpa nickel and 5,000 tpa cobalt would be produced on-site. Product would be stored in an on-site product storage area (Figure A2-8) for periodic transport by backloading sulphur trucks to the rail siding and then by rail to Newcastle for export.

A2.7 ON-SITE REAGENT PRODUCTION

The following reagents would be manufactured on-site for use in ore processing:

- sulphuric acid;
- oxygen;
- nitrogen;
- hydrogen;
- hydrogen sulphide; and
- limestone slurry.

The following sections summarise the operation of the on-site reagent plants.

A2.7.1 Sulphuric Acid Plant

Sulphuric acid would be produced on-site in a conventional sulphur based double adsorption contact acid plant. The plant would produce concentrated sulphuric acid from sulphur dioxide generated by burning sulphur in a combustion furnace. Heat generated in the sulphur combustion furnace would be utilised to produce steam for process uses. Sulphuric acid production would be approximately 620,000 tpa and on-site storage would be provided by a 10,000 t storage tank located within an acid resistant bunded facility.

Sulphuric acid would be principally used in the acid leaching of ore and in the zinc and cobalt extraction process.

A2.7.2 Oxygen and Nitrogen Plant

Air would be separated into oxygen and nitrogen in a conventional cryogenic air separation unit. Air is compressed, dried and cooled before being separated in a cryogenic distillation unit. Oxygen and nitrogen can be produced in liquid or gas forms for use in the process plant. Oxygen would be utilised for sulphide leaching while nitrogen would be used as a plant purge gas during startup and shutdown procedures.

A2.7.3 Hydrogen Plant and Hydrogen Sulphide Plant

Hydrogen would be produced through the reforming reaction of natural gas and steam. When superheated in the presence of a nickel catalyst, gas and steam would produce hydrogen and carbon oxides and when cooled in the presence of water vapour, produce carbon dioxide and hydrogen gas. Following removal of carbon oxides and residual methane, product hydrogen would be supplied to the hydrogen sulphide plant at a rate of approximately 4.5 t/day.

Hydrogen sulphide would be manufactured by reacting hydrogen gas with liquid sulphur in a dedicated hydrogen sulphide plant. Liquid sulphur from the sulphuric acid plant would be recirculated around a reacting vessel and hydrogen would be added to produce hydrogen sulphide gas. The gas would then be separated from the reaction vessel, cooled and pumped to the sulphide precipitation and impurity removal circuits.

Hydrogen sulphide would not be stored on-site and production would be variable according to requirements, averaging approximately 64 t/day.

In the event of plant failure or shutdown, excess hydrogen sulphide would be directed to a hydrogen sulphide flare stack for combustion disposal.

A2.7.4 Limestone Slurry Preparation

Limestone mined for the limestone quarry (EIS Part B) would be deposited at the limestone ROM stockpile and would then be reclaimed by front end loader to the limestone feed bin. Following screening and impact crushing, the limestone is fed to the limestone ball mill for further particle breakdown in the presence of process water and grinding media (steel balls). Discharge from the ball mill is screened and oversize material (rejects) removed from the circuit.

The recovered slurry passes through a cyclone cluster for separation of larger particles for return to the ball mill and the remainder is transferred to the limestone slurry tanks. Limestone slurry is used in the leach solution, tailings and barren solution neutralisation circuits. Consumption of limestone would be approximately 560,000 tpa.

A2.8 TAILINGS STORAGE FACILITY

A2.8.1 Tailings Quantities and Storage Requirements

Approximately 50 Mt of tailings would be produced over the EIS term with a tailings production rate of approximately 2.5 Mtpa. The tailings would be stored in the TSF which would be divided into northern and southern cells. Respective surface areas would be approximately 105 ha and 115 ha. Tailings would be discharged with a solids concentration of approximately 48% (ratio of mass of solids to total mass of solids and liquor).

The TSF cells would be operated alternatively to maximise drying and tailings density.

A2.8.2 Design of the Tailings Storage Facility

The tailings disposal strategy is to provide secure, long term storage within two dedicated cells. The operating aims of the facility would be to:

- maximise the dry density and long term strength of the storage structure;
- maintain stability; and
- maximise evaporation and minimise seepage potential by rapid removal of supernatant water to the evaporation ponds.

The tailings storage would be located to the east of the process plant area, between the process plant and the evaporation ponds (Figure A2-3).

The storage would be constructed in stages throughout the mine life, by upstream lifts that increase the height of the embankments in advance of storage requirements. Embankment lifts would be constructed using tailings material. An initial starter embankment would be constructed during the construction phase and would provide the required storage for the initial phase of production. The outer embankment batters would be progressively rehabilitated as soon as practicable after construction of each lift is completed.

Table A2-5 shows the provisional embankment levels for the two cells for those years shown on Figures A2-2 to A2-5.

Subaerial tailings deposition in the TSF would involve peripheral discharge of tailings from a spigotted ring main located around the perimeter embankment of each of the tailings storage cells.

Table A2-5
Provisional TSF Embankment Heights

MPF Operating Year	Northern Cell Embankment Crest Level (AHD m)	Southern Cell Embankment Crest Level (AHD m)
Year 1	Construction yet to commence	296
Year 5	290	296
Year 10	296	302
Year 20	310	311

After: BRM (2000) and Golder Associates (2000)

Deposition would be controlled to form a decant pond towards the centre of each of the tailings storage cells, away from the main perimeter embankment (Figure A2-3).

As the tailings beach develops, segregation of the tailings solids would occur. Coarse sediments would settle rapidly and would be deposited close to the spigot discharge point, finer sediments would settle more slowly and tend to be deposited further towards the centre of the storage. This deposition process would create a beach of changing slope, becoming flatter with increasing distance from the discharge point. As a result, water contained within the tailings would drain towards the decant pond area, thus maximising the exposure of the tailings surface to air-drying and increasing tailings dry densities.

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

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

A2.8.3 Construction Materials

Construction materials for the TSF would include earthen material (mine waste material from open pit mining and borrow within the TSF) for the starter embankments, decant causeway and floor liner. All required materials for the construction of the TSF are to be sourced from within the MPF site.

Geotechnical testwork performed on these potential construction materials indicated adequate quantities of suitable materials are available from within the proposed tailings storage area and mine waste material. In addition, this testwork has indicated that adequate quantities of suitable material are also available on-site for the evaporation ponds and evaporation surge dam. Further control testing would be performed periodically during construction to confirm construction suitability.

The TSF starter embankment, and other initial embankments, would be constructed using either mine waste materials or locally borrowed soils.

Materials utilised for construction would be capable of producing required densities and permeabilities when engineered, and have no potential to generate acid drainage (chemically inert). The total footprint of the two TSF cells would be stripped of topsoil then ripped to a depth of 1 m before being re-engineered by moisture conditioning and compaction. If during construction the *in situ* soils were found to be not suitable for this purpose then suitable clay material would be imported from other MPF site areas where necessary.

Filter sand and washed aggregate material would be imported for the construction of the underdrainage and seepage interception system.

A2.8.4 Embankment Details

Figure A2-9 shows the conceptual starter embankment construction detail and subsequent embankment lifts over the life of the mine.

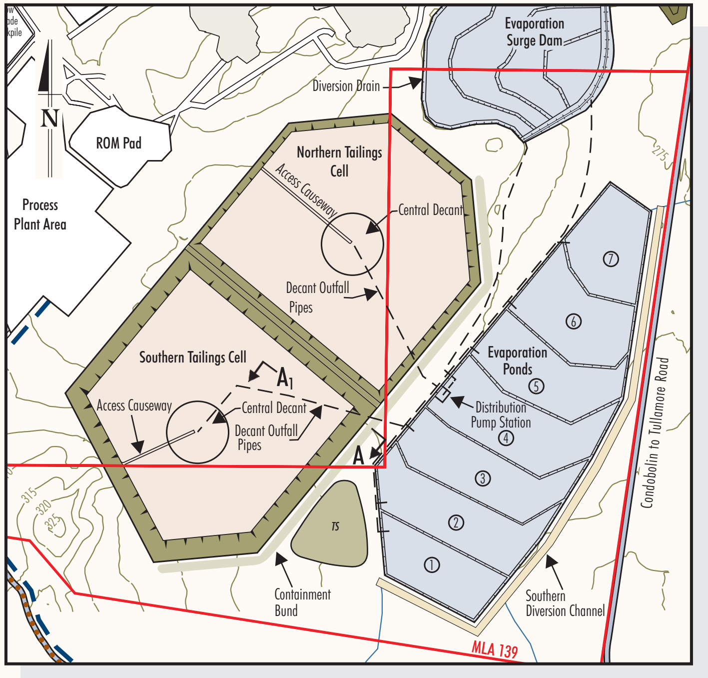
Starter Embankments

The starter embankment of the southern TSF cell would be constructed over an estimated 6 month period during the construction phase and the northern cell starter embankment constructed at approximately Year 2.

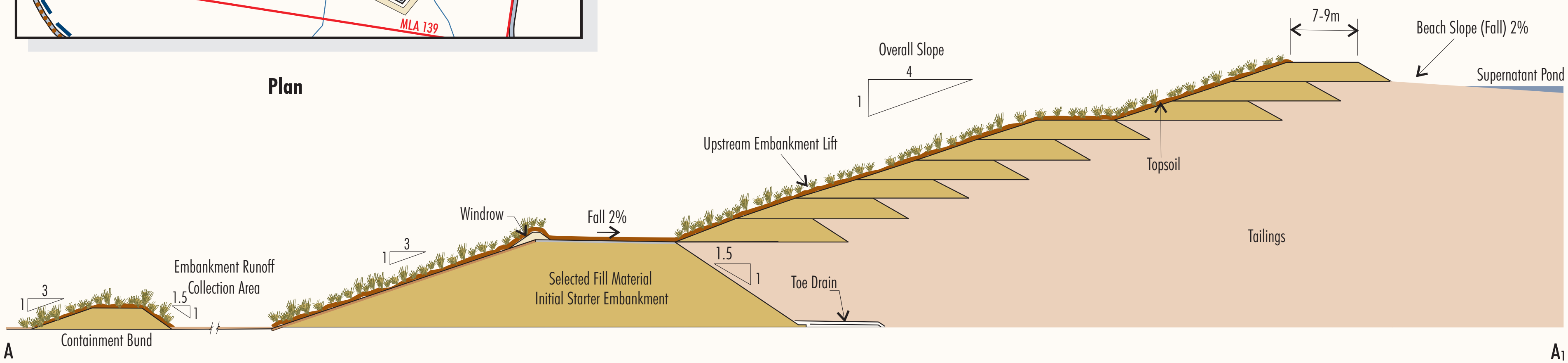
Water management structures including a diversion drainage channel would be constructed prior to commencement of the starter embankment. Further water management detail is provided in Section A2.11.

The starter embankments would be excavated to the depth of suitable foundation determined by *in situ* geotechnical assessment. Excavated material unsuitable for embankment construction would be selectively placed within the storage facility away from foundations and borrow areas.

The starter embankments would be relatively homogeneous with no internal partitioning of construction materials (Figure A2-9). Embankment materials would be engineered to produce a dense, low permeability, stable structure.



Plan



Conceptual Cross Section Through TSF Embankment

Not to Scale

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FIGURE A2-9

Tailings Storage Facility Embankment Details & Conceptual Storage Cross Section

BLACK RANGE MINERALS

Resource Strategies

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The starter embankments would have internal batter slopes of 1V:1.5H and external batter slopes of 1V:3H, as indicated on Figure A2-9. The external batter would be covered with a topsoil layer, whilst the crest would be covered with selected fill to form a surface for trafficking by vehicles.

The starter embankment would incorporate a tailings underdrain and seepage interception system running along its upstream toe. A number of drain outlets would pipe the collected waters to sumps from where it would be pumped back to the TSF or into the evaporation ponds.

The outer batter of the starter embankment would be rehabilitated as soon as practicable after completion. Outer batters of upstream lifts would similarly be rehabilitated progressively. Section A5 provides details on the rehabilitation strategy for the tailings storage.

Upstream Lifts

The perimeter embankment around the tailings beach would be raised in an upstream direction in 1.5 m high lifts with internal batter slopes of 1V:1.5H and external batter slopes of 1V:3H (Figure A2-9). Reverse graded berms would be constructed at approximately 10 m vertical intervals. The upstream lift sections would extend from the existing embankment crest on the dry tailings beach. Upstream lifts would be constructed using tailings excavated from the tailings beach, placed in 300 mm thick layers and then compacted to the required density. The overall slope of the TSF outer embankment would be 1V:4H.

When the tailings beach has filled to within 300 mm of the inner crest level of a TSF cell embankment, tailings deposition would be shifted into the alternative TSF cell to allow for drying and construction of the next upstream lift embankment.

A2.8.5 Seepage Control

Detailed flow modelling and engineering studies have been undertaken to engineer the tailings storage design to minimise the potential for seepage and to comply with EPA requirements for seepage control permeabilities. The proposed seepage mitigation measures are outlined below:

- Sub-excavation and re-engineering to a depth of 1 m of clay foundation materials beneath the embankment footprint. This would assist in preventing shallow, lateral migration of tailings water beneath the embankment.
- Direct seepage control would be implemented through the construction of a low permeability base over the footprint of the TSF cells. The base would be ripped, moisture conditioned and compacted to form a low permeability liner.
- Discharge of the tailings into the storage in a manner that maximises storage densities and reduces tailings permeabilities.
- A seepage interception drain would be installed at the inner toe of the TSF perimeter embankment to intercept seepage through the tailings and near-surface soils under the storage. This drain would also control the level of the phreatic surface within the tailings and would comprise a drainage blanket overlying a drainage trench. Seepage collected in the seepage interception drain would be drained through pipes under the TSF perimeter embankment to seepage collection sumps. These sumps would be dewatered to either the TSF decant pond or the evaporation ponds.

A2.8.6 Water Management

Tailings Water Management

Implicit within the operating rationale of the TSF is the minimisation of the volume of water contained in the storages to prevent potential lateral seepage embankment instability. This would be achieved by continuous decanting of supernatant waters to the evaporation ponds to maintain the TSF decant ponds at an operating diameter of approximately 300 m. The underdrainage and seepage collection systems would also be integral in controlling the volume of water held in the tailings storages as both surface water and water contained within tailings solids (Figure A2-10).

The tailings would be pumped from the process plant to the TSF in a 250 mm diameter (approx.) pipeline. The pipeline would continue around the four sides of each TSF cell to form a ringmain, on the inside of the TSF perimeter embankment. The tailings slurry would be discharged into the TSF cells through spigots branching from the ringmain.

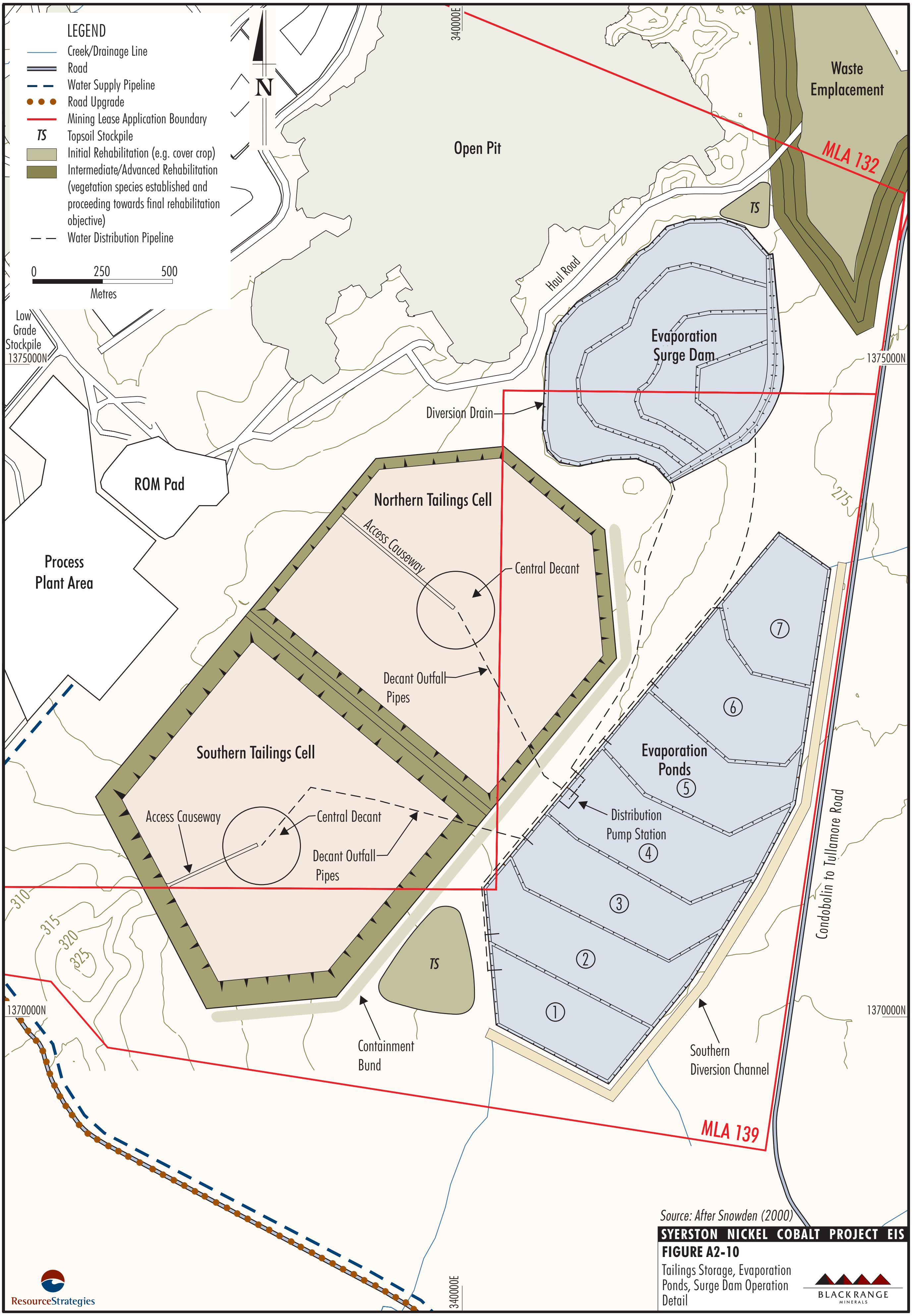

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FIGURE A2-10

Tailings Storage, Evaporation Ponds, Surge Dam Operation Detail

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The method of tailings deposition would facilitate the formation of a central decant pond remote from the TSF perimeter embankment.

Following tailings deposition, supernatant water would drain to the central decant pond and decant towers within each of the TSF cells. A series of temporary inlet towers spaced at intervals along the length of the decant pipelines would allow the decanting of supernatant water during the initial development phase of the tailings beach.

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

Stormwater Management

No surface water inflows onto the tailings surface from upslope catchments would occur as the TSF is proposed to be a ‘turkeys nest’ arrangement with a fully encompassing raised perimeter embankment (Figure A2-9). The only predicted inflows to the TSF would be tailings slurry, incident rainfall onto the decant ponds and runoff from the embankment crest, internal batters and tailings beach.

The TSF cells would be operated at all times to maintain a freeboard storage, above the level of the decant pond, in excess of that required to store the volume of runoff generated from a 1 in 100 year average recurrence interval (ARI) storm event of 72 hours duration. The decant system would be designed to remove the quantity of water generated by a storm of this magnitude to the evaporation ponds or evaporation surge dam within five days of the event occurring.

Underdrainage and Seepage Collection System

The underdrainage and seepage collection system would comprise a blanket drain to be constructed along the internal toe of the TSF embankment and a seepage collection and interception trench under the blanket drain. These drains would be integral in the control of the phreatic surface level within the tailings and in the interception of seepage through the tailings and near ground soils under the TSF.

Drain outlet pipes would convey any collected waters under the TSF embankment to a series of sumps. These sumps would be dewatered to the TSF decant ponds or to the evaporation ponds.

A2.9 PROCESS WATER EVAPORATION SYSTEM

Due to the predicted levels of total dissolved solids (TDS) of supernatant water decanted from the TSF, minimal opportunity exists for its reuse in the process plant. Various alternatives for the treatment and/or disposal of these waters have been investigated, as discussed in Section I, with the preferred option being disposal through the development of a process water evaporation system.

The proposed process water evaporation system would comprise the evaporation ponds, evaporation surge dam and associated pump/pipe systems. The operational objective of the process water evaporation system would be to dispose (via evaporation) of all supernatant water decanted from the TSF and incident rainfall over the life of the mine. The system would be operated as a contained system with the maintenance of a freeboard storage, above the normal operating levels, in excess of that required to store the volume of runoff generated from a 1 in 100 year ARI storm event of 72 hours duration.

There would be seven evaporation ponds, whilst the evaporation surge dam would be divided into four, to maximise evaporative surface areas (Figure A2-10). The evaporation ponds and evaporation surge dam would have total surface areas and storage capacities of approximately 120 ha and 2,400 ML, and 60 ha and 1,500 ML, respectively.

The perimeter embankment of the evaporation ponds would be constructed as water retaining structures, with a central low permeability clay core. The embankments would have a 10 m wide crest, internal batter slope of 1V:5H and external batter slope of 1V:3H (Figure A2-11). The evaporation surge dam main embankment would be similar in design, however, with internal and external batter slopes of 1V:3H (Figure A2-11).

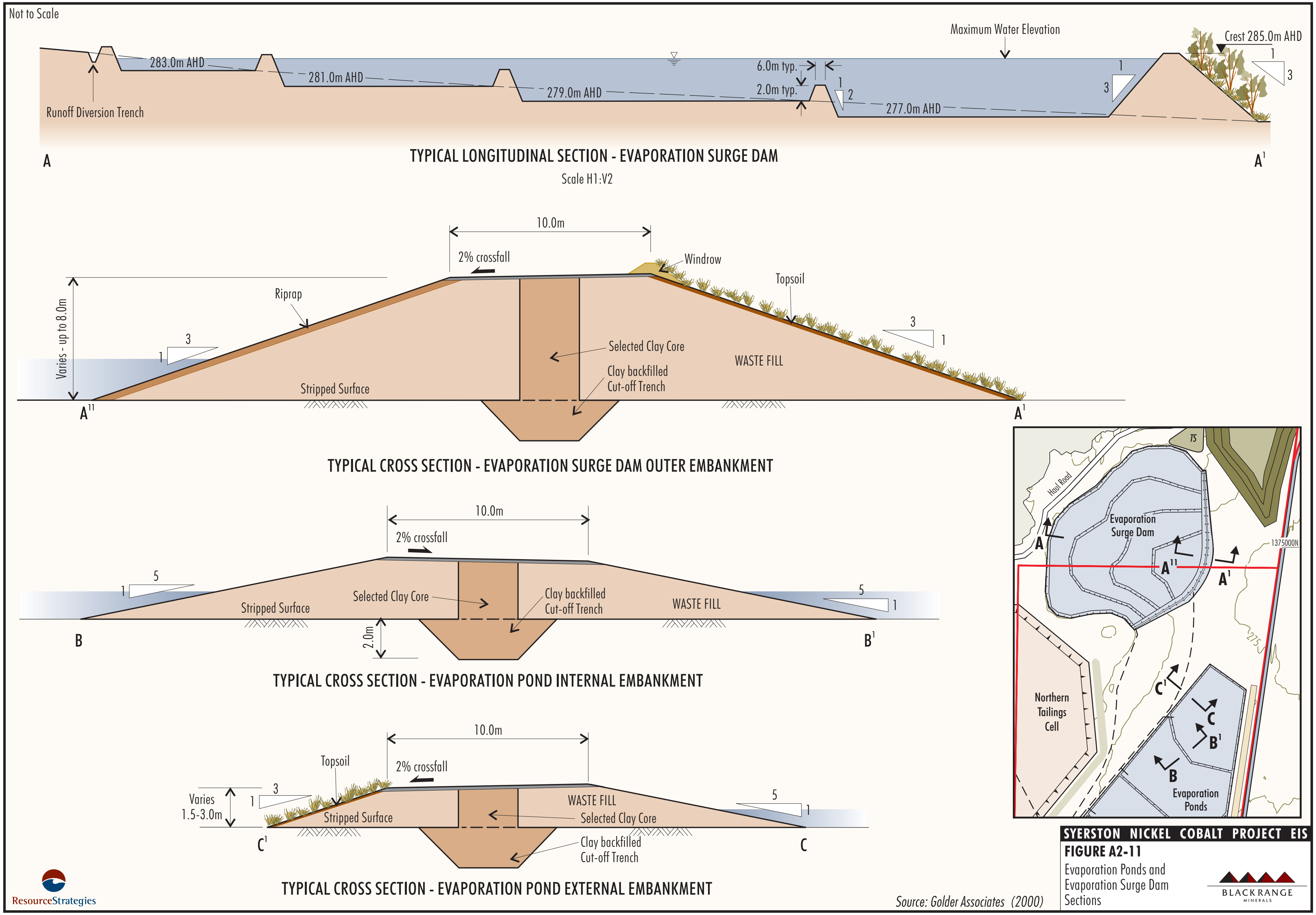

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FIGURE A2-11

Evaporation Ponds and Evaporation Surge Dam Sections

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A2.9.1 Construction Materials

Materials utilised for construction of the evaporation ponds and surge dam embankments would be capable of producing acceptable densities and permeabilities when engineered, and have no potential to generate acid drainage (chemically inert). The total footprint of the evaporation ponds and surge dam storage areas would be stripped of topsoil then ripped to a depth of 1 m before being re-engineered by moisture conditioning and compaction. If during construction the *in situ* soils were found to be unsuitable for this purpose then alternative materials would be imported where necessary.

Materials for the construction of the evaporation surge dam embankment and evaporation pond perimeter embankment would be borrowed from within the storage areas or from mine waste material. Selected clay fill material capable of being engineered to the required densities and low permeabilities would be used for the construction of the clay cores.

A2.9.2 Operation of Process Water Evaporation System

Supernatant waters decanted from the TSF cells would gravitate through the decant pipelines to evaporation pond 4 (Figure A2-10). From pond 4 water would be distributed to ponds 5, 6 and 7 by gravity through the distribution pipeline and pumped upslope to ponds 1, 2 and 3.

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

No surface water inflows into the evaporation ponds from upslope catchments would occur as the evaporation ponds would be a ‘turkeys nest’ arrangement with a raised perimeter embankment. Only incident rainfall into the storage and runoff from the embankment crest and internal batters would contribute to the stored waters. Similarly, surface water inflows into the evaporation surge dam would not occur due to the proposed construction of an upslope diversion drain (Figure A2-10).

The evaporation ponds and surge dam would be operated at all times to maintain a freeboard storage in excess of that required to store the runoff volume generated from a 1 in 100 year ARI storm event of 72 hours duration.

A2.10 WATER SUPPLY

A2.10.1 MPF Water Demand

The main water usage for the MPF would be associated with ore processing (including water for steam production). Other water supply requirements include cooling water, water for dust suppression on haul roads and internal access roads, and potable and non-potable uses around the site.

The total raw water demand for the MPF is estimated to be up to approximately 17.5 ML/day (6,300 ML per year). This includes water demand for processing (approximately 17 ML/day) and other site activities (expected to be of the order of 0.5 ML/day).

A feature of the proposed process for the recovery of nickel and cobalt from lateric ore is that the process water cannot be recycled as it becomes saturated with calcium and magnesium salts that cannot be economically removed. Consequently water used in the process must predominantly be ‘new’ water from the raw water sources. Water losses in the system would include tailings pore water, and evaporation losses from open tanks within the process plant, the tailings decant pond, evaporation ponds and surge dam. Some efficiency in raw water consumption can be gained within the process by the reuse of:

- neutralised barren liquor from the sulphide precipitation circuit in the CCD circuit;
- brine evaporator product water; and
- spent electrowinning liquor in the sulphide grinding and solution neutralisation circuits.

Raw water consumption on the MPF site would also be lowered by maximising the solids concentration of the tailings slurry discharged to the TSF. Wherever possible water required for dust suppression (approximately 0.5 ML/day), and similar purposes such as moisture conditioning of soils in earthworks construction, would be sourced from the TSF decant system.

The proposed raw water supply scheme would predominantly comprise the development of two borefields. Water would also be sourced from the collection of internal site runoff and pit dewatering. The proposed raw water supply scheme layout, shown on Figure A2-12, is described below.

A2.10.2 Water Supply Borefields

Two borefields (eastern and western borefields) each comprising three production bores are proposed to be developed within the Lachlan River Palaeochannel, at its intersection with the Bland Creek Palaeochannel, located approximately 65 km to the south of the MPF site. Groundwater investigations and supply feasibility assessments by Coffey Geosciences (2000) (Appendix E) indicate that the borefields could maintain a supply of up to approximately 17 ML/day (6,300 ML/year) for a 30 year period.

The reticulation system from the borefields to the MPF site would be constructed with a capacity of approximately 17 ML/day. The borefields reticulation system would include a break storage tank with a working capacity of 0.6 ML, a buried 450 mm internal diameter (ID) (approx.) pipeline to deliver raw water to the MPF site and power supply from existing infrastructure. The proposed bore locations and water supply pipeline route are described in Part C of the EIS. Balancing storages in the form of a raw water storage tank (2 ML capacity) and raw water dam (30 ML capacity) would be constructed within the proposed process plant area (Figure A2-8).

A2.10.3 Internal Runoff Collection

MPF site runoff would be collected by a series of bunds and collection ponds. Runoff from the waste emplacements and other disturbed areas would be collected following rainfall events and transferred to the raw water dam or other retention ponds for reuse in the processing plant or to satisfy other operational requirements such as dust suppression. Surface water runoff that accumulates within the open pit excavations during wet periods would be treated similarly or where possible allowed to pond in in-pit sumps to maximise evaporation.

A2.10.4 Mine Dewatering

Groundwater inflows to each of the proposed open pit excavations are expected to be negligible with none of the excavations deep enough to intersect the local groundwater table. Any inflows that did occur would be pumped to the raw water dam for use in the process plant, used for dust suppression or allowed to evaporate from in-pit sumps.

A2.10.5 Water Treatment

There would be three types of water treatment at the site, namely:

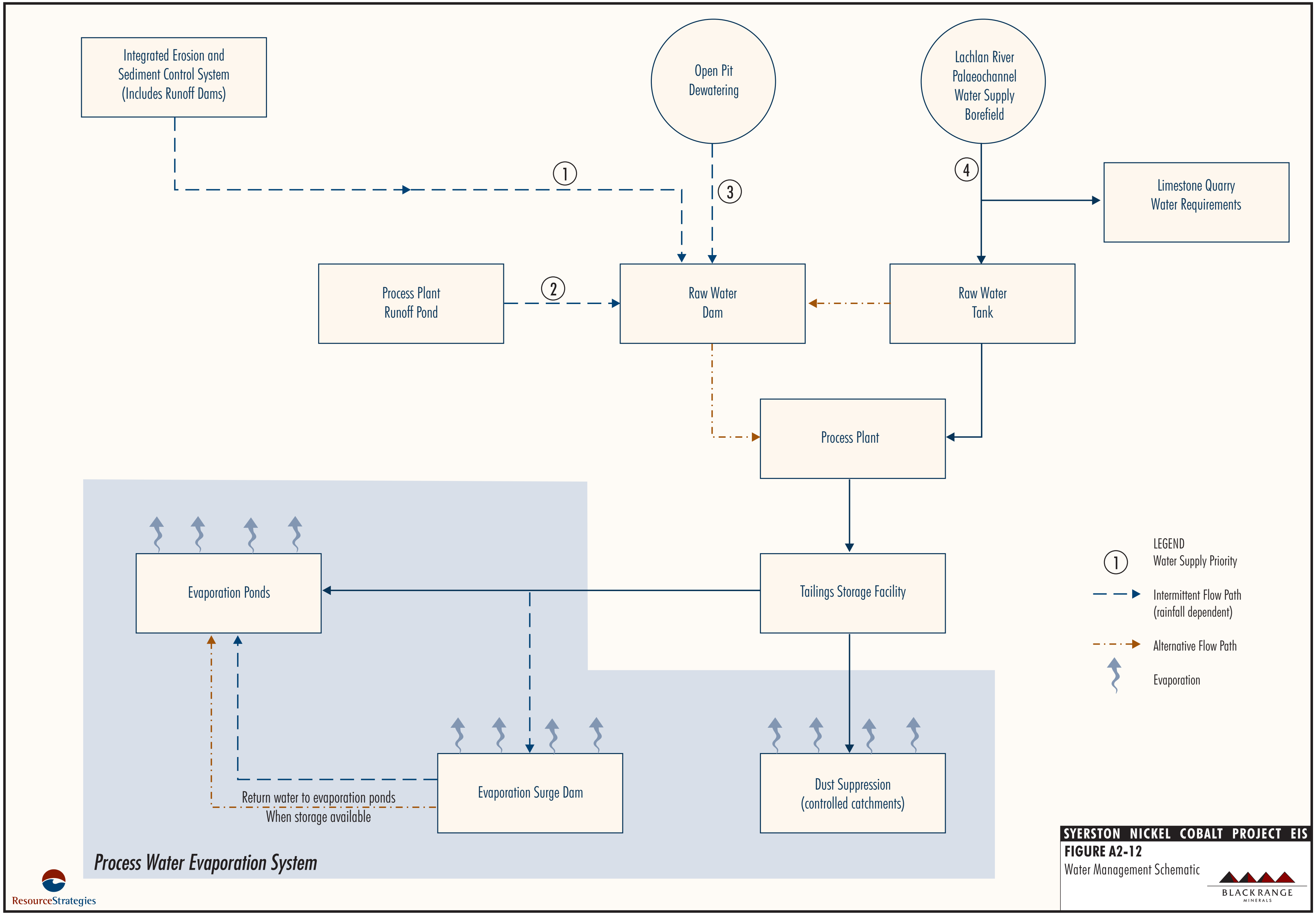
- filtration;
- two stage reverse osmosis treatment for potable water; and
- mixed bed de-mineralisation for water/steam used in the process plant.

The filtration stage is required to remove suspended solids to minimise potential for downstream blockages. The reverse osmosis plant produces water of potable quality that would be stored in a dedicated 2.5 ML tank. The de-mineralised water plant produces water of boiler feed quality, required as top-up to the water/steam circuits and refinery water. This water would be stored in a dedicated 2.5 ML tank.

A2.11 WATER MANAGEMENT

A2.11.1 Overview

The overall objective of the MPF water management system is to control runoff from MPF development/construction areas and operation areas, while diverting upstream water around such areas. The water management system would include both permanent features that would continue to operate post-closure (eg. diversion dam, northern and southern diversion channels) and temporary structures servicing the life of the mine requirements only. The water management system would be progressively developed during the construction and operation of the MPF as diversion and containment requirements change.



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The water management system requires alteration of some existing ephemeral drainage paths by the development of the northern and southern diversion channels (Figure A2-13). The northern diversion channel would allow upper catchment surface runoff to flow around the southern and eastern limits of open pits in the west of the MPF site and back into an existing drainage line. Similarly, the southern diversion channel would allow upper catchment surface runoff to flow around the southern and eastern perimeter of the evaporation ponds and back to an existing drainage path. These diversion system features would be designed to ensure long term stability as well as compatibility with existing hydrological features, landforms and vegetation.

An internal drainage system would be constructed to ensure waters generated within development/construction areas and operation areas are controlled (eg. waters that potentially contain increased sediment loads). This system would consist of a series of permanent small drains designed to act as internal catchment divides and deliver water from disturbed areas to sediment dams.

Sediment control structures such as sediment dams and sediment fences would be employed where necessary within and downstream of individual areas of disturbance and infrastructure. These sediment control structures and associated drainage systems form the Integrated Erosion and Sediment Control System (Section 2.11.3) during the life of the MPF. These structures would be constructed in a staged manner as the MPF is developed.

The water management system during the construction and operating phases is described below and shown on Figures A2-13 and A2-14. Water management during the post-closure phase is discussed in Section A5.

A2.11.2 Water Management Objectives

The objectives of water management for the MPF are to:

- contain water generated within MPF development/construction and operational areas;
- provide a reliable supply of water for processing (as discussed in Section A2.10); and
- control water on-site in a manner consistent with regulatory requirements and safe and efficient mining and processing operations.

A2.11.3 Construction Phase

The major components of the water management system during the construction phase are shown on Figure A2-13 and include the following:

- northern diversion;
- southern diversion;
- evaporation surge dam diversion; and
- integrated erosion and sediment control system.

Northern Diversion

The northern diversion is designed to collect and convey upper catchment runoff around the western cluster of open pits into the existing drainage line to the north of the MPF site (Figure A2-13). The channel would be designed in accordance with peak flows from a 1 in 100 year ARI rainfall event (Golder Associates, 2000a).

The diversion system would be a permanent feature designed to direct drainage around the rehabilitated MPF site in the long term and would generally comprise a gently sloping grassed invert to encourage low flow velocities. Where grades are steep the channel would be armoured to protect against excessive erosion.

The northern diversion would be developed during the construction phase of the MPF prior to pre-stripping of open pits in the north-west of the MPF site (Figure A2-13).

Southern Diversion

The southern diversion is designed to collect and convey upper catchment runoff around the southern and eastern edge of the TSF and evaporation ponds and into the existing drainage path at the western boundary of the MPF site. The southern diversion would be a permanent feature and would be designed as per the northern diversion. The diversion would be developed during the construction phase of the MPF, prior to the construction of the TSF and evaporation ponds (Figure A2-13).

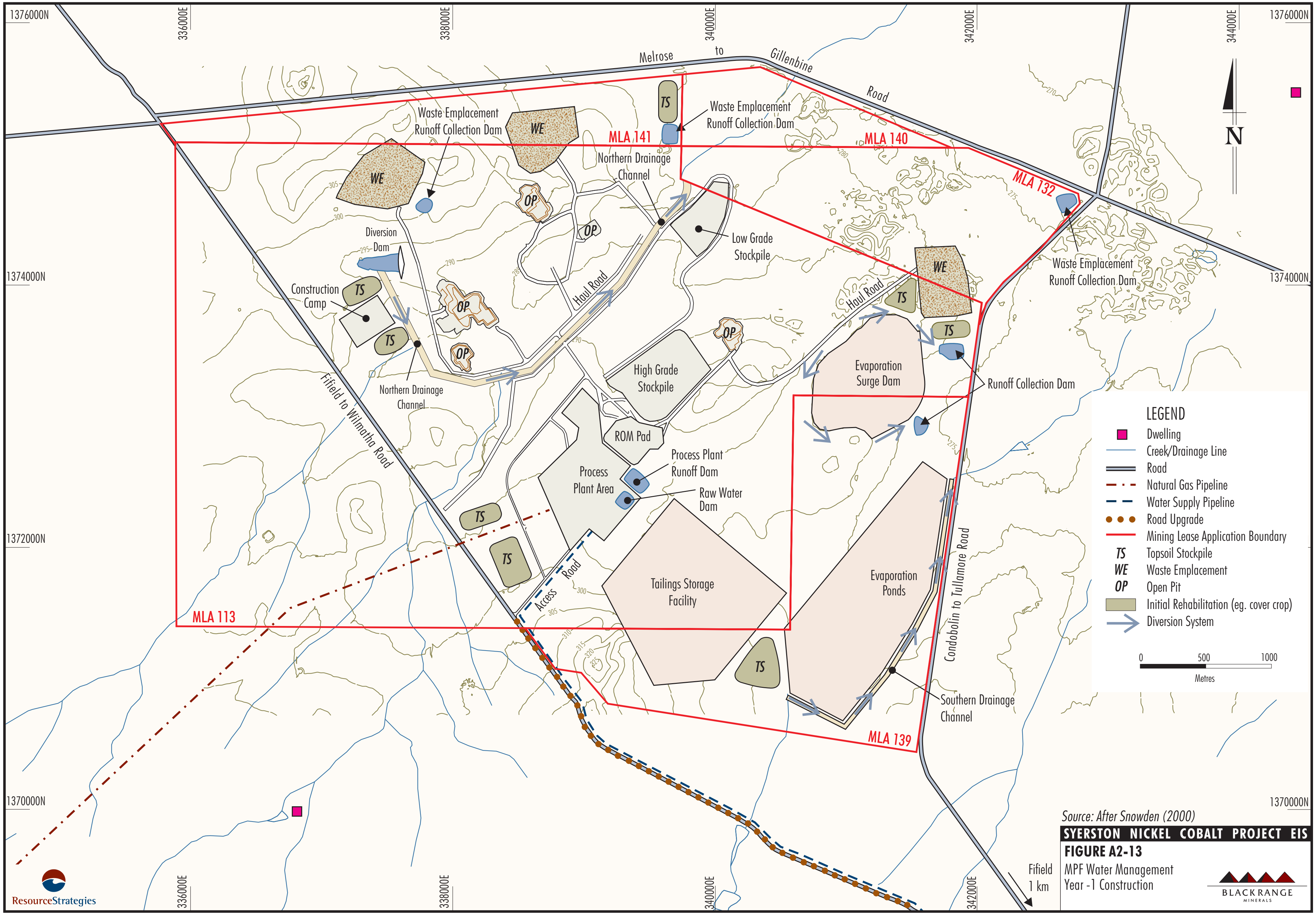

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FIGURE A2-13

MPF Water Management
Year -1 Construction

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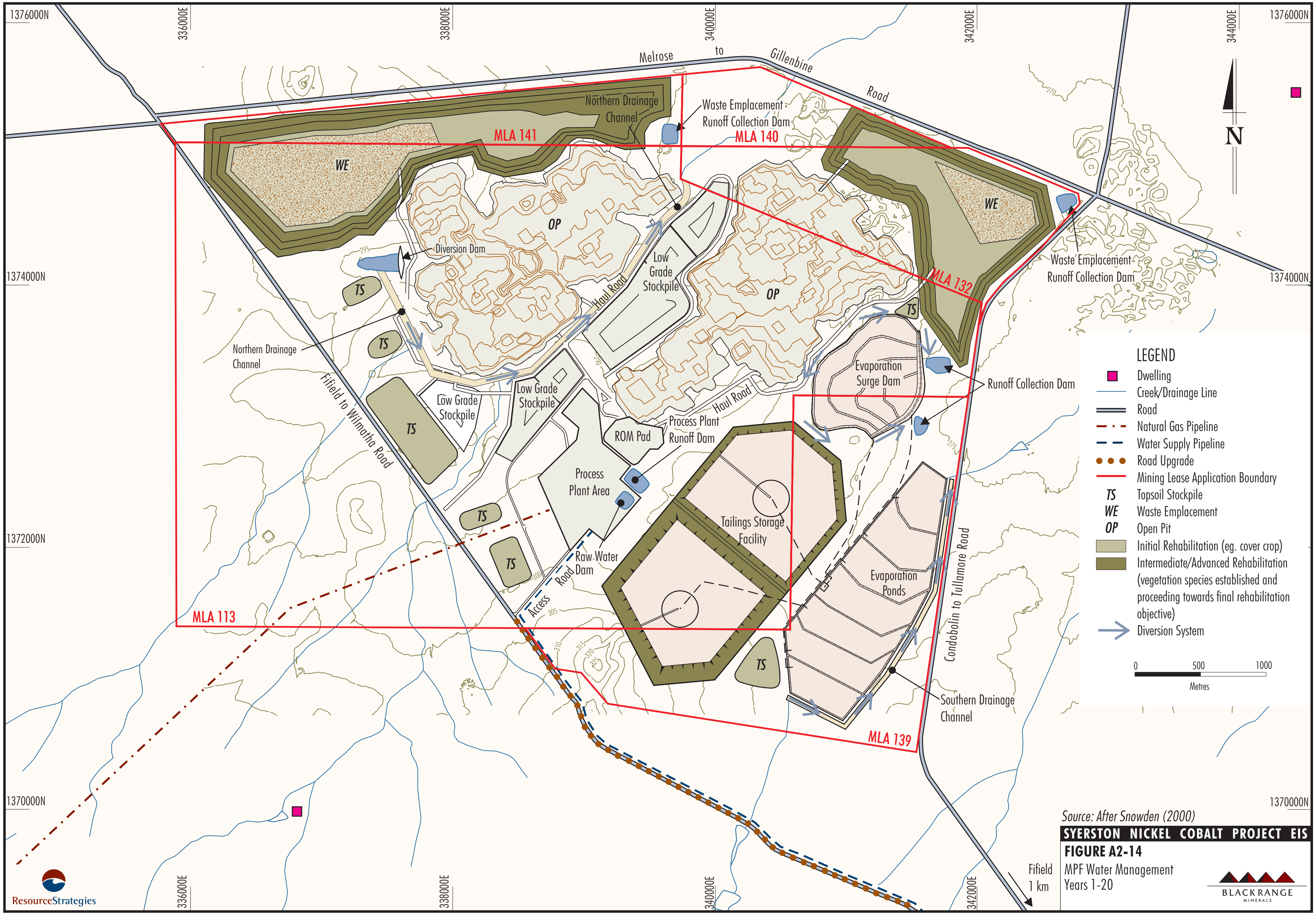

Source: After Snowden (2000)

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FIGURE A2-14

MPF Water Management
Years 1-20

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Evaporation Surge Dam Diversion

The surge dam diversion would be constructed prior to construction of the evaporation surge dam to divert upstream surface water flows around the dam and to minimise inflows (Figure A2-13). The diversion would be a permanent feature and would be designed in accordance with the northern and southern diversions.

Integrated Erosion and Sediment Control System

Prior to the commencement of construction activities BRM would develop an Integrated Erosion and Sediment Control Plan (IESCP) in consultation with the relevant authorities. The IESCP would detail the measures proposed to effectively control downstream water quality impacts during the MPF construction phase. The objectives and relevant design criteria of the proposed erosion and sediment control measures would be consistent with current accepted practices for similar projects in the region (eg. 1 in 20 year ARI rainfall event lasting 1 hour).

Consistent with the water management objectives presented in Section A2.11.2 the objectives of the IESCP water management strategies would be to:

- control soil erosion and sediment generation from areas disturbed by construction activities; and
- minimise the potential for site activities to impact on downstream water quality.

The proposed construction phase water management strategy would incorporate the following components:

- construction sequencing to reduce the potential for sediment generation to minimum practicable levels;
- upslope water diversions;
- construction of sediment dams sized in accordance with the IESCP design criteria (Section A4.3.1);
- use of small scale runoff controls comprising silt fences and rockfill filter bunds; and
- rapid stabilisation and/or revegetation of disturbed areas.

Sediment dams would be dewatered to the raw water dam or used for dust suppression. Bunding and sediment control works would be constructed and stabilised prior to the initiation of any bulk stripping or clearing activities. Upon completion of earthworks, batter stabilisation, sealing and revegetation of disturbed areas would be undertaken (including revegetation of topsoil stockpiles).

A2.11.4 Operation Phase

The key components of the water management system during the operation phase of the MPF are shown on Figure A2-14. The water management strategy for key MPF areas is provided in Appendix E (Coffey Geosciences, 2000) and summarised below:

- *Water Supply System*. The MPF water supply system is described in Section A2.10.
- *Pit Dewatering.* As discussed in Section A2.10.4 groundwater inflows to the open pits are expected to be negligible as excavation depths would generally be above the local groundwater table. During prolonged wet periods incident rainfall and runoff that accumulates within the pits would be dewatered to the raw water dam for inclusion in the process plant water supply circuit, used for dust suppression or allowed to pond in in-pit sumps to maximise evaporation.
- *Waste Emplacements*. Toe drains and storages sized to contain runoff from a 1 in 100 year ARI rainfall event would be constructed in stages around the waste emplacements. These structures would be temporary over the life of the mine. Seepage and runoff intercepted by this system would be pumped to the raw water dam for inclusion in the process plant water supply circuit.
- *Processing Plant and Ore Stockpile Areas*. Runoff from the processing plant site and ore stockpile areas would be intercepted and conveyed to the process plant runoff pond via bunded collection drains constructed around the perimeter of the plant area. The plant runoff pond would have sufficient capacity to provide containment of all runoff from a 1 in 100 year ARI 48 hour rainfall event. Any areas used for the storage of lubricants, fuels or process reagents would be bunded.

- *Tailings Storage Facility.* As discussed in Section A2.8.6, supernatant water liberated by settling and consolidation of the tailings would be decanted under gravity from the two (northern and southern) TSF cells to evaporation pond No. 4 from where it would be distributed by pump or gravity to the other six evaporation ponds. A toe drain and 1.5 m high containment bund would be constructed around the embankment to collect runoff from the external batters and any accidental spills. Any water collected in these bunded areas would be pumped back into the TSF or to the evaporation ponds.
- *Evaporation Ponds.* As discussed in Section A2.9, during the operation phase of the MPF the evaporation ponds would be the primary method of disposal of excess water decanted from the TSF and from the underdrainage and seepage collection system. There would be seven interconnected shallow ponds with a total area of approximately 120 ha (Figure A2-10). As the evaporation ponds would be a 'turkeys nest' storage with a perimeter embankment there would be no contributing upslope catchment. The southern diversion channel would divert any upslope runoff around the southern and eastern embankments of the evaporation ponds during rainfall events (Figure A2-10).
- *Evaporation Surge Dam*. As discussed in Section A2.9, during the operation phase of the MPF the evaporation surge dam would be used to store and evaporate tailings decant water during periods when there is no available storage capacity in the evaporation ponds. The evaporation surge dam would comprise four evaporation ponds with a total area of approximately 60 ha. The diversion drain immediately upslope of the evaporation surge dam would divert any upslope runoff around the northern and southern abutments of the storage during rainfall events (Figures A2-10 and A2-14).
- *Integrated Erosion and Sediment Control System*. Components of the integrated erosion and sediment control system, developed for the construction phase of the MPF, which are required for the operation phase of the MPF would be maintained. This would include components associated with development of the waste emplacements, lifting of the TSF embankment, and other areas that have not been stabilised and/or revegetated.

A2.12 ELECTRIC POWER

A2.12.1 Power Generation

Electrical demand of the MPF of approximately 34 MW would be provided by an on-site natural gas fired co-generation plant. The plant would comprise two 20 MW gas turbine generators and a 10 MW steam turbine generator.

An auxiliary steam boiler, and heat recovery and steam generation units on each gas turbine generator would provide supplementary steam for process heating requirements and generation of power. Emergency electrical requirements would be provided by three 1 megavolt amps (MVA) diesel generators.

A2.12.2 Power Distribution

On-site electrical distribution would be via a combination of 11 kV (high voltage) and 415 V (low voltage) for process plant requirements and conventional 240 V supply to workshops, administration and amenities areas.

A2.13 INFRASTRUCTURE AND SERVICES

A2.13.1 Access to the MPF Site

As part of the materials transport route road upgrades described in Part B of the EIS, a portion of the Fifield to Wilmatha Road which traverses MLA 113 would be upgraded. During the construction period, up to two site access roads would be constructed off this road *viz.* construction camp access road and MPF access road. The access roads would provide all weather access to the construction camp and MPF site.

Following closure of the construction camp this access road would be closed and MPF site access would be limited to one road.

A2.13.2 Internal Roads

The access road would extend to the main carpark and administration area. During the construction period internal haul roads to the TSF, waste emplacements and ROM pad would be constructed using conventional formed gravel road construction techniques. Light vehicle access tracks to major MPF components would also be constructed during this period.

A2.13.3 Sewage Treatment and Waste Disposal

A sewage reticulation system would be installed at the MPF site to collect and treat sewage and waste water from the on-site ablution facilities. Sewage would feed by gravity to a sewage treatment plant (STP) which would consist of anaerobic and aerobic treatment and final sterilisation. Effluent produced from the STP would be recycled for use on rehabilitated and landscaped areas. Sludge from the STP would be periodically collected for disposal by a licensed contractor.

Refuse collected from ablution areas and non-recyclable dry refuse such as timber and plastics would be collected and stored in bulk bins for either regular disposal by a licensed waste disposal contractor at a municipal dump or disposal within the waste emplacements in accordance with council and EPA requirements.

Recyclable materials such as metal drums, paper and aluminium would be collected and separated on-site for collection by contractor.

Waste oil from all machinery would be collected by a mobile vehicle and then transferred to a waste oil storage tank. Waste oil would then be periodically removed from the site for recycling or disposal at a regulated disposal facility.

A2.13.4 Potable Water

The potable water requirements of the MPF would be met as part of the general water treatment plant, with sufficient capacity to supply approximately 400 persons.

A2.13.5 Communications

Three communication systems would be used at the MPF:

- telephones providing outside call capability and intercom facilities through a PABX system;
- digital mobile phone network;
- radio system for mobile communications; and
- computer network and email communications.

Process plant units would be controlled from a central control room using a Distributed Control System which would use fibre optic cable for data transfer.

A2.13.6 Site Buildings

A plan view of the proposed site buildings is shown on Figure A2-8 and the main buildings are described below.

Administration

The administration buildings would provide air conditioned offices and facilities for the majority of administration and operational staff. The buildings would be of conventional modular transportable design, incorporating pre-stressed concrete floor, steel frame with metal clad roof and appropriate exterior walls for thermal insulation and noise reduction.

Workshop and Warehouse

A combined workshop and warehouse building is provided to serve the process plant. The building would be a conventional, steel framed, metal clad, concrete floored structure and would include mechanical, electrical and welding workshops, mobile plant service bays, warehouse, store yard and associated maintenance offices and staff facilities.

The workshop facilities would be designed for minor repairs and regular services of equipment. Major repairs and specialised service work would be carried out off-site. The mine vehicle workshop and offices would be separate to the process plant and owned and operated by the mining contractor.

The warehouse would occupy approximately half of the building and would provide sufficient storage for four weeks of process consumables in addition to a regular range of equipment spares.

Amenities Building

The amenities building is a single building located adjacent to the administration building. Facilities include a meals/training room, ablutions, nurses station, first aid facilities and general offices. An adjoining area outside the building would provide a covered site for the on-site ambulance and fire control vehicle.

Laboratory

The laboratory building would incorporate a metallurgical laboratory as well as all the facilities required for grade control analysis, process plant analysis and final product analysis. The laboratory building would be located to the east of the administration building.

A2.13.7 Security and Public Workplace Safety

The security of the MPF site would be maintained by restricting access to authorised personnel. The MPF site would be fenced and only one access from the Fifield to Wilmatha Road would be provided via a gatehouse. The gatehouse would be manned 24 hrs/day and would be linked to the administration office to control all vehicle movements and visitors to the MPF site. Warning signs would be posted around the mining lease boundary.

A2.13.8 Fuel Storage

Fuelling of open pit mine vehicles would occur at the bunded fuel storage and distribution facility located within the mining contractor area (Figure A2-8). Fuel usage would be approximately 13,000 L to 14,000 L per day. Fuel would be supplied to the site by standard tankers.

On-site storage for fuel would be at a 50,000 L double-walled diesel fuel storage tank located adjacent to the processing plant and two 50,000 L tanks located within the fuel storage and distribution facility for the mining contractors. The contractor tanks would be bunded to contain 110% of the capacity volume of one tank.

The containment bund and double-walled tank would be designed and constructed in accordance with the requirements of Australian Standard (AS) 1940 - *The Storage and Handling of Flammable and Combustible Liquids*.

The facility includes a concreted and bunded tanker unloading facility and a bunded fast filling station for heavy equipment.

A2.14 MANAGEMENT OF MAJOR PROCESS REAGENTS

A2.14.1 Reagent Transport

Where appropriate, reagents for the MPF would be transported in accordance with State regulations for the transport of dangerous goods. These regulations apply versions of the *Australian Code for the Transport of Dangerous Goods by Road and Rail* (1995).

A2.14.2 Sulphur

Prilled elemental sulphur would be delivered from the rail siding to the MPF site via road trains and dumped to a specifically designed sulphur receival bin and then conveyed to either the 10,000 t sulphur stockpile or to the sulphuric acid plant (Figure A2-8). The sulphur stockpile would be located on an engineered hardstand and would be bunded, with all runoff reporting to a sump for disposal within the processing plant. The stockpile and sulphur conveyors and handling points would be fitted with dust suppressant sprays to reduce the incidence of fugitive sulphur dust. Reclaim from the sulphur stockpile would be by front end loader to a feed bin.

A2.14.3 Limestone

Crushed limestone from the quarry would be stockpiled on an engineered hardstand located in the limestone handling area (Figure A2-8) and then loaded on demand to a feed bin and apron feeder for conveying to the limestone slurry preparation circuit. Water sprays would be fitted on the transfer points in limestone handling to reduce the production of limestone dust.

A2.14.4 Sulphuric Acid

Sulphuric acid trucked to site during plant startup and produced on-site during normal operations would be stored in a 10,000 t storage tank located adjacent to the sulphur stockpile (Figure A2-8). The storage facility would be located within a lined earth bund and sulphuric acid transfer pump points would be located on acid resistant concrete areas with sumps and bunds.

A2.14.5 Chemical Storage

All chemical materials brought on-site for use at the operation would be recorded in an inventory register that would be updated and available at all times for inspection by workers and appropriate authorities. Storage would be provided within the workshop/store area and would be separated according to chemical types and storage requirements.

A2.14.6 Industrial Gases

Industrial gas plants on-site would produce nitrogen, hydrogen, oxygen and hydrogen sulphide for use in the process plant. Hydrogen and hydrogen sulphide would not be stored on-site and would be produced on demand. Oxygen and nitrogen would be stored on-site for plant uses according to standard industrial gas storage and safety regulations.

In the event of plant failure or shutdown excess hydrogen would be vented to the atmosphere and hydrogen sulphide would be directed to the hydrogen sulphide flare for combustion disposal.

A2.15 WORKFORCE

A2.15.1 Construction Phase

During the peak year of the construction phase of the MPF, an average of approximately 600 contractors would be required to build and install the infrastructure at the MPF site. Up to approximately 1,000 contractors may be required during the peak construction period. The construction workforce would be housed in an on-site camp for the construction period as described in Section A2.3.3.

A proportion of the construction phase workforce would include workers who would also form part of the operational phase workforce. These include employees involved with management, plant operation and other service positions.

A2.15.2 Operational Phase

Approximately 400 permanent positions would be created by the Project. It is estimated that approximately 100 of these jobs would be provided by the mining and maintenance contractors and 300 provided by BRM. It is expected that the majority of the workforce would be drawn from outside the region due to the highly specialised nature of the processing plant and that approximately 27% of the BRM provided jobs would be filled by workers from the local area.

During operations, mining and processing would be undertaken 24 hrs/day, seven days a week.

A2.15.3 Workforce Accommodation

Accommodation for approximately 1,000 workers required during the construction phase would be provided by a temporary on-site construction camp. The camp would include the following components:

- workforce accommodation;
- recreational and mess areas; and
- ancillary infrastructure including water supply and treatment plants, sewage treatment and electrical supply.

Both local and outside labour would be employed during the construction and operational phases of the MPF. It is anticipated that the majority of the operational workforce would settle in nearby, larger towns including Condobolin, Parkes, Trundle and Tullamore (Appendix G) (Martin and Associates, 2000).

SECTION A3 - DESCRIPTION OF THE EXISTING ENVIRONMENT

MINE AND PROCESSING FACILITY

PREPARED BY
RESOURCE STRATEGIES PTY LTD

OCTOBER 2000
Project No. BRM-01\2.2
Document No. PART A - SECTION 3-G.DOC

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A3 DESCRIPTION OF THE EXISTING ENVIRONMENT

The following section describes the existing local and regional environment for the Project. This description includes specific references to the MPF site, not including the limestone quarry, rail siding, natural gas and water supply pipelines and the borefields. Descriptions of the existing environment relevant to these Project components external to the MPF site are presented within Parts B and C of this EIS.

A3.1 LAND RESOURCES

A3.1.1 Physiographic Setting

The proposed MPF site is located within the headwaters of Bullock Creek, a tributary of the Bogan River, which flows to the Darling River some 330 km north of the MPF site. The MPF site is approximately 45 km north-east of Condobolin and 80 km north-west of Parkes in the Central West Region of NSW (Figure I-1).

The MLA area for the MPF site covers approximately 2,665 ha. The region supports mainly dryland agriculture with the nearest large scale irrigation farming occurring in the Jemalong/Wyldes Plains Irrigation Districts in the Lachlan Valley to the south of the site.

The general landscape of the MPF site is flat to very gently undulating and is bisected by a shallow drainage line running diagonally across the site to the north-east (Figure A3-1). Several areas of low hills occur across the site with broad shallow valleys between.

The majority of the vegetation in the area has been heavily cleared for grazing and cropping landuse activities. Remnant and regrowth native vegetation is generally restricted to elevated areas and along drainage lines. Less disturbed areas of remnant vegetation occur in the north of the MPF site within Fifield State Forest and on the western extremity of MLA 139.

The site is bounded by the Condobolin to Tullamore Road to the east and the Melrose to Gillenbine Road to the north (Figure A3-1). The Fifield to Wilmatha Road bisects MLA 113 in the west.

There are several small old mine workings and mullock heaps scattered in the north-eastern corner of the MPF site. Surface elevations in the MPF site vary from approximately 325 m AHD in the south, down to approximately 275 m AHD in the north-eastern section.

The potential impacts of the Project on local topography are discussed in Section A4.1.

A3.1.2 Meteorology

Climate

The MPF site lies within a region which is located between the belts of subtropical high pressure systems and the zone of mid-latitude westerly winds. In summer, synoptic high pressure systems dominate the climate while low pressure systems pass at regular intervals bringing milder temperatures and southerly winds.

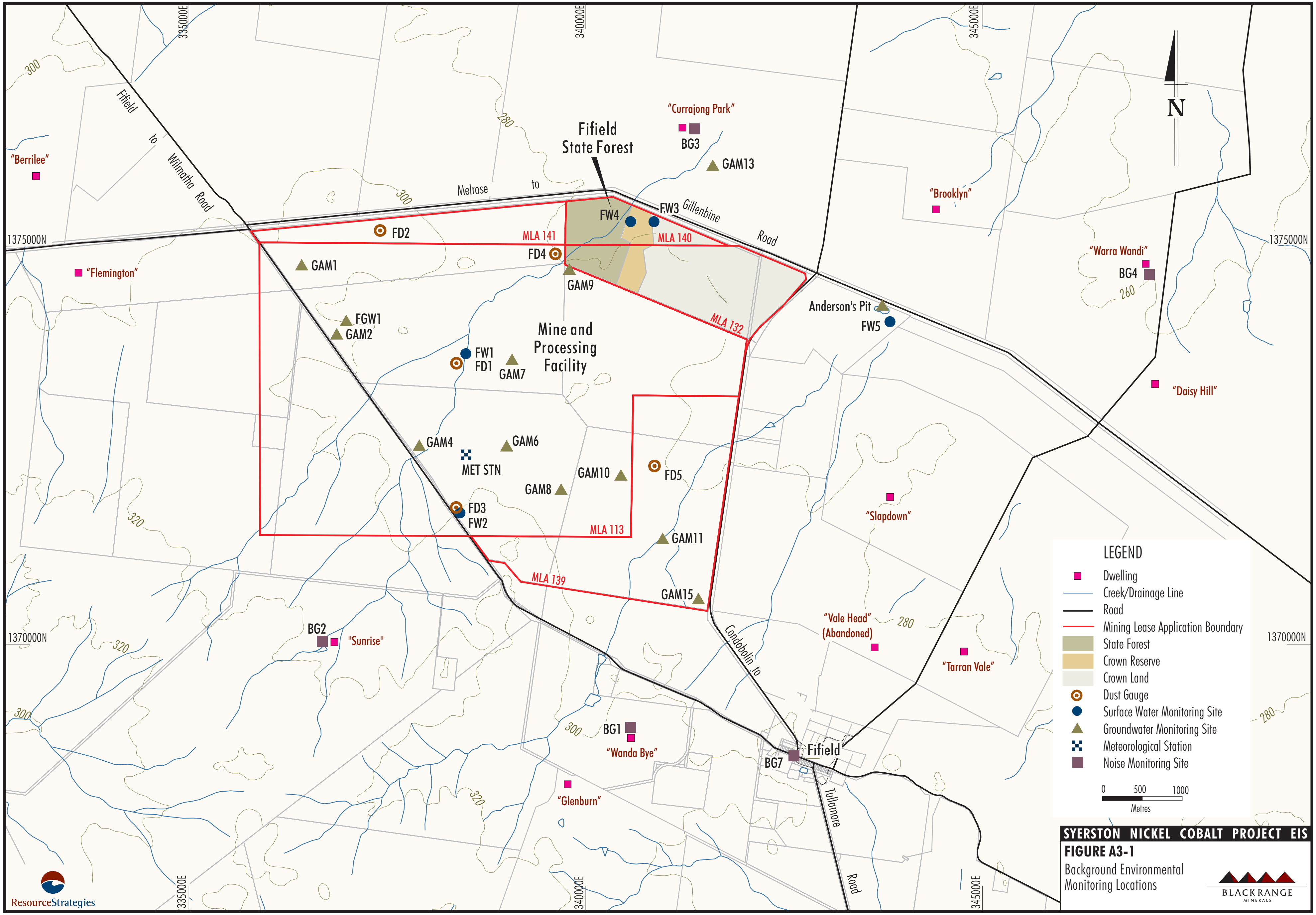
In winter, the main influence on climatic conditions is from the mid-latitude westerlies. The presence of high pressure systems is interrupted by the passage of cold fronts which bring low temperatures and precipitation to the region.

The nearest meteorological stations operated on behalf of the Bureau of Meteorology are the Condobolin Agricultural Research Station (#50052) at Condobolin and the Murrumbogie Station (#50028) at Trundle (Figure I-2).

A continuously recording meteorological station was installed at the MPF site in September 1998 (Figure A3-1). The station records wind speed and direction, air temperature, relative humidity, solar radiation and rainfall.

Temperature

Historical data show the warmest months within the region are November through to March, with the coolest temperatures falling from May through to September. Mean monthly temperatures for the MPF site are presented in Table A3-1.



SYERSTON NICKEL COBALT PROJECT EIS

FIGURE A3-1

Background Environmental Monitoring Locations

BRM-98-01-PtA-S3_008G

Table A3-1
Summary of Meteorological Data

Month	Mean Daily Temperature (Station #50052[1])		Mean Monthly Rainfall		Mean Monthly Pan Evaporation of MPF Site[3] (mm)
	Maximum (°C)	Minimum (°C)	Station #50052[1] (mm)	Station #50028[2] (mm)	
January	33.4	17.6	56.2	51.0	275.7
February	32.5	17.8	40.7	43.4	226.6
March	29.3	14.8	40.5	41.2	195.3
April	24.3	9.7	35.4	37.0	120.1
May	19.4	6.8	38.1	39.3	69.5
June	15.6	3.8	26.8	38.8	45.2
July	14.9	2.6	37.8	36.0	50.6
August	16.8	3.4	35.4	37.0	74.2
September	19.7	5.4	29.1	32.5	108.3
October	24.5	9.2	53.3	42.0	168.5
November	28.2	12.6	37.4	37.7	219.4
December	31.7	15.5	41.7	43.7	279.5
Total			**472.4**	**479.6**	**1,832.9**

1 Condobolin Agricultural Research Station

2 Murrumbogie Station

3 Site-specific data set generated based on data from Condobolin Agricultural Research Station and the Condobolin Soil Conservation Service Office Station (Appendix D)

The highest average monthly maximum temperature (33.4°C) occurs in January. The lowest average monthly minimum temperature (2.6°C) occurs in July.

Wind Speed and Direction

Wind roses for the MPF area, recorded at the site meteorological station (Figure A3-1), are presented in Figure A3-2. The annual wind roses reflect seasonal as well as diurnal trends with three prevailing wind directions from the north-east, south to south-east and south-west sectors. Wind speeds during the year are generally moderate and usually range between 7 and 10 km/hr, increasing up to and between 18 and 30 km/hr in summer during the afternoons.

Rainfall

The nearest long-record daily rainfall station is the Murrumbogie Station (#50028) at Trundle, approximately 30 km south-east of the site. This rainfall station has 116 years of record (1883 to date). Rainfall data recorded at this station was utilised for the hydrological modelling presented in Appendix D (Golder Associates, 2000a). The mean annual rainfall recorded at the Murrumbogie Station is approximately 480 mm.

A summary of the recorded rainfall data is provided in Table A3-1.

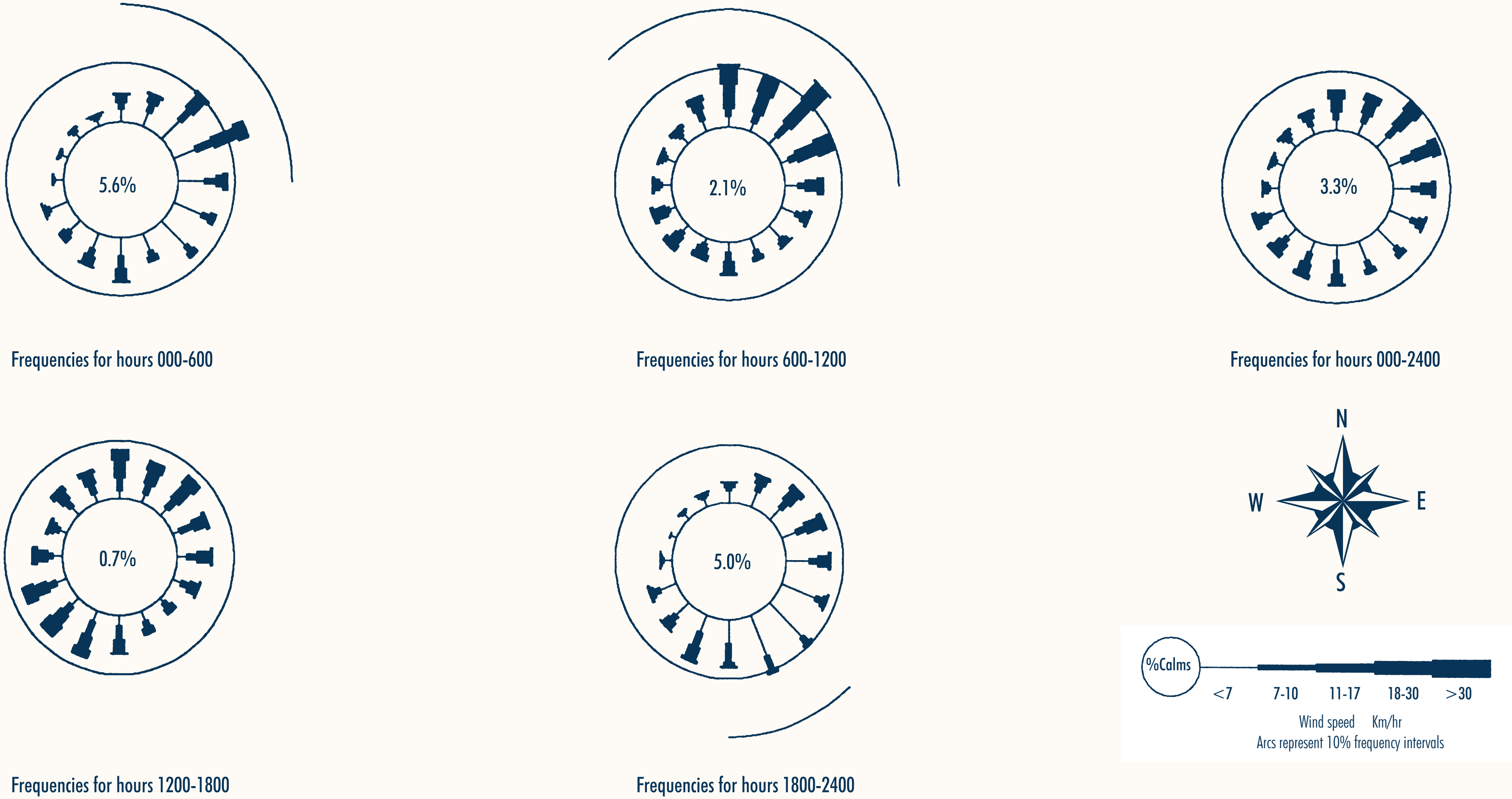
Evaporation

Two pan evaporimeters have been operated close to the site (both 45 km south-west), at the Condobolin Agricultural Research Station (#50052, 1973 to date) and the Condobolin Soil Conservation Service Office Station (#50102, 1970 to 1985). A composite site specific record has been developed from these data sets, giving a long term annual mean for the site of approximately 1,833 mm (Appendix D).

The data presented in Table A3-1 shows that rain falls relatively uniformly throughout the year while evaporation fluctuates between summer and winter. Mean annual evaporation is almost four times the mean annual rainfall.

Monthly trends in evaporation show January and December as having the highest rates of evaporation (275.7 mm and 279.5 mm respectively), while June and July record the lowest rates (45.2 mm and 50.6 mm respectively).

When considering average annual rainfall, in comparison to the evaporation data, a strong moisture deficit (net difference between evaporation and rainfall) is evident for an average year. This moisture deficit is most pronounced during summer months, coinciding with periods of higher evaporation.



Source: P.Zib & Associates (2000)

SYERSTON NICKEL COBALT PROJECT EIS

FIGURE A3-2

Annual Wind Roses
1999

ResourceStrategies

BLACK RANGE MINERALS

BRM-98-01-Pt A-S3_012C

A3.1.3 Geology

Regional Geology

The Project area is located on the Narromine 1:250,000 map sheet of the Geological Survey of NSW. Interpreted regional basement geology and major structural features are shown in Figure A3-3.

Rocks of the Girilambone Group form the basement for the region surrounding the MPF area and are dated as Early to Late Ordovician. Lithologies are dominated by fine quartz sandstone and interbedded siltstone and shale, mostly metamorphosed to quartzite, phyllite and schist (Sherwin, 1996).

Several mafic to ultramafic complexes have intruded into the Girilambone Group sediments and form a roughly north-south belt passing through the Project area. The intrusives are typically deeply weathered with little or no surface expression. The boundaries and internal structures shown in Figure A3-3 are largely defined by aeromagnetic anomalies and, where available, by exploration drill holes and trenching.

Intrusive Complexes

The geology of the Fifield region is dominated by a series of Alaskan type mafic to ultramafic intrusive bodies of Devonian to Late Ordovician age which have intruded into the sediments of the Girilambone Group. The intrusions occur within a well defined north trending belt of gravity highs and are characterised by strong, positive aeromagnetic anomalies (Derrick, 1988).

Two important intrusive bodies occur in the vicinity of the MPF site. The nearly contiguous Tout and Owendale complexes extend for several kilometres north and west of Fifield. The Tout complex, also known as the Flemington Intrusive is the underlying host to the Syerston mineralisation. The Owendale complex is believed to be the host to the platinum group mineralisation in the area.

Both complexes can be divided into a series of distinct rock types believed to represent different intrusive events becoming successively more mafic (Sherwin, 1996).

Nickel and cobalt mineralisation has localised within the laterite profile overlying the dunite core of the complex.

Local Geology

The MPF site encompasses a portion of the Tout Intrusive. The intrusion contains an oblate dunite core approximately 2 km north-south by 3 km east-west. This is surrounded by ultramafic and mafic rocks, principally olivine pyroxenite, gabbro and diorite.

Basement outcrop in the area is very limited due to the deep weathering profile. Lithological boundaries are largely defined by aeromagnetic interpretations, geological logging and scandium analysis (BRM, 1999).

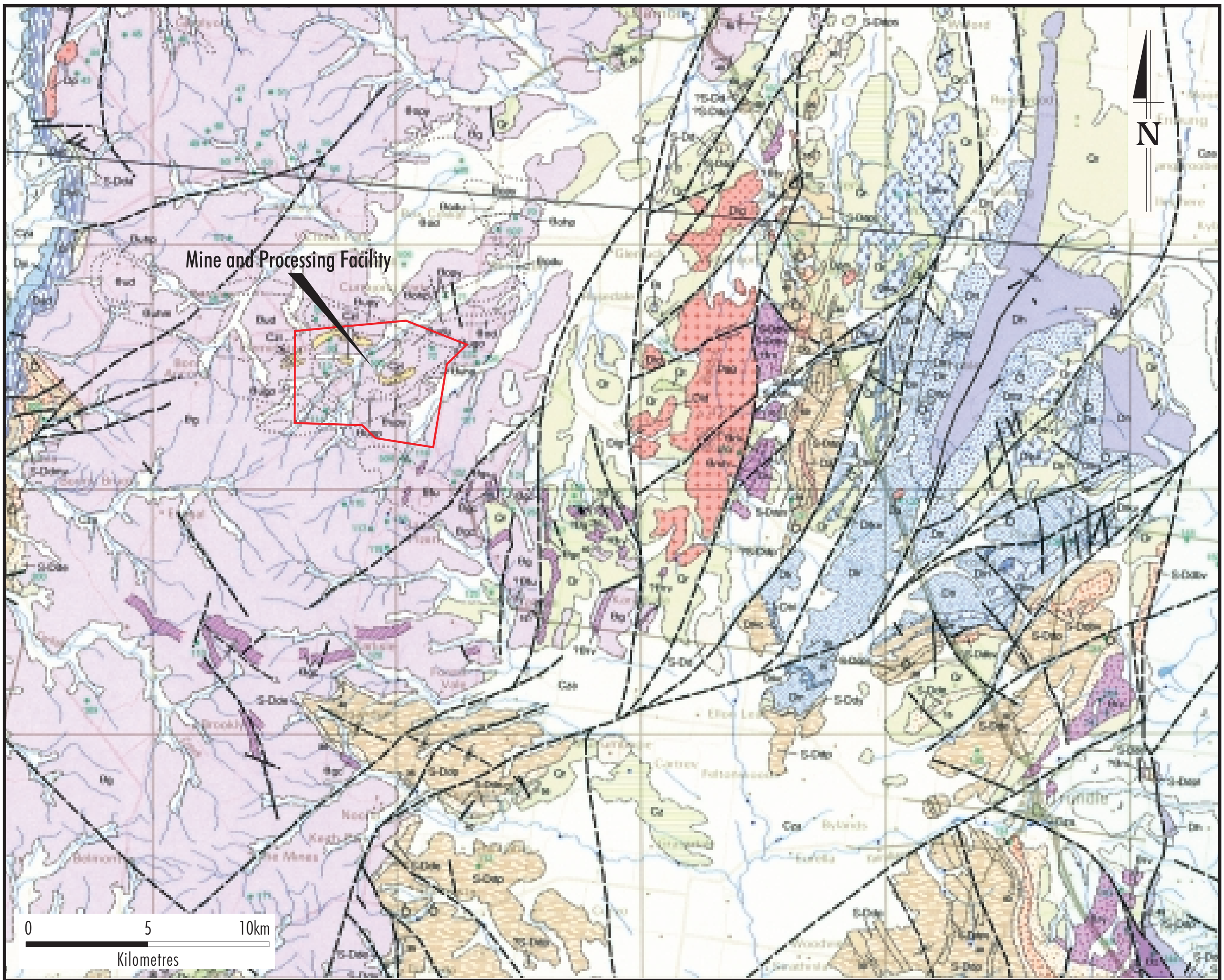
Nickel/cobalt laterite deposits form within surficial weathering mantles developed almost exclusively over olivine-rich ultramafic basement rocks (Burger, 1996). They are formed by the progressive oxidation of bedrock minerals followed by leaching of magnesium oxide silica soluble compounds and accumulation of relatively insoluble compounds (iron, nickel). Syerston is a Type C nickel laterite deposit as classified by Brand *et al* (1996) to be oxide deposits dominated by iron oxy-hydroxides (eg. goethite) forming a layer at the pedolith-saprolith boundary.

The Syerston deposit has resource grade nickel and cobalt mineralisation confined to the lateritised zone of the weathering profile overlying the dunite core of the Tout intrusive complex. Silicate clay minerals are largely absent from the deposit, with nickel occurring in association with zones dominated by goethite.

Mineralisation also occurs within a weakly developed laterite profile overlying pyroxenite peripheral to the dunite. The mineralised portion is termed Peripheral Laterite.

A3.1.4 Soils

The soils of the MPF site have been classified and mapped based on the Great Soil Group System (Stace, *et al.*, 1968). A summary of the key findings of the soil survey of the MPF site is provided below and is shown on Figure A3-4.



HERVEY GROUP

Conglomerate, and coarse grained thick cross bedded quartz sandstone and red siltstone. Medium to fine cross bedded sandstone interbedded with reddish purple mudstone.

INTRUSIVES

Gobondery Granite

Pink, fine to medium grained fluorite bearing granite

Minor intrusives

Aplite

Quartz feldspar porphyry intrusions

Feldspar porphyry with mafic xenoliths

Looney Intrusive Complex

Diorite pervasively intruded by granite

Diorite

TRUNDLE GROUP

Troffs Formation

Medium to coarse grained sandstone interbedded with fine sandstone and mudstone

Limestone (not on map face - REFERENCE only)

Purnim Volcanic Member

Andesitic lavas

Kadungle Volcanics

Rhyolitic lavas and possible ignimbrites

Clonolly Ignimbrite Member

Fine grained well laminated ignimbrite

Connemarra Formation

Siltstone, mudstone and marl

Limestone

Qr - Residual deposits
Qt - Scree and talus deposits
Cza - Alluvium, dominantly red silt with some pebble bands and quartz grit; includes relict meanders but currently is being eroded
Cz - Alluvium but without any obvious meanders
Czi - Silcrete
J - Friable, poorly exposed off white fine sandstone and mudstone

YARRA YARRA CREEK GROUP

Inverleith Sandstone

Flaggy, fine to medium grained planar bedded sandstone with thicker cross bedded units in the lower part

Daalboro Sandstone

Coarse grained, massive to cross bedded very thickly bedded sandstone

DERRIWONG GROUP

Undifferentiated

Yarrabandai Formation

Fine to medium grained flaggy, planar bedded sandstone

Cookeys Plains Formation

Shale, siltstone and fine grained sandstone

Limestone

Coarse to medium grained sandstone

Meloola Volcanics

Fine grained siliceous volcanics

Fermoy Volcanics

Feldspar porphyry lava or shallow intrusive

Byong Volcanics

Feldspar porphyry lava or shallow intrusive

Edols Conglomerate

Mass flow polymictic conglomerate and massive to planar bedded medium grained sandstone

Calarie Sandstone

Massive bedded variably developed basal conglomerate and interbedded coarse sandstone; subordinate planar bedded medium grained sandstone

OOTHA FORMATION

Interbedded shale, siltstone and fine grained sandstone with graded bedding

COTTON FORMATION

Undifferentiated siltstone, phyllite and shale

Approximate Fault
Magnetic Anomaly
Approximate Fault

RAGGATT VOLCANICS

Andesitic lavas and volcanogenic sandstone

Calc-silicate sediments, hornfelsed near Gobondery Granite

GOONUMBLA VOLCANICS

Tholeiitic gabbro

MURGA INTRUSIVE COMPLEX

Probable Alaskan type intrusive complex defined by intense aeromagnetic anomaly

MURRUMBOGIE INTRUSIVE COMPLEX

Hornblendite and hornblende diorite

TOUT INTRUSIVE COMPLEX

Dunite

Pyroxenite

Hornblende quartz monzonite

Hornblende pyroxenite

Gabbro

Olivine pyroxenite

Monzo-diorite

OWENDALE INTRUSIVE COMPLEX

Dunite

Pyroxenite

Hornblende pyroxenite

Monzo-diorite

GIRILAMBONE GROUP

Undifferentiated multiply deformed quartzite and phyllite with numerous quartz veins

Thinly bedded chert

Volcanics, altered andesitic lavas

Source: Department of Mineral Resources (1997)

Narromine, S1/55-3, 1:250 000

SYERSTON NICKEL COBALT PROJECT EIS

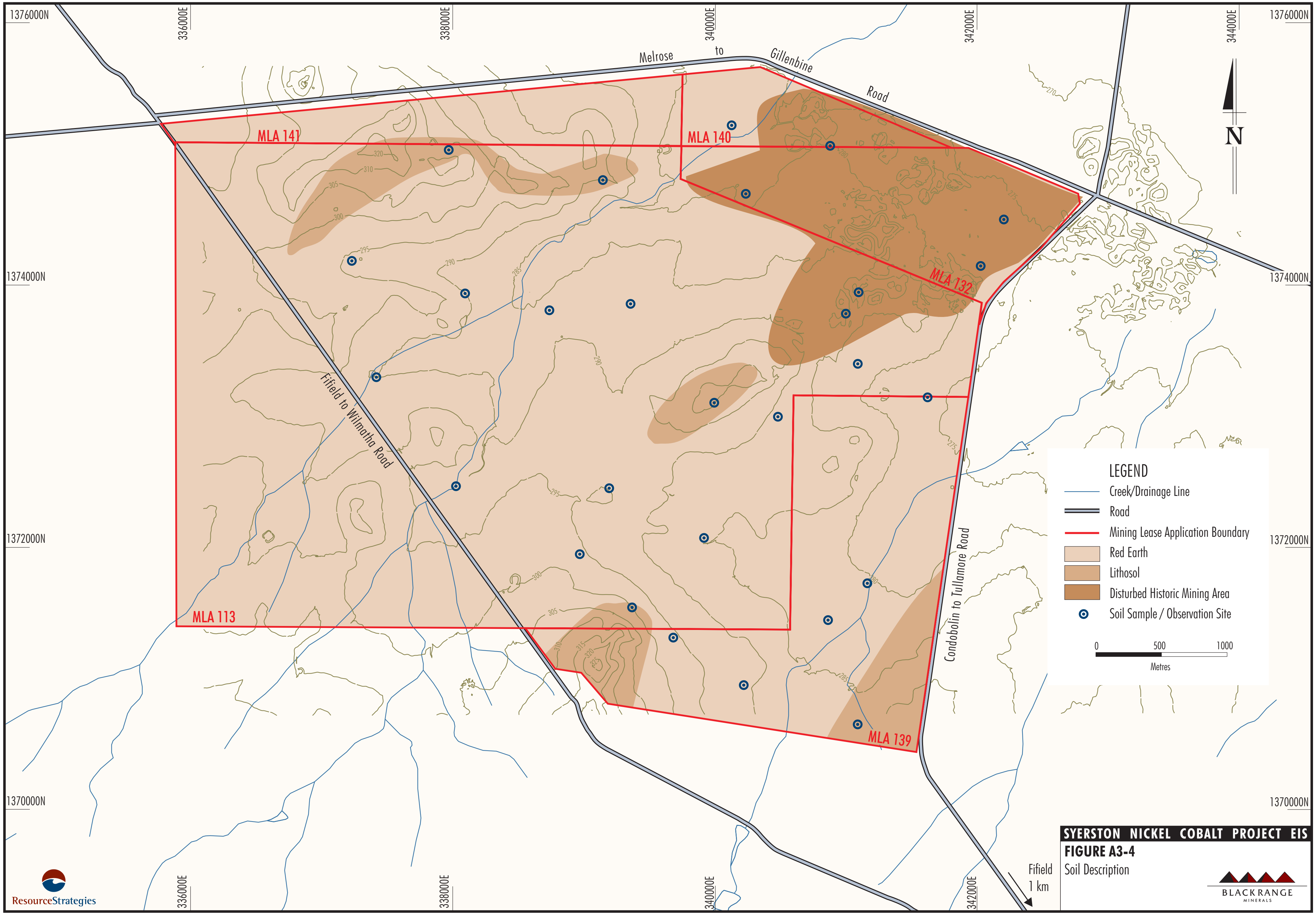
FIGURE A3-3

Regional Geology

BLACK RANGE MINERALS

ResourceStrategies

BRM-98-01-PtA-S3_003B



SYERSTON NICKEL COBALT PROJECT EIS

FIGURE A3-4

Soil Description

BRM-98-01-Pt A-S3_009C

The two major soil types encountered in the MPF site were lithosols and red earths.

The physical and chemical characteristics of these soils are presented in Appendix O (Resource Strategies, 2000b). Section A4.1 and Appendix O provide a discussion of the potential impacts of the proposed development on the soils of the MPF area and proposed mitigation measures to ameliorate these impacts.

A3.1.5 Agricultural Suitability

The agricultural suitability assessment for the MPF site was conducted in accordance with the five class system (Riddler, 1996), which classifies land according to its productivity for a wide range of agricultural activities. Appendix O provides further detail.

Three agricultural suitability classes (Classes 3, 4 and 5) were identified in the MPF site and are shown on Figure A3-5.

Class 3 agricultural suitability is defined as:

> *Grazing land or land well suited to pasture improvement. It may well be cultivated or cropped in rotation with pasture but the overall level of production is moderate as a result of edaphic or environmental constraints. Erosion hazard or soil structural breakdown limit the frequency of ground disturbance and conservation or drainage works may be required* (Cunningham *et al.* undated).

The land on flat areas associated with the northern drainage line on the MPF site are mapped as Suitability Class 3 land. The area is characterised by flat to gently inclined cropping and grazing land. The area is currently cropped on a rotational basis for fodder crops and grain and grazed by sheep on improved pastures. Erosion hazard, soil structural breakdown plus other factors such as climate, limit the capacity for cultivation.

Class 4 agricultural suitability is defined as:

> *Land suitable for grazing but not cultivation. Agriculture is based on native pastures or improved pastures established using minimum tillage techniques. Production may be high seasonally but the overall level of production is low as a result of a number of major constraints, both environmental and edaphic* (Cunningham *et al*., undated).

The majority of the MPF site is classified as Suitability Class 4. Class 4 areas are characterised by lower fertility land and include lower slopes and flats on the MPF site. Sheep and cattle grazing on improved and native pasture dominates landuse in these Class 4 areas.

Class 5 agricultural suitability is defined as:

> *Land unsuitable for agriculture or at best suited only to light grazing. Agricultural production is very low or zero as a result of severe constraints, including economic factors, which preclude improvement* (Cunningham *et al*., undated).

Suitability Class 5 areas were identified in small areas on the MPF site. These areas are generally characterised by ridgelines with shallow soils and high erosion potential. Current landuse on these areas includes State Forest, historic mine workings and grazing.

A3.1.6 Rural Land Capability

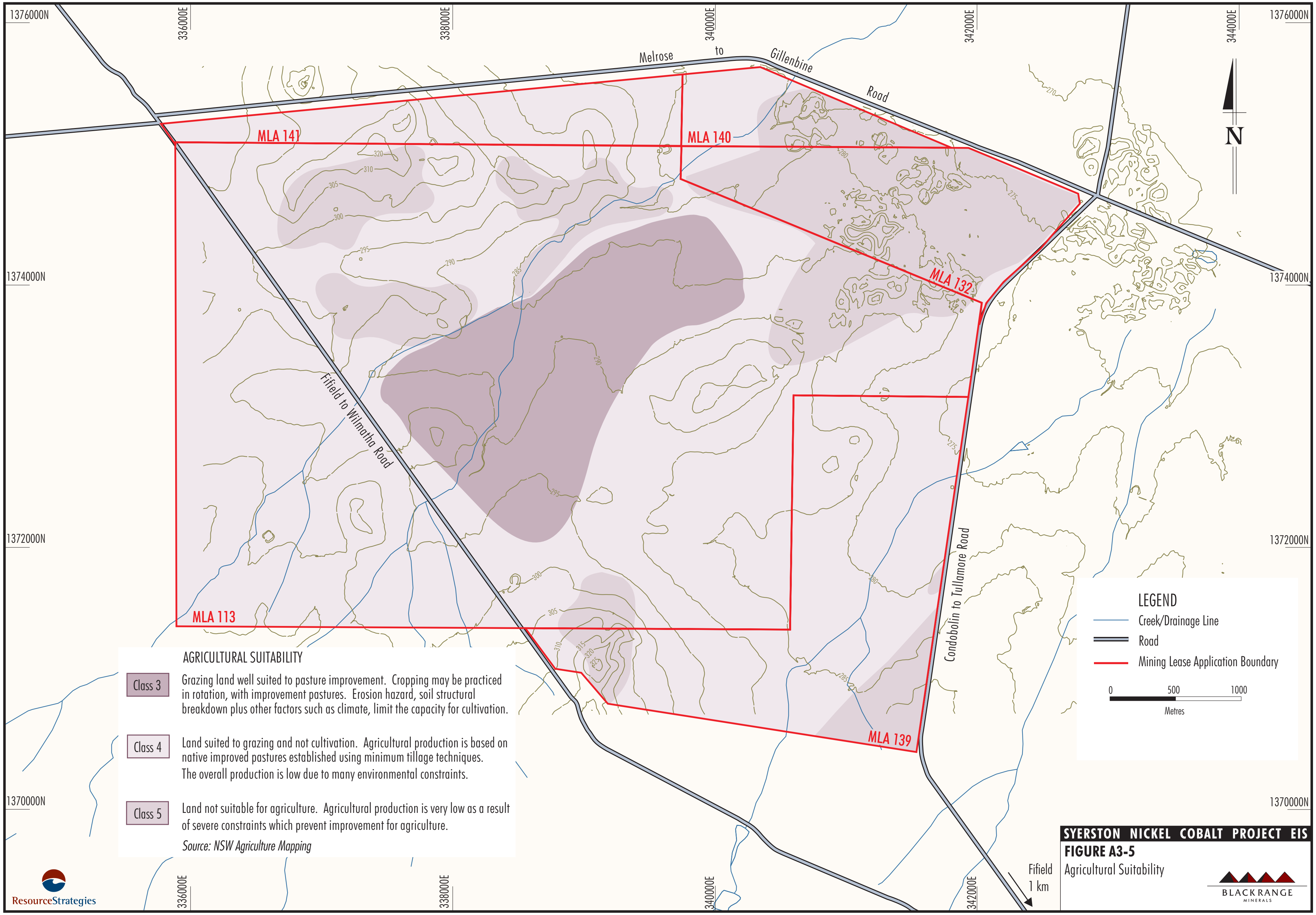
The rural land capability assessment has been conducted in accordance with the standard NSW eight class system. This system is based on the assessment of biophysical characteristics categorising land in terms of its general limitations such as erosion hazard, climate and slope. Land is classed based on the limitations to a particular type of landuse (Emery, 1985). Appendix O contains detailed discussion on rural land capability.

Four land capability classes were identified, *viz*. classes III, IV, VI and VII (Figure A3-6).

Class III Capability is defined as:

> *Land capable of being regularly cultivated with structural soil conservation works such as diversion banks, graded banks and waterways, together with soil conservation practices such as strip cropping, conservation tillage and adequate crop rotations* (Cunningham *et al.*, undated).

Class III land occurs along areas associated with the northern drainage line on the MPF site (Figure A3-6). These areas are currently used for cropping. Limiting factors for this Class include erosion hazard and climate.



AGRICULTURAL SUITABILITY

Class 3	Grazing land well suited to pasture improvement. Cropping may be practiced in rotation, with improvement pastures. Erosion hazard, soil structural breakdown plus other factors such as climate, limit the capacity for cultivation.
Class 4	Land suited to grazing and not cultivation. Agricultural production is based on native improved pastures established using minimum tillage techniques. The overall production is low due to many environmental constraints.
Class 5	Land not suitable for agriculture. Agricultural production is very low as a result of severe constraints which prevent improvement for agriculture.

Source: NSW Agriculture Mapping

ResourceStrategies

SYERSTON NICKEL COBALT PROJECT EIS

FIGURE A3-5

Agricultural Suitability

BLACK RANGE MINERALS

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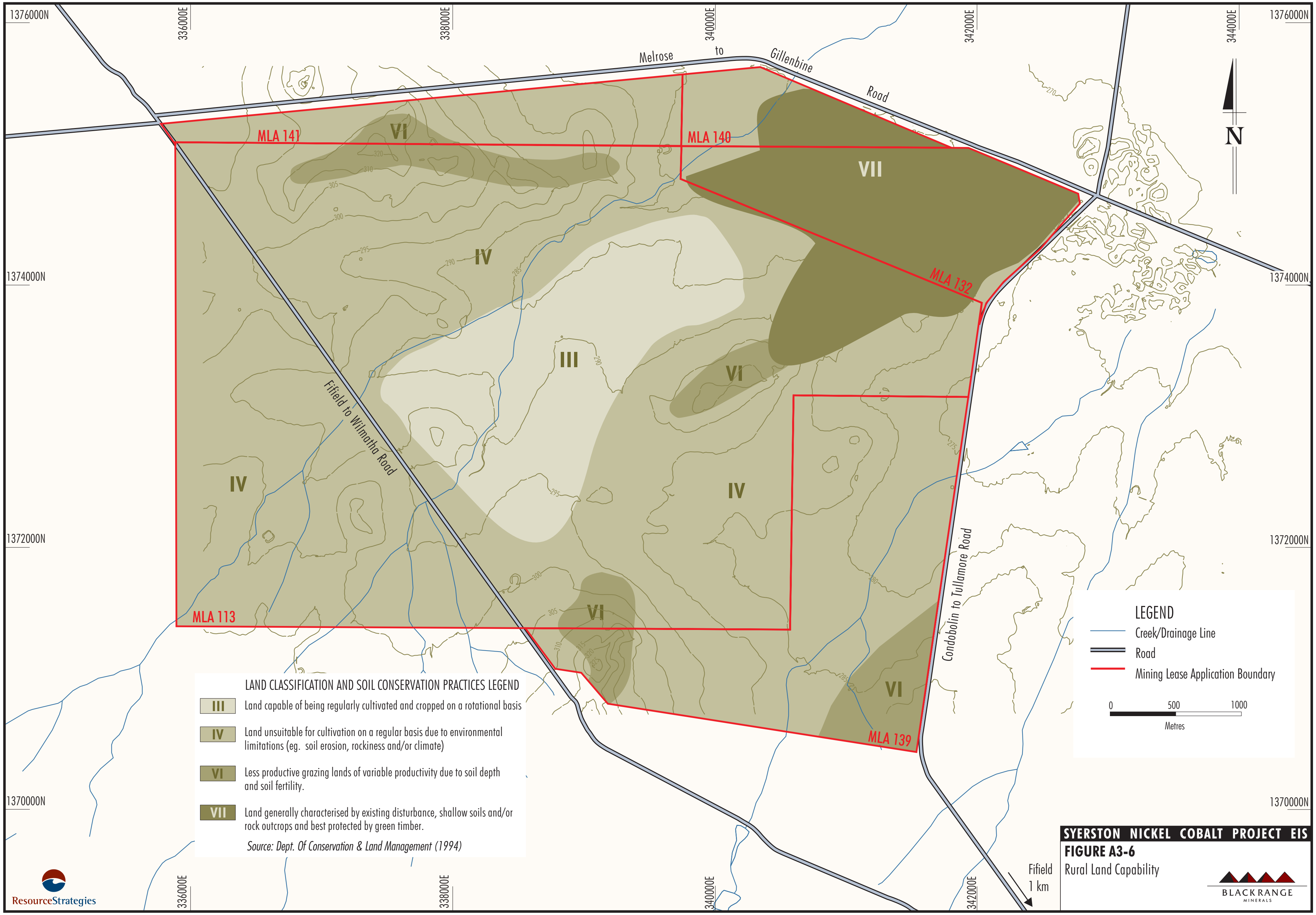

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Class IV Capability is defined as:

> *Land not capable of being regularly cultivated but suitable for grazing with occasional cultivation with soil conservation practices such as pasture improvement, stock control, application of fertiliser and minimal cultivation for the establishment or re-establishment of permanent pasture* (Cunningham *et al.*, undated).

Class IV land represents the highest quality grazing land on the MPF site which is occasionally cultivated for grain and fodder crops. This capability class occurs over the majority of the MPF site (Figure A3-6). Factors limiting higher capability include erosion hazard and rockiness. These areas are currently used for grazing with occasional cropping.

Class VI Capability is defined as:

> *Land not capable of being cultivated but suitable for grazing with soil conservation practices including limitation of stock, broadcasting of seed and fertiliser, prevention of fire and destruction of vermin. This class may require some structural works* (Cunningham *et al*, undated).

Class VI land is characterised by steeper grazing lands. These occur along ridgelines in the MPF site (Figure A3-6). Limitations include rockiness, shallow depth of soil, erosion hazard and high degree of slope. These areas are currently used for grazing.

Class VII land Capability is defined as:

> *Other lands best protected by green timber* (Cunningham *et al.*, undated).

Class VII land is restricted to the State Forest area and historical mine workings on the MPF site.

A3.1.7 Visual Character

The regional visual character of the MPF site surrounding environment is characterised by cleared cropping and grazing land for the majority with an area of remnant bushland to the south-west of the site. Previous mining areas exist to the south-east of the site, within the north-eastern portions of the site and also to the north-east of the site.

The small village of Fifield is located approximately 4.5 km to the south-east, with Condobolin (the largest nearby town) located approximately 45 km to the south-west (Figure I-2). The topography of the area is relatively flat with the greatest expressions of relief being Boona Mountains approximately 20 km to the west and Gobondry Mountains approximately 10 km to the east.

Views of the MPF site from the surrounding region are limited due to the lack of public vantage points, the relatively flat topography and shielding roadside vegetation.

The southern portion of the MPF site is visible from the Condobolin to Tullamore Road when heading north from Fifield and on the Fifield to Wilmatha Road from both the northern and southern approaches to the MPF site. The northern view is limited due to vegetation along the northern boundary of the site.

The potential impacts of the Project on the visual character of the area (including night lighting) and associated mitigation measures are addressed in Section A4.2 and Appendix N (Resource Strategies, 2000c).

A3.1.8 Landuse

The dominant landuse in the region is agriculture, principally grazing (sheep and cattle) and cropping. Sheep presently graze paddocks within the MPF site. The Fifield State Forest, Crown reserve and Crown land are located within the northern boundary of the MPF site (Figure A3-1). Portions of the State Forest, Crown reserve and Crown land have previously been mined.

A3.1.9 Bushfire Hazard

The potential bushfire hazard within the vicinity of the MPF site is dependent on weather conditions, accumulation of fuel (dry vegetation matter), extent and density of remnant woodland and intensity of surrounding landuses, primarily grazing.

The proposed MLA and surrounding areas have generally low tree density resulting in scattered leaf litter accumulation and low ground fuel loads. The grass areas have the potential to act as a moderate fire hazard under certain growth and climatic conditions.

The MPF site and its surrounds mainly exhibit a low risk of grass fires due to the continual high intensity grazing. The closest fire brigades to the MPF site are located at the village of Fifield and the townships of Trundle and Tullamore.

A3.2 WATER RESOURCES

A3.2.1 Regional Hydrology

This section presents a summary of regional and local hydrology based on Appendix D. Section A4.3 presents a summary of the potential impacts of the Project on background hydrology and associated mitigation measures.

The proposed MPF site lies within the Murray-Darling Basin in the headwaters of Bullock Creek. Figure A3-1 shows the main natural drainage lines that drain the MPF site. Bullock Creek drains to the Bogan River, upstream of the township of Nyngan, some 50 km north-east of the MPF site. The Bogan River flows north-west from its headwaters in Herveys Range, north of the township of Parkes, to the Darling River some 330 km north of the MPF site (Figure I-1).

The Darling River flows south-west into the Murray River at the township of Wentworth approximately 70 km east of the South Australian border.

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

North of the township of Tullamore, Bullock Creek flows at relatively low gradients (approximately 1 in 1,000) across topography indicative of flood inundation. South of Tullamore the creek bed gradients increase to approximately 1 in 300.

A3.2.2 Local Drainage and Topography

The MPF site is predominantly cleared, gently sloping grazing land that falls to the north-east at a slope of approximately 0.5%. There are some isolated rises within the site of less than 30 m above the surrounding terrain.

The north-eastern portions of the MPF site have previously been mined, with numerous waste emplacements and shallow pits, the largest containing water in all but the driest of periods.

The MPF site is drained generally to the north-east by unnamed ephemeral drainage lines (Figure A3-1). Several of these drainage lines lose definition to the north-east of the site due to the flat open terrain or are excised by the old mine workings. Portions of flow occurring in these drainage paths during periods of rainfall would be captured in these workings or farm dams, or dispersed as overland flow in the floodplain to the north-east of the MPF site.

A3.2.3 Surface Water Quality

A baseline surface water quality monitoring programme has been undertaken by BRM since 1997 at monitoring sites FW1, FW2 and FW3 (Figure A3-1). Monitoring sites FW4 and FW5 were added to the monitoring programme in May 2000. Table A3-2 presents a statistical summary of the recorded data and relevant ANZECC Water Quality Guidelines (1992).

Table A3-2 indicates that the recorded surface water quality generally complies with the ANZECC (1992) water quality guidelines for the protection of aquatic ecosystems and livestock watering. Some exceptions were slightly elevated concentrations of iron, cadmium and copper recorded in some samples. In the case of cadmium, only one exceedance was recorded.

A3.2.4 Groundwater

Hydrogeology of MPF Site

Golder Associates (2000c) have conducted a detailed drilling, testing and hydrogeological modelling investigation across the MPF site. Groundwater sampling and water analysis were also undertaken. No evidence was found in the public record of any previous relevant hydrogeological surveys undertaken in the area. A summary of studies undertaken by Golder Associates is presented in Appendix D. The following sections summarise the baseline hydrogeological conditions at the MPF site.

Table A3-2
Surface Water Quality
ANZECC Guidelines and Monitoring Results

Parameter	Units	ANZECC Water Quality Guidelines		Monitoring Results
		Aquatic Ecosystems	Livestock Watering	
Electrical Conductivity (EC)	µS/cm	<1,500	5,882[1] 8,824[2]	42 to 395
pH	pH units	6.5 to 9.0	-	7.01 to 8.95
Sodium (Na)	mg/L	-	-	3 to 48
Potassium (K)	mg/L	-	-	2 to 13
Calcium (Ca)	mg/L	-	1,000	<1 to 22
Magnesium (Mg)	mg/L	-	600	1 to 22
Iron (Fe)	mg/L	1.0	-	<0.1 to 3.7
Chloride (Cl)	mg/L	-	-	<1 to 32
Sulphate (SO_4)	mg/L	-	1,000	<1 to 6
Bicarbonate (HCO_3)	mg/L	-	-	22 to 184
Carbonate (CO_3)	mg/L	-	-	<1 to 48
Arsenic (As)	mg/L	0.05	0.5	<0.01
Cadmium (Cd)	mg/L	0.0002 to 0.002*	0.01	<0.001 to 0.017
Copper (Cu)	mg/L	0.002 to 0.005*	5.0[1] 0.5[2]	<0.001 to 0.006
Nickel (Ni)	mg/L	0.015 to 0.15*	1	<0.001 to 0.004
Lead (Pb)	mg/L	0.001 to 0.005*	0.1	<0.001 to 0.002
Zinc (Zn)	mg/L	0.005 to 0.05**	20	<0.001 to 0.031
Suspended Solids	mg/L	<10% change seasonal mean	-	4 to 40

1 Beef Cattle
2 Sheep
* Depends upon hardness of water
** Provided iron not present as Fe (II)

Hydrogeological field investigations identified three types of aquifers likely to occur at the MPF site:

- alluvial;
- fractured rock; and
- chemical.

Alluvial aquifers are saturated alluvial sands and gravels, generally occupying recent and palaeo-drainage systems. An unsaturated palaeochannel located above the water table has been mapped through the MPF site, but no known major saturated palaeochannel aquifers have been located within 10 km of the MPF site (Appendix D).

The site specific investigations conducted by Golder Associates (2000c) indicate that local aquifers are rare and confined to one occurrence of a fractured rock aquifer in the north-west of the site. No perched aquifers were found.

Recharge within the region is generally confined to catchment divides, where outcrops of basement rock occur. These outcrops have open fractures and joints exposed to the atmosphere and are therefore able to receive rainfall. Local groundwater associated with this recharge is generally fresh to brackish. A groundwater recharge zone was identified in the north-west of the MPF site.

No major surface expressions (ie. wetlands, local lakes or rivers) into which groundwater discharge is expected to occur were located in the MPF site or surrounds. Some waterlogged areas that exist on the MPF site are, however, likely to become periodic zones of groundwater discharge.

Groundwater generally flows to the north-east, following the direction of the fall in the topography. Hydraulic conductivities measured at the site are low (Appendix D).

Groundwater Quality

Groundwater sampling and analysis from 10 boreholes within the MPF site (GAM-1, 2, 4, 6, 7, 8, 9, 10, 11 and 15) and 2 boreholes off site (GAM-13 and Anderson's Pit) was conducted in September 1999 (Figure A3-1). FGW1 (Figure A3-1) was monitored monthly between October 1998 and March 2000. Groundwater quality is discussed in more detail in Appendix D.

Table A3-3 provides the range of groundwater quality results recorded by the sampling events along with relevant ANZECC (1992) water quality guidelines.

Groundwater quality within the MPF site is generally poor but highly variable, and expected to range from saline (>10,000 mg/L) when sourced from zones of low permeability and slow groundwater movement and/or groundwater discharge areas to fresh (<1,000 mg/L) adjacent to areas of recharge.

Table A3-3
Groundwater Quality
ANZECC Guidelines and Monitoring Results

Parameter	Units	ANZECC Water Quality Guidelines		Recorded Range		
		Aquatic Ecosystem	Livestock Watering	FGW1	GAM-1, 2, 4, 6, 7, 8, 9, 10, 11, 15	GAM13 & Anderson's Pit
pH	pH units	6.5 – 9.0	-	6.43 – 8.82	7.3 – 8.6	7.95 – 8.18
Electrical Conductivity (EC)	µS/cm	1,500	5,882[1] 8,824[2]	536 – 916	307 – 13,800	132 – 4,410
Total Dissolved Solids (TDS)	mg/L	<1,000	-	-	214 – 10,100	70 – 3,100
Suspended Solids (SS)	mg/L	<10% change seasonal mean	-	11 – 21,800	107 – 394,000	-
Hardness ($CaCO_3$)	mg/L	500	-	339 – 376	61 – 849	64 – 789
Calcium (Ca)	mg/L	-	1,000	48 – 57	3 – 289	4 – 74
Magnesium (Mg)	mg/L	-	600	48 – 64	59 – 464	8 – 287
Sodium (Na)	mg/L	-	-	30 – 37	50 – 2,050	7 – 431
Potassium (K)	mg/L	-	-	<1 – 2	2 – 69	8 – 16
Chloride (Cl)	mg/L	-	-	26 – 72	30 – 3,760	4 – 879
Sulphate (SO_4)	mg/L	400	1,000	5 – 29	21 – 2,060	251
Bicarbonate (HCO_3)	mg/L	-	-	-	61 – 849	64 – 789
Carbonate (CO_3)	mg/L	-	-	-	8 – 11	-
Iron (Fe)	mg/L	1.0	-	<0.1 – 6.4	No Data	-
Arsenic (As)	mg/L	0.05	0.5	<0.01	No Data	-
Cadmium (Cd)	mg/L	0.0002 – 0.002*	0.01	<0.005 - <0.01	No Data	-
Copper (Cu)	mg/L	0.002 – 0.005*	5.0[1] 0.5[2]	<0.01 – 0.17	0.001 – 0.007	0.002
Manganese (Mn)	mg/L	-	-	<0.01 – 7.57	0.004 – 0.556	0.034
Nickel (Ni)	mg/L	0.015 – 0.15*	1	<0.01 – 1.30	0.002 – 0.027	0.003
Lead (Pb)	mg/L	0.001 – 0.005*	0.1	<0.001 – 0.051	No Data	-
Zinc (Zn)	mg/L	0.005 – 0.05**	20	<0.01 – 0.24	0.006 – 0.007	0.006
Mercury (Hg)	mg/L	0.0001	-	No Data	No Data	No Data

Source: Golder Associates (2000) and R. W. Corkery & Co. (2000)

1 Beef Cattle
2 Sheep
* Depends upon hardness of water
** Provided iron not present as Fe (II)

The pH of groundwater samples varied from slightly acidic to mildly basic. The results of the trace metal analyses revealed that the samples from the MPF site were generally within the ANZECC (1992) guideline values for the protection of aquatic ecosystems, however, groundwater results from monthly monitoring at FGW1 revealed elevated lead concentrations in almost half of the samples.

The results indicate that the groundwater is suitable for stock watering at selected locations, with the exception of water sourced from "Berrilee" (Figure A3-1), where it is of an acceptable standard for domestic purposes (Golder Associates, 2000a).

A3.3 FLORA

A3.3.1 Background

Historically, the lands of the MPF site have been used for cropping, grazing, forestry and mining. The flatter terrain with deeper soils has mostly been cleared of its native vegetation cover and is used for cropping, principally wheat and cereal crops. The wheat paddocks have only scattered remnant native trees occurring singly or as small clusters. Hills on the site retain a greater cover of native vegetation, but have generally been significantly thinned in the past to promote growth of grasses for grazing. Dense regeneration of White Cypress Pine (*Callitris glaucophylla*) has occurred on some of these areas. Strips of natural vegetation have been left along the drainage lines in the farmed areas.

The north-eastern portions of the site have been heavily disturbed by previous mining activities for magnesite, including parts of Fifield State Forest, the Crown reserve and the Crown land. Few old growth trees remain in Fifield State Forest due to past logging for White Cypress Pine (*Callitris glaucophylla*) and thinning out of competing eucalypts, so that the forest is now dominated by regenerating *C. glaucophylla*.

Cunningham (1997) surveyed the MPF site and identified nine plant communities (including agricultural systems) and a total of 94 species. Four distinct natural plant communities were identified, namely:

1. Watercourse Woodland (*Eucalyptus melliodora*);
2. Box-Pine Woodland (*E. microcarpa/E. populnea* subsp. *bimbil/Callitris glaucophylla*);
3. Mugga Ironbark-Tumbledown Gum Woodland (*Eucalyptus sideroxylon/ Eucalyptus dealbata*); and
4. Wilga-Belah Woodland (*Geijera parviflora/Casuarina cristata*).

Bower and Kenna (2000) surveyed the MPF site in December 1998 and October 1999 and the remainder of the Project area in October 1999, January 2000 and June 2000 (Appendix I). Areas of remnant vegetation within the MPF site were systematically searched to compile a comprehensive species list and to detect any threatened species that may be present. Opportunistic observations of other species were made when moving around the MPF site.

A3.3.2 Vegetation Alliances/Associations

Bower and Kenna (2000) recognised 11 vegetation alliances, comprising 24 vegetation associations within the Project area. The vegetation falls into four major groupings:

1. Floodplain communities of the Lachlan River and associated creeks:
   - *Eucalyptus camaldulensis* alliance
   - *Eucalyptus largiflorens* alliance
   - *Stipa aristiglumis* alliance
   - *Marsilea drummondii* alliance
2. Seasonally wet low lying and gilgai communities:
   - *Acacia pendula* alliance
   - *Allocasuarina luehmanii* major community
   - *Eucalyptus socialis/Eucalyptus dumosa* alliance
3. Alliances on undulating stagnant alluvial and erosional soil landscapes:
   - *E. populnea* alliance
   - *E. microcarpa* alliance
4. Hill communities on shallow rocky soils:
   - *E. sideroxylon/E. dealbata* alliance
   - *Eucalyptus viridis* alliance

Based on the flora survey and mapping of the MPF site by Bower and Kenna (2000), eight vegetation associations were defined by the largest and most numerically dominant overstorey plant species.

Figure A3-7 shows each of the eight associations, grouped into the following five categories.

Category 1 - Yellow Box Woodland ***(E. melliodora/C. glaucophylla*****) (Association 1*****)***

This association predominates along the drainage lines within the MPF site. It occurs in the south western parts of Fifield State Forest on a broad alluvial fan where a drainage line runs out onto flat country. Here there are large specimens of *E. melliodora* and few *C. glaucophylla* in an open eucalypt woodland formation. Elsewhere, it tends to form relatively narrow strips along the drainage lines and some *E. microcarpa* and *E. populnea* subsp. *bimbil* may also be present.

Category 2 - Other Box-Pine Woodland Associations (Mosaics of associations in the *E. populnea* and *E. microcarpa* alliances) (Associations 2 to 5)

Four associations within the box-pine woodland alliances are the dominant communities of the MPF site. They are well represented in near natural condition in Fifield State Forest, except that thinning of the eucalypts has changed the ratio of trees in favour of White Cypress Pine. These communities would formerly have dominated most of the flatter farmland areas now used for cropping. It also occupies the lower slopes and low ridges where the main remnants now persist on the farmland.

A small area of pure *E. populnea* open woodland with a grassy understorey persists within MLA 113. This association type was not seen elsewhere in the study area and may represent an isolated occurrence.

Categories 3 & 4 - Mugga Ironbark - (*E. sideroxylon*) (Association 6) and Mugga Ironbark/Grey Box (*E. sideroxylon/ E. microcarpa*) (Association 7)

These two associations are a relatively minor component of the native vegetation of the MPF site. They occur on stony rises in the north of MLA 141 and in the south of MLA 139. The northern occurrence is small and semi-cleared. It contains *E. sideroxylon*, *E. microcarpa*, and *E. populnea* subsp. *bimbil*, but not *E. dealbata*. However, the latter occurs nearby in the absence of *E. sideroxylon*. The tree species present suggest the northern occurrence is a marginal or ecotonal example of this community.

The southern occurrence is more significant and more typical of the *E. sideroxylon*/*E. dealbata* alliance. It contains *E. microcarpa* on the lower slopes grading into *E. sideroxylon* and *E. dwyeri* on the upper slopes while *Acacia doratoxylon* and *Callitris endlicheri* occur on the ridgetops.

Category 5 - Wilga-Rosewood Woodland (*Geijera parviflora/Alectryon oleifolius*) (Association 8)

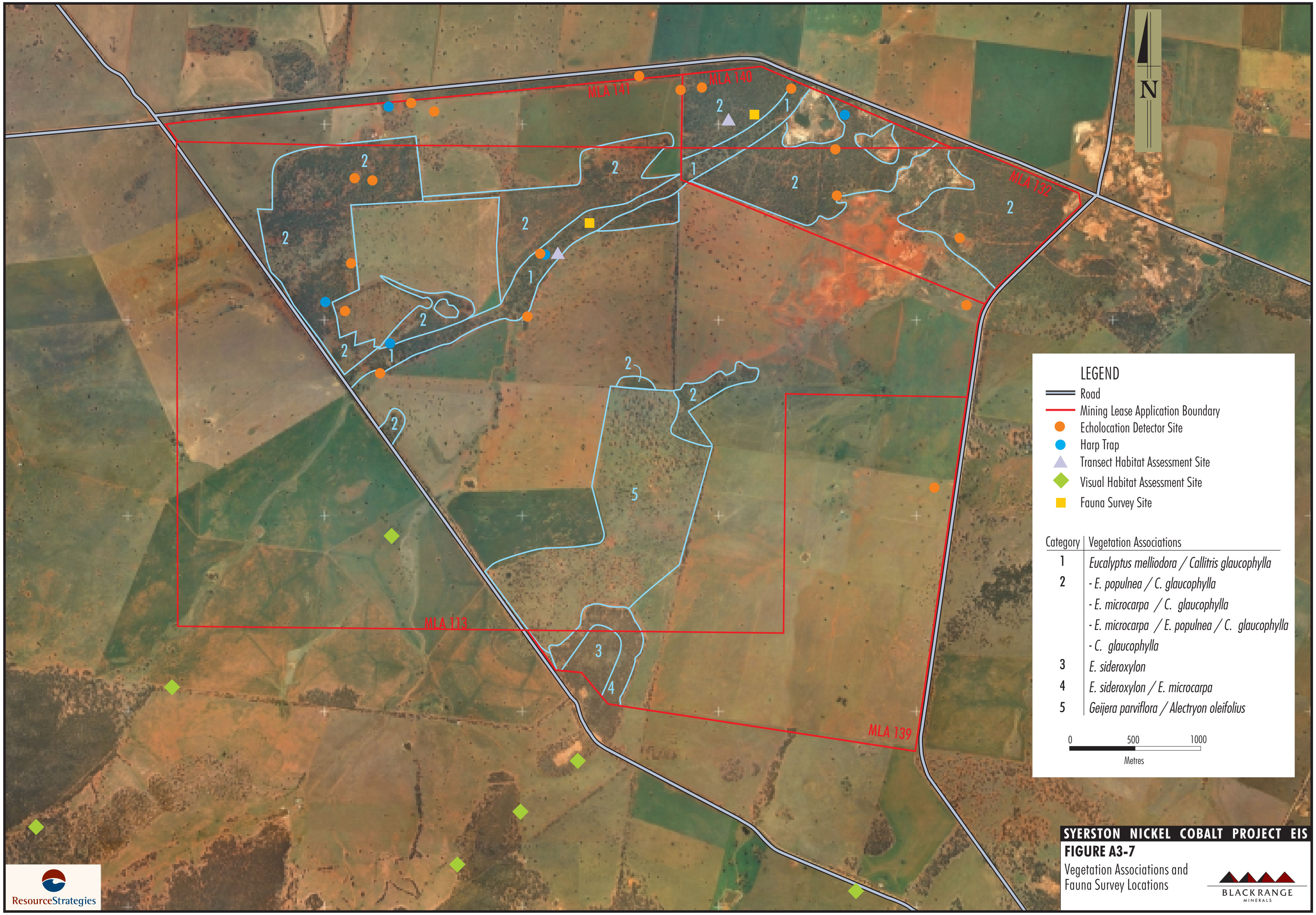
This association occurs in the south-eastern parts of the area on a gilgai landscape and has been substantially thinned for cropping and grazing. Belah (*Casuarina cristata*) is a common associate, with smaller numbers of White Cypress Pine (*C. glaucophylla*), Grey Box (*E. microcarpa*) and Poplar Box (*E. populnea* subsp. *bimbil*).

A3.3.3 Flora Species

A total of 321 native and 112 introduced plant species were recorded in the Project area (Appendix I). Some 252 taxa were recorded on the MPF site, of which 184 were native and 68 introduced. The most common shrubs in the box-pine woodlands are species of wattle (*Acacia* spp.), cassia (*Senna artemisioides* ssp. *filifolia*), hop bush (*Dodonaea viscosa*) and western boobialla (*Myoporum montanum*), while *Callitris endlicheri*, *Cassinia laevis* and *Leptospermum divaricatum*, characterise the hill communities of the *Eucalyptus sideroxylon/E. dealbata* alliance. Grasses and members of the daisy and saltbush families dominate the highly diverse ground layer. Goodenias (Goodeniaceae) and Sidas (Malvaceae) are also prominent.

A3.3.4 Introduced Species and Weeds

The dominant weeds in the Project area are grasses and herbaceous daisies, predominantly as groundcover, particularly along roadsides (Appendix I). Of the 68 introduced and weed species recorded at the MPF site the following were the most abundant: Saffron Thistle (*Carthamus lanatus*), Maltese Cockspur (*Cenaurea melitensis*), Catsears (*Hypochaeris* spp.), Common Sowthistle (*Sonchus oleraceus*), Velvet Pink (*Petrorhagia velutina*), clovers (*Trifolium* spp.) and the grasses (*Pentaschistis airoides*, *Rostraria cristata* and *Vulpia muralis*).



BRM-98-01-Pt A-S3_004B

Source: © The Land Information Centre
Panorama Avenue Bathurst 2795

A3.3.5 Threatened Flora Species

No plant species listed as threatened under the NSW *Threatened Species Conservation Act, 1995* or the Commonwealth *Protection of the Environment Biodiversity Conservation Act, 1999* were recorded within the MPF site by Bower and Kenna (2000).

Eight Part Tests of Significance were undertaken for 18 species under Section 5A of the EP&A Act in order to ascertain likely impacts on threatened flora species, populations or ecological communities, or habitats, as a result of the proposed Project. The findings of the assessment are discussed in Section A4.5 of the EIS.

A3.4 FAUNA

A3.4.1 Background

The Project area was surveyed for avifauna, mammals, reptiles and amphibians by Mount King Ecological Surveys (2000) in January 1999 and November 1999 and Greg Richards and Associates (2000) in December 1998, October 1999 and March 2000 (Appendices JA, JC and JD).

The surveys employed a variety of methods to survey fauna, including Elliott traps, pit traps, hair tubes, spotlighting, searches for herpetofauna, call playback, harp traps, echolocation call detector systems and general observations. The location of the survey sites within the MPF site are shown on Figure A3-7.

A3.4.2 Fauna Species

Avifauna

Of the 209 bird species known in the region (ie. NPWS Atlas of NSW Wildlife records for the Condobolin, Tullamore, Peak Hill, Bogan Gate and Boona Mount 1:100,000 map sheets), 93 (44%) were recorded within the Project area (Appendix JA). Four of these species are new records for the general area (ie. not listed in the NPWS Wildlife database). These were the Red-capped Robin, Pied Honeyeater, Blue-winged Parrot and White-breasted Woodswallow. MPF site surveys recorded 54 species.

Many species recorded at the MPF site are associated with the woodland habitat, with a range of middle and upper foliage feeders (eg. Honeyeaters, Robins and Thornbills) and other birds utilising the branches and hollows for perching and nesting (eg. the Eastern Rosella and Crested Pigeon). Few lower storey and ground birds were located within the MPF site woodland habitat.

A range of birds utilise the extensive areas of grassland habitat at the MPF site, including the Emu, Brown Songlark, Richards Pipit and the introduced Common Starling. A variety of parrots feed within the grassland habitat, including the Galah, Little Corella, Cockatiel and Red-rumped Parrot, although these birds also use the woodland habitat. Raptors (eg. Black-shouldered Kite, Australian Hobby, Little Eagle, Spotted Harrier and Nankeen Kestrel) were observed hunting over the grassland habitat, as well as other habitats.

Few bird species were observed utilising the water-filled mine pits, the dominant birds being the Australian Grebe and the Darter. In contrast, the farm dams at the MPF site supported a greater diversity of birds, including four species of duck, the Pacific Heron, the Sacred Kingfisher and the Welcome Swallow.

Mammals

Twenty-five mammals (including six introduced) were recorded within the Project area. In comparison, twenty-two species (including five introduced) were recorded at the MPF site, including the Short-beaked Echidna, Common Dunnart, Eastern Grey Kangaroo, Swamp Wallaby, Common Brushtail Possum and 12 bat species (Appendices JA, JB and JC).

The Eastern Grey Kangaroo was the most sighted mammal in the grassland and woodland habitats. There were also several sightings of Swamp Wallabies within the shrub and woodland near the water-filled pits on the MPF site.

The Common Brushtail Possum was the only arboreal marsupial located at the MPF site. There was evidence for the presence of the Short-beaked Echidna in Fifield State Forest. The Common Dunnart and House Mouse (introduced) were trapped within the MPF site.

Bat activity at the MPF site was greatest at waterbodies during the survey, however a higher number of species were recorded in vegetated areas.

Reptiles

A total of 11 reptile species were recorded in the Project area (28% of species known from region, Appendix JA). Four reptiles were recorded in the MPF site including the Eastern Blue-tongued Lizard, Shingleback Lizard, Common Dwarf Skink and Eastern Brown Snake.

Amphibians

Five amphibians (36% of the species known from the region) were recorded within the Project area (Appendix JA). The only frog species located within the MPF site was the Common Eastern Toadlet.

A3.4.3 Significant Fauna Species

Six species listed as vulnerable in the *Threatened Species Conservation Act, 1995* were recorded within the Project area and surrounds during the surveys (Appendices JA, JC and JD), *viz*. Barking Owl (*Ninox connivens*), Pied Honeyeater (*Certhionyx variegatus*), Major Mitchell's Cockatoo (*Cacatua leadbeateri*), Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*), Little Pied Bat (*Chalinolobus picatus*) and the Greater Longeared Bat (*Nyctophilus timoriensis*).

The Yellow-bellied Sheathtail Bat and Little Pied Bat were the only threatened fauna species recorded at the MPF site.

The three threatened bird species were recorded in the vicinity of the Project area, in a tract of woodland on the "Sunrise" property, to the south of the MPF site. The Little Pied Bat and Yellow-bellied Sheathtail Bat were recorded at numerous locations in the Project area and surrounds, while the Greater Longeared Bat was only recorded in a tract of undisturbed forest (Appendices JA, JC and JD).

Eight Part Tests of Significance have been conducted for the threatened fauna species listed in Table A3-4 by Mount King Ecological Surveys and Resource Strategies (2000) and Greg Richards and Associates (2000) (Appendices JB, JC and JD). The findings are discussed in Section A4.6 of the EIS.

Table A3-4
List of Threatened Fauna Species Addressed by Eight Part Tests of Significance

Common Name	Scientific Name
Square-tailed Kite	*Lophoictinia isura*
Grey Falcon	*Falco hypoleucos*
Major Mitchell's Cockatoo	*Cacatua leadbeateri*
Superb Parrot	*Polytelis swainsonii*
Swift Parrot	*Lathamus discolor*
Turquoise Parrot	*Neophema pulchella*
Painted Honeyeater	*Grantiella picta*
Bush Stone-curlew	*Burhinus grallarius*
Pied Honeyeater	*Certhionyx variegatus*
Barking Owl	*Ninox connivens*
Plains-wanderer	*Pedionomus torquatus*
Black-breasted Buzzard	*Hamirostra melanosternon*
Malleefowl	*Leipoa ocellata*
Glossy Black-cockatoo	*Calyptorhynchus lathami*
Koala	*Phascolarctos cinereus*
Squirrel Glider	*Petaurus norfolcensis*
Stripe-faced Dunnart	*Sminthopsis macroura*
Brush-tailed Phascogale	*Phascogale tapoatafa*
Yellow-bellied Sheathtail Bat	*Saccolaimus flaviventris*
Little Pied Bat	*Chalinolobus picatus*
Greater Longeared Bat	*Nyctophilus timoriensis*

A3.5 AIR QUALITY

A study of air quality conditions of the MPF site was conducted by P. Zib & Associates (2000). Dust deposition rates were monitored from five gauges located within the MPF site boundaries (Figure A3-1) between September 1997 and May 2000. Qualitative assessments were made regarding the total suspended particulates (TSP) and atmospheric gases of the region. The air quality assessment by P. Zib & Associates (2000) is presented as Appendix A of this EIS.

A3.5.1 Dust Deposition

Background air quality monitoring was undertaken to characterise the existing air quality in terms of atmospheric dust prior to the construction of the MPF. Atmospheric dust is currently generated in the MPF site and surrounds by agriculture and vehicular traffic on predominantly unpaved roads. The action of strong winds on dry, barren areas may also result in the generation of airborne dust at times.

Monthly dust monitoring data was collected and mean annual rates of dust deposition (insoluble solids), standard deviations from the mean and the mean ash fractions remaining in the sample after ignition were calculated. Results are summarised in Table A3-5.

The mean deposition rates over a period of 32 months ranged from 1.01 g/m^2/month at Site FD4 to 1.35 g/m^2/month at site FD5. The standard deviations from the mean ranged from about 82% to 132% of the mean value.

The mean fractions of ash remaining in the samples after organic material was removed by ignition were between 62% and 69%. The ash fractions indicated that although organic material of mainly plant and insect origin was a component of the recorded results, the organic content was well within the normal range.

A3.5.2 Concentrations of Total Suspended Particulates (PM_{10})

There are no records of concentrations of TSP and particles with a diameter less than 10 microns (PM_{10}) in the ambient air at the MPF site. Given the recorded low levels of dust deposition, the concentrations of TSP/PM_{10} are also expected to be correspondingly low. Mean annual TSP concentrations of not more than 20 to 30 micrograms per cubic metre (μg/m^3) are normally found in areas similar to that of the MPF site. PM_{10} concentrations are then generally less than half the TSP concentrations.

A3.5.3 Atmospheric Gases

The MPF site is situated in a rural environment with no significant industrial installations in the immediate vicinity. Road and rail traffic represents only a minor source of emissions of atmospheric gases such as nitrogen and sulphur oxides, hydrocarbons and carbon monoxide. As a result, the existing levels of oxides of sulphur and nitrogen and the criteria air pollutants of gaseous origin are expected to be low. Particulate matter remains the main component of the airborne material in the ambient air.

Table A3-5
Mean Dust Deposition Rates
September 1997 to May 2000

Site	Deposition Rate (g/m^2/month)				No. of Measurements
	Water Insoluble		Ash Fraction		
	Mean	Std. Dev.	Mean	Std. Dev.	
FD1	1.05	(0.86)	62%	(19.7%)	30
FD4	1.01	(0.85)	69%	(21.3%)	32
FD5	1.35	(1.78)	64%	(22.7%)	32

A3.6 ACOUSTICS

Acoustic studies have been conducted for the Project by Richard Heggie Associates (2000) (Appendix K). A major component of the acoustic studies is the determination of existing background or ambient noise levels of the MPF site and surrounds.

To characterise and quantify the existing acoustical environment, ambient noise surveys using unattended loggers were initially conducted in November 1999. To supplement these measurements and to assist in identifying the character and duration of ambient noise sources, operator-attended surveys were also conducted throughout the measurement period. The location of the background noise monitoring sites is presented in Figure A3-1.

To quantify prevailing meteorological conditions throughout the ambient noise monitoring surveys, an automatic weather station was installed at the MPF site. The automatic weather monitor was configured to continuously record a number of parameters such as wind speed, wind direction, rainfall, air temperature and relative humidity. The noise levels recorded during periods of any rainfall and/or wind speeds in excess of 5 metres per second (m/s) were discarded.

Noise levels are expressed as A-weighted decibels (dBA). This system simulates the response of the human ear, which is more sensitive to high frequency sounds and de-emphasises lower frequency sounds. The A-weighting also expresses noise levels on a consistent scale enabling the assessment of cumulative levels. Table A3-6 provides information on common noise sources for comparative reference.

Hearing "nuisance" for most people begins at noise levels of about 70 dBA, while sustained noise levels of 85 dBA (ie. 8 hours) can cause hearing damage.

Measured or predicted noise levels are expressed as statistical noise exceedance levels (L_{AN}) which are the levels exceeded for a specified percentage of the interval period. For example, L_{A90} refers to the noise level that is exceeded for 90% of the sampling period and is referred to as the average minimum, or background noise level. L_{A10} is the noise level that is exceeded for 10% of the sampling period and is considered to be the average maximum noise level.

Table A3-6
Relative Scale of Various Noise Sources and Effect on People

Noise Level (dBA)	Relative Loudness	Common Indoor Noise Levels	Common Outdoor Noise Levels
110 – 130	Extremely noisy	Rock band	Jet flyover at 1,000 m
100	Very noisy	Inside subway train	Petrol engine lawn mower at 1 m
90	Very noisy	Food blender at 1 m	Diesel truck at 15 m
90	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 area 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	-
10-0	Silent	Threshold of hearing	-

Source: Modified from US Dept. Interior, Robinson Project EA (1994) and Richard Heggie Associates (1995)
*Reference level – 70 dBA

L_{Aeq} is the equivalent continuous sound pressure level and refers to the steady sound level, which is equal in energy to the fluctuating level over the interval period.

A3.6.1 Background Noise Monitoring

A summary of the results of the background noise surveys are given in Table A3-7.

Review of the data presented in Table A3-7 indicates that the background $L_{A90(15minute)}$ noise levels at the various monitoring locations ranged from 31 dBA to 35 dBA during daytime, 28 dBA to 36 dBA during evening and 26 dBA to 30 dBA during night-time. The measured background noise levels are typical of those of a rural environment with little transportation noise and no industrial noise sources.

At each monitoring location, night-time operator-attended noise surveys of 15 minutes duration were conducted during the deployment and collection of the noise loggers. The operator-attended noise measurement results confirm the results obtained with unattended noise loggers and support the use of the noise levels in being representative of the background noise environment at the various residences in the vicinity of the MPF site. The operator-attended noise measurements are presented in Appendix K

A3.7 ABORIGINAL HERITAGE

Assessment of the Aboriginal heritage of the MPF site has been undertaken by Archaeological Surveys and Reports (2000) with the report presented as Appendix L to this EIS.

The assessment was undertaken with the assistance of a representative of the Condobolin Local Aboriginal Land Council (LALC) (September 1997 survey) and the Wiradjuri Regional Aboriginal Land Council (RALC) (December 1999 and April 2000 survey). This section summarises the findings of Appendix L relevant to the MPF site.

The majority of the MPF site has been subject to alteration and disturbance through landuse practices.

There are few references to the first contact between the non-indigenous settlers and the indigenous occupants of the region. Available publications relating the history of the Condobolin area suggest that the first settlers arrived in the early 1890s (Appendix L).

The Condobolin/Fifield area was part of Wiradjuri (sometimes 'Warradgerry') country when the first settlers took up land along the Lachlan in the 1830s. Craze and Marriott (1988) suggest that the Wiradjuri numbered between 1,000 and 1,500.

The Wiradjuri occupied a large area extending from the Murray River in the south to between the Lachlan and Macquarie Rivers in the north-west, and east as far as the highlands near Mudgee and Bathurst. By 1853 the Wiradjuri population had contracted from a widely scattered population of numerous small tribes constantly on the move, to a few concentrated groups camping near major watercourses.

Table A3-7
Summary of Background $L_{A90(15minute)}$ Noise Levels

Monitoring Locations (Figure A3-1)	MPF Site $L_{A90(15minute)}$ Rating Background Noise Level		
	Daytime 0700-1800 hrs	Evening 1800-2200 hrs	Night-time 2200-0700 hrs
BG1 "Wanda Bye"	34	36	28
BG2 "Sunrise"	35	35	28
BG3 "Currajong Park"	35	28	27
BG4 "Warra Wandi"	31	34	30
BG7 Cnr Slee Street, Fifield	31	29	26

Note: The L_{A90} represents the level exceeded for 90% of the interval period and is referred to as the average minimum or background noise level.

A3.7.1 Survey Area

The MPF site was surveyed in two parts as shown on Figure A3-8. The north-eastern corner of the proposed MPF site has been significantly altered by historic open cut magnesite mines, mullock heaps and service roads. In the remaining northern half and central section of the MPF site vast areas were cleared in the early 1970s, and have been under cereal crops since then. Impacts to the southern and south-eastern sections are less apparent, but clearly show that vast areas have been cleared in pasture improvement. In the south-western corner there are pits and mullock heaps that probably date from the brief early phase of small-scale gold mining activity in the 1890s and later (Cook and Garvey, 1999).

A3.7.2 Survey Results

A search of the NSW NPWS Aboriginal Sites Register found that no sites have previously been recorded in the MPF site.

Artefacts were found in three locations in the MPF site. Sites 1 and 2 were found adjacent to the main drainage line (Figure A3-8). Site 3 was found adjacent to a drainage depression that feeds into a farm dam in the southern portion of the MPF site (Figure A3-8).

As well as the artefacts a scarred tree was observed beside the Fifield to Wilmatha Road (Figure A3-8). There are no clear marks to indicate whether the bark was removed by a steel or stone axe. However, as the shape of the scar appears to be that typically identified with ‘shield scars’, it has been recorded as an Aboriginal site.

A summary of the findings of the survey is presented below. Photographs of three of the sites are presented in Appendix L.

Site 1

An isolated flake of milky white quartz, on an eroded surface in an area of mixed regrowth of cypress pine and eucalypt, immediately to the south of the central drainage line.

Site 2

An open scatter and possible knapping floor of 7 artefacts, on an actively eroding track and stock-entry point, on the northern bank of the central drainage line.

All artefacts were flakes, one of orange volcanic material, one of dark indurated sandstone, two of dark brown chert, one of brown chert, one of grey-brown chert, and one of brown chert with a quartz band.

Site 3

An isolated flake of brown/red vitreous volcanic material, in an actively eroding area, in a partially cleared area, adjacent to a drainage depression. This site is within a short distance of gold mine workings (to the south-east).

Scarred Tree

Scarred tree beside the Fifield to Wilmatha Road.

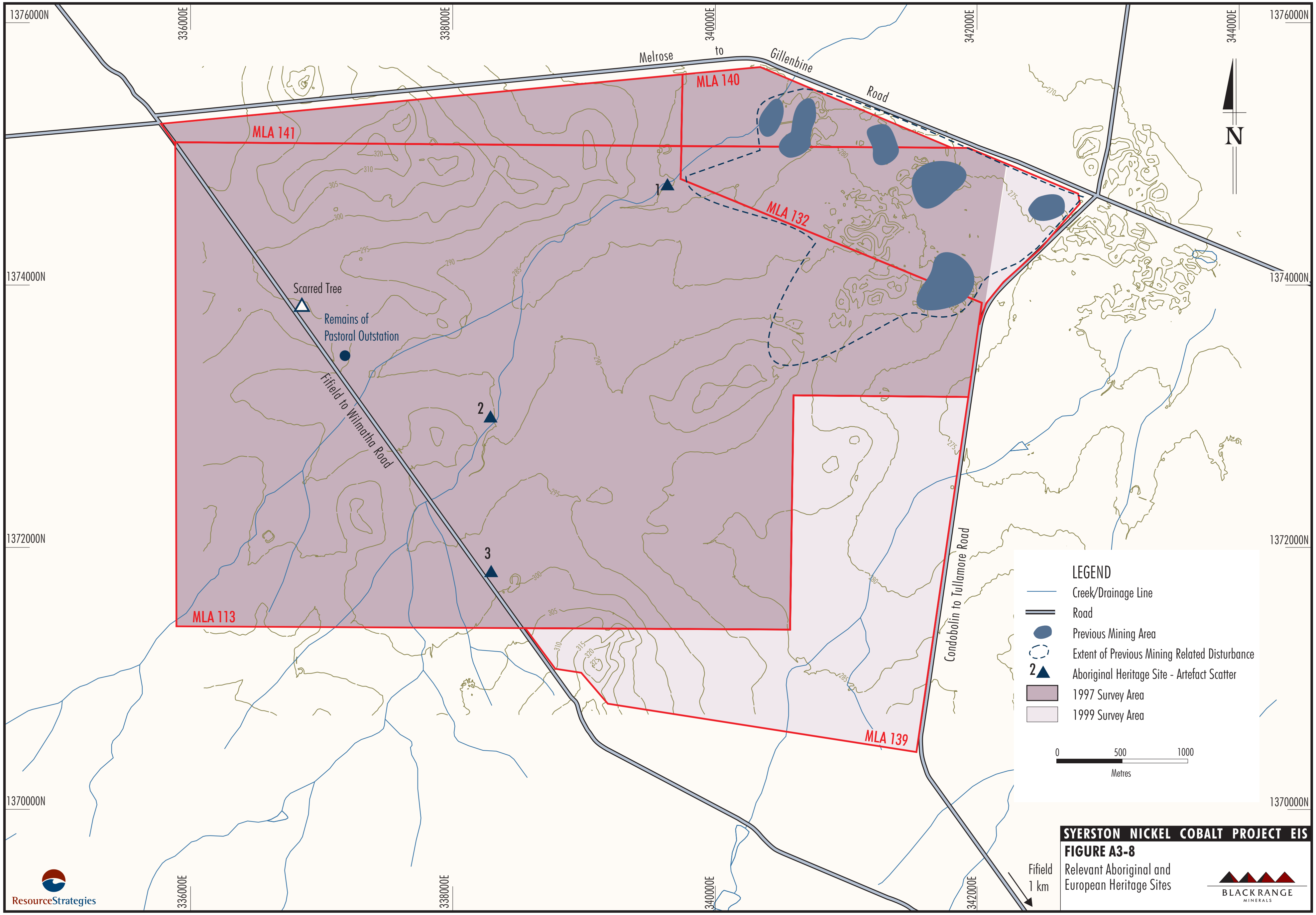
Of the four sites the scatter at Site 2 and the scarred tree are the only two that provide useful information that Aboriginal people were occupying the area. Although the scarred tree is of uncertain origin, the scatter at Site 2 indicates that this was a knapping site, if not a camp site. The other two isolated artefacts (Sites 1 and 3) indicate that Aboriginal people used the area, but the two artefacts were probably discarded or dropped in transit, and do not represent identifiable activities or functions of the findspots associated with the artefacts.

A3.8 EUROPEAN HERITAGE

An assessment of European heritage for the Project was undertaken by Heritage Management Consultants (2000) and is reported in Appendix M of this EIS. This assessment addressed exploration, settlement and mining in the area surrounding the MPF site along with impacts of the proposed development.

Assessment of the heritage values of the site has been undertaken within the criteria framework established by the Heritage Office of NSW (Appendix M).

John Oxley’s party undertook the first European exploration of the area, and passed south of Fifield and probably north of Trundle in 1817. There are no early descriptions or events identified relating to exploration occurring within the various areas affected by the Project.



SYERSTON NICKEL COBALT PROJECT EIS

FIGURE A3-8

Relevant Aboriginal and European Heritage Sites

BRM-98-01-Pt A-S3_006F

Pastoral settlement of the Condobolin area began in 1844 with the town being gazetted in 1859. Initial settlement of the Trundle area was based on grazing and utilised the water supply in Trundle Lagoon. After the arrival of the railway in 1907, the area was opened up for wheat growing.

The Fifield area has a strong mining history with intermittent prospecting for alluvial gold and platinum being in the two decades prior to the Fifield platinum discovery in 1893 by Messrs Fifield, Rand and Party of rich alluvial gold near the site of the present village of Fifield.

The Fifield Platinum Field was Australia's first significant producer of platinum with the field being worked from its discovery in 1897.

In 1874 tin deposits were discovered north-west of Fifield and gold west of Trundle. Magnesite was discovered in the early 1900s north of Fifield with the area still being mined in the 1980s. Fifield was one of Australia's major sources of magnesite.

The Lachlan Shire Local Environmental Plan (LEP) lists heritage items of local, regional or state significance within the shire, however at present, the Lachlan Shire LEP has no heritage items of local, regional or state significance within the Project area, listed.

Places of importance at the State level can be entered in the NSW Heritage Register. At present no place in the Lachlan Shire is entered in the Heritage Register, and no places identified in the survey (Appendix M) would have sufficient significance to be registered.

The *Heritage Act, 1977* also provides protection for historical artefacts which relate to the European settlement of the area which is 50 or more years old. No items demonstrably older than 50 years have been identified on the MPF site.

A3.8.1 Surveys and Assessment

The northern section of the MPF site has been disturbed by historical magnesite mining (Figure A3-8). The mining disturbance consists of open-cut pits with associated overburden mounds and areas of scraped land. These features have been rehabilitated by surface sculpting and revegetation.

A small amount of material from the processing plant remains on-site but is not sufficiently intact to be of heritage importance. The historical mining area is assessed as being of local significance, but degraded.

On the western boundary of the MPF site are located the remains of a number of buildings (Figure A3-8). These building remains are divided into two clusters, which are assumed to have been connected in their use. The northern section consists of a collapsed building with a verandah which may have been a bunk house/quarters. Thirty metres to the south are what are interpreted as being a loading ramp, engine mounting and stumps for a small shed. To the east is a standing building housing a single pan toilet. A rural dam is located 40 m south-east of this site. The southern section of the site is located approximately 30 m to the south-east of the dam, and consists of a small ruined two-stand woolshed. These buildings and yards are interpreted as being a post-1958 pastoral outstation for small-scale shearing operations. This site is locally significant in this context.

A3.9 COMMUNITY INFRASTRUCTURE AND SOCIAL ASSESSMENT

A community infrastructure and social impact assessment has been prepared for the Project by Martin and Associates (2000) (Appendix G). The study focus was to assess sub-regional housing and infrastructure issues associated with the proposed workforce. A summary of the study in relation to the background social environment is provided below.

A3.9.1 Demographic Profile

Regional Population Trends

Table A3-8 summarises the trend in estimated residential populations of the local government areas of Parkes, Lachlan and Forbes from 1986 to 2011.

Growth in the sub-region over the past 20 years has been variable with Parkes Shire experiencing considerable growth in the 1990s, while growth was steady in other urban areas. The surrounding rural areas have experienced periods of decline over the same period.

Table A3-8
Estimated Resident Population of Study Area 1986 – 1996
and Projections to 2001, 2006 and 2011

Shire	Area (km^2)	Estimated Resident Population					
		1986	**1991**	**1996**	**2001**	**2006**	**2011**
Parkes Shire	5,919	14,047	13,936	15,064	15,366	15,875	16,383
Lachlan Shire	14,965	8,040	7,687	7,425	7,102	6,795	6,487
Forbes Shire	4,717	10,500	10,351	10,138	9,925	9,712	9,499
Total Study Area	**25,601**	**32,587**	**31,974**	**32,627**	**32,393**	**32,381**	**32,369**

Source: Australian Bureau of Statistics Census Data (1996) in Martin and Associates (2000)

The total population of the study area in 1991 was 31,974 and 32,627 in 1996. Baseline population projections indicate that without the Project the population would continue to decrease slightly to 32,393 by 2001 and be virtually stable after this point to 2011.

Contrary to this overall trend is Parkes Shire, which has shown buoyant growth since the early 1990s due to mining and a general diversification of its economy into agricultural processing and transport and mining services. Substantial growth in the diversification of the Parkes economy could offset declines in the other two local government areas leading to an overall net increase in population.

A3.9.2 Age of the Population

The general similarity in the population of the three local government areas (Parkes, Lachlan and Forbes) is apparent with the median age only ranging from 34 to 35 years. The only noteworthy difference is the larger proportion of young adults and teenagers in Forbes. This could be explained by the presence of the Red Bend Catholic College which has a substantial boarding school population. Parkes also has a significantly higher median household income, indicating a higher proportion of families with two incomes.

A3.9.3 Employment Profile

Unemployment in the region had been approximately the same as the NSW level up until 1996 but since then the level has consistently been below the State level. The regional labour market unemployment data is summarised in Table A3-9 (Appendix G).

Employment data suggests that the local labour market is becoming restricted for semi-skilled and skilled workers.

A3.9.4 Housing and Community Infrastructure

Housing

A breakdown of dwellings by type in Parkes, Lachlan and Forbes Shires as calculated in the 1996 census, is presented in Table A3-10.

Permanent housing and residential construction in the township of Parkes experienced a short term boom associated with the construction stage of the North Parkes Mine which lasted for around 18 months in 1993/94. Since 1993/94 when there were over 130 residential building applications the number of applications have gradually returned to the pre-mining level of activity with between 70-100 building applications being received per year. Rural residential blocks are limited in the Parkes Shire and are only presently available to the south of the town.

In Condobolin, the housing stock available is significantly lower than in Parkes. Building applications for residential construction are currently running at around 20-25 per year.

Trundle and Tullamore in Parkes Shire, have some land available in the villages that is zoned for housing but both towns are severely restricted in growth potential due to the lack of a reliable water supply.

Fifield village has a very small population (less than 20 people). This village is severely restricted in growth potential due to its relative isolation and the high cost of the provision of services.

Table A3-9
Rate of Unemployment (%) by Local Government Area

Shire	Unemployment Rate (%)						
	Mar-97	**Mar-98**	**Mar-99**	**Jun-99**	**Sep-99**	**Dec-99**	**Mar-00**
Forbes	6.2	5.8	6.2	4.8	5.6	4.7	5.1
Lachlan	7.1	6.1	6.6	5.1	5.8	4.6	5.3
Parkes	8.4	7.5	7.5	5.5	6.4	5.5	6.1
Total Study Area	**7.2**	**6.5**	**6.8**	**5.1**	**5.9**	**4.9**	**5.5**

Source: Australian Bureau of Statistics Census Data (1996) in Martin and Associates (2000)

Table A3-10
Housing Stock in the Study Area (1996)

Type	Parkes Shire		Lachlan Shire		Forbes Shire	
	Occupied Dwellings	**Unoccupied Dwellings**	**Occupied Dwellings**	**Unoccupied Dwellings**	**Occupied Dwellings**	**Unoccupied Dwellings**
House	4,831	406	2,439	603	3,539	355
Townhouse	81	7	13	3	84	9
Flat	383	41	119	39	232	35
Caravan	110	3	37	4	70	0
Other	325	11	154	67	280	49
Total	**5,730**	**468**	**2,762**	**716**	**4,205**	**448**

Source: Australian Bureau of Statistics Census Data (1996) in Martin and Associates (2000)

Short Term Accommodation

The short term accommodation available in the Project area includes serviced apartments, rental houses, motels and hotels.

Consultation with real estate agents found that there was a mini-boom in demand for accommodation during the North Parkes Mine construction period (1993/94), particularly for rental houses and serviced apartments in Parkes. During the peak construction period rental accommodation was very tight and dropped below a vacancy rate of 2%. Since the end of the construction period the vacancy rates have returned to normal levels with considerable excess capacity for sale and rent.

Community Infrastructure

The Parkes health service incorporates the Parkes District Hospital and a Community Health Centre. The hospital has 63 beds and provides a broad range of district hospital services supported by visiting medical services. The Lachlan Health Services Plan indicates that there is an oversupply of acute hospital beds.

Condobolin has a district hospital which was reported by the hospital manager to have an excess of acute hospital beds. The hospital is supported by visiting services form Parkes, Forbes and Orange with urgent or higher risk patients generally evacuated to either Parkes or Orange, and occasionally Sydney. There is a separate Aboriginal Health Centre in the main street of the town which provides women's nursing, mental health workers and an alcohol worker.

The region has a range of kindergartens, government and non-government primary and secondary schools. The Red Bend Catholic College in Forbes provides the main private secondary school in the study area.

Other community facilities and services in Parkes are extensive and include child care facilities (including long day care, kindergarten and family day care), family services, youth services, aged and disabled services, public libraries and theatres. Non-government organisations and the private sector provide many of the services. The level and standard of facilities varies significantly throughout the shire.

The smaller settlements do not have the range of services that are provided in Parkes but the informal sector is more active in the villages in supporting needy social groups. There is a wide range of recreation available including active and passive opportunities in Parkes.

Condobolin is a much smaller centre than Parkes but still provides a reasonable range of facilities and services for a town of this size. Child care services include a pre-school kindergarten and there is a family day care scheme operating. There is a library and aged care services. There are also family support, alcohol and drug services and women's services including crisis accommodation and domestic violence services. Active recreation is very well catered for with many sporting clubs.

A3.10 BENEFIT COST ANALYSIS AND REGIONAL ECONOMIC ASSESSMENT

A benefit cost analysis and regional economic impact assessment has been prepared for the Project by Gillespie Economics (2000) (Appendix H). The report provides an overview of the Central West regional economy, a regional economic impact analysis considering the likely economic contribution of the Project to the region and a benefit cost analysis considering the economic efficiency of the Project.

A3.10.1 Central West Economic Overview

The economic assessment is based on 1995/96 input-output analysis for the Central West Statistical Division of NSW. Statistical Local Areas included in this region are Blayney, Cabonne, Evans, Orange, Greater Lithgow, Oberon, Rylstone, Bland, Cowra, Forbes, Lachlan, Parkes and Weddin.

Consideration is also given to the potential impacts on small towns in the immediate vicinity of the Project such as Tullamore, Fifield, Trundle, Ootha and Condobolin.

In 1995/96 the Gross Regional Product (GRP) for Central West economy was $3,448 million (M) that included $1,883M paid to households as wages and salaries (including imputed payments to self-employed and employers) and $1,565M in Other Value Added contributions. The employment total for the Central West economy was 69,013 with average wage and salary earned being $27,000 per person.

The comparative contribution of various industries to the GRP, employment and export earnings for the Central West are presented in Table A3-11.

A comparison with NSW data reveals that in the Central West economy, agriculture/forestry/fishing, mining, utilities are of greater relative importance than they are to the NSW economy, while services are of less relative importance. The relative importance of manufacturing and building are similar in the Central West to NSW.

The Central West region imports ($2,476M) a slightly greater value of goods and services than it exports ($1,976M). A majority of exports relate to the manufacturing, mining and agriculture/ forest/fishing sector with the contribution of each of these sectors to exports being 44%, 20% and 24% respectively.

Table A3-11
Contributions to Gross Regional Product, Employment and Exports by the Industry Sector of the Central West 1995/96

Sector	Percentage of Total Employment	Percentage Contribution to GRP	Percentage Contribution to Exports
Agriculture/Forestry and Fishing	15	11	24
Mining	3	9	20
Manufacturing	12	13	44
Utilities	2	6	7
Building	5	4	0
Services	63	51	5

Source: Powell *et al.* (1999) in Gillespie Economics (2000)

As is the case with most regions, the largest import items are goods for consumption by local households (ie. 27% of all imports). However, there are also significant imports to the services and manufacturing sectors. Expenditure on capital items represented 15.7% of imports.

Household expenditure was $2,706M. This is 78% of the GRP of $3,448M and more than the payments to households as wages and salaries. A number of factors potentially contribute to this including a high proportion of non-working dependents (such as retirees), a high level of social welfare recipients, the earnings from investments and a likely significant "informal" economy. These factors enable regional households to spend much more on consumption expenditure than they earn from wage and salary employment (Powell *et al*., 1999).

In terms of output, food manufacturing is the most significant industry sector in the regional economy, followed by retail trade and property services. The greatest sectoral contribution to regional value added are from coal mining, food manufacturing, utilities, retail trade transport, property services, education and health.

In terms of employment the tertiary sectors contribute the greatest level reflecting their labour intensive nature. In terms of wages to households the tertiary sectors again are substantial contributors. The majority of exports from the region are in the agriculture, mining and manufacturing sectors while imports are more evenly spread across sectors.

The mining sectors are also one of the most productive sectors of the Central West economy (as measured through GRP per employee) and has the highest average wage of all the economy sectors.

Section A4.12 and Appendix H provides a discussion of the potential economic impacts of the Project.

A3.11 TRANSPORT

The transport assessment conducted by Masson Wilson Twiney (2000) addresses the potential impacts of the Project on the local and regional traffic network (Appendix C). This section provides a summary description of the existing transport system.

A3.11.1 Road Network and Traffic

The road system in the vicinity of the MPF site is shown on Figure A3-9. Roads that would potentially be used by traffic generated by the Project are described below.

State Route 90 connects Parkes and Condobolin through Bogan Gate and Ootha. The road has one lane in each direction and travels through flat terrain with overtaking generally allowed.

The Tullamore to Bogan Gate Road (MR 350) from Bogan Gate to Tullamore intersects with State Route 90 at a cross intersection in Bogan Gate with priority to traffic on State Route 90. It has a two lane sealed carriageway.

The Middle Trundle Road (SR 83) runs north-west from State Route 90 to intersect with the Tullamore to Bogan Gate Road just south of Trundle. This road provides a route which is just under 10 km shorter between Parkes and Trundle than the route which travels through Bogan Gate.

The Fifield to Trundle Road (SR 64) intersects with the road from Bogan Gate to Tullamore some 6 km north of Trundle. At the western end of the road, it intersects with the Condobolin to Tullamore Road.

The Condobolin to Tullamore Road (MR 57 North) runs north from State Route 90, east of Condobolin, though Fifield and Tullamore.

The Melrose to Gillenbine Road (SR 44) runs east-west along the northern boundary of the MPF site. It intersects with the Condobolin to Tullamore Road at a cross intersection. It is an unpaved road which is generally straight and through flat terrain. It continues west from the site and intersects with the Springvale Road (SR 60).

The Fifield to Wilmatha Road (SR 34) runs north from Fifield, through the MPF site and intersects with the Melrose to Gillenbine Road at a cross intersection. It is an unpaved road which is generally straight and through flat terrain.

The Springvale Road (SR 60) is a sealed road and is generally straight and runs through flat terrain.

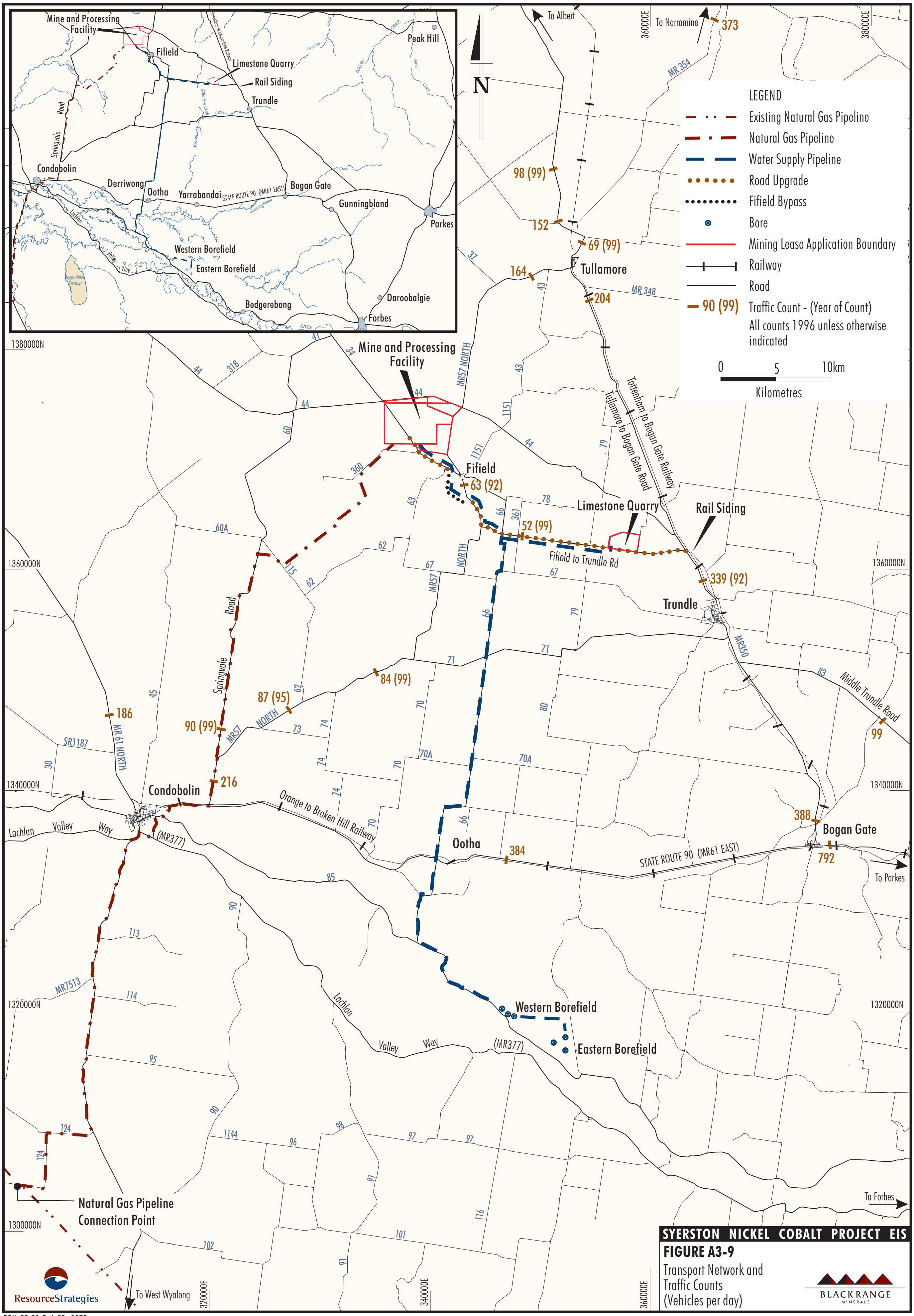


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FIGURE A3-9

Transport Network and Traffic Counts (Vehicles per day)

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A3.11.2 Existing Traffic Flows

Figure A3-9 indicates daily traffic volumes on roads most likely to be affected by the Project. The traffic counts are generally very low as would be expected on essentially local rural access roads.

Table A3-12 below summarises daily traffic volumes on roads leading to and from the MPF site. Proportions of heavy (large rigid vehicles and articulated) vehicles are also indicated. The location and date of the counts are shown on Figure A3-9. The "Quality of Service" is also given in Table A3-12 based on the assessment criteria detailed in Appendix C. Quality of Service relates daily traffic volumes to the standard of the road in order to give an indication of the driver's experience.

Table A3-12 indicates that the roads which are sealed in the vicinity of the MPF site and the principal ones leading to and from it presently exhibit 'Good' operating conditions. Those roads which are unsealed presently exhibit 'Fair' or 'Poor' operating conditions.

Traffic volumes tend to vary throughout the day resulting in varying traffic conditions. It is therefore appropriate to also examine the operation of roads during peak traffic flows in terms of capacity.

Table A3-13 presents indicative peak hour traffic flows for the MPF site's principal access routes.

The AUSTROADS (1998) guide defines the theoretical capacity of a two lane two way road (ie. single stream of traffic in each direction) under ideal conditions as 2,800 vehicles per hour. Table A3-13 indicates that peak hourly traffic flows are very low in comparison. This suggests that there are no road capacity issues relating to the existing road system and traffic volumes (Appendix C). The quality of service on the roads is therefore the governing factor in assessing the operation of the existing road system.

The potential impacts of the Project on the local and regional road transport system are presented in Section A4.13.

Table A3-12
Existing Daily Traffic Volumes and Quality of Traffic Service Assessment

Road	Location (Year of Count)	Daily Traffic Flow	Percent Heavy Vehicles	Carriageway Description	Quality of Service
State Route 90	East of Bogan Gate (96)	792	-	Two lane seal	Good
MR 350	Bogan Gate to Trundle (96)	388	-	Two lane seal	Good
MR 350	North of Trundle (92)	339	-	Two lane seal	Good
SR 83	East of MR 350 (96)	99	-	Gravel(1) two lane seal	Fair/good
SR 64	East of MR 57 North (99)	52	17.1%	One lane seal	Good
MR 57 North	North of State Route 90 (96)	216	-	Two lane seal	Good
MR 57 North	North-east of SR 60 (95)	87	10.6%	Gravel	Fair
MR 57 North	South of Fifield (92)	63	-	Two lane seal	Good
SR 44	East of SR 60(2)	90	-	Gravel	Fair(2)
SR 34	South of SR 44(2)	90	-	Gravel	Fair(2)
SR 60	North of MR 57 North (99)	90	12.6%	Two lane seal	Good
MR 57 North	South of Tullamore (96)	164	-	Gravel(3) two lane seal	Poor/good
MR 57 North	North of Tullamore (96)	98	17.4%	Gravel	Fair

Source: Traffic Counts by Lachlan and Parkes Shire Councils and RTA
(1) Fair on gravel sections, good on sealed section
(2) No traffic data available, assumes similar volumes to SR60 for worst case
(3) Poor on gravel sections, good on sealed section

Table A3-13
Existing Peak Hour Flows

Road	Location	AM Peak (vehicles/hour)	PM Peak (vehicles/hour)
State Route 90	East of Bogan Gate	57	86
MR 350	Bogan Gate to Trundle	28	42
MR 350	North of Trundle	24	37
SR 83	East of MR 350	7	11
SR 64	East of MR 57 North	4	6
MR 57 North	North of SR 90	16	24
MR 57 North	North-east of SR 60	6	10
MR 57 North	South of Fifield	5	7
MR 57 North	South of Tullamore	12	18
SR 44	East of SR 60[(1)]	6	10
SR 60	North of MR 57 North	6	10

Source: Masson Wilson Twiney (2000)
[(1)] No traffic data available, assumes similar volumes to SR60 for worst case

SECTION A4 - POTENTIAL IMPACTS AND MITIGATION MEASURES

MINE AND PROCESSING FACILITY

PREPARED BY
RESOURCE STRATEGIES PTY LTD

OCTOBER 2000
Project No. BRM-01\2.3
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A4 POTENTIAL IMPACTS AND MITIGATION MEASURES

This section describes the potential environmental, social and economic impacts and impact mitigation requirements for the Project MPF site. Descriptions of potential impacts and mitigation measures associated with Project components external to the MPF site are presented within Parts B and C of this EIS.

Sections A4.11 and A4.12 discuss the potential impacts and mitigation measures in relation to the Project on a whole-of-project basis. This is appropriate as the community infrastructure, social and economic effects are whole-of-project driven.

A4.1 LAND RESOURCES

Section A3.1 provides a description of land resources within the MPF site and surrounds. In relation to land resources, the development of the MPF site has the potential to create changes in:

- topography and landscape features;
- soil quality and erosion potential;
- landuse;
- land contamination status; and
- bushfire hazard.

These aspects are discussed in the following sections.

A4.1.1 Topography and Landscape Features

Potential Impacts

The development of the MPF site would require modification of the existing topography. The open pits, waste emplacements, TSF and water management structures are permanent features which, once rehabilitated, would form part of a new final landform.

The principal modifications to existing topography within the MPF site relate to the construction/establishment of the following items (Figures A2-2 to A2-5):

- TSF;
- evaporation ponds and surge dam;
- waste emplacements;
- eastern and western open pits;
- hardstand areas for various mining infrastructure components;
- erosion and sediment control features; and
- surface water management structures.

The TSF would change existing topography through the construction of perimeter embankments ranging from approximately 10 m (in the south-west corner of the southern cell) to a maximum height of approximately 30 m (in the north-east corner of the northern cell) above the existing topography. At the cessation of mining the TSF would comprise a rehabilitated area of approximately 220 ha (Section A5) and would create a permanent landscape change.

The evaporation ponds and surge dam are water storages located in the south-eastern and eastern portions of the MPF site (Figure A2-5). The evaporation ponds would be low-set terraced structures with perimeter embankments in the order of 3 m in height above the existing ground surface. On the completion of mining activities these ponds would have their embankments reprofiled (rounded/flattened) and would be rehabilitated to the target end landuse of grazing pastures (Section A5). Post-mining, the evaporation ponds would not be considered to be a significant change in the existing MPF site topography or landscape.

The evaporation surge dam would be a conventional valley-type dam with an embankment in the order of 8 m in height above the existing ground surface. The evaporation surge dam external embankment batter would be revegetated at the completion of construction. The evaporation surge dam would potentially remain as water storage for stock watering (Section A5.3) and would constitute a permanent change to the existing MPF site topography but not be inconsistent with the surrounding landscape.

The western and eastern waste emplacements would form elevated landforms across the northern and north-eastern boundaries of the MPF site (Figure A2-5). Placement of the estimated 125 Mt of mine waste material in these emplacements would significantly change the existing topography of these portions of the MPF site. Both waste emplacements would have final top surfaces up to approximately 30 m above the existing ground surface, comprising a total rehabilitated area of approximately 400 ha.

Development of the eastern and western open pits would comprise a significant change to the existing topography and landscape. Subject to the development and finalisation of final rehabilitation concepts (Section A5.3) the open pits would remain as permanent voids with selective revegetation across portions of their bases and internal batters. The eastern and western pits would cover a total area of approximately 415 ha with depths generally less than 50 m and a maximum depth of approximately 65 m.

Due to the gently sloping nature of the MPF site topography, the development of hardstands as infrastructure areas as well as temporary erosion and sediment control structures would not be a significant change in topography. At the completion of mining activities, these areas would be revegetated to the target end landuse of grazing pastures.

As described in Section A2.11, as part of the water management system for the MPF site, the northern, southern and evaporation surge dam diversion channels would be developed. These and other minor channels would modify flow paths within the site.

Mitigation Measures

Progressive rehabilitation would be used to integrate constructed landforms with the surrounding landscape. Rehabilitation strategies and final landuse/landform proposals are detailed in Section A5. The location and final shape of the waste emplacements, TSF and evaporation ponds are designed to integrate with local topographical features, wherever possible, including:

- terracing of the evaporation ponds to minimise embankment heights;
- terracing of the evaporation surge dam storage area to minimise internal partitioning embankment heights;
- broad low-set waste emplacements along catchment divides;
- progressive rehabilitation of the TSF external batters on the completion of each embankment lift;
- revegetated areas to be contiguous with areas of preserved woodland wherever possible; and
- revegetated external batters of the waste emplacements and TSF to have an overall gradient of 1V:4H.

Section A4.2 discusses additional measures for mitigating potential impacts of the MPF on the landscape visual character.

A4.1.2 Soils and Erosion Potential

A description of the soils of the MPF site is presented in Appendix O and summarised in Section A3.1. As illustrated on Figure A3-4, a survey of the MPF site identified the two main soil types of red earths and lithosols.

Potential Impacts

Potential impacts of the MPF on soils relate primarily to:

- loss of *in situ* soil resources from beneath mine landforms (ie. soil material not pre-stripped during construction of landforms);
- alteration of physical and chemical soil properties during stripping and stockpiling operations;
- reduced soil quality (structure, fertility and microbial activity) of long term stockpiles;
- contamination of soil with process waters, reagents or chemicals;
- erosion of soil from the outer batters of waste emplacements and tailings storages, the verges of access and haul roads and areas in which vegetation has been cleared or water is concentrated; and
- erosion of stockpiled soil.

Mitigation Measures

An Integrated Erosion and Sediment Control Plan (IESCP) would be developed for the construction and operational phases of the MPF. The IESCP would describe how erosion and sedimentation would be controlled in disturbed areas by applying methodologies developed in consultation with the relevant Government agencies in the pre-construction phase.

The primary objectives of the IESCP would be to:

- control soil erosion and sediment generation from areas disturbed by the construction and operation of the MPF; and

- prevent the uncontrolled runoff of surface waters from disturbed areas to downstream watercourses.

Construction works would be sequenced to minimise the area of disturbance at any given time, in conjunction with the implementation of a progressive rehabilitation programme (Section A5). Specific mitigation measures to control soil erosion and sediment migration would include:

- review and approval of Construction Environmental Management Plans prepared prior to works;
- minimising disturbance during construction and operation of the MPF and restricting access to undisturbed areas;
- progressive rehabilitation/revegetation of MPF infrastructure areas at the earliest possible stage;
- minimising compaction during soil excavation and movement;
- use of erosion control features (eg. silt fences and temporary sediment traps, diversion banks, channels and rip-rap structures) to minimise sediment migration, divert surface water around disturbed areas and to control runoff velocity; and
- construction of collection drains, diversion drains and culverts to control surface runoff from roads.

In addition to the above, the following soil resource management strategies are proposed:

- formulation of soil stripping guidelines including nomination of appropriate depths, scheduling and locating areas to be stripped;
- storage of soil in a manner which maintains the long term viability of the resource;
- selective stockpiling of soil according to soil type (ie. great soil group, soil horizon); and
- segregation of recovered soil based on seed content (ie. endemic woodland, agricultural lands).

Soil stockpiles would be managed to ensure long term viability through implementation of the following management practices:

- stockpiles to be located outside proposed disturbance areas;
- stockpiles to be formed with a 'rough' surface to reduce erosion potential and promote revegetation; and
- stockpiles to be fertilised and seeded to maintain soil organic matter levels, soil structure and microbial activity.

Further detail with respect to the quantification of soil resources, stripping and re-application schedules and stockpiling inventories, would be included as part of the Mining Operations Plan (MOP) for the MPF. The preparation of a MOP is a regulatory requirement of the DMR. Further discussion on the IESCP and the MOP are contained in Section A6.

A4.1.3 Landuse

The MPF site is characterised by cleared, grazing and cropping land with areas of State Forest, Crown reserve and Crown land (Section A3.1).

Potential Impacts

The potential impact of the MPF on landuse would be the loss of existing landuse associated with the development of the following MPF components:

- TSF;
- evaporation ponds and surge dam;
- waste emplacements;
- open pits; and
- infrastructure areas.

Mitigation Measures

The rehabilitation objectives proposed for areas disturbed during the development of the MPF are for the end landuse of grazing and areas of endemic woodland (Section A5.1). Strategies for the management of weeds and feral species would be addressed in a Site Management Plan (SMP) as detailed in Section A6.

Significant areas of existing land degradation within the MPF site (associated with historic mining areas) (Figure A3-4) would be consumed by the progressively rehabilitated eastern waste emplacement and open pit. Section A5 describes rehabilitation concepts and objectives for the MPF site.

A4.1.4 Agricultural Suitability and Rural Land Capability

Section A3.1 and Appendix O describe the agricultural suitability and rural land capability classifications for the MPF site. Agricultural suitability classes for the MPF site consist of Classes 3, 4 and 5. Rural land capability Classes III, IV, VI and VII were recorded at the site.

Potential Impacts

Changes would occur to the existing agricultural suitability and rural land capability classes of land disturbed by mining activities (ie. waste emplacements, open pits, TSF, evaporation ponds and surge dam, processing plant and infrastructure areas, stockpiles and roads).

The agricultural suitability and rural land capability classes of areas within the MPF site (not disturbed by mining) would not change as a result of mining. However, the isolation of portions of these areas during the construction and operation of the MPF would result in the loss of land otherwise suitable for agricultural production.

Mitigation Measures

As discussed in Section A4.1.3, the rehabilitation and post-closure landuse objectives for rehabilitated areas within the MPF site are to provide for stable landforms revegetated to grazing pastures or endemic woodland (Section A5).

Management of areas undisturbed by mining within the MPF site would be detailed in the Site Management Plan (Section A6) to be prepared in consultation with relevant authorities and neighbouring landholders. The plan would detail strategies for the management of weeds and feral species, restoration of degraded areas and revegetation where necessary.

A4.1.5 Land Contamination Potential

The risk assessment study is detailed in Appendix B (SHE Pacific, 2000) and identifies sources of potential risk to the public and environment. The following section focuses on management issues related to the potential for land contamination within the MPF site.

Potential Impacts

Fuels and Oils

The accidental spillage of fuels and oils from storage and plant areas within the MPF has been identified as a key potential risk for land contamination.

Process Reagents

An outline of the main process reagents required for the operation of the MPF is presented in Section A2.6. Some reagents have the potential for land contamination in the event of an uncontrolled release. Details on the transport, storage and management of major process reagents are provided in Section A2.14.

Mitigation Measures

Fuels and Oils

Mitigation measures to prevent or reduce the potential for contamination of land from fuels and oils include:

- Carriers of potentially hazardous goods would be required to be appropriately licensed in accordance with the provisions of the *Australian Code for the Transport of Dangerous Goods by Road and Rail*.
- Carriers would be required to provide a communications system (eg. two-way radio or mobile telephone) in truck cabs to allow for prompt notification in the event of an accident.
- Appropriately sized bunds around fuel, oil and process reagent stores/stockpiles would be constructed (Section A4.3) with above ground installation of associated pipework to enable the containment of spills and detection of leaks.
- Where applicable, operation of storage areas would be in compliance with the requirements of the Australian Standard AS 1940-1993 – *The Storage and Handling of Flammable and Combustible Liquids*.

Process Reagents

Processing reagents would be stored and handled within bunded storage areas, in compliance with the relevant Australian Standards. Bunding would be designed to contain spill volumes equal to 110% of the volume of the largest tank within the bund or 10% of the total volume stored within the area.

Other features would include:

- removal of collected rainwater from bunded areas via the installation of drain valves and pipework or pumps where required;
- provision of a pump to transfer any chemical spills within bunded areas back to appropriate storage tanks or process tanks; and
- provision of fire protection facilities compatible with the volatility and flammable properties of stored reagents.

The tailings delivery pipeline associated with the TSF would be designed and constructed to contain spills from ruptures or breakages and would be monitored regularly (Section A4.3).

Evaporation Residues

Salts would be removed prior to rehabilitation and contaminated soils would be treated and disposed of in accordance with EPA requirements.

A4.1.6 Bushfire Hazard

A description of bushfire issues associated with the MPF site and surrounds is presented in Section A3.1. The potential bushfire hazards and associated mitigation measures are presented below.

Potential Impacts

Fires moving on or off the MPF site present potentially serious impacts to surrounding properties and to MPF personnel and equipment. The degree of potential impact would vary with climatic conditions (eg. temperature and wind) and the quantity of available fuel (eg. non-grazed pasture grasses and native forest).

Mitigation Measures

The extensive areas of managed pasture land surrounding the MPF site are expected to restrict the movement and magnitude of any bushfire.

Bushfire management procedures would be developed for the MPF site as part of the SMP, in consultation with local bushfire brigades and the Lachlan Shire Council. These procedures would include consideration for the use of an on-site fire tender and mine water trucks. An outline of the SMP is presented in Section A6.

During induction all MPF workers would undergo training in bushfire prevention and management strategies including:

- identifying construction and operational areas with fire potential;
- identifying surrounding areas with the potential to carry fire;
- appropriate and safe activities in fire-sensitive areas; and
- awareness of fire prevention and fighting protocols and procedures.

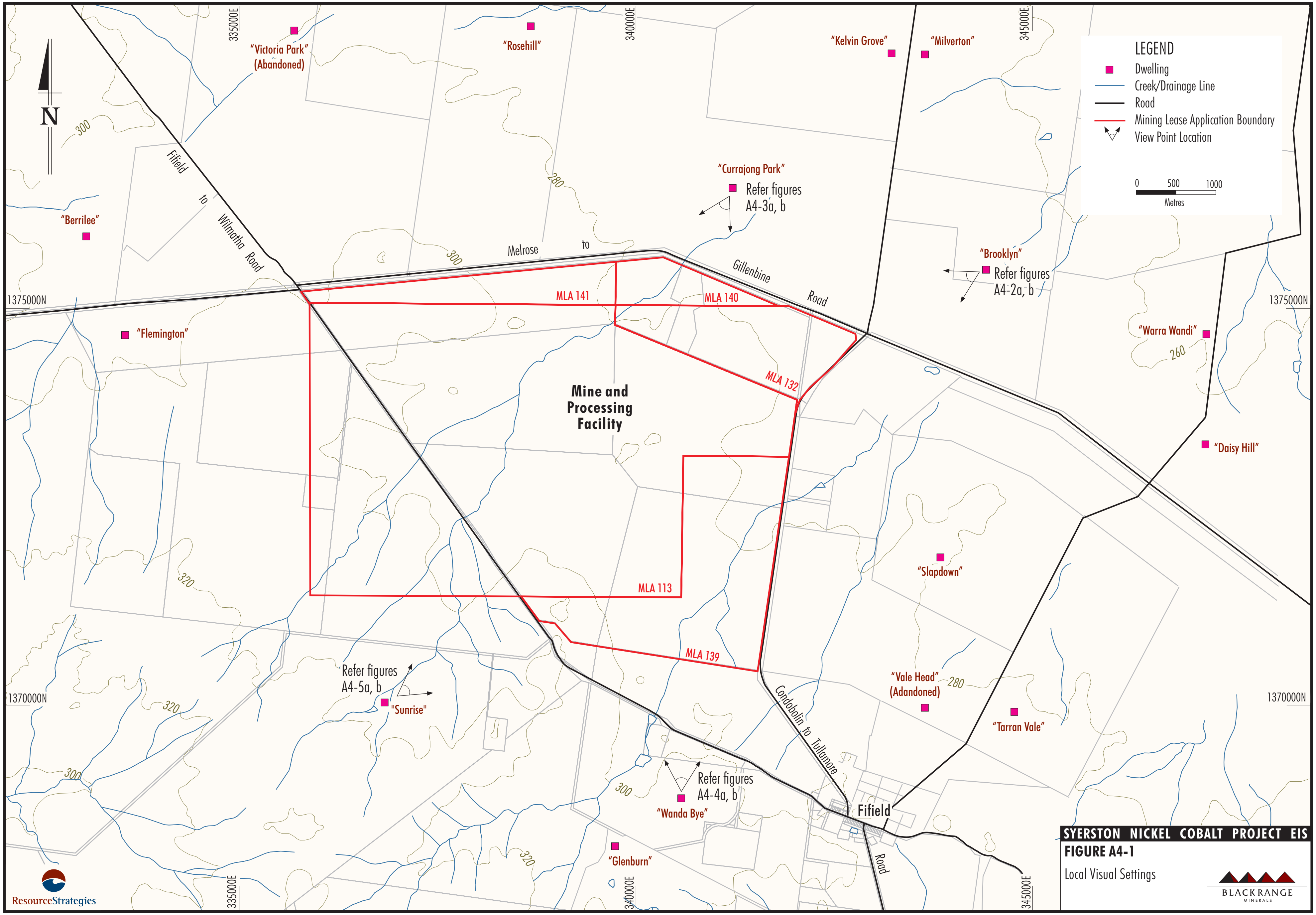
In addition to environmental responsibilities there exists significant economic incentive to prevent fire damage to the considerable investment in MPF infrastructure.

A4.2 VISUAL FEATURES

A description of the visual features of the MPF site and surrounds, the potential visual impacts of the MPF, and associated mitigation measures are presented in Appendix N. A summary of the existing visual character and landscape of the MPF site is presented in Section A3.1.

The visual impacts of the MPF are determined by the scale and massing of buildings and the degree of landscape change that is proposed, be it through altering vegetation patterns or substantial landform change. These changes are assessed based on views from adjoining properties or public access areas and the visual sensitivities (Appendix N).

Visual simulations from various point locations (Figure A4-1) around the MPF site provide existing and simulated views of MPF landforms during early (Year 5) and advanced stages (Year 20) (Figures A4-2 to A4-5). These simulations illustrate mitigation measures (eg. rehabilitation) to minimise potential visual impacts.



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Existing View

Simulated View Year 5 Eastern Waste Emplacement

SYERSTON NICKEL COBALT PROJECT EIS

FIGURE A4-2a

Views from "Brooklyn"
- Existing and Year 5

ResourceStrategies

BLACK RANGE MINERALS

BRM-98-01-PtA-S4_006A

Existing View

Simulated View Year 20 Eastern Waste Emplacement

SYERSTON NICKEL COBALT PROJECT EIS

FIGURE A4-2b

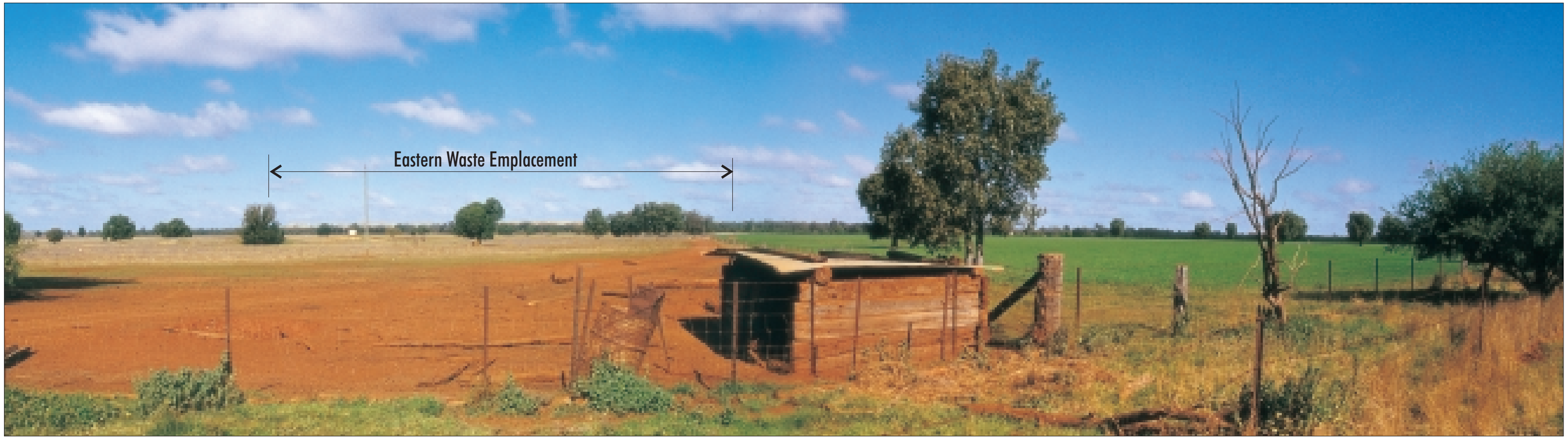
Views from "Brooklyn"
- Existing and Year 20

BLACK RANGE MINERALS

ResourceStrategies

BRM-98-01-PtA-S4_007A

Existing View



Simulated View Year 5

SYERSTON NICKEL COBALT PROJECT EIS

FIGURE A4-3a

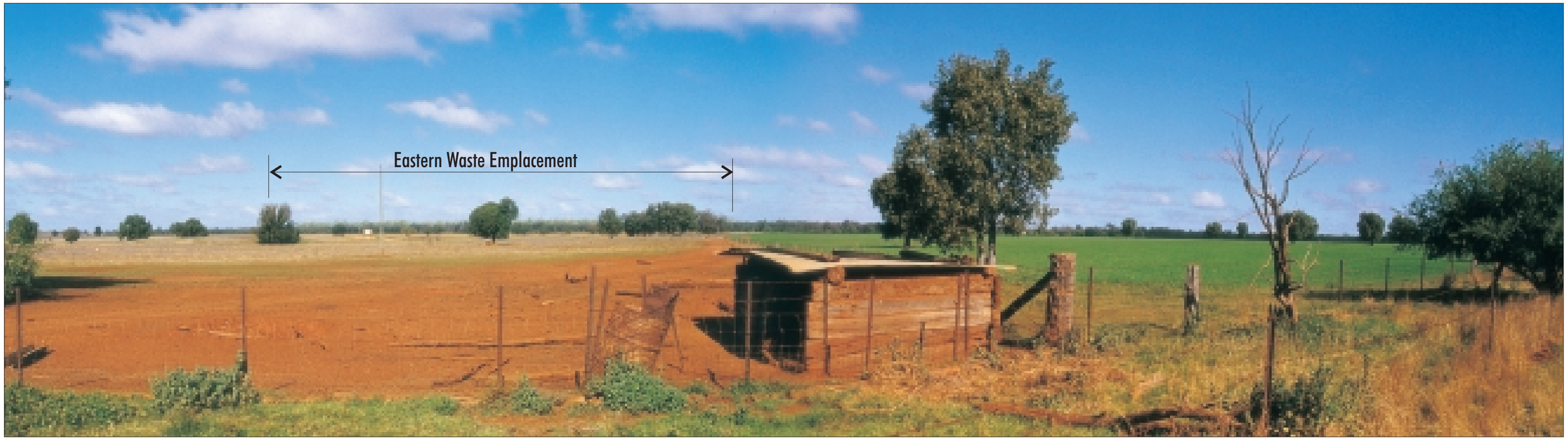
Views from "Currajong Park"
- Existing and Year 5

BLACK RANGE MINERALS

ResourceStrategies

BRM-98-01-PtA-S4_008A

Existing View



Simulated View Year 20

SYERSTON NICKEL COBALT PROJECT EIS

FIGURE A4-3b

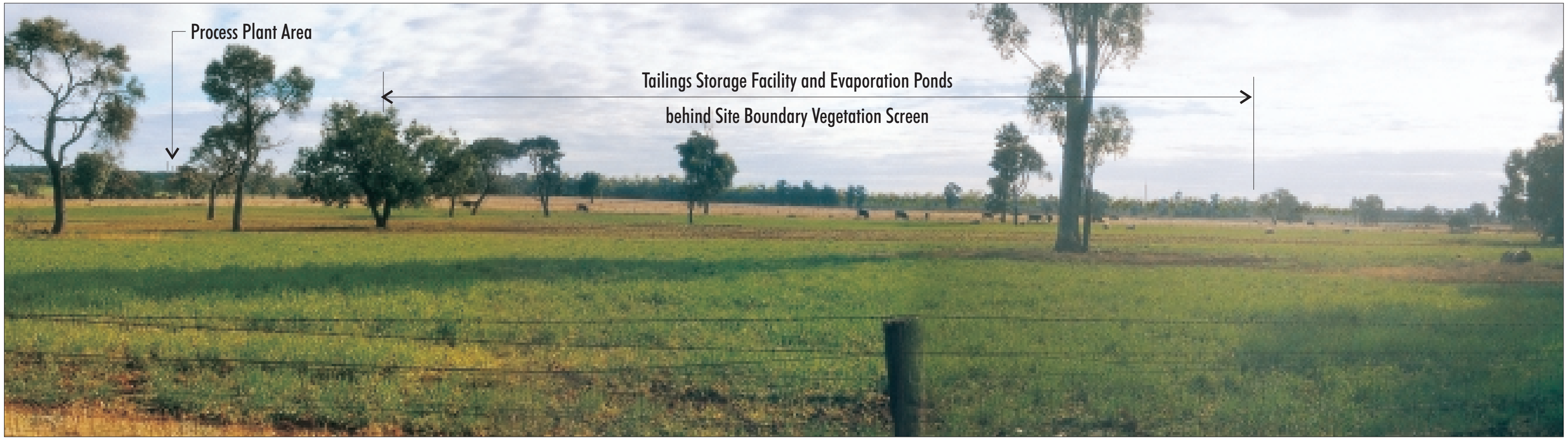
Views from "Currajong Park" - Existing and Year 20

BLACK RANGE MINERALS

ResourceStrategies

BRM-98-01-PtA-S4_009A

Existing View



Simulated View Year 5 Tailings Storage Facility and Process Plant Area

ResourceStrategies

SYERSTON NICKEL COBALT PROJECT EIS

FIGURE A4-4a

Views from "Wanda Bye" - Existing and Year 5

BLACK RANGE MINERALS

BRM-98-01-Pt A-S4_001B

Existing View

Simulated View Year 20 Tailings Storage Facility and Process Plant Area

SYERSTON NICKEL COBALT PROJECT EIS

FIGURE A4-4b

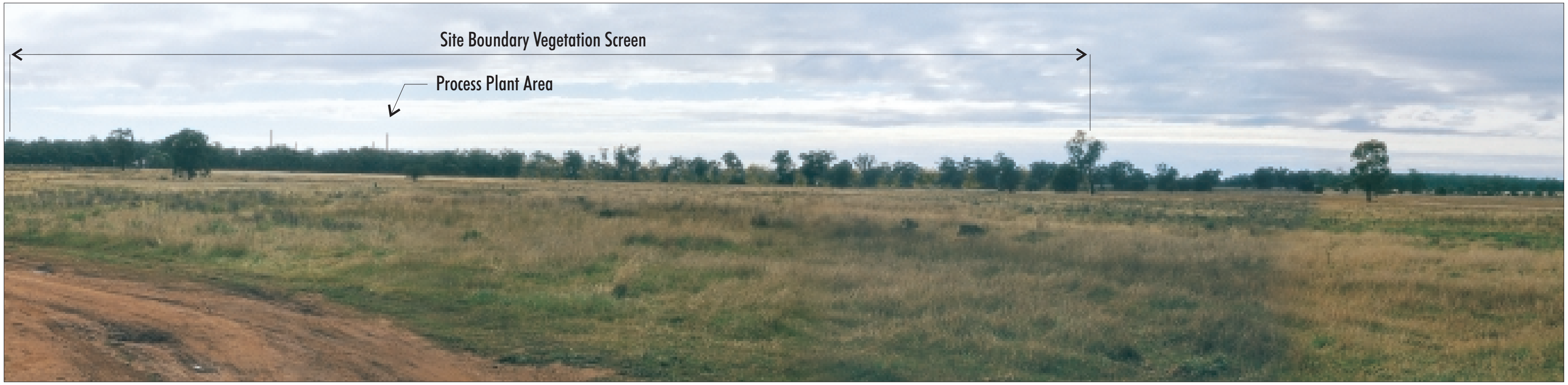
Views from "Wanda Bye"
- Existing and Year 20

BLACK RANGE MINERALS

Resource Strategies

BRM-98-01-Pt A-S4_002B

Existing View



Simulated View Year 5 Process Plant Area

SYERSTON NICKEL COBALT PROJECT EIS

FIGURE A4-5a

Views from "Sunrise"
-Existing and Year 5

BLACK RANGE MINERALS

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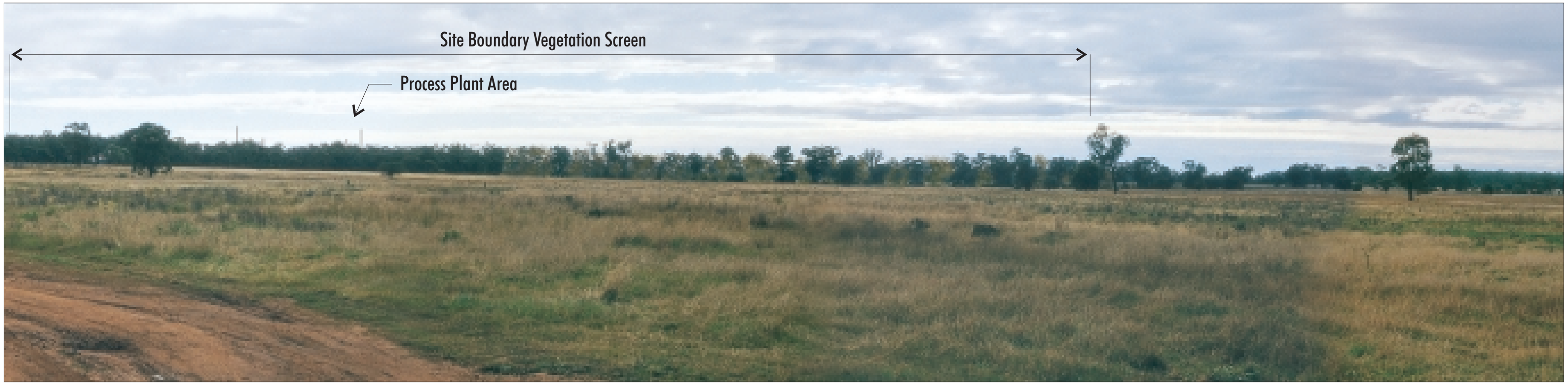
BRM-98-01-PtA-S4_004B

Existing View



Simulated View Year 20 Process Plant Area

ResourceStrategies

BRM-98-01-PtA-S4_005B

SYERSTON NICKEL COBALT PROJECT EIS

FIGURE A4-5b

Views from "Sunrise"
- Existing and Year 20

BLACK RANGE MINERALS

A4.2.1 Landform Change

The MPF is set in a rural environment that, in some areas, has been previously disturbed by mining activities. Permanent landform changes that would result from developments on the MPF site are discussed in Section A4.1.

Other areas on the MPF site (including soil stockpile sites, ROM and low grade stockpile sites and processing facility) would be decommissioned at various stages during and after the mine life and rehabilitated to approximate original landforms.

The waste emplacements would have a progressively changing form. The waste emplacements have been designed to minimise their visual impact on the local landscape with 1V:4H overall outer batter slopes, a progressive rehabilitation strategy and relatively low elevation (regionally equivalent to the effect of the low hills of Gobondry Mountains approximately 10 km to the east of the MPF).

The TSF would ultimately fill to form a flat plain that would be rehabilitated at the end of mine life. The outer slopes of the TSF perimeter embankment would be battered to 1V:4H and revegetated progressively during operations. Screen planting would also be undertaken around the MPF site boundary to restrict views of the facility (Section A5).

Multiple open pits would be progressively developed over the mine life and by Year 20 there would be two pits (eastern and western).

The evaporation surge dam could be retained as a farm water dam at the completion of operations. The outer batter of the main embankment would be revegetated with grasses at the completion of construction.

A4.2.2 Visual Impact

The eastern waste emplacement would be located in the north-eastern corner of the MPF site (Figure A2-5) with distant views available from both “Brooklyn” homestead (to the north-east) and “Currajong Park” (directly north) (Figure A4-1). Visual simulations of the views from “Brooklyn” and “Currajong Park” homesteads in Year 5 and Year 20 are presented in Figures A4-2 and A4-3.

Views from both of these homesteads would be obscured by vegetation within the Melrose to Gillenbine Road corridor and by vegetation along the northern boundary of the MPF site. These areas of vegetation and relatively long distance (approximately 1 km to “Currajong Park” and 2 km to “Brooklyn”) from these residences would limit the visual impact of the waste emplacement. The impacts would be further reduced by progressive rehabilitation of these landforms.

The TSF would be located in the southern section of the MPF site between the processing facility and the evaporation ponds (Figure A2-5). Views of the TSF from nearby residences “Wanda Bye” and “Sunrise” (Figure A4-1) for Year 5 and Year 20 are simulated on Figures A4-4 and A4-5. These simulations show the limited visibility of the TSF from these residences. Views of the TSF would also be available from the Fifield to Wilmatha Road to the south and a small section along the Condobolin to Tullamore Road along the eastern boundary of the MLA.

The factors limiting visibility of the TSF are the location of the evaporation ponds and scattered areas of vegetation on adjoining properties and road reserves. The evaporation ponds would be visible through the roadside vegetation along the Condobolin to Tullamore Road and from “Wanda Bye” and the Fifield to Wilmatha Road to the south of the MLA (Figure A4-1). Visual simulations of the view from “Wanda Bye” in Year 5 and Year 20 are presented on Figure A4-4.

The processing facility is located approximately 500 m from the Fifield to Wilmatha Road (Figure A2-5). Views of sections of the processing facility would be available from both the “Sunrise” and “Wanda Bye” homesteads and the Fifield to Wilmatha and the Condobolin to Tullamore Roads. Views of the facility from both roads would be obscured due to the location of MPF structures and landforms (ie. evaporation ponds, TSF and topsoil stockpiles). Views from “Sunrise” would include the tops of stacks above the treeline approximately 3 km to the north-east of the homestead, however visibility at such a large distance would be limited. Figure A4-5 presents visual simulations from “Sunrise”. Lighting associated with the stacks and the H_2S flare would be visible from greater distances.

A4.2.3 Night Lighting

Lighting of the processing facility, active open pits and waste emplacement areas would be required for 24 hour operations.

The significance of night lighting impacts relates to the contrast between light and dark in a rural landscape. The main regional impact of light emissions is that a glow would be seen in the night sky above the MPF from the surrounding region and residences. Fixed (buildings and stacks) and mobile lights, such as used on the waste emplacement, would be visible from some roads and on occasions at some of the surrounding properties. The lighting and flare associated with the higher stacks are likely to be visible from portions of the "Wanda Bye" and "Sunrise" properties.

A4.2.4 Mitigation Measures

The limited population residing in the vicinity of the MPF minimises the potential for visual impacts.

Views of the MPF would be limited by the proposed boundary vegetation screens, existing vegetation (eg. roadside vegetation) and the absence of elevated public viewpoints surrounding the site. Figures A4-4 to A4-5 show the mitigating effect of the proposed vegetation screen in Year 5 and Year 20.

Progressive rehabilitation of the waste emplacements would minimise their visual impact and would reduce contrast with surrounding areas. Views of the progressive waste emplacement construction and rehabilitation in Year 5 and Year 20 from properties to the north ("Brooklyn" and "Currajong Park") are shown on Figures A4-2 and A4-3.

Revegetation of the evaporation ponds and TSF outer batters would be undertaken during construction as would development of the MPF site perimeter vegetation screen.

The architectural detailing of proposed buildings is important in moderating the visual impact of the facilities and their relationship with the surrounding environment. The general massing of all the proposed buildings is fixed by the functional requirements of the processes and equipment located within the buildings.

The application of a consistency of detailing and careful colour selection would, however, maximise the appropriate fit of these industrial buildings into their adjoining landscape.

Colour plays a significant role in the visibility of the proposed infrastructure. It is proposed that appropriate colours be used where possible to help the infrastructure blend in with the surrounding grasslands.

The impacts of night lighting would be minimised by only lighting those areas required and using directional lighting where possible to reduce light spill.

A4.3 SURFACE WATER RESOURCES

Hydrological studies have been undertaken as part of the development of water management systems for the MPF site and are summarised in Appendix D. The studies involved hydrological modelling of drainage paths within the MPF site and water balance modelling of the process water management system (including the TSF, evaporation ponds and surge dam).

A description of the existing water quality of drainage paths within the MPF site is provided in Section A3.2.

The following discussion describes the potential impacts of the MPF on surface water resources and outlines mitigation measures. In summary, the potential surface water impacts of the MPF include lowering of surface water quality by runoff, seepage or the uncontrolled release of water from construction or operation areas.

A4.3.1 Surface Water Quality

Potential Impacts

Surface water runoff from MPF landforms, disturbed areas and infrastructure areas could potentially contain contaminants such as sediments, dissolved solids, oil, grease, process reagents and by-products (eg. tailings). The potential impacts associated with these contaminants are summarised in Table A4-1.

Table A4-1
Potential Surface Water Quality Impacts

MPF Development/Construction[1] and Operation Areas[2]	Potential Impact Scenario	Type of Potential Contamination
Process plant area (including reagent stockpiles)	Drainage of sediment laden runoff to downstream surface waters during construction of process plant area/hardstand. Spillage and/or uncontrolled drainage to downstream surface waters during operation.	Sediments, process reagents, fuel, oil, lubricants and process by-products.
Infrastructure (roads, hardstands, pipelines and stockpiles)	Drainage of sediment laden runoff to downstream surface waters during construction. Spillage to downstream surface waters during operation.	Sediments, fuel, oil and lubricants.
Run-of-mine (ROM) and low grade stockpiles	Drainage of sediment laden runoff to downstream surface waters during construction of stockpile area/hardstand. Uncontrolled drainage from stockpiles to downstream surface waters during operation.	Sediments and dissolved solids.
Tailings storage facility	Drainage of sediment laden runoff to downstream surface water during construction. Spillage during extreme rainfall events and/or seepage to downstream surface waters. Uncontrolled runoff from the embankments. Surface expression of seepage from TSF.	Sediments and dissolved solids.
Tailings reticulation pipelines	Drainage of sediment laden runoff to downstream surface waters during construction of pipeline. Spillage to downstream surface waters resulting from rupture of pipeline during operation.	Sediments and dissolved solids.
Evaporation ponds and surge dam	Drainage of sediment laden runoff to existing drainage paths during construction. Spillage to downstream surface waters during operation.	Sediments and dissolved solids.
Process water reticulation pipelines	Drainage of sediment laden runoff to downstream surface waters during construction of pipeline. Spillage to downstream surface waters resulting from rupture of pipeline during operation.	Sediments and dissolved solids.
Waste emplacements	Drainage of sediment laden runoff to downstream surface waters. Uncontrolled drainage from the dump to downstream surface waters.	Sediments.
Open pits	Drainage of sediment laden runoff to downstream surface waters during pre-stripping and initial pit development.	Sediments.
Sewage treatment plant	Spillage of treated or untreated sewage to downstream surface waters during operation.	Treated or untreated sewage containing bacteria, organic matter and nutrients.
Diversion channels and associated dam	Drainage of sediment laden runoff to downstream surface waters during construction and prior to channel stabilisation.	Sediments.

1 Areas significantly disturbed by development or construction activities.
2 Areas containing fuels, lubricants, process chemicals, mine waste or process by-products (eg. tailings).

Mitigation Measures

Water management studies have been undertaken in order to develop a water management system for the MPF site to minimise any potential surface water quality impacts. The overall objective of the MPF site water management system is to contain any potentially contaminated water generated within development/construction and operational areas while diverting all other water around these areas.

Minimising Disturbance Areas

Areas disturbed by mining would be minimised. The MPF site would be segregated into undisturbed runoff areas, development/construction runoff areas and operation runoff areas to minimise the generation of waters requiring on-site containment.

Containment and Recycling

Runoff from development/construction areas and operation areas would be intercepted and channelled to containment storages across the MPF site. Accumulation of waters stored in these storages would be managed by priority reuse in the process plant water circuit where possible or by evaporative disposal from the TSF, evaporation ponds and/or evaporation surge dam.
A summary of the capacity and function of the containment storages is provided in Table A4-2.

The proposed seepage control methods for the TSF are described in Section A2.8 and Appendix D. Seepage through the stored tailings and laterally through the compacted clay base of the TSF would be intercepted by the seepage collection system and directed to the evaporation ponds or returned to the TSF decant pond. Any limited seepage that is expressed as surface runoff at the external toe of the TSF embankment would be collected within the TSF perimeter bunding system (catchment paddocks) and similarly directed to the evaporation ponds.

Runoff from the waste emplacements would be directed to sediment dams designed in accordance with the IESCP and the criteria stated in Table A4-2.

Table A4-2
Summary of Containment Water Storages

Component	Function	Capacity
TSF	Storage of tailings and rainfall. Decanted water directed to evaporation ponds or surge dam as it can not be reused in the process plant water circuit.	Sufficient operational freeboard to contain a 1 in 100 years ARI[1] rainfall event lasting 72 hours.
Evaporation ponds	Storage and evaporation of rainfall, excess water in the site water management system, excess water decanted from the TSF, water from the TSF seepage collection system, and return water from the evaporation surge dam. Excess water pumped to the evaporation surge dam intermittently.	Sufficient operational freeboard to contain a 1 in 100 years ARI rainfall event lasting 72 hours.
Evaporation surge dam	Storage and evaporation of incident rainfall and excess water in the site water management system (primarily excess water from TSF and evaporation ponds). Water pumped back to the evaporation ponds when storage capacity available.	Sufficient operational freeboard to contain a 1 in 100 year ARI rainfall event lasting 72 hours.
Process plant site runoff pond	Processing plant runoff storage and emergency containment of process water or reagent spills. Water pumped to the process plant for reuse.	Runoff from the contributing catchment resulting from 1 in 100 year ARI rainfall event lasting 48 hours.
Sediment control structures	Storage of runoff from development/construction areas. Water pumped or delivered to process water pond for reuse or allowed to rejoin the diversion system dependent on quality.	Runoff from the contributing catchment resulting from 1 in 20 year ARI rainfall event lasting 1 hour.
Bunded process water and tailings pipelines	Containment of potential spills from pipelines. Any spills pumped back to process water pond or TSF as appropriate.	Volume from 10% of the maximum pumping capacity for a 14 hour period plus volume stored in upslope portions of pipe.

[1] Average Recurrence Interval

Progressive Stabilisation and Revegetation of Disturbed Areas

Development/construction areas and operation areas would be progressively rehabilitated. Rehabilitation would involve reprofiling, where necessary, to provide long term stability. Following stabilisation, the available areas would be revegetated. It is anticipated that once rehabilitated areas become established, surface runoff would be of comparable quality to undisturbed areas.

Active treatment systems in the form of temporary sediment retention storages, silt fences and passive measures such as vegetation buffers would be employed as interim erosion and sediment control measures during the rehabilitation process.

Erosion and Sediment Control

Erosion and sediment control measures would be designed in accordance with the above water management principles and would be based on design criteria to be developed in the IESCP in consultation with the relevant authorities.

The IESCP would provide for the sequencing of construction works to minimise the area of disturbance at any given time, in conjunction with the implementation of a progressive rehabilitation programme. Specific mitigation measures to control soil erosion and sediment migration are described in Section A4.1.

A4.3.2 Process Water Management

A water quality and quantity balance for the proposed TSF and evaporation ponds/surge dam system is presented in Appendix D. The objective of this study was to size and design the evaporation ponds and surge dam for the containment and evaporative disposal of supernatant waters dewatered from the TSF.

The TSF is divided into northern and southern cells, with surface areas of approximately 115 and 105 ha respectively. All supernatant liquors released by the tailings, plus rainfall runoff from the surface of the TSF would be decanted to the evaporation ponds (Figure A2-10). Process water in excess of the storage capacity of the evaporation ponds would be temporarily stored in the evaporation surge dam and returned to the evaporation ponds as necessary for evaporative disposal. The evaporation surge dam is also designed to maximise evaporation.

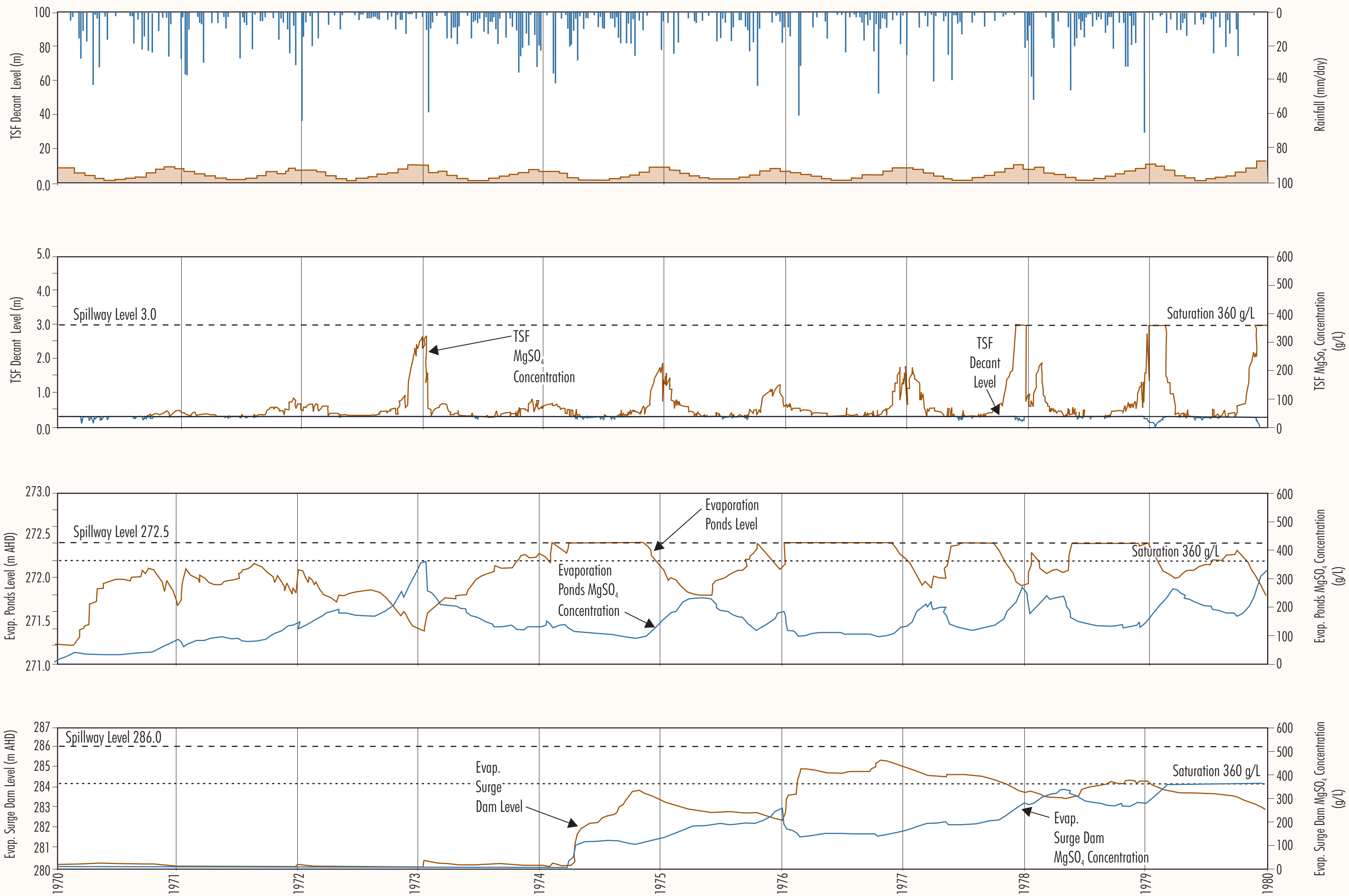
The processing operation would produce about 2.55 Mtpa of tailings which would be pumped to the TSF at a solids content of about 48% (ie. approximately 7.6 ML/day of liquor). Based on laboratory testing, it is expected that the tailings would settle to an initial dry density of 1.1 tonnes per cubic metres (t/m^3). This would release approximately 3.2 ML/day of supernatant liquor from the tailings. This liquor would flow down the tailings beach to the decant pond. The TSF would be operated with a nominal decant pond diameter of 300 m under normal operating conditions.

The liquor accompanying the tailings would have a total dissolved solids (TDS) content of approximately 26,600 milligrams per litre (mg/L), principally consisting of magnesium sulphate (epsom salts - $MgSO_4$) (Appendix D). The TDS level is too high for the decant liquor to be reused in the process plant or to be treated economically. Approximately 0.48 ML/day of decanted waters would be used for dust suppression on mine haul roads within controlled catchments.

During the evaporation process, magnesium sulphate, calcium sulphate and other sulphates would precipitate and accumulate at the base of the evaporation ponds and surge dam. Periodically these products of crystallisation would be removed and deposited into the TSF.

The water balance for the TSF was run over a series of 10 and 30 year sequences using daily rainfall and evaporation data (Appendix D). The period between 1970 to 1980 was an extreme wet period with a storm greater than the 1:100 year ARI 72 hour design storm event in early 1976. This period proved to be the most critical 10 year sequence for the TSF, determining the required size of the evaporation ponds and surge dam. The water balance modelled over this period of record (Figure A4-6) indicated the following:

- At no time during the period of analysis does the TSF spill. The TDS of supernatant waters in the decant pond during the modelled period generally oscillates around a concentration of approximately 60,000 mg/L, rising during periods of low rainfall to the saturation level (360,000 mg/L).



Source: Golder Associates (2000)

SYERSTON NICKEL COBALT PROJECT EIS

FIGURE A4-6

TSF Water Balance

ResourceStrategies

BLACK RANGE MINERALS

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- The evaporation ponds fill rapidly after commissioning, reaching an operating depth of approximately 2.2 m within 12 months. Thereafter, there are year long periods when the evaporation ponds operate at full capacity with excess water transferred to the evaporation surge dam. During dry years the water level in the evaporation ponds reduces and water is returned from the evaporation surge dam.
- TDS concentrations in the evaporation ponds increase to approximately 200,000 mg/L and remain between 100,000 and 200,000 mg/L for most of the period. This variation is due to the flushing effect of rain falling on the evaporation ponds and decant flows during wet periods.
- Very little liquor is transferred to the evaporation surge dam during the first four years modelled. Subsequently, the water level in the evaporation surge dam remains at about half depth, and only rises to some 500 mm below the spillway level during the heavy rainfall periods in 1976 (Figure A4-6). The TDS level in the evaporation surge dam rises over the modelled period, remaining at saturation (360 000 mg/L) towards the end of the period.

As the modelled period (1970-1980) coincides with the wettest 10 year period on record, the water balance results shown on Figure A4-6 would indicate maximum required storage capacity. Conversely, due to the high rainfall and dilution effects over this period TDS levels would generally be lower than would be expected in the driest 10 year period on record. For the driest 10 year period it would be expected that saturation concentrations (360,000 mg/L) would be reached more frequently, and for longer periods, in both the evaporation ponds and the surge dam.

Additional analyses were undertaken for 30 and 40 year sequences from 1970 to 2000, 1940 to 1970 and 1900 to 1940. There was no system overflow during the 100 years of historical record modelled. The modelled periods exceed the expected operational life of the TSF and evaporation ponds/surge dam system.

For all of the rainfall events modelled, the evaporation surge dam did not overflow during the life of the MPF. The rainfall data for this period included a 220 mm 72 hour rainfall event in 1976, which exceeds the estimated 180 mm generated from the 1 in 100 year 72 hour design storm event.

A4.4 GROUNDWATER RESOURCES

To assess the potential impacts of the MPF on local groundwater systems in the vicinity of the TSF, evaporation ponds and surge dam a hydrogeological study was undertaken (Appendix D).

A summary of the hydrogeology of the MPF site is presented in Section A3.2. A summary of the potential hydrogeological impacts and mitigation requirements is presented below.

A4.4.1 Potential Impacts

The TSF, evaporation ponds and surge dam are located to the east and north-east of the process plant area (Figure A2-5). Sections A2.8 and A2.9 describe the design, construction and function of these storages.

TSF seepage is defined as the fluid that moves beyond the embankment and the compacted clay material, blanketing the floor of the TSF. Seepage may either appear at the surface outside of the TSF perimeter embankment or remain beneath the ground. In order to assess the potential for seepage migration from the TSF, detailed analyses and modelling have been undertaken. An overview of the modelling and key findings is provided below.

The model was run for a 50 year period to simulate the placement of tailings over a period of 20 years, followed by the capping of the TSF with a low infiltration surface treatment. The gradual increase in height of the stored tailings was represented in six discrete stages as indicated in Table A4-3.

Table A4-3
Summary of TSF Seepage Modelling Sequence

Total Time (yrs)	Height of Tailings (m)
1	5
4	10
8	15
13	19
17	23
20	27.5
50	27.5

Source: Golder Associates (2000)

The addition of a low permeability compacted layer on the base of the TSF, evaporation ponds and surge dam was also modelled to examine the influence of such a layer on seepage movement. The inclusion of a compacted clay layer at the base of the storages was found to significantly reduce the modelled seepage rate through the base of the storage (Golder Associates, 2000c). Model runs also included the proposed seepage collection system along the internal toe of the TSF perimeter embankment (Section A2.8).

The geochemical characterisation of mine wastes (including tailings) is detailed in Appendix F. In summary, acid drainage should not occur in the TSF over the life of the mine. The tailings would be neutralised in the process plant and would be discharged at a pH of approximately 7 to 7.5 with excess limestone. The near neutral pH would also reduce the risk of Cr, Fe and Ni becoming soluble. Notwithstanding, an on-going geochemical testwork programme would be undertaken to confirm the long term behaviour of tailings.

As discussed in Section A4.3.1, process water stored in the evaporation ponds and surge dam is expected to contain elevated TDS concentrations (predominately magnesium sulphate – epsom salts) due to evapo-concentration effects (Appendix D). The quality of any limited seepages from these storages would reflect these elevated concentrations.

In summary, the hydrogeological studies undertaken indicate that seepage from the TSF and evaporation ponds and surge dam is likely to have negligible impact on existing groundwater levels or quality. Based on the hydrogeological modelling the potential groundwater impacts include the following:

- Saturation of the soils underlying the TSF and evaporation ponds over the first five years of operation is expected.
- Lateral spreading of the groundwater mound is expected with rises in water table elevation extending to a maximum distance of some 825 m from the TSF and evaporation ponds total footprint after 50 years.
- The potential for seepage of liquor from the TSF, evaporation ponds and surge dam is constrained by low permeabilities in the underlying and adjacent soil and rock and also the maximum height of saturated tailings and the shallow depth of water (typically less than 2.5 m) in the evaporation ponds.
- Beyond the zone of raised groundwater velocities induced by the operation of the TSF, evaporation ponds and surge dam the groundwater system is inferred to have low to very low velocities. The estimated regional groundwater velocity of 0.1 m/year is equivalent to 100 m per 1,000 years (Appendix D). The localised groundwater mound associated with the TSF, evaporation ponds and surge dam is expected to dissipate in the order of 50 to 150 years from the cessation of operations.

When assessing these impacts, it should be noted that:

- Regional surveys did not locate any groundwater use within 5 km down-gradient of the MPF TSF site.
- Local groundwater quality in the vicinity of the MPF site has been assessed as saline with limited beneficial use.

A4.4.2 Mitigation Measures

The proposed control measures for the TSF and evaporation ponds are described in Sections A2.8 and A2.9 respectively and include the following:

- Pre-stripping of soils would be undertaken beneath embankment footprints.
- Construction of low permeability clay liners under the TSF, evaporation ponds and surge dam storage areas would be carried out by compacting *in situ* clay material to a depth of 1 m. Laboratory testing has indicated that the *in situ* clays would achieve a permeability of less than 1×10^{-9} m/s after compaction.
- Installation of an underdrainage and seepage interception drain. This drain would lower the internal phreatic surface of the deposited tailings and intercept any seepage flowing laterally through the upper layers of the underlying soils. Collected waters would be pumped back to the TSF or to the evaporation ponds.

These seepage control measures are designed to provide a physical control barrier to limit seepage from the TSF and evaporation ponds. The mechanisms outlined below have not been included within the modelling of seepage effects. They would be expected to provide further control for seepage effects and include:

- consolidation of tailings materials to reduce permeability; and
- adsorption of tailings chemicals onto clay colloids within subsoils beneath the storage.

The proposed rehabilitation and water monitoring strategies for the MPF site (described in Sections A5 and A6) have been designed to facilitate long term rehabilitation of mine landforms, including the management of any seepage issues. Groundwater levels and quality would be monitored by a network of monitoring bores around the perimeter, and downstream of, the TSF, evaporation ponds and surge dam (Section A6).

A4.5 FLORA

A description of the flora of the MPF site and surrounds is presented in Appendix I and summarised in Section A3.3.

A4.5.1 Potential Impacts

Vegetation Disturbance

Historical activities on the MPF site have resulted in the clearance of native vegetation for grazing, cropping and historic mining activities
Table A4-4 summarises the vegetation of the MPF site into four categories based on levels of disturbance. Endemic woodland comprises areas of relatively undisturbed woodland with native species comprising associations of White Cypress Pine and Box Woodland associations while cleared land with Wilga/Rosewood patches covers a relatively small area of the MPF that has been thinned for cropping and grazing. The majority of the MPF site is classified as land cleared for agricultural purposes while the north-eastern portion of the MPF site has been disturbed by previous mining and has regenerating Cypress Pine and weeds. The Fifield State Forest (Figure A3-1) supports the best-preserved natural plant communities and the majority would not be disturbed by the MPF.

Construction and operation of the MPF would disturb approximately 55% of the total MPF site. Significant portions of this area would be rehabilitated with pasture or endemic woodland (Section A5). Portions of the final voids would be selectively rehabilitated to grassland or endemic vegetation. Following rehabilitation there would be a net increase in endemic woodland areas and a net decrease in pasture/cropping land when compared to the existing condition.

Table A4-4
MPF Site Vegetation Disturbance

Vegetation	Approximate Area (ha)	
	Existing	Potentially Disturbed by MPF
Endemic woodland	600	320
Cleared land with Wilga/Rosewood patches	150	75
Cleared land for grazing and cropping	1,870	1,030
Historic mining land with regenerating Cypress pine and weeds	40	25
Total Area	**2,665[1]**	**1,450**

[1] Error due to rounding

Flora and Air Emissions

Air emissions associated with the Project are discussed in Section A4.7 and Appendix A.

Studies have shown that excessive dust generation (eg. during the construction phase) can impact on the health and viability of surrounding vegetation. Dust can affect vegetation by inhibiting physiological processes such as photosynthesis, respiration and transpiration, and allow penetration of phytotoxic gaseous pollutants (Eller, 1977; Thompson *et al.*, 1984; Farmer, 1993).

Weeds

As a result of past disturbance the MPF site has a high level of introduced and weed species (Section A3 and Appendix I).

Disturbance can favour the colonisation and spread of weed species. Control measures to prevent weeds spreading and out-competing native flora are therefore often required. Many weed species are effective competitors for resources and have the potential to exclude native species from the landscape. This can result in changes in the composition and structure of plant communities. Personnel and vehicles are often responsible for the dispersal of weed species onto sites of disturbance.

A4.5.2 Significant Flora

No species listed as threatened under the NSW *Threatened Species Conservation Act, 1995* or the Commonwealth *Protection of the Environment Biodiversity Conservation Act, 1999* were found within the MPF site. In accordance with the provisions of Section 5A of the EP&A Act (8 Part Test of Significance) 18 species were assessed (Attachment I-C of Appendix I) and it is considered that the proposed MPF site would not have a significant affect on these threatened plant species, populations, ecological communities or habitats.

A4.5.3 Mitigation Measures

The following undertakings are designed to assist in the mitigation of potential impacts of the MPF on flora:

- Retention, wherever feasible, of mature remnant trees within the MPF site is to be a high priority in formulating the final detailed layout of MPF infrastructure.
- Remnant patches of native vegetation immediately adjoining proposed disturbance areas within the MPF site are to be delineated and clearly marked or fenced to prevent accidental damage during construction works.
- Any disturbance to drainage systems and associated vegetation is to be conducted in accordance with integrated erosion and sediment control initiatives and relevant statutory conditions.
- Where temporary access to any portion of the MPF site is required, clearance of native trees is to be avoided wherever practicable.
- Where the removal of vegetation is necessary for the operation of the MPF site, specific procedures are to be in place for efficient clearing operations, to maximise the harvesting of valuable timber resources and to effectively recycle or dispose of other vegetative parts.
- In areas of significant earthworks, soil resources are to be identified, stripped and stockpiled.
- A range of dust control practices/safeguards are to be employed including watering of potential dust-generating surfaces, minimising areas of soil stripping ahead of operations, restricting the speed of vehicles travelling on unsealed surfaces, prevention of truck overloading and spillage during loading and hauling, fitting of drills, etc. with dust control equipment together with progressive revegetation.
- A weed control programme would be coordinated with surrounding landholder programmes.
- The rehabilitation programme would maximise the opportunities for the creation of native vegetation links (Section A5).
- Key rehabilitation concepts include the establishment of endemic woodland species similar to existing woodland and to re-establish pastures where practical.
- A net gain of woodland is expected, following rehabilitation.

A4.6 FAUNA

Details of the fauna surveys and assessments conducted for the MPF site are presented in Appendices JA, JC and JD. A summary of the main findings is presented in this section.

A4.6.1 Potential Impacts

Habitat Disturbance

Estimates of the area of vegetation disturbance within the MPF site are provided in Table A4-4. Despite the relatively disturbed nature of the MPF site and surrounds, existing patches of remnant vegetation provide (to varying degrees) opportunities for foraging, breeding and/or nesting; predator avoidance; and movement between areas thus promoting genetic diversity and facilitating dispersal/migration. These opportunities could potentially be reduced as a result of clearance activities associated with the development of the MPF.

Feral Species

A total of five non-native vertebrate mammals were recorded within the MPF site during the surveys (Appendix JA). These species include the Red Fox, which presents a significant risk to native fauna in the area. Predation by the Fox is listed in Schedule 3 of the NSW *Threatened Species Conservation Act*, *1995* as a key threatening process.

There is potential for feral animals to be attracted to the MPF site by provision of harbour (eg. stockpiled timber), discarded food scraps and other rubbish. These factors could result in an increase in the population or concentration of feral species in and around the MPF site.

Fauna and Noise Emissions

A noise impact assessment of the MPF (Appendix K) has characterised and quantified the existing acoustic environment surrounding the MPF area as well as the predicted MPF related noise emission levels. A summary of the noise report is presented in Sections A3.6 and A4.8.

In relation to fauna, no firm policy or guidelines exist on the noise levels considered acceptable or conversely the level or character of noise that may disturb or otherwise effect essential behavioural characteristics.

Numerous studies have however been undertaken on the effects of noise on wildlife (eg. Algers *et al*., 1978 in Richard Heggie Associates, 1997; Allaire, 1978; Ames, 1978; Busnel, 1978; Lynch & Speake, 1978; Shaw, 1978; Streeter *et al*., 1979; Poole, 1982 in Richard Heggie Associates, 1997) and in essence, the studies indicate that many species are well adapted to human activities and noises.

The literature also shows that with respect to impulsive acoustic stimuli (eg. sonic boom, explosion), the majority of well-controlled experiments concluded that the behaviour (including breeding) of domestic animals and some characteristically shy, wild species was unaffected by repeated sonic booms (Lynch & Speake, 1978; Welch & Welch, 1978).

Notwithstanding, the proposed development has the potential to increase the existing level of noise eg. during construction and as a result of operational activities and the movement of vehicles). Additional noise emissions have the potential to disrupt the routine activities of vertebrate fauna.

Fauna and Road Traffic

The movement of construction and operational vehicles has the potential to increase the incidence of fauna mortality via vehicular strike.

Fauna and Artificial Lighting

Little information is available on the potential impacts of lighting on wildlife. Potential impacts of lighting associated with the MPF on fauna however are likely to relate to alteration of forage zones, primarily for insectivorous bird and bat species.

Birds such as Australian Owlet-nightjar (*Aegotheles eristatus*) and Kookaburra (*Dacelo novaeguineae*) are known to forage on insects around lights and studies (Hickey & Fenton, 1990; Rydell, 1992; Blake *et al*., 1994 all in Greg Richards and Associates, 1997) show that insects can be up to 40 times more prevalent around lights (eg. street lights, low and high pressure sodium lamps).

Greg Richards and Associates (1997) notes that bats would undoubtedly be drawn to lighting and some bat species may be drawn away from their natural foraging habitat. Conversely bats foraging around artificial lighting may be considered a positive impact, drawing insects away from habitat that may not necessarily be available and concentrating prey in more accessible areas (*ibid.*).

The presence of lights and concentrations of bats may increase the incidence of predation on them by Owls (*ibid.*). Although there appears to be little study on the topic, there have been numerous observations of bats appearing to forage above lights for the majority of time (*ibid.*). Bats reportedly seldom cross the light cone except when chasing insects (Belwood & Fullard, 1984; Schnitzler *et al*., 1987; Kronwitter, 1988; Hickey & Fenton, 1990; Rydell, 1991 all in Greg Richards and Associates, 1997), which is assumed to be a predator avoidance strategy (Hickey & Fenton, 1990 in Greg Richards and Associates, 1997).

Fauna and Human Intrusion

Human presence in an area has the potential to impact on fauna through deliberate and accidental interactions (eg. unauthorised shooting or captures, disruption to local fauna by domestic pets and by unauthorised entry of personnel into areas of remnant vegetation).

Tailings, Evaporation Ponds Water and Surge Dam

Large water bodies, including those that are man-made (such as the TSF, evaporation ponds and surge dams) have the potential to attract wildlife, particularly waterbirds (Bradford *et. al*, 1991; Tanji *et. al*, 1992; Roberts, 1995; Tanner *et. al*, 1999). The available literature indicates that the concentrations of magnesium sulphate and calcium sulphate in the storage facilities are not dissimilar to that found in some natural saline lake ecosystems. Calcium sulphate is precipitated from saline lakes in many parts of Australia including the salt lakes of southern South Australia (Warren, 1982). Very little information on mammal associations with salt lakes *per se* is available in the literature, however it is suggested that adequate vegetation for food must be present before use or colonisation could occur (Hammer, 1986).

A4.6.2 Significant Fauna

Eight Part Tests of Significance (Appendices JB and JC) were completed for the threatened fauna species listed in Table A3-4. Based on the information presented in the 8 Part Tests and the mitigation measures in respect of flora (Section A4.5.2) and fauna (Section A4.6.3), it was determined that no threatened fauna species would be significantly affected by the MPF to the extent of undermining the viability of a local population of that species.

In consideration of the potential impacts associated with the MPF on fauna, a number of mitigation measures and features have been developed.

A4.6.3 Mitigation Measures

In addition to the measures/principles presented in regard to flora (Section A4.5.3) the following initiatives have been developed to mitigate the potential impacts of the MPF on local fauna:

- In recognition of the habitat value of extant areas of native vegetation, the removal of native vegetation is to be undertaken, where possible, in late autumn or winter to minimise disturbance to potential breeding activities.
- Prior to ground disturbance works, mature trees with hollows are to be identified, marked and retained wherever feasible. Where feasible, mature, hollow-bearing trees within the proposed clearance zone could be used in the rehabilitation programme.
- Undertake pre-clearance surveys to establish bat roosts in trees which require removal and relocation of the roosts away from the impact areas.
- Provide a number of artificial roosts (bat houses) at strategic locations in the MPF site and surrounds to replace any roosts that would be lost.
- Rehabilitation concepts for the MPF site aim to maximise opportunities for the creation of habitat continuous with existing preserved woodland (Section A5) and giving consideration to the installation of nest/roost boxes and exclusion of grazing in selected areas.
- In addition to revegetation of the MPF site areas of existing native habitat would, where possible, be preserved (Section A5). A primary aim of preserving such areas would be to maintain biodiversity and to facilitate the potential for linking these areas to rehabilitation areas. Management activities could include (but not necessarily be limited to) exclusion of grazing, weed and feral species control, fertilising, supplementary planting and provision of habitat features (eg. hollows, ground shelter).

- A clean, rubbish-free environment is to be maintained across the MPF site, particularly around administration and contractor areas. This would discourage scavenging and reduce the potential for colonisation of these areas by non-endemic fauna (eg. introduced rodents, birds).
- To reduce the potential for vehicle strike, speed limits would be imposed on vehicles using roads and tracks in the MPF site and signposting installed. In addition employees would undergo an education programme during induction, on flora and fauna resources of the MPF site and surrounds.
- Feral animal control programs and site management strategies developed for the MPF site would be co-ordinated with adjacent landholders.
- The TSF, evaporation ponds and surge dam would be inspected daily for fauna, as a precautionary measure, during the course of normal daily maintenance inspections. In the unlikely event that the storages become a focus for avifauna, the use of hazing techniques (as adopted in the mining industry elsewhere) could be considered to minimise bird usage of the storages.

A4.7 AIR QUALITY

An air quality assessment is presented in Appendix A. The assessment considers the air emissions likely to be generated by the MPF and the likely potential impact of such emissions. Relevant emissions include the generation and dispersion of atmospheric dust from mining operations as well as gaseous emissions from the proposed processing facility. A description of the existing air quality of the MPF site is presented in Section A3.5.

A summary of the findings of Appendix A relating to the MPF is presented below.

A4.7.1 Gaseous Emissions

Air Quality Criteria

Projected emissions from the plant, proposed emission controls and safeguards and monitoring were detailed in an Environmental Management Statement (EMS) (SNC-Lavalin, 2000a) and the gaseous emissions assessment is based on this EMS.

Table A4-5 presents gaseous emission goals relevant to the MPF.

Table A4-5
NSW EPA Goals for Gaseous Emissions

Potential Pollutant	Goal	Averaging Time	Agency
Sulphur dioxide (SO_2)	572 $\mu g/m^3$	1 hour	NEPC[1]
	229 $\mu g/m^3$	24 hours	NEPC
	57 $\mu g/m^3$	1 year	NEPC
Nitrogen dioxide (NO_2)	246 $\mu g/m^3$	1 hour	NEPC
	61 $\mu g/m^3$	1 year	NEPC
Hydrogen sulphide (H_2S)	0.14 $\mu g/m^3$	3 minutes	Victorian EPA

Source: EPA (1998)

[1] National Environmental Protection Council (NEPC)

During normal operations the potential gaseous emissions of the processing facility would comprise:

- low pressure steam from the acid leach flash vessel scrubber;
- water vapour (as evaporation) from open tanks, the TSF, evaporation ponds and surge dam;
- mist and water vapour from the main cooling tower;
- sulphur dioxide from the sulphuric acid plant and hydrogen sulphide flare;
- nitrogen oxides from the co-generation plant turbines, boilers and intermittent emissions from the nitric vent fan;
- oxygen, hydrogen and water vapour from the electrowinning processes;
- carbon dioxide from the neutralisation circuits where limestone is consumed and from the co-generation and hydrogen plants;
- trace emissions of hydrogen sulphide from the hydrogen sulphide plant and process circuits; and
- process steam releases.

In the event of plant failure or upset conditions, additional emissions may potentially occur. These emissions are addressed as part of the risk and hazard assessment (Section A4.13 and Appendix B).

The projected gaseous emissions from the processing facility during normal operations are presented in Table A4-6. Estimated stack heights are also provided.

The emissions data provided in Table A4-6 and meteorological data were used to calculate ground level concentrations of sulphur dioxide (SO_2), oxides of nitrogen (NO_x) and hydrogen sulphide (H_2S) in the ambient air surrounding the processing facility. Ground level concentrations were calculated over three minute, one hour, 24 hour and one year intervals using a standard Gaussian plume model (AUSPLUME) for comparison with relevant air quality goals (Table A4-5).

Sulphur Dioxide

Maximum ground level concentrations of SO_2 were calculated over one hour, 24 hour and one year periods. The predicted concentrations at the MPF site remained below the NEPC's National Environment Protection Measure (NEPM) goals of 572 $\mu g/m^3$, 229 $\mu g/m^3$ and 57 $\mu g/m^3$ respectively (Appendix A). The predicted maximum SO_2 one hour ground level concentrations are illustrated on Figure A4-7.

Nitrogen Oxides

Maximum ground level concentrations of NO_x were modelled for intervals of one hour and one year. Modelling was undertaken assuming partial conversion of NO_x to NO_2 (50%) at the point of emission over one-hour periods and complete conversion from NO_x to NO_2 was assumed over an annual period.

Nitrogen oxides emission modeling results for one hour and one year indicated compliance with the NO_2 NEPM goals of 246 $\mu g/m^3$ and 61$\mu g/m^3$, respectively (Appendix A). Figure A4-8 illustrates the predicted one hour NO_2 ground level concentrations.

Modelling over a one hour period assuming full conversion of NO_x to NO_2 at the point of emission indicated there would be exceedance of the NO_2 NEPM goal of 246 $\mu g/m^3$ at the MPF site boundaries. The main contributor to the predicted highest concentrations of NO_X when presented as 100% NO_2 would be emissions from the nitric vent fan.

Hydrogen Sulphide

Maximum ground level concentrations of H_2S were modelled for three minute intervals in order to compare emissions with the Victorian EPA criteria of 0.14 $\mu g/m^3$. Modelling results indicated compliance with the goal at the MPF site boundary (Figure A4-9).

Clean Air (Plant and Equipment) Regulation, 1997

The projected continuous MPF emissions of NO_x, H_2S and SO_2 comply with the maximum concentrations specified in the *Clean Air (Plant and Equipment) Regulation, 1997* (Appendix A). Intermittent NO_x emissions from the nitric vent fan are expected for one to two days per week. When all the NO_x emissions are expressed as NO_2, the nitric vent fan emission would exceed the 2 g/m^3 maximum concentration specified in the *Clean Air (Plant and Equipment) Regulation, 1997.*

Mitigation Measures

Mitigation and control measures to limit gaseous emissions or to aid dispersion have been incorporated in the design of the processing facility and ancillary plants. These measures include the following:

- Excess or waste hydrogen sulphide gas would be converted to SO_2, NO_2 and carbon dioxide (CO_2) at the hydrogen sulphide flare stack by combustion with natural gas at a height of up to 80 m.
- SO_2 emissions of the sulphuric acid plant would be released from a stack up to 80 m in height.
- Combustion gases of the hydrogen plant including CO_2 and NO_2, would be released from a 36 m high reformer stack.
- Entrained traces of sulphuric acid in uncondensed steam emitted from the final letdown flash vessel at the acid leach circuit would be removed by a scrubber with 99% efficiency and the steam released from a 40 m high stack.

Table A4-6
Atmospheric Emissions Point Sources – Normal Operations

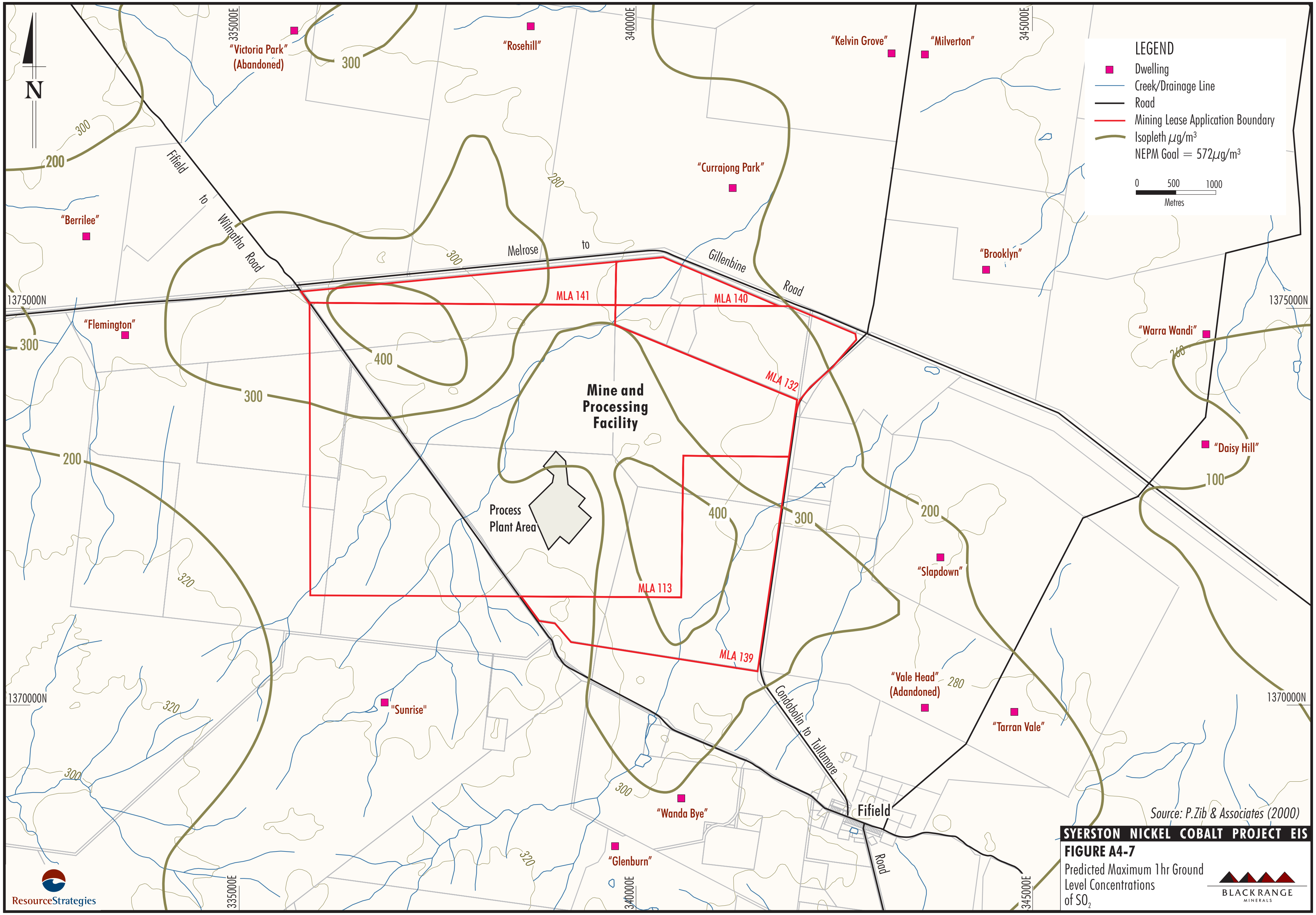
Source	Acid High Pressure Leach Scrubber	CCD Thickeners	Tailings Neutralisation Vent Stack	Leach Liquor Neutralisation Tank Vents	Vent from Extraction Fan over Sulphide Filter	Sulphide Leach Vent	Power Plant Heat Recovery Steam Generator (HRSG)	Main Plant Cooling Tower
Description	**Uncondensed Steam**	**Water Vapour**	**Water Vapour with Carbon Dioxide**	**CO_2 evolved from Neutralisation and Water Vapour**	**Air Combined with trace quantities of H_2S**	**Oxygen and Water Vapour[3]**	**Combustion Gases**	**Water Vapour**
Stack Height (m)	40	9	16	15	15	15	25	10
Emission Volume (Am^3/hr)	68,000	60,000	7,400	10,000	18,000	1,430	136,000	55,000
Emission Temperature (°C)	99	82	85	70	50	100	160	27
Sulphur Dioxide (g/s)	-	-	-	-	(2)	-	0.11	-
Oxides of Nitrogen[1] (g/s)	-	-	-	-	-	-	2.6	-
Water Vapour (kg/s)	11.1	9.7	0.75	0.63	-	0.4	3.7	11.6
Carbon Dioxide (kg/s)	-	-	1.22	2.83	-	-	4.5	-

Table A4-6 (Continued)
Atmospheric Emissions Point Sources – Normal Operations

Source	**Nitric Vent Fan**	**Nickel Electrowinning Tankhouse Vents**	**Sulphuric Acid Plant**	**Limestone Wet Scrubber**	**Flare Stack**	**Hydrogen Reformer Stack**
Description	**Air and Trace Oxides of Nitrogen**	**Water Vapour, Oxygen and Hydrogen [4]**	**Residual Gas ex-acid Production**	**Water Vapour and Water Mist**	**Water Vapour and Sulphur Dioxide**	**Combustion Gases**
Stack Height (m)	10	10	80	20	80	36
Emission Volume (Am^3/hr)	1,000	9,100	78,000	24,000	6,000	7,800
Emission Temperature (°C)	25	55	75	25	700-750	204
Sulphur Dioxide (g/s)	-	-	25.7	-	21.3	-
Oxides of Nitrogen[1] (g/s)	7.0[5]	-	-	-	0.11	0.12
Water Vapour (kg/s)	0.1	1.6	-	0.55	-	0.20
Carbon Dioxide (kg/s)	-	-	-	-	0.0007	0.48

Source: SNC-Lavalin (2000)

1. Oxides of nitrogen expressed as nitrogen dioxide.
2. Hydrogen sulphide emission expected to be 0.0003 g/s.
3. Vented gas would contain 1.0 kg/h oxygen and 0.4 kg/h nitrogen.
4. Exit gas would contain 4.4% oxygen and 0.1% hydrogen.
5. Once a week for one to two days.



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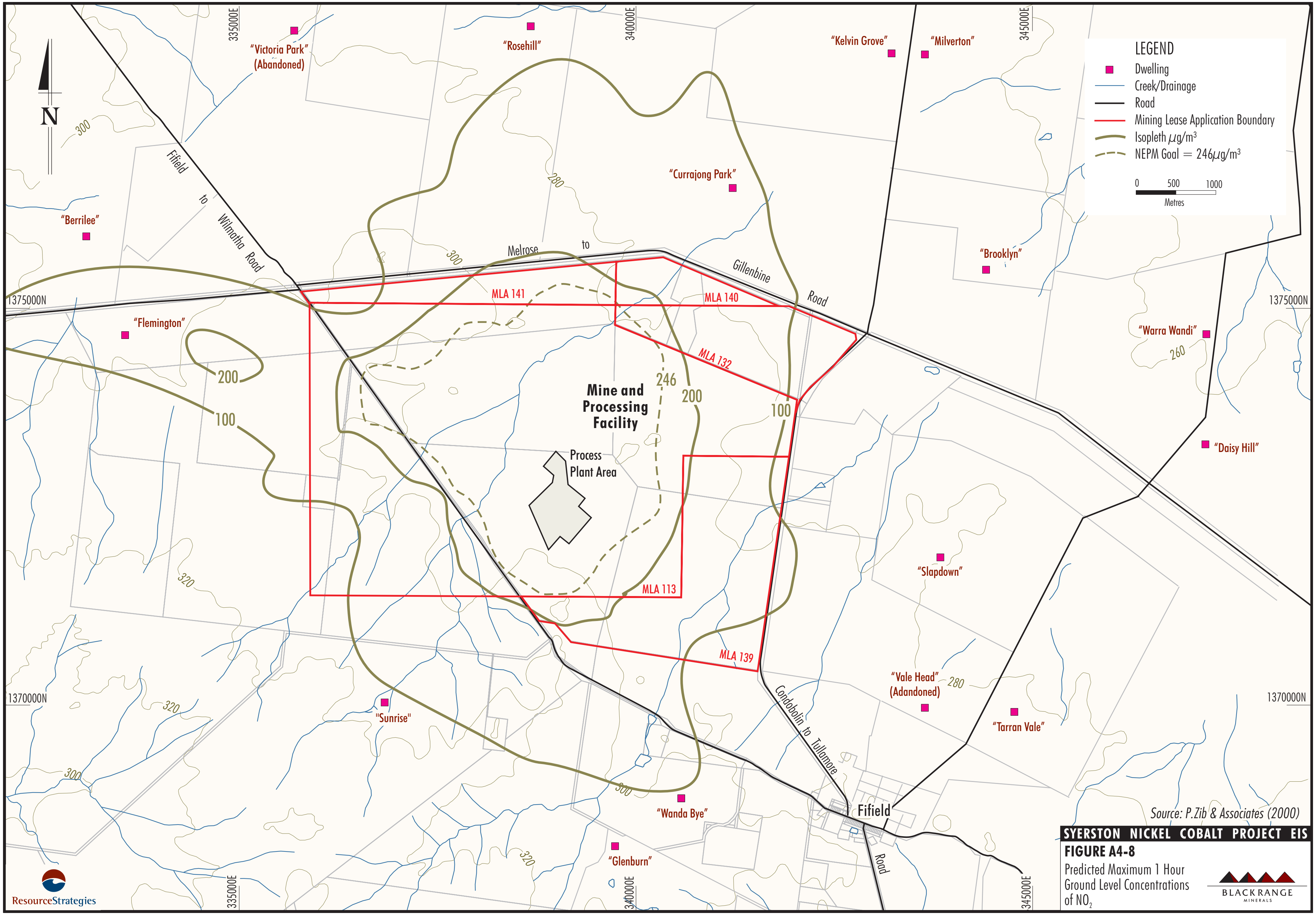

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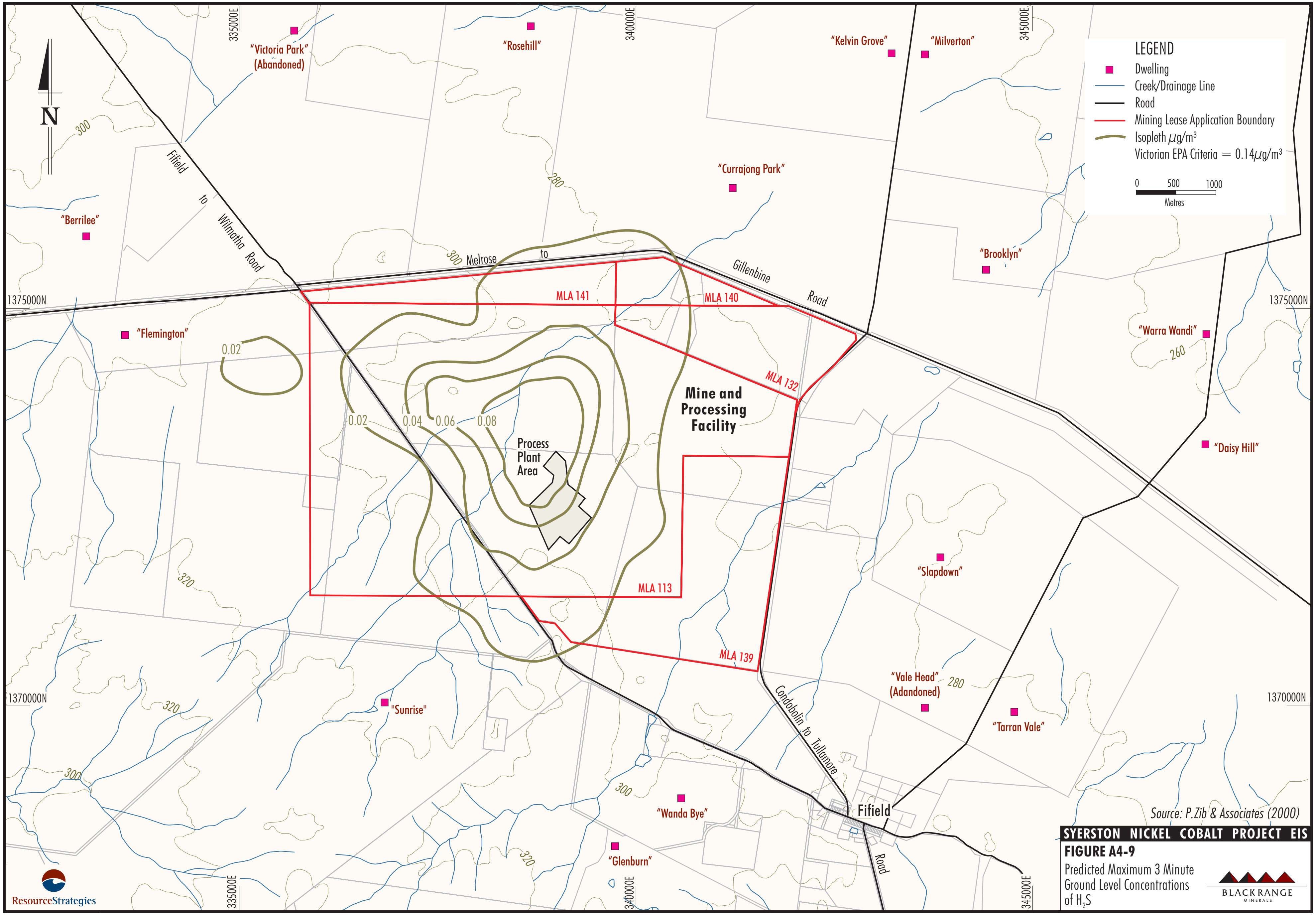

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FIGURE A4-9

Predicted Maximum 3 Minute Ground Level Concentrations of H_2S

BRM-98-01-Pt A-S4_018D

- CO_2 emissions from the tailings neutralisation circuit and leach liquor neutralisation tank would be vented from a 16 m high stack and a vent above the tank respectively.
- Combustion gases at the co-generation power plant including SO_2, CO_2 and NO_2 would be vented from a 25 m high stack.

The emission rates provided in Table A4-6 incorporate these emission mitigation measures at major point source locations.

It is proposed that additional testing be undertaken during the detailed design phase to evaluate the actual proportion of NO_x and NO_2 emissions from the nitric vent fan. In the event that testwork indicates potential non-compliance with the NO_2 NEPM one hour goal at the MPF boundaries or the *Clean Air (Plant and Equipment) Regulation, 1997*, further emission engineering controls at the vent would be implemented to achieve compliance.

In addition to the proposed emission mitigation measures included in the plant design consultation with EPA and refinements to technical matters are on-going. A comprehensive gaseous emissions monitoring programme is proposed (as a component of the Air Quality Management Plan) to provide on-going assessment of compliance (Section A6.4.2).

A4.7.2 Dust Deposition

Air Quality Criteria

Dust deposition guidelines used in the assessment are based on NSW EPA guidelines for protecting amenity. The specific effects contributing to this degradation of amenity mainly relate to the presence of visible dust either in the air or deposited on surfaces.

The EPA amenity criteria for dust deposition are shown in Table A4-7. The criteria seek to limit the maximum increase in the mean annual rate of dust deposition from a new development to 2 g/m^2/month.

Table A4-7
NSW EPA Criteria for Dust Fallout

Existing Dust Level (g/m^2/month)	Maximum Acceptable Increase Over Existing Dust Level (g/m^2/month)	
	Residential Suburban	Rural, Semi Rural, Urban Commercial and Industrial
2	2	2
3	1	2
4	0	1

Source: EPA (1998) in P. Zib and Associates (2000)

Potential Impacts

The predicted increases in the mean annual dust deposition rates for the MPF site and surrounding properties during construction (Year -1), and operations (Year 5, Year 10 and Year 20) were modelled and assessed and the detailed results are presented in Appendix A. The assessment indicates that off-site dust deposition rates would remain below the EPA amenity criteria for Years 5 and 20 (Appendix A). During construction and Year 10, off-site dust deposition rates would be slightly higher than the EPA amenity criteria but would comply at all nearby residences. A summary of the results for construction and Year 10 is presented below.

Construction

Rates of dust deposition during construction would decrease rapidly with distance from the areas of disturbance. Residences in the vicinity of the MPF site would experience an increase in dust deposition of up to 0.3 g/m^2/month, significantly less than the EPA amenity criteria of 2 g/m^2/month (Figure A4-10). A potential exceedance of the 2 g/m^2/month amenity criteria is predicted for a small strip of farmland located to the east of the MPF site (Figure A4-10). This land is not used for residential purposes.

Year 10

In Year 10 the concentration of activity associated with the development of the western and eastern waste emplacements would result in a shift in dust deposition contours to the north of the MPF site (Figure A4-11). No residences in the vicinity of the MPF site would experience increases in dust deposition rates greater than the EPA amenity criteria of 2 g/m^2/month.

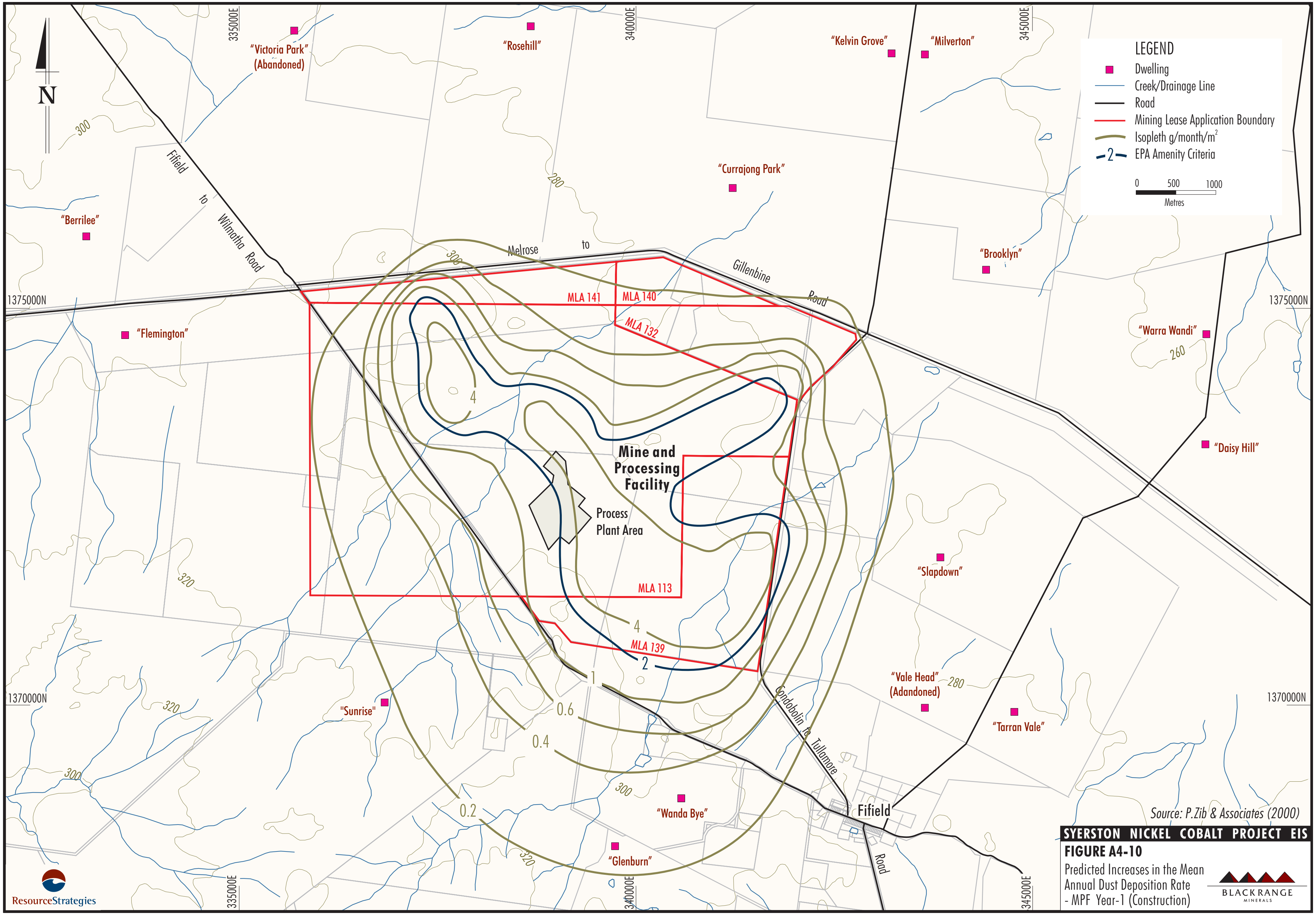

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FIGURE A4-10

Predicted Increases in the Mean Annual Dust Deposition Rate - MPF Year-1 (Construction)

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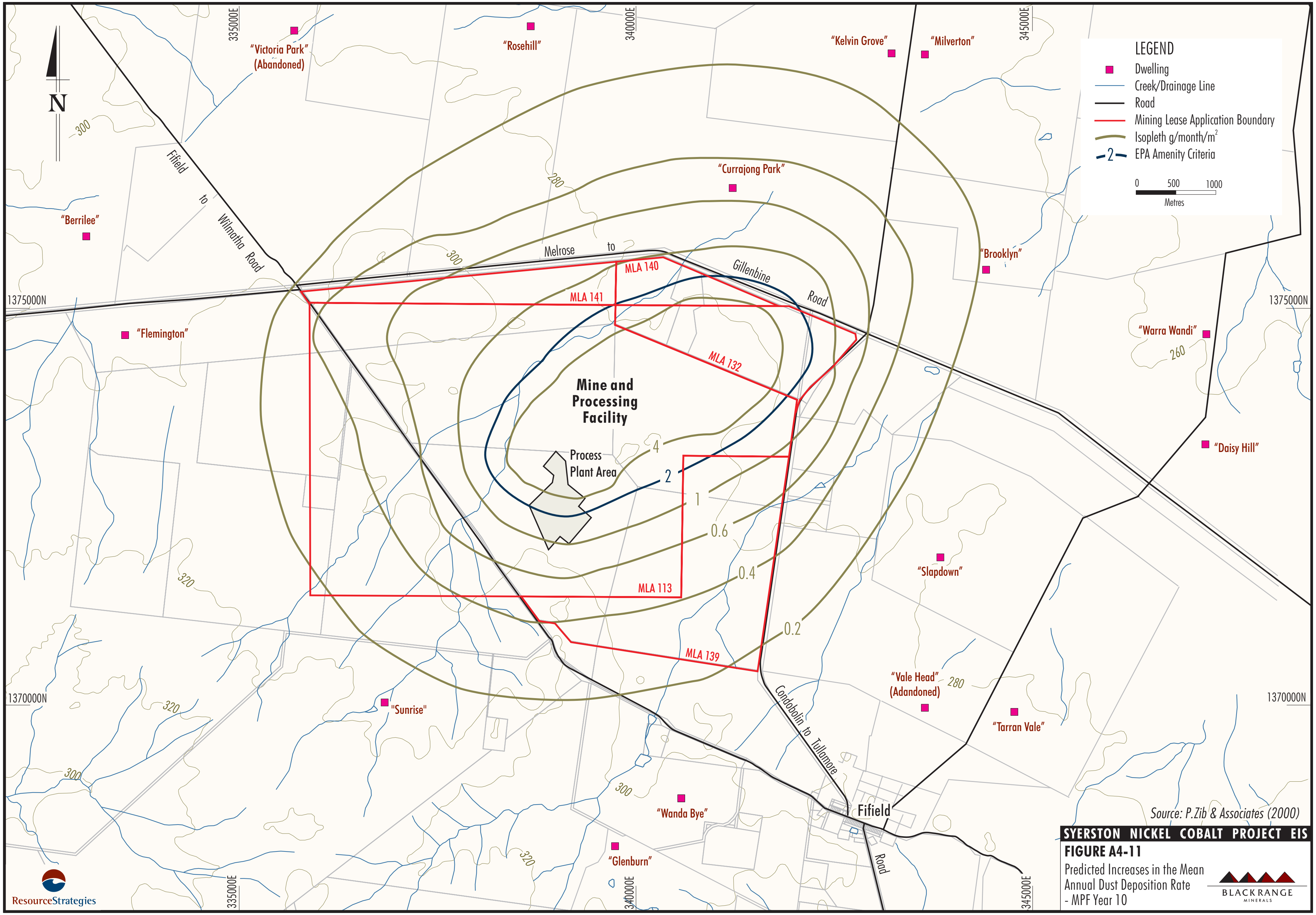

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FIGURE A4-11

Predicted Increases in the Mean Annual Dust Deposition Rate - MPF Year 10

BRM-98-01-Pt A-S4_014D

Dust deposition would potentially increase by up to approximately 0.5 g/m^2/month at "Currajong Park" located to the north of the eastern waste emplacement (Figure A4-11). A potential exceedance of the 2 g/m^2/month EPA amenity criteria is predicted for a small strip of farmland located to the immediate north of MLA 140 (Figure A4-11). This land is not used for residential purposes.

Mitigation Measures

A range of air quality safeguards would be employed to reduce emissions of atmospheric dust from the MPF site. These safeguards are based on current control techniques as recommended by the EPA. The main components of these controls include watering of disturbed areas, road maintenance, prevention of truck overloading and the resulting spillage during loading and hauling, use of dust suppressants or cover crops on stockpiles, and progressive rehabilitation of disturbed areas.

Dust deposition would be monitored to assess the effectiveness of general dust control methodologies. Section A6 details the proposed monitoring programme.

A4.7.3 Concentrations of Particulate Matter

Air Quality Guidelines

The health effects of dust are related to the concentration of suspended particles in the air as distinct from dust deposition. The effects of inhaled dust are specifically related to the types of particles inhaled, particle size, the ability of the respiratory tract to capture and eliminate the particles and the reactivity of the particles with lung tissue.

EPA air quality criteria designed to protect public health are presented in Appendix A. The list contains goals for total suspended particulates (TSP) and particulate matter less than 10 microns (μm) in diameter (PM_{10}).

The National Health and Medical Research Council of Australia (NHMRC, 1985) recommend an annual concentration of 90 $\mu g/m^3$ as the maximum permissible level of TSP in the air to protect public health in residential environments.
There is currently no air quality goal applicable to PM_{10} emissions from the MPF. The EPA has advised that the NEPM PM_{10} goal of 50 $\mu g/m^3$ over 24 hours is not appropriate for establishing regulatory limits for one particular development (P. Zib and Associates, 2000).

Potential Impacts

Modelling, assessment and detailed results of the potential increases in mean annual TSP for the MPF site and surrounding properties during construction (Year –1) and operation (Year 5, Year 10 and Year 20) are presented in Appendix A. As the existing TSP environment at the MPF site is anticipated to range from 20 $\mu g/m^3$ to 30 $\mu g/m^3$, an increase of 60 $\mu g/m^3$ would be required to reach the NHMRC guideline of 90 $\mu g/m^3$ (Appendix A).

The modelling indicates the annual mean levels of TSP would comply with the 90 $\mu g/m^3$ NHMRC guideline at the MPF site boundary during construction and Year 5 (Appendix A). During Year 10 and Year 20 the modelling indicates off-site TSP levels would be slightly higher but would comply at all nearby residences. A summary of the results for Year 10 and Year 20 is presented below and illustrated on Figures A4-12 and A4-13.

Year 10

Emissions from mining and waste emplacement development activity in the north-east of the MPF site during Year 10 are anticipated to result in a potential increase of TSP to the north of the site. The results indicate TSP concentrations at "Currajong Park" would increase by approximately 20 $\mu g/m^3$. Other nearby residences would experience an increase in TSP of less than 10 $\mu g/m^3$ (Figure A4-12). These concentrations at residences remain significantly below the NHMRC 90 $\mu g/m^3$ limit.

Exceedance of the NHMRC 90 $\mu g/m^3$ limit is predicted for a small strip of farmland to the north of MLA 140 (Figure A4-12). This land is not used for residential purposes.

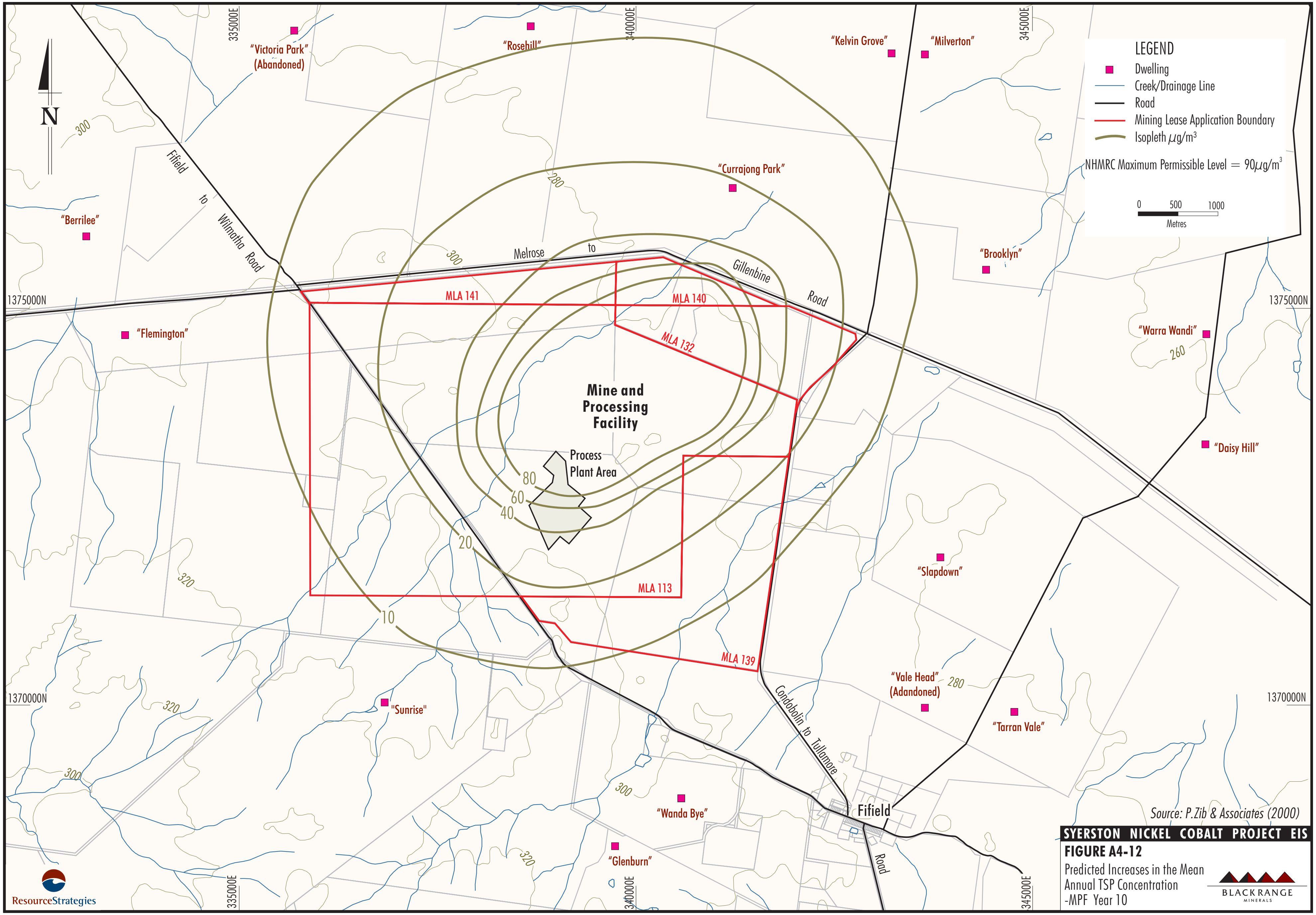

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FIGURE A4-12

Predicted Increases in the Mean Annual TSP Concentration -MPF Year 10

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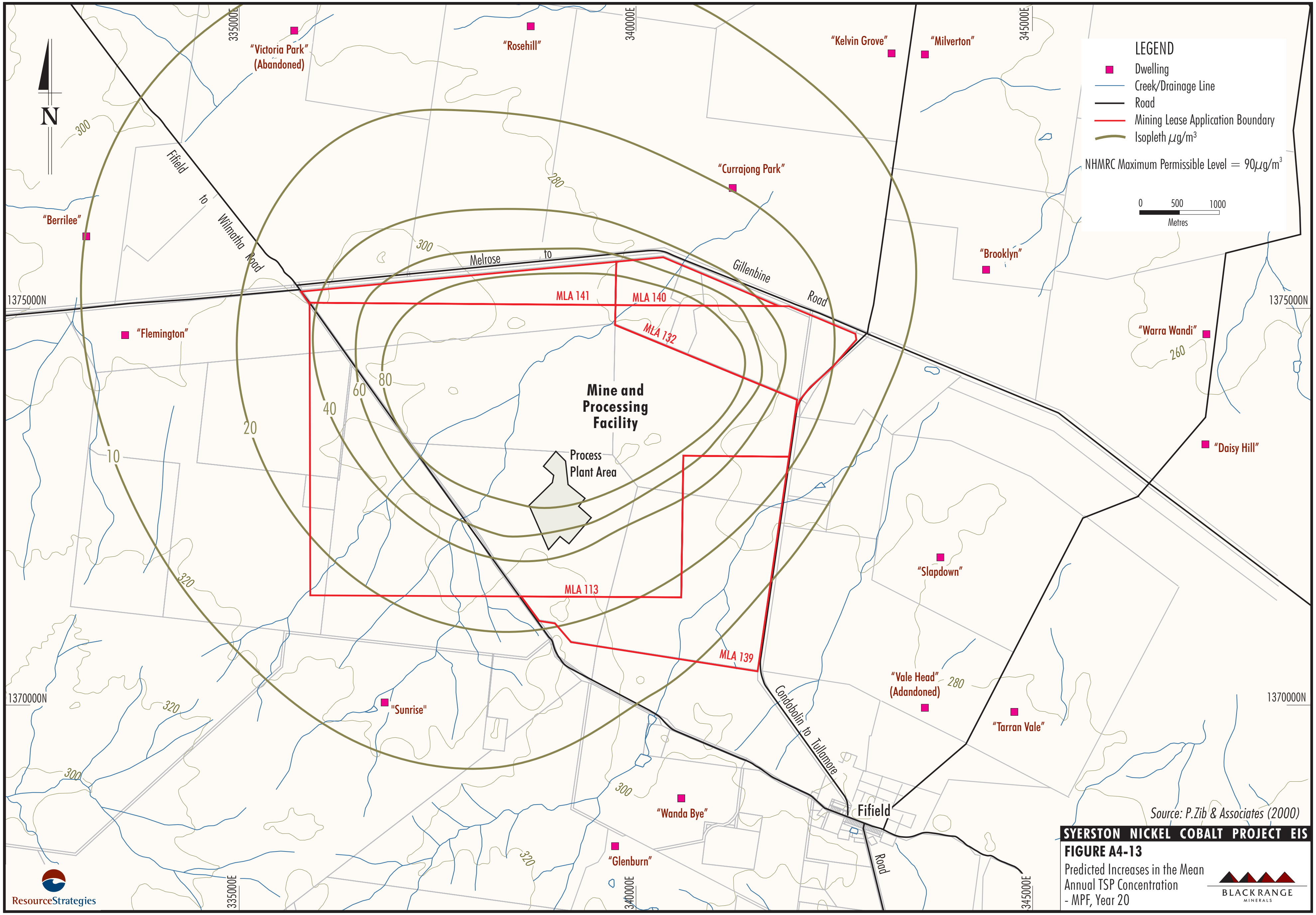

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FIGURE A4-13

Predicted Increases in the Mean Annual TSP Concentration - MPF, Year 20

BRM-98-01-Pt A-S4_012E

Year 20

In Year 20 the TSP modelling indicates compliance with the NHMRC 90 $\mu g/m^3$ limit at nearby residences, with "Currajong Park" predicted to receive an increase of 20 $\mu g/m^3$ and other nearby residences would experience an increase in TSP of less than 15 $\mu g/m^3$ (Figure A4-13).

Exceedance of the NHMRC 90 $\mu g/m^3$ limit is anticipated for a small strip of farmland to the north of MLA 141 (Figure A4-13). This land is not used for residential purposes.

Mitigation Measures

Dust control measures outlined in Section A4.7.2 would also provide control of TSP and PM_{10} emissions. Monitoring would also be conducted to assess the general effectiveness of control methodologies. Details of air quality monitoring are included in Section A6.

A4.8 ACOUSTICS

An assessment of the potential noise impacts as a result of the proposed development at the MPF site is presented in Appendix K and is summarised below.

A4.8.1 Noise Impact Assessment Procedures

The EPA Industrial Noise Policy (January 2000) provides the framework and process for the MPF noise impact assessment. In accordance with the objectives of the policy, background noise levels (rating background noise level) for the MPF areas and surrounds have been characterised and are outlined in Section A3.6 and Table A3-7. Noise criteria have been derived for the MPF using the policy which forms the basis for impact assessment and the requirement for mitigation measures.

Noise modelling was undertaken to assess emission levels for the MPF. The computer model established incorporates noise source information (sound levels and locations), meteorological effects, surrounding terrain, receiver locations (surrounding residential dwellings) and noise attenuation due to spherical spreading and atmospheric absorption.

The results from noise modelling were then compared against noise criteria to assess potential noise impacts.

The meteorological effects included in the modelling are those characterised as "prevailing" in accordance with EPA assessment methodologies. The definition of prevailing conditions included statistical analysis of site meteorological data (including consideration of wind speed and direction, and temperature inversions). Noise emissions were modelled for the following prevailing conditions:

- calm daytime conditions;
- autumn/winter south south-easterly evening wind conditions;
- winter south-easterly night time wind conditions; and
- moderate winter temperature inversion conditions.

A4.8.2 Noise Criteria

Construction Phase

The EPA recognises that construction noise is of relatively short duration but can be higher than operation phase noise. Accordingly, construction noise is addressed separately.

The majority of the construction activities at the MPF would be undertaken within the EPA's preferred daytime construction hours and therefore the level restrictions, at receiver locations (Figure A4-14), presented in Table A4-8 are applicable.

In addition to the above daytime criteria, the $L_{A10(15minute)}$ noise level emitted by construction works undertaken outside the above construction hours should not exceed the relevant rating background level (RBL) during the period by more than 5 dBA, independent of the duration of the construction activity.

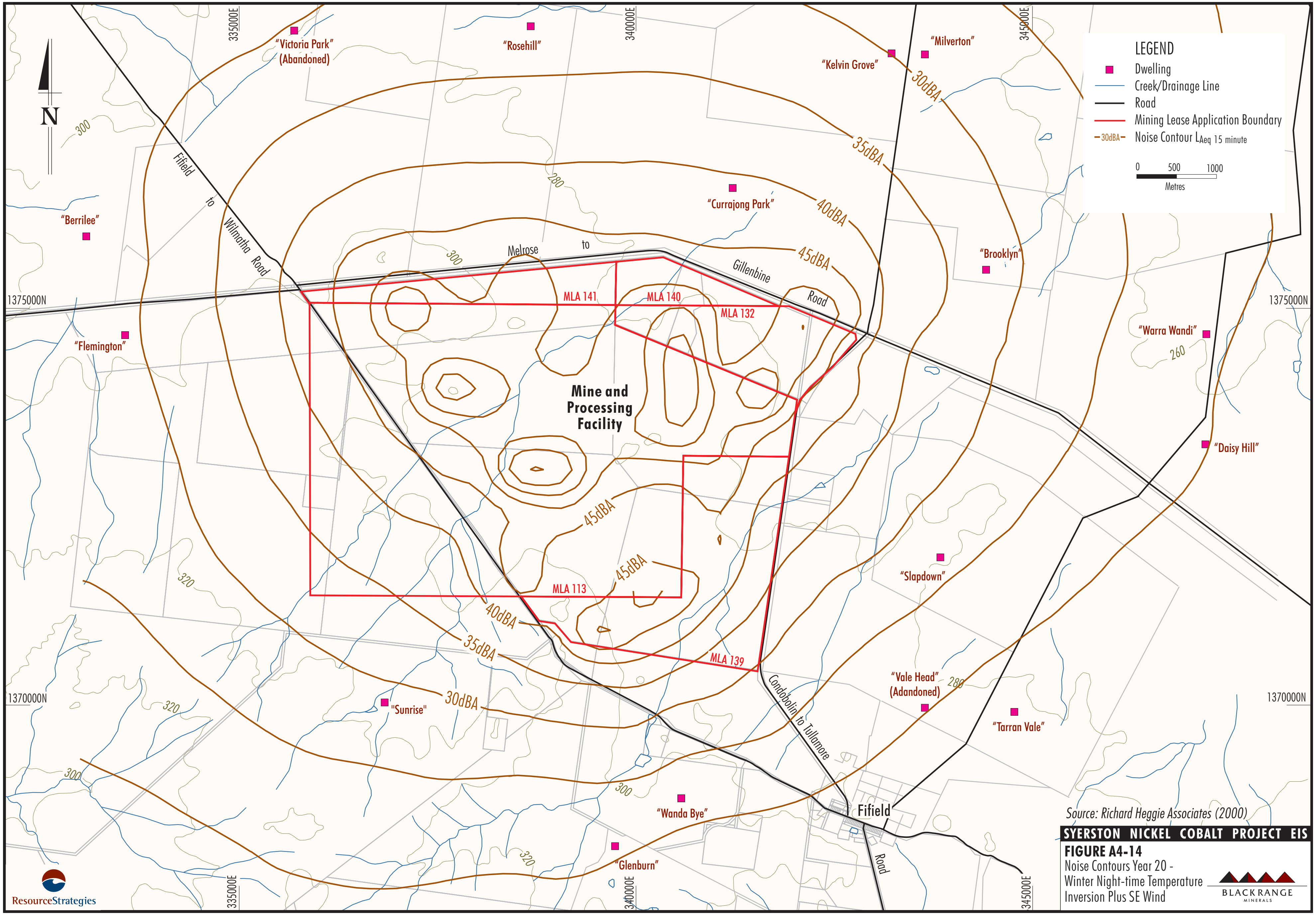

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Table A4-8
$L_{A10(15minute)}$ Construction Noise Assessment Criteria – dBA

Receiver Location	Cumulative Period of Exposure/Noise Assessment Criterion $L_{A10(15minute)}$		
	<4 Weeks 0700 - 1800 hrs	**4 to 26 Weeks 0700 – 1800 hrs**	**>26 Weeks 0700 – 1800 hrs**
BG1 (“Wanda Bye”)	54	44	39
BG2 (“Sunrise”)	55	45	40
BG3 (“Currajong Park”)	55	45	40
BG4 (“Warra Wandi”)	51	41	36
BG7 (Fifield)	51	41	36

Source: Richard Heggie Associates (2000)

Operational Phase

The operational noise emission criteria for receiver locations (Figure A4-14) surrounding the MPF site are presented in Table A4-9. These are based on intrusiveness criteria ($L_{Aeq(15minute)}$) which are the controlling noise criteria.

A4.8.3 Assessment Areas

Background noise levels were nominated for residences surrounding the MPF site based on the background noise monitoring (Section A3.6). These residences form the basis for assessing MPF noise emissions and their locations are shown on Figure A4-14. They include:

- “Brooklyn”;
- “Currajong Park”;
- “Rosehill”;
- “Flemington”;
- “Sunrise”;
- “Wanda Bye”;
- “Glenburn”;
- Fifield;
- “Warra Wandi”; and
- “Slapdown”.

A4.8.4 Noise Emissions Associated with the MPF

Potential Impacts During Construction and Mining

Noise emissions have been modelled for daytime construction (Year –1), and daytime, evening and night time for operations (Years 5 and 20) at the residences listed above. Modelling has assumed concurrent operation of mobile equipment and processing plant under the prevailing meteorological conditions.

The results of the modelling (for prevailing meteorological conditions) are summarised below:

- Noise emissions during construction are below the recommended criteria at all locations listed above.

Table A4-9
Mine Operational Noise Emission Criteria – dBA

Receiver Location	Period (Monday to Sunday) – Hours		
	Intrusiveness Criteria $L_{Aeq(15minute)}$		
	0700-1800	**1800-2200**	**2200-0700**
BG1 (“Wanda Bye”)	39	41	35
BG2 (“Sunrise”)	40	40	35
BG3 (“Currajong Park”)	40	35	35
BG4 (“Warra Wandi”)	36	39	35
BG7 (Fifield)	36	35	35

Source: Richard Heggie Associates (2000)

- Noise emissions during Year 5 are below the recommended criteria at all locations listed above except for "Currajong Park" during the evening (predicted 1 dBA/2 dBA exceedance) and night time (predicted 1 dBA/3 dBA exceedance).
- Noise emissions during Year 20 are below the recommended criteria at all locations listed above except for "Currajong Park" during the evening (predicted 3 dBA/4 dBA exceedance) and night time (predicted 3 dBA/5 dBA exceedance).

Figure A4-14 presents the predicted noise emission contours for Year 20 mine operations under the prevailing meteorological conditions of winter night time temperature inversion plus south-easterly wind.

Mitigation Measures

Confirmatory monitoring is proposed throughout operations (Section A6), notably later during the MPF life, when exceedances of up to 5 dBA at "Currajong Park" are predicted. This would be followed by actions such as the attenuation of noise at the source or at the receiver. Attenuation may take the form of earthen bunds on the MPF site or noise controls on mobile equipment. Property acquisition could also be undertaken.

A4.9 ABORIGINAL HERITAGE

A survey and assessment of Aboriginal artefacts associated with the MPF site was undertaken in consultation with the Condobolin LALC (September 1997 survey) and the Wiradjuri RALC (December 1999 and April 2000 survey), and is reported in Appendix L.

Four Aboriginal sites were identified within the MPF site (Figure A3-8):

Site 1

An isolated flake of milky white quartz on an eroded surface in an area of mixed regrowth of cypress pine and eucalypt, immediately to the south of the central drainage line.

Site 2

An open scatter and possible knapping floor of 7 artefacts on an actively eroding track and stock-entry point, on the northern bank of the central drainage line. All artefacts were flakes, one of orange volcanic material, one of dark indurated sandstone, two of dark brown chert, one of brown chert, one of grey-brown chert, and one of brown chert with a quartz band.

Site 3

An isolated flake of brown/red vitreous volcanic material in an actively eroding partially cleared area, adjacent to a drainage depression.

Scarred Tree

Scarred tree beside the Fifield to Wilmatha Road.

A4.9.1 Potential Impacts

Site 1 would be disturbed by the construction and operation of the MPF. The remaining sites would be demarcated to avoid disturbance.

A4.9.2 Mitigation Measures

Site recording forms would be completed for each of the four sites and lodged with NPWS for listing on the Aboriginal Sites Register. It would therefore be necessary for BRM to obtain written consent to disturb or destroy any of the sites from the Condobolin LALC or the Wiradjuri RALC as well as to obtain a "Consent to Destroy" from the NPWS.

In accordance with the *National Parks and Wildlife Act, 1974,* all artefacts, bone or discrete shell distributions uncovered during earthmoving operations would be reported to the Condobolin LALC, Wiradjuri RALC and NPWS prior to further disturbance. Work in such an area would not recommence without approval from these councils/authorities.

A4.10 EUROPEAN HERITAGE

A4.10.1 Potential Impacts

An assessment of the European heritage of the MPF site was undertaken (Appendix M) and a summary of the findings is presented in Section A3.8.

Within the MPF site, the remains of a pastoral outstation were assessed as a heritage site of local significance (Figure A3-8).

A4.10.2 Mitigation Measures

Where possible, disturbance to the pastoral outstation would be avoided (eg. during construction of the construction camp). If disturbance is unavoidable, the site would be recorded for archival purposes.

A4.11 COMMUNITY INFRASTRUCTURE AND SOCIAL ASSESSMENT

A community infrastructure and social assessment has been prepared for the MPF site (Appendix G). The aim of the study was to assess sub-regional housing and infrastructure issues associated with the proposed workforce and the findings are summarised below.

A4.11.1 Construction Phase Impacts

Workforce

Construction employment effects are normally short term with abrupt peaks and very rapid declines in the workforce. A construction workforce is highly transient and although total numbers of the workforce may appear stable this may result from equal numbers of incoming and outgoing workers. This highlights the need for flexible accommodation arrangements. Due to the size of the proposed workforce and the relative geographical isolation, a construction camp would be built.

There would be a pre-construction period of approximately 12 months for planning which would require very limited on-site personnel.

The actual construction period would be approximately 24 months in duration. Initial establishment works for the construction camp and completion of essential on-site infrastructure would be completed in 3 months and any workforce prior to this would be accommodated off-site. The size of the workforce at the third month would be approximately 180, resulting from a gradual buildup averaging 60 persons/month.

It is estimated that approximately 21% of the jobs would be filled by residents from the local area (within 100 km of the Project) (Appendix G) and the majority of skilled labour (and other skill categories) would be drawn from outside the region.

It has been estimated that in the peak year of construction the workforce would average approximately 600 employees with a peak at approximately 1,000 employees over several months.

Population and Housing

Flow-on employment of approximately 220 jobs would be created for short periods in the region during the construction period. The predicted accommodation requirements related to the Project construction phase are presented in Table A4-10.

The numbers presented in this table have been rounded from those calculated from modelling predictions presented in Appendix G.

Table A4-10
Projected Workforce, Population Increase and Accommodation Requirements During the Construction and Operational Phases

	Average for Peak Year of Construction Phase				Operation Phase			
	Workers	Total Population Increase	Accommodation		Workers	Total Population Increase	Accommodation	
			Family	Single[1]			Family	Single
Direct Employment								
Local	130	-	-	-	100	-	-	-
Non-local	480	560	50	435	270	590	190	80
Sub Total	610	560	50	435	370	590	190	80
Flow-on Employment								
Local (Consumption Induced)	140	-	-	-	340	-	-	-
Non-local (Production Induced)	80	190	80	-	190	410	130	60
Sub Total	220	190	80	-	530	410	130	60
TOTAL	**830**	**750**	**130**	**435**	**900**	**1,000**	**320**	**140**

Adapted from: Martin and Associates (2000)
[1] Construction camp

A4.11.2 Operational Phase Impacts

Operational Workforce

The operational workforce for the Project is expected to be approximately 400 full time jobs. Based on likely workforce skill requirements it is predicted that 27% of the workforce would be local and the remainder sourced from outside the region (Table A4-10).

Population and Housing

The projected increases in population and housing requirements during the operational phase are shown in Table A4-10 and are based on the projected direct workforce and flow-on multipliers calculated by Gillespie Economics (2000) (Appendix H). Flow on employment would lead to 530 additional jobs and a total population of 996 for the region (Appendix G).

Table A4-10 highlights the shift from high to low numbers of single employees which takes place between the construction and operation phases. The associated shift in accommodation requirements is also reflected.

A4.11.3 Impacts on Community Services and Facilities

Health Services

Parkes has a large district hospital and a community health centre with a range of services. This would address the needs of the construction workforce.

No significant impact on the delivery of acute hospital care is anticipated at the Condobolin Hospital as there is currently excess capacity in the system. Community health services may experience some increase in demand during the construction phase due to the presence of a large construction workforce and the relatively remote location of the construction camp.

No significant impacts on hospital services or community health services are anticipated during the operational phase as there would be adequate time for normal planning procedures to occur.

It is anticipated that the Project may lead to a gradual additional demand being placed on community support services and facilities, particularly in the Condobolin area as the level and range of services is not as broad as those offered in Parkes.

School Facilities – Operational Phase

The number of children anticipated to go to Parkes is relatively large (161). The size of the existing school population (total enrolment in 1997 was 2,800) in Parkes itself and the presence of a large private college in Forbes suggests that significant capacity problems in any one school would not be anticipated. The number of children attending Condobolin schools could increase by approximately 50 and the number of schools and childcare facilities are considered adequate to cater for the increased need.

Workforce

It is noted above that there would be a proportionally large non-local component of the direct workforce. Labour would probably be attracted to the region as part of the continuing multiplier effect.

The assumptions used for the impact estimates on population, accommodation and community facilities for the Project reflect the need to plan for a higher non-local component for both phases of the Project.

A4.11.4 Mitigation Measures

Population and Housing

The likely demand for housing in Parkes associated with the Project workforce and flow on employment would be a total of 344 housing units (241 units suited for married couples/ families and 103 single units). As Parkes has an estimated 500 housing units available for sale or rent and the normal annual rate of residential building activity in Parkes in recent years has been in the vicinity of 70-100 building applications, the increase in demand could be accommodated. In Condobolin, the estimated demand in housing units associated with the Project would be 110 units in a town that normally processes around 20 building applications per year. The approximate housing stock available in the town is currently around 50 housing units. Therefore the housing sector would need to improve to accommodate the increased activity.

Community Infrastructure and Services

As the construction workforce may have different health and welfare needs to the existing population, on-going liaison with the NSW Department of Health and Community Services is recommended to ensure that existing services are rationalised to the extent possible, to offer appropriate services to the incoming population. Areas of community support that should be reviewed further are women's counselling and support services and social and counselling services. Emergency health requirements would be serviced by an on-site registered nurse stationed at a first-aid station and supported by trained para-medical site personnel and an ambulance.

In the larger towns of Parkes and Condobolin the other elements of community infrastructure such as education, health, other community services and recreational services appear to have sufficient excess capacity to accommodate the increase in population and housing that would accompany the Project.

In order to ensure that adequate levels of service are maintained in the communities affected by the Project, on-going liaison with the relevant Government authorities (eg. Education and Training, Health and Community) would occur.

A4.12 REGIONAL ECONOMIC IMPACT AND BENEFIT COST ANALYSIS

The detailed economic impact and benefit cost analysis of the Project is discussed in Appendix H.

The establishment and operation of the Project would stimulate demand in the local and regional economy leading to increased business turnover in a range of sectors and increased employment opportunities. Towns that can provide the inputs to the Project and/or the products and services required by employees would benefit from the proposal by way of an increase in economic activity.

A4.12.1 Regional Economic Impact

Project Construction

Economic activity associated with the construction phase could essentially occur in the building, construction and the metal/machinery/equipment manufacturing sectors. In the order of $300M is projected to be plant and equipment costs and $329M as building and construction expenditure.

A regional economic impact analysis using input-output analysis, estimated that the peak year of the construction phase of the Project is likely to contribute in the order of $67M in annual direct and indirect regional output or business turnover, $35M in annual direct and indirect regional value added, including $25M in annual household income.

These particular impacts on the regional economy are only likely to be experienced for a period of around one year with lesser construction impacts felt over a further one to two years.

Project Operations

The operation of the Project is likely to contribute in the order of $351M in annual direct and indirect regional output or business turnover, $190M in direct and indirect regional value added including $41M in household income.

Annual operating costs would be in the order of $65M for reagents (ie. $9M for gas, $6.5M for limestone and $49.5M imports). In the order of $81M of production costs would be allocated between intermediate sectors within the Central West regional economy and imports. The bulk of purchases would be from outside the region, 80% of the remaining production costs were allocated to imports and the 20% of production costs would be expended within the Central West region as follows:

- 12% would be spent on mining related aspects (generally in proportion to the expenditure profile in the region for the non-ferrous metal ores sector [ie. the parent sector within which activities such as nickel and cobalt mining are located]).
- 88% would be spent on ore processing facilities related aspects (generally in accordance with the expenditure profile in the region for the basic non-ferrous metal and products sector [ie. the parent sector within which activities such as refining of nickel and cobalt are located]).

These impacts would be built up to over a number of years as scheduled production rates increase over time and may then continue for a number of years while the Project operates at full production levels.

End of Mine Life

The construction and operation of the Project would stimulate demand in the local and regional economy leading to increased business turnover in a range of sectors and increased employment opportunities. Cessation of the Project would, however, lead to a reduction in economic activity.

A4.12.2 Mitigation Measures

Minimisation of the impacts on the regional economy associated with MPF cessation can occur through retention of displaced workers within the region, even if they remain unemployed. This is because even expenditure by the unemployed in the regional economy (albeit at reduced levels) contributes to final demand.

Given the long term nature of the Project it is not possible to foresee the likely circumstances within which Project cessation would occur. It is therefore important for regional authorities and leaders to take every advantage from the stimulation to regional economic activity and skills and expertise that the Project would bring to the region, to strengthen and broaden the regions economic base.

A4.12.3 Benefit Cost Analysis of the Project

In benefit cost analysis, a resource is anything that is capable of affecting the utility of individuals and the community (through direct use of the resource as well as non-use) and includes man-made as well as natural resources. To identify and measure the changes in benefits and costs or consumers and producers surpluses that may result from a proposal it is essential to examine a range of information on physical, ecological, cultural and social impacts which can be interpreted in terms of economic efficiency.

Economic Costs

Opportunity Costs

The MPF area is characterised by cleared pastoral lands predominantly used for agriculture. There is an opportunity cost associated with using this land for mining, ore processing and associated activities, instead of using it in its next best use permissible under the existing landuse regulations. An indication of the opportunity cost of the land can be gained from its current market value. Nevertheless, it should be noted that the value included is likely to overestimate the opportunity cost of the land, since the purchase price is often greater than the true market value.

For the purpose of this analysis it is assumed that all plant and machinery would be newly purchased with the opportunity cost of this plant and machinery captured by its market values as opposed to the use of existing equipment.

Capital Cost of Project Establishment, Construction of the Processing Facility and Associated Infrastructure Establishment

The capital cost of the mine establishment (summarised in Table A4-11, for details see Appendix H), construction of the processing facility and associated infrastructure is estimated to be approximately $629M expended over a three year period (ie. $119.4M in Year 1, $319.5M in Year 2 and $190.1M in Year 3).

Table A4-11
Capital Cost of Project Establishment

Capital	Cost
Direct Costs	$405,677,845
Indirect Costs	$98,672,791
Owner's Costs	$124,744,164
TOTAL Development Capital	$629,094,800

Source: Gillespie Economics (2000)

Annual Operating Costs of the Project

Total operating costs vary from year to year but are in the range of $115M to $143M per annum (excluding royalty payments) including $25.5M in payments to labour.

Royalties are a cost to BRM, however, they are part of the overall producer surplus benefit of the mining activity that is redistributed by government. They are therefore not included in the calculation of the resource costs of Project operation.

Rehabilitation Costs

Operating costs referred to above, include an allowance for on-going rehabilitation related to the progressive rehabilitation of disturbance areas during mining operations, infrastructure decommissioning and final rehabilitation. The rehabilitation objectives of the Project are to provide a landform, which is stable and compatible with sustainable end landuse objectives. This includes a landform that contains mining and processing wastes in the long term and achieves an acceptable standard of surface and groundwater quality both on and off the Project sites.

Economic Benefits

The analysis indicated that the total net quantified production benefits of the Project are likely to have a net present value in the order of $1,176M, with $762M of these benefits accruing to Australia. This figure of $762M represents the minimum opportunity cost to Australian society of not proceeding with the proposal. This is a minimum opportunity cost as some of the potential production benefits of the proposal remained unquantified, namely benefits associated with utilising labour that would otherwise remain unemployed.

Alternatively stated, any environmental externalities from the Project, after mitigation by BRM, would need to be valued at greater than $762M to make the proposal questionable from an economic efficiency perspective.

To put this threshold value in some context, every household in the region of Forbes, Lachlan and Parkes would need to be willing to pay in order of $71,969 to avoid the identified potential environmental impacts of the Project, to make the proposal undesirable from an Australian economic efficiency perspective. Alternatively each household in the Central West Statistical Division would need to be willing to pay in the order of $11,929 to avoid the identified potential environmental impacts of the Project, to make the proposal undesirable from an Australian economic efficiency perspective. The equivalent figure for NSW households is $337.

A4.13 RISK ASSESSMENT

A Preliminary Hazard Assessment (PHA) was conducted to obtain a comprehensive understanding of the hazards and risks associated with the Project and to identify relevant mitigation measures. The assessment was conducted in accordance with DUAP criteria published in the department's Hazardous Industry Planning Advisory Paper No. 4 and is presented as Appendix B.

Potential hazards related to the MPF are discussed in this section while those hazards pertaining to associated Project infrastructure (ie. limestone quarry, transport, natural gas pipeline, etc.) are discussed in Sections B4.11 and C4.10.

The methodology for hazard analysis and risk assessment included:

- identification of hazards to the public and environment associated with the Project 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 DUAP guidelines and criteria.

A4.13.1 Potential Hazards

The hazard identification procedure included assessment of hazardous materials to be processed or stored on the MPF site. Potential hazardous incidents were then identified for discrete areas within the MPF site. These included the:

- process plant;
- steam and power co-generation plant;
- industrial gas plants;
- sulphur handling area and sulphuric acid plant;
- fuel storage areas and caustic soda storage area; and
- mining area.

Possible initiating events, consequences and prevention/protection measures were identified for the potential incidents. The large distances from the processing plant to MPF site boundaries, and to the nearest residences, were found to control the significance of the incidents and their potential hazardous impacts. The consequences of those events considered significant and with potential to impact at distances beyond the MPF site boundary were then assessed (consequence analysis). Gaseous releases, fires and explosions were identified as the most significant hazardous incidents at the MPF.

The consequence analysis incorporated release sources, release rates, release duration, meteorological data and terrain effects within a model which presented the potential effect on people, property and/or the environment.

The consequences of scenarios associated with the following were assessed:

- 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 frequency of these significant hazardous incident scenarios was then assessed and the combination of this and the above used to assess risks.

The following types of risks were assessed:

- individual fatality risk;
- injury and irritation risk;
- fire and explosion injury risk;
- societal risk; and
- cumulative risk.

Generally a conservative approach was adopted and mitigation of risk was not included in the assessment.

Individual Fatality Risk

Off-site individual fatality risk at the nearest MPF site boundary was found to be due to one event only; a major release of sulphur dioxide.

The calculated risk value for off-site fatalities compared favourably with DUAP target criteria.

Toxic Injury and Irritation Risk

The calculated toxic injury risk levels were found to be low. This low level was attributable to the conservative modelling approach, large distances and low population density of the surrounding environment.

The irritation toxic risk level was also found to be low.

Fire and Explosion Injury Risk

It was determined that there was no credible likelihood of exceeding the DUAP target criteria at any site boundaries.

Societal Risk

Only catastrophic vessel or pipe failure within the sulphuric acid plant could potentially cause off-site fatality. Given the rural nature of the land with low population density, the calculation of societal risk was not justified (ie. the likelihood of multiple fatalities was found to be very low).

Cumulative Risk

Cumulative risk is the summation of calculated levels of risk from all hazardous facilities within a particular area and given the rural location and the calculated low levels of individual fatality risk posed by the proposed facility at the site boundaries, the assessment of cumulative risk was not justified.

Risk of Domino (or Knock-on) Effects

The proposed site layout includes generous separation distances between most process areas, hence the likelihood of propagation due to thermal radiation or overpressure from fires or explosions has been found to be low. Another minor risk is the likelihood of propagation by events such as earthquakes or aircraft crashes. In the unlikely event of a domino incident the effects would largely be contained on site. As there are low off-site levels of individual fatality risk, irritation risk and injury risk, the level of risk from a domino type incidents was found to be low.

Risk to the Biophysical Environment

Given the limited number of events (large effect, short term releases) that can occur at this site with off-site impacts (due to the large distance to the nearest site boundary) and the rural nature of the surrounding area, the risk to people and other biological groups (animals, plants etc.) was found to be low. Whilst off-site effects can be expected if a major release were to occur, there were no identified whole systems or populations at unacceptable levels of risk due to the potentially hazardous events reviewed in the PHA.

Transport Risk

Potential impacts and mitigating measures relating to transport are discussed in Section B4.

A4.13.2 Mitigation Measures

The risk assessment demonstrated that most incidences related to the MPF site would have negligible impacts as a result of the distance between the processing facility and the MPF site boundary and the nearest occupied residence (SHE Pacific, 2000).

The following mitigation measures/factors reduce the potential hazardous risk imposed by the Project:

- storage tanks and handling facilities would be constructed in accordance with Australian Standard specifications, and regularly inspected;
- operators would be trained to minimise the possibility of operator error;
- instrumentation would be installed to monitor tank levels;
- potential ignition sources would be controlled and fire detection and fire fighting systems installed;
- implementation of a site security system (eg. security, personnel, gates, fencing, signage, patrols);
- low population and rural nature of the surrounding region;
- individuals can move away from the hazard (eg. drive, shelter);
- short (7-20 minutes) gaseous cloud duration;

- the implementation of internationally recognised standards, proven quality construction companies and a robust safety and security management system;
- in the event of a major hydrogen sulphide release BRM would enact an Emergency Response Plan (ERP) (Section A6) should off-site people be at risk; and
- the Final Hazards Analysis and HAZOP studies would specifically address the hydrogen sulphide and sulphur dioxide isolation systems, emergency procedures and explore additional preventative measures.

A4.14 TRANSPORT

A survey of the existing transport system and an assessment of the potential traffic impacts of the MPF is presented in Appendix C. The potential impacts and mitigation measures of traffic during the construction and operation phases associated with the MPF site is discussed below.

A4.14.1 Impact of MPF Generated Traffic

The potential impacts on local roads were assessed based on AUSTROADS level of service classification. Service levels are defined qualitatively by describing operational conditions (speed, travel time, maneuverability, traffic interruptions, comfort, convenience and safety) within a traffic stream and their perception by motorists and/or passengers.

The transport network surrounding the MPF site is shown on Figure A3-9 and discussed in Section A3.11.

Construction Phase Transport Demands

Traffic generated by the MPF construction workforce would focus on the following routes:

- the Tullamore to Bogan Gate Road (MR350) plus State Route 90 to/from Parkes;
- the Middle Trundle Road (SR 83) between State Route 90 and the Tullamore to Bogan Gate Road; and
- the Springvale Road (SR 60) and the Condobolin to Tullamore Road (MR 57 north) to/from Condobolin would be used to a lesser extent by construction workforce living in Condobolin.

At the peak of construction, traffic increases on State Route 90, the Tullamore to Bogan Gate Road, the Middle Trundle Road, the Fifield to Trundle Road and the Condobolin to Tullamore Road, to and from Parkes and Condobolin would be comparable to those estimated for the operational phase of the MPF (discussed below). This estimated construction-generated traffic is summarised in Table A4-12 and would consist of the following:

- travel by employees not resident on the MPF site;
- recreational travel by employees resident in the camp;
- bus trips to/from the airport; and
- delivery of food and other consumable supplies to the camp.

It is expected that there would be a total of some 420 vehicle trips generated per day by the MPF on average throughout the construction period with some 580 vehicle trips per day during the peak construction month. Oversize vehicles would be used to transport some of the plant equipment to the MPF site from major cities such as Sydney and Adelaide.

Operation Phase Transport Demands

Approximately 550 vehicle movements are forecast for the operational phase of the MPF.

Raw Material

The schedule of raw materials and product to be transported is detailed in Appendix C. An estimated 49 road material movements to and from the MPF site are predicted daily, excluding those associated with the rail siding and limestone quarry (described in Part B of this EIS).

Employee Traffic

Employee traffic on roads leading to and from the MPF would be determined by the distribution of employee residences, the number that attend work each day and the proportion that drive cars. It is estimated that approximately 294 employee vehicle movements would be generated per weekday and less on weekends and public holidays. Peak weekday employee traffic is expected between 6.00 am and 7.00 am and 6.00 pm and 7.00 pm, with the majority of traffic between the MPF site and Parkes (65%) and Condobolin (29%).

Other MPF Traffic

Other traffic visiting the MPF during the operational phase would include daily consumables, locally sourced spare parts and equipment, maintenance contractors, MPF staff visiting off-site facilities, regulating inspectors and general visitors.

Approximately 100 vehicle movements per day (90% towards Parkes and 10% towards Condobolin) would be expected predominantly between 7:00 am and 6:00 pm.

Table A4-13 summarises the potential impact of the MPF on the existing road transport system. The quality of service on most roads serving the MPF would remain satisfactory (Appendix C). Of the nine roads directly affected by traffic associated with the MPF (Table A4-13), only three would have a reduction in the quality of service:

- the Middle Trundle Road (SR 83) (gravel section east of Tullamore to Bogan Gate Road);
- the Melrose to Gillenbine Road (SR 44) (east of the Springvale Road, worst case scenario assumed due to no available data); and
- the Fifield to Wilmatha Road (SR 34) (south of the Melrose to Gillenbine Road, worst case scenario assumed, as above).

A4.14.2 Mitigation Measures

In addition to the proposed roadworks associated with the materials transport route (Section B2), the following mitigating measures are proposed (Appendix C) to improve the transport network affected by the MPF.

Appropriate sections of the Melrose to Gillenbine Road and the Fifield to Wilmatha Road between the Springvale Road and the MPF site would be sealed. In addition, the usage of the Middle Trundle Road by light traffic associated with the MPF would necessitate the sealing of some 15 kilometres of road.

Heavy vehicles would be required to use the nominated route through Bogan Gate on State Route 90 and the Tullamore to Bogan Gate Road.

Some intersections along the roads to and from Parkes and Condobolin would be upgraded to provide sheltered right turn bays and appropriate truck turning radii. Improvements at the following intersections are considered necessary:

- State Route 90/Tullamore to Bogan Gate Road – AUSTROADS Type C intersection;
- State Route 90/Condobolin to Tullamore Road – AUSTROADS Type C intersection; and
- Springvale Road/Condobolin to Tullamore Road – AUSTROADS Type B intersection if the Springvale Road is retained as the cross of the T-intersection.

Intersection upgrades proposed along the Fifield to Trundle Road are discussed in Section B4.10.2.

Lighting should be provided at the intersections of the Condobolin to Tullamore Road/Fifield to Trundle Road.

Appropriate signage complying with the relevant standards would also be provided at new and upgraded intersections.

Table A4-12
Construction Traffic Estimates (vehicles/day) for Peak and Average Periods

	Average Period			Peak Period		
	Heavy	**Light**	**Total**	**Heavy**	**Light**	**Total**
Workforce	22	106	128	34	212	246
Major Equipment & Supplies	15	-	15	24	-	24
Other Traffic	90	180	270	100	200	300
Total (rounded up)	**130**	**290**	**420**	**160**	**420**	**580**

Source: Masson Wilson Twiney (2000)

Table A4-13
Existing and Future Daily Traffic Volumes on Affected Roads

Road	Location	Existing Daily Traffic Volume (vehicles/day)		Future Daily Traffic Volume (vehicles/day)		Existing Quality of Service	Future Quality of Service
		Total	Heavy(1)	Total	Heavy		
State Route 90	East of Bogan Gate	792	95	887	190	Good	Good
MR 350	Bogan Gate to Trundle	388	47	485	142	Good	Good
SR 83	East of MR 350	99	12	340	12	Fair/Good(2)	Poor/Good(2)
MR 57 Nth	North of State Rd 90	216	26	305	29	Good	Good
MR 57 Nth	North of Fifield Bypass	63	9	65	9	Good	Good
SR 44	East of SR 60	90	11	179	14	Fair(3)	Poor(3)
SR 34	South of SR 44	90	11	179	14	Fair(3)	Poor(3)
SR 60	North of MR 57 Nth	90	11	179	14	Good	Good
MR 57 Nth	South of Tullamore	164	20	170	20	Poor/Good(4)	Good

Source: Masson Wilson Twiney (2000)

(1) Assumed at 12% of total when heavy vehicle count not available
(2) Fair/poor on gravel section, good on sealed section
(3) No traffic data available, assume similar volume to Springvale Road for worst case
(4) Poor on gravel section, good on sealed section

Minor upgrades to the level crossings would be required to an appropriate level of safety. These improvements are likely to take the form of sight distance improvements or the replacement of give way signs with stop signs. Such upgrades would be conducted to the satisfaction of RTA.

The configuration of intersections, upgrades and any other modifications would be agreed with the Councils and RTA, during the detailed design phase.

Further mitigation measures associated with the potential impacts of the Project on the transport system, specifically those related to the transportation of materials from the rail siding and limestone quarry, are presented in Section B4.

SECTION A5 - REHABILITATION

MINE AND PROCESSING FACILITY

PREPARED BY
RESOURCE STRATEGIES PTY LTD

OCTOBER 2000
Project No. BRM-01\2.4
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A5 REHABILITATION

This section outlines the proposed concepts for the final rehabilitation of the MPF site. Rehabilitation concepts for the limestone quarry, rail siding, natural gas pipeline, borefields and water supply pipeline are presented in Parts B and C of this EIS.

As described in Section A2.1, the estimated total operating life of the Project is expected to be more than 30 years, however, the term of the EIS is 21 years. Consistent with this, the concepts presented in this section are for the rehabilitation of the MPF site as it would be in Year 21 (ie. the predicted extent of the open pit excavations, waste emplacements and TSF lifts at this time). Notwithstanding this, the concepts presented remain applicable to Project closure after more than 30 or more years of operation.

General arrangements showing the proposed sites for progressive rehabilitation of the MPF site are discussed in Section A2.2 and presented as Figures A2-2 to A2-5.

Rehabilitation proposals presented in this section should be regarded as preferred concepts. Post-closure rehabilitation requirements and water management provisions would ultimately be formulated in consultation and with the agreement of key government agencies and other stakeholders. Rehabilitation is a prescribed condition under the *Mining Act, 1992* and is subject to regulatory authority agreement and approval.

The finalisation of rehabilitation concepts would require the conduct of design studies and trials and would be reported in the Mining Operations Plan (MOP) (Section A6.3.2) prior to implementation. Rehabilitation trials would be undertaken over the life of the mine to refine the designs and confirm performance. The agreed rehabilitation concepts would be formulated into the rehabilitation section of the MOP. The proposals put forward in this section are therefore general concepts, maintaining a degree of flexibility to take into account future consultations, research and design.

A5.1 REHABILITATION OBJECTIVES

Rehabilitation objectives for the MPF are to:

- provide acceptable post-mine landforms with a diversity of plant species suitable for the proposed final landuse targets of grazing pastures and endemic woodland;
- construct stable landforms that cater for the long term containment of mining wastes in a manner that conforms with regulatory requirements and landuse objectives;
- prevent detrimental effects on the water quality of downstream watercourses into the long term;
- provide vegetative cover to reduce the potential for erosion; and
- provide visual enhancement of post-mining landforms and rehabilitated infrastructure areas.

A5.2 REHABILITATION PROGRAMME

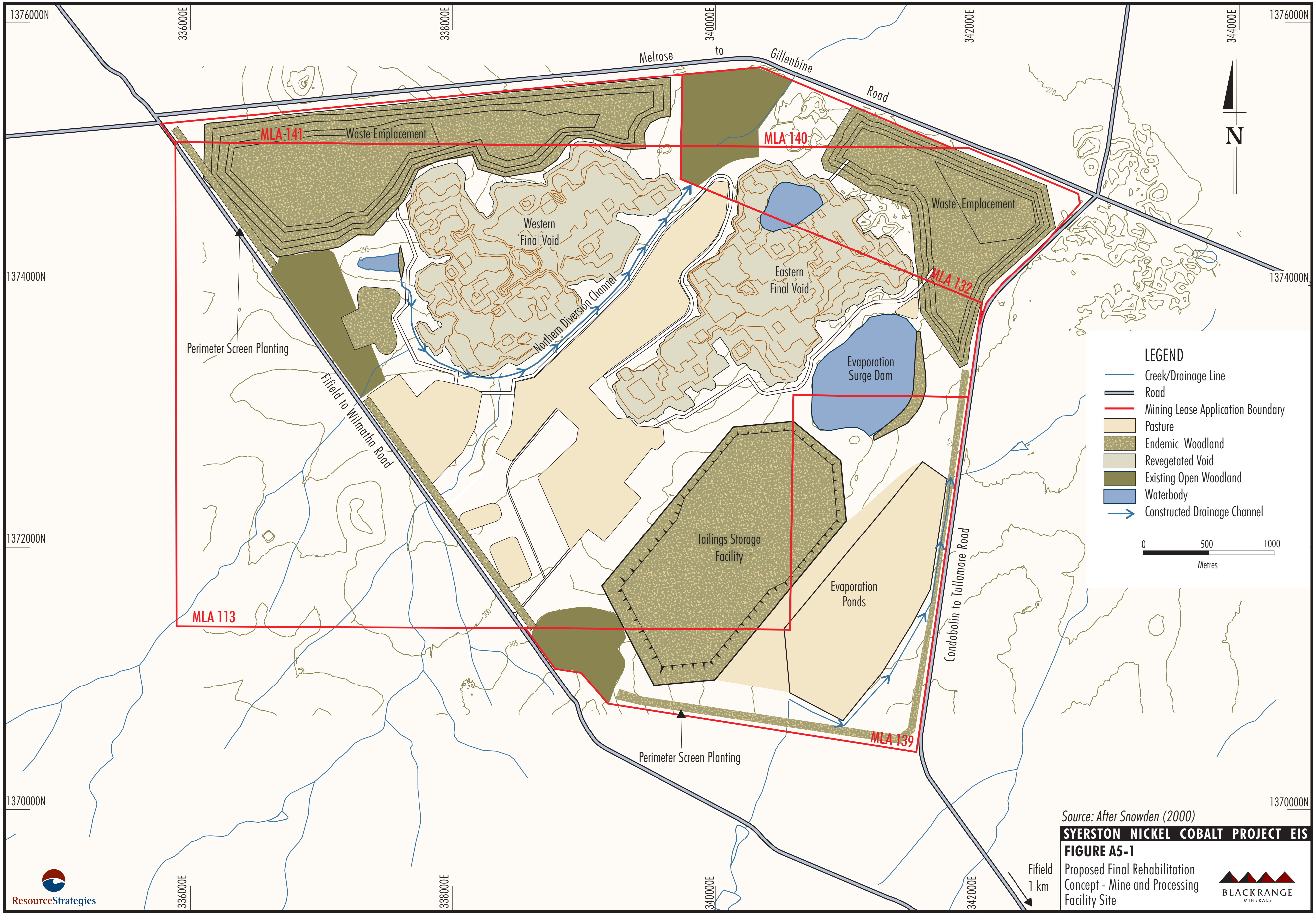
The rehabilitation programme would be developed in the MOP to ensure suitable rehabilitation options are implemented according to end landuse objectives and to include the requirements of the key authorities and other stakeholders. The MPF rehabilitation programme would be based on the following general principles:

(i) Preservation of areas of existing vegetation wherever possible.

(ii) Rehabilitation of MPF landforms is to be progressive and conducted in accordance with approved plans.

(iii) The stability of newly prepared (ie. topsoiled) landforms prior to the establishment of long term vegetation is to be protected via the construction of moisture-retaining passive drainage systems, water-holding structures (eg. surface depressions) and, where appropriate, the use of authorised hybrid cover crops to provide initial erosion protection.

(iv) Where possible, revegetated landforms are to form an expansion of, and be continuous with, existing woodland areas (Figure A5-1).



Source: After Snowden (2000)

SYERSTON NICKEL COBALT PROJECT EIS

FIGURE A5-1

Proposed Final Rehabilitation Concept - Mine and Processing Facility Site

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(v) Outer embankments of the TSF are to be rehabilitated progressively during operational years.

(vi) Livestock to be selectively excluded from rehabilitated areas not zoned for an end landuse of grazing by perimeter fencing and/or bunding.

(vii) Rehabilitation concepts should be flexible and allow for adjustments, based on trials, to improve the programme.

(viii) The annual rehabilitation programme and budget is to be prepared by a site team incorporating the MPF senior management.

A5.2.1 Land Clearance

The general arrangement of the MPF site as it develops over time is presented in Section A2.2 (Figures A2-2 to A2-5). Table A5-1 provides the approximate surface infrastructure disturbance areas within the MPF site. The total area of the MPF site is approximately 2,665 ha. The total area to be disturbed by MPF site operations is estimated to be approximately 1,450 ha. Although progressive, the majority of surface disturbance would occur in the construction phase and during the first year of mining operations.

Table A5-1
Proposed Disturbance and Soil Stockpile Areas

Description of Disturbance Area	Approximate Area (ha)
Eastern and western open pit excavations	415
Waste emplacements	400
Evaporation ponds and associated infrastructure	120
Evaporation surge dam and associated infrastructure	60
Tailings storage facility	220
Process plant, roads and associated stockpiles	175
Soil stockpiles	60
Total Disturbance	**1,450**

Land clearance protocols would be as follows:

(i) Pre-mining commitments (eg. soil conservation and erosion control plans) to be checked off for completeness.

(ii) Trees to be checked for presence of fauna (eg. roosting bats) with a relocation programme undertaken in the event that they occur, in accordance with an approved plan.

(iii) Land clearance and soil/mine waste stripping (for rehabilitation and construction purposes) is to be progressive in accordance with the stripping procedures discussed in Section A5.2.2.

(iv) Individual trees or areas not to be disturbed are to be preserved and protected (eg. by tape and signage) where possible to enhance succession into the rehabilitated areas. Areas of existing woodland which would be preserved where practicable are shown on Figure A5-1.

A5.2.2 Soil and Mine Waste Handling

Suitable topsoils and subsoils would be stripped from areas to be disturbed and would be stockpiled in accordance with procedures to be detailed in the MOP and the Integrated Erosion and Sediment Control Plan (IESCP) (Section A6.3.4). Soils would be progressively stripped and stockpiled in a manner that minimises the degradation of soil quality, including the following procedures:

- topsoil and subsoils would be stockpiled separately if different soil horizons are evident;
- stockpiles would not be located in drainage lines or trafficable areas;
- upslope surface water runoff would be diverted around soil stockpiles and ancillary infrastructure;
- stockpiling time would be minimised by prioritising the reuse of these materials;
- stockpiles would be seeded with suitable endemic grass and legume species as soon as practicable after construction, if extended storage is anticipated;
- colonising weed species would be controlled;
- stockpiled soils would be monitored and rejuvenated if necessary; and
- soil stockpiles would be located adjacent to disturbance areas.

Sufficient soil is expected to be stockpiled to enable re-application to a depth of approximately 0.5 m on the TSF, evaporation ponds and waste emplacements and approximately 0.2 m on other MPF landforms including decommissioned infrastructure areas (Appendix O). Assessment of appropriate cover strategies for all landforms would be the subject of research over the Project life. Where appropriate and feasible certain areas of the final void landforms may have soil re-applied to facilitate revegetation. The depths of cover stated above are considered a conservative provision for rehabilitation works.

A5.2.3 Erosion and Sediment Control Works

An IESCP would be developed prior to the commencement of construction, in consultation with the relevant authorities (Section A6.3.4). The IESCP would specifically address erosion and sedimentation control requirements prior to construction, during the operational phase and post-closure (until rehabilitated landforms stabilise).

A description of the MPF water management systems is presented in Section A2.11 and in Appendix D. Runoff from areas upslope of the western pit would be diverted around the eastern limit of the pit by the northern diversion channel. This northern diversion channel would discharge to the natural drainage line within the existing State Forest at the northern limit of the site (Figure A5-1). The northern diversion channel would be armoured (where necessary) and stabilised by revegetation. The northern diversion may remain as a permanent water management structure (Section A5.3.2).

Suitable rock would be placed in constructed rip-rap or gabion baskets at key locations such as drainage confluences and outfalls to maintain long term channel stability. Where appropriate, sediment control dams constructed in accordance with the IESCP would remain as water sources for native fauna and stock, post-mine closure.

A5.3 FINAL LANDFORM AND REVEGETATION CONCEPTS

This section presents preferred concepts for rehabilitated landforms and revegetation procedures. These concepts would be further developed over the life of the MPF utilising the outcomes of on-going consultation with relevant authorities, other stakeholders and the results of rehabilitation trials.

The final landform concepts presented in this section are proposed to provide a balanced rehabilitation outcome, recognising the alternative landuses that exist in the region and aiming to establish a combination of grazing land and endemic woodland on final landforms.

Final landform concepts are depicted in Figure A5-1. Final landform and revegetation concepts are to be consistent with the rehabilitation objectives of grazing pastures and endemic woodland (Section A5.1). Wherever possible, it is proposed to link existing woodland areas with woodland rehabilitation areas to create an expansion of these existing areas.

A5.3.1 Infrastructure Areas

MPF infrastructure includes; the processing plant and associated infrastructure/services, a run of mine (ROM) ore stockpile and limestone stockpile pad, a sulphur stockpile, internal access and haul roads, administration and workshop buildings and sewage and water treatment plants.

These infrastructure items would be removed following the completion of mining and the foundation soils would be tested if necessary for any residual contamination (which, if found, would be removed or treated in accordance with EPA requirements). The area would then be contour ripped, topsoiled and revegetated with endemic seed and/or tubestock. Foundation slabs of certain buildings may be retained for suitable end-use goals and in agreement with the relevant authorities and other stakeholders. Alternatively, they would be excavated for disposal in the base of the void or buried as landfill in an approved manner.

The construction camp would be dismantled at the end of construction (Year 1) and a portion of the area used as a topsoil stockpile. Due to its location, adjacent to a preserved woodland area, it would be rehabilitated to an endemic woodland (Figure A5-1).

Roads that have no specific post-mining use would be ripped, topsoiled and seeded to facilitate the rehabilitation objectives of the MPF. Reagents and fuels unused at the completion of processing would be returned to the supplier in accordance with relevant safety and handling procedures.

A5.3.2 Final Voids

By Year 21, the western and eastern final voids (Figure A5-1) would be relatively shallow with surface areas of approximately 215 ha and 200 ha, respectively.

These broad open pit excavations would contain significant internal areas of irregular terrain comprising a series of benches and batter slopes. Some of these areas would present the potential for topsoiling and active revegetation. This concept would be the subject of trials during the life of the Project.

Several options would be investigated for the rehabilitation of the final voids, with the concepts to be developed subject to the outcomes of trials and consultation with the relevant authorities and other stakeholders. Potential rehabilitation concepts would include:

- flatten pit slopes where feasible as part of the mine operation. Rehabilitate flattened slopes with topsoil and native vegetation;
- leave pit slopes unchanged with direct revegetation of accessible benches;
- topsoil and revegetate selected portions of the final void floors with native grasses; and
- utilise the voids as backfill areas for mine waste.

In addition, future consideration could also include the possible use of mine voids for tailings containment.

A conceptual cross-section of the rehabilitated eastern final void and adjacent waste emplacement is presented on Figure A5-2.

As discussed in Section A5, the rehabilitation concepts presented in this section are for the MPF site at Year 21. As the estimated total operating life of the MPF is more than 30 years, the voids shown on Figure A5-1 are not at their potential final extent (ie. they are shown as they would be in Year 21).

Safety and access considerations for the final voids would be designed in consultation with the DMR and other relevant stakeholders.

Water Management

Long term water management strategies for the final voids would most likely comprise one of two options, *viz:*

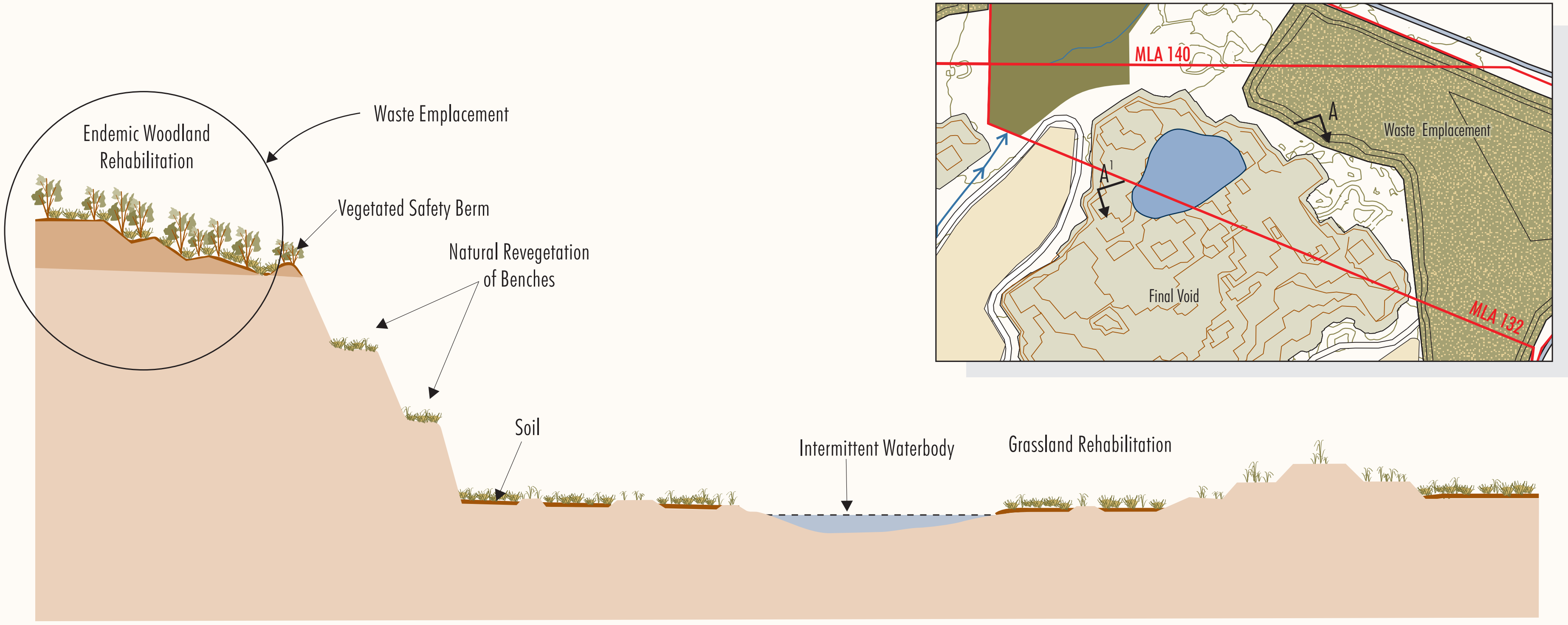
(i) maximise surface water runoff into the final voids by breaching upslope diversions and harvesting additional catchment runoff where possible; or

(ii) minimise surface water runoff into the final voids by maintaining stabilised/revegetated upslope surface water diversions (including the northern diversion channel).

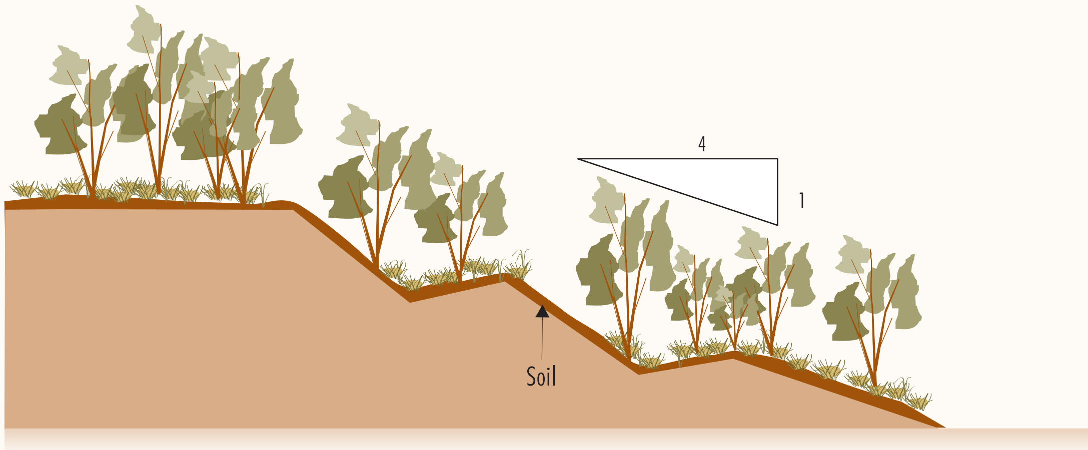
Maximisation of surface water inflows to the final voids is expected to result in the formation of waterbodies at a level equal to, or elevated above, the local water table (measured to be at approximately 240 m AHD). The minimum inverts of the eastern and western final voids are estimated to be 2 m below and 4 m above the measured local water table level, respectively. Consequently, the potential depth and aerial extent of these waterbodies would be limited. Under this scenario of maximising inflows, it would be expected that some recharge/leakage from the waterbodies to the groundwater system would occur.

Due to the relatively fresh (low salinity) nature of surface water flows in the MPF site, the water quality of waterbodies in the final voids would be expected to be generally of lower salinity than the moderate to highly saline groundwaters (Section A3.2) beneath the MPF site.

Under the minimisation of surface water inflows scenario, perennial waterbodies would most likely not occur due to the dominance of evaporation over rainfall (ie. in the order of 4 to 1). In the case of the eastern void where the invert is expected to intercept the water table by some 2 m, a slight groundwater sink may develop with a net groundwater inflow due to evaporative losses. Under such a scenario the salinity of any waters in the eastern final void would trend upwards due to evapo-concentration effects. The final rehabilitation concept shown on Figure A5-1 show the northern diversion channel still in place (ie. inflow minimisation scenario).



CONCEPTUAL CROSS SECTION A - A'



WASTE EMPLACEMENT

Not to scale

SYERSTON NICKEL COBALT PROJECT EIS

FIGURE A5-2

Conceptual Cross Section - Waste Emplacement & Eastern Final Void

BLACK RANGE MINERALS

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A5.3.3 Tailings Storage Facility

The TSF rehabilitation objectives are to:

(i) Establish permanently stable landforms with approximate overall slopes in the order of 1V:4H.

(ii) Establish vegetative communities which are endemic to the region and which enhance remnant habitat extension opportunities.

(iii) Exclude widespread intensive grazing and primary production by the creation of an endemic woodland area.

Upstream lifting of the TSF embankments would facilitate progressive rehabilitation of the external batters over the life of the MPF. Rehabilitation of the top surfaces can only be undertaken at the completion of its operational life. Rehabilitation techniques would be determined through experimental trials. Rehabilitation concepts for the batters and top surface are described in more detail below.

Tailings Storage Facility External Batters

Rehabilitation concepts for the TSF batters are shown in Figure A5-3. The rehabilitation procedures and features are as follows:

(i) Overall external batter slopes of approximately 1V:4H.

(ii) Progressive rehabilitation of the batters would commence following the completion of each embankment lift.

(iii) Drainage on the batters would be facilitated by the construction of berms to reverse grade, and be left rough to enhance absorption. The berms would longitudinally fall to low depressions constructed every 50-100 m along the berm to cater for high rainfall events.

(iv) Ripping to create surface roughness and absorption prior to revegetation operations would be undertaken.

(v) Topsoil of approximately 0.5 m in depth would be placed on the TSF.

(vi) Initial revegetation would be undertaken using native and introduced grasses to facilitate rapid stabilisation.

(vii) Final long term revegetation would comprise the use of native species to re-establish endemic woodland with shrub and grassland communities.

Tailings Storage Facility Top Surfaces

At the completion of discharge into the TSF, the tailings surfaces would form a low, internally draining landform. The controlled placement of cover materials would be used to facilitate the development of a number of surface swale drains to minimise the potential for erosion. The storage surfaces would form contained catchments (ie. would not spill over the batters). Surface materials, a passive drainage regime and revegetation would maximise water storage and/or evapotranspiration.

Experimental trials would be undertaken to refine the rehabilitation cover system. Options for surface treatment prior to revegetation would include:

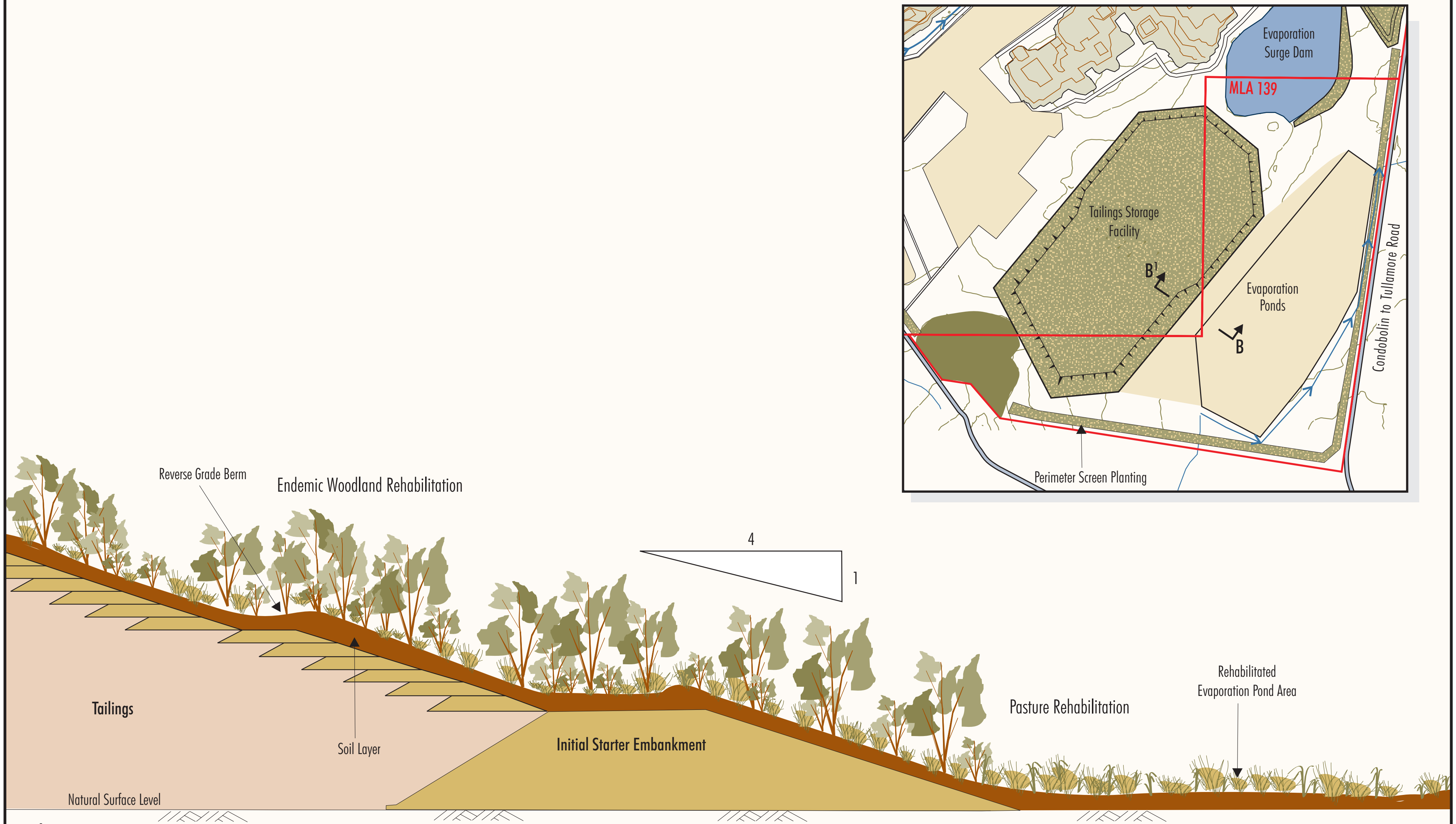
- placement of mine waste material to serve as a stabiliser and to enhance soil and vegetation trapment;
- covering the tailings surface directly with variable thicknesses of soil; and
- direct planting into tailings without the establishment of a soil cover.

The results of surface treatment trials and consultation with relevant stakeholders during the mine life would determine the final tailings surface treatment option selected. The rehabilitation concepts shown on Figure A5-3 are for the end landuse objective of endemic woodland with shrub and grassland communities.

Tailings Storage Facility Infrastructure

At the completion of processing, tailings disposal infrastructure would be rehabilitated as follows:

- The decant area would be allowed to dry and the decant tower would be permanently capped with fill and/or a concrete plug.
- The underdrains and associated sumps (which previously conveyed decanted water to the evaporation ponds) would be grouted.
- The tailings discharge pipes and other infrastructure would be dismantled for reuse or disposal with the bulk of MPF infrastructure.



CONCEPTUAL CROSS SECTION B[1] - B

Not to Scale

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FIGURE A5-3

Conceptual Cross Section - Tailings Storage Facility & Evaporation Ponds

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- The TSF would be fenced to prevent stray stock from foraging on seedlings and disturbing the revegetation process until completed.

A5.3.4 Evaporation Ponds

Rehabilitation of the evaporation ponds (approximately 120 ha) would be undertaken in accordance with MPF rehabilitation principles and the post-mining landuse objectives. Figures A5-1 and A5-3 depict the final rehabilitation of the evaporation ponds. Any salt deposits on the base of the ponds would be removed and placed in the TSF at the completion of processing.

Two options are suggested for the post-mining landuse of the evaporation ponds area, *viz*:

(i) remain as water storage infrastructure for future landuse opportunities (eg. stock watering or crop irrigation); or

(ii) rehabilitated to the end landuse of grazing pastures.

Rehabilitation of the evaporation ponds would consist of breaching of the internal partition embankments and the north-eastern external embankment to allow drainage in a north-easterly direction along a swale exiting the MLA boundary beneath the Condobolin to Tullamore Road (Figure A5-1). Internal and external embankments and batters would be flattened to a maximum slope of 1V:3H (Figure A5-3). The post-mining landuse option of grazing would be achieved by the addition of soil and pasture seeds.

Evaporation Surge Dam

The rehabilitation concept for the evaporation surge dam would be to retain it as a water storage facility. The upslope diversion channel to the west of the storage and the internal pond partitions would be breached to allow surface water inflows to pond against the main embankment (Figure A5-1). Any salt crystals on the base of the dam would be removed and placed in the TSF at the completion of processing.

A5.3.5 Waste Emplacements

Batter drainage would be via the use of wide reverse-graded berms, located every 10 m in vertical height. The berms would diffusely grade inwards and the surfaces would be kept as rough as possible to maximise absorption, to avoid the use of artificial drainage structures on the batters. Drainage on the top surfaces of the emplacements would be similarly managed via a series of small shallow basins (depressions), and woodland vegetation with a high water demand. The use of depressions is aimed at maximising internal drainage without creating permanent ponding. Drainage from the waste emplacement surfaces would be diverted either to the final voids or alternatively to natural drainage lines. A cross-section through the waste emplacement is presented in Figure A5-2.

The cover system selected for the waste emplacement is based on the following principles:

- the aridity of the region, whereby annual average evaporation exceeds precipitation by a factor of almost 4 to 1 and where the rainfall pattern is evenly spread over the year;
- the high water-holding capacity of the contour-shaped surfaces;
- the high absorption and water-holding capacity of the deep cover system, which is intentionally left uncompacted and with surface roughness;
- the high soil moisture usage potential of deep rooted, woodland overstorey with a shrub and understorey; and
- the non-acid forming characteristics of the mine waste material.

Revegetation Strategy

The revegetation proposals for the waste emplacements aim to re-establish woodland, shrub and grassland communities that are endemic to the region and evident in remnant patches. Rehabilitation would follow similar methodologies as the TSF, with soil placement on the mine waste followed by seeding or tubestock planting of native species.

The waste emplacements would range in elevation from approximately 300 m AHD to 330 m AHD (approximately 30 m in height) have an overall slope of 1V:4H and the revegetation plan would recognise the associations that naturally occur across the continuum of slope and elevation. Revegetation strategies would be refined through experimentation during the mine life.

A5.4 MONITORING AND MAINTENANCE

It is proposed that a rehabilitation plan would be prepared in consultation with government stakeholders and reported in the MOP and Site Management Plan (SMP) (Section A6.3). The MOP includes mining and rehabilitation operations, environmental controls and procedures required for compliance. The SMP includes procedures and protocols for the management of topsoil, vegetation, bushfires, hazards, weeds, pests and native fauna.

The management and monitoring of rehabilitation progression would be detailed in the abovementioned plans and updated periodically.

SECTION A6 - ENVIRONMENTAL MANAGEMENT AND MONITORING

MINE AND PROCESSING FACILITY

PREPARED BY
RESOURCE STRATEGIES PTY LTD

OCTOBER 2000
Project No. BRM-01/2.5
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A6 ENVIRONMENTAL MANAGEMENT AND MONITORING

A6.1 INTRODUCTION

This section presents the objectives and broad details of the environmental management and monitoring programmes proposed for the MPF. The environmental management and monitoring programmes proposed for the limestone quarry, rail siding and materials transport route are detailed in Part B, Section B6 of the EIS. Part C, Section C6 details environmental management and monitoring for the natural gas pipeline, borefields and water supply pipeline.

The proposed programmes have been formulated from the results of the environmental baseline studies and impact assessment conducted for the Project and should be considered provisional. The programmes would be subject to further development in consultation with stakeholders.

A6.2 ENVIRONMENTAL MANAGEMENT SYSTEM

In order to facilitate an integrated and structured approach to environmental management, an Environmental Management System (EMS) would be developed for the Project. The EMS would outline the organisational structure, responsibilities, practices, processes and resources for implementing and maintaining environmental objectives for the Project.

The EMS would be developed in accordance with Australian/New Zealand Standard ISO 14001 and include the following core components:

- environmental policy;
- planning;
- implementation and operation;
- checking and corrective action; and
- management review.

The planning component would review all environmental aspects, identify and evaluate legal requirements, establish environmental objectives and targets, and formalise the environmental management programme.

The implementation and operational phase would involve the following:

- definition of the EMS structure and delegation of responsibility;
- implementation of training and awareness programmes and provision of staff with appropriate education, training and/or experience;
- establishing and maintaining communication procedures;
- documenting the components of the EMS, including relevant procedures and establishing a document control system; and
- preparation of contingencies and emergency response plans.

For the checking and corrective action element, environmental records would be reviewed and the Project's performance assessed in relation to the environmental objectives. The results of the monitoring programme would be reported in the Annual Environmental Management Report (AEMR) and used to assess compliance with the requirements of the system.

The management review component would involve audits of the EMS, with respect to the requirements of ISO 14001, to ensure its continuing suitability, adequacy and effectiveness.

A6.3 ENVIRONMENTAL MANAGEMENT PLANS

Environmental management of the MPF would encompass a range of management plans. An overview of these management plans is provided below.

A6.3.1 Construction Environmental Management Plan

Due to the distinct differences in construction and operational activities, a management plan would be prepared to specifically address the activities to be undertaken during the construction phase.

The Construction Environmental Management Plan (CEMP) would establish the specific design criteria and general management strategies to be adopted during construction with respect to:

- vegetation conservation;
- erosion and sediment control;
- water management;

- soil management;
- waste management;
- storage of hazardous goods;
- air and noise aspects;
- heritage issues;
- rehabilitation; and
- environmental monitoring.

The CEMP would be prepared in consultation with key agencies and stakeholders prior to the commencement of activities.

A6.3.2 Mining Rehabilitation and Environmental Management Process – Mining Operations Plan and Annual Environmental Management Report

As part of the NSW Department of Mineral Resources (DMR) Mining Rehabilitation and Environmental Management Process (MREMP), a Mining Operations Plan (MOP) and an Annual Environmental Management Report (AEMR) would be prepared for the Project.

Mining Operations Plan

The Mining Operations Plan (MOP) provides a detailed account of the proposed development of the MPF for a nominated period. It includes all mining and rehabilitation operations and relevant environmental controls and procedures required for compliance with mining lease conditions.

The MOP is configured to provide consideration of the environment from the design stage, through to the operational stage and final closure of the MPF. The plan concentrates on short term mining operational actions while taking into consideration longer term objectives for final rehabilitation and landuse. The key areas to be identified by the MOP include:

- areas to be disturbed;
- mining method(s) to be used and their sequence;
- existing and proposed surface infrastructure;
- progressive rehabilitation methods and schedules;
- areas of environmental sensitivity;
- water management systems; and
- proposed resource recovery.

Land management aspects (such as soil resources, vegetation, bushfire hazard, weeds, pests and native fauna) would be addressed in the Site Management Plan (SMP) (refer Section A6.3.3).

Annual Environmental Management Report

The Annual Environmental Management Report (AEMR) would provide an assessment of the management and monitoring programmes being undertaken for the MPF, performance in terms of MOP requirements and recommendations for future environmental management and monitoring. Accordingly, the programme would be subject to annual review and continuous improvement as a result of stakeholder input.

A6.3.3 Site Management Plan

A SMP would be prepared to provide procedures and protocols for the management of lands associated with the MPF. It would address, but not be limited to, the management of topsoil, vegetation, bushfires, weeds, pests and native fauna. It would be subject to periodic review and appropriate revision.

Topsoil Management

This section would detail topsoil and subsoil management for MPF activities, including calculation of volumes of suitable material to be stripped, storage procedures and suitability for rehabilitation purposes.

Vegetation Management

This section would provide information on vegetation of the MPF and surrounds, proposed extent of vegetation removal/modification and mitigation measures for the preservation, protection and enhancement of flora.

Bushfire Management

The bushfire management component would include aspects relating to fuel management and fire incident control, namely:

- identification of fire hazards and assets at risk;
- identification of areas within the MLAs requiring fuel management;
- description of fuel management strategies;
- planning and implementation procedures for hazard reduction;

- detection, reconnaissance and reporting of fires; and
- fire fighting activities.

Pest Control and Weed Management

This section would identify measures to control or minimise the potential for the spread of noxious weeds. The weed species to be targetted would also be addressed and potential problem areas would be identified. It would also detail management strategies to control or minimise the potential adverse impacts pests may have on the MPF and surrounds.

Native Fauna Management

A variety of measures would be incorporated into the day-to-day management of the MPF to reduce the potential for adverse impacts on native wildlife. These measures would be outlined in the SMP and may include, but not necessarily be limited to: limiting vehicular speeds, prohibiting the introduction of animals on to the site, maintaining a clean, rubbish free environment, wildlife rescue and rehabilitation plans and inspections of the TSF, evaporation ponds and evaporation surge dam for fauna during the course of normal daily maintenance inspections.

A6.3.4 Integrated Erosion and Sediment Control Plan

The methods for the control of erosion and sedimentation in areas disturbed within the MPF would be detailed within a comprehensive Integrated Erosion and Sediment Control Plan (IESCP). The primary objective of the plan would be to control the movement of sediment from areas disturbed by mine related activities. The IESCP would be designed to address the progressive development of the site and to provide design standards for specific control measures.

A6.3.5 Air Quality Management Plan

An Air Quality Management Plan (AQMP) would provide procedures for the control of gaseous and particulate emissions from the MPF. The plan would identify emission sources and outline monitoring procedures and protocols for controls at these sources, as well as establish procedures and protocols for local area air quality monitoring. Relevant air quality objectives and regulatory requirements would be incorporated within the AQMP objectives.

A6.3.6 Waste Management Plan and Hazardous Waste and Chemical Management Plan

The Waste Management Plan (WMP) would identify site waste management practices, including the nature, generation and destination of wastes generated by the MPF. The Hazardous Waste and Chemical Management Plan (HWCMP) would provide detail on the appropriate transport, handling, storage and disposal procedures for hazardous wastes generated at the MPF site, as well as appropriate emergency response procedures in the event of spills. The HWCMP for the MPF would be linked with (and may form part of) an overall HWCMP for the Project encompassing the MPF, limestone quarry, rail siding, materials transport route, natural gas pipeline, borefields and water supply pipeline.

The plans would be utilised to investigate all avenues and potential methods of waste reduction and cleaner production consistent with the NSW Government's Waste Reduction Goals.

A6.3.7 Emergency Response Plan

An Emergency Response Plan (ERP) would be developed to assist personnel in responding to all on site emergencies, providing guidance in identifying and reacting to an emergency situation. The plan would address operational, environmental and personal safety emergencies at the MPF. As with the HWCMP this would be linked to a whole of Project ERP.

A6.3.8 Closure Plan

Prior to Project completion, a Closure Plan would be prepared for the MPF, detailing decommissioning and rehabilitation proposals. The plan would be formulated in consultation with relevant government agencies, other stakeholders and would consider:

- the requirements for stable and permanent landforms;
- final landuse options and preferences;
- landforms, soils, hydrology and ecosystems having maintenance needs no greater than those for the surrounding land;
- hazards to persons, stock or native fauna; and
- concerns of adjacent landholders.

A6.4 ENVIRONMENTAL MONITORING PROGRAMME

Key environmental issues for the MPF have been identified through specific issues investigations, mine planning and consultation with the government and community. Proposed monitoring would cover a suite of environmental factors with specific focus on the following key issues:

- meteorology (temperature, rainfall, evaporation, wind direction and wind speed);
- air quality (dust deposition, total suspended particulates and gaseous emissions);
- noise (operator attended and unattended);
- surface water (quality);
- groundwater (level, quality and use);
- erosion and sediment control (structural integrity and effectiveness);
- weed and animal pest control;
- rehabilitation performance; and
- landholder and community consultation.

The following sections detail proposed monitoring programmes addressing each of these issues. The parameters and frequency of all monitoring activities would be reviewed annually through the MREMP.

A6.4.1 Meteorology

The automated meteorological station at the MPF site would be maintained to record temperature, rainfall, evaporation, wind direction and wind speed. The station is currently situated in close proximity to proposed infrastructure and would therefore be moved to the south-east corner of MLA 139 prior to construction (Figure A6-1). The collated meteorological data would be maintained on a database to provide information relevant to environmental aspects such as noise and air quality.

A6.4.2 Air Quality

The air quality monitoring programme would be used to assess compliance of the operating mine with air quality objectives and EPA licence conditions. The programme would involve dust deposition, total suspended particulates and gaseous emissions monitoring.

Dust Deposition and Total Suspended Particulates

The dust monitoring programme would consist of six dust gauges positioned to monitor dust deposition at the nearest residences, *viz.* "Flemington", "Currajong Park", "Brooklyn", "Slapdown", "Wanda Bye" and "Sunrise" (Figure A6-1). Samples would be collected monthly and analysed for ash content, combustible matter and insoluble solids.

If required, a total suspended particulates (TSP) monitoring programme would be formulated in consultation with the EPA and other relevant authorities.

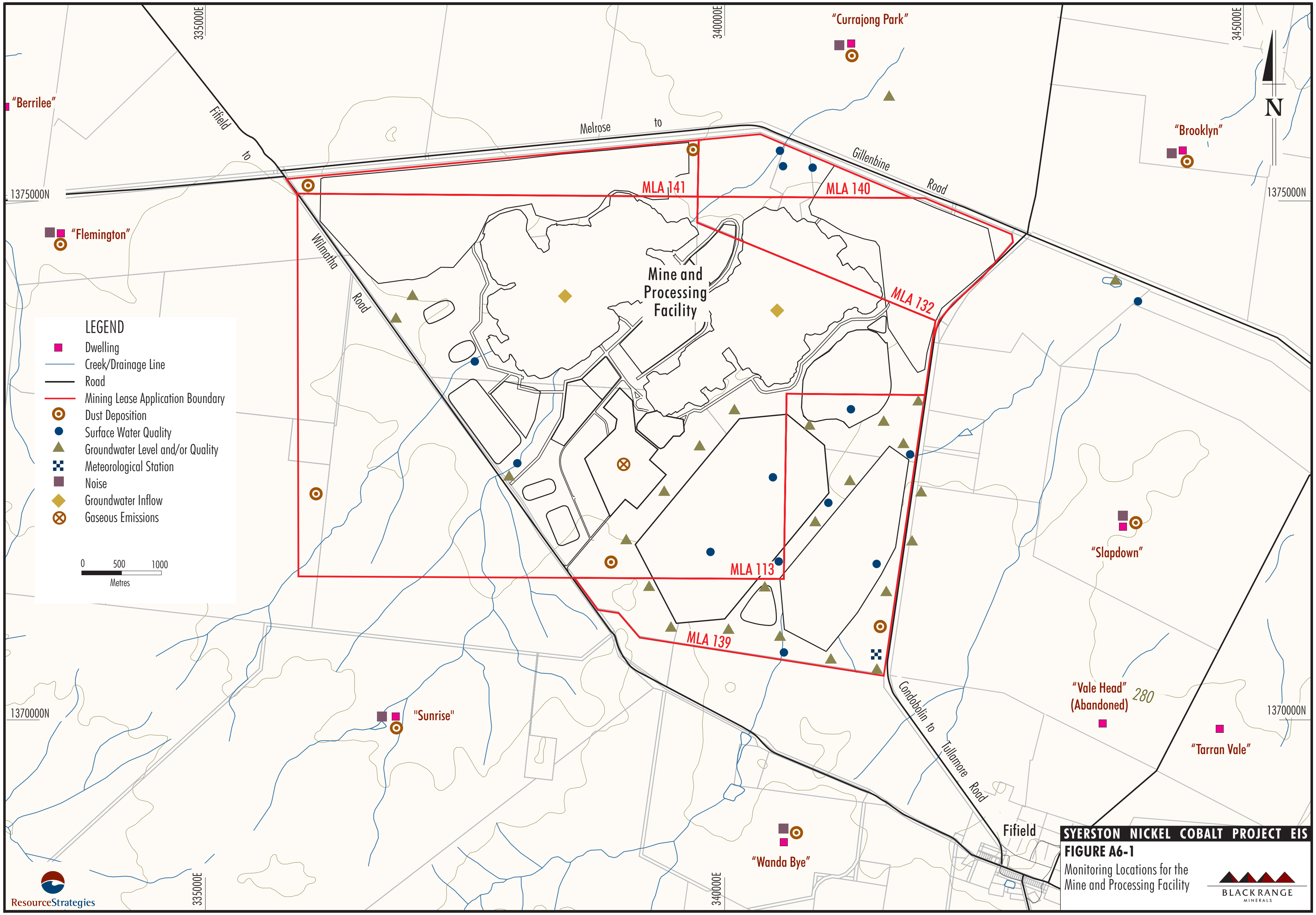
Gaseous Emissions

A routine gaseous emissions monitoring programme would be established once steady state conditions prevail in the processing plant. This programme would be designed in consultation with the EPA and other relevant authorities and is likely to include monitoring of:

- sulphur dioxide from appropriate emission points including the sulphuric acid plant stack;
- the co-generation plant exhaust for oxides of nitrogen;
- oxides of nitrogen in the hydrogen plant emissions;
- the acid pressure leach scrubber stack; and
- the nitric acid wash tank vent stack for oxides of nitrogen.

National Pollutant Inventory Reporting

The National Pollutant Inventory (NPI) is an Internet database designed to provide the community, industry and government with information on the types and amounts of certain chemicals being emitted to the air, land and water. BRM would report their emissions annually to the EPA consistent with NPI requirements.



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Greenhouse Gas Emissions

An inventory of greenhouse gas emissions would be maintained and used to assist investigations for improved energy efficiency. The output of greenhouse gas emissions would be estimated annually.

A6.4.3 Noise

Noise levels would be regularly monitored during construction and operation at selected residences in the vicinity of the MPF to verify the predictions of the noise impact assessment and assess compliance with EPA noise criteria. Noise monitoring is proposed to be conducted at the "Wanda Bye", "Sunrise"," Currajong Park", "Brooklyn", "Slapdown" and "Flemington" properties (Figure A6-1).

A6.4.4 Water Resources

Surface Water

Surface water quality monitoring would be conducted at sites along drainage lines (when flowing) for pH, electrical conductivity (EC), suspended solids, and selected metals and nutrients (up to six samples per year). Figure A6-1 presents the general locations of these monitoring sites which include current baseline monitoring locations.

Water quality samples from the TSF (decant ponds and underdrainage), evaporation ponds and evaporation surge dam would be collected and analysed for major cations and anions, total suspended solids, total dissolved solids, pH, alkalinity, EC and selected metals (Figure A6-1).

The monitoring of water contained within the erosion and sediment control structures is addressed below in Section A6.4.5.

Groundwater

A network of monitoring bores would be established during construction to monitor the potential impact of the TSF and the evaporation ponds on the groundwater table and groundwater quality (refer Figure A6-1 for general locations).

A selection of the network monitoring bores would be utilised throughout the life of the mine to monitor (monthly) a suite of groundwater quality parameters including EC, pH, major cations, major anions and selected metals.

During the first few years of operation, the entire network of bores would be monitored monthly for groundwater level, EC, pH and total dissolved solids. Thereafter, sampling would be reduced to approximately twice per year and following review through the AEMR process the number of monitoring sites may also be modified.

Groundwater inflow rates into the open pits (Figure A6-1) and the amount of water sourced from the borefields for use at the MPF would also be monitored (Section C6.3).

A6.4.5 Erosion and Sediment Control

Erosion and sediment control structures would be inspected on a regular basis and following rainfall events in order to assess the structural integrity and effectiveness of the control structures and any pumping requirements. Results of this monitoring would be used to evaluate necessary ameliorative measures.

Event monitoring of EC, total suspended solids and pH would be conducted within sediment dams and in receiving waters in the event of any sedimentation basin discharges, during or immediately following rainfall events.

A6.4.6 Weed and Animal Pest Control

Regular site inspections would be conducted to detect areas requiring the implementation of weed or pest management strategies.

A6.4.7 Rehabilitation Performance

Routine monitoring of rehabilitation activities would be undertaken to assess the condition of mine infrastructure, growth rates and performance of revegetation and the general progression of rehabilitated land.

Rehabilitation trials and research specific to the MPF would be conducted over the life of the Project and would investigate plant species selection, growth rates, surface treatments on mine landforms, directing seeding and manual planting techniques, seed harvesting techniques and fertiliser application during revegetation.

A6.4.8 Landholder and Community Consultation

Local stakeholders and relevant interest groups would be invited to participate in a community consultation programme formulated by BRM to disseminate environmental performance information and Project development updates.

BRM propose to maintain a register of environmental complaints and appropriate staff would be inducted in a formalised procedure for complaints receipt, register and response.

Both of these initiatives would be implemented on a whole-of-project basis incorporating the MPF, limestone quarry, the rail siding, the materials transport route, natural gas pipeline, borefields and water supply pipeline.

A6.4.9 Tailings Geochemistry

Notwithstanding the predicted long term non-acid forming nature of tailings (Appendix F), an on-going geochemical programme would be undertaken to confirm the long term behaviour of tailings.

A6.4.10 Post Operations Monitoring

Although the current Development Application for the Project is for 21 years, the size of the mining reserve indicates a potential mine life of greater than 30 years. Relevant monitoring programmes would be maintained post-mining, as determined in consultation with key agencies.

SECTION B1 - INTRODUCTION

LIMESTONE QUARRY, RAIL SIDING AND MATERIALS TRANSPORT ROUTE

PREPARED BY
RESOURCE STRATEGIES PTY LTD

SEPTEMBER 2000
Project No. BRM-01\2.0
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B1 INTRODUCTION

B1.1 PROJECT OVERVIEW

Section I establishes that the main text sections of this EIS are presented as three parts (Parts A to C). Part B addresses the construction and operation of the proposed limestone quarry, rail siding and materials transport route. More specifically these entail:

- quarrying, crushing and transport of limestone from a deposit located approximately 20 km south-east of the MPF site;
- construction of a rail siding on the Tottenham to Bogan Gate Railway approximately 25 km to the south-east of the MPF site; and
- upgrading of sections of existing local roads and a new section of road to connect the MPF site to the proposed limestone quarry and rail siding (materials transport route).

An overview of the Project is provided on Figure I-1.

The main components of the Project located at the MPF site are addressed in Part A and Part C addresses the natural gas pipeline, borefields and water supply pipeline.

Appendices A to O provide supporting documentation to the EIS, including a number of independent specialist reports.

B1.2 LAND TENURE

The following sub-sections provide a description of existing land tenure and alternatives considered for the Project components addressed in Part B.

B1.2.1 Limestone Quarry

The limestone quarry is situated approximately 20 km south-east of the MPF and adjacent to the Fifield to Trundle Road. A MLA covering parts of two privately owned properties has been lodged with the DMR. BRM has secured options to purchase these properties. Figure B1-1 shows the location of the MLA relative to the properties.

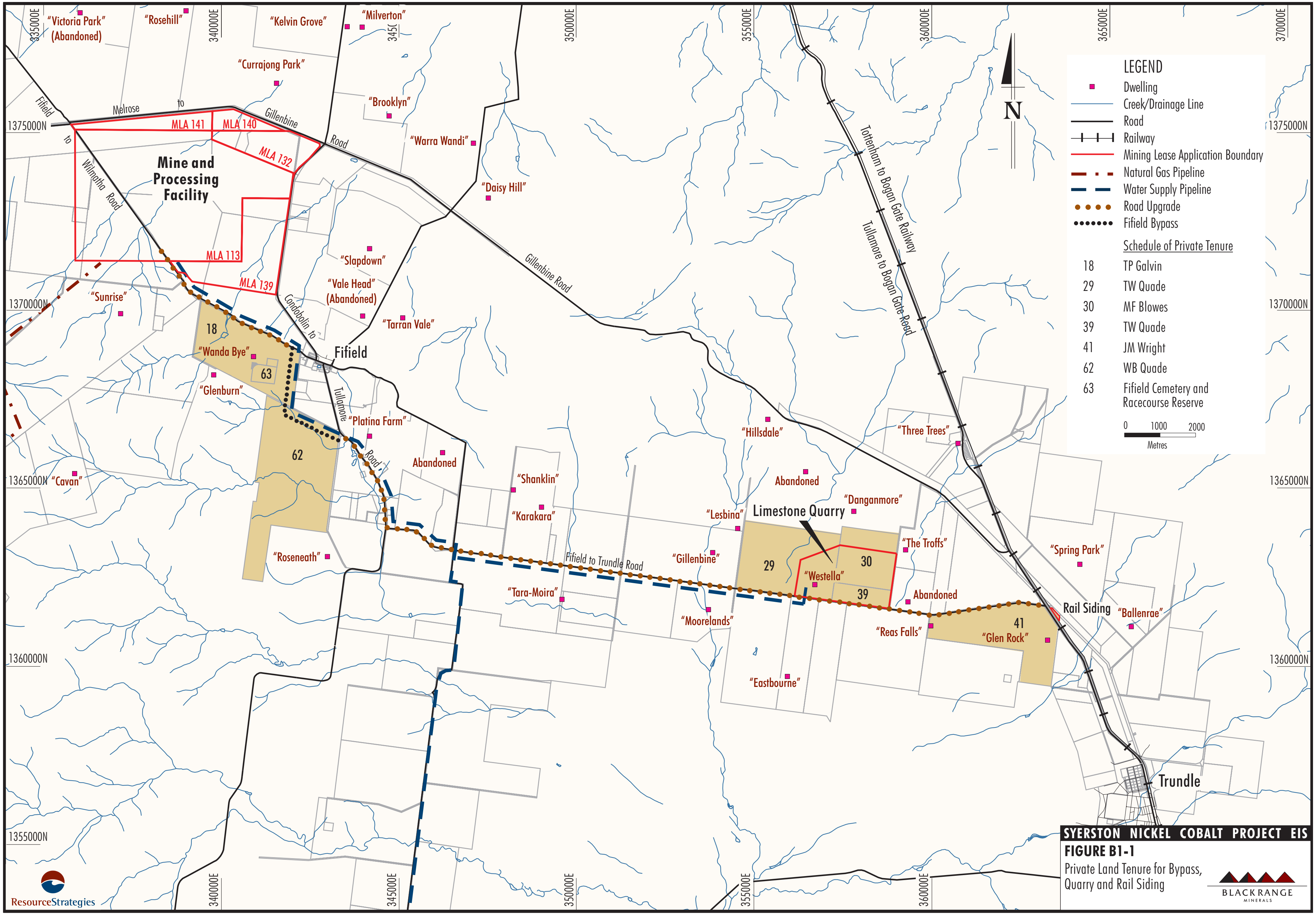
B1.2.2 Rail Siding

The proposed rail siding is situated on the eastern side of the Tottenham to Bogan Gate Railway which is located some 25 km to the south-east of the MPF site. The proposed rail siding would be situated wholly within a small portion of the property “Glen Rock” (Figure B1-1). BRM has secured an option to purchase the relevant portion of “Glen Rock”.

B1.2.3 Materials Transport Route

Heavy vehicle access to the MPF site would primarily be via the Fifield to Trundle Road, the Condobolin to Tullamore Road and the Fifield to Wilmatha Road. This route connects the MPF with the proposed limestone quarry and the rail siding (Figure B1-1). Upgrades of the road surface, width of the pavement and type of intersections along this route are proposed to service the predicted increase in traffic. A new section of road to bypass the village of Fifield is also proposed (the Fifield bypass).

The proposed upgrades to the Fifield to Trundle Road, the Condobolin to Tullamore Road, and the Fifield to Wilmatha Road are all located within existing road reserves. The proposed Fifield bypass route would be situated predominantly within private land which has been cleared for agricultural purposes. The existing private land tenure for the materials transport route is illustrated on Figure B1-1.



SYERSTON NICKEL COBALT PROJECT EIS

FIGURE B1-1

Private Land Tenure for Bypass, Quarry and Rail Siding

BRM-98-01-Pt B-S1_001F

SECTION B2 - PROJECT DESCRIPTION

LIMESTONE QUARRY, RAIL SIDING AND MATERIALS TRANSPORT ROUTE

PREPARED BY
RESOURCE STRATEGIES PTY LTD

SEPTEMBER 2000
Project No. BRM-01\2.1
Document No. PART B - SECTION 2-G.DOC

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B2 PROJECT DESCRIPTION

B2.1 LIMESTONE QUARRY

B2.1.1 Overview

The Project requires approximately 560,000 tpa of crushed limestone. The limestone would predominantly be used to neutralise process liquids and slurries, following acid leaching. In order to meet this demand, BRM is proposing to mine the Gillenbine limestone deposit, located approximately 20 km south-east of the MPF.

The deposit is located within a sedimentary sequence of shale and siltstone and extends some 1 km north-south and 1 km east-west and has been identified to a depth of 35 m. The site of the quarry is generally cleared and the elevation of the deposit is approximately 260 m AHD. The deposit is located adjacent to the Fifield to Trundle Road. Access to the limestone quarry from the Fifield to Trundle Road would be adjacent to the existing entrance to the “Westella” homestead (Figure B2-1).

Quarrying would utilise conventional open pit drill and blast methods. The limestone would be crushed to a particle size less than 100 mm before being trucked to the MPF. Waste rock and low grade limestone would be deposited in an emplacement surrounding the open pit.

The staged development of the quarry is shown in Figures B2-1 and B2-2.

B2.1.2 Construction

Prior to the commencement of quarrying, numerous construction and site preparation activities would be undertaken. These would include:

- soil stripping and stockpiling;
- construction of site offices and workshops;
- construction of water supply and water management infrastructure; and
- construction and commissioning of the crushing facility.

The construction period would extend for approximately three months.

Prior to the commencement of construction activities, detailed site management procedures for controlling surface disturbance would be developed in consultation with relevant government agencies. These procedures would include management of vegetation removal, stripping and stockpiling of soil resources and the installation of appropriate erosion and sedimentation control structures. Details of these management activities are provided in Section B4.1.2.

B2.1.3 Quarry Operation

Waste Rock Removal and Stockpiling

Waste rock would be progressively removed using an excavator and/or front-end loader. Where necessary, blasting would be used to fragment the rock. One or more pit dump trucks would be used to transport the material from the open pit to the crushing area.

Topsoil and any other material with rehabilitation potential would either be temporarily stored in one of two topsoil stockpiles (Figure B2-1) or used directly in site rehabilitation.

The low grade limestone and waste rock would be placed in an emplacement located around the margins of the open pit (Figures B2-1 and B2-2). The batters of the emplacement would be progressively rehabilitated when finalised, as would the top surface when the dump reaches its final elevation of approximately 7 m. The rehabilitation strategy for the quarry is discussed in detail in Section B5.

Limestone Extraction

The limestone would be extracted using drill and blasting methods. Low grade limestone and other waste rock (ie. overburden) would be selectively mined to minimize dilution of high grade limestone.

Following blasting, the broken material would be loaded with a front end loader and transported to the nearby crushing facility, ROM high grade limestone stockpile or waste and low grade emplacement using 40 t articulated dump trucks. The ROM high grade limestone stockpile would be maintained at approximately 40,000 t.

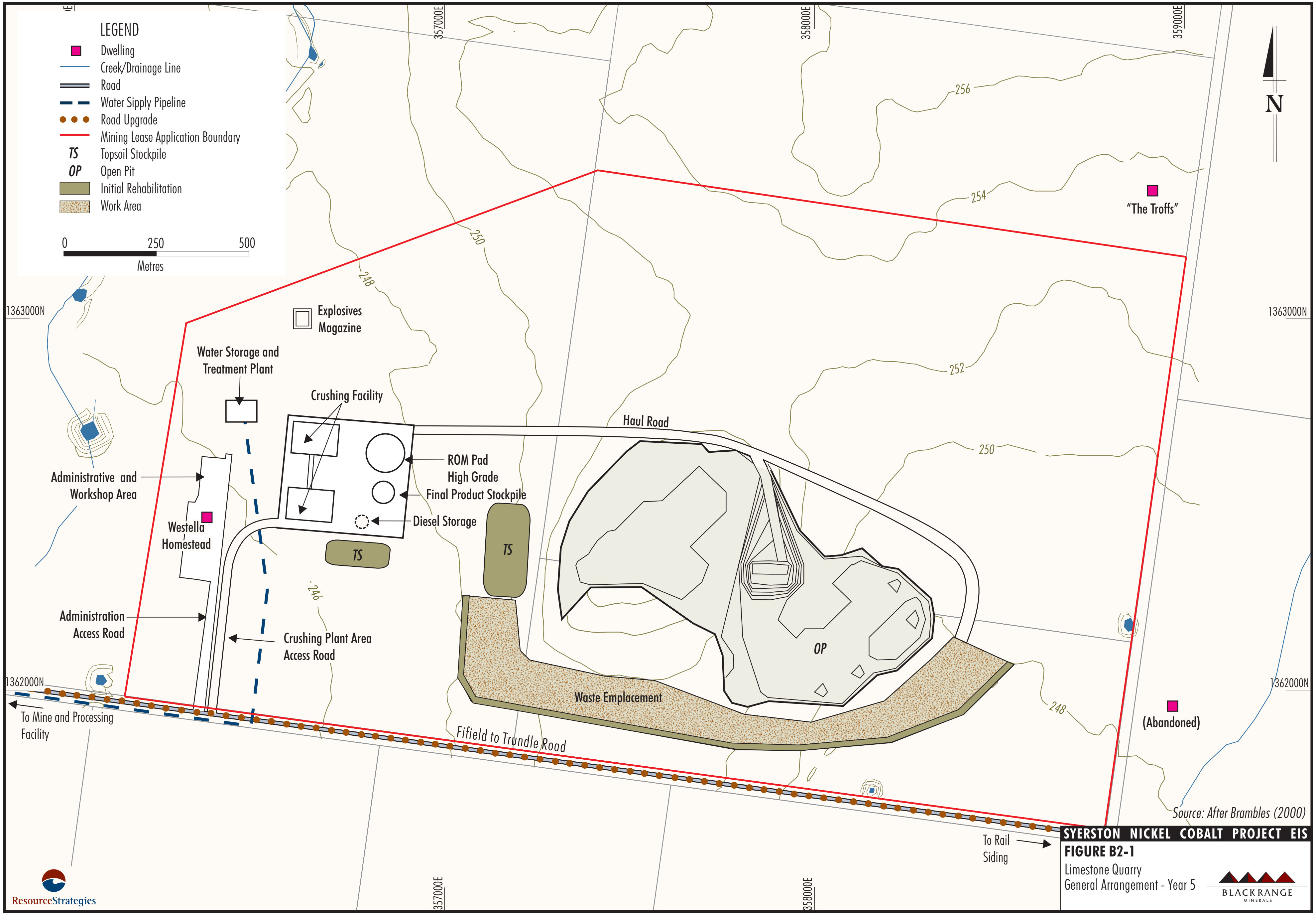

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FIGURE B2-1

Limestone Quarry
General Arrangement - Year 5

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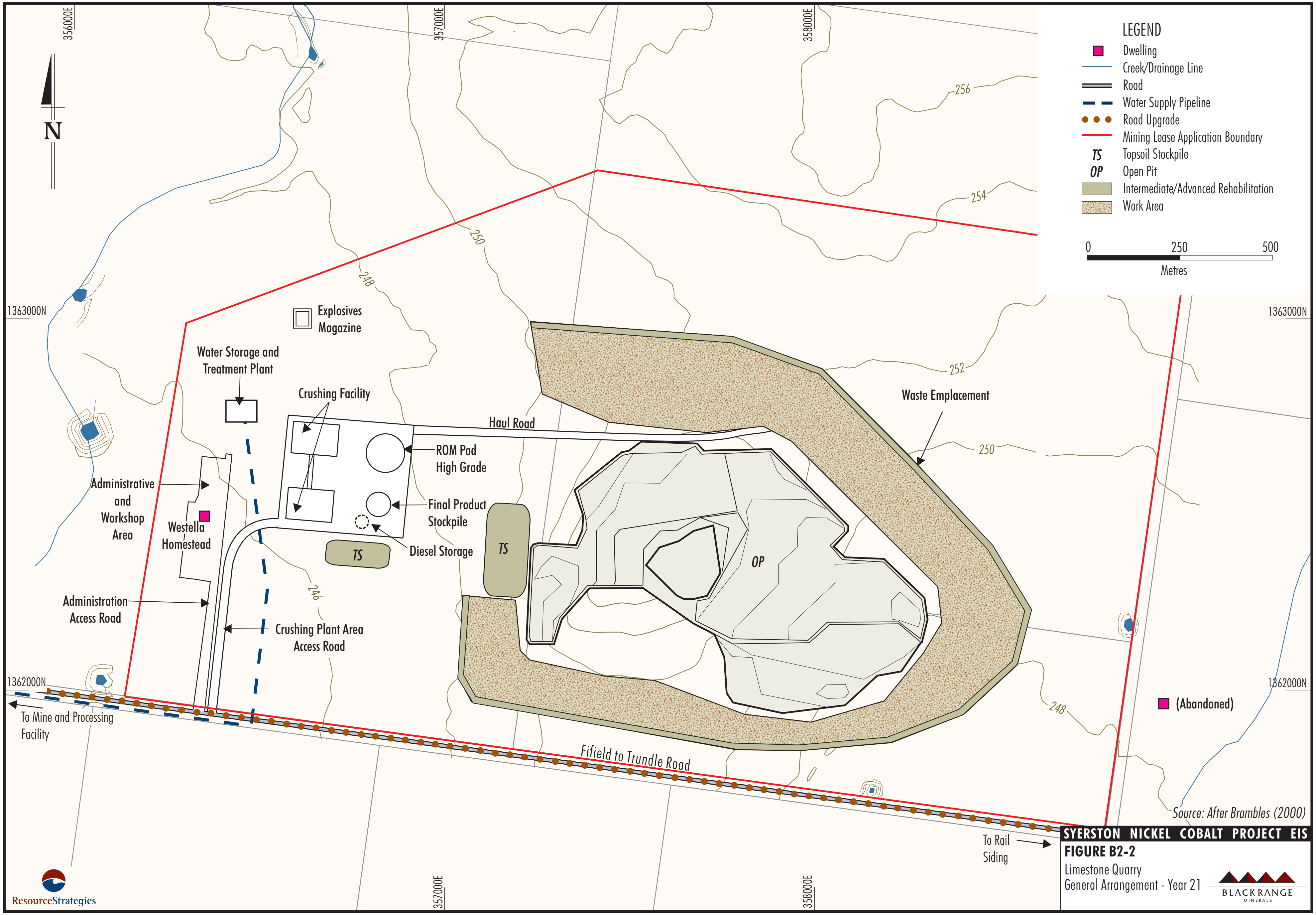

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FIGURE B2-2

Limestone Quarry
General Arrangement - Year 21

BRM-98-01-PtB-S2_002I

Table B2-1 provides the provisional mining and delivery schedule of limestone and waste rock during Years 1 to 5 of operation. From Year 5 onwards production rates would be approximately 560,000 tpa.

B2.1.4 Limestone Crushing and Screening

The ROM high grade limestone would be crushed at the quarry site prior to transport to the MPF site. The ROM stockpile material would be fed by front end loader onto a screen to separate oversize material which would be fed by conveyor directly into a 200 t/hr throughput primary jaw crusher. The primary crusher output would then pass through a second screen, and any oversize material would be returned to the crusher. The high grade limestone product would be less than 100 mm in size.

B2.1.5 Product Transport

The crushed high grade limestone would be transported to the MPF site via the Fifield to Trundle Road, the proposed Fifield bypass, and the Fifield to Wilmatha Road using side tipping road trains.

Loading and haulage of crushed limestone to the MPF would be conducted five to six days per week, 52 weeks per year. It is estimated that haulage would occur on approximately 260 days per year. Haulage trucks would operate 24 hours per day (ie. 2 by 12 hour shifts). Up to 40 truck loads would be required per 24 hour period, resulting in a maximum delivery rate of some 2,000 t/day of crushed limestone to the 20,000 t MPF ROM limestone stockpile.

For safety reasons haul trucks carrying limestone would not operate on the public roads between the MPF and the quarry at times during which the school bus is operating. In addition, all truck cabins would be fitted with two-way radios.

Limestone usage at the MPF is described in Section A2.

B2.1.6 Ancillary Infrastructure

Site Buildings

The site offices (ie. administration area) would be located at the existing "Westella" homestead (Figure B2-1). Workshops and maintenance facilities would be constructed adjacent to the site offices and would be supplied by the mining and crushing contractor.

Electricity Supply

The existing electricity supply to the "Westella" homestead would be utilised at the site offices and workshops. Industrial electrical requirements of the crushing facility would be provided by a diesel powered 500 kV generator set as existing electricity supply is insufficient.

Fuel Storage

The diesel fuel requirements of the quarry operation and electrical generator set would be provided by a 50,000 L bunded storage and fuel dispensing facility located adjacent to the crushing plant (Figure B2-1).

Table B2-1
Provisional Limestone Production Schedule

Type of Material	Year of Operation				
	Year 1 (t)	**Year 2 (t)**	**Year 3 (t)**	**Year 4 (t)**	**Year 5 (t)**
High grade limestone mined/crushed and delivered to MPF	384,000	492,800	532,000	560,000	560,000
Low grade limestone mined	9,700	72,400	114,100	51,700	37,700
Waste rock removed	119,400	110,600	184,300	156,400	99,200
Total Material Movement	**513,100**	**675,800**	**830,400**	**768,100**	**696,900**

Source: SNC-Lavalin (2000)

A containment bund would be constructed around the fuel storage and would be designed in accordance with the requirements of Australian Standard (AS) 1940 – *The Storage and Handling of Flammable and Combustible Liquids*.

Explosive Storage

Explosives required for the quarry operation including detonators, ANFO and initiating products would be stored in dedicated magazines (Figure B2-1) in accordance with AS 2187 *Explosives – Storage, Transport and Use*.

Water Supply and Treatment

Approximately 50 ML of raw water per annum would be required at the quarry. The main water usage would be associated with crushing and mining activities. Other water requirements would include potable water requirements. A 12 km spur line from the main water supply pipeline would supply water to the quarry. A raw water dam/tank would be constructed on-site.

The potable water requirements of the quarry workforce would be provided by a package water treatment plant.

Sewage Treatment and Waste Disposal

Sewage would be treated in the existing septic system at the "Westella" homestead.

Non-hazardous refuse generated in the administration and workshop facilities would be stored in marked containers on-site and periodically removed to a municipal tip by a licensed contractor or disposed within the waste emplacement.

Waste oil from fixed and mobile equipment would be stored temporarily on-site and periodically collected for recycling or disposal at a licensed facility.

B2.1.7 Consumables

Approximate annual consumption rates for the main consumables at the quarry would be:

- diesel 0.7 ML;
- oil and lubricants 50 t;
- raw water 50 ML; and
- explosives and detonators 350 t.

Consumables would be stored in accordance with the relevant standards and regulations.

B2.1.8 Workforce

Construction

During the three month quarry construction period, approximately 15 to 20 personnel would be required on-site to construct the crushing facility, administration and workshop facilities, development of site water control structures and commencement of soil stripping and stockpiling.

Construction would be undertaken during daylight hours, five days per week. The majority of the workforce would work 7.00 am to 5.00 pm shifts.

Operation

During operation approximately 30 personnel would be required to operate the quarry, crushing facility and undertake the associated maintenance and administrative duties.

Operation of the quarry would be undertaken during daylight hours, five days per week with 7.00 am to 5.00 pm shifts.

As described in Section B2.1.5, loading and transport of crushed limestone would be undertaken 24 hours per day on five to six days per week.

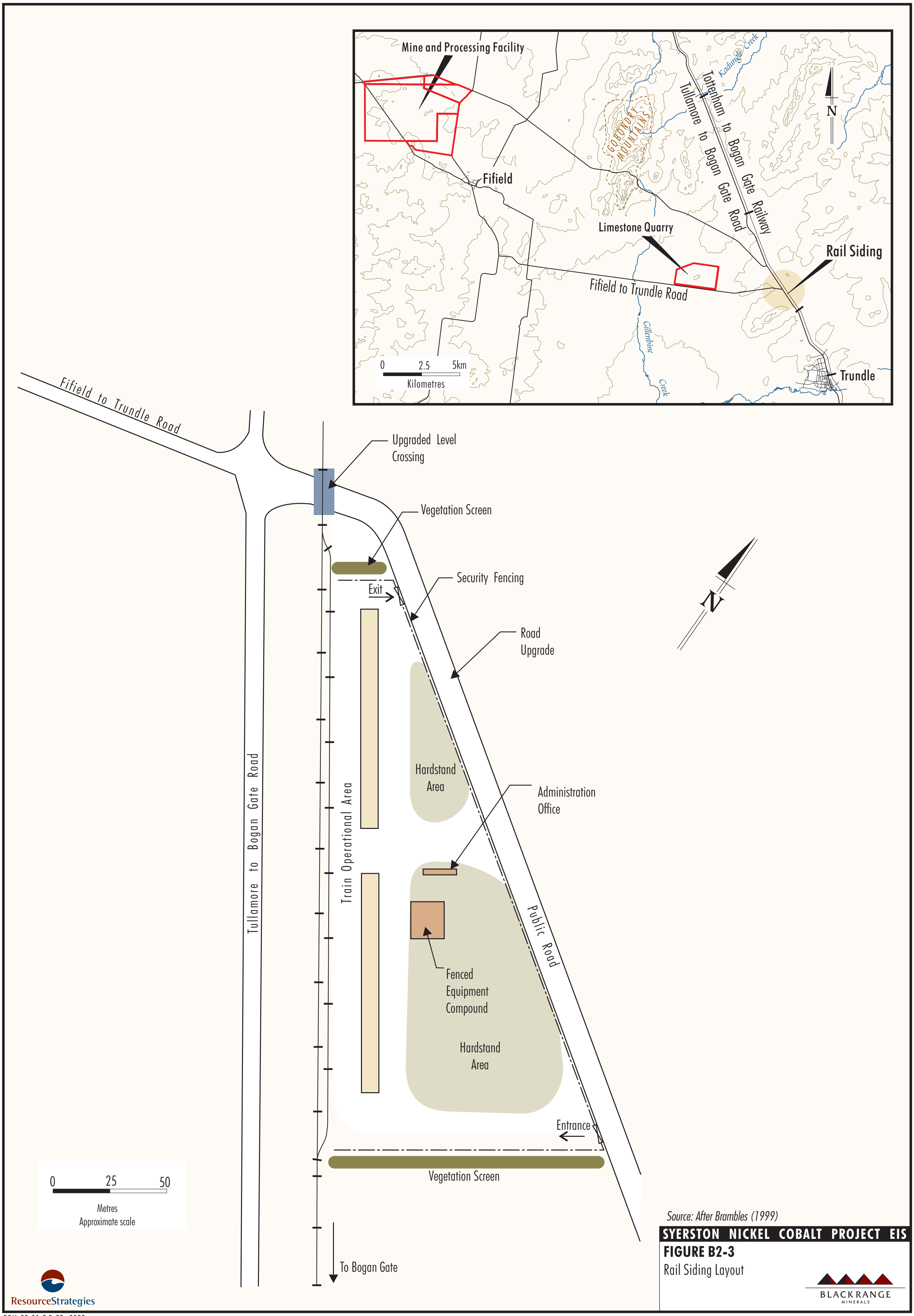
B2.1.9 Security

The MLA area surrounding the quarry would be fenced in order to restrict unauthorised access.

B2.2 RAIL SIDING

B2.2.1 Overview

A rail siding would be constructed on the Tottenham to Bogan Gate Railway and would be used in the delivery of consumables and product to and from the Project. The proposed siding site is located some 25 km south-east of the MPF site (Figure B1-1). The rail siding would be located on privately owned property adjoining the eastern side of the rail line and would include container loading and unloading facilities, administration office, equipment compound, fuel storage, and short term container storage facilities (Figure B2-3).



Source: After Brambles (1999)

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FIGURE B2-3

Rail Siding Layout

ResourceStrategies

BLACKRANGE MINERALS

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Vehicular access to the siding would be provided by upgrading an existing access road located to the north and east of the siding.

B2.2.2 Construction

Development of the rail siding would require construction of a rail spur line, installation of appropriate switching and rail signals, construction of loading and unloading facilities, hardstands, access road upgrade, rail crossing upgrade and administrative facilities. The construction and commissioning of the rail siding would take approximately three months.

B2.2.3 Siding Operation

The rail siding would primarily be used to transfer some 210,000 tpa of prilled elemental sulphur railed from Newcastle, and for nickel and cobalt product back-loading in general goods wagons.

Other consumables required for the Project would be transported by rail where appropriate.

Each sulphur transport train would be approximately 44 wagons in length and would have 39 sulphur wagons and five general goods wagons. Each sulphur wagon would be fitted with two purpose-built tipping containers and the general goods wagons would carry conventional side opening, lockable containers.

Due to the length of the train it would be split in half and 22 wagons would be left at either the nearby Troffs siding or remain on the rail line, while the remaining wagons are unloaded at the siding.

Incoming containers would be unloaded at the siding by forklift and stored on a hardstand with capacity for some 170-180 containers. The train would then be loaded with any empty sulphur containers and general goods containers containing mineral product. A typical turnaround time of approximately four hours for the arrival, unloading, re-loading and departure of trains is expected. Containers arriving at the rail siding would be loaded onto road trains for transport to the MPF site via the materials transport route (Section B2.3). Road trains would enter the site from the south-east and then travel past the siding and exit at the north (Figure B2-3).

An average of six train movements per week (three trains) would be required. The trains would arrive or depart according to freight scheduling.

B2.2.4 Ancillary Infrastructure

Ancillary infrastructure located at the siding would include electricity supply, administration office, site lighting, security fencing, an equipment storage compound including a 50,000 L bunded fuel storage and on-site ablution facilities.

A containment bund would be constructed around the fuel storage and would be designed in accordance with the requirements of AS 1940 – *The Storage and Handling of Flammable and Combustible Liquids*.

B2.2.5 Workforce

Construction

Approximately 15 personnel would be required on-site during the three month construction period.

Operation

Operation of the rail siding would require a workforce of approximately five personnel.

B2.2.6 Security

The siding compound would be fenced in order to restrict unauthorised access.

B2.3 MATERIALS TRANSPORT ROUTE

B2.3.1 Overview

Access to the MPF site from the rail siding, limestone quarry and the Tullamore to Bogan Gate Road would be provided by construction of a Fifield bypass and upgrades of the Fifield to Trundle Road, and sections of the Condobolin to Tullamore Road and the Fifield to Wilmatha Road (Figure B1-2).

The proposed Fifield bypass would link the Fifield to Wilmatha Road with the Condobolin to Tullamore Road, allowing traffic to bypass Fifield approximately 1 km to the south-west of the village (Figure B2-4).

B2.3.2 Regional Transport Network

The Central West regional network of main roads, highways and rail lines links it with the urban centres of Sydney, Newcastle and Melbourne. The Project is well situated to take advantage of the regional road and rail transport network, being some 25 km north-west of the Tottenham to Bogan Gate Railway and some 90 km from the Newell Highway at Parkes.

Heavy vehicle road access to the MPF site from Sydney or Newcastle would be via Parkes, State Route 90 and the Tullamore to Bogan Gate Road to the intersection with the Fifield to Trundle Road. From this intersection general heavy transport for the Project would join the materials transport route. Some heavy vehicles would access the Project from the north and would utilise the Tullamore to Bogan Gate Road.

B2.3.3 Materials Transport Route Upgrades

Road upgrades would involve the following works:

- widening of existing roads to provide a 8.5 m pavement and 3 m wide gravel shoulder at property accesses;
- upgrades of intersections where necessary to the relevant AUSTROADS standards in order to accommodate the increased traffic numbers and to improve the safety and/or operational efficiency; and
- construction of the Fifield bypass to have an 8.5 m pavement and AUSTROADS standard intersections with existing roads.

Construction of the Fifield bypass would be undertaken by BRM. Road upgrades on existing roads would be progressively undertaken by either the local council (with the proponent contributing) or by BRM.

Fifield Bypass

The proposed Fifield bypass would be approximately 3 km long and would connect the Fifield to Wilmatha Road and the Condobolin to Tullamore Road and would bypass the village to the south-west. The bypass would comprise a 1.6 km long north/south section from the Fifield to Wilmatha Road which would run inside and parallel to the eastern boundary of the Galvin property, cross an existing crown land road reserve, and then a 1.4 km section would run south-east within the Quade property to connect with the Condobolin to Tullamore Road. The bypass route is shown in Figure B2-4.

Rail Siding Access Road

The proposed rail siding is located approximately 200 m to the south of the intersection of the Fifield to Trundle Road and the Tullamore to Bogan Gate Road. The intersection of the rail siding access road and the Tullamore to Bogan Gate Road would be constructed to AUSTROADS guidelines. The road would be constructed to 8.5 m sealed pavement and would cross the rail line to the north of the rail siding and then run down the eastern side of the siding complex to the haul truck entry point (Figure B2-3). The intersection of the Tullamore to Bogan Gate Road and the Fifield to Trundle Road would also be upgraded to AUSTROADS standards.

B2.3.4 General Intersection and Road Upgrades

In addition to upgrades of the materials transport route from the rail siding and limestone quarry to the MPF site, additional light and heavy traffic on local roads associated with the Project may necessitate upgrades at some intersections.

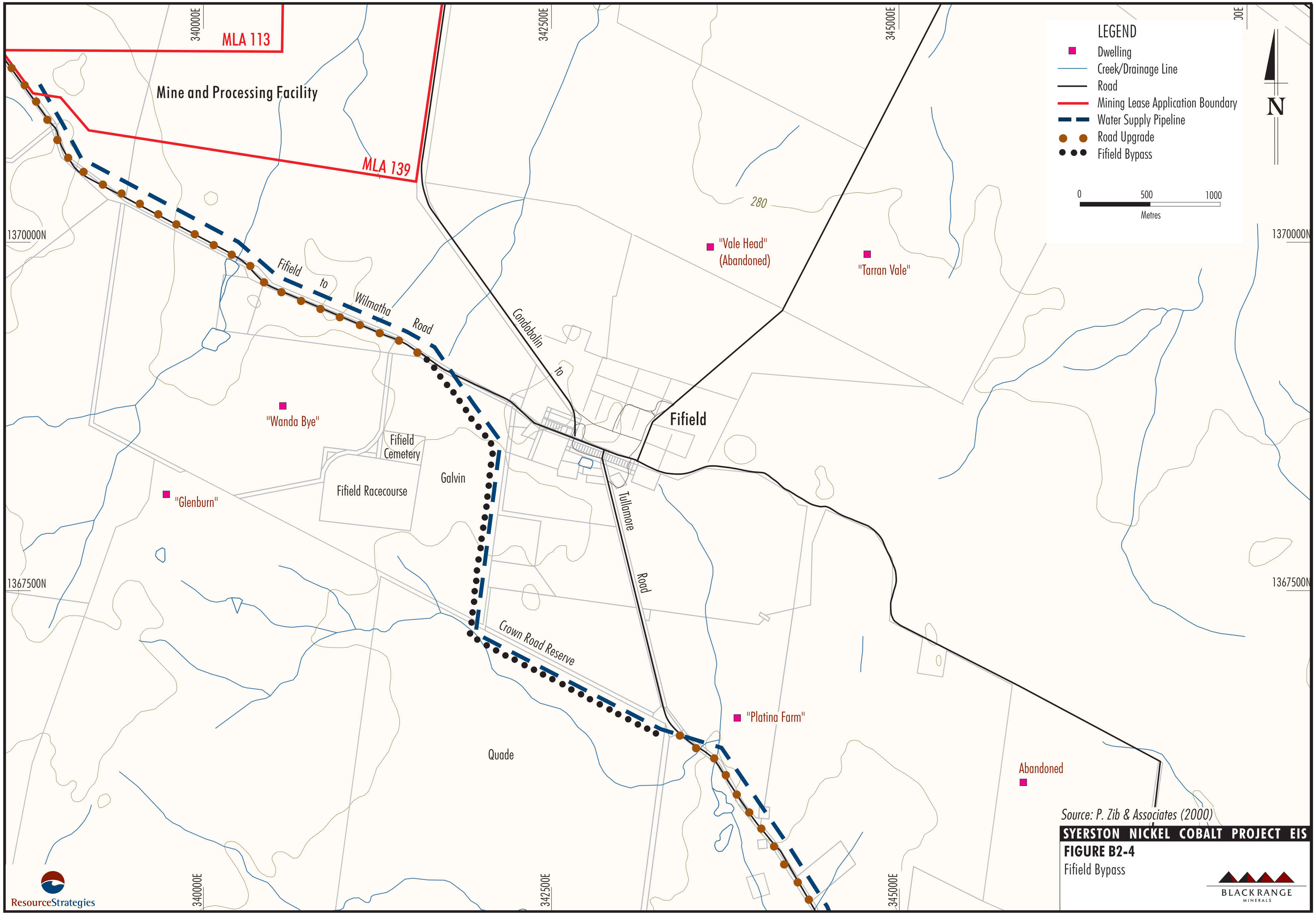

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FIGURE B2-4

Fifield Bypass

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In addition, the Middle Trundle Road is predicted to carry a significant volume of light traffic to the Project area from Parkes. The gravel sections of this road may require sealing to improve road safety and efficiency on this route between the Tullamore to Bogan Gate Road and State Route 90.

The potential impacts of the Project upon the general road network and proposed mitigation measures are discussed in Section A4.14 and Appendix C.

SECTION B3 - DESCRIPTION OF THE EXISTING ENVIRONMENT

LIMESTONE QUARRY, RAIL SIDING AND MATERIALS TRANSPORT ROUTE

PREPARED BY
RESOURCE STRATEGIES PTY LTD

SEPTEMBER 2000
Project No. BRM-01\2.2
Document No. PART B - SECTION 3-F.DOC

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B3 DESCRIPTION OF THE EXISTING ENVIRONMENT

The following section describes the existing environment relevant to the proposed development of the limestone quarry, rail siding and materials transport route. Descriptions of the existing environment relevant to other Project components are presented in Parts A and C of this EIS.

B3.1 LAND RESOURCES

B3.1.1 Physiography and Landuse

Much of the land within the Project area has been subject to alteration and disturbance through past landuse practices including cropping, grazing, forestry and mining.

The flatter terrain with deeper soils has mostly been cleared of its native vegetation cover, and is generally used for cropping, principally wheat growing. The hills tend to have a greater cover of native vegetation, but have generally been significantly thinned in the past to promote growth of grasses for grazing.

Limestone Quarry

The limestone deposit occurs as a low hill in the middle of the Gillenbine Creek plain. Elevations vary from approximately 250 m AHD on the surrounding plain, up to approximately 260 m AHD at the crest of the knoll which marks the highest point of the deposit.

The limestone quarry area consists of cleared land currently used for grazing and occasional cropping. The low hill is composed of limestone and there is only very shallow and generally infertile topsoil on the crest and slopes. The rocky nature of the ground over the deposit has restricted pasture improvement. Colluvial soils at the base to the west and north-east of the deposit have been ploughed for pasture improvement.

Rail Siding

The rail siding site is located in predominantly cleared dry sclerophyll woodland country and is on the broad level summit of a low rise (approximately 270 m AHD). From the top of the rise the land falls gently away to the east and west. The rail siding area is currently used for occasional grazing.

Fifield Bypass

The proposed bypass route crosses gently undulating grazing and fodder-crop pastoral country. There is little relief and elevations along the route range from approximately 310 m AHD in the north to approximately 280 m AHD in the east.

The paddocks traversed by the route have been cleared, and periodically ploughed for pasture improvement.

B3.1.2 Geology

Figure A3-3 provides an illustration of regional geology, including the limestone quarry, rail siding, materials transport route and bypass areas. Further details of the geology at the limestone quarry is provided below.

Limestone Quarry

The limestone quarry site is situated within a series of north-east trending faults. The limestone deposit is Devonian in age, and lies within the Connemarra Formation. Other rocks within this formation include siltstone, mudstone and marl to the north of the deposit, and a fine grained, well laminated ignimbrite to the south.

The Connemarra Formation is overlain by the Silurian aged Cookeys Plains Formation and Quaternary alluvium, which outcrop to the south-west and east of the quarry, respectively. The Silurian rocks are dominantly shale, siltstone and fine grained sandstone.

BRM identified the Westella Limestone deposit in 1998 whilst undertaking a series of prospecting traverses. In July 1999 a Reverse Circulation (RC) drilling programme was carried out to provide an initial assessment of the magnitude and quality of the deposit. Analysis of the samples indicated that the limestone was of suitable quality to meet the requirements of the Project. Subsequent RC and diamond drilling has been conducted to delineate the deposit.

The interpretation of the drilling results indicated that the deposit is dominated by limestones of clastic or detrital origin. They comprise flat lying to gently dipping layers of Calcarenite and Calcilutite overlain by a 1-3 m thick cap of re-precipitated carbonate material (Calc Tufa) derived from weathering of the limestones.

Minor beds of grey to brown mudstone, green to brown sandstone and clay also occur.

B3.1.3 Soils, Agricultural Suitability and Rural Land Capability

Limestone Quarry

Soil types mapped for the limestone quarry MLA area are based on the Great Soil Group System (Stace *et al.*, 1968). This system is a broad classification of soils, each Great Soil Group referring to a range of soils in the field.

Red earth and brown clay soils types were identified within the limestone quarry MLA area (Figure B3-1). The physical and chemical characteristics of these soils are described in Appendix O.

The agricultural suitability assessment of the Project area (Appendix O) has been conducted in accordance with the five class system (Riddler, 1996) which allows for assessment and identification of land based on suitability for agricultural purposes. Two agricultural suitability classes were identified in the limestone quarry MLA area (Classes 3 and 4) as illustrated on Figure B3-2.

Class 3 agricultural suitability is defined by Cunningham *et al*., (undated in Riddler, 1996) as:

> "*Grazing land or land well suited to pasture improvement. It may well be cultivated or cropped in rotation with pasture and the overall level of production is moderate as a result of edaphic or environmental constraints. Erosion hazard or soil structural breakdown limit the frequency of ground disturbance and conservation or drainage works may be required*."

Class 4 agricultural suitability is defined (*ibid.*) as:

> "*Land suitable for grazing but not cultivation. Agriculture is based on native pastures or improved pastures established using minimum tillage techniques. Production may be high seasonally but the overall level of production is low as a result of a number of major constraints, both environmental and edaphic*."

The rural land capability assessment has been conducted in accordance with the standard NSW eight class system. This system is based on assessment of biophysical characteristics categorising land in terms of general limitations such as erosion hazard, climate and slope.
Land is classed on the limitations to a particular type of landuse (Emery, 1985).

Three rural land capability classes were identified within the limestone quarry MLA area *viz*.
Classes III, IV and VI (Figure B3-3).

Class III Capability is defined as:

> *"Land capable of being regularly cultivated with structural soil conservation works such as diversion banks, graded banks and waterways, together with soil conservation practices such as strip cropping, conservation tillage and adequate crop rotations."* (Cunningham *et al.*, undated)

Class IV Capability is defined (*ibid.*) as:

> "*Land not capable of being regularly cultivated but suitable for grazing with occasional cultivation with soil conservation practices such as pasture improvement, stock control, application of fertiliser and minimal cultivation for the establishment or re-establishment of permanent pasture*."

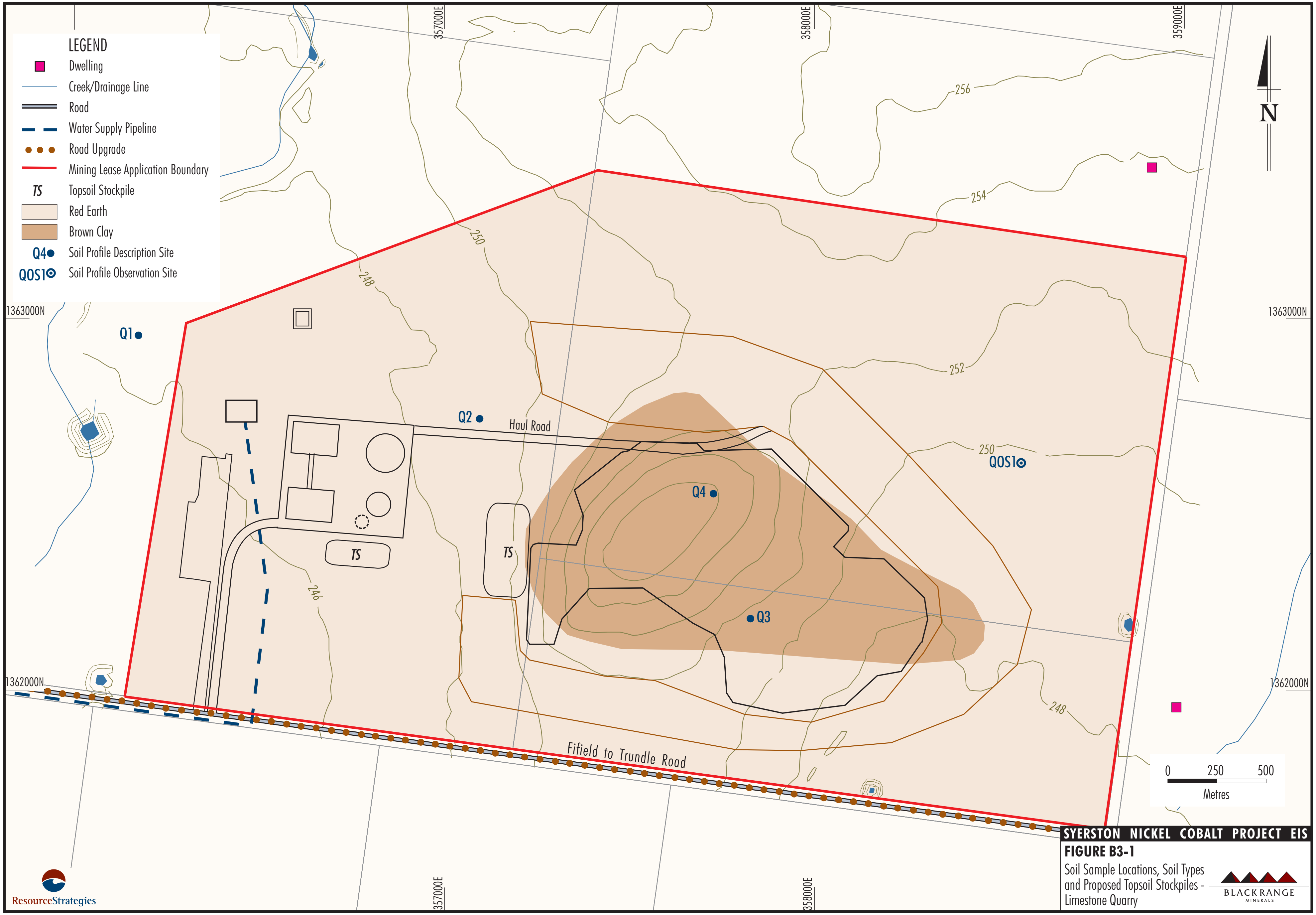
Class VI Capability is defined (*ibid.*) as:

> *"Land not capable of being cultivated but suitable for grazing with soil conservation practices including limitation of stock, broadcasting of seed and fertiliser, prevention of fire and destruction of vermin. This class may require some structural works."*

Rail Siding and Materials Transport Route

The soils, land capability and agricultural suitability of these areas have been qualitatively examined from aerial photographs and mapping information from the limestone quarry and MPF. The soils, agricultural suitability and land capability of these areas would not differ greatly from those identified within the MPF (Part A Section A3.1.4) and the limestone quarry MLA area.

The agricultural suitability of the Fifield bypass has been mapped by the Department of Agriculture as Class 4.



SYERSTON NICKEL COBALT PROJECT EIS

FIGURE B3-1

Soil Sample Locations, Soil Types and Proposed Topsoil Stockpiles - Limestone Quarry

BLACK RANGE MINERALS

Resource Strategies

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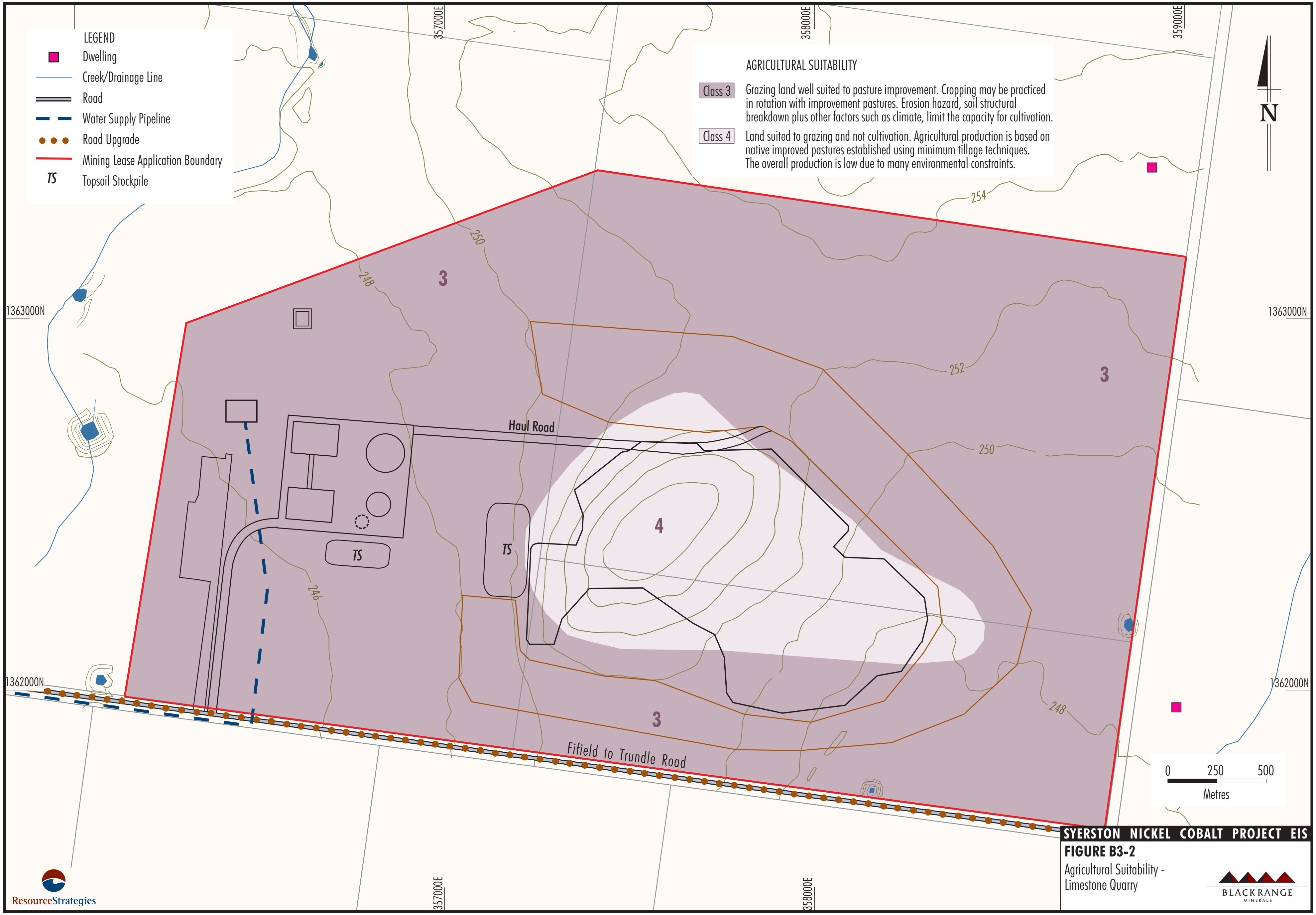

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FIGURE B3-2

Agricultural Suitability - Limestone Quarry

BLACK RANGE MINERALS

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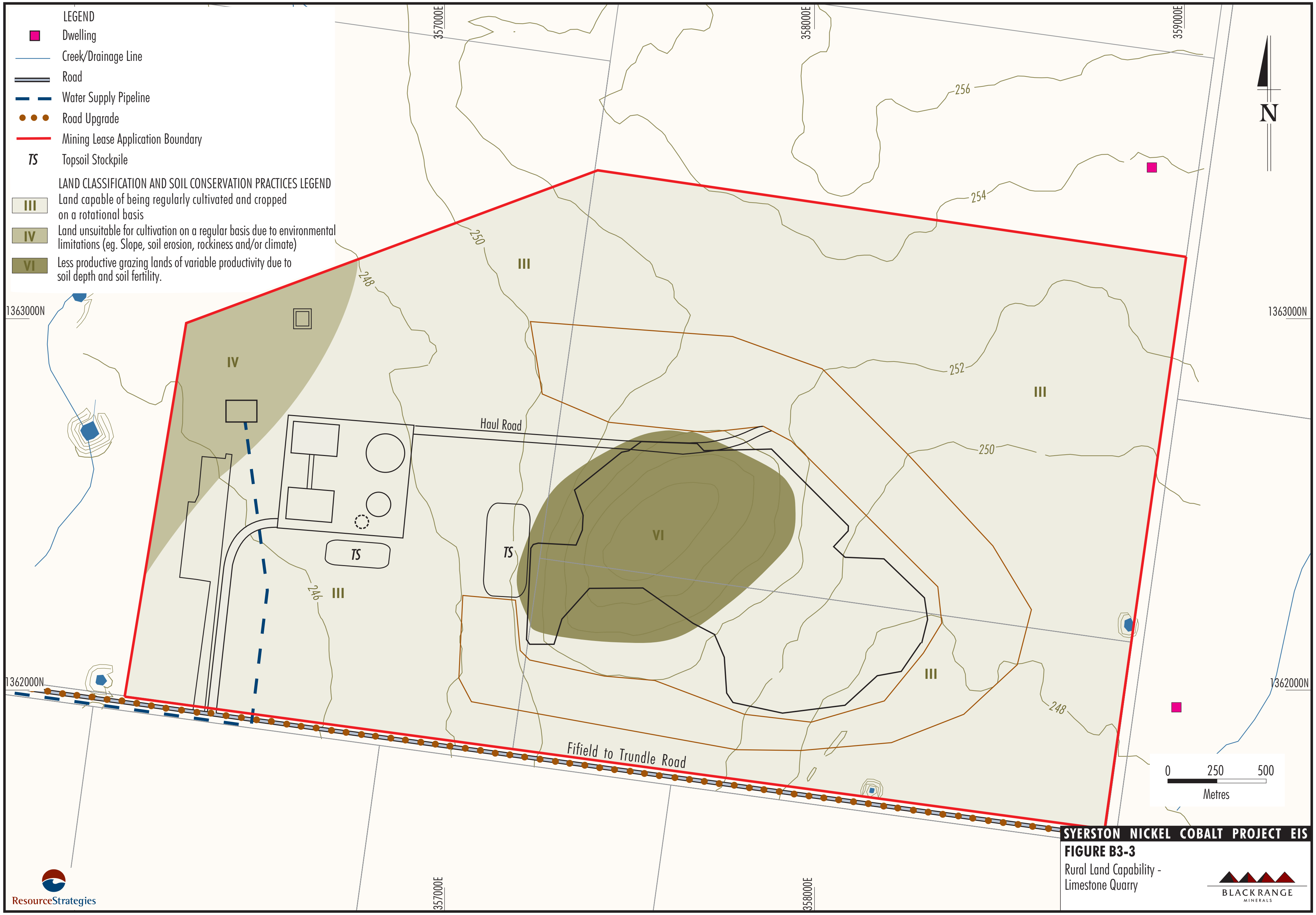

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FIGURE B3-3

Rural Land Capability - Limestone Quarry

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B3.1.4 Visual Character

The visual catchments of the limestone quarry and rail siding are characterised by undulating and predominantly cleared country, with patches of remnant or regrowth vegetation located primarily along road reserves, drainage lines and property boundaries.

Limestone Quarry

The visual character of the limestone quarry area is dominated by gentle slopes within an area cleared for grazing and other agricultural practices, with scattered remnant vegetation. The quarry deposit rises to a height of approximately 10 m above the surrounding country. Views of the limestone quarry area are available from the Fifield to Trundle Road and the nearby homesteads of "The Troffs" (optioned to BRM), "Moorelands" and "Reas Falls". These properties are located approximately 300 m north, 3 km west south-west and 1 km east south-east of the quarry boundary respectively (Figure B3-4).

Remnant vegetation along the Fifield to Trundle Road and the Tullamore to Bogan Gate Road screens the limestone quarry from the Tullamore to Bogan Gate Road.

Rail Siding

The rail siding is located between a band of remnant vegetation to the east and the Tullamore to Bogan Gate Road and the Tottenham to Bogan Gate Railway to the west. The site has limited relief and views are available from the Tullamore to Bogan Gate Road, the Tottenham to Bogan Gate Railway and the "Glen Rock" homestead.

The potential visual impacts of the proposed developments, along with associated mitigation measures are addressed in Section B4.2 and Appendix N of the EIS.

B3.2 FLORA

B3.2.1 Regional Flora

A discussion of regional flora is provided in Part A, Section A3.3.

B3.2.2 Flora Survey Methodology

Bower and Kenna (2000) conducted a flora survey of the limestone quarry, the rail siding and the materials transport route in October 1999, January 2000 and June 2000 (Appendix I).

Two of the easternmost cultivation paddocks of the limestone quarry site were traversed by vehicle with frequent stops to examine plants of interest, while the cleared limestone outcrop was examined on foot. The entire site of the proposed rail siding was surveyed on foot. The materials transport route was surveyed at a series of sites, by 15 minute searches along a 25 m length of road at each site.

Target searches were also conducted for rare or threatened Australian plants listed under *Rare or Threatened Australian Plants* (ROTAP) (Briggs and Leigh, 1996), the *Threatened Species Conservation Act, 1995* and the *Environment Protection and Biodiversity Conservation Act, 1999*.

B3.2.3 Flora Survey Results

A summary of the flora survey results and assessed conservation value is provided below. Detailed species lists and vegetation association descriptions are provided in Appendix I.

Limestone Quarry

The limestone outcrop at the centre of the proposed limestone quarry is vegetated with scattered trees and native grasses. It is surrounded by intensively managed farmland paddocks used for cropping and grazing. Isolated trees occur within the ploughed areas and some native herb and grass species were recorded in the unploughed corners of paddocks. The remnant trees and the roadside vegetation indicate the area was formerly dominated by box-pine woodland (*E. populnea* and *E. microcarpa* alliances).

Eighty-nine plant species were recorded during the survey. Of these 50 were introduced species. Due to previous clearing and land disturbance activities the site is considered to have limited value for conservation.

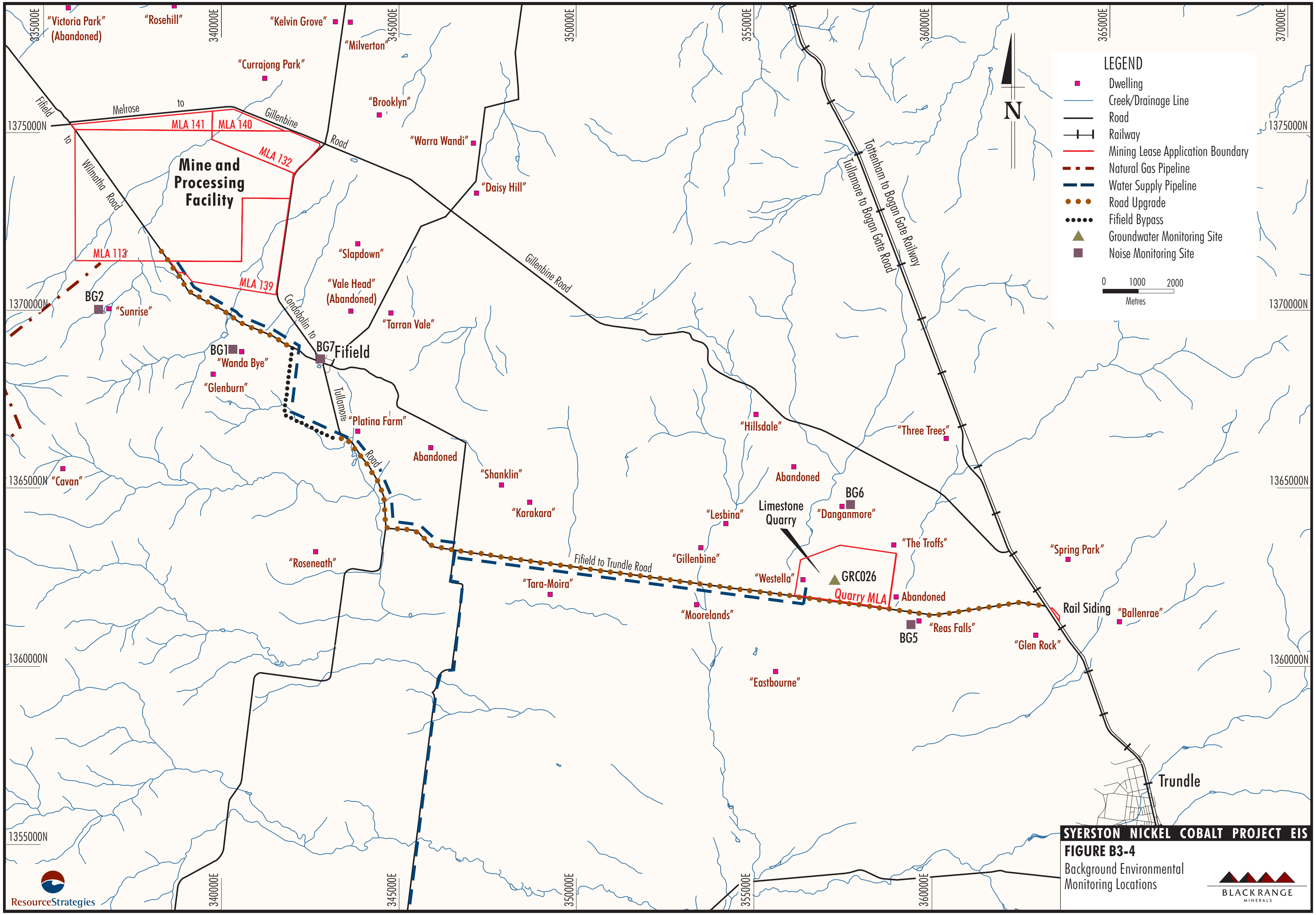

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FIGURE B3-4

Background Environmental Monitoring Locations

BRM-98-01-Pt B-S3_001F

Rail Siding

The proposed rail siding is characterised by native grassland vegetation with a wide diversity of native grasses and herbs. The adjoining roadside trees and few remaining paddock trees suggest that prior to European disturbance, the area was predominantly a grassy, open Poplar Box (*E. populnea*) woodland.

While the area is a good sample of the original box-pine woodland understorey, it is small, bordered by a rail line and road, and has limited conservation value.

Materials Transport Route

The materials transport route is a narrow road easement over most of its length and has thin strips of remnant native vegetation beside it. The Fifield bypass component is situated within land which has been cleared for cropping and grazing. The three vegetation associations identified along the Fifield to Trundle Road, the Condobolin to Tullamore Road, the Fifield to Wilmatha Road components of the materials transport route were:

- *E. populnea/E. microcarpa/C. glaucophylla;*
- *E. populnea/C. glaucophylla;* and
- *E. microcarpa/C. glaucophylla*.

Three vegetation associations were identified in the vicinity of the Fifield bypass:

- *E. microcarpa;*
- *E. sideroxylon/E. microcarpa;* and
- *Allocasuarina luehmanii*.

Most of the associations belong to the box-pine woodland mosaic of *E. populnea* and *E. microcarpa* alliances.

Due to its narrowness, high degree of disturbance and isolation within cleared farmland, the road reserve vegetation has limited value for flora conservation.

B3.2.4 Significant Species

No plant species listed as threatened under the NSW *Threatened Species Conservation Act, 1995* or the Commonwealth *Protection of the Environment Biodiversity Conservation Act, 1999* were identified within the limestone quarry, rail siding and materials transport route survey areas.

B3.3 FAUNA

B3.3.1 Regional Fauna

A discussion of the fauna of the Project area and surrounds is provided in Part A, Section A3.4 and Appendices JA, JC and JD.

B3.3.2 Fauna Surveys

Avifauna, mammals (excluding bats), reptiles and amphibians in the vicinity of the materials transport route, rail siding and limestone quarry were surveyed by Mount King Ecological Surveys in November 1999 and March 2000 (Appendix JA). Greg Richards and Associates (2000) surveyed the bat fauna in October 1999 and March 2000 (Appendix JD).

A summary of the fauna survey methodologies and findings is presented below.

B3.3.3 Survey Methodology

Mount King Ecological Surveys (2000) employed a variety of techniques to survey the terrestrial fauna of the rail siding site including Elliott trapping, pit traps, hair tubes, spotlighting for nocturnal fauna, herpetofauna (reptiles and amphibian) searches, nocturnal bird call playback and general observations.

Active searches, spot surveys and general observations were undertaken for the materials transport route and limestone quarry. Habitat assessments were also undertaken utilising transects and visual observations.

The assessment of the bat fauna by Greg Richards and Associates (2000) utilised the following strategy:

- preliminary assessment of bat habitat in the area; and
- bat fauna survey (electronic bat detectors).

A number of regional reference sources containing results of regional fauna surveys were also reviewed and where appropriate referenced in the fauna survey reports. A detailed description of fauna survey methodology is available in Appendices JA and JD.

B3.3.4 Fauna Survey Results

Mount King Ecological Surveys (2000) recorded a total of 29 birds, five mammals and one reptile along the materials transport route. In comparison, 16 birds and three mammals were recorded at the rail siding, while only one bird (Australian Raven) was recorded at the limestone quarry (Appendix JA).

Of the seven mammals recorded by Mount King Ecological Surveys (2000), only two were native, *viz*. the Common Dunnart and the Eastern Grey Kangaroo recorded at the rail siding and materials transport route, respectively. The Shingleback Lizard was the only reptile recorded in the study area.

Within the Project area infrastructure areas (ie. areas covered by Parts B and C of the EIS), eleven bat species were recorded (Appendix JD). As a component of the bat survey, Greg Richards and Associates (2000) assessed the quality of bat habitat along the materials transport route, at the rail siding and limestone quarry. The assessment indicated that the materials transport route contained a small (less than 1 km) section of habitat considered to be of reasonable quality for bat fauna. Predominantly characterised by cleared pasture and cropping land, the Fifield bypass, limestone quarry and rail siding were areas considered to consist of low quality bat habitat (Appendix JD).

B3.3.5 Significant Species

Six species listed as threatened under the NSW *Threatened Species Conservation Act, 1995* were identified within the Project area and surrounds *viz*. *Saccolaimus flaviventris* (Yellow-bellied Sheathtail Bat), *Chalinolobus picatus* (Little Pied Bat), *Nyctophilus timoriensis* (Eastern Longeared Bat), *Ninox connivens* (Barking Owl), *Certhionyx variegatus* (Pied Honeyeater) and *Cacatua leadbeateri* (Major Mitchell's Cockatoo).

The Little Pied Bat was identified in the Fifield to Trundle Road corridor near the eastern border of the limestone quarry MLA. The other species were either identified in the vicinity of the MPF area and/or pipeline corridor areas and are discussed in Part A and Part C respectively.

B3.4 WATER RESOURCES

B3.4.1 Surface Water

The proposed limestone quarry is located within the Lachlan River catchment. The catchment has an area of some 84,700 km^2 and has an estimated mean annual flow of 147,000 ML/year at Forbes (Murray-Darling Basin Ministerial Council, 1999).

The Lachlan River is situated approximately 50 km south of the quarry and runs east-west through central NSW and past the townships of Cowra, Forbes and Condobolin, and into the Murrumbidgee River, approximately 82 km west of Hay. The Murrumbidgee River flows into the Murray River.

The Murrumbidgee and the Lachlan Rivers are both highly regulated. The mean average annual flow of the Murrumbidgee is 4,592,000 ML/year (Murray-Darling Basin Ministerial Council, 1999) at Wagga Wagga, and of this, substantial amounts are diverted for irrigation.

The limestone deposit MLA is situated on the crest of a gentle rise with slopes falling away to the sides and is drained by two unnamed drainage lines running north-south and located immediately west and immediately east of the MLA. The drainage lines terminate/lose definition south of the site.

Gillenbine Creek is an ephemeral stream situated approximately 4 km west of the quarry. Gillenbine Creek flows into Yarrabandai Creek some 9 km south-west of the quarry and then via Gunningbland Creek and Goobang Creek into the Lachlan River.

The proposed rail siding is also located within the Lachlan River catchment and is drained by an unnamed drainage line passing approximately 1 km to the south-east of the siding.

The proposed Fifield bypass would be located on the divide between the Lachlan River and Bullock Creek/Darling River catchments. The northern portion of the bypass is drained by an unnamed drainage line running north-east to Bullock Creek. The southern portion of the bypass drains to the south-east via an unnamed drainage line, which is a minor tributary of Gillenbine Creek.

A general discussion of the Bullock Creek/Darling River catchment is provided in Part A, Section A3.2.1.

B3.4.2 Groundwater

Limestone Quarry

The general stratigraphy of the limestone deposit is characterised by a thin layer of residual soil up to 0.4 m thick overlying a layer of weathered Calc Tufa up to 3 m thick, overlying up to approximately 25 m of Calilutite and Calcarenite (limestone). Below the limestone is black shale.

Groundwater was encountered within the limestone deposit during exploration drilling. The groundwater inflow rate was measured as 0.5-1.0 L/s in only one exploratory drillhole between 16 m and 21 m depth from the surface (Golder Associates, 2000d).

B3.5 ABORIGINAL HERITAGE

B3.5.1 Background

An assessment of the Aboriginal heritage of the Project area has been undertaken by Archaeological Surveys and Reports (2000) (Appendix L). The assessment was undertaken with the assistance of a representative of the Condobolin LALC (September 1997 survey) and the Wiradjuri RALC (December 1999 and April 2000 surveys).

A general discussion of the archaeological history of the region is provided in Part A, Section A3.7.

B3.5.2 Site Surveys

The materials transport route was surveyed by investigation of mature trees, erosion features and drainage and creek lines. The routes were inspected by vehicle, with frequent stops and examination of likely features on foot.

The limestone quarry and rail siding areas were inspected by foot.

B3.5.3 Survey Results

A search of the NSW NPWS Aboriginal Sites Register found that no sites had previously been recorded in the area of the limestone quarry, rail siding or materials transport route.

No sites were identified along the materials transport route, limestone quarry or at the rail siding during this investigation.

Archaeological Surveys and Reports (2000) concluded that it is unlikely that any artefacts of significance are present and if there are any sites present and not identified during the survey, they are likely to be isolated artefacts.

B3.6 EUROPEAN HERITAGE

An assessment and report addressing European heritage was undertaken by Heritage Management Consultants (2000) in accordance with the criteria framework established by the Heritage Office of NSW (Appendix M).

B3.6.1 European History

A discussion of the European history of the region is provided in Part A, Section A3.8 and Appendix M.

B3.6.2 Assessment

Limestone Quarry

The site of the proposed limestone quarry has been extensively ploughed and cleared. Building materials and rubbish has been dumped at several sites within the limestone quarry MLA area. These dumps may have been associated with former buildings that have been removed, or alternatively may have come from outside the quarry area.

None of the dumped material was considered significant from a European heritage point of view and no other evidence of historical interest was identified at this site.

Rail Siding

No articles or sites with European heritage significance were identified at the proposed rail siding location.

Materials Transport Route

The majority of the materials transport route is a typical country road, and no sites of heritage significance were located along the proposed upgrade route.

The proposed Fifield bypass component is to be situated within land cleared for cropping and grazing. No sites of heritage significance were located along the route.

B3.7 ACOUSTICS

Assessment of the existing acoustic environment and potential acoustical impacts of the Project has been undertaken by Richard Heggie Associates (2000) (Appendix K).

Background noise has been monitored at five properties in the vicinity of the limestone quarry, rail siding and materials transport route. The monitoring involved unattended and attended background noise measurements in November 1999.

The locations of the monitoring sites are shown on Figure B3-4. A summary of the results of the background noise surveys is presented in Table B3-1.

The results of the background noise monitoring are expressed as A-weighted decibels (dBA) as this represents the response of the human ear. Noise levels are presented as an L_{A90}. This refers to the noise level exceeded for 90% of the sampling period and is also known as the average minimum, or background noise level. L_{A10} is the noise level which is exceeded for 10% of the sampling period and is considered to be the average maximum noise level. L_{Aeq} is the equivalent continuous sound pressure level and refers to the steady sound level, which is equal in energy to the fluctuating level over the interval period.

For most people, hearing “nuisance” begins at noise levels of about 70 dBA, while hearing damage can occur if levels of 85 dBA are sustained (ie. for periods of 8 hours or more).

B3.8 AIR QUALITY

An assessment of the air quality environment of the Project area and surrounds has been undertaken by P. Zib and Associates (2000) (Appendix A).

The following is a summary of the existing ambient dust deposition concentrations, total suspended particulates and industrial gases. Ambient air quality is determined by a range of land management activities and environmental factors, such as the type of vegetation cover, and meteorological conditions.

Table B3-1
Background Noise Monitoring Results

Monitoring Locations	Background Noise Levels (L_{A90} dBA)			
	Rail Siding and Materials Transport Route			Limestone Quarry
	Daytime 0700-1800 hours	Evening 1800-2200 hours	Night-time 2200-0700 hours	Daytime 0700-1700 hours
BG1 “Wanda Bye”	34	36	28	34
BG2 “Sunrise”	35	35	28	35
BG5 “Reas Falls”	32	30	26	32
BG6 “Danganmore”	31	31	26	31
BG7 Cnr. Slee Street, Fifield	31	29	26	32

B3.8.1 Dust Deposition

Dust deposition monitoring has been undertaken at the MPF site since September 1997 (Figure A3-1). A summary of the monitoring results is provided in Part A, Section A3.5.1 and further details in Appendix A. No background dust deposition monitoring has been undertaken to date at the limestone quarry site.

The results at the MPF site indicate a level of dust generation typical of the rural setting, which is largely dependent on prevailing landuse and meteorological conditions. On average, dust deposition levels in the area are less than 2 g/m^2/month and well within the NSW EPA amenity criteria of a total average of 4 g/m^2/month.

The background dust deposition levels at the limestone quarry are likely to be similar to the dust deposition levels results at the MPF site.

B3.8.2 Total Suspended Particulates

The National Health and Medical Research Council of Australia set maximum annual permissible levels of total suspended particulates (TSP) to protect public health in residential environments, of 90 $\mu g/m^3$.

No background monitoring of TSP has been undertaken for the Project. Considering the rural setting and general landuse, an annual average background level of approximately 30 $\mu g/m^3$ would be expected. During land disturbance activities such as ploughing and harvesting, or during extended dry or windy periods, higher TSP levels are likely to be experienced. Particulate matter less than 10 microns in diameter (PM_{10}) generally comprises less than half of TSP.

B3.8.3 Atmospheric Gases

No monitoring of atmospheric gases has been undertaken. Due to the rural setting and relative distance to any major industrial areas such as coal fired power stations, the relative level of atmospheric gases would be anticipated to be low, and approaching baseline levels.

SECTION B4 - POTENTIAL IMPACTS AND MITIGATION MEASURES

LIMESTONE QUARRY, RAIL SIDING AND MATERIALS TRANSPORT ROUTE

PREPARED BY
RESOURCE STRATEGIES PTY LTD

SEPTEMBER 2000
Project No. BRM-01\2.3
Document No. PART B - SECTION 4-F.DOC

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B4 POTENTIAL IMPACTS AND MITIGATION MEASURES

B4.1 LAND RESOURCES

Section B3.1 describes the land resources in the vicinity of the limestone quarry, rail siding and materials transport route. The proposed activities associated with these sites have the potential to create changes in:

- topography and landscape features;
- soil quality and erosion potential;
- landuse;
- land contamination status; and
- bushfire hazard.

These aspects are discussed in the following sub-sections.

B4.1.1 Topography and Landscape Features

Potential Impacts

Of the three components of the Project covered by Part B of the EIS, only the limestone quarry has the potential to appreciably impact on the topography and landscape of the area. Activities within the proposed quarry area that would result in a modification of topography include excavation of the open pit, construction of the waste emplacement and construction of level hardstand areas for buildings/workshops Both the rail siding and upgrades to the materials transport route would require minimal alteration of the existing topography (ie. they would involve limited cut and fill type earthworks).

Mitigation Measures

In designing the configuration of the limestone quarry open pit and waste emplacement consideration has been given to the impact of the operation on the existing topography and landscape. The waste emplacement has been designed to progressively encircle the open pit and would act as a screen between activities in the open pit and traffic travelling along the Fifield to Trundle Road (Figure B2-1). The final shape of the waste emplacement (when viewed from the road) would resemble a low mesa-shaped hill with a crest slightly lower (ie. 1-2 m) than the original limestone knoll.

Progressive rehabilitation would be used to further integrate constructed landforms with the surrounding landscape. The rehabilitation strategies for the limestone quarry, rail siding and materials transport route are detailed in Section B5.

B4.1.2 Soils and Erosion Potential

Potential Impacts

Potential impacts of the quarry, rail siding and materials transport route on soils relate primarily to:

- alteration of soil structure beneath infrastructure items, hardstand areas and roads;
- soil contamination as a result of spillage of hydrocarbons or other chemicals;
- increased erosion and sediment movement during construction; and
- alteration of physical and chemical soil properties (eg. structure, fertility, microbial activity) during stripping and stockpiling operations.

Mitigation Measures

An Integrated Erosion and Sediment Control Plan (IESCP) for the quarry (incorporating construction phase controls for the rail siding and materials transport route) would be prepared in consultation with relevant government agencies prior to the commencement of construction activities. The primary objectives of the IESCP would be to:

- control soil erosion and sediment generation from areas disturbed by quarrying and construction activities; and
- maintain water quality (particularly in terms of total suspended solids content) in local watercourses within permitted standards.

Specific mitigation measures to control soil erosion and sediment migration would include:

- review of Construction Environmental Management Plans prior to carrying out the works;
- minimising disturbance during construction and operation of the works and restricting access to undisturbed areas;

- progressive rehabilitation/revegetation of infrastructure areas from the earliest practicable stage;
- minimising compaction during soil excavation and movement;
- use of erosion control features (eg. silt fences and temporary sediment traps, diversion banks, channels and rip-rap structures) to minimise sediment migration, divert surface water around disturbed areas and to control runoff velocity;
- construction of roads at an appropriate slope along contours; and
- construction of collection drains, diversion drains and culverts to control surface runoff from roads.

In addition to the above, the following soil resource management strategies are proposed:

- formulation of stripping guidelines including nomination of appropriate depths, scheduling and locating areas to be stripped;
- storage of topsoil in a manner which maintains the long term viability of the resource;
- selective stockpiling of soil according to soil type (ie. great soil group, soil horizon); and
- segregation of recovered soil based on seed content (ie. native pasture area, native woodland area, improved pasture area).

Topsoil stockpiles would be managed to maximise long term viability through implementation of the following management practices:

- stockpiles to be located outside proposed mine disturbance areas;
- stockpiles to be formed with a ‘rough’ surface to reduce erosion hazard, increase drainage and promote revegetation; and
- stockpiles be fertilised and seeded to maintain soil organic matter levels, soil structure and microbial activity.

Further detail with respect to the quantification of soil resources, stripping and re-application schedules and stockpiling inventories, would be included as part of the Mining Operations Plan (MOP) for the quarry. The preparation of a MOP is a regulatory requirement of the Department of Mineral Resources (DMR).

Further discussion on the IESCP and MOP is contained in Section B6.

B4.1.3 Landuse

The predominant landuses in the vicinity of the proposed limestone quarry, rail siding and materials transport route are agricultural production and existing road corridors. The agricultural suitability of land in the quarry and rail siding areas is classified as Class 3 and/or Class 4 (Section B3.1.3).

During the life of the quarry the affected areas would be fenced to exclude stock access. The overall rehabilitation strategy for the quarry site is to revegetate disturbed areas with a mixture of pasture and native woodland species (Section B5).

The construction of the rail siding would also result in a minor loss of agricultural land. The rehabilitation strategy adopted for the rail siding at closure would determine whether the loss of agricultural land would be permanent (ie. if the siding is retained) or temporary (ie. if infrastructure is decommissioned and the site revegetated). The closure strategy would be determined in consultation with the relevant government agencies as part of the Mining and Rehabilitation Environmental Management Process (MREMP). The MREMP is discussed further in Section A6.

The road upgrade works along the proposed materials transport corridor are primarily located within existing road corridors and as a result, do not alter the current landuse of these areas. The Fifield bypass route would be located on cleared agricultural land currently used for grazing and/or cropping. The landuse in this small area would be permanently altered.

B4.1.4 Land Contamination Status

The primary land contamination risks identified in the limestone quarry area (Appendix B), rail siding and along the materials transport route are spills in diesel or oil storage areas and off-site spills of diesel as a result of vehicle accidents.

The mitigation measures to prevent or reduce the potential for contamination of land from fuels and oils at the limestone quarry, rail siding and materials transport route would include the following:

- carriers of potentially hazardous loads would be required to be appropriately licensed in accordance with the provisions of the *Australian Code for the Transport of Dangerous Goods by Road and Rail*;
- carriers would be required to provide a communications system (eg. two-way radio or mobile telephone) in truck cabs to allow for prompt notification in the event of an accident;
- appropriately sized bunds around fuel and oil stores would be constructed and the installation of associated pipework would be above ground to enable the containment of spills and detection of leaks; and
- operation of storage areas would be in compliance with the requirements of the Australian Standard AS 1940-1993 – *The Storage and Handling of Flammable and Combustible Liquids* where applicable.

The rail siding area would primarily be used as the transfer point of some 210,000 tpa of sulphur (for use in the MPF) and back-loading of nickel and cobalt product (for sale). These materials would be packaged in covered rail/road containers. Long term storage of containers at the rail siding site is not proposed. The water management system for the siding hardstand areas would provide for the containment of runoff from these areas (Section B4.3.1).

B4.1.5 Bushfire Hazard

Potential Impacts

Fires present potentially serious impacts to surrounding properties and to personnel and equipment. The degree of potential impact would vary with climatic conditions (eg. temperature and wind) and the quantity of available fuel (eg. non-grazed pasture grasses and native forest).

Mitigation Measures

The areas surrounding the limestone quarry, rail siding and materials transport route are predominantly cleared grazing land and as such, generally have low to moderate bushfire potential (ie. the movement and magnitude of any bushfire would be restricted).

All employees would undergo training in bushfire prevention and management strategies as a component of the site induction programme. The training would include:

- identifying construction and operational areas with fire potential;
- identifying surrounding areas with the potential to carry fire;
- scheduling appropriate and safe activities in fire-sensitive areas; and
- awareness of fire prevention and fighting protocols and procedures.

In addition to environmental responsibilities there exists significant economic incentive to prevent fire damage to the considerable investment in infrastructure and equipment.

Bushfire management is a component of the Environmental Management Plan (Section B6).

B4.2 VISUAL FEATURES

Descriptions of the visual features of the quarry, rail siding and materials transport route areas, the potential visual impacts and associated mitigation measures, are presented in Appendix N. A summary of the existing visual features and landscape of the quarry, rail siding and materials transport route is presented in Section B3.1.4.

B4.2.1 Landscape Impacts and Mitigation Measures

Landscape impacts change the general character of the existing landscape. Such impacts can result from landform modification, vegetation removal and modifications to drainage patterns.

Potential landscape impacts are typically either temporary (ie. short term and reversible) or permanent (irreversible). Potential temporary impacts are a function of the projected life of the operation and the nature of the modifications resulting from the works. Items likely to constitute a temporary impact are the limestone quarry, rail siding support facilities, infrastructure, administration buildings, work sheds and pipelines.

Permanent landscape impacts associated with the limestone quarry, rail siding and materials transport route would result from:

- construction of the quarry open pit;
- construction of the quarry waste emplacement;

- construction of the additional rail spur line, siding and associated hardstand area; and
- the upgrade of the materials transport route (including road surface, intersections and the Fifield bypass).

Limestone Quarry

The limestone quarry waste emplacement batters would be graded to 1V:4H. The final height of the quarry waste emplacement would not exceed that of the original hill present on the site. Operations in the quarry open pit and infrastructure area night lighting would be progressively screened from view as the waste emplacement and topsoil stockpiles are developed and the quarry operations extend below the ground surface.

The waste emplacement would be constructed progressively with the batters closest to the Fifield to Trundle Road developed first in order to screen the operation. Progressive revegetation of the outer batters would soften the visual impact of the emplacement. In addition, a vegetation screen would be planted between quarry infrastructure areas and the Fifield to Trundle Road. Simulated views from the road towards the quarry, administration area at the "Westella" property and the waste emplacement are presented in Figures B4-1 and B4-2.

Views of the quarry and infrastructure areas from the two nearest properties outside the quarry MLA, "Reas Falls" and "Moorelands" (Figure B1-1), would be obscured due to distance and existing vegetation both within the road corridor and scattered across the properties.

The colour scheme used for limestone quarry buildings and other surface infrastructure would be designed, where possible, to integrate the facility with the surrounding environment.

Rail Siding

Permanent landform changes associated with the rail siding would be minor and include a rail spur line, an administration building and a hardstand area.

Views of the proposed rail siding would be available from the intersection of the Fifield to Trundle Road and the Tullamore to Bogan Gate Road and also along the northern and southern approaches to the siding along the Tullamore to Bogan Gate Road. Views of the siding would be obscured in part by vegetation on land adjacent to the site, however, views of the siding would be available at close proximity as there is limited screening vegetation between the road, rail line and proposed siding.

Views from "Glenrock" homestead (approximately 1 km south-west of the siding – Figure B1-1) towards the proposed rail siding would be available, however, the level of visual impact would be minimal due to the proposed lowset rail siding infrastructure.

Lighting required for the proposed facility would include focussed spotlights and shielded lighting to reduce the potential for light spillage off-site.

Vegetation screens at either end of the site would be planted in order to reduce the extent of views from the Tullamore to Bogan Gate Road.

As for the MPF area and limestone quarry, the colour scheme of proposed infrastructure would be selected to integrate the facility with the surrounding environment.

B4.3 WATER RESOURCES

B4.3.1 Surface Water Quality

Potential Impacts

Surface water runoff from disturbed areas associated with the limestone quarry, rail siding and materials transport route could potentially contain sediments, dissolved solids, oil, grease and other spilt consumables (eg. sulphur, limestone) being transported to or from the MPF area. The potential surface water quality impacts in regard to the quarry, rail siding and materials transport route are summarised in Table B4-1.

Existing View

Simulated View Year 5

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FIGURE B4-1a

Views from Fifield to Trundle Rd
to "Westella"
-Existing and Year 5

BLACK RANGE MINERALS

ResourceStrategies

BRM-98-01-Pt B-S4_005C

Existing View

Simulated View Year 21 Waste Emplacement

ResourceStrategies

SYERSTON NICKEL COBALT PROJECT EIS

FIGURE B4-1b

Views from Fifield to Trundle Rd to "Westella" - Existing and Year 21

BLACK RANGE MINERALS

BRM-98-01-Pt B-S4_006C

Existing View

Simulated View Year 5

SYERSTON NICKEL COBALT PROJECT EIS

FIGURE B4-2a

Views from Fifield to Trundle Rd to the Limestone Deposit - Existing and Year 5

BLACK RANGE MINERALS

Resource Strategies

BRM-98-01-Pt B-S4_007C

Existing View

Simulated View Year 21

SYERSTON NICKEL COBALT PROJECT EIS

FIGURE B4-2b

Views from Fifield to Trundle Rd to the Limestone Deposit - Existing and Year 21

ResourceStrategies

BLACK RANGE MINERALS

BRM-98-01-Pt B-S4_008C

Table B4-1
Potential Surface Water Quality Impacts

Construction and Operation Areas	Potential Impact Scenario	Type of Potential Contamination
Run-of-mine (ROM) limestone stockpile and waste emplacement	Drainage of sediment laden runoff to downstream surface waters during construction of stockpile area/hardstand. Uncontrolled drainage from stockpiles to downstream surface waters during operation.	Sediments and dissolved solids.
Limestone crushing plant	Drainage of sediment laden runoff to downstream surface waters during construction of crushing plant area/hardstand. Spillage to downstream surface waters during operation.	Sediments, fuel, oil and lubricants.
Infrastructure (roads, hardstands and topsoil stockpiles)	Drainage of sediment laden runoff to downstream surface waters during construction. Spillage to downstream surface waters during operation.	Fuel, oil, hydraulic fluid and sediments.
Rail siding hardstand	Drainage of sediment laden runoff. Spillage during operation.	Sediments, reagents, product.
Materials transport route	Drainage of sediment laden runoff to downstream surface waters during road upgrade works and associated creek crossings. Potential erosion and sedimentation resulting from runoff from road surface and associated drainage system. Spillage during transport.	Sediments, fuel, reagents, product.

Mitigation Measures

The overall objective of the water management system for the limestone quarry, rail siding and materials transport route is consistent with that proposed for the MPF area. In summary, all potentially contaminated water generated within construction and operational areas would be controlled via drainage channels and dams, while all other water would be diverted around these areas. The water management strategy would involve the principles outlined below.

(i) Operational areas of disturbance would be kept as small as possible.

(ii) Where practicable, construction works would be sequenced so as to minimise the area of progressive disturbance at any given time.

(iii) Work areas would be segregated into undisturbed runoff areas, construction runoff areas and operational runoff areas to minimise the generation of waters requiring on-site control.

(iv) Runoff from construction and operation areas would be intercepted and channelled to storages.

(v) Water which accumulated in these storages would be reused where practicable.

(vi) Progressive rehabilitation would be used to stabilise disturbed land surfaces (eg. quarry waste emplacement). Once the areas have been reprofiled and/or revegetation is established, it is anticipated that runoff from these areas would be of comparable quality to runoff from surrounding undisturbed areas.

(vii) Treatment systems such as temporary sediment retention dams, silt fences and vegetation buffers would be employed as interim erosion and sediment control measures during the rehabilitation process.

As discussed in Section B4.1.2, an IESCP would be prepared in consultation with relevant government agencies prior to the commencement of construction activities. The IESCP would detail specific mitigation measures to control soil erosion and sediment migration and therefore protect downstream surface water resources.

B4.3.2 Groundwater Hydrology

A summary of the hydrogeology of the limestone quarry area is presented in Section B3.4.2. A discussion of the potential impacts of the quarry on the local groundwater hydrology and mitigation measures to manage these impacts is presented below. The activities proposed at the rail siding and materials transport route are not predicted to create any impact on groundwater resources in the area.

The excavation of the limestone quarry open pit would involve the intersection of some groundwater containing structures. Flow from these structures into the void would be expected to create a localised drawdown effect within the host rock. Limited groundwater resources encountered during exploratory drilling would suggest that these effects would be minimal. Groundwater monitoring in the limestone quarry area is discussed in Section B6.

During quarrying an in-pit water collection sump and pumping system would be operated. The sump would collect a combination of groundwater inflows, direct rainfall and surface runoff. This water would be pumped from the open pit for recycling in the crushing plant or would be used for watering haul roads.

There are no registered groundwater extraction licences or users in the immediate vicinity of the limestone quarry. No specific measures to reduce the groundwater effects of the open pit are therefore proposed. Groundwater level monitoring in the limestone quarry area and the measurement of underground inflow rates would be used to evaluate the drawdown effects of the quarry open pit (Section B6).

B4.4 FLORA

A description of the flora of the limestone quarry area, rail siding and materials transport route and surrounds is presented in Appendix I and summarised in Section B3.2.

B4.4.1 Potential Impacts

Vegetation Disturbance

The construction of the quarry, rail siding and materials transport route would not result in the removal or modification of significant areas of native vegetation. Vegetation clearance would mostly be restricted to areas of open farm land with predominantly native grasses and scattered trees. All of the proposed disturbance areas have been assessed as having limited value for flora conservation (Appendix I).

Weeds

The land disturbance activities required during construction of and operation of the quarry, rail siding and materials transport route can favour the colonisation and spread of weed species.

Many weed species that occur in the region are effective competitors for resources and have the potential to restrict or exclude the growth of native species. This can result in changes in the composition and structure of plant communities. In addition, personnel and vehicles can translocate seeds of weed species into new areas and onto sites of disturbance.

Significant Flora

No plant species listed as threatened under the NSW *Threatened Species Conservation Act 1995,* or the Commonwealth *Protection of the Environment Biodiversity Conservation Act, 1999* were found within the quarry, rail siding or materials transport route during the flora survey. In addition, no plant species listed in *Rare or Threatened Australian Plants* (ROTAP) (Briggs and Leigh, 1996), were recorded in these areas.

B4.4.2 Mitigation Measures

The following measures would be adopted in order to mitigate potential impacts on flora associated with the construction and operation of the limestone quarry, rail siding and materials transport route:

- Vegetation clearance protocols would be adopted during construction. The protocols would include but not be restricted to progressive clearing where practicable, maximum harvesting of cleared timber resources and recycling or disposal of other non-harvestable vegetative parts.
- A weed control programme would be developed (Section A6).
- Progressive rehabilitation using a mixture of endemic woodland and grass species would be used where practicable.

B4.5 FAUNA

Details of the fauna surveys and assessments are presented in Appendices JA, JB, JC and JD. A summary of the findings from these appendices relevant to the limestone quarry area, rail siding and materials transport route is presented below.

B4.5.1 Potential Impacts

Habitat Disturbance

Despite the predominantly cleared nature of the majority of the quarry, rail siding and materials transport route areas, the existing patches of remnant vegetation provide opportunities for fauna usage. These opportunities would be reduced as a result of clearance activities.

Feral Species

Several feral species (Appendix JA) are known to occur in the region and/or were recorded during the surveys. These species include the House Mouse, European Rabbit, Red Fox, Feral Pig and Feral Cat. Predation and/or competition for resources by these species could impact on the native fauna of the region (eg. predation by the Red Fox is listed in Schedule 3 of the *Threatened Species Conservation Act, 1995* as a key threatening process). There is potential for feral animals to be attracted to the quarry and rail siding operational areas due to discarded food scraps and other rubbish.

Fauna and Road Traffic

The movement of construction and operational vehicles (in particular movements along the materials transport route) has the potential to increase the incidence of fauna mortality via vehicular strike.

Barrier Effects

The presence of linear features such as the public roads that make up the materials transport route has the potential to impede faunal movement/dispersal patterns. Although the route primarily involves the upgrading of existing roads (ie. the barrier effect already exists), a relatively short section of new road would be constructed for the Fifield bypass.

Fauna and Noise Emissions

The proposed limestone quarry and rail siding have the potential to disrupt vertebrate fauna by increasing the existing noise levels. As discussed in Appendix JA, whilst some specific studies of the effects of noise on wildlife are reported in the scientific literature there are no guidelines on the noise levels that may disturb or affect vertebrate fauna.

The studies however, indicate that many species are well adapted to human activities and noises. Birds tend to habituate to constant steady noises, even of a relatively high level in the order of 70 decibels (dBA).

Fauna and Artificial Lighting

Little information is available on the potential impacts of lighting on wildlife. Potential impacts of the limestone quarry and rail siding development are likely to relate to the alteration of forage zones, primarily for insectivorous bird and bat species.

B4.5.2 Mitigation Measures

In addition to the vegetation management measures detailed in Section B4.4.2, the following initiatives have been developed to manage potential impacts on local fauna.

- Prior to ground disturbance works, mature trees with hollows would be identified, marked and retained where practicable.
- Mature, hollow-bearing trees identified in the pre-clearance survey that cannot be avoided would be inspected and any animals found would be relocated.
- A clean, rubbish-free environment would be maintained, particularly around administration and contractor areas. This would discourage scavenging and reduce the potential for colonisation of these areas by non-endemic fauna (eg. introduced rodents, birds).
- To reduce the potential for vehicle strike, speed limits would be imposed on vehicles using roads and tracks in the quarry and rail siding areas. Vehicles using public roads would be required to operate within the legal speed limits at all times.
- Employees would undergo an education programme during induction on flora and fauna resources.
- Feral animal control programs and site management strategies would be developed for the limestone quarry and rail siding areas.

B4.5.3 Significant Fauna

Eight Part Tests of Significance (Appendices JB and JD) were completed for 21 threatened fauna species known or considered likely to occur in the area (including the six threatened species recorded during the Project area fauna surveys - Section B3.3.5). Of the six species recorded, only the Little Pied Bat (*Chalinolobus picatus*) was identified in an area of relevance to the quarry, rail siding or materials transport route (ie. in the Fifield to Trundle Road corridor near the eastern border of the limestone quarry MLA area).

The Eight Part Test for the Little Pied Bat is detailed in Appendix JD. It was determined that the road works required to upgrade the materials transport route would not involve removal of significant areas of known habitat for *C. picatus*.

The Test concluded that the proposed road upgrades were not considered to be processes that would severely impact the Little Pied Bat. Notwithstanding, the following management strategy would be adopted where vegetation clearing was required:

- the removal of large mature trees would be avoided where practicable;
- in cases where the removal of large trees cannot be avoided, a pre-clearance survey would be used to ascertain if the trees contain bat colonies (particularly any threatened species); and
- any bat colonies would be relocated.

B4.6 AIR QUALITY

An air quality assessment is presented in Appendix A. The assessment considers the air emissions likely to be generated and the likely impact of such emissions.

Emissions relevant to the quarry, rail siding and materials transport route are restricted to the generation and dispersion of atmospheric dust from the limestone quarry and limestone crushing operations. The materials transport route and rail siding are not considered to be dust generating activities as the majority of vehicle movements will be on sealed road surfaces.

Dust and total suspended particulates (TSP) emissions for the limestone quarry were modelled for Years 5 and 21. Year 5 was adopted as indicative of general operational conditions during the majority of the EIS period and Year 21 was adopted as a potential worst case year, due to the increased elevation of the waste emplacement.

B4.6.1 Dust Deposition

Air Quality Criteria

Air quality guidelines used in the assessment were based on NSW EPA guidelines for protecting amenity. The specific effects contributing to a reduction of amenity mainly relate to the presence of visible dust either in the air or on surfaces.

Details of the EPA amenity criteria for dust deposition are shown in Table B4-2. The criteria seek to limit the maximum increase in the mean annual rate of dust deposition from a new development to 2 g/m^2/month.

Potential Impacts

The predicted increases in the mean annual dust deposition rates during Year 5 and Year 21 are shown on Figures B4-3 and B4-4.

Table B4-2
NSW EPA Criteria for Dust Fallout

Existing Dust Level (g/m^2/month)	Maximum Acceptable Increase Over Existing Dust Level (g/m^2/month)	
	Residential Suburban	Rural, Semi Rural, Urban Commercial and Industrial
2	2	2
3	1	2
4	0	1

Source: NSW Environment Protection Authority

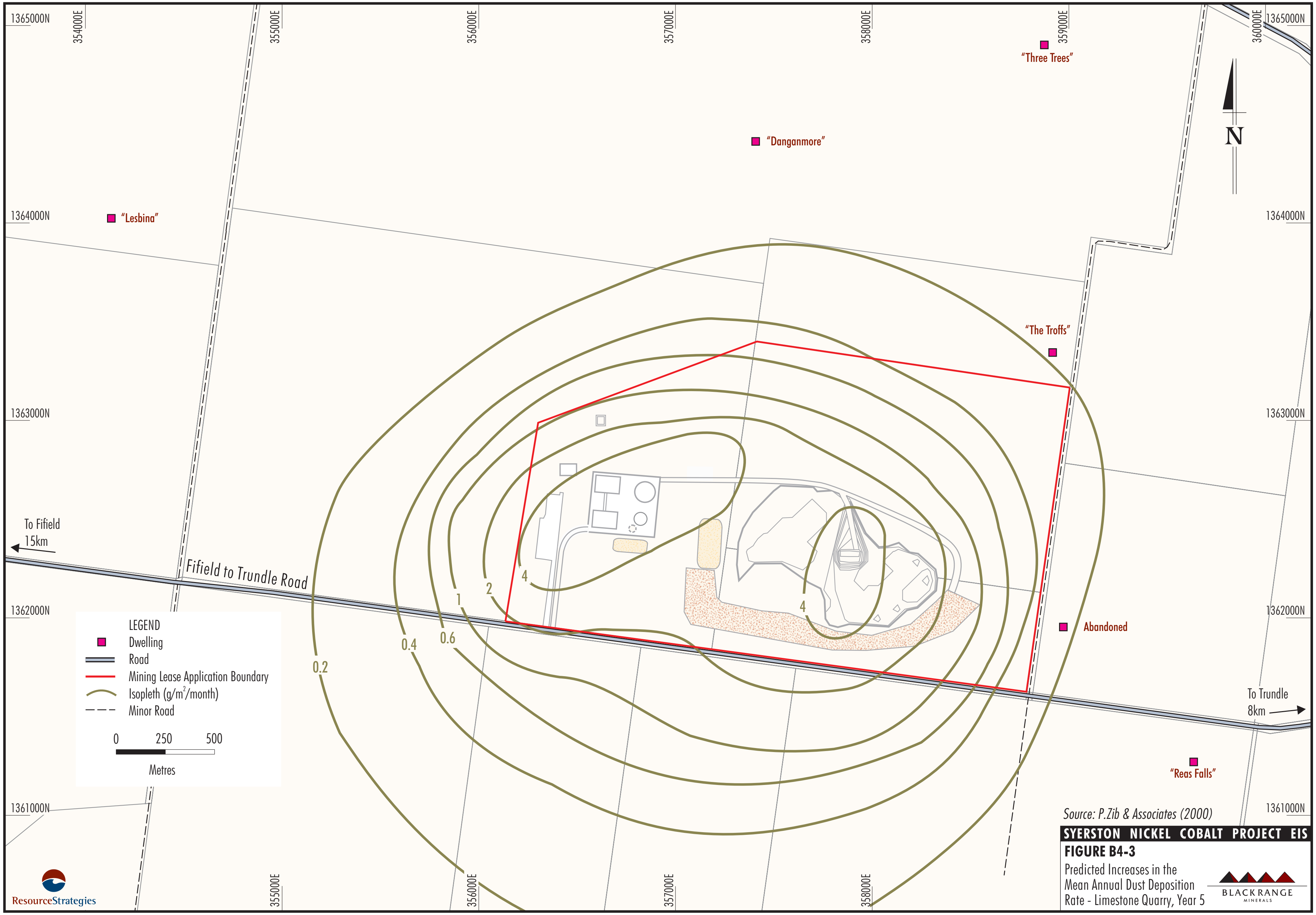

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FIGURE B4-3

Predicted Increases in the Mean Annual Dust Deposition Rate - Limestone Quarry, Year 5

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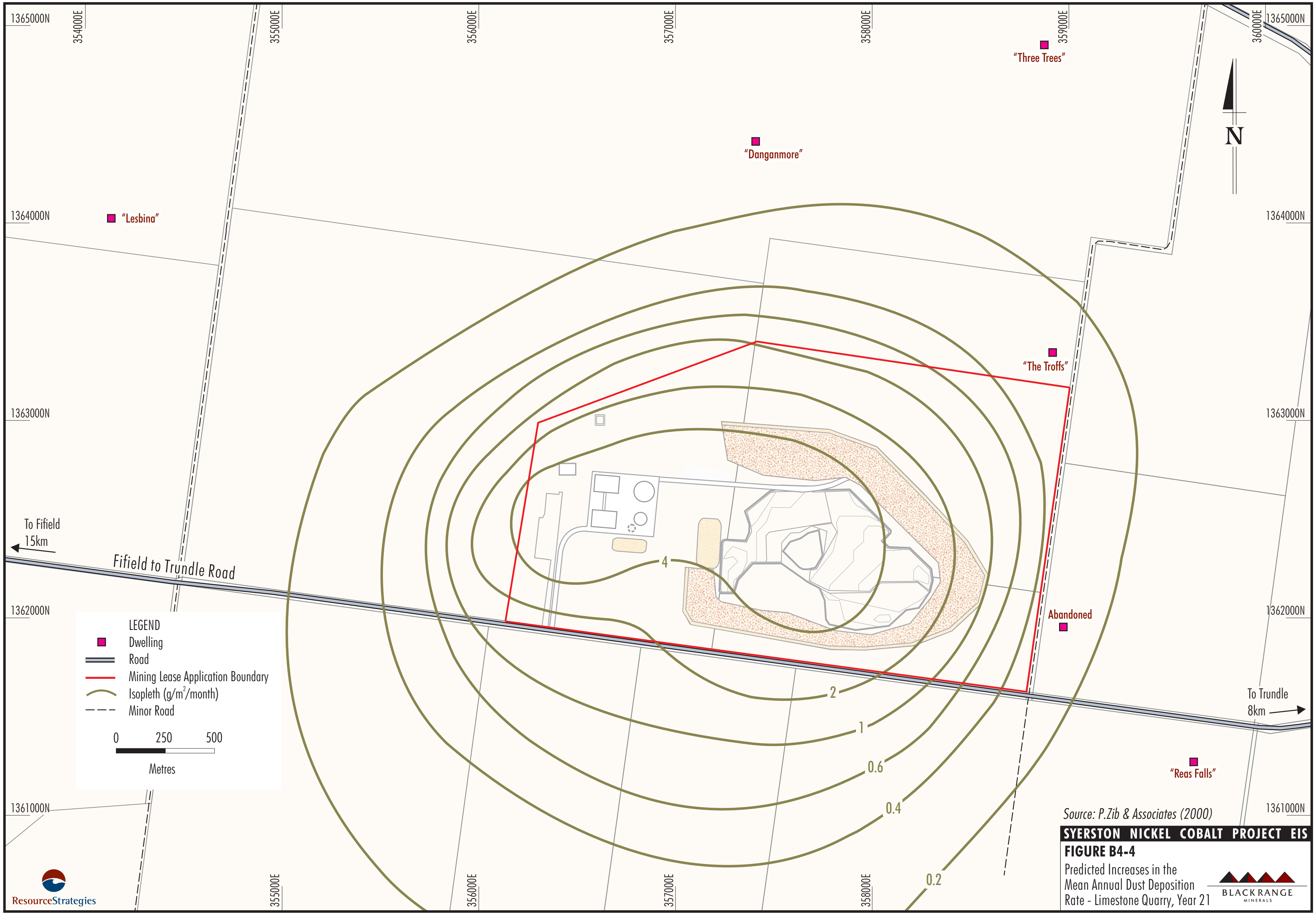

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FIGURE B4-4

Predicted Increases in the Mean Annual Dust Deposition Rate - Limestone Quarry, Year 21

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Modelling predictions indicate that the EPA amenity criteria would be met for all non-Company owned or optioned residences. Exceedance of the criteria is predicted for a small area of farmland to the south of the Fifield to Trundle Road and the "Westella" property (BRM optioned) to the west of the MLA, during Year 5 and Year 21 (Figures B4-3 and B4-4).

Limestone haulage to the MPF site would be in covered containers. No significant dust emissions are anticipated from haulage operations on the materials transport route.

Mitigation Measures

Notwithstanding the predicted impact of dust generating activities, a range of air quality safeguards would be employed to reduce emissions of atmospheric dust from the limestone quarry. These safeguards are based on current control techniques as recommended by the EPA and include watering of disturbed areas, prevention of truck overloading and spillage during loading and hauling, use of dust suppressants or cover crops on stockpiles, installation of fogging water sprays on crushing and screening operations and progressive rehabilitation of disturbed areas.

B4.6.2 Concentrations of Particulate Matter

Air Quality Guidelines

The health effects of dust are related to the concentration of suspended particles in the air as distinct from dust deposition. The effects of inhaled dust are specifically related to the types of particles inhaled, particle size, the ability of the respiratory tract to capture and eliminate the particles and the reactivity of the particles with lung tissue.

The National Health and Medical Research Council of Australia (NHMRC, 1985) recommend an annual concentration of 90 $\mu g/m^3$ as the maximum permissible level of TSP in the air to protect public health in residential environments. There is currently no air quality goal which is applicable to PM_{10} emissions from a proposed development (P. Zib and Associates, 2000).

Potential Impacts

Figures B4-5 and B4-6 show predicted increases in the mean annual concentrations of TSP during Year 5 and Year 21 in the limestone quarry area.

A qualitative assessment of the baseline levels of TSP at the quarry indicates levels of 20 to 30 $\mu g/m^3$ would be anticipated in a typical rural environment (P. Zib and Associates, 2000).

An increase of up to 60 $\mu g/m^3$ could therefore be accommodated without exceedance of the NHMRC TSP guideline.

The results of the TSP modelling indicate compliance with the guideline at all non-company owned or optioned residences The NHMRC guideline may be exceeded on occasion in a small area to the west of the MLA boundary within the "Westella" property (BRM optioned) during Year 21 (Figures B4-5 and B4-6).

Mitigation Measures

The dust control measures outlined in Section B4.6.1 would also provide control of TSP and PM_{10} emissions.

B4.7 ACOUSTICS

B4.7.1 Noise Impact Assessment Procedure

The regulation of noise generating activities in NSW is vested in Local Government and the EPA. The EPA's Industrial Noise Policy dated January 2000 provides a framework and process for deriving noise criteria for consents and licences. It enables the EPA to regulate premises that are scheduled under the *Protection of the Environment Operations Act, 1997*.

Under the Policy, the intrusiveness and potential affect on the amenity of the receiving environment may need to be considered.

The intrusiveness criterion essentially means that the equivalent continuous noise level (L_{Aeq}) of the source should not be more than 5 decibels above the rating background level (L_{A90}).

The amenity assessment is based on noise criteria specific to landuse and associated activities. The criteria relate only to industrial-type noise and do not include road, rail or community noise. The existing noise level from industry is measured. If it approaches the criterion value, then noise levels from new industries need to be designed so that the cumulative effect does not produce noise levels that would significantly exceed the criterion. For high-traffic areas there is a separate amenity criterion.

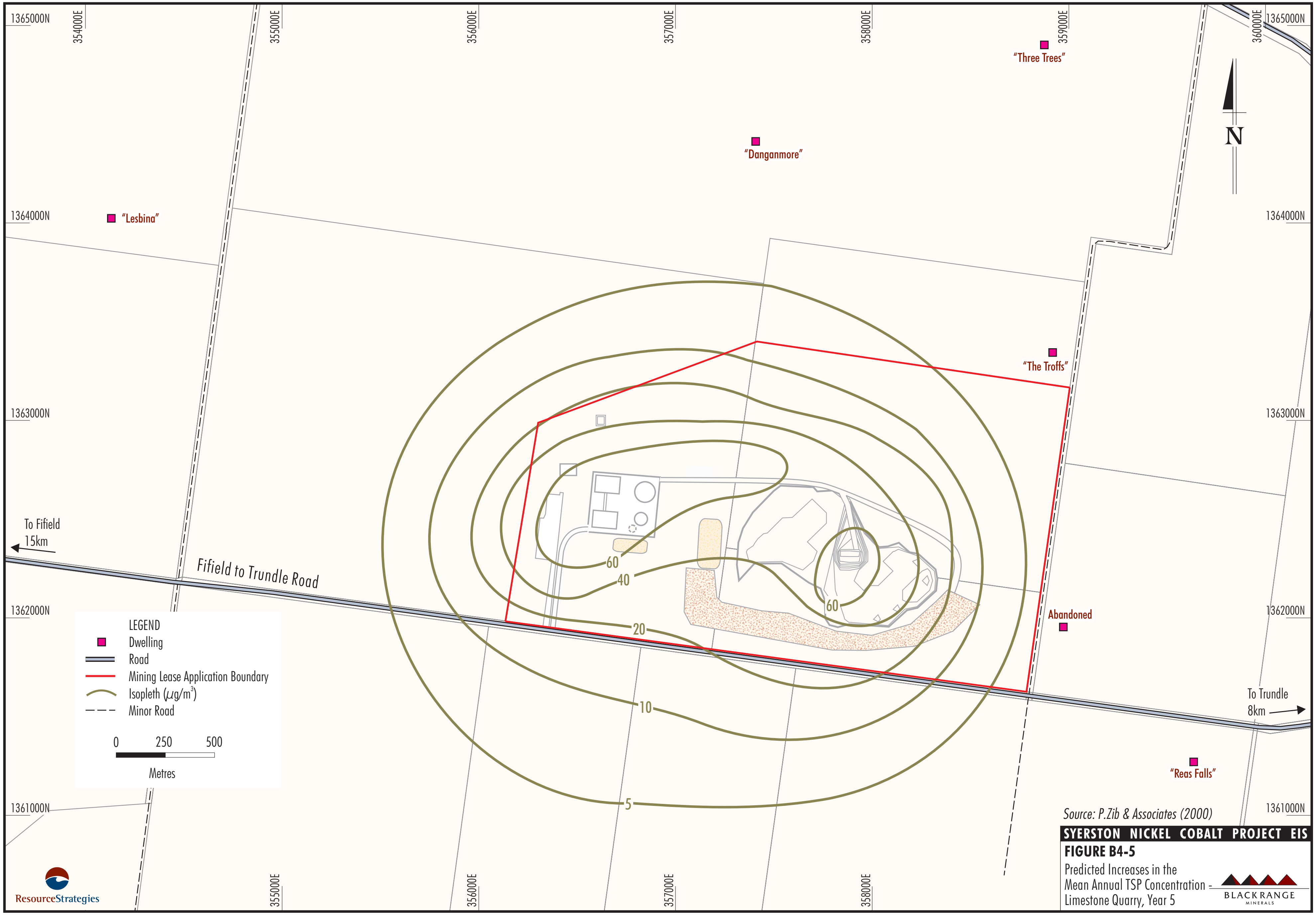

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FIGURE B4-5

Predicted Increases in the Mean Annual TSP Concentration - Limestone Quarry, Year 5

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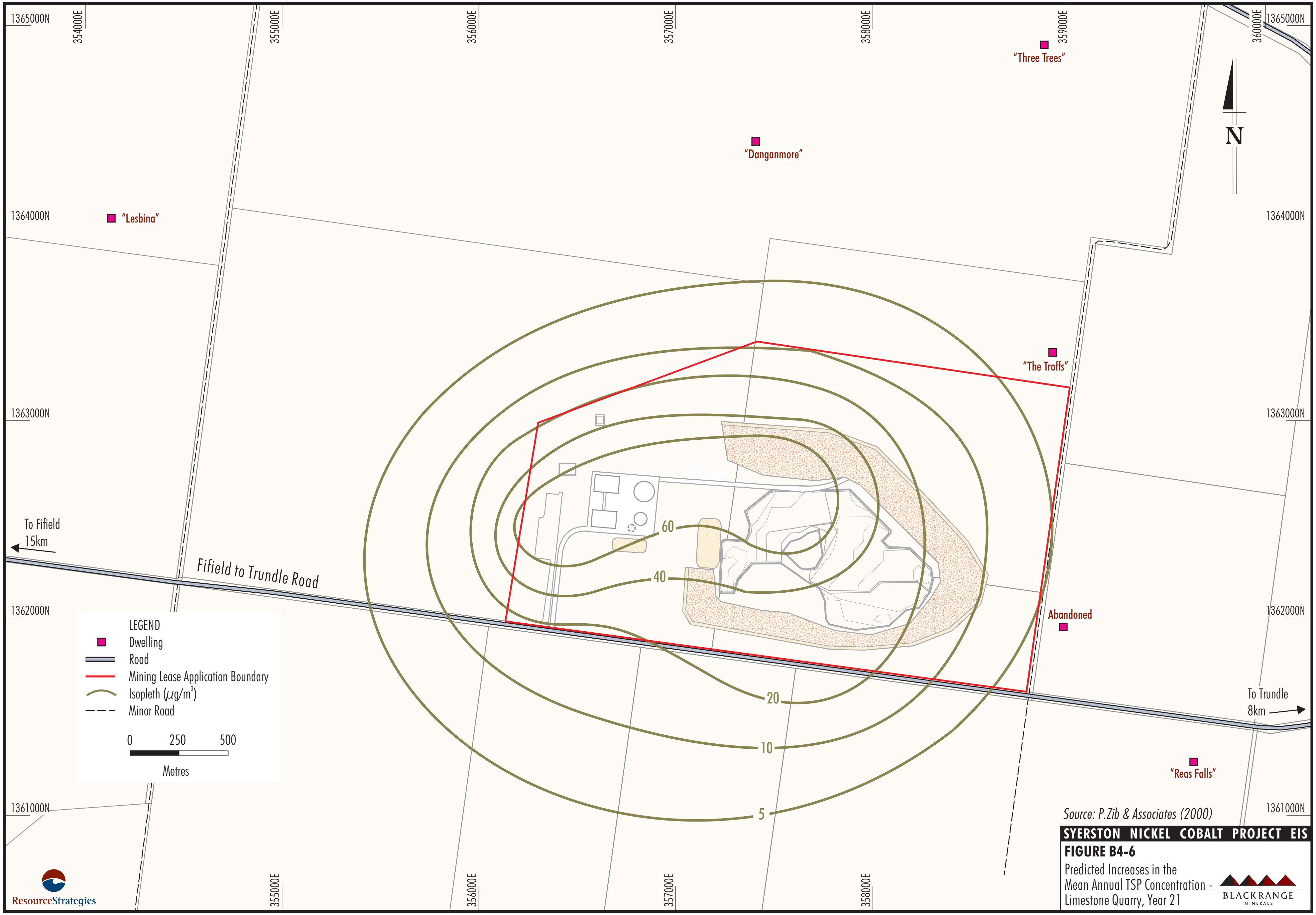

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FIGURE B4-6

Predicted Increases in the Mean Annual TSP Concentration - Limestone Quarry, Year 21

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A detailed discussion of the noise criteria relative to the Project is provided in Appendix K.

B4.7.2 Potential Impacts

The predicted noise impacts associated with the limestone quarry, rail siding and materials transport route are discussed below. Where appropriate the relevant EPA noise criteria are provided.

Limestone Quarry Noise Emissions

The predicted contributed daytime $L_{Aeq(15minute)}$ noise emissions under the prevailing meteorological conditions are presented in Table B4-3. The noise emissions were calculated at the residences surrounding the quarry site and were based on the predicted level of noise generating activity during Year 5 of the quarry operation (Figure B4-7).

As indicated by Table B4-3, the noise modelling predicted the following:

- the daytime $L_{Aeq(15minute)}$ noise emissions at the assessment locations would be below the recommended criteria during prevailing meteorological conditions except at "Moorelands", "Lesbina" and "Eastbourne"; and
- the predicted $L_{Aeq(15minute)}$ noise emissions at "Lesbina" and "Eastbourne" would be marginally (2 dBA) and at "Moorelands" moderately (5 dBA) above the criteria under prevailing meteorological conditions.

Limestone Quarry Emissions for Blasting

Blasting at the limestone quarry would be used to fracture the material to a size that can be handled by the mining equipment. Blasting would be required periodically and would utilise an ammonium nitrate fuel oil mix (ANFO) or emulsion type explosive.

A maximum instantaneous charge (MIC) of 87 kg per blast is predicted and was used for the blasting impact assessment (Appendix K).

The predicted levels of ground vibration and airblast at the three nearest potentially affected residential dwellings are provided in Table B4-4.

The following blast impacts were predicted:

- predicted levels of ground vibration at the residential properties comply with the structural damage criterion of 5 mm/s recommended for low-rise residential buildings;
- predicted levels of ground vibration at the residential properties comply with the human comfort criterion of 5 mm/s for daytime blasting (Monday to Saturday 0900 hours to 1700 hours);
- predicted levels of peak airblast at all residential properties are well below the structural damage limit of 132 dB Linear; and

Table B4-3
Predicted Daytime $L_{Aeq(15minute)}$ Quarry Operating Noise Emissions
Year 5 - dBA

Location	**$L_{Aeq(15minute)}$ Noise Emission**	**$L_{Aeq(15minute)}$ Noise Criteria***
	Calm	**Daytime (0700 hrs to 1700 hrs)**
"Reas Falls"	30	37
"Moorelands"	**42**	37
"Gillenbine"	36	37
"Lesbina"	**38**	36
"Hillsdale"	24	37
"The Troffs"	33	36
"Eastbourne"	**38**	36

* Refer to Appendix K for definition of EPA criteria.

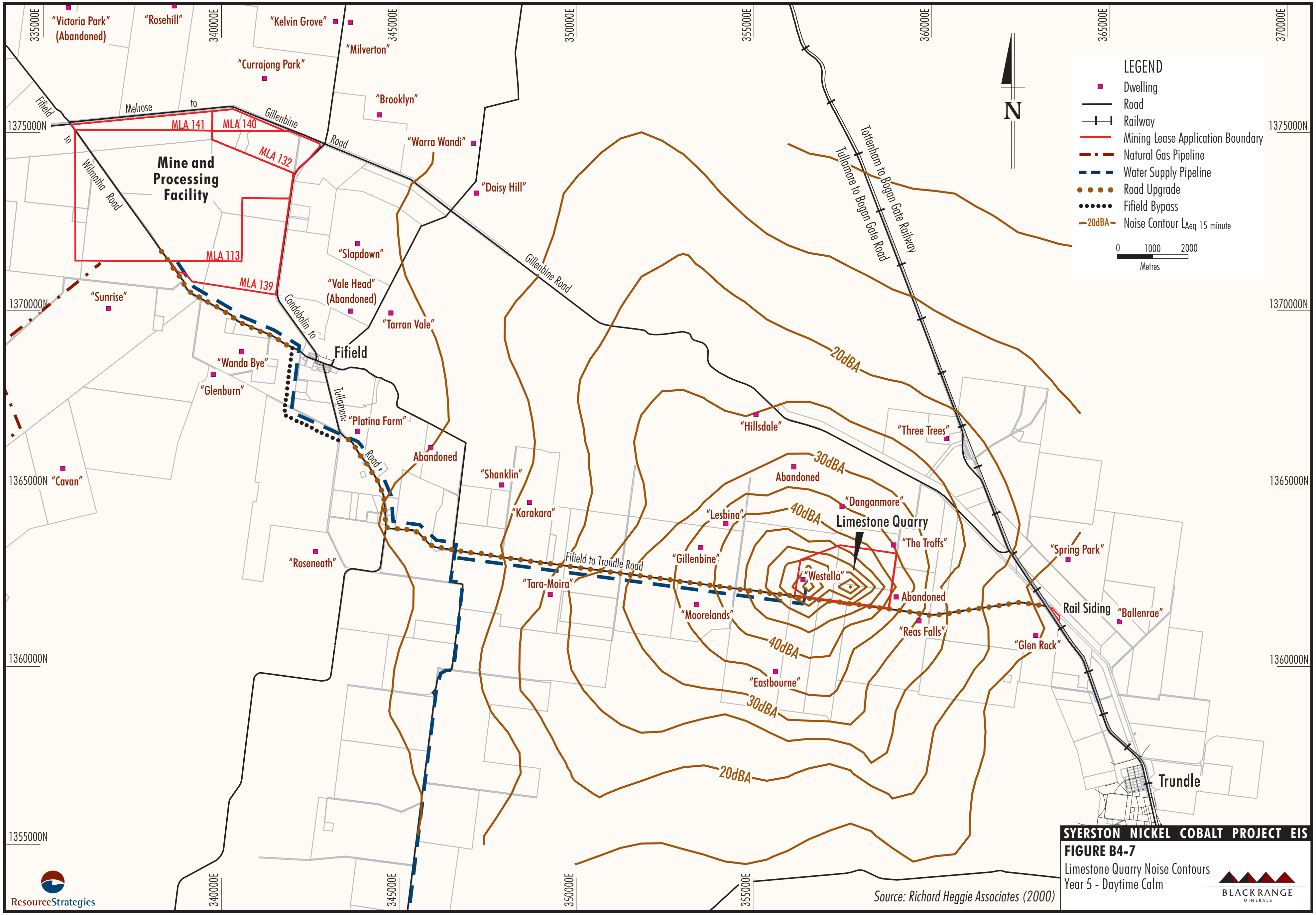

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FIGURE B4-7

Limestone Quarry Noise Contours
Year 5 - Daytime Calm

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Table B4-4
Predicted Limestone Quarry Blast Emissions

Location	Distance from near point of blasting (m)	Predicted Blast Emission Level*	
		PVS Ground Vibration Velocity (mm/s)	Peak Linear Airblast Level
"Reas Falls"	1,450	0.2	104 dB Linear
"Danganmore"	1,650	0.1	103 dB Linear
"The Troffs"	1,150	0.2	106 dB Linear

* Refer to Appendix K for definition of relevant EPA blasting criteria.

- predicted levels of peak airblast at all residential properties comply with the human comfort criterion of 115 dB Linear for daytime blasting (Monday to Saturday 0900 hours to 1700 hours).

Rail Traffic Noise Emissions

A maximum of six train movements (ie. three return trips) per week would be required to transport sulphur and other materials to the rail siding. The closest potentially affected residences to the siding are "Glen Rock" and "Ballenrae". These residences are offset approximately 1 km from the rail line respectively (Figure B1-1).

Richard Heggie Associates (Appendix K) calculated the 24 hour equivalent continuous noise level (L_{Aeq}) and the maximum passby level at these two residences with the additional train movements (Table B4-5).

The predicted noise levels are well below the EPA criteria for $L_{Aeq(24hour)}$ and maximum levels (L_{Amax}) at both residences.

Construction Noise Emissions During the Upgrade of the Materials Transport Route

Roadworks to upgrade the materials transport route would be conducted progressively in sections. As a result, construction noise emissions would be audible at the nearest residences for a limited duration (ie. as the roadworks occur on the section of road immediately adjacent to the residence). Construction activities would occur during daylight hours only.

Noise Emissions Associated with Mine Traffic on the Materials Transport Route

Potential noise impacts from use of the materials transport route during operation of the Project has been assessed (Appendix K). For landuse developments with the potential to create additional traffic on nearby roads the EPA $L_{Aeq(1\ hour)}$ criteria for daytime (0700 – 2200 hours) and night-time (2200 – 0700 hours) are 60 dBA and 55 dBA respectively. In areas where these criteria are already exceeded the development should not lead to an increase in existing noise levels of more than 2 dBA.

The traffic noise impact assessment for the Project (Appendix K) utilised the US Environment Protection Agency's (US EPA's) method for prediction of $L_{Aeq(1hour)}$ noise level for a range of offset distances of the closest residences adjacent to the local access roads. The method is an internationally accepted theoretical traffic noise prediction model which takes into account numerous factors. These include the (L_{Amax}) vehicle noise levels (light and heavy), receiver offset distance, passby duration, vehicle speed, ground absorption, number of hourly vehicle movements, receiver height, truck exhaust height and the height and location of any intervening barriers.

The existing and predicted construction and operational noise levels at potentially affected receivers adjacent to the materials transport route are presented in Table B4-6.

In summary, the traffic noise impact assessment indicated that peak hour noise levels would be lower than both the relevant EPA daytime and night-time traffic noise criteria of $L_{Aeq(1hour)}$ 60 dBA and 55 dBA respectively during both construction and operation of the Project.

Table B4-5
Predicted Noise Levels Due to Rail Transportation

Receiver	Maximum Number of Train Movements per Day	Predicted Noise Level		EPA Recommended Criteria	
		$L_{Aeq(24hour)}$	L_{Amax}	$L_{Aeq(24hour)}$	L_{Amax}
"Glen Rock"	4	35 dBA	38 dBA	60 dBA	85 dBA
"Ballenrae"	4	33 dBA	14 dBA	60 dBA	85 dBA

Source: Richard Heggie Associates (2000)

Table B4-6
Existing and Predicted Traffic Noise Levels

Receiver	Road	Location	Offset Distance	Peak Traffic Noise Levels - $L_{Aeq(1hour)}$		
				Existing (dBA)	Construction (dBA)	Operation (dBA)
Fifield Village	Fifield Bypass	-	1,100 m	50	50	50
"Platina Farm"	Condobolin to Tullamore Road	North of State Route 90	300 m	34	41	36
"Gillenbine"	Fifield to Trundle Road	East of Condobolin to Tullamore Road	1,100 m	21	33	35
"Reas Falls"	Fifield to Trundle Road	East of Condobolin to Tullamore Road	325 m	28	40	42
"Glen Rock"	Tullamore to Bogan Gate Road	North of Trundle	750 m	30	35	35

Source: Richard Heggie Associates (2000)

B4.7.3 Mitigation Measures

Based on the findings of the acoustic impact assessment of the limestone quarry, rail siding and materials transport route summarised above, the following mitigation measures are proposed.

- The limestone quarry waste emplacement would be constructed to a final height of approximately 7 m and would progressively encircle the open pit on the southern, eastern and northern sides. This structure would provide both visual and noise screening of the in-pit activities.
- Noise monitoring in the vicinity of the quarry, rail siding and materials transport route would be undertaken on an on-going basis.
- If necessary, further noise monitoring, property owner discussions and consideration of mitigating measures (eg. point source attenuation, acoustic barriers or dwelling treatments) would be undertaken.

B4.8 ABORIGINAL HERITAGE

A search of the NSW NPWS Aboriginal Sites Register found that no sites had previously been recorded in the area of the limestone quarry, rail siding or materials transport route. No sites were identified in these areas during the surveys conducted by Archaeological Surveys and Reports (2000) (Appendix L).

Potential Impacts

While no sites have been identified within the proposed disturbance areas, there is some potential for individual artefacts occurring buried within the topsoil. However, given the highly disturbed nature of the majority of the proposed disturbance areas, this is considered unlikely (Archaeological Surveys and Reports, 2000).

Mitigation Measures

Earthmoving operators and contractors employed during construction would be obliged to comply with the *National Parks and Wildlife Act, 1974.* If bone or stone artefacts or discrete distributions of shell are unearthed during earthworks, works in the vicinity of the find would cease and the local Aboriginal Land Council and representatives of the NPWS would be informed. Works would not recommence in the immediate area until the find had been inspected and permission given for works to proceed.

In the event that it becomes necessary to disturb or destroy any archaeological site during the development, a "Consent to Destroy" would be sought from NPWS. Salvage of any such sites would be undertaken by a qualified archaeologist accompanied by a representative of the local Aboriginal community.

B4.9 EUROPEAN HERITAGE

The Lachlan and Parkes Shire Local Environmental Plans do not list any sites of European heritage significance in the limestone quarry, rail siding or materials transport route. No sites of heritage significance were identified within these areas during the survey conducted by Heritage Management Consultants (2000) (Appendix M).

B4.10 TRANSPORT

An assessment of the existing traffic network and potential Project related traffic impacts of the Project is presented in Appendix C. A summary of the results of the study, including mitigation measures, relating to the limestone quarry, rail siding and materials transport route is presented below.

Potential impacts and mitigation measures relating to other roads in the local transport network are described in Section A4.14.

B4.10.1 Potential Impacts

Operational Phase

The predicted increases in traffic on the materials transport route during the operational phase of the Project are summarised in Table B4-7.

Table B4-7 indicates that at the Fifield bypass there would be an increase of approximately 449 vehicles comprising approximately 196 trucks and 253 light vehicles along the materials transport route in the operational period. These movements include employee and general transport movements and road haulage of consumables and products.

Transport of consumables from the rail siding and limestone from the quarry to the MPF site would contribute approximately 100 truck movements per day (50 round trips). Nickel and cobalt products would be back-loaded on incoming general goods containers and therefore would not contribute any additional truck movements.

Approximately six rail movements on the Tottenham to Bogan Gate Railway would be required each week for the transport of sulphur, other consumables and cobalt and nickel products.

Increased road traffic accessing the rail siding via the existing level crossing adjacent the site has the potential to interrupt rail traffic.

Table B4-7
Existing and Predicted Operational Traffic Movements – Materials Transport Route

Road	Existing Daily traffic Volume		Predicted Daily traffic Volume		Existing Quality of Service	Future Quality of Service
	Total	Heavy	Total	Heavy		
Tullamore to Bogan Gate Road	339	41	685	136	Good	Good
Fifield to Trundle Road	52	9	499	205	Good	Good[(1)]
Fifield Bypass	-	-	449	196	-	Good[(1)]

Source: Masson Wilson Twiney (2000)
[(1)] Assumes constructed with two lane seal as proposed.

Construction Phase

During the peak of construction activities at the rail siding and limestone quarry, each site would contribute about 50 vehicle movements per day along the materials transport route. It is proposed that the construction periods for each site (three months for each) would not overlap. Over the whole construction period (ie. some six months) an average of approximately 30 vehicle movements per day is predicted (Appendix C).

A large proportion of general construction traffic for the MPF site including workforce, equipment and supply deliveries, and other traffic would use the materials transport route.

The movement of consumables along the materials transport route during the construction period would be significantly less than during the operational phase as no sulphur or limestone truck movements would be required.

Oversize Traffic

During the construction period there may be a requirement for the transport of oversize or overweight vehicles along the materials transport route. These loads cannot be avoided as they represent the smallest size into which some of the plant items can be broken down.

Any oversize loads would be transported in accordance with the relevant permits, licences and escorts, as required by the regulatory authorities.

B4.10.2 Mitigation Measures

The following mitigation measures are proposed to minimise the potential impact of the Project on the local transport network:

- upgrade of the Fifield to Trundle Road;
- upgrade of sections of the Fifield to Wilmatha Road;
- upgrade of sections of the Condobolin to Tullamore Road;
- construction of the Fifield bypass;
- traffic on the materials transport route would have priority at all intersections apart from at the Fifield to Trundle Road/Tullamore to Bogan Gate Road intersection;
- lighting would be installed at the intersections of the Fifield to Trundle Road/Tullamore to Bogan Gate Road and the Fifield to Trundle Road/Condobolin to Tullamore Road;
- intersections subject to increased traffic would be upgraded in accordance with AUSTROADS guidelines to provide improved signage, sheltered right turn lanes, left turn deceleration lanes and improved left turn radii where appropriate;
- 3 m wide shoulders would be provided for approximately 30 m on either side of all minor roads and property accesses along the materials transport route;
- haulage along the materials transport route would be restricted during operation hours of school buses; and
- minor upgrades to the railway level crossing at the access road may be required. Upgrades would be conducted to the satisfaction of the relevant road and rail authorities.

Subject to the improvements and management measures above, the materials transport route would be able to satisfactorily accommodate the increase in traffic associated with the construction and operational phases (Masson Wilson Twiney, 2000).

B4.11 RISK ASSESSMENT

Appendix B details the results of the preliminary hazard assessment conducted for the Project. The objectives of the assessment were to:

- develop a comprehensive understanding of the hazards and risks associated with the Project;
- review the adequacy of the proposed safeguards and recommend improvements if appropriate; and
- evaluate the risk from the proposed development to the surrounding landuse with regard to the Hazardous Industry Planning Advisory Papers developed by DUAP.

B4.11.1 Identified Hazards and Mitigating Measures

The following hazards were identified at the limestone quarry, rail siding or materials transport route:

- incidents associated with on-site storage of diesel;
- hazards associated with the transport of materials;
- incidents involving explosives (limestone quarry); and
- breaches of security.

These potential hazards are described below along with mitigation measures proposed to minimise risk.

Diesel Storage Incidents

Diesel storage tanks would be located at the limestone quarry and rail siding. The following potential incidents were identified in the hazard assessment:

- loss of containment due to impact, equipment failure, handling error or leak causing environmental harm or land contamination; and
- diesel fire following loss of containment, causing harm to persons or property.

Mitigation Measures

The following mitigation measures are proposed:

- diesel storages would be bunded in accordance with Australian Standards to contain 110% of the contents of the tank;
- storage tanks and handling facilities would be constructed in accordance with Australian Standard specifications, and regularly inspected;
- operators would be trained to minimise the possibility of operator error during fuel transfer and vehicle filling;
- instrumentation would be installed to monitor tank levels; and
- potential ignition sources would be controlled and fire detection and fire fighting systems installed.

Transport Hazards

The materials transport corridor would be used to transfer consumables and product between the rail siding and MPF site. The following hazards were identified in the hazard assessment:

- rail transport hazards including loss of containment of sulphur or other consumables;
- dust explosion or fire relating to sulphur transport; and
- road transport hazards relating to loss of containment of liquid or solid materials or explosions or fires relating to flammable liquid transport.

Mitigation Measures

The following mitigation measures are proposed:

- the design of sulphur containers would be in accordance with conventional specifications and sulphur would be shipped in a prill form to minimise the quantity of dust;
- incoming containers would be of robust design and would be unloaded by forklift at the rail siding and transferred to the MPF site via truck, to minimise rehandling of contained goods;
- product would be backloaded in general goods containers, to minimise total transport movements;
- solid and liquid consumables would be transported in accordance with the Australian Code for the Transport of Dangerous Goods by Road and Rail (where applicable); and
- goods transport contracts would specify compliance with relevant regulations and the Project's Hazardous Waste and Chemical Management Plan (HWCMP) (Section A6.3.6).

Explosives

Explosives would be used at the limestone quarry to fracture limestone and waste rock during mining. An on-site explosives magazine would be located north of the crushing plant (Figure B2-1). Hazards associated with the use of explosives include risk of accidental explosion, fire or generation of flyrock during blasting activities.

Mitigation Measures

The use of explosives at the limestone quarry would be in accordance with standard mining and regulatory practice. Risk management measures would include:

- explosive charges would be stored separately to detonators or initiating products;
- explosives would be stored in a facility built in accordance with Australian Standard (AS) 2187 *Explosives – Storage Transport and Use*; and
- explosives would only be used by trained personnel in accordance with the quarry safety management system.

Breach of Security

Potential breaches of security could include deliberate sabotage and trespass. Control measures to minimise the likelihood of these events include:

- implementation of a site security system (eg. security, personnel, gates, patrols);
- restriction of access to the rail siding and limestone quarry sites to employees and registered visitors; and
- fencing and the display of appropriate signage around the limestone quarry and rail siding areas.

B4.12 SOCIO-ECONOMICS

The potential socio-economic impacts of the Project are assessed in Sections A4.11 and A4.12.

SECTION B5 - REHABILITATION

ROADS, RAIL SIDING AND LIMESTONE QUARRY

PREPARED BY
RESOURCE STRATEGIES PTY LTD

SEPTEMBER 2000
Project No. BRM-01\2.4
Document No. PART B - SECTION 5-E.DOC

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B5 REHABILITATION

B5.1 REHABILITATION OBJECTIVES

Rehabilitation objectives specific to the limestone quarry and associated infrastructure are:

- to provide acceptable post-mine landforms suitable for the proposed final landuses; including grazing and cropping and a woodland/pasture habitat; and
- to revegetate the adjacent disturbed areas of the Fifield bypass and materials transport route in order to support stable and safe roadsides.

Specific rehabilitation strategies for the limestone quarry, rail siding and materials transport route have been developed in consideration of the following factors:

- the limestone quarry site has been used in the past for grazing and limited cropping;
- the proposed Fifield bypass is through grazing land and the materials transport route is an upgrade of the existing road system;
- the disturbance area of the rail siding is minimal and is located on grazing land; and
- all three sites have been disturbed by previous landuse and are of low conservation value.

B5.2 REHABILITATION PROGRAMME

B5.2.1 Land Clearance

The limestone quarry, rail siding and materials transport route are characterised by disturbed areas which have been predominantly utilised for grazing and cropping (Section B3). The limestone deposit area has scattered trees and together with the eastern portion of the limestone quarry site has relatively low agricultural value. Both the rail siding and materials transport route modifications are on existing agricultural areas or road reserves.

Vegetation clearance protocols adopted during construction would be the same as other parts of the Project (Section A5.2.1).

Typical land clearance protocols are outlined below.

(i) Preparation of relevant pre-mining plans/commitments (eg. soil conservation and erosion control plans).

(ii) A check of trees in clearance areas for presence of fauna (eg. roosting bats) with a relocation programme undertaken in the event that they occur, in accordance with an approved plan.

(iii) Progressive land clearance and soil/mine waste stripping (for rehabilitation and construction purposes) in accordance with the stripping procedures discussed in Section B5.2.2.

(iv) Preservation and protection of individual trees or areas (eg. by tape and signage) not to be disturbed where possible to enhance succession into the rehabilitation areas.

The provisional disturbance areas for the limestone quarry and rail siding are presented in Table B5-1.

Table B5-1
Proposed Areas of Disturbance Associated with the Limestone Quarry and Rail Siding

Description of Disturbance Area	Area (ha)
Limestone Quarry	
Waste emplacement	55.6
Open pit excavation	47.5
Ancillary infrastructure	17.7
Potential topsoil stockpiles	4.0
Total	**124.8**
Rail Siding	
Total	**4.2**

B5.2.2 Soil and Waste Rock Handling

Suitable topsoil material would be progressively stripped and stockpiled using the same protocols described in Section A5.2.2. A summary of the soil clearance protocols relevant to the limestone quarry, rail siding and materials transport route is provided below.

- Topsoil and subsoils would be stockpiled separately if different soil horizons are evident.
- Stockpiles would not be located in drainage lines or trafficable areas.

- Upslope surface water runoff would be diverted around stockpiles and ancillary infrastructure.
- Stockpiling time would be minimised by prioritising the reuse of these materials.
- Stockpiles would be seeded with suitable grass and legume species as soon as practicable after construction if extended storage is anticipated.
- Colonising weed species would be controlled.

B5.2.3 Erosion and Sediment Control Works

An Integrated Erosion and Sediment Control Plan (IESCP) would be prepared and would detail erosion and sediment controls for the construction and operation phases. The IESCP would specifically address pre-disturbance erosion control designs for layout development areas, access roads and tracks.

B5.3 FINAL LANDFORM AND REVEGETATION CONCEPTS

B5.3.1 Limestone Quarry

The final rehabilitation concept for the limestone quarry is presented in Figure B5-1 and is consistent with the end use objective of grazing/pastures.

Decommissioning of Infrastructure

The infrastructure required to operate the limestone quarry is described in Section B2 and includes; site buildings, processing equipment, electricity supply, fuel and explosive storage facilities, water supply/treatment and sewage/waste disposal plants.

The overall objectives and strategies for decommissioning and rehabilitation of infrastructure areas are described in Section A5.3.1. In summary:

- infrastructure areas would be rehabilitated to pastures where practical or retained as required in consultation with DMR and relevant stakeholders;
- the explosives magazine would be decommissioned in accordance with the Closure Plan as a component of the MREMP;
- the water storage facility would remain or be removed as required by the landowner; and
- areas where topsoil had been stockpiled would be revegetated to pastures or allowed to revegetate naturally once the topsoil had been removed.

Final Void

At the end of the mine life the limestone quarry would be approximately 35 m deep and would occupy an area of some 48 ha. Once quarry operations cease and the in-pit pumping system is decommissioned the final void is expected to gradually fill with water. Inflows from the local aquifer, direct rainfall and runoff are expected to slowly increase the water level in the void to an equilibrium level approximately 16 to 21 m deep.

The long term rehabilitation strategy for the limestone quarry void is to leave the void surrounds safe (for humans and stock) and revegetated in a manner consistent with the overall Project rehabilitation philosophy and objectives. The void surrounds would be fenced upon completion of mining and public warning signage would be placed along the fence. Bunding is considered unnecessary due to the close proximity of the waste emplacement batters.

The batter and berm surfaces above the final water level in the void would be left in a roughened state to encourage natural succession. The berms would be topsoiled and planted with a mixture of endemic woodland and grass species where practical. In the longer term there may be opportunities to develop wetland habitat adjacent to the final waterbody.

Waste Emplacement and Screening Vegetation

The waste emplacement would enclose the limestone quarry with the exception of the access points along the western side. The cover system and revegetation strategy selected for the waste emplacement is based on the same principles as those of the MPF, which include the placement of a soil layer and the progressive rehabilitation of batters with grass cover, tubestock and seeds of native woodland species. This would serve to limit grazing (post-operations) and provide a perimeter screening. The top surface of the waste emplacement would be constructed to a height of approximately 7 m and would be rehabilitated with soil and a combination of endemic woodland species and pasture grasses once mining operations had ceased (Figure B5-2).

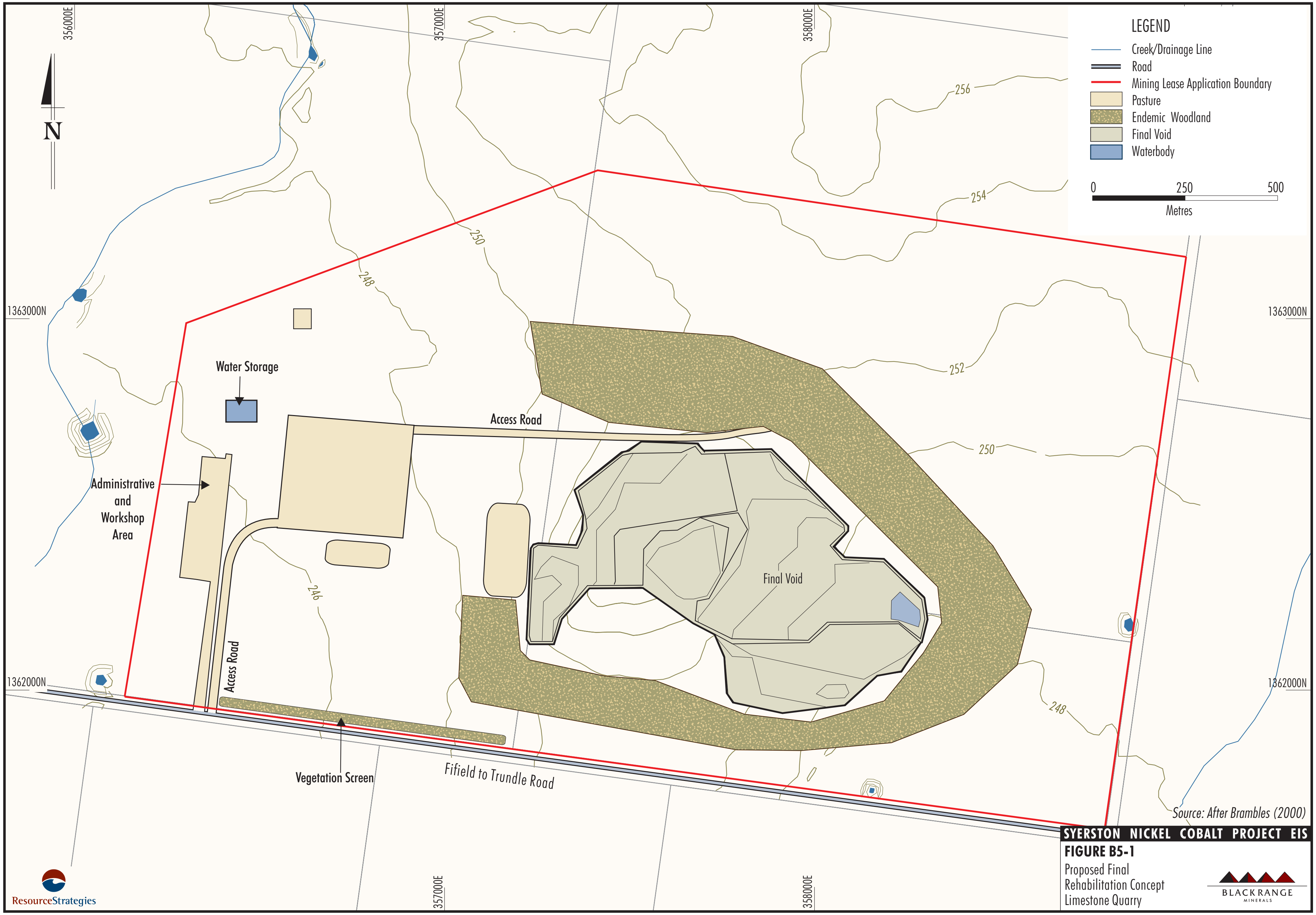

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FIGURE B5-1

Proposed Final Rehabilitation Concept Limestone Quarry

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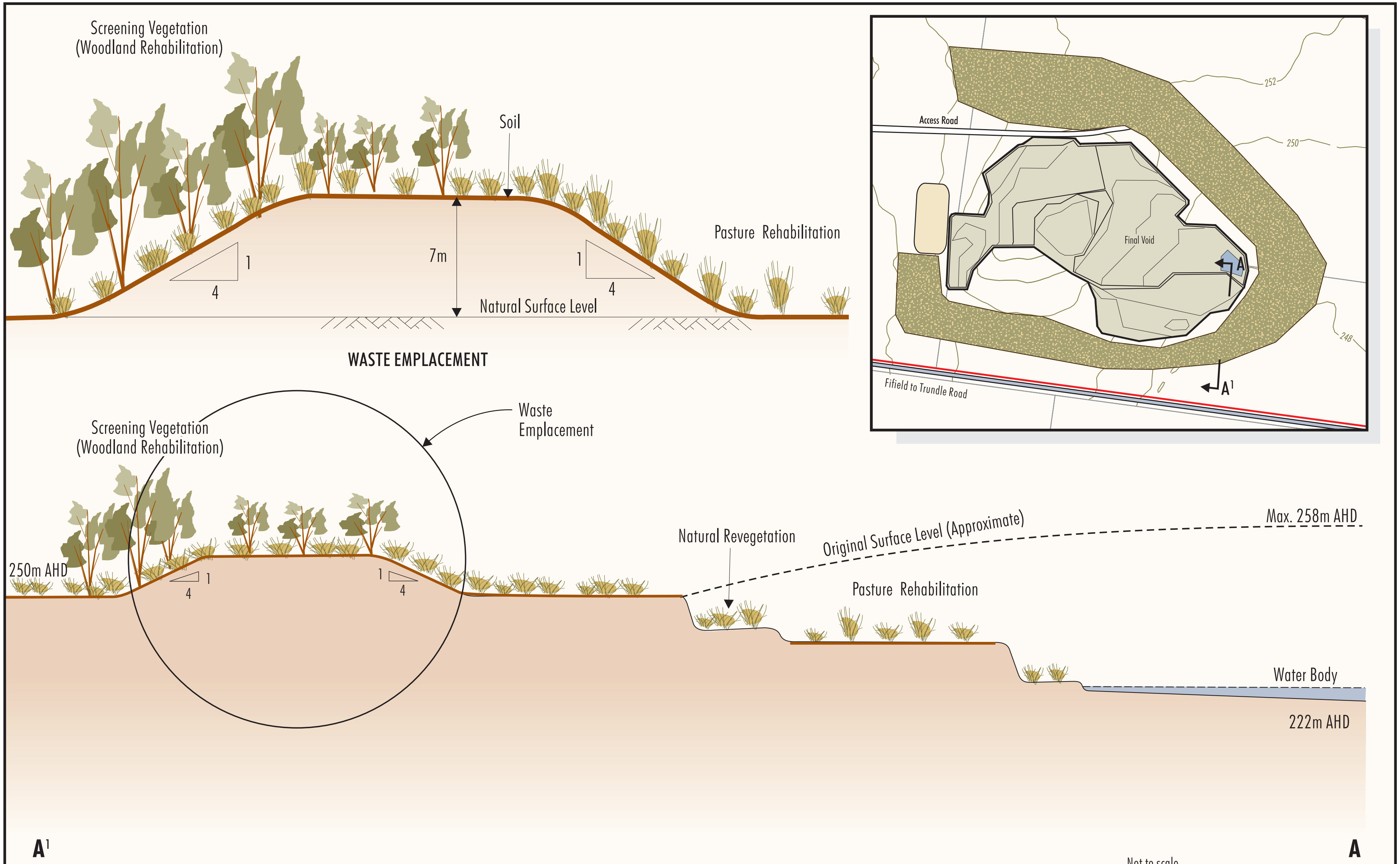

CONCEPTUAL CROSS SECTION A1-A

Not to scale

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FIGURE B5-2

Conceptual Cross Section Waste Emplacement and Final Void

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ResourceStrategies

BRM-98-01- Pt B-S5_002E

An on-going monitoring and research programme would be developed for the quarry and would be used to assess the appropriateness of the above strategy. Rehabilitation trials would be conducted on various growth media (ie. types and depths) and revegetation species composition.

B5.3.2 Rail Siding

Infrastructure for the rail siding includes site buildings, equipment compound, electricity supply, fuel storage and container laydown areas. A site layout of the rail siding is presented in Figure B2-3. Rehabilitation and decommissioning of this infrastructure would follow the procedures for the Project in accordance with the requirements of the relevant government agencies and as determined by future land and facility use.

B5.3.3 Materials Transport Route

The upgrade of the materials transport route includes access points, intersections and the Fifield bypass. The final landform concept of the materials transport route, including the Fifield bypass, is that of a safe and stable embankment and verge. Controls to reduce sediment erosion would be constructed in accordance with AUSTROADS and NSW Roads and Traffic Authority (RTA). Areas where road alterations are made would be re-fenced.

B5.4 MONITORING AND MAINTENANCE

It is proposed that a rehabilitation strategy, as part of the MOP and operation Environmental Management Plans (EMPs) would be prepared in consultation with government agencies and other stakeholders for the limestone quarry and rail siding (Section B6).

The management and monitoring of rehabilitation progression would be detailed in the above-mentioned plans and updated periodically.

SECTION B6 - ENVIRONMENTAL MANAGEMENT AND MONITORING

LIMESTONE QUARRY, RAIL SIDING AND MATERIALS TRANSPORT ROUTE

PREPARED BY
RESOURCE STRATEGIES PTY LTD

SEPTEMBER 2000
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B6 ENVIRONMENTAL MANAGEMENT AND MONITORING

B6.1 INTRODUCTION

Environmental management and monitoring of the limestone quarry, rail siding and materials transport route would be facilitated by a variety of management plans and monitoring programmes. This section details the objectives and components of these plans and programmes which should be considered provisional and subject to further development in consultation with relevant authorities and stakeholders.

B6.2 ENVIRONMENTAL MANAGEMENT PLANS

B6.2.1 Construction Environmental Management Plans

Separate Construction Environmental Management Plans (CEMPs) would be prepared for the limestone quarry and rail siding in consultation with government agencies and stakeholders. Management during the construction of the Fifield to Trundle Road, the Condobolin to Tullamore Road and the Fifield to Wilmatha Road would be undertaken in consultation with the local Council and RTA.

The CEMPs would include procedures for:

- management of vegetation removal;
- stripping and stockpiling of soil resources;
- installation of appropriate erosion and sediment control;
- provision of dust and noise control measures; and
- rehabilitation procedures.

The erosion and sediment control procedures outlined in the CEMPs, would be detailed in an Integrated Erosion and Sediment Control Plan (IESCP).

B6.2.2 Mining Operations Plan

As described in Section A6, the Mining Operations Plan (MOP) provides a detailed account of a proposed development for a nominated period. A MOP for the limestone quarry would be prepared and would include details of mining and rehabilitation operations and relevant environmental controls and procedures required for compliance with mining lease conditions.

The MOP would be configured to provide consideration of the environment from the design stage, through to the operational stage and final closure of the quarry. The plan would concentrate on short term mining operational actions while taking into consideration longer term objectives for final rehabilitation and landuse. The key areas to be identified by the MOP include:

- areas to be disturbed;
- mining method(s) to be used and their sequence;
- existing and proposed surface infrastructure;
- progressive rehabilitation methods and schedules;
- areas of environmental sensitivity;
- water management systems; and
- proposed resource recovery.

B6.2.3 Operation Environmental Management Plans

Environmental Management Plans (EMPs) would be formulated to detail environmental management and monitoring procedures to be implemented during operation of the limestone quarry and rail siding. The programmes would focus on the potential impacts and mitigation measures as presented in Section B4 and would be developed in discussion with relevant agencies and stakeholders.

The environmental aspects covered in the EMPs would include, but not necessarily be limited to:

- land resources (eg. landscaping and restoration works, hazardous materials management, waste disposal, erosion and sediment control);
- water management (eg. groundwater inflows, surface water runoff);

- noise and blasting (eg. management measures to minimise noise);
- air quality (eg. dust control measures);
- flora and fauna (eg. landscaping features);
- weed control;
- bushfire management;
- visual aspects (eg. visual impact minimisation measures);
- transport (eg. hours of operation, site access); and
- environmental monitoring.

Both the Construction and Operation EMPs would be working documents that are held on-site. The overall objectives of the EMPs are to:

- minimise the potential for construction and operating activities adversely impacting on adjoining properties;
- minimise disturbance to the existing social and physical environment; and
- adequately monitor construction and operation to allow the early detection and mitigation, if required, of any impacts on the existing environment.

B6.2.4 Closure Plans

Prior to Project completion, Closure Plans would be prepared to detail decommissioning and rehabilitation proposals for the limestone quarry, rail siding and materials transport corridor.

The plans would be formulated in consultation with relevant government agencies, other stakeholders and would consider:

- the requirements for stable and permanent landforms;
- final landuse options and preferences;
- landforms, soils, hydrology and ecosystems having maintenance needs no greater than those for the surrounding land;
- hazards to persons, stock or native fauna; and
- concerns of adjacent landholders.

B6.3 ENVIRONMENTAL MONITORING PROGRAMME

Detailed environmental monitoring programmes for the limestone quarry, rail siding and materials transport route (including parameters, frequencies and analytical procedures) would be specified in the Construction and Operation Environmental Management Plans and (for post-closure) the Closure Plans, following discussions with regulators and other stakeholders. The provisional environmental monitoring programmes are detailed below.

Groundwater

Groundwater in the vicinity of the limestone quarry would be monitored throughout the Project life at three monitoring bores (Figure B6-1 for general locations). The monitoring bores would be constructed prior to the commencement of construction. Groundwater levels, electrical conductivity (EC) and pH would be initially measured at quarterly intervals, while a suite of groundwater quality parameters (eg. EC, pH, major cations and anions) would be monitored at the bores annually.

In addition, a review of any groundwater bores local to the site and their extraction rates would be undertaken prior to construction to provide further information on the local groundwater system and groundwater use.

Groundwater inflow rates into the quarry would be monitored (Figure B6-1). Inflows into the limestone quarry would be collected and pumped to the site water storage and reused in the mining or crushing operations.

Surface Water Quality

The drainage lines located in the vicinity of the limestone quarry and surface water at the rail siding would initially be monitored quarterly subject to runoff occurring. Figure B6-1 presents the general locations of the proposed surface water quality sampling sites. The following parameters would be monitored: electrical conductivity, pH and total suspended solids.

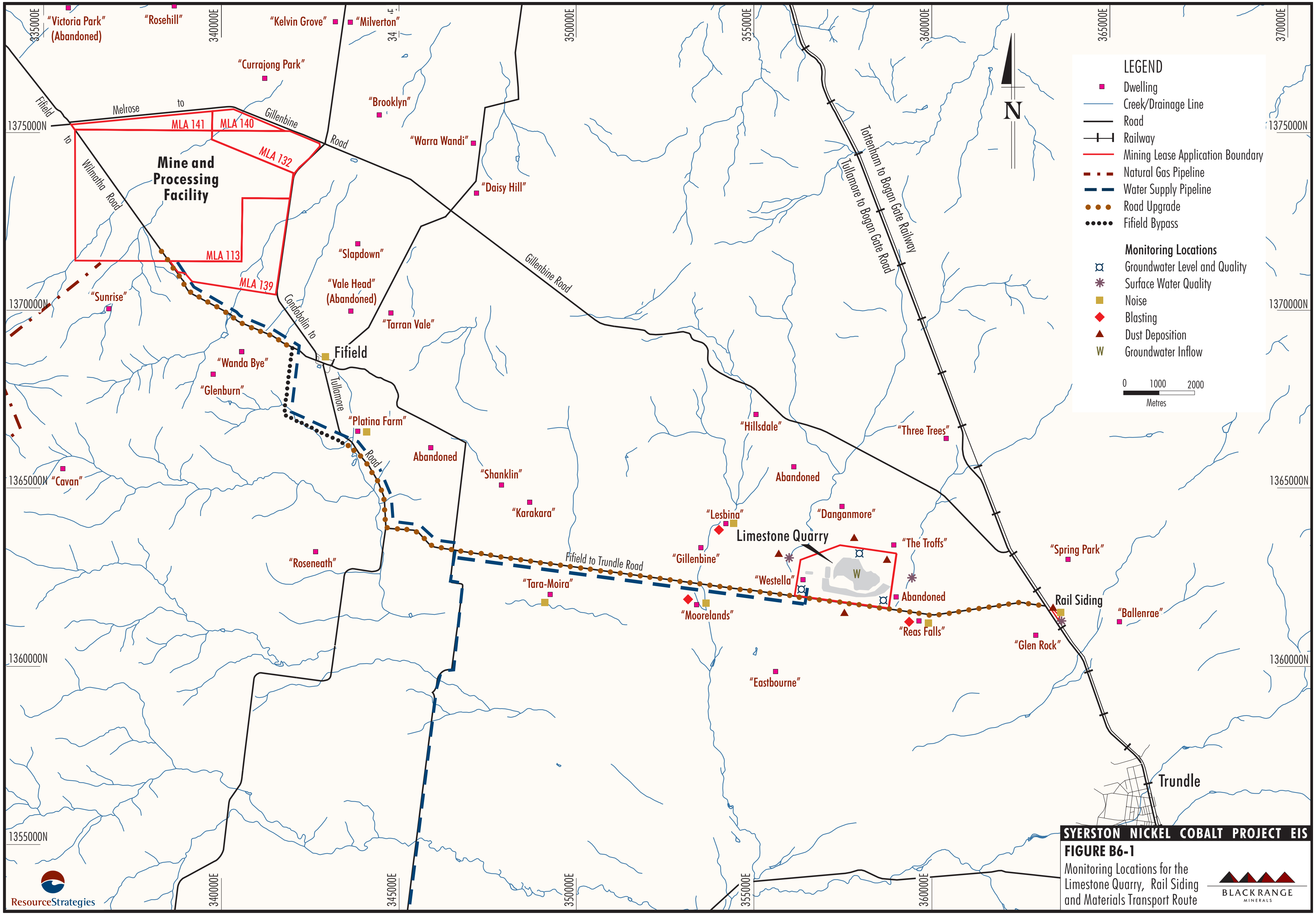

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FIGURE B6-1

Monitoring Locations for the Limestone Quarry, Rail Siding and Materials Transport Route

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Erosion and Sediment Control

Erosion and sediment control structures utilised at the limestone quarry, rail siding and materials transport corridor would be monitored to assess landform stability, effectiveness and maintenance requirements. In the event that an extreme rainfall period occurs (above sediment dam design capacity) resulting in spillage from a sediment dam, surface water quality would be sampled in the associated storage and in the receiving waters and analysed for the surface water quality parameters outlined above.

Noise

Richard Heggie Associates (2000) conducted a detailed acoustic study to determine existing baseline conditions and to predict noise levels at neighbouring residences during construction and operation of the quarry, rail siding and bypass (Section B3.7). Based on the study's recommendations a representative sample of properties would be monitored periodically for noise during construction and operation, including: "Reas Falls", "Lesbina", "Moorelands", "Tara-Moira", "Platina Farm", the village of Fifield and the rail siding (Figure B6-1).

The monitoring programme would be used to assess the predictions of the noise impact assessment.

Blasting

Vibration and sound overpressure from blasting activities at the limestone quarry would be measured quarterly at the properties "Reas Falls", "Moorelands" and "Lesbina" during operation (Figure B6-1). The monitoring programme would be used to assess the prediction of the blasting impact assessment.

Air Quality

Monthly samples would be collected from dust deposition gauges at selected sites in the vicinity of the limestone quarry and rail siding (Figure B6-1 for general locations) and analysed for ash content, combustible matter and insoluble solids.

If required, a total suspended particulates (TSP) monitoring programme would be formulated in consultation with the EPA and the relevant authorities.

The monitoring programme would be used to assess compliance with air quality standards and EPA licence conditions.

Rehabilitation Performance

Routine monitoring would be undertaken at the limestone quarry, rail siding and materials transport route to assess the performance of the revegetation and general progression of rehabilitated land following construction and, in the case of the limestone quarry, progressively over the life of the Project.

Landholder and Community Consultation

Local stakeholders and relevant interest groups associated with the limestone quarry, rail siding and road upgrade works (including the Fifield bypass) would be invited to participate in the community consultation programme formulated by BRM.

Periodic Review

The parameters and frequency of all monitoring activities would be reviewed through the Mining Rehabilitation and Environmental Management Process (MREMP) associated with the MPF (Section A6.3.2).

B6.4 ENVIRONMENTAL PERFORMANCE REPORTING

The Annual Environmental Management Report (AEMR) prepared for the MPF would present the results and findings of the above monitoring programmes and would be subject to annual review and continuous improvement as a result of stakeholder input.

The AEMR enables the environmental objectives outlined in the Construction and Operation Environmental Management Plans and (prior to Project closure) the Closure Plans to be assessed and modified, if necessary.

SECTION C1 - INTRODUCTION

NATURAL GAS PIPELINE, WATER SUPPLY PIPELINE AND BOREFIELDS

PREPARED BY
RESOURCE STRATEGIES PTY LTD

OCTOBER 2000
Project No. BRM-01\2.0
Document No. PART C - SECTION 1-G.DOC

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C1 INTRODUCTION

C1.1 PROJECT OVERVIEW

Section I outlines that the main text sections of this EIS are presented as three parts (Parts A to C). Part C addresses the construction and operation of the natural gas pipeline, water supply pipeline and borefields (Figure C1-1).

More specifically these entail:

- a natural gas pipeline extending approximately 90 km from the existing Moomba to Sydney natural gas pipeline (south of Condobolin) to the MPF site;
- two borefields (eastern and western) located in the Lachlan Valley Palaeochannel (west of Forbes);
- a main water supply pipeline from the borefields to the MPF site (approximately 65 km); and
- an associated water supply spur line from the main water supply pipeline to the proposed limestone quarry (approximately 12 km).

An overview of the Project is provided on Figure I-1.

The main components located at the MPF site are addressed in Part A, while Part B addresses the limestone quarry, rail siding and materials transport route.

Appendices A to O provide supporting documentation to the EIS, including a number of independent specialist reports.

C1.2 LAND TENURE

C1.2.1 Natural Gas Pipeline

With the exception of the northern section, the natural gas pipeline is situated within road reserves and a rail corridor where it crosses the Orange to Broken Hill Railway line (Figure C1-2).

The northern section of the natural gas pipeline is located on private property. Property ownership for this section of the pipeline is shown on Figure C1-2.

C1.2.2 Water Supply Pipeline

The main water supply pipeline is also situated within road reserves for the majority of its length.

A component of the main water supply pipeline is positioned within the road reserve of the proposed Fifield bypass. The Fifield bypass consists of two parcels of private land and a Crown road reserve (Figure C1-2).

From its connection with the main water supply pipeline to the limestone quarry, the water supply spur line would be located within the road reserve of the Fifield to Trundle Road.

The spur line enters privately owned land within the limestone quarry MLA. BRM has secured options to purchase this property.

The main water supply pipeline also crosses the Orange to Broken Hill rail corridor (Figure C1-2).

C1.2.3 Borefields

The western borefield is located along the western boundary of the property “Astron Park” (Hayes), while the eastern borefield is located on ”Gloaming” (Ridley) (Figure C1-2).

The pipeline linking the eastern and western borefields would also be located on the above privately owned properties (Figure C1-2).

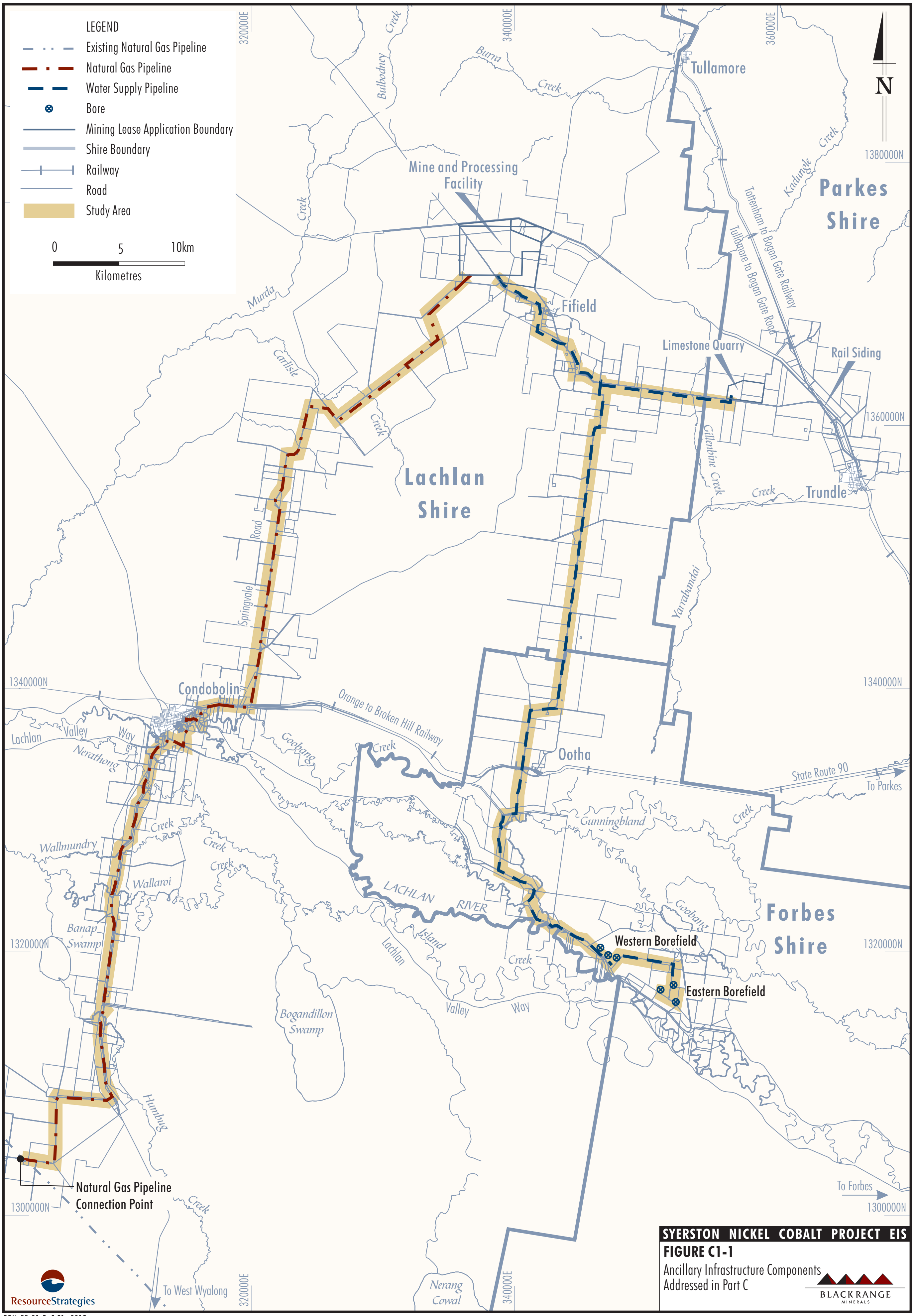

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FIGURE C1-1

Ancillary Infrastructure Components Addressed in Part C

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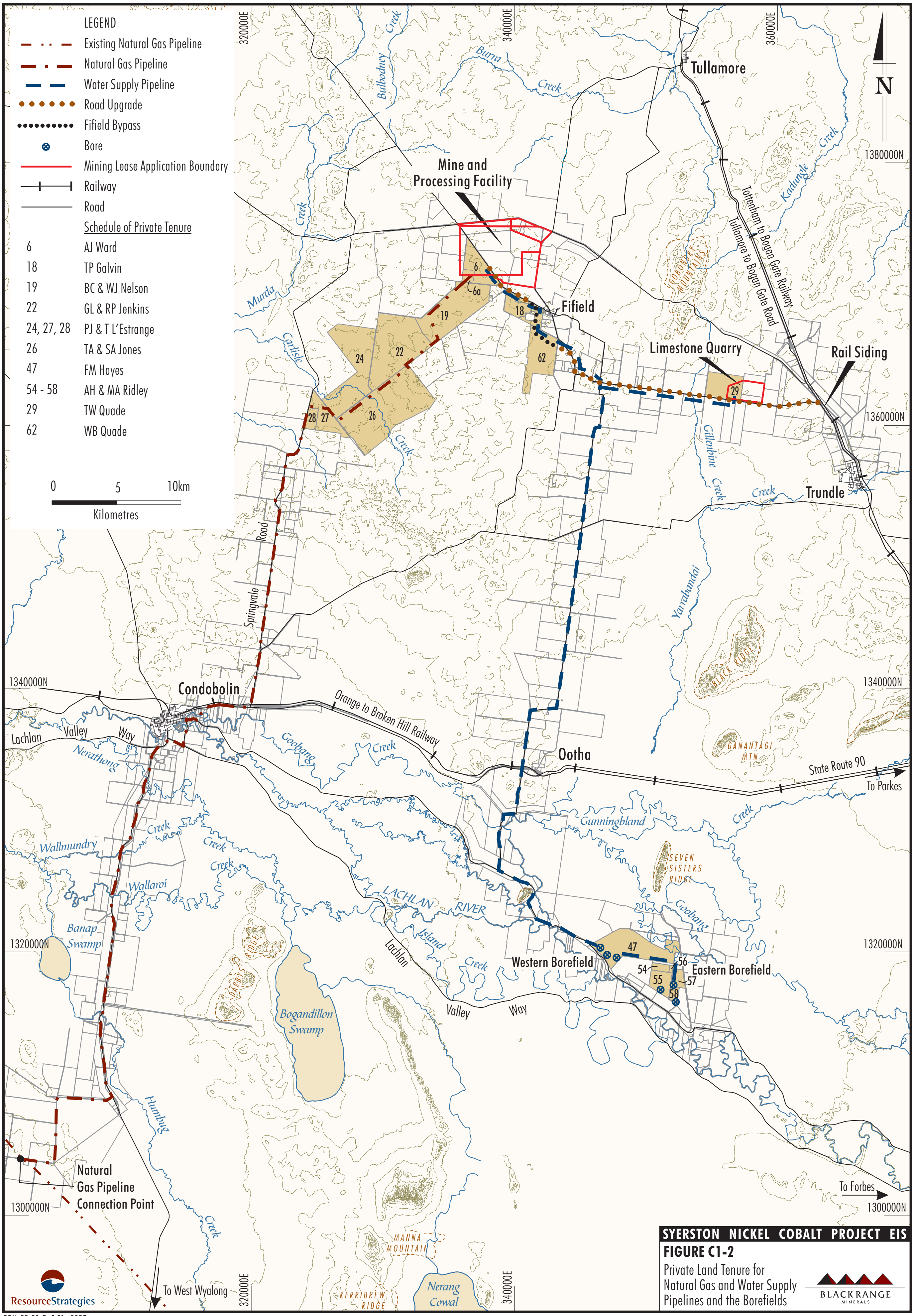

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FIGURE C1-2

Private Land Tenure for Natural Gas and Water Supply Pipelines and the Borefields

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SECTION C2 - PROJECT DESCRIPTION

NATURAL GAS PIPELINE, WATER SUPPLY PIPELINE AND BOREFIELDS

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RESOURCE STRATEGIES PTY LTD

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C2 PROJECT DESCRIPTION

C2.1 NATURAL GAS PIPELINE

C2.1.1 Natural Gas Requirement and Provision

Typical natural gas requirements for the Project are shown in Table C2-1.

Electricity would be generated by two 20 MW gas turbines each fitted with a Heat Recovery Steam Generator (HRSG) unit and a 10 MW steam turbine. The steam required for use in the process would be generated through heat recovery from the sulphuric acid plant or from steam produced from the HRSGs or auxiliary boiler.

The power generation and distribution system would provide electricity for the process plant power requirements for both normal and emergency operations.

The average demand for energy at the MPF site is expected to be approximately 34 MW.

At the power plant, steam is raised by three separate units:

- the power plant gas turbine HRSG(s);
- the sulphuric acid plant waste heat boilers; and
- an auxiliary boiler.

Natural gas would be supplied to the power plant via a pipeline from south of Condobolin to the MPF site (Figure C1-1).

A plant reticulation system would distribute natural gas to the following components of the co-generation plant:

- gas turbine generators;
- hydrogen plant;
- hydrogen sulphide flare;
- minor process plant uses; and
- heat recovery steam generator booster and an auxiliary boiler.

Typical chemical composition of the natural gas supply to be used for the Project is presented in Table C2-2.

C2.1.2 Alternatives Considered

Two alternatives for the supply of natural gas were initially investigated. These were a 70 km pipeline from Alectown (near Parkes) to the MPF site and a pipeline from south of Condobolin to the MPF site (Figure C2-1).

After consultation with local Councils and communities and review of the cost of the alternatives, it was decided to focus on the option of running the natural gas pipeline through Condobolin. Lachlan Shire Council have advised BRM of their intention to commission a spur line from the Project's natural gas pipeline to allow the provision of natural gas to Condobolin.

As discussed in Section I4.3, the option of using electricity from the public grid was discounted due to the capital and operating costs and the processing advantages of natural gas over electricity (eg. the requirement for natural gas for steam and hydrogen production).

Table C2-1
Natural Gas Consumption Summary

	Natural Gas Consumed GJ/h	Remarks
Gas turbines generating approximately 20 MW; secondary steam turbine generating approximately 10 MW	318	Overall efficiency of turbine and generator 30%; HRSG boiler efficiency
HRSG duct firing for supplementary steam raising up to 70 t/h	140	Intermittent requirement
Auxiliary boiler of steam at 30 t/h	100	Boiler efficiency 80%; intermittent requirement
Sulphuric acid plant start-up	54	15 MW burner
Hydrogen plant	35	At 5 tpd H_2
H_2S flare pilot burner	4	Estimate 100 Nm^3/h

Source: SNC-Lavalin (2000)

Table C2-2
Typical Natural Gas Chemical Composition

Composition	Unit	Value
Methane CH_4	% by volume	88.8
Ethane C_2H_6	% by volume	7.8
Propane C_3H_8	% by volume	0.2
Butanes and Pentanes	% by volume	Trace
Carbon Monoxide	% by volume	-
Hydrogen	% by volume	-
Carbon Dioxide	% by volume	1.9
Oxygen	% by volume	-
Nitrogen	% by volume	1.3
Total		**100**
Water Vapour	mg/m^3(st)	112
Total Sulphur (typical)	mg/m^3(st)	6
Total Sulphur (maximum)	mg/m^3(st)	23
Hydrogen Sulphide (typical)	mg/m^3(st)	3
Hydrogen Sulphide (maximum)	mg/m^3(st)	6
Properties		
Heating Value – gross	MJ/m^3(st)	38.8
Heating Value – net	MJ/m^3(st)	35
Relative Density	Air	0.615
Mean Molecular Mass	kg/kgmol	17.9
Carbon:Hydrogen Ratio	H/C	3.78
Density	kg/m^3 (st)	0.755
Stoichiometric Air/Gas:	Volume/Volume	9.91
Stoichiometric Combustion Products:		
Carbon Dioxide CO_2	% by volume	9.81
Water Vapour H_2O	% by volume	18.5
Nitrogen	% by volume	71.7
Total		**100**
Carbon Dioxide on a Dry Basis	% by volume	12
Dew Point of Flue	^oC	59
Flame Speed @ Stoichiometric Combustion	m/s	0.4
Specific Heat @ 15^{o}C	kJ/m^3C	1.51
Ratio of Specific Heats	Cp/Cv	1.33
Viscosity @ normal temperature and pressure (NTP)	Pa s	0.000011
Upper Flammability Limit in Air	% by volume	15
Lower Flammability Limit in Air	% by volume	5

Note: (st) indicate standard conditions which are taken to be 15^{o}C and 101.325 kPa
Source: SNC-Lavalin (2000)

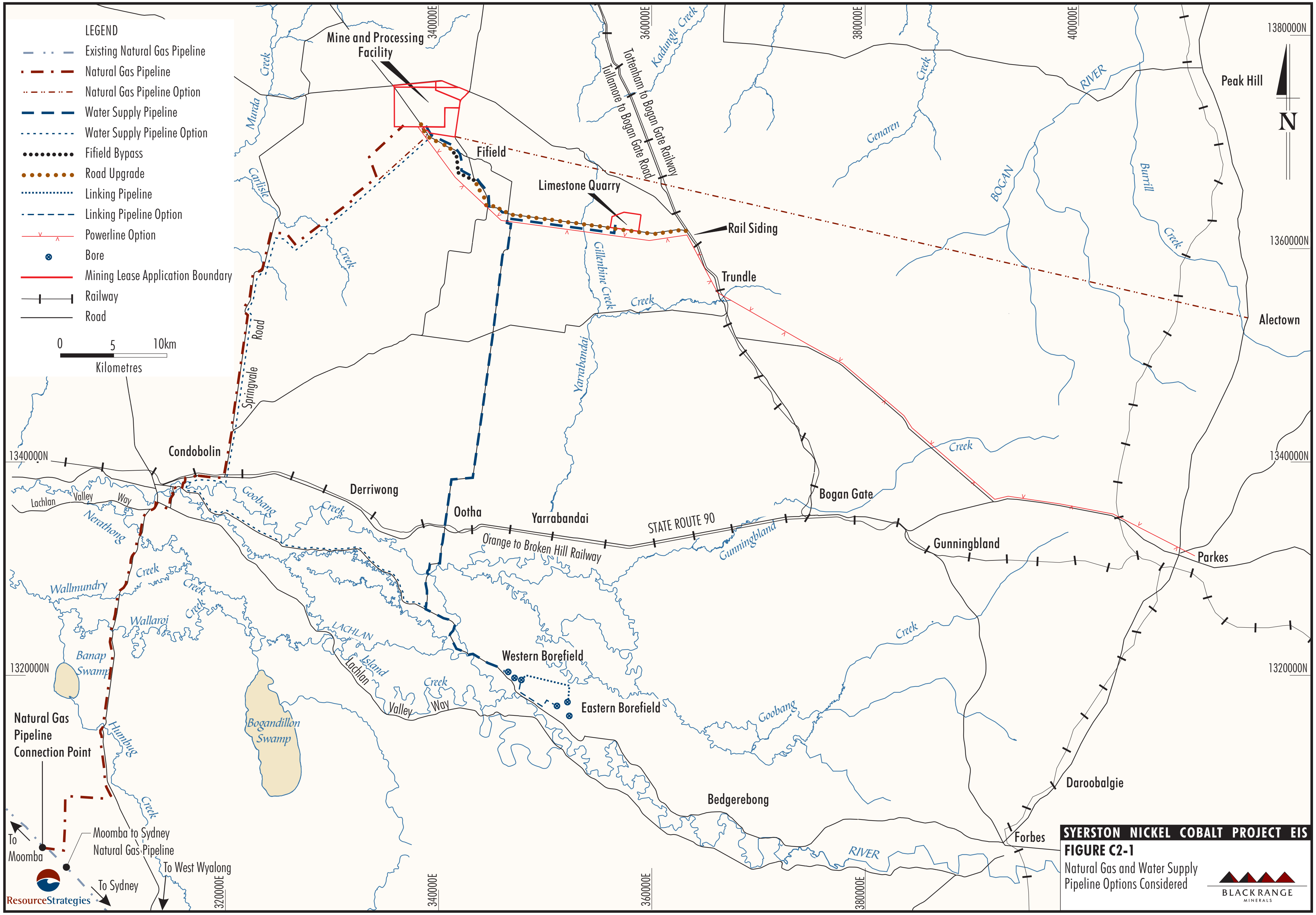

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FIGURE C2-1

Natural Gas and Water Supply Pipeline Options Considered

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The preliminary assessment of the natural gas pipeline identified an area of remnant vegetation with potential significance to fauna. It was recommended that the pipeline be re-routed around this area. As a result further site work was undertaken and an alternative to this section of the pipeline was selected by BRM (Figure C2-1).

C2.1.3 Proposed Pipeline

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

The proposed natural gas pipeline is approximately 90 km long, and would connect the MPF site with the existing Moomba to Sydney natural gas pipeline in the vicinity of the Milne Scraper Station and the Microwave Tower west of the Condobolin to West Wyalong Road. Figure C2-2 illustrates the proposed alignment of the natural gas pipeline and associated infrastructure.

A standard agreement would be entered into between Eastern Australia Pipelines Limited (EAPL) addressing the connection of the natural gas pipeline to the Moomba to Sydney line.

The proposed natural gas pipeline would be made of steel with an anti-corrosion coating and have a diameter of 168 mm. For the majority of its length the pipeline would be buried and have a clearance of 750 mm to the surface. The pipeline would be bored at river crossings.

For all but the 15 km between the Springvale Road and the Fifield to Wilmatha Road, the natural gas pipeline would run alongside roads and tracks within existing road easements.

For the other 15 km the pipeline would be located on private properties and would follow fencelines, tracks and a partially cleared paddock (Figure C2-3).

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

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

The alignment around Condobolin has been selected in consultation with Lachlan Shire Council and has taken into consideration the Council's intention to run a lateral line from the Project line into Condobolin.

The natural gas pipeline would be designed with an appropriate control system capable of safely operating the section and if required, safely shutting it down (in accordance with AS 2885.1 – *Pipelines - Gas and Liquid Petroleum*).

Installation of the pipeline in a road reserve would include the following provisions:

(a) Traffic in the reserve.

(b) Effects on the pipeline from an accident involving traffic.

(c) Effects on the traffic from a puncture, rupture or leak from the pipeline.

(d) Inconvenience to other parties during inspection or repair of the pipeline.

(e) Risk of external damage to the pipeline.

(f) Requirements for corrosion mitigation.

(g) Liaison with the authority responsible for the reserve.

(h) Effect on pipeline of maintenance of the reserve.

Protection of the pipeline from corrosion through the application of direct current (Cathodic Protection) would be employed as soon as possible after pipeline construction.

Prior to commencing construction of the natural gas pipeline the plans and procedures listed below would be prepared and approved and personnel trained in their application (see Section C6 for detail).

(a) Operating, maintenance and repair procedures.

(b) Safety and operating plans including emergency plans.

(c) An environmental code of practice to deal with possible pipeline leaks and ruptures.

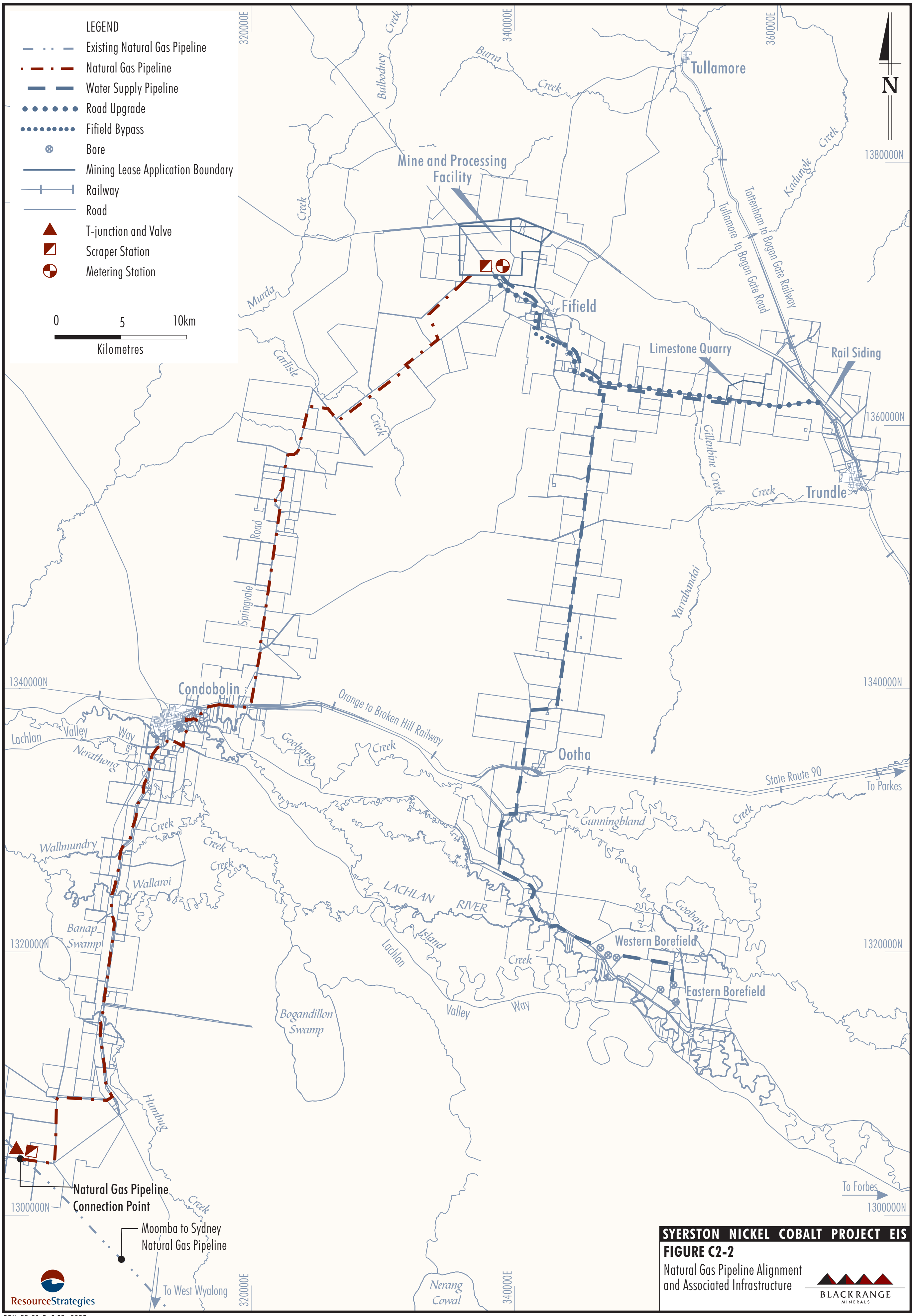

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FIGURE C2-2

Natural Gas Pipeline Alignment and Associated Infrastructure

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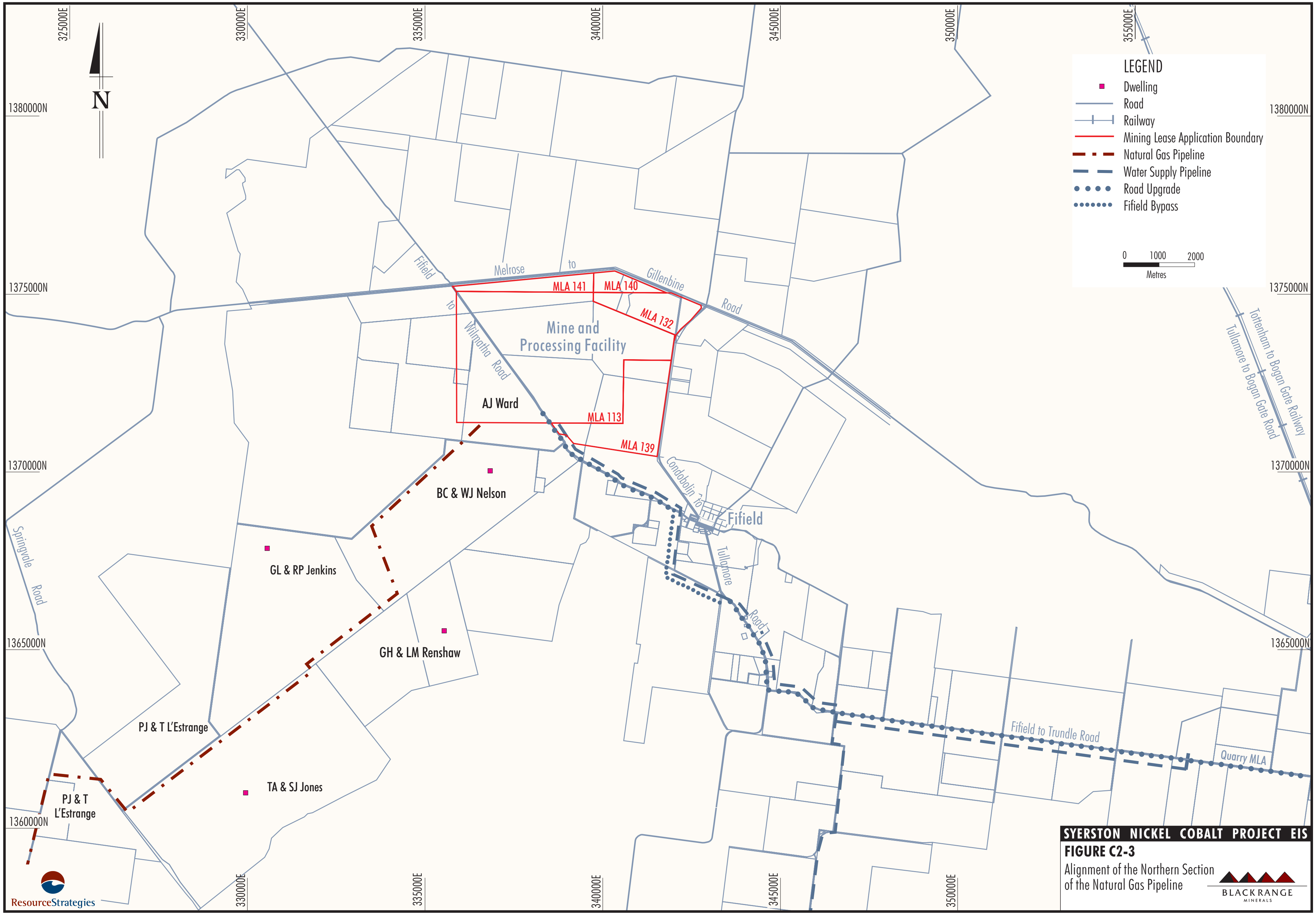


SYERSTON NICKEL COBALT PROJECT EIS

FIGURE C2-3

Alignment of the Northern Section of the Natural Gas Pipeline

BRM-98-01-Pt C-S2_003G

C2.1.4 Associated Infrastructure

The infrastructure associated with the proposed natural gas pipeline (Figures C2-2 and C2-4) is likely to include:

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

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

C2.1.5 Construction Phase

Prior to commencing any on-site work a Construction Environmental Management Plan (CEMP) detailing the proposed clearing, stripping, excavation, bedding, pipelaying, backfilling, and restoration activities (Section C6) would be produced.

The minimum easement required for the construction of the pipeline is 9 m. This would allow for a 3 m construction road, pipe layout area, trench and an area to stockpile trench spoil and topsoil or road base material (Figure C2-5). The pipeline would be laid approximately 1-2 m under the ground's surface with a 750 mm ground clearance above the pipeline.

In areas where the pipeline is to be laid on private property, an easement of 15 m would be required.

The following section describes the activities associated with construction of a typical natural gas pipeline.

Clearing

The extent of clearing for the pipeline would be the practicable minimum required for the construction of works.

Damage to trees and shrubs would be kept to a minimum and clearing would not be undertaken outside of the proposed pipeline easement.

Felled trees and shrubby vegetation greater than 1.5 m in height would be removed from the site to minimise potential fire hazards.

Surface Stripping

Undeveloped Areas (including Road Verges and Rural Properties)

Topsoil would be stripped to a nominal depth of 200 mm and stockpiled separately to the remainder of the excavated trench materials.

Bituminous Road Pavements, Kerbs and Concrete Paving

Kerbing, pavements and concrete paving would be marked out and saw-cut prior to excavation work. The surface materials would be stripped to the subgrade level, removed and disposed of, off-site.

Excavation

Before commencing excavation the contractor would strip and stockpile topsoil or other surface materials.

Trenches/excavations would be excavated to the depths and widths necessary to allow installation of the pipeline to the levels, grades or covers specified.

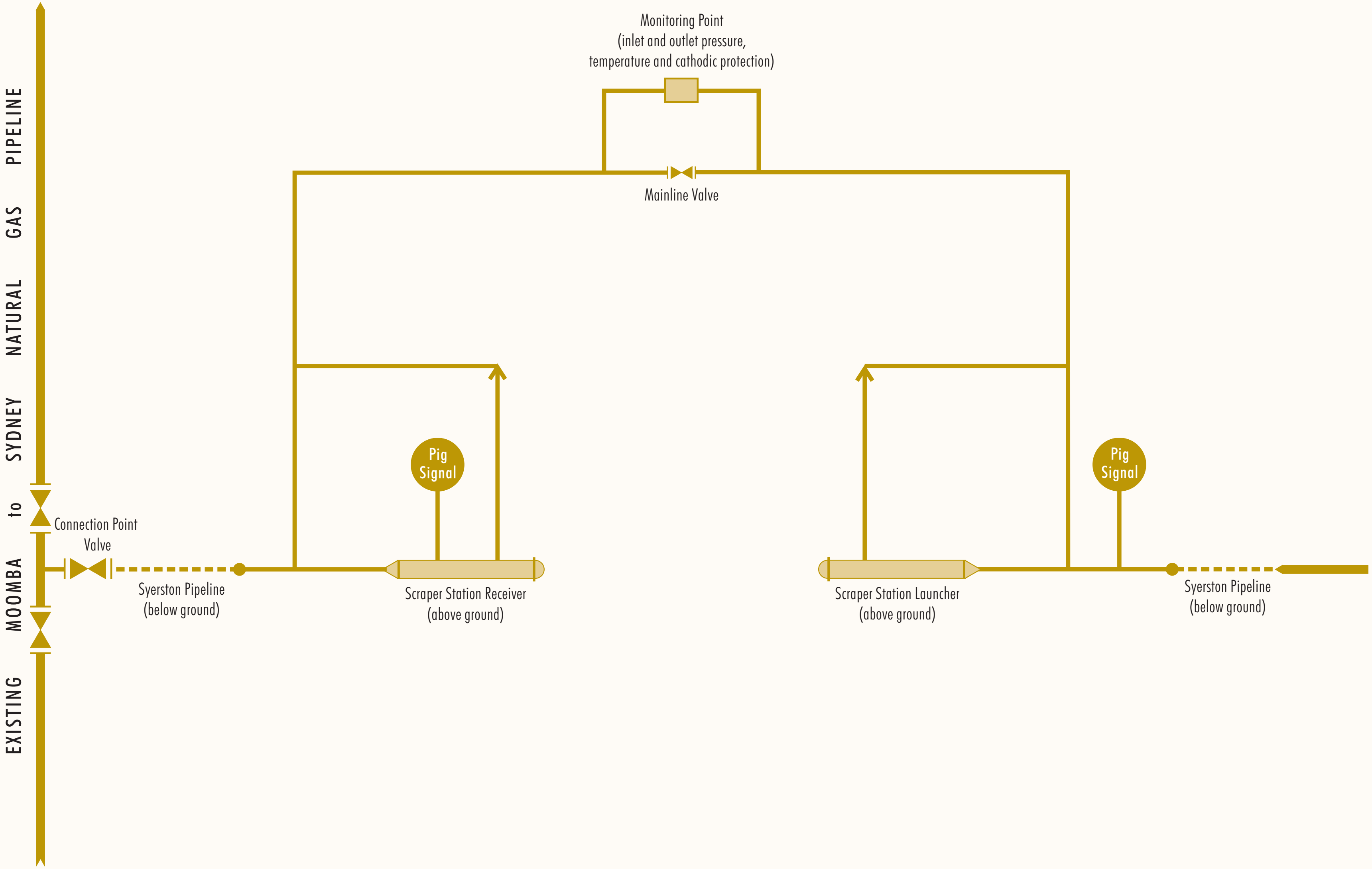
Trenches would be opened in advance of the pipe laying, only to enable the work to proceed without delay. All trenches left open would be securely barricaded, signposted and illuminated in accordance with statutory and regulatory requirements.

Although blasting is not anticipated, approval would be obtained from the relevant authorities if required.

Trench Dimensions

Trench widths would comply with the respective pipe manufacturer's specifications.

Allowance would be made for widening and deepening of trenches at pipe joints, valves and structures.



Source: Chevron (1998)

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FIGURE C2-4

Schematic Layout for the Proposed Connection Point and Scraper Station

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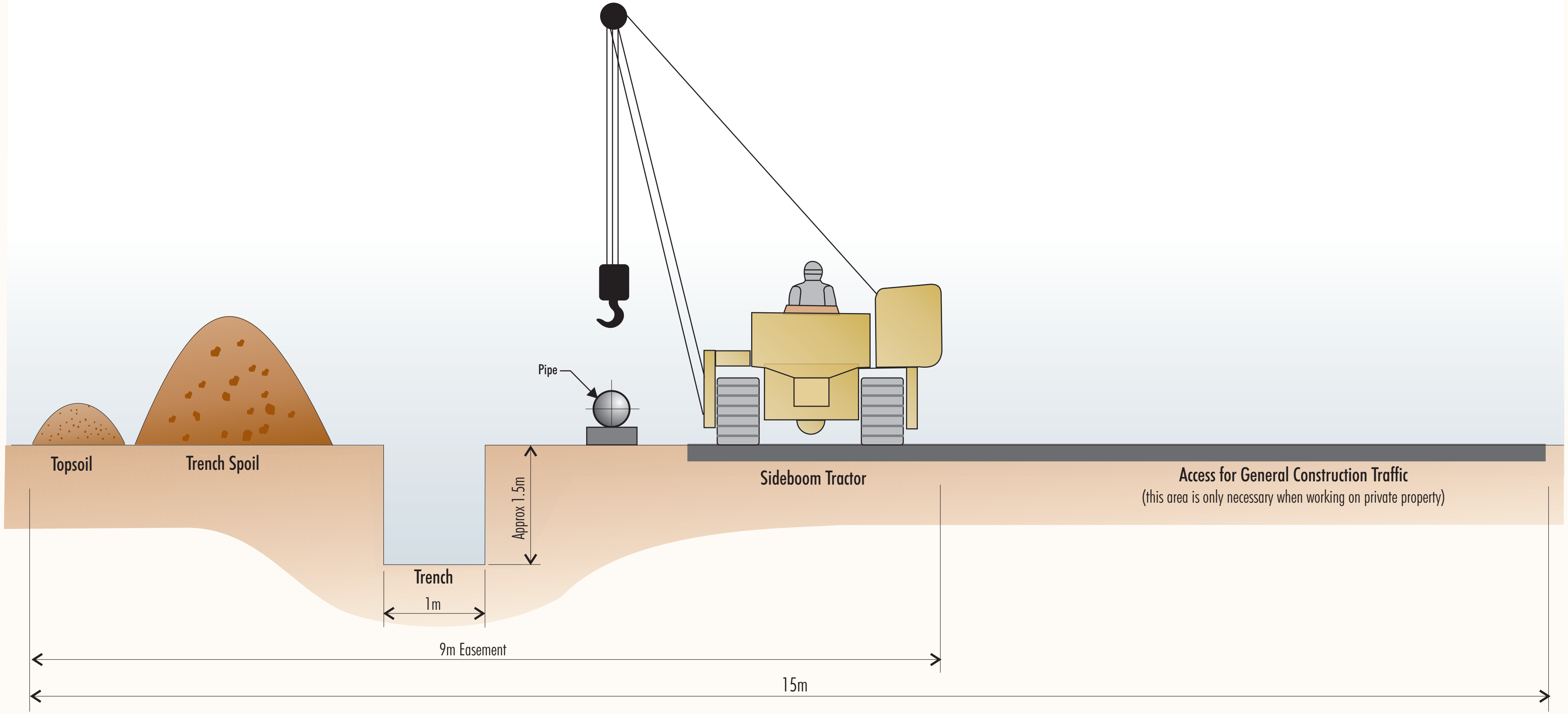

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FIGURE C2-5

Disturbance Area Requirements for Typical Pipeline Construction

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BRM-98-01-Pt C-S2_006C

Construction of the Pipeline

Transportation of pipes, unloading and handling, and laying of the pipeline would be performed in accordance with the Contractor's handling and installation manual.

Backfill

The top 200 mm of backfill material in grassed areas would be removed and stockpiled during stripping prior to trench construction.

Marker Posts

Marker posts are required to indicate pipeline and valve locations in rural and undeveloped land situations.

Rehabilitation

Properties affected by construction work would be rehabilitated to the pre-construction condition.

C2.1.6 Operation Phase

Procedures would be developed and implemented for the operation and maintenance of the pipeline in accordance with AS 2885.3. The procedures would include detailed plans and instructions for persons responsible for the operation and maintenance of the pipeline during normal conditions.

Pipeline surveillance would be carried out by the operator to ensure the pipeline is free from identifiable leaks and to identify any unacceptable risks to the pipeline, particularly external interference near the pipeline.

The type of surveillance and the frequency required for safe pipeline operation would vary and is related to the consequences of a hazard and the hazard reduction measures in place, and is dependent upon factors which include:

- activities by third parties which could affect the pipeline; and
- proximity to built-up areas.

The pipeline route would be patrolled and inspected at approved intervals in accordance with the requirements of AS 2885.3.

Landowners, authorities and other relevant bodies would be provided with a 24 hour contact telephone number in case of an emergency relating to the natural gas pipeline and would be provided with information to ensure that their activities do not endanger the pipeline structure.

Constraints on access to the pipeline and agricultural activities adjacent to the pipeline would be implemented.

Vegetation along the pipeline route would be managed to allow access.

Agricultural activities deeper than 300 mm such as deep ripping and the installation of drainage systems are not permitted on the pipeline easement, or when no easement exists, a minimum of 3 m (but preferably 6 m) each side of the pipeline, without the approval of the operating authority.

The use of mechanical equipment is not permitted within 1 m of the pipeline unless under direction from the line operator inspector. Under no circumstances is mechanical equipment to be used closer than 0.3 m to the pipeline.

A Natural Gas Pipeline Safety and Operating Plan and Engineering Plans would be developed and implemented by the line operator. The requirements of the Plans are outlined in Section C6.

As part of the Safety and Operating Plan (as required by AS 2885.3), a plan detailing the inspections and tests necessary for maintenance would be prepared.

An audit would be conducted periodically to:

(a) assess the integrity of the pipeline;

(b) review the operational and maintenance procedures of the pipeline; and

(c) implement, if necessary, appropriate measures to maintain pipeline integrity.

The inspection and assessment of the pipeline would include:

(a) a visual survey of all above ground sections of the pipeline and associated equipment, to locate and assess any defects; and

(b) an audit to assess the effectiveness of corrosion control facilities.

C2.2 WATER SUPPLY BOREFIELDS

C2.2.1 Water Supply Requirement and Provision

The main water usage for the Project would be associated with ore processing. Other water supply requirements include cooling water, water for dust suppression on haul roads and internal access roads, potable and non-potable uses around the site for both the MPF and the limestone quarry. Figure C2-6 outlines the raw water supply scheme for the Project.

The raw water demand for the Project is estimated to be approximately 10.5 ML/day (3,900 ML per year).

A feature of the proposed process for the recovery of nickel and cobalt from lateritic ore is that the process water cannot be recycled as it becomes saturated with calcium and magnesium salts that cannot be economically removed. Consequently, water used in the process must predominantly be “new” water from the raw water sources. Water losses in the system would include tailings pore water, and evaporative losses from the tailings decant pond, evaporation ponds and surge dam.

Some efficiency in raw water consumption can be gained within the process by the reuse of:

- neutralised barren liquor from the sulphide precipitation circuit in the CCD circuit; and
- water from the brine crystalliser.

Raw water consumption on the mine site would also be lowered by maximising the solids concentration of the tailings slurry discharged to the tailings storage facility. Wherever possible water required for dust suppression (approximately 0.5 ML/day) would be sourced from the TSF decant system.

The proposed raw water supply scheme would predominantly comprise the development of two borefields (eastern and western).

C2.2.2 Water Supply Borefields

Two borefields (eastern and western borefields) each comprising three bores (two production and one standby) are proposed to be developed within the Lachlan River palaeochannel, at the intersection with the Bland Creek palaeochannel, located south of the MPF site (Figure C2-7).

The reticulation system from the borefields to the MPF site would be constructed with a capacity of approximately 17.5 ML/day and is expected to provide water to the Project at a rate of 10.5 ML/day. The borefield reticulation system would include a break storage tank with a working capacity of 0.6 ML, a buried 457 mm ID pipeline to deliver raw water to the MPF site and power supply from existing infrastructure.

The proposed bore locations and linking pipeline route are shown on Figure C2-7. It is proposed to bury the pipeline, where possible, along the route. However, at river and major tributary crossings the pipeline would cross the watercourse on a raised structure. Balancing storages in the form of a raw water storage tank (2 ML capacity) and raw water dam (30 ML capacity) would be constructed within the MPF area. The proposed raw water supply scheme layout is shown on Figure C2-6.

Groundwater investigations and supply feasibility assessments by Coffey Geosciences (2000) indicate that the borefields could maintain a supply of approximately 17 ML/day (6,300 ML/year) for a 30 year period. Six months sequential pumping of each alternate borefield is proposed to reduce the impact on groundwater levels in a localised extraction area.

Two bores in each field of three bores would be actively pumped. To reduce mutual interference effects, the “standby” bore would be located between the primary pumping bores and would only be activated in the event of breakdown or scheduled maintenance on the two production bores.

Each of the six proposed groundwater bores would require licensing under Part 5 of the *Water Act, 1912*.

The results of the borewater analysis is presented in Table C2-3.

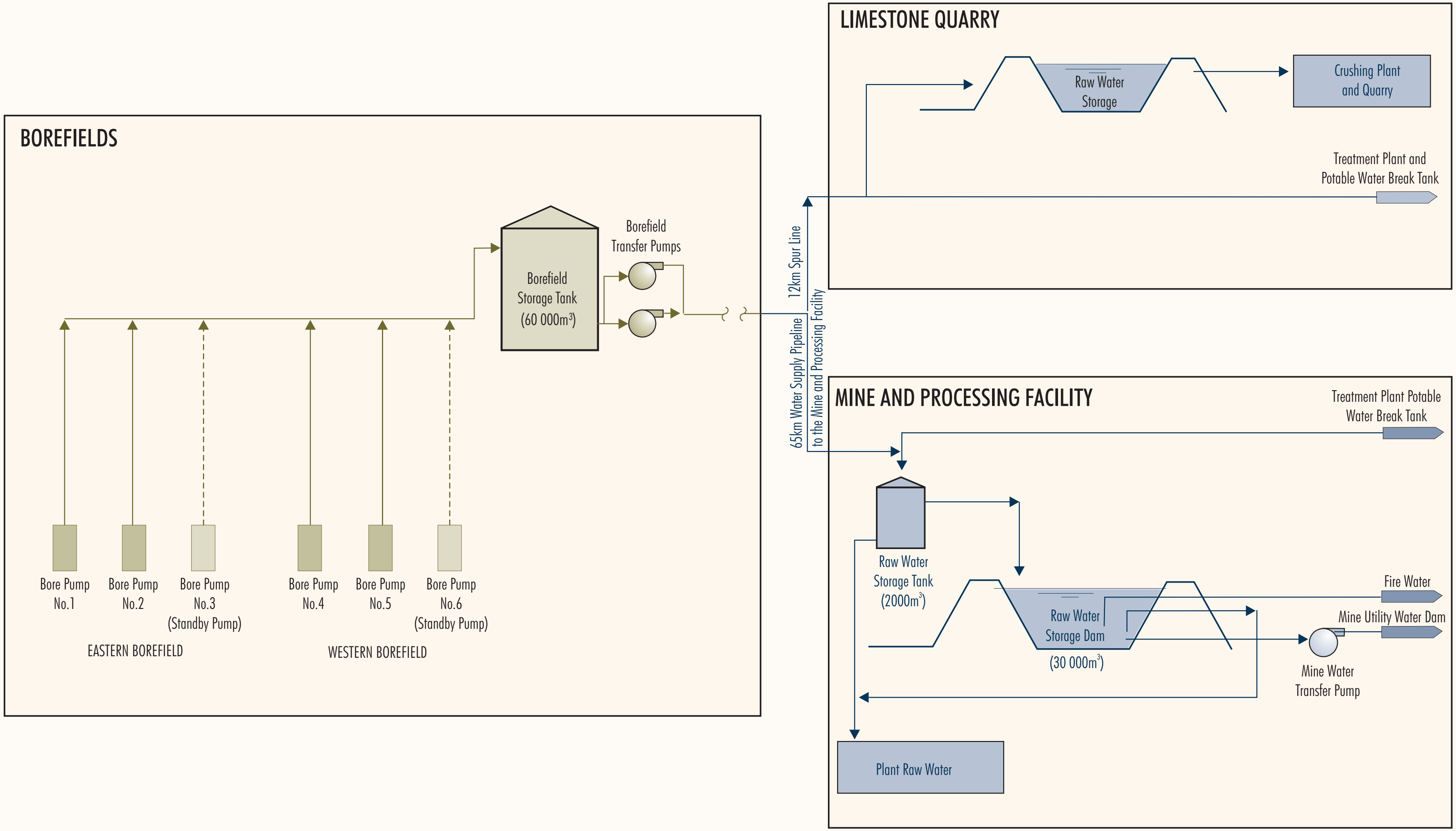

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FIGURE C2-6

Raw Water Supply Scheme

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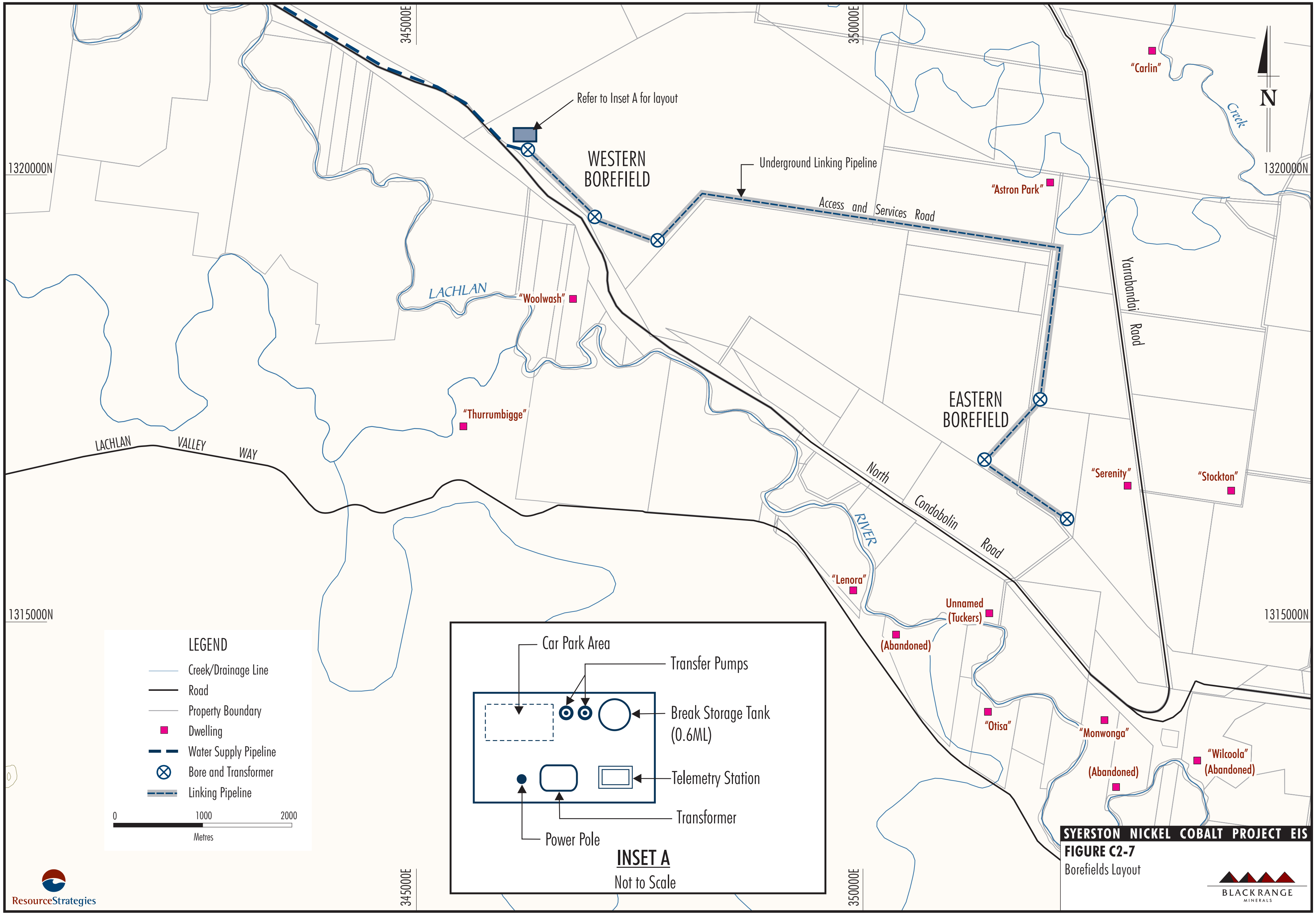

FIGURE C2-7
Borefields Layout

BRM-98-01-Pt C-S2_004D

Table C2-3
Raw Water Analysis

Component	Units	Design Value
pH		7.3
Sodium	mg/L as Na	245
Potassium	mg/L as K	4.4
Calcium	mg/L as Ca	36
Magnesium	mg/L as Mg	35
Chloride	mg/L as Cl	320
Hardness (Equiv. $CaCO_3$)	mg/L	310
Bicarbonate (HCO_3)	mg/L	230
Sulphate	mg/L	110
Nitrate as N	mg/L	<0.01
Ammonia as N	mg/L	<0.01
Ferrous Iron Fe^{2+}	mg/L	0.71
Ferric Iron Fe^{3+}	mg/L	0.70
Fluoride as F	mg/L	0.35
Manganese	mg/L	0.07
Arsenic	mg/L	<0.01
Copper	mg/L	0.002
Lead	mg/L	<0.001
Zinc	mg/L	0.013
Strontium	mg/L	0.88
Selenium	mg/L	<0.01
Barium	mg/L	<0.1
Aluminium Al^{3+}	mg/L	<0.1
Silica (as Si)	mg/L	6.5
Phosphate PO_4^{3-}	mg/L	0.03
Total Phosphorous	mg/L	0.15
Total Dissolved Solids	mg/L	870
Suspended Solids	mg/L	<2
Turbidity	NTU	12
Chemical Oxygen Demand	mg/L	10
Biochemical Oxygen Demand	mg/L	<2

Source: SNC-Lavalin (2000)

C2.2.3 Alternatives Considered

Possible sources for the supply of water previously investigated are the Lachlan River or groundwater in the vicinity of the river or the Project area. An embargo has been placed on the issue of new surface water entitlements for the extraction of water from the Lachlan River for some years, as part of the Murray-Darling Basin Cap. A water supply scheme based on surface water entitlements was not adopted due to the Project's need for a highly reliable water supply scheme.

A possible alternative initially investigated involved upgrading the line size of the existing water supply pipeline from Forbes to Tottenham. This would minimise permit and licensing issues and costs could be shared. A lateral from this pipeline would be some 20 km long. However, in consultation with local and state agencies, a dedicated supply has been adopted to facilitate management, security, maintenance and metering of the supply.

BRM commenced a hydrogeological investigation for groundwater supply to the Project. The investigation was focussed on the area to the north of the Lachlan River. This option was later developed as the preferred option.

Two alternatives were considered for the linking pipeline between the eastern and western borefields (Figure C2-1). The preferred option was selected based on the objectives of minimising vegetation clearing and disruption to land management practices.

C2.2.4 Borefields and Associated Infrastructure

Bores and pump stations at the proposed eastern and western borefields would be raised above flood level and each bore fenced with a disturbance area of approximately 10 m^2. The bores would be approximately 140 m deep and connected via an underground pipeline to a pump station near the western borefield and then the main pipeline to the MPF. The infrastructure required at the pump station is shown in Figure C2-7 and consists of the following:

- break storage tank (0.6 ML capacity);
- transfer pumps (two at 100% capacity);
- transformers (seven);
- telemetry station;
- linking pipeline between the borefields; and
- access and service road.

The borefields are located approximately 7 km apart and would be linked by an access road running along the alignment of the linking pipeline.

Transformers would be located at each of the six bore locations to service each bore pump and at the pumping station to service the transfer pumps. Power would be provided to the borefield by a local supplier from a nearby substation.

C2.2.5 Construction Phase

Prior to commencing any on-site work a CEMP detailing the proposed clearing, stripping, excavation, bedding, pipelaying, backfilling, and restoration activities (Section C6) would be prepared.

The minimum easement required for the construction of the pipeline linking the borefields is 15 m.

This would allow for a 3 m construction road, pipe layout area, trench, area to stockpile trench spoil and soil and turning bays to allow construction traffic to turn and pass (Figure C2-5). The pipeline would be laid approximately 1.5 m under the ground surface.

C2.2.6 Operation Phase

Procedures would be developed and implemented for the operation and maintenance of the borefields and associated infrastructure. Inspections would be undertaken periodically or whenever it is considered that damage may have occurred.

Constraints or access to the borefields and linking pipeline and agricultural activities would be implemented.

The landowners/occupiers directly affected by the location of the borefields and associated infrastructure would be provided with information to provide for the safety of the public and continuity of Project operations.

Inspection and assessment of the borefields and associated infrastructure would include the following:

(a) visual survey of all infrastructure;

(b) lifting of the bores for maintenance; and

(c) audit of corrosion control measures to assess effectiveness.

Assessment frequency would be determined by performance history, manufacturer's requirements and deterioration rate.

C2.3 WATER SUPPLY PIPELINE ROUTE

C2.3.1 Alternatives Considered

Two alternatives were considered for the alignment of the water supply pipeline from the borefields adjacent to the Lachlan River to the MPF site (Figure C2-1).

Two options were considered.

(1) A pipeline running from the western borefield to Condobolin where it would then share a common trench with the natural gas pipeline north to the MPF and quarry.

(2) A pipeline running north past Ootha, towards Fifield then north-west to the MPF and quarry within road reserves.

After preliminary assessment of these options it was decided to develop the option of running the pipeline north past Ootha and to the MPF and limestone quarry, due to the extra distance and associated cost involved with running the pipeline west to Condobolin to link up with the natural gas pipeline. In addition, a relatively clear alignment existed on the Ootha route whereby the pipeline could be laid in cleared road reserves for much of its route thereby minimising disturbance to vegetation.

C2.3.2 Main Pipeline, Spur Line and Associated Infrastructure

The pipeline route follows existing road reserves from the raw water supply borefield to the MPF site as shown on Figure C2-8. The pipeline is to be laid below ground within the existing road reserves.

The proposed water supply pipeline is approximately 65 km long, and would connect the MPF site with the eastern and western borefields adjacent to the Lachlan River.

For all but the Fifield bypass and the last kilometre or so where the pipeline enters the borefields, the pipeline would run alongside roads and tracks within existing road corridors.

Forbes Shire Council alignment preferences for locating the pipeline in the road reserve are that it be laid 8 m from the constructed centre of the road unless the road is fenced, in which case the pipeline is to be 2 m from the boundary reserve (fence). For waterbody crossing in Forbes Shire, the pipeline is not to be affixed to any of Council's bridges.

A 12 km spur line would run from the main pipeline to the limestone quarry located approximately 20 km south-east of the MPF (Figure C2-8).

The main water supply pipeline would be a 457 mm ID Mild Steel Cement Lined (MSCL) pipe capable of a 720 m^3/h. The pipe would be fitted with a polyethylene sleeve for corrosion protection.

The spur line from the main water supply line (south of Fifield) to the limestone quarry would be a 121 mm ID MSCL pipe capable of a 10 m^3/h. The pipe would be fitted with a polyethylene sleeve for corrosion protection.

The MPF site, limestone quarry and borefield infrastructure associated with the water supply pipelines (main pipeline and the spur line to the quarry) are shown on Figure C2-8. The borefield infrastructure is addressed in Section C2.2.4 while the infrastructure located at the MPF site and limestone quarry are addressed in Section A2.10 and Section B2.1.6 respectively.

C2.3.3 Construction Phase

Prior to commencing any on-site work a CEMP detailing the proposed clearing, stripping, excavation, bedding, pipelaying, backfilling, and restoration activities (Section C6) would be prepared.

The minimum easement required for the construction of the pipeline is 9 m. This would allow for a 3 m construction road, pipe layout area, trench and an area to stockpile trench spoil and topsoil or road base material (Figure C2-5). The pipeline would be laid approximately 1.5 m under the ground's surface with a 750 mm ground clearance above the pipeline.

In areas where the pipeline is required to cross existing roads or rail lines, an application would be lodged with the relevant road or rail authority and Council.

During the detailed design of the alignment, inquiries would be made with the relevant authorities regarding existing and proposed underground cables/services in the area.

Clearing

Vegetation clearing for the pipeline would be kept to a practicable minimum required for construction. Damage to trees and shrubs would be kept to a minimum.

Clearing would be restricted to the proposed pipeline easement.

Felled trees and shrubby vegetation greater than 1.5 m in height would be removed from the site to minimise potential fire hazards associated with the large stockpiles of vegetation.

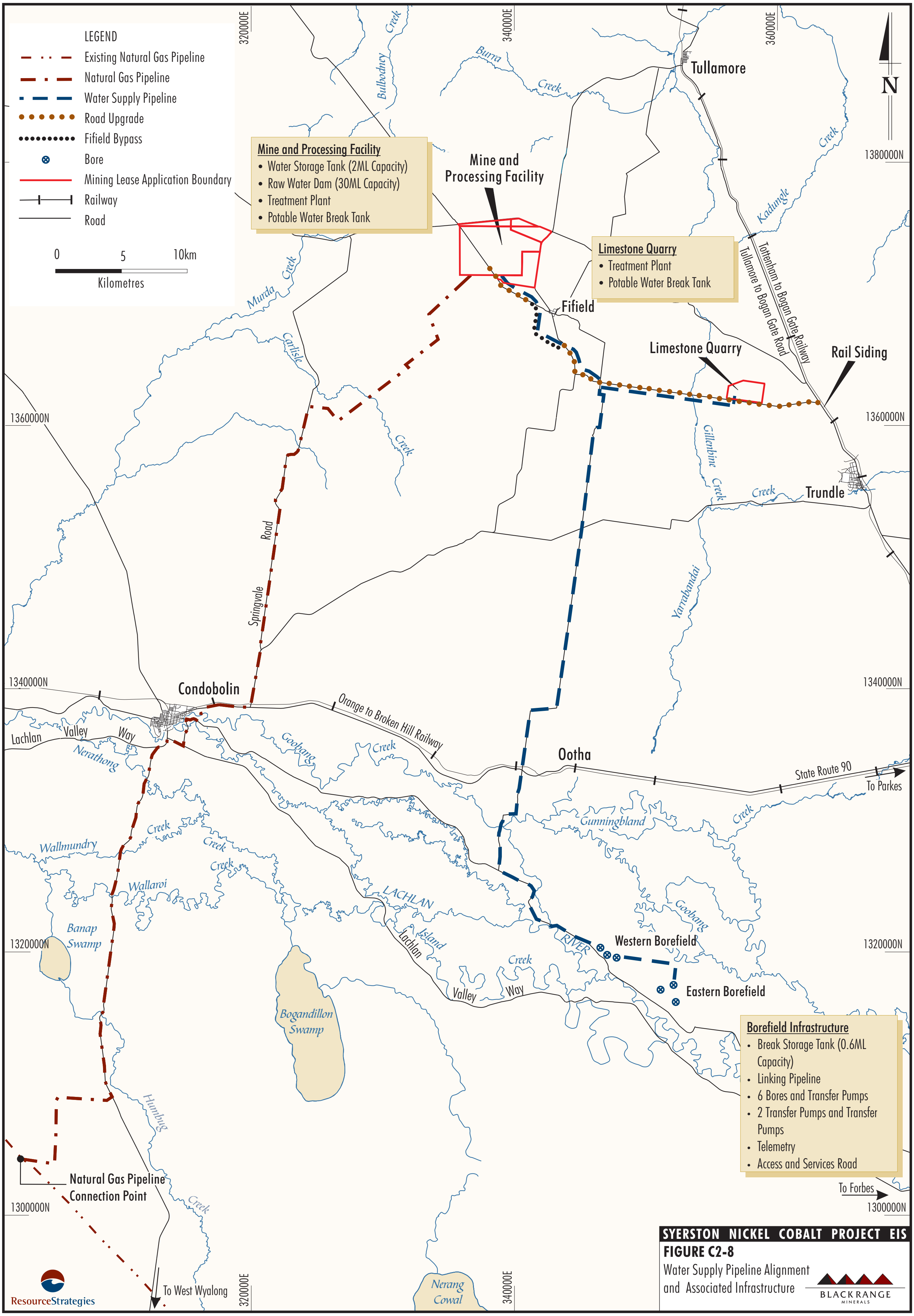

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FIGURE C2-8

Water Supply Pipeline Alignment and Associated Infrastructure

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Surface Stripping

Undeveloped Areas (including Road Verges)

Soil would be stripped to a nominal depth of 200 mm and stockpiled separately to the remainder of the excavated trench materials.

Bituminous Road Pavements, Kerbs and Concrete Paving

Kerbing, pavements and concrete paving would be marked out and saw-cut prior to excavation work. The surface materials would be stripped to the subgrade level, removed and disposed of, off-site.

Excavation

Before commencing excavation topsoil or other surface materials would be stripped and stockpiled.

Trenches/excavations would be excavated to the depths and widths necessary to allow installation of the pipeline to the levels, grades or covers specified.

Trenches would be opened, however not excessively, in advance of the pipe laying, only to enable the work to proceed without delay. The length of open trench at any time would be minimised as far as practicable. All trenches left open would be securely barricaded, signposted and illuminated in accordance with statutory and regulatory requirements.

Although blasting is not anticipated, approval would be obtained from the relevant authorities, if required.

Trench Dimensions

Trench widths would comply with the respective pipe manufacturer's specifications.

Allowance would be made for widening and deepening of trenches at pipe joints, valves and structures.

Construction of the Pipeline

Transportation of pipes, unloading and handling, and laying of the pipeline would be performed in accordance with the Contractor's handling and installation manual.

Backfill

The top 200 mm of backfill material in grassed areas would be removed and stockpiled during stripping prior to trench construction and would be returned and compacted to the density of the surrounding soil.

Marker Posts

Marker posts would be installed to indicate pipeline and valve locations in rural and undeveloped land situations.

Rehabilitation

Properties which have been affected by construction work would be rehabilitated to the pre-construction condition.

C2.3.4 Operation Phase

Procedures would be developed and implemented for the operation and maintenance of the water supply pipeline and associated infrastructure. Inspections would be undertaken periodically or whenever it is considered that damage may have occurred.

Landowners, authorities and other relevant bodies would be provided with a 24 hour contact telephone number in case of an emergency relating to the water supply pipelines.

The landowners/occupiers directly affected by the location of the borefields and associated infrastructure would be provided with information to ensure public and Project safety.

Certain constraints on landuse activities such as maintaining access, prohibition of buildings near the pipeline, restriction on addition of fill, control of vegetation, power and telegraph poles, fencing and agricultural activities adjacent to the pipeline would be implemented.

Periodic inspections and assessments of the pipeline would include:

(a) a visual survey of all above ground sections of the pipeline and associated equipment, to locate and assess any defects; and

(b) an audit to assess the effectiveness of corrosion control facilities.

SECTION C3 - DESCRIPTION OF THE EXISTING ENVIRONMENT

NATURAL GAS PIPELINE, WATER SUPPLY PIPELINE AND BOREFIELDS

PREPARED BY
RESOURCE STRATEGIES PTY LTD

SEPTEMBER 2000
Project No. BRM-01\2.2
Document No. PART C - SECTION 3-F.DOC

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C3 DESCRIPTION OF THE EXISTING ENVIRONMENT

The following section provides a description of the existing local and regional environment relevant to the development of the water supply borefields, water supply pipeline, and the natural gas pipeline for the Project.

C3.1 LAND RESOURCES

C3.1.1 Physiography and Landuse

The natural gas and water supply pipelines would be established in existing road reserves beside public roads for the majority of their length. Land adjacent to the road corridors is characterised by cleared agricultural land. Both the eastern and western borefields would be located in previously cleared and cultivated agricultural areas.

The natural gas pipeline traverses country ranging in elevation from approximately 200 m AHD east of Condobolin, rising to 320 m AHD and then falling to enter the MPF site at approximately 300 m AHD. North of the Lachlan River the proposed water supply pipeline traverses gentle downs-like country of broad low rises that increase in height towards the north. The water supply pipeline rises from an elevation of approximately 200 m AHD at Ootha to enter the MPF site at 300 m AHD.

The proposed natural gas and water supply pipelines and the borefields are located predominantly in the Lachlan River catchment. The Lachlan catchment drains to the great Cumbung Swamp and, in times of extremely high flow, to the Murrumbidgee River. The northern portions of the natural gas and water supply pipelines are located within the Bogan River catchment. The Bogan River catchment flows to the Darling River which in turn flows into the Murray River. The borefields area is situated on the floodplain of the Lachlan River, immediately downstream of the junction of Bumbuggan Creek with the Lachlan River.

Several watercourses are traversed by the natural gas pipeline including the Lachlan River, Humbug Creek, Wallaroi Creek, Wallamundry Creek and Nerathong Creek. The water supply pipeline traverses Goobang Creek and Bumbuggan Creek.

C3.1.2 Borefield Geology

Geology of the borefields area has been described by Coffey Geosciences (2000), and summarised below.

The proposed borefields are located near the confluence of the Lachlan River and Bland Creek Palaeochannels in the deepest section of the Lachlan River Palaeovalley.

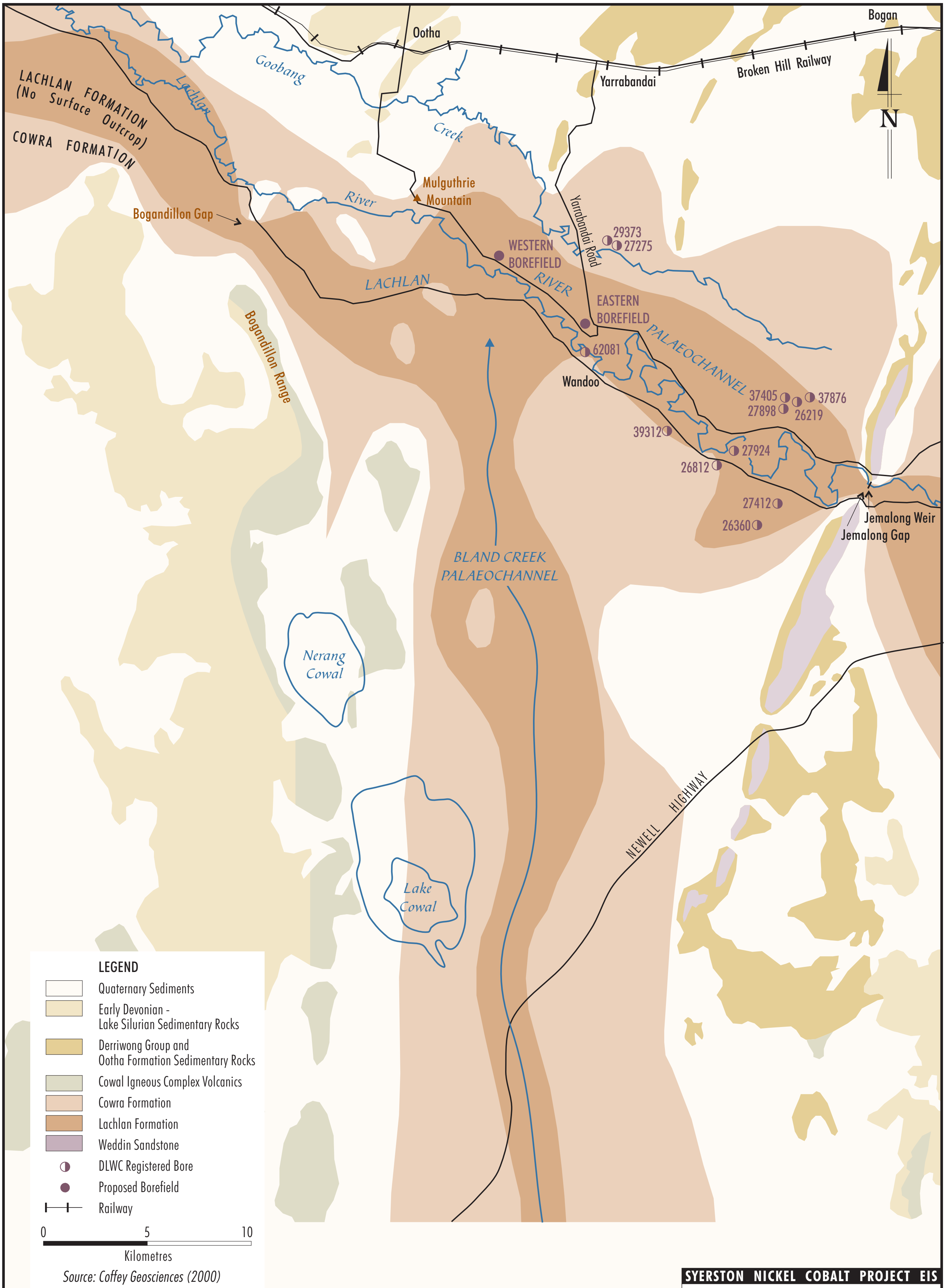
Figure C3-1 indicates the location of the regionally extensive Lachlan River and Bland Creek Palaeochannels in which the Lachlan Formation sediments have been deposited.

The Lachlan River alluvium consists of Quaternary to Tertiary age fluvial clay, silt, sand and gravel sediments which are subdivided into the Cowra Formation and the underlying Lachlan Formation. Depth to basement bedrock is highly variable, ranging from 0 m to over 140 m beneath the surface. The deep incised Lachlan River Palaeochannel is orientated east-west and joins the north-south trending Bland Creek Palaeochannel near the proposed borefields. A summary of the regional geology is included in Section A3.1.3 of this EIS.

The Lachlan Formation occupies the valley palaeochannel floor that is incised into the underlying basement. It is not exposed at the surface. The Cowra Formation overlies the Lachlan Formation, and overlaps onto the basement at the fringes of the palaeochannel.

Cowra Formation

The Cowra Formation consists of interbedded clay and silt with minor sand and gravel lenses. The Cowra Formation sediments differ considerably from the Lachlan Formation in both colour and composition. The Cowra Formation is dominantly orange-brown to pale brown clay and silt with minor sand and polymictic gravel. The thickness of the Cowra Formation varies from 30 m to 40 m at Cowra, 64 m at Forbes and 80 m near Mulguthrie Mountain.



Source: Coffey Geosciences (2000)

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FIGURE C3-1

Combined Hydrogeological/
Geological Map

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Lachlan Formation

The Lachlan Formation is restricted in width beneath the floodplain and consists of light grey, interbedded sand and gravel with minor silt and clay units. The subrounded to rounded sand and gravel are dominantly grey, quartzose sediments, with lesser chert and jasper. The sand and gravel frequently occur in the deeper lithological sequence in bands from 10 m to 20 m thick.

The depth of the Lachlan Formation gradually increases to the west. Depth to the base of the Lachlan Formation ranges from 75 m to 90 m near Jemalong Weir (Williamson, 1986) to 137 m in the western borefield.

Basement Lithologies

Bedrock below the Lachlan River floodplain consists of Silurian phyllite, schist, micaceous siltstone, sandstone, dolomite, andesite and conglomerate within the north-south trending Tullamore and Murda Synclines. Outcropping bedrock consists of the Devonian Weddin Sandstone at Jemalong Gap. Andesite, dacite, rhyolite, tuff and limestone are present north of Goobang Creek whilst sandstone, shale and conglomerate are located at Mulguthrie Mountain along with the Womboyne Conglomerate at Bogandillon Gap. The valley-in-valley palaeochannels are present within the bedrock profile.

C3.2 WATER RESOURCES

C3.2.1 Surface Water

Regional Hydrology

The regional hydrology of the area has been described by Coffey Geosciences (2000) and is summarised below.

The Lachlan River Valley has a catchment area of about 84,700 km^2. The mean annual flow of the river at Forbes is about 1.27x10^6 ML with 60% of the flow occurring between June and September. Operation of Wyangala Dam, Lake Brewster and Lake Cargelligo has had substantial effects on the river flow, with changed seasonal patterns, reduced flow variability and lower water volumes in the downstream reaches of the river (Bish & Williams, 1994).

Water level in the Lachlan River is gauged at Jemalong Gap and is generally at approximately 220 m AHD, although may rise to 225 m AHD during periods of high flow. Significant floods reportedly occur about once every ten years although local flooding in the vicinity of the river may occur more frequently. Flood runoff from the Lachlan River flows into the floodplain from breakouts at various points along the river. Significant flows occur to the south-west into Lake Cowal.

Flooding depths to the north of the river have been observed to be less than 1 m at the proposed western and eastern borefields. The western borefield lies on the southern boundary of a floodway.

Surface Water Quality

Sampling from the Lachlan River indicated that surface water is marginally more alkaline than the groundwaters and has a similar salinity to the shallower Cowra Formation aquifer. Metals were generally low, iron marginally elevated and bicarbonate/magnesium/chloride (HCO_3/Mg/Cl) were dominant.

C3.2.2 Groundwater

Background

Groundwater contained within the Lachlan River alluvial aquifers was identified as a potential source of raw water supply for the Project. Two borefields, designated the “western” and “eastern” borefields (Figure C3-1) have been hydrogeologically assessed, with a summary of the findings presented in Section C4.2.

Appendix E presents the results of a hydrogeological assessment of an area concentrated on the broad alluvial flats between Jemalong Gap and Bogandillon Gap, and southwards to the lower sections of the Bland Creek system (Figure C3-1).

The proposed western and eastern borefields for the Project are located within the central southern section of the Department of Land and Water Conservation's (DLWC's) Zone 5 of Groundwater Management Area 11 (Figure C3-2). As part of NSW's State Groundwater Management Policy, an Upper Lachlan Groundwater Management Plan was developed in February 1997 by the DLWC with the objectives to:

- ensure ecological sustainability of the resource;
- allocate water equitably;
- encourage development which optimises economic benefit to the region, State and Nation while protecting the wider environment; and
- slow, halt or reverse any degradation in groundwater resources.

Groundwater Management Area 11 is divided into eight zones within the Lachlan River alluvium and its tributaries. Area 11 is located upstream of Lake Cargelligo and extends to the headwaters of the Lachlan River.

The total amount of groundwater that could be extracted from each zone was estimated by the DLWC from the average saturated thickness, an assumed drainable porosity and aquifer surface area.

Groundwater usage for Zones 5 and 6 is shown in Table C3-1.

Authority to grant licences for extraction of groundwater rests with the DLWC under Part 5 of the *NSW Water Act, 1912*. Applications for production bore licenses were made by BRM in July 1998.

Hydrogeology of Borefields

Groundwater movement is generally from east to west. Between Jemalong Gap and Bogandillon Gap, the major aquifer is the deep, confined sands and gravels of the Lachlan Formation.

Few irrigation bores are located north of the Lachlan River between Mulguthrie Mountain and the Warroo channel system. The Bland Creek Palaeochannel, which also contains the Lachlan Formation, enters the Lachlan system to the south of Mulguthrie Mountain and east of the Bogandillon Range (Figure C3-1).

Cowra Formation

Cowra Formation aquifers are generally extensive, however the potential for groundwater supplies is limited compared with the Lachlan Formation as there is less water level drawdown available and the aquifer is generally less permeable. Groundwater yield from the Cowra Formation is generally less than 60 L/s.

Within the Cowra Formation, the natural northerly shallow groundwater movement in the Bland Creek Palaeochannel has been reversed in recent times and the Bland Creek catchment is thought to no longer contribute underflow to the Lachlan River system (Coffey Geosciences, 1994a). This is primarily due to the development of the Warroo Groundwater Mound within the Jemalong-Wyldes Plains Groundwater Irrigation District (Figure C3-2). The mound results from vertical infiltration of surface water through earthen irrigation channels and increased groundwater accessions due to the changed landuse for clearing and irrigation (Anderson *et al*., 1993).

Table C3-1
Groundwater Use in Zones 5 and 6 of
DLWC Groundwater Management Area 11

Zone	Area (ha)	Average Saturated Thickness (m)	Assumed Porosity %	Volume Available (ML/yr)	Allocation Ceiling (ML/yr)	Allocations as of 1999 (ML/yr)
5	207,181	92	0.12	251,601	125,801	18,537
6	94,127	92	0.15	142,885	71,443	16,704

Note: The available volume assumes 33% of available recharge and a 30 year allocation period.
Source: Coffey Geosciences (2000)

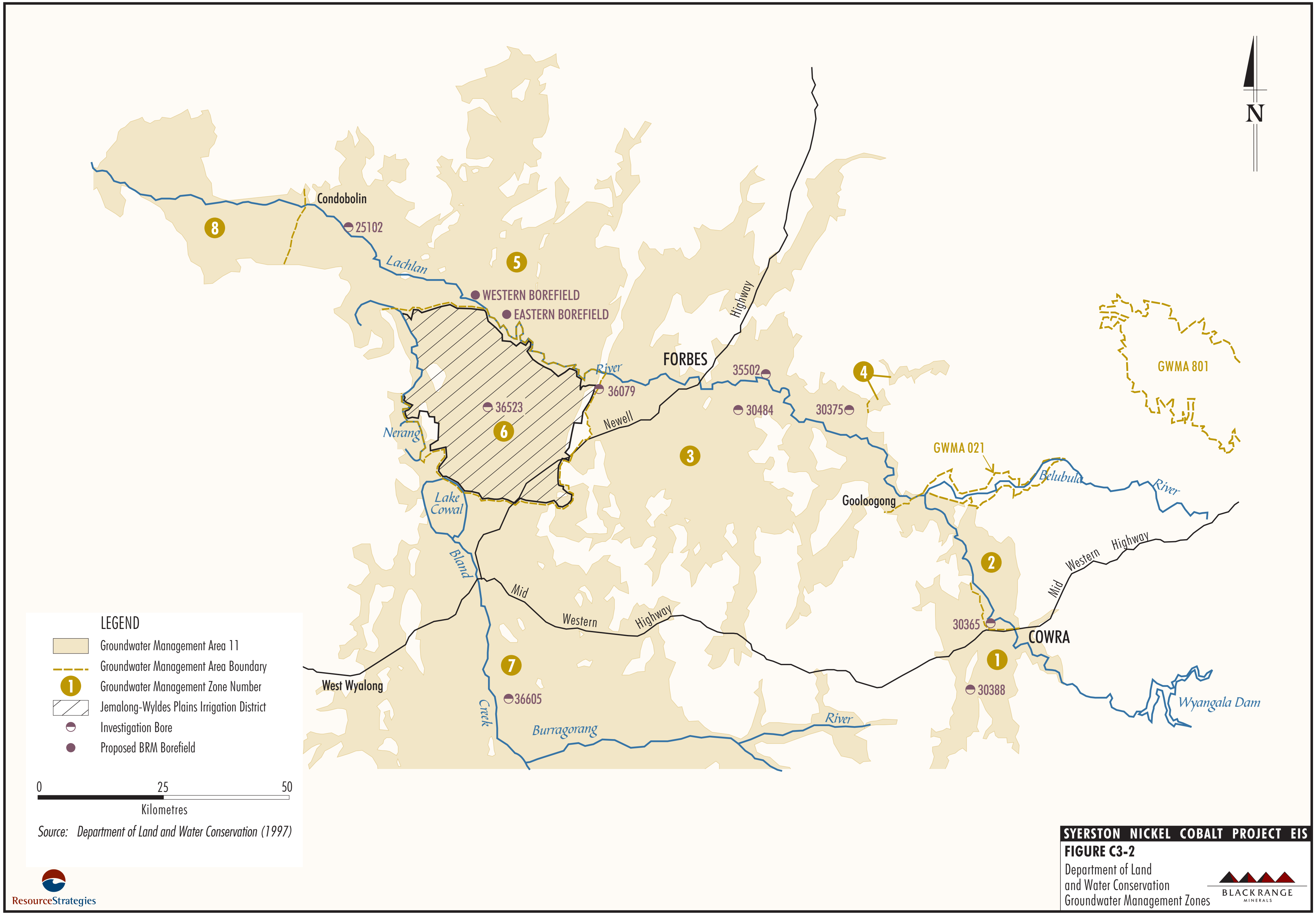

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FIGURE C3-2

Department of Land and Water Conservation Groundwater Management Zones

BRM-98-01-Pt C-S3_007F

Soil salinisation and water logging is a recognised problem in the Jemalong-Wyldes Plains area, south of the Lachlan River, especially near Bogandillon Range.

Lachlan Formation

The Lachlan Formation is restricted to the entrenched bedrock section of the Lachlan River Valley and contains the more productive aquifers. The sand and gravel confined aquifers are irregularly distributed, hydraulically interconnected and vary considerably in thickness. Maximum aquifer thickness does not necessarily correspond with the deepest part of the valley, nor in the area of the most productive aquifers. The Lachlan Formation aquifers vary in the silt and clay content and therefore not all aquifers are potential groundwater extraction targets.

The Lachlan Formation aquifers between Jemalong Gap and Bogandillon Gap are generally extensive, although the palaeochannel is restricted in width to a few kilometres at each Gap.

In the Jemalong Gap to Bogandillon Gap area, licensed bore data indicate groundwater yields from the Lachlan Formation of up to 195 L/s. To the east of Forbes, production bores extract groundwater for Parkes town and Northparkes Copper/Gold Mine water supply. Groundwater yields up to 200 L/s are obtained for the Parkes area from combined production bores screened in both Lachlan and Cowra Formation aquifers.

Transmissivities in the Lachlan Formation range from 23 m^2/d to 3,374 m^2/d (Williamson, 1986). Standing water levels are between 2 m and 10 m beneath the surface and major aquifers are potentially intersected between 80 m and 120 m beneath the surface (Williamson, 1986).

Outside the palaeochannel it is unlikely that large groundwater yields (in excess of 60 L/s) would be available as bedrock is encountered at a depth less than 80 m beneath the surface and the Lachlan Formation is not usually present or thins out markedly at or below this depth.

Within the Bland Creek Palaeochannel, groundwater yields from the Lachlan Formation range up to 50 L/s. Transmissivity values range from 94 m^2/day to 555 m^2/day (Coffey Geosciences, 1994a).

The Warroo Groundwater Mound appears to have applied a hydraulic pressure loading to the Lachlan Formation within the Bland Creek Palaeochannel and caused a reversal of groundwater flow away from the Lachlan system toward Lake Cowal (Coffey Geosciences, 1994b).

Groundwater Quality

Salinity varies substantially in the Lachlan River Valley from less than 500 mg/L to in excess of 30,000 mg/L. Salinity tends to increase away from rivers, creeks and channels towards basement rock outcrops. There is a natural increase in salinity downstream along the groundwater flow path from east to west.

In the study area, the total dissolved solids (TDS) of shallow aquifers in the Cowra Formation generally range from 800 mg/L to 1,000 mg/L. Groundwater in the Lachlan Formation is around 650 mg/L TDS at Mulguthrie Mountain and in excess of 1,950 mg/L TDS in the restricted bedrock channel near Condobolin (Williamson, 1986).

The Lachlan Formation has sodium in excess of magnesium and calcium, though occasionally the latter two ions are in reverse order. Of the anions, bicarbonate exceeds chloride and sulphate is subordinate (Williamson, 1986).

The Lachlan Formation groundwater in the Bland Creek Palaeochannel (Hawkes, 1998) is described as sodium:chlorine (Na:Cl) dominated with lower bicarbonate than the overlying Cowra Formation waters. In general, the salinity of the Bland Creek Palaeochannel groundwater is suitable for most irrigation purposes.

In general the groundwater salinity from investigation bores in the Lachlan Formation aquifer varies from 760 mg/L to 870 mg/L (low salinity). The pH is slightly alkaline and nutrient levels (ammonium and total phosphorous) are elevated. Metals are at low concentrations and are within ANZECC (1992) criteria. Groundwater within this aquifer was found to be sodium/chlorine/ bicarbonate ($Na/Cl/HCO_3$) dominant.

Groundwater in the shallow Cowra Formation (Figure C3-3) is bicarbonate/sodium/magnesium ($HCO_3/Na/Mg$) dominant.

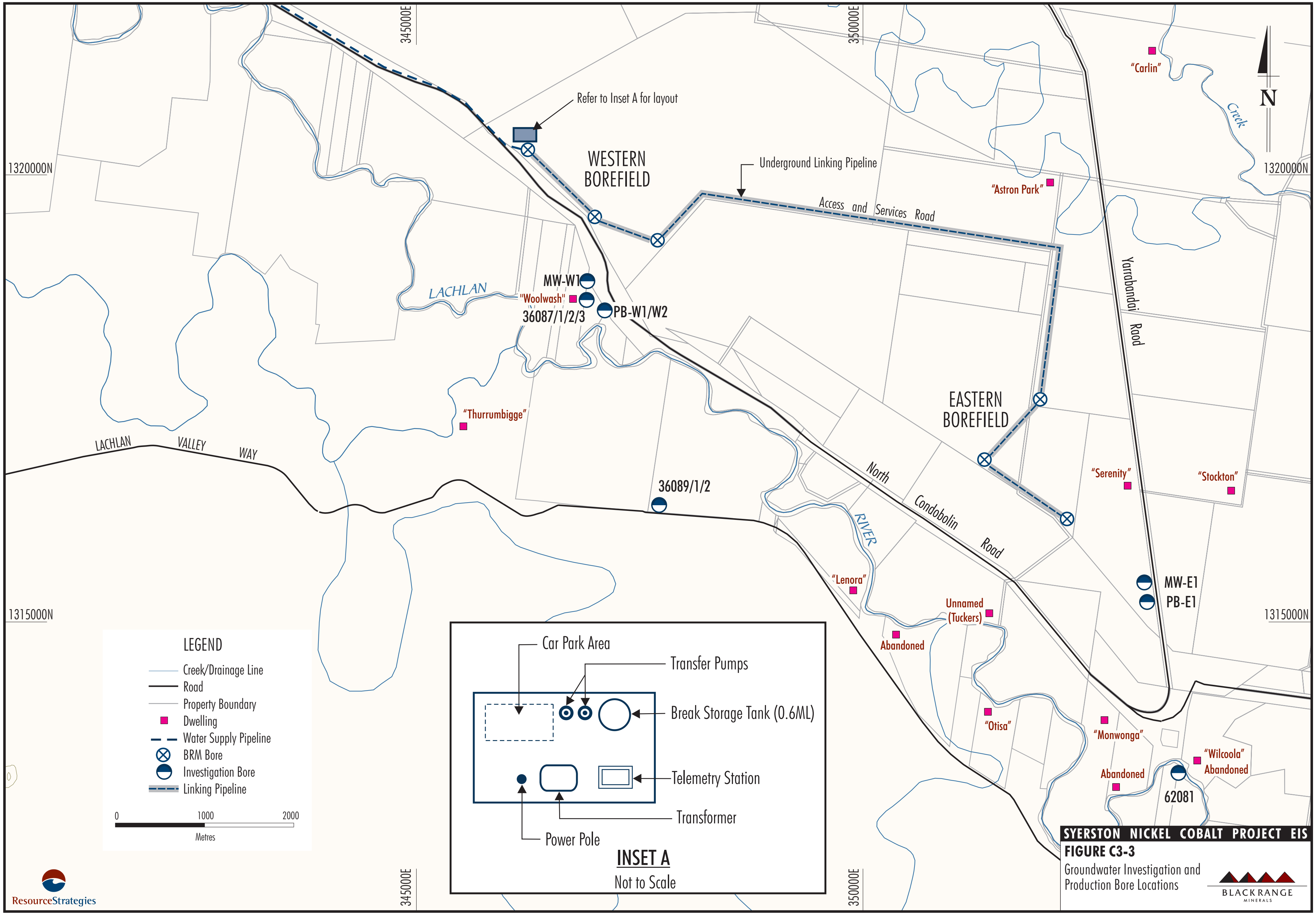

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FIGURE C3-3

Groundwater Investigation and Production Bore Locations

BLACK RANGE MINERALS

Resource Strategies

BRM-98-01-Pt C-S3_009C

Groundwater Levels

Water levels in the aquifer of the Lachlan River and Bland Creek Valleys have been measured in DLWC observation piezometers for over thirty years. Groundwater levels in the Lachlan River Valley between Jemalong Gap and Condobolin and in the Bland Creek Valley to the south range from 0.3 m to 69.5 m below surface.

Groundwater level variations are correlated to rainfall, with "wet" years such as 1983 and 1988/89 resulting in major aquifer recharge events compared to "dry" years.

The piezometric surfaces in the Lachlan Formation and the contact with the Cowra Formation (bores 36087/3 and 36087/2, respectively – Figure C3-3) are responsive to regional recharge events (with time lag) and are hydraulically interconnected. These piezometric surfaces are variable, and generally up to 2 m higher than in the shallower Cowra Formation indicating a greater pressure head in the Lachlan Formation. The piezometric surface in the Cowra Formation is more responsive to recharge events, the response being more rapid than deeper aquifer units. These facts suggest that hydraulic connection between the Lachlan and upper Cowra Formation aquifer is not significant and there is no recharge from shallow to deeper aquifers at this location under current steady state condition.

Water levels monitored near the proposed Project borefields in Zone 5 (Figure C3-2), indicate a 2 m to 3 m net rise in water level in the Cowra Formation between 1968 and 1993 with changes in the piezometric surface generally related to seasonal events. Zone 6 (Figure C3-2), which includes the Jemalong-Wyldes Irrigation District, had a dramatic rise in water level in the 1950s due to flooding, with rises of up to 5 m and no apparent recession. The groundwater mound was centred beneath a shallow prior stream alluvial deposit and is still expanding (Bish and Williams, 1994). Between 1988 and 1992 the mound rose by approximately 1 m within the Cowra Formation. The area at the crest of the mound is at risk from water logging and salinisation. Groundwater within the mound drains toward Bogandillon Creek and Lake Cowal (Bish and Williams, 1994).

Groundwater Flow

Groundwater flow within the Lachlan Formation aquifers is generally constrained within the Lachlan River and Bland Creek Palaeochannels, ie. westward, sub-parallel to flow in the Lachlan River and northward, sub parallel to Bland Creek up to the confluence of the two systems. Groundwater flows west of the confluence toward Condobolin. Local variations in hydraulic gradient and flow direction would be expected around bedrock highs projecting through the alluvial sequence.

Hydraulic Parameters

The underlying basement lithology is not impermeable, however the contrast between hydraulic conductivity in the Lachlan Formation and the basement would be so large that the basal contact may be regarded as a no-flow boundary.

Test pumping results indicate that the transmissivity of the Lachlan Formation aquifers ranges from 500 m^2/day to 700 m^2/day in the western borefield to 1,100 m^2/day to 1,500 m^2/day in the eastern borefield. The variation potentially arises from changes in gravel thickness and sediment grain size.

At both test sites, no preferred directions in transmissivity were noted from observation piezometers and the aquifer may be regarded as isotropic. Storativity values range from approximately 10^{-3} in the eastern borefield to 10^{-4} in the western borefield, which are within the expected range for a confined aquifer.

The potential drawdown effects of the extraction of groundwater for the Project on the Lachlan Formation are presented in Section C4.2 and Appendix E.

C3.3 FLORA

C3.3.1 Background

Service corridors for the natural gas and water supply pipelines would be established in existing easements beside public roads for the majority of their length. The density of native vegetation currently remaining in the easements varies considerably along the corridors and depends on the width of the easement and degree of past disturbance.

The wider corridors are Travelling Stock Routes subject to periodic grazing during droughts. These generally retain more or less intact samples of the original vegetation.

C3.3.2 Flora Survey

Bower and Kenna (2000) surveyed components of the natural gas pipeline, water supply pipeline and borefields in October 1999, January 2000 and June 2000. The flora survey methodology is discussed in detail in Appendix I and is summarised below.

The natural gas and water supply pipelines were surveyed by systematic 15 minute searches along a 25 m length of roadside at each site extending to the fenceline on both sides. Where the natural gas pipeline crosses farmland the searches covered a width of approximately 100 m.

Sampling sites were spaced at 4 km intervals in uniform terrain with additional sites between these if different habitats were encountered, such as creeks or rocky hilltops (Figure C3-4).

The borefields were covered by vehicle with three naturally vegetated sites sampled in detail.

The flora surveys included targetted searches for threatened flora species.

C3.3.3 Vegetation Alliances/Associations

Natural Gas Pipeline

Seven vegetation alliances were identified along the natural gas pipeline route (Figure C3-4), comprising 17 vegetation associations. The 17 associations consisted of:

- two floodplain associations (the *Eucalyptus camaldulensis* and *E. largiflorens* associations);
- four associations on ephemerally wet sites (the *Acacia pendula, A. oswaldii, A .pendula/ A. oswaldii* and *E. dumosa* associations);
- six box-pine woodland associations (the *E. populnea, E. microcarpa, E. populnea/ E. microcarpa, E. microcarpa/ Callitris glaucophylla, E. microcarpa*/ *E. populnea/C. glaucophylla, Geijera parviflora/Alectryon oleifolius* associations); and
- five hill associations (the *E. microcarpa/ E. dwyeri* and *E. populnea/E. dwyeri, E. sideroxylon, E. sideroxylon/ E. viridis/ E. dwyeri* and *E. viridis* associations).

To the north of Condobolin the natural gas pipeline route is vegetated mainly by remnants of box-pine woodlands (Figure C3-4).

To the south of Condobolin, remnant vegetation predominantly consists of acacia shrublands dominated by Myall (*A. pendula*) and Black Box (*E. largiflorens*).

Water Supply Pipeline

Five vegetation alliances were identified along the water supply pipeline (Figure C3-4) comprising seven vegetation associations:

- two floodplain associations (the *Stipa aristiglumis* and *E. camaldulensis* associations);
- three box-pine woodland associations (the *E. populnea/E. microcarpa/ C. glaucophylla, E. microcarpa/C. glaucophylla* and *E. populnea/E. microcarpa* associations); and
- two hill associations (the *E. sideroxylon/ E. dwyeri* and *E. microcarpa*/ *E. dwyeri* associations).

For a distance of approximately 15 km north-west of the borefields, the water supply pipeline traverses floodplain communities in which the flora is adapted to periodic flooding. The River Red Gum, *E. camaldulensis*, is the dominant tree species forming monospecific forest stands along creeks and rivers and across associated floodplains.

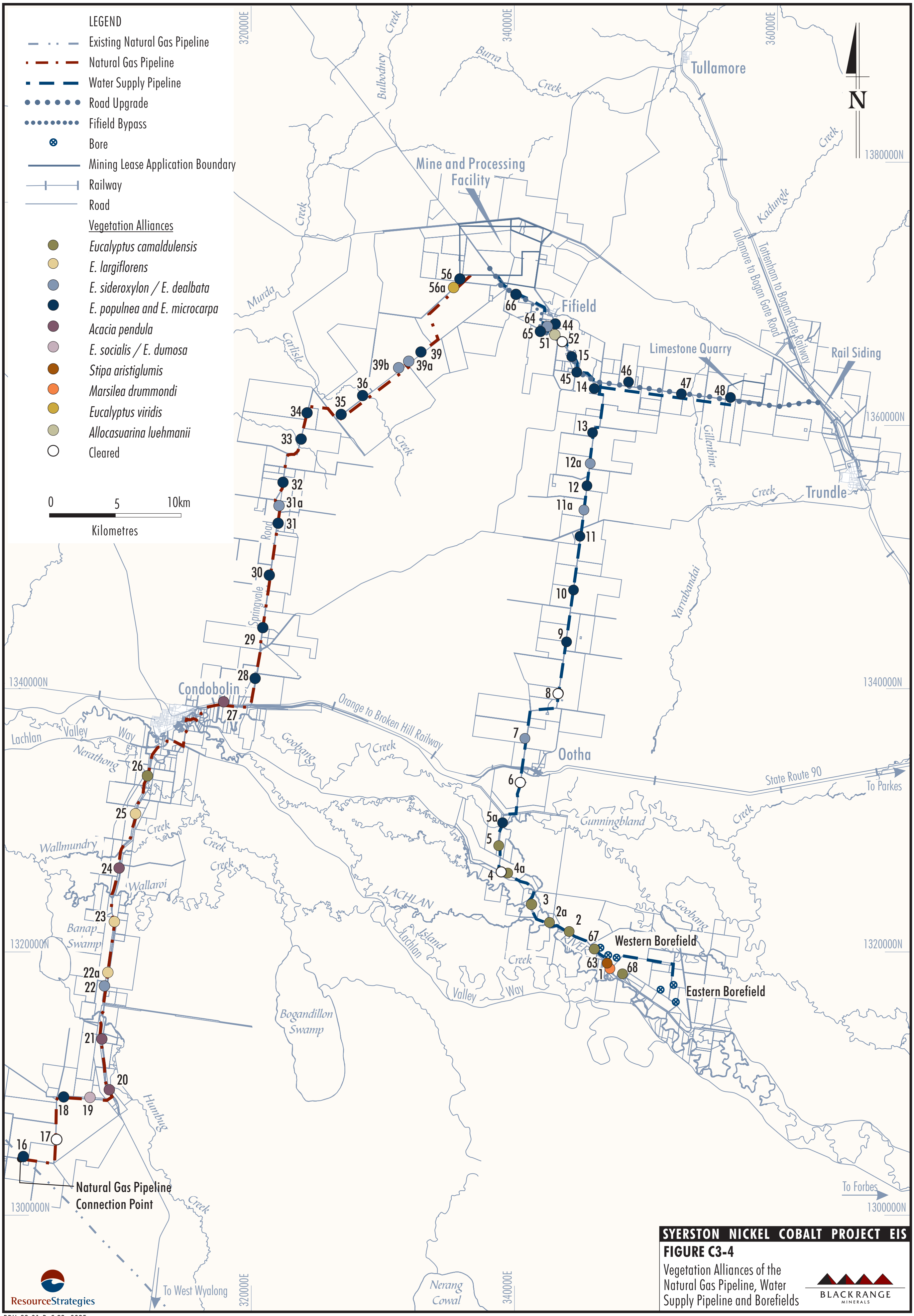

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FIGURE C3-4

Vegetation Alliances of the Natural Gas Pipeline, Water Supply Pipeline and Borefields

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North of Goobang Creek (Figure C3-4) the water supply pipeline predominantly traverse box-pine woodlands (*E. populnea* and *E. microcarpa* alliances) all the way to the MPF and limestone quarry sites. Associations of the *E. sideroxylon/ E. dealbata* alliance are also present.

Borefields

The borefields are situated in cleared agricultural land. Three floodplain alliances are present in the vicinity of the borefields: River Red Gum (*E. camaldulensis*) woodlands (Sites 67 and 68), Plains Grass (*Stipa aristiglumis*) grasslands (part of Site 67) and Common Nardoo (*Marsilea drummondii*) ephemeral wetlands (Site 63 and part of Site 67).

C3.3.4 Introduced Species and Weeds

The dominant weeds were grasses (Poaceae) and herbaceous daisies (Asteraceae). These were present on nearly all sites and often represented the bulk of the ground cover. The most common weedy daisy species included Capeweed (*Arctotheca calendula*), Saffron Thistle (*Carthamus lanatus*), Cretan Weed (*Hedypnois cretica*), Smooth Catsear (*Hypochaeris glabra*), Catsear (*Hypochaeris radicata*), Prickly Lettuce (*Lactuca serriola*) and Common Sowthistle (*Sonchus oleraceus*).

The most prominent grass weeds were species of Wild Oats (*Avena* spp.), Bromes (*Bromus* spp.), Barley Grasses (*Hordeum* spp.), Ryegrasses (*Lolium* spp.) and Vulpias (*Vulpia* spp.). These grasses comprised most of the biomass in the understorey on many sites in spring. However, they tended to die off in summer to be replaced by native species.

Other prominent and widespread weeds included Paterson's Curse (*Echium plantagineum*), Common Peppercress (*Lepidium africanum*), Indian Hedge Mustard (*Sisymbrium orientale*), Velvet Pink (*Petrorhagia velutina*), Wild Sage (*Salvia verbenaca*) and Curled Dock (*Rumex crispus*). Only one introduced weedy shrub was recorded, African Boxthorn (*Lycium ferocissimum*).

One or more species of deliberately introduced clovers (*Trifolium* spp.) or medics (*Medicago* spp.) also occurred at most sites.

C3.3.5 Significant Flora

No plant species listed as threatened under the NSW *Threatened Species Conservation Act 1995* or the Commonwealth *Protection of the Environment Biodiversity Conservation Act, 1999* were recorded by Bower and Kenna (2000) during the surveys of the natural gas pipeline, water supply pipeline or borefields.

However, one species, the Austral Pillwort (*Pilularia novae-hollandiae*), listed as endangered in the NSW *Threatened Species Conservation Act 1995*, has previously been recorded by Bower (unpublished report, 1998) in the vicinity of Site 23 on the natural gas pipeline (Figure C3-4). *P. novae-hollandiae* is a small grass-like perennial fern that grows in mud when seasonally dry depressions fill with water in winter.

Eight Part Tests of Significance were completed for 18 threatened plant species known or considered possible occurrences in the Project area (Appendix I). The findings of the assessment are discussed in Section C4.3.

Club-leaved Phebalium (*Phebalium obcordatum*), listed as rare in *Rare or Threatened Australian Plants* (ROTAP) (Briggs and Leigh, 1996), was recorded at Site 39a on the natural gas pipeline route. At Site 39a, *P. obcordatum* occurs in a heath understorey in a community dominated by Mugga Ironbark (*E. sideroxylon, E. viridis* and *E. dwyeri*) in undulating country on poor soils near the top of the divide between the Lachlan and Macquarie River Valleys. Only one population was found, numbering less than ten plants.

The Myall (*Acacia pendula*) alliance recorded along the West Wyalong to Condobolin Road was considered by Bower and Kenna (2000) to be significant roadside vegetation as it contains vegetation that is poorly conserved in large conservation reserves in the wheat belt of NSW.

Bower and Kenna (2000) also considered that remnant vegetation along the Ootha to Fifield Road in the vicinity of Sites 9 to 11a to be significant roadside vegetation as it contains well-developed box-pine woodland with good species diversity and relatively few weeds.

C3.4 FAUNA

C3.4.1 Fauna Surveys

The natural gas and water supply pipelines were surveyed for avifauna, mammals (excluding bats), reptiles and amphibians by Mount King Ecological Surveys (2000) in November 1999 and the borefields in March 2000 (Appendix JA). Greg Richards and Associates surveyed these areas for bats in October 1999 and March 2000 (Appendix JD).

Sites were selected within the Project area to survey terrestrial fauna and conduct targeted searches for threatened fauna.

Mount King Ecological Surveys (2000) employed a variety of techniques to survey the terrestrial fauna of the study area. Elliott traps, pit traps, hair tubes, spotlighting, searches for herpetofauna, nocturnal call playback and general observations were employed to survey the fauna of a tract of woodland on the "Sunrise" property in the vicinity of the natural gas pipeline.

Active searches, spot surveys and general observations of terrestrial fauna were made along the natural gas pipeline, water supply pipelines and borefields. Calls of amphibians were recorded and analysed.

Habitat assessments utilising transects and visual observations were also undertaken by Mount King Ecological Surveys (2000) and the methodology is detailed in Appendix JA.

Greg Richards and Associates (2000) surveyed the bat fauna and utilised the following strategy:

- preliminary assessment of bat habitat in the area; and
- bat fauna survey (electronic bat detectors).

C3.4.2 Fauna Survey Results

A summary of the Mount King Ecological Surveys (2000) terrestrial fauna survey results is provided in Table C3-2. Detailed species lists are provided in Appendix JA.

Table C3-2
Terrestrial Fauna Survey Results[2]

Fauna Type	Natural Gas Pipeline[1]	Water Supply Pipeline	Borefields
Birds	60	40	3
Mammals	7	5	0
Reptiles	7	4	0
Amphibians	5	0	0
Total	**79**	**49**	**3**

1 The survey area included a large tract of woodland on the "Sunrise" property, to the south of the MPF site (Sites S1, S2 and S3 on Figure C3-5a). The position of the pipeline was subsequently moved to avoid this tract of woodland.

2 Mount King Ecological Surveys (2000)

Of the ten mammals recorded by Mount King Ecological Surveys (2000) in the vicinity of the natural gas pipeline, water supply pipeline and borefields, five were native and five were introduced (Appendix JA).

Twenty-one bird species were recorded within the vicinity of the natural gas pipeline and the water supply pipeline and included the Darter, Wood Duck, Crested Pigeon, Galah, Eastern Rosella, Willie Wagtail and Australian Magpie. Two nocturnal bird species, *viz*. the Barking Owl and Barn Owl were recorded in the vicinity of the natural gas pipeline.

Reptiles recorded in the study area included Monitors, Skinks, the Shingleback Lizard and the Eastern Long-necked Turtle.

Amphibians recorded in the vicinity of the natural gas pipeline include the Common Eastern Toadlet, Eastern Banjo Frog, Spotted Grass Frog, Giant Banjo Frog and Long-thumbed Frog.

Greg Richards and Associates (2000) recorded eleven bat species within the natural gas pipeline, water supply pipeline and borefields and surrounds during the surveys (Appendix JD).

The habitat assessment conducted by Mount King Ecological Surveys (2000) considered the following areas of remnant vegetation in Table C3-3 to be of high habitat value (Figure C3-5a for site locations).

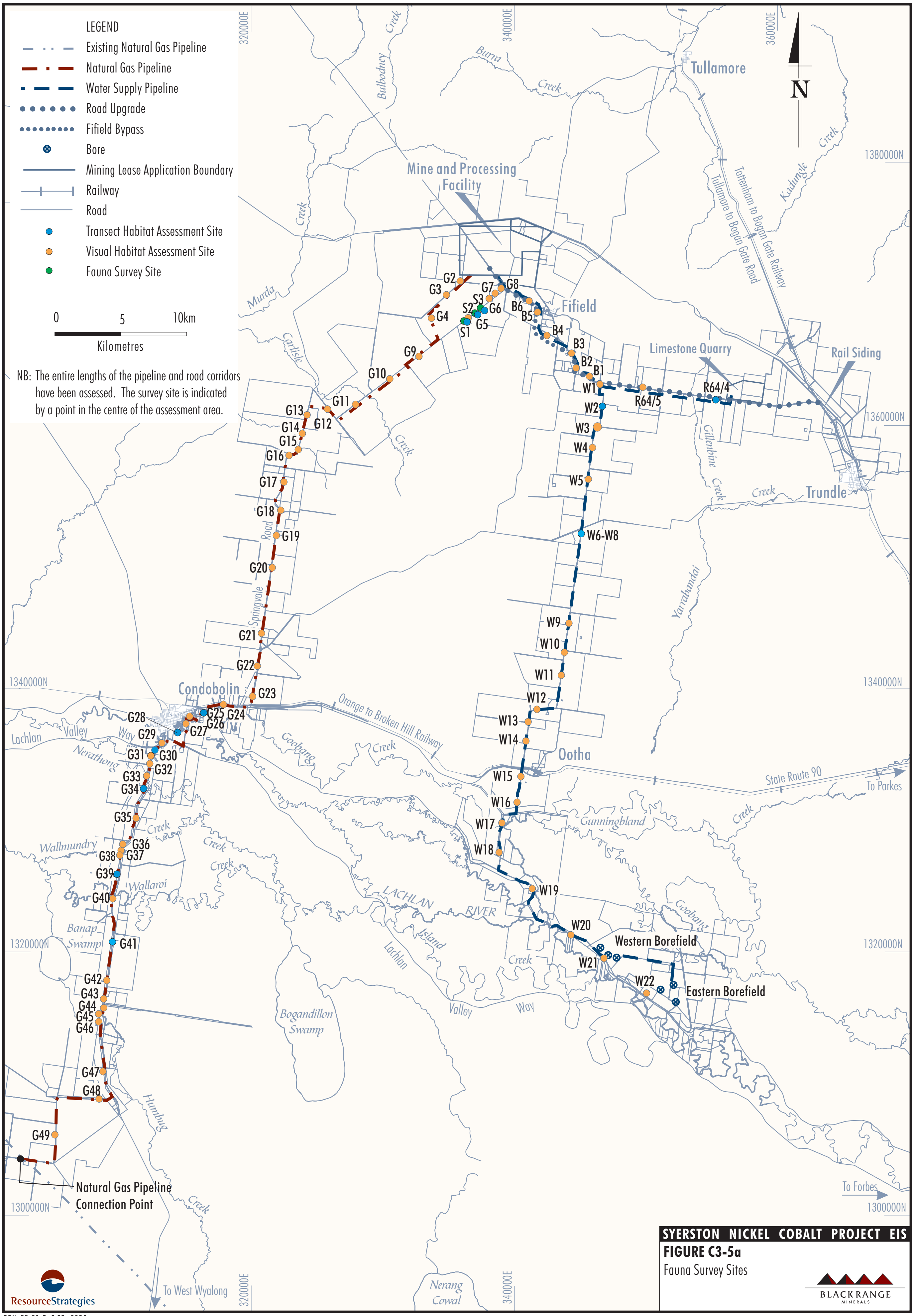

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FIGURE C3-5a

Fauna Survey Sites

Resource Strategies

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Table C3-3
Remnant Vegetation of High Habitat Value

Infrastructure Component	Site Location (Figure C3-5a)	Description
Natural Gas Pipeline	G20	Continuous strip of woodland on the Springvale Road
	G34	Stand of trees on Nerathong Creek
	G38	Stand of trees on Wallamundry Creek
	G40	Trees on Wallaroi Creek
	G46	Trees on Humbug Creek
	G47	Shrubs along Main Road 61 North
Water Supply Pipeline	W2	Line of tree along Shire Road 66
	W6-W9	Line of trees along Shire Road 66 (between "Pleasant View" and "Kars")
	W13	Patch of woodland with mature trees on road near "Tilga"
	W17	Trees beside Goobang Creek
	R64/4	Narrow line of trees along the Fifield to Trundle Road
	R64/5	Scattered mature trees along the Fifield to Trundle Road
Borefields	No areas at the borefields were considered to be of high habitat value	

Section C4.4 discusses potential impacts and mitigation measures of the natural gas pipeline, water supply pipeline and borefields on fauna.

C3.4.3 Significant Fauna Species

Six fauna species listed as threatened under the NSW *Threatened Species Conservation Act, 1995* were recorded during the surveys, *viz*. the Pied Honeyeater (*Certhionyx variegatus*), Barking Owl (*Ninox connivens*), Major Mitchell's Cockatoo (*Cacatua leadbeateri*), Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*), Little Pied Bat (C*halinolobus picatus*) and Greater Longeared Bat (*Nyctophilus timoriensis*) (Appendices JA and JD).

Three threatened bird species were recorded within the woodland surveyed on the "Sunrise" property outside of the pipeline corridor. The three threatened bat species were recorded at the locations shown in Figure C3-5b.

The survey suggested that cropland, pasture land and habitat with few scattered trees were of low habitat value to threatened bat species. *C. picatus* occupied a greater range of habitats than did *S. flaviventris* and *N. timoriensis*, the latter only recorded in a tract of undisturbed forest. *S. flaviventris* and *N. timoriensis* appeared to prefer to forage in high quality habitat only.

Eight Part Tests of Significance have been conducted for 21 threatened species known or considered likely to occur in the Project area and surrounds (including the six threatened species recorded during the surveys) (Appendices JB, JC and JD). The findings are discussed in Section C4.4 of the EIS.

C3.5 AIR QUALITY

No quantitative studies have been undertaken to assess existing air quality for the natural gas and water supply pipeline or for the borefields.

Ambient air quality, however, would be determined by local land management activities (eg. farming and road traffic). Particulate matter and dust would be expected to represent the majority of foreign material found in ambient air.

C3.6 ACOUSTICS

No site specific background noise assessment was undertaken for the natural gas and water supply pipeline or the borefields.

Existing background noise levels would not be expected to exceed those typically measured in most rural settings due to the remote, and mostly rural location of the study area.

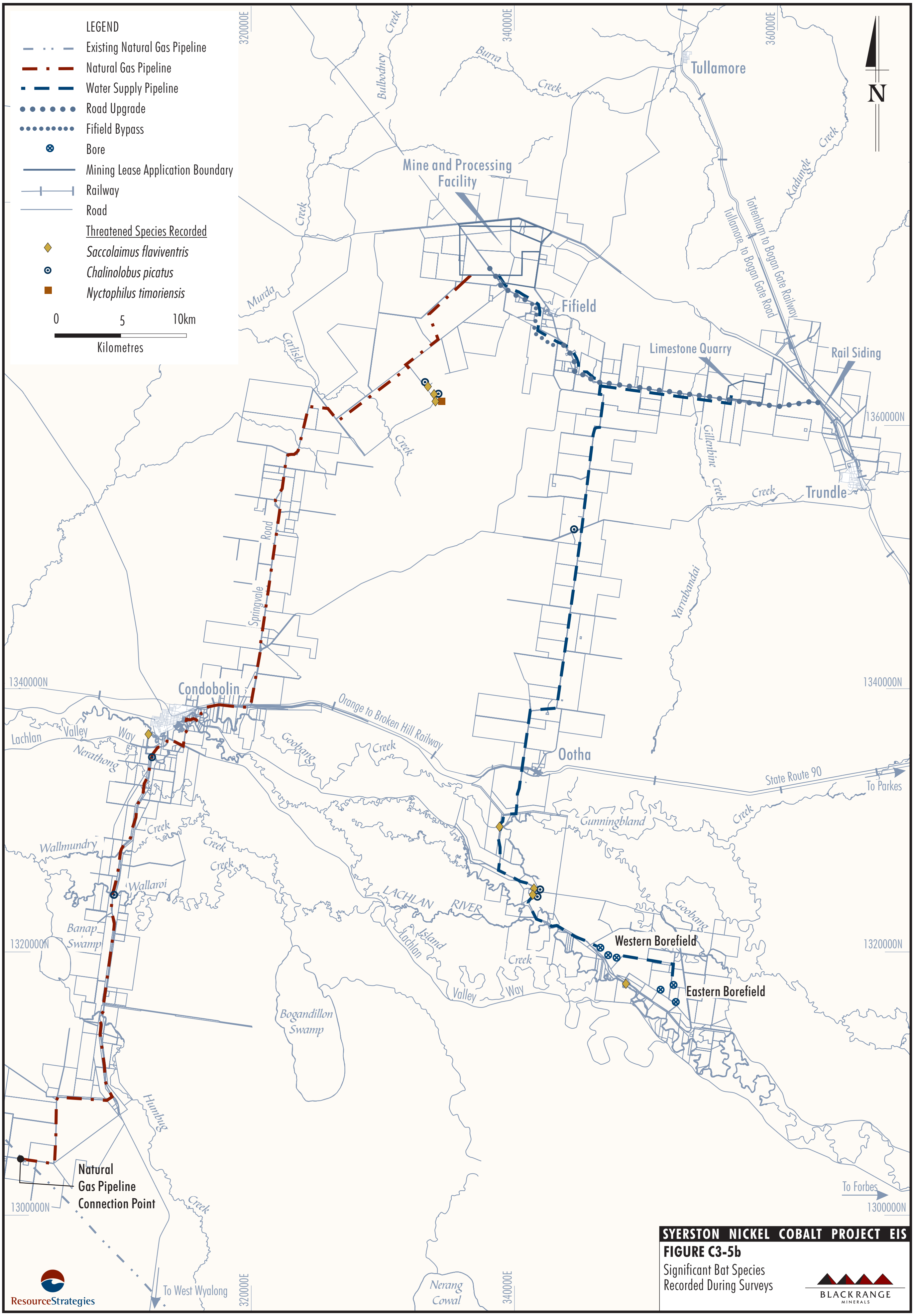

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FIGURE C3-5b

Significant Bat Species Recorded During Surveys

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C3.7 ABORIGINAL HERITAGE

Assessment of the Aboriginal heritage of the Project area has been undertaken by Archaeological Surveys and Reports (2000) (Appendix L). The assessment of the natural gas pipeline, water supply pipeline and borefields was undertaken with the assistance of a representative of the Condobolin LALC and the Wiradjuri RALC (December 1999 and April 2000 survey).

A general description of the Aboriginal population prior to European settlement is provided in Section A3.7.

In order to determine the archaeological significance of the Project area and surrounds, archaeological surveys and assessments were undertaken focussing on the natural gas pipeline, water supply pipeline, eastern and western borefields and linking pipeline.

Natural Gas Pipeline

A search of the NSW NPWS Aboriginal Sites Register found two sites within proximity to the natural gas pipeline, namely a carved tree (#35-4-0001 on Figure C3-6) and an open camp site at Humbug Creek (#43-1-0003 on Figure C3-6). The carved tree was moved to the Condobolin Community Centre in June 1981.

Nine additional sites were recorded along or in the vicinity of the natural gas pipeline route. Figure C3-6 shows the alignment of the natural gas pipeline, the known archaeological sites and the archaeological sites recorded during the assessment. A summary of the findings of the survey is presented in Table C3-4.

A discussion of the recommendations for site management is provided in Section C4.7 and Appendix L.

Water Supply Pipeline

A search of the NSW NPWS Aboriginal Sites Register found that only two sites had previously been recorded in the vicinity of the water supply pipeline. Both sites are carved trees (sites #43-1-0010 and #43-1-0009 on the Aboriginal Sites Register) and are shown on Figure C3-6.

No new sites were recorded along the proposed water supply pipeline route during the assessment.

Borefields and Pipeline Link

A search of the NSW NPWS Aboriginal Sites Register found that no sites have been recorded in the vicinity of the borefields. No sites were recorded during the assessment within the borefields area.

C3.8 EUROPEAN HERITAGE

An assessment of European heritage for the study area was undertaken by Heritage Management Consultants in December 1999 and March 2000.

A general description of the European history of the Project area is provided in Section A3.8.

Natural Gas Pipeline Route

One site of local historical interest and one of local heritage significance were located within the natural gas pipeline route.

At two sites within the natural gas pipeline corridor along the Springvale Road and the Condobolin to West Wyalong Road, a series of old pine telephone poles of local historical significance were identified (Figure C3-7).

A pine log structure was also identified south of the proposed natural gas pipeline alignment (Figure C3-7). The “log cabin” type structure stands 6 logs high with the northern wall completely removed. The structure is either a sheepfold or a hut and has a Currajong tree growing within the hut. The history of this structure is not known, however, it is likely to be older than 50 years and therefore a relic under the *Heritage Act, 1977* and assessed as having local heritage significance.

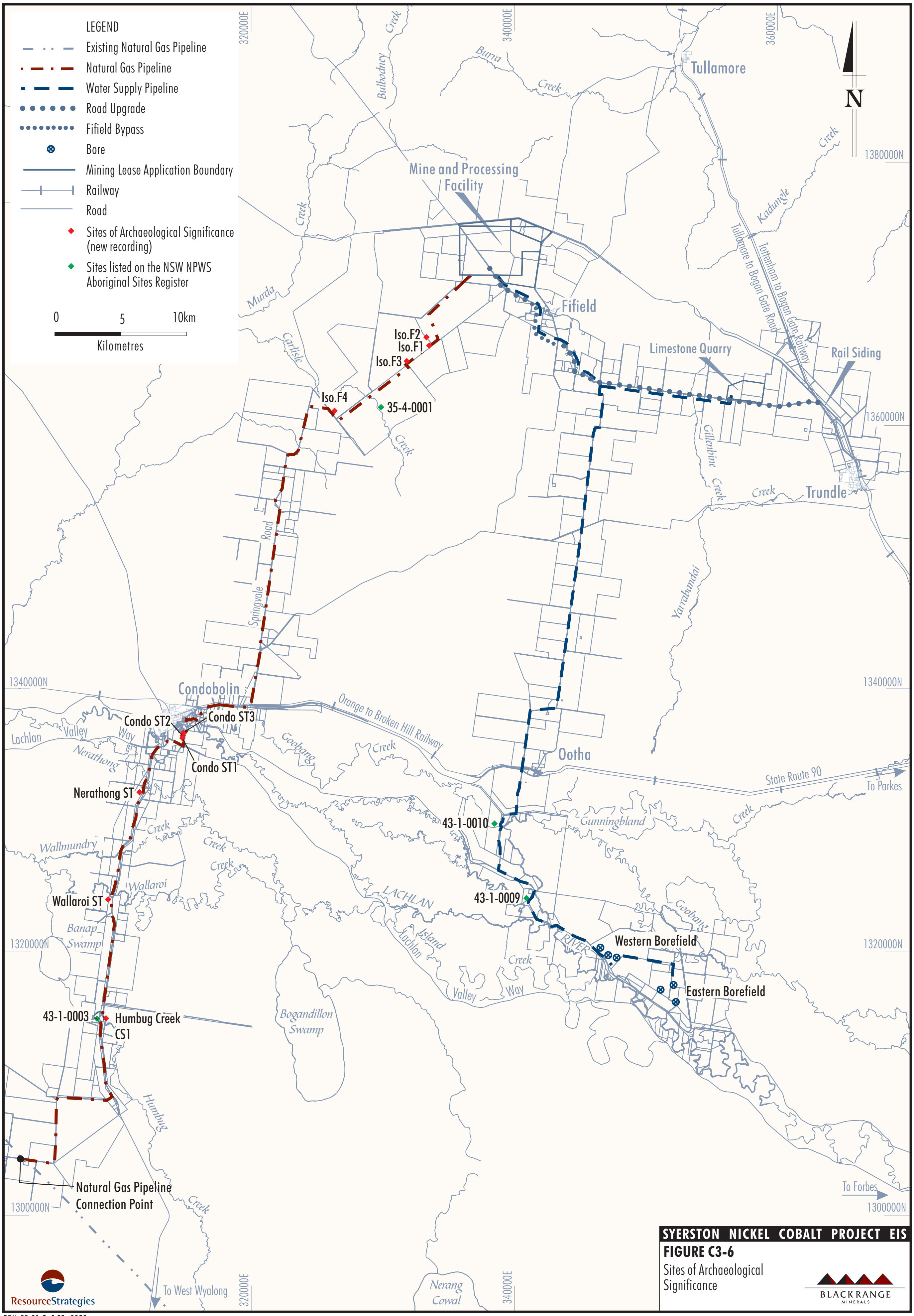

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FIGURE C3-6

Sites of Archaeological Significance

BLACK RANGE MINERALS

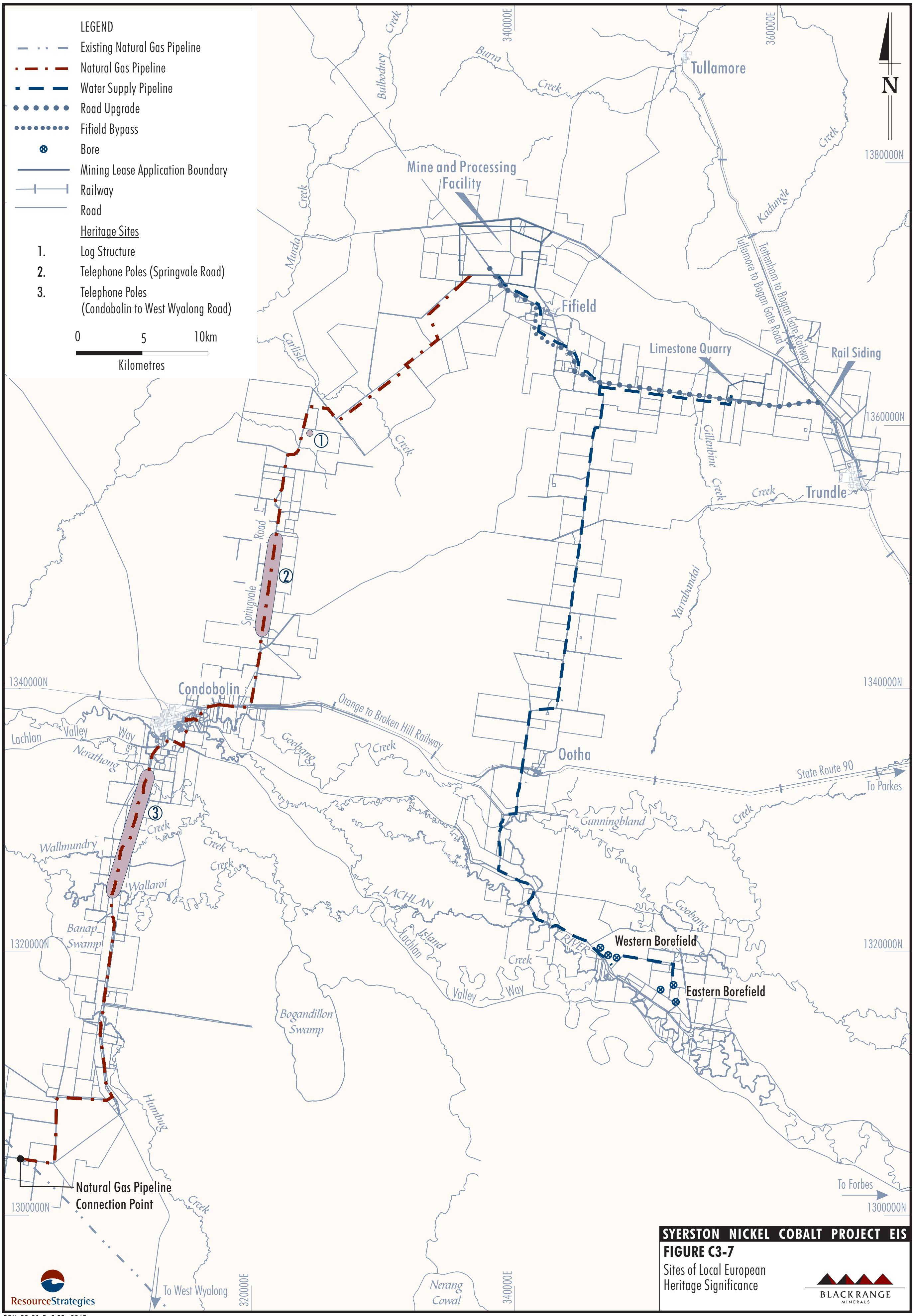

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FIGURE C3-7
Sites of Local European Heritage Significance

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BLACK RANGE MINERALS

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Table C3-4
Summary of Archaeological Sites Recorded

Site Name	Site Type	Description
Iso.F1	Isolated artefact	An isolated flake of silcrete with possible use/wear
Iso.F2	Isolated artefact	An isolated flake of black chert
Iso.F3	Isolated artefact	An isolated large flake of quartzite
Iso.F4	Isolated artefact	An isolated flake (split cone) of quartzite
Condo ST1	Scarred tree	A scarred tree
Condo ST2	Scarred tree	A scarred tree ‘mutilated’ by many random steel axe cuts
Condo ST3	Scarred tree	A scarred tree which has three scars, two of which appear to have been made by deliberate bark removal, and the third, which may or may not be natural
Nerathong ST	Scarred tree	A scarred tree
Wallaroi ST	Scarred tree	A scarred tree
Sites Previously Recorded		
Humbug CS1 43-1-0003[1]	Camp site	An extensive camp site and scarred tree
Lara, Boxdale 35-4-0001[1]	Carved tree	A carved tree in the vicinity of the natural gas pipeline
Edol’s Station 43-1-0010[1]	Carved tree	A carved tree in the vicinity of the water supply pipeline
Coobong, Mulguthrie 43-1-0009[1]	Carved tree	A carved tree in the vicinity of the water supply pipeline

Source: Archaeological Surveys and Reports (2000)
1 NSW NPWS Aboriginal Sites Register Number

Water Supply Pipeline Route

No sites of interest or significance were identified within the road reserve along which the pipeline would run.

Water Supply Borefields

The exact location of the borefields had not been finalised at the time when field assessment was undertaken. The existing test bore locations and the general area between them was surveyed. There are no sites of historical interest near them. Given that the general borefields area is open paddocks with no evidence of homestead or shed developments not currently occupied, there would be little likelihood of sites of historical interest being located there (Appendix M).

C3.9 SOCIO-ECONOMICS

Assessments of the existing social and economic climate of the Project area have been undertaken (Part A Sections 3.9 and 4.9) and are included as Appendices G and H of this EIS (respectively).

C3.10 TRANSPORT

A traffic impact assessment report (Appendix C), prepared by Masson Wilson Twiney (2000), provides details of the existing road network and traffic volumes associated with the Project area. These are summarised in Section A3.11 of the EIS.

SECTION C4 - POTENTIAL IMPACTS AND MITIGATION MEASURES

NATURAL GAS PIPELINE, WATER SUPPLY PIPELINE AND BOREFIELDS

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SEPTEMBER 2000
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C4 POTENTIAL IMPACTS AND MITIGATION MEASURES

C4.1 LAND RESOURCES

C4.1.1 Soils and Erosion Potential

Potential Impacts

Potential environmental impacts relating to soils and their erosion potential are dependent on the following:

- topography of the land traversed by pipelines;
- erosion status;
- drainage;
- slope stability; and
- excavation material (ie. presence or absence of rock).

There is potential for erosion downslope of and in disturbance areas during the construction phase.

Mitigation Measures

Construction activities would be designed to minimise disturbance areas and the potential for erosion and sediment movement with rehabilitation being undertaken as soon as practicable following completion of construction.

Sediment and runoff controls such as silt fences and hay-bale baffles would be installed in road verges and downslope of disturbance areas prior to construction works commencing.

Disturbance areas would be stick-raked, slashed or otherwise cleared such that seed/root stock is left in the ground and surface soils are disturbed as little as possible.

Erosion and sediment control would be further addressed in the CEMPs for the natural gas and water supply pipelines and the borefields (Section C6).

C4.1.2 Land Contamination Potential

Potential Impacts

During construction, liquids such as diesel, paints and herbicides may be stored at locations along the pipeline corridors or at the borefields.
Spillage of these liquids could potentially result in localised environmental impacts.

Mitigation Measures

All waste generated by construction works would be removed from site to facilities authorised to accept such materials.

Fuels and other liquid consumables would be stored and handled in accordance with Australian Standards where applicable.

Should a spill of a contaminant occur, the site would be remediated to the satisfaction of the relevant authority. Relevant control measures would be detailed in the CEMPs.

C4.1.3 Bushfire Hazard

Potential Impacts

During construction of the pipelines, welding splatter could potentially cause small fires.

Once constructed, the buried pipelines would not be susceptible to bushfires. However, above ground borefield and pipeline infrastructure (eg. scraper stations, transfer pumps and telemetry station) could be susceptible to bushfires.

Mitigation Measures

The proposed natural gas pipeline would mainly lie within road corridors and property boundaries, while the water supply pipeline would be located exclusively within road corridors. Therefore, only small isolated strips of vegetation are located throughout the study area. These extensively cleared areas within the Project area present a low fire risk.

Fire prevention would be addressed in the CEMPs.

The borefield infrastructure and above ground infrastructure on the natural gas and water supply pipelines would be kept clear of vegetation to minimise the risk from bushfires.

C4.2 WATER RESOURCES

C4.2.1 Surface Water

Potential Impacts

Surface water runoff from disturbed areas associated with pipeline and pumping infrastructure construction could potentially contain sediments or traces of contaminants (eg. diesel). In addition, where pipelines cross watercourses, there is increased potential for erosion, sedimentation or contamination.

During the operation phase, potential surface water impacts include sedimentation or water quality impacts upon surface waters associated with rupture of the water pipeline and the loss of contained groundwater to watercourses.

Mitigation Measures

Construction

Construction surface water management measures would include:

- minimisation of the area of disturbance and progressive rehabilitation as soon as practicable after the completion of works; and
- installation of temporary sediment retention ponds and silt fences as interim erosion and sediment control measures.

At major watercourse crossings, the natural gas pipeline would be bored under the stream channel and water supply pipeline would be suspended above streams on elevated structures. These construction methods would minimise disturbance to the stream banks and channels.

As discussed in Section C4.1.1 and C4.1.2, sediment and erosion control measures and contamination control measures would be detailed in the CEMP.

Operation

During operation, the water supply pump system would be fitted with an automatic, pressure sensitive shutdown system to rapidly cease pumping in the event of pipeline rupture. Loss of contained water would therefore be generally limited to waters contained in the pipeline and upslope from the pipeline break.

Section C3.2.2 describes the groundwater quality in the western and eastern borefields. In summary, the water has low salinity, is slightly alkaline and has low metal concentrations and moderately elevated nutrient levels. In the event of a pipeline rupture, groundwater from the water supply pipeline would be unlikely to have a significant impact on surface water quality.

C4.2.2 Groundwater

A hydrogeological assessment was carried out on the unconsolidated alluvial sediments of the Lachlan River Valley in central NSW to assess the potential impacts of the groundwater extraction for the Project over a period of 30 years (Appendix E). As a result of consultation with the DLWC, potential drawdown effects were modelled using two different methods. In terms of potential drawdown, Model 1 is considered to be the “worst case” scenario and Model 2 the “best case”. The results of this modelling are summarised below. The study area comprised the broad alluvial flats between Jemalong Gap and Bogandillon Gap and southwards to the southern sections of the Bland Creek system.

Potential Impacts

In summary, the potential impacts of the borefields on local and regional groundwater regimes include:

- a depletion of the aquifer during the extraction period due to a proposed maximum extraction rate of 200 L/s which is greater than the aquifer’s recharge rate;
- a predicted drawdown of about 3-4 m after 30 years of extraction around the aquifer boundaries in Model 1 and up to 0.5 m with Model 2. The water level drawdown in the vicinity of the production borefields after 30 years is predicted to be approximately 3.5 m to 14 m;
- variable impacts on shallow bores in the Cowra Formation dependent on the depth of bore screens and their proximity to the Syerston borefields;
- increased recharge from the Lachlan River to the groundwater system which may result from pumping in the borefields;
- a lowering of the groundwater mound beneath Jemalong-Wyldes Plains;

- a reversal of groundwater flow direction near the groundwater mound beneath Jemalong-Wyldes Plains, resulting in restoration of the original groundwater flow path northwards from the Bland Creek Palaeochannel to the Lachlan River Palaeochannel;
- a decrease in groundwater levels in deeper aquifers of the Lachlan River valley resulting in induced vertical infiltration from shallow aquifers; and
- an additional 1 m to 5 m (Model 1) groundwater level drawdown in the proposed Cowal Gold Mine production borefield (located approximately 25 km south of the Syerston borefields).

As Lake Cowal, Nerang Cowal and Bogandillon Swamp are generally hydraulically isolated from the Lachlan aquifer system, it is predicted that they would not be affected (Appendix E).

Figure C4-1 illustrates schematically how the predicted drawdown effect would decrease with distance from the borefield.

Mitigation Measures

Hydrogeological conditions would be monitored at the borefields as part of a proposed Borefields Management Plan (Section C6).

The number and location of the monitoring piezometers would be determined in consultation with the relevant government authorities. Should disruption to surrounding bores occur, due to water table drawdown, then ameliorative measures such as bore reconditioning, lowering existing pump sets and/or refitting would be undertaken.

In order to minimise impacts on groundwater reserves and surrounding bores, six month sequential pumping of each alternate borefield is proposed. This is expected to reduce the impact on groundwater levels at each extraction area. Two bores in each field of three bores would be actively pumping. To reduce mutual interference effects, the holes furthest apart in each field would be the primary production bores. Typically, the “standby” bore would be located between the primary pumping bores and would only be activated in the event of breakdown or scheduled maintenance on the alternate production bore.

C4.3 FLORA

A description of the flora of the natural gas pipeline, water supply pipeline and borefields and surrounds is presented in Appendix I and summarised in Section C3.3.

C4.3.1 Potential Impacts

Vegetation Disturbance

Construction of the natural gas and water supply pipelines and borefields would require the removal/modification of vegetation. The borefields and northern section of the natural gas pipelines would be located on private property, which has been cleared for agricultural activities. Accordingly, construction of the natural gas pipeline, water supply pipeline and borefields would require minimal vegetation clearance due to their placement primarily in previously cleared areas. The remainder of the natural gas and water supply pipelines would be situated within predominantly cleared existing road corridors, although some clearance of remnant vegetation may be required.

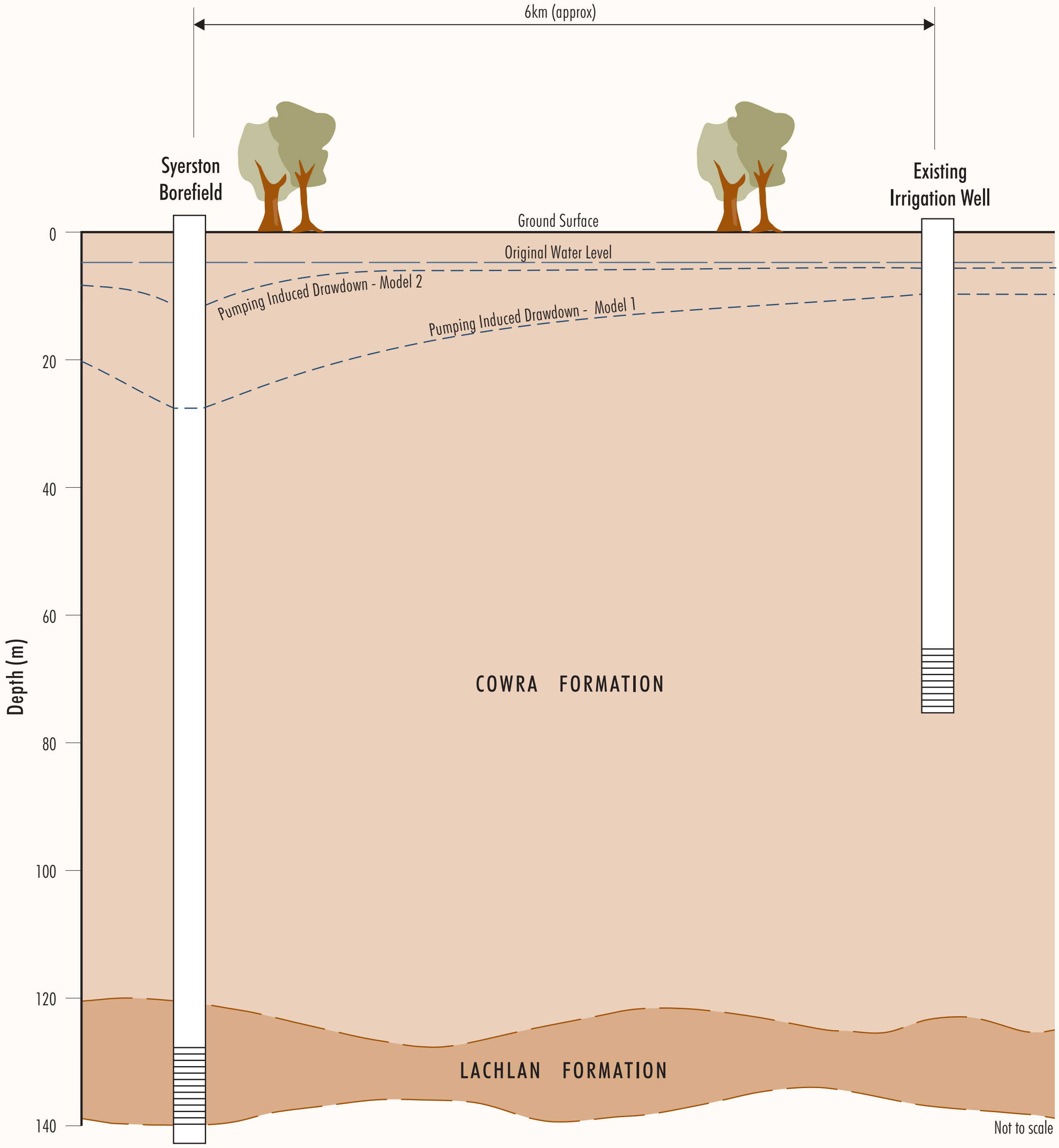
Weeds

The presence and possible introduction of weed species poses a potential threat to native plant species by reducing floristic structures and diversity. The land disturbance activities associated with the construction of the natural gas pipeline, water supply pipeline and borefields has the potential to act as a catalyst for weed incursion.

Significant Flora

While no threatened flora species listed in the *Threatened Species Conservation Act, 1995* were identified by Bower and Kenna (2000) during the surveys of the natural gas pipeline, water supply pipeline and borefields, the Austral Pillwort (*P. novae-hollandiae*) has previously been recorded in the vicinity of Site 23 on the natural gas pipeline (Bower, unpublished report).

Although not threatened under the *Threatened Species Conservation Act, 1995*, the Club-leaved Phebalium (*P. obcordatum*) recorded at Site 39a on the water supply pipeline route is considered to be rare by Briggs and Leigh (1996) *Rare or Threatened Australian Plants*.



Source: Coffey Geosciences (2000)

SYERSTON NICKEL COBALT PROJECT EIS

FIGURE C4-1

Drawdown at the Borefields and Surrounding Areas

BLACK RANGE MINERALS

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In addition, Bower and Kenna (2000) considered the following areas to contain areas of significant roadside vegetation:

- the West Wyalong to Condobolin Road which retains a significant sample of the Central Lachlan Valley flora particularly the Myall (*Acacia pendula*) alliance; and
- the Ootha to Fifield Road in the vicinity of Sites 9 to 11a which support well developed box-pine woodland containing good species diversity with relatively few weeds.

The significant flora described above could potentially be impacted by the clearance activities along the pipeline routes.

C4.3.2 Mitigation Measures

The measures outlined below would be adopted in order to mitigate potential impacts on flora associated with the construction of the natural gas and water supply pipelines and borefields.

- Clearance of trees or shrubs to be avoided, wherever practicable. BRM propose to replant two trees for every tree removed as a result of pipeline development.
- Retention, wherever feasible, of mature remnant trees.
- Where practicable, construction laydown areas to be located on already disturbed sites and care to be taken with vehicles and earth moving equipment to avoid unnecessary disturbance.
- Vegetation clearance protocols to be adopted during construction. The protocols would include, but would not be restricted to: progressive clearing where practicable, maximum harvesting of cleared timber resources, recycling or disposal of other non-harvestable parts and delineation of "management zones" such as those listed below.
- Avoidance of gilgai areas at Site 23 on the natural gas pipeline route when constructing the pipeline to prevent potential damage to the local population of the threatened Austral Pillwort.
- Protection of the population of the Club-leaved Phebalium at Site 39a on the natural gas pipeline would be protected, if practicable by minimising vegetation disturbance.
- Particular caution to be undertaken on the West Wyalong to Condobolin Road and the Ootha to Fifield Road to minimise impacts on valuable Myall (*Acacia pendula*) alliance communities on the natural gas pipeline route and significant remnants of box-pine woodlands from Sites 9 to 11a on the water supply pipeline route.

C4.4 FAUNA

A description of fauna (including habitat) on the pipeline routes and borefields is presented in Appendices JA and JD and summarised in Section C3.4.

C4.4.1 Potential Impacts

Habitat Disturbance

Construction of the natural gas pipeline, water supply pipeline and borefields may necessitate the removal of some trees and middle and lower storey vegetation and has the potential to reduce habitat opportunities for fauna. Mount King Ecological Surveys (2000) identified several areas along the natural gas and water supply pipeline routes to be of high habitat value (refer Section C3.4.2).

The natural gas pipeline and water supply pipeline would predominantly be located within the cleared section of the road reserve and would be positioned to minimise vegetation clearance, where practicable.

Creation of Barriers to Movement

The removal of vegetation from areas identified to be of high habitat value during construction and maintenance of the pipelines could create "gaps" in the linear habitat (corridor) provided by the road reserve vegetation.

Often such a gap may not be important. Birds and larger arboreal mammals can still travel along the corridor without too much exposure to predators. However, smaller animals (eg. reptiles) require ground cover to avoid predation.

In the case of both pipeline routes, disturbance during construction would be temporary. As soon as the pipeline is laid, the disturbed area would be covered with the original topsoil and re-growth of vegetation would be expected. As much of the route covered by the pipeline is open land, and several of the areas of timber contain small tracks and clearings, it is unlikely that the relatively narrow clearing required for the pipelines would result in significant barriers to animal movement.

Temporary Creation of Trenches

A trench approximately 2 m deep would be constructed to accommodate the natural gas and water supply pipelines and it is anticipated that the trench could remain open for a period of several days before the pipe is buried.

The open trench has the potential to act as a "pit trap" for ground fauna moving across the pipeline routes (Ayers and Wallace, 1997). Large animals (eg. kangaroos and wallabies) could potentially be injured falling into the trench, whilst smaller animals may be trapped in the trench.

Fauna and Dust/Noise Emissions

Dust and noise generated from construction activities associated with the natural gas pipeline, water supply pipeline and borefields has the potential to impact upon fauna in the vicinity of the works. Given the temporary nature of the construction, the activities are considered unlikely to have a significant impact on nearby fauna. Further discussion on the effect of noise on fauna is provided in Section A4.6.

Significant Fauna

Eight Part Tests of Significance (Appendices JB and JD) were completed for 21 threatened fauna species known to occur or considered to possibly occur in the Project area. Based on the information presented in the Eight Part Tests and the mitigation measures in respect of flora (Section C4.3.2) and fauna (Section C4.4.2), it was determined that no threatened fauna species would be significantly affected by the construction of the natural gas pipeline, water supply pipeline or borefields to the extent of undermining the viability of a local population of that species.

C4.4.2 Mitigation Measures

The following measures would be adopted in order to mitigate the potential impacts on fauna associated with the construction of the natural gas pipeline, water supply pipeline and borefields.

- Where practicable, pipelines to be positioned in the cleared section of the road reserve to minimise disturbance to trees and shrubs.
- The pipeline corridors to be kept as narrow as possible.
- Trees of high habitat value (eg. large, hollow bearing) to be avoided, where practicable. A pre-construction survey of the pipelines to highlight trees worthy of retention.
- In the case of creek crossings, large habitat trees in the vicinity of the proposed crossing to be identified and avoided where practicable. Erosion and sediment controls to be implemented at creek crossings.
- Inspection of large trees for fauna prior to removal and the relocation of any animals (and bat colonies) found to alternative suitable habitat.
- Care to be adopted in the areas considered to be of high habitat value identified by Mount King Ecological Surveys (2000) during pipeline construction.
- Following construction, the disturbance areas to be rehabilitated with native grasses and forbs, creating ground cover for small fauna.
- The planting of endemic shrubs and trees within the road reserve to replace trees and shrubs removed. BRM propose to replant two trees for every tree removed as a result of pipeline development.
- The pipeline trenches be left exposed for as short a period as possible.
- The ends of trenches be ramped to allow larger sized fauna to escape.
- A member of the construction crew be made responsible for inspecting daily and if necessary clearing the trench of any fauna prior to the pipe being lowered.

- Constructing temporary fencing along the exposed trench (eg. with shade cloth or silt fabric) has successfully been adopted elsewhere and could be considered for the high habitat areas identified in this study.

C4.5 AIR QUALITY

Potential Impacts

The construction and operation of the natural gas and water supply pipelines and the borefields is not anticipated to introduce any major sources of air pollutants to the area, although minor dust emissions from disturbance areas during construction may occur.

Mitigation Measures

As the need arises dust suppression measures (eg. watering of disturbance areas) would be implemented. Progressive rehabilitation would also contribute to dust impact minimisation.

Vehicle emissions are expected to occur for a short period of time during the construction phase and are unlikely to have a significant impact on air quality.

Dust suppression, erosion control and vegetation clearing would be addressed in the CEMP.

C4.6 ACOUSTICS

Potential Impacts

Vehicles and plant operating along the natural gas and water supply pipeline corridors would generate noise during construction.

Proposed Mitigation

The temporary nature of the expected noise and the remote location of the majority of the pipeline routes and borefields mean that increased noise levels are unlikely to result in any significant impact.

C4.7 ABORIGINAL HERITAGE

Potential Impacts

An archaeological assessment of the natural gas and water supply pipelines and borefields area was undertaken by Archaeological Surveys and Reports (2000) (Appendix L).

This assessment was undertaken with the assistance of a representative of the Condobolin LALC and the Wiradjuri RALC. Thirteen sites were recorded within the area during the survey component of the assessment.

Natural Gas Pipeline

Two of the 13 recorded sites are located within the proposed natural gas pipeline corridor, *viz.* an isolated artefact (Iso.F1) and a camp site on Humbug Creek (Humbug CS1).

Artefact Iso.F1 (Figure C3-6) is likely to be destroyed through construction of the pipeline.

The camp site on Humbug Creek (Figure C3-6) is of high cultural significance and research potential. It is located within the pipeline corridor and could potentially be disturbed.

Water Supply Pipeline

No sites of archaeological significance were located within water supply pipeline corridors.

Borefields

No sites of archaeological significance were recorded in the vicinity of the borefields.

Mitigation Measures

Natural Gas Pipeline

A written agreement would be obtained from the Condobolin LALC or the Wiradjuri RALC for the destruction of Iso.F1 and an application for a Consent to Destroy lodged with NPWS.

Disturbance of the Humbug Creek site (CS1) is largely avoidable by locating the natural gas pipeline in the area already disturbed between an existing bridge and side track.

Mitigation measures for the site would comprise:

- pipeline to cross the creek within existing disturbed areas (ie. a strip from 10 m to the west of the existing bridge to 5 m east of the existing side track);
- pipeline to be laid within the existing "graded" profile of the road for at least 75 m south to 50 m north of the bridge; and
- highly visible temporary flagging to be erected to delineate the working area.

A representative of the Condobolin LALC or Wiradjuri RALC would be in attendance to monitor any earthworks for the pipeline within the area 75 m south and 50 m north of the bridge.

General Mitigation Measures

Earthmoving operators and contractors would be obliged to comply with the *National Parks and Wildlife Act, 1974*. If bone or stone artefacts or discrete distributions of shell are unearthed during earthworks, works in the vicinity of the find would cease.

In the event that it becomes necessary to disturb or destroy any archaeological site uncovered by earthworks, a "Consent to Destroy" would be sought from NPWS. Salvage of any such sites would be undertaken by a qualified archaeologist accompanied by a representative of the local Aboriginal community.

Works would not recommence in the immediate area until the find had been inspected and permission given for works to proceed.

C4.8 EUROPEAN HERITAGE

Potential Impacts

Assessment of the European heritage significance of the disturbance areas of the natural gas and water supply pipelines and the borefields have been assessed by Heritage Management Consultants (Appendix M).

A pine log structure of local heritage significance and a series of telephone poles of local historical interest are located within the natural gas pipeline corridor (Figure C3-7). These sites may potentially be disturbed during pipeline construction works.

Mitigation Measures

The old telephone poles would be avoided and left undisturbed wherever possible.

It is proposed that the pipeline be placed no nearer than 15 m from the pine log site, as there is evidence that artefacts may be spread around the site. If it is not possible to keep construction works at least 15 m from the site, the immediate surrounds of the site (ie. 5 m from its centre) would be fenced to protect the site.

C4.9 SOCIO-ECONOMICS

The potential socio-economic impacts of the Project are assessed in Sections A4.11 and A4.12.

C4.10 RISK ASSESSMENT

Potential Impacts

A preliminary hazard assessment was conducted for the Project (Appendix B). The findings relevant to the natural gas and water supply pipelines and borefields are presented below.

The major hazards associated with the proposed pipeline infrastructure are loss of containment from the natural gas pipeline (eg. leaks due to corrosion, mechanical damage) leading to fires or explosions.

This includes the possibility of a vapour cloud explosion resulting from a large leak of natural gas (although such clouds are typically difficult to ignite).

Diesel spills and fires also present a potential on-site risk during construction.

Mitigation Measures

The natural gas pipeline has been routed to avoid sensitive areas, where possible. This includes routing the pipeline around the outskirts of Condobolin. The closest residences to the proposed natural gas pipeline are at a distance of approximately 100 m, with schools and hospitals being more than 2 km away.

The mitigation measures outlined below would be adopted to reduce potential hazards and risks associated with the natural gas pipeline:

- Pipeline to be laid in accordance with the relevant standards and codes (eg. AS 2885, *Pipelines – Gas and Liquid Petroleum*).

  Measures recommended in this standard include burial to avoid damage, corrosion protection features, flow monitoring and fracture control plans (including means of isolation), signage, deep burial and large wall thickness to protect against common digging activities (eg. ploughing, digging, fence post drilling, etc.) and minimisation of joints.

- Provision of efficient fire alarm and fire suppression system for the natural gas pipeline infrastructure.

- Installation of automatic monitoring and shut-down facilities on the pipeline.
- A detailed emergency response plan would be prepared.
- Operator training to reduce the likelihood of spillage of stored material (eg. diesel) during construction.

The measures proposed to mitigate risks to the public have been assessed as being adequate to cover risks associated with public property.

C4.11 TRANSPORT

Potential Impacts

As the natural gas and water supply pipelines are situated within road reserves for the majority of their lengths, construction of the pipelines has the potential to disrupt traffic on these roads.

In addition, the natural gas pipeline crosses the Orange to Broken Hill Railway at the Condobolin to Tullamore Road rail crossing, while the water supply pipeline crosses the same railway to the west of Ootha. Construction of the pipelines has the potential to interrupt rail transport during this period.

Mitigation Measures

Safety and traffic control measures would be implemented during construction of the natural gas and water supply pipelines in accordance with the requirements of relevant road and rail transport authorities.

SECTION C5 - REHABILITATION

NATURAL GAS PIPELINE, WATER SUPPLY PIPELINE AND BOREFIELDS

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RESOURCE STRATEGIES PTY LTD

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C5 REHABILITATION

C5.1 POST CONSTRUCTION REHABILITATION

Rehabilitation would be undertaken in accordance with the Construction Environmental Management Plans (Section C6.2) to be approved by relevant authorities.

C5.1.1 Natural Gas Pipeline and Water Supply Pipeline

The main rehabilitation objectives following construction of these structures are as follows:

- replacement of soil from original location;
- management of weed species;
- management of tree growth; and
- implementation of erosion and sediment control measures.

C5.1.2 Borefields

Rehabilitation would not be warranted post borefields construction however the following management strategies would be implemented:

- control of weed species; and
- implementation of erosion and sediment control measures.

C5.2 DECOMMISSIONING OPTIONS

C5.2.1 Natural Gas Pipeline and Water Supply Pipeline

The following options exist at the decommissioning stage of the pipelines:

- disconnect and leave the pipeline infrastructure for future use (including the possibility of retaining the natural gas pipeline to Condobolin for local use);
- utilise the pipeline for other purposes; and
- dismantle the pipeline and return the area to its former condition.

In addition to these the section of natural gas pipeline between Condobolin and the MPF may be disconnected with ownership transferred to the relevant landowner/authority.

The final options for pipeline decommissioning are dependent on the future landuse requirements of the landowner and local authorities.

C5.2.2 Borefields

The following options exist at the decommissioning stage of the borefields:

- transfer ownership to regional landholders with bores and transfer stations remaining in working condition; and
- dismantle and cap bores, and remove infrastructure (including borehead facilities).

As for final pipeline options, the decommissioning options would be determined in consultation with landowners and relevant authorities.

C5.3 DISMANTLING AND REHABILITATION

C5.3.1 Natural Gas Pipeline and Water Supply Pipeline

If the option to dismantle pipeline infrastructure is selected the following procedures would be followed:

- remove infrastructure and backfill trenches;
- rehabilitate disturbed areas;
- provide for stock, native fauna and human safety; and
- amend titles information and dissolve agreements with affected landowners.

Rehabilitation would be undertaken in accordance with the Closure Plan (Section C6.2) developed in consultation with relevant authorities. Objectives would be to:

- backfill the trenches with soil from the area;
- implement erosion and stabilisation controls at potentially sensitive areas (eg. river crossings);
- reflect the vegetation of the existing environment (ie. pasture and woodland areas to be rehabilitated accordingly); and
- manage weed species.

C5.3.2 Borefields

If the option to dismantle pipeline infrastructure is selected, the following procedures would be followed:

- removal of pumping and electrical infrastructure;
- plugging and capping of bores;
- rehabilitation based on future landuse; and
- amend titles information and dissolve agreements with affected landowners.

Rehabilitation of the borefields and linking pipeline would be undertaken in consultation with immediately affected landowners and relevant authorities and in accordance with the Closure Plan (Section C6.2).

Rehabilitation for the borefield linking pipeline would be as for the natural gas and water supply pipelines and rehabilitation objectives for the borefield would be to:

- reflect the vegetation of the existing environment; and
- manage weed species.

SECTION C6 - ENVIRONMENTAL MANAGEMENT AND MONITORING

NATURAL GAS PIPELINE, WATER SUPPLY PIPELINE AND BOREFIELDS

PREPARED BY
RESOURCE STRATEGIES PTY LTD

SEPTEMBER 2000
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C6 ENVIRONMENTAL MANAGEMENT AND MONITORING

C6.1 INTRODUCTION

This section details the environmental management and monitoring programmes proposed for the natural gas pipeline, water supply pipeline and borefields. The provisional programmes presented below would be developed further in consultation with stakeholders during the assessment phase of the EIS and during formulation of the management plans.

The Environmental Management System (EMS) developed and implemented for the MPF would also encompass environmental management of the natural gas pipeline, water supply pipeline and borefields (Section A6.2). The results of the management and monitoring programmes for the pipelines and borefields would be reported within the Annual Environmental Management Report (AEMR)(Section A6.3.2).

C6.2 ENVIRONMENTAL MANAGEMENT PLANS

C6.2.1 Construction Environmental Management Plan

Prior to the commencement of construction works, individual Construction Environmental Management Plans (CEMPs) would be prepared for the natural gas pipeline, water supply pipeline and borefields. The construction phase encompasses all works associated with the preparation of the site and installation of infrastructure.

The aims of the CEMP would include, but would not be restricted to:

- minimisation of the area of land to be disturbed;
- protection of environmentally sensitive areas (eg. remnant vegetation, drainage patterns);
- native fauna management (eg. inspections of open pipeline trenches for fauna);
- weed control measures;
- recovery and management of soil resources from disturbance areas;
- minimisation of dust and noise impacts;
- water management and surface hydrology (eg. creek crossings);
- Aboriginal and European heritage issues (protection, salvage and monitoring);
- control of erosion and sediment transportation detailed in an Integrated Erosion and Sediment Control Plan (IESCP)
- construction rehabilitation/revegetation measures (Section C5); and
- traffic management.

Each CEMP would be developed in consultation with the relevant government agencies and stakeholders.

C6.2.2 Natural Gas Pipeline Safety and Operating Plan

A Safety and Operating Plan would be prepared for the natural gas pipeline in accordance with AS 2885.3 *Pipelines – Gas and Liquid Petroleum, Part 3: Operation and Maintenance.* The plan would detail the policy of protection of personnel, the public and the environment including measures to:

- protect the pipeline and associated installations;
- promote public awareness of the pipeline;
- operate and maintain the pipeline in a safe manner;
- respond to emergencies;
- minimise product leakage; and
- periodically review the plan.

Audits would be conducted to assess the integrity of the natural gas pipeline, review the operational and maintenance procedures of the pipeline and implement, if necessary, appropriate measures to ensure continuing pipeline integrity.

C6.2.3 Water Supply Pipeline Safety and Operating Plan

A SOP would be prepared for the water supply pipeline prior to the commencement of operation. The plan would detail operating, maintenance, repair, inspection, safety and emergency procedures relevant to the pipelines. The plan would be periodically reviewed and revised as appropriate.

C6.2.4 Borefields Management Plan

The Borefields Management Plan would be formulated to detail the management and monitoring programmes to be implemented during operation of the borefields and would be prepared in consultation with the DLWC.

C6.2.5 Closure Plan

Decommissioning and rehabilitation proposals for the natural gas pipeline, borefields and water supply pipeline would be detailed in a Closure Plan prior to Project completion. Close-out and rehabilitation criteria and the continuation of relevant monitoring programmes would be determined in consultation with key agencies principally through the Mining Rehabilitation and Environmental Management Process (MREMP). Decommissioning and rehabilitation of the natural gas and water supply pipelines and borefields is discussed further in Section C5.

C6.3 ENVIRONMENTAL MONITORING PROGRAMME

C6.3.1 Construction Phase

Regular inspections of the natural gas and water supply pipelines and borefields would be undertaken during construction to assess compliance with the CEMP.

The results of monitoring would be used to formulate necessary ameliorative responses.

C6.3.2 Operational Phase

Infrastructure Inspections

Monitoring of the natural gas pipeline, water supply pipeline and borefields would be carried out in accordance with the natural gas and water supply pipeline SOPs and Borefields Management Plan, respectively.

Borefields Monitoring Programme

The borefields monitoring programme would be conducted in accordance with the Borefields Management Plan. Data collected during the programme would enable review of borefields management and sustainability and verification of EIS modelling. The monitoring programme would include, but not necessarily be limited to:

- a bore census (including collation of all relevant quality, quantity, yield, depth and usage data) of all bores within a 10 km radius of the Project borefields prior to commencement of groundwater extractions;
- daily rainfall at the borefields;
- continuous groundwater level monitoring in production bores and in standby bores;
- quarterly monitoring of pH, EC, redox potential, CO_2, bicarbonate and temperature at the wellhead;
- monthly groundwater level monitoring and bore usage in observation piezometers, including PB-W1, PB-W2 and PB-E1 (Figures C3-1 and C3-3) and in selected regional bores within a 10 km radius of the borefields;
- annual monitoring in ten bores within a 10 km radius of the borefields of water quality from each production bore. Parameters to be monitored may include, but not necessarily be restricted to the following:
  - pH, electrical conductivity, redox potential, temperature and dissolved CO_2 at the time of sampling;
  - suspended solids, total dissolved solids, total alkalinity and methyl orange alkalinity;
  - major cations (Ca, Mg, Na, K) and major anions (Cl, SO_4, F, NO_3);
  - metals including Fe^{2+}, Fe^{3+} and Mn on filtered and acid preserved samples; and

- annual groundwater usage and level monitoring in selected regional bores within a 20 km radius of the borefields.

Figures C3-1 and C3-3 present the production and monitoring bore locations.

C6.3.3 Post Operations Monitoring

The continuation of relevant monitoring programmes would be determined in consultation with relevant agencies and stakeholders. Rehabilitation criteria would be agreed upon with these agencies principally through the MREMP which would include detailed decommissioning and rehabilitation proposals for the natural gas and water supply pipelines and borefields prior to Project completion. Rehabilitation of the natural gas and water supply pipelines and borefields is discussed further in Section C5.

SECTION 7 - REFERENCES

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SECTION 8 - ABBREVIATIONS AND ACRONYMS

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8 ABBREVIATIONS AND ACRONYMS

ACN	Australian company number
AEMR	Annual Environmental Management Report
AHD	Australian Height Datum
Al^{3+}	aluminium ion
Am^3/hr	actual gas flow rate (cubic metres per hour)
AMG	Australian map grid
ANFO	Ammonium Nitrate and Fuel Oil (explosive)
ANZECC	Australian and New Zealand Environmental Conservation Council
approx.	approximately
AQMP	Air Quality Management Plan
ARI	average recurrence interval
AS	Australian Standard
As	arsenic
AUSPLUME	Gaussian plume model
bcm	bank cubic metres
BRM	Black Range Minerals Ltd
Ca	calcium
$CaCO_3$	calcium carbonate, gypsum
CCD	Counter Current Decantation
Cd	cadmium
CEMP	Construction Environmental Management Plan
CH_4	methane
C_2H_6	ethane
C_3H_8	propane
Cl	chlorine
cm	centimetre
Co	cobalt
CO_2	carbon dioxide
CO_3	carbonate
C_p/C_v	ratio of specific heats
Cu	Copper
DA	Development Application
dBA	"A"-weighted decibels
DLWC	Department of Land and Water Conservation
DMR	Department of Mineral Resources
DUAP	Department of Urban Affairs and Planning
EC	electrical conductivity
Eh	redox potential
EIS	Environmental Impact Statement
EL	Exploration Licence
EMP	Environmental Management Plan
EMS	Environmental Management System
EPA	Environment Protection Authority
EP&A Act	*Environmental Planning and Assessment Act, 1979*
EPBC Act	*Environment Protection and Biodiversity Conservation Act, 1999*
EPCM	engineering procurement and construction management
ERP	Emergency Response Plan
ESD	Ecologically Sustainable Development
Fe	iron

Fe^{2+}	ferrous iron
Fe^{3+}	ferric iron
GJ/h	giga joule per hour
GRP	Gross Regional Product
g/s	grams per second
$g/m^2/month$	grams per square metre per month
h	hour
H	horizontal
H_2	hydrogen
H_2O	water
H_2S	hydrogen sulphide
ha	hectare
H/C ratio	hydrogen to carbon ratio
HCO_3	bicarbonate
HFC	hydrofluorocarbons
Hg	mercury
HRSG	Heat Recovery Steam Generator
HWCMP	Hazardous Waste and Chemical Management Plan
Hz	Hertz
IESCP	Integrated Erosion and Sediment Control Plan
JORC	Joint Ore Reserves Committee Code
JV	joint venture
K	potassium
kg	kilogram
kg/kg.mole	kilogram per kilogram mole
kg/m^3	kilogram per cubic metres
kg/s	kilogram per second
kg/t	kilogram per tonne
kJ	kilojoule
$kJ/m^3.ºC$	kilojoules per cubic metre degree celsius
km	kilometre
km^2	square kilometre
km/hr	kilometres per hour
kPa	kilopascals
kPa.g	kilopascal grams
kV	kilovolt
L	litre
L_{AN}	statistical noise exceedance levels with “A” weighting
L_{A10}	noise level exceeded 10% of the time with “A”-weighting
L_{A90}	noise level exceeded 90% of the time or background with “A”-weighting
$L_{A90(15\ minute)}$	noise level exceeded 90% of the time or background with “A”-weighting, for 15 minute intervals
L_{Aeq}	equivalent continuous sound pressure level with “A” weighting
LALC	Local Aboriginal Land Council
lb	pound
LEP	Local Environmental Plan
Lpa	litres per annum
L/s	litres per second
LSC	Lachlan Shire Council
m	metre
m^2	square metre
m^3	cubic metre
M	million, mega

Mg	magnesium
mg/L	milligrams per litre
mg/m^3	milligrams per cubic metre
MgO	magnesium oxide, magnesite
$MgSO_4$	magnesium sulphate, Epsom salts
m^3/hr	cubic metres per hour
MIC	maximum instantaneous charge
MJ	mega (million) joules
MJ/m^3	megajoule per cubic metre
ML	megalitres (million litres)
MLA	Mining Lease Application
mm	millimetre
Mn	manganese
MOP	Mining Operation Plan
MPF	mine and processing facility
MR	Main Road
MREMP	Mining Rehabilitation Environmental Management Plan
m/s	metres per second
Mt	mega tonnes (million tonnes)
Mtpa	mega (million) tonnes per annum
MVA	megavolt amps
MW	megawatt
N	nitrogen
N_2O	nitrous oxide
Na	sodium
NEPC	National Environment Protection Council
NEPM	National Environmental Protection Measure
NHMRC	National Health and Medical Research Council
Ni	nickel
NiEq	nickel equivalent
Nm^3/h	cubic metres per hour volumetric discharge at normal conditions
NO_2	nitrate
NO_x	oxides of nitrogen
NPWS	National Parks and Wildlife Service
NPI	National Pollution Inventory
NSESD	National Strategy for Ecologically Sustainable Development
NSW Ag	NSW Agriculture
OP	open pit
pa	per annum
PABX	private automatic branch exchange
Pb	lead
PFC	perfluorocarbons
PHA	preliminary hazard assessment
PM_{10}	particulate matter with diameter less than 10 µm
PO_4^{3-}	phosphate
ppm	parts per million
PSC	Parkes Shire Council
Pt	platinum
PVC	polyvinyl chloride
RALC	Regional Aboriginal Land Council
ROM	Run-of-Mine
ROTAP	Rare or Threatened Australian Plants
RTA	Roads and Traffic Authority

SD	standard deviation
SEPP	State Environmental Planning Policy
SF_6	sulphur hexafluoride
Si	silicon
SiO_2	silica, silicon dioxide
SMP	Site Management Plan
SO_2	sulphur dioxide
SO_4^{2-}	sulphate
Spp.	plural species
SR	State Road
Std. Dev.	standard deviation
STP	sewage treatment plan
SS	suspended solids
subsp.	subspecies
t	tonne
t/day	tonnes per day
TDS	total dissolved solids
tpa	tonnes per annum
TSC Act	*Threatened Species Conservation Act, 1995*
TSF	tailings storage facility
TSP	total suspended particulates
TSR	travelling stock route
UNEP	United Nations Environment Programme
V	volts, vertical
viz.	namely
W	watt
WMP	Waste Management Plan
Zn	zinc
^oC	degrees Celsius
$\mu g/m^3$	micrograms per cubic metre
µS/cm	microsiemens per centimetre
$	Australian dollars
%	percent

UNITS

The prefixes for units used are as follows:

P	peta	10^{15}	1 000 000 000 000 000
T	tera	10^{12}	1 000 000 000 000
G	giga	10^{9}	1 000 000 000
M	mega	10^{6}	1 000 000
k	kilo	10^{3}	1 000
m	milli	10^{-3}	0.000 1
µ	micro	10^{-6}	0.000 000 1

SECTION 9 - GLOSSARY

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9 GLOSSARY

Acid leaching

The process whereby nickel and cobalt is leached from the ore slurry with the application of sulphuric acid in a high pressure and high temperature vessel (autoclave) to produce a slurry containing dissolved nickel and cobalt sulphates, and leach residue.

Adsorption

The collection of one substance on the surface of another.

Alluvial

A general term for clay, silt, sand and gravel transported by water and deposited, on the bed of a flood plain, river or stream.

Amenity

Useful and enjoyable quality.

Anion

Negative ion, ie. an atom or molecule that has gained one or more electrons.

Anode

An electrode where negative ions (electrons) are discharged, and oxidation occurs during the process of electrowinning.

Anolyte

Spent electrolyte (see electrolyte).

Ambient air quality

Quality of the outdoor air to which people, structures, plants and animals are exposed.

Aquifer

A sub-surface rock formation containing water in recoverable quantities.

Autoclave

A vessel in which chemical reactions are conducted under pressure and at high temperatures; usually constructed from thick-walled steel.

Average Recurrence Interval (ARI)

The average or expected period (in years) between exceedances of a given flood event (flood flow or rainfall amount). Also known as ‘return period’.

Background

The condition (eg. noise levels, bird populations) already present in an area before the commencement of a specific activity (eg. a mining operation).

Ball mill

A piece of milling equipment used to grind ore into small particles. A cylindrical rotating steel container containing steel balls as a media.

Barren liquor

Solution remaining when metals have been removed by chemical extraction.

Baseline data

Data collected over time to define specific characteristics of an area (eg. ambient air quality or existing surface water quality) prior to the commencement of an activity (eg. a mining operation), and include existing landuse activities.

Basement rock

Unweathered rock lying below the soil and weathering profile.

Batter

An engineered slope of soil or rock fill on either side of the upslope or downslope of a road, embankment or mine waste storage; the sloping banks of cut earth separating different levels in an open-cut pit.

Beach

The shape that the solid component of tailings forms when deposited into the tailings storage facility.

Berm

A low bank or flat built onto a slope to improve its structural stability and reduce erosion.

Borewater

Groundwater sourced from bores.

Cathode

An electrode where positive ions are discharged during the process of electrowinning.

Cation

Positive ion, ie. an atom or molecule that has lost one or more electrons.

Caustic soda

NaOH; sodium hydroxide.

Chemically inert

A chemical substance that does not easily react with other substances.

Clarifier

Process equipment used to separate suspended solids from solutions.

Clastic

Formed from fragments of pre-existing rock.

Co-generation plant

Plant that produces electricity and steam from natural gas.

Colloids

A mixture of particles suspended in a dispersing medium.

Colluvial

A general term for deposits on slopes or at the base of slopes that have been transported chiefly by mass flow due to gravity.

Concentration

The amount of a substance per unit of mass or volume of the medium in which it occurs.

Condenser

A chamber in which vapours are condensed to a liquid.

Conductivity

The measurement of the ability of a substance (either a measure of solid, liquid or gas) to transmit electricity; used to determine the amount of salt in a soil sample.

Counter current decantation (CCD)

A circuit in the process of ore concentration, that operates via several stages of 're-pulping' (or washing) of pressure leach slurry on a counter current principle, where thickened slurry and separated solution move in opposite directions around the circuit.

Cross-section

A two-dimensional diagram of an object presented as if the object had been cut along its length.

Crusher

That part of an ore-processing plant where the ore is mechanically reduced into smaller pieces.

Cryogenic

Refers to low temperature (<0°C) substances and equipment.

Culvert

Large pipe or channel carrying water underneath a structure (eg. roads or railway tracks) or underneath the ground.

Cyclone

A conical vessel that uses centrifugal action to separate particulate matter from air, slurry or water.

dB

Decibel; unit used to express sound intensity.

dBA

Decibels, A-weighted scale; unit used for most measurements of environmental noise; the scale is based upon typical responses of the human ear to sounds of different frequencies.

dBA(L)

Linear decibels; measurable effect of event (eg. blast) on air pressure including measurement of generated energy below the limit of human hearing.

Decant pond

A pond, formed in a tailings storage by runoff of tailings supernatant liquor, from which water is discharged (decanted) from the pond.

Decant water

Water that has been decanted (by gravity, or pumped from a tailings pond).

Detrital

A mineral grain derived mechanically from parent rock, generally resistant to weathering.

Devonian

A period of the Palaeozoic era, thought to have covered the span of time between 400 million years to 350 million years ago.

Dew point

The temperature at which a sample of moist air becomes saturated and either condenses or forms dew if above ground or in contact with the ground, respectively.

Diatomaceous earth

Occurs as a siliceous deposit, and is heat and chemical reaction resistant, and often used in fireproof cements, insulation, filters and absorbents in explosives manufacturing.

Diluent

Volatile liquid with the ability to dilute solvents.

Dunite

An intrusive igneous rock (rock formed from the solidification of magma) with coarse-grained characteristics consisting of greater than 90% of the mineral olivine.

Ecosystem

An interacting system of animals, plants, other organisms and non-living parts of the environment.

Ecotonal

Transitional between two different habitats.

Edaphic

Pertaining to ecological formations or effects resulting from or influenced by local conditions of the soil or substrate; also an old term applied to any soil characteristic that affects plant growth.

Electrical conductivity (EC)

The ability of a substance (either solid, liquid or gas) to transmit electricity.

Electrolyte

A compound that dissociates into ions when in solution.

Electrowinning

The recovery of metals from solution of their salts by electrolysis, by the metal depositing on the cathode.

Embankment lifts

An embankment is constructed by the placement of a series of progressively higher and narrower earth or rock layers; each separate layer is called a lift.

Emission

The discharge of a substance (eg. dust) into the environment.

Endemic

Native plant or animal restricted to a specific locality or geographic region.

Exothermic reaction

Reaction in which heat is generated.

Filter cake

The layer of precipitate that builds up on the cloth of a filter press.

Filter press

Used to filter slurry or solution, and comprises of filter cloths into which the slurry or solution to be filtered is pumped.

Flare stack

Chimney used for the purpose of combustion and dispersion of gaseous emissions.

Flash vessel

Process equipment used to reduce temperature and pressure, by separating liquid fractions of substances by boiling point.

Flocculant

Reagent used in the thickener to help promote settlement of solids.

Fluvial

Within, or with origins from a river.

Freeboard

Excess storage capacity, to the overflow level.

Forb

Herbaceous or slightly woody, annual or sometimes perennial plant; not a grass.

Gabion baskets

Baskets constructed to hold earth or stones, in order to provide foundation, or prevent erosion.

Goethite

Hydrated iron oxides and iron hydroxides that are the chief mineral in limonite, and are rusty brown in colour.

Greenhouse gases

Gases with potential to cause climate change (eg. methane, carbon dioxide and non-methane volatile organic compounds). Usually expressed in terms of global warming potential carbon dioxide equivalent.

Groundwater

All waters occurring below the land surface; the upper surface of the soils saturated by groundwater in any particular area is called the water table.

Habitat

The particular local environment occupied by an organism.

Hazing techniques

Mechanisms used to discourage fauna from using a particular area.

Herpetofauna

Collective term for reptiles and amphibians.

Hydrograph

Graphical plot of flow rate versus time.

Input-Output Analysis

An analysis approach that relies on an economic model of the structural interrelationships between sectors within an economy to estimate the impacts of a shock to the economy.

In situ

The original position of formation, deposition, or growth, etc, as opposed to transported material.

Inter-generational equity

That the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.

Intra-generational equity

The concept that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of their own generation.

Isotropic

A medium with uniform physical properties in all directions.

Knapping site

Site used for breaking and shaping stones and flints.

Laterite

A residual clay that mainly consists of hydroxides of iron and aluminium. Generally found due to the weathering of igneous rocks, of basic composition.

Lithology

Characteristics of rock including mineral composition, structure, grain-size and arrangement.

Mafic

One of the three major classes of igneous rock (solidified magma). Dark coloured and generally rich in magnesium and iron.

Magnesium oxide

MgO; may come in the form of calcined magnesite and dolomite.

Multiplier

Summary measures used for predicting the total impact on all industries in an economy of changes in the demand for the output of any one industry.

Oxidation

The process by which an element or compound undergoes a chemical reaction involving the removal of electrons; involves reaction with oxygen to form an oxide (eg. the rusting of iron) (see Redox).

Palaeochannel

An ancient stream channel that is now buried.

Palaeozoic

Refers to a major era in geological time (225-600 million years ago).

Permeability

The ability of a rock or soil to allow fluid to pass through it.

pH

A measure of the degree of acidity of a solution; expressed numerically (logarithmically) on a scale of 1 to 14, on which 1 is most acid, 7 is neutral, and 14 is most basic (alkaline).

Phreatic surface

The upper surface of the zone of saturation in a tailings storage facility.

Piezometer

A hollow tube protruding into the ground used to measure the level of the groundwater at a certain location.

Pisolitic

Used to describe the structure of certain sedimentary rocks containing pisoliths.

Polymictic gravel

A spherical or ellipsoidal concretionary or accretionary body resembling a pea in shape and limited in size to bodies of over 2 mm diameter.

Potable water

Water of quality suitable for human consumption.

Prilled

Granular solids.

Producers' surplus

The difference between the costs of the inputs used in the production process and the price received for the finished product.

Raffinate

The product of the extraction of liquid from the required solute.

Recharge

The addition of water to an aquifer, directly from the surface, indirectly from the unsaturated zone, or by discharge from overlying or underlying aquifer systems.

Redox

Reduction-oxidation reactions – reactions in which one or more electrons are transferred.

Relative humidity

The ratio of actual moisture in the air to the amount the air could hold if saturated, at a given temperature.

Ring-main

Closed loop of piping through which tailings slurry is delivered to the tailings storage facility.

Rip-rap

Rock material (gravel) laid down to protect the outer surface of dams by reducing runoff flow.

ROM

Run-of-mine ore, stockpiled and used to feed the mill and process plant.

Salinity

The total concentration of dissolved solids in water, commonly expressed as parts of dissolved solids per million parts of solution (ppm), or milligrams of dissolved solids per litre of solution (mg/L); the significance of salinity depends on the nature as well as the amount of the dissolved solids.

Scandium

Sc – a rare element, and one of the least basic rare earth metals. Scandium is not widely used due to its rarity.

Seepage

Liquid or fluid such as water, seeping or flowing from beneath the ground to the surface.

Siliceous

Term used to describe material that has a large silica component.

Sound pressure level

Refers to the steady sound level, which is equal in energy to the fluctuating level over a particular period.

Spigots

Points on the tailings pipeline used to discharge tailings slurry to the tailings storage facility.

Spur line

A secondary pipeline to a main pipeline, generally smaller in diameter.

Stoichiometric

The exact ratio of elements or compounds required to form pure chemical compounds.

Sub-aerial tailings depositional technique

Method of tailings deposition involving the progressive peripheral depositional technique discharge of tailings slurry, above water, around the storage (typically via a spigotted main line) with thin-layer beaching resulting.

Supernatant

The layer of water above settled solids.

Swale drain

Broad, cut to fill contour drain designed for low flow velocities, generally grassed.

Tailings

Neutralised residue from processing and extraction of product from ore.

Tailings pore water

Water held within the tailings mass.

Telemetry station

Remotely controlled station often used for data collection.

Temperature inversion

An atmospheric phenomenon in which air temperature increases with height over a particular interval.

Thickener

Recycles process water and thickens slurry by allowing solids to settle. Solids are often worked towards a central hole in the base with revolving rakes.

Total suspended particulate matter (TSP)

Particulate matter suspended in solution or air (TSP).

Total suspended solids

A common measure used to determine suspended solids concentrations in a waterbody and expressed in terms of mass per unit of volume (eg. milligrams per litre).

Transmissivity

The rate (m^2/day) at which water is transmitted through a unit width of aquifer.

Turbidity

A measure of disturbed sediment within a liquid, often noted by the degree of cloudiness or muddiness.

Ultramafic

Igneous rock (formed by the solidification of magma) dominated by ferromagnesian minerals), but with no feldspar (aluminium silicate).

Underdrainage

Artificial drainage that removes infiltration or seepage water from underneath a structure (eg. a tailings storage or a stockpile).

Water table

The surface below ground level that is saturated with water. Where the water table rises above ground level, a river, spring or lake is formed.

ATTACHMENT 1

DIRECTOR-GENERAL'S REQUIREMENTS

New South Wales Government
Department of Urban Affairs and Planning

Mr Russell Hetherington
Hetherington
1st Floor
503 Willoughby Road
WILLOUGHBY NSW 2068

Contact: Chris Ritchie

Our Reference: S98/01078/Pt1

Your Reference:

Proposed Syerston Nickel and Cobalt Project
Fifield, Lachlan Local Government Area

Dear Mr Hetherington,

I refer to the planning focus meeting for the above project and your request of 12 October 1998, seeking the requirements of the Director-General for the preparation of the required environmental impact statement (EIS).

Under clause 55 of the *Environmental Planning and Assessment Regulation 1994* (the Regulation), the EIS should consider the issues that have been outlined in Attachment No. 1.

Attachment No. 2 outlines the statutory matters that must be included in any EIS under clauses 54 and 54A of the Regulation.

You have identified that certain licenses or approvals may be required from a number of agencies should consent be required for the proposal. As you are aware, under these circumstances, the proposal would be "integrated development". Subsequently, and in accordance with clause 55(3) of the Regulation, the Department has sought the EIS requirements of the relevant agencies providing general terms of approval prior to determination. These requirements are included as Attachment 3.

Notwithstanding these attached requirements, the Department urges that you continue to consult with relevant local, State and Commonwealth government authorities, service providers and community groups, and where relevant, take into account any comments. It is also recommended that you regularly liaise with this Department during the preparation of the EIS.

Please note that, as this proposal is state significant development, the development application should be lodged with the Department rather than the Council. When submitting your development application (DA), please include at least 4 copies of the EIS and any other supporting documentation. As "integrated development", copies of the EIS and supporting documents should also be submitted with <u>each</u> of the relevant

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approval bodies (including a fee of $250) at the same time that you lodge them with the Department. I suggest that you contact each approval body to determine how many copies they will require.

Please contact Chris Wilson on (02) 9391 2344 if you require any further information regarding the Director-General's requirements for the EIS.

Yours sincerely,

for Geoff Noonan 9/12/98
Director
Development and Infrastructure Assessment
As Delegate for the Director-General

ATTACHMENT NO. 1

PROPOSED SYERSTON NICKEL COBALT PROJECT
FIFIELD, LACHLAN LOCAL GOVERNMENT AREA

The matters listed below should be clearly and succinctly outlined in the text and where appropriate supported by adequate maps, plans, diagrams or other descriptive details to enable all concerned to gain a clear understanding of the full scope of the development and its likely impact on the environment.

There may be other issues, not included, that are appropriate for consideration in the EIS. It is the applicant's responsibility to identify and address as fully as possible the matters relevant to the specific development proposal in complying with the requirements for the preparation of an EIS.

1. Planning and Environmental Context

Planning Information and Permissibility

❑ Description of the planning framework, including:
- zonings, permissibility and any land use constraints;
- compatibility of the proposal with Lachlan Local Environmental Plan (1991) and other Lachlan Shire Council codes and policies, relevant State Environmental Planning Policies (ie. SEPP 11, SEPP 33 & SEPP 44) and any relevant draft plans;
- where relevant consideration of Parkes Local Environment Plan (1990) and draft plan (1997);
- consideration of the Native Vegetation Conservation Act (1997) will be required for any activities under Part 5 of the Act (ie pipelines and rail construction);
- description of existing and projected land uses in the surrounding locality;
- any heritage items or environmental protection areas likely to be affected by the proposal; and,
- consideration of the Threatened Species Act and compliance with Section 5A (8 Part Test) of the Environmental Planning and Assessment Act, 1979.

❑ description of statutory requirements of other regulatory agencies, in particular, those required for integrated development.

Site Description and Locality Information.

❑ The following information should be provided:
- title and ownership details; land tenure and lease details;
- site description and maps, plans, aerial photographs clearly identifying the location of the proposal relative to the surrounding road network and communities including, Fifield, Trundle, Tullamore, Melrose and Condobolin and any other dwellings and land use likely to be affected by the development, ie. utilities, including transmission lines, pipelines cables or easements, sight lines from dwellings or public spaces such as roads.

Overview of the Affected Environment.

❑ This should provide details of the environment in the vicinity of the development site and those aspects of the environment likely to be affected by any facet of the proposal. Baseline information should be provided on the following:

- meteorological characteristics which may influence the construction and operation of the development. These may include prevailing wind and intensity, average yearly rainfall, seasonal distribution of rainfall, storm intensity, storm return period; temperature inversions etc;
- surface contours and general topography. These may include slope gradient, slope length, catchment size, drainage;
- presence and condition of surface and sub-surface water resources, including groundwater bores within 1km, and the relationship of groundwater with excavation depth;
- mapping of the location and description of all native fauna habitats, vegetation communities and plant species that are within the area to be impacted and identification of those which are likely to be of local, regional or state conservation significance, including the presence of critical habitat of threatened species, populations or ecological communities;
- mapping of the location and description of Aboriginal sites and relics within the area to be impacted and identification of any areas of high archaeological potential;
- any heritage items or environmental protection areas;
- soil profiles, and the presence of any Protected Lands under the Soil Conservation Act 1938;
- visual amenity;
- socio-economic profile;
- existing and adjoining land uses; and
- suitability of the land for agricultural purposes.

Offsite baseline data may be used provided it is representative of on site conditions.

2. A Full Description Of The Development

Resource

❑ Describe the characteristics and economic significance of the resource. Information provided should include:
- the geological factors influencing resource quality and occurrence, size and quality of any proven, possible or probable reserves;
- characteristics of identified deposits including location, geology, extent, and significant internal variations in grade/quality;
- characteristics of the deposit location, geology, extent and internal variations in grade/quality;
- whether other potentially recoverable commodities occur at the site and whether they can be stockpiled for later recovery;
- exploration methods and summary of results; and
- depth of overburden and topsoil and overburden characteristics.

Proposed Works

❑ Describe the proposed mining method/s and proposed processing plant. The description should include:
- the proposed scale of extraction, including estimated daily, weekly and annual volumes of material to be extracted and transported;
- expected life of the operation and staging;
- depth and rate of mining;
- type of machinery and equipment to be used;
- plans of operation and mining / production techniques, including any proposed blasting and crushing;

- product preparation, including crushing, screening or washing;
- details of the pressure acid leaching process, decantation circuit, slurry circuit; solution neutralisation circuit, sulphide precipitation circuit and nickel and cobalt refinery;
- solid and liquid waste disposal facilities;
- hours of operation for construction, extraction, ore handling, processing, transport and maintenance;
- quantities and management of topsoil, overburden, tailings and ore to be stockpiled;
- number of persons to be employed (during construction and operation);
- methods of loading and transporting of material within the site and from the site, for example access roads, conveyors, loaders, and rail sidings;
- on-site water management, including surface site drainage and erosion controls;
- proposals for dealing with interception of ground waters and containment of runoff, water treatment and off-site discharge;
- quantities and method of storage of fuels and chemicals on the site;
- sanitary and waste disposal arrangements;
- proposed facilities for truck parking and washdown areas; and
- office facilities and any proposed on-site workers dwellings.

Utility Services

❑ Whether the water and gas pipelines are part of this application and will be addressed in the EIS.

❑ Nature, extent, the potential environmental impact and the proposed location of any additional infrastructure on and off site necessary to meet the project's construction and operational needs. The following should be considered:
  - details of the expected load requirements for the power supply during both the construction and operational phases;
  - details of any proposed on-site power generating facility;
  - the potential influence on power supply as a direct result of the project and from new developments that may occur as a result of the project. Advance Energy should be consulted in regards to this issue and any potential statutory requirements concerning its use and supply;
  - natural gas pipeline;
  - water requirements, ie proposed supply and storage, water recycling and reuse options;
  - transportation infrastructure; and
  - waste disposal options.

Site Layout Plans

❑ Plans clearly indicating the location and layout of the proposal including;
  - maximum area to be disturbed;
  - processing, storage, loading of transport plant;
  - storage areas for overburden, ROM and product ore; and
  - general internal and external dimensions of all structures to be erected.

Alternatives and Justification

❑ Consideration of alternatives and justification for the preferred proposal. This should include an assessment of the environmental impacts or consequences of adopting alternatives including:
  - mining and processing options, techniques or technology
  - mine design, site layout or access roads;
  - proposed processing plant location and technology to be utilised;

- proposed infrastructure location;
- plant inputs including water supply;
- the marketability of the expected products;
- that the operation will be sufficiently viable to limit potential disruption to the local community;
- that the operation will be sufficiently profitable to pay for necessary rehabilitation;
- waste disposal methods; and
- alternative rehabilitation options.

❑ The selection of the preferred options should be justified in terms of:
- type, quality and quantities of ore in relation to market demand; and
- environmental factors including bio-physical, economic and social factors.

3. Analysis of Environmental Impacts and Mitigating Measures

Environmental impacts usually associated with open cut mining operations are listed below. The potential impacts of the proposal on the environment should be addressed in the EIS in satisfactory detail and suitably quantified. In addition, an assessment of the proposed mitigation and management strategies and their effectiveness to mitigate the impacts during and after the operation should be made.

Cumulative Impact

❑ Any likely cumulative effects of the proposed operation. For example, identify any cumulative impacts on the surrounding rural area, having regard to dust, noise, vibration, visual impact, water quality issues, traffic impacts, vegetation and fauna habitat.

Air Quality

❑ Issues to consider include:
- identification of all sources of air pollution such as mining, processing, handling, sewage treatment, chemical storage and use, or transport operations (vehicle exhaust gases) and management measures to be implemented to ensure compliance with air quality objectives;
- demonstration of compliance with relevant air quality objectives for emission points, particularly in relation to sulphur dioxide, hydrogen sulphide and nitrogen oxide should power be generated on-site;
- impact of acid mist from acid leaching process on adjacent vegetation and measures to mitigate;
- identification of dust sources such as construction activities, areas denuded of vegetation, rail loading facilities, drilling and blasting, reclaiming, transportation and dumping of ore, rehabilitation and measures to minimise;
- meteorological conditions under which nearby residences and sensitive land uses may be affected by the operation; and
- proposed on-going monitoring regime to ensure the adequacy of mitigation measures proposed.

❑ Consider the quantity and impact of greenhouse gases and the emission of greenhouse depleting substances from the development.

Water Quality

❑ Issues to consider include:
- all potential sources of water pollution;

details of control measures to be implemented to prevent adverse impacts by waste water, tailings storage, mine pit/s, leachate and contaminated stormwater on the water quality of surface and groundwater resources;
- contingency plans to manage any contaminated water in excess of re-use storage capacity (including contaminated fire fighting water);
- details of stormwater diversion works, their capacity and stabilisation;
- design details for tailings ponds and sediment control works (ie. minimum retention capacity and permeability);
- potential effects on water quality of nearby watercourses;
- groundwater characteristics of the whole site and potential impacts resulting from both processing plant chemicals and mining operations;
- design and location of waste rock emplacement;
- water pollution controls for chemical impoundments and chemical storage areas, machinery repair, maintenance and parking areas (ie. synthetic membranes and bunding);
- details of site drainage, erosion and sediment control measures;
- possible siltation, sedimentation effects;
- details of all transfer lines/pipes and spillage containment measures; and
- a water management plan detailing site water balance, re-use and disposal of wastewater and water monitoring measures.

Noise and Vibration Impacts

❑ Issues to consider include:
- existing acoustic environment including background noise levels (L_{90}), noise sources and estimated levels (L_{10}) from both construction and operational phases of the development prepared in accordance with EPA guidelines;
- noise levels from fixed and mobile noise sources, including trucks and rail transport along their respective haulage routes;
- noise emissions from any blasting and compliance with EPA adopted guidelines;
- predicted future noise levels at potentially affected residences; and
- mitigation and management measures to control the generation of noise to ensure compliance with relevant noise standards and proposed monitoring program.

Transportation Impacts

❑ Issues to consider include:
- transport routes and possible alternative routes or transport modes;
- a comprehensive traffic study detailing the potential impact of mine related traffic on the local and regional road networks during both the construction and operational stages and the upgrading of these networks required as a result of this traffic. The study should also estimate for both stages of the development average and maximum hourly, daily and weekly transport movements (by type);
- the origin of any incoming material (ie consumable items), their mode of transport to the site, the likely impacts and the proposed amelioration measures;
- detail sources of limestone including quantities, haul rates, haul routes and an outline of the proposed haulage timetable;
- details of the required service infrastructure, including its characteristics, vehicle movements additional to haulage tasks and address any potential impacts;
- the capacity and safety of roads/intersections, site access and egress, and rail facilities and the need for any upgrading or augmentation as a result of the development;
- details of the rail spur, including its proposed location;
- consideration of the safety requirements for any railway crossings, particularly for MR350, MR57 and MR61;

- consideration of the possible use of rail for long distance bulk haulage of material coming into the mine and product leaving the site;
- the need for any road diversions and subsequent impacts on travelling stock routes; and
- details of contingency plans for when rail timetabling for Syerston is not available should be provided to the RTA. The impacts associated with this contingency plan should be considered.

Visual Impact

❑ Issues to consider include:

- visibility of the mine from nearby properties and surrounds;
- lighting impacts from night time operations;
- visual impacts from the clearing of vegetation, exposure of highwalls and shape location and size of stockpiles;
- proposed landscaping to reduce visual impacts; and
- an assessment of the potential to minimise visual impacts associated with the entire mining operations through integration of mitigation measures.

Hazard Assessment

❑ The Applicant shall complete a preliminary hazard analysis (PHA) in accordance with Hazardous Industry Planning Advisory Paper (HIPAP) No 6 – Guidelines for Hazard Analysis. The PHA shall consider the potential hazards from both accidental releases of materials used in the processing of the ore and natural events (including bushfires, landslip, flooding or subsidence).

The PHA shall include:

- a list of all dangerous goods to be used including fuels and explosives. This shall include quantities stored; storage and transport arrangements; and loading and unloading procedures.
- detail of protection measures to prevent site contamination.
- detailed site layout to scale indicating storage and processing areas.
- a description of all processes involving dangerous goods including a comprehensive identification of possible causes of potentially hazardous incidents and their consequences to public safety or the environment and an outline of all operational and organisational safety controls. This shall also include detailed assessment of equipment to remove oxides of sulphur from exhaust gases generated during the sulphuric acid generation process.
- the consequences in relation to public safety or impact on the environment if a hazardous event were to occur. This shall include detailed dispersion modelling of any releases of oxides of sulphur.
- a quantified risk assessment of the proposed development, in particular storage and use of ammonia gas.
- details of hazard mitigation measures, assessment of the adequacy of operational and emergency procedures involving dangerous and hazardous goods. A detailed discussion, including quantified measurements where appropriate, of vapour emission control procedures, monitoring arrangements, and anticipated emission increases resulting from the proposal.
- details of the proposed gas supply pipeline and on site power generation equipment including a risk assessment of the relevant sections of the gas pipeline. The discussion should also include the impact of gas supply/electricity generation failure on plant operation.
- details of ammonia storage including detection equipment and protection measures.

Transport:

- a comprehensive traffic management plan including proposed routes for dangerous goods and process equipment to ensure residential, commercial and environmentally sensitive areas are avoided where possible. The Department's draft "Route Selection" Guidelines should be referenced.
- discussion of alternative modes for transport of dangerous goods to and from the site and reasons for the preferred mode(s) of transport.
- anticipated impacts on road surfaces or rail facilities associated with the development together with the need for any upgrading of facilities.
- discussion of the proposed gas pipeline route(s)
- a detailed discussion, including quantified measurements where appropriate, of: groundwater and surface water contamination risks; spillage detection, control, containment, clean up, and disposal procedures. This shall include discussion of the levels of chemicals in the tailings dam and evaporation pond

Agricultural Viability

❑ Issues to consider include:

- sensitive agricultural uses in the vicinity of the mine;
- any effects on the agricultural viability of the adjoining land holdings, particularly in relation to dust, noise, transport, water and property severance. This should include any details of proposed buffer areas, landuse and its management;
- impact on the agricultural land resources both locally and regionally;
- the proposed rehabilitation, including details of staging rehabilitation, use of overburden, its storage and placement and suitability to the end landuse;
- rehabilitation measures and evaluation processes should be described eg overburden analysis, seed selection and establishment rates, ongoing management regime and reports on progress;
- appropriate consultation with the local community. This should include providing the community with suitable details to assist them in understanding the development process and impact of the operation; and
- impact on future land supply and population growth. This should include an assessment of the impact of population growth on rural subdivision demands and its potential impact on the Lachlan Shire's land resources, requirements for the workforce eg living options and the current and future needs.

Flora and Fauna

❑ The EIS should consider any potential impacts on the critical habitat of any endangered species, population or ecological community, and any areas of habitat significance or use as a wildlife corridor and taking into consideration the following issues;

- the removal of native vegetation as part of the extraction and any other associated activities;
- possible wildlife hazards (eg. open pit areas and blasting activities);
- the disposal of wastes or by-products;
- the possible disturbance to threatened species or their habitat during both construction and operational phases of the mine; and
- appropriate ameliorative measures to reduce impacts.

❑ Results and the methods used to obtain them should be included in or as a supplement to the EIS.

❑ Results of the 8 Part test required by Section 5A of the Environmental Planning and Assessment Act, 1979 relating to the need to prepare a Species Impact Statement. If determined that an SIS is required, this document should be prepared in support of the EIS.

Heritage Aspects

- ❑ the EIS should include an assessment of whether there is any likely affectation of sites of Aboriginal, archaeological or European heritage value located in the vicinity of the operations and any proposed measures to mitigate impacts or conserve the heritage significance of the sites or items.
- ❑ the EIS should identify the need for any applications for "Consent to Destroy" under Section 90 of the NPWS Act and include sufficient supporting information in the EIS (ie archaeological survey).

Economic and Social Environment

- ❑ Issues to be addressed should include:
  - Social Impact Assessment of the proposal. This is to include details of the proposed workforce and its impacts on the amenities, services and infrastructure (ie housing and local road networks) of the nearby population centres during both the construction and operation phases;
  - primary economic costs and benefits of the proposal and feasible alternatives;
  - the risk of premature closure of the operation for economic reasons; and
  - an assessment of the economic effects of the proposal and its feasible alternatives in accordance with the Department's guideline entitled 'Economic Effects and Evaluation in Environmental Impact Assessment'.

Rehabilitation

- ❑ Outline of the proposed rehabilitation plans for the site, including the actual mine, processing, tailings and transport areas. This should include a description of the final landform with reference to both existing and proposed works.
- ❑ Outline proposals and management issues for post mining land uses, ie. use and management of void/s.

4. Consultation

Potentially Affected Landowners

- ❑ Consideration and review of key issues that emerged from discussions with potentially affected landowners.

Community Consultation

- ❑ Details of any consultation with the local community undertaken to date. Consideration and review of key issues discerned by the community.

DEPARTMENT OF URBAN AFFAIRS AND PLANNING

Attachment No. 2

STATUTORY REQUIREMENTS FOR THE PREPARATION OF AN ENVIRONMENTAL IMPACT STATEMENT UNDER PART 4 OF THE ENVIRONMENTAL PLANNING AND ASSESSMENT ACT 1979

In accordance with the *Environmental Planning and Assessment Act 1979* (the Act), an environmental impact statement (EIS) must meet the following requirements.

Content of EIS

Pursuant to Schedule 2 and clause 54A of the *Environmental Planning and Assessment Regulation 1994* (the Regulation), an EIS must include:

1. A summary of the environmental impact statement.
2. A statement of the objectives of the development or activity.
3. An analysis of any feasible alternatives to the carrying out of the development or activity, having regard to its objectives, including:
   (a) the consequences of not carrying out the development or activity; and
   (b) the reasons justifying the carrying out of the development or activity.
4. An analysis of the development or activity, including:
   (a) a full description of the development or activity; and
   (b) a general description of the environment likely to be affected by the development or activity, together with a detailed description of those aspects of the environment that are likely to be significantly affected; and
   (c) the likely impact on the environment of the development or activity, having regard to:
      (i) the nature and extent of the development or activity; and
      (ii) the nature and extent of any building or work associated with the development or activity; and
      (iii) the way in which any such building or work is to be designed, constructed and operated; and
      (iv) any rehabilitation measures to be undertaken in connection with the development or activity; and
   (d) a full description of the measures proposed to mitigate any adverse effects of the development or activity on the environment.
5. The reasons justifying the carrying out of the development or activity in the manner proposed, having regard to biophysical, economic and social considerations and the principles of ecologically sustainable development.
6. A compilation, (in a single section of the environmental impact statement) of the measures referred to in item 4(d).
7. A list of any approvals that must be obtained under any other Act or law before the development or activity may lawfully be carried out.
8. For the purposes of Schedule 2, the principles of ecologically sustainable development are as follows:
   (a) The precautionary principle - namely, that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.
   (b) Inter-generational equity - namely, that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.
   (c) Conservation of biological diversity and ecological integrity.
   (d) Improved valuation and pricing of environmental resources.

Note

The matters to be included in item (4)(c) might include such of the following as are relevant to the development or activity:

(a) the likelihood of soil contamination arising from the development or activity;

(b) the impact of the development or activity on flora and fauna;

(c) the likelihood of air, noise or water pollution arising from the development or activity;
(d) the impact of the development or activity on the health of people in the neighbourhood of the development or activity;
(e) any hazards arising from the development or activity;
(f) the impact of the development or activity on traffic in the neighbourhood of the development or activity;
(g) the effect of the development or activity on local climate;
(h) the social and economic impact of the development or activity;
(i) the visual impact of the development or activity on the scenic quality of land in the neighbourhood of the development or activity;
(j) the effect of the development or activity on soil erosion and the silting up of rivers or lakes;
(k) the effect of the development or activity on the cultural and heritage significance of the land.

An environmental impact statement referred to in Section 78A(8) of the Act shall be prepared in written form and shall be accompanied by a copy of Form 2 of the Regulation signed by the person who has prepared it.

Procedures for public exhibition of the EIS are set down in clauses 57 to 61 of the Regulation.

Attention is also drawn to clause 115 of the Regulation regarding false or misleading statements in EISs.

<u>Note</u>
If the development application to which the EIS relates is not exhibited within 2 years from the date of issue of the Director-General's requirements, under clause 55(7) of the Regulation the proponent is required to reconsult with the Director-General.

—✧—

EPA

Environment
Protection
Authority
New South Wales

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QUEANBEYAN NSW 2620
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Facsimile: 02 6299 3525

Mr D Mutton – Acting Director
Development and Infrastructure Assessment
Department of Urban Affairs and Planning
GPO Box 3927
SYDNEY NSW 2001

Our Reference: S98/01078
Your Reference: 290102A1

Dear Mr Mutton

Proposed Nickel and Cobalt Mine – Black Range Minerals NL

I refer to your request for the Environment Protection Authority's (EPA's) requirements for the Environmental Impact Statement (EIS) in regard to the above proposal, received by the EPA on 20 October 1998.

The EPA emphasises the importance of ensuring that it is provided with all necessary information essential to its determination of the proposal and preparation of general terms of approval and appreciates the opportunity of providing its information requirements for the subject proposal.

The EPA has considered the details of the proposal as provided by the Department of Urban Affairs and Planning (DUAP) and the applicant and accordingly, has formulated its requirements for the EIS. The EPA provides full detail of the information it requires in Attachment 'A'. However, in summary, the EPA requires information in regard to the following aspects of the proposal:

1. Statutory approval and/or licenses;
2. Long term conservation values of the area;
3. Risk of impact on the regional and local environment (from mine construction, operation and rehabilitation);
4. Surface water and groundwater protection;
5. Integrity of tailings and wastewater evaporation storages;
6. Noise amenity maintenance;
7. Air quality protection;
8. Waste management and cleaner production principles;
9. Risk assessment;
10. Rehabilitation and environmental monitoring.

Based upon the information provided to the EPA, the applicant will require an Environment

Protection Licence (EPL) to construct and operate the mine and processing facility if the Protection of the Environment Operations (POEO) Act 1997 has commenced at the time of determination. However, prior to implementation of the POEO Act a Pollution Control Approval to construct pollution control works and PCL to operate under the Pollution Control Act 1970 will be required.

To assist the EPA in assessing the EIS once it has been lodged with the consent authority, it is suggested that the format of the EIS follow the format of DUAP's EIS guidelines and the specific EIS requirements as outlined in Attachment A. The EPA would like to receive 10 copies of the final EIS for assessment purposes.

Should you have any further enquiries regarding this matter please contact Nigel Sargent or David Baxter of this office on (02) 6299 3330.

Yours sincerely

2/11/98

Ross Carter
Regional Manager
Southern Tablelands
for Director General

cc Black Range Minerals NL
PO Box 7754
Cloisters Square
Perth WA 6850

ATTACHMENT A
ENVIRONMENT PROTECTION AUTHORITY REQUIREMENTS FOR ENVIRONMENTAL IMPACT STATEMENT

SYERSTON NICKEL-COLBALT PROJECT

STATUTORY

Should consent be given to the development following the implementation of the Protection of the Environment Operations Act, 1997, the proposed development will be scheduled under the meaning of the Act ("Mineral processing or metallurgical works" and as a "Mine"). The proponent therefore, would be required to hold an Environment Protection Licence issued by the Environment Protection Authority in relation to scheduled development work or scheduled activities.

Should the development be given consent under the existing legislation (Pollution Control Act's) then the proponent would require a Pollution Control Approval to construct the development and a Pollution Control Licence to operate.

COMPATIBILITY WITH LONG TERM CONSERVATION VALUES

The proponent should detail the strategies and actions envisaged to secure the long term conservation values of the area in the context of both the operational mine and post closure.

RISK OF IMPACT ON THE REGIONAL ENVIRONMENT

The proponent must be able to demonstrate that major safeguards will be put in place which ensure that the operational areas of the mine are separated from the regional environment. This relates specifically to the proponent being able to demonstrate that mine site operations (including tailings storages and evaporation basins) are prevented from impacting on the regional environment during construction, operation and post closure of the proposed development.

The Environmental Impact Statement (EIS) should also consider the impact of the abstraction of process water in the context of the NSW Water Reform Process, in this regard the Department of Land and Water Conservation should be contacted.

RISK OF IMPACT ON REGIONAL AND LOCAL ENVIRONMENT FROM MINE CONTRUCTION, OPERATION AND REHABILITATION

There are a number of issues which stem from this including;

- Surface water and groundwater protection
- Integrity of tailings and wastewater evaporation storages
- Noise amenity maintenance
- Air quality protection
- Waste management/cleaner production
- Risk assessment and

- Rehabilitation and Environmental monitoring

SURFACE WATER AND GROUNDWATER PROTECTION

The proponent must be able to demonstrate that regional and local surface water and ground waters will be protected from the operational and post closure impact of the mine development. Appropriate sediment, erosion, chemical pollutant, environmental monitoring and environmental management plans should be formulated as part of the planning process.

In assessing the potential impact on surface receiving waters for the proposal, the proponent should consider the toxicity and appropriate testing protocols of any wastewater that has the potential to leave the site.

The EIS should also include a water balance model for the proposed development which considers the impact of the proposed development in terms of water harvesting and the potential for the final void to become a localised sink for groundwater. The sediment, erosion and chemical pollutant control plans should be determined around an annual recurrence interval of a 1:100 year, 72 hour storm event for the operational period of the mine.

The potential impact of the final void (including water quality if applicable) on the surrounding environment should be discussed within the EIS.

The treatment and disposal of domestic effluent from both the construction and permanent workforce, including the proposed infrastructure, must be documented within the EIS.

INTEGRITY OF TAILINGS AND WASTEWATER EVAPORATION STORAGES

The tailings and wastewater storage's must be designed to ensure protection of surface waters and ground waters. Management plans for the above mentioned structures should be developed within the EIS. In general, it should be demonstrated that the structures have a suitable level of integrity to ensure long term stability and are capable of hydraulic conductivities no faster than 1×10^{-9} metres/second.

The EIS should identify proposed environmental safeguards should the tailings and/or wateswater storage containment structures, either fail through a structural collapse or leakage. The potential risks to wildlife which may use the tailings and wastewater evaporation storages should also be addressed.

NOISE AMENITY MAINTENANCE

The proponent should undertake comprehensive mine noise (including road traffic noise), blast overpressure and ground vibration modelling, impact assessment and mitigation recommendations.

The noise assessment model should also include both the construction and operational phases of the mine under existing meteorological conditions such as winds and temperature inversions. Such an assessment should include the operational period of the mine over a 24 hour period and include any sleep arousal impacts.

The following criteria and guidelines should be adopted;

Noise:	NSW EPA Environmental Noise Control Manual
Blast/Vibration:	ANZECC Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration.

AIR QUALITY PROTECTION

Syerston is in a rural environment with no significant industrial installations near the project area. Therefore, pollutants such as oxides of sulphur and nitrogen, ozone and carbon monoxide are low, and the main component of air borne material in the ambient air is particulate matter. The EPA would expect the proponent to undertake extensive air quality monitoring, modelling, impact assessment and mitigation in accordance with the appropriate guidelines or standards. The types of issues that the proponent should address in terms of the air quality component supporting the EIS are the following:

1) A comprehensive description of the process including unit operations and in particular:
   - Ore preparation
   - Pressure leaching
   - Counter current decanting (CCD) washing
   - Solution neutralisation
   - Sulphide precipitation & grinding
   - Sulphide leach and impurities removal
   - Solvent extraction
   - Nickel and cobalt electrowinning
   - Sulphuric acid production
   - Hydrogen sulphide production
   - Any other unit operations not included above.

2) Process flow diagram showing process and emission streams.

3) Inventory of raw materials, solvents and chemicals used including composition.

4) Inventory of solvent losses including make-up solvent used.

5) Inventory of production outputs, by-products, and wastes including composition.

6) Description of the proposed method of disposal of by-products and wastes.

7) Inventory of all air pollutants emitted from the process (eg peak emissions in g/s, annual total emissions in tpa, and all supporting calculations for emission inventory).

8) Description and location of point and fugitive emission sources.

9) List of air pollution control equipment proposed and estimated performance.

10) Complete material and energy balances for each unit operation.

11) Plant layout including equipment schedule.

12) Proposed licence limit concentrations in a table for each source and pollutant.

13) In order to assess the impact of air emissions from the proposed development, the following information should be provided:

- Assess and report historical and existing air quality data at the site;
- Identify all air quality issues and past trends at the proposed site;
- Assess and report on the dispersion meteorology at the proposed site (wind rose diagrams, wind speed, direction, stability class, temperature inversions etc);
- Detail air emission concentrations used in the impact assessment;
- Detail ambient air quality criteria referenced in the impact assessment;
- Assess air emissions (fugitive and point) during construction and operational phases;
- Detail pollution control methods to be implemented to minimise air emissions;
- Conduct an impact assessment study of the proposed plant and any future expansions;
- Conduct construction phase impact assessment and actual mitigation measures;
- Conduct operational phase impact assessment and actual mitigation measures;
- For all sources, supply all stack and fugitive source release parameters such as temperature, exit velocity, stack dimensions and table of emission rates for all pollutants;
- Carry out air dispersion modelling for air pollutants released from the development;
- Monitoring and prediction of dust composition, including heavy metal emissions, particularly $Cr6^{+}$.
- Predict ground level concentrations at the plant boundary and beyond for all pollutants and determine impacts. The report should also include isopleths (contours), table summarising maximum predicted concentrations, incremental increases, and background levels for all pollutants and dispersion model input and output files; and
- Carry out an impact assessment on global issues such as green house and ozone depletion.

13) A detailed air quality management plant should be provided in the EIS. This should include details of a periodic source emission testing, continuous emission monitoring, ambient monitoring, weather monitoring and reporting program.

14) The proponent should consider the use of published air quality goals, criteria and regulations recommended by the EPA in carrying out the air quality impact assessment study. These are given below:

Amenity Criteria for Dust:

The relevant air quality criteria to be considered when assessing the impact on residential amenity due to dust emissions should be in accordance with the information shown in Table 1.

Table 1:- Amenity Criteria for Dust

Pollutant	Goals	Agency
Dust deposition rates	4g/m²/month (annual average)	SPCC / EPA
Total Suspended Particulate (TSP)	90 µg/m³ (annual average)	NHMRC

The proponent must give due consideration to the amenity based criteria for dust deposition as detailed in Table 2.

Table 2:-EPA Criteria for Dust Fallout

Existing Dust Level (g/m²/month)	Maximum Acceptable Increase Over Existing Dust Level (g/m²/month)	
	Residential, Suburban	Rural, Semi-Rural, Urban, Commercial and Industrial
2	2	2
3	1	2
4	0	1

Criteria Pollutants:

The regional ambient air goals for criteria pollutants are detailed in Table 3.

Table 3

Pollutants	Goals	Agency
Sulphur dioxide Sulphur dioxide Sulphur dioxide	0.20 ppm (1-hour) 0.08 ppm (24-hour) 0.02 ppm (1-year)	NEPM NEPM NEPM
Particles as PM_{10}	50 µg/m3 (24-hour)	NEPM
Lead	0.50 µg/m3 (1-year)	NEPM
Carbon monoxide	9.0 ppm (8-hour)	NEPM
Photochemical Oxidants (as ozone)	0.10 ppm (1-hour) 0.08 ppm (4-hour)	NEPM NEPM
Nitrogen dioxide	12 ppm (1-hour) 0.03 ppm (1-year)	NEPM NEPM

Point Source Emissions:

The stack emissions shall not exceed the limits set in the Clean Air (Plant and Equipment) Regulation, 1997, under the Clean Air Act 1961. However, depending on the results of the air quality impact assessment, licence limit concentrations may need to be more stringent than the regulations to ensure public health and the environment are adequately protected.

Ground Level Concentrations (GLC):

The NSW EPA does not have either specific emission limits or ambient design criteria for odorous and toxic air pollutants. However, Victoria EPA has published design ground level concentration (glc) criteria for a wide variety of toxic and odorous air pollutants including many organic solvents. The use of the Vic EPA design glc criteria in general, would provide a suitable basis for assessing the emissions from the proposed development.

Health Risk Assessment (HRA)

The EIS shall include an air quality impact assessment for toxic substances such as heavy metals and organic compounds using an appropriate methodology such as HRA.

WASTE MANAGEMENT AND CLEANER PRODUCTION

The proposed development has a potential to generate significant quantities of waste materials/products including; heat, solvents, by products and water. The EIS should investigate all avenues of waste reduction and cleaner production consistent with the NSW Governments Waste Reduction Goals.

A waste management plan should be developed in association with the EIS which will address the issue of waste generation, reduction, management and disposal for the proposed development.

RISK ASSESSMENT

The EIS should consider the full range of likely risk scenarios (things that might go wrong) associated with the proposed development (including transport issues), and the potential impacts on human health and the environment should the risk scenario eventuate.

The risk assessment could also be used to assess the impact of the normal operation of the mine and might include, risk of release of chemicals (evaporation of liquids or movement of dust), risk of noise impacts, risk of impacts on surface water and groundwater, etc. Once the risk scenarios have been identified, the assessment should outline appropriate management actions to further minimise the risk likelihood.

A Hazardous Waste and Chemical Management Plan should be prepared as part of the EIS process which considers the management of all aspects of hazardous waste and chemical management on the site.

REHABILIATION AND ENVIRONMENTAL MONITORING

The EPA considers that it is essential that progressive staged rehabilitation of the mine site should be undertaken throughout the operational phase of the development through to post closure. This process should be documented in the EIS and carried out in consultation with key Government Agencies.

A detailed monitoring management program which includes baseline monitoring should be included in the EIS. The monitoring management program must be able to demonstrate that the selected monitoring sites and parameters have been chosen to ensure that the statements of the environmental performance set out in the EIS are able to be met.

The expected composition of both the final tailings and evaporation storage's should be provided along will an assessment of potential risk of harm to the environment and proposed rehabilitation plan.

David Mutton
Acting Director
Development and Infrastructure Development
Department of Urban Affairs and Planning
GPO Box 3927
SYDNEY NSW 2001

Your Reference: S98/01078

Contact: Rei Beumer
Phone: (02) 6852 1222

26th October 1998

Syerston Proposed Nickel and Cobalt Mine Project

Please find attached the Department of Land and Water Conservation's requirements for the EIS for the proposed Project as requested. These requirements are provided in view of the responsibilities vested in the Department and the policies and legislation it administers.

Preliminary investigation indicates that, at this early stage, there is no obvious reason for the Department to not grant approval provided the relevant conditions and requirements stipulated by the Department to minimise environmental impact are met and complied with.

The Department has welcomed the opportunity to provide comment and looks forward to further involvement with this Project as required in the future. Should you require further information, please contact Mr Bruce Rutherford, telephone (02) 6841 5233 or Mr Rei Beumer, telephone (02) 6852 1222.

Yours faithfully,

Don Martin
Regional Director
Central West Region

EIS REQUIREMENTS FOR SYERSTON MINE PROJECT

1. IMPACT ASSESSMENT

To allow Departmental staff to properly assess those aspects of the project which normally concern it, namely,
⇒ potential Crown land impacts,
⇒ soil and water management,
⇒ erosion and sediment control, and
⇒ site rehabilitation,

the following information should be provided,
⇒ how the project will proceed,
⇒ its general layout, and
⇒ the relationship of the various project components to the topography, soils and vegetation.

With regard to all information required, there should be a full and open assessment of proposals made as well as of alternatives. Information should address:

1.1. The Mining Proposal
This should include the following:
⇒ the development proposal - description with detailed maps, plans and diagrams of the site and the proposed development;
⇒ quarrying method, sequencing, site preparation, any pre-quarrying operations;
⇒ stockpile locations and topsoil stockpile management;
⇒ management of hazardous and potentially polluting substances - management of contingencies;
⇒ decommissioning at end of quarry life, remaining features and land use proposals.

1.2. Mine Infrastructure
⇒ the relationship of plant and building layout,
⇒ stockpile areas,
⇒ access roads,
⇒ water supply dams, and
⇒ other infrastructure to the proposed development where soil disturbance will take place.

1.3. Transportation
⇒ site access, and
⇒ hardstand areas.

These are often major sources of sediment movement.

1.4. Services
⇒ Where soil disturbance is proposed - water, electricity, telephone,
⇒ septic tank waste disposal and soil suitability for its absorption, and
⇒ rehabilitation of disturbed areas created by the installation of services.

1.5. Water Requirements

Operational water requirements and the proposed water sources, including a full impact assessment if groundwater is proposed to be used.

1.6. Waste Management

Management, treatment and storage of toxic, hazardous, contaminated or potentially polluting substances or wastes. Waste materials should be managed in such a way so as to protect water resources from pollution and degradation.

1.7. Consultation

Negotiation and consultation with neighbouring and potentially affected landholders and stakeholders. Consultation with relevant government agencies.

1.8. Existing Environment

This section should include a full and detailed biophysical description of the following for the site and immediate locality:

⇒ topography
⇒ drainage pattern
⇒ geology
⇒ vegetation
⇒ soils
⇒ rural land capability
⇒ agricultural land suitability
⇒ climatic data
⇒ water resources, both surface and groundwater
⇒ quality of surface and groundwater
⇒ hydrogeology of the site
⇒ water use in the area
⇒ existing landuse

2. INTEGRATED SOIL AND WATER MANAGEMENT PLAN

Particular detail is required of an Integrated Soil and Water Management Plan which should be presented, as far as possible, as an integral unit within the EIS. The Plan should include the following:

2.1 Soil Management

⇒ a description of the soil types present on all proposed work areas, roads, infrastructure and land areas which will be affected by mining or other activities associated with the project,
⇒ soil profile descriptions,
⇒ soil characteristics (both physical and chemical),
⇒ topsoil and subsoil stripping program,
⇒ minimisation of sterilising topsoil resources,
⇒ soil stockpile locations,
⇒ stockpile management,
⇒ topsoil and subsoil reuse proposals together with proposals for rejuvenating any topsoil stockpiled for long term use when decommissioning of structures such as plant sites and haul roads.

2.2 Land Management
Proposals for all acquired lands not required for mining purposes should be addressed, preferably in the form of a general landuse plan which should include;

⇒ an inventory of soils.
⇒ rural land capability,
⇒ agricultural suitability,
⇒ present land use and land condition.
⇒ erosion control,
⇒ projected land uses, and
⇒ timber and pasture management.

2.3 Surface Water Management
This should include management of clean and dirty runoff

⇒ from adjacent lands,
⇒ from the quarry and waste areas, and
⇒ from infrastructure, access roads and other features of the mine,

together with runoff water management and water quality impacts for water now passing through, leaving and flowing adjacent to the site. Potentially polluting waters should be contained and managed on the site.

2.4 Groundwater Management
The following should be undertaken;

⇒ a hydrogeological survey of the site and locality to determine subsurface conditions and the risk to groundwaters from all activities associated with the development,
⇒ a detailed on-site survey and assessment should be undertaken, and
⇒ the documenting of the location, details and usage of all bores in the area of the mine.

2.5 Erosion and Sediment Control
This should include;

⇒ management and control of erosion and sediment movement at all stages of the project, and
⇒ specifications of temporary and permanent structures.

Particular attention should be given to opening up any new or undisturbed areas. Erosion and sediment control should receive close attention on all internal access roads and haul roads as experience shows these areas to be major sources of sediment.

2.6 Rehabilitation
Information is required in relation to all aspects of the operation. This should include;

⇒ conceptual end-use landforms,
⇒ soil (topsoil/subsoil) management,
⇒ ongoing rehabilitation of all disturbed areas,
⇒ revegetation techniques and seeding proposals, including species and rates (both for stability of disturbed areas during the operation and final end-use),
⇒ tree planting proposals,
⇒ decommissioning of various components of the project as they become redundant, and
⇒ a maintenance program for rehabilitation and plantings.

The Department recommends a rehabilitation policy of grass first - trees later. In this way erosion and sediment movement is arrested at the earliest opportunity without tree plantings hindering any remedial or repair work.

3. RELEVANT APPROVALS

The most relevant approvals for this development are likely to be under **The Water Act, 1912** with respect to;

⇒ water supply (i.e. dams on watercourses and extraction from watercourse or bore),
⇒ diversion of watercourses, and
⇒ monitoring bores or piezometers

The Native Vegetation Conservation Act, 1997 does not apply to this proposal as it is classified as a designated development and is therefore excluded from the provisions of this Act. However, the Proponent should be aware of the requirements of the Threatened Species Conservation Act, 1995 (TSC Act) in relation to the removal of native vegetation and the possible impact on threatened species. The TSC Act is administered by the National Parks and Wildlife Service.

4. CONTACTS

The Department of Land and Water Conservation, Central West Region contacts for further information or technical advice for this project, are:

Paul Wettin	Ph:	(02) 6360 8376
	Fax:	(02) 6361 3839
Bruce Rutherford	Ph:	(02) 6841 5233
	Fax:	(02) 6841 5230
Rei Beumer	Ph:	(02) 6852 1222
	Fax:	(02) 6852 3419

NSW NATIONAL PARKS AND WILDLIFE SERVICE

Ir Peter Downes
egional Manager
outhern and Western Region
epartment of Urban Affairs and Planning
PO Box 3927
YDNEY NSW 2001

Dur reference:
our reference:

nquiries: Dave Robson
ione: (02) 68835336

1 October 1998

TTENTION: CHRIS WILSON

ear Mr Downes,

EPP 34 - DEVELOPMENT APPLICATION
LACK RANGE MINERALS NL - PROPOSED NICKEL AND COBALT
INE PROJECT, FIFIELD - LACHLAN SHIRE

hank you for inviting the Service to comment on the above proposal and its oposed Environmental Impact Statement. I would like to offer the following ivice regarding the National Parks and Wildlife Service (NPWS) concerns and terests surrounding the proposed development at Syerston.

he NPWS is responsible for the:

- **National Parks and Wildlife Act 1974** - Under this Act, the Service is responsible for the establishment, management and protection of various conservation reserves, the protection and care of Aboriginal relics and places (Section 85), the protection and care of native fauna (Section 92), and the protection of native plants (Section 114).

- **Threatened Species Conservation Act 1995** - This Act aims to conserve threatened species of fauna and flora, populations and ecological communities, to promote their recovery and to manage the processes that threaten them.

he Service's comments are confined to these areas of responsibility. The nvironmental Planning and Assessment Act (1979), requires that the EIS fully escribe the proposal, the existing environment and the likely impacts of the

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proposal. This allows the community to properly review and assess the impacts of the proposal during the public participation phase.

The Service understands that the Minister for Urban Affairs and Planning is the Consent Authority for this development. For the Minister to form sound conclusions regarding the significance of impacts of the proposed works to native flora, fauna and cultural heritage, the Minister will need to ensure that the following issues have been adequately addressed by the proponents in the proposed EIS.

Apart from issues covered by the Service's normal EIA guidelines (attached), there are a number of issues that the EIS will need to address about the significance of any operational or long-term impacts by presenting adequate and conclusive data to support any conclusions. The following dot points summarise these issues.

- All areas affected by the proposal will need adequate fauna, flora and archaeological surveys including tailings impoundments, power line route, roads / TSR, water pipeline etc.
- Consideration of issues such as noise, dust, light, water and soil management and monitoring must all recognise and account for the wildlife and conservation values of the area.
- The EIS should identify the possible long term impacts to wildlife (eg on reproduction/general health) as a result of exposures to any chemicals, heavy metals or highly saline pit water (during operation and after decommissioning).
- The EIS should also consider ameliorative options that may eliminate or reduce impact to flora and fauna.
- The EIS should detail a proposed Environmental Management Plan that includes appropriate monitoring, ecologically sustainable land management, and protection and enhancement of the conservation values on and surrounding the mining lease. In addition a contingency plan should be outlined to be implemented in the event of unfavorable monitoring results.
- The proposed mine will add to existing cumulative impacts from past agricultural activities. The EIS should demonstrate how the proposal is consistent with the "long-term (ecologically) sustainable development" of the region.
- The EIS should consider the long-term management of the landscape of the mining lease and outline a detailed rehabilitation strategy

THREATENED SPECIES

The EIS must consider the requirements of the Threatened Species Conservation Act. The EIS should identify known and likely threatened species including Threatened Flora species.

The threatened species assessment (Section 5a - 8 part test) should indicate likely threats and possible measures to mitigate against these effects. If there is a likelihood of significant impact on threatened species despite these mitigating measures, then an SIS is required.

ABORIGINAL CULTURAL HERITAGE

The Service understands that a preliminary archaeological survey identified some sites that may require destruction or removal if the project is to proceed. Where a relic or an Aboriginal place is known to occur on land prior to the lodgment of a development application, and the development proposal will damage, deface or destroy the relic or Aboriginal place, thereby requiring a consent to destroy from the Director-General of NPWS (under Section 90 of the N.P.&W Act 1974), the NPWS will become an approval body under the recent amendments to Part 4 of the EP&A Act 1979 to integrate the development approval process (IDA).

As identified at the PFM, the proponents are advised to undertake an anthropological assessment of the significance of the Fifield area to the Aboriginal community. Consultation with the local Aboriginal community should be instigated as early as possible in the assessment process. The first point of contact should be Deborah Coe of the Condobolin Local Aboriginal Land Council. Other land councils or members from the local Aboriginal community may also need to be involved. The EIS should contain a full record of evidence of the consultation undertaken and agreements with the Aboriginal Community.

The following points outline specific information that should be contained in the cultural heritage assessment:

- The archaeological survey should provide adequate information relating to the survey methodology and the survey coverage for assessment by the Service.
- A letter is required from the local Aboriginal community stating that they were represented during the survey and whether or not they support any recommendations in the report.
- The significance of any recorded sites to the local Aboriginal community and to science must be established and documented.

Due to other priorities the above contribution may be as much advice as NPWS can make available on this proposal. In the event, however that the Consent Authority were to ultimately conclude that a Section 90 Consent to Destroy (NP&W Act), or DG's requirements for a Species Impact Statement (TSC Act) were required, NPWS would be required to provide further advice and statutory input. I reiterate, that if neither of these outcomes are deemed necessary, the NPWS is unlikely to be able to provide further comment on either the draft or final EIS. If you require further clarification of this response please contact me on (02) 6883 5336.

Yours sincerely,

D. Robson

Dave Robson
ENVIRONMENTAL PLANNING MANAGER
WESTERN ZONE

NATIONAL PARKS AND WILDLIFE SERVICE
WESTERN ZONE

ENVIRONMENTAL ASSESSMENT GUIDELINES
CULTURAL HERITAGE

Aboriginal sites are widespread throughout New South Wales. There is considerable regional variation in the types of sites, their age, their contents and how they are situated on the landscape. It is important that these sites are conserved as fragile and irreplaceable Aboriginal heritage. In some cases there is Aboriginal oral tradition concerning specially significant sites or landscape features

The National Parks and Wildlife Service has a statutory role in the protection and preservation of Aboriginal sites. This includes reviewing and assessing the Aboriginal cultural and archaeological aspects of environmental studies, as well as a regulatory role in their impact or destruction.

The EIS or other environmental assessment should consider Aboriginal cultural heritage, even if the area is disturbed in some way. The EIS should consider:

- Accessing the Service's Aboriginal Sites Register in the initial planning stage. This is to determine if there are any already known sites which will require protection, or a Consent to Destroy (see below). The Register is not a conclusive indicator of the likelyhood of sites that may exist in the development area. The Register of Aboriginal Sites is available from the NPWS, Register Officer (02) 9585 6471. A routine search with map coordinates provided will cost $30.00, a larger search will cost $80.00/hour.

- The Aboriginal community (Local Aboriginal Land Council in the first instance) needs to be consulted so that they can be advised that there may be impact to sites relevant to their heritage. There also may be knowledge in the community about sites in the development area, particularly those related to oral tradition. This process of Aboriginal consultation should be maintained throughout the entire EIS procedure.

- An assessment of the need for an archaeological survey, and if so, to what level of detail. This should be defined by a study plan or research design. In most cases, an on-the-ground systematic archaeological investigation will be needed. If there is a likelihood of buried sites not visible on the surface, a Permit from the Service may be needed for sub-surface testing.

- The outcome of the survey is to determine what sites can be avoided, and what ones cannot. Another objective is to assess the significance of the sites. It maybe that damage or destruction of some sites is unacceptable, or that special safe-guards are needed for others.

If Aboriginal relics/places are known to be directly or indirectly adversely affected, the Proponents will need to apply for, and be issued, a "Consent to Destroy" by the Director-General of the NPWS to comply with Section 90 of the National Parks and Wildlife Act (1974). A necessary part of this is a written statement of interest or acceptability of the proposed impact from the Aboriginal community.

Normally, Special Conditions are attached to a Consent. These may include provisions for impact minimisation and salvage. Salvage is a form of mitigation by documenting in detail what is to be lost by the impact. Frequently it involves archaeological excavation and analysis, or other types of recovery and study.

Alternatively the development might be redesigned by the Proponent to accommodate and protect the site(s). The archaeological survey, analysis and reporting, as well as the negotiation with the Aboriginal community, can be a lengthy process. If salvage for a Consent is needed, then this can add on more time. It is important to begin the study for Aboriginal site impacts in the very earliest stages to avoid delays in the developmental project.

The Service has produced detailed guidelines for consultants and these are available from the Cultural Heritage Manager.

Further information should be sought from the Cultural Heritage Manager at the NPWS office at Dubbo.

Cultural Heritage Manager
Aboriginal Heritage Division
National Parks and Wildlife Service
48 -52 Wingewarra St
DUBBO NSW 2830

PH (02) 6883 5345
FAX (02) 6834 9382

NSW NATIONAL PARKS & WILDLIFE SERVICE
WESTERN ZONE

ENVIRONMENTAL ASSESSMENT GUIDELINES FLORA AND FAUNA

INTRODUCTION

The Environmental Planning and Assessment Act (1979) requires that proponents of a development/activity and the Consent / Determining Authorities adequately assess the impact of a development or activity in any Environmental Impact Assessment (EIA) documents. These EIA documents include:

- Statement of Environmental Effects (SoEE), or
- Review of Environmental Factors (REF), or
- Environmental Impact Statement (EIS).

These are introductory, generic specifications of the National Parks and Wildlife Service (NPWS) for an adequate assessment of the impacts of a development proposal on native flora and fauna (ie including protected and threatened species). However, the Service recognises that the scale and complexity of the project will to some extent, dictate the level of information that is required to address the questions posed below. Consequently, flora and fauna assessments need to be tailored to suit the proposal. For example, a development which is proposed on land which has already been totally (or substantially) cleared should address the issues raised below but the amount of work required to address these issues may be substantially less than if the area comprised undisturbed bushland and, therefore, of more significant wildlife habitat value. A preliminary assessment, including a desktop investigation and a preliminary site inspection, may indicate the need for a detailed survey of the site.

Aboriginal cultural heritage and archaeological sites may still be present on substantially disturbed areas and appropriate assessment of these is required. (Please refer to separate Cultural Heritage Assessment Guidelines included.)

It is up to the proponent (and later the consent and/or determining authorities after appropriate consultation) to determine the detail and comprehensiveness of assessment required to form legally defensible conclusions regarding the impact of the proposal. The scale and intensity of the proposed development should dictate the detail of investigation.

It is important that all conclusions are supported by adequate data and that these data are clearly presented in EIA documentation.

The Service will consider the following issues when reviewing an EIA document are:

1. **Concerns** - What are the Service's concerns regarding the conservation of natural and cultural heritage in accordance with the relevant legislation? Is the proposal likely to affect natural and cultural heritage? How?

2. **Provision of Information** - Is adequate information provided for a valid assessment of the impacts?

3. **Validity of Conclusions** - Has the proponent arrived at valid conclusions as a result of the assessment of impacts?

4. **Recommended Conditions to Consent** - Should Consent or Approval be granted, what conditions (if any) are required to ensure that the project is developed, and thereafter managed in accordance with natural and cultural heritage conservation and the provisions of legislation administered by the Service?

Thus the EIA document should fully describe the existing environment including flora and fauna, so that future impacts can be properly assessed and then reviewed (eg during the public participation phase).

FLORA

Background

The Australian flora comprises many endemic taxa and is therefore unique in the world.

The Service is concerned at the extent to which vegetation has been cleared and otherwise modified in Western NSW and this has recently been highlighted in the State of the Environment Report (1996). Evidence strongly suggests that many plant species and communities are threatened with extinction.

Although the proposed site may be disturbed by various landuses, any remnants of native vegetation are of significant natural heritage value, including riparian and wetland areas. The area of vegetation and habitat at the proposed site may provide an area of high biological diversity, high conservation value or may not be well represented or protected elsewhere. It may also act as a corridor or migratory route for wildlife, drought refuge habitat or have other important values.

The NSW community places a high value on those areas of native vegetation that remain. The NPWS is committed to the protection, appropriate

management, and where necessary, rehabilitation of native vegetation. For these reasons, the Service considers that careful planning should precede any development which involves further vegetation clearance or other significant impact within areas of remnant vegetation.

Report Requirements

The EIA documentation should include a report on the flora which includes the following:

- detailed location map and identification of the area surveyed (including the location of photographs, transects, areas of significance etc),
- at least one of the following: a land satellite image, vegetation communities map, aerial photograph, or a remnant vegetation map,
- a complete plant list (including scientific names of those plants) of all tree, shrub, ground cover and aquatic species, categorised according to country of origin (ie., native *vs* exotic),
- a detailed description of vegetation structure (in terms of a scientifically accepted classification system) and spatial distribution (i.e. plant densities and patterning) on the site, including a vegetation map,
- describe the condition and integrity of the vegetation including a description of any past disturbance,
- an account of the likely original vegetation communities (pre-, or at early settlement), and an assessment of the likely regional distribution of the original communities,
- an assessment of whether the plant communities are adequately represented in conservation reserves or otherwise protected,
- an account of the hydrology of the area and how this relates to the dynamics of the vegetation communities,
- a list of known and likely threatened species as listed under Schedules 1 & 2 (Threatened Species Conservation Act 1995) which might occur at the site. The NPWS database needs to be accessed and the likelihood of occurrence of threatened flora species determined,
- an assessment of the impacts of the proposal on flora, on-site and off-site (eg siltation, water availability or drainage changes) and measures to mitigate these impacts,
- an assessment of the significance of the impact of the development at both the site and at the regional scale,
- a detailed rehabilitation/management plan including a list of the plant species to be used during rehabilitation (if required),
- detail methodologies used and a list of the reference literature cited, and
- any other issues that may be considered relevant.

The above guidelines will provide some data for the "Eight Part Test of Significance" required for threatened flora and fauna under Section 5a of the

EP&A Act or an application made to clear native vegetation under the Native Vegetation Conservation Act (1997). However the above relates mostly to the specific environmental assessment processes under the EP&A Act and does not constitute an "Eight Part Test of Significance".

Native Vegetation Conservation Act (1997)

The Service suggests that the proponents should also consider the provisions of the Native Vegetation Conservation Act (1997). The proposal may require the consent of the Director General of Land and Water Conservation.

The Native Vegetation Conservation Act also allows for Regional Vegetation Committees to create Regional Vegetation Management Plans that will set guidelines for vegetation management in each region. Please contact the Department of Land and Water Conservation if the proposed development is in one of these Regions or if you have any other queries regarding the NVC Act.

FAUNA

Background

Evidence suggests that Western NSW has suffered the highest extinction rate for indigenous mammals of any region in the world. Many other vertebrate species are currently threatened. One of the major reasons for such a high level of extinction has been the destruction of habitat. Native vegetation including wetland, riparian and remnant environments, are very significant areas of fauna habitat. Therefore any development in such areas should fully consider the impact on fauna and its habitat.

Report Requirements

The EIA document should include a report on the fauna (including protected and threatened species), which includes the following:

- detailed location map and identification of the area surveyed (including the location of photographs, transects, areas of significance etc),
- at least one of the following: a land satellite image, vegetation communities map, aerial photograph, or a remnant vegetation map,
- a complete list of all known and likely terrestrial and aquatic species (eg birds, mammals, reptiles and amphibians including scientific names). It is suggested that invertebrates also be considered as they form part of the food chain for many fauna species,
- those species which are protected, threatened or listed under any international agreements, as well as introduced species,
- those species known or likely to breed in the area,
- any species which have specific habitat requirements found within the project area,
- those species or populations which may be near the limit of their geographic range or are a disjunct/isolated population,
- assessment of the importance or otherwise of the location as a corridor, migratory route or drought refuge, in relation to other remnant vegetation, riparian and wetland areas or habitat in the region,
- assessment of the impacts of the proposal on all fauna and its habitat, at both the site and at the regional scale,
- identification of any mitigation measures proposed to limit or ameliorate the impact of the proposal,
- detailed methodologies used and a list of the reference literature cited, and,
- any other issues that may be considered relevant.

SEPP No. 44 - Koala Habitat Protection

The Shire may be listed in Schedule 1 of SEPP No. 44 - Koala Habitat Protection. If so, the requirements of the SEPP regarding Koala habitat protection should be considered by the proponents.

THREATENED SPECIES OF FAUNA AND FLORA

Apart from the need to consider the impact on protected species, the proponents will need to address the requirements of legislation that currently governs threatened species protection and impact assessment in NSW.

Attached is an information package on the Threatened Species Conservation Act (1995). The proponents will need to consider the provisions of this Act.

If during the flora or fauna assessment or survey, threatened species are found or are likely to occur in the area, the proponents must undertake an "Eight Part Test of Significance" as outlined in the new section 5A of the EP&A Act (as amended by the TSC Act) to determine whether or not the development would be likely to have a significant impact upon threatened species.

If, after having addressed Section 5A, the assessment concludes that there is likely to be a significant impact to threatened species then the proponents will need to furnish a Species Impact Statement (SIS) to the Director-General of

NPWS, in accordance with any formal requirements which she might deem appropriate, in this case. The proponent (not the consultant) must write to the Director General for such requirements.

Methods to reduce the impact on the protected and threatened species should be considered fully.

The Service advises that conducting an 'Eight Part Test' or a SIS according to the provisions of the EP&A Act and the TSC Act is a complex task and should be undertaken by suitably qualified person(s).

Eight Part Test

The '8 part test' is a statutory mechanism which allows decision makers to assess whether a proposed development or activity is likely to have a significant effect on threatened species, populations or ecological communities, or their habitats.

The '8 part test' is contained within section 5A of the EP&A Act and consists of eight factors which need to be addressed for informed decisions to be made regarding the effect of a proposed development or activity on threatened species, populations or ecological communities, or their habitats.

An information circular is available from the Western Zone for detailed information about the '8 part test".

AVAILABLE DATA

The Service can supply, at the standard cost, fauna prediction data and recorded fauna sightings data (Wildlife Atlas of NSW) to help in the investigation.

The following information on site recordings of Flora and Fauna is available from NPWS:

- Atlas of NSW Wildlife (1995). A NPWS database containing records of fauna and flora, including threatened species. Computer printouts for all records on a 1:100,000 mapsheet are available (at cost) from the Data Licensing Officer on (02) 9585 6684.
- Threatened Species of Western NSW (Dec. 1996). Species profiles including likely distribution, habitat and threats. Ringbound folders are available at $75.00 (plus $5 postage) from the Western Zone Office, Dubbo (02) 68835 300.

Other reference literature may be available for the subject locality/region. The proponent should explore this possibility thoroughly.

FURTHER INFORMATION

Should you wish to clarify any issues raised here or require further information please feel free to contact:

Environmental Planning Unit
Western Zone office
National Parks and Wildlife Service
48 -52 Wingewarra St
DUBBO NSW 2830

PH (02) 6883 5336
FAX (02) 6884 9382

RTA

Roads and Traffic Authority

WESTERN REGION
Road Safety, Traffic and Development Section
51-55 Currajong Street
PO Box 334
PARKES NSW 2870

DATE: 1 October, 1998

TO: Sam Haddad
DUAP
FAX: 02 9391 2111

FROM: Barry Garment
Development Officer
PHONE: 02 6862 8687
FAX: 02 6862 8414
EMAIL: barry-j-garment@rta.nsw.gov.au

FILE:

SUBJECT: Syerston Nickel Cobalt Project

CC: Lachlan & Parkes Shire Councils

Number of pages including this sheet: 1

As indicated at the Planning Focus Meeting on 24 Sept, the RTA requires the identification of the range of road movements by all types of vehicle during both the development and operational stages of the proposal.

In particular, the following issues should be addressed during preparation of the EIS:

Road Transport

- Preliminary indications are that the 3.0mt/a processing option will result in up to 200 semi trailer movements per day for limestone haulage. The sources of the limestone should be identified, together with quantities, haul routes, and an outline haulage timetable.
- The haulage fleet required for transport of limestone has potential to require a service infrastructure which would result in a significant number of vehicle movements additional to the actual haulage task. The characteristics of this infrastructure and its impacts should also be addressed.
- General issues relating to transport of the 600t Autoclave/s should be noted, but it is acknowledged as unlikely that detail issues would be known at time of preparation of the EIS.

Road/Rail Issues

- Preliminary indications are that the 3.0mt/a processing option will result in up to 4 train movements per day for general haulage along the Bogan Gate to Tullamore branch line.
- This frequency of service will require active control (Flashing Lights and Bells) at each of the railway crossings of MR350 (Bogan Gate to Tullamore Rd), MR57 (Condobolin to Tullamore) and of MR61 (Parkes to Condobolin).
- The RTA will require identification of contingencies for those occasions when rail timetabling for Syerston is not available (eg during grain haulage or other non-availability of rail). It is noted that daily inputs of freight other than limestone will require up to 150 semi trailer movements if rail is not available.

Yours Faithfully

NSW Heritage Office

Contact: M North
Telephone: 02-9849 9568
northm@heritage.nsw.gov.au
File: S90/07298/1
Your Ref: S98/01078

Mr David Mutton
Acting Director
Development and Infrastructure Assessment–DUAP
Governor Macquarie Tower
1 Farrer Place
Sydney 2000

Attention: Katherine de Silva

Dear Mr Mutton,

Re: Nickel and Cobalt Mine, Fifileld, Lachlan

I refer to your letter of 20/10/98 requesting comments on heritage requirements for the preparation of the above EIS. The EIS heritage assessment should address the following issues:

- The heritage significance of the site and any impacts the development may have upon this significance should be assessed. This assessment should include natural areas and places of Aboriginal, historic or archaeological significance. It should also include a consideration of wider heritage impacts in the area surrounding the site.
- The Heritage Council maintains the State Heritage Inventory which lists some items protected under the Heritage Act, 1977 and other statutory instruments. This register can be accessed through the Heritage Office home page on the Internet (http:/www.heritage.nsw.gov.au), or can be searched by Heritage Office staff by request. You should consult lists maintained by the NSW National Parks and Wildlife Service, the National Trust, the Australian Heritage Commission and the local council in order to identify any identified items of heritage significance in the area affected by the proposal. You should be aware however, that these lists are constantly evolving and that items with potential heritage significance may not yet be listed.
- Non-Aboriginal heritage items within the area affected by the proposal are should be identified by field survey. This should include any buildings, works, relics (including relics underwater), trees or places of non-Aboriginal heritage significance. A statement of significance and an assessment of the impact of the proposal on the heritage significance of these items should be undertaken. Any policies to conserve their heritage significant should be identified. This assessment should be undertaken in accordance with the guidelines in the NSW Heritage Manual. The field survey and assessment must be undertaken by a qualified archaeologist with historic sites experience. The Heritage Office can provide a list of suitable consultants.
- The relics provisions in the Heritage Act require an excavation permit to be obtained from the Heritage Council prior to commencement of works if disturbance to a site with

known or potential archaeological relics is proposed. If any unexpected archaeological relics are uncovered during the course of work excavation should cease and an excavation permit obtained.

For guidelines regarding the assessment of Aboriginal sites, please contact the NSW National Parks and Wildlife Service on (02) 9858 6444.

I have enclosed a printout of heritage items listed in the State Heritage Inventory database for the Shire of Lachlan. Impacts upon any of these heritage items by the proposal must be addressed in the EIS.

The Heritage Office would be happy to review any further documentation that may address any likely heritage impacts. If you have any questions, please do not hesitate to contact MacLaren North on (02) 9849 9568.

Yours sincerely

30/10/98

Rosalind Strong
Director

Encl: SHI printout

NSW State Heritage Inventory

Search Criteria:

Item Name:

Property Identifier:

Heritage Listings:

Street Name:

Suburb / Town:

Local Govt Area: Lachlan

Item Type:

Item Sub Type:

Search Results

Item Name	Address	Suburb	LGA	Listing No.
All Saints Anglican Parish Church		Condobolin	Lachlan	
All Saints' Parish Church		CONDOBOLIN	Lachlan	
Barratta Homestead And Stables	Moulemein Road, Approx. 50	BARRATTA	Lachlan	
Bogandillon Swamp			Lachlan	
Burdenda Carved Trees 15km NNE		Tottenham	Lachlan	
Cadow Homestead			Lachlan	
Cadow: Outbuildings & Cemetery	Forbes Road, Approximately	CONDOBOLIN	Lachlan	
Community Centre formerly Comm		Condobolin	Lachlan	
Community Centre Formerly Comm		CONDOBOLIN	Lachlan	
Condobolin General Cemetery	Boona Street	Condobolin	Lachlan	
Courthouse		Condobolin	Lachlan	
General Cemetery	Boona Street Corner Maitlan	CONDOBOLIN	Lachlan	
General Cemetery	Nymagee Road Corner Albert	TOTTENHAM	Lachlan	
General Cemetery	Nymagee Road Corner Albert	TOTTENHAM	Lachlan	
General Cemetery	Bena - Condobolin Road, 1k	BENA	Lachlan	
Goobothery Hill Site			Lachlan	
Goodwill and Manse			Lachlan	
Louisiana Carved Tree			Lachlan	
Melrose Homestead	Cobar Road, 55km North-we	CONDOBOLIN	Lachlan	
Melrose Homestead & Outbuildings	Cobar Road		Lachlan	
Mineral Hill		Mineral Hill	Lachlan	
National Australia Bank		Lake Cargelligo	Lachlan	
Private Cemetery on 'Cadow'	1km north off South Forbes R	Condobolin	Lachlan	
Private Cemetery On Cadow	South Forbes Road (off, 1km	CADOW	Lachlan	
Richard Cunninghams Grave		Tottenham (16.5 km f	Lachlan	
Royal Mail Hotel		LAKE CARGELLIGO	Lachlan	
Royal Mail Hotel		Lake Cargelligo	Lachlan	
State Bank		Lake Cargelligo	Lachlan	
Tinda General Cemetery	Tinda - Vermont Hill Road, 2k	TINDA	Lachlan	
Tollingo Mallee Area			Lachlan	
Water Tower		Condobolin	Lachlan	
Woggon Nature Reserve			Lachlan	