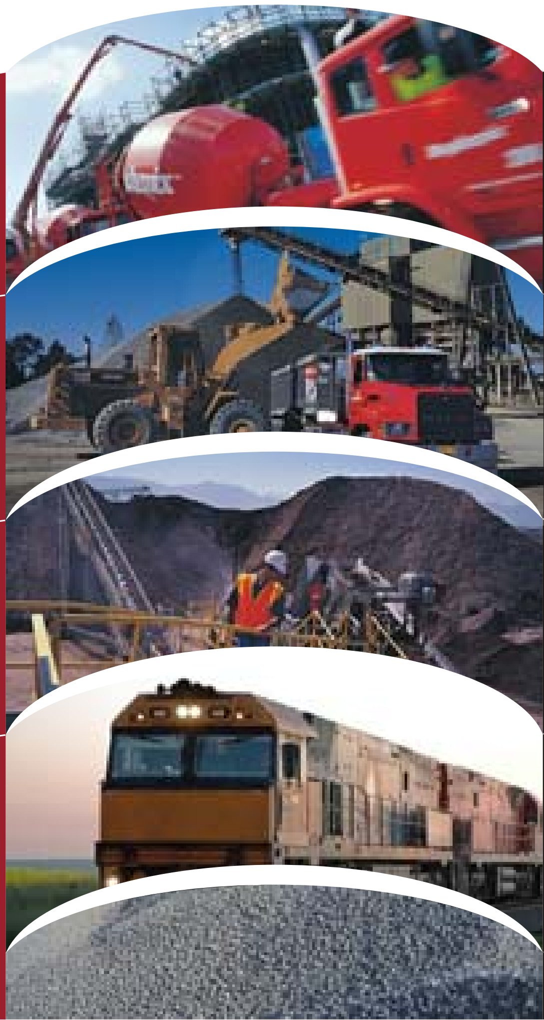
Environmental Impact Statement

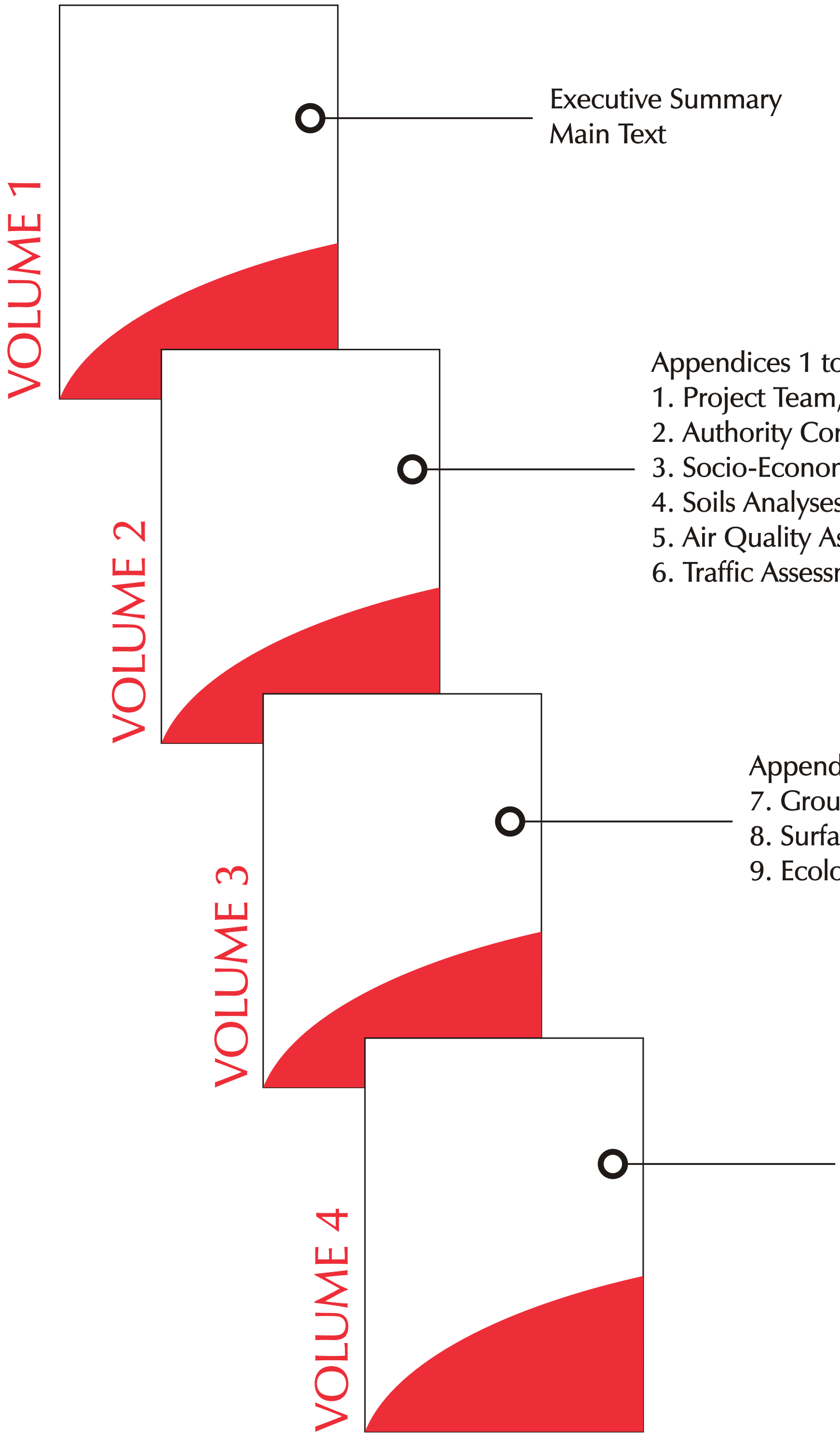
Readymix Holdings Pty Ltd
Proposed Lynwood Quarry, Marulan



VOLUME 1
MAIN TEXT

MAY 2005

Umwelt
Environmental Consultants



Executive Summary
Main Text

Appendices 1 to 6
1. Project Team, EIS Form & Land Schedule
2. Authority Correspondence
3. Socio-Economic Assessment
4. Soils Analyses
5. Air Quality Assessment
6. Traffic Assessment

Appendices 7 to 9
7. Groundwater Assessment
8. Surface Water Management
9. Ecology Assessment

Appendices 10 to 12
10. Noise & Blasting Assessment
11. Aboriginal Archaeology Assessment
12. Historic Heritage Assessment

CONTENTS OF VOLUME 1

- Executive Summary
- Main Text

TABLE OF CONTENTS

EXECUTIVE SUMMARY ... 1

1.0 INTRODUCTION ... 1.1

1.1 OBJECTIVES AND OVERVIEW OF THE PROJECT ... 1.1
1.1.1 Objectives ... 1.1
1.1.2 Overview of the Project ... 1.2
1.2 READYMIX HOLDINGS PTY LIMITED ... 1.3
1.3 OVERVIEW OF THE EXISTING ENVIRONMENT ... 1.3
1.3.1 Project Area and Surrounding Land Use ... 1.3
1.3.2 Property Description and Land Ownership ... 1.4
1.3.3 Overview of Environmental Features ... 1.4
1.4 PLANNING AND APPROVALS PROCESS ... 1.5
1.4.1 Approval Process ... 1.5
1.5 CONSULTATION ... 1.6
1.6 PROJECT TEAM ... 1.6
1.7 EIS STRUCTURE ... 1.7

2.0 STAKEHOLDER CONSULTATION AND IDENTIFICATION OF ENVIRONMENTAL ISSUES ... 2.1

2.1 STAKEHOLDER CONSULTATION ... 2.1
2.1.1 Authority Consultation ... 2.1
2.1.2 Community and Other Stakeholder Consultation ... 2.2
2.2 IDENTIFICATION OF ENVIRONMENTAL ISSUES ... 2.4
2.2.1 Issues Raised by Authority Stakeholders ... 2.4
2.2.2 Issues Raised by Community and Other Stakeholders ... 2.5
2.2.3 Environmental Issue Summary ... 2.6

3.0 DESCRIPTION OF THE PROJECT ... 3.1

3.1 THE DEVELOPMENT APPLICATION AREA ... 3.1
3.2 RESOURCE, PRODUCTS AND MARKETS ... 3.1
3.2.1 Target Resource ... 3.1
3.2.2 Products and Markets ... 3.2
3.3 CONSTRUCTION PHASE ... 3.4
3.3.1 Construction Phase Site Access ... 3.5
3.4 PROPOSED QUARRYING OPERATIONS ... 3.6
3.4.1 Conceptual Quarry Plan ... 3.6
3.4.2 Conceptual Production Schedule ... 3.7

3.4.3 Out-of-pit Overburden Emplacement Areas 3.7
3.4.4 Quarrying Techniques and Equipment 3.8
3.4.5 Drill and Blast 3.11
3.5 PROPOSED INFRASTRUCTURE 3.11
3.5.1 Crushing and Screening Process 3.11
3.5.2 Rail Loading Facility and Rail Transportation 3.14
3.5.3 Truck Loading Facility and Road Transportation 3.16
3.5.4 Access Road and Hume Highway Intersection 3.16
3.5.5 Workshop and Refuelling Facility 3.17
3.5.6 Rail Bridge 3.17
3.5.7 Administration, Laboratory and Employee Facilities 3.18
3.5.8 Electrical and Power Reticulation 3.18
3.5.9 Other Infrastructure 3.18
3.5.10 Staged Construction of Infrastructure 3.18
3.6 LIGHTING 3.19
3.7 WATER SERVICES 3.19
3.7.1 Operational Water 3.19
3.7.2 Potable Water 3.19
3.7.3 Sewage Treatment 3.19
3.8 SITE SECURITY 3.20
3.9 HOURS OF OPERATION 3.20
3.9.1 Construction Phase 3.20
3.9.2 Operational Phase 3.20
3.10 CONSTRUCTION AND OPERATIONAL WORKFORCE 3.21
3.10.1 Construction Workforce 3.21
3.10.2 Operational Workforce 3.21
3.11 REHABILITATION AND DECOMMISSIONING 3.21
3.11.1 Rehabilitation 3.21
3.11.2 Conceptual Decommissioning Plan 3.23

4.0 RELEVANT PLANNING CONSIDERATIONS 4.1

4.1 COMMONWEALTH LEGISLATION 4.1
4.1.1 Environment Protection and Biodiversity Conservation Act 1999 ..... 4.1
4.1.2 Native Title Act 1993 ..... 4.1
4.2 NEW SOUTH WALES LEGISLATION 4.2
4.2.1 Environmental Planning and Assessment Act 1979 ..... 4.2
4.2.2 Water Management Act 2000 ..... 4.4
4.2.3 National Parks and Wildlife Act 1974 ..... 4.5

4.2.4 Threatened Species Conservation Act 1995 .... 4.6
4.2.5 Fisheries Management Act 1994 .... 4.6
4.2.6 Protection of the Environment Operations Act 1997 .... 4.6
4.2.7 Roads Act 1993 .... 4.7
4.2.8 Crown Lands Act 1989 .... 4.7
4.2.9 Aboriginal Land Rights Act 1983 .... 4.8
4.2.10 Heritage Act 1977 .... 4.8
4.2.11 Environmentally Hazardous Chemicals Act 1985 .... 4.8
4.2.12 Dangerous Goods Act 1975 .... 4.8
4.2.13 Dams Safety Act 1978 .... 4.9
4.2.14 Native Vegetation Conservation Act 1997 .... 4.9

4.3 STATE ENVIRONMENTAL PLANNING POLICIES 4.9

4.3.1 State Environmental Planning Policy 11 .... 4.9
4.3.2 State Environmental Planning Policy 33 .... 4.10
4.3.3 State Environmental Planning Policy 34 .... 4.10
4.3.4 State Environmental Planning Policy 44 .... 4.10
4.3.5 State Environmental Planning Policy 55 .... 4.10
4.3.6 State Environmental Planning Policy 58 .... 4.11

4.4 REGIONAL ENVIRONMENTAL PLANS AND STRATEGIES 4.11

4.4.1 Draft Drinking Water Catchment Regional Environmental Plan 4.11
4.4.2 Sydney to Canberra Corridor Strategy 4.12

4.5 LOCAL ENVIRONMENTAL PLAN AND LAND ZONING 4.12

4.5.1 Mulwaree Local Environmental Plan 4.12

5.0 EXISTING ENVIRONMENT AND IMPACT ASSESSMENT 5.1

5.1 GEOLOGY 5.1

5.1.1 Regional Geology 5.1
5.1.2 Geological Investigations 5.1
5.1.3 Geology of the Project Area 5.2

5.2 TOPOGRAPHY, SOILS, LAND CAPABILITY AND AGRICULTURAL SUITABILITY 5.3

5.2.1 Topography 5.3
5.2.2 Soils 5.4
5.2.3 Land Capability 5.7
5.2.4 Agricultural Suitability 5.8

5.3 CLIMATE 5.9

5.3.1 Temperature 5.10
5.3.2 Rainfall and Evaporation 5.10
5.3.3 Wind Speed and Direction 5.11

5.4 LAND USE AND TENURE ... 5.12
5.4.1 Land Use ... 5.12
5.4.2 Land Ownership ... 5.15
5.5 PUBLIC INFRASTRUCTURE ASSESSMENT ... 5.16
5.5.1 Roads and Traffic ... 5.16
5.5.2 Rail Infrastructure ... 5.20
5.5.3 Utilities and Other Infrastructure ... 5.20
5.6 WATER RESOURCE ASSESSMENT ... 5.21
5.6.1 Groundwater ... 5.21
5.6.2 Surface Water ... 5.24
5.6.3 Water Planning Context ... 5.29
5.7 ECOLOGICAL ASSESSMENT ... 5.29
5.7.1 Existing Flora ... 5.29
5.7.2 Existing Fauna ... 5.33
5.7.3 Ecological Impact Assessment ... 5.35
5.8 AIR QUALITY ... 5.37
5.8.1 Air Quality Goals ... 5.37
5.8.2 Existing Air Quality ... 5.38
5.8.3 Assessment Methodology ... 5.39
5.8.4 Dust Controls Included in Modelling ... 5.40
5.8.5 Air Quality Impact Assessment ... 5.40
5.9 NOISE AND BLASTING ... 5.42
5.9.1 Noise Assessment ... 5.42
5.9.2 Blasting Assessment ... 5.52
5.10 HERITAGE ASSESSMENT ... 5.55
5.10.1 Aboriginal Archaeology ... 5.55
5.10.2 Historic Heritage ... 5.59
5.11 VISUAL ASSESSMENT ... 5.64
5.11.1 Existing Visual Amenity ... 5.64
5.11.2 Visibility of the Project ... 5.65
5.11.3 Viewing Points and Assessment Methodology ... 5.66
5.11.4 Visual Impacts and Management ... 5.66
5.12 HAZARD ASSESSMENT ... 5.69
5.12.1 SEPP 33 Assessment ... 5.69
5.12.2 Bushfire Hazard ... 5.73

5.13 GREENHOUSE GAS EMISSIONS AND ENERGY CONSUMPTION ASSESSMENT 5.76
5.13.1 Assessment Context 5.76
5.13.2 Calculations and Assessment Findings 5.77
5.13.3 Emissions Context 5.79
5.13.4 Impact of Maximum Rail Transport Scenario 5.79
5.14 SOCIO-ECONOMIC ASSESSMENT 5.79
5.14.1 Assessment Methodology 5.79
5.14.2 Social Profile 5.80
5.14.3 Socio-Economic Impact Assessment 5.82
5.15 OVERVIEW OF CUMULATIVE IMPACTS 5.85

6.0 ALTERNATIVES AND JUSTIFICATION 6.1
6.1 ALTERNATIVE LOCATIONS AND CONSTRUCTION MATERIAL SOURCING OPTIONS 6.1
6.1.1 Alternative Locations Considered 6.1
6.1.2 Alternative of Expanding Existing Quarries 6.1
6.1.3 Alternative Sources of Construction Materials 6.2
6.2 ALTERNATIVE QUARRY AND INFRASTRUCTURE PLANS 6.3
6.2.1 Alternative Quarry Plans 6.3
6.2.2 Alternative Quarrying Techniques 6.4
6.2.3 Alternative Infrastructure Options 6.4
6.3 ALTERNATIVE OF NOT PROCEEDING 6.8
6.4 JUSTIFICATION FOR THE PROPOSED DEVELOPMENT 6.8
6.4.1 Need for and Supply of Construction Materials 6.8
6.4.2 Justification for Lynwood Quarry 6.10
6.4.3 Ecologically Sustainable Development 6.13

7.0 ENVIRONMENTAL MANAGEMENT AND MONITORING 7.1
7.1 ENVIRONMENTAL MANAGEMENT SYSTEM 7.1
7.1.1 Environmental Management Plans 7.2
7.2 ENVIRONMENTAL MANAGEMENT MEASURES 7.3
7.2.1 Topsoil Management 7.3
7.2.2 Roads and Traffic Management 7.4
7.2.3 Water Management 7.5
7.2.4 Ecology Management 7.8
7.2.5 Dust Control 7.10
7.2.6 Noise and Blasting Management 7.11
7.2.7 Aboriginal Archaeology Management 7.13

7.2.8 Historic Heritage 7.14
7.2.9 Visual Impact Management and Landscaping 7.15
7.2.10 Waste Management 7.16
7.2.11 Greenhouse Gas Emissions and Energy Use 7.16
7.2.12 Rehabilitation and Site Decommissioning 7.17
7.3 ENVIRONMENTAL MONITORING PROGRAM 7.18
7.3.1 Meteorological Monitoring 7.18
7.3.2 Water Monitoring 7.18
7.3.3 Ecological Monitoring 7.19
7.3.4 Air Quality 7.19
7.3.5 Noise and Blast Monitoring 7.20
7.4 ONGOING COMMUNITY INVOLVEMENT AND MONITORING 7.21
7.4.1 Community Communication Mechanisms 7.21
7.4.2 Community Contributions 7.21
7.4.3 Monitoring 7.22

8.0 CHECKLIST OF AGENCY REQUIREMENTS 8.1

9.0 REFERENCES 9.1

10.0 ABBREVIATIONS AND GLOSSARY 10.1
10.1 ABBREVIATIONS 10.1
10.2 GLOSSARY 10.2

FIGURES

1.1 Locality Plan 1.1

1.2 Proposed Development 1.1

1.3 Land Ownership 1.4

3.1 Construction Phase Conceptual Layout 3.5

3.2 Year 1 Quarry Plan 3.6

3.3 Year 2 Quarry Plan 3.6

3.4 Year 5 Quarry Plan 3.6

3.5 Year 10 Quarry Plan 3.6

3.6 Year 15 Quarry Plan 3.6

3.7 Year 20 Quarry Plan 3.6

3.8 Year 25 Quarry Plan 3.6

3.9 Year 30 Quarry Plan 3.6

3.10 Schematic Representation of Quarry Process 3.8

3.11 Key Infrastructure Components 3.11

3.12 Crushing and Screening Plant Layout 3.12

3.13 Crushing and Screening Plant Representative Cross-section 1 ....3.12

3.14 Crushing and Screening Plant Representative Cross-section 2 ....3.12

3.15 Crushing and Screening Plant Representative Cross-section 3 ....3.12

3.16 Crushing and Screening Flow Chart 3.12

3.17 Proposed Interchange 3.17

3.18 Workshop, Store and Administration Area Elevation 3.17

3.19 Country Energy Proposed Substation and Proposed Lynwood Quarry Electricity Supply Network 3.18

3.20 Possible Staged Construction Layout of Crushing and Screening Plant 3.18

3.21 Representative Cross-section of Rehabilitated Quarry Benches 3.23

3.21a Representative Cross-section of Rehabilitated Quarry Pit 3.23

3.22 Year 30 Progressive Rehabilitation 3.23

3.23 Year 30 Conceptual Final Rehabilitation....3.23

4.1 Zoning 4.13

4.2 Proposed Future Land Use – Mulwaree Settlement Strategy 4.16

5.1 Regional Geology 5.1

5.2 Exploration Drilling Program 5.1

5.3 Site Geology 5.2

5.4 Representative Geological Cross-sections 5.2

5.5 Topography and Drainage 5.3

5.6 Soil Landscapes....5.4

5.7 Land Capability 5.7

5.8 Post Quarrying Land Capability 5.8

5.9 Agricultural Suitability....5.9

5.10 Monitoring Locations Plan 5.9

5.11 Average Monthly Rainfall at Marulan 5.10

5.12 Existing Land Use....5.12

5.13 Proposed Crown Road and Crown Road Reserve Closures....5.16

5.14 Services in the Vicinity of the Project Area 5.20

5.15 Water Management System 5.26

5.16 Vegetation Communities and Significant Flora Species 5.30

5.17 Threatened Fauna Species Locations....5.34

5.18 24-hour Average PM_{10} Contours Years 10 and 30....5.41

5.19 Annual Average PM_{10} Contours Years 10 and 30....5.41

5.20 Annual Average TSP Contours Years 10 and 30....5.41

5.21 Annual Dust Deposition Contours Years 10 and 30 ....5.41

5.22 Predicted Noise Contours during Calm Meteorological Conditions, Year 10 ....5.48

5.23 Predicted Noise Contours during Prevailing Evening Wind Conditions, Year 10 ....5.49

5.24 Predicted Noise Contours during Temperature Inversion Conditions, Year 1 ....5.49

5.25 Aboriginal Sites within the Project Area 5.56

5.26 Recommended Management Measures for Aboriginal Sites 5.59

5.27 Historic Heritage Sites within the Project Area 5.60

5.28 Existing Hume Highway Road Reserve & Proposed Interchange on 1958 Parish Map 5.60

5.29 Viewing Locations – Location 2...5.66

5.30 Viewing Locations – Location 5...5.66

5.31 Viewing Locations – Location 6...5.66

5.32 Viewing Locations – Location 7...5.66

5.33 Visual Transect Assessment Point 2, 5 & 6 ....5.67

5.34 Visual Transect Assessment Point 7 ....5.68

6.1 Selected Alternative 30 Year Quarry Plans 6.3

6.2 Selected Alternative Infrastructure Designs Considered 6.5

6.3 Selected Alternative Hume Highway Intersection Options Considered 6.7

7.1 Habitat Management Area and Riparian Zone Rehabilitation 7.8

7.2 Proposed Vegetated Screens 7.15

7.3 Proposed Monitoring Locations 7.18

APPENDICES

1 Project Team, EIS Form and Land Schedule

2 Authority Correspondence

3 Socio-Economic Assessment

4 Soils Analyses

5 Air Quality Assessment

6 Traffic Assessment

7 Groundwater Assessment

8 Surface Water Management

8B Water Planning Context

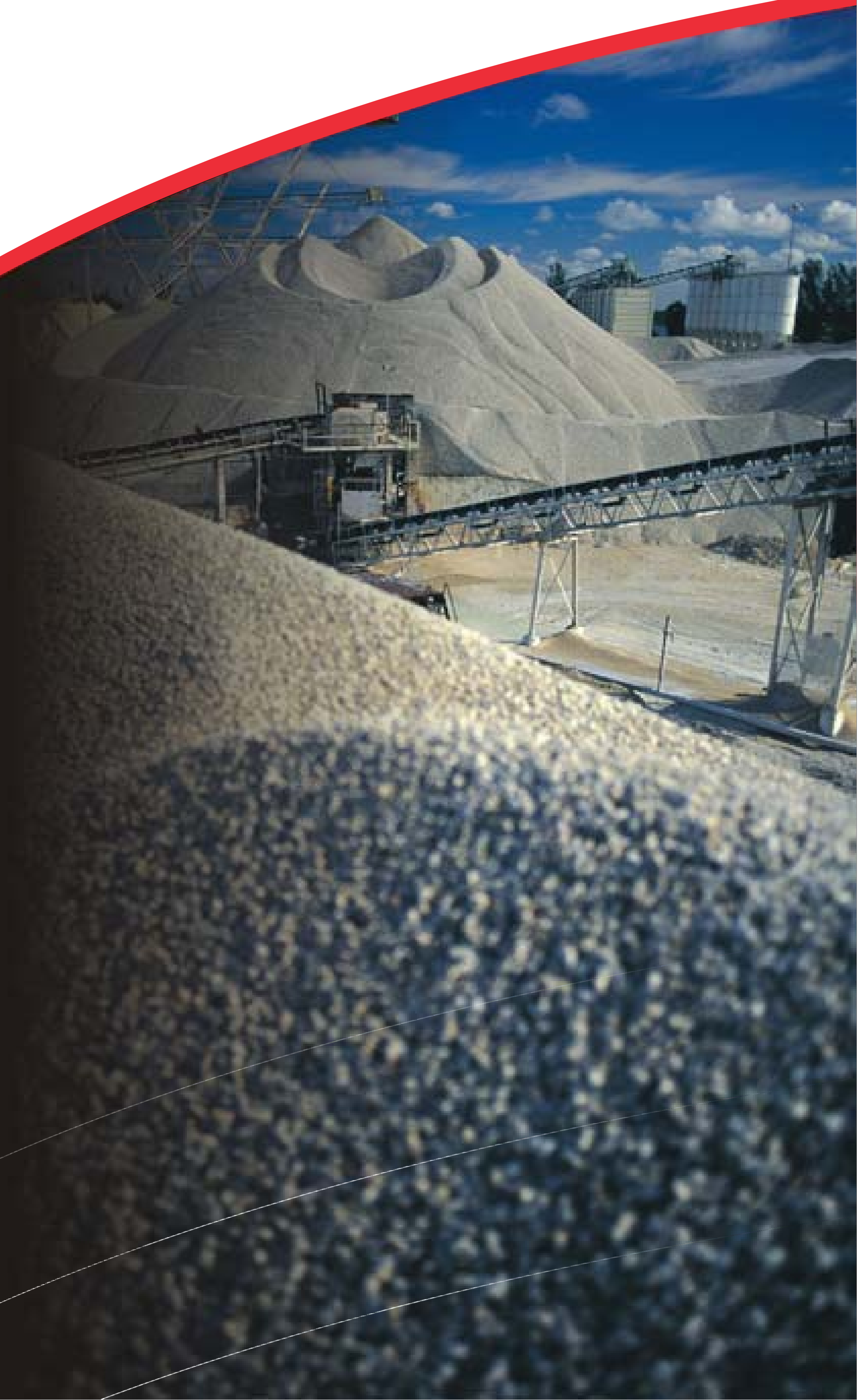
9 Ecology Assessment

10 Noise and Blasting Assessment

11 Aboriginal Archaeology Assessment

12 Historic Heritage Assessment

Executive Summary



Executive Summary

Introduction

Readymix Holdings Pty Limited (Readymix) proposes to establish a hard rock quarry on its land to the west of Marulan in the Southern Tablelands region of NSW. The proposed Lynwood Quarry (the project) will be located in the Goulburn Mulwaree Local Government Area approximately 160 kilometres southwest of Sydney and approximately 27 kilometres northeast of Goulburn (refer to **Figure 1**).

The project is intended to provide a long-term supply of high quality construction material into the Sydney, regional and local markets. The supply to the Sydney market is intended to replace Readymix's current production from the Penrith Lakes Scheme which is likely to be exhausted around 2010. The project area contains a substantial, high quality hard rock resource with ready transport access to the Main Southern Railway and Hume Highway. The quarry is proposed to produce up to 5 million tonnes per annum (Mtpa) of saleable quarry product with approval sought for an initial 30 year quarrying period. The target resource has an expected life of in excess of 90 years.

The Project

The location and extent of the 30 year quarry plan is shown on **Figure 2**. The quarry pit is proposed to be located to the north of the Main Southern Railway in the western portion of the project area, with further resource existing to the east of the proposed quarry pit and to the south of the railway.

The key infrastructure proposed to be established for the quarry will include:

- a modern three phase crushing and screening plant which will be enclosed and have a dust extraction system;
- a balloon rail loop and train loading facility;
- a truck loading facility;
- an access road linking directly with the Hume Highway via an interchange to be constructed south of Marulan; and
- other ancillary infrastructure including a pre-coat plant, workshop, laboratory, office and amenity buildings, wheel wash station, weighbridge and other minor works.

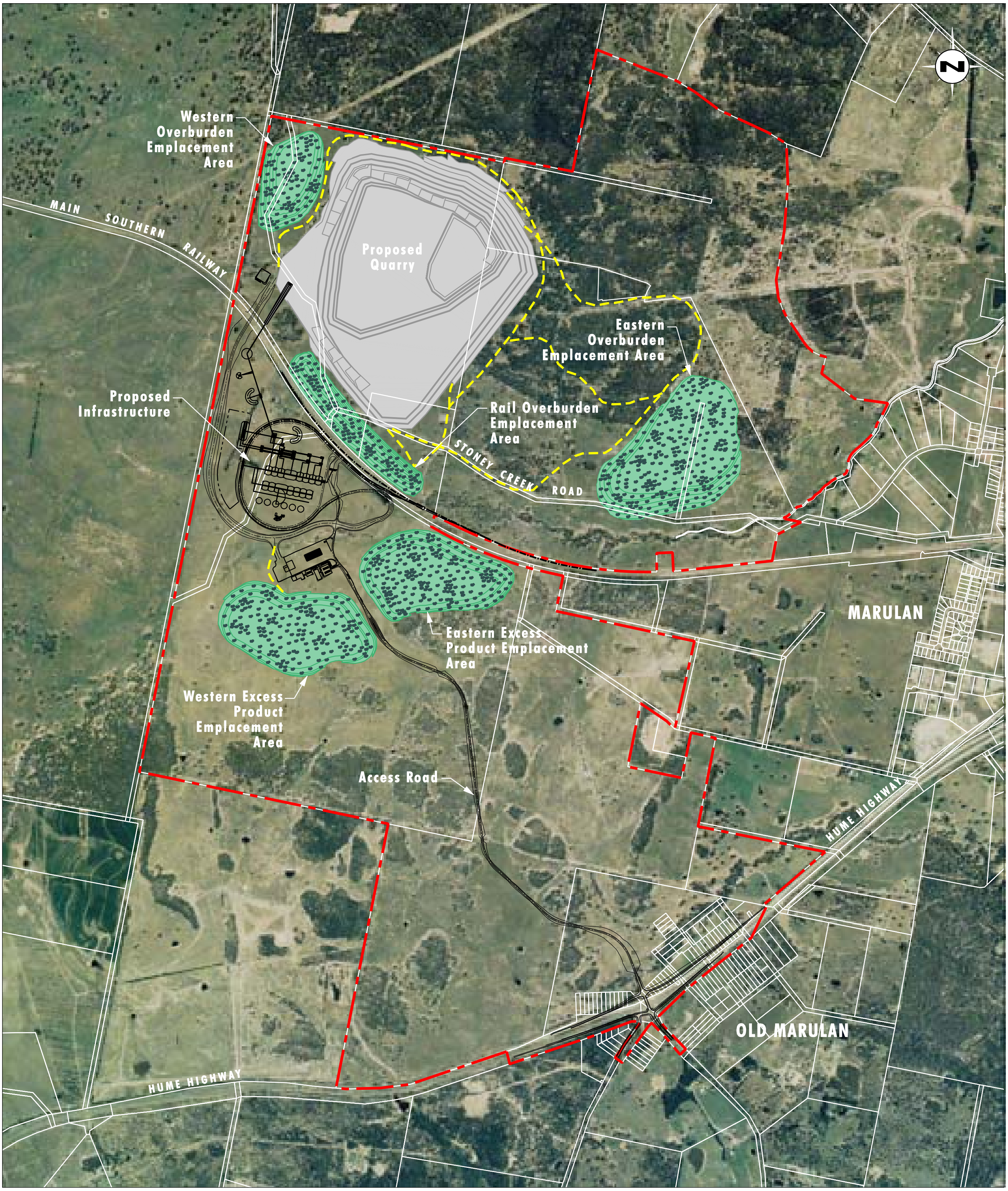
Approval is sought to transport all of the 5 Mtpa saleable product from the project via the dedicated train loading facility, with approval also sought to transport up to 1.5 Mtpa of the total 5 Mtpa by road transport via the Hume Highway.

Some of the material extracted as part of the quarrying process will not be suitable for processing and sale and consequently emplacement areas will be required. Due to quarry planning constraints and the potential for resource sterilisation, in-pit dumping will not be possible and consequently out-of-pit emplacement areas will be required. The proposed location of these emplacement areas is shown on **Figure 2**.

The quarry is proposed to generally operate 24 hours per day, seven days per week. Operating hours will be limited for some activities, to reduce potential noise impacts.

FIGURE 1

Locality Plan



Base Source: LPI 2004, Readymix Holdings Pty Ltd (Aerial Photo March 2005)

0 0.5 1 1.25km

Legend

- Project Area
- Haul Road
- Quarry Area
- Rehabilitated Area

FIGURE 2

Proposed 30 Year Quarry Plan

Justification

This project, if approved, will provide a long-term, high quality supply of heavy construction materials into the Sydney and regional markets. This supply is needed to replace supply from existing quarries that are nearing the end of their resources and is essential for the security and economic viability of the Sydney construction industry. The project will provide direct employment for approximately 115 people at the quarry, flow-on employment for an estimated 129 people and security of employment for personnel working in Readymix's Sydney region concrete and asphalt businesses. The project will also provide major economic benefits in the form of capital expenditure ($150M to $195M), wages (estimated direct $9.1M per annum, and indirect $6.7M per annum), annual operating expenditure, and through payment of State and Commonwealth taxes and fees.

It should also be noted that the Lynwood resource has been identified by the Department of Primary Industries (DPI) (Mineral Resources Division) as a regionally significant hard rock resource in the Department's Section 117 (2) advice to Goulburn Mulwaree Council under the *Environmental Planning and Assessment Act* 1979 (NSW). This advice facilitates the consideration of the resource during future planning decisions within the region.

Lynwood Quarry has been designed to ensure that environmental impacts are reduced as much as practicable, with the impact assessment contained in this Environmental Impact Statement (EIS) demonstrating that the project complies with relevant legislation, government policy and guidelines.

Social impacts have also been assessed and it is considered that the social benefits of the project will outweigh any potential negative impacts. The detailed community involvement program undertaken as part of the project has demonstrated that the project has the strong support of the local community with key findings including:

- the majority of the local community is supportive of the project, with approximately 80% of respondents to a random phone survey approving of the proposal;
- nearly all respondents (92%) believed the proposed quarry would make an important contribution to the local economy and that it would not detract from the area (78%); and
- the majority of respondents (79%) believed that the benefits a quarry would bring to the area would outweigh any of the disadvantages.

Consultation

Extensive consultation with community, government authority and other relevant stakeholders was undertaken throughout the project. The consultation program was designed to inform stakeholders about the project and to allow early identification of any issues for consideration in the project design and EIS process. The detailed consultation program included newsletters, individual meetings, presentations to community interest groups and an information day. Consultation was also undertaken with representatives of the local Aboriginal community as part of the Aboriginal archaeological and cultural heritage assessment process.

Extensive government authority consultation included the planning focus meeting, individual agency meetings and site inspections. Owners of services and infrastructure within or in close proximity to the project area were also consulted, including the Australian Rail Track Corporation (ARTC), AGL and Country Energy.

Approval Process

The project is Designated Development pursuant to Schedule 3 of the *Environmental Planning and Assessment Regulation* 2000 (NSW). Therefore, this EIS has been prepared to accompany the Development Application (DA) submitted for the project.

The project is also State Significant Development in accordance with a declaration under Section 76A(7) of the *Environmental Planning and Assessment Act* 1979 (NSW) by the then Minister for Urban Affairs and Planning dated 3 August 1999. Consequently, the DA and EIS will be submitted to the Department of Infrastructure, Planning and Natural Resources (DIPNR) for determination by the Minister for Infrastructure and Planning.

If development consent is granted, various approvals, licences and permits will be required prior to the commencement of certain site activities. Therefore, under Section 91 of the EP&A Act, the development is also Integrated Development. The agencies that administer these subsequent approvals are referred to as approval bodies. The approval bodies will assess the DA and provide general terms of approval for the Minister for Infrastructure and Planning to consider in regard to development consent, if granted. The approval bodies include the Department of Environment and Conservation (DEC), DIPNR, Roads and Traffic Authority (RTA), Goulburn Mulwaree Council, Department of Lands and NSW Heritage Office.

Environmental Assessment

Land & Environmental Context

Readymix owns the majority of land within the project area. Other land ownership within the project area includes several small parcels of Crown land adjacent to the Hume Highway, a small area of Crown land associated with the bed of Joarimin Creek, a number of Crown road reserves, a small area of land owned by the Roads & Traffic Authority (RTA) adjacent to the Hume Highway and two small parcels of old system title land whose owner cannot be located.

The project area lies within the catchments of Joarimin, Lockyersleigh and Marulan Creeks. Joarimin and Lockyersleigh Creeks drain to the Wollondilly River which is part of the Warragamba Dam catchment area, forming part of Sydney's drinking water supply. Marulan Creek is part of the Shoalhaven River system which also contributes to Sydney's drinking water supplies.

The majority of the project area has been previously cleared, with relatively large patches of remnant vegetation existing in the northern portion of the project area. The balance of the project area consists of cleared grazing land with small patches of vegetation. The vegetation was generally found to have been heavily modified by past and ongoing agricultural activities and was considered to be reasonably representative of regional vegetation communities and condition.

The project area is surrounded by rural land to the north, west and south. A rural residential subdivision is located adjacent to the northeastern boundary and the township of Marulan approximately 1 kilometre to the east of the project area boundary. The township of Marulan has a population of approximately 450 people.

Water Resources

Groundwater

Groundwater is generally present throughout the area, however, the porphyry bedrock is poorly to very poorly permeable. The water table is generally well below ground surface, even in the vicinity of drainage lines.

Groundwater inflows into the quarry are expected to gradually increase over the life of the quarry due to its expanding footprint and depth. The predicted average inflow rates are relatively low (maximum 26.6 ML per year in year 30), consistent with the very low hydraulic conductivity values derived from the piezometer testing program. Groundwater modelling indicates that the impact of the quarry on groundwater levels during the life of the project will be limited to within 1.5 kilometres or less of the quarry pit. No existing groundwater bores are predicted to be impacted by the project. There are no groundwater dependent ecosystems within the predicted area of influence and therefore the project will not impact on any such ecosystems.

Surface Water

As discussed above, the project area is located within the catchments of Joarimin, Lockyersleigh and Marulan Creeks, which form part of the Sydney drinking water catchment. Consequently, a comprehensive water management system has therefore been developed for the project to ensure that the impacts on surface water resources are minimised.

The proposed water management system will capture runoff from the proposed disturbance area. The system has been designed to capture the majority of this water for re-use on site, but during prolonged wet periods a proportion of this water may be released off site. The sizing and design of the sediment control dams will ensure that downstream water quality is maintained. Water quality modelling shows that the project will reduce pollutant loads at the project area boundary when compared with the existing situation, providing a beneficial effect on downstream water quality.

Surface water capture associated with the proposed project will result in a decrease in annual flow volumes immediately downstream of the quarry on both Joarimin and Lockyersleigh Creeks. Flows in Marulan Creek will be unaffected. This reduction in flows will not impact on downstream water users, nor significantly impact on available aquatic habitat or availability of watering holes along the creeks. The impact of the project on the annual flow volumes of the Wollondilly River downstream of its confluence with Joarimin Creek (i.e. downstream of the project) are estimated to be less than or equal to 0.1%. On this basis it is considered that the project will not have a significant adverse impact on water quality or quantity in the Wollondilly River system or on the Warragamba Dam catchment.

The project will be a net water user in dry rainfall years once full production is reached and an external water supply will therefore be required. A number of potential external water supply sources have been identified in order to ensure sufficient water is available for the operation. These include the use of existing surface water extraction licences and potential re-use of effluent from the Marulan sewage treatment plant.

The water management system developed for the project ensures that it is consistent with all relevant planning policies, catchment and regional plans.

Air Quality

An air quality assessment has been conducted for the project to quantify and assess dust emissions and impacts from the project. Preliminary dust modelling was undertaken early in the design phase of the quarry in order to identify any potentially significant dust issues so that appropriate controls could be built into the project design. One of the major controls was the purchase of appropriate buffer land to the east of the quarry resource. The establishment of this buffer land has ensured that impacts on nearby residential receivers is limited. Other key dust controls include the enclosure of the crushing and screening plant and the use of a dust extraction system.

Air quality modelling has been completed for deposited dust, total suspended particulates and PM_{10} dust concentrations for numerous quarry stages. The assessment found that the project will comply with the relevant air quality goals at all existing residences and approved residential locations.

Noise and Blasting

Noise

A comprehensive noise impact assessment was undertaken for the project. This assessment provides details of existing noise levels within the project area and surrounds, determines the noise impact assessment criteria based on existing noise levels and the relevant DEC guidelines, predicts noise levels that are expected to result from the project and provides an assessment of these noise levels against the relevant criteria.

A background noise level survey was undertaken for the project identifying a number of existing noise influences within the vicinity of the project area. Some monitored locations exhibited typical ‘rural’ noises (wind in the trees, birds, etc.), while other locations were dominated by noises from the Hume Highway, Main Southern Railway and noise from the Marulan township. These measured background noise levels were used to develop the noise criteria that apply to the project.

Preliminary noise modelling was a key factor in quarry planning and infrastructure layout, with a number of additional engineering and management controls developed to minimise noise impact. Key controls include limiting working hours of specific plant and equipment, enclosure of the crushing and screening plant, lining of the truck and train loading bins and noise attenuation of specific mobile equipment.

Noise impacts were predicted for both calm and prevailing weather conditions for six representative operational scenarios. Noise emissions from the project are predicted to meet all project specific noise criteria for operation during daytime, evening and night-time periods at all existing and approved residential locations. The assessment identified that the project will exceed noise goals on portions of two parcels of vacant land adjacent to the project area. Noise levels from the project are also predicted to be below relevant sleep disturbance goals for night-time operations at all assessment locations.

Assessments of rail transport noise impacts found that the predicted increase of noise emissions from total rail movements on the Main Southern Railway will be imperceptible to residential receivers along the rail line. The assessment also found that the road traffic noise resulting from vehicle movements at peak road transport levels will be imperceptible to receivers along the roadway and are within the relevant DEC noise limit.

Modelling of construction phase noise impacts was also undertaken and found that the predicted noise levels will meet all construction noise goals at all existing and approved residential locations.

Blasting

Airblast and ground vibration were predicted using the developed site laws for the project area. The assessment predicted that airblast and ground vibration will comply with the relevant criteria at all surrounding residential receivers for each stage of the project.

The assessment also considered potentially sensitive infrastructure. Predicted vibration levels at the closest point of the quarry to the natural gas pipeline, proposed drinking water holding tank and Main Southern Railway are predicted to be below the level likely to cause impact on these structures. Specific blast design controls are required to manage impacts on the Main Southern Railway.

Ecology

Seven vegetation communities were described within the project area including five woodland/forest communities, derived pasture and aquatic vegetation. The vegetation of the project area has been heavily modified by past and ongoing agricultural activities, resulting in fragmentation and degradation. In terms of the general diversity of flora species and vegetation communities, the project area appears to be reasonably representative of surrounding areas.

No threatened flora species were recorded within the project area during the detailed site surveys, however, one species subject to a preliminary determination to be listed as a vulnerable species under the TSC Act was recorded, Camden woollybutt (*Eucalyptus macarthurii*). This species was recorded in a small stand (0.18 hectares) and appeared to be either planted or to have established as a direct result of ground disturbance. Five threatened fauna species were also recorded in the project area, including the squirrel glider, speckled warbler, eastern bentwing-bat, eastern freetail-bat and eastern false pipistrelle. Five migratory species listed under the Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth) were also recorded.

The project will require the removal of approximately 103 hectares of woodland / forest vegetation. This impact is considered unlikely to be significant in a local or regional context, particularly when considering the proposed mitigation measures. These measures include the establishment of a habitat management area, rehabilitation of riparian corridors and revegetation with the aim of establishing a vegetated corridor through the project area.

An assessment of the impact of the project on threatened species in accordance with Section 5A of the *Environmental Planning and Assessment Act* 1979 (NSW) found that project will not significantly impact on these species. A number of management and mitigation measures are proposed to minimise potential impacts including the re-establishment of an area of Camden woollybutt and provision of habitat structures for threatened fauna species.

An assessment of the potential impact of the project on migratory species in accordance with the *EPBC Act 1999* found that none will be significantly impacted.

Heritage

Aboriginal Heritage

A comprehensive Aboriginal archaeological and cultural heritage assessment was undertaken for the project in accordance with DEC guidelines and in consultation with representatives of the local Aboriginal community. The survey recorded a total of 50 previously unrecorded sites within the project area. Of the sites recorded, 29 were artefact scatters (with two or more artefacts), 12 were isolated finds, seven were scarred trees and two were stone arrangements. Including four sites previously recorded, a total of 54 sites occur within the project area, with only 14 of these sites to be impacted by the project.

A stone arrangement recorded near the southern boundary of the project area was identified by the Aboriginal community as having played a role in male initiation and was therefore assessed as having the highest Aboriginal cultural heritage significance of all sites. This site, in addition to the other most significant sites within the project area, is proposed to be conserved as part of a Cultural Heritage Management Area, to be managed in consultation with the local Aboriginal community.

Historic Heritage

The site of the former Marulan township (to the south of the existing township) is listed on the State Heritage Register (SHR). Part of this SHR area lies within the project area. There are limited surface features within this portion of the SHR and the project will only disturb 10% of the SHR area. The survey of the project area also identified nine non-indigenous heritage sites. The project will result in the disturbance of four of these sites.

It is considered that the loss of heritage values as a result of the project will be offset by the potential for archaeological investigation, recording and interpretation resulting in an increased knowledge of the historical occupation and use of the Marulan region, including gaining a better understanding the occupation and use of the Old Marulan Township. Specific heritage management measures are proposed to ensure this increased knowledge is achieved.

Visual Amenity

The primary components of the project that will impact on visual amenity will be the eastern emplacement areas, with the highest points of these area visible from some residences to the east. These areas will be constructed during the early years of the project and once established, will provide visual screening of the remainder of the project area. Following rehabilitation, these vegetated areas will blend in with the surrounding vegetated topography and will not cause significant visual impact.

Filtered views of the project area are available from one isolated residence to the south. Readymix is prepared to undertake reasonable on-site measures to minimise adverse visual impacts on this location, should the property owner so desire.

Views of quarry operations from major transport corridors will be limited to views from the Main Southern Railway, with these views of short duration. Potential impacts on night-time scenic quality are not considered to be significant due to the proposed lighting controls and the existing light impacted night-time visual character of the area.

Land Use

The proposed quarry has been designed to minimise potential impacts on adjoining land uses, including a range of measures to reduce dust, noise and blasting impacts. The dust, noise and blasting impact assessments show that the quarry will not significantly impact on any nearby residences or approved future residential locations. The project is also compatible with the other surrounding land uses including agricultural, plantation, industrial and transport corridors.

Should future land use patterns in the Marulan area follow the draft Mulwaree Settlement Strategy (Mulwaree Shire Council, 2003) the potential for future land use conflicts surrounding the project will be limited. The project is also considered to be consistent with the Sydney to Canberra Corridor Strategy.

Transport

The project includes the connection of the quarry access road directly onto the Hume Highway via an interchange type intersection. This ensures that operational phase traffic will not impact on the Marulan township and also has the added benefit of upgrading the existing Hume Highway / South Marulan Road intersection, which does not meet current RTA standards. Traffic impacts on the Hume Highway itself will be minor and traffic conditions will continue to be satisfactory.

During the construction phase, access to the project area will be primarily via the Marulan light industrial area avoiding impacts on residential areas. The assessment of traffic impacts during the construction phase indicates that impacts will be acceptable and that the traffic conditions on the road network will be satisfactory.

In regard to the capacity of the Main Southern Railway to accommodate additional train movements due to the project, ARTC has confirmed that there is sufficient capacity to accommodate the train movements that will be generated by the project.

Socio-economics

A comprehensive socio-economic impact assessment has been completed for the project, including a detailed community involvement program.

The project will make a significant contribution to the local, regional and State economies during the construction phase through capital expenditure of between approximately $150M and $195M and employment of up to 140 construction personnel. Annual gross salaries and wages in the order of $14.8 million is estimated for the construction workforce and an additional $5.9 million is expected to be generated through additional gross salaries in the local and regional economies (due to flow on effects from predicted expenditure patterns of the construction workforce).

During the operational phase, it is estimated that there will be an operational workforce of approximately 115 employees. The direct payment of an estimated $9.1 million in annual gross salaries and wages to this workforce is expected to lead to an additional $6.7 million in annual income being generated in other sectors, of which $4.5 million is expected to be additional household expenditure. The predicted total direct and indirect economic impact of local operating expenditure is estimated to be approximately $10 million per annum.

The detailed community program included stakeholder interviews, meetings, an information day and a random phone survey to identify stakeholder views about the project. In summary, this program found that the project has the strong support of the local community, with key findings including:

- the majority of respondents (80%) indicated that they either strongly approved or approved of the quarry proposal;
- over half (55%) of all respondents indicated that there were no impacts or issues of concern associated with the proposal;
- while a significant percentage of the community believe the quarry will go ahead regardless of what the community thinks (52%), the majority of residents trusted the development approval process that is being undertaken for the quarry (74%);
- the majority of respondents (79%) believed that the benefits a quarry would bring to the area would outweigh any of the disadvantages; and
- nearly all respondents (92%) believed the proposed quarry would make an important contribution to the local economy and that it would not detract from the area (78%).

SECTION 1

Introduction

1.0 Introduction

Readymix Holdings Pty Limited (Readymix) proposes to establish a hard rock quarry on its land to the west of Marulan in the Southern Tablelands region of New South Wales (NSW). The proposed quarry is referred to as Lynwood Quarry, after the name of the grazing property ("Lynwood") on which it is located. The proposed Lynwood Quarry (the project) will be located in the Goulburn Mulwaree Local Government Area (LGA) approximately 160 kilometres southwest of Sydney and approximately 27 kilometres northeast of Goulburn (refer to **Figure 1.1**).

Through this project Readymix seeks to develop a substantial, high quality hard rock resource, with ready access to key transport infrastructure. The Main Southern Railway bisects the project area and the Hume Highway adjoins Readymix's southern boundary (refer to **Figure 1.2**). The project area boundary is approximately 1 kilometre to the west of Marulan (refer to **Figure 1.2**). Readymix has a sound knowledge of the hard rock resource, due to both an extensive exploration drilling program and 20 years local experience quarrying the same rock type at its Johniefelds Quarry, located on Brayton Road approximately 2 kilometres north of the project area.

The project is intended to provide a long-term supply of high quality construction material into the Sydney, regional and local markets. The supply to the Sydney market is intended to replace Readymix's current production from the Penrith Lakes Scheme which is likely to be exhausted around 2010. The quarry is planned to produce up to 5 million tonnes per annum (Mtpa) of product including structural rock, rock aggregate, manufactured sand and road base. Whilst the resource has an expected life of in excess of 90 years, initial approval is sought for a 30 year quarry period.

1.1 Objectives and Overview of the Project

1.1.1 Objectives

The objectives of the project are to:

- provide a long-term secure supply of hard rock construction materials to the Sydney market, replacing the current production from the Penrith Lakes Scheme once it is exhausted in around 2010;

- provide a long-term secure supply of hard rock construction materials to the local and regional markets, including the ability to replace supply from existing Readymix quarries once their resources are exhausted;

- develop the Lynwood resource to maximise resource recovery and yield whilst maintaining economic viability;

- conduct operations in an environmentally responsible manner by understanding and effectively managing environmental impacts;

- develop an ongoing relationship with the local community through development of effective communication channels and ongoing involvement in the form of employment and contributions; and

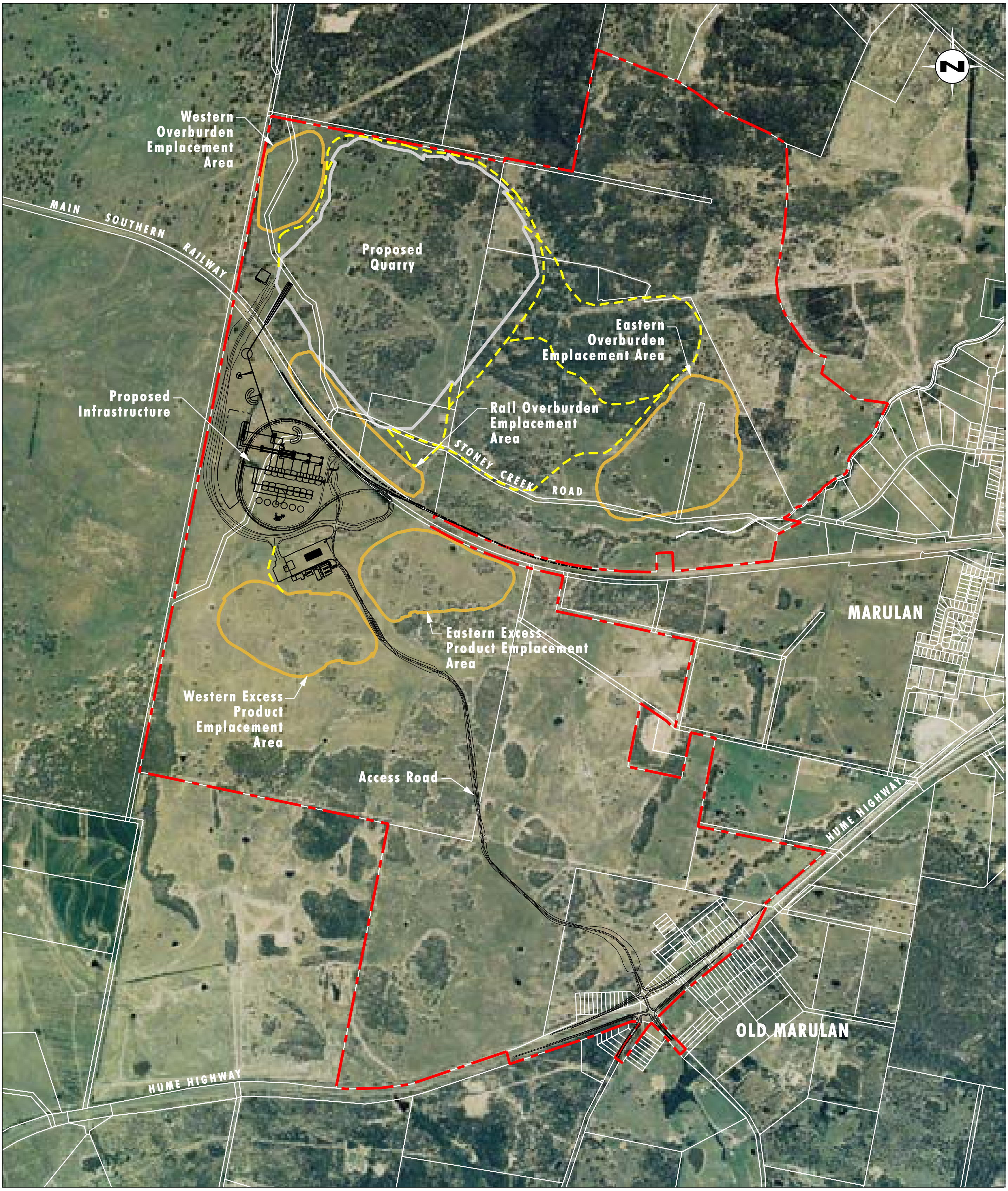
- contribute to the local, regional and State economies through capital expenditure, employment and economic supply of construction materials.

Umwelt
Environmental Consultants

FIGURE 1.1

Locality Plan

Umwelt Environmental Consultants



Base Source: LPI 2004, Readymix Holdings Pty Ltd (Aerial Photo March 2005)

0 0.5 1 1.25km

Legend

- Project Area
- Proposed Quarry
- Proposed Emplacement Areas
- Proposed Access Road and Infrastructure Area
- Proposed Haul Road

FIGURE 1.2

Proposed Development

File Name (A4): R03_V1/1829_274.dgn

1.1.2 Overview of the Project

Lynwood Quarry is proposed to produce up to 5 Mtpa of saleable product. The location and extent of the 30 year quarry pit is shown on **Figure 1.2**. The quarry pit is proposed to be located to the north of the Main Southern Railway near the western edge of the project area, with further resource existing to the east of the proposed quarry pit and to the south of the railway.

The key infrastructure proposed to be established for the quarry will include:

- a modern three phase crushing and screening plant which will be enclosed and have a dust extraction system;
- a balloon rail loop and rail loading facility for loading product into trains;
- a truck loading facility for loading product into road haulage trucks;
- an access road linking directly with the Hume Highway via an interchange to be constructed south of Marulan;
- various other infrastructure including a pre-coat plant, workshop, laboratory, office and amenity buildings, wheel wash station, weighbridge and other minor infrastructure.

Approval is sought to transport all of the 5 Mtpa saleable product from the site via the dedicated rail loading facility, with approval also sought to transport up to 1.5 Mtpa of the total 5 Mtpa by road transport via the Hume Highway interchange.

Some of the material extracted as part of the quarrying process will not be suitable for processing and sale and consequently emplacement areas will be required. This material consists of both overburden material which will be excavated and taken directly to emplacement areas without passing through the crushing and screening plant, and non-aggregate material generated at various phases of the crushing and screening process. Due to quarry planning constraints and the potential for resource sterilisation, in-pit dumping will not be possible and consequently out-of-pit emplacement areas will be required. The proposed location of these emplacement areas is shown on **Figure 1.2**.

The quarry is proposed to generally operate 24 hours per day, seven days per week. Operating hours will be limited for some activities to reduce potential noise impacts. At full production, the quarry will employ approximately 115 people plus provide substantial flow-on work in the form of contracts and supply services.

As Lynwood Quarry is a greenfields project (that is, there is not currently any quarrying activity at the site), there will be substantial construction works undertaken prior to the commencement of quarrying. The construction phase will last for approximately two years with employment peaking at approximately 140 personnel.

1.1.2.1 Project Justification

A detailed justification for the project is contained in **Section 6.0**, which addresses the need for heavy construction materials, the justification for selecting the Lynwood Quarry as the source of these materials, and the economic benefits of the project, and also considers the social and environmental implications of the project, particularly at a local level.

This project, if approved, will provide a long-term, high quality supply of heavy construction materials into the Sydney and regional markets. This supply is needed to replace supply from existing quarries that are nearing the end of their resources and is essential for the security and economic viability of the Sydney construction industry. The project will provide direct employment for approximately 115 people at the quarry, flow-on employment for an estimated 129 people (refer to **Section 5.14**) and security of employment for personnel working in Readymix's Sydney region concrete and asphalt businesses. The project will also provide major economic benefits in the form of initial capital expenditure during the construction phase ($150M to $195M), wages (direct $9.1M per annum, indirect $6.7M per annum), annual operating expenditure, and through payment of State and Commonwealth taxes and fees.

It should also be noted that the Lynwood resource has been identified by the Department of Primary Industries (DPI) (Mineral Resources Division) as a regionally significant hard rock resource in the Department's Section 117 (2) advice to Goulburn Mulwaree Council under the *Environmental Planning and Assessment Act* 1979 (EP&A Act). This advice ensures that the resource is recognised as being of regional significance and is considered during future planning decisions within the region.

Lynwood Quarry has been designed to ensure that environmental impacts are reduced as much as practicable, with the impact assessment contained in this Environmental Impact Statement (EIS) demonstrating that the project complies with relevant legislation, government policy and guidelines (refer to **Sections 4.0** and **5.0**). Social impacts have also been assessed and it is considered that the social benefits of the project will outweigh any potential negative impacts. The detailed community involvement program undertaken as part of the project has demonstrated that the project has the strong support of the local community.

1.2 Readymix Holdings Pty Limited

Readymix is one of the leading suppliers of heavy construction material products in Australia, operating over 80 quarries, over 200 fixed concrete plants and a fleet of over 900 concrete delivery trucks. In excess of 3000 people are currently employed by Readymix, which operates in all mainland states and territories of Australia. Existing Readymix quarries provide products for a diverse range of customers and applications throughout Australia, including rail ballast, aggregates, gravels, road pavement materials, manufactured and natural sands and armour stone. These products are essential for building and maintaining Australia's modern communities.

Readymix was the first company to introduce pre-mixed concrete to the Australian construction industry in 1939 from its plant in Glebe in the inner west of Sydney. Since this time, Readymix has prided itself on its development of innovative products and production of high quality quarry materials, maintained through comprehensive on-site product testing programs. Readymix has a long history of operating successful quarry operations, purchasing its first quarry in 1957 in Sydney.

Readymix is a member of the Rinker Group, which is listed on the Australian Stock Exchange.

1.3 Overview of the Existing Environment

1.3.1 Project Area and Surrounding Land Use

Agriculture is the predominant land use within and surrounding the project area. The project area is currently used for cattle grazing except for an area on the eastern boundary which is leased by Readymix to Orica Explosives. Other land uses within the vicinity of the project area are the residential area of Marulan, located approximately 1 kilometre to the east of the nearest proposed works, small areas of industrial land, an existing hard rock quarry approximately 2 kilometres to the north, transport corridors and associated services. Of these, the key land uses that will be sensitive to potential impacts are the rural residential areas and residential area associated with Marulan. A full description of the existing and proposed future land use within the vicinity of the project area and potential impacts on these land uses is included in **Section 5.0**.

1.3.2 Property Description and Land Ownership

Readymix owns all of the land within the project area excluding several small parcels of Crown land adjacent to the Hume Highway, a small area of Crown land associated with the bed of Joarimin Creek, a number of Crown road reserves, a small area (0.15 hectares) of land owned by the Roads & Traffic Authority (RTA) adjacent to the Hume Highway (refer to **Figure 1.3**) and two small parcels of old system title land whose owner cannot be located. Full property descriptions for land within the project area are provided in **Appendix 1**. The project area shown on **Figure 1.2** corresponds to the development application (DA) boundary.

Ownership of the land surrounding the project area is shown on **Figure 1.3**. In order to maintain privacy, private landowners are not named, however, the major adjoining land holdings are shown by different colours and the individual properties within close proximity to the project area are numbered. Ownership details for the relevant properties are contained in **Appendix 1**. A parcel of land (property 52) has recently been subject to subdivision to create a number of rural residential lots. The cadastral information purchased from Land & Property Information Service (LPI) does not show this recent subdivision, however, the subdivision boundaries are indicated on **Figure 1.3**.

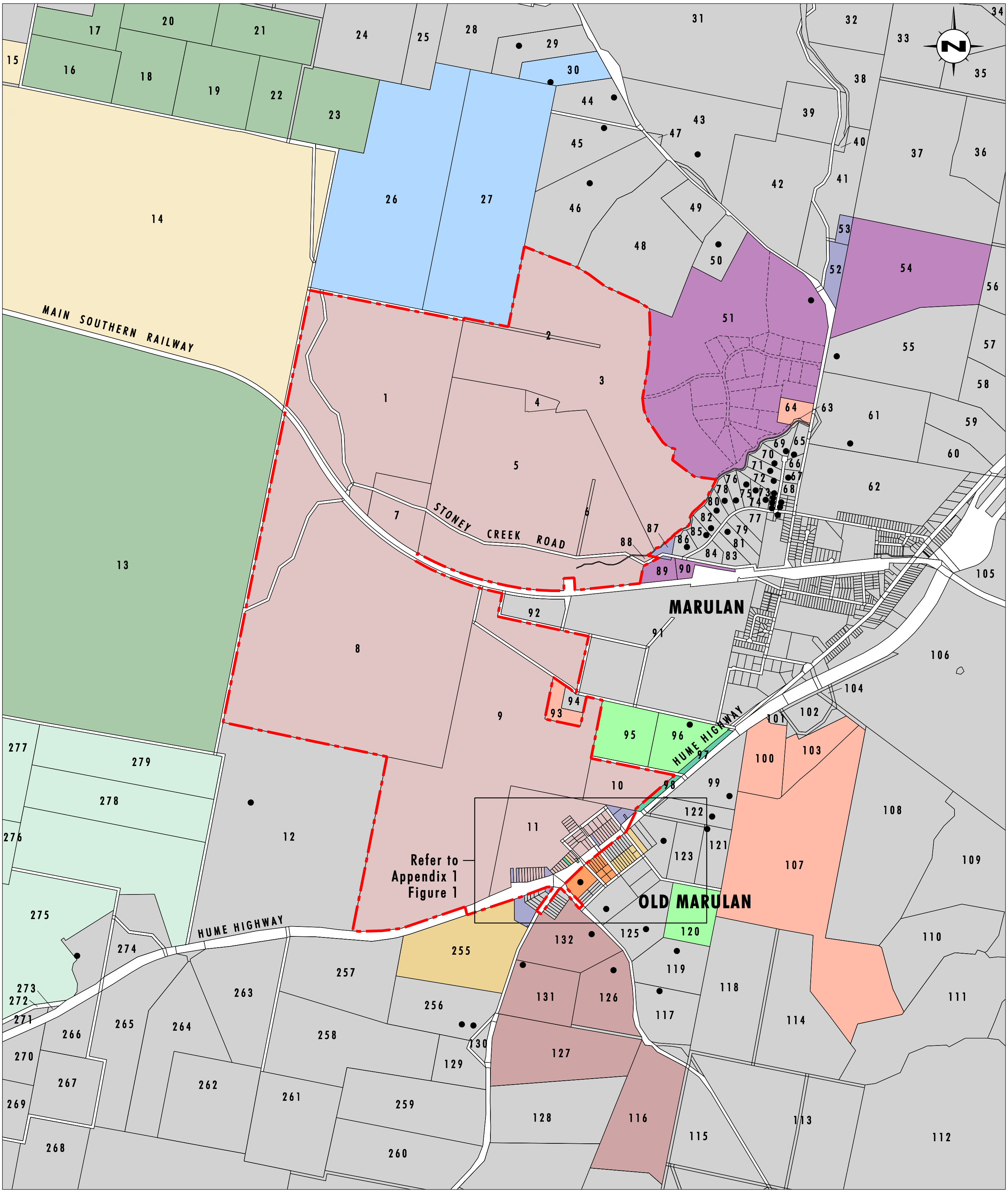
Readymix is seeking an agreement with the adjoining land owners to the west of the project area to lease a minimum 1 kilometre wide strip of land for the duration of the project. There is an approved house location within this proposed buffer, however as Readymix intends to hold a lease over this location, potential impacts on this location have not been assessed in this EIS.

1.3.3 Overview of Environmental Features

The project area lies within the catchments of Joarimin, Lockyersleigh and Marulan Creeks. Joarimin and Lockyersleigh Creeks drain to the Wollondilly River which is part of the Warragamba Dam catchment area, forming part of Sydney's drinking water supply. Marulan Creek is part of the Shoalhaven River system which also contributes to Sydney's drinking water supplies. The topography of the project area generally consists of undulating ridges separated by drainage valleys, with elevations ranging from 710 mAHD in the north, to around 630 mAHD near Joarimin Creek.

Annual average rainfall for Marulan is 665 mm and is slightly summer dominant. Annual average evaporation is, however, well in excess of rainfall, being 1205 mm. Average wind speeds are relatively high, particularly in autumn, winter and spring when westerly winds are dominant. Summer winds are predominantly from the east.

The majority of the project area has been previously cleared, however, remnant vegetation exists in portions of the north of the project area. The balance of the project area consists of cleared grazing land with small patches of vegetation. The vegetation was generally found to have been heavily modified by past and ongoing agricultural activities and was considered to be reasonably representative of regional vegetation communities and condition.



Base Source: LPI 2004, Readymix Holdings Pty Ltd

0 600 1200 1800m

Legend

- Project Area
- Residence
- Readymix Holdings
- Crown Land
- RTA
- Goulburn Mulwaree Council
- Other Private Land

FIGURE 1.3

Land Ownership

File Name (A4): R03_V1/1829_251.dgn

1.4 Planning and Approvals Process

This section contains an overview of the planning context for the project and the process followed during the preparation of the EIS. A full description of the planning context is contained in **Section 3.0**.

The project is Designated Development pursuant to Schedule 3 of the *Environmental Planning and Assessment Regulation* 2000 (NSW) (EP&A Regulation). Therefore, this EIS has been prepared to accompany the DA submitted for the project.

The project is also State Significant Development as it is a class of development included in a declaration under Section 76A(7) of the EP&A Act made by the then Minister for Urban Affairs and Planning dated 3 August 1999. Consequently, the DA and EIS will be submitted to the Department of Infrastructure, Planning and Natural Resources (DIPNR) for determination by the Minister for Infrastructure and Planning.

If development consent is granted, various approvals, licences and permits will be required prior to the commencement of certain site activities. Therefore, under Section 91 of the EP&A Act, the development is also Integrated Development. The agencies that administer these subsequent approvals are referred to as approval bodies. The approval bodies will assess the DA and provide general terms of approval for the Minister for Infrastructure and Planning to consider in regard to development consent, if granted. Details of the approval bodies and the required subsequent integrated approvals for the project are provided in **Section 4.2**. The approval bodies include the Department of Environment and Conservation (DEC), DIPNR, Roads and Traffic Authority (RTA), Goulburn Mulwaree Council, Department of Lands and NSW Heritage Office.

1.4.1 Approval Process

The key steps involved in preparation of the DA and EIS to date and the process of DA determination are summarised in **Table 1.1**.

Table 1.1 - Approval Process

Approvals Process	Project Development / Status
Initial Consultation with DIPNR	Readymix met with DIPNR to discuss the proposal in early 2004. DIPNR confirmed that the project was state significant, designated and integrated development.
Consultation	Community and government consultation commenced early in the project design and environmental impact assessment (EIA) phase and has been ongoing throughout the process. Details of consultation are provided in **Section 2.1**.
Planning Focus Meeting	A planning focus meeting was facilitated by DIPNR at Marulan on 30 August 2004. The meeting enabled the project to be presented to the relevant government agencies and discussion of agency requirements in relation to the EIS. The meeting was based on a planning focus document, which outlined the proposed development, areas of environmental impact and proposed assessment methods and management strategies. The document was provided to all relevant agencies prior to the meeting.
Director-General's Requirements (DIPNR)	The Director-General's requirements for the preparation of an EIS were requested in September 2004 with the submission of Form A. Following consideration of the written requirements of relevant agencies, DIPNR issued the Director-General's requirements on 1 October 2004.

Table 1.1 - Approval Process (cont)

Approvals Process	Project Development / Status
Conduct EIA and prepare EIS.	EIA conducted and EIS prepared. This included iterative environmental investigations in order to refine project design and ensure appropriate environmental outcomes were achievable.
Lodgement of DA	The DA and accompanying EIS will be lodged with DIPNR and other approval bodies in May 2005. Copies of the EIS will also be provided to other agencies and made available to the community.
Public Exhibition of EIS	The DA and EIS will be advertised and placed on public exhibition for at least 30 days. Written submissions to DIPNR will be invited from the government agencies and the community during the public exhibition period.
Assessment	DIPNR will undertake an assessment of the DA and may request additional information from Readymix in order to make the assessment.
Determination	The Minister will determine the DA after consideration of the DIPNR assessment report, public submissions received and relevant matters under Section 79C of the EP&A Act. Notification of the decision will be provided to the applicant, relevant agencies and the public and if approved, development consent will be issued together with a detailed schedule of conditions.
Post Development Consent Approvals	If development consent is granted, several post-development approvals will be required, as discussed in **Section 4.2**.

1.5 Consultation

Extensive consultation with community, government authority and other relevant stakeholders was undertaken throughout the project. The consultation program was designed to inform stakeholders about the project and to identify any issues of concern as early as possible in the process so that they could be investigated and addressed as appropriate. The consultation program included detailed community consultation involving newsletters, individual meetings, presentations to community interest groups and an information day. Consultation was also undertaken with representatives of the local Aboriginal community as part of the Aboriginal archaeological and cultural heritage assessment process.

In addition, extensive government authority consultation was undertaken including the planning focus meeting, individual agency meetings and site inspections. Owners of services and infrastructure within or in close proximity to the project area were also consulted, including the Australian Rail Track Corporation (ARTC), AGL and Country Energy.

Further details regarding the consultation program are included in **Section 2.0**.

1.6 Project Team

Umwelt (Australia) Pty Limited (Umwelt) prepared this EIS on behalf of Readymix. A number of organisations undertook specialist studies as part of quarry planning and EIA process, including:

- Richard Heggie and Associates Pty Ltd — Noise and blasting assessment
- Holmes Air Sciences — Air quality assessment

• Peter Dundon & Associates	Groundwater assessment
• Coakes Consulting Pty Ltd	Community involvement program and social impact assessment
• Transport & Urban Planning Pty Ltd	Traffic and transport impact assessment
• Asset Geotechnical	Soil survey
• Minter Ellison Lawyers	Legal advice
• Bell Cochrane & Associates	Geological investigations and quarry planning

A full listing of the project team members and their respective roles is provided in **Appendix 1**.

1.7 EIS Structure

This EIS has been prepared in accordance with Clauses 72 and 73 of the EP&A Regulation (refer to EIS form in **Appendix 1**). An overview of the layout of this EIS is provided below.

The **Executive Summary** provides a brief overview of the project, key environmental assessment results and an outline of proposed environmental management procedures.

Section 1.0 provides background to and sets the context for the project. It consists of an introduction to the project, the project objectives, an overview of the site and surrounding environment, an overview of the approvals and consultation process, and an outline of the structure of the EIS.

Section 2.0 describes the stakeholder consultation process and the environmental issues identified as part of this process for detailed consideration in the EIS.

Section 3.0 contains a detailed description of the proposed development.

Section 4.0 describes the planning context of the development, including the applicability of Commonwealth and State legislation, State and regional planning policies and local planning policies and strategies.

Section 5.0 contains a description of the existing environment and a comprehensive analysis and assessment of the environmental impacts of the project, including project-specific and cumulative impacts.

Section 6.0 outlines the alternatives to the project, including consideration of the alternative of not proceeding, and contains a detailed section on the justification for the project.

Section 7.0 details the proposed environmental management and monitoring programs to be adopted throughout the life of the project.

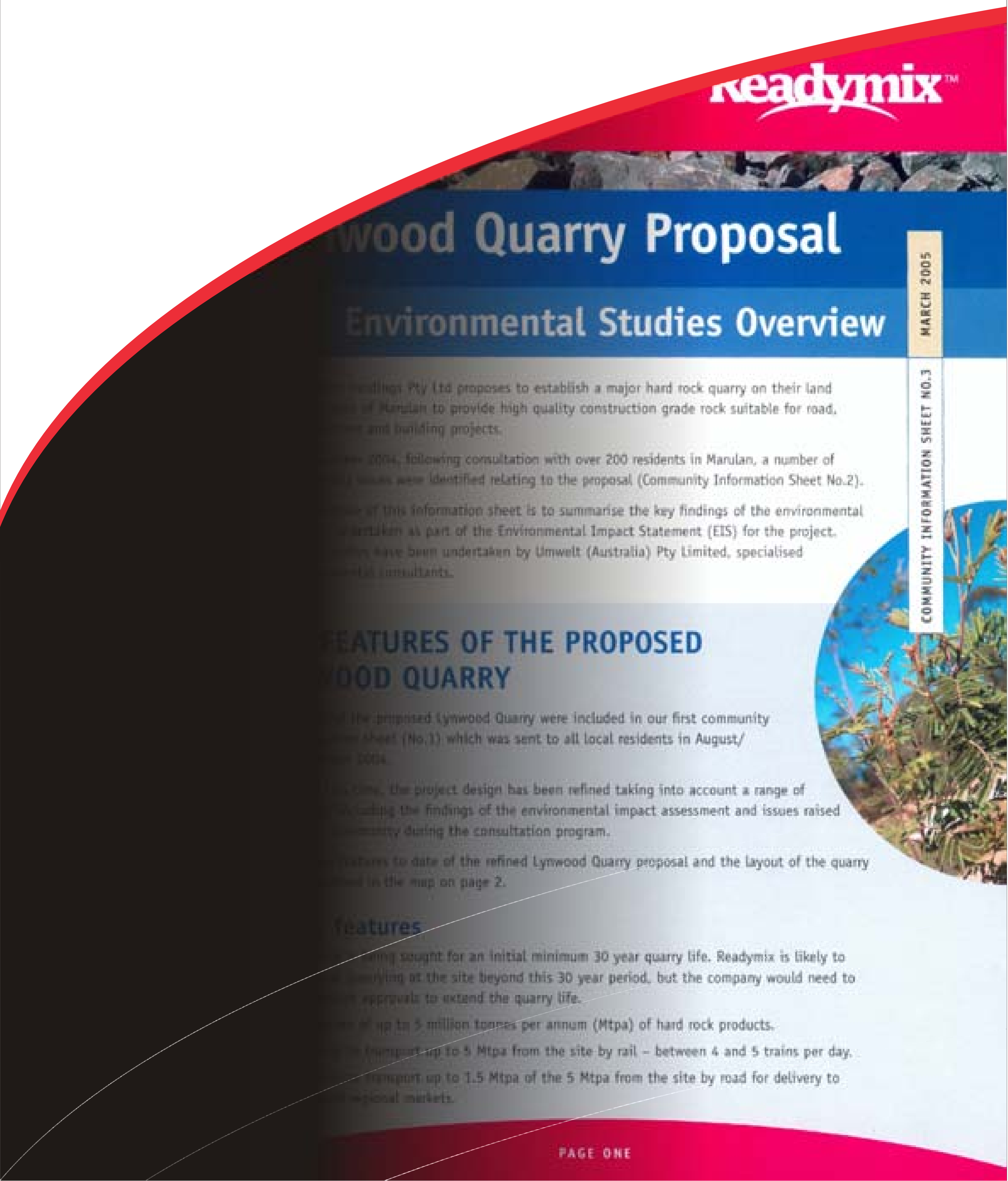
Sections 8.0 to 10.0 contain reference information including a checklist of the Director-General's requirements (incorporating the requirements of other agencies) considered in preparation of the EIS, a list of references referred to in the EIS and a list of abbreviations and a glossary of technical terms.

The Executive Summary and **Sections 1.0** to **10.0** form Volume 1 of the EIS and are referred to as the EIS main text.

The **Appendices** form Volumes 2-4 of the EIS and include the EIS form and Schedule 1, and technical reports which provide further detail regarding many of the key environmental issues addressed in the main text. Each of the appendices is referred to in the relevant section of the main text.

SECTION 2

Stakeholder Consultation & Identification of Environmental Issues



2.0 Stakeholder Consultation and Identification of Environmental Issues

2.1 Stakeholder Consultation

Consultation with community, government authorities and other relevant stakeholders commenced during the initial project planning phase undertaken in early 2004. Consultation has continued throughout the design and EIA process, aiming to inform stakeholders about the project and identify any issues of concern to be investigated and addressed, as appropriate. The consultation program involved extensive government authority consultation including the planning focus meeting and issue specific meetings and site inspections with individual agencies. A detailed community consultation program was also conducted involving newsletters, individual meetings, presentations to community interest groups and an information day.

The details of the consultation program are included in **Sections 2.1.1** and **2.1.2**, with an outline of the issues identified through the consultation program contained in **Section 2.2**.

2.1.1 Authority Consultation

All relevant government authorities were consulted throughout the EIA process, enabling the key authority issues to be identified and the planning and approval process to be refined. The authority consultation program commenced with initial briefing meetings held with DIPNR, Goulburn Mulwaree Council (both the Council officers and Councillors), DEC, RTA, DPI and the Sydney Catchment Authority (SCA).

The formal EIS consultation process commenced with the planning focus meeting which was held in Marulan on 30 August 2004. Prior to this meeting information about the project was provided to the relevant authorities via the preparation and distribution of a planning focus document. This document included an overview of the project, an outline of the authority and community stakeholder consultation programs, information about the existing environment and preliminary details from project specific studies. The planning focus document was distributed by DIPNR, and it is understood that it was provided to the following authorities:

- DIPNR;
- Goulburn Mulwaree Council;
- DPI (formerly Department of Mineral Resources, NSW Fisheries and NSW Agriculture);
- DEC (formerly Environment Protection Authority (EPA) and National Parks & Wildlife Service (NPWS));
- RTA;
- ARTC (formerly Rail Infrastructure Corporation);
- Country Energy;
- NSW Heritage Office;
- Department of Lands; and
- SCA.

The planning focus meeting was attended by representative of DIPNR (both the development assessment and natural resources divisions), DPI, DEC, Goulburn Mulwaree Council and ARTC. The meeting was coordinated and chaired by the Major Development Assessment branch of DIPNR and included a presentation on the project followed by a period of open discussion. Following the meeting DIPNR requested that all agencies (including those not present at the meeting) provide correspondence regarding the matters to be addressed in the EIS. This correspondence formed the basis of the Director-General's Requirements for the EIS, issued by DIPNR on 1 October 2004. A checklist of the Director-General's Requirements and where each requirement is addressed in the EIS is included in **Section 8.0**.

During the completion of the EIA process and preparation of the EIS, a number of meetings were held with the relevant government agencies in order to discuss specific impact assessment findings and proposed management measures. This included meetings with DIPNR, DEC, RTA, NSW Heritage Office, Goulburn Mulwaree Council, ARTC, Country Energy and the Department of Lands.

Copies of correspondence received from government authorities during the EIA process, including a copy of the Director-General's Requirements, is included in **Appendix 2**. A summary of the issues raised during the consultation process is included in **Section 2.2**.

2.1.2 Community and Other Stakeholder Consultation

A comprehensive community involvement program was undertaken for the project by Coakes Consulting. This program commenced early in the EIA process with the identification of stakeholders and appropriate mechanisms by which to involve each of these stakeholder groups. Based on this analysis, a range of communication mechanisms was used to provide community stakeholders with information regarding the project and an opportunity to comment on and/or ask questions about the project. The program continued throughout the EIA process and community involvement is planned to be an ongoing component of Readymix's operations at Lynwood Quarry, should approval be granted. The key mechanisms used during the stakeholder involvement program are outlined in **Table 2.1**.

Table 2.1 – Community Involvement Methods

Method	Description
Community Information Sheets (CIS)	Three community information sheets were distributed to the entire Marulan township and relevant surrounding areas, including to owners of vacant land. These three information sheets included: • CIS 1 to provide details of the Lynwood Quarry proposal, consultation process and EIA process; • CIS 2 to provide community feedback on the issues raised during interviews with Marulan residents and landowners, and the results of a telephone survey; and, • CIS 3 to provide an update on the quarry design and an overview of the EIA findings. Copies of the information sheets are included in **Appendix 3**.
Personal Interviews	Semi-structured interviews were undertaken with 55 stakeholders from the community e.g. local residents, community groups, businesses, schools, etc., to identify salient community issues and to assess likely impacts of the proposal.

Table 2.1 – Community Involvement Methods (cont)

Method	Description
Community Presentations	Presentations were made to community groups to outline and provide feedback on the project.
Open Information Day	An information day was held to present the outcomes of the EIA and social impact assessments and to enable questions to be asked of the project team. The information day was attended by approximately 90 people.
Random Telephone Survey	A survey was undertaken of the wider community in and around Marulan (174 households) to identify attitudes towards the proposal.

Through these consultation mechanisms, it is considered that Readymix has provided an opportunity for all relevant community stakeholders to participate in the community consultation program. The program was well received within the Marulan community and surrounds, as demonstrated by the high number of people who attended the community open day held in Marulan, and the positive feedback received on this day.

2.1.2.1 Aboriginal Community Groups

There are two Aboriginal community groups known to have an interest in the project area, being the Gundungurra Tribal Council Aboriginal Corporation #6 (GTCAC) who has lodged a Native Title claim that includes the Marulan area, and the Pejar Local Aboriginal Land Council (LALC). Both of these groups were involved in the Aboriginal archaeological fieldwork undertaken as part of the project and contributed to the Aboriginal cultural heritage assessment.

Both groups were also provided with a draft of the Aboriginal archaeology assessment so that they could provide input and comment on the impact assessment and management recommendations prior to finalisation.

2.1.2.2 Service Providers

A number of service providers who have infrastructure within or in close proximity to the project area were consulted during the EIA process. This included Country Energy as discussed in **Section 2.1.1**, with AGL also consulted in regard to the natural gas pipeline which runs through the northwestern corner of the project area.

Country Energy has held numerous discussions with Readymix regarding the project and its interactions with power supply infrastructure. Readymix is in the process of finalising an agreement with Country Energy in relation to establishing a major regional sub-station on the Lynwood property and the relocation of the currently disused 132 kV powerline that runs through the proposed quarry area (refer to **Sections 3.5.8** and **5.5**).

Readymix has corresponded with AGL regarding the project, including providing AGL with a summary of the assessment methodology and impact assessment findings in relation to potential vibration impacts on the pipeline. AGL did not advise Readymix of any additional requirements to the assessment that had already been completed.

Readymix has also corresponded with ARTC in relation to potential vibration impacts on the Main Southern Railway, providing a summary of the assessment methodology and impact assessment findings. ARTC did not advise Readymix of any additional requirements to the assessment that had already been completed.

2.2 Identification of Environmental Issues

2.2.1 Issues Raised by Authority Stakeholders

The issues raised by authority stakeholders in relation to the project are primarily contained within the Director-General's Requirements for the EIS (refer to **Section 8.0** and **Appendix 2**). A summary of the key issues raised is provided below:

- the planning context and approval path for the development;
- the justification for the project;
- potential impacts including:
  - surface and groundwater;
  - noise;
  - blasting;
  - air quality;
  - soils;
  - land use;
  - traffic and transport;
  - ecology;
  - Aboriginal and historic heritage;
  - visual and landscaping;
  - hazards;
  - waste management;
  - livestock management;
  - impacts on agriculture;
  - utilities and services;
  - social impacts;
  - economic impacts;
- rehabilitation and final land use;
- environmental monitoring and management requirements; and
- a resource assessment.

2.2.2 Issues Raised by Community and Other Stakeholders

The issues raised by the community and other stakeholders centred on the perceived benefits and environmental impacts of the proposed Lynwood Quarry. These included employment opportunities, dust, blasting, transport, noise, water, property value and ecology. In addition, the issue of potential contributions to the community from Readymix was raised by a number of stakeholders. A summary of the key issues raised by community stakeholders is included below, with a detailed description of issues and stakeholder attitudes included in **Section 5.14** and the Social Impact Assessment report included as **Appendix 3**.

The majority of personal meetings with community stakeholders regarding the project were with those residents closest to the project area. The issues raised during these meetings were therefore primarily potential impact issues such as dust, blasting, transport, noise and property values, with issues relating to impacts on the natural environment, including impacts on water and ecology, also being raised. The issue of the project's contribution to the Marulan community was also frequently raised.

The community consultation program indicated that the majority of the Marulan community is supportive of the project, with approximately 80% of respondents to the random phone survey approving of the proposal (refer to **Table 2.2**). The responses were given in relation to the question "*given what you now know about the proposed quarry, would you…*".

Table 2.2 – Community Stakeholder Attitudes towards the Project

Response	Percentage
Strongly approve	23.0
Approve	56.9
Have no opinion either way	15.5
Disapprove	2.9
Strongly Disapprove	1.7

Of the 80% of stakeholders who approved of the proposal, the two most common reasons given were that it would 'provide employment' (83%) and 'support the local economy' (43%).

The issues raised by community stakeholders involved in the random phone survey are included in **Table 2.3**. As indicated in **Table 2.3**, over half (55%) of all respondents indicated that there were no impacts or issues of concern associated with the proposal. Common issues raised included dust (24%), traffic impacts (12%) and noise (12%). The responses were given in relation to the question "*are there any potential impacts associated with the quarry and the transport of quarry materials that you are concerned about?*"

Table 2.3 – Issues Raised by Community Stakeholders during the Random Phone Survey

Issue	Percentage of Respondents
No issues or impacts of concern	55
Dust	24
Traffic	21
Noise	16
Vibration	3

Table 2.3 – Issues Raised by Community Stakeholders during the Random Phone Survey (cont)

Issue	Percentage of Respondents
Land values	3
Water consumption	3
Natural environment (water, ecology)	2
Visual impacts	2
Changes to the character of the community	1
Rehabilitation of the site	1
Health impacts	1
Other (issues only raised by one respondent)	6

Questions were also asked during the random phone survey to determine community attitudes to the project. Key responses included:

- nearly all respondents (92%) believed the proposed quarry would make an important contribution to the local economy in the region and that it would not detract from the area (78%).
- the majority of respondents (79%) believed that the benefits a quarry would bring to the area would outweigh any of the disadvantages;
- a significant percentage of the community believe the quarry will go ahead regardless of what the community thinks (52%); and
- the majority of residents trusted the development approval process that is being undertaken for the quarry (74%).

2.2.3 Environmental Issue Summary

The identification and prioritisation of environmental issues associated with the project is based on consideration of:

- the planning context for the project (refer to **Section 4.0**);
- the environmental context of the project area and region (refer to **Section 5.0**);
- the outcomes of the community and authority stakeholder consultation programs as discussed in this section;
- a review of previous investigations in the vicinity of the project area; and
- the findings of environmental studies completed as part of the preparation of this EIS.

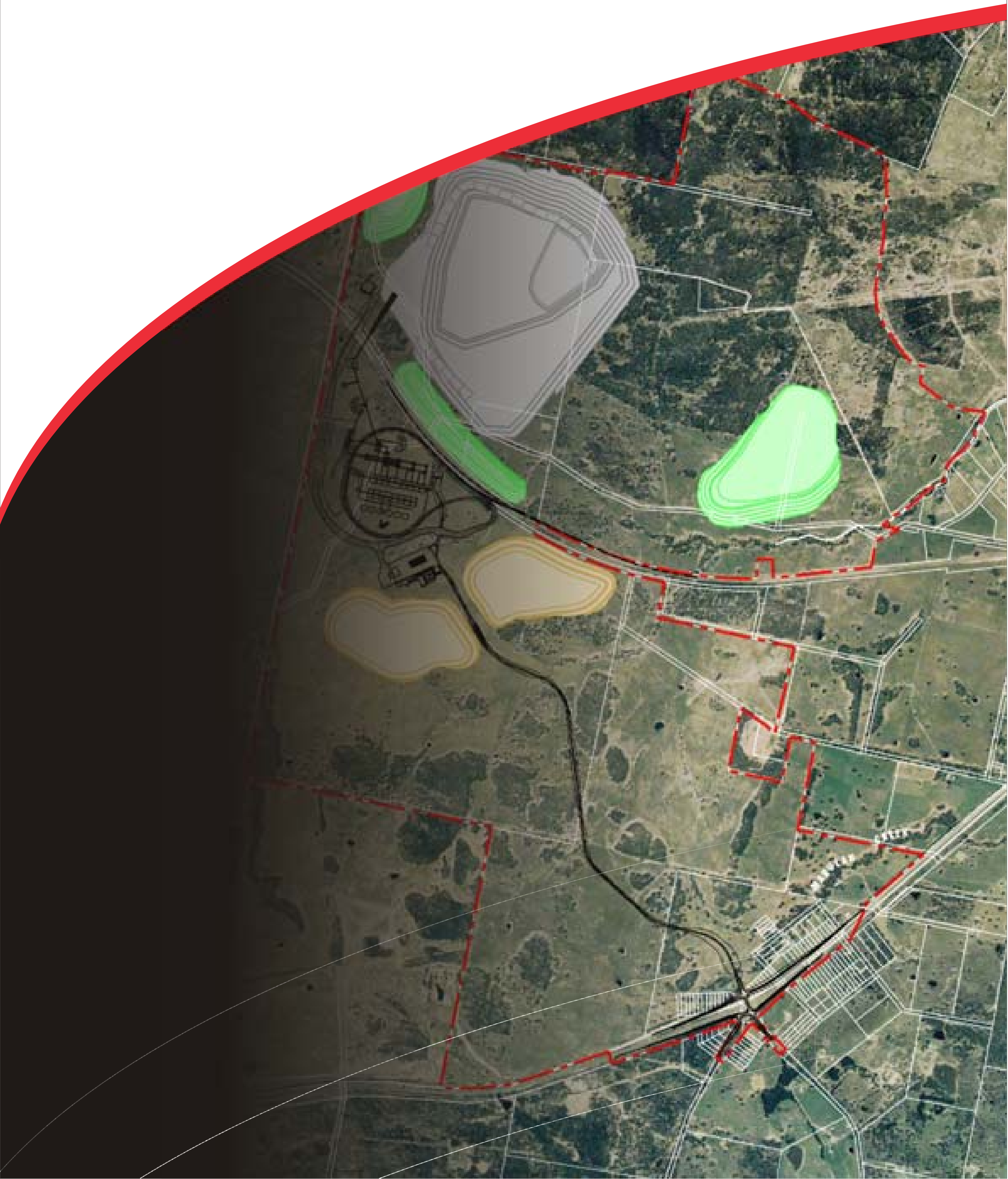
On this basis, the key environmental and community issues that have been addressed in detail as part of the EIA process for the project are:

- the noise and blasting impacts of the project (refer to **Section 5.9**);
- the air quality impacts of the project (refer to **Section 5.8**);
- the impacts of the project on traffic, roads and rail transportation (refer to **Section 5.5**);
- the impacts of the project on surface and groundwater (refer to **Section 5.6**);
- the impacts of the project on ecology (refer to **Section 5.7**);
- the impact on the Aboriginal cultural heritage and historic heritage values of the project area (refer to **Section 5.10**);
- the visual impacts of the project (refer to **Section 5.11**);
- post quarrying land capability and land use, and the potential impact on surrounding and future land use (**Section 5.0**);
- the socio-economic impacts of the project (refer to **Section 5.14**);
- the cumulative impacts of the project in combination with surrounding land uses (refer to **Section 5.15**); and
- the ongoing environmental management, environmental monitoring and community involvement proposed as part of the project (refer to **Section 7.0**).

These key issues are addressed in detail in the following sections together with other environmental issues required to be addressed to ensure a comprehensive EIA process.

SECTION 3

Description of the Project



3.0 Description of the Project

The conceptual design for Lynwood Quarry has evolved throughout the EIA process in light of ongoing exploration and geological modelling work, environmental constraints and opportunities and in consideration of stakeholder consultation outcomes. A detailed description of the conceptual features that comprise the Lynwood Quarry project is included in this section.

3.1 The Development Application Area

The project area lies wholly within Goulburn Mulwaree LGA in the parishes of Marulan and Uringalla. The DA boundary corresponds to the project area boundary shown on **Figure 1.2**. This boundary includes land owned by Readymix, several small parcels of Crown land, a parcel of land owned by the RTA, two small parcels of privately owned land, several Crown road reserves and sections of the Main Southern Railway, Hume Highway, South Marulan Road, Jerrara Road and Stoney Creek Road. A schedule of lands within the DA area is included in **Appendix 1**.

3.2 Resource, Products and Markets

3.2.1 Target Resource

The project area contains a substantial, high quality hard rock resource, suitable for the generation of quarry products for use in the construction industry. The target rock is Bindook Porphyry which is an igneous rock that was typically formed by cooling of magma at depth. It is characterised by the presence of a few relatively large mineral grains which exist in a finer groundmass of crystals.

The target porphyry resource extends across the project area on both the northern and southern sides of the railway, however the higher quality resource on the northern side of the railway is the initial target. This northern resource will provide in excess of 90 years production at 5 Mtpa. The total extent of the resource within the project area has the potential to provide for up to 130 years of production at an extraction rate of 5 Mtpa. Initial approval is sought as part of this project for a period of 30 years. The extent of the northern resource is shown on **Figure 1.2**.

The porphyry resource has been identified by the DPI (Mineral Resources Division) as a regionally significant resource in the Department's Section 117 (2) advice to Goulburn Mulwaree Council under the EP&A Act. The aim of this advice is to inform Goulburn Mulwaree Council about the existence of a significant mineral resource so that protection of the resource can be considered as part of the local planning process.

3.2.1.1 Resource Quantity Statement

The resource quantities within the northern resource area (the project area north of the Main Southern Railway) and the southern resource area (the project area south of the Main Southern Railway) have been estimated using a detailed geological model developed from the extensive exploration program undertaken at the site (refer to **Section 5.1**).

The resource quantities in the northern resource area (the initial target area), southern resource area and the proposed Year 30 quarry pit are outlined below.

Northern Resource Area

The northern resource is the initial target area as exploration drilling indicates that it is a more consistent resource in terms of quality and has fewer intrusions. The size of the northern resource is indicated in **Table 3.1**.

Table 3.1 – Northern Resource Area - Resource Statement

Rock Type	Quantity
Overburden	6.5 million cubic metres in situ
Weathered Porphyry	40.2 million tonnes
Fresh Porphyry	418.3 million tonnes
Total Porphyry Resource	**458.5 million tonnes**

Southern Resource Area

The southern resource area has greater quality variability than the northern area, however it still contains a large resource of high quality material suitable for extraction once the northern resource reaches its economic limit (refer to **Table 3.2**).

Table 3.2 – Southern Resource Area - Resource Statement

Rock Type	Quantity
Overburden	5.3 million cubic metres in situ
Weathered Porphyry	27 million tonnes
Fresh Porphyry	187 million tonnes
Total Porphyry Resource	**214 million tonnes**

Year 30 Quarry Pit

The proposed Year 30 quarry pit forms part of the northern resource area. The quantity of resource within the proposed extraction area is shown in **Table 3.3**.

Table 3.3 – 30 Year Quarry Pit - Resource Statement

Rock Type	Quantity
Overburden	3.8 million cubic metres in situ
Weathered Porphyry	18 million tonnes
Fresh Porphyry	141 million tonnes
Total Porphyry Resource	**159 million tonnes**

3.2.2 Products and Markets

3.2.2.1 Quarry Products

The crushing and screening process produces products ranging in size from approximately 0.3 metre down to fine manufactured sand. The quarry also has the potential to produce larger rock fragments by by-passing the crushing and screening plant. Typical products planned to be produced by the quarry include:

- spalls (up to 300 mm);
- ballast (typically used for railway ballast);
- aggregate products ranging in size from 4.5 mm to 20 mm;
- coarse and fine manufactured sand; and
- road base.

It is also planned to have a pre-coat plant at the site. This plant coats aggregate products with a bitumen emulsion for use in bitumen road works.

These quarry products have a range of applications in the construction and landscaping industries including:

- use of aggregates in concrete, bituminous surfacing, asphalt, landscape works, drainage works, road construction and gravel surfacing;
- railway ballast;
- rock for gabion baskets and wire mattresses used in stabilisation (e.g. road batters) and drainage works;
- rock for coastal protective works;
- manufactured sand for use in concrete, as fill and in landscaping applications;
- road base for use in road construction, as fill and in landscaping applications; and
- oversize rock for landscaping, decorative and stabilisation works.

It is expected that the majority of product from Lynwood Quarry will be used for construction projects, primarily in concrete and in roadway construction.

Product Quality

As part of the exploration program extensive rock testing was undertaken to assess the potential of the resource to produce suitable quarry products. This testing program demonstrated that the resource meets the highest standards currently required in NSW for construction aggregates including for both concrete aggregate and construction use.

The current Australian Standard for Aggregates and Rock for Engineering Purposes, AS 2758 specifies a range of test properties for acceptance of aggregate products for the following uses:

- concrete aggregates;
- aggregates for sprayed bituminous surfacing;
- aggregates for gabion baskets and wire mattresses;
- asphalt aggregates; and
- railway ballast.

Testing has indicated that the resource meets all of the above criteria and is suitable for use in all of these construction applications.

3.2.2.2 Markets

The proposed quarry is intended to provide a long-term supply of high quality construction material into the Sydney, regional and local markets. The proposed supply to the Sydney market will replace Readymix's current production from the Penrith Lakes Scheme which is likely to be exhausted around 2010. The Penrith Lakes Scheme is a joint venture project between Readymix, Boral Pty Ltd (Boral) and Hanson Australia Pty Limited (Hanson) with joint production from the scheme peaking at 6.73 Mt in 1999/2000. Since this time annual production has fallen to 5.05 Mt in 2003/04 and is projected to be only approximately 4.6 Mt in 2004/05. Production is expected to continue to gradually fall until closure of the operation in around 2010.

If the current supply from Penrith Lakes into the Sydney market is not replaced, the closure of this operation will result in a shortage of construction material in the Sydney and surrounding regional markets. Lynwood Quarry will allow Readymix to continue to supply into the Sydney market at current levels, plus provide the ability to cater for predicted future increases in market demand over the project life.

Lynwood Quarry will also provide Readymix with the potential to supply construction material into both the local and regional markets including the southern outskirts of Sydney, the Southern Tablelands Region (Moss Vale, Mittagong, Goulburn, etc.) and southern markets including the Australian Capital Territory (ACT). Readymix currently has existing quarry operations that supply some of these local and regional markets (e.g. Johniefelds quarry near Marulan), however, a number of these quarries will exhaust their economic resources over the proposed life of the Lynwood Quarry, providing the potential for Readymix to supply into these markets from Lynwood. The quarry will also allow Readymix to meet predicted future increased demand for construction materials in the local and regional markets.

3.3 Construction Phase

As the proposed Lynwood Quarry is a greenfields project, substantial construction works will be required prior to the quarry becoming operational. The construction phase is expected to last approximately two years and will include the following key activities:

- construction of initial site access road and set-up of construction compounds including supply of services (e.g. electricity, water, etc.);
- construction of water storages;
- set-up of mobile concrete and crushing plants;
- construction of the overpass over the Main Southern Railway for access between the quarry and infrastructure areas;
- construction of the Hume Highway interchange and permanent site access road;
- extraction of material from the primary crusher area (approximately 150,000 m^3 of overburden and moderately weathered material). The excavation of this material is likely to require blasting with the excavated material processed through the mobile crushing plant to produce road base / fill to be used in the construction project;

- excavations for the rail loop and reclaim tunnel. Again, the excavation process may require blasting and overburden and moderately weathered material will be generated. This material will also be utilised in the construction project;

- construction of the crushing and screening plant, rail facility, truck loading facility and other infrastructure;

- construction of rail lines and connection to the Main Southern Railway;

- construction of the remaining facilities including workshops, site offices, amenities, laboratory, weighbridge, stores, parking areas, site roads, safety bunds, etc.;

- construction of water management structures and installation of pumps, pipelines, etc; and

- installation of security fencing and gates to ensure public safety and security for the quarry operations.

The conceptual locations of the construction compounds, mobile crushing and concrete plants and key construction areas are shown on **Figure 3.1**. It is also likely that a second construction compound will be required for the construction of the interchange on the western side of the Hume Highway, with this compound to be located within the road reserve. The crushing plant will have a nominal capacity of 300 tonnes per hour and will have appropriate environmental controls including dust suppression sprays. The mobile concrete plant will have a capacity of up to approximately 75 m^3 per hour.

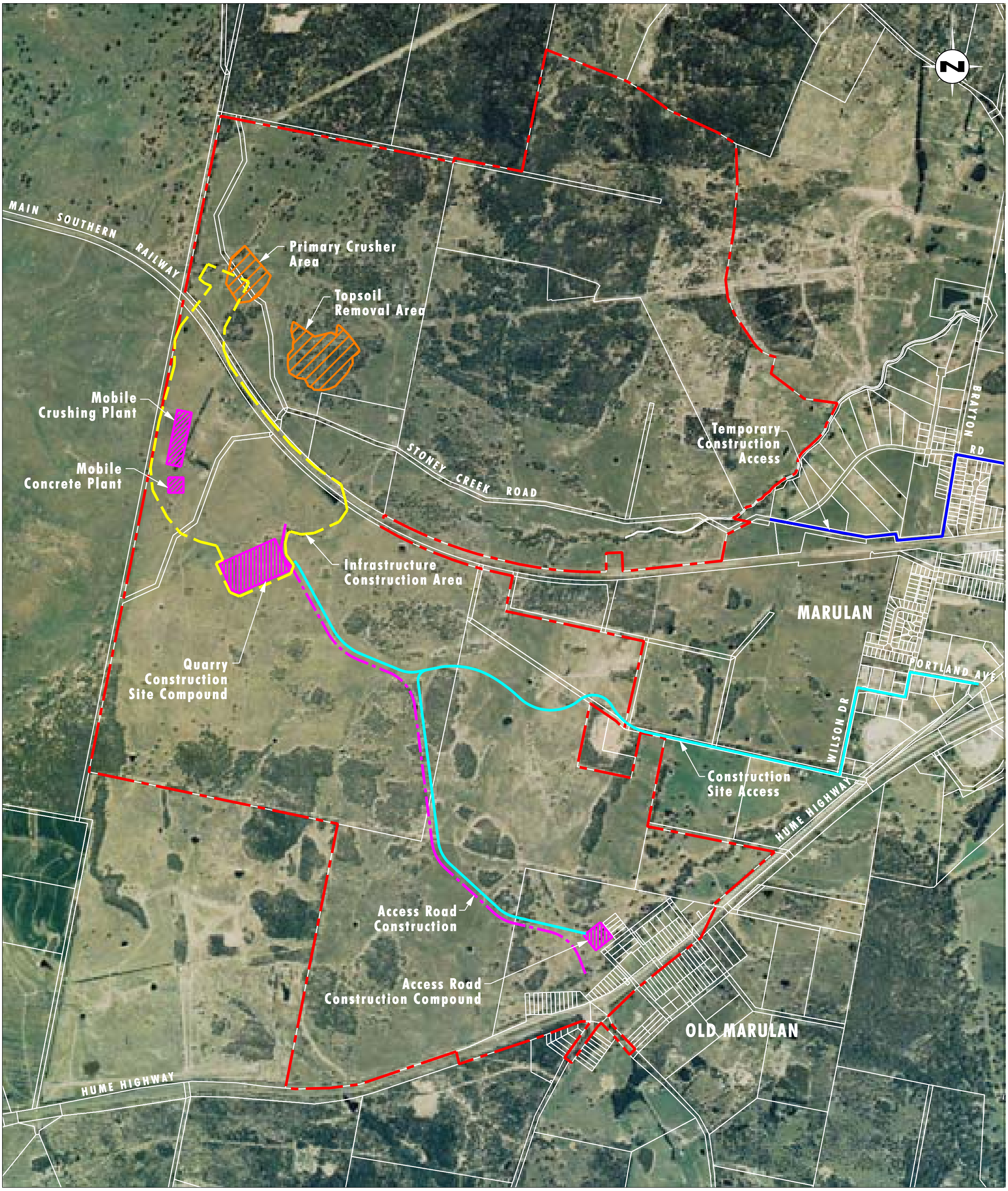
During excavation of the primary crusher box cut, the rail cutting and other construction areas, the volume of crushed material generated may be in excess of that required for on-site construction. Readymix therefore seeks approval to generate up to 100,000 tonnes of saleable product per annum during the two year construction period and to transport this product from the site via the construction access route discussed in **Section 3.3.1**. On a five day per week basis, the transport of this material from the site would equate to approximately 13 product truck loads per day.

Clearing and topsoil stripping within the Year 1 quarry footprint will also be undertaken as part of the construction phase in order to facilitate early commencement of production following the completion of the construction phase.

3.3.1 Construction Phase Site Access

Figure 3.1 also shows the conceptual locations of the construction phase site access tracks. Access to the site during this period will be gained from Wilson Drive which currently provides access to the Marulan Waste Management Facility and to Orica Explosives. Orica leases an area of land from Readymix adjacent to the waste management facility. Access to Wilson Drive from the Hume Highway will be gained from the existing Portland Avenue intersection (Marulan cross median intersection) and then through the Marulan light industrial area. This route was selected as it allows construction phase traffic to access the site without passing through any residential areas. The route does pass one isolated residence on Wilson Drive, however, this residence is on land proposed to be rezoned for industrial development. Readymix has discussed the construction phase of the project with the owner of this property and it is understood that the current resident is likely to move out prior to commencement of construction. If the residence still exists at the time of construction and is available for tenancy, Readymix proposes to rent the residence for the duration of the construction phase.

Umwelt Environmental Consultants



Base Source: LPI 2004, Readymix Holdings Pty Ltd (Aerial Photo March 2005)

0 0.5 1 1.25km

Legend
- Project Area
- Access Road Construction
- Construction Site Access
- Temporary Construction Access
- Infrastructure Construction Area
- Construction Compounds and Plant Locations

FIGURE 3.1

Construction Phase Conceptual Layout

File Name (A4): R03_V1/1829_173.dgn

During the early phases of construction and prior to the completion of the rail overpass, access to the northern portion of the site will also be gained via Stoney Creek Road which is currently and has historically been, the access point for the Lynwood property. Construction traffic along Stoney Creek Road will be minimal and will only occur until the rail overpass is completed. In order to avoid crossing the Portland Avenue rail level crossing, all construction traffic accessing the site on the northern side of the Main Southern Railway will use Brayton Road to gain access to Stoney Creek Road.

Wilson Drive, Portland Avenue and Stoney Creek Road are all Council roads and the use of these roads for construction access has been discussed with Goulburn Mulwaree Council. Minor upgrade works along Wilson Drive and Portland Avenue will be required to facilitate access by heavy vehicles. These works are discussed in **Section 7.2.2**.

3.4 Proposed Quarrying Operations

3.4.1 Conceptual Quarry Plan

Lynwood Quarry is planned to produce approximately 5 Mtpa saleable product when at full production. The operation will ramp up to full production over a period of approximately three years. As discussed in **Section 3.2.1**, at a production rate of 5 Mtpa, the Lynwood resource provides for over 90 years of quarrying in the northern resource area. This DA seeks approval for an initial 30 year period. Readymix plans to seek future approval to continue quarrying operations after this initial 30 year period in order to utilise the economically viable extent of the resource.

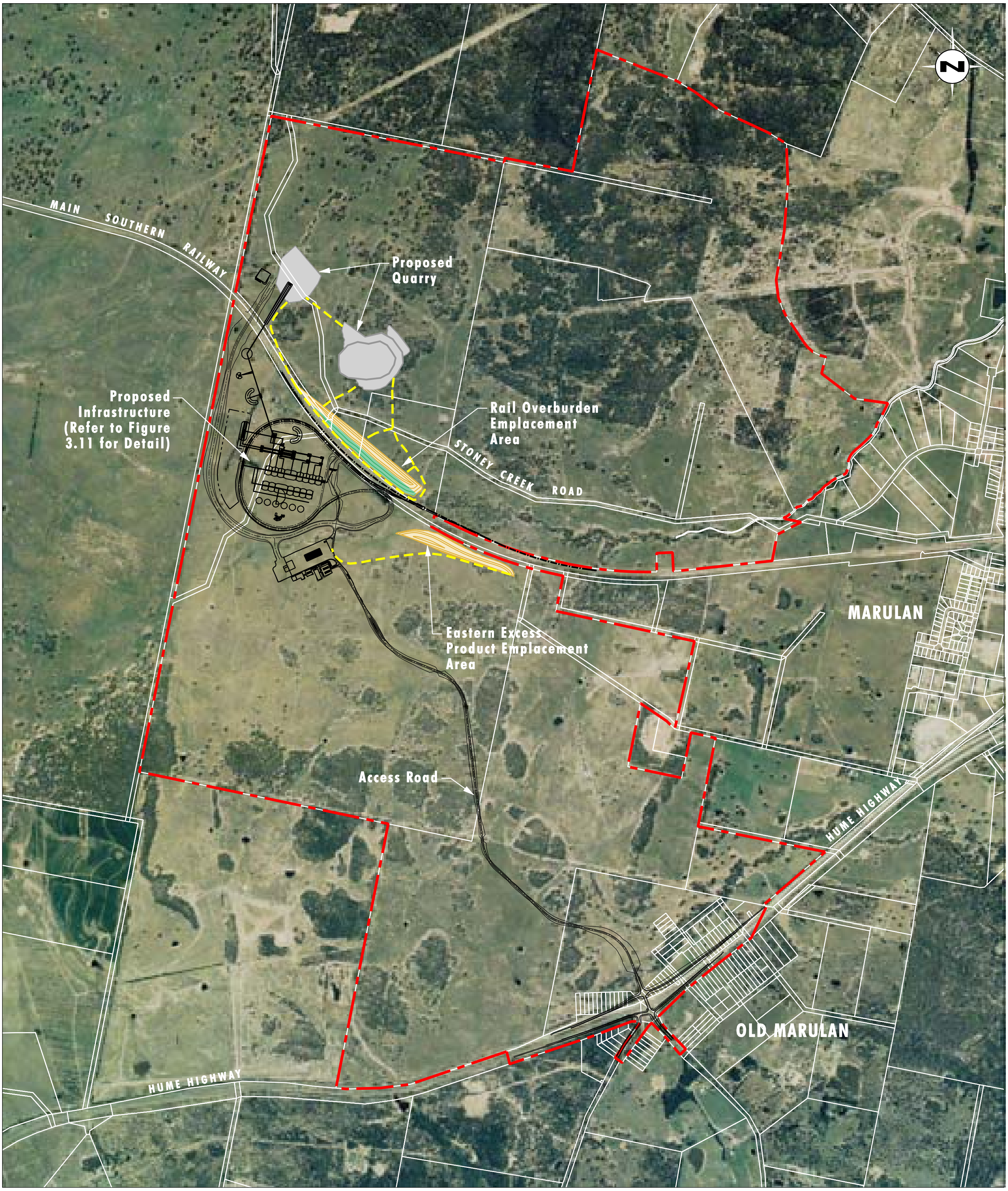
Over the initial 30 year period, the project will produce approximately 145 Mt of quarry product. Some of the material extracted as part of the quarrying process will not be suitable for sale and consequently emplacement areas will be required. This material consists of both overburden which will be excavated and taken directly to emplacement areas without passing through the crushing and screening plant, and also material generated at various phases of the crushing and screening process. Due to the depth of the resource and the number of years which will be required in order to reach a terminal face, in-pit dumping will not be possible during the initial 30 year quarry period without sterilising future resources, and therefore all emplacement areas are planned to be out-of-pit (refer to **Sections 3.4.3** and **3.5.1.2**).

The footprint of the conceptual quarry plan and associated infrastructure for the initial 30 year period is shown on **Figure 1.2**. The conceptual quarry plans for Years 1, 2, 5, 10, 15, 20, 25 and 30 are shown on **Figures 3.2** to **3.9**.

As indicated on **Figure 3.2**, the quarry will commence in an area to the east of the primary crusher box cut. The reason for commencing in this location is that it is in a zone of reduced weathering depth and therefore the ratio of overburden to saleable material is reduced compared to other locations. In Year 2 (refer to **Figure 3.3**), the quarry pit will continue to expand, deepen and extend to the west. Between Years 2 and 5 the quarry footprint will grow further to the north and continue to deepen reaching approximately 630 mAHD (refer to **Figure 3.4**). By Year 10 (refer to **Figure 3.5**) the quarry pit will extend further to the north occupying an area of approximately 75 hectares, which is in the order of two thirds of the 30 year quarry footprint.

The quarry footprint will continue to expand between Years 10 and 15, with the 15 year footprint almost totally occupying the 30 year footprint (refer to **Figure 3.6**). After this time, the majority of quarry development will be through increased depth with only minimal footprint increases between Years 15 and 20, and Years 20 and 25 (refer to **Figures 3.7** and

Umwelt
Environmental Consultants



Base Source: LPI 2004, Readymix Holdings Pty Ltd (Aerial Photo March 2005)

0 0.5 1 1.25km

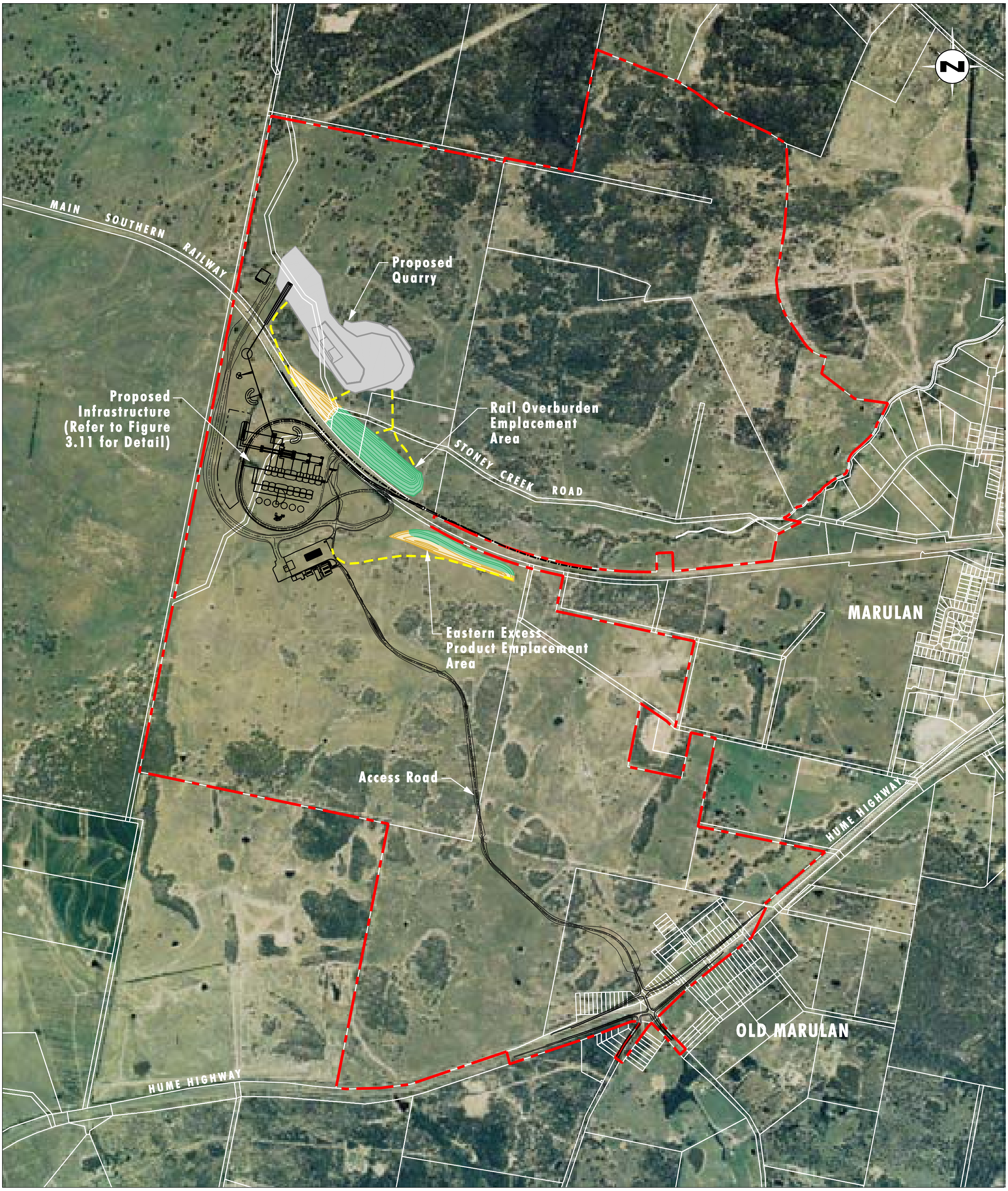
Legend

- Project Area
- Haul Road
- Quarry Area
- Emplacement Area
- Rehabilitated Area

FIGURE 3.2

Year 1 Quarry Plan

Umwelt
Environmental Consultants



Base Source: LPI 2004, Readymix Holdings Pty Ltd (Aerial Photo March 2005)

0 0.5 1 1.25km

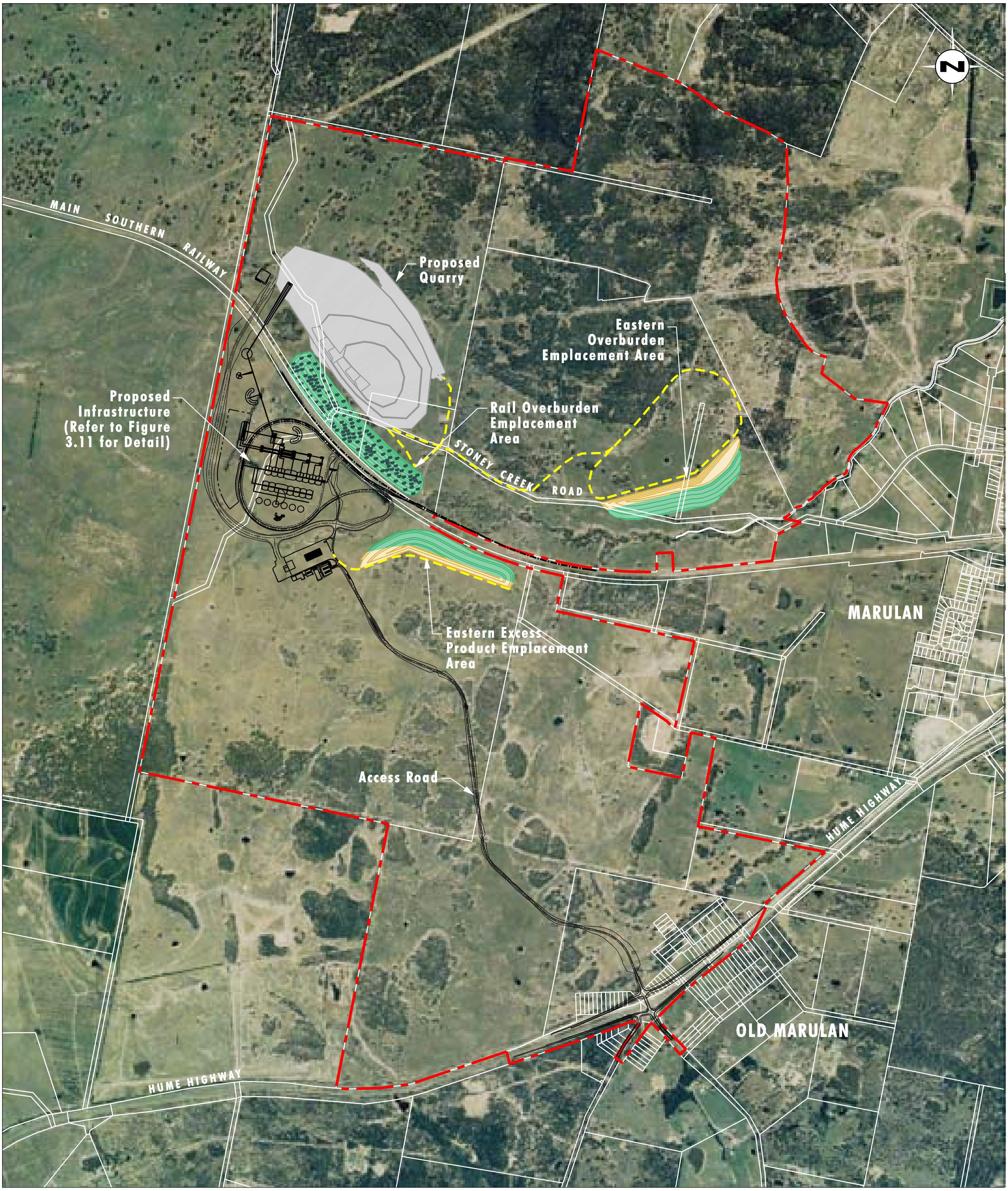
Legend

- Project Area
- Haul Road
- Quarry Area
- Emplacement Area
- Rehabilitated Area

FIGURE 3.3

Year 2 Quarry Plan

File Name (A4): R03_V1/1829_137.dgn



Base Source: LPI 2004, Readymix Holdings Pty Ltd (Aerial Photo March 2005)

0 0.5 1 1.25km

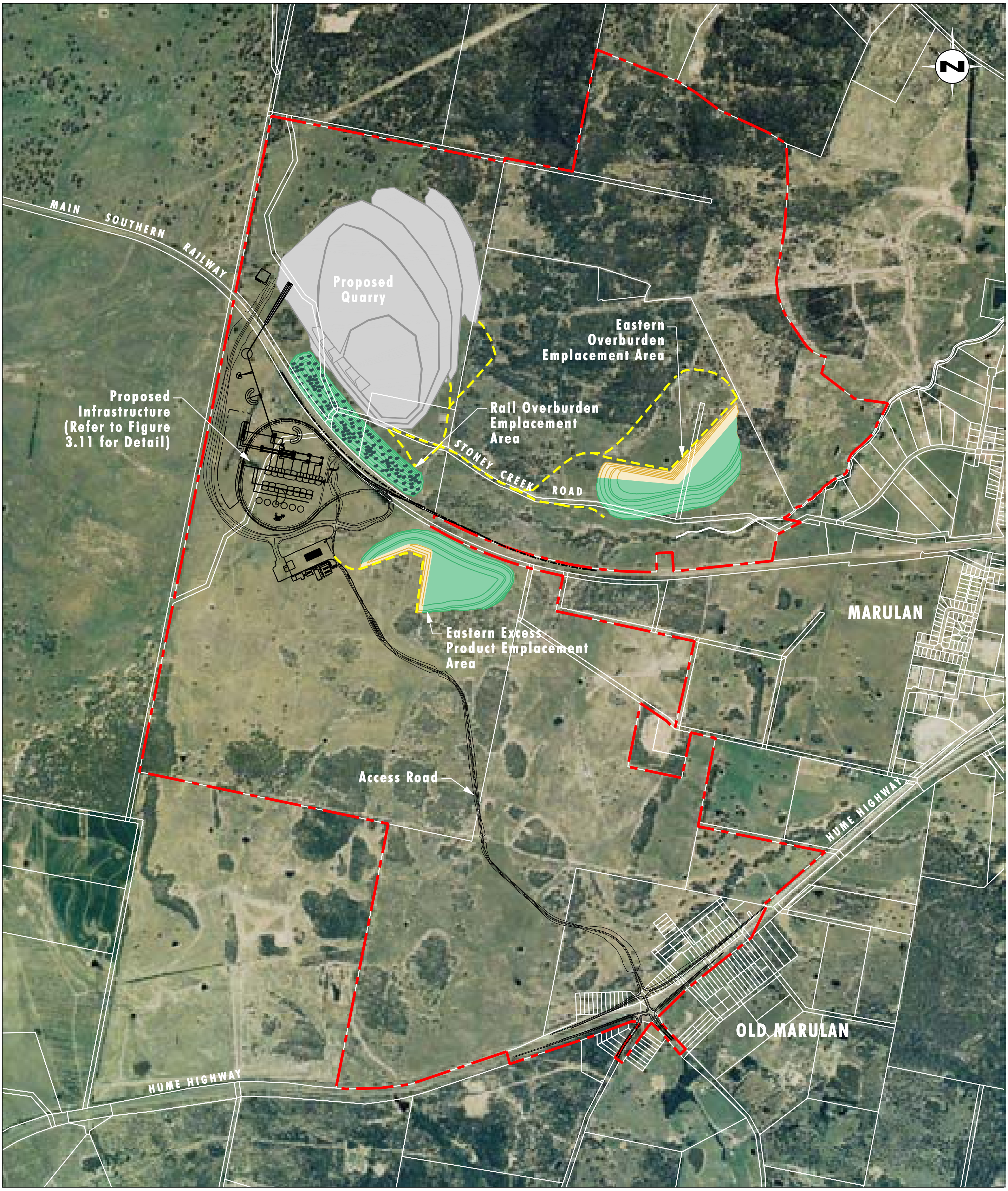
Legend

- Project Area
- Haul Road
- Quarry Area
- Emplacement Area
- Rehabilitated Area

FIGURE 3.4

Year 5 Quarry Plan

File Name (A4): R03_V1/1829_138.dgn



Base Source: LPI 2004, Readymix Holdings Pty Ltd (Aerial Photo March 2005)

0 0.5 1 1.25km

Legend

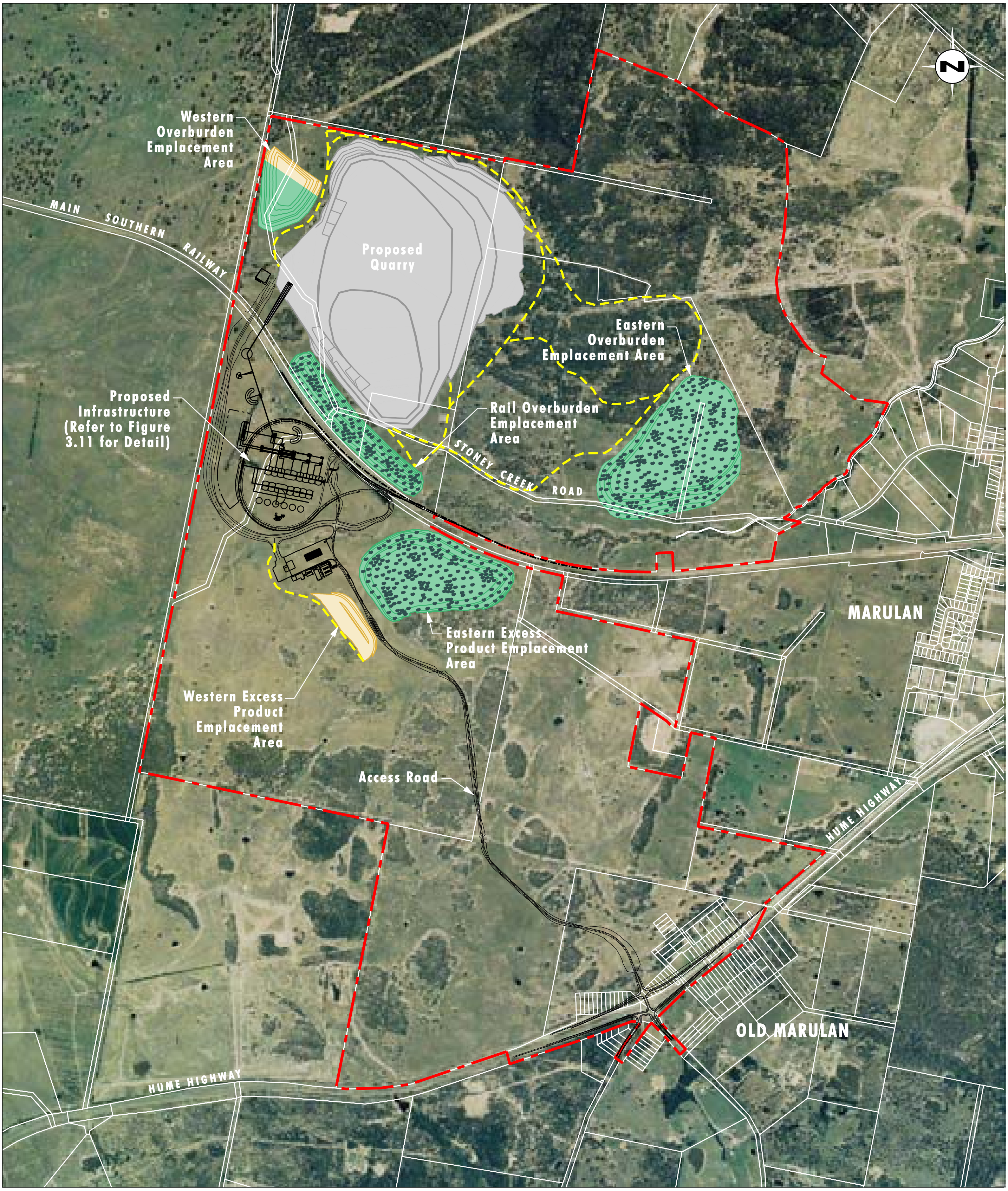
- Project Area
- Haul Road
- Quarry Area
- Emplacement Area
- Rehabilitated Area

FIGURE 3.5

Year 10 Quarry Plan

File Name (A4): R03_V1/1829_139.dgn

Umwelt
Environmental Consultants



Base Source: LPI 2004, Readymix Holdings Pty Ltd (Aerial Photo March 2005)

0 0.5 1 1.25km

Legend

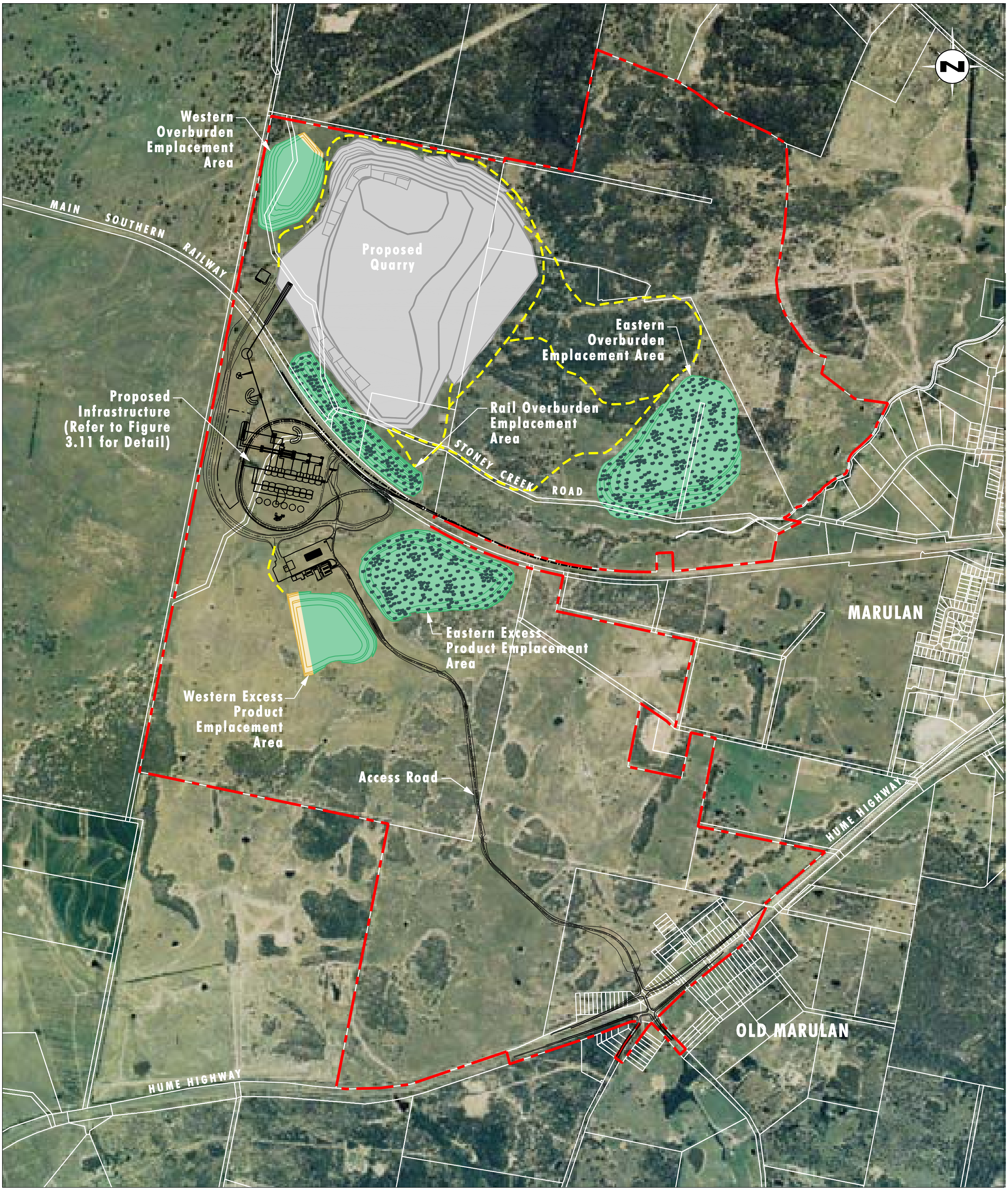
- Project Area
- Haul Road
- Quarry Area
- Emplacement Area
- Rehabilitated Area

FIGURE 3.6

Year 15 Quarry Plan

File Name (A4): R03_V1/1829_140.dgn

Home TOC Next



Base Source: LPI 2004, Readymix Holdings Pty Ltd (Aerial Photo March 2005)

0 0.5 1 1.25km

Legend

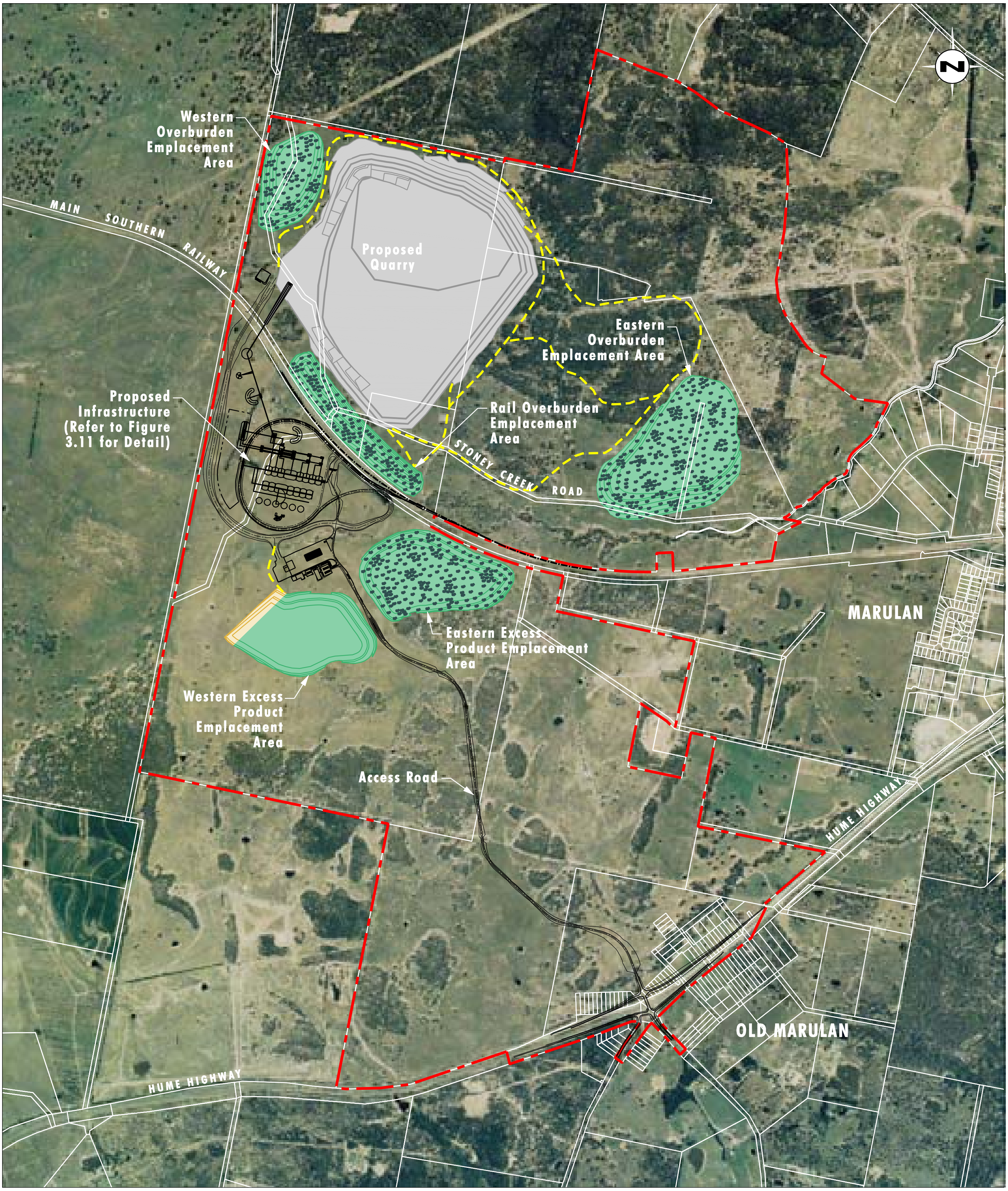
- Project Area
- Haul Road
- Quarry Area
- Emplacement Area
- Rehabilitated Area

FIGURE 3.7

Year 20 Quarry Plan

File Name (A4): R03_V1/1829_141.dgn

Umwelt
Environmental Consultants



Base Source: LPI 2004, Readymix Holdings Pty Ltd (Aerial Photo March 2005)

0 0.5 1 1.25km

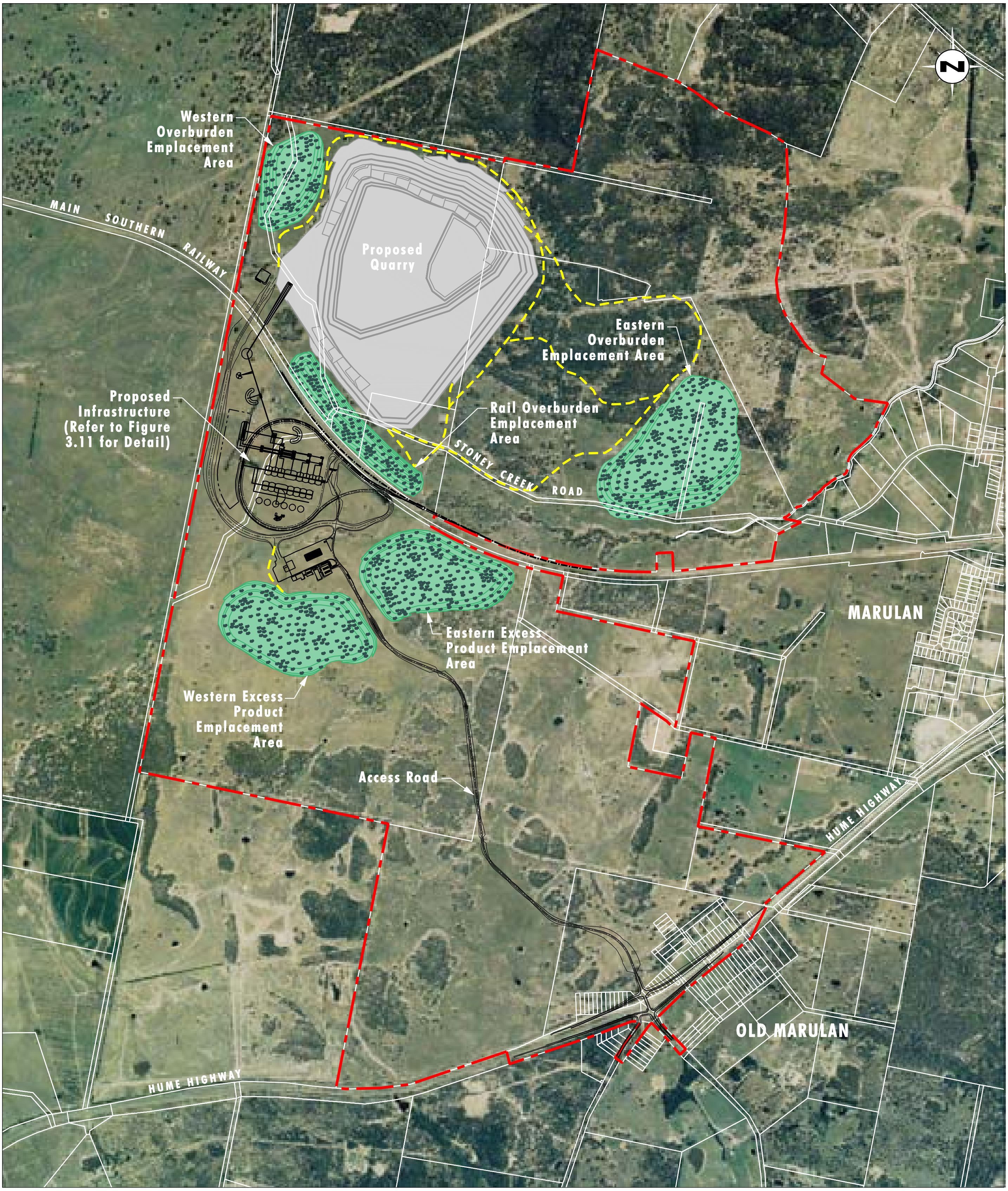
Legend

- Project Area
- Haul Road
- Quarry Area
- Emplacement Area
- Rehabilitated Area

FIGURE 3.8

Year 25 Quarry Plan

Umwelt
Environmental Consultants



Base Source: LPI 2004, Readymix Holdings Pty Ltd (Aerial Photo March 2005)

0 0.5 1 1.25km

Legend

- Project Area
- Haul Road
- Quarry Area
- Emplacement Area
- Rehabilitated Area

FIGURE 3.9

Year 30 Quarry Plan

3.8). There is no expected increase in the quarry footprint between Years 25 and 30 (refer to **Figure 3.9**). The total quarry footprint in Year 30 will be approximately 110 hectares.

During the initial 30 year period, the quarry pit will reach a maximum depth of approximately 570 mAHD. This equates to a maximum depth below the existing land surface of approximately 140 metres on the northern face of the quarry and 85 metres on the southern face of the quarry. The predicted approximate depths reached in each of the stage plans discussed above are outlined in **Table 3.4**.

Table 3.4 - Predicted Approximate Depths Reached in Each Stage of Quarry Development

Year	Predicted Depth (mAHD)
1	660
2	645
5	630
10	630
15	630
20	615
25	615
30	570

3.4.2 Conceptual Production Schedule

At full production, Lynwood Quarry will produce approximately 5 Mtpa saleable product. Production is expected to ramp up to 5 Mtpa over a period of three years and is expected to sustain this level of production for the remainder of the initial 30 year quarry plan. The amount of material extracted from the quarry during each year will vary depending on the ratio of overburden to primary raw feed (the rock which is delivered into the crushing and screening plant) and the extent of weathered rock.

3.4.3 Out-of-pit Overburden Emplacement Areas

The target hard rock resource is overlain by overburden material which is not suitable for generating a saleable product. The majority of this overburden material is highly weathered Bindook Porphyry and granite. The depth of weathering is variable across the site, typically being between 1 and 10 metres, but up to 30 metres in some areas. The weathering affects the structure of the rock and results in a decomposed ‘clayey’ material with no structural strength. This material cannot be used to generate quarry products and is handled separately to primary raw feed material.

Due to the fact that the overburden material is on top of the target resource and must be removed first, there is no option other than to place this material out-of-pit. There will be potential in the post Year 30 development of Lynwood Quarry to place overburden material in-pit, however, in-pit dumping cannot occur within the initial 30 year period without sterilising part of the resource. Dumping material in-pit cannot occur until the quarry reaches a terminal face; that is a face which cannot be extended either laterally or in depth. A terminal face is not developed until the quarry reaches maximum depth in a given area. Due to the extent of the resource at the Lynwood site, the maximum depth of the quarry will not be reached in the first 30 years, meaning that no terminal faces will be developed and out-of-pit emplacement areas will be required for all overburden extracted during this period.

Three overburden emplacement areas have been designed to accommodate the overburden material removed during the initial 30 year quarrying period. These three emplacement areas are shown on the staged conceptual quarry plans included as **Figures 3.2** to **3.9** and are known as the Railway Overburden Emplacement Area, the Eastern Overburden Emplacement Area and the Western Overburden Emplacement Area. The Railway Overburden Emplacement Area will be developed first and will have a capacity of approximately 1.3 million metres cubed (Mm^3), will occupy an area of approximately 12 hectares and will reach a height of approximately 685 mAHD. This emplacement area will be used for approximately the initial three years of the operation, following which emplacement will commence in the Eastern Overburden Emplacement Area. This emplacement area will have a capacity of approximately 3.2 Mm^3, a footprint of approximately 31 hectares, and will reach its capacity in about Year 12 at a height of approximately 660 mAHD. Following this time, all overburden will be emplaced in the Western Overburden Emplacement Area which will have a capacity of approximately 1.1 Mm^3, a footprint of approximately 11 hectares and reach a height of approximately 690 mAHD.

The overburden emplacement areas will be constructed in 1.5 to 2 metre lifts by dumping of material by truck and spreading and track rolling by dozer. A 4 metre high outer shell will be maintained on the eastern edge of these emplacement areas at all times during the construction of the eastern emplacement areas in order to reduce potential noise impacts and, for the Eastern Overburden Emplacement Area, to reduce the duration of visibility of working equipment as the dump nears its maximum height. The emplacement areas will be designed to create an uneven final landform with swales and areas of uneven ground to resemble the surrounding natural landform. Further details on rehabilitation of overburden emplacement areas are provided in **Section 3.11**.

3.4.4 Quarrying Techniques and Equipment

The quarrying process which will be used at Lynwood Quarry consists of four principal stages:

- clearing and topsoil stripping;
- overburden removal and emplacement;
- blasting, loading and haulage of primary raw feed material; and
- crushing and screening.

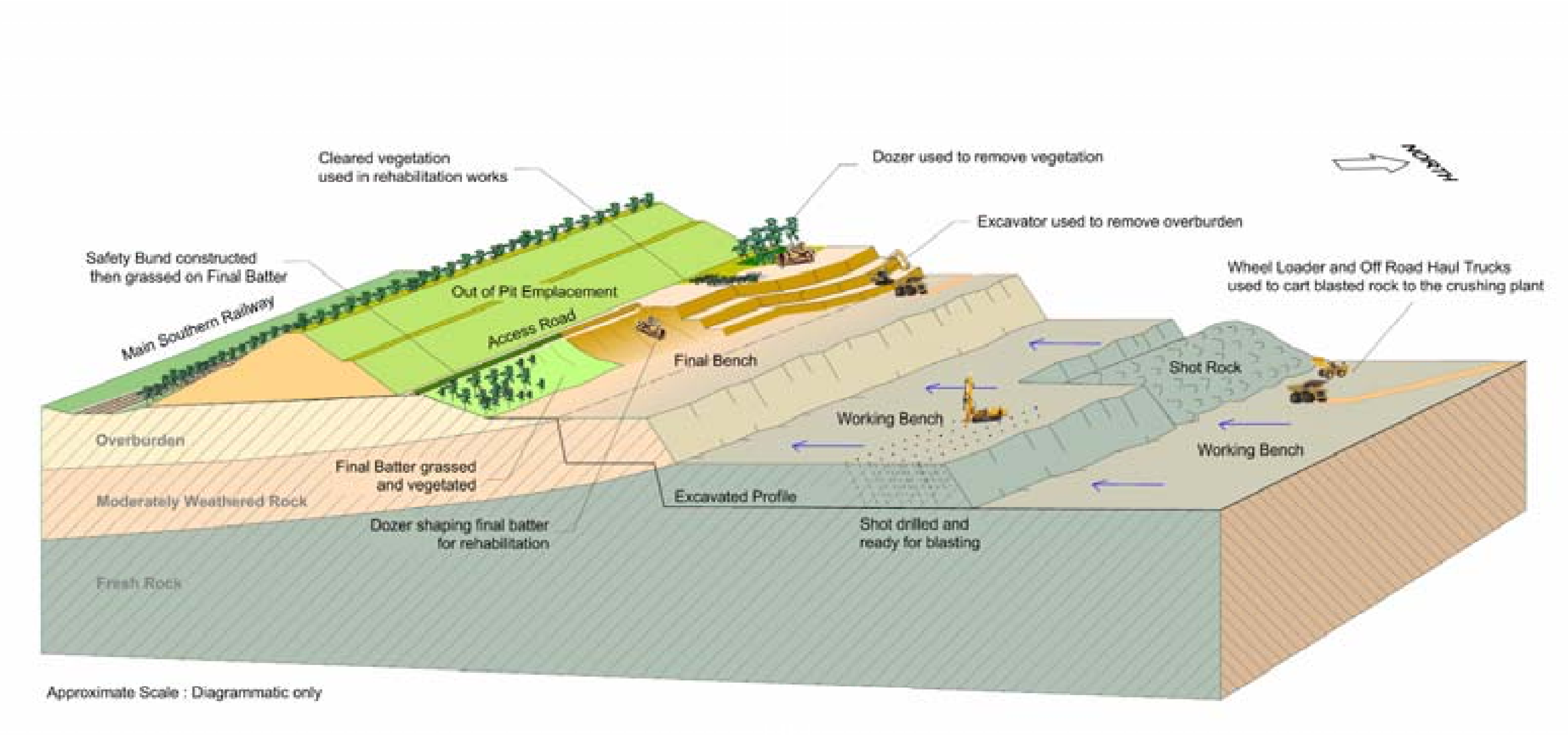
Crushing and screening is discussed in detail in **Section 3.5.1**, with the remaining three stages described below. A schematic representation of the quarrying process is included as **Figure 3.10**.

3.4.4.1 Clearing and Topsoil Stripping

The quarrying process will commence with clearing of vegetation and stripping of topsoil. Vegetation clearing will typically be undertaken using a dozer and/or excavator in accordance with the clearing procedure discussed in **Section 7.2.4**, with all cleared material stockpiled for later use in rehabilitation works. This material will be either mulched and spread over rehabilitated areas after the placement of topsoil, or placed on rehabilitated emplacement areas using an excavator to create habitat structures and aid in soil stabilisation.

Based on the soil survey undertaken in the project area (refer to **Section 5.2.2**), topsoil depth typically ranges from approximately 0.1 metre to 0.15 metre. Depths of 0.05 metre and 0.2 metre occur in small sections of the project area. The depth of topsoil stripping will be

Umwelt
Environmental Consultants



Source: Bell Cochrane & Associates

FIGURE 3.10

Schematic Representation of Quarry Process

determined on a day to day basis to ensure maximum recovery of suitable topsoil, however, in general, a topsoil stripping depth of 0.15 metre will be adopted for the quarry. Topsoil will be pushed into stockpiles using a dozer and then loaded using a front-end loader into haul trucks (nominally 100 tonne dump trucks) for dumping into stockpiles. These stockpiles will be located within the footprint of the overburden emplacement areas for use in progressive rehabilitation of these emplacement areas, and for storage for use in rehabilitation of the final quarry benches. Topsoil will be stored in stockpiles which are approximately 3 metres in height and will be planted with a cover crop if they are to remain in place for longer than six months. Where possible, freshly stripped topsoil will be placed directly onto shaped overburden emplacement areas to reduce the potential for loss of soil structure and make best use of soil seed stores.

Clearing and topsoil stripping will be undertaken in daylight hours only (7 am to 6 pm) seven days per week.

3.4.4.2 Overburden Removal

As discussed in **Section 3.4.3**, the target resource is overlain by highly weathered rock (overburden) which will not produce a saleable product. Due to the extent of weathering, it is predicted that up to approximately 65% of this material will be able to be extracted without the need for blasting. The overburden will be pushed into stockpiles by a dozer with ripping undertaken as necessary. The material will then be loaded into 100 tonne haul trucks (or similar equipment) by a front-end loader for delivery to overburden emplacement areas.

The remaining approximately 35% of overburden material may require drilling and blasting, particularly closer to the contact zone between highly and moderately weathered rock. Following blasting, the resultant material will be loaded and hauled to emplacement areas as discussed above. Should the blasting result in the formation of oversize rock fragments (+1 metre), these will be broken up by an excavator with a rock hammer. This is, however, considered unlikely to be necessary for the majority of blasted overburden material due to its highly weathered nature.

Overburden removal and haulage will be undertaken in daylight hours only (7 am to 6 pm) seven days per week.

3.4.4.3 Blasting, Loading and Haulage of Primary Raw Feed

Following the removal of overburden, the target resource will be drilled and blasted to allow the rock to be broken into sizes which can be readily handled and transported to the primary crusher. Should the blasting result in the formation of oversize rock fragments (+1 metre), they will be broken up using an excavator with a rock hammer. This work will be completed in daylight hours only and it is not anticipated that breaking of oversize rock will occur for more than approximately three hours per day.

The rock will then be loaded by front-end loaders into dump trucks and hauled to the primary crusher for the commencement of the crushing and screening process. Loading and haulage of rock from the quarry to the primary crusher will occur between 7 am and 10 pm seven days per week.

3.4.4.4 Haul Roads

Haul roads will be built to provide access between the quarry pit, emplacement areas and infrastructure area and will change over the life of the quarry depending on the quarry stage and which emplacement areas are being used. The conceptual locations of haul roads for each of the staged quarry plans are included on **Figures 3.2** to **3.9**. Haul roads will be constructed and maintained by track rolling and grading dumped material. Main haul roads will have an approximately 16 metre wide trafficable area with bunds and drains along the edges of the roads. Appropriate sediment and erosion controls will be constructed along the roads in accordance with the measures outlined in **Section 5.6**. Roads will be watered using two water carts, with additional contractor equipment brought on site as necessary during overburden haulage campaigns. The water carts will be filled using diesel pumps with stand pipes that will be placed at the various water storage dams located around the quarry.

3.4.4.5 Quarry Mobile Equipment

A conceptual list of the mobile equipment is provided in **Table 3.5**. This equipment may change during the life of the quarry to meet operational demands and reflect changes in technology. The mobile equipment fleet will be managed, however, to ensure that any changes in equipment types do not increase the environmental impact of the quarry operations (including considerations of noise, dust and consumption of natural resources). The considerations of noise impacts will be undertaken by comparing the sound power levels of the equipment listed in **Table 3.5**, to that of the proposed modified equipment.

Table 3.5 - Conceptual Mobile Equipment

Activity / Application	Item[1]
Clearing	1 x D10 Dozer
	1 x 45 Tonne Excavator
Topsoil Stripping	1 x D10 Dozer
	1 x 990 Loader
	3 x 100 Tonne Haul Trucks
Drilling	3 x Hydraulic Rock Drill (Tamrock Pantera 1100 or equivalent)
Overburden Removal	1 x D10 Dozer
	1 x 990 Loader
	3 x 100 Tonne Haul Trucks
Load and Haul	1 x 992 Loader
	1 x 990 Loader
	6 x 100 Tonne Haul Trucks
Dozer (clearing, overburden, shaping emplacement areas, etc.)	1 x D10 Dozer
Watercarts	2 x converted 50 Tonne Haul Trucks
Excavator with Rock Hammer	1 x 45 Tonne Excavator with Hammer
Grader	1 x Grader (140H or equivalent)
Sales/Stockpile Loaders	2 x 980G Loader
Stockpiling	1 x 50 Tonne Haul Truck
Miscellaneous Plant	1 x Rough Terrain Forklift
	1 x Bobcat
	3 x Diesel Pit Pumps (including standpipes)

Note[1]: This equipment or similar will be used during the life of the project.

It should be noted that some of the equipment specified will be used for multiple tasks. For example, it is possible that the same dozer will be used for clearing, topsoil stripping, overburden removal and shaping of emplacement areas. There is also significant overlap between the haul trucks, with the same fleet likely to be used for both overburden load and haul and primary raw feed load and haul.

3.4.5 Drill and Blast

As indicated in **Table 3.5**, three hydraulic rock drills will be operated in order to reach a production level of 5 Mtpa. The hydraulic rock drills will drill holes between 89 mm and 115 mm diameter with up to 300 holes per blast. Drill holes will typically be to a depth of 15 metres with a 1 metre sub drill, resulting in the establishment of approximately 15 metre quarry benches. Drilling will be undertaken in daylight hours only (7 am to 6 pm) up to seven days per week and only one drill will operate on the upper bench at any one time to ensure potential noise impacts are minimised.

Blasting will be carried out on an approximately weekly basis with minimum blasts of approximately 115,000 tonnes of rock required to meet production demands. A detailed design and predictive model will be completed for each blast to ensure that vibration and blast overpressure limits are met, however, the typical MIC (maximum instantaneous charge) used for blasting undertaken at the quarry will be up to 160 kg. The MIC limit has been determined by detailed modelling and will ensure compliance with blast overpressure and vibration limits (refer to **Section 5.9**). Blasts with smaller MICs may be required in some locations to meet limits for infrastructure within the project area and some nearby residential receivers. Due to operational requirements, during some weeks multiple blasts may be required to meet production demands whilst ensuring the blast limits are met. Blasts will be initiated using electronic detonators where required to provide the maximum level of control over the explosive charge. No explosives are planned to be stored on site, with all explosives brought onto the site as needed and loaded directly into the drill holes.

Blast monitoring will be undertaken for each blast and the results of this monitoring will be fed back into the site blast model to identify any differences to the blast design predictions. This will allow ongoing refinement of blast design on site. Substantial historical blasting data exists for the Johniefelds Quarry which Readymix operates in similar geological conditions to the north of the project area. This data has been reviewed as part of the blasting impact assessment conducted for this EIS and used to assist in the development of blast site laws for Lynwood Quarry.

Blasting will typically occur between the hours of 10 am and 3 pm, with no blasts undertaken outside the hours of 9 am to 5 pm Monday to Saturday. Blasts will be timed to ensure they do not occur when there is a train on the Main Southern Railway adjacent to the quarry.

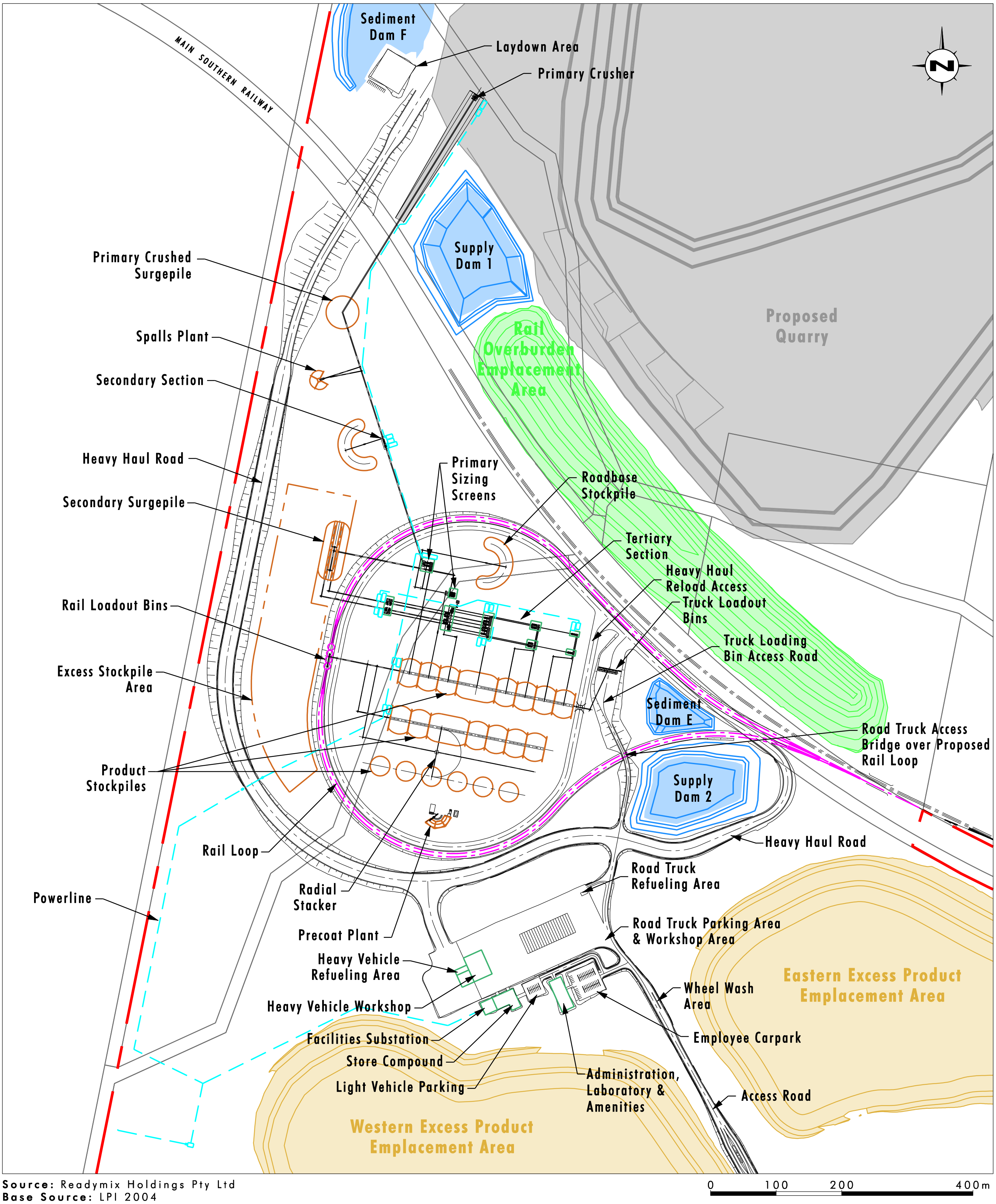
3.5 Proposed Infrastructure

Site infrastructure proposed to be established for the quarry includes the crushing and screening plant, pre-coat plant, transportation facilities, site workshop, administration and bathhouse buildings, site services and other minor infrastructure. The key site infrastructure components are shown on **Figure 3.11** and are described in further detail below.

3.5.1 Crushing and Screening Process

The crushing and screening process passes rock through a series of crushers to reduce the rock into various sized fragments. The actual size of the crushed rock depends on the size and design of the crusher and the properties of the rock. The crushing process on its own does not result in uniformly sized rock fragments. A series of screens are therefore used following each crusher to sort the crushed rock into various size categories. Rocks which are larger than the size of the screen do not fall through and are directed into a particular part of the plant, whilst rocks which are smaller than the screen spacing fall through and are sent to a different location. By passing the crushed rock through a series of crushers and screens it is separated into a range of size categories, resulting in a number of different crushed rock products.

Umwelt
Environmental Consultants



Source: Readymix Holdings Pty Ltd
Base Source: LPI 2004

Legend

Project Area
Powerline

FIGURE 3.11

Key Infrastructure Components

In order to ensure the most efficient utilisation of the resource, it is proposed to construct a high quality, modern three phase crushing and screening plant. The plant has been designed to deliver single sized products to dedicated product stockpiles for ready delivery to markets by both rail and truck. The plant has the capacity to produce product rock from sizes of approximately 0.3 metre diameter down to fine sand. The typical product streams that will be generated are:

- spalls (up to 0.3 metre);
- ballast;
- -20 mm to +14 mm aggregate;
- -14 mm to +12 mm aggregate;
- -12 mm to +8 mm aggregate;
- -8 mm to +6 mm aggregate;
- -6 mm to +4.5 mm aggregate;
- coarse manufactured sand; and
- fine manufactured sand.

The crushing and screening process will also produce a lower quality crushed rock which will be suitable for use as road base. The quarry will also be able to produce rock of size 0.5+ metres for specific construction purposes, as necessary.

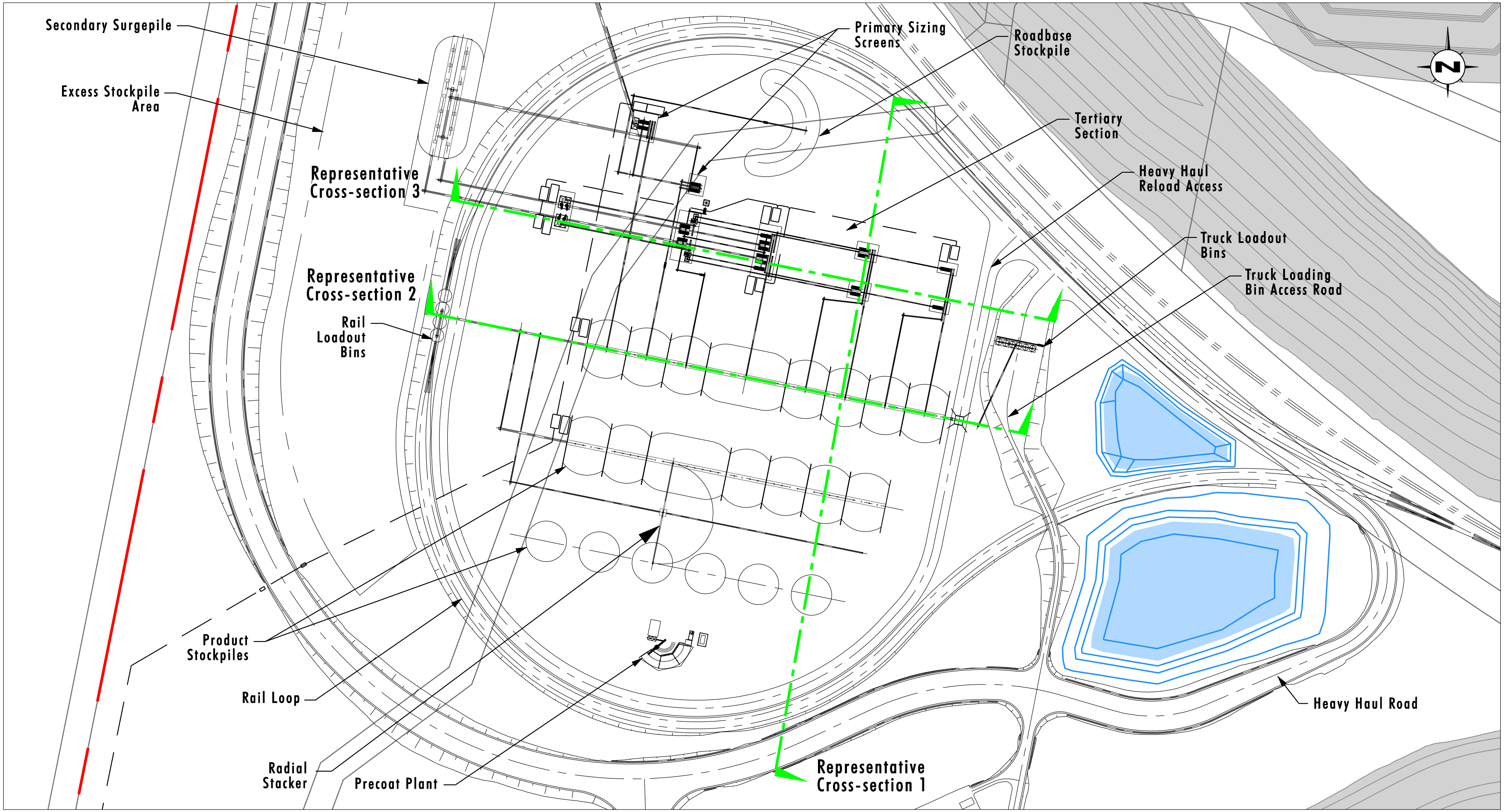
The crushing and screening plant will have three phases that have been designed to achieve the following outputs:

Primary Section	2000 tonnes per hour
Secondary Section	1700 tonnes per hour
Tertiary Section	1500 tonnes per hour.

The layout of the plant is shown on **Figure 3.12**, with representative cross-sections provided as **Figures 3.13** to **3.15**. Rock enters the crushing and screening process when it is dumped by either dump truck or loader into the primary crusher hopper. The primary crusher is a large gyratory crusher which will be located within a box cut so that the top of the hopper bin is at ground level. The box cut will be to a depth of approximately 21 metres and will be wide enough to allow access by service vehicles. From the primary crusher the rock continues through the crushing process generally as shown in the simplified flow chart included as **Figure 3.16**. As noted in the flow chart, rock is able to be handled differently to meet product demand and according to rock quality.

The plant includes a number of surge piles which allow independent operation of each section of the plant. The post secondary section surge pile also allows blending of the different quality raw feeds into the tertiary section to ensure that desired product specifications are met. The plant will have two identical tertiary sections (each of 750 tonnes per hour capacity) to allow for flexibility of production and maintenance activities.

Umwelt
Environmental Consultants



Source: Readymix Holdings Pty Ltd
Base Source: LPI 2004

Legend

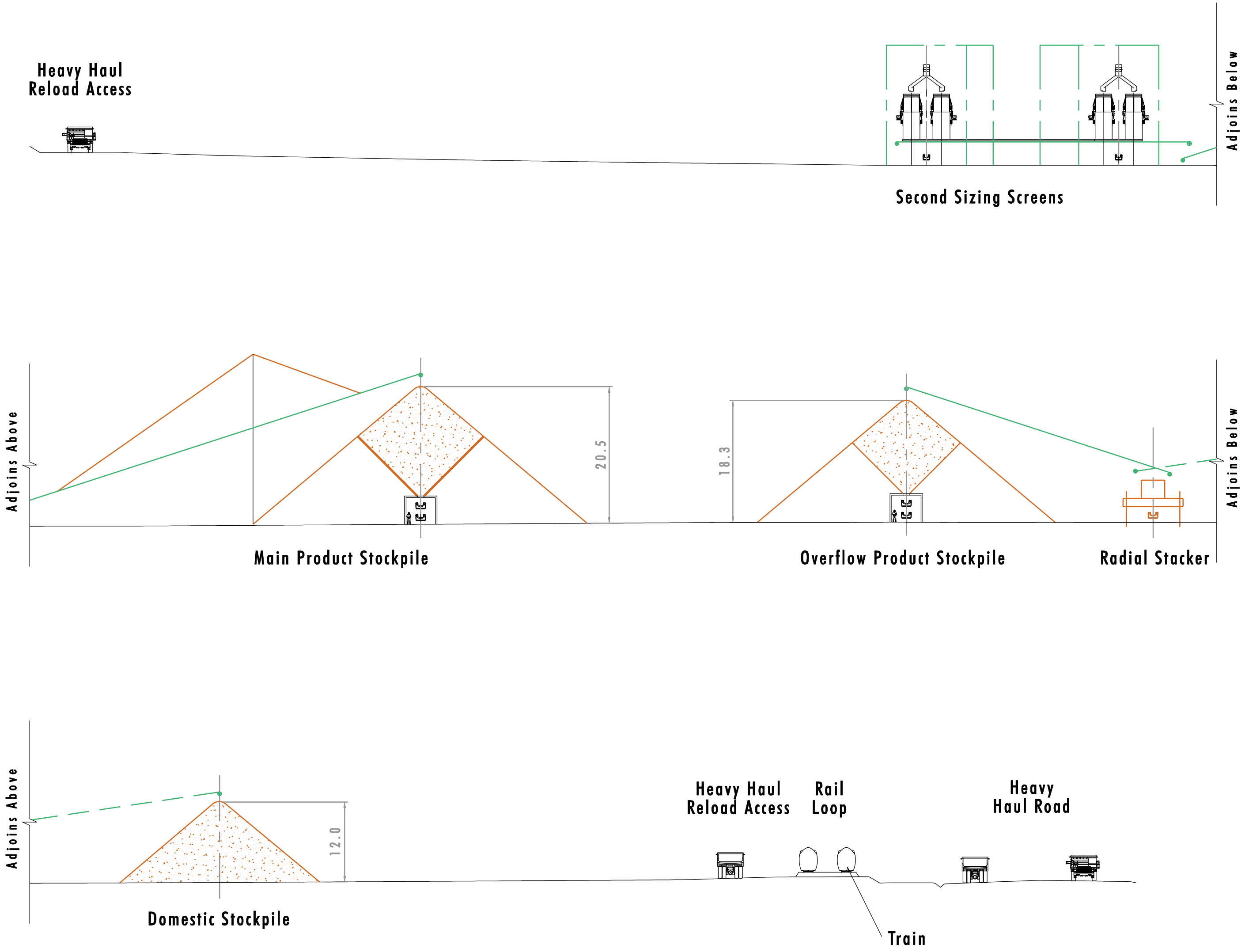
Project Area
Cross-section Locations

FIGURE 3.12

Crushing and Screening Plant Layout

File Name (A4): R03_V1/1829_177.dgn

Umwelt
Environmental Consultants



Source: Readymix Holdings Pty Ltd

0 10 25 50m
Horizontal Scale

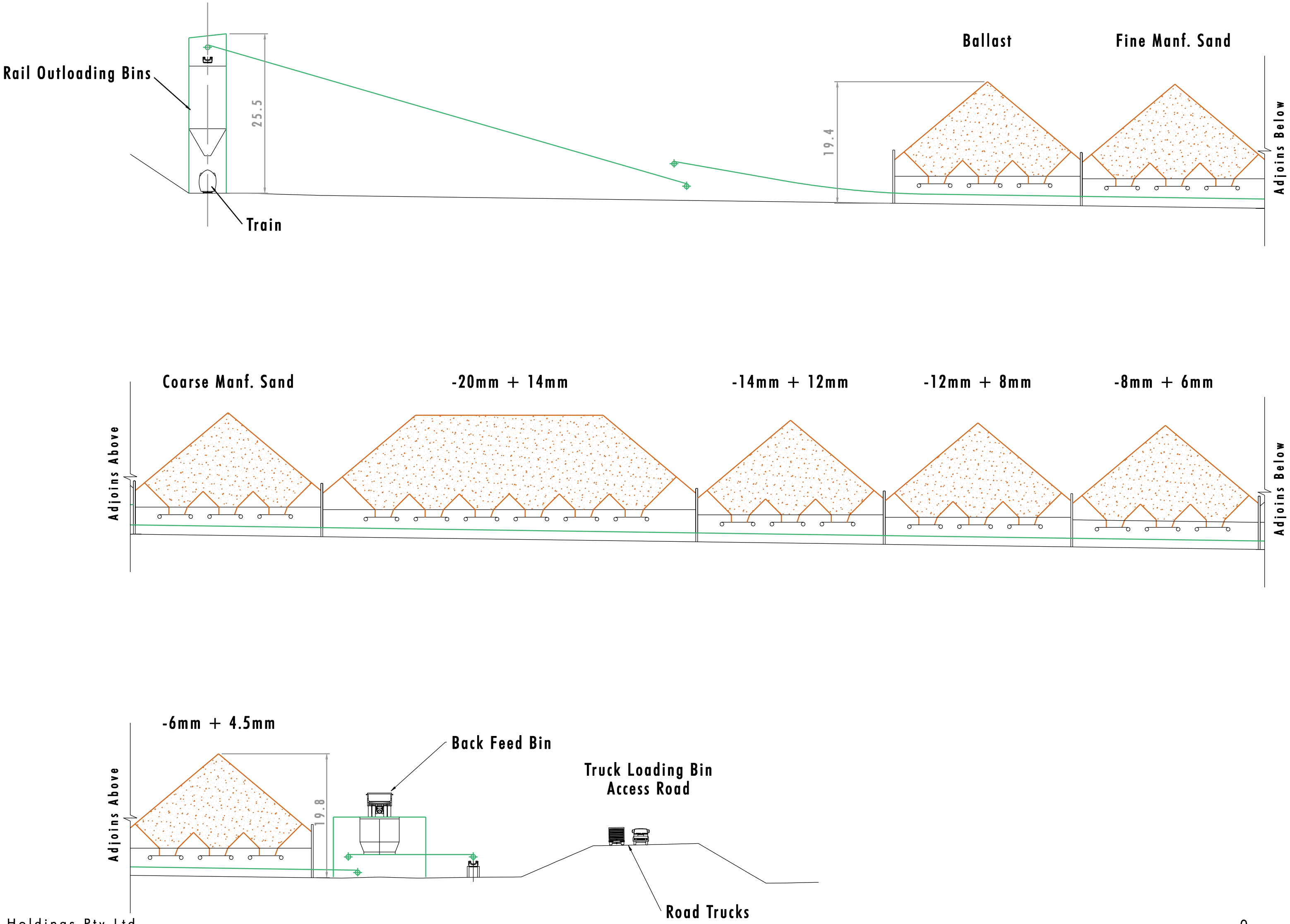
Note

Height not to scale. Heights as per labels

FIGURE 3.13

Crushing and Screening Plant Representative Cross-section 1

File Name (A4): R03_V11829_125.dgn



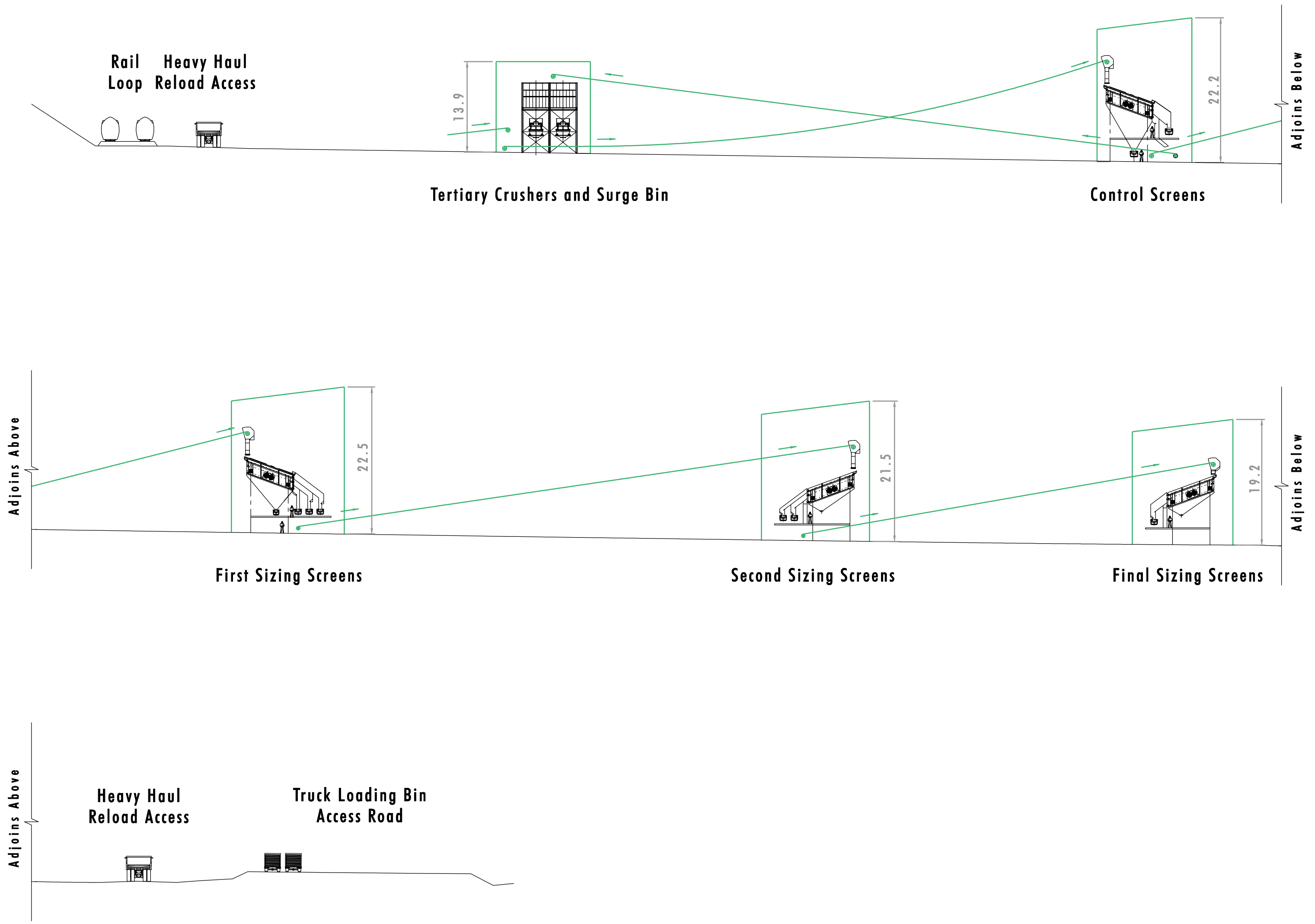
Source: Readymix Holdings Pty Ltd

0 10 25 50m
Horizontal Scale

Note
Height not to scale. Heights as per labels

FIGURE 3.14

Crushing and Screening Plant Representative Cross-section 2



Source: Readymix Holdings Pty Ltd

0 10 25 50m
Horizontal Scale

Note
Height not to scale. Heights as per labels

FIGURE 3.15

Crushing and Screening Plant Representative Cross-section 3

Umwelt
Environmental Consultants

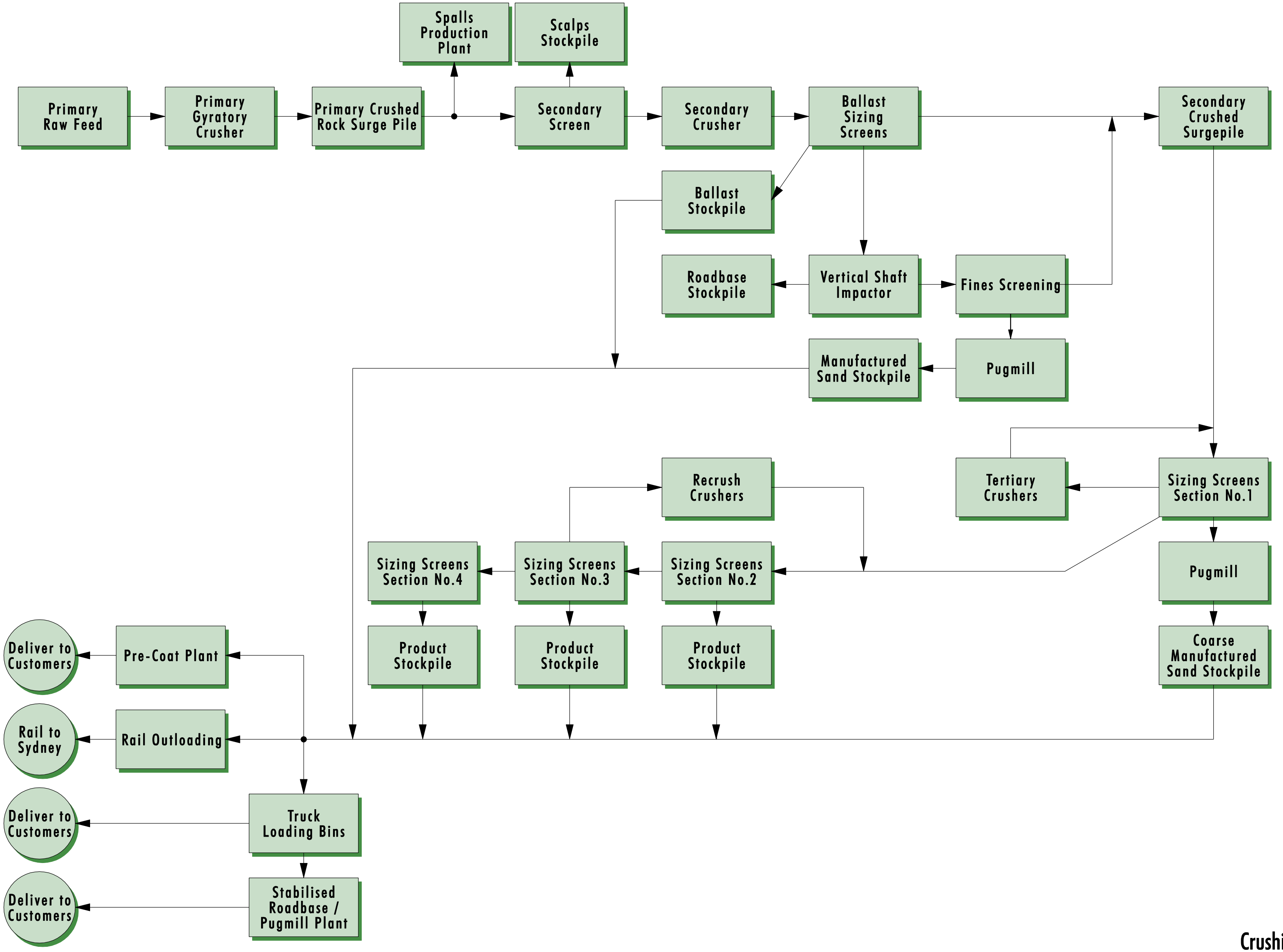


FIGURE 3.16

Crushing and Screening Flow Chart

Source: Readymix Holdings Pty Ltd

File Name (A4): R03_V1/1829_143.dgn

Each section of the crushing and screening plant excluding the primary crusher and spalls plant will be fully enclosed to reduce noise and dust emissions. The primary crusher is below ground level and both the primary crusher and spalls plant will have dust suppression sprays to control dust. The spalls plant will have rubber screen mats to reduce noise and will only be used on a short-term campaign basis during daytime hours. Dust extraction systems will be installed at all enclosed screens and crushers to assist in the reduction of off-site dust impacts and as part of site occupational health and safety (OH&S) management. All conveyors will be enclosed on top and on one side to further reduce the potential for dust generation. Water sprays will not be required on the conveyor system as the conveyor will be covered on two sides as discussed above and all transfer points will be enclosed.

All coarse aggregate products resulting from the crushing and screening process will be rinsed to reduce dust when they are handled and to improve customer acceptability. The fine material washed off the aggregates will be reclaimed by passing water through a cyclone and a dewatering screen and will be added to the manufactured sand product. This process negates the need for fines or slurry ponds which are used at some quarries with older style plants and also recycles the plant water, reducing the total water demand of the plant.

3.5.1.1 Product Stockpiling

There are four product stockpiling areas that will be used to store the various products generated by the crushing and screening process (refer to **Figure 3.11**). The first series of stockpiles will be located adjacent to the tertiary section. These stockpiles will be fed by a series of conveyors that drop material directly onto the stockpiles. Below the stockpiles will be a reclaim tunnel system that will load from the bottom of the stockpile directly onto a conveyor for delivery of product to the rail loading bin. Once this first series of stockpiles is fully occupied, product will be delivered by conveyor to a radial stacker that will load out onto a second series of stockpiles. These stockpiles will also have a reclaim tunnel system that will allow material to be automatically delivered to the rail loading system. The radial stacker will also have the ability to rotate through 180° which will provide the ability to load out excess product to a third series of stockpiles. These stockpiles will not have a reclaim tunnel system and once the stockpiles are established, the product will be rehandled via front-end-loader and trucks or through the reload bin system to the truck loading bin.

In the event that the above product stockpiles are fully occupied, an excess product stockpiling area outside of the rail loop will be utilised (refer to **Figure 3.11**). Product will be delivered to this stockpiling area by haul truck after being loaded by front-end-loader from one of the product stockpiles discussed above.

Due to the product rinsing process, dust generation will not be an issue for the majority of product stockpiles as the material will be damp when stockpiled. The only product stockpiles that may be a source of dust are the manufactured sand stockpiles and the road base stockpile. Stockpiles for these product types will have water cannons that will be used to seal the surface of the stockpiles to prevent dust generation during high wind periods. In addition, the manufactured sand will be passed through a pug mill where water will be added to achieve a 2% moisture content which will reduce the potential for dust generation. The primary surge and scalps stockpiles which are not product stockpiles but are part of the crushing and screening process will also have water cannons that will be used to suppress dust as needed.

3.5.1.2 Excess Product Emplacement Areas

The quantity of manufactured sand generated as part of the crushing and screening process is expected to be in excess of the available market for this material. Readymix will continue to investigate possible markets for this material and it is anticipated that as natural sand becomes more difficult to obtain, market acceptability of manufactured sand will increase.

This particularly applies to the proportion of manufactured sand which customers will accept in their concrete. A 15% to 20% increase in the amount of manufactured sand included in concrete would significantly reduce the amount of excess manufactured sand produced by the quarry. Readymix is currently undertaking a number of trials to attempt to resolve customer concerns about an increased manufactured sand percentage in concrete.

In addition to excess manufactured sand, the quarry will also produce scalps which cannot be reclaimed to produce an aggregate product. This material will have the potential to produce a road base product, however, as with the manufactured sand discussed above, Readymix does not currently envisage a sufficient road base market to sell all of this material. Opportunities for increasing the road base market for material from Lynwood Quarry are currently being investigated.

As it is unlikely that all of this product will be sold, Readymix proposes to establish two excess product emplacement areas to the south and southeast of the infrastructure area. These two emplacement areas, known as the eastern and Western Excess Product Emplacement Areas are shown on **Figure 3.9**. The Eastern Excess Product Emplacement Area will have a total capacity of approximately 2.4 Mm^3, occupy a footprint of approximately 22 hectares and reach a maximum height of approximately 672 mAHD. The Western Excess Product Emplacement Area will have a total capacity of approximately 2.5 Mm^3, a footprint of approximately 24 hectares and reach a maximum height of approximately 681 mAHD.

The emplacement areas will be constructed in a similar manner to the overburden emplacement areas by truck dumping and shaping by one of the loaders or a dozer. The construction of these emplacement areas will take place during daylight hours only. The emplacement areas will be progressively rehabilitated as per the overburden emplacement areas, however, should Readymix be able to increase the markets for either manufactured sand or road base, this material will be reclaimed and sold as product. As depicted on **Figures 3.2** to **3.9**, the Eastern Excess Product Emplacement Area will be established first, followed by the Western Excess Product Emplacement Area should it be required.

3.5.1.3 Pug Mills

As shown on the process flow chart on **Figure 3.16**, the crushing and screening plant will include three pug mills which will be used to assist in the production of both manufactured sand and road base products. A pug mill has a series of paddles which mix and move material through the machine. When water is added, the pug mill will ensure consistent moisture control of the discharged product.

3.5.1.4 Pre-coat Plant

It is also proposed to construct a pre-coat plant as shown on **Figure 3.11**. The pre-coat plant will comprise a small loading hopper into which aggregate is loaded and then passed through the pre-coat plant which sprays the aggregate with a bitumen emulsion before loading the ‘coated’ aggregate out into a small stockpile. This coated material is used for asphalt, typically on roadways. The pre-coat product will be loaded directly from the stockpile by front-end loader into road trucks for delivery off site.

3.5.2 Rail Loading Facility and Rail Transportation

Approval is sought to transport up to 5 Mtpa by rail, however, in most years, part of this 5 Mtpa will be delivered by truck to local and regional markets. Trains from Lynwood Quarry will deliver product to a distribution centre in Sydney which will be subject to a separate development approval process (refer to **Section 3.5.2.1**).

The project includes the establishment of a balloon rail loop that will be accessed from a turn out point on the Main Southern Railway, approximately 2.5 kilometres west of Marulan. The balloon loop will have double track sections both before and after the train loading bins to ensure that it can hold two unloaded trains and two loaded trains at the same time. This holding capacity is required due to the restricted number of train paths available on the Main Southern Railway and the need to ensure that trains can enter and leave the Lynwood Quarry balloon loop at specified times without blocking the Main Southern Railway. The total length of railway track to be constructed for the project will be approximately 2.5 kilometres. The balloon loop will be constructed with a slight grade from west to east and will require both cut and fill during the construction phase to create the required rail embankment.

Trains will be loaded by an automatic loading bin system with a series of four bins loaded by conveyors from the reclaim tunnel systems located below the product stockpiles (refer to **Figure 3.11**). The lower section of each bin will be lined to reduce the impact noise of loading an empty bin and the train loading point will be enclosed to reduce potential noise emissions associated with quarry product falling into rail wagons. The trains hauling product from the site will have a capacity of approximately 3500 tonnes, with up to six trains per day required to deliver product to the Sydney distribution centre. The rail loadout facility will be required to operate 24 hours per day, seven days per week to ensure that Readymix can utilise the available train paths on the busy Main Southern Railway. ARTC has advised that sufficient capacity exists on the rail network to accommodate the additional trains that will be generated by the Lynwood Quarry (refer to **Appendix 2**).

3.5.2.1 Preferred Sydney Distribution Centre Proposal

Quarry products from Lynwood Quarry will be delivered to the Sydney region markets via a Regional Distribution Centre (RDC). Readymix's currently preferred option for the RDC is at Rooty Hill in Sydney's western suburbs. A separate DA and EIS will be lodged by Readymix for the proposed facility.

The proposed Rooty Hill RDC will unload up to 4 Mtpa of quarry product delivered from Lynwood Quarry by rail and then process and distribute this product to various locations across Sydney in accordance with market demands. The Rooty Hill site is adjacent to the M7 motorway and therefore provides ready access to Sydney's main road network. In addition, product from Lynwood Quarry may be sent to Sydney by rail for markets such as rail ballast and other rail unloading facilities.

Should this currently preferred option not be available to receive the required product capacity from Lynwood Quarry, further distribution centre options would need to be pursued by Readymix.

3.5.2.2 Replacement of Marulan Rail Ballast Loading Facility

Readymix currently delivers rail ballast to trains for use on the rail network via a rail siding on the Main Southern Railway in the middle of the township of Marulan. Ballast is delivered to the Marulan rail siding via truck from Readymix's Johniefelds Quarry and is loaded onto trains using Johniefelds' front-end-loader which is road registered. Both Johniefelds and Goulburn Mulwaree Council (when formerly Mulwaree Shire Council) have historically received complaints about the noise generated by the loading facility.

The Lynwood Quarry rail loading facility will be able to load rail ballast via the automated train loading bins and therefore Readymix plans to cease loading of ballast at the Marulan rail siding once this facility becomes operational. Readymix also plans to remove the residual ballast stockpiles at the Marulan rail siding and rehabilitate/landscape any areas no longer required for rail maintenance use in cooperation with ARTC, who owns and operates the siding.

3.5.3 Truck Loading Facility and Road Transportation

As discussed in **Section 3.5.2**, the majority of product from Lynwood Quarry is proposed to be transported from site by rail, however local and regional markets will be serviced by road transport. Therefore, approval is also sought to deliver product by truck to local and regional markets up to a maximum of 1.5 Mtpa.

Road trucks will be loaded either by the automated overhead truck loadout system or directly from the stockpiles via front-end loader. There will be six truck loading bins for out-loading product into road trucks, with these bins filled via conveyor from the reload bin system. The facility will also have a stablement silo which will enable stablement (a material with cement like properties) to be mixed with road base product. Trucks will be loaded 24 hours per day, seven days per week.

Road haulage of product at 1.5 Mtpa equates to approximately 162 truck loads per day. Product trucks will typically be truck and dog, however some B-doubles may also be used. Trucks will exit the site via a wheel wash to limit mud or dirt tracking as the trucks leave the site and then a twin weighbridge which records product loads. After passing through the weighbridge, the loaded trucks will travel along the Lynwood Quarry sealed access road for a distance of approximately 2.5 kilometres before reaching the proposed intersection with the Hume Highway (refer to **Section 3.5.4**). All loads will be covered to limit potential for product spillage during haulage.

Once on the Hume Highway, truck destination will be variable depending on customer location. It is expected that product from the quarry will be delivered both south to Goulburn, Canberra and surrounds, to Southern Tablelands destinations and north to destinations on the southern margins of Sydney. Once Lynwood Quarry is operational, all product trucks will leave and access the site via the proposed site access road / Hume Highway intersection and there will be no product transportation through the township of Marulan.

Readymix plans to use both its own trucks and contractor vehicles for road haulage and provision has been made at the Lynwood site for parking, refuelling and maintenance of these vehicles (refer to **Section 3.5.5**).

3.5.4 Access Road and Hume Highway Intersection

Following the construction phase, access to Lynwood Quarry will be via an intersection on the Hume Highway, with no access through the township of Marulan. The intersection location was determined in close consultation with the RTA and is proposed to be at the existing South Marulan Road intersection. This location was not originally Readymix's preferred location as it is a more complex intersection and is therefore more costly, without providing any additional benefits to Readymix compared to other locations. Readymix does, however, acknowledge that this location provides benefits to other existing and future road users, including future industrial operations, and has agreed to construct the intersection at this location.

The existing South Marulan Road intersection is a cross median access which currently provides a poor level of service for vehicular movements and does not comply with current RTA standards (refer to **Section 5.5.1**). During the design and impact assessment phase of the project and through discussions with the RTA, it was determined that an interchange type intersection was required at this location in order to fix the existing problems and provide safe access to and from Lynwood Quarry. Constructing an interchange type intersection at this location provides Readymix with safe access onto the Hume Highway, upgrades the current poor quality intersection and provides potential safe access for other existing and proposed industrial developments onto the Highway, including the road haulage trucks from

Boral's existing South Marulan Quarry. As the interchange will benefit other future industrial users of the intersection, Readymix considers that future industrial development proposals which propose to use this intersection should bear part of the cost of the intersection, either by a cost sharing arrangement prior to the construction or by a percentage reimbursement to Readymix if construction is already completed. It is understood that such an arrangement could be achieved by the inclusion of specific conditions on development consents granted for future industrial developments.

The interchange will have a flyover and on and off ramps on both the north and south bound lanes of the Hume Highway (refer to **Figure 3.17**). The interchange will also provide access to the Lynwood Quarry access road, South Marulan Road and Jerrara Road, the latter providing access to the Bungonia State Conservation Area. The interchange design will ensure that private property access points are retained. Once construction is complete, management of the interchange will be handed over by Readymix to the RTA who will be responsible for the ongoing maintenance and management of the intersection.

The Lynwood Quarry access road will be constructed from the Hume Highway interchange to the quarry industrial area and will be a two lane (one lane in each direction) sealed road built to a standard to enable it to carry the anticipated volume of heavy vehicle traffic.

3.5.5 Workshop and Refuelling Facility

A heavy vehicle workshop will be located in the quarry infrastructure area as shown on **Figure 3.11**. The workshop will be used for maintenance of all heavy vehicles on site and also for the maintenance of Readymix's road truck fleet. The workshop building will be constructed as a metal clad building on a concrete slab and will have a maximum height of approximately 20 metres (refer to **Figure 3.18**). A heavy and light vehicle washdown bay will also be constructed adjacent to the workshop with all washdown water reporting to a sediment trap and oil separator prior to being reclaimed for use as process or dust suppression water. In addition, an adjacent parking area will be established for heavy vehicles.

The workshop will have a bunded storage area for oil, waste oil, coolant and other necessary chemicals. The storage area will be constructed in accordance with the relevant Australian Standards and DEC guidelines. All oils and chemicals stored inside the workshop will be stored in bunded cabinets or on bunded pallets.

Refuelling facilities for both heavy vehicles and road haulage trucks will be located as shown on **Figure 3.11**. These refuelling facilities will be fed from two above ground 100,000 litre diesel tanks with typically three fuel deliveries per week (by road tanker) required to supply fuel to the heavy vehicle and road truck fleets. The fuel tanks will be bunded in accordance with relevant Australian Standards and DEC guidelines. All runoff from the refuelling area and the nearby truck parking areas will report to a sediment trap and oil separator before being reclaimed for use as process or dust suppression water.

3.5.6 Rail Bridge

A single lane heavy vehicle rail crossing bridge will be constructed to provide quarry vehicles with safe access across the Main Southern Railway. The bridge will be located near the western boundary of the project area as shown on **Figure 3.11**. All quarry vehicles will use this crossing point, with no vehicles using the current level crossing on the property. The current level crossing will be closed. The bridge will be of sufficient height to allow clearance for two rail containers in accordance with ARTC long-term planning guidelines.

Base Source: Readymix Holdings Pty Ltd (Aerial Photo March 2005)

0 100 200 250m

Legend

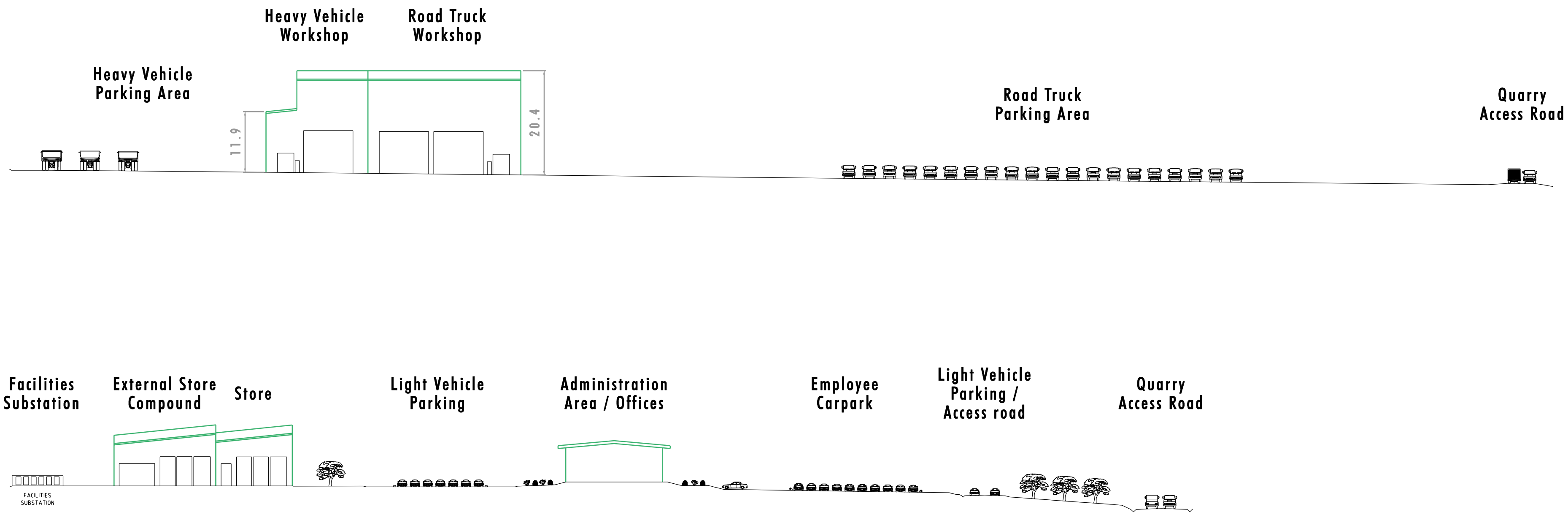
Project Area

FIGURE 3.17

Proposed Interchange

Home TOC Next

Umwelt
Environmental Consultants



Source: Readymix Holdings Pty

0 20 40 60m
Horizontal Scale

Note

Height not to scale. Heights as per labels

FIGURE 3.18

Workshop, Store and Administration Area Elevation

3.5.7 Administration, Laboratory and Employee Facilities

The Lynwood Quarry industrial area will have administration, laboratory and employee washroom facilities as shown on **Figure 3.11**. The conceptual design of these buildings is provided on **Figure 3.18**. Separate staff amenity buildings will be provided for quarry personnel working in the production and crushing and screening plant areas, administration, laboratory and weighbridge areas. The laboratory facilities are required so that quarry products can be tested on an ongoing basis to ensure that they meet customer specifications.

3.5.8 Electrical and Power Reticulation

Readymix is in the process of negotiating an agreement with Country Energy regarding the establishment of a new substation for the Marulan township within the project area. The new substation and associated transmission lines will be established by Country Energy and are planned to be located as shown on **Figure 3.19**. Country Energy will seek the appropriate approvals for establishment of this infrastructure. As part of the agreement, Country Energy will remove the existing high voltage powerline which passes through the northern portion of the property and which is within the footprint of the proposed quarry.

The energy supply for Lynwood Quarry will be taken directly from this substation with Readymix installing both a 10 MVA and 5 MVA transformer in the Country Energy substation. Powerlines will carry power from the substation to the infrastructure areas as shown on **Figure 3.19**. It is expected the quarry will use approximately 32,000,000 kW hours per annum.

3.5.9 Other Infrastructure

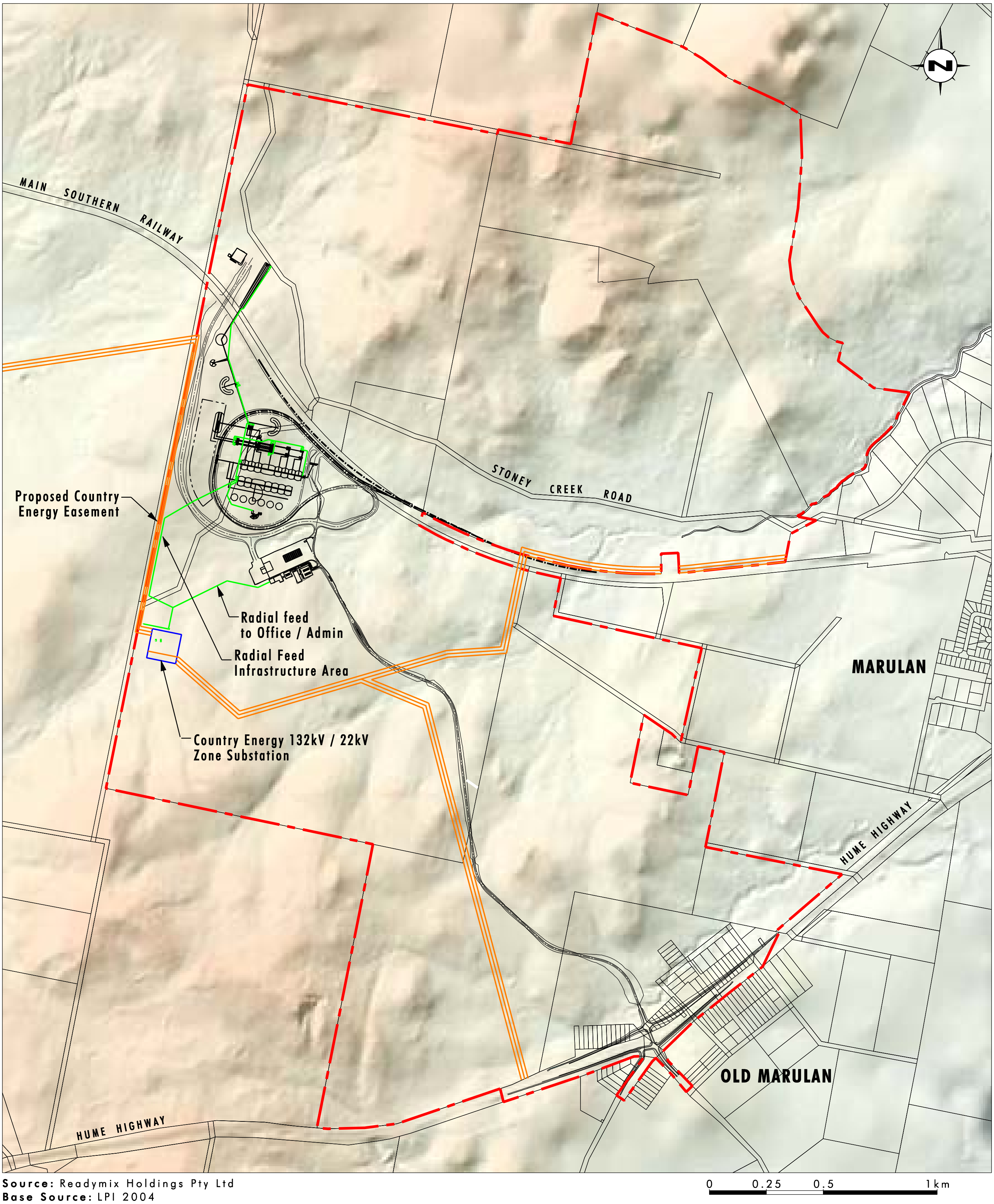
Other infrastructure required for operation of the quarry will include:

- a store building and yard that will be used to store all various ancillary materials needed to operate the quarry;
- a laydown area adjacent to the primary crusher that will be used to store plant components;
- a crib hut (meal room) for production personnel near the primary crusher; and
- mobile crib hut facilities which will be located in working areas and moved as needed. Some of these crib huts will contain pump-out toilet facilities. These facilities will be contained by earth bunding and located within the dirty water catchment area to ensure any runoff from these areas is appropriately contained.

3.5.10 Staged Construction of Infrastructure

Depending on market demands, Lynwood Quarry may not ramp up to maximum production of 5 Mtpa saleable product as quickly as projected (currently planned to reach 5 Mtpa in Year 3). In this event, construction of the crushing and screening plant may be staged. As described above, the tertiary section of the plant has been designed to consist of two identical components and should the construction be staged, only one component of the plant may be constructed during the initial construction period. Construction of the product stockpile areas may also be staged, as may the construction of the automated truck loading facility, with all road trucks initially loaded by the two loaders. An example of a possible staged construction scenario is provided as **Figure 3.20**. As the plant layout and operation under any staged construction option would be only a partial component of the total planned

Umwelt
Environmental Consultants



Source: Readymix Holdings Pty Ltd
Base Source: LPI 2004

Legend

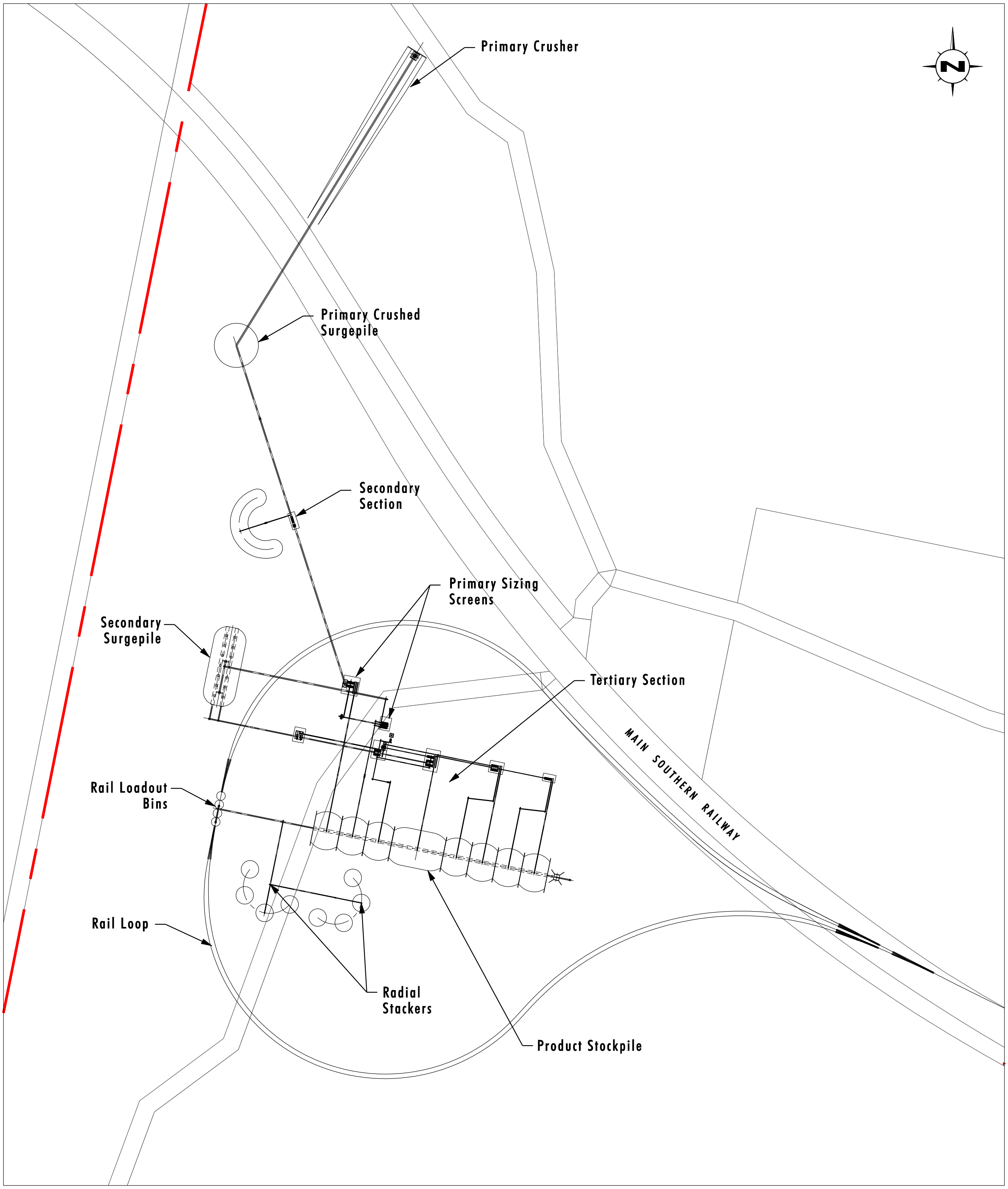
- Project Area
- Proposed Country Energy Easement
- Proposed Country Energy Substation
- Proposed Lynwood Quarry Power Supply Infrastructure

FIGURE 3.19

Country Energy Proposed Substation and Proposed Lynwood Quarry Electricity Supply Network

File Name (A4): R03_V1/1829_185.dgn

Umwelt
Environmental Consultants



Source: Readymix Holdings Pty Ltd
Base Source: LPI 2004

Legend
Project Area

FIGURE 3.20

Possible Staged Construction Layout of Crushing and Screening Plant

File Name (A4): R03_V1/1829_180.dgn

infrastructure, the staged construction infrastructure would have the same or a reduced overall environmental impact when compared to the total planned infrastructure.

3.6 Lighting

Lighting will be required in the quarry infrastructure area due to the night-time operation of the crushing and screening plant and the loading facilities. Lighting will be kept to the minimum required for operational needs and safety. All lights will have shields and be directed down onto working areas to ensure that fugitive light emissions are limited.

There will not be any mobile lighting plant required for quarrying activities, with any activities undertaken after dark being lit only by the mobile plant headlights.

3.7 Water Services

Water usage requirements, water sources and general water management are discussed in detail in **Section 5.6**, with the discussions below limited to infrastructure associated with water supply and use.

3.7.1 Operational Water

Operational water including water for dust suppression and operation of the crushing and screening plant will be sourced from groundwater inflows, surface water capture and external water supply. Groundwater inflow into the pit will be pumped out using diesel pumps to one of two water storage dams located in the vicinity of the pit. The same system will be used for rainfall into the quarry pit. Surface runoff from overburden emplacement areas, infrastructure areas (including buildings) and excess product emplacement areas will also be captured and transferred to water storage dams. The proposed locations of these water storage dams are shown on **Figure 3.11**.

External water supplies will be delivered to Lynwood Quarry via pipelines for which the final locations are yet to be determined. Approval for the installation of these pipelines will be obtained under the *Pipelines Act* 1967 and is therefore not required as part of this DA. Several viable options existing for pipeline easements including use of existing infrastructure easements, use of road reserves in agreement with Goulburn Mulwaree Council or use of private land by agreement with the landholder.

A detailed site water balance including description of the above-mentioned water sources is contained in **Section 5.6**.

3.7.2 Potable Water

Potable water consumption at Lynwood Quarry is expected to be in the order of 3.5 ML per annum when at full production. Potable water is planned to be sourced from Goulburn Mulwaree Council via its existing Marulan town water supply, subject to finalisation of an agreement. Should this supply be problematic, Readymix will install a package water treatment plant adjacent to the infrastructure area to supply the necessary potable water.

3.7.3 Sewage Treatment

Sewage from each of the amenity areas will be treated via 'envirocycle' type package sewage treatment systems with the resulting treated effluent reclaimed and delivered to the site water storage dams. This water will then be re-used for haul road watering and as process water.

Some mobile crib huts may have pump-out toilet facilities, with sewage from these locations being removed from the site by a licensed waste removal contractor for delivery to an approved wastewater treatment facility.

3.8 Site Security

Prior to the commencement of operations, Readymix will install fencing around the quarry and infrastructure areas in order to ensure site security. In some places this will be an upgrade of existing fencing and in other areas (e.g. around the quarry pit) security will be established through the erection of a 1.8 metre chain wire fence. No barbed wire will be used on these fences due to the potential for native fauna species to become caught. Lockable gates will be provided at all possible site access points, including the main access road, to prevent unauthorised access.

3.9 Hours of Operation

3.9.1 Construction Phase

Construction phase hours of operation will be 7 am to 6 pm Monday to Friday and 7 am to 1 pm on Saturday. No audible construction activity will be undertaken outside these hours or on Sundays or public holidays.

3.9.2 Operational Phase

Operational phase hours of operation have been determined by production needs and by the need to minimise environmental impacts. In order to satisfy these requirements, various quarry activities will have different hours of operation. Hours of operation for each of the key quarry activities are detailed in **Table 3.6**.

Table 3.6 - Operational Phase Hours of Operation

Activity	Hours of Operation
Clearing and topsoil stripping	7 am to 6 pm, seven days per week
Overburden removal and emplacement	7 am to 6 pm, seven days per week
Drilling	7 am to 6 pm, seven days per week
Blasting	9 am to 5 pm, 6 days per week (excluding Sundays)
Quarrying of primary raw feed	7 am to 10 pm, seven days per week
Crushing and screening	24 hours, seven days per week
Train loading and product delivery by rail	24 hours, seven days per week
Truck loading and product delivery by road	24 hours, seven days per week
Infrastructure area ancillary operations (e.g. maintenance activities)	24 hours, seven days per week

Hours of operation were originally planned to be 24 hours per day, seven days per week for all quarry activities in order to provide maximum production flexibility. During the EIA process, however, it became evident that conducting some operations during evening and night-time hours may cause noise impacts on nearby residents. Hours of operation were therefore limited for some activities in order to avoid noise sensitive periods (i.e. temperature inversion and air drainage flow conditions that occur at night). The restriction of operating hours impacted on the operational equipment fleet for the quarry, with additional equipment required to be operated for some activities so that they can be completed within the specified working hours. This has also increased project costs.

3.10 Construction and Operational Workforce

3.10.1 Construction Workforce

As discussed in **Section 3.3**, the construction phase is expected to last for approximately two years. During this period, construction workforce numbers will vary depending on the construction activities being undertaken and are expected to peak at approximately 140 personnel. Workforce numbers will be above 90 personnel for the majority of the construction phase.

3.10.2 Operational Workforce

When at full production, Lynwood Quarry is expected to employ approximately 115 personnel. The quarry will generally operate over two main shifts, day shift and afternoon shift, with some activities also being undertaken during night shift (including product loadout, plant maintenance and on occasion crushing and screening plant operation). Workforce numbers are expected to broadly comprise those listed in **Table 3.7**.

Table 3.7 - Breakdown of Lynwood Quarry Workforce

Workforce Sector	Workforce Number
Managers and Supervisors	11
Production Personnel	42
Stores and Administration	2
Laboratory	5
Road Transport	35
Transport Maintenance	7
Non-permanent Positions (contractor) – blasting, equipment operators	13
Total (approximate)	**115**

In addition to these personnel, specialist contractors will also be required to complete specific maintenance tasks and to provide other specialist services to the quarry. Depending on the extent and consistency of regional and local market demand, road transport employment may be via contractor positions, however, it is considered likely that a combination of Readymix and contractor trucks will be required.

3.11 Rehabilitation and Decommissioning

3.11.1 Rehabilitation

Progressive rehabilitation will be undertaken throughout the life of the quarry, particularly focussing on rehabilitation of the out-of-pit emplacement areas. Where practical, progressive rehabilitation of final benches in the quarry pit will also be undertaken. Due to the extent of the resource, there will not be many final benches reached in the initial 30 year period that do not have the potential to be expanded or modified by in-pit dumping during a subsequent quarrying period. Further discussion of rehabilitation practice, progressive rehabilitation and conceptual Year 30 closure rehabilitation is provided in the following sections.

3.11.1.1 Rehabilitation Practice

Rehabilitation of areas disturbed by the project is planned to result in increased areas of native vegetation and associated habitat for native fauna, with selective use of some areas for managed grazing. To achieve this outcome, the emplacement areas and other disturbed areas, excluding the quarry pit, will be rehabilitated using a mixture of primarily native grass, shrub and tree species (cover crop species will also be used to improve initial rehabilitation groundcover whilst native species establish). The benches of the quarry pit will also be rehabilitated using native species as described below.

Emplacement Area Rehabilitation

Once bulk dumping and reshaping has occurred to achieve the desired landform, the surface of the emplacement areas will be shaped to have swales, small drainage hollows and a generally irregular landform to resemble the natural surrounding landform. This level of detail is difficult to show on engineering design plans and will be managed on an area by area basis by the Lynwood Quarry environmental officer and quarry management team. Finally shaped areas will be topsoiled using a 0.2 metre topsoil depth which is higher than the existing average topsoil depth across the project area. This is possible due to the small quantity of topsoil required to rehabilitate the quarry pit benches. Where possible, topsoiling of the emplacement areas will be undertaken using recently stripped topsoil, with the areas then planted with a native species and cover crop mix consisting of the species discussed in **Section 7.2.4** to achieve a woodland / open forest type native vegetation community. Surface habitat features consisting of large rocks and trees and logs from clearing undertaken elsewhere on site will also be placed across the rehabilitated area. These features will provide potential fauna habitat and will aid in achieving a stable landform, with placed cleared trees also potentially acting as a local seed source.

Quarry Pit Rehabilitation

Rehabilitation of the quarry pit will be achieved by battering back the upper benches which occur in the highly weathered material to remove the bench landform and achieve a more stable sloping landform. This battering back of benches is only practical in the upper benches of weathered material and is not possible for lower benches as the rock is harder and there is insufficient space. Once the battering back of these upper benches is complete, the shaped areas will be topsoiled and seeded with a native species and cover crop mix as per the emplacement areas.

Rehabilitation of the remaining quarry benches will be completed by placing an approximately 1 metre thick layer of overburden on the quarry bench. A bund will be created on the outer edge of the quarry bench to act as a safety barrier and also to make the bench internally draining, ensuring any rain captured will be retained and be available for vegetation on the bench. The overburden will then be covered with available topsoil excluding an access track area which will be retained along the entire bench. Topsoil will be spread to a depth of approximately 0.1 metre which is representative of the naturally occurring topsoil depth across the majority of the site. A reduced extent of topsoil depth is considered appropriate for the quarry benches as these areas will not be subject to grazing pressure (by either native animals or domestic stock) and limited potential erosion impact.

Once topsoil placement has been completed, the benches will be seeded with a native tree species mix and a grass species mix also used on the safety bund. Sub-drilling completed for each bench results in approximately 1 metre depth of cracking of the bench floor from drilling and impact by quarry equipment. Consequently, it is considered that the approximate 1 metre depth of overburden plus the ability of trees to extend roots to a depth of at least 1 metre into the underlying rock substrate should achieve acceptable levels of tree stability.

A representative cross-section of the rehabilitated quarry pit showing the proposed rehabilitation techniques is included as **Figures 3.21** and **3.21a**.

The floor of the quarry pit will not be rehabilitated as it would be cost prohibitive to reclaim the overburden from the emplacement areas and place it in the pit. In addition, the quarry pit floor will be periodically inundated, making establishment of vegetation in this area difficult. Should Readymix be granted approval to extend the quarry beyond the initial 30 year period, in-pit dumping of overburden and excess product is likely during such later stages, enabling rehabilitation of at least part of the quarry floor.

3.11.1.2 Progressive Rehabilitation

Rehabilitation of each section of the emplacement areas will be completed progressively on achievement of a final landform in that section to ensure that rehabilitation is completed in as timely a manner as possible. The progressive rehabilitation of the emplacement areas is shown on **Figures 3.2** to **3.9,** with the conceptual final Year 30 rehabilitation progress shown on **Figure 3.22**. Progressive rehabilitation of the quarry pit itself will be more difficult to achieve as there will be few final bench areas created during the initial 30 year quarry period that will not potentially be altered by subsequent quarrying activity should approval be granted to extend the life of the quarry. Some progressive rehabilitation will be achieved by Year 30, as shown on **Figure 3.22**.

3.11.2 Conceptual Decommissioning Plan

As discussed previously, Lynwood Quarry is planned to continue beyond the initial 30 year approval period with potential additional resources existing both to the north and south of the Main Southern Railway. Should, however, Readymix not be granted approval to extend the quarry, it will be decommissioned and closed at the end of Year 30. The remainder of this section discusses the conceptual decommissioning plan for closure of the quarry in Year 30.

3.11.2.1 Decommissioning of Plant and Equipment

Should Lynwood Quarry not be granted approval to continue beyond Year 30, the plant and equipment will be decommissioned, transferred or sold, either for use at another quarry or industrial operation, or for scrap metal. All surface infrastructure including the crushing and screening plant and rail facility will be removed and the areas containing this infrastructure recontoured, including removing the rail embankment and filling in the primary crusher box cut. The access road will also be removed. The reshaped areas will then be seeded with a native tree and grass species mix to establish woodland vegetation.

All haul roads will also be removed and water management controls either removed or modified to assist in stabilisation of the final landform and to capture any sediment runoff from the rehabilitated areas.

3.11.2.2 Conceptual Year 30 Rehabilitation

By Year 30, the majority of the emplacement areas will already have been rehabilitated as shown on **Figure 3.22**. For a Year 30 closure, the remaining sections of the emplacement areas will also be rehabilitated and connected through vegetated corridors to the rehabilitated former infrastructure areas and remnant vegetation retained in the project area (refer to **Figure 3.23**). Rehabilitation of the quarry pit will also be completed, with each of the

Umwelt
Environmental Consultants

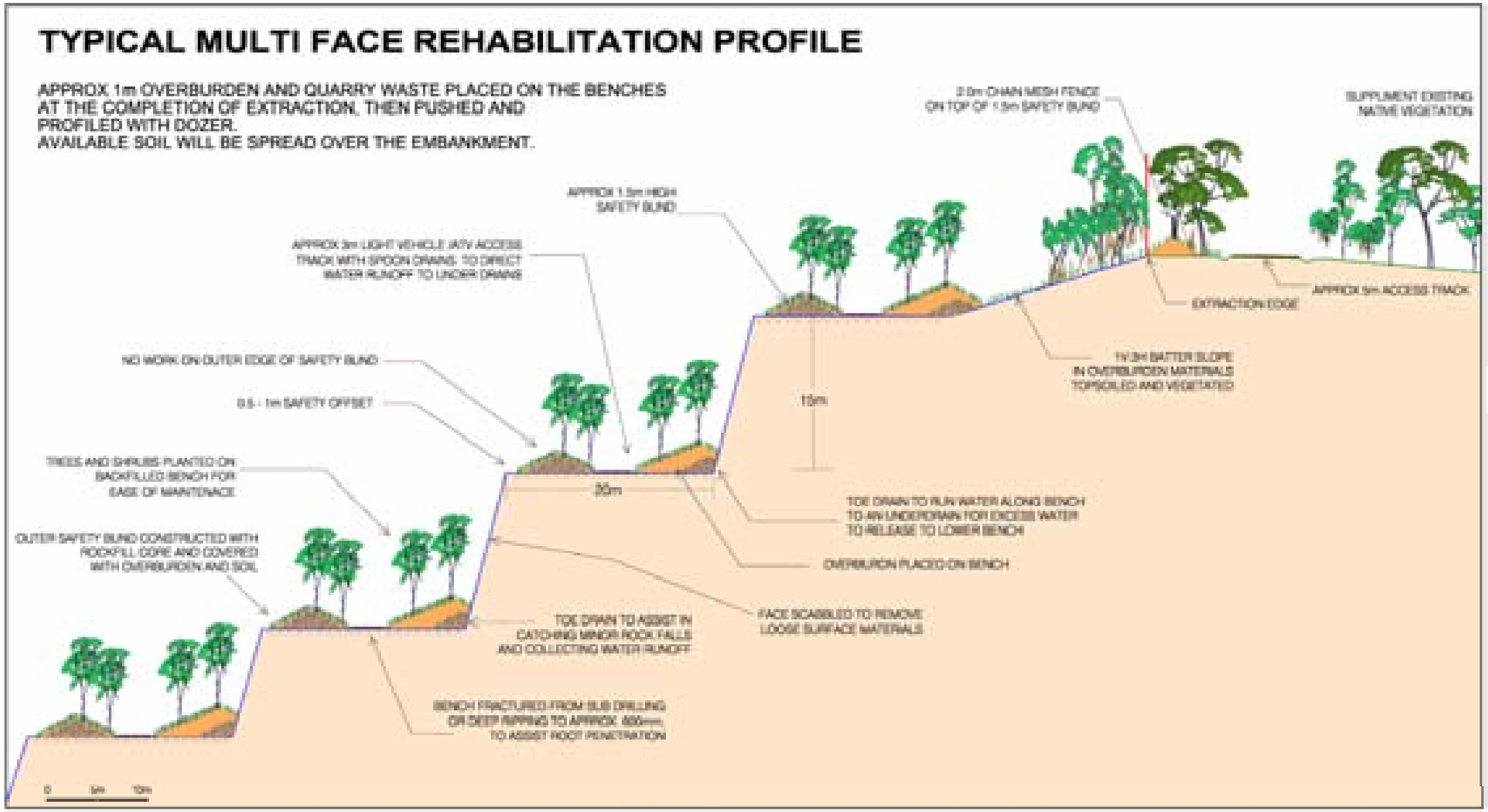


FIGURE 3.21

Representative Cross-section of Rehabilitated Quarry Benches

Source: Bell Cochrane & Associates

File Name (A4): R03_V1/1829_232.dgn

Umwelt
Environmental Consultants

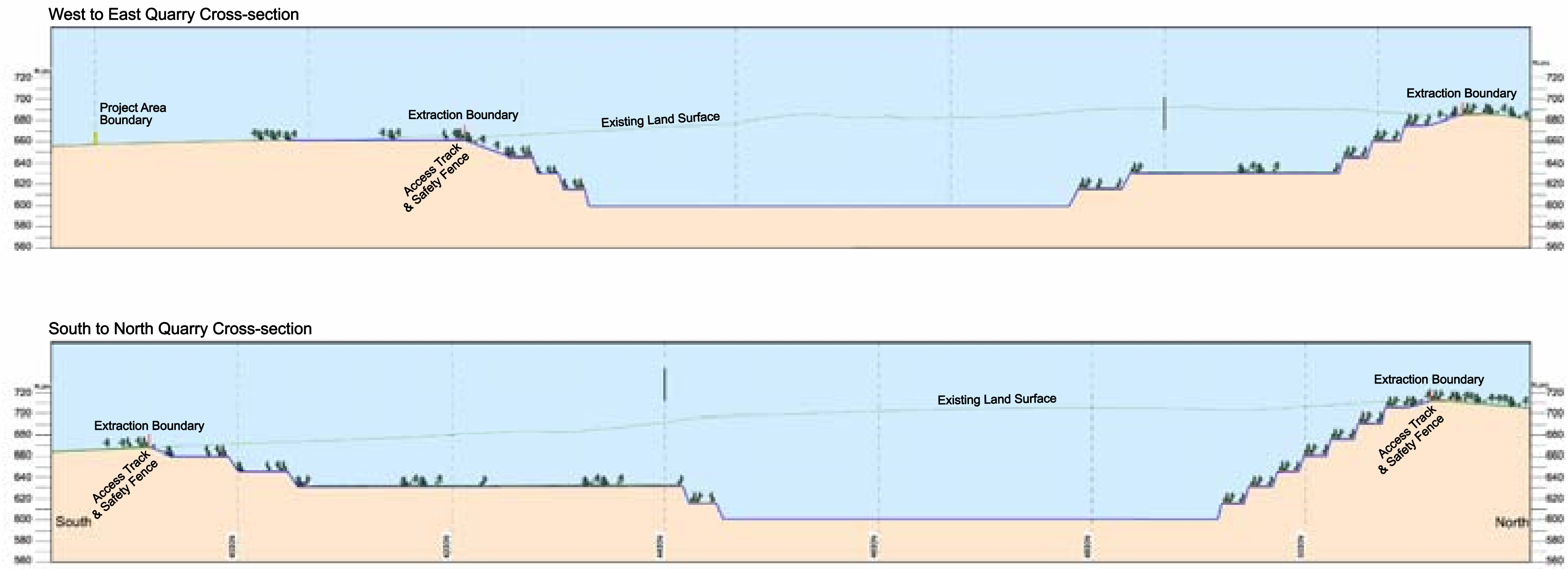
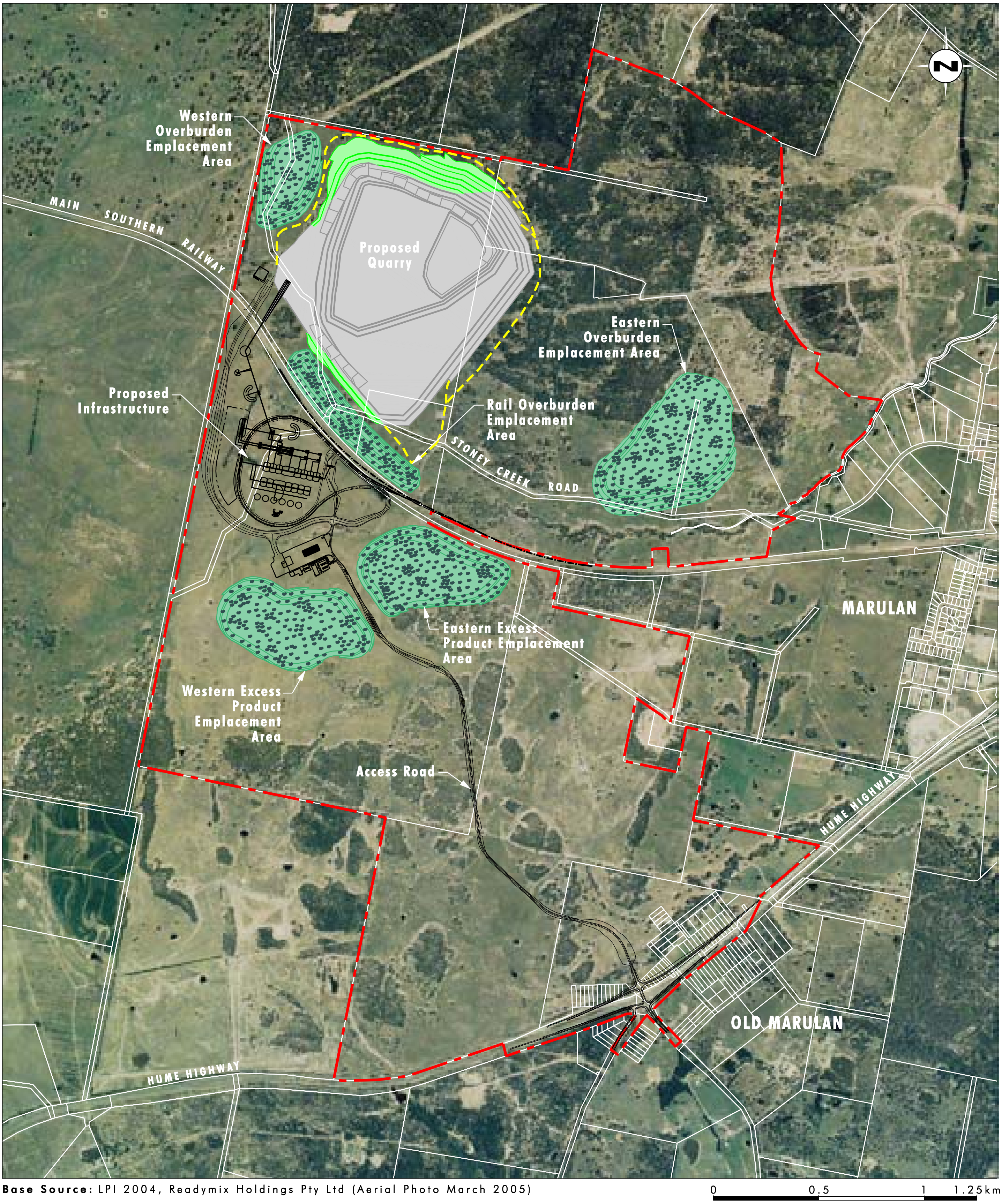


FIGURE 3.21a

Representative Cross-section of Rehabilitated Quarry Pit

Source: Bell Cochrane & Associates

File Name (A4): R03_V1/1829_276.dgn



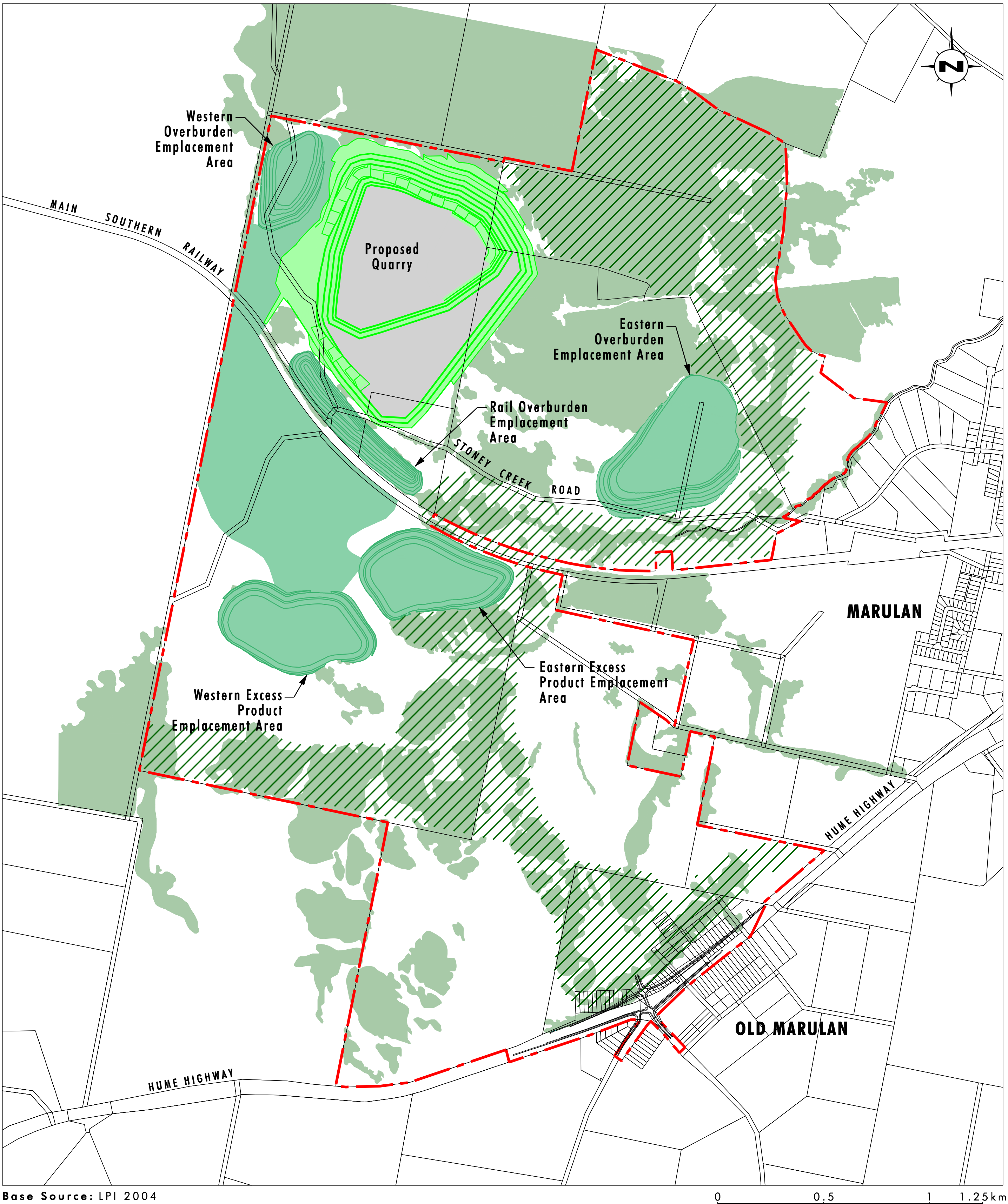
Legend

- Project Area
- Haul Road
- Rehabilitated Area
- Rehabilitated Quarry Batters

FIGURE 3.22

Year 30 Progressive Rehabilitation

Umwelt
Environmental Consultants



Legend

- Project Area
- Existing Vegetation
- Rehabilitated Area
- Rehabilitated Quarry Batters
- Assisted Natural Regeneration (Habitat Corridor Function Enhancement)

FIGURE 3.23

Year 30 Conceptual Final Rehabilitation

File Name (A4): R03_V1/1829_235.dgn

benches treated and planted with native trees as discussed in **Section 3.11.1.1**. A conceptual Year 30 closure final rehabilitation plan is included as **Figure 3.23**.

3.11.2.3 Conceptual Year 30 Closure Final Land Use

As discussed briefly in **Section 3.11.1.1**, conceptual final land use for the majority of the project area is increased areas of native vegetation and native fauna habitat, with use of parts of the site for managed grazing. Grazing activity will be focussed on the portion of the project area to the south of the Main Southern Railway, with limited grazing undertaken on the northern side of the railway. Long-term, it is expected that the native vegetation (including the rehabilitated areas) to the north of the railway will reach a suitable quality such that managed grazing will cease to have beneficial effects on rehabilitation progress and will therefore be discontinued. In the area to the south of the railway, the final rehabilitated area will provide the dual roles of native vegetation / native fauna habitat and managed grazing land. The southern area rehabilitation will provide increased areas of native vegetation and will aim to connect these areas to existing vegetated corridors to provide connectivity through the site to existing vegetated areas to the south and north.

Final land use for the quarry pit itself is more problematic as there are few potential uses for a quarry void. Typical uses include a water storage or water recreation facility (e.g. Penrith Lakes Scheme voids were converted into a rowing centre for the Sydney 2000 Olympic Games). Such uses will not be possible for the Year 30 Lynwood Quarry void as groundwater modelling indicates that there will not be sufficient groundwater or surface water inflow to create a permanent water body in the void. The void would still have the potential to be used as a water storage void for pumped water (e.g. as part of a drinking water supply scheme), however it is considered unlikely that this final land use would be pursued. Potential uses could include a recreation facility for rock climbing or other similar adventure sports to build on the existing regional reputation for such sports which are currently undertaken in the Bungonia area. Current Readymix quarry sites have also been used as training areas for the Australian Army and the final quarry void could also provide such a use.

As discussed previously, Readymix intends to continue the quarry beyond Year 30 and should this approval be granted, future quarrying would be likely to include in-pit dumping of overburden and excess product material. Based on initial groundwater modelling, this in-pit dumping is likely to result in greater recovery of local groundwater levels which, depending on the final void configuration, may result in a final void waterbody being formed. This would allow additional possible final void land uses to be considered.

SECTION 4

Relevant Planning Considerations

4.0 Relevant Planning Considerations

Following are details of the relevant Commonwealth, State, regional and local planning provisions and a discussion of the application of these planning provisions to the project.

4.1 Commonwealth Legislation

4.1.1 Environment Protection and Biodiversity Conservation Act 1999

The Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) commenced on 16 July 2000, and is administered by the Commonwealth Department of the Environment and Heritage.

Under the EPBC Act, approval of the Commonwealth Minister for the Environment and Heritage is required for any action that may have a significant impact on matters of national environmental significance. These matters are:

- World Heritage properties;
- National Heritage Places;
- Ramsar wetlands;
- migratory species, threatened species, or ecological communities listed in the EPBC Act;
- Commonwealth land, Commonwealth marine areas; and
- nuclear actions (including uranium mining).

No threatened or migratory species listed under the EPBC Act were recorded within the project area during the detailed ecological survey program. Because potentially suitable habitat is present, a number of species were, however, considered to potentially occur in the project area. An assessment of the impact of the project on these species was undertaken. It was determined that species listed under the EPBC Act are unlikely to be significantly impacted by the project (refer to **Section 5.7**). On this basis, approval under the EPBC Act is not required for the project.

None of the other above listed triggers for assessment under the EPBC Act are relevant to the project.

4.1.2 Native Title Act 1993

The Commonwealth government enacted the *Native Title Act* 1993 in response to the High Court of Australia decision in *Mabo v Queensland* (1992). In this case, the High Court recognised the ownership of land by Australia's Indigenous people at common law prior to European settlement of Australia. This decision resulted in the recognition that a form of native title rights existed and hence entitled Aboriginal people to claim ownership of land in certain circumstances.

The objectives of the Act are:

(a) to provide for the recognition and protection of native title;

(b) to establish ways in which future dealings affecting native title may proceed and to set standards for those dealings;

(c) to establish a mechanism for determining claims to native title; and

(d) to provide for, or permit, the validation of past acts, and intermediate period acts, invalidated because of the existence of native title.

The Act is administered by the National Native Title Tribunal. The Tribunal is responsible for maintaining a register of native title claimants and bodies to whom native title rights have been granted. The Act prescribes that native title can be extinguished under certain circumstances, including the granting of freehold land. Areas of land within the project area where native title may not have been extinguished include vacant Crown land. As discussed in **Section 1.3.2**, several small parcels of Crown land are located within the southern portion of the project area in the area of the proposed Hume Highway interchange.

A native title claim over the Marulan area, including the land within the project area, was lodged in 1997 by the Gundungurra Tribal Council Aboriginal Corporation #6 (GTCAC). The notification of the claim is complete and it is currently subject to mediation. Accordingly, the appropriate processes under the *Native Title Act* 1993 in relation to this project must be undertaken so that the project complies with the requirements of the Act. Essentially this will involve negotiating with the relevant Native Title Claimant for any areas of land that have not had the native title rights extinguished, to validate the future acts required for the project.

4.2 New South Wales Legislation

4.2.1 Environmental Planning and Assessment Act 1979

The EP&A Act defines the approval process for proposed developments in NSW. The EP&A Act is administered by DIPNR.

The objectives of the EP&A Act relevant to the project encourage:

- the proper management, development and conservation of natural and artificial resources;
- the promotion and co-ordination of the orderly and economic use and development of land;
- the protection of the environment;
- ecologically sustainable development;
- economically sustainable development; and
- the provision of increased opportunity for public involvement and participation in the environmental planning and assessment process.

For private developments for which approval is required (as defined by the relevant Local Environmental Plan [refer to **Section 4.5**] and the EP&A Act), development consent is required under Part 4 of the EP&A Act.

4.2.1.1 State Significant Development

The EP&A Act provides that development proposals that are of State significance are determined by the Minister administering the EP&A Act (currently the Minister for Infrastructure and Planning). The types of development that are considered to be of State significance are those that have been the subject of a declaration by the Minister in accordance with Section 76A (7) of the EP&A Act and those detailed in various other planning instruments (e.g. *SEPP34 – Major Employment Generating Industrial Development*).

This project is State Significant Development in accordance with a declaration by the Minister dated 3 August 1999. This declaration provided that extractive industries which include a total resource greater than 5 million tonnes and/or a proposed extraction rate greater than 200,000 tonnes per annum, are to be considered as State Significant Development.

As the project is classed as State Significant Development, the consent authority is the Minister for Infrastructure and Planning.

4.2.1.2 Designated Development

Schedule 3 of the EP&A Regulation prescribes the types of development that are designated and require an EIS to be prepared in accordance with the relevant provisions of the EP&A Act and Regulations. Such development is referred to as ‘designated development’. When considering the DA, the consent authority must consider the likely impacts of that development, as outlined in the EIS, as well as any submissions made by other government agencies, local councils and the public.

Extractive industries (including quarries) that generate more than 30,000 cubic metres per year product and/or disturb more than 2 hectares of land and/or are located within 40 metres of a natural water body are included in Schedule 3 of the Regulation. The project meets all three of these criteria, and is therefore categorised as designated development and will require an EIS to accompany the DA.

4.2.1.3 Integrated Development

A development that requires any of the approvals identified in Section 91 of the EP&A Act in addition to requiring development consent under Part 4 of the Act is defined as ‘integrated development’. The agencies that administer these approvals are referred to as Approval Bodies. A copy of the DA and EIS is to be provided to each of the Approval Bodies within two days of lodgement of the DA with the consent authority. The Approval Bodies consider the EIS and provide general terms of any approval proposed to be granted by the approval body in relation to the development to the consent authority for incorporation in any consent conditions for the development. The terms of any approvals, permits or licences issued by these Approval Bodies and required within the first three years for continued operation of the development, must not be inconsistent with any development consent granted. Further, the consent authority must refuse the application if an Approval Body will not grant an approval.

A list of Approval Bodies and the required subsequent integrated approvals for the project are included in **Table 4.1**.

Table 4.1 – Approval Bodies and Required Integrated Approvals

Approval Body	Subsequent Approval
Department of Environment and Conservation (DEC)	An environment protection licence under the *Protection of the Environment Operations Act* 1997
	Section 87 and 90 consents in regard to Aboriginal objects under the *National Parks and Wildlife Act* 1974
Department of Infrastructure, Planning and Natural Resources (DIPNR)	A licence under Part 2 of the *Water Act* 1912 for extraction of surface waters.
	A licence under Part 5 of the *Water Act* 1912 for extraction of groundwater inflow into the quarry pit.
	A Part 3A permit under the *Rivers and Foreshores Improvement Act* 1948 to undertake works within 40 metres of a stream or river.
Goulburn Mulwaree Council	Section 138 approval under the *Roads Act* 1993 for road works on South Marulan Road and Jerrara Road.
Roads and Traffic Authority	Approval under the *Roads Act* 1993 for connection to the Hume Highway.
NSW Heritage Office	Section 57 permit in regard to disturbance of items listed on the State Heritage Register (i.e. part of old Marulan township area) under the *Heritage Act* 1977.
Department of Lands	Authority to close a Crown road (Stoney Creek Road) under the *Roads Act* 1993.

4.2.1.4 Environmental Planning and Assessment Regulation 2000

The EP&A Regulation sets out a number of matters that an EIS must address, and also requires the proponent to consult with the Director-General of DIPNR to determine the requirements for the EIS. This EIS has been prepared in consultation with DIPNR and in accordance with the EP&A Regulation and the Director-General's requirements (refer to **Section 8.0** for a checklist of requirements and **Appendix 1** for the EIS form required under Section 71 of the Regulation).

4.2.2 Water Management Act 2000

This Act is administered by DIPNR and consolidates water management in NSW. Once the provisions of the *Water Management Act* 2000 have commenced in all areas, the Act will repeal a number of legislative instruments including the licensing provisions of the *Water Act* 1912 and the *Rivers and Foreshores Improvement Act* 1948.

As required by the *Water Management Act* 2000 DIPNR has produced a State Water Management Outcomes Plan (SWMOP). The SWMOP sets the direction for all water management action in NSW by establishing the overarching policy context, targets and strategic outcomes for management of the State's water resources. The project is consistent with the objectives of the SWMOP (refer to **Section 5.6**).

The licensing and approval provisions of the *Water Management Act* 2000 are not yet in force in the Wollondilly and Shoalhaven catchments because, at the time this EIS was prepared, there were no water sharing plans in place. Therefore, the relevant provisions of the *Water Act* 1912 and *Rivers and Foreshores Improvement Act* 1948 apply to the project. The relevant provisions of these two Acts are provided below.

4.2.2.1 Water Act 1912

The *Water Act* 1912 is administered by DIPNR. A licence must be obtained under Part 2 of the *Water Act* 1912 for works undertaken for the purpose of changing the course of a river (including a stream, perennial or intermittent, flowing in a natural channel). A Part 2 licence will be required for the extraction of surface waters. Readymix will require a surface water extraction licence for the project. Due to the current water licence embargo in the Wollondilly River catchment, the licence will have no usage allocation until Readymix purchases an existing allocation which can be transferred to this new licence with DIPNR's approval.

In addition to this surface water licence, a licence must be obtained under Part 5 of the *Water Act* 1912 to extract groundwater. Readymix currently holds a Part 5 licence that covers the groundwater monitoring piezometers installed at the site, however, a further licence will be required for the extraction of groundwater inflow from the pit itself. The Part 5 licence which covers the groundwater piezometers may need to be modified to include new bores as the quarry progresses and existing bores are removed.

These licences under the *Water Act* 1912 will be held by Readymix until such time as the *Water Management Act* 2000 licensing provisions come into effect in the Wollondilly catchment and new licences are issued under that Act.

4.2.2.2 Rivers and Foreshores Improvement Act 1948

DIPNR also administers the *Rivers and Foreshores Improvement Act* 1948. This Act requires a permit to be obtained under Part 3A of the Act to excavate or remove materials from 'protected land' or do anything likely to interfere with the flow of 'protected waters'. The legislation defines 'protected waters' as rivers, lakes into and from which rivers flow, and coastal lakes/lagoons along with their channels to the sea. 'Protected land' covers the bed, bank or shore of 'protected waters' as well as land within 40 metres, including any deposited material.

Part 3A permits will be required for a number of works to be constructed as part of the project as they will be constructed within protected land. These include the road and infrastructure crossings on Joarimin Creek, Marulan Creek and Lockyersleigh Creek, and also the construction of infrastructure or emplacement areas and associated drainage works. The specific works for which Part 3A permits will be required are described in **Section 5.6**.

4.2.3 National Parks and Wildlife Act 1974

The *National Parks and Wildlife Act* 1974 provides for the protection of native flora and fauna and the protection, preservation and management of all Aboriginal relics throughout NSW, irrespective of land tenure. The Act is administered by DEC.

A Section 90 consent is required under the Act prior to the destruction of any known Aboriginal archaeological objects, with a Section 87 Preliminary Research Permit required to conduct excavations in areas of potential archaeological deposit (PAD) or in areas where further work to define the extent of a particular site is required. As archaeological objects and PADs have been identified within areas to be disturbed by the project (refer to **Section 5.10.1**), a Section 90 consent and Section 87 Permit will be required from DEC.

There are no specific requirements for the proposed development imposed by the sections of the Act which address native flora and fauna protection, with requirements under this section of the Act addressed by gaining development consent under the EP&A Act.

4.2.4 Threatened Species Conservation Act 1995

The *Threatened Species Conservation Act* 1995 (TSC Act) is administered by DEC and provides protection for threatened plants and animals native to NSW (excluding fish and marine vegetation, which are protected under the *Fisheries Management Act* 1994) and integrates the conservation of threatened species into development approval processes under the EP&A Act. Under the EP&A Act, impacts on threatened species listed under the TSC Act are assessed by an eight-part test. Where a development is likely to have a significant impact on a threatened species, population or ecological community, the preparation of a Species Impact Statement (SIS) is required.

Five threatened species listed under the TSC Act have been recorded within the project area, plus one species for which a preliminary determination has been made, with potential habitat for a number of other species also being identified. None of these species are predicted to be significantly impacted by the proposed quarry and as such an SIS is not required (refer to **Section 5.7**).

4.2.5 Fisheries Management Act 1994

The *Fisheries Management Act* 1994 provides for the conservation of the State's aquatic resources and is administered by DPI (Fisheries Division). The Act applies to all aquatic animals, whether alive or dead, excluding marine mammals, reptiles, birds and amphibians, which are covered by the provisions of legislation administered by DEC. The Act requires that potential impacts of development on fish passage, water quality, fish habitat, riparian vegetation and threatened species be addressed during the environmental planning and assessment process. Where there is likely to be a significant impact on threatened species, the preparation of a SIS is required (under the EP&A Act). An assessment of the impact of the project on aquatic ecology is included in **Section 5.7**. The assessment concludes that the project will not significantly impact any threatened aquatic species and that a SIS is not required.

Under the *Fisheries Management Act* 1994, a permit must be obtained for any development/works which involves dredging or reclamation, any structure that may inhibit or obstruct the movement of fish within a waterway, cause damage or destruction of marine vegetation or involve the use of explosives. A permit is not required, however, for any works which require approval under the *Rivers and Foreshores Improvement Act* 1948. Given that the project will require permits under the *Rivers and Foreshores Improvement Act* 1948, it will not require a permit under the *Fisheries Management Act* 1994 for these works.

4.2.6 Protection of the Environment Operations Act 1997

The *Protection of the Environment Operations Act* 1997 (POEO Act) is administered by DEC and establishes the procedures for issue of licences for environmental protection including waste, air, water and noise pollution control. The owner or operator of a premise that is engaged in scheduled activities is required to hold an Environment Protection Licence (EPL) and comply at all times with the conditions of that licence.

The project will require an EPL because extractive industries (including quarries) are a scheduled activity listed in Schedule 1 of the POEO Act. A number of other activities proposed to be undertaken at the site may also be classed as scheduled activities including:

- the pre-coat plant – '*bitumen pre-mix or hot-mix industries where crushed or ground rock is mixed with bituminous or asphaltic materials that have an intended production capacity of more than 150 tonnes per day or 30,000 tonnes per year'*; and

- the construction phase mobile concrete plant – '*concrete works that produce pre-mixed concrete or concrete products and have an intended production capacity of more than 30,000 tonnes per year'.*

The activities specifically listed on the EPL will be determined in consultation with DEC during the licence application process, with an appropriate licence boundary also determined at this time.

4.2.7 Roads Act 1993

The *Roads Act* 1993 is administered by either the RTA, local council or the Department of Lands. The RTA has jurisdiction over major roads, the local council over minor roads and the Department of Lands over Crown roads. Under Section 138 of Part 9, Division 3 of the Act, a person must not undertake any works that impact on a road, including connecting a road (whether public or private) to a classified road, without approval of the relevant authority.

As part of the project, Readymix proposes to undertake road works on several public roads and will therefore require Section 138 Consents. This includes works on South Marulan Road and Jerrara Road for the proposed intersection with the Hume Highway. The construction phase access will also include the connection of the site access track to the end of Wilson Road. As all of these roads are Council roads, the Section 138 approvals will be required from Goulburn Mulwaree Council. Approval under the *Roads Act* 1993 will also be required for connection of the proposed interchange to the Hume Highway. This approval will be required from the RTA.

The *Roads Act* 1993 also determines the rights of the public and adjacent landowners to use public roads and establishes procedures for the opening and closing of public roads. Under the Act, an application must be made to the Minister for Lands for the closure of Crown roads.

Stoney Creek Road is a Crown road at the point at which is passes through the project area and it is proposed to close this section to prevent access into the site by unauthorised personnel. This unauthorised access would pose a significant public safety risk if the road was not closed. Readymix will therefore seek approval from the Department of Lands to close Stoney Creek Road at the Readymix property boundary.

4.2.8 Crown Lands Act 1989

The *Crown Lands Act* 1989 provides for the administration and management of Crown land in the eastern and central divisions of the State. Crown land may not be occupied, used, sold, leased, dedicated, reserved or otherwise dealt with unless authorised by this Act or the *Crown Lands (Continued Tenures) Act* 1989.

There are several small parcels of Crown land within the project area adjacent to the Hume Highway. This land will be affected by the construction of the proposed interchange. There are also a number of Crown road reserves within the project area. The approval of the Department of Lands will be sought to close these Crown road reserves (as discussed in **Section 5.5.1**). There are suitable alternative Crown road reserves currently in existence to provide access to properties surrounding the project area. Readymix will also seek the approval of the Department of Lands to construct the interchange on the parcel of Crown land in the south of the project area, with this intersection being handed over to RTA control once constructed.

4.2.9 Aboriginal Land Rights Act 1983

The *Aboriginal Land Rights Act* 1983 provides for the constitution of local, regional and State Aboriginal Land Councils. Part 6 of the Act prescribes a mechanism for Land Councils to claim Crown land. Readymix is not aware of any land rights claims made over the vacant Crown land within the project area, at the time of preparation of this EIS. Therefore Part 6 of the Act is not relevant to this assessment.

4.2.10 Heritage Act 1977

The *Heritage Act* 1977 provides for the conservation and management of the State's built, marine, moveable and natural heritage. The Act provides for the constitution of the Heritage Council of NSW by which authority it is administered through the NSW Heritage Office. The Heritage Council maintains the State Heritage Register and the State Heritage Inventory, which list respectively heritage items of State significance and of local significance. The Heritage Council may also request local councils to prepare environmental planning instruments to protect items of local significance.

Under the Act, no item of historic heritage may be disturbed without an excavation permit from the Heritage Council unless subject to an exemption. An excavation permit is required under Section 60 of the Act for items listed on the State Heritage Register and under Section 140 of the Act for all other heritage items.

A number of heritage items were recorded in the project area, including a section of the Old Marulan Township which is listed on the State Heritage Register (refer to **Section 5.10.2**). A section of this State Heritage Register area will be impacted by the construction of the proposed Hume Highway interchange. In addition, a number of heritage items were recorded within the footprint of the proposed quarry and associated infrastructure, outside the State Heritage Register area. Excavation permits under both Section 60 and Section 140 of the *Heritage Act* 1977 will therefore be required from the Heritage Council.

4.2.11 Environmentally Hazardous Chemicals Act 1985

DEC is granted power under the *Environmentally Hazardous Chemicals Act* 1985 to assess and control chemicals by making a Chemical Control Order (CCO). A CCO can prohibit specified activities or require them to be licensed; prohibit activities that don't comply with the conditions of the order; or permit an activity unconditionally. CCOs exist for certain chemicals such as PCBs. Readymix does not propose to store, transport or use any chemicals currently subject to a CCO. Should such chemicals be required during the life of the project, Readymix will manage the chemicals in accordance with the relevant CCO, including obtaining any appropriate licences.

4.2.12 Dangerous Goods Act 1975

The *Dangerous Goods Act* 1975 is administered by WorkCover and requires that licences be held for the storage, transport and use of dangerous goods, as prescribed by the *Dangerous Goods Regulation* 1999. Readymix will require a number of dangerous goods licences for the proposed quarry including licences for the proposed diesel storage. Licence requirements will be refined at the detailed design phase and applications for the relevant dangerous goods storages will be made to WorkCover. At this stage Readymix propose to have all explosives delivered to site on a blast by blast basis and does not propose to store any explosives in the project area. A dangerous goods licence for explosives will not therefore be required. This proposed practice may, however, need to be revisited in the future depending on explosive material supply locations and transportation requirements. The transport and storage of dangerous goods at the proposed quarry is discussed in **Section 5.12.1**.

4.2.13 Dams Safety Act 1978

The *Dams Safety Act* 1978 requires that the NSW Dams Safety Committee periodically review large dams that may constitute a hazard to human life and property. These dams are known as prescribed dams and are listed in Schedule 1 of the Act.

A number of dams will be constructed as part of the project water management system. This will include both on-stream dams that will discharge in certain rainfall events and water storage dams that will only be filled via pumping. Once the detailed engineering design of these dams is complete, Readymix will consult with the Dams Safety Committee to confirm whether or not any of the dams will be prescribed dams.

4.2.14 Native Vegetation Conservation Act 1997

The provisions of the *Native Vegetation Conservation Act* 1997 are not applicable to activities that are subject to development consent and therefore are not applicable to this project.

The *Native Vegetation Conservation Act* 1997 is to be repealed on the commencement of the *Native Vegetation Act* 2003. This repeal will not alter the above position regarding this project.

4.3 State Environmental Planning Policies

State Environmental Planning Policies (SEPPs) are environmental planning instruments created by the State government. The SEPPs that are potentially relevant to the project include:

- *SEPP 11 – Traffic Generating Development*;
- *SEPP 33 – Hazardous and Offensive Development*;
- *SEPP 34 – Major Employment Generating Industrial Development*;
- *SEPP 44 – Koala Habitat Protection*;
- *SEPP 55 – Remediation of Land*; and
- SEPP 58 – *Protecting Sydney's Drinking Water Supply*.

The applicability of these SEPPs to the project is discussed below.

4.3.1 State Environmental Planning Policy 11

SEPP No. 11 – Traffic Generating Development requires that the RTA is made aware of, and given the opportunity to make representations in respect of, developments listed in Schedule 1 of that SEPP. Extractive industries are listed in Schedule 1 and therefore this SEPP is applicable to the project. The RTA has been consulted in regard to this proposal and an assessment of the impact of the project on roads and traffic is included in **Section 5.5.1**.

4.3.2 State Environmental Planning Policy 33

SEPP No. 33 – Hazardous and Offensive Development requires the consent authority to consider whether an industrial proposal is a potentially hazardous industry or a potentially offensive industry. Under Clause 3 a potentially hazardous industry is defined as a development that "*would pose a significant risk in relation to the locality: to human health, life or property; or to the biophysical environment, and includes a hazardous industry and a hazardous storage establishment*". A potentially offensive industry is defined as a development that "*would have a significant adverse impact in the locality or on the existing or likely future development on other land, and includes an offensive industry and an offensive storage establishment*".

The aim of this policy is to link the permissibility of a proposal to its safety and pollution control performance. The assessment process is applicable to the storage and handling of hazardous materials on the site and transportation of hazardous materials to and from the site. The assessment establishes whether the proposal is potentially hazardous and if this is not the case, SEPP 33 is not applicable.

A hazard assessment has been conducted for the project and has determined that the project is not potentially hazardous. Therefore SEPP 33 is not applicable. The hazard assessment is contained in **Section 5.12.1**.

4.3.3 State Environmental Planning Policy 34

SEPP No. 34 – Major Employment Generating Industrial Development prescribes that the Minister for Infrastructure and Planning is the consent authority for development to which the policy applies. The SEPP applies to projects that involve capital expenditure in excess of $20 million and/or will employ more than 100 people once operational and that are listed in Schedule 1 (b). Metals, minerals or extractive material processing is listed in Schedule 1 (b) and therefore the proposed quarry potentially triggers SEPP 34, however, Schedule 1 (c) lists *quarrying or the obtaining of extractive material* and *extractive material crushing* as activities excluded from triggering the SEPP. SEPP 34 is not therefore relevant to this project.

As discussed in **Section 4.2.1.1** the project is State Significant Development due to a declaration made on 3 August 1999 by the then Minister for Urban Affairs and Planning in accordance with Section 76A (7) of the EP&A Act. The Minister for Infrastructure and Planning will therefore be the consent authority for the project.

4.3.4 State Environmental Planning Policy 44

SEPP No. 44 – Koala Habitat Protection applies to the extent that in LGAs listed in Schedule 1 of the policy (including the former Mulwaree Shire, now part of Goulburn Mulwaree LGA), a Council is restricted from granting development consent for proposals on land identified as core koala habitat without preparation of a koala plan of management.

A detailed assessment has been conducted as part of the ecological assessment to determine whether core koala habitat exists in the project area. As discussed in **Section 5.7**, no core koala habitat exists and therefore a koala plan of management is not required.

4.3.5 State Environmental Planning Policy 55

SEPP No. 55 – Remediation of Land aims to provide a Statewide planning approach to the remediation of contaminated land and also to reduce the risk of harm to human health and the environment by consideration of contaminated land as part of the planning process.

Under the SEPP, a consent authority must not consent to the carrying out of development on land unless it has considered potential contamination issues.

There are no known areas of contaminated land within the project area, with the past use of the project area primarily limited to agricultural purposes, resulting in a limited potential for contaminated areas to occur. The portion of the land leased from Readymix by Orica Explosives was subject to a detailed development assessment process (including development of an EIS) prior to the establishment of the facility and therefore measures are in place to ensure contamination does not occur. There will be no impact on this portion of the land as part of the project.

Based on the above, SEPP 55 does not place any constraints on gaining approval for the proposed quarry.

4.3.6 State Environmental Planning Policy 58

SEPP No. 58 – Protecting Sydney's Water Supply requires that the Chief Executive of the SCA is made aware of developments in the hydrological catchment of the Sydney water supply. Under Clause 10 of the SEPP, a consent authority must consider the following prior to granting consent for projects on land within the Sydney drinking water hydrological catchment:

- whether the development will have a neutral or beneficial effect on the water quality of the rivers, streams or groundwater in the hydrological catchment, including during periods of wet weather;
- whether the water quality management practices proposed to be carried out as part of the development or activity are sustainable over the long term; and
- whether the development or activity is compatible with relevant environmental objectives and water quality standards for the hydrological catchment when the Government establishes these objectives and standards.

The concurrence of the Chief Executive of the SCA is normally required for designated developments, however, it is not required for this project as it is classed as State significant development.

A detailed assessment against the matters listed in Clause 10 has been undertaken for the project and is discussed in **Section 5.6**.

4.4 Regional Environmental Plans and Strategies

4.4.1 Draft Drinking Water Catchment Regional Environmental Plan

'Sustaining the Catchments' is the Draft Regional Environmental Plan (REP) developed by the SCA to provide direction for the health of Sydney's drinking water catchments. The Draft REP was released during March 2004. When finalised, the REP will replace SEPP 58 which is currently operating in the Sydney drinking water catchment.

Under the Draft REP the proposed quarry is classified as a Level 1 Assessment. This classification is achieved because it can be readily demonstrated that a neutral or beneficial effect on water quality will occur as the water quality impacts of the proposal will be contained on site (refer to **Section 5.6.2**). On this basis, an offset strategy is not required for the project. Nevertheless, Readymix will pursue opportunities for the re-use of Marulan's

Wastewater Treatment Plant effluent which is currently disposed of via irrigation, which if realised, will provide a further beneficial effect on water quality as part of the project.

4.4.2 Sydney to Canberra Corridor Strategy

The Sydney to Canberra Corridor Strategy (Department of Planning, 1995) outlines the strategic direction for the corridor of land along the Hume and Federal Highways, including future land use patterns and resource management. The strategy does not recommend detailed solutions to identified issues, but provides a framework for the development of responses by those with responsibility for planning decisions within the Corridor.

The project area falls within the central sector of the corridor (incorporating the former Goulburn, Mulwaree and Tallaganda Councils) with some of the key strategies relevant to this sector including:

- encouraging a shift in population focus from the northern to the central sector;

- developing the central sector as the major regional centre for the Corridor. Goulburn is planned to continue its role as a focus for transport and strengthen its function as an industrial and employment centre; and

- fostering local economic development and employment growth and maximising local employment opportunities to decrease reliance on commuting. Development is to be compatible with environmental considerations.

The strategy also states that the economic importance of minerals and extractive resources in the Corridor should be recognised and steps taken to ensure that these resources are not sterilised by competing land uses.

In summary, the strategy seeks economic and population growth in the central sector that is compatible with environmental considerations. It highlights the importance of protecting resources of extractive materials and the need to provide employment opportunities. It is considered that this project is compatible with these aims as it provides significant economic benefits and employment opportunities for the region, whilst appropriately managing environmental impacts, including not significantly impacting on surrounding land uses.

4.5 Local Environmental Plan and Land Zoning

4.5.1 Mulwaree Local Environmental Plan

The local environmental planning instrument relevant to the proposed quarry is the Mulwaree Local Environmental Plan (LEP) 1995. The Mulwaree LEP covers the former Mulwaree Shire which was incorporated as part of the Goulburn Mulwaree LGA in 2004. Currently, the Mulwaree LEP remains in force for this part of the Goulburn Mulwaree LGA.

The principal aims of the Mulwaree LEP are:

- to encourage the proper management, development and conservation of natural and man-made resources within the Mulwaree area by protecting, enhancing, and conserving:

    - prime crop and pasture land;
    - timber, mineral, soil, water and other natural resources;
    - places of significance for nature conservation;
    - features and places of high scenic or recreational value; and

- places and buildings of archaeological or heritage significance, including aboriginal relics and places; and

- to replace the existing planning controls with a single local environmental plan to help facilitate growth and development of the Mulwaree area in a manner which is consistent with the objectives specified above and which:

  - minimises the cost to the community of fragmented and isolated development of rural land;
  - facilitates the efficient and effective delivery of services and facilities;
  - facilitates a range of residential and employment opportunities in accordance with demand;
  - facilitates farm adjustments;
  - ensures that the efficiency of arterial roads is not adversely affected by development on adjacent land;
  - identifies suitable localities and standards for the development of rural small holdings;
  - provides for the protection and enhancement of heritage items within the towns, villages and other localities within the Mulwaree area; and
  - facilitates the protection of the Warragamba and Shoalhaven Catchment areas; and

- to afford protection to the environmental heritage within the Mulwaree area by:

  - conservation of the environmental heritage;
  - integration of heritage conservation into the planning and development control processes;
  - providing for public involvement in matters relating to the conservation of the environmental heritage; and
  - ensuring that development is undertaken in a manner that is sympathetic to and does not detract from the heritage significance of heritage items and their settings.

The project, including proposed environmental management outcomes, is consistent with these objectives.

4.5.1.1 Zoning

The project area is subject to three separate zonings under the Mulwaree LEP 1995 (refer to **Figure 4.1**). These three zones are:

- 1(a) – General Rural;

- 1 (b) – Rural - Urban Investigation; and

- 1 (c) – Rural Small Holdings.

The objectives of each of these three zones are outlined below.

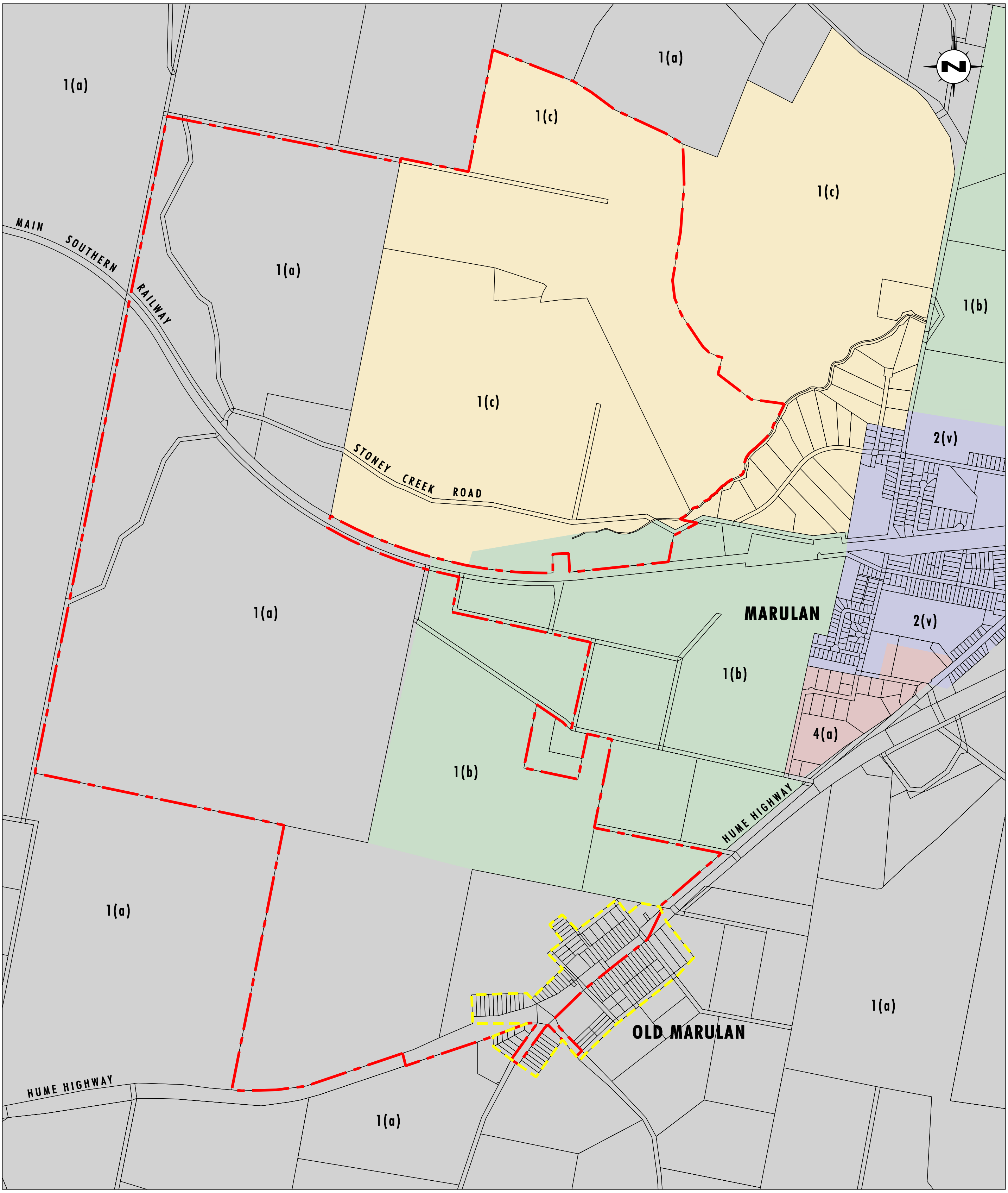
Zone 1 (a) General Rural

The objectives of this zone are to promote the proper management and utilisation of resources by:

a) promoting, enhancing and conserving:

   i) agricultural land, particularly prime crop and pasture land, in a manner which sustains its efficient and effective agricultural production potential;

Umwelt
Environmental Consultants



Source: Mulwaree Shire Council, 1995
Base Source: LPI 2004

0 0.5 1 1.25km

Legend

Project Area
SHR Boundary Old Marulan Township

FIGURE 4.1

Zoning

File Name (A4): R03_V1/1829_253.dgn

ii) soil stability by controlling and locating development in accordance with soil capability, as identified by the Department of Conservation and Land Management (now DIPNR);

iii) forests of existing and potential commercial value for timber production;

iv) valuable deposits of minerals, coal, petroleum, and extractive materials by controlling the location of development for other purposes in order to ensure the efficient extraction of those deposits;

v) trees and other vegetation in sensitive areas and in any place where the conservation of the vegetation is significant to the protection of scenic amenity or natural wildlife habitat or is likely to control or contribute to the control of land degradation;

vi) water resources and water catchment areas for use in the public interest;

vii) localities of significance for nature conservation, including localities with rare plants, wetlands, permanent watercourses and significant wildlife habitat; and

viii) places and buildings of archaeological or heritage significance, including aboriginal relics and places; and

b) minimising the costs to the community of:

i) fragmented and isolated development of rural land; and

ii) providing, extending and maintaining public amenities and services; and

c) providing land for future urban development, for rural residential development and for development for other non-agricultural purposes, in accordance with the need for that development, and subject to the capability of the land and its importance in terms of the other objectives of this zone.

The project meets the objective of this zone by promoting the use of a valuable hard rock resource whilst appropriately managing impacts on ecology, water resources, areas of archaeological and heritage significance and surrounding agricultural land uses.

Zone 1 (b) Rural – Urban Investigation

The objectives of this zone are:

i) to identify land surrounding the City of Goulburn, and surrounding other land within the Mulwaree area that is within the Village Zone, which may be required to accommodate the future urban growth of the City and villages;

ii) to permit interim development of the land within this zone for purposes that will not compromise their possible future use for urban and related development and which will maintain the existing character of the locality;

iii) to set aside land uncommitted to other uses for the determination of its long term use in the light of future circumstances and demand, including demand for adequate areas of land for industrial and residential purposes;

iv) to permit detailed investigation of the suitability of the land for a variety of urban purposes consistent with general and particular future requirements;

v) to restrict development of the land for any purpose which may prejudice the eventual future use of the land for urban purposes;

vi) to ensure that development conserves, enhances and does not adversely affect the physical characteristics, environmental qualities and scenic attributes of perimeter urban lands; and

vii) to ensure that development does not create an unreasonable or uneconomic demand for the provision or extension of public amenities or services.

As discussed in **Section 4.5.1.4** Council currently proposes to change this zoning to facilitate the extraction of the target resource and limit potential future land use conflicts in accordance with DPI's Section 117(2) advice (refer to **Section 3.2.1**).

Zone 1 (c) Rural Small Holdings

The objectives of this zone are:

a) to promote the development of land identified as suitable for rural residential or hobby farm development;

b) to permit home industries which are compatible with the environmental capabilities of the land and which will not adversely affect the quality of water resources in the vicinity; and

c) to preserve and enhance the amenity of the rural residential and hobby farm area by ensuring that development is carried out in a sympathetic manner.

As discussed in **Section 4.5.1.4**, Council currently proposes to change this zoning to facilitate the extraction of the target resource and limit potential future land use conflicts, in accordance with DPI's Section 117(2) advice (refer to **Section 3.2.1**).

Permissibility of the Proposed Quarry

The majority of land proposed to be disturbed by Lynwood Quarry is zoned 1 (a) (refer to **Figure 4.1**). Extractive industries are permissible on land zoned 1(a) with development consent. In addition, the development of a quarry is consistent with the objectives of this zone, particularly the objective to *promote, enhance and conserve valuable deposits of extractive materials*.

Extractive industries are not permissible on land zoned 1 (b) and 1 (c), however, because the project is State Significant Development, the Minister for Infrastructure and Planning can approve the development in accordance with Section 76 (8)(c) of the EP&A Act. In any event, Goulburn Mulwaree Council plans to rezone the portions of the project area currently subject to 1 (b) and 1 (c) zonings to a new 1 (e) Employment / Natural Resource zone to recognise the importance of the resource (refer to **Section 4.5.1.4**).

4.5.1.2 Development Control Plans

There are no development control plans currently prepared by Goulburn Mulwaree Council that are relevant to the proposed quarry (i.e. the DCPs prepared by the former Mulwaree Shire Council).

4.5.1.3 Mulwaree Section 94 Contributions Plan

The Mulwaree Section 94 Development Contributions Plan 2003-2008 was adopted by the former Mulwaree Shire Council on 7 January 2004 and is relevant to this project. As outlined in the plan, there are a number of fundamental principles that Council is required to follow when imposing contributions under Section 94. The primary principal is that Council must establish a nexus (a direct relationship) between the need created by the development and the provision of public amenities and public services.

Section 2.6 of the Section 94 plan states that it applies to extractive industries, however, there are no guidelines to determine how the plan applies to such a development except in relation to traffic generation. During the operational phase of the quarry, Readymix will be gaining direct access onto the Hume Highway and will not be using any Council roads, and therefore such a contribution is not relevant. Readymix will undertake the necessary upgrade works and repair any damage to the construction access route, as determined in consultation with Council.

The plan also states that Council may accept an “in-kind” contribution or provision of a material public benefit in lieu of a monetary contribution. Such a contribution would need to be equal in dollar value to the calculated Section 94 levy.

4.5.1.4 Mulwaree Settlement Strategy

Prior to the formation of Goulburn Mulwaree Council, Mulwaree Shire Council had adopted a Settlement Strategy for the LGA. This strategy has since been endorsed by Goulburn Mulwaree Council and a broad planning study is being undertaken to gain information on which to refine the Settlement Strategy and undertake Local Environmental Studies. Following this process, a revised LEP will be developed for the newly formed LGA.

The core objectives of the Settlement Strategy are:

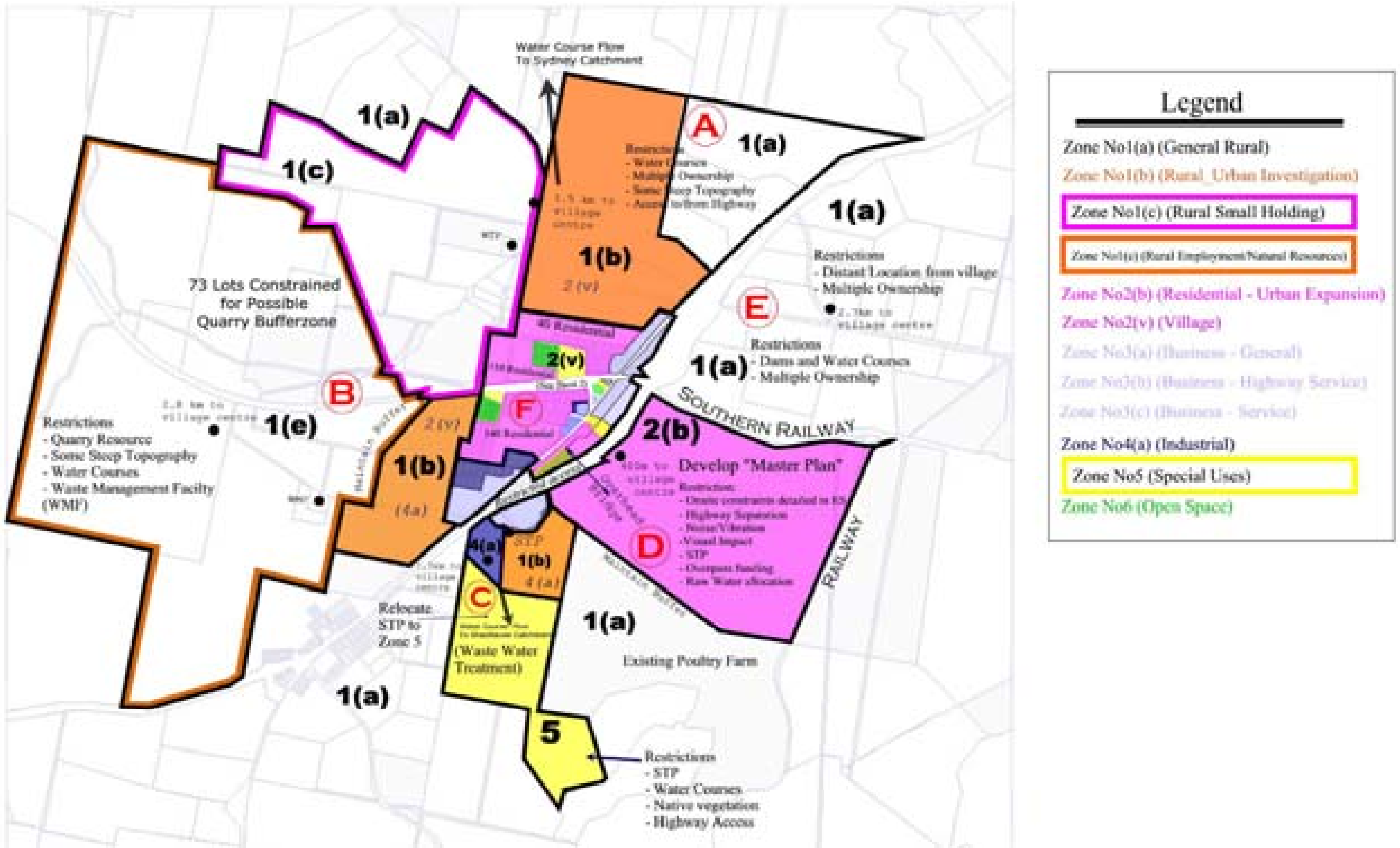
- to enhance individual and community well-being and welfare by following a path of economic development that safeguards the welfare of future generations;
- to provide for equity within and between generations;
- to protect biological diversity and maintain essential ecological processes and life support systems;
- to protect the resource base and natural areas;
- to maximise access to goods, services and opportunities, and reduce the need to travel;
- to maximise resource efficiency and minimise environmental and social impact; and
- to create and maintain a high level of liveability and safety.

The Mulwaree Settlement Strategy recognises the importance of the hard rock resource that is the subject of this development proposal, with the majority of the Readymix land holding proposed to be converted to a 1 (e) Employment / Natural Resource zoning. The strategy also addresses the issue of buffer land around the proposed quarry in order to ensure that the resource can be extracted in an economically viable manner without significant adjoining land use constraints. The Greater Marulan Structure Plan from the strategy shows the proposed future zonings of the project area and surrounds and is included as **Figure 4.2**.

The proposed development is consistent with the Mulwaree Settlement Strategy, with the strategy promoting the development of the resource by providing a more appropriate zoning and protection from potential future land use conflicts.

Umwelt Environmental Consultants

Greater Marulan Structure Plan



Source: Mulwaree Shire Council, 2003

FIGURE 4.2

Proposed Future Land Use - Mulwaree Settlement Strategy

File Name (A4): R03_V1/1829_268.dgn

SECTION 5

Existing Environment & Impact Assessment

5.0 Existing Environment and Impact Assessment

5.1 Geology

5.1.1 Regional Geology

The project area lies near the divide of the volcanics that underlie the majority of the Southern Tablelands and the sedimentary formations to the east of this region in the upper reaches of both the Sydney basin and the Shoalhaven catchment. To the northeast of the project area the geology is comprised primarily of Triassic and Permian sedimentary formations, with these extending north throughout the Sydney basin. To the east lie Permian and Devonian sedimentary formations, including the extensive gorges and drainage valleys found within the Bungonia State Conservation Area. The project area and land to the north, south and west, are dominated by Ordovician, Silurian and Tertiary volcanics (refer to **Figure 5.1**). In the Marulan area, there is a broad north-south trending band of Devonian age (approximately 360 – 415 million years) acid volcanic ignimbritic tuffs/lavas (referred to as Bindook Porphyry) bounded and partially intruded by granites. This band of Bindook Porphyry adjoins the early Devonian Marulan Granites to the east and the Carboniferous Lockyersleigh Adamellite to the west.

The Bindook Porphyry found within the project area has been classified as being part of the Joarimin Ignimbrite which is a sub-group of the Bindook Volcanics. Mapping by the NSW Geological Survey has outlined another intrusive granitic body, named the Lynwood Granite, in the western portion of the project area (Bell Cochrane & Associates, 2004). Geological investigations undertaken by Readymix in the project area have also identified other more localised features that are not identified in regional scale mapping and are described in the following sections.

5.1.2 Geological Investigations

Initial geological investigations began at Lynwood in 1980, with Readymix geologists undertaking visual and aerial photography assessments to determine the quarrying potential of the site. In 1990, Boral conducted a test excavation at Lynwood on the southern portion of the project area in order to confirm rock quality and quarrying potential. Since the late 1990s Readymix has undertaken further detailed geological investigations including a comprehensive drilling program that was completed in 2004.

Readymix has completed a total of 306 percussion exploration drill holes and 18 diamond exploration drill holes at regular intervals over the project area (refer to **Figure 5.2**). The drilling program has predominately been to a 40 metre depth (percussion drilling) with diamond drill holes undertaken to a depth of up to 150 metres.

The initial detailed drilling program was focused on the southern portion of the project area which was thought to contain the higher quality and quantity resource. This program identified a substantial resource, however, it was more variable in quality than expected. Readymix therefore commenced a reconnaissance drilling program on the northern portion of the project area. This program identified that a larger resource existed in this area and also indicated that it had a more consistent high quality. These findings were confirmed by a subsequent more detailed drilling program which found that the northern area contained a substantial, high quality resource with generally good quality consistency.

To complement the drilling program, geophysical surveys, surface sampling and laboratory analysis of rock samples has been undertaken to determine both the extent and quality of the Lynwood resource.

Umwelt
Environmental Consultants

Source: Geological Survey of NSW, Goulburn 1:250 000 Geological Sheet 2004

Legend

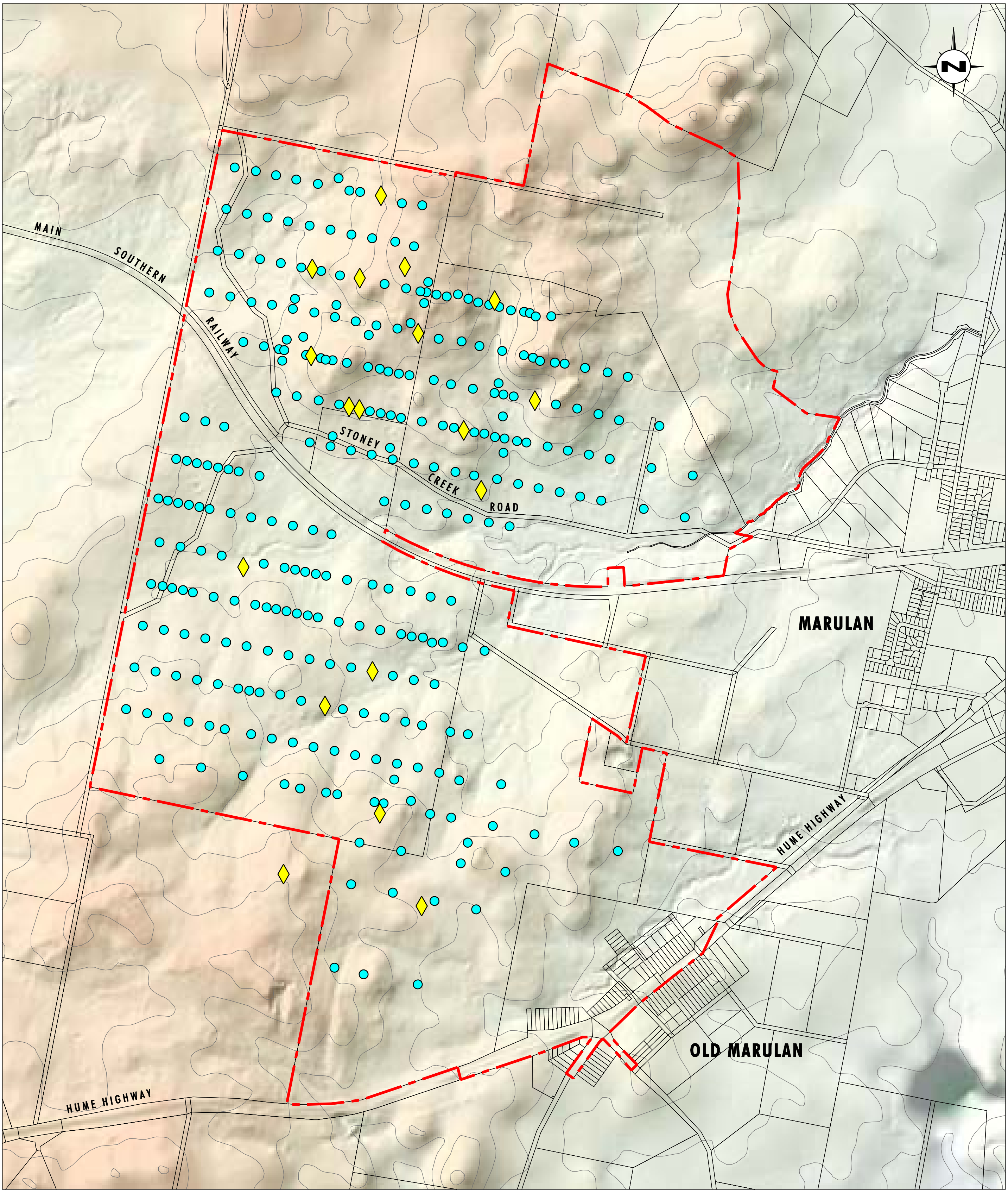
- Project Area
- Lambie Group
- Adaminaby Group
- Bindook Volcanic Complex
- Megalong Formation
- Currawang Basalt
- Uringalla Granite
- Marulan Granite
- Glenrock Granite
- Berry Siltstone
- Lockyersleigh Adamellite
- Mount Pleasant Granite
- Hawkesbury Sandstone
- Tarlo Formation
- Lurnley Adamellite
- Springponds Granodiorite
- Undifferentiated Cainozoic Clastic Sediment
- Undifferentiated Mesozoic Mafic Extrusive
- Undifferentiated Tertiary Clastic Sediment
- Unnamed Tertiary Mafic Extrusive
- Undifferentiated Silurian Clastic Sediment
- Undifferentiated Silurian Chemical Sediment
- Unnamed Devonian Felsic Intrusive

FIGURE 5.1

Regional Geology

File Name (A4): R03_V1/1829_270.dgn

Umwelt
Environmental Consultants



Source: Readymix Holdings Pty Ltd
Base Source: LPI 2004

0 0.5 1 1.25km

Legend

Project Area
Percussion Exploration Drillholes
Diamond Exploration Drillholes

FIGURE 5.2

Exploration Drilling Program

Conductivity surveys were also undertaken to determine the average ground value conductivity. Conductivity values basically reflect the clay content or weathering state of materials. Initial conductivity surveys targeted the southern portion of the project area with later surveys covering the remainder of the project area. Consistent with other geological investigations, the conductivity survey indicated that the southern resource area was more variable in quality compared to the northern resource area. The conductivity survey results, when reviewed in light of the drilling program results, indicated that there are large areas north of the Main Southern Railway which show consistent low conductivity values, indicating widespread “massive” porphyry (high quality rock).

In addition to the conductivity surveys, a magnetic survey conducted within the northern portion of the project area provided information regarding the extent of alteration and the structure of the Bindook Porphyry. Again, this survey indicated the presence of a large high quality resource.

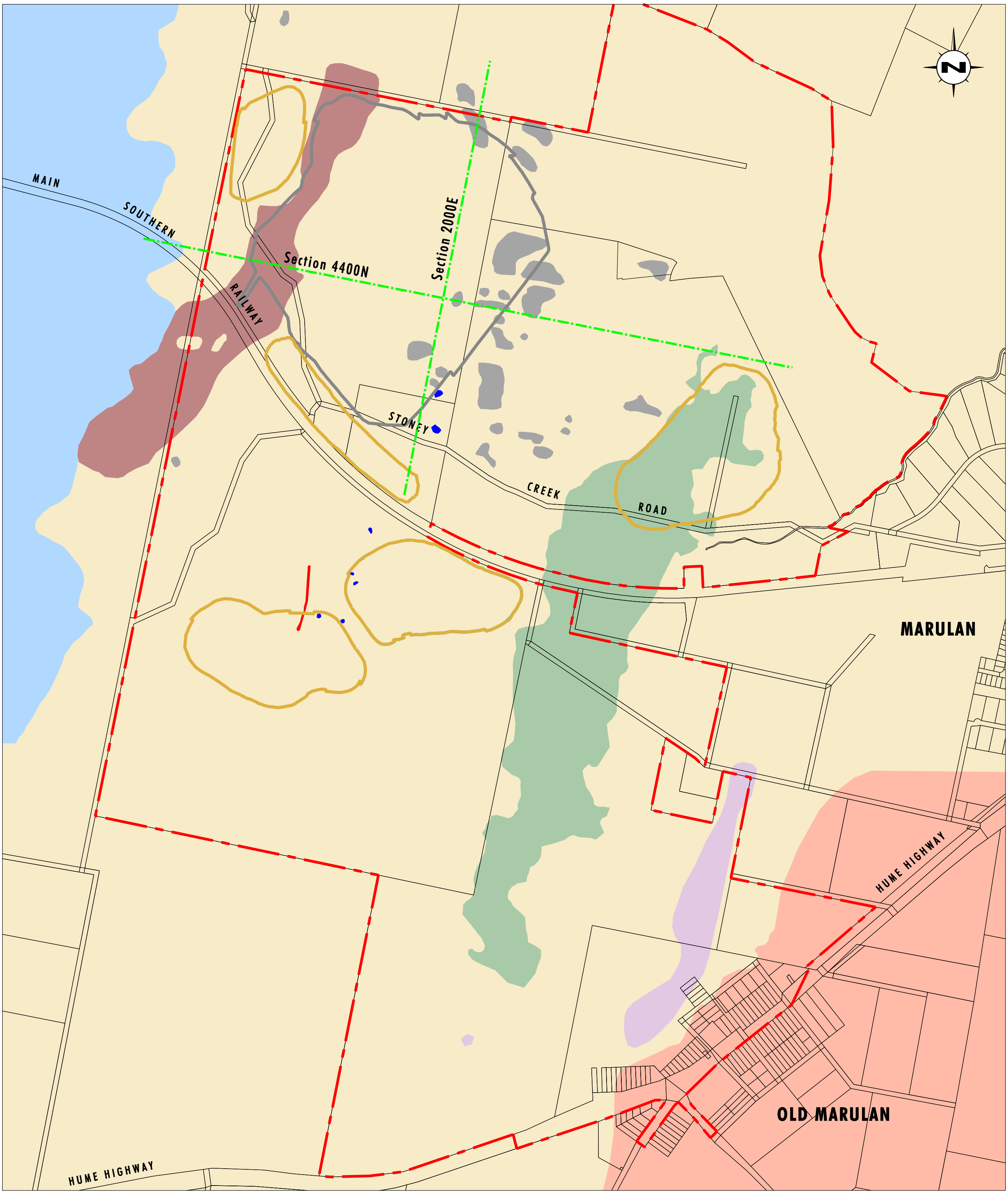
The information obtained from this comprehensive exploration program has given Readymix a sound understanding of the target porphyry resource, providing a high level of geological certainty about the potential of the resource to produce quarry products that will meet market specifications. The results of the exploration program have been used to develop a detailed geological model for the project, with this model providing the basis for the quarry pit design, crushing and screening plant design, expected yield, overburden and excess product emplacement volume requirements and product types.

5.1.3 Geology of the Project Area

The target resource, Bindook Porphyry, is the predominant rock type within the project area (refer to **Figure 5.3**). The porphyry resource occurs on both the northern and southern sides of the Main Southern Railway with the higher quality resource located to the north. Other significant geological features include narrow strips of intrusive rock from the neighbouring granite plutons, occurring on the eastern and western sides of the project area (refer to **Figure 5.3**). A band of Porphyric Adamellite (a granite) trending north-south occurs to the east of the project area, while an Adamellite Dyke trending northeast-southwest occurs to the west. These areas of granite are generally deeply weathered with little or no outcrop. The southeastern portion of the project area also contains an Andesite intrusion, with Marulan Creek generally marking the boundary between the Bindook Porphyry and the Marulan Granite to the southeast. Minor accumulations of sand also occur in the northern resource area (refer to **Figure 5.3**).

The depth of weathering of the porphyry resource across the site is variable. Weathering is mostly shallow (between 1 and 10 metres), however, weathering is in excess of 30 metres in places. The weathering profile ranges from decomposed porphyry with essentially clayey properties (overburden) to a mixture of jointed hard and softer brown rock (weathered porphyry). The porphyry ranges from massive, to strongly fractured with closely spaced near vertical joints/fracture planes. These fracture/shear zones often appear light to pale in colour due to secondary alteration. The fresh porphyry is typically dense and dark in colour and exhibits a porphyritic texture of coarse quartz and felspar grains in a fine tuffaceous to glassy groundmass. Representative geological cross sections showing the weathering profile of the northern resource are included as **Figure 5.4**, with the cross-section locations included on **Figure 5.3**.

Umwelt
Environmental Consultants



Source: Bell Cochrane & Associates
Base Source: LPI 2004

0 0.25 0.5 1km

Legend

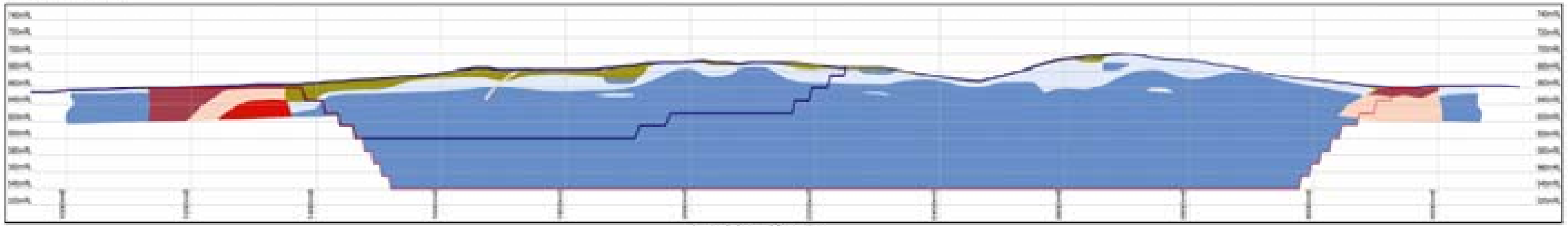
- Project Area
- Proposed Quarry Area
- Proposed Emplacement Area
- Cross-section Location
- Bindook Porphyry
- Sand
- Lockyersleigh Adamellite
- Adamellite Dyke
- Adamellite Dyke/Sills
- Siliceous Dyke
- Porphyritic Adamellite
- Andesite
- Marulan Granite

FIGURE 5.3
Site Geology

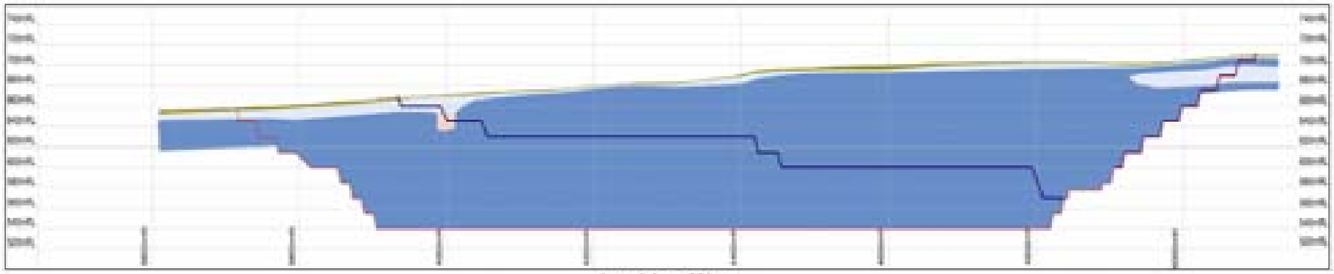
File Name (A4): R03_V1/1829_238.dgn

Umwelt
Environmental Consultants

Section 4400N



Section 2000E



Source: Bell Cochrane & Associates

Legend

- Overburden (porphyry)
- Weathered Porphyry
- Fresh Porphyry
- Overburden (adamellite)
- Weathered Adamellite
- Fresh Adamellite
- Year 30 Pit Boundary

FIGURE 5.4

Representative Geological Cross-sections

5.2 Topography, Soils, Land Capability and Agricultural Suitability

5.2.1 Topography

The project area is primarily located in the Joarimin Creek Catchment, with a portion of the Lockyersleigh Creek Catchment in the northeast and Marulan Creek Catchment in the southern portion of the project area (refer to **Figure 5.5** and **Section 5.6.2**).

The topography of the project area consists of ridges with saddles and crests to the north and south, dissected by the Joarimin Creek valley flowing through the middle generally from the southwest to the northeast (refer to **Figure 5.5**). The southern portion of the project area slopes towards the south and southeast towards Marulan Creek and the Hume Highway. The area north of the Main Southern Railway rises gently from Joarimin Creek then more steeply to low rocky crests (maximum elevation 710 mAHD). To the south of the Main Southern Railway the relief is more gently undulating with broad ridges and slopes, saddles and low spurs. The elevation of the project area ranges from approximately 710 mAHD in the north, to around 630 mAHD near Joarimin Creek. There are no areas of very steep gradient, although some of the spurs have short, steep slopes which can range in gradient up to 5-8 degrees.

A ridge located generally along the northern boundary of the project area separates it from residences to the north and defines the boundary of the sub-catchments of Lockyersleigh and Joarimin Creeks. To the west, the land slopes gently towards the main channel of Lockyersleigh Creek. To the south, a ridge again separates the project area from surrounding land uses, except for one residence to the south that is located on the northern side of the ridge. The Hume Highway also forms part of the southern boundary with land to the south of the highway comprised of more elevated areas.

To the east, a ridge (approximately 670 mAHD) to the north of the Main Southern Railway separates the project area from rural residential areas and the township of Marulan. To the south of the Main Southern Railway there is another minor ridge (650 to 670 mAHD) providing some separation from the township and the project area, however, this ridge is less prominent compared to the surrounding topography.

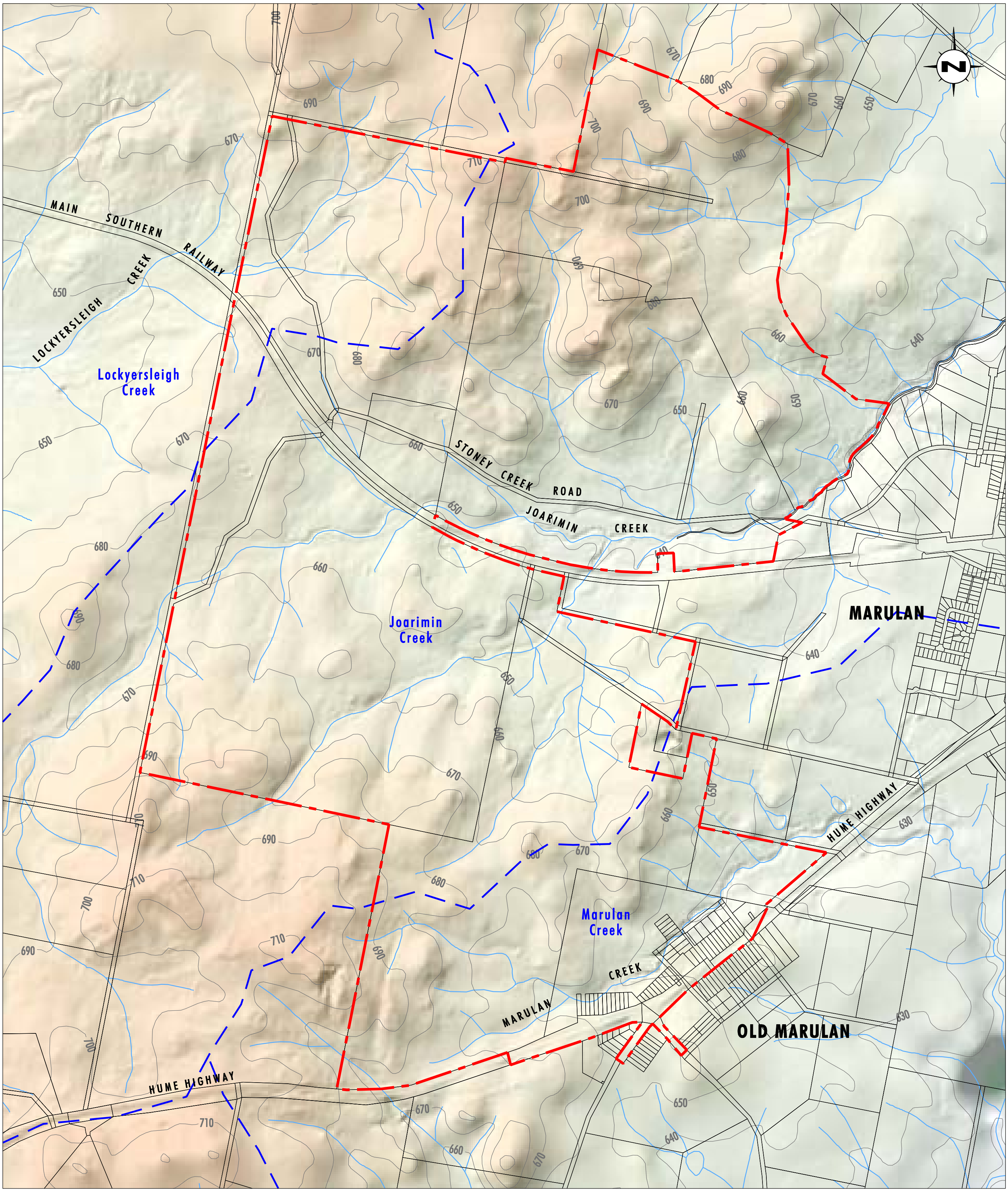
5.2.1.1 Impacts on Topography

The proposed quarry will impact on the topography of the project area both by excavation for the quarry pit and establishment of out-of-pit emplacement areas for overburden and excess product. There will also be minor impacts on topography due to the construction of quarry infrastructure including levelling of the infrastructure pads, establishment of the rail loop and construction of dams and roads.

The quarry pit itself will significantly alter the topography of the area to the north of the Main Southern Railway with the current generally south facing slope to the south of the ridge excavated to a depth of up to approximately 140 metres (as measured on the northern quarry face). During the initial 30 year period, there will be no potential for in-pit dumping and therefore there is no potential to fill in part of the quarry void and reduce topographical change.

The overburden and excess product emplacement areas will result in less substantial changes to the topography of the site. The overburden emplacement areas to the north of the Main Southern Railway have been designed to blend with the surrounding topography, as far as practicable. The Eastern Overburden Emplacement Area (refer to **Figure 1.2**) has been placed behind the north-south running ridge separating the project area from rural

Home TOC Next



Base Source: LPI 2004

0 0.5 1 1.25km

Legend

- Project Area
- Catchment Boundary
- Contour (10m Interval)
- Creek / Drainage Line

FIGURE 5.5

Topography and Drainage

File Name (A4): R03_V1/1829_237.dgn

residential areas to the east. The emplacement area will extend 14 metres above the ridge in its southern portion in order to provide the required capacity but the design of the emplacement area generally follows the ridge line to minimise visual impacts, particularly once rehabilitation of the area is complete. In addition, once bulk dumping and shaping of the overburden emplacement area has been completed, the surface will be reshaped to provide a more natural, less regular landform with swales, drainage depressions and other surface features. This final shaping will ensure that the emplacement area blends in more sympathetically to the surrounding topography and will avoid the formation of large flat areas as part of the rehabilitation design. This style of final shaping will be undertaken for all emplacement areas (refer to **Section 3.11**).

The locality of Western Overburden Emplacement Area (refer to **Figure 1.2**) is more constrained and will result in the formation of a small hillock. The maximum height of this emplacement area will be 690 mAHD which is less than the maximum elevation of the existing topography within the northern portion of the project area (ie. 710 mAHD). The emplacement area will therefore not result in significant topographic contrast in the context of the northern ridge topography.

The Rail Overburden Emplacement Area has been designed in the form of a large bund to separate the quarry pit from the Main Southern Railway in order to provide visual screening. The bund will be elevated approximately 18 metres above the surrounding land surface, however, it is not of sufficient height to be a major topographic feature in the context of the surrounding natural topography.

The two excess product emplacement areas to the south of the Main Southern Railway were also designed to blend in as much as practical with the surrounding topography. Given the lack of significant variations in relief at this location, the maximum height of the Eastern and Western Excess Product Emplacement Areas have been limited to 672 mAHD and 681 mAHD respectively to reduce the extent of this impact.

5.2.2 Soils

This section summarises the soil landscapes within the project area and soil characteristics that are relevant to disturbance and re-use. A detailed soil survey was undertaken by Asset Geotechnical Pty Ltd to build on the regional mapping undertaken by DIPNR (2003) and to determine required soil management measures. The detailed soil analyses are included in **Appendix 4** and summarised below.

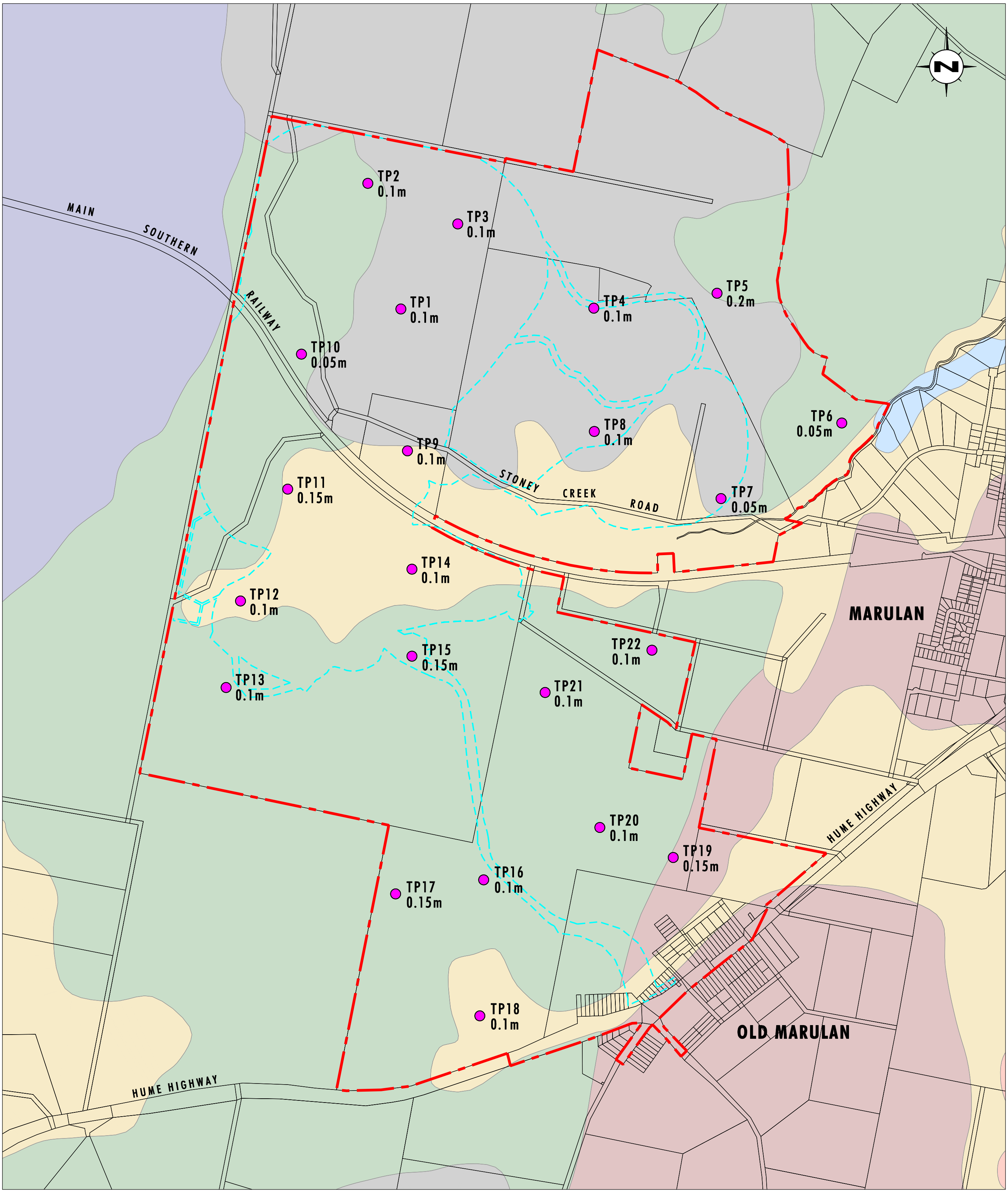
5.2.2.1 Soil Landscapes

Soil landscape mapping of the Marulan region has been undertaken by DIPNR (2003). This mapping indicates that four soil landscape units occur in the project area (refer to **Figure 5.6**). These four landscape units include the Bindook Road soil landscape, Bindook Road variant A soil landscape, Jaqua soil landscape and Marulan soil landscape. The characteristics of these four soil landscape units are described in detail in **Appendix 4**, adapted from DIPNR (2003).

Based on the soil landscape descriptions provided in **Appendix 4**, the soils within the project area are generally characterised as having a weak sandy loam material in the A1 horizon, with the subsoils being clayey in nature. These soils generally have a moderate to high concentrated and non-concentrated flow erodibility and a moderate to severe gully erosion risk, with gully erosion present in many drainage lines in the project area. Some subsoils within these soil landscape groups are dispersive.

The fertility of the soil is low over the majority of the project area with some small patches having moderate fertility. Lower slopes are generally poorly drained with soils generally

Umwelt
Environmental Consultants



Source: DIPNR, 2003
Base Source: LPI 2004

0 0.5 1 1.25km

Legend

- Project Area
- Approximate Disturbance Footprint

Soil Landscape Units

- Lockyersleigh
- Bindook Road Variant A
- Bindook Road
- Jaqua
- Marulan
- Paddy's River
- Soil Test Pit Location

0.1m Topsoil Depth

FIGURE 5.6

Soil Landscapes

File Name (A4): R03_V1/1829_255.dgn

having moderate to high salinity. The plant available water holding capacity (PAWC) of the soils is moderate to low across the site.

5.2.2.2 Soil Survey Methodology

To further characterise soils within the project area, a soil survey was undertaken by Asset Geotechnical on 3 and 4 November 2004. The survey included 22 soil test pits (refer to **Figure 5.6**). The test pits were excavated to depths ranging from 0.35 metre to 1.3 metre and were terminated in weathered bedrock. The soil profile exposed was then described and a detailed test pit log prepared (refer to **Appendix 4**). Samples of selected soil profiles were also taken for laboratory testing.

Laboratory testing included pH, conductivity and chloride levels for all samples, with selected samples also tested for cation exchange capacity, Emerson aggregate class, percentage exchangeable sodium, resistivity, sulphate, total phosphorous, available potassium and total sulphur. A total of 33 soil samples were tested.

5.2.2.3 Soil Analysis Results

The soil analysis results (refer to **Appendix 4**) indicated that the soils are not dispersive by nature, with Emerson Aggregate Test (EAT) classes being between class 5 and class 8. Consequently, soil dispersion is not considered a constraint to use of these soils for topdressing purposes. However, as discussed in **Section 5.2.2.1**, some of the clayey subsoils occurring in the project area are expected to be dispersive and this has been considered in design of the water management system (refer to **Section 5.6**).

The soil analyses also indicated that the soils range from moderately acidic to neutral (pH 4.5 to 7.1) and slightly saline to non-saline (0.330 to 0.015 dS/m). The soils generally have a low cation exchange capacity (2.5 to 15.8) with the soil therefore having a limited ability to retain nutrients. The soil phosphorous levels are generally sufficient to allow use of the pastures as grazing land, however, potassium and sulphur levels are relatively low. Some addition of fertiliser is therefore likely to be required as part of the rehabilitation process in order to ensure good growth of initial cover crops, but ongoing fertiliser application will not be required to provide a native vegetation or managed grazing land use.

A range of soil management measures proposed to be implemented as part of the project in response to these soil properties is discussed in **Section 7.2.1**.

5.2.2.4 Topsoil Depth

Topsoil depth across the site is variable depending on slope and soil type, with depth typically averaging between 0.1 and 0.15 metre. Shallow topsoil depths of 0.05 metre and areas with no topsoil (or no soil at all in areas of rock outcrop) were also recorded. Limited areas had soil depths of 0.25 metre or greater, typically in slope wash areas or areas adjacent to drainage lines. The topsoil depth at each of the soil test pit locations is shown on **Figure 5.6**.

5.2.2.5 Availability of Suitable Topdressing Material

The availability of soil suitable for use as topdressing material has been assessed based on soil mapping, soil analysis results and topsoil depth. The depth of suitable topdressing material across the site is generally shallow, with topsoil stripping activities to be managed on a day to day basis to ensure that all suitable topdressing material is recovered.

Estimated suitable topsoil stripping depths for the various disturbance areas across the site are included in **Table 5.1**. Also included are the estimated quantities of topdressing material that will be gained from each stripping area. In addition to the topdressing material included in **Table 5.1**, some of the cleared vegetation will be mulched and this material will also be used in rehabilitation to add organic material to respread topsoil, increasing the overall availability of topdressing material.

Table 5.1 - Approximate Volume of Topsoil Available for Stripping in Proposed Disturbance Areas

Proposed Disturbance Area	Estimated Stripping Depth (m)	Estimated Volume of Topsoil Material (m^3)
Quarry Pit	0.1	110,000
Eastern Overburden Emplacement Area	0.1	31,000
Western Overburden Emplacement Area	0.1	11,000
Rail Overburden Emplacement Area	0.15	17,000
Eastern Excess Product Emplacement Area	0.15	32,600
Western Excess Product Emplacement Area	0.15	35,000
Infrastructure Area	0.15	40,600
Total		**277,200**

Topsoil disturbed in other construction areas, apart from the main infrastructure area, has been excluded from the above calculations as this material will be used as part of the construction process (e.g. on road batters etc).

5.2.2.6 Topdressing Material Balance

As discussed in **Section 3.11**, the out-of-pit emplacement areas will be topdressed with a depth of 0.2 metre of topsoil to ensure a good rehabilitation outcome. The remaining topdressing material will be used to assist in the rehabilitation of the quarry pit benches or will be stored for use in final decommissioning works in the infrastructure area. The topsoil balance for the project is included in **Table 5.2**.

Table 5.2 - Topsoil Balance

Rehabilitation Area	Volume of Topsoil Material Required (m^3)
Eastern Overburden Emplacement Area	62,000
Western Overburden Emplacement Area	21,800
Rail Overburden Emplacement Area	22,700
Eastern Excess Product Emplacement Area	43,500
Western Excess Product Emplacement Area	47,000
Infrastructure Area (at 0.2 metre depth on project decommissioning)	54,000
Total Rehabilitation Requirement	**251,000**
Total Topsoil Available	**277,200**
Remaining Topsoil Available for use in Quarry Pit	**26,200**

As demonstrated in **Table 5.2**, there will be sufficient topsoil material for rehabilitation of each of the disturbed areas outside of the quarry pit, plus some remaining topsoil for use in rehabilitation of the quarry pit benches.

5.2.2.7 Soil Contamination

There are no known areas of soil contamination in the project area and given the past agricultural use of the property, soil contamination is considered unlikely. A preliminary soil contamination assessment has been undertaken for the project area and has identified some small areas that may be subject to minor, localised soil contamination. These areas are associated with former sheep dips, a sheep foot bath (a shallow dip) and farmhouse fuel and oil storage areas. There is no evidence of significant contamination at these sites (e.g. no significant staining of the ground, lack of grass cover, etc.) and these areas are not considered to present a significant health or environmental risk. Three of the areas, being one sheep dip, the sheep foot bath and the farmhouse fuel and oil storage areas will be disturbed by the proposed quarry and associated infrastructure. A phase 2 contamination assessment (involving soil testing) will be undertaken in each of these areas prior to ground disturbance in order to identify any necessary control measures.

5.2.3 Land Capability

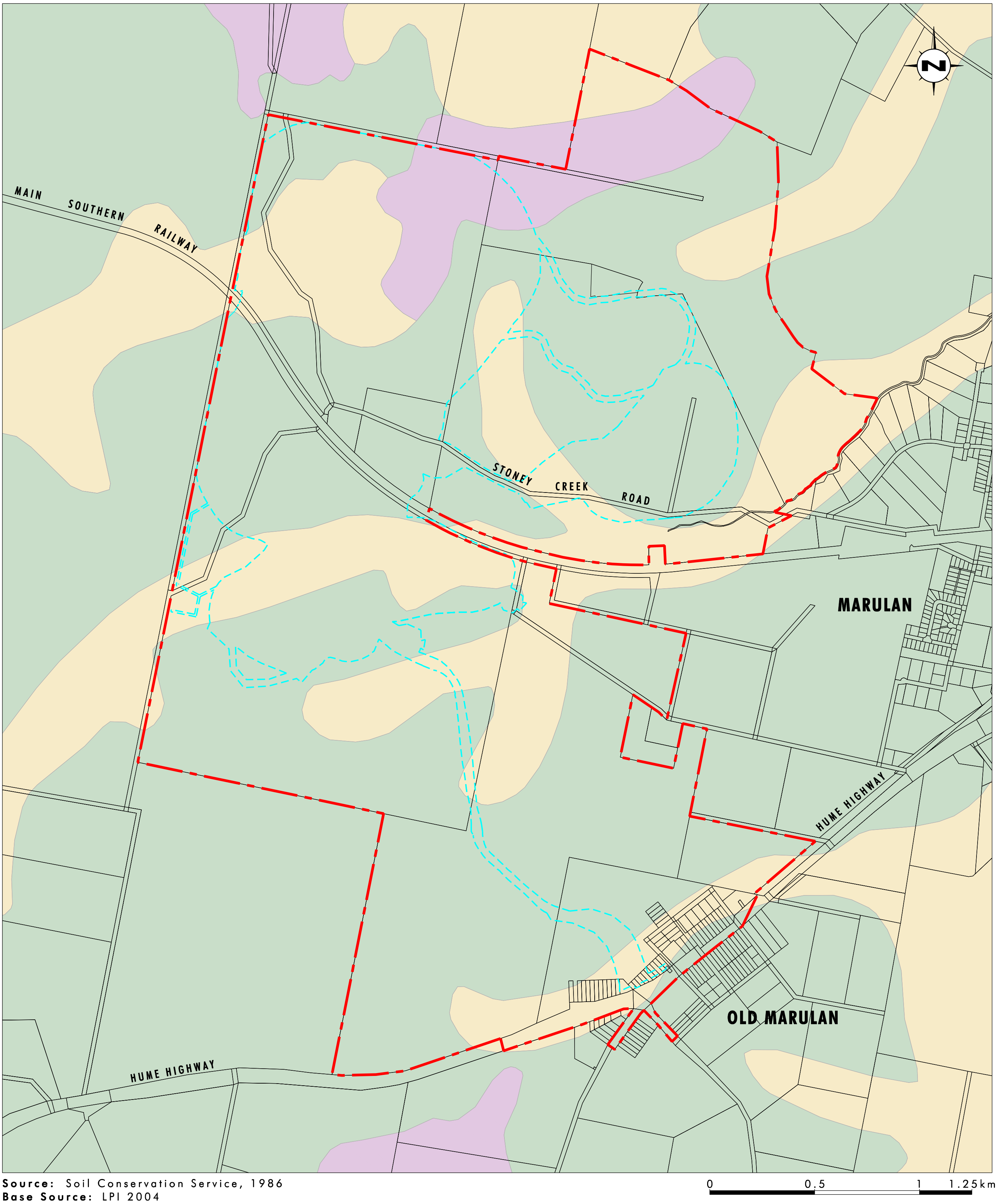
Land capability is defined as “the ability of the land to accept a type of intensity of use permanently, or for specified periods under specific management, without permanent damage” (Houghton and Charman 1986). Rural land capability classes for NSW have been developed by the former NSW Soil Conservation Service (now DIPNR). This classification divides land capability into eight classes based on the biophysical characteristics of the land and the extent to which these will limit a particular land use. The relevant classification classes are provided in **Table 5.3**. The classifications outline the types of land uses which may be appropriate for a location and also the potential land management practices which may need to be undertaken to protect the productivity of the land.

Table 5.3 - Land Capability Classes

General Capability	Land Capability Classes	Interpretations and Implications
Suitable for grazing and occasional cultivation	IV	Land not suitable for cultivation on a regular basis owing to limitations of slope gradient, soil erosion, shallowness or rockiness, climate, or a combination of these factors. Comprises the better classes of grazing land.
	V	Land not suitable for cultivation on a regular basis owing to considerable limitations of slope gradient, soil erosion, shallowness or rockiness, climate, or a combination of these factors. Soil erosion problems are often severe. Production is generally lower than for grazing lands in Class IV.
Suitable for Grazing but not for cultivation	VI	Productivity will vary due to soil depth and fertility. Comprises the less productive grazing lands.
Land best protected by green timber	VII	Generally comprises areas of steep slopes, shallow soils and/or rock outcrop.
Unsuitable for agricultural or pastoral uses	VIII	Cliffs, lakes or swamps and other lands unsuitable for agricultural and pastoral production.

Land capability within the project area has been mapped by the NSW Soil Conservation Service (now DIPNR) at a scale of 1:50,000 (Soil Conservation Service, 1986). This mapping identifies land of capability classes IV, V and VI as occurring in the project area (refer to **Figure 5.7**). The majority of the project area is classified as Class IV land, that is, land which is suitable for grazing and occasional cultivation. Areas of Class V land occur in the vicinity of drainage lines including along the main channel and tributaries of Joarimin

Umwelt
Environmental Consultants



Source: Soil Conservation Service, 1986
Base Source: LPI 2004

Legend

- Project Area
- Approximate Disturbance Footprint
- Class IV
- Class V
- Class VI

FIGURE 5.7

Land Capability

File Name (A4): R03_V1/1829_134.dgn

Creek, Lockyersleigh Creek and also along Marulan Creek in the southern portion of the project area. An area of Class VI land is also located in the more elevated northern section of the project area.

Class IV land requires a number of soil conservation measures to be implemented in order to maintain its agricultural productivity. Recommended measures include pasture improvement, stock control, application of fertiliser and minimal cultivation for establishment and re-establishment of permanent pasture as necessary. Class V land requires these same measures to ensure ongoing productivity, however, it is also recommended that structural conservation works such as absorption banks, diversion banks and contour ripping may be required. For Class VI land which is suitable only for grazing and not for cultivation, it is recommended that conservation practices including limiting stock, broadcasting seed and fertiliser, preventing fire and destroying vermin will be required to ensure ongoing productivity. Some isolated structural works may also be required.

Over the initial 30 year life of Lynwood Quarry it is proposed to disturb a total of approximately 230 hectares of land. Of this, approximately 125 hectares are Class IV, approximately 75 hectares are Class V and approximately 30 hectares are Class VI. As discussed previously, this land is currently used for low intensity grazing, with no cultivation undertaken within the project area.

5.2.3.1 Post Quarrying Land Capability

As discussed in **Section 3.11**, the portions of the project area disturbed for establishment of emplacement areas and infrastructure are planned to be rehabilitated to establish increased areas of native vegetation with a ground cover of native grasses. The rehabilitated area will be suitable for managed grazing, however, it is proposed to manage the area predominantly for its habitat values, particularly the area north of the Main Southern Railway. The quarry pit itself will be rehabilitated through the establishment of trees on the final quarry benches.

The anticipated post quarrying land capability is shown on **Figure 5.8**.

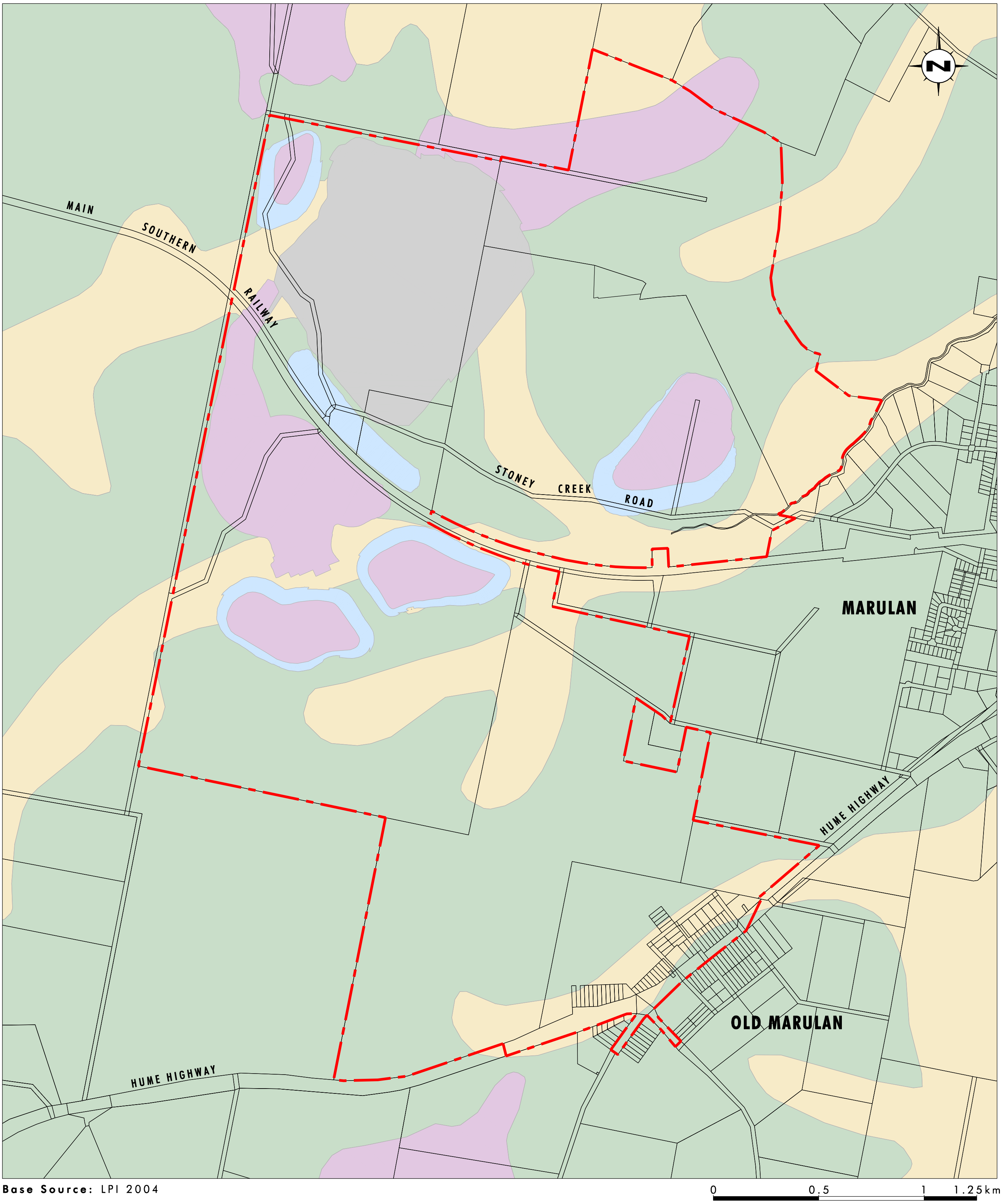
The post quarrying land capability of rehabilitated areas is expected to be predominately Class VI, that is, land which is suitable for grazing but not for cultivation. Limited areas of Class VII will also exist on the steeper slopes around the edges of the emplacement areas, with the quarry void itself unsuitable for any agricultural or pastoral use and consequently classed as Class VIII land.

5.2.4 Agricultural Suitability

Agricultural suitability is an assessment of the potential agricultural productivity of an area of land. It is based on consideration of land capability together with limitations such as climatic factors, soil physical characteristics, soil chemical characteristics, erosion potential, drainage, stoniness, soil depth and topography. Agricultural suitability in NSW has been classified into five classes by DPI (Agriculture division), formerly NSW Agriculture. These five classes are:

- Class 1 - suitable for intense cultivation;
- Class 2 - suitable for cultivation;
- Class 3 - suitable for grazing and pasture improvement;
- Class 4 - marginally suitable for grazing; and
- Class 5 - unsuitable for agriculture.

Umwelt
Environmental Consultants



Legend
- Project Area
- Class IV
- Class V
- Class VI
- Class VII
- Class VIII

FIGURE 5.8

Post Quarrying Land Capability

File Name (A4): R03_V1/1829_269.dgn

Agricultural suitability of the project area has been mapped by DPI at a scale of 1:50,000 (NSW Agriculture, 1988). The mapping indicates that two classes of agricultural suitability occur within the project area, being Class 4 and Class 5 (refer to **Figure 5.9**). A more detailed description of the characteristics of these two classes is included below (adapted from NSW Agriculture, 2002).

> Class 4 – Land that is suitable for grazing but not suitable for cultivation. Agriculture is based on native pastures or improved pastures established using minimum tillage techniques. Production may be seasonally high but the overall production level is low as a result of major biophysical, social and economic constraints.
>
> Class 5 – Land is not suitable for agriculture or at best is suited to only light grazing. Agricultural production is very low or zero as a result of severe biophysical, social and economic constraints, which preclude improvement.

As shown on **Figure 5.9**, the majority of the project area is classified as Class 4 land, being marginally suitable for grazing but not suitable for cultivation. There are also two areas of Class 5 land (land unsuitable for agriculture) located in the northern portion of the project area on the more elevated, rocky outcrop areas. Based on this agricultural suitability mapping, the project area does not contain high quality agricultural land.

The majority of the proposed disturbance area is Class 4 land, with only small areas of Class 5 land proposed to be disturbed, primarily for haul roads.

During quarrying, agricultural land uses will be limited in the project area due to the potential safety risks to Readymix production personnel and risks to stock due to machinery movements and creation of voids. Some managed grazing will be undertaken on portions of the site, particularly to the south of the Main Southern Railway, however, during the life of the quarry agricultural productivity will be limited.

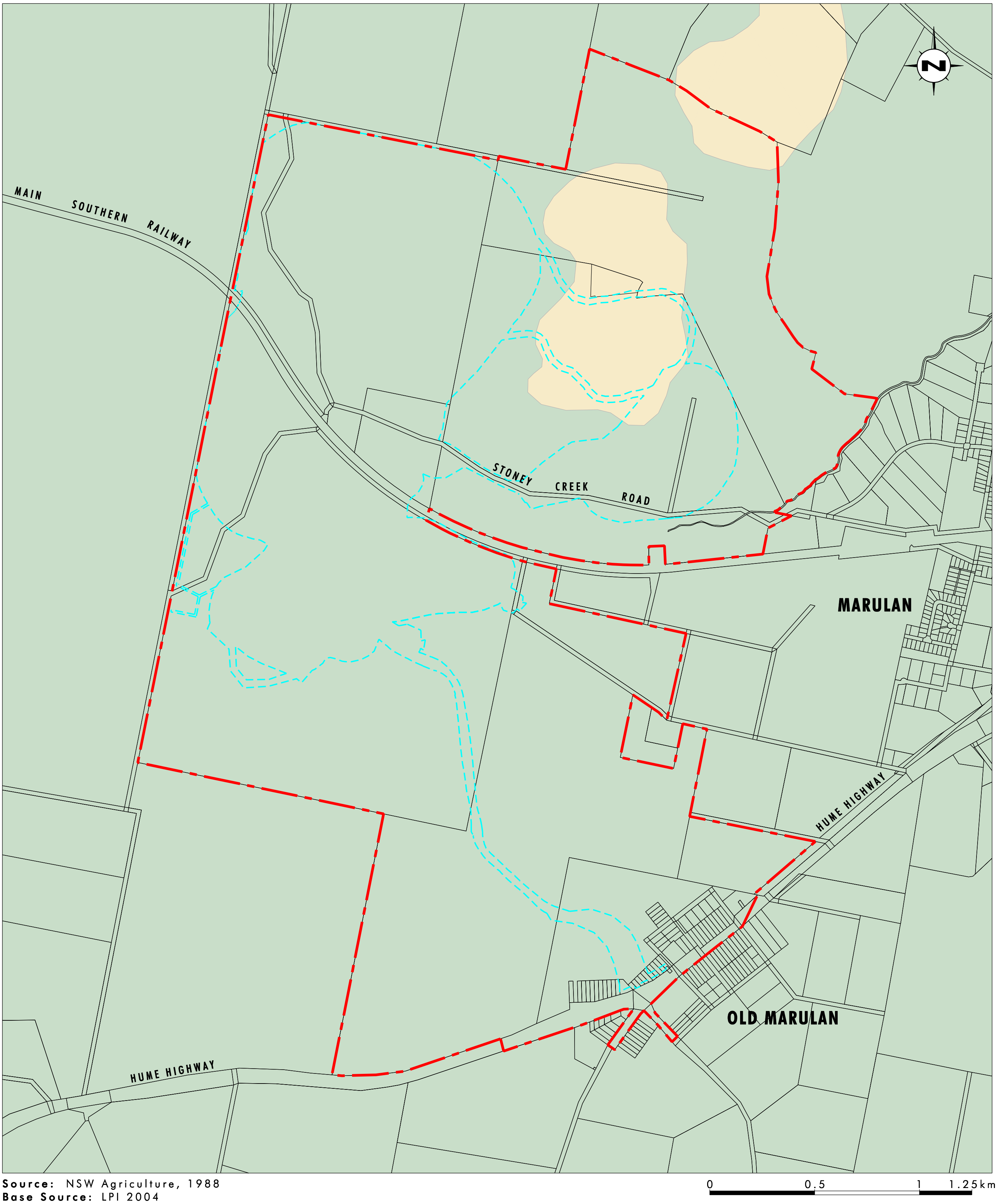
5.2.4.1 Post Quarrying Agricultural Suitability

The agricultural suitability of the rehabilitated landform will be primarily Class 4, with an increased area of Class 5 land due to the quarry pit. Native woodland / open forest vegetation with a native grass groundcover will be established on the rehabilitated emplacement areas and decommissioned infrastructure areas, with this land all being potentially suitable for low intensity managed grazing. The quarry void itself will, however, not be suitable and will consequently be Class 5 land.

5.3 Climate

The climate of the Marulan/Goulburn region is cool temperate, with seasonal climatic variation ranging from hot summers to cold winters. Rainfall is slightly summer dominant, with high intensity short duration storms a feature of the summer months. Winters are cold with frosts occurring between June and August.

A meteorological monitoring station designed in accordance with relevant Australian Standards (AS 2923-1987) was installed in the project area in June 2004 (refer to **Figure 5.10** for location). The station records temperature, wind speed, wind direction and sigma-theta in 10-minute periods, and also records rainfall. The station was damaged by cattle resulting in the loss of some data, however, approximately nine months of site specific weather data had been collected at the time of completion of the EIS. A meteorological station will be retained on site for the duration of the project. When necessary, the station will be relocated from its current position which is within the disturbance footprint.



Source: NSW Agriculture, 1988
Base Source: LPI 2004

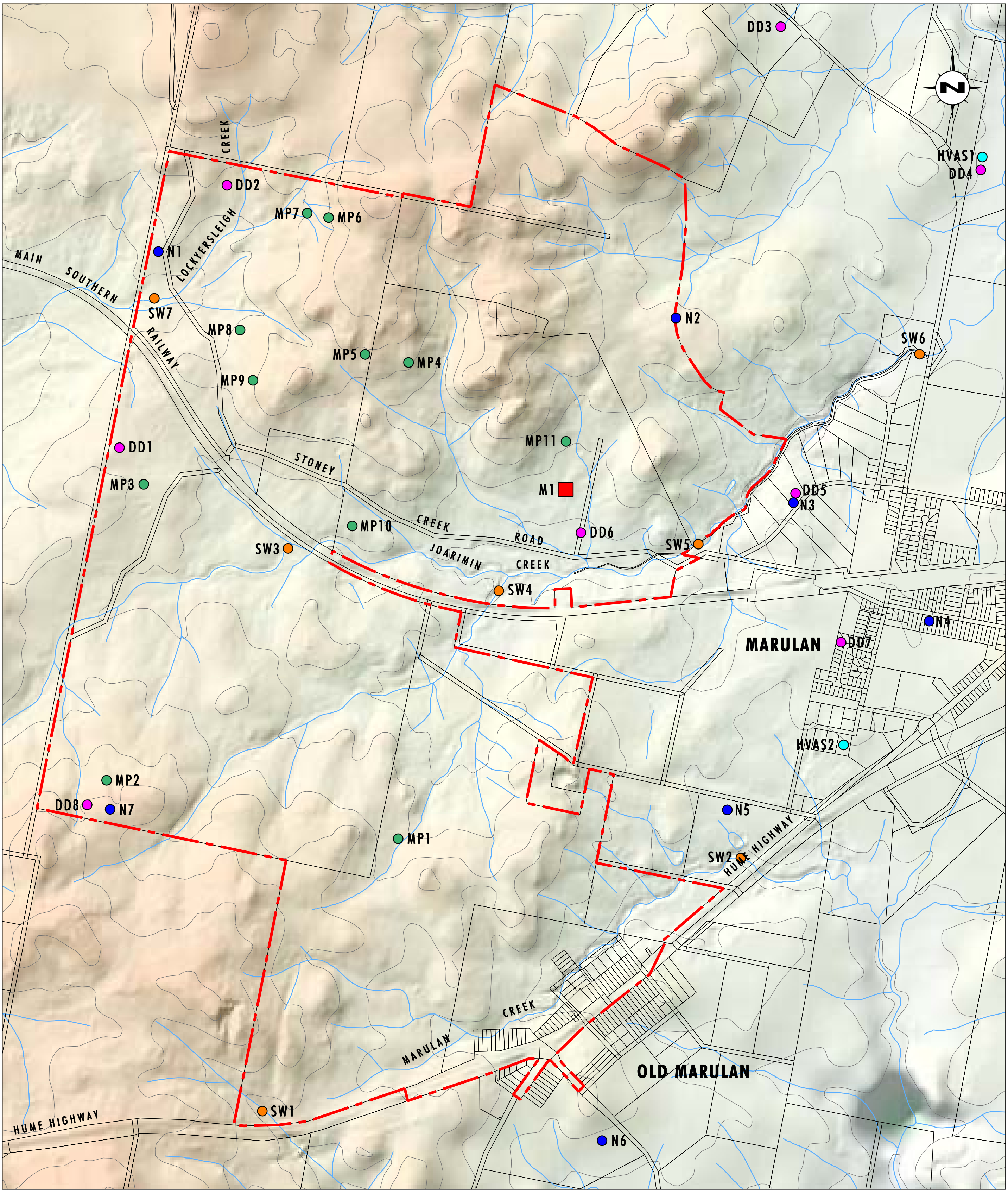
Legend

- Project Area
- Approximate Disturbance Footprint
- Class 4
- Class 5

FIGURE 5.9

Agricultural Suitability

Umwelt
Environmental Consultants



Base Source: LPI 2004

Legend

- Project Area
- Depositional Dust Monitoring Location
- PM10 Dust Monitoring Location
- Meteorological Station
- Noise Monitoring Location
- Surface Water Monitoring Location
- Groundwater Monitoring Location

FIGURE 5.10

Monitoring Locations Plan

File Name (A4): R03_V1/1829_245.dgn

5.3.1 Temperature

The nearest meteorological stations collecting temperature data are in Goulburn, with data obtained from a station located at Progress Street, Goulburn (Station 70263). Meteorological data is available at this station for the period 1972 to 2003. Average maximum and minimum monthly temperatures recorded at Progress Street are presented in **Table 5.4**.

Table 5.4 - Average Monthly Maximum and minimum temperatures Recorded at Station 70263, Progress Street, Goulburn

Month	Average monthly minimum temperature (ºC)	Average monthly maximum temperature (ºC)
January	13.4	27.5
February	13.5	26.5
March	11.2	24.0
April	7.8	20.0
May	4.9	16.0
June	2.4	12.4
July	1.4	11.5
August	2.0	13.1
September	4.5	16.3
October	6.7	19.4
November	9.1	22.2
December	11.6	25.8
Annual Average	**7.4**	**19.6**

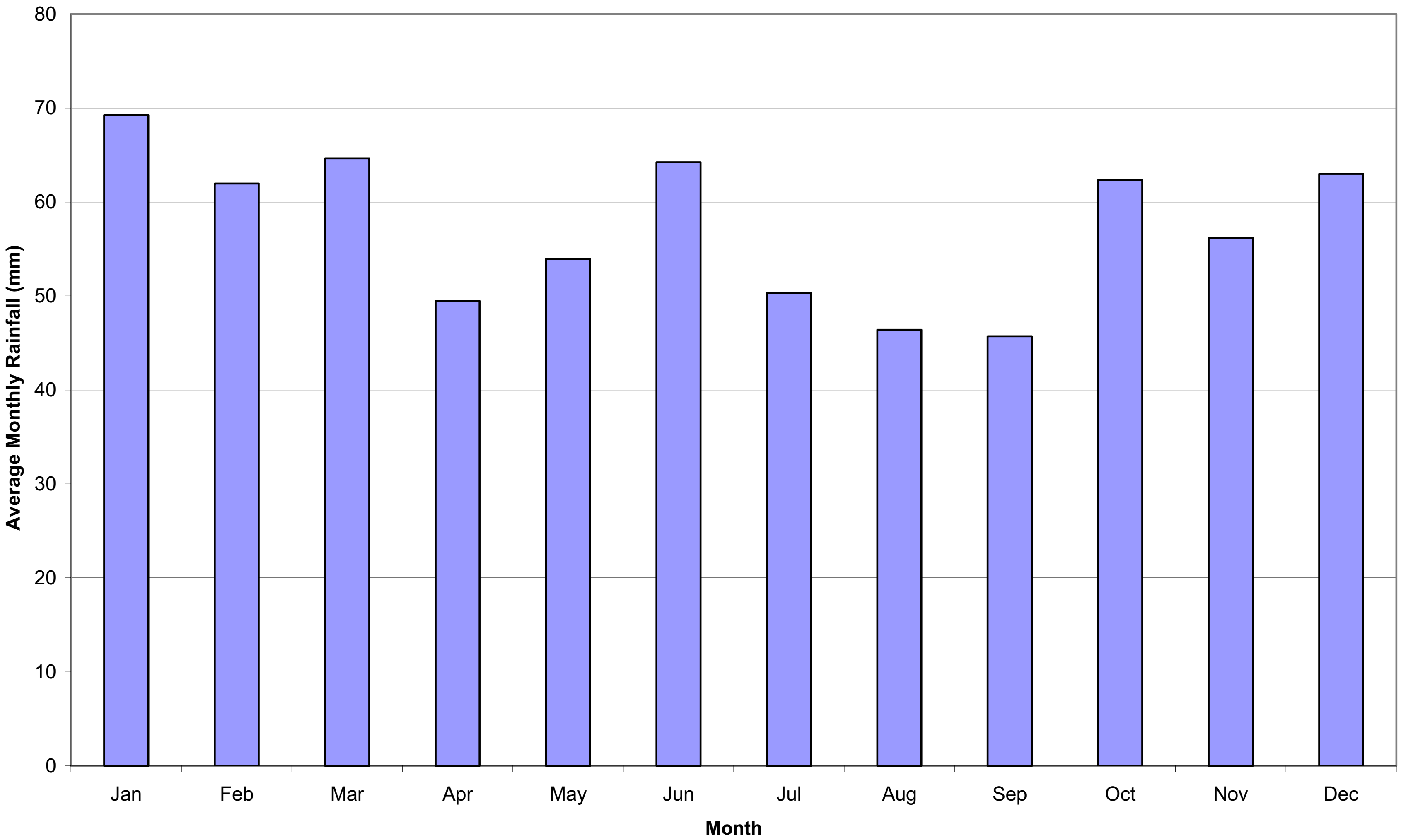
January is the warmest month, with an average monthly maximum temperature of 27.5 ºC. July is the coldest month, with an average minimum of 1.4 ºC and an average maximum of 11.5ºC. During winter, average monthly maximum temperatures range from 11.5 ºC to 13.1 ºC, with summer average monthly maximum temperatures ranging from 25.8 ºC to 27.5 ºC. Average monthly minimum temperatures range from 1.4 ºC to 2.4 ºC in winter and from 9.1 ºC to 13.4 ºC in summer.

5.3.2 Rainfall and Evaporation

5.3.2.1 Rainfall

The nearest meteorological station to the project area with long-term rainfall data is located in George Street, Marulan (Station 70063). This station recorded rainfall for the period 1894 to 2003. The station did not operate between 1927 and 1940, and no rainfall data is available for this period. Annual rainfall data was also excluded for years when there was not a full year of data available.

Based on the results available from the George Street station, the average annual rainfall for Marulan is 665 mm and is slightly summer dominant. Average monthly rainfall for Marulan is shown on **Figure 5.11**, with January having the highest monthly average of 69 mm and August and September sharing the lowest monthly average of 46 mm.



Source: Bureau of Meteorology, 2004

FIGURE 5.11

Average Monthly Rainfall at Marulan

5.3.2.2 Evaporation

The nearest meteorological monitoring station to the project area measuring evaporation is located in Goulburn (Station 70263). Annual evaporation measured at this location ranges from 938 mm to 1983 mm per year for the period of record (1979 to 2003). Analysis of the historical record shows an expected trend of evaporation increasing during summer months and decreasing during winter months. From this analysis average monthly evaporation data has been derived and is shown in **Table 5.5**.

Table 5.5 - Average Monthly Evaporation

Month	Average Evaporation (mm)
January	192
February	143
March	105
April	75
May	53
June	42
July	43
August	53
September	72
October	99
November	138
December	189
Annual Average	**1205**

The annual average evaporation of 1205 mm is well in excess of Marulan's annual average rainfall of 665 mm.

5.3.3 Wind Speed and Direction

Wind speed and direction data is recorded at the meteorological station located on the Lynwood property. As discussed above, there is not yet 12 months of data available from this station. A full annual data set was required for the dust and noise modelling undertaken for the project (refer to **Sections 5.8** and **5.9**) with data therefore obtained from the "Wangi" meteorological station which is located approximately 8 kilometres southwest of the project area. At this station, 100% of the data was collected in 2000, providing a full local data set for use in modelling.

Wind roses showing wind speed and direction results obtained from both the Lynwood and Wangi meteorological stations are included in **Appendix 5**. The wind data obtained from Lynwood indicates the wind patterns are predominately from the east and west. Summer winds are predominately from the east with westerly winds being dominant in winter and spring. There is presently no meteorological data available at Lynwood for autumn. Average annual wind speed is 3.6 m/s, with stronger westerly winds (> 6 m/s) recorded in winter and spring.

Westerly winds are also common at the "Wangi" station, however, the wind pattern is less pronounced and more evenly distributed over all sectors (refer to **Appendix 5**). The average annual wind speed at the Wangi site is 3 m/s.

The annual percentage of "calm" winds (winds less than or equal to 0.5 m/s) recorded from each site is very similar at around 8%.

5.4 Land Use and Tenure

5.4.1 Land Use

5.4.1.1 Regional Land Use Patterns

The dominant land use within the Goulburn Mulwaree LGA is agriculture, predominantly grazing, with some large expanses of remnant native vegetation remaining in the northeastern portion of the LGA. The major residential area for the LGA is Goulburn, however, smaller towns are present throughout the LGA including Marulan which is the second largest residential centre.

The former Mulwaree Shire (now Goulburn Mulwaree LGA) is well known as a sheep grazing area that produces high quality, fine Merino wool (Mulwaree Shire Council, 2003), with large areas also used for cattle grazing. Other regional land uses include plantation forestry, intensive agriculture (vineyards, olive groves, poultry farming, etc.), small areas of industrial land uses and extractive industries, with growing numbers of small rural holdings and rural residential developments. The LGA also has good transport linkages to both Sydney and Canberra, making it an ideal 'weekend retreat' location for people living in these major urban centres (Mulwaree Shire Council, 2003).

The township of Marulan is a service centre for not only the surrounding rural areas, but also for traffic on the Hume Highway. The town has a long history of servicing transport routes, initially the Main Southern Railway with the original township relocated to be closer to the railway station, and more recently the Hume Highway with the truck weigh station and service centres on both the north and south bound sides of the highway. Marulan also has an association with extractive industries, through South Marulan Quarry and Readymix's Johniefelds Quarry.

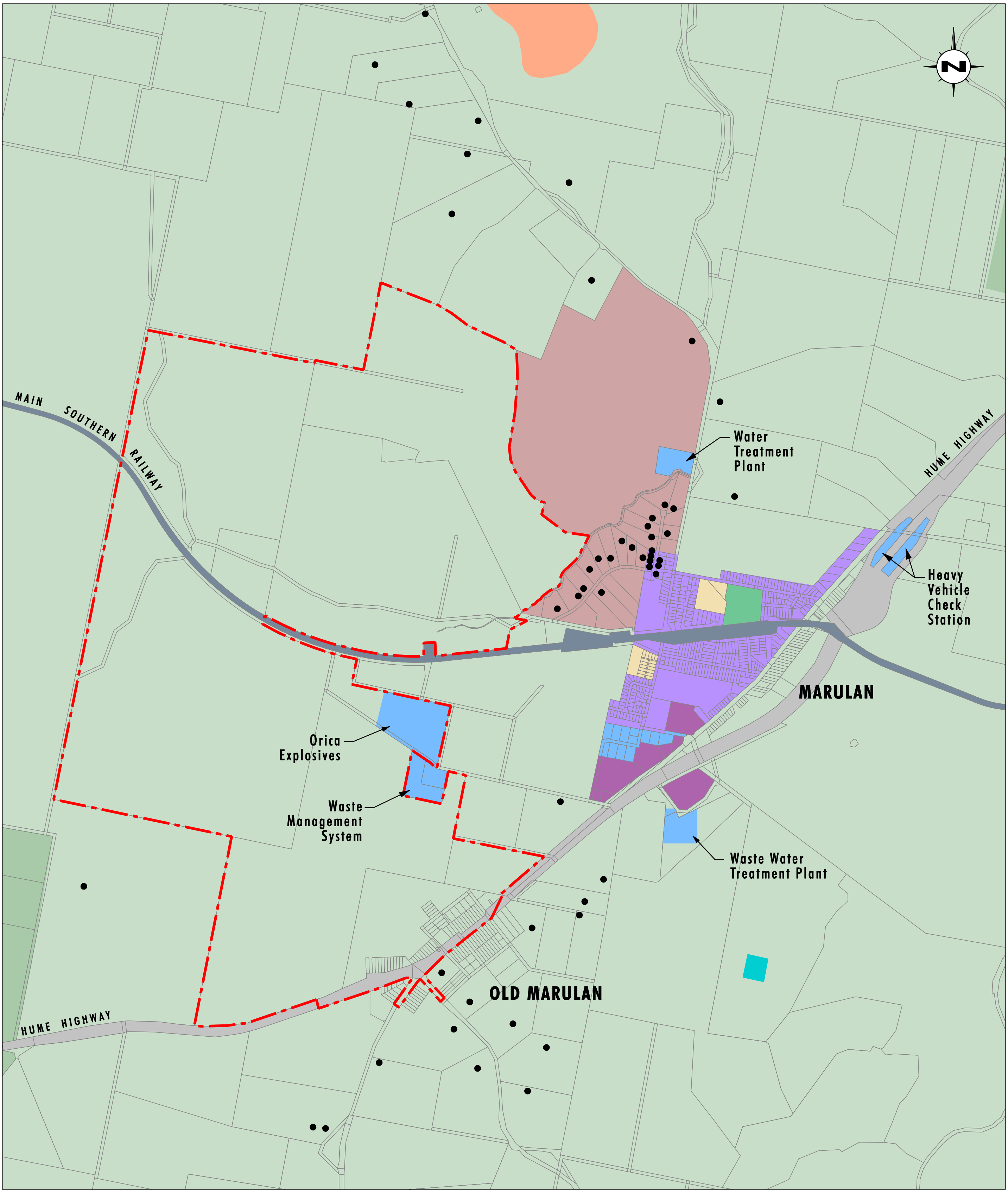
5.4.1.2 Surrounding Land Use

The predominant land uses within the vicinity of the project area are agricultural land uses, the residential area of Marulan, rural residential areas, small areas of industrial land, an existing quarry, transport corridors and associated services. Existing land use surrounding the project area is shown on **Figure 5.12**. Of these land uses, the dominant uses are agriculture which surrounds the project area to the north, west and south, and residential / rural residential areas which occur to the east. Further details of the surrounding land uses are included below.

Residential

The township of Marulan is located to the east of the project area, approximately 1 kilometre from the nearest point of the project area boundary and approximately 2.5 kilometres from the nearest edge of the quarry pit. Based on the most recent census data available (ABS, 2001), Marulan had a population of 442 in 2001, with 171 occupied dwellings within the township. The 2001 census data showed that there had been a noticeable population increase in the region since 1991, with a 23% population increase within Marulan. The township has continued to grow since 2001, particularly due to the subdivision of surrounding land for rural residential development as discussed below. Current predictions of the likely future population growth of Marulan estimate that it will reach a population of approximately 2850 by 2016 (SGE Economics and Planning Pty Ltd, 2003).

Umwelt
Environmental Consultants



Base Source: LPI 2004

0 0.5 1 1.75km

Legend

- Project Area
- Grazing
- Residential
- Rural Residential
- Industrial
- Business Highway Service
- Recreation
- Intensive Agriculture
- Open Space
- Pine Tree Plantation
- Highway
- Railway
- Quarry
- Residences

FIGURE 5.12

Existing Land Use

File Name (A4): R03_V1/1829_016.dgn

Marulan has a number of businesses centred on the Hume Highway in the form of highway service centres. The town's main street, George Street, contains the majority of remaining businesses and community centres including the public primary school, town hall, post office, the Terminus Hotel, cafés and the general store. The majority of the businesses are south of the Main Southern Railway.

Rural Residential

Rural residential developments (1 (c) Rural Small Holding under the Mulwaree LEP, 1995) have been developed in areas surrounding the township of Marulan within the last five years, with a number of additional rural residential subdivisions currently proposed. A rural residential subdivision adjoins the northeastern boundary of the project area (refer to **Figure 5.12**). A number of houses have been built in the first stage release area of this rural residential subdivision in the past five years, and construction of houses in the second stage release area commenced recently.

Surrounding Residences

The surrounding residences are shown on **Figure 5.12**. These include residences within the Marulan Township (approximately 1 kilometre from the Eastern Overburden Emplacement Area at its closest point), residences that are part of the rural residential area to the northeast, and other surrounding rural residences. The nearest house in the rural residential area is approximately 500 metres to the east of the Eastern Overburden Emplacement Area.

Rural residences are primarily located to the north (along Brayton Road) and south (South Marulan Road and Jerrara Road) of the project area. Many rural lots in these areas do not currently have residences. The nearest rural residence to the north is approximately 1.3 kilometres from the quarry pit, with the nearest residence to the south being approximately 1.2 kilometres south of the Western Excess Product Emplacement Area. To the west of the project area, there are larger rural holdings with the only residence on the adjacent western landholding being located approximately 3 kilometres from the project area boundary.

Agriculture

Agricultural land use surrounding the project area is primarily cattle and sheep grazing land. The rural zoned land adjoining the project area to the north and south is largely vegetated and subject to only low intensity grazing pressure, or is not grazed at all. The land to the west of the project area is held in a few larger holdings, has been largely cleared and is subject to higher intensity grazing pressure.

In addition to grazing, more intensive agricultural activities occur in the local area including poultry farming to the east of the Hume Highway (approximately 4 kilometres from the project area) and agricultural uses such as olive groves.

Industrial

A number of small industrial developments are located within and adjacent to Marulan as indicated on **Figure 5.12**. These areas include:

- the Marulan light industrial area which is located in the southern portion of the township;
- a lime crushing / loading plant located in the middle of the Marulan residential area adjacent to the Main Southern Railway (it is understood that the operator of this facility plans to relocate this plant out of town);

- the Marulan Waste Management Facility which is adjacent to the project area boundary;
- the Marulan Water Treatment Plant and Wastewater Treatment Plant; and
- the Orica Explosives plant which is located within the project area on land leased from Readymix, adjacent to the Marulan Waste Management Facility.

Extractive Industries

As discussed previously, Readymix operates the Johniefelds Quarry which is located on the Johniefelds property, Brayton Road approximately 2 kilometres north of the project area and approximately 3.2 kilometres to the northwest of Marulan (refer to **Figure 5.12**). Boral's South Marulan Quarry is located approximately 6.5 kilometres southeast of Marulan and the proposed Ardmore Park sand and gravel quarry is located near Bungonia approximately 18 kilometres south of the project area.

Transport Corridors

Two major transport corridors occur within the vicinity of the project area, the Main Southern Railway which bisects the project area and the Hume Highway which forms part of the southern boundary of the project area. Associated with these major transport corridors are the Marulan train station and rail siding / ballast loading area, the heavy vehicle checking station and various highway service centres, including centres on both the north and south bound lanes of the highway.

Plantations

A number of softwood plantations (pine trees) are located within the area surrounding the project area, including plantations approximately 3.1 kilometres to the northeast and 500 metres southwest of the project area. Part of the plantation area to the southwest (north of the Hume Highway) has recently been subdivided into smaller rural lots and there is potential for a number of rural residences to be established in this area during the life of the quarry.

5.4.1.3 Future Surrounding Land Use – Mulwaree Settlement Strategy

As discussed in **Section 4.5**, a Settlement Strategy has been developed for Marulan and surrounding areas (Mulwaree Shire Council, 2003). This strategy has been adopted by Goulburn Mulwaree Council and provides an indication of future land use patterns in the Marulan area. The 'Greater Marulan Structure Plan' from the strategy shows the proposed revised zonings in Marulan, including urban expansion areas to the east of the Hume Highway and protection of the Lynwood resource by a 1 (e) Rural Employment / Natural Resource zoning. Potential future land use patterns in the Marulan area based on the Greater Marulan Structure Plan included in the draft Settlement Strategy are shown on **Figure 4.2**.

The Strategy proposes the extension of the 1 (e) zoning further east of the Readymix land holding in some locations in order to protect the resource by reducing the potential for future land use conflicts. Land to the east of the 1 (e) holding is proposed to remain as 1 (b) urban investigation to the south of the Main Southern Railway, with land to the north proposed to remain as 1 (c) Rural Small Holding. All other land surrounding the Readymix land holding is proposed to remain as 1 (a) General Rural, with the western boundary of the Marulan residential area proposed to remain in its current location.

5.4.1.4 Project Area Land Use

The majority of the project area is currently being used for relatively low intensity agricultural purposes, with managed grazing being undertaken on both the northern and southern portions of the site. A small section of the project area near the eastern boundary is also currently leased by Readymix to Orica Explosives for operation of a bulk quarry services storage depot.

5.4.1.5 Potential Land Use Impacts

On-Site Impacts

On-site land use impacts will include cessation of grazing across the majority of the project area for the duration of the quarry project. Some managed grazing will be possible in portions of the project area (primarily to the south of the Main Southern Railway) whilst the quarry is operational. These areas will be limited due to safety risks for Readymix personnel and potential injury to stock. Once rehabilitation of the out-of-pit emplacement areas is complete, these areas will be potentially suitable for use as managed grazing land.

Off-Site Impacts

The proposed quarry has been designed as much as possible to reduce potential impacts on adjoining land uses, including implementing a range of measures to reduce dust, noise and blasting impacts. The dust, noise and blasting impact assessments show that the quarry will not significantly impact on any nearby residences or approved future residential locations (refer to **Sections 5.8** and **5.9**).

The proposed quarry is also compatible with the other surrounding land uses including agricultural, plantation, industrial and transport corridors. The quarry will not affect adjoining agricultural uses, with sufficient off-set distances retained between the quarry and these agricultural areas to limit potential impacts associated with noise and blasting. There is a long history of stock grazing on and immediately adjacent to land used for quarrying and mining, showing that these two land uses are compatible.

Potential impacts on the transport corridors mainly relate to vibration and dust impacts, with the project designed to ensure that the relevant vibration criteria can be satisfied at all locations (refer to **Section 5.9.2**). The substantial distance between the Hume Highway corridor and the quarry pit / infrastructure area and the comprehensive dust controls proposed will ensure that dust will not significantly impact on the road transport corridor.

Should future land use patterns in the Marulan area follow the draft Mulwaree Settlement Strategy (Mulwaree Shire Council, 2003) the potential for future land use conflicts surrounding the proposed quarry will be limited. As requested by Council, Readymix will provide information about the proposed development of the quarry and associated impacts to Goulburn Mulwaree Council for consideration in the development of a new LEP for the Marulan area.

5.4.2 Land Ownership

5.4.2.1 Project Area

Readymix owns all of the land within the project area excluding several small parcels of Crown land adjacent to the Hume Highway, a number of Crown road reserves, 0.15 hectare of land owned by the RTA adjacent to the Hume Highway, a narrow tract of Crown land associated with the bed of Joarimin Creek (refer to **Figure 1.3**) and two small parcels of old system title land whose owner cannot be located.

As discussed in **Section 5.5.1**, Readymix proposes to close the Crown road reserves which currently exist within the project area (refer to **Figure 5.13**), with this process likely to be completed prior to the commencement of construction. Readymix has discussed the closure of these road reserves and land owner's consent with the Department of Lands.

The RTA has also been consulted regarding land owner's consent for the block of land that will be impacted by the construction of the proposed interchange. The entire footprint of the interchange is likely to be resumed by the RTA to manage the interchange once construction is complete.

As part of the quarry design, Readymix has retained a buffer zone on its own land between the quarry and developed areas to the east. Readymix is also in the process of finalising a long-term lease over a minimum 1 kilometre wide buffer of agricultural land adjoining the western boundary of the project area. This arrangement will ensure that land impacted by noise, dust and blasting to the west of the proposed quarry is leased by Readymix for the life of the project.

5.4.2.2 Surrounding Land

Ownership of the land surrounding the project area is also shown on **Figure 1.3**. The individual properties within close proximity to the project area are numbered on **Figure 1.3** and a schedule of land ownership is included in **Appendix 1**. As indicated by **Figure 1.3**, the land to the west and north of the project area is primarily larger rural land holdings, with the land to the east and south primarily smaller holdings (rural residential and residential to the east and smaller rural holdings to the south).

5.5 Public Infrastructure Assessment

5.5.1 Roads and Traffic

A comprehensive road traffic and transport impact assessment has been completed for the proposed development by Transport and Urban Planning and is included as **Appendix 6**. A summary of the key findings of the assessment is provided in this section.

5.5.1.1 Principal Road Network

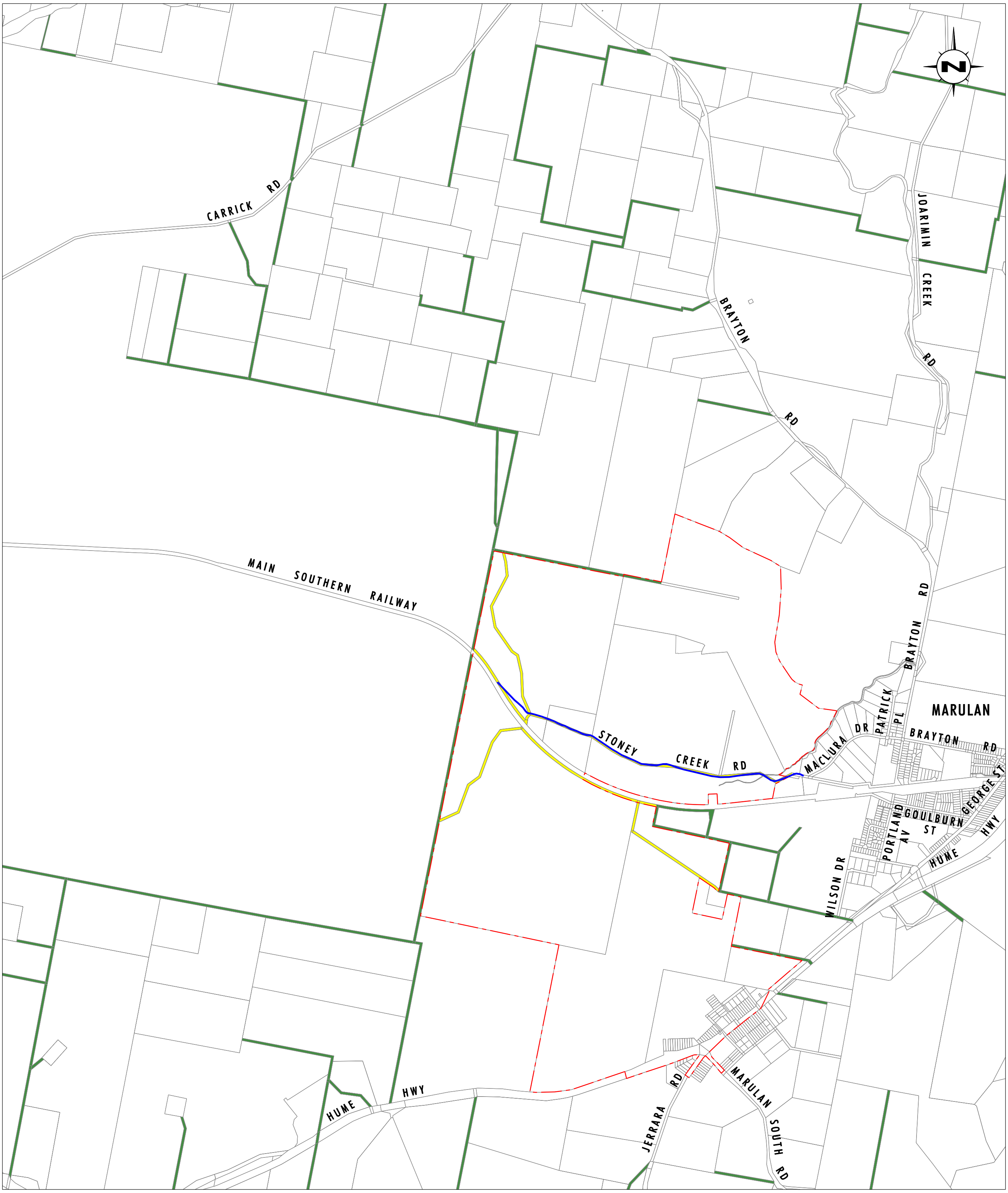
The principal road network that will provide access to the proposed Lynwood Quarry and form the main transport routes following the commencement of operations includes:

- the Hume Highway, which is a State Road and National route under the control of the RTA; and
- a dedicated two lane access road which will be constructed on Readymix land between the quarry infrastructure area and the Hume Highway interchange.

As discussed in **Section 3.3.1**, during the construction phase, the principal access roads will be:

- the Hume Highway (State Road);
- Portland Avenue (Council Road); and
- Wilson Drive (Council Road).

Umwelt
Environmental Consultants



Source: Readymix Holdings Pty Ltd
Base Source: LPI 2004

Legend

- Project Area
- Crown Road Reserves
- Crown Roads Reserves Proposed to be Closed
- Formed Section of Stoney Creek Road

FIGURE 5.13

Proposed Crown Road and Crown Road Reserve Closures

File Name (A4): R03_V1/1829_184.dgn

Stoney Creek Road will also be used for limited access to the northern portion of the project area prior to the completion of the rail overpass (refer to **Section 3.3.1**).

Hume Highway

The Hume Highway is a high standard four lane divided road with dual carriageways and is the main road corridor between Sydney and the ACT / Melbourne. The speed limit on the Hume Highway near Marulan is 110 km/h, with a high level of traffic management provided including wide shoulders, delineation and signage. The Hume Highway has a theoretical capacity in each direction of travel (i.e. each carriageway) of 3600 equivalent passenger car units (pcu's) per hour.

Portland Avenue / Wilson Drive

Portland Avenue is accessed from the Hume Highway via a cross median intersection and provides access to and from Marulan and the Hume Highway service centres. Portland Avenue intersects with Wilson Drive which terminates at the project area boundary, a distance of approximately 2.2 kilometres by road from the Hume Highway.

The Portland Avenue / Wilson Drive route is a sealed road with no kerb or guttering and gravel shoulders, that provides for two lanes of traffic (single lane in each direction). The speed limit along these roads is 50 km/h.

5.5.1.2 Existing Traffic Conditions

Hume Highway

A traffic count on the Hume Highway was undertaken in February 2005 in order to determine current traffic volumes and classifications (refer to **Appendix 6**). The traffic count found that the average two way traffic volume on the Hume highway is 18,694 vehicles per day (5 day average), of which 28% are heavy vehicles (Austroad Classes 3-12). On a seven day average, movements are 19,662 vehicles per day, of which 22% are heavy vehicles. Friday and Sunday carry the greatest traffic volumes, likely associated with people travelling to and from Sydney and Canberra for the weekend.

The traffic count also found that traffic flows are consistent throughout the day and traffic conditions are good with the highway having significant spare capacity based on its design capacity (refer to **Section 5.5.1.1**).

A review of the existing Hume Highway / South Marulan Road intersection (the location of the proposed interchange) was also undertaken. This assessment found that the current cross-median access does not comply with current RTA standards.

Portland Avenue / Wilson Drive

Traffic counts were also undertaken on Portland Avenue / Wilson Drive as part of the assessment, including manual counts on key intersections. The traffic counts found that typical weekday volumes (five day average) on Portland Avenue are 453 vehicles per day, of which 14% are heavy vehicles. The seven day average, two way traffic volume is 421 vehicles per day (12% heavy vehicles). These traffic volumes represent light traffic conditions on Portland Avenue and are consistent with Level of Service A road conditions.

Traffic counts on Wilson Drive found that typical weekday (five day average) and seven day average two way traffic volumes are in the order of 116-119 vehicles per day. Heavy vehicles comprise 20% to 21% of these vehicles. These traffic volumes represent very light traffic conditions consistent with Level of Service A road conditions.

The Hume Highway / Portland Avenue intersection currently has a Level of Service A/B which represents good to satisfactory traffic conditions. The Portland Avenue / George Street intersection operates at a Level of Service A with low vehicle delays. Traffic conditions at the intersection of Portland Avenue and Wilson Drive are good with minimal delay, due to the low traffic volume which uses this intersection.

5.5.1.3 Impact Assessment

Construction Traffic

The construction access route will be via the Hume Highway, Portland Avenue and Wilson Drive. Predicted traffic volumes are discussed in **Section 3.3.1** and **Appendix 6**. This route was selected as it passes through the Marulan light industrial area and therefore avoids impacts on residential areas and other potentially sensitive land uses. The route passes one residence, however, as discussed in **Section 3.3.1**, Readymix has discussed potential impacts with the owner of this property and reached an agreement.

During the busiest phases of construction, the two way traffic volume on Portland Avenue will increase from 421 vehicles per day to approximately 691 vehicles per day and from 119 vehicles per day to 389 vehicles per day on Wilson Drive. Portland Avenue and Wilson Drive have sufficient capacity to easily absorb these increases, however, minor upgrade works will be required along the route to facilitate construction traffic access. These works will include maintenance of minimum pavement widths, provision of delineation along the route and regular road maintenance along both Portland Avenue and Wilson Drive.

In order to assess worst-case construction traffic impacts on traffic flow at the Hume Highway / Portland Avenue intersection, traffic flow modelling was undertaken during the predicted morning and afternoon construction peak hour volumes (refer to **Appendix 6**). The traffic flow modelling indicated that the intersection will continue to operate at a good to satisfactory Level of Service (A/B Service) with acceptable vehicle delays. Traffic flow modelling also indicated that impacts on the Portland Avenue / George Street and Portland Avenue / Wilson Drive intersections will be minimal.

The additional traffic using Portland Avenue and Wilson Drive during the construction phase is also not expected to have any negative impacts on pedestrian safety. Pedestrian activity in Portland Avenue and Wilson Drive is minimal with conditions for pedestrians to remain unchanged during the construction phase.

The use of Stoney Creek Road during the construction phase will be restricted to less than 10 vehicle trips per day (i.e. 10 movements in / 10 movements out) during the construction of the rail overpass. Once the bridge over the rail line is completed, Stoney Creek Road will not be used as a construction access route. Vehicles using Stoney Creek Road during the initial phases of construction will access the road via Brayton Road and not via the rail level crossing on Portland Avenue / Stoney Creek Road. This small number of vehicles using Stoney Creek Road will have minimal impacts on the road and on nearby residences.

The assessment of traffic impacts during the construction phase indicates that the impacts will be acceptable and that the traffic conditions on the road network will be satisfactory during the construction period.

Operational Traffic

During the operational phase, all access will be via the Hume Highway interchange and quarry access road with no access to the site directly from Marulan. This will ensure that operational phase traffic, including road product haulage, does not impact on the Marulan township.

At a production level of 5 Mtpa saleable product, with transport of 1.5 Mtpa of product by road, the proposed quarry will generate up to approximately 285 trips per day (285 movements in and 285 movements out). Of these approximately 170 trips (60%) will be heavy vehicle trips.

The Hume Highway at Marulan carries some 18,694 vehicles per day on an average weekday, of which 5219 are heavy vehicles. The proposed additional traffic on the Hume Highway will represent an increase of 3.1% in total vehicles and an increase in heavy vehicles of 6.5% at Marulan. These increases are minimal in real terms, with the Highway having sufficient available capacity to absorb these traffic volumes.

During the design and impact assessment phase of the project and through discussions with the RTA, it was determined that an interchange type intersection was required for the connection of the proposed quarry access road onto the Hume Highway. This interchange is proposed to be at the existing Hume Highway / South Marulan Road intersection. The construction of an interchange at this location would both fix the existing problems at the intersection and provide safe access to and from Lynwood Quarry. Readymix has accepted responsibility for undertaking the required works, however, it also notes that this upgrade provides significant benefits to other existing and future road users, including future industrial operations. On this basis, Readymix requests that any future developments that propose to use this intersection contribute to the construction costs.

The interchange will be a grade separated intersection and will be designed in accordance with RTA and Austroad Standards with appropriate deceleration and acceleration lanes for vehicles to exit and enter the Hume Highway (refer to **Section 3.5.4**).

Traffic flow modelling was undertaken in order to assess the potential impact of the interchange on the Hume Highway. The modelling indicates that the interchange intersections will operate at a good level of service (Level of Service A) with low vehicle delays during peak quarry traffic movements. The interchange will provide a high level of road safety for vehicles entering and leaving the Hume Highway, including those accessing South Marulan Road and Jerrara Road, with an overall improvement to traffic flow and road safety at the intersection.

In summary, the assessment of operational traffic impacts indicates that the impacts will be minor and traffic conditions on the Hume Highway will continue to be satisfactory. The proposed interchange on the Hume Highway will provide a high level of road safety and adequate road and intersection capacity for quarry traffic to enter and leave the Hume Highway. The interchange will also improve access to South Marulan and Jerrara Roads for other traffic not associated with the quarry.

Closure of Stoney Creek Road

As discussed in **Section 5.4.2**, Stoney Creek Road traverses part of the project area to the north of the Main Southern Railway. The road is not fully formed, becoming an unformed Crown road reserve on the Lynwood property (refer to **Figure 5.13**). In order to ensure public safety, Readymix proposes to close Stoney Creek Road at the Readymix property boundary (refer to **Figure 5.13**). As the road is not fully formed, it only currently provides access to the Lynwood property, however, the Crown road reserve provides potential access to adjoining properties to the north and west of the project area. These lots are also potentially accessed by use of alternative existing Crown road reserves (refer to **Figure 5.13**) and therefore, the closure of the formed section of Stoney Creek Road and the Crown road reserves within the project area is considered unlikely to impact on accessibility to any private properties.

5.5.2 Rail Infrastructure

5.5.2.1 Existing Rail Traffic

Data regarding the existing rail traffic on the Main Southern Railway has been obtained from ARTC (N. Angelos pers. comm., 8 December 2004), indicating that the railway currently accommodates approximately 166 train movements each way on a weekly basis. This equates to a total of approximately 332 rail movements per week (an average of 47 movements per day). Existing rail movements consist of freight movements and passenger services. Approximately 52% of movements are timetabled freight services, 12% are unscheduled freight movements, 17% are Countrylink services, with City Rail services comprising the remaining 19%. Existing rail movements are also seasonally affected, with movements increasing during good harvests by up to approximately 40 movements per week (N. Angelos pers. comm., 8 December 2004).

5.5.2.2 Rail Impact Assessment

The project will add up to six trains per day when at production of 5 Mtpa, with an average of approximately four trains per day. This equates to an additional eight movements per day on average or an additional 56 movements per week. This is an increase of approximately 17% (or 15% during peak movement periods) on the Main Southern Railway at Marulan.

Readymix has consulted with ARTC in regard to the capacity of the Main Southern Railway to accommodate these additional movements. ARTC has confirmed in writing that it has reviewed the current rail corridor capacity and has determined that there is sufficient capacity on the Main Southern Railway to accommodate the train movements that will be generated by the project (refer to **Appendix 2**).

Other potential impacts on rail infrastructure associated with the project are related to blasting and associated vibration. These impacts are discussed in detail in **Section 5.9**.

5.5.3 Utilities and Other Infrastructure

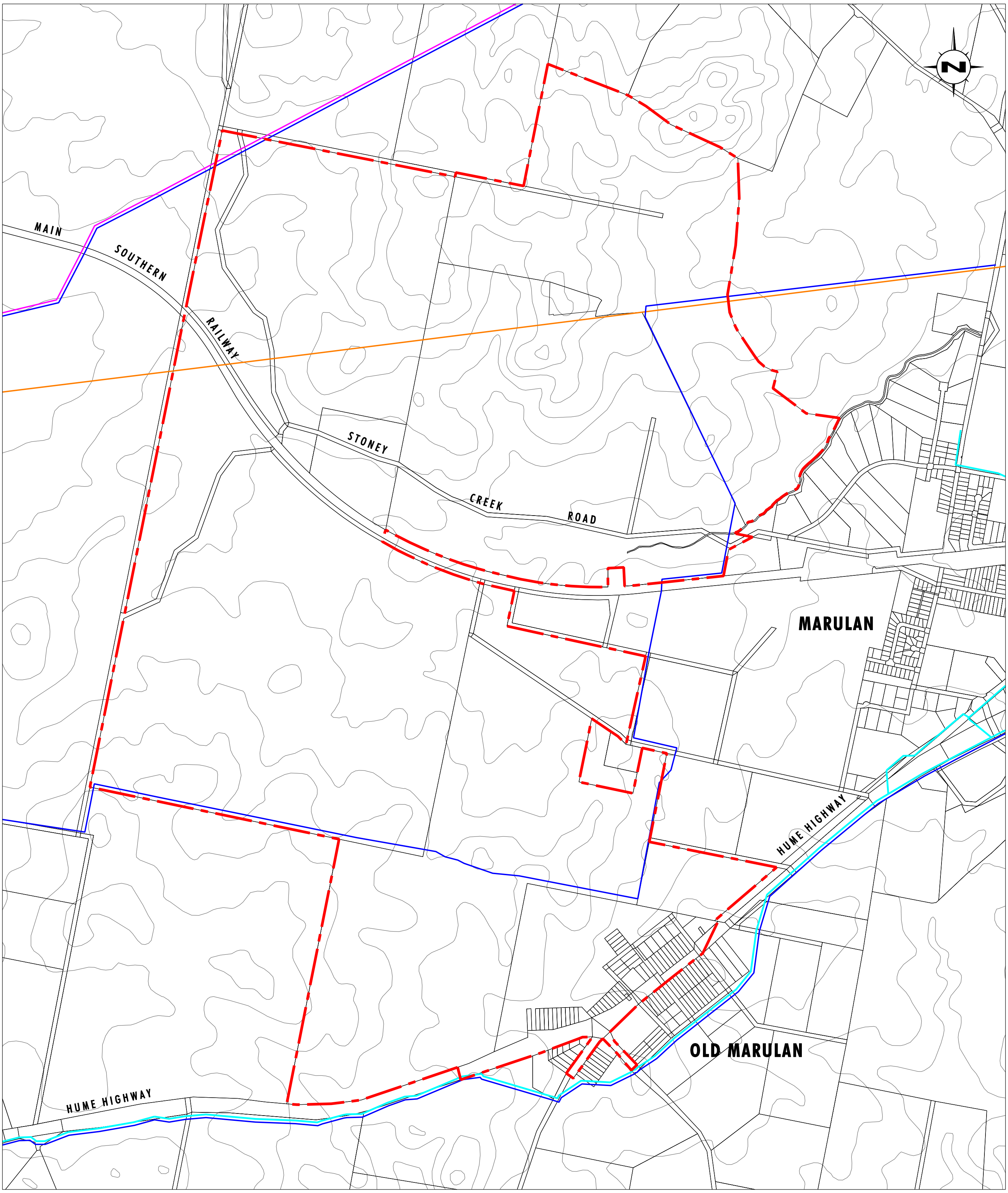
5.5.3.1 Electricity Supply

A 132 kV powerline passes through the project area as shown on **Figure 5.14**. This location will be impacted by the proposed quarry and the powerline will need to be relocated. As discussed in **Section 3.5.8**, Readymix is in the process of negotiating an agreement with Country Energy regarding the establishment of a new substation for the Marulan township, in the project area. This agreement will include decommissioning and removal of the existing transmission line by Country Energy and the establishment of new lines that will traverse areas not proposed to be impacted by the quarry. The project will not therefore adversely impact on power supply infrastructure.

5.5.3.2 Natural Gas Pipeline

A natural gas pipeline managed by AGL passes through the northwest corner of the project area as shown on **Figure 5.14**. There will be no disturbance of this pipeline, with potential impacts limited to vibration due to blasting. The blasting impact assessment has indicated that vibration levels experienced at the pipeline will be well within the relevant structural

Umwelt
Environmental Consultants



Base Source: LPI 2004, Dial before you dig

0 0.5 1 1.25km

Legend

- Project Area
- 132kV Line
- Natural Gas Pipeline
- Optic Fibre Line
- Communications Line (Optus)

FIGURE 5.14

Services in the Vicinity of the Project Area integrity criteria (refer to **Section 5.9**) and on this basis, the project will not impact on the pipeline. Readymix has corresponded with AGL regarding relevant vibration impact assessment criteria and assessment findings as detailed in **Section 5.9** of this EIS. AGL has not requested any additional assessment work.

5.5.3.3 Communications Infrastructure

Both optic fibre and other communications cables pass through and adjacent to the project area as indicated on **Figure 5.14**. The proposed quarry infrastructure will cross some of these communication cables and therefore the construction works will need to consider the location and sensitivity of the cables and any necessary works or management controls. Readymix will undertake detailed consultation with the owners of the infrastructure as part of the final design and construction phases to ensure that any potential impacts are appropriately managed.

5.5.3.4 Drinking Water Supply Infrastructure

The Marulan drinking water supply treatment plant and associated supply infrastructure are located approximately 1.25 kilometres to the east of the Eastern Overburden Emplacement Area and will not be subject to impacts from the development. The drinking water holding tank for the rural residential area to the northeast of the project area is planned to be located within the project area boundary. As discussed previously, Readymix purchased an area approved for rural residential development to provide a buffer between the proposed quarry and residential areas, with this purchase agreement including the retention of the drinking water holding tank for this development on Readymix property. It is expected that this tank will be enclosed and therefore the only potential impact of the project is due to vibration, with predicted vibration impacts well within the relevant structural integrity criteria (refer to **Section 5.9**). The project will not therefore have any impact on Marulan's drinking water supply infrastructure.

5.6 Water Resource Assessment

5.6.1 Groundwater

A comprehensive assessment of potential groundwater impacts associated with the project has been undertaken by Peter Dundon & Associates. The full assessment report is included in **Appendix 7**, with a summary provided in this section.

5.6.1.1 Existing Groundwater Environment

In order to monitor the characteristics of the groundwater within the project area a network of 11 piezometers was installed in July 2004 (refer to **Figure 5.10**). These piezometers have been tested for yield and are tested monthly for groundwater level and quarterly for water quality. This data, along with groundwater interception records from the extensive exploration drilling program has facilitated the description of the existing groundwater environment.

Groundwater is generally present throughout the area, however, the porphyry bedrock is poorly to very poorly permeable. Most exploration holes drilled on the site yielded no water during drilling, although all holes still open to sufficient depth were found to contain groundwater when inspected. Localised fracture zones provide discontinuous regions of moderate permeability.

Measured groundwater elevations ranged from around 630 mAHD to 675 mAHD. The water table is generally well below ground surface, even in the vicinity of Joarimin Creek (e.g. near

Joarimin Creek the water table was measured at approximately 6 metres below the surface). In the vicinity of the proposed quarry, the water table is expected to be encountered at depths of between 10 and 30 metres below the current ground surface. Groundwater levels generally follow the topography and groundwater flow direction is expected to generally follow surface water flows.

As the groundwater surface is generally more than 5 metres below the ground surface, there is no direct interconnection with the surface water environment within the project area. Downstream from the project area within Joarimin Creek, there is some evidence in the surface water quality monitoring data that during extended periods without surface water runoff, stream baseflow is maintained by small volumes of groundwater discharge. This is reflected in a marked increase in salinity of the water in Joarimin Creek during such periods.

Groundwater Quality

Groundwater quality is quite variable across the site. Measured TDS (total dissolved solids) ranges from less than 400 mg/L to more than 7500 mg/L. This high degree of variability in salinity is believed to indicate a generally low hydraulic conductivity and poor lateral continuity within the bedrock formation. Monitoring also indicates that the groundwater pH is near neutral.

Due to the variable salinity, and the presence of some dissolved metals at elevated concentrations, the groundwater is not suitable for potable use. A number of dissolved metals are also present at concentrations in excess of ANZECC (2000) guidelines for freshwater ecosystem protection. Aluminium, cadmium, chromium, copper, lead, iron, manganese, nickel and zinc concentrations all exceeded ANZECC freshwater ecosystem protection guidelines in some or all of the monitoring piezometers (refer to **Appendix 7**).

Existing Groundwater Users

A search of the DIPNR database of registered groundwater bores identified 12 registered bores within 5 kilometres of the project area and a further 21 within 10 kilometres of the project. The nearest bore is approximately 1.8 kilometres north of the 30 year quarry pit, with the next nearest bores in each direction being approximately 3 kilometres to the east, 3.6 kilometres to the south and 2.9 kilometres to the west. The reported yields of the 12 registered bores within 5 kilometres range up to a maximum of 2.9 L/sec, however, the average for all the remaining bores for which yield data is available is only 0.3 L/sec. Salinity is variable, from fresh to saline.

5.6.1.2 Groundwater Impact Assessment

The proposed quarry will not extend below the groundwater table during the first year, however, for the remainder of the quarry life some part of the quarry pit will be below the groundwater table. By the end of Year 30, the pit floor will be more than 100 metres below the pre-project groundwater table level at the northern end of the pit. It will therefore be necessary to control groundwater inflows into the quarry for the duration of the project past Year 1 and there is potential for the project to impact on the local groundwater system. A detailed groundwater model was therefore developed to determine the impact of each stage of the quarry development on local groundwater levels and groundwater quality. The key findings of this assessment are included below.

Groundwater Make

Groundwater inflows into the quarry are expected to gradually increase over the life of the quarry due to its expanding footprint and depth. The predicted average inflow rates are listed in **Table 5.6**.

Table 5.6 – Average Groundwater Inflow Rates

Year	Estimated Pit Floor Level (mAHD)	Average Inflow Rate	
		m^3/day	ML/year
1	660	0	0
2	645	2.0	0.7
5	630	11.1	4.0
10	630	16.0	5.5
15	630	22.8	8.3
20	615	38.2	13.9
25	615	47.8	17.6
30	570	72.8	26.6

These inflow rates are very modest, however, they are consistent with the very low hydraulic conductivity values derived from the piezometer testing program.

Impact on Groundwater Levels

The groundwater impact modelling indicates that the impact of the quarry on groundwater levels during the life of the project will be limited to within 1.5 kilometres or less of the quarry pit. The maximum drawdown of existing groundwater levels of 75 metres will occur in the deepest part of the pit. Groundwater contours showing the predicted drawdown effects are included in **Appendix 7**.

No existing groundwater bores are predicted to be impacted by the proposed quarry.

Post Quarrying Recovery of Groundwater Levels

Evaporation rates will greatly exceed the predicted ongoing rate of groundwater inflow to the pit, and will prevent a permanent water body developing within the pit if the project does not continue beyond Year 30. It is likely that temporary accumulations of water will develop within the pit following periods of heavy rainfall, however, evaporation will remove this water gradually. It is predicted that groundwater levels will remain below the pit floor in the long-term.

As the final Year 30 quarry will remain a permanent groundwater sink as discussed above, groundwater will continue to flow inwards towards the pit. A groundwater depression will therefore remain around the decommissioned quarry. At a distance of about 1.5 kilometres east of the pit, a further lowering of groundwater levels by between 5 and 10 metres is predicted to occur during the 100 years after completion. In all other locations, no significant further change in groundwater levels is predicted to take place.

It should be noted that these predictions are based on the quarry operation ceasing after 30 years, with no in-pit dumping of overburden and excess product occurring during this period. Should Readymix be granted consent to continue quarrying operations beyond Year 30 and in-pit dumping be undertaken, it would have an ameliorating effect on long-term groundwater impacts, by allowing partial recovery of groundwater levels within the filled area and thus reducing the impact on groundwater levels to the east.

Impact on Groundwater Quality

It is expected that the quality of groundwater flowing into the pit will initially be quite variable, however, as the quarry footprint expands, it will become more consistent due to the increase in groundwater inflow from different portions of the aquifer. Outside the quarry pit, a slight reduction in groundwater salinity may occur due to the potential reduction in evapotranspiration caused by lowering of the groundwater table, however, this effect will only occur within 1.5 kilometres of the pit (the area affected by drawdown).

Should the quarry close at the end of Year 30, the lack of permanent ponding of water within the pit will result in an accumulation of salt on the pit bottom that would cause any temporary water ponding in the pit bottom after rain to become salty relatively quickly. However, as the pit is predicted to be a groundwater sink, with groundwater flowing inwards towards the pit, the saline water will be prevented from escaping. This saline water will not, therefore, impact on regional groundwater quality.

The project is likely to lead to a reduction in the already small contribution of groundwater baseflow to flows within Joarimin Creek in the area affected by drawdown. However, as this groundwater contribution currently leads to a marked increase in salinity once surface runoff ceases, any impact of the project in reducing this baseflow component would be beneficial in terms of water quality (refer to **Appendix 7**).

5.6.2 Surface Water

A detailed surface water management study and impact assessment has been completed for the project and is included in **Appendix 8**. A summary of the assessment is provided below.

5.6.2.1 Existing Surface Water Environment

Catchment Areas

The project area is located within the catchments of Joarimin, Lockyersleigh and Marulan Creeks. Joarimin Creek has a catchment area of approximately 5440 hectares and drains in a northeasterly direction to the Wollondilly River. Lockyersleigh Creek has a catchment area of approximately 2630 hectares and drains in a northwesterly direction to enter the Wollondilly River upstream of the Joarimin Creek confluence. The Wollondilly River has a catchment area of approximately 10,030 km^2 and is part of the Warragamba Dam catchment which contributes to Sydney's drinking water supplies.

Marulan Creek has a catchment area of approximately 2055 hectares and drains in a southeasterly direction to the Shoalhaven River via Barbers Creek. The Shoalhaven River is part of the Tallowa Dam catchment and also contributes to Sydney's drinking water supplies.

The boundaries of the subcatchments within the project area are shown on **Figure 5.5** and the subcatchment areas are listed in **Table 5.7**.

Table 5.7 - Project Area Subcatchments

Creek	Catchment Area	
	Total Area (ha)	Within Project Area (ha)
Joarimin Creek	5440	749
Lockyersleigh Creek	2630	102
Marulan Creek	2055	160

Baseline Water Quality

A surface water quality monitoring program was established in the project area and surrounds in July 2004 to determine baseline water quality. The monitoring points are shown on **Figure 5.10** and include four locations on Joarimin Creek, two locations on Marulan Creek and one location on Lockyersleigh Creek. The Lockyersleigh Creek monitoring point was established in November 2004. All of the creeks within the project area are ephemeral and therefore the number of water quality samples collected each month has varied, with water samples collected at only one location every month since July 2004. A full description of existing surface water quality is included in **Appendix 8**, with a summary of the key findings included below:

- water quality in Joarimin Creek ranged from neutral to alkaline with pH ranging from 6.2 to 9.7. Electrical conductivity ranged from 256 to 3255 µS/cm;

- water sampling at the two locations on Marulan Creek has resulted in the collection of three samples at each location. Water quality was neutral with pH ranging from 6.2 to 6.8. Electrical conductivity ranged from 100 to 1003 µS/cm; and

- only one water sample has been taken at the Lockyersleigh Creek monitoring point. This sample had a pH of 6.6 and electrical conductivity of 3700 µS/cm.

Water Users

One extraction licence exists on Joarimin Creek downstream of the project area at Johniefelds Dam (6.4 kilometres from the project area). A second licence exists for the dam itself. No other licences exist on Joarimin Creek. Licences also exist on tributaries of Lockyersleigh and Marulan Creeks, however, flows in these tributaries will not be affected by the project.

5.6.2.2 Lynwood Quarry Water Management System

The Lynwood Quarry water management system has been designed to achieve the following key outcomes:

- diversion of clean water runoff around the proposed disturbance areas;

- prevention of surface water inflows into the quarry pit;

- capture of all runoff from disturbed areas and provision of adequate treatment prior to re-use, or release off site in significant rainfall events;

- provision of adequate water storage on site to ensure continued water supply for dust suppression and operation of the crushing and screening plant in dry periods;

- separation of groundwater and treated effluent from surface waters to ensure that this water is contained and re-used on site; and

- compliance with relevant legislative requirements and industry guidelines including:

  - likely conditions on the EPL, including compliance with Schedule 2 of the *Clean Waters Regulation* 1972;

  - SEPP58 and Sustaining the Catchments (Draft REP);

- likely conditions on the development consent;
- *Managing Urban Stormwater: Soils and Construction* (NSW Department of Housing 1998) – the Blue Book; and
- Guidelines for Establishing Drainage Lines on Rehabilitated Minesites (Draft) (DLWC, 1999).

The key features of the water management system are shown on **Figure 5.15** and include clean water drains, creek realignments around the quarry pit and infrastructure areas, catch drains to convey dirty water to sediment dams, five sediment control dams and two water storage dams. Water supply for the infrastructure area will be from these two water storage dams which will be fed by collected pit water, water from the sediment control dams, treated effluent from the infrastructure area and in dry periods from external water supplies. The sediment control dams will be generally kept in a drawn down state by the transfer of water to these water storage dams, ensuring that they retain sufficient treatment capacity.

The proposed water management system will capture runoff from the footprint of the Year 30 disturbance area. This area includes the quarry pit, overburden and excess product emplacement areas, haul road routes and the infrastructure area. The system has been designed to capture the majority of this water for re-use on site, but during prolonged wet periods a proportion of this water may be released off site. The sizing and design of the sediment control dams will ensure that any water released from the site is of an appropriate quality. The two water storage dams do not have catchment areas and will therefore not be significantly affected by rainfall events, ensuring that the groundwater and treated effluent stored in these dams is not released.

Project Water Balance

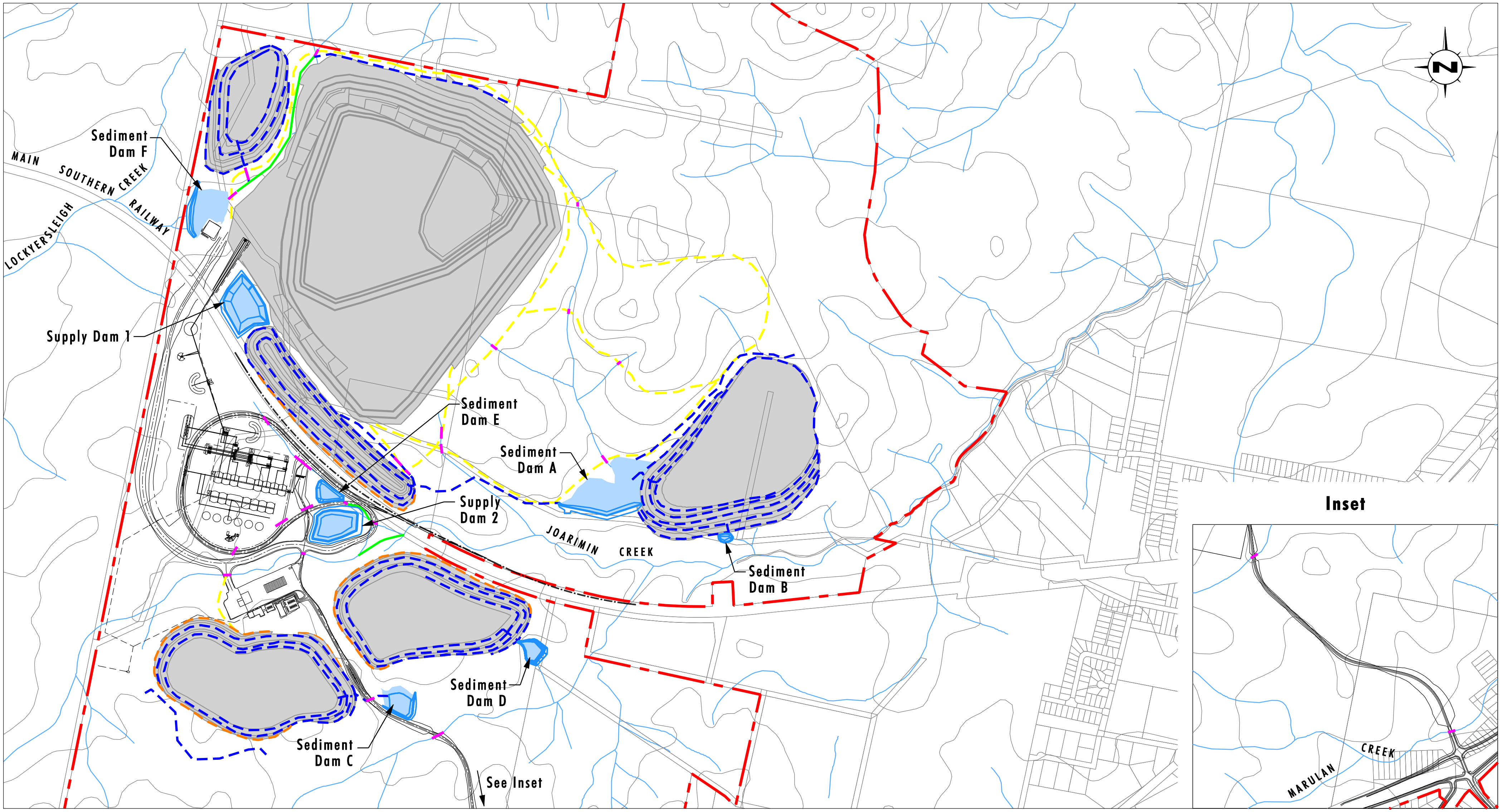
Predicted water uses at the quarry include:

- the crushing and screening plant;
- haul road dust suppression;
- stockpile dust suppression; and
- potable water.

At full production, the raw water demand for the project will range between approximately 190 ML per year and 215 ML per year depending on climatic conditions and the quarry stage (which influences factors such as length of haul roads). Potable water demand will be in the order of 3.5 ML/year.

Based on the surface water capture by the proposed water management system discussed above, the water balance for representative years of the proposed quarry for wet, dry and average rainfall years is shown in **Table 5.8**.

Umwelt
Environmental Consultants



Base Source: LPI 2004, Readymix Holdings Pty Ltd

0 0.25 0.5 1km

Legend

- Project Area
- Creek Realignment
- Catch Drain
- Sedimentation Fence
- Culvert
- Haul Road

FIGURE 5.15

Water Management System

File Name (A4): R03_V1/1829_252.dgn

Table 5.8 – Predicted Water Balance

Rainfall Condition	Annual Rainfall (mm)	Water Balance (ML/Year)				
		Year 1	Year 5	Year 12	Year 20	Year 30
Dry Year (10th percentile)	407	51	-70	-83	-65	-48
Average Year (50th percentile)	607	193	69	54	80	93
Wet Year (90th percentile)	872	421	297	283	303	320

As indicated in **Table 5.8**, the quarry will be a net water user in dry rainfall years, once full production is reached. An external water supply will therefore be required in order to make up this water deficit. During wet years the sediment control dams will overflow, releasing treated water into the catchments of Joarimin and Lockyersleigh Creeks.

External Water Supply

A number of potential external water supply sources have been identified in order to ensure sufficient water is available for operation of the quarry in dry rainfall years. These potential external supplies include:

- purchase of an existing allocation and conversion to an industrial allocation, if required, for use at the site. Water pumping location to be determined in consultation with DIPNR;

- use of existing industrial allocation from Johniefelds Dam by way of agreement with the owner. This allocation of 74 ML per annum is currently used at Readymix's Johniefelds Quarry; and

- supply of treated effluent from the Marulan Wastewater Treatment Plant by agreement with Goulburn Mulwaree Council.

Readymix is currently in the process of further investigating each of these external supply options.

In addition, it is proposed subject to agreement with Goulburn Mulwaree Council to source potable water from the Marulan town water supply system.

5.6.2.3 Impacts on Surface Water

Impacts on Surface Water Flows

Surface water capture associated with the proposed quarry water management system will result in a decrease of annual flow volumes immediately downstream of the quarry on both Joarimin and Lockyersleigh Creeks. Flows in Marulan Creek will be unaffected. The reduction in annual flow volumes for Joarimin Creek at the project area boundary will range from 6% to 25%, with the reduction in annual flow volumes at Johniefelds Dam (approximately 6.4 kilometres downstream of the project area) being between 2% and 8%. The reduction in annual flow volumes for Lockyersleigh Creek at the project area boundary will range from 31% to 93% and at the proposed boundary of the leased buffer area from 16% to 33%. It should be noted that only a small sub-catchment of Lockyersleigh Creek occurs within the project area, thus explaining why there is a significant percentage of capture of surface flows at the project area boundary. The total impact of surface water capture on Lockyersleigh Creek overall is small, with the reduction in annual flow volumes at the confluence of Lockyersleigh Creek with the Wollondilly River being between 1% and 6%.

Impacts on the annual flow volumes of the Wollondilly River downstream of its confluence with Joarimin Creek (i.e. downstream of the project) are estimated to be less than or equal to 0.1%. On this basis it is considered that the proposed development will not have a significant adverse impact on water quality or quantity in the Wollondilly River system or on the Warragamba Dam catchment.

Environmental flows in Joarimin and Lockyersleigh Creeks will be sufficient to ensure that similar volumes of water are stored in the small water holes that exist within these creek systems. This will ensure that the project does not significantly impact on available aquatic habitat nor on availability of watering holes along the creeks. These environmental flows will be maintained by the substantial catchment areas that will remain undisturbed and free flowing at the boundary of the project area.

Impacts on Flooding

The project will result in a minor decrease in peak flood flows, velocities and water levels downstream of the project area on both Joarimin and Lockyersleigh Creeks, when compared to the existing situation. This decrease will occur due to the capture of water by the proposed water management system and the realignment of a section of Joarimin Creek immediately upstream of the Main Southern Railway (refer to **Figure 5.15**).

The project will, however, result in a slight increase in the flood level of Marulan Creek immediately downstream of the project area. This increase will be up to 6 mm during the 1 in 20 year ARI storm event. This minimal increase is considered unlikely to significantly impact on the downstream environment.

Impacts on Water Quality

Runoff from all disturbed areas within the Year 30 quarry footprint will be captured on site for treatment, ensuring that water overflows from the sediment control dams during high rainfall events will have an acceptable quality. The major potential pollutant source due to activities within the Year 30 footprint is sediment mobilisation and potentially associated nutrient and salt loads. The water management system has been designed to treat any water that discharges from the system such that downstream water quality is maintained. Pollutant load modelling shows that the project will reduce pollutant loads at the project area boundary when compared with the existing situation. The sediment control dams will also have oil / fuel spillage containment controls ensuring that any spills of this material will not impact on the downstream environment.

Readymix also proposes to develop and implement a property management plan for its land holding. The property has a long history of agricultural land use and portions of the project area, including the three drainage systems, are currently subject to significant erosion. The property management plan will outline how these eroded areas are to be rehabilitated in order to reduce sediment loads and improve downstream water quality. This will include measures such as the protection / regeneration of riparian corridors and effective management of grazing pressures. The proposed property management plan is discussed in more detail in **Section 7.1.1** and will assist with achievement of a beneficial effect on water quality.

In addition to reduction of sediment loads from the project area, Readymix also proposes to pursue the option of using the treated effluent from the Marulan Wastewater Treatment Plant. Sewage effluent is typically high in nitrates and phosphate, and the use of this water at

Lynwood Quarry would assist in reducing potential water quality impacts downstream of the existing effluent irrigation area.

5.6.3 Water Planning Context

There are a number of legislative instruments and State or catchment based plans and policies relating to management of water that apply to the proposed quarry. These include:

- the State Water Management Outcomes Plan;
- the Warragamba Catchment Blueprint;
- the Southern Catchment Blueprint;
- the Statement of Joint Intent for the Hawkesbury Nepean River System;
- the Statement of Joint Intent for the Shoalhaven River System;
- SEPP 58 – Protecting Sydney's Water Supply; and
- Draft REP – Sustaining the Catchments.

A detailed assessment of the project against the requirements of each of these plans/policies has been completed and is included in **Appendix 8B**.

5.7 Ecological Assessment

A comprehensive ecological survey and assessment was undertaken for the project, including a detailed analysis of the potential impact of the project on terrestrial and aquatic flora and fauna, including threatened species. A summary of the key findings of the assessment are provided below, with the full ecological assessment report included as **Appendix 9**.

5.7.1 Existing Flora

A comprehensive flora survey was undertaken in the project area, including two spring surveys for a period of one week each (November 2003 and September 2004) and an additional winter survey (July 2004). The surveys considered and specifically targeted threatened flora species and endangered ecological communities known or with potential to occur in the local area.

5.7.1.1 Vegetation of the Region

The project area lies within the South Eastern Highlands Bioregion which is bounded by the Coastal South East Corner, Sydney Basin, Australian Alps and South Western Slopes bioregions (NPWS 2003). The vegetation of this bioregion varies across the landscape according to geology, temperature and rainfall, and has been extensively cleared for agriculture and urban development. The diversity of the landscape has contributed to the development of a variety of Woodland/Open Forest communities with different eucalypt associations. Some of the dominant canopy species in these communities include yellow box (*Eucalyptus melliodora*), red box (*E. polyanthemos*), Blakely's red gum (*E. blakelyi*), white box (*E. albens*), red stringybark (*E. macrorhyncha*) and broad-leaved peppermint (*E. dives*). There are also small patches of Argyle apple (*E. cinerea*) occurring in habitats around Goulburn. Creeklines within this bioregion are typically dominated by river oak (*Casuarina cunninghamiana* subsp. *cunninghamiana*) (NPWS 2003).

Extensive grassland communities are characteristic of this bioregion, particularly on the driest plains of the Monaro. Species typical of this grassland vegetation include snow grass (*Poa sieberiana*), spear grasses (*Austrostipa scabra, A. variabilis*) and kangaroo grass (*Themeda australis*).

Within the South Eastern Highlands Bioregion, there are numerous conservation reserves, covering approximately 14% of the land area (NPWS 2003). The reserves closest to the project area include: Bungonia State Conservation Area (SCA), occurring approximately 17 kilometres south of Marulan; Morton National Park, occurring approximately 15 kilometres southeast of Marulan; and Tarlo River National Park occurring approximately 43 kilometres northwest of Marulan.

DIPNR and DEC have produced a draft vegetation map of the Goulburn and Moss Vale 1:100,000 sheets, as part of a broader vegetation map covering the Sydney and South Coast regions (Tindall et al. 2004). Investigation of the vegetation mapping found that three woodland / forest vegetation communities were mapped as occurring within the project area: Tableland Grassy Box–Gum Woodland; Tableland Low Woodland; and Western Tablelands Dry Forest. In addition, non-native/non-vegetated areas were mapped. The flora survey undertaken as part of the project confirmed the presence of these three communities, plus two additional vegetated communities (refer to **Section 5.7.1.2**).

Where appropriate, the vegetation communities recorded within the project area have been named in accordance with the vegetation communities mapped by Tindall et al. (2004).

5.7.1.2 Vegetation of the Project Area

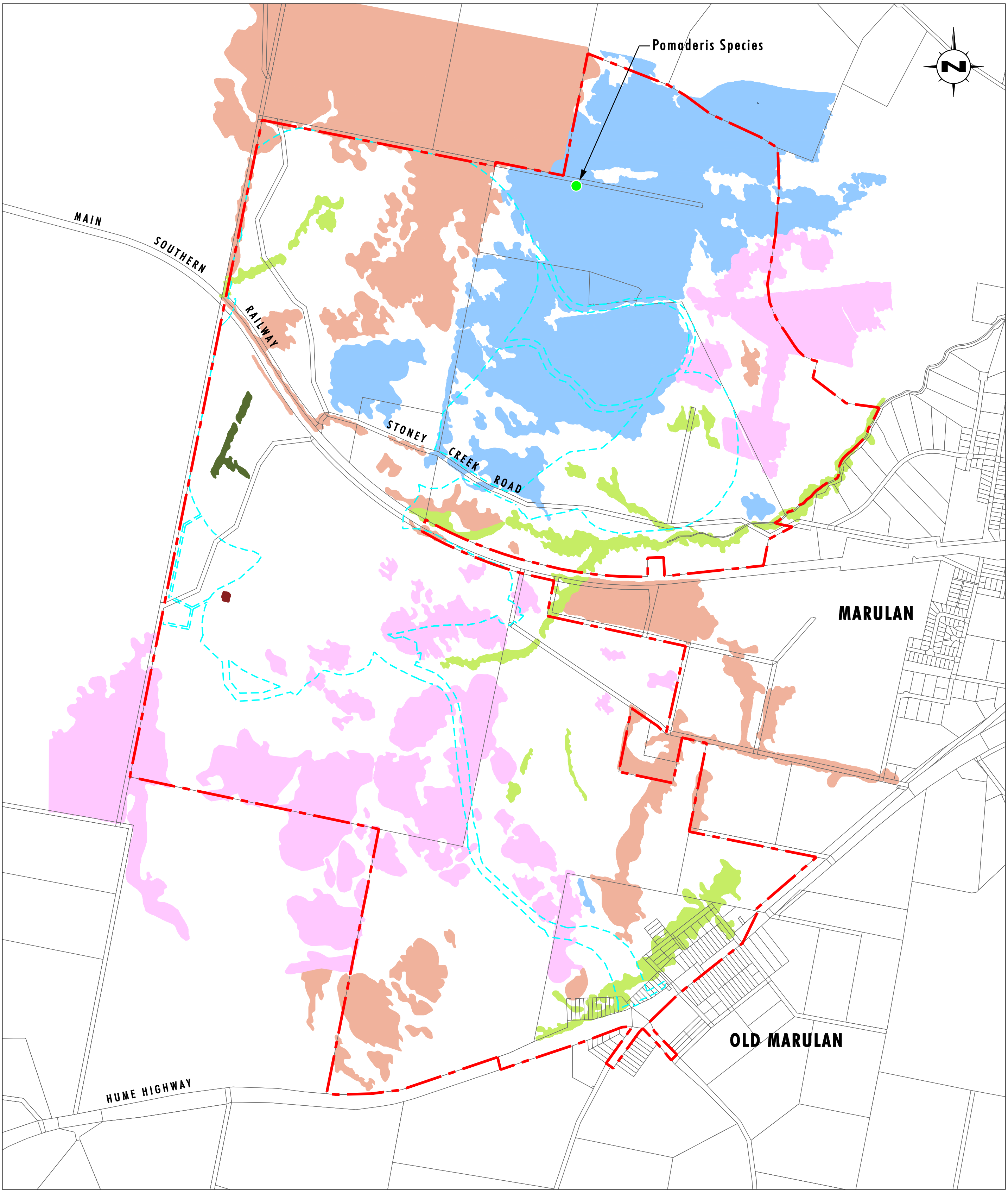
A total of 207 flora species were recorded in the project area as a result of systematic and opportunistic surveys. Of these, 154 (74%) are indigenous to the project area, while 53 (26%) are exotic or non-local natives. A flora species list for the project area is included in the ecological assessment report (refer to **Appendix 9**).

The floristic diversity of the project area is regarded as moderate. The overall number of plant species recorded was affected by prevailing drought conditions, however, it is expected that the majority of vascular plant species present were recorded. It is considered that the floristic diversity recorded within the project area is representative of similar disturbed woodlands and derived pastures occurring more widely across the Central and Southern Tablelands.

Seven vegetation communities were described within the project area including five woodland/forest communities, derived pasture and aquatic vegetation. The extent of each of the vegetation communities (except aquatic habitat) is shown on **Figure 5.16**, with descriptions of each community included below. Aquatic habitat is described below but was not mapped separately because it covers a very narrow band along several creeklines. The aquatic habitat is located within the area mapped as Riparian Gum – Box – Apple Woodland community. The vegetation of the project area has been heavily modified by past and ongoing agricultural activities, resulting in fragmentation and degradation.

In terms of the general diversity of vegetation communities, the project area appears to be reasonably representative of surrounding areas. It contains an assemblage of vegetation communities that are commonly found in the highly fragmented grazing environment of the Southern and Central Tablelands, with a number of exposed rocky hilltops supporting western scribbly gum (*E. rossii*) that are representative of extensive (but largely un-reserved) tracts of land between Marulan and Goulburn.

Umwelt
Environmental Consultants



Base Source: LPI 2004

0 0.25 0.5 1.0km

Legend

- Project Area
- Approximate Disturbance Footprint
- Unit 1 Tableland Low Woodland
- Unit 2 Western Tablelands Dry Forest
- Unit 3 Tableland Grassy Box-Gum Woodland
- Unit 4 Riparian Gum-Box-Apple Woodland
- Unit 5 Camden Woollybutt Low Open Forest
- Plantation
- Derived Pasture

FIGURE 5.16

Vegetation Communities and Significant Flora Species

File Name (A4): R03_V1/1829_239.dgn

Unit 1 - Tableland Low Woodland

This vegetation community covers approximately 110 hectares of the project area, being the dominant community south of the Main Southern Railway. It occurs on poor soils usually on a rocky substrate. The community is dominated by western scribbly gum (*Eucalyptus rossii*). Red stringybark (*E. macrorhyncha*), blue-leaved stringybark (*E. agglomerata*), bundy (*E. goniocalyx*) and brittle gum (*E. mannifera* subsp. *mannifera*) may all be abundant, sparse or absent in areas covered by this community. Black she-oak (*Allocasuarina littoralis*) formed a relatively dense mid-understorey at some sites, particularly in the remnants north of the railway line.

The understorey is generally open through to entirely absent, however, occasionally it is moderately dense. Characteristic shrub species include *Brachyloma daphnoides,* narrow-leaved geebung (*Persoonia linearis*)*, Hibbertia obtusifolia,* and urn heath (*Melichrus urceolatus*). The ground layer is typically sparse and less than 0.5 metre in height, and is dominated by a range of sedges, grasses and forbs. At many sites nodding blue-lily (*Stypandra glauca*) was very dominant, together with red-anther wallaby grass (*Joycea pallida*). Other common species included ivy goodenia (*Goodenia hederacea*)*, Lepidosperma gunnii, Dianella revoluta,* twisted mat-rush (*Lomandra obliqua*)*, Gonocarpus tetragynus,* many-flowered mat-rush (*Lomandra multiflora*)*, L. filiformis* and *Patersonia sericea*.

Unit 2 - Western Tablelands Dry Forest

This vegetation community covers approximately 170 hectares of the project area and occurs primarily in the central northern portion of the project area. An additional small remnant was mapped to the south near Marulan Creek. It consists of an open eucalypt forest dominated by blue-leaved stringybark (*Eucalyptus agglomerata*) with relatively few other canopy species. Kurrajong (*Brachychiton populneus* subsp. *populneus*) occurs sparsely, with bundy (*E. goniocalyx*), yellow box (*E. melliodora*) or red stringybark (*E. macrorhyncha*) being moderately common in some places.

An open to sparse understorey of sclerophyllous shrubs is usually present and may include narrow-leaved geebung (*Persoonia linearis*)*, Kunzea parvifolia*, *Brachyloma daphnoides*, urn heath (*Melichrus erubescens*)*, Hibbertia obtusifolia* and nodding blue-lily (*Stypandra glauca*). The open ground layer consists of sedges and forbs including *Goodenia hederacea,* pomax (*Pomax umbellata*)*,* twisted mat-rush (*Lomandra obliqua*) and weeping grass (*Microlaena stipoides* var*. stipoides*).

Unit 3 - Tableland Grassy Box-Gum Woodland

This vegetation community was mapped across a substantial part of the project area north of the Main Southern Railway, covering a total of approximately 75 hectares of the project area. It is characterised by yellow box (*Eucalyptus melliodora*) and red stringybark (*E. macrorhyncha*). In places Blakely's red gum (*E. blakelyi*) and broad-leaved peppermint (*E. dives*) are more common, as well as blue-leaved stringybark (*E. agglomerata*) and bundy (*E. goniocalyx*). There is occasionally a sparse shrub layer, with common species including peach heath (*Lissanthe strigosa*) and urn heath (*Melichrus urceolatus*). The groundlayer is mostly grassy, with principal species including speargrass (*Austrostipa scabra*), *Lomandra filiformis* subsp *coriacea,* kangaroo grass (*Themeda australis*) and weeping grass (*Microlaena stipoides* var*. stipoides*).

Unit 4 - Riparian Gum-Box-Apple Woodland

This vegetation community is restricted to ephemeral watercourses and immediately adjacent areas, and covers approximately 35 hectares of the project area. The community varies considerably between first order tributaries and higher order creeks within the project area. Typically, the first order tributaries are dominated by yellow box (*Eucalyptus melliodora*), with a combination of either red stringybark (*E. macrorhyncha*), cabbage gum (*E. amplifolia* subsp. *amplifolia*), apple box (*E. bridgesiana*), Argyle apple (*E. cinerea*) or Blakely's red gum (*E. blakelyi*). Further down the catchment these same species were often present, but usually with cabbage gum dominating. Other tree species which become locally common along higher order creeks included forest red gum (*E. tereticornis*) and swamp gum (*E. ovata*). Along Marulan Creek in the south of the project area, grey box (*E. moluccana*) dominates some sites, with a few specimens of narrow-leaved peppermint (*E. radiata*) also located.

Generally, there was little or no mid-understorey present in this vegetation community, although black wattle (*Acacia decurrens*) may be locally abundant and native cherry (*Exocarpos cupressiformis*) may occur rarely. An understorey was typically absent, however, in some places, blackberry (**Rubus fruticosus* sp. aggregation) dominated in dense infestations. The groundcover varied from being moderately dense in places, through to sparse or totally absent. It was dominated by a range of native and introduced species, although along the edges of creeklines introduced species were often dominant. Some of the more common species included couch (*Cynodon dactylon*), three-awn wire grass (*Aristida ramosa*), wallaby grasses (*Austrodanthonia laevis* and *A. racemosa* var. *racemosa*), corkscrew grass (*Austrostipa scabra*), umbrella sedge (**Cyperus eragrostis*) and rushes (*Juncus planifolius*, *J. sarophorus* and *J. usitatus*).

In places this vegetation community bears some visual resemblance to the White Box Yellow Box Blakely's Redgum Woodland Endangered Ecological Community (EEC) listed under the TSC Act, although a detailed examination of its floristic composition does not support such a classification (refer to **Appendix 9**).

Unit 5 - Camden Woollybutt Low Open Forest

Camden woollybutt (*Eucalyptus macarthurii*) was recorded as a monospecific dominant in an isolated approximately 0.2 hectare stand about 1 kilometre south of the Main Southern Railway (refer to **Figure 5.16**). At the time of inspection the site was devoid of other species, except for sparse grasses (*Austrodanthonia laevis*). It is likely that this species was either planted on this site, or it colonised in response to a major disturbance event. *Eucalyptus macarthurii* has recently been subject to a preliminary determination under the TSC Act (refer to **Section 5.7.1.3**).

Aquatic Vegetation

The project area supports very limited aquatic vegetation and where it is present it is usually very simple in terms of complexity. This vegetation was not mapped separately, due to the very limited area that it covers, and is included as a component of the Riparian Gum-Box-Apple Woodland.

Most creeklines support vegetation that prefers moist or waterlogged soil. Along the edges of semi-permanent ponds a variety of sedges, rushes and forbs were present. Common species included umbrella sedge (**Cyperus eragrostis*), *Cyperus laevis*, rushes (*Juncus planifolius*, *J. sarophorus* and *J. usitatus*) and couch (*Cynodon dactylon*). Aquatic vegetation was very limited on farm dams within the project area, likely due to cattle impacts. The most common aquatic species observed at dams included water-milfoil (*Myriophyllum variifolium*), sea celery (*Apium prostratum* subsp. *prostratum*), water ribbons (*Triglochin procerum*), ferny azolla (*Azolla pinnata*), spikerush (*Eleocharis* sp.) and duckweed (*Wolffia australiana*).

Derived Pasture

Much of the project area (approximately 630 hectares) is covered by a pasture derived from the previous clearing of forest and woodland vegetation. It varies in structure and composition depending on grazing history and the substrate on which it occurs. In general, it is dominated by a mix of exotic and native species, although in most places where active grazing occurs exotic species dominate in terms of percentage cover. Common pasture species include sorrel (**Acetosella vulgaris*), dead nettle (**Lamium amplexicaule*), fireweed (**Senecio madagascariensis*), sheep burr (*Acaena novae-zeelandiae*), squirrel tail fescue (**Vulpia bromoides*), white clover (**Trifolium repens*), corkscrew grass (*Austrostipa scabra*), phalaris (**Phalaris aquatica*) and wallaby grasses (*Austrodanthonia racemosa* var. *racemosa* and *A. laevis*).

5.7.1.3 Significant Flora and Vegetation Communities

A number of threatened flora species are considered to potentially occur within the vicinity of the project area based on previous records and habitat profiling, however, no species were recorded within the project area during the detailed site surveys. A preliminary determination has been made to list Camden woollybutt (*Eucalyptus macarthurii*) as a vulnerable species under the TSC Act, however, this listing has not been completed. This species is also listed on the Rare or Threatened Australian Plants (ROTAP) database as 2RCi (Briggs and Leigh 1996). This indicates that it is regarded as having a range of over 200 kilometres, is considered to be rare and is inadequately conserved within conservation reserves (Briggs and Leigh 1996). The location of this small stand (0.2 hectare) of vegetation is shown on **Figure 5.16**.

Two EECs are also known to occur within the region. Natural Temperate Grassland of the Southern Tablelands of NSW and the ACT is listed as an EEC under the EPBC Act, while White Box Yellow Box Blakely's Red Gum Woodland is listed as an EEC under the TSC Act. Targeted surveys were conducted to specifically determine whether these vegetation communities were present in the project area, with detailed analyses undertaken of the survey results in comparison to the available descriptions of the communities. The survey and assessment work found that these communities were not present within the project area.

The survey did, however identify a flora species of botanical significance, being a possibly undescribed species of *Pomaderris*. A small population of the *Pomaderris* species was recorded in the northern extremity of the project area, outside the proposed disturbance area (refer to **Figure 5.16**). Collected specimens were identified as most likely being *Pomaderris lanigera* - *P. intermedia/andromedifolia*, however, it could represent a new as yet undescribed species.

5.7.2 Existing Fauna

Two spring fauna surveys and a winter survey were undertaken in order to account for seasonal and temporal variations in fauna populations within the project area. Week long surveys were undertaken in November 2003 and September 2004, with a three day survey undertaken in July 2004. All surveys considered and targeted threatened fauna species known or considered to potentially occur in the local area.

5.7.2.1 Fauna Survey Results

A total of 111 fauna species, including five threatened species, were recorded over the three survey periods. A description of the recorded species assemblages is included below, with a full species list included in the Ecological Assessment provided in **Appendix 9**.

Birds

A total of 69 bird species were recorded over the three fauna survey periods. The most commonly recorded species were the eastern rosella (*Platycercus eximius*), crimson rosella (*Platycercus elegans*), grey fantail (*Rhipidura fuliginosa*), white-winged chough (*Corcorax melanorhamphos*) and white-throated treecreeper (*Corombates leucophaeus*). The threatened (TSC Act) speckled warbler (*Pyrrholaemus sagittata*) was identified at two sites during spring 2003 (refer to **Figure 5.17**).

Mammals

A total of 27 mammal species were recorded over the three survey periods. The most commonly recorded species were the common brushtail possum (*Trichosurus vulpecula*), sugar glider (*Petaurus breviceps*), wombat (*Vombatus ursinus*) and eastern grey kangaroo (*Macropus giganteus*). Four threatened mammal species (TSC Act) were recorded during the survey program including the squirrel glider (*Petaurus norfolcensis*), eastern bentwing-bat (*Miniopterus schreibersii oceanensis*), eastern freetail bat (*Mormopterus norfolkensis*) and eastern false pipistrelle (*Falsistrellus tasmaniensis*) (refer to **Figure 5.17**).

Herpetofauna

A total of six frog species were recorded during the spring surveys in 2003 and 2004, with no frog species recorded in the 2004 winter survey. The species recorded were the eastern dwarf tree frog (*Litoria fallax*), spotted marsh frog (*Limnodynastes tasmaniensis*), Peron's tree frog (*Litoria peronii*), brown froglet (*Crinia parinsignifera*), common eastern froglet (*C. signifera*) and smooth toadlet (*Uperoleia laevigata*). No threatened frog species were identified during the surveys.

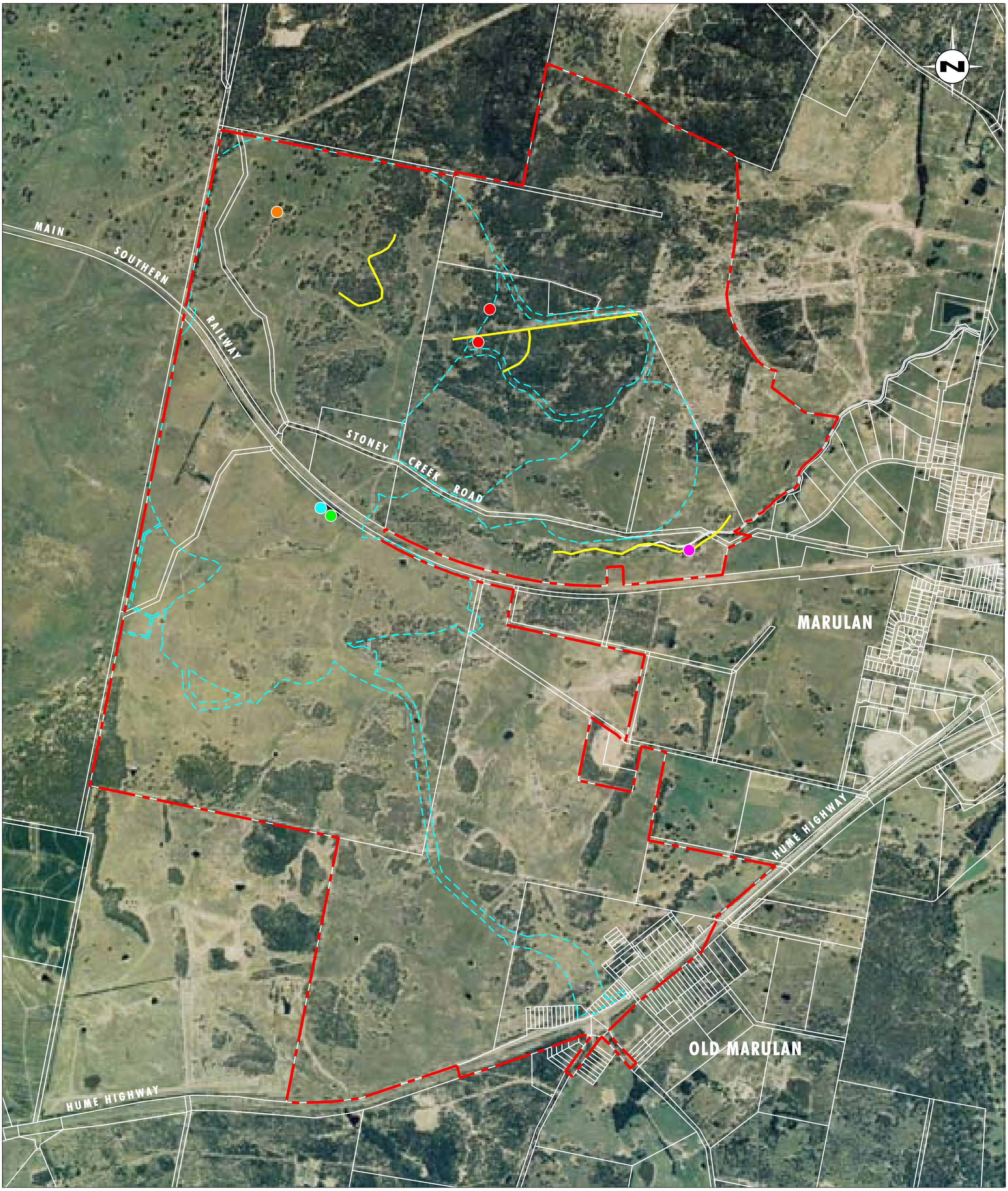
A total of nine reptile species were recorded during the spring surveys in 2003 and 2004, with no reptile species recorded in the 2004 winter survey. The species recorded were the eastern bearded dragon (*Pogona barbata*), copper-tailed skink (*Ctenotus taeniolatus*), land mullet (*Egernia major*), White's skink (*Egernia whitii*), grass skink (*Lampropholis delicata*), garden skink (*Lampropholis guichenoti*), red-bellied black snake (*Pseudechis porphyriacus*), eastern blue-tongued lizard (*Tiliqua scincoides*) and snake-necked turtle (*Chelodina longicollis*). No threatened reptile species were identified during the surveys.

Significant Fauna Species

Five threatened fauna species were recorded during surveys in the project area. The species recorded were the squirrel glider, speckled warbler, eastern bentwing-bat, eastern freetail bat and eastern false pipistrelle. The locations in which these species were recorded are shown on **Figure 5.17**. The project area is also considered to provide potential habitat for a number of other threatened species known to occur in the region and these are discussed in detail in **Appendix 9**.

No threatened species listed under the EPBC Act were recorded in the project area. The project area is, however, considered to provide potential habitat for several threatened species known to occur in the region. Five migratory species listed under the EPBC Act were recorded: the Australian wood duck (*Chenonetta jubata*), Pacific black duck (*Anas*

Umwelt
Environmental Consultants



Base Source: LPI 2004, Readymix Holdings Pty Ltd (Aerial Photo March 2005)

0 0.5 1 1.25km

Legend

- Project Area
- Approximate Disturbance Footprint
- Squirrel Glider
- Squirrel / Sugar Glider Hair Sample
- Speckled Warbler
- Eastern Freetail-bat
- Eastern False Pipistrelle
- Eastern Bentwing-bat Echolocation Record

FIGURE 5.17

Threatened Fauna Species Locations

File Name (A4): R03_V1/1829_240.dgn

superciliosa), grey teal (*Anas gracilis*), Australian hobby (*Falco longipennis*) and nankeen kestrel (*Falco cenchroides*).

5.7.3 Ecological Impact Assessment

5.7.3.1 Flora Impact Assessment

Impacts on Terrestrial Vegetation Communities

The proposed quarry will require the removal of approximately 103 hectares of woodland/forest vegetation and approximately 260 hectares of derived pasture. As discussed in **Section 5.7.1.2**, the vegetation within the project area is reasonably representative of the vegetation of the region, containing an assemblage of vegetation communities that are commonly found in the highly fragmented grazing environment of the Southern and Central Tablelands. The quarry will require a high proportion of Tablelands Grassy Box-Gum Woodland and Camden Woollybutt Low Woodland within the project area to be cleared, however, a large proportion of the other dominant natural vegetation communities will be retained. Large areas of Tablelands Grassy Box-Gum Woodland occur on land surrounding the project area, with unaffected areas of this community also occurring in the project area. It is proposed to completely offset the removal of Camden Woollybutt Low Woodland with a new revegetated site, with rehabilitation and assisted regeneration works across the remainder of the project area further reducing the impact of the project on other native vegetation communities (refer to **Section 7.2.4**).

Two EECs have been previously recorded in the region and a detailed survey and analysis of the potential occurrence of these communities was undertaken. Neither of the EECs were recorded in the project area and therefore the proposed quarry will not impact on any endangered vegetation communities.

Based on the detailed impact assessment undertaken in the ecological assessment report (refer to **Appendix 9**), the impact of the proposed quarry on vegetation communities in a local or regional context is unlikely to be significant, particularly when considering the proposed mitigation measures outlined in **Section 7.2.4**. These measures include the establishment of a habitat management area, rehabilitation of riparian corridors and revegetation with the aim of establishing a vegetated corridor through the site.

Impact on Aquatic Flora

Surface water capture associated with the proposed quarry will reduce the volume of flow in Joarimin Creek and to a lesser extent in Lockyersleigh Creek. Flow in Marulan Creek will be unaffected. This has the potential to impact on aquatic vegetation along these creeks, however, the extent of available habitat for aquatic flora within these creek systems is limited due to the relatively few semi-permanent pools. The extent of available habitat is unlikely to be significantly affected by the proposed quarry. As the volume of water stored in semi-permanent pools within the creek system is limited, the volume of flow within the creek system required to retain these pools is also low. On this basis, it is not expected that the reduction in flow along the creeks will be sufficient to significantly impact the extent of aquatic flora habitat available. The project is therefore considered unlikely to significantly impact on aquatic vegetation.

Impact on Significant Flora Species

No threatened flora species or endangered populations were recorded in the project area, however one species subject to a preliminary determination under the TSC Act was recorded, Camden woollybutt (*Eucalyptus macarthurii*). The proposed development would require the removal of the entire stand of this species (about 0.2 hectare). It is reasonably likely that this species was planted on the site, and is probably not naturally occurring, however, it is proposed to establish new plantings of double the present area to offset the impact on this species. **Section 7.2.4** provides further details on this proposed mitigation measure.

An assessment under Section 5A of the EP&A Act indicates that the project would be unlikely to significantly impact this species, and five threatened flora species for which potential habitat was considered to be present. An assessment of listings under the EPBC Act similarly concluded that the proposal is unlikely to significantly impact any listed species or communities (refer to **Appendix 9**).

One other flora species of botanical significance, *Pomaderris lanigera* - *P. intermedia / andromedifolia* was identified in the project area. Expert advice suggests that this taxon could possibly constitute a new species, however further research and survey would be required to confirm or refute this. The area in which this taxon occurs is proposed to be part of a habitat management area and will therefore not be affected by the proposed quarry (refer to **Section 7.2.4**).

5.7.3.2 Fauna Impact Assessment

Impact on Fauna Habitat

The impact of the proposed quarry on native fauna species will arise primarily from the direct loss of fauna habitat. The project area is located in a region that has been subject to a long history of vegetation clearing for agricultural purposes such as grazing. This has led to the current condition where the vegetation of the region is highly fragmented and degraded.

The project will result in the loss of approximately 100 hectares of native vegetation within the project area. This loss will impact on fauna species utilising that habitat, however, it is considered unlikely that this impact will be significant from a regional perspective due to the proximity of similar quality adjoining vegetation and due to the detailed ameliorative measures that will be implemented as part of the project. These ameliorative measures include the establishment of a habitat management area in the northeastern portion of the property, revegetation of areas within the project area, erection of nest boxes and implementation of detailed clearing procedures to reduce the impact on native fauna, particularly threatened species (refer to **Section 7.2.4**).

The project also has the potential to contribute to localised fragmentation. The vegetation in the project area, and local area in general, is highly fragmented into pockets of vegetation of varying sizes, features and habitat quality. Many fragments consist of canopy species only, with little or no understorey vegetation. Such areas are likely to provide greatly reduced protection to fauna species, particularly when dispersing. While the proposed quarry is likely to contribute to the fragmentation of the existing vegetation of the site, ameliorative measures proposed include the reservation of a large area of continuous vegetation and the revegetation of additional areas in order to increase connectivity throughout the project area and to adjoining habitats (refer to **Section 7.2.4**).

Impact on Significant Fauna Species

Five threatened species were recorded in the project area, being the squirrel glider, speckled warbler, eastern bentwing bat, eastern false pipistrelle and eastern freetail bat. The project area was also considered to provide potential habitat for a further 15 threatened species not recorded during the field surveys. An assessment of the impact of the project on these species in accordance with Section 5A of the EP&A Act (eight-part test) found that project will not significantly impact on these species.

A number of threatened and migratory species listed under the EPBC Act were also considered to potentially occur and five listed migratory species were recorded. An assessment of the potential impact of the project on these species in accordance with the EPBC Act found that none will be significantly affected by the proposed quarry.

Although the project is not considered likely to significantly impact on any threatened fauna species, a number of management and mitigation measures are proposed in order to minimise potential impacts. These measures are discussed in **Section 7.2.4** and in **Appendix 9**.

An assessment of koala habitat undertaken in accordance with SEPP 44 found that the project area does not contain potential koala habitat.

5.8 Air Quality

A comprehensive air quality impact assessment has been undertaken for the project by Holmes Air Sciences in accordance with DEC guidelines. The assessment report is included in **Appendix 5**, with an overview of the assessment provided in this section.

5.8.1 Air Quality Goals

In its guidelines, *Approved Methods and Guidance for the Modelling of Air Pollutants in NSW* (EPA, 2001), the EPA (now DEC) specifies air quality assessment criteria relevant for assessing impacts from quarrying activities. These criteria relate to dust deposition and dust concentration.

5.8.1.1 Dust Deposition

Dust deposition levels refer to the quantity of dust particles that settle out of the air as measured in grams per square metre per month (g/m²/month) at a particular location. DEC expresses dust deposition criteria in terms of an acceptable increase in dust deposition over the existing background deposition levels as shown in **Table 5.9**. For example, in residential areas with annual average dust deposition levels of between 0 and 2 g/m²/month an increase of up to 2 g/m²/month would be permitted before it was considered that a significant degradation of air quality had occurred.

Table 5.9 – DEC Goals for Dust Deposition (Insoluble Solids)

Existing dust fallout level (g/m²/month)	Maximum acceptable increase over existing fallout levels (g/m²/month)	
	Residential	Other
2	2	2
3	1	2
4	0	1

5.8.1.2 Dust Concentration

Dust concentration refers to airborne dust and is measured in micrograms per cubic metre (µg/m³). Relevant criteria for dust concentration are defined in terms of two classes, TSP and PM_{10}. TSP relates to all suspended particles which are usually in the size range of zero to 50 micrometres (µm). Particle sizes larger than 50 µm are measured in dust deposition levels. PM_{10} refers to particulate matter with a diameter less than 10 µm. TSP measurements include PM_{10} particles.

Goals for dust concentration are referred to as long term (annual average) and short term (24 hour maximum) goals. Relevant goals for TSP and PM_{10} are outlined in **Table 5.10** in relation to both project specific and cumulative goals applied at a regional level. The TSP and PM_{10} annual average goals relate to the total dust burden in the air and not just the dust from the project. Therefore, background levels need to be considered when using these goals to assess impacts.

Table 5.10 – Goals for Dust Concentration

Pollutant	Standard/ Goal	Averaging Period	Agency
Total suspended particulate matter (TSP)	90 $\mu g/m^3$	Annual mean	National Health & Medical Research Council
Particulate matter < 10 μm (PM_{10})	50 $\mu g/m^3$	24-hour maximum	DEC
	30 $\mu g/m^3$	Annual mean	DEC long-term reporting goal
	50 $\mu g/m^3$	(24-hour average, 5 exceedances permitted per year)	National Environment Protection Council

The quarrying operations will also potentially result in the emission of crystalline silica dust. At this time there are no ambient air quality assessment criteria that are relevant to these emissions. An assessment of this potential impact and potentially applicable criteria are, however, discussed in **Section 5.8.5.1**.

5.8.1.3 Other emissions

Other emissions from quarrying activities include sulphur from the combustion of fuel. The sulphur content of Australian diesel is considered to be too low and quarrying equipment is too widely dispersed over quarry sites to cause sulphur dioxide goals to be exceeded at quarry sites, even on sites where large quantities of diesel are used. For this reason no detailed study is required to demonstrate that emissions of SO_2 from the quarry will not significantly affect ambient SO_2 concentrations. In addition, NO_x and CO emissions are too small and too widely dispersed to require a detailed modelling assessment.

The potential issue of odour was raised by DEC in the Director-General's requirements (refer to **Section 8.0**). Odour is not considered to be an issue for the project as there are only minor potential sources of odour (e.g. precoat plant), all of which are located in the infrastructure area which is a significant distance from any potentially affected receivers.

An assessment of greenhouse gas emissions has been undertaken for the project and is included in **Section 5.13**.

5.8.2 Existing Air Quality

Monitoring has been undertaken of existing dust deposition and dust concentration levels within and surrounding the project area since July 2004. The dust monitoring network consists of eight depositional dust gauges and two high volume air samplers (HVAS) measuring PM_{10}. The second HVAS (HVAS2) was installed in December 2004. The location of the background dust monitoring points is shown on **Figure 5.10**.

Average monthly dust deposition levels recorded during the monitoring program were below an annual average level of 4 g/m²/month at all locations (refer to **Appendix 5**). DD6, located within the project area near Stoney Creek Road (an unsealed road), recorded the highest average of 3.6 g/m^2/month. All remaining sites, with the exception of DD2, located in the northwest corner of the project area (2.7 g/m^2/month), recorded average dust deposition rates of less than 2 g/m^2/month. Both DD6 and DD2 are located within relatively close proximity of a dirt road which is considered likely to be the source of the increased dust levels measured at these points. The average background dust deposition level across all sites is 1.7 g/m^2/month, however, the background deposition levels in the residential areas are lower than the average over all sites (the level recorded at DD7 in Marulan township was 1.1 g/m^2/month).

The HVASs run on a six day cycle, measuring a 24 hour air sample every six days. Since the commencement of monitoring in June 2004, site HVAS1 has recorded an average PM_{10} concentration of 13.9 $\mu g/m^3$. The highest 24-hour PM_{10} concentration during this period was 61.4 $\mu g/m^3$, with widespread dust storms occurring in the region around this time. This result is above the 50 $\mu g/m^3$ goal for a 24-hour sampling period, indicating that there are existing sources of dust in the area which contribute to elevated concentrations. HVAS2 has recorded an average PM_{10} concentration of 13.1 $\mu g/m^3$, with a maximum of 20.9 $\mu g/m^3$.

From the available monitoring data, the following background concentrations have been applied at the nearest residences for impact assessment purposes:

- annual average TSP of 33 $\mu g/m^3$;
- annual average PM_{10} of 13 $\mu g/m^3$; and
- annual average dust deposition of 1.7 g/m^2/month.

5.8.3 Assessment Methodology

In August 2001, DEC published new guidelines for the assessment of air pollution sources using dispersion models (EPA, 2001). The guidelines specify how assessments based on the use of air dispersion models should be undertaken. DEC includes guidelines for the preparation of meteorological data, the way in which emissions should be estimated and the relevant air quality criteria for assessing the significance of predicted concentration and deposition rates from a proposed development. The approach taken in this assessment follows as closely as possible the approach suggested by the guidelines.

The US EPA Industrial Source Complex Model (Short-term Version 3) (ISCST3) computer–based dispersion model was used to assess the dispersion of dust from various stages of the project. The model is an advanced Gaussian dispersion model approved by the US EPA for use in regulatory assessments undertaken in the US and it is one of the most widely used regulatory models in the world. The model is accepted by DEC for assessing the dispersion of dust. The model uses hourly data on wind speed, wind direction, temperature, atmospheric stability as well as the number of days in which rain is likely to fall. The data used for this assessment has been taken from a meteorological station located within the project area as well as data available from the "Wangi" meteorological station located approximately 8 kilometres southwest of the project area.

The model also requires estimates of particulate matter emission rates for each activity associated with the project and considers dust emissions due to wind erosion from exposed areas such as overburden dumps and stockpiles.

The conceptual quarry plans for Years 2, 5, 10, 15, 20, 25 and 30 have been analysed and detailed dust emission inventories have been developed for each of these years. The operations under each of these operational scenarios have been combined with emission factors developed, both within NSW and by the US EPA, to estimate the amount of dust produced by each activity. There were significant revisions to the US EPA emission factors for quarry operations in 2003. The emission factors applied are considered to be the most up to date methods for determining dust generation rates. The fraction of fine, inhalable and coarse particles for each activity has been taken into account in the dispersion modelling. The model uses the Gaussian dispersion equation to simulate the dispersion of a dust plume from either point area or volume sources.

The emissions of dust from the project were represented by a series of volume sources located according to the location of activities for the modelled scenario. The location and type of these sources for each modelled scenario are detailed in **Appendix 5**. Estimates of emissions for each source were developed on an hourly time step taking into account the activities that would take place at that location. Thus, for each source, for each hour, an emission rate was determined which depended upon the level of activity and the wind speed.

5.8.4 Dust Controls Included in Modelling

Preliminary dust modelling was undertaken early in the design phase of the quarry in order to identify any potentially significant dust issues so that appropriate controls could be built into the project design. One of the major controls was the purchase of appropriate buffer land to the east of the quarry resource. The establishment of this buffer land has ensured that impacts on nearby residential receivers is limited. The following dust control measures have been adopted as part of the project:

- enclosing conveyors on the top and on one side;
- enclosing of the crushing and screening plant and the fitting of a dust extraction system;
- dust suppression sprays on the primary crusher which will be located below ground level in a box cut but will not be enclosed;
- fitting drills with either water sprays or dry dust collection devices;
- controlling stockpiles of fine material with water sprays;
- confining traffic to identified haul road routes;
- removal and rehabilitation of unnecessary roads;
- keeping exposed areas to a minimum;
- watering of haul roads;
- cleaning of areas which could become sources of wind blown dust due to build-up of settled fine material;
- reviewing meteorological conditions prior to blasting to minimise the exposure of residences to dust emissions; and
- daily assessment of meteorological conditions to identify wind conditions that may be conducive to excessive dust generation – for example, very high winds.

5.8.5 Air Quality Impact Assessment

For each of the operational scenarios selected, dust impacts were predicted in the form of both single point calculations at representative residential receiver locations and dust contours. Single point calculations were undertaken at eight locations surrounding the quarry, with locations selected to represent potentially affected existing and potential future residences in various wind directions. The single point calculations and predicted dust contours for each stage are included in **Appendix 5**, with representative worst-case dust contours included as **Figures 5.18** to **5.21**. Conceptual quarry stages at Years 10 and 30 were selected to represent the worst-case scenario because Year 10 is during construction of the eastern overburden and excess product emplacement areas and Year 30 has the largest overall footprint.

A comparison of the model predictions with the air quality goals discussed in **Section 5.8.1** indicates the following:

- maximum 24-hour average PM_{10} concentrations due to the operations are below the 50 $\mu g/m^3$ goal at all residences;

- annual average PM_{10} concentrations due to the operations are below the 30 $\mu g/m^3$ goal at all residences. If an annual average background PM_{10} of 13 $\mu g/m^3$ is added to the model predictions, concentrations at all residences are still below the 30 $\mu g/m^3$ goal;

- annual average TSP concentrations due to the operations are below the 90 $\mu g/m^3$ goal at all residences. If an annual average background TSP of 33 $\mu g/m^3$ is added to the model predictions, concentrations at all residences are still below the 90 $\mu g/m^3$ goal; and

- the predicted contribution of the quarry to dust deposition levels is well below the 2 g/m^2/month criteria at all residences, with the maximum predicted increase being 0.7 g/m^2/month at assessment point 3 (refer to **Figure 5.21**) in Year 10. Model predictions at the nearest residences are also below the 4 g/m^2/month goal when an existing background dust deposition level of 1.7 g/m^2/month is added.

A review of the dust contour plots for each of the quarry stage plans (refer to **Appendix 5** and **Figures 5.18** to **5.21**) indicates that air quality impacts to the east of the project area will generally be higher than those predicted to the west. The westerly winds that are common in the area would be driving this pattern.

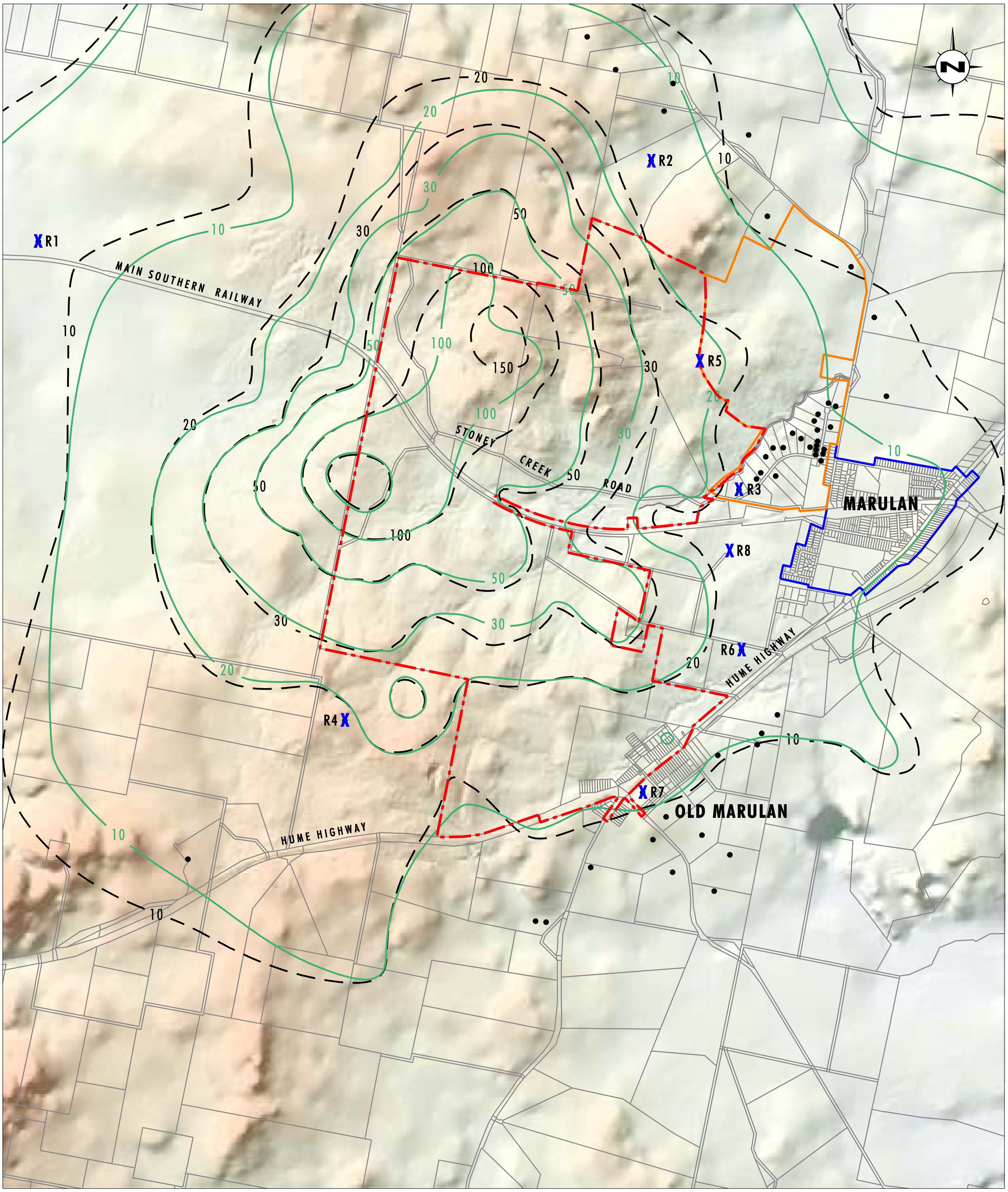
Although the air quality assessment indicated that the quarry will not exceed air quality goals at any residences or approved future residential locations, there will be some impact on vacant land. A property is considered to be potentially dust affected if greater than 25% of that property will be impacted above the relevant criteria. Only one vacant property will be potentially dust affected, being property 27 (refer to **Figure 1.3**) which may be impacted by maximum 24-hour PM_{10} dust post approximately Year 10 (approximately 30% affectation).

5.8.5.1 Crystalline Silica Dust

Silica (SiO_2) occurs in abundance in nature and comprises minerals composed of silicon and oxygen. It exists in crystalline and amorphous forms which relate to the structural arrangement of the oxygen and silicon atoms. Only the crystalline forms are known to have the potential to cause health effects. The target porphyry resource contains a silica component and therefore an assessment of potential health impacts has been undertaken for the project.

No criteria have been developed for ambient levels of silica dust due to emissions from fugitive sources such as mines, quarries, unsealed rural roads, agricultural activities and the like. The assessment contained in **Appendix 5** is based on OH&S criteria and found that the silica dust levels generated by the quarry will be well below the relevant OH&S exposure limit.

Umwelt
Environmental Consultants



Source: Holmes Air Sciences, 2005 (Refer to Appendix 5)
Base Source: LPI 2004

0 0.5 1 2km

Legend

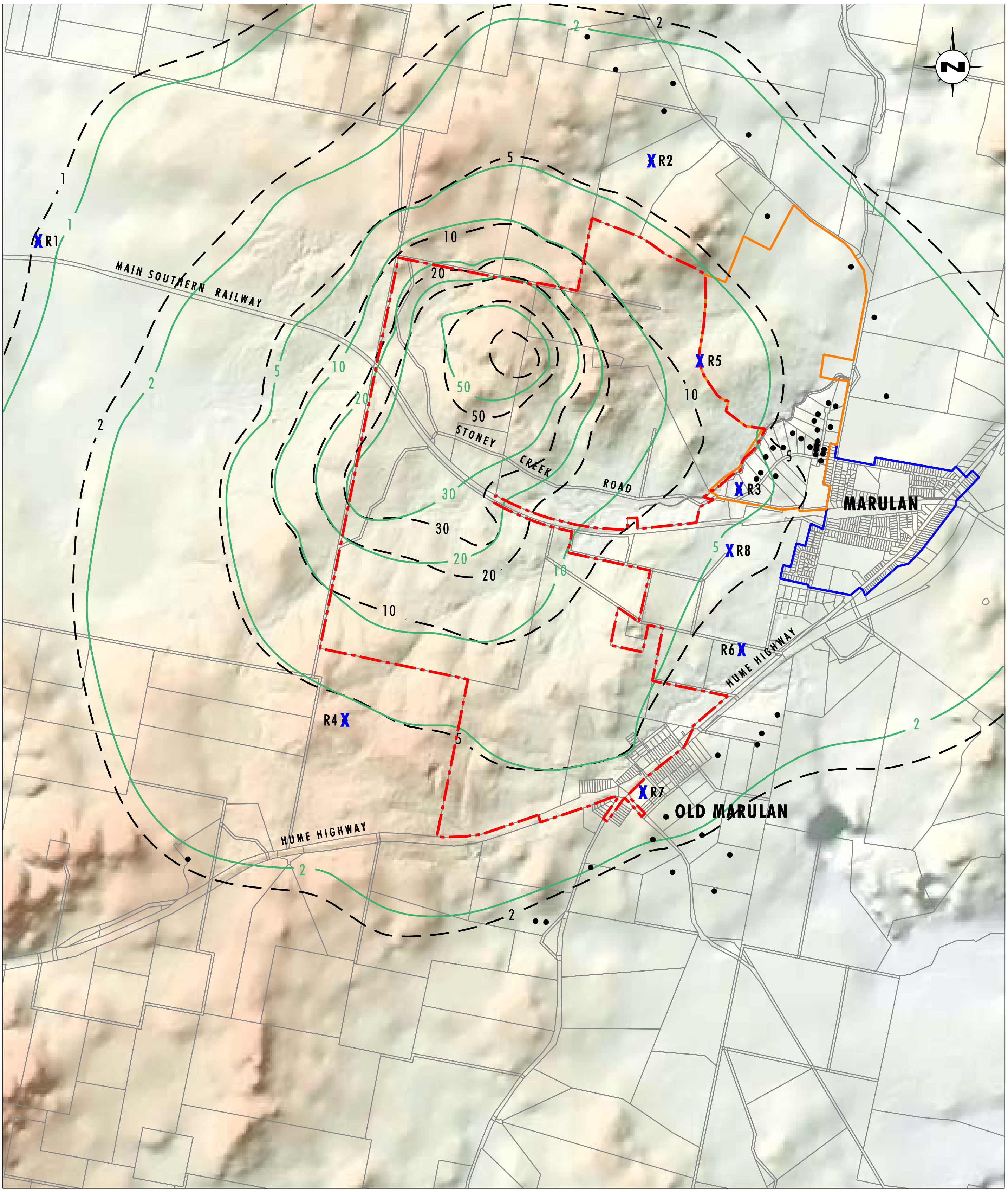
- Project Area
- Year 10 PM_{10} - $\mu g/m^3$
- Year 30 PM_{10} - $\mu g/m^3$
- R1 Assessment Location
- Residence
- Marulan Residential Area
- Marulan Rural Residential Area

FIGURE 5.18

24-hour Average PM_{10} Contours Years 10 and 30

File Name (A4): R03_V1/1829_254.dgn

Umwelt
Environmental Consultants



Source: Holmes Air Sciences, 2005 (Refer to Appendix 5)
Base Source: LPI 2004

0 0.5 1 2km

Legend

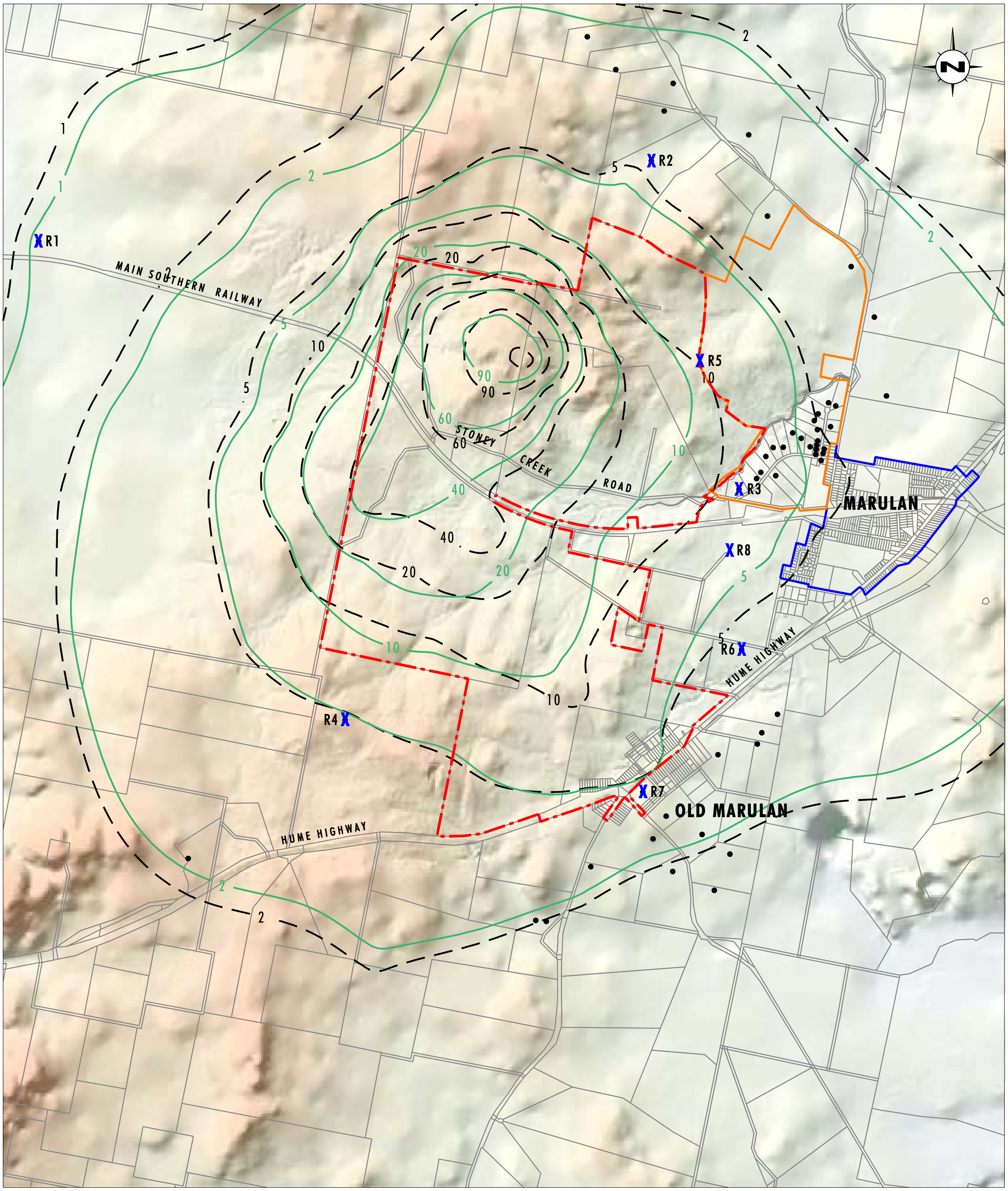
- Project Area
- Year 10 PM_{10} - $\mu g/m^3$
- Year 30 PM_{10} - $\mu g/m^3$
- R1 Assessment Location
- Residence
- Marulan Residential Area
- Marulan Rural Residential Area

FIGURE 5.19

Annual Average PM_{10} Contours Years 10 and 30

File Name (A4): R03_V1/1829_264.dgn

Umwelt
Environmental Consultants



Source: Holmes Air Sciences, 2005 (Refer to Appendix 5)
Base Source: LPI 2004

0 0.5 1 2km

Legend

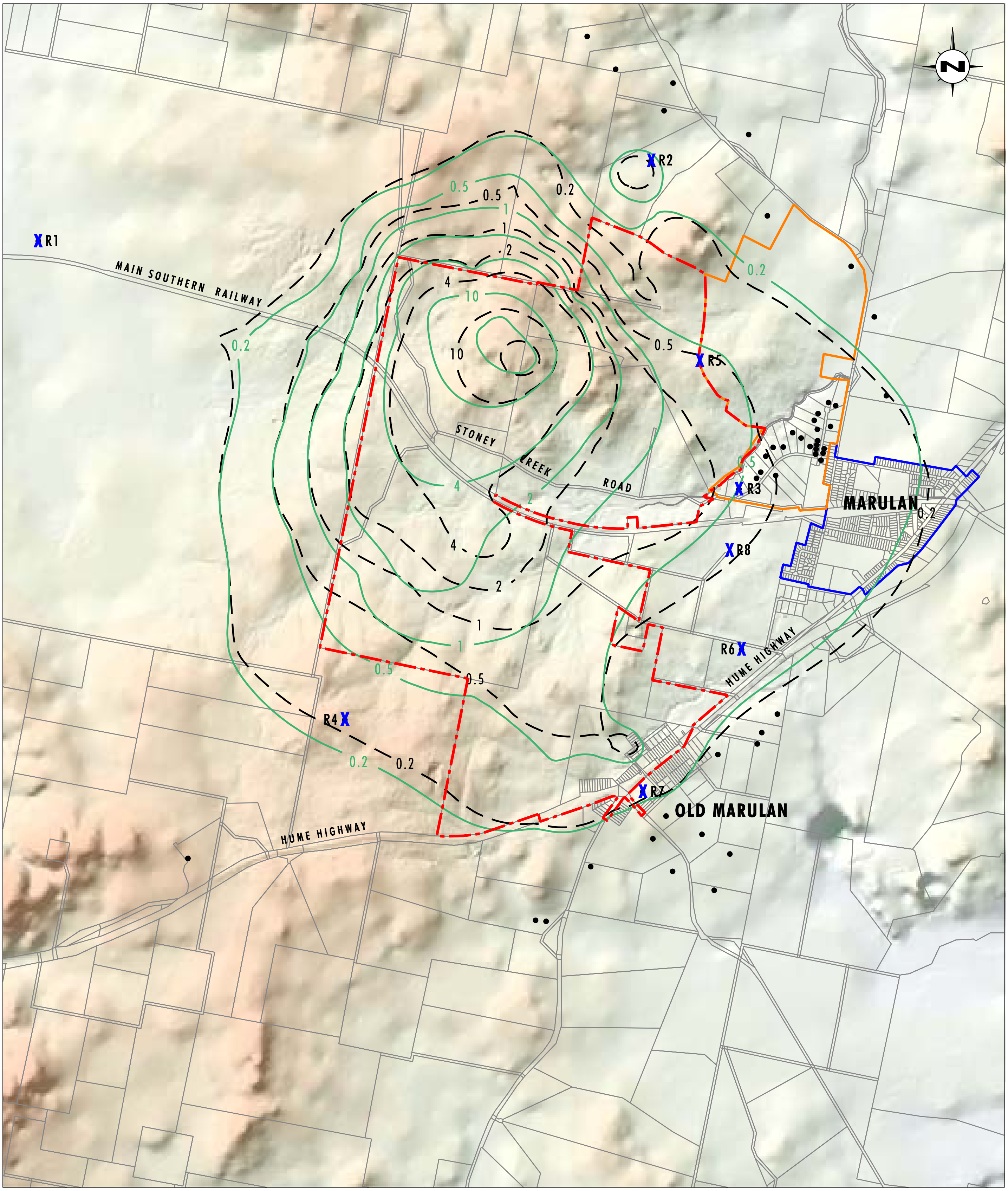
- Project Area
- Year 10 TSP - $\mu g/m^3$
- Year 30 TSP - $\mu g/m^3$
- R1 Assessment Location
- Residence
- Marulan Residential Area
- Marulan Rural Residential Area

FIGURE 5.20

Annual Average TSP Contours Years 10 and 30

File Name (A4): R03_V1/1829_265.dgn

Umwelt
Environmental Consultants



Source: Holmes Air Sciences, 2005 (Refer to Appendix 5)
Base Source: LPI 2004

0 0.5 1 2km

Legend

- Project Area
- Year 10 Dust Deposition - $g/m^2/month$
- Year 30 Dust Deposition - $g/m^2/month$
- R1 Assessment Location
- Residence
- Marulan Residential Area
- Marulan Rural Residential Area

FIGURE 5.21

Annual Dust Deposition Contours Years 10 and 30

File Name (A4): R03_V1/1829_266.dgn

5.8.5.2 Cumulative Air Quality Impacts

There are no significant existing industrial sources of dust in the vicinity of the project area. Any potential cumulative impacts have, however, been assessed as part of the above modelling and impact assessment process as the background monitoring data includes the impacts of any existing industrial sources and the annually averaged assessment criteria include background dust levels.

Based on the assessment findings, the cumulative impacts of the project and any other existing local industrial sources of dust are predicted to be within the relevant criteria.

5.9 Noise and Blasting

5.9.1 Noise Assessment

A comprehensive noise impact assessment for the project was undertaken by Richard Heggie Associates Pty Limited. This assessment provides details of existing noise levels within the project area and surrounds, determines the noise impact assessment criteria based on existing noise levels and the relevant DEC guidelines, predicts noise levels that are expected to result from the project and provides an assessment of these noise levels against the relevant criteria. An overview of the noise assessment findings is provided in this section, with the full assessment report included as **Appendix 10**.

5.9.1.1 Existing Noise Levels

In order to determine existing ambient noise levels within and surrounding the project area, a background noise monitoring survey was undertaken. Monitoring was undertaken at seven locations including existing residential locations and areas of vacant land. The background noise monitoring locations are shown on **Figure 5.10**.

The background noise monitoring program consisted of unattended continuous noise logging and operator attended noise surveys. The operator attended noise surveys help to define noise sources and the character of noise in the area and are therefore used to quantify unattended noise logging results.

The measured background noise levels for the project area and surrounds are included in **Table 5.11**.

Table 5.11 – Summary of Existing Ambient Background Noise Levels

Location	Description	Background Noise Level (LA90 dBA) Rating Background Level	Measured Existing LAeq Noise Level (dBA)	Estimated Contribution from Existing Industrial Noise Sources (LAeq(period) dBA)
N1	Daytime	30*	52	<35
	Evening	30*	45	<35
	Night	30*	49	<35
N2	Daytime	37	47	<35
	Evening	33	50	<35
	Night	33	51	<35

Table 5.11 – Summary of Existing Ambient Background Noise Levels (cont)

Location	Description	Background Noise Level (LA90 dBA) Rating Background Level	Measured Existing LAeq Noise Level (dBA)	Estimated Contribution from Existing Industrial Noise Sources (LAeq(period) dBA)
N3	Daytime	30*	49	<35
	Evening	32	45	<35
	Night	31	49	<35
N4	Daytime	40	58	51
	Evening	41	53	<35
	Night	40	51	<35
N5	Daytime	43	53	<35
	Evening	48	57	<35
	Night	41	56	<35
N6	Daytime	42	52	<35
	Evening	42	52	<35
	Night	38	50	<35
N7	Daytime	34	49	<35
	Evening	33	42	<35
	Night	32	42	<35

Notes:

- For Monday to Saturday, Daytime 7.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm; Night-time 10.00 pm - 7.00 am.
- On Sundays and Public Holidays, Daytime 8.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm; Night-time 10.00 pm - 8.00 am.
- The LA90 represents the level exceeded for 90% of the interval period and is referred to as the average minimum or background noise level
- The LAeq index corresponds to the level of noise equivalent to the energy average of noise levels occurring over a measurement period.
- *RBL adjusted to 30dBA where the measured RBL is less than 30dBA as per INP methodology

The attended noise monitoring indicated that the main noise influences at sites N1, N2, N3 and N7 were typical ‘rural’ noises (wind in the trees, birds, etc.) plus noise from the Main Southern Railway and Hume Highway traffic. Noise monitoring sites N4, N5 and N6 were influenced by noise from the Marulan township, the Main Southern Railway and Hume Highway traffic, generally having higher background noise levels than sites N1, N2, N3 and N7.

5.9.1.2 Relevant Noise Goals

There are a number of different noise criteria that apply to the project, with different criteria applying to noise associated with the normal operation of the quarry; noise from construction activities; rail and road traffic noise; and noise of short duration that could possibly cause sleep disturbance. An overview of the guidelines relevant to these types of noise emissions and the criteria applicable to this project are outlined below.

Operational Noise Criteria

The Industrial Noise Policy (INP) was released by the NSW EPA in January 2000. The INP addresses industrial noise only; it does not address construction or transportation noise other than movements of vehicles and equipment on site. The objectives of the INP are as follows:

- to establish noise criteria that would protect the community from excessive intrusive noise and preserve amenity for specific land uses;

- to use criteria as the basis for deriving project specific noise levels;

- to promote uniform methods to estimate and measure noise impacts, including a procedure for evaluating meteorological effects;

- to outline a range of mitigation measures that could be used to minimise noise impacts;

- to provide a formal process to guide the determination of feasible and reasonable noise limits for consents or licences that reconcile noise impacts with economic, social and environmental considerations of industrial development; and

- to carry out functions relating to the prevention, minimisation and control of noise from premises scheduled under the Act.

The assessment of industrial noise sources in accordance with the INP has two components, assessment of intrusive noise impacts and assessment of noise amenity levels. The intrusiveness and amenity limits applied to a project are derived independently. The intrusiveness criteria is aimed at controlling noise sources such that the impact of the noise from the industrial operation does not exceed the existing background noise levels by more than 5 dB, whereas the amenity criteria is designed to limit continuing increases in noise levels in an area from new industrial noise sources. These amenity and intrusiveness criteria are then compared to determine the Project Specific Operational Noise Goals. The Project Specific Operational Noise Goals reflect the most stringent noise level requirement from the noise goals derived from both the intrusive and amenity criteria. These goals set the benchmark against which noise impacts are assessed. The INP recommends the application of the most stringent requirement as the Project Specific Operational Noise Goal so that both the intrusive noise is limited and amenity is protected. A full explanation of the determination of the relevant noise criteria for this project is provided in **Appendix 10**.

<u>Intrusiveness Criteria</u>

The intrusiveness criterion is expressed as:
$L_{Aeq\ 15\ minute} \leq$ RBL + 5 dBA

Where:
- $L_{Aeq\ 15\ minute}$ is the L_{Aeq} from the source, measured over 15 minutes;
- RBL is the Rating Background Level.

<u>Amenity Criteria</u>

Amenity criteria are set by the INP based on the acoustic classification of the receiver. This classification is based on the acoustic environment existing at that location. The acoustic classification of the seven noise monitoring locations and the 14 noise assessment locations (refer to **Section 5.9.1.3**) are contained in **Table 5.12**.

In accordance with the INP, acceptable noise targets for individual developments are determined so that the total industrial noise does not exceed amenity limits.

Table 5.12 – Acoustic Classification of Noise Monitoring and Assessment Locations

Noise Monitoring Location	Noise Assessment Location	Acoustic classification
N1	1	Rural
N2	2, 3, 12, 13	Rural
N3	4, 5, 6	Rural
N4	7, 8	Suburban
N5	9	Suburban
N6	10	Suburban
N7	11, 14	Rural

Assessing Sleep Disturbance

DEC has acknowledged that the relationship between maximum noise levels and sleep disturbance is not currently well defined. Criteria for assessing sleep disturbance has not been defined under the INP but it is assumed that conformance with the INP would protect against the likelihood of awakening reactions. Notwithstanding this, sleep arousal has been assessed using the guidelines set out in DEC's Environmental Noise Control Manual (ENCM).

To avoid the likelihood of sleep disturbance the ENCM recommends that the $L_{A1(1minute)}$ of the noise source under consideration should not exceed the background noise level (LA90) by more than 15 dBA when measured outside the bedroom window of the receiver during night-time hours (10 pm to 7 am).

Project Specific Operational Noise Goals

The Project Specific Operational Noise Goals have been determined for the project in accordance with the methods discussed above and are outlined in **Table 5.13**. The noise assessment locations are discussed in **Section 5.9.1.3**.

Table 5.13 – Project Specific Operational Noise Goals for Noise Assessment Locations

Assessment Location	Description	Criterion LAeq(15minute) dBA	Sleep Disturbance Criterion LA1(1 minute) dBA
Location 1	Daytime	35	N/A
	Evening	35	N/A
	Night	35	45
Location 2	Daytime	42	N/A
	Evening	38	N/A
	Night	38	48
Location 3	Daytime	42	N/A
	Evening	38	N/A
	Night	38	48
Location 4	Daytime	35	N/A
	Evening	37	N/A
	Night	36	46

Table 5.13 – Project Specific Operational Noise Goals for Noise Assessment Locations (cont)

Assessment Location	Description	Criterion LAeq(15minute) dBA	Sleep Disturbance Criterion LA1(1 minute) dBA
Location 5	Daytime	35	N/A
	Evening	37	N/A
	Night	36	46
Location 6	Daytime	35	N/A
	Evening	37	N/A
	Night	36	46
Location 7	Daytime	45	N/A
	Evening	45*	N/A
	Night	41*	55
Location 8	Daytime	45	N/A
	Evening	45*	N/A
	Night	41*	55
Location 9	Daytime	48	N/A
	Evening	47*	N/A
	Night	46	56
Location 10	Daytime	47	N/A
	Evening	45*	N/A
	Night	40*	53
Location 11	Daytime	39	N/A
	Evening	38	N/A
	Night	37	47
Location 12	Daytime	42	N/A
	Evening	38	N/A
	Night	38	48
Location 13	Daytime	42	N/A
	Evening	38	N/A
	Night	38	48
Location 14	Daytime	39	N/A
	Evening	38	N/A
	Night	37	47

Note: *Derived from the amenity criteria.

Construction Noise Criteria

The ENCM also sets out noise criteria applicable to construction projects for the purpose of defining intrusive noise impacts. Based on the ENCM, the project specific noise limits outlined in **Table 5.14** will apply to the construction phase.

Table 5.14 – Construction Noise Criteria

Total Construction Period	Acceptable LA10 Noise Level[1]
4 weeks and under	Background LA90 plus 20 dBA
4 weeks to 26 weeks	Background LA90 plus 10 dBA
Greater Than 26 Weeks	Background LA90 plus 5 dBA

Note[1]: Applicable between the hours of 7.00 am and 6.00 pm Monday to Friday, and 8.00 am to 1.00 pm Saturdays. For all other times construction noise must be inaudible at the receiver. No audible construction work is to take place on Sundays or Public Holidays.

Rail Traffic Noise Criteria

The guidelines for noise assessment of rail traffic is outlined in the ENCM, which provides criteria for residential receivers specified as both a 24 hour L_{Aeq} and as a maximum passby level, neither of which should be exceeded. This guideline will apply to rail movements associated with the project and gives maximum levels of:

$L_{Aeq\ 24\ hour}$ = 60 dB(A) (24 hour "noise exposure")

LA_{max} = 85 dB(A) (maximum of any passby event)

Road Traffic Noise Criteria

DEC (then the EPA) released the Environmental Criteria for Road Traffic Noise (ECRTN) in May 1999. This document sets out noise criteria applicable to different road classifications for the purpose of defining traffic noise impacts.

The primary transport route to the site will be via an internal access road to the Hume Highway. Access to the project area during construction will utilise the local road network. The noise limits for the arterial and local roads used to access the site are outlined in **Table 5.15**.

Table 5.15 – Criteria for Road Traffic Noise

Policy	Descriptor	Traffic Noise Goal
7. Land use developments with the potential to create additional traffic on existing freeways/arterials	$L_{Aeq(15hour)}$ daytime $L_{Aeq(9hour)}$ night-time	60 dBA* 55 dBA*
13.Land use developments with the potential to create additional traffic on local roads	$L_{Aeq(1hour)}$ daytime $L_{Aeq(1hour)}$ night-time	55 dBA* 50 dBA*

* In all cases (where criteria are already exceeded, or where existing noise levels are within 2 dBA of the criterion), traffic arising from the development should not lead to an increase in existing noise levels of more than 2 dBA.

While no well defined sleep disturbance criteria applicable to road traffic exists in NSW, the RTA recognises that events likely to cause sleep arousal can occur and are dependent on both the maximum noise level of the source and the ambient background noise level at the residence. Where the L_{Amax} noise level is greater than 65 dBA and the L_{Amax} minus the L_{Aeq} noise level is greater than or equal to 15 dBA the event is recognised as a "significant" event, or an event likely to cause sleep disturbance at a residence.

The assessment of traffic noise impact needs to consider the likelihood of sleep disturbance in relation to these criteria.

5.9.1.3 Quarry Noise Impact Assessment

The potential for noise impacts was identified early in the EIA process and consequently extensive iterative modelling was conducted in order to determine potential noise impacts and refine the design of the quarry and quarry infrastructure, and to determine additional noise management measures required to be implemented for the project. This section outlines the noise modelling method and assessment results.

Prediction Method

Noise levels were predicted using the Environmental Noise Model (ENM) to determine the acoustic impact of quarrying and associated activities. This model takes into account geometric spreading, atmospheric absorption, barriers and ground attenuation. The model was based on mobile equipment and plant sound power level data, which included the number and type of mobile equipment, noise specifications and likely positioning based on each quarry stage plan.

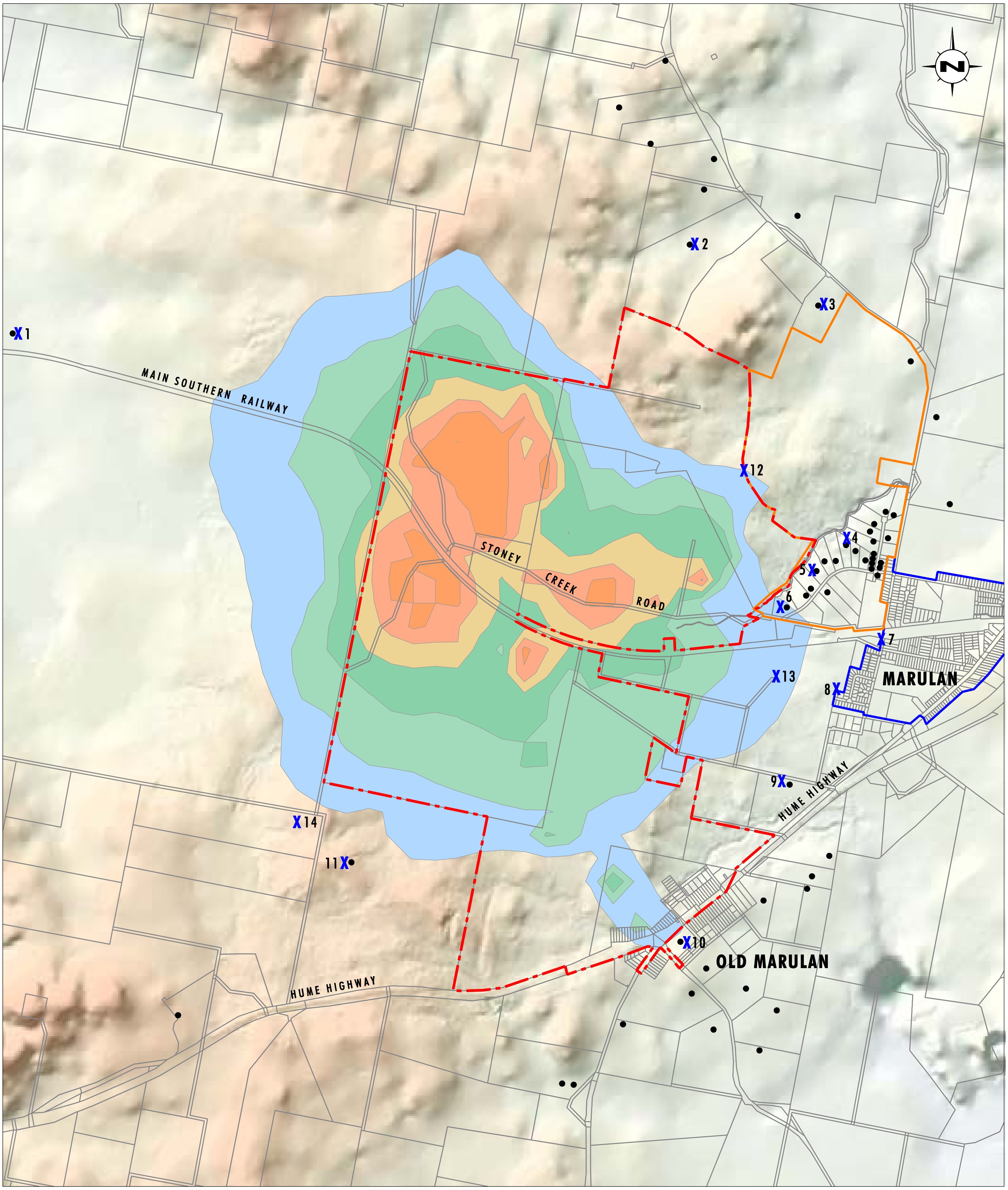
The ENM calculates noise levels at specified receiver locations (single point calculation) and generates noise level contours over a defined area (contour calculation). The single point feature of ENM was used to assess impacts at the nearest residential receptors and other potentially sensitive locations (i.e. areas approved or proposed for future residential or rural residential development). Fourteen assessment locations (single point calculation locations) were selected to be used in the noise impact assessment, with these 14 locations shown on **Figure 5.22**.

Six representative operational scenarios were selected for modelling: Years 1, 5, 10, 15, 20 and 30. For each of these scenarios, a digital landform created from the existing topography combined with the staged quarry landform was input into the model. The location of fixed infrastructure and the mobile equipment were then entered into the model with mobile equipment placed in strategic locations to represent the typical operations of the quarry at each stage. Typical noise levels produced by each piece of equipment were then used to generate predicted noise levels at receiver locations and noise contours for the six meteorological scenarios detailed in **Table 5.16**.

Table 5.16 – Meteorological scenarios used in noise modelling

Assessment Condition	Temperature °C	Wind Speed Direction (m/s)	Relative Humidity (%)	Temperature Gradient °C/100m
Calm	20	Calm	65	0
Evening Prevailing Westerly Wind	10	2.5 m/s	80	0
Night Prevailing Westerly Wind	4	2.5 m/s	90	0
Temperature Inversion	4	Calm	90	-3
Temperature Inversion and Drainage Flow from the South East	4	2.0 m/s	90	-3
Temperature Inversion and Drainage Flow from the North West	4	2.0 m/s	90	-3

Umwelt
Environmental Consultants



Source: Richard Heggie Associates Pty Ltd
Base Source: LPI 2004

0 0.5 1 2km

Legend

- Project Area
- X 1 Noise Assessment Location
- ● Residence
- Marulan Residential Area
- Marulan Rural Residential Area

Noise Level dBA

- 65
- 60
- 55
- 50
- 45
- 40
- 35

FIGURE 5.22

Predicted Noise Contours during Calm Meteorological Conditions, Year 10

File Name (A4): R03_V1/1829_271.dgn

Noise Management Controls Included in Modelling

As discussed in **Section 6.2**, preliminary noise modelling was a key factor in the finally selected quarry plan and infrastructure layout, with a number of additional engineering and management controls also developed to minimise noise impact. Controls taken into account in the noise models include:

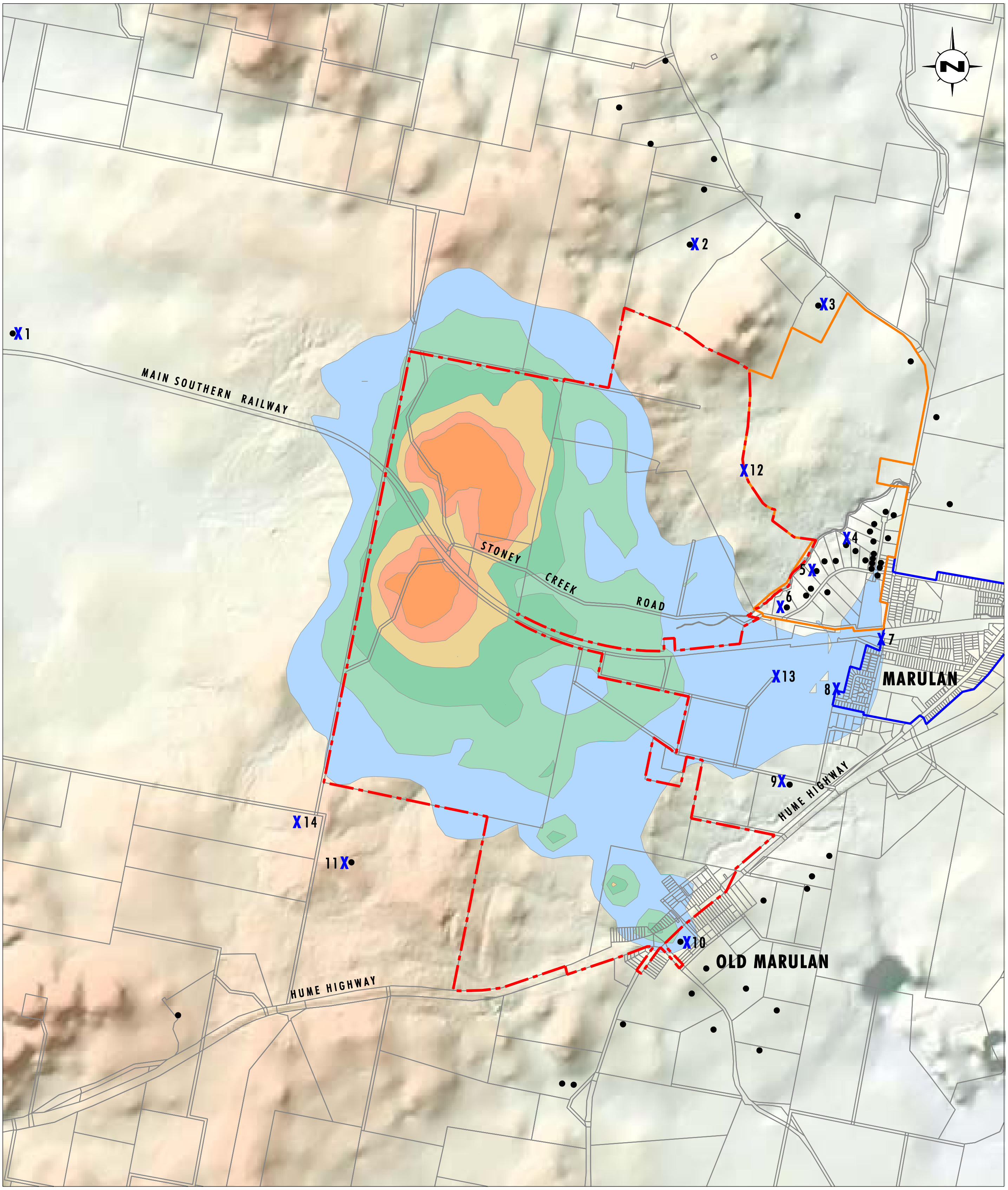
- all crushing and screening facilities are enclosed by buildings, except for the primary gyratory crusher and spalls plant;
- the spalls plant has rubber screen mats;
- the pug mills are enclosed by buildings;
- train and truck loading bins are lined on the base to reduce impact noise when bins are being loaded from empty;
- trucks dumping the leading row of overburden on the Eastern Overburden Emplacement Area will have attenuation to a maximum sound power level of 111 dBA when dumping;
- the spalls plant will operate during the daytime only;
- the grader will operate during the daytime only;
- the clearing and topsoil stripping fleet will operate during the daytime only;
- the overburden removal and emplacement fleet will operate during the daytime only;
- when operating on eastern emplacement areas, the majority of operations occurring on the top of the emplacement areas will occur behind an earth mound created on the eastern edge of the emplacement area by the first row of dumping;
- the load and haul fleet will operate during the daytime and evening only;
- no dumping on the leading edge of either the Eastern Overburden Emplacement Area or the Eastern Excess Product Emplacement Area will occur while the dozer is operating on the leading face of either of the aforementioned emplacement areas;
- the number of product trucks leaving the quarry at night will be limited to a maximum of 32 movements per hour.

Project Specific Operational Noise Impacts

The noise modelling results found that the proposed quarry is predicted to meet all project specific noise criteria for operation during daytime, evening and night-time periods at all residential locations under calm, prevailing wind and temperature inversion / drainage flow weather conditions with the abovementioned noise controls in place. The single point calculations and predicted noise contours for each stage are included in **Appendix 10**, with representative worst-case noise contours for each meteorological scenario included as **Figures 5.22** to **5.24**. Predicted noise results are L_{Aeq} in accordance with INP requirements.

Figure 5.22 shows the predicted noise contours during calm meteorological conditions (daytime operations) in Year 10. Year 10 is generally a worst-case scenario for the majority of residential receivers as at this stage overburden emplacement is occurring on the Eastern

Umwelt
Environmental Consultants



Source: Richard Heggie Associates Pty Ltd
Base Source: LPI 2004

0 0.5 1 2km

Legend

- Project Area
- X 1 Noise Assessment Location
- Residence
- Marulan Residential Area
- Marulan Rural Residential Area

Noise Level dBA

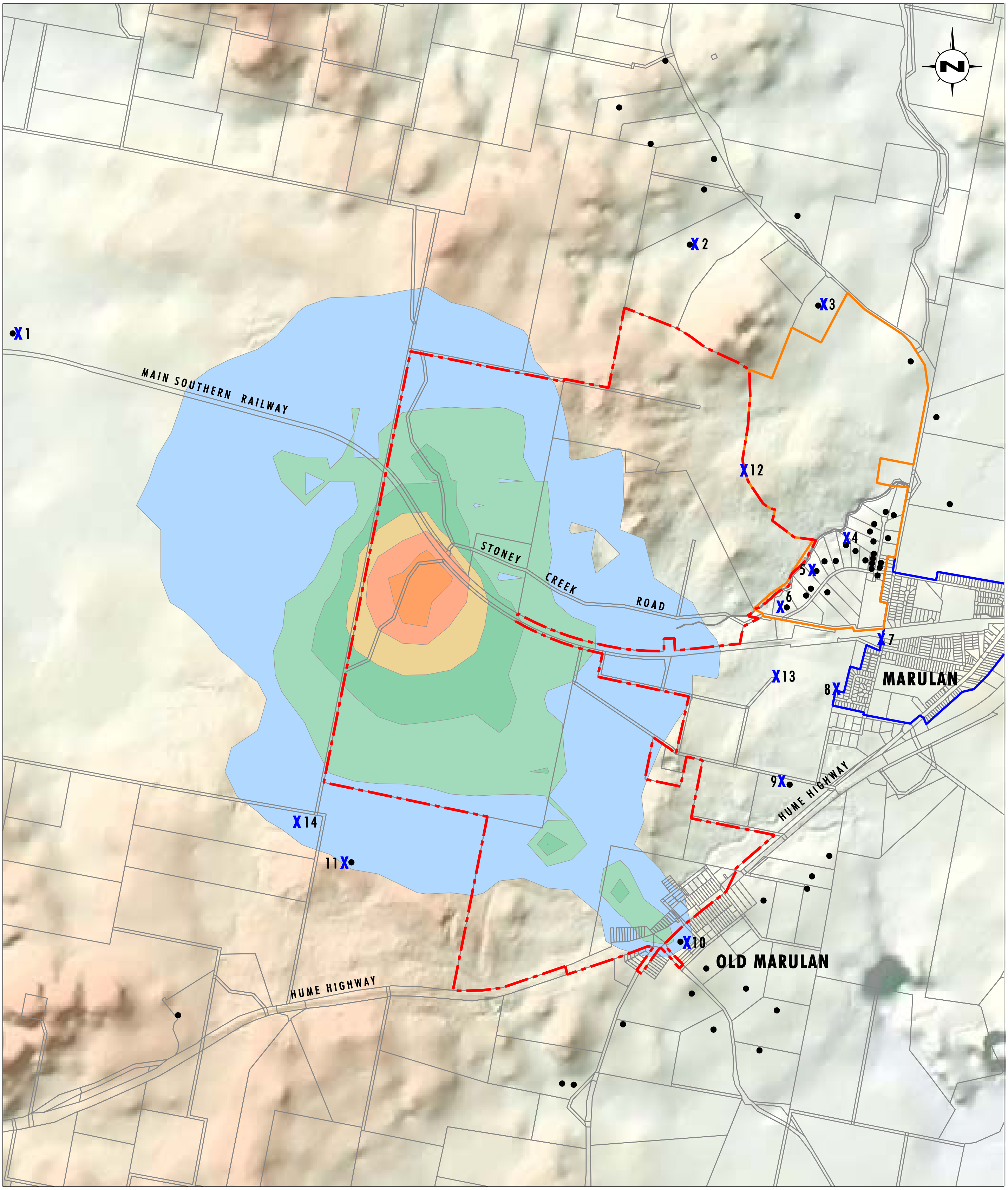
65
60
55
50
45
40
35

FIGURE 5.23

Predicted Noise Contours during Prevailing Evening Wind Conditions, Year 10

File Name (A4): R03_V1/1829_272.dgn

Umwelt
Environmental Consultants



Source: Richard Heggie Associates Pty Ltd
Base Source: LPI 2004

0 0.5 1 2km

Legend
- Project Area
- X 1 Noise Assessment Location
- Residence
- Marulan Residential Area
- Marulan Rural Residential Area

Noise Level dBA
65
60
55
50
45
40
35

FIGURE 5.24

Predicted Noise Contours during Temperature Inversion Conditions, Year 1

File Name (A4): R03_V1/1829_273.dgn

Overburden Emplacement Area and emplacement of excess product is occurring on the Eastern Excess Product Emplacement Area. In Year 10 the quarry has also developed to almost its full footprint, with the majority of quarrying being undertaken in the upper benches. **Figure 5.23** shows the predicted noise contours during prevailing evening wind conditions in Year 10. **Figure 5.24** shows the predicted noise contours during temperature inversion conditions during Year 1. As temperature inversion conditions occur at night and night-time operations will only consist of activities in the infrastructure area, Year 1 is a worst-case during night-time conditions as subsequent years have additional topographical screening between the infrastructure area and residential receivers due to the modified quarry landform.

The noise predictions indicate that the quarry will not cause noise levels above the relevant criteria at any residences or approved future residential locations. A vacant property is considered to be noise affected if greater than 25% of that property will be impacted above the relevant criteria. Potentially noise affected properties (refer to **Figure 5.22**) include:

- property 93 in most years of operation. Property 139 is a small parcel of land (7.4 hectares) adjacent to the Main Southern Railway which is heavily vegetated. The property is zoned 1 (a) General Rural and currently does not appear to be used for any specific land use; and

- property 27 under evening prevailing wind conditions in Years 1, 10 and 20. Property 49 is a heavily vegetated parcel of land adjoining the northern boundary of the project area. The property is zoned 1 (a) General Rural and currently does not appear to be used for any specific land use.

Noise modelling was conducted for sleep disturbance using the L_{A1} noise level of truck loading and train loading from each of the loading bins. The loading of trucks and the rail bins was considered to have the greatest potential for sleep disturbance. Modelling was conducted for acoustically adverse weather conditions, including temperature inversion and relevant drainage flow winds. Predictions were done for Year 1 which is the worst-case for night-time operations as discussed above. The modelling predicted that $L_{A1(1minute)}$ noise levels will be below project specific sleep disturbance goals for night-time operation of the quarry at all assessment locations. This being the case, sleep disturbance is unlikely to occur at residential locations surrounding the proposed quarry.

Construction Noise

Two construction scenarios were selected for modelling of construction noise impact, being the earthworks and the foundation works. These stages were selected as they require the largest usage of plant and equipment and therefore represent the worst-case construction scenarios.

The construction earthworks scenario involved construction equipment operating at the proposed location of the infrastructure area to level the area in preparation for foundations. Similarly, the worst-case foundation works scenario will occur for the eastern-most buildings.

Modelling of the earthworks and foundation construction stages found that noise levels for both construction stages are predicted to meet all construction noise goals at all residential locations (refer to **Appendix 10**).

Rail Traffic Noise

Rail noise predictions were made for the existing rail traffic flow on the Main Southern Railway plus six return rail trips from the project area (predicted average trips are four per day). The assessment only considers train noise when they rejoin the Main Southern

Railway as noise associated with the loading and despatch of trains within the confines of the on-site rail loop are considered as part of the operational noise modelling for the project area.

The noise from rail traffic was predicted at 25 metres, 50 metres and 100 metres distance from the rail line to account for possible closer residential receivers than those in the vicinity of the proposed quarry.

Calculation of the 24 hour equivalent noise level ($L_{Aeq(24\ hour)}$) and the maximum (L_{Amax}) passby noise levels indicate that the proposed quarry rail movements (at six trains per day) will increase the $L_{Aeq\ (24\ hour)}$ noise level by approximately 0.6 dBA. The L_{Amax} noise level would remain unchanged. The contribution of Lynwood Quarry's rail movements is predicted to meet DEC's $L_{Aeq\ (24\ hour)}$ criterion of 60 dBA and the L_{Amax} criterion of 85 dBA at a distance of 25 metres. The predicted increase of noise emissions from total rail movements on the Main Southern Railway of 0.6 dBA would be imperceptible to residential receivers along the rail line.

Road Traffic Noise

Construction Road Traffic Noise

Construction road noise modelling was undertaken for the predicted busiest period of construction, allowing for up to 135 vehicle trips (i.e. 270 movements) a day (including 18 heavy vehicle trips). The assessment was based on the proposed construction access route discussed in **Section 3.3.1**, with the nearest potentially affected residential receiver approximately 40 metres from the route. There is also an existing residence on Wilson Drive, however, this land is proposed for future industrial development and Readymix has reached an agreement with the owner regarding the construction period.

Modelling of construction road traffic found that the traffic noise level from vehicles accessing the project area during the peak of construction is predicted to be below the ECRTN limit for traffic generated on a local road of $L_{Aeq\ (1hour)}$ 55 dBA.

Operational Traffic Noise

Modelling of operational traffic noise impacts was conducted using traffic noise levels measured during operator attended surveys, as input into the United States Federal Highways road traffic noise model (USFH) to compare existing and future traffic noise levels. The USFH method for prediction of $L_{Aeq(period)}$ road traffic noise levels is an internationally accepted theoretical traffic noise prediction model which takes into account the L_{Amax} noise levels of vehicles, receiver offset distance, passby duration, vehicle speed, ground absorption (based on the ratio of soft ground and average height of propagation), number of hourly vehicle movements, receiver height, truck exhaust height and the height and location of any intervening barriers.

The proposed vehicle movements at peak production and road transport levels are discussed in **Section 5.5.1**. When the proposed quarry is operating at this peak transport level, the increase in traffic noise on the Hume Highway is predicted to be between $L_{Aeq(15hour)}$ daytime 0.2 dBA and $L_{Aeq(9hour)}$ night time 0.4 dBA. These predicted increases are considered to be imperceptible to receivers along the roadway and are also within the 2 dBA increase in $L_{Aeq(period)}$ noise level allowable under the ECRTN.

It should be noted that traffic on the access road from the quarry infrastructure area to the Hume Highway was considered as part of the operational noise assessment. These traffic movements are subject to more stringent noise criteria than vehicles on the Hume Highway.

Cumulative Noise Impact Assessment

Potential cumulative noise impacts resulting from the project and other industrial noise sources have been determined in accordance with DEC's INP. Cumulative noise impacts from existing and successive developments are embraced by the INP procedures by ensuring that the appropriate noise emission criteria are established with a view to maintaining acceptable noise amenity levels for residences. The cumulative impact of the project was therefore assessed by determination of the amenity noise levels discussed in **Section 5.9.1.2**.

The only location where existing industrial noise was evident during background noise monitoring was noise monitoring location N4. Noise from an existing industrial source (fertiliser handling facility) at this location was measured during the daytime at $L_{Aeq(15\ minute)}$ 51 dBA, with no contribution during the evening or night-time periods. The noise level from the project area at location N4 is predicted to be less than $L_{Aeq(15\ minute)}$ 30dBA during daytime. This is more than 20dBA below the existing L_{Aeq} industry noise, meaning it would not contribute to the cumulative industrial noise level of the area.

The project will not therefore significantly add to noise impacts from existing industrial developments, complying with the relevant amenity criteria at all receiver locations.

5.9.2 Blasting Assessment

Richard Heggie Associates also undertook a detailed blasting impact assessment for the project, with the results of this assessment contained within **Appendix 10**. A summary of the key findings of the blasting assessment are included below.

5.9.2.1 Proposed Blasting Practice

Explosives are used in quarrying in order to dislodge overburden and raw feed to enable the extraction of the resource. To achieve this, holes are drilled in a designed pattern giving strict attention to their angle, depth and spacing. These holes are then filled with an explosive charge consisting of an emulsion type explosive. The charge is initiated with the aid of primers and detonators. The detonation of each hole is delayed in a pre-designed sequence to ensure that each hole is fired individually in close succession. This delayed firing technique improves the efficiency of the blast and also reduces its environmental impacts.

The design of a blast depends on its location, geological structures in that area, volume of resource in the target area and any limiting factors in relation to potentially sensitive locations (including residences and infrastructure). Blast design is therefore completed on a blast by blast basis, ensuring that all these factors are considered and ensuring that the blast impacts remain within acceptable limits. Readymix provided typical blast design parameters for use in the assessment. These standard design parameters are included in **Table 5.17**.

Table 5.17 – Typical blast design parameters

Blast Design Parameter	Typical Dimension
Number of holes/rows	Up to 300
Hole diameter / Hole inclination	89 to 115mm / 10^{o}
Bench height	15 m
Burden	2.8 m (for 89 mm hole diameter)
Spacing	3.0 m (for 89 mm hole diameter)
Subdrill	1.0 m

Table 5.17 – Typical blast design parameters (cont)

Blast Design Parameter	Typical Dimension
Stemming length	2.8 m
Delay timing	None (single hole per delay)
Column explosive	Emulsion
Maximum Instantaneous Charge (MIC)	100 kg to 160 kg per hole

In order to provide local information for input into the blasting predictive model, an analysis of four years blast emission data from Readymix's nearby Johniefelds Quarry was undertaken. The analysis of this data assisted in the development of blasting site laws for use in impact predictions. As Johniefelds Quarry extracts the same body of resource as the proposed Lynwood Quarry, it is considered that this historical blasting data provides valuable local context for use in blasting predictions.

5.9.2.2 Blast Impact Assessment Criteria

Criteria for Residential Receivers

DEC has guidelines for blasting based on human comfort levels. These guidelines have been adapted from the ANZECC Guidelines "*Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration*". These criteria are detailed below.

Blasting Overpressure

The recommended maximum level for airblast is 115 dB Linear Peak. This level may be exceeded on up to 5% of the total number of blasts over a period of 12 months, however, the level should not exceed 120 dB Linear Peak at any time.

Ground Vibration

The recommended maximum level for ground vibration is 5 mm/s peak particle velocity (ppv). The ppv level of 5 mm/s may be exceeded on up to 5% of the total number of blasts over a period of 12 months, however, the level should not exceed 10 mm/s at any time.

Criteria for Infrastructure

Ground vibration criteria are also applied to infrastructure to prevent structural damage. The closest infrastructure, not owned by Readymix, that may be susceptible to vibration impacts are the Main Southern Railway (including bridges and culverts), the natural gas pipeline and the potable water tank proposed to be located in the northeast of the project area (refer to **Section 5.5.3**). Appropriate criteria have been determined for each of these structures and are discussed below.

Main Southern Railway and Water Tank

In order to assess the impact on these structures, the British Standard 7385: Part 2-1993 "*Evaluation and measurement for vibration in buildings Part 2*" was deemed the most appropriate. This standard provides criteria against which the likelihood of building damage from ground vibration can be assessed. It is consistent with Australian Standards related to ground vibration effects, however it also includes an allowance for resonance, making it more conservative than the Australian Standard.

The recommended limits for transient vibration to ensure minimal risk of cosmetic damage to *reinforced or framed structures – industrial and heavy commercial buildings* is 50 mm/s at 4 Hz and above. To provide a conservative estimate for structures that may experience resonance effects, a 50% reduction factor should be applied, resulting in a criterion of 25 mm/s at 4 Hz and above.

The conservative criterion of 25 mm/s has been adopted for this project.

Natural Gas Pipeline

No relevant Australian Standard exists for vibration impacts on pipelines, with an international standard therefore adopted for this assessment. Guideline vibration limits for the gas pipeline have been determined in accordance with German Standard DIN 4150-3 1999 "*Effect of Vibration on Structures*". From this standard, the values for evaluating the effects of short-term vibration on buried pipework are considered appropriate. The relevant limits are detailed in **Table 5.18**.

Table 5.18 – Guideline Vibration Values for Evaluating Effects of Short-Term Vibration on Buried Pipework

Pipe Material	Guideline Values for velocity measured on the pipe in mm/s
Steel (including welded)	100
Clay, concrete, reinforced concrete, pre-stressed concrete, metal (with and without flange)	80

5.9.2.3 Blast Impact Assessment

Residential Receivers

Airblast and ground vibration were predicted using the developed site laws for the project area for Years 1, 5, 10, 15, 20 and 30 of the proposed quarry. The resulting airblast and vibration levels were calculated for the same 14 assessment locations used in the noise assessment (refer to **Section 5.9.1**). The predictions reflected the worst-case airblast and vibration levels that would be experienced for each of the quarry stages modelled.

The assessment of blasting impact on residential receivers predicted that airblast and ground vibration will comply with the ANZECC/DEC criteria at all surrounding residential receivers for each stage of development. In order to ensure compliance, MIC limits of between 100 kg and 160 kg will be initially applied to the blast design, depending on distance from the nearest residential receiver and on which bench the blast is occurring. This does not place a significant constraint on the operation of the quarry but will be regularly reviewed and refined in order to optimise blast design. During the life of the quarry, higher MICs may be applicable depending on changing technology, refined site laws, and based on actual monitoring results.

Infrastructure

Airblast and ground vibration levels at potentially sensitive infrastructure were also predicted using the developed site laws for the project area. As for the residential receivers, predictions were made for Years 1, 5, 10, 15, 20 and 30 of the proposed quarry. The predictions reflected the worst-case airblast and vibration levels that would be experienced for each of the quarry stages modelled.

The assessment found that predicted vibration level at the closest point of the quarry to the natural gas pipeline and proposed drinking water holding tank will be below the level likely to cause impact on these structures (based on an MIC of 160 kg). The assessment also found that vibration levels at the Main Southern Railway will be below the level likely to cause impact, however, control of MIC values will be required when blasting in parts of the quarry close to the railway. Based on current site laws, MIC values will need to be limited to 80 kg in some locations in Year 1, 105 kg in some locations in Year 5 and 130 kg in some locations in other years. These MIC limits do not place a significant constraint on the operation of the quarry but will be refined as the quarry develops.

5.10 Heritage Assessment

5.10.1 Aboriginal Archaeology

A comprehensive Aboriginal archaeological and cultural heritage assessment has been undertaken for the project in accordance with DEC guidelines and in consultation with representatives of the local Aboriginal community. The Aboriginal archaeology assessment report is included as **Appendix 11**, with a summary included in this section.

5.10.1.1 Aboriginal Consultation

The project area falls within the boundaries of a Native Title application which was lodged by the Gundungurra Tribal Council Aboriginal Corporation #6 (GTCAC) on 29 April 1997. The project area also falls within the boundaries of the Pejar Local Aboriginal Land Council (PLALC). The GTCAC and PLALC were therefore contacted regarding the project, with representatives participating in the field survey and providing feedback on Aboriginal cultural heritage values of the project area and sites/objects located within the project area.

Following the completion of the field survey, a draft Aboriginal archaeology assessment report was prepared and provided to both the GTCAC and PLALC, so that they could comment on the report and provide any further feedback on Aboriginal cultural heritage values. The comments received were then incorporated into the Aboriginal cultural heritage component of the report and the management recommendations reviewed in light of the comments. The comments received on the draft report from the Aboriginal community are included as an appendix to the assessment report (refer to **Appendix 11**).

5.10.1.2 Previous Archaeological Survey and Assessment

There have been a number of archaeological assessments carried out in the general Marulan area over the last 25 years. A DEC/AHIMS (Aboriginal Heritage Information Service) Site Register search was undertaken for an area approximately 20 km^2 centred on the project area. Twenty-nine previously recorded sites were identified by this search. A review of available previous survey and assessment reports was also undertaken. This review identified an additional three isolated find sites recorded by Navin (1990) and a quarry site that do not appear in the register. Five of the previously recorded sites (two artefact scatters and three isolated finds) are within the project area.

Of the sites previously recorded within the Marulan area, open camp sites (artefact scatters) are the most common site (22) followed by isolated finds (10). Sites were most often located within 50 metres of creeklines (53%) and often directly adjacent to creek lines on elevated terraces. Sites were also relatively common on ridge crests and saddles and on spur slopes.

5.10.1.3 Survey Methodology and Results

A field survey was undertaken by Umwelt's Aboriginal archaeologists and representatives of the local Aboriginal community, between 26 July and 6 August 2004. The survey was carried out on foot with participants walking at approximately 15-20 metre intervals inspecting all areas of ground surface visibility. The survey strategy was formulated in light of the predictive model developed prior to the survey, and was designed to assess all landforms with a high potential for sites and a representative sample of all other landform units. The survey covered the entire project area, including the creek systems and a representative sample of the crests, saddles and slopes.

The survey recorded a total of 52 previously unrecorded sites, 50 of which were situated within the project area. (Note: two sites were later found to be outside the project area, with some property boundaries not formally marked at the time of the survey.) Of the sites recorded, 29 were artefact scatters (with two or more artefacts), 12 were isolated finds, seven were scarred trees and two were stone arrangements. The locations of the sites recorded by the survey, plus previously recorded sites, are shown on **Figure 5.25**. A detailed description of each site is included in **Appendix 11**. Including four of the five sites previously recorded within the project area (one of the sites MQ2 was re-recorded as MRN5), a total of 54 sites occur within the project area.

5.10.1.4 Significance Assessment

The assessment of significance of Aboriginal sites has two defined components: cultural significance, which is determined by the Aboriginal community, and archaeological / scientific significance, which is determined by an archaeologist based on the ability of the site to contribute to scientific understanding of Aboriginal culture prior to European settlement. These two components are not interrelated, with sites potentially having different cultural and scientific significance values.

Aboriginal Cultural Significance

Aboriginal cultural significance can only be assessed by the relevant Aboriginal community groups and as discussed above, often varies from that of archaeological/scientific significance.

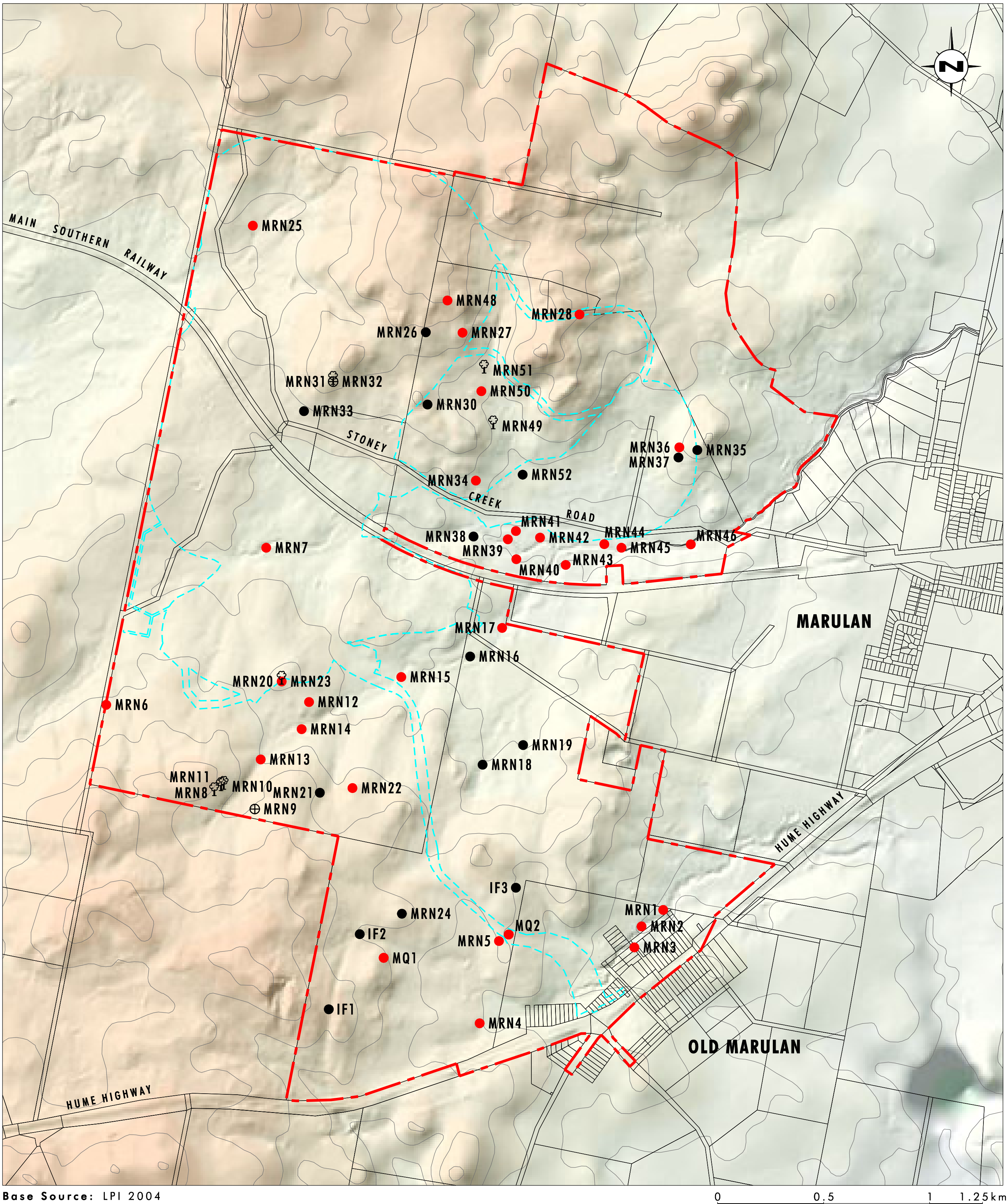
Of the sites in the project area, the Aboriginal community have assessed 33 to be of low cultural significance, 13 of moderate cultural significance, five of moderate-high cultural significance and three of high cultural significance. A stone arrangement (MRN9) was identified by the Aboriginal community as having played a role in male initiation and was therefore assessed as having the highest Aboriginal cultural heritage significance. The scarred trees and artefact scatters located within the general vicinity of MRN9 had their Aboriginal cultural significance increased to moderate to high or high due to their relationship to what was seen as an important ceremonial site. The remainder of the scarred trees were assessed as having moderate or moderate to high Aboriginal significance. One artefact scatter (MRN27) was assessed as having high Aboriginal significance.

Archaeological/Scientific Significance

The archaeological or scientific significance of Aboriginal sites was also assessed according to their value to contribute to furthering the archaeological/scientific understanding of Aboriginal culture.

One stone arrangement (MRN32) and three of the scarred trees (MRN31, 49 and 51) were not assessed as being archaeological sites but were recorded in line with the wishes of the Aboriginal community. These sites have been assessed as having no archaeological

Umwelt
Environmental Consultants



Legend
- Project Area
- Approximate Disturbance Footprint
- Artefact Scatter
- Isolated Find
- Stone Arrangement
- Scarred Tree

FIGURE 5.25

Aboriginal Sites within the Project Area

File Name (A4): R03_V1/1829_241.dgn

significance. The remaining sites were assessed for archaeological/scientific significance based upon the following criteria:

- rarity;
- representativeness;
- integrity;
- connectedness;
- complexity; and
- potential archaeological deposit (PAD).

A detailed description of these criteria and the determination of archaeological significance is included in **Appendix 11**.

Of the sites located within the project area, eleven sites were assessed as being above overall low archaeological significance. These sites include the stone arrangement MRN9, the scarred trees MRN8, 10, 11 and 23, the artefact scatter sites MRN27, 28, 48 and 50 and the isolated find sites MRN26 and 30.

The scarred trees and stone arrangement (MRN 9) had the highest archaeological significance (moderate or moderate to high) mainly derived from their rarity, representativeness, integrity and connectedness.

The isolated finds and artefact scatter sites gained the majority of their archaeological significance due to their unusual geological location (rarity and representativeness), and in some cases due to their complexity. The degree of prior disturbance (including extensive wombat burrowing) within the project area has resulted in an overall lack of site integrity for these sites. Thus none of the isolated finds or artefact scatter sites have high research potential. It is, however, considered that as so little is actually known about the Aboriginal use of this area, further investigation at sites located within the proposed disturbance area and with the highest potential for complexity, is warranted.

All of the sites located within the project area are assessed as having low archaeological significance for PAD on a local and regional scale. The lack of PAD in the area of the stone arrangement and scarred trees limits their potential for research, though it does not limit their Aboriginal cultural heritage or conservation value.

The rarity of the stone arrangement site (MRN9) indicates that its conservation is warranted along with the scarred trees in that general area (MRN8, 10, 11 and 23).

5.10.1.5 Impact of the Project

Of the 54 known sites within the project area, only 14 will be impacted by the proposed quarry and associated infrastructure after 30 years of operation. These 14 sites are listed in **Table 5.19**.

Table 5.19 – Aboriginal Sites Impacted by the Proposed Quarry

Site Type	Site
Stone Arrangement	MRN32
Scarred Tree	MRN31
Artefact Scatter	MRN5 (MQ 2), MRN7, MRN25, MRN27, MRN28, MRN36, MRN48
Isolated Find	MRN26, MRN33, MRN35, MRN37, MRN52

All four site types located during the survey are represented by the sites that are within the proposed area of impact, as well as by the sites outside the area of impact. Of the rarer site types (scarred trees and stone arrangements), the scarred tree (MRN31) and the stone arrangement (MRN32) that will be impacted by the development, were not assessed as archaeological sites and were only recorded in accordance with the wishes of the Aboriginal community representatives. It is also noted that the scarred tree recorded as MRN31 is dead. The scarred trees and the stone arrangement outside the area of impact were, however, assessed as archaeological sites.

Of the 14 sites to be impacted by the project, 10 sites are of low Aboriginal significance, three of moderate significance and one of high significance. The majority of sites with moderate to high Aboriginal significance are located within areas that will not be impacted by the project. In addition, Readymix proposes to establish a Cultural Heritage Management Area to protect and manage the sites within the area identified by the Aboriginal community as containing a complex of inter-related sites of high Aboriginal cultural heritage significance.

In relation to archaeological significance, of the 14 sites to be impacted by the proposed quarry, eight have low significance, three have low to moderate significance and one has moderate significance (MRN27). Of these sites, only one (MRN27) has sufficient complexity to have research potential.

5.10.1.6 Aboriginal Heritage Management Options

A number of options are available for management of Aboriginal sites within the project area. These options are listed below and discussed in detail in **Appendix 11**.

- Option 1: site conservation - conserve all or a selected number of Aboriginal sites/areas within the project area;
- Option 2: site destruction without salvage;
- Option 3: site destruction with salvage (surface collection);
- Option 4: site destruction with salvage (sub-surface salvage);
- Option 5: Section 90 consent with salvage (scarred tree removal); and
- Option 6: subsurface testing.

Recommendations as a result of the analysis and discussion of these options are briefly outlined below and discussed in greater detail in **Section 7.2.7**.

- The preparation and implementation of an Aboriginal Cultural Heritage Management Plan (ACHMP) to ensure the ongoing management/protection of Aboriginal sites/values within the project area during the life of the quarry.

- A number of sites will be conserved as part of a Cultural Heritage Management Area (refer to **Figure 5.26**). Other significant sites (MRN20 and 23) will be conserved within a fenced area with an appropriate buffer zone to developed areas.

- The known sites and those areas which will not be directly or indirectly impacted by the quarry or its infrastructure will be managed to conserve their cultural heritage sites/values. The *in situ* management of these sites and areas will be detailed in an ACHMP.

- A number of other sites will be subject to Section 90 consent applications (some with salvage some without salvage) made to the Director-General of DEC. Readymix will require Section 90 consent for any sites located within the area of impact. As Section 90 consents have a life of two years, the initial Section 90 consent application will be for those areas to be impacted by the construction phase (first two years), initial quarry development and the clearing of vegetation from the Railway Overburden Emplacement Area (first three years). Applications for Section 90 consents can then be staged as the development progresses. The details of the Section 90 salvage operations will be determined in consultation with the relevant Aboriginal community groups and DEC as part of the permit application process.

- A Section 87 Preliminary Research Permit application will be made to the Director-General of DEC to allow Aboriginal monitoring of initial ground disturbance works in the areas of Joarimin Creek and Marulan Creek to be crossed by the access road.

The implementation of these recommendations to the sites within the project area is shown on **Figure 5.26**.

5.10.2 Historic Heritage

A comprehensive assessment of historic (non-indigenous) archaeology has been undertaken as part of the project within the framework of the *NSW Heritage Manual* published by the NSW Heritage Office and DIPNR. The full assessment report is provided as **Appendix 12**, with the main findings summarised below.

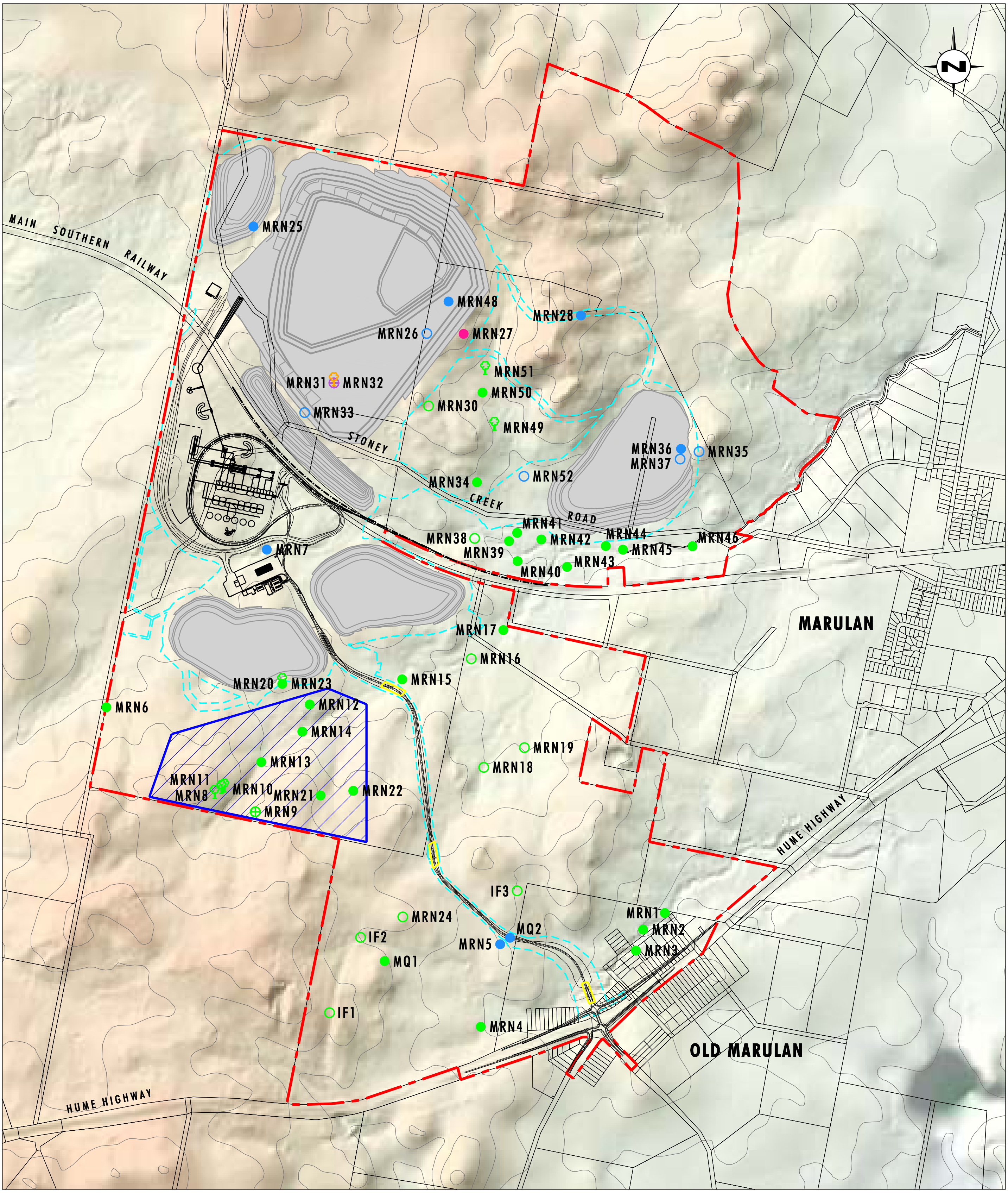
5.10.2.1 Historical Context

Historical records associate the Marulan area with expeditions in the late eighteenth century and early nineteenth century for the purpose of finding land suitable for grazing and agricultural expansion south of the “exhausted” Sydney settlement. The first land grants for the “New Country” were offered in late 1820 by Governor Macquarie, with improvements to transport routes shortly following settlement of the area. By 1830 Surveyor General Major Thomas Mitchell had surveyed the newly settled area and marked out the line of the Great South Road (now known as the Hume Highway) and associated branch roads (Eddy, 1985:28). Five years later in 1835 there were convict work parties employed on the length of the South Road from Liverpool to Marulan (Sargent, 2003).

The junction of the Great South Road and the road to Bungonia was identified by Mitchell as a suitable location to serve travellers on the new roads, with the site of the new village named Marulan. The layout of the village was approved in 1834 and notified in the Government Gazette in 1835. Mitchell saw the function of Marulan as a wayside settlement and selected a site where traffic would be greatest and where fresh water would be available. By 1838, Marulan boasted an inn, a blacksmiths and a post office which served the basic needs of travellers.

By 1868, the construction of the Main Southern Railway was completed. The railway passed approximately 2.5 kilometres to the north of the Marulan village, eliminating much of the

Umwelt
Environmental Consultants



Base Source: LPI 2004, Readymix Holdings Pty Ltd

0 0.5 1 1.25km

Legend

- Project Area
- Cultural Heritage Management Zone
- Approximate Disturbance Footprint
- Artefact Scatter
- Isolated Find
- Stone Arrangement
- Scarred Tree

Management Recommendations

- Managed In-situ
- Section 90 Consent with Collection
- Section 90 Consent with Subsurface Salvage
- Section 90 Consent for Scarred Tree Removal
- Section 90 Consent without Salvage
- Section 87 Permit for Monitoring of Access Track Construction

FIGURE 5.26

Recommended Management Measures for Aboriginal Sites

File Name (A4): R03_V1/1829_242.dgn

through traffic upon which Marulan businesses had relied. Businesses and residents quickly relocated to a new village area forming around the railway station. This village was initially known as Mooroowoolen and is now the site of the present day Marulan township. The old Marulan inns gradually closed and the school and churches eventually relocated to the new village of Mooroowoolen, leaving the old township of Marulan in a state of ruin. This site is now known as 'Old Marulan' and occurs in the vicinity of the junction of the Hume Highway, South Marulan Road and Jerrara Road in the southern portion of the project area (refer to **Figure 5.27**).

5.10.2.2 Archaeological Context

A search of the relevant heritage registers and inventories (Australian Heritage Places Inventory, Australian Heritage Database, Register of the National Trust (NSW), State Heritage Register, State Heritage Inventory and Mulwaree LEP 1995) was undertaken for this project. The searches identified a number of listed heritage places/items associated with Marulan, however, only one site was relevant to the project area. This was the "Whole of Township" listed on the State Heritage Register (SHR), which lies partially within the project area. The "Whole of Township" listing refers to the Old Marulan Township. The listing was gazetted in April 1999 based on the archaeological study and report prepared for the then Department of Environment and Planning, by archaeologist Helen Temple (date unknown). The Old Marulan Township SHR boundary is shown on **Figure 5.27**.

All other listed items identified by the register and inventory searches are located outside the project area and appear to have no direct association with any elements within the project area. Those sites are all of sufficient distance from the project area to not be impacted by blasting.

Old Marulan Township SHR Area

As discussed above, Helen Temple (date unknown) undertook an archaeological study on the Old Marulan Township. This is the only known previous historical archaeological report covering any part of the project area.

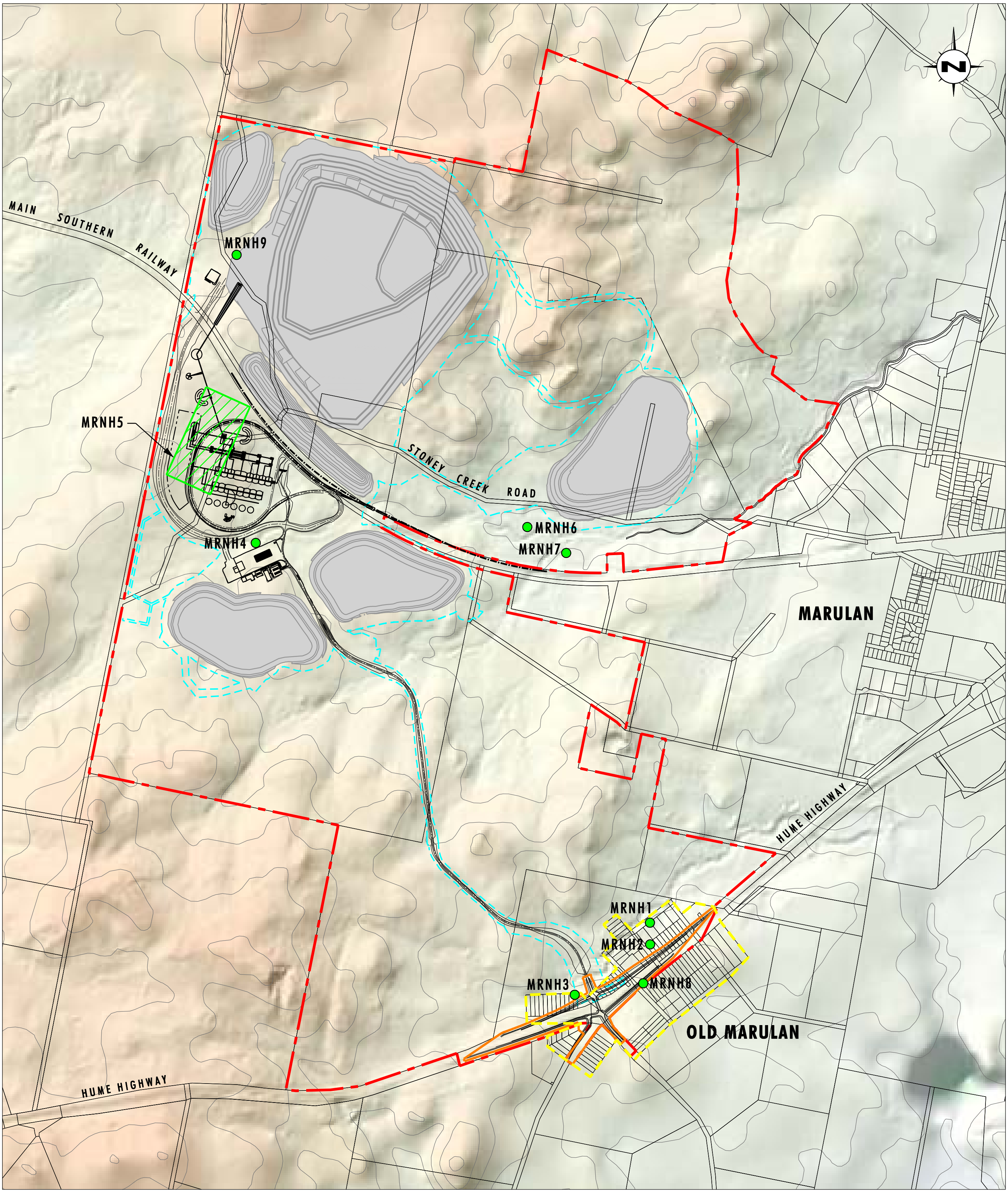
Within the SHR area, Temple's report recorded surface evidence of archaeological sites along the southeastern side of the Hume Highway. Although acknowledged as less visible on the surface, Temple also recorded sites along the northwestern side of the highway. No systematic archaeological excavation was, however, undertaken within the township curtilage.

The various construction stages of the Hume Highway would have caused disturbance to those structures remaining in the SHR area (both surface and subsurface structures) with road frontages along both the eastern and western alignments of the former Great South Road. The location of the existing Hume Highway road reserve over the 1958 parish map (refer to **Figure 5.28**) provides an indication of the impact of the highway on the Old Marulan township. As indicated on **Figure 5.28**, the current road lies over where the buildings on the western edge of the Great South Road would have been located. There is, however, potential for evidence of outbuildings such as stables and privies, and associated structures such as cisterns for water supply, to remain in subsurface context in the SHR area to the west of the present day highway.

5.10.2.3 Results of Surface Site Inspection

A detailed survey of the project area for potential heritage items was undertaken by Umwelt's heritage archaeologists. The survey identified nine non-indigenous heritage sites in addition to the Old Marulan Township SHR area. The locations of these sites in relation to the

Umwelt
Environmental Consultants



Base Source: LPI 2004, Readymix Holsings Pty Ltd

0 0.5 1 1.25km

Legend

- Project Area
- Approximate Disturbance Footprint
- Historic Site Location
- Heritage Site Precinct
- SHR Boundary Old Marulan Township
- Interchange Construction Footprint

FIGURE 5.27

Historic Heritage Sites within the Project Area

File Name (A4): R03_V1/1829_243.dgn

Umwelt
Environmental Consultants

Source: LPI Parish Maps, Marulan Edition 9

0 100 200 300m

Legend

Hume Highway Road Reserve
Proposed Interchange

FIGURE 5.28

Existing Hume Highway Road Reserve & Proposed Interchange on 1958 Parish Map

File Name (A4): R03_V1/1829_277.dgn

proposed quarry are shown on **Figure 5.27**, with a brief description of the sites included in **Table 5.20**. A detailed description and interpretation of the sites is included in **Appendix 12**.

5.10.2.4 Statement of Heritage Impact

This Statement of Heritage Impact has been prepared in accordance with guidelines of the NSW Heritage Manual, 1996, published by the NSW Heritage Office.

The project has the potential to enhance heritage significance:

- generally, through the exposure of material evidence and the facilitation of its interpretation to augment the existing historical and archaeological record regarding the Old Marulan Township and the surrounding pastoral holdings;

- through the recovery, interpretation and conservation of movable artefacts relating to the above;

- through the potential for further archaeological study of the brick clamps which may lead to a better appreciation of brick making technology of the early nineteenth century; and

- if appropriate and as determined through consultation with the NSW Heritage Office, through the formal recognition and preservation of significant material.

The project will also, however, detrimentally impact upon items of heritage significance through the destruction of surface and/or sub-surface material evidence, particularly in regard to the stone line (MRNH4), homestead (MRNH5), timber lined cistern/well (MRNH8), and the sheep dip (MRNH9). The construction of the proposed interchange will result in the disturbance of approximately 3.4 hectares of the SHR area outside of the existing road reserves. This equates to approximately 10% of the SHR area currently unaffected by road reserves.

Having regard to the assessment of heritage significance and the impact of the proposed quarry, the project has the potential to impact on the heritage values of the project area which can be appraised at:

- the State level to a rare degree within the SHR limits of the Old Marulan Township;

- the local level to a rare degree regarding the pisé building located at Site MRHN5 (homestead); and

- the local level to a representative degree regarding the balance of the project area.

The impact on heritage values as a result of the project may be mitigated by the archaeological management of any known and/or exposed material evidence. Having regard to the assessment of significance and the practical impact of the project, it is considered that the loss of heritage values will be offset by the potential for archaeological investigation, recording and interpretation resulting in an increased knowledge of the historical occupation and use of the Marulan region. An outline of proposed heritage management measures is included in **Section 7.2.8**, with a detailed description included in **Appendix 12**.

Table 5.20 – Non-Indigenous Heritage Sites within the Project Area

Site Reference	Description	Detail	Location within Project Area	Potential Impact on sites from construction and operation
MRNH1	Circular Sheep Dip	Intact race and circular sheep dip constructed of brick. Remains of a draining pen with concrete floor and fencing were observed at the southern end of the dip. A section of race wall had been collapsed, although remaining largely intact.	Within the southern boundary of project area and within the Old Marulan Township SHR area.	No direct impact anticipated.
MRNH2	Stone lined cistern	Rectangular stone lined pit approximately 4.8 metres long, 3.2 metres wide and 1.8 metres deep. The stones lining the pit were unshaped rubble, laid in dry stone formation and placed without any apparent attempt at coursing. Surface evidence indicated an association with a former occupation site indicated by a scatter of bricks, two stone fruit trees, scattered surface metal and part of a "Consol" rabbet plane.	Within the southern boundary of project area and within the Old Marulan Township SHR area approximately 100 metres south of MRNH1.	No direct impact anticipated.
MRNH3	Possible grave sites	Three potential grave sites indicated by placed stones.	Within the southern boundary of the project area and within the Old Marulan Township SHR area.	No direct impact anticipated.
MRNH4	Stone line	A line of 17 field stones stretching 4.5 metres in length in a NE/SW orientation. A single fragment of blue transfer ceramic was located on the southern bank of the drainage line directly opposite the site.	Within the proposed quarry infrastructure area.	Complete demolition and excavation for quarry infrastructure. Excavation of surrounding area for infrastructure may reveal associated subsurface evidence which may assist in interpretation.
MRNH5	Homestead	A complex of buildings and structures including a cottage, shearing shed, yards and races, sheep dip, meat house, pisé building (possibly a milk room) and a windbreak of exotic trees.	Within the proposed quarry infrastructure area.	Complete demolition and excavation for quarry infrastructure. Excavation may reveal artefacts associated with the settlement and use of the site and may reveal evidence of any former and/or earlier forms of structures.

Table 5.20 – Non-Indigenous Heritage Sites within the Project Area (cont)

Site Reference	Description	Detail	Location within Project Area	Potential Impact on sites from construction and operation
MRNH6	Brick clamp	Consists of the remains of a brick "clamp", an early brick making process. Surface evidence consisted of mounds of earth within which defined rows of bricks could be identified. Bricks observed on the surface were clearly hand pressed with a rectangular frog mark.	Within the project area south of Stoney Creek Road and north of the Main Southern Railway.	No direct impact anticipated.
MRNH7	Possible clay pits	Two large circular depressions which are possibly former clay pits from which clay was procured for the brick making process. Located in close proximity to the brick clamp.	Within the project area south of Stoney Creek Road and north of the Main Southern Railway.	No direct impact anticipated.
MRNH8	Timber lined cistern/well	Consists of an approximately 2.5 metre square cistern/well lined with concrete and timber. Given its location on the former Great South Road frontage this structure may represent a community water storage/source.	Located within the Hume Highway road reserve on the eastern side of the present highway.	Demolition due to construction of exit ramp for interchange. Excavation may reveal further subsurface evidence associated with this site.
MRNH9	Sheep dip	Constructed of concrete, the structure consisted of a small plunge style dip ~5.6 metres long, ~0.5 metres wide and ~0.6 metres deep at the plunge end.	Within the northeastern portion of the project area, approximately 500 metres north of the Main Southern Railway.	Demolition by quarrying/construction of drainage facilities. Excavation may reveal evidence of any former structures such as holding and draining pens.
Old Marulan Township	Township boundary as defined by SHR listing	The ground surface alongside the Hume Highway is covered by tree regrowth and/or long grassy vegetation which largely obscures visibility of any remaining surface evidence of the Old Marulan Township within the majority of the project area. It appears that little surface evidence remains in the western precinct. However, the potential for subsurface evidence remains high. The eastern precinct contains clear surface evidence of former structures although these are, for the most part, located on private land outside the project area and therefore closer inspection was not undertaken.	As shown on **Figure 5.27**.	Excavation within SHR limits for construction of the interchange. Any excavation has the potential to expose relics associated with the former Old Marulan Township.

5.11 Visual Assessment

5.11.1 Existing Visual Amenity

5.11.1.1 Regional Scenic Quality

The Goulburn/Mulwaree region has a diversity of landforms, vegetation and land uses resulting in considerable variation in scenic quality. In general terms, scenic quality is considered to improve with increasing diversity of topographic ruggedness, vegetation patterns, natural and agricultural landscapes and water bodies. Scenic quality is typically considered to decrease with views of the built environment.

The Goulburn Mulwaree LGA is characterised primarily by grazing land, with portions of dense forested areas and plantations also a feature of the landscape. Tallong and Wingello, located more than 7 kilometres to the east, and the Bungonia State Conservation Area 10 kilometres to the south of Marulan are characterised by the presence of large tracts of dense vegetation in National Parks and State Conservation Areas and have areas of significant topographical variation (gorges and other drainage valleys surrounded by elevated areas) due to the local geology. These areas are considered to have a high scenic quality with panoramic views available from strategic elevated locations.

The land to the west of these areas (including Marulan and Goulburn) has significantly less topographic variation, generally being rolling hills (the Southern Tablelands landform). Typical land uses are grazing with greater areas of cleared land. The scenic quality of this land is reduced compared to the areas to the east, however, some areas with views of drainage lines, pastoral grasslands and surrounding tree covered ridges retain a relatively high degree of scenic quality. This portion of the region typically has scattered elements of the built environment impacting on the scenic quality including residential areas, industrial areas, infrastructure corridors and clearing of plantation areas. These visual elements reduce the overall scenic quality of the regions visual landscape.

5.11.1.2 Marulan Scenic Quality

The scenic quality of Marulan and surrounding areas is typical of the Southern Tablelands except with a higher than typical number of infrastructure intrusions. The Hume Highway forms the western and southern boundaries of the town whilst the Main Southern Railway bisects the town. The service centres that adjoin the highway also contribute to the reduction of scenic quality, giving a commercial character to the local visual landscape. The town itself has a moderate visual quality having a combination of older houses and buildings in the centre of town surrounded by new modern homes in the outer edges of the township.

The area surrounding the town is a mix of cleared grazing land and forested areas, with little variation in topographical relief. Joarimin and Marulan Creeks are both natural visual features, however, much of the riparian vegetation associated with these creeks has been cleared and flows are ephemeral, reducing the overall contribution of these landscape features. Views of the Marulan Waste Management Facility and the Orica Explosives bulk storage depot are also visible from limited areas of the township and surrounds, impacting on overall visual amenity.

In summary, the Marulan visual landscape is dominated by the Hume Highway and associated service centres, residential areas, the Main Southern Railway, light industrial areas and developing rural residential areas surrounded by primarily cleared low rolling hills and valleys with minor drainage lines and patches of remnant vegetation. The scenic quality is considered to be low-moderate in the areas surrounding the Hume Highway and service centres, moderate in the township and surrounds and moderate to moderate–high in surrounding areas primarily unaffected by infrastructure and with remnant native vegetation.

5.11.1.3 Site Scenic Quality

The topography of the project area consists of vegetated ridges to the north and south, with the primarily cleared Joarimin Creek valley located in the centre of the site. This valley is bisected by the Main Southern Railway. The southern portion of the project area slopes to the southeast towards Marulan Creek, with this area having patches of vegetation and riparian vegetation along the creek. The Hume Highway provides the southeastern boundary of the project area and is visually prominent in this area.

The north of the project area consists of vegetated undulating hills and ridgelines which screen the project area from land to the north. This northern ridge has a spur which runs along the eastern edge of the project area, providing visual separation between the project area and the rural residential and residential areas to the east. A lower elevation ridge runs along the eastern side of the property to the south of the Main Southern Railway. This lower ridge provides some visual separation between the project area and the township of Marulan, however, it is not as significant as the spur to the north.

To the south, the topography again provides visual shielding of the majority of the project area. The low ridge that separates the catchments of Marulan and Joarimin Creeks is of sufficient elevation to shield the project area from the Hume Highway except for distant views of the ridge along the northern boundary.

The Main Southern Railway is visible from the majority of the project area and surrounds and detracts from the overall visual amenity.

Overall, the project area is considered to be of moderate scenic quality.

5.11.1.4 Night Scenic Quality

Due to the presence of the major transport corridors and associated service centres, the night-time scenic quality of the Marulan township is unlike that of a typical rural town. The Hume Highway is subject to traffic throughout the night, particularly heavy vehicle traffic and is therefore a significant source of light. The highway service centres operate 24 hours per day and therefore also contribute significantly to night-time lighting impacts. The trains using the Main Southern Railway also contribute, however this impact is less significant than the highway and service centre contributions.

The night-time lighting associated with the township of Marulan is typical of a small rural town, with insufficient sources of late night lighting to be visually intrusive.

Overall, the night-time visual amenity of the Marulan township and surrounding areas is considered to be impacted by existing lighting emissions associated with the major transport corridors and is not typical of a small rural town.

5.11.2 Visibility of the Project

The dominant visual features of the proposed quarry include the Eastern Overburden Emplacement Area (maximum height of 660 mAHD), Railway Overburden Emplacement Area (maximum height of 685 mAHD), Western Overburden Emplacement Area (maximum height of 690 mAHD), Eastern Excess Product Emplacement Area (maximum height of 672 mAHD) and the Western Excess Product Emplacement Area (maximum height of 681 mAHD).

These features will be visible from some viewing points surrounding the site as outlined in **Section 5.11.3**. The visibility of the quarry infrastructure will be relatively low from most viewing locations, with views only likely to be possible from one residence to the south and from trains using the Main Southern Railway. The proposed Hume Highway interchange and quarry access road will be visible to traffic on the Hume Highway and from some residences in the Old Marulan township area.

5.11.3 Viewing Points and Assessment Methodology

A detailed visual assessment was undertaken for the project to identify surrounding locations from which views of the quarry may be possible and identify necessary mitigation measures. The visual assessment was undertaken from 11 representative potential viewing locations or assessment points. The locations of nine of these assessment points are shown on **Figure 5.29**. The remaining two points were the nearest residence to the west (approximately 3 kilometres) and a residence to the north (approximately 17 kilometres), both of which are outside of the area included on **Figure 5.29**, but have been confirmed to be unaffected by views of the project. Selection of these assessment points was based on topography and was confirmed by site inspection. The initial visual impact assessment was undertaken using a topography based digital model of the Year 30 quarry landform. The model includes an allowance for areas where it was perceived that vegetation would provide a significant visual barrier, acting as a screen between the viewing location and the quarry.

The initial assessment indicated that views of the quarry and associated infrastructure would not be possible from assessment points 1, 8, 9, 10 or 11. Of those points that would have potential views, assessment point 2 was considered to be a representative worst-case for points 2 and 3, and assessment point 5 was considered to be a representative worst-case for points 4 and 5. On this basis, it was decided to undertake a more detailed transect analysis for:

- assessment point 2 – western end of Maclura Drive, in the recently developed rural residential area adjacent to the northeastern project area boundary;
- assessment point 5 – Stoney Creek Road south of Brayton Road intersection, on the western fringe of Marulan urban area, north of the Main Southern Railway;
- assessment point 6 – western edge of Marulan township south of the Main Southern Railway and sporting fields; and
- assessment point 7 – Private residence to the south of the project area.

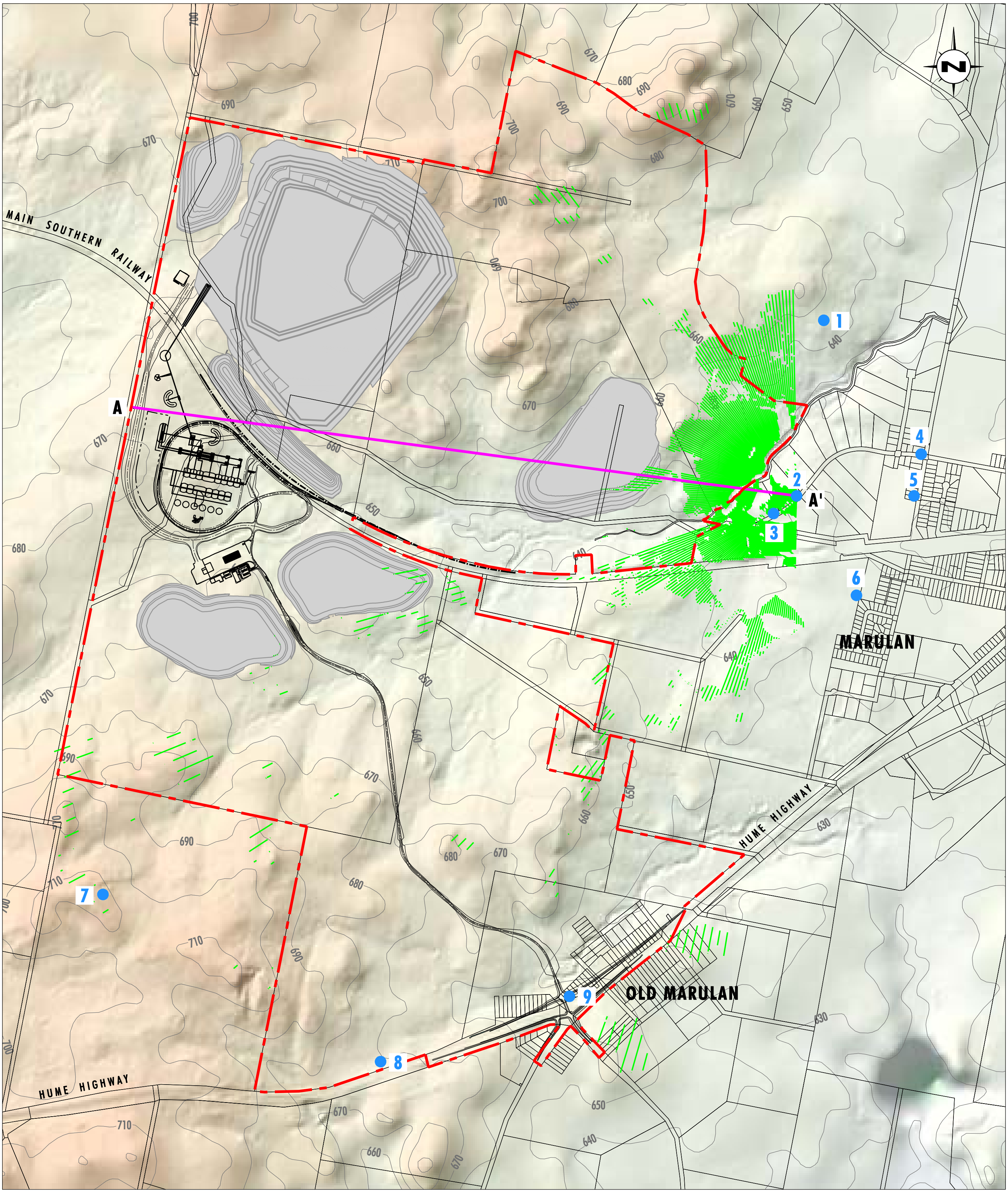
The transect analysis was conservatively completed based on the topographical model of the Year 30 quarry landform without any allowance for tree screening. Vegetated locations are, however, shown on the cross-section. Viewlines for key stages of quarry development were then determined for each transect to show the extent of visual impacts.

The assessment was completed using the Year 30 landform as this is considered to be representative of the worst-case for most viewing locations. In addition, an analysis of viewing impacts from assessment point 7 was undertaken using the Year 15 landform. This analysis was undertaken to determine visual impacts prior to the development of the Western Excess Product Emplacement Area which will provide some additional screening for views from this location.

5.11.4 Visual Impacts and Management

Areas visible from assessment points 2, 5, 6 and 7, based on the digital terrain analysis, are shown on **Figures 5.29** to **5.32**. A detailed description of the visual impacts for each assessment point is provided below.

Umwelt
Environmental Consultants



Base Source: LPI 2004, Readymix Holdings Pty Ltd

0 0.5 1 1.25km

Legend

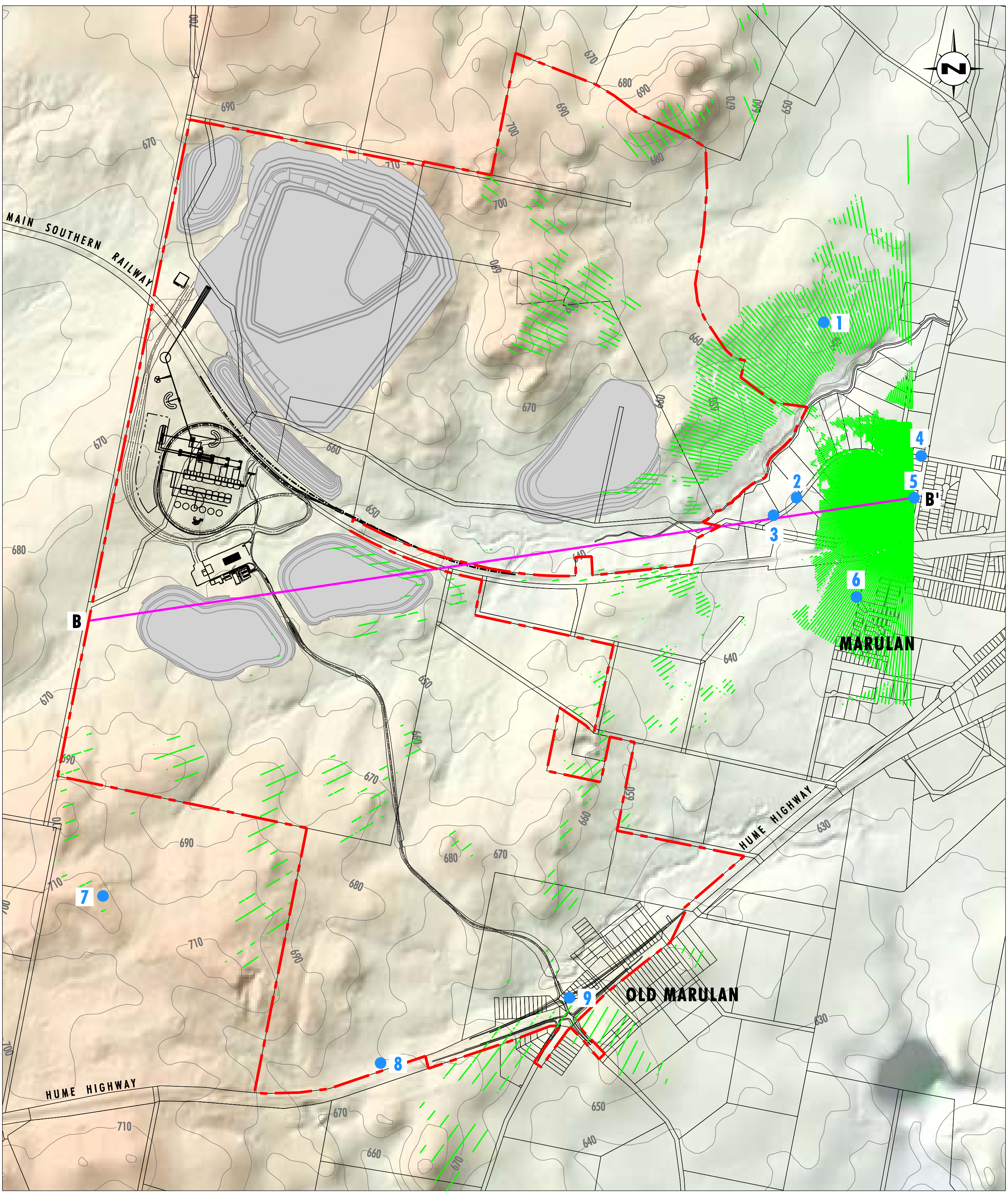
- Project Area
- Assessment Point
- Cross-section Location
- Areas visible from Location 2

FIGURE 5.29

Viewing Locations
Location 2

File Name (A4): R03_V1/1829_258.dgn

Umwelt
Environmental Consultants



Base Source: LPI 2004, Readymix Holdings Pty Ltd

0 0.5 1 1.25km

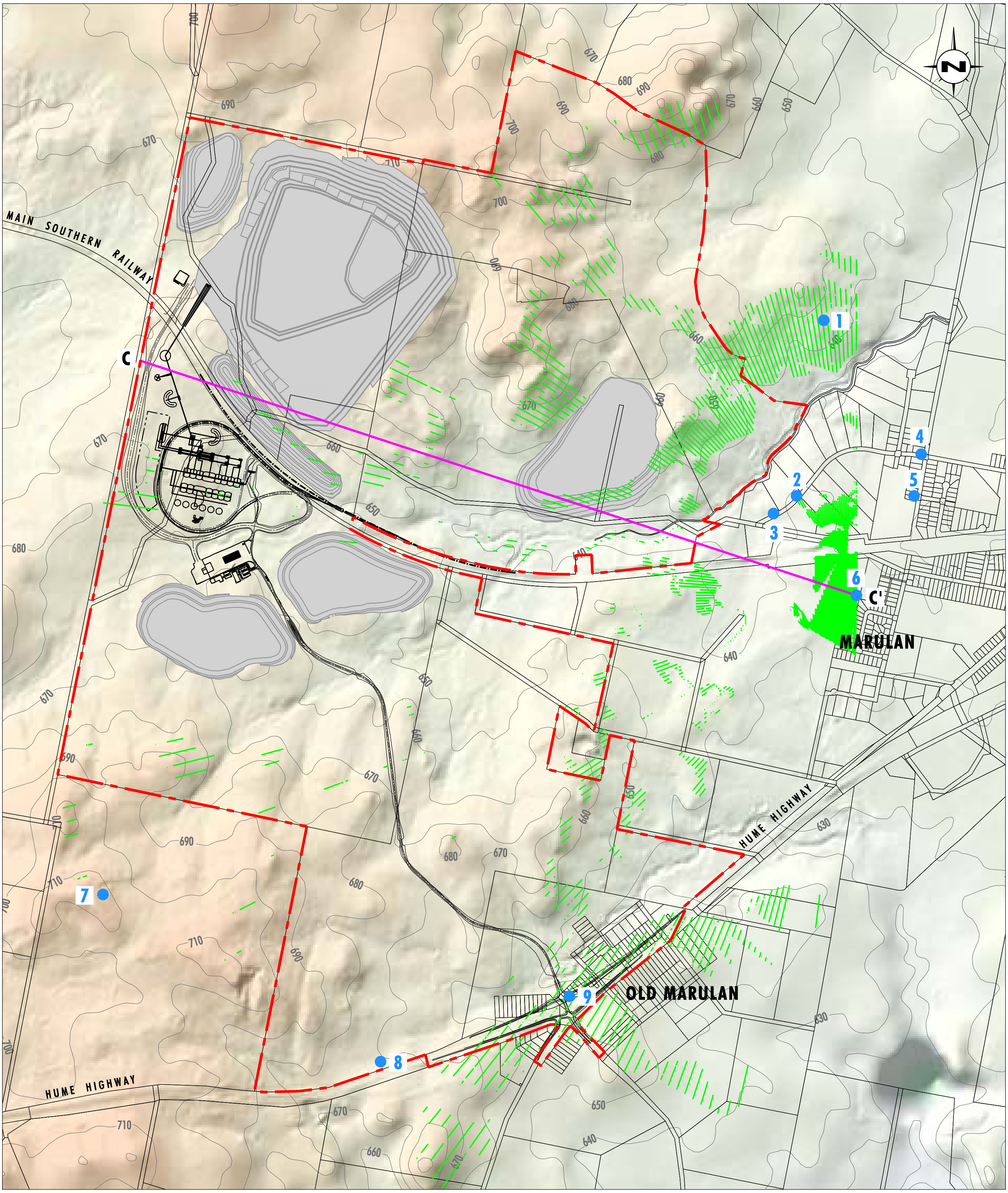
Legend

- Project Area
- Assessment Point
- Cross-section Location
- Areas visible from Location 5

FIGURE 5.30

Viewing Locations
Location 5

Umwelt
Environmental Consultants



Base Source: LPI 2004, Readymix Holdings Pty Ltd

0 0.5 1 1.25km

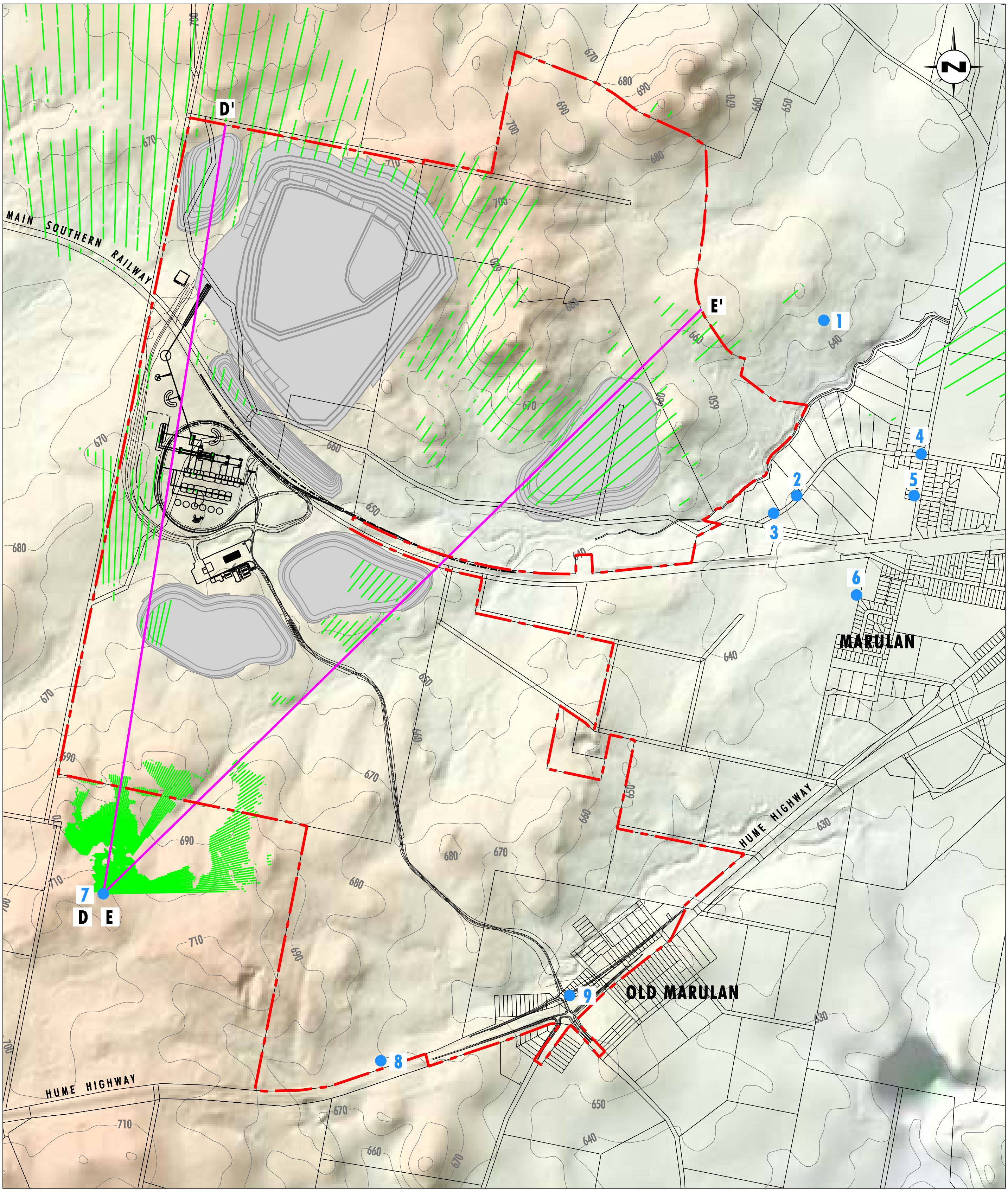
Legend

- Project Area
- Assessment Point
- Cross-section Location
- Areas visible from Location 6

FIGURE 5.31

Viewing Locations Location 6

Umwelt
Environmental Consultants



Base Source: LPI 2004, Readymix Holdings Pty Ltd

0 0.5 1 1.25km

Legend

- Project Area
- Assessment Point
- Cross-section Location
- Areas visible from Location 7

FIGURE 5.32

Viewing Locations Location 7

Assessment Point 2

The views from assessment point 2 will be limited to the highest points of the Eastern Overburden Emplacement Area and the Eastern Excess Product Emplacement Area (refer to **Figure 5.29**). The Eastern Overburden Emplacement Area has been placed behind the north-south spur of the northern ridge and the northern half of the emplacement area is shielded from view. Remnant vegetation on this ridge will also assist in screening views, however, views of the southern portion of the emplacement area will be possible as there is no screening vegetation and less shielding from natural topography. Views of the Eastern Excess Product Emplacement Area will also be shielded by existing vegetation, however, topographical screening is not as prominent.

The selected visual transect location for assessment point 2 is shown on **Figure 5.29** with the transect included in **Figure 5.33**. This transect location was selected as it shows the impact of the Eastern Overburden Emplacement Area which is approximately 600 metres from the viewing location and is considered to be the worst-case impact from this location. The transect shows that filtered views of the Eastern Overburden Emplacement Area will be possible through existing vegetation. The Year 12 viewline shows the worst-case impact due to the emplacement area although the leading edge of the emplacement area in this location should be rehabilitated by Year 10, at the latest. Readymix proposes to plant additional screening vegetation to the east of the proposed emplacement area early in the project, however, the effectiveness of this screening by Year 12 will depend on climatic conditions and consequent tree growth rates. A bund will also be established on the eastern edge of the emplacement area during construction of each section, providing screening of working machinery during most of the construction period.

Once the emplacement area is completed and rehabilitated, visual impacts will no longer be an issue from this location, as shown by the Year 15 to 30 viewline.

Assessment Point 5

The areas likely to be visible from assessment point 5 based on the initial digital terrain analysis will be similar to those discussed for assessment point 2, including views of the eastern overburden and excess product emplacement areas (refer to **Figure 5.30**).

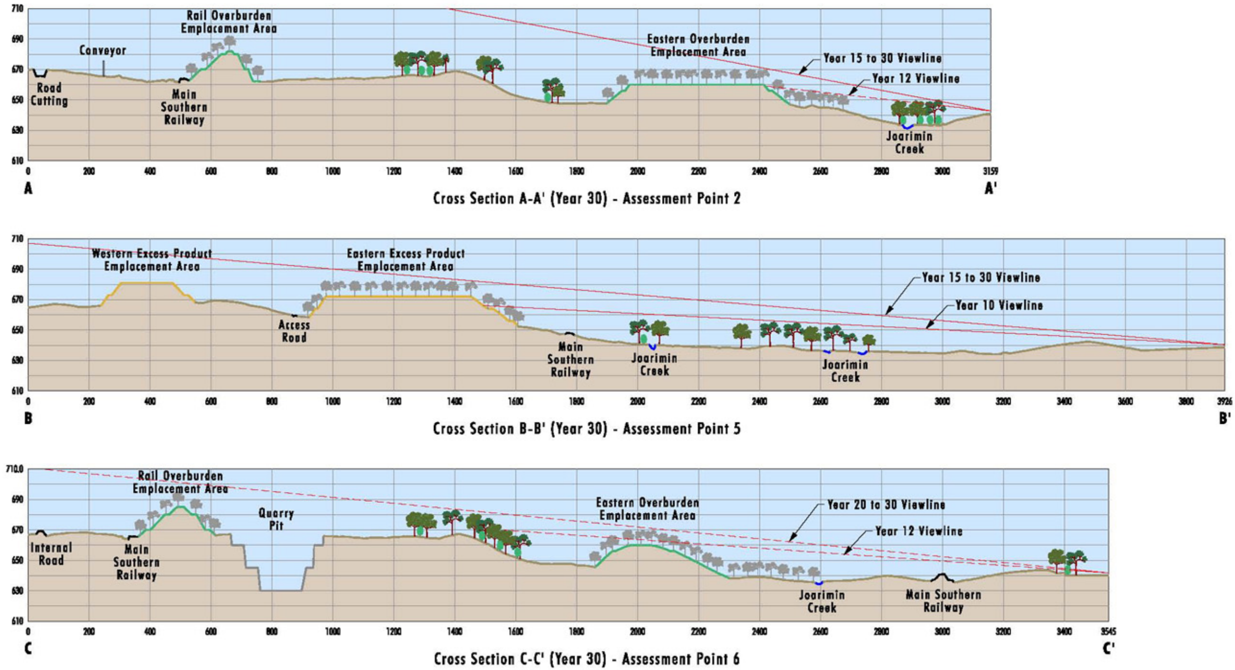
The selected visual transect location for assessment point 5 is shown on **Figure 5.30** with the transect included in **Figure 5.33**. This location was selected as it is representative of the worst-case views from residences on the western boundary of Marulan to the north of the Main Southern Railway. The transect shows that views of the Eastern Excess Product Emplacement Area will be possible across the Joarimin Creek valley during its construction, with Year 10 representative of the worst-case views from this location. The excess product emplacement area is approximately 2.3 kilometres from assessment point 5, reducing the overall extent of visual impact. Construction of this emplacement area will be completed behind an eastern bund for the majority of the time, limiting views of machinery. Due to topography, there is little that can be done to limit views of this location, however, timely rehabilitation of the leading edge of the emplacement area will reduce the duration of impact.

Once rehabilitation of the emplacement area is complete, post Year 10, visual impacts will cease and the vegetated emplacement area will prevent views of the Western Excess Product Emplacement Area.

Assessment Point 6

Based on the initial digital terrain analysis, assessment point 6 will have views of the Eastern Overburden Emplacement Area, the highest point of the Eastern Excess Product Emplacement Area, the rail overburden emplacement area and possible views of the highest

Umwelt



Legend
- Unaffected Viewline
- Filtered Viewline
- Proposed Tree Planting

0 40 60 80m
Vertical Scale

0 200 400 600m
Horizontal Scale

FIGURE 5.33

Visual Transect Assessment Point 2, 5 & 6

File Name (A4): R03_V1/1829_262.dgn

points in the infrastructure area (refer to **Figure 5.31**). Foreground vegetation is likely to substantially screen most of these views.

The selected visual transect location for assessment point 6 is shown on **Figure 5.31** with the transect included as **Figure 5.33**. This location was selected as it is representative of the worst-case views from residences on the western boundary of Marulan to the south of the Main Southern Railway. The transect shows that filtered views of the Eastern Excess Product Emplacement Area will be possible through trees located in the foreground. Once construction of the overburden emplacement area is complete (after about Year 12), vegetation on the emplacement area will prevent views of the rest of the quarry.

Assessment Point 7

Assessment point 7 is located on an elevated property/residence to the south of the project area and will therefore have potential views across the majority of the quarry and associated works. Based on the initial digital terrain analysis, each of the overburden emplacement areas, the northern most bench of the quarry pit and the quarry infrastructure area will be visible from this location, although intervening vegetation will provide some screening effects (refer to **Figure 5.32**).

The selected visual transect locations for assessment point 7 are shown on **Figure 5.32** with the transects included as **Figure 5.34**. Two transects were selected to assess the different views from this location. Cross-sections were completed for transect $D–D^1$ for both the Year 15 and Year 30 landforms to assess the screening effect of the Western Excess Product Emplacement Area.

As shown by cross-section $D–D^1$ for Year 15 (refer to **Figure 5.34**), filtered views of the infrastructure area, quarry pit and Western Overburden Emplacement Areas may be possible from this viewing location. In Year 30, the Western Excess Product Emplacement Area may also be visible through the foreground vegetation. The only possible visual mitigation measures to limit these views are treatments at the viewing location and in the immediate foreground, as topographical constraints will prevent on-site treatments from being effective. Some on-site controls are however proposed, including using natural tones (typically green tones) for infrastructure cladding to ensure that the infrastructure blends into the background as much as possible, and timely rehabilitation of disturbed areas.

In terms of viewing location visual treatments, Readymix is prepared to undertake reasonable on-site measures to minimise adverse visual impacts should the property owner so desire.

The visual impact of views along cross-section $E–E^1$ are less significant than those discussed above, with filtered views possible of the eastern overburden and excess product emplacement areas. These views will only be impacted during the first 15 years of the project, after which rehabilitation progress should be sufficient to make any impact insignificant.

Visual Impacts on Transport Corridors

Commuters travelling along the Main Southern Railway will have views of the quarry and quarry infrastructure area, however, the duration of the views will be short due to the speed of commuter trains. Potential mitigation measures to limit the visual impact of the quarry are limited due to topography and the separation distance between the railway and infrastructure areas. Visual shielding of the quarry pit itself will be provided by the rail overburden emplacement area. As the quarry is close to Marulan which presently provides ‘developed area’ views, the extension of these developed views, although of a different character, will not be as significant as if the quarry was located within a fully rural area.

Umwelt
Environmental Consultants

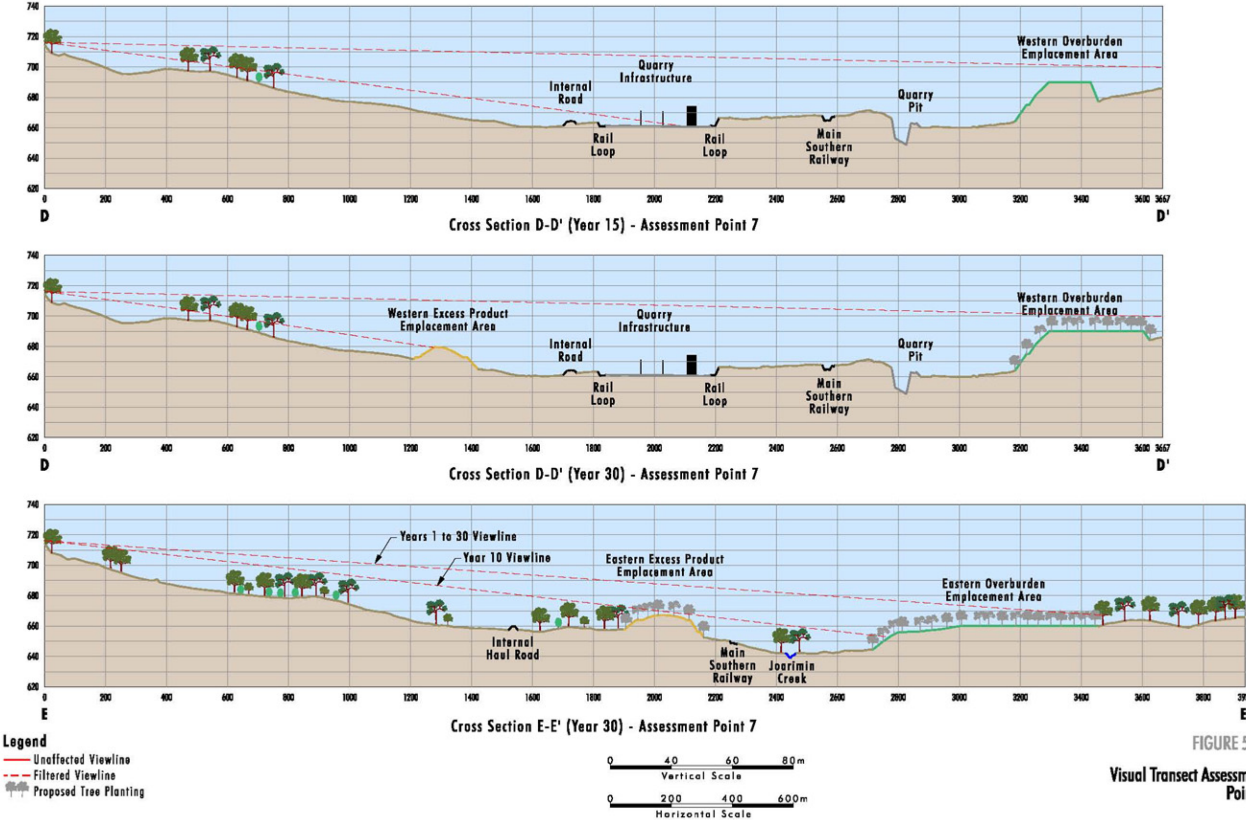


FIGURE 5.34

Visual Transect Assessment Point 7

File Name (A4): R03_V1/1829_263.dgn

Assessment points 8 and 9 were located on the Hume Highway to assess potential views of the quarry by those travelling on the highway. This assessment indicated that intervening topography and vegetation will prevent views of the quarry and infrastructure areas excluding the access road and interchange. These infrastructure areas are, however, in character with the highway visual landscape and these impacts are therefore not considered to be significant.

Impacts on Night-time Scenic Quality

The majority of visible quarry operations will not occur during night-time periods, with activities limited to the infrastructure area and load and haul of primary raw feed. No mobile lighting plant will be used with potential impacts limited to mobile equipment headlights and fixed lighting. Mobile equipment headlights will be screened from all viewing locations except assessment point 7 and will be no greater than existing impacts from the Marulan township and existing transport corridors. Fixed lighting will be limited to the minimum required for operational needs and safety with glare shields fitted to reduce fugitive emissions. Views of the lit infrastructure area will generally be limited to assessment point 7.

Given the current night-lighting impacts on Marulan and surrounding areas, the additional lighting impacts resulting from the quarry are not considered to be significant.

Summary of Visual Impacts

The primary components of the project that will impact on visual amenity will be the eastern emplacement areas. These areas will be constructed during the early years of the project and once established, will provide visual screening of the remainder of the project area. Once rehabilitation of these areas is complete, their vegetated areas will blend in with the surrounding vegetated topography and will not be significantly visually different.

Potential filtered views of the project area are available from one isolated residence to the south. Readymix is prepared to undertake reasonable on-site measures to minimise adverse visual impacts on this location, should the property owner so desire.

Views from major transport corridors will be limited to views from the Main Southern Railway, with these views of short duration. Potential impacts on night-time scenic quality are not considered to be significant due to the proposed lighting controls and existing light impacted night-time visual character.

5.12 Hazard Assessment

5.12.1 SEPP 33 Assessment

State Environmental Planning Policy No. 33 (SEPP 33) – *Hazardous and Offensive Development* applies to all industries that are considered to be potentially hazardous industry or potentially offensive industry. The policy is designed to ensure industrial proposals only proceed if they are suitably located and able to demonstrate that they can be built and operated with an adequate level of safety (DUAP, 1994).

Clause 3 of the policy contains the definitions of potentially hazardous industry and potentially offensive industry and these are presented below.

> **Potentially hazardous industry** means a development for the purposes of any industry which, if the development were to operate without employing any measures (including for example, isolation from existing or likely future development on other land) to reduce or

minimise its impact in the locality or on the existing or likely future development on other land, would pose a significant risk in relation to the locality:

a) to human health, life or property, or
b) to the biophysical environment,

and includes a hazardous industry and a hazardous storage establishment.

Potentially offensive industry means a development for the purposes of an industry which, if the development were to operate without employing any measures (including, for example, isolation from existing or likely future development on other land) to reduce or minimise its impact in the locality or on the existing or likely future development on other land, would emit a polluting discharge (including for example, noise) in a manner which would have a significant adverse impact in the locality or on the existing or likely future development on other land, and includes an offensive industry and an offensive storage establishment.

The proposed quarry is not classified as a ‘potentially hazardous industry’ as demonstrated by the risk screening process outlined in **Section 5.12.1.1** and therefore a Preliminary Hazard Analysis (PHA) is not required. The proposed quarry does not constitute a hazardous industry as defined by SEPP 33.

The proposed quarry is, however, ‘potentially offensive industry’ as defined by SEPP 33 and an assessment of potential offensiveness is included in **Section 5.12.1.2**. The assessment demonstrates that the proposed quarry does not constitute an offensive industry as defined by SEPP 33.

Based on the findings of the assessments the proposed development is neither hazardous nor offensive as defined by SEPP 33 and therefore SEPP 33 does not apply to the development.

5.12.1.1 Assessment of Potential Hazard

In order to determine whether an industry is classified as ‘potentially hazardous industry’, DIPNR has developed a risk screening procedure based on the quantity of dangerous goods involved in the proposal and the distance of these materials from the site boundary. Hazardous materials are classified by the Australian Code for the Transport of Dangerous Goods by Road and Rail (Australian Dangerous Goods Code). If a project proposes to store quantities of these goods below the relevant thresholds it can be assumed there is unlikely to be a significant off-site risk and the proposal is therefore not classified as ‘potentially hazardous industry’. Hazardous materials that will be used by the project and an estimate of the maximum quantity of these materials likely to be stored on site at any one time is provided in **Table 5.21**.

The ‘site boundary’ for the purposes of this risk screening procedure is considered to be the Readymix property boundary (refer to **Figure 1.3**). All land in the immediate vicinity of the storage areas is owned by Readymix (refer to **Section 1.3.2** and **Figure 1.3**). The closest private residence to a proposed hazardous material storage location is approximately 1.6 kilometres to the south.

As outlined in **Table 5.21**, Readymix will not store explosives or other Class 1 goods at the quarry. Explosives will be supplied by a contractor on a per blast basis.

None of the relevant quantity screening thresholds or transportation screening thresholds will be exceeded for this project, with all hazardous materials delivered to the site by appropriately licensed contractors. Therefore, the proposed quarry is not considered to be ‘potentially hazardous industry’ and SEPP 33 does not apply.

Table 5.21 – Hazardous Materials Storage in the Project Area

Dangerous Goods Classification	Hazardous Materials	Mode of Storage	Maximum Quantity Stored	Distance from Site Boundary (m)	Screening Threshold*	No. of Vehicle Movements	Transportation Screening Thresholds*
Class 1 – Explosives (1.1)	Explosives	Not stored on site	N/A	N/A	2000 t stored at approx. 1800m	150	
(1.1)	Detonator Assemblies	Not stored on site	N/A	N/A			
(1.1)	Boosters	Not stored on site	N/A	N/A			
(1.1)	Detonating Fuse	Not stored on site	N/A	N/A			
Class 2 – Gases (2.1)	Acetylene	Bottles stored in bunded cabinet	16 bottles (40-50L/bottle)	>450m	2000m^3 at 100m	52	>500 annual vehicle movements or > 5 tonnes / load
(2.1)	LPG	Bunded compound	20 bottles (40-50L/bottle)	>350m	16m^3 (above ground) or 64m^3 (underground or mounded)		
(2.2)	Nitrogen	Bunded storage facility	4 cylinders	>350m	Excluded		Excluded
(2.2)	Argon	Bunded storage facility	10 cylinders	>350m			
Class 3 – Flammable Liquids PGIII	Paints, primers	Stored in workshop/store room	<60L	>450m	>2m3 >2000m^3 at 50m	2	>1000 annual vehicle movements
C1	Diesel	Above ground tanks in bunded area	Two 100,000L tanks	>350m	Excluded	150	Excluded
C2	Engine Oils, Degreaser	Stored in workshop/store room	Max. 20,000L oil and 1000L grease	>450m		24	

Table 5.21 – Hazardous Materials Storage in the Project Area (cont)

Dangerous Goods Classification	Hazardous Materials	Mode of Storage	Maximum Quantity Stored	Distance from Site Boundary (m)	Screening Threshold*	No. of Vehicle Movements	Transportation Screening Thresholds*
C2	Waste Oils	Waste oil tank in bunded area	2,500L	>350m		12	
Class 8 – Corrosive Substances	Paints, Primers	Stored in workshop/store room	<60L	>450m	50 tonnes / 50 m^3	2	>5 tonnes / load or >500 annual vehicle movements
	Heavy Vehicle Batteries	Stored in workshop/store room	Up to 5 heavy vehicle batteries	>450m		12	

Note: * The screening threshold as detailed in the Department of Planning (1994) determines the quantity of a hazardous material that is required in order for a proposed development to be considered potentially hazardous. Materials stated to be 'excluded' pose no significant hazard (Department of Planning, 1994).

5.12.1.2 Assessment of Potential Offensiveness

In order to determine whether or not the proposal is potentially offensive, it is recommended by DIPNR (Department of Planning, 1994) to consider the following:

- Does the proposal require a licence under any pollution control legislation administered by DEC?
- Does the proposal require pollution control approval pursuant to any legislation or by-laws administered by Council?
- Does the proposal cause offence having regard to the sensitivity of the surrounding environment?

The proposed quarry will require an EPL as extractive industries are an activity listed in Schedule 1 of the POEO Act and as such the development is considered to be 'potentially offensive development'. DIPNR (Department of Planning, 1994) also states, however, that if an EPL can be obtained for a development, the development is not considered to be an 'offensive industry' and is permissible under SEPP 33.

Subject to approval being granted for the proposed quarry, Readymix will apply to DEC for an EPL. The final scope of the EPL will be determined in consultation with DEC during the licence application process, however, advice from DEC during the EIA consultation process has indicated that a licence is likely to be granted for the project. On this basis, it is considered that as an EPL can be obtained for the project, it is not an offensive industry as defined by SEPP 33 and therefore SEPP 33 does not apply.

5.12.2 Bushfire Hazard

Under Section 63 of the *Rural Fires Act* 1997, Readymix is required to take all practical steps to prevent bushfires and minimise the danger of the spread of bushfires on or from land under its control. The potential threat of bushfire to people and infrastructure has been assessed generally in accordance with the principles of the NSW Rural Fire Service guidelines '*Planning for Bushfire Protection. A Guide for Councils, Planners, Fire Authorities, Developers and Home Owners*' (2001).

The bushfire hazard pertaining to a particular area is assessed by rating the two main land based factors of fire, vegetation (fuel) and terrain (slope), on their relative contributions to a potential fire. The intention of bushfire protection is to prevent flame contact on a structure, reduce the radiant heat to below ignition thresholds for the various elements of a building/structure, minimise the potential for embers to cause ignition, and reduce the effects of smoke on people, including fire fighters.

A bushfire within the project area would have the potential to cause damage or harm to neighbours, staff, facilities, biodiversity and cultural heritage.

5.12.2.1 Existing Bushfire Regime

The fire season for the Southern Tablelands region predominantly occurs during the spring and summer months (Bureau of Meteorology, 2004). The region is characterised by a cool temperate climate with very cool winters and warm to hot summers.

The topography of the project area consists of ridges with saddles and crests to the north and south, with the Joarimin Creek valley running through the middle of the project area from the southwest to the northeast (refer to **Figure 5.5**). The southern portion of the project area slopes towards the south and southeast towards Marulan Creek and the Hume Highway.

The topography of the project area ranges from approximately 710 mAHD in the north, to around 630 mAHD near Joarimin Creek. There are no areas of very steep gradient, however, some of the spurs have short, steep slopes which can range in gradient up to 5-8 degrees.

Vegetation of the project area consists predominantly of woodlands and derived pastures. The vegetation of the project area has been heavily modified by past and ongoing agricultural activities which have resulted in fragmentation and degradation.

Bushfire prone lands are generally those woodlands and grasslands that by virtue of their bushfire hazard and proximity to existing or proposed development, hold a significant risk to people and property in the event of a bushfire (NSW Rural Fire Service, 2001).

5.12.2.2 Bushfire Hazard and Risk

As discussed in **Section 3.11.1**, rehabilitation of areas disturbed by the project is planned to result in increased areas of native vegetation and associated habitat for native fauna, with selective use of some areas for managed grazing. In addition, it is proposed to establish habitat management areas and return existing areas of pasture to native woodland habitat, to mitigate the loss of vegetation and habitat associated with the project. Over time, the increase in woodland areas has the potential to increase the bushfire hazard in the locality, due to a general increase in forested areas and associated increased fuel loads. This potential increase in bushfire hazard will require hazard management measures to be employed at the site.

Although rehabilitation and vegetation regeneration works associated with the project have the potential to increase bushfire hazards within the project area, this risk can be effectively managed through implementation of appropriate hazard management measures. The project is therefore considered unlikely to impact on bushfire hazard outside the project area. With regard to potential future residential development of adjacent land to the east, bushfire risk will need to be assessed for any new developments, ensuring that appropriate residential planning strategies are implemented and that future residential developments are provided an acceptable level of protection from surrounding bushfire prone land.

The degree of potential bushfire impact will vary with climatic conditions, fuel loads present in these areas and appropriate planning associated with future development. Due to its nature as a proposed quarry site, however, emergency preparedness of the project will be high and fire fighting support equipment will be available on site during the life of the operation.

5.12.2.3 Bushfire Risk Management Strategies

Identification of Ignition Sources

Bushfire ignition sources include natural occurrences such as lightning strikes, while other potential occurrences include factors such as sparks from overhead powerlines caused by impact from flying debris during windy conditions, and human ignition. Traffic on adjacent and nearby public roads such as the Hume Highway, Brayton Road and Stoney Creek Road, and rail movements on the Main Southern Railway can be considered potential ignition sources. Possible on-site ignition sources also include fuel and oil storage facilities and sparks from machinery used on site.

Areas of native woodland and unmanaged native grasslands may be considered areas of potential bushfire hazard, including the proposed habitat management areas. Potential ignition sources such as welding and cutting will be restricted to workshop areas or within active parts of the quarry that have been cleared of vegetation, reducing the potential for these activities to act as ignition sources.

On-site Fire Fighting Equipment

Readymix will operate two water carts which can be used for fire fighting as required. These water carts together with graders, loaders and bulldozers used for quarrying, will provide effective bushfire fighting capability. In addition, emergency preparedness training for quarry personnel will include bushfire control techniques.

Additional fire services, such as fire hydrants, extinguishers and hose reels will be provided and maintained in accordance with OH&S guidelines, where necessary, at infrastructure required for the project. Mobile fire fighting equipment will also be provided on mobile equipment and light vehicles operated at the quarry.

Water for use in fire fighting will be made available from the site water management system, ensuring that there will always be sufficient water available on site for bushfire fighting purposes.

Control Measures

Firebreaks will be maintained in the form of roads and associated easements, rail lines, electricity easements, quarry access roads and fire trails to prevent the spread of bushfires onto or from adjacent properties. The active quarrying areas including the quarry pit and out-of-pit emplacement areas will also provide effective fire breaks.

The requirement for fuel reduction measures or additional fire breaks will be assessed on an annual basis by the Lynwood Quarry Environmental Officer in consultation with the local Rural Fire Service. Fuel reduction activities will be undertaken as required by the Rural Fire Service and will be designed to minimise impacts on biodiversity and threatened species. Hazard reduction activities will consider the most recently available information regarding fire regimes of threatened species known or considered to potentially occur within the project area. Selective grazing will be one tool used for fuel reduction purposes within the project area.

Asset protection zones in the form of hardstand areas, lawns or bare earth will be established and maintained around the quarry's permanent infrastructure in order to reduce bushfire risk at these locations. These areas will be maintained as fuel reduced areas throughout the life of the project.

5.12.2.4 Summary of Ongoing Bushfire Management

Ongoing bushfire management involves continual identification and review of the level of risk posed by bushfires to assets and the development and implementation of adequate strategies to protect these assets.

Bushfire management procedures will be considered in the Property Management Plan (refer to **Section 7.1.1**), including consideration of:

- identification of bushfire issues relevant to the local environment;
- analysis of bushfire risk;
- appropriate hazard reduction and bushfire risk mitigation measures;
- bushfire emergency preparedness requirements;

- standard procedures to be followed in the event of a bushfire; and
- roles and responsibilities of all employees.

Fire awareness and training will also be covered during the Lynwood Quarry induction, which all Readymix employees and contractors will be required to have completed prior to commencing work at the site.

5.13 Greenhouse Gas Emissions and Energy Consumption Assessment

Energy use and greenhouse emissions have been considered in the design of the project. Within the physical constraints of the project area, the quarry has been designed to minimise diesel consumption of mobile equipment and electricity use for material processing and handling. This has been considered in quarry and infrastructure design and layout, energy supply options and equipment selection to minimise energy use and greenhouse emissions.

A detailed assessment of greenhouse gas emissions and energy consumption has been undertaken for the project, and the findings are outlined in **Sections 5.13.1** to **5.13.4**. A discussion of appropriate greenhouse gas emission and energy conservation measures is included in **Section 7.2.11**.

5.13.1 Assessment Context

The calculation of greenhouse gas emissions has been undertaken based on the following guidelines:

- NSW Energy and Greenhouse Guidelines for Environmental Impact Assessment, Sustainable Energy Development Authority (now DEUS) and Planning NSW (now DIPNR) (2002) (NSW Guidelines);
- the World Resources Institute (WRI) and World Business Council for Sustainable Development (WBCSD) Greenhouse Gas Emissions Reporting Protocol (the WRI/WBCSD GHG Protocol); and
- the Australian Greenhouse Office (AGO) Factors and Methods Workbook August 2004.

The WRI/WBCSD GHG Protocol has three “scopes” of emission categories as listed below:

- Scope 1 – energy use from sources owned or operated by the organisation;
- Scope 2 – purchased electricity, heat, cooling or steam; and
- Scope 3 – electricity transmission and distribution losses, energy used in the production of fuels used for electricity generation and transport and the energy used in the transportation of products.

Scope 1 and 2 are required to be included in an assessment report, whilst Scope 3 is optional. All three of the scopes have been completed for this project in order to provide a comprehensive assessment.

5.13.2 Calculations and Assessment Findings

Energy consumption at Lynwood Quarry will consist of diesel for mobile equipment and electricity for material processing and handling. Energy will also be required for transportation of the product by rail and road, with both modes of transport consuming diesel fuel. Estimates of diesel consumption for mobile equipment and electricity consumption for material handling were used to calculate total energy consumption, using data provided by Readymix based on the project design and its experience at other operations. The total diesel and electricity usage was then converted to tonnes of carbon dioxide equivalent using AGO emission factors. The transport type (rail or road) and distance was used to determine diesel consumption based on default fuel efficiency figures. Diesel consumption was then converted to TCO2e based on standard AGO emission factors.

Estimates of energy use and greenhouse emissions at a production rate of 5 Mtpa saleable product with 3.5 Mtpa transported via rail and 1.5 Mtpa transported via road are shown in **Tables 5.22** and **5.23**, respectively.

Table 5.22 – Predicted Annual Energy Use at Maximum Production

Scope	Energy	Quarry Site	Rail Transport*	Road Transport**	Total
	Production/Transport (tonnes)	5,000,000	3,500,000	1,500,000	5,000,000
Scope 1 (Direct)	Electricity GJ	-	-	-	-
	Diesel GJ	91,057	-	-	91,057
	Total Energy Consumption GJ	91,057	-	-	91,057
Scope 2 (Indirect)	Electricity GJ	114,836	-	-	114,836
	Diesel GJ	-	-	-	-
	Total Energy Consumption GJ	114,836	-	-	114,836
Total Scope 1 and 2	**Total Energy Consumption GJ**	**205,893**	**-**	**-**	**205,893**
Scope 3 (Other Indirect)	Electricity GJ	-	-	-	-
	Diesel GJ	-	331,072	227,972	559,044
	Total Energy Consumption GJ	-	331,072	227,972	559,044
Total Scope 1, 2 and 3	**Total Energy Consumption GJ**	**205,893**	**331,072**	**227,972**	**764,937**
	Energy Intensity GJ/T Product	**0.041**	**0.095**	**0.152**	**0.153**

*Rail transport to Sydney Unloading Facility – 380 km return

**Road transport assumptions

- 16%to Illawarra area – 260 km return
- 17% to Local area – 90 km return
- 42% to Canberra/ACT – 280 km return
- 25% to Southern Sydney – 300 km return

Table 5.23 – Predicted Annual Greenhouse Emissions at Maximum Production

Scope	Greenhouse Emissions (TCO2e)	Quarry Site	Rail Transport*	Road Transport**	Total
	Production/Transport (tonnes)	5,000,000	3,500,000	1,500,000	5,000,000
Scope 1 (Direct)	Electricity TCO2e	-	-	-	-
	Diesel TCO2e	6,369	-	-	6,369
	Explosives TCO2e	245	-	-	245
	Total Energy Consumption TCO2e	**6,614**	**-**	**-**	**6,614**
Scope 2 (Indirect)	Electricity TCO2e	28,518	-	-	28,518
	Diesel TCO2e	NA	-	-	NA
	Total Energy Consumption TCO2e	28,518	-	-	28,518
Total Scope 1 and 2	**Total Energy Consumption TCO2e**	**35,132**	**-**	**-**	**35,132**
Scope 3 (Other Indirect)	Electricity TCO2e	5,104	-	-	5,104
	Diesel TCO2e	701	25,731	17,718	44,150
	Total Energy Consumption TCO2e	5,805	25,731	17,718	49,254
Total Scope 1, 2 and 3	**Total Energy Consumption TCO2e**	**40,937**	**25,731**	**17,718**	**84,386**
	Greenhouse Intensity TCO2e /T Product	**0.008**	**0.007**	**0.012**	**0.017**

*Rail transport to Sydney Unloading Facility – 380 km return
**Road transport
- 16%to Illawarra area – 260 km return
- 17% to Local area – 90 km return
- 42% to Canberra/ACT – 280 km return
- 25% to Southern Sydney – 300 km return

In summary, these calculations show:

- total annual greenhouse emissions of 84,386 tonnes of carbon dioxide equivalent (TCO2e);
- consumption of diesel represents approximately 57% of total emissions;
- consumption of electricity represents approximately 42% of total emissions; and
- use of explosives represents less than 1% of total emissions

Diesel use consists of transport of product by rail (51%), transport of product by road (35%) and use at the quarry (14%). All electricity is used on site for material processing and handling.

Total energy consumption at 5 Mtpa is 764,937 GJ (0.765 PJ) and is dominated by diesel use which represents 85% of total consumption. Energy intensity measured as energy consumption (including product transport) per unit of output is 0.153 GJ/tonne of material.

5.13.3 Emissions Context

As the expected greenhouse gas emissions from the project were greater than 20,000 TCO2e, a Level 2 assessment was required under the NSW Guidelines. The 20,000 TCO2e trigger is approximately 1.3% of the estimated annual average increase in emissions from 1990 to 2010 and therefore any project with emissions of this magnitude requires a specific assessment as undertaken in **Section 5.13.2**.

At 84,386 TCO2e the greenhouse emissions from Lynwood Quarry are significantly lower than the 500,000 TCO2e trigger proposed in the draft regulation to the Commonwealth EPBC Act. The emissions are therefore not considered to be of national environmental significance.

The predicted greenhouse emissions from the proposed Lynwood Quarry represent approximately 0.015% of Australia's total greenhouse gas emissions in 2002. The project is classified as 'Other Mining' under the Australia and New Zealand Standard Industrial Classification (ANZSIC). Emissions from the project represent approximately 0.65% of the 'Other Mining' industry total emissions in 1999 (Australian Greenhouse Office, 2000).

5.13.4 Impact of Maximum Rail Transport Scenario

Approval is sought to allow transport of the entire 5 Mtpa saleable product to Sydney markets by rail, should Readymix so desire based on future markets. The assessment included in **Sections 5.13.2** and **5.13.3** is based on 3.5 Mtpa by rail and 1.5 Mtpa by road as this is considered a worst-case energy and greenhouse option. A comparison assessment is included below for a 5 Mtpa by rail case.

The option of transporting 100% of the product from Lynwood Quarry to Sydney by rail would result in a decrease in energy use and associated greenhouse emissions. Energy consumption would decrease by 86,000 GJ or 11% and greenhouse emissions would decrease by 6,700 TCO2e or 8%.

This calculation does not, however, apply if material proposed for local and regional markets was required to be supplied by rail, because this may require product to be transported from Sydney back to these markets by road, resulting in a greater level of energy consumption and greenhouse emissions.

5.14 Socio-Economic Assessment

A comprehensive socio-economic impact assessment has been completed for the proposed development by Coakes Consulting and is included as **Appendix 3**. A summary of the key findings of the assessment is provided in this section.

5.14.1 Assessment Methodology

Socio-economic assessment is concerned with assessing and predicting the likely consequences of a proposed action in both social and economic terms. While economic assessment emphasises the monetary effects of an action or proposal, social impact assessment is concerned with assessing benefits and costs in non-monetary terms. The social impact assessment and economic assessment methodologies utilised for the project are outlined below.

5.14.1.1 Social Impact Assessment

Social impact assessment is a tool used to predict the future effects of a particular proposal on people, that is their way of life (how they live, work and interact with each other), their culture (norms and traditions) and their community (institutions and structures) (Armour, 1990).

The social impact assessment process has a number of phases. These include:

- assessment and evaluation of issues, which includes:
    - profiling to understand the community;
    - scoping to identify Stakeholder issues;
- prediction of the likely effects of the project;
- mitigation or working with the community to develop appropriate strategies; and,
- monitoring and management of the issues throughout the life of the project.

Community involvement is an integral component of any social assessment process and there are a variety of methods of involving the community and collecting relevant information. The full range of methods used to obtain, communicate and disseminate information about the project were discussed in **Section 2.1**. Where possible, data/information was collected using a range of methods and techniques. This approach is referred to as 'triangulation' and has been used to account for some of the problems inherent in the use of single methods and assist in addressing issues associated with data reliability and validity.

5.14.1.2 Economic Impact Assessment

The economic impact assessment has been based on information provided by Readymix, a survey of existing Readymix employees and a survey of existing customers of Readymix's operations in the area. This information has been used to predict likely economic impacts resulting from the proposal and is discussed in detail in **Section 5.14.3**.

5.14.2 Social Profile

The following section outlines the socio-economic and demographic characteristics of the assessment area, namely the town of Marulan and the Goulburn Mulwaree LGA.

5.14.2.1 Demographic Profile

Goulburn is the largest urban centre in the Goulburn Mulwaree LGA with an estimated population of 21,400 at the most recent census in 2001 (ABS, 2001). Goulburn serves as a regional service centre for the LGA. After Goulburn, the town of Marulan, with an estimated population of 442 in 2001, is the next largest township in the LGA.

In 2001, Marulan had a resident population of 442 who were accommodated in 171 occupied dwellings. There has been a noticeable population increase in the region since 1991 with a 23% population increase within Marulan and 27% increase in population within the former Mulwaree LGA (no census data is currently available for the newly formed Goulburn Mulwaree LGA).

The population is relatively mobile and in 2001 42% of the population in Marulan and 33% of the population within the former Mulwaree LGA indicated they were located at a different address five years ago. In both Marulan and the former Mulwaree LGA there has been a trend towards smaller families with a decline in occupancy rate of households from 2.8 in 1991 to 2.6 in 2001.

Since 1991, Marulan has experienced a significant decline in the number of houses that were fully owned (-18.7%) and an increase in the number of houses being purchased (+20.4%). In contrast, the former Mulwaree LGA only experienced a 2.8% decline in the number of houses fully owned and a 0.8% increase in the number of houses being purchased.

In comparison to the NSW population, Marulan and the broader region have a comparatively young population, translating to a significantly higher child dependency ratio and significantly lower percentage of elderly in the population. This may relate to the number of people in families with children and one-parent families exceeding the NSW State average.

The local economy is primarily agricultural with an emphasis on sheep farming. The area also supports some tourism-related activities due to its proximity to Sydney and the number of National Parks and other natural attractions.

Marulan is primarily a retail location with a relatively high percentage of employment in the retail sector and the transport and storage sectors. Marulan also has a greater percentage of households on low and middle incomes when compared to the NSW State average.

Since 1991 the unemployment rate has declined in Marulan and the former Mulwaree LGA. However, relative to the NSW State percentages there are fewer people employed full time and a higher percentage of people employed part-time.

5.14.2.2 Recent Community Issues

Several studies that have been recently commissioned on Marulan and its surrounding region provide an indicator of likely trends in community composition, and subsequent reaction to changes that may occur in the area. The Mulwaree Shire Settlement Strategy (Mulwaree Shire Council, 2003), the Goulburn and Mulwaree Demographic Profile and Projections (SGS Economics and Planning Pty Ltd, 2003) and the Cultural Map of Mulwaree (Mulwaree Shire, 2004) were reviewed to assess historical response to change. This review has revealed issues that are relevant for the region in general and Marulan in particular. These issues include growth, sustainability and connectedness and are discussed below.

Growth

The growth of Marulan is an issue that is closely linked to the town's identity and is a matter of significant local concern. This was discussed in the Mulwaree Shire Settlement Strategy (Mulwaree Shire Council, 2003).

While the Council is encouraging the growth of the centre, it appears that they have a clear objective to consider the environmental and social impact of change through both long and short term goals that embrace the needs and considerations of community members. The growth of Marulan is a significant issue particularly as changes to geographic and social geographic character of the town will ultimately impact on community identity.

Marulan is already undergoing considerable change and, over the past ten years, has experienced considerable growth. This growth is not across all age groups but seems most pronounced in the under 14 and 40 to 60 year age groups with comparatively few young adults. This trend is indicative of second home buyers interested in adopting a rural lifestyle but with the flexibility of access to centres such as Sydney and Canberra. Furthermore, it suggests that the types of individuals moving to the area are those with non-dependent children or those in search of a second home.

Generally, it has been suggested that the population increase in the area is affected by population pressures in Sydney, affordable prices in the region, the availability of larger areas of land, and the desire for a less urbanised lifestyle for family reasons (SGS Economics and Planning Pty Ltd, 2003).

Sustainability

In April 2003, Goulburn and Mulwaree Councils commissioned SGS Economics to compile a "Goulburn and Mulwaree Demographic Profile and Projections Report" (SGS Economics and Planning Pty Ltd, 2003).

The report predicts that it is likely that Marulan will grow significantly in the next decade with a predicted six-fold increase in population; from a population of 442 at the 2001 census to a "most likely" population of 2850 by 2016 (SGS Economics and Planning Pty Ltd, 2003).

The report cautions that the development of Marulan should be well managed to ensure that there is sufficient land, infrastructure and associated services, while also ensuring that it retains its sense of place. This is particularly relevant given Marulan's current small size.

Connectedness

The issue of connectedness is relevant for the people of Marulan. While the Cultural Map of Mulwaree (Mulwaree Shire Council, 2004) addressed identity, it was also concerned with Marulan's connectedness with other centres. While there is potential for conflict between the issues of growth and sustainability versus Marulan's identity and sense of place, the issue of connectedness is a common thread in this discussion.

Growth and sustainability appears to have been addressed through the desire to encourage migration to the centre, while simultaneously, the cultural map places an emphasis on encouraging the recollection of history of the region to provide connectedness in the lives and experiences of the people who reside in the area.

5.14.3 Socio-Economic Impact Assessment

5.14.3.1 Social Impacts

Social impact assessment involves the cooperation and coordination of a number of 'social partners' or stakeholders. As Burdge (2004) outlines, stakeholders may be affected groups or individuals that:

- live near a resource;
- are forced to relocate;
- have an interest in the proposed action or change;
- use or value a resource; or
- are interested in its use.

In order to determine social impacts associated with the project, survey methods were used to obtain the views of the general community and stakeholders with a specific interest in the proposed development.

To ensure appropriate sampling of the community, it was divided into three different groupings:

- **adjoining property owners** - residents and other industries in close proximity to the project area;

- **special interest groups** - those groups with a particular interest in the operation i.e. local government and associated sub-committees, State government agencies, environmental groups, recreational groups; and

- **wider community** - residents of Marulan and surrounding areas.

A range of survey methods were used to obtain the views and perceptions of the project from stakeholders in and around Marulan. These methods differed according to whether the people consulted were adjoining property owners, members of special interest groups or members of the wider Marulan community. Adopted methods included personal consultation (including face-to-face semi-structured interviews with 55 stakeholders) and a random telephone survey (174 households). A number of other methods were also used, primarily to provide information to the community. These included detailed Community Information Sheets and an open day.

The issues raised by stakeholders centred on the perceived environmental impacts of the proposed Lynwood Quarry. These included, in order of importance, dust, blasting, transport, noise, water, property value and ecology. In addition, the issues of potential contribution to the community and employment opportunities were discussed.

As discussed in **Section 2.1.2**, a random telephone survey was also conducted to ascertain the attitude of the wider Marulan community toward the proposed quarry. Respondents were asked a number of questions which examined knowledge and awareness of the proposal, beliefs about the potential impacts of the proposal, evaluative judgments about the proposal, attitudes towards the proposal and questions relating to the social and demographic characteristics of respondents. Attitude statements were also used to assess community attitudes towards the quarry proposal.

In summary, the results of the survey indicated that awareness of the quarry proposal was high, with 85% of respondents aware of the proposal. Forty-one percent of all survey respondents indicated that they had no specific knowledge of the proposal. The majority of respondents (80%) indicated that they either ‘strongly approved’ or ‘approved’ of the quarry proposal. Over half (55%) of all respondents indicated that there were no impacts or issues of concern associated with the proposal. Of the remaining respondents, 24% raised the issue of dust from the operation. Other impacts of quarry operations raised most frequently were traffic congestion caused by trucks from the quarry (21%), and noise from quarry operations (16%).

Attitude statements indicated that while a significant percentage of the community believe the quarry will go ahead regardless of what the community thinks (52%), the majority of residents trusted the development approval process that is being undertaken for the quarry (74%). In addition, the majority of respondents (79%) believed that the benefits a quarry would bring to the area would outweigh any of the disadvantages. Nearly all respondents (92%) believed the proposed quarry would make an important contribution to the local economy and that it would not detract from the area (78%).

5.14.3.2 Economic Benefits and Costs

The key economic impacts of the construction and operational phases of the proposed quarry are significant and result largely from the increased workforce associated with the two phases.

Construction Phase

The economic impacts of the construction phase are based on a two year construction period with an estimated peak construction workforce of 140. It is estimated that of this construction workforce, 119 (85%) will reside in Goulburn, 14 will reside in Marulan (10%) and 7 (5%) will reside outside the Goulburn Mulwaree LGA.

The key construction impacts are therefore related to household expenditure, salaries and wages, and capital expenditure.

Over a two year construction period household expenditure by construction workers is estimated to be approximately $7.9 million in Goulburn, $1.4 million in areas outside the Goulburn Mulwaree LGA and $0.5 million within the town of Marulan (based on predicted residence location during the construction phase and predicted disposable household income).

Annual gross salaries and wages in the order of $14.8 million will be paid to the construction workforce and an additional $5.9 million will be generated through additional gross salaries in the LGA economy (due to flow on effects from predicted expenditure patterns of the construction workforce).

Capital expenditure associated with construction is estimated to be between approximately $150M and $195M on completion of the project. Much of the direct and indirect economic benefits associated with the purchase of capital expenditure items required in construction are likely to occur outside the LGA, primarily within the Sydney metropolitan area.

As discussed above, the location of employee expenditure is primarily influenced by the place of residence of the workforce. For Marulan to derive the most benefit from this expenditure, it needs to embark on a proactive process to manage these impacts. The key variable that will affect whether this income will accrue to Marulan or other centres in the region is the availability of suitable accommodation and related services.

Operational Phase

During the operational phase, it is estimated that there will be an operational workforce of approximately 115 employees. Initially it is estimated that employees will reside primarily in Goulburn and other rural towns (75), Marulan (34) and locations outside the LGA (6). However, after several years of operation, it is expected that the proportion of employees residing in Marulan would increase as the town grows.

The predicted economic impacts caused by the operational phase are: job creation, household expenditure, salaries and wages, operating expenditure, quarry income, and population impacts.

Operation of the proposed quarry is anticipated to result in the creation of an additional 129 indirect jobs in other sectors of the economy within the LGA.

Using estimates in relation to the likely residential location of employees and the distribution of household expenditure, it is estimated there will be $4.2 million in annual household expenditure occurring within Goulburn, $0.9 million occurring within Marulan and $0.9 million in locations outside the LGA during the initial years of quarry operations. However, after several years of established quarry operations it is likely that the workforce will increasingly reside in Marulan and household expenditure in Marulan will increase. This would necessitate an increase in the size and number of commercial businesses within Marulan in order to supply goods and services to an increasing number of employees.

In relation to the operational workforce, the direct payment of $9.1 million in annual gross salaries and wages would lead to an additional $6.7 million in annual income being generated in other sectors, of which $4.5 million would be additional household expenditure.

Operational expenditure is based on quarry operations and the transport of quarry materials. It is expected that many purchases of goods and services associated with the project will occur outside the LGA due to the current lack of such goods and services within the LGA. Based on these assumptions, the predicted total direct and indirect economic impact of local operating expenditure is estimated to be $10.5 million per annum. It is possible that the level of local expenditure would increase during the operational phase of the quarry as some of the major suppliers may relocate to the local area to enable more competitive supply of goods and services.

The application of a family size multiplier of 3.5 (based on the existing Readymix workforce in the local area) and the consideration of housing availability indicate that on commencement of quarry operations, the Marulan population (based on the latest available census information from 2001) would increase by an estimated 27%. The remainder of the workforce is expected to live elsewhere in the LGA, including in Goulburn which is approximately 25 kilometres from the project area. A portion of the workforce is also expected to live in areas outside the LGA within the Southern Tablelands and the southern outskirts of Sydney (approximately one hour drive from the project area). Data from the 2001 census indicates that approximately 24% of houses within the former Mulwaree LGA were unoccupied in 2001 (some 817 residences) and that 7.6% of houses within the former Goulburn LGA were unoccupied (some 642 residences). These statistics indicate that there is sufficient existing housing within the current Goulburn Mulwaree LGA to support the projected workforce.

Should Marulan grow as currently projected, it is expected that the increased availability of local housing will result in a greater percentage of the workforce residing in Marulan over the life of the operation. The final number of employees residing in Marulan will depend on the future growth of the town and associated provision of services, and on lifestyle choices by the employees and their families.

These predicted economic impacts, particularly those resulting from the predicted initial and possible future population increases during the operational phase, confirm the need for the current planning studies being undertaken by Goulburn Mulwaree Council. With careful planning of the Marulan area, there is an opportunity to ensure that the considerable potential benefits of the project accrue to Marulan as opposed to other areas within and outside the LGA. If these economic and population growth impacts are well managed, they represent a significant opportunity for the development of Marulan.

5.15 Overview of Cumulative Impacts

Potential cumulative impacts associated with the construction and operation of the proposed Lynwood Quarry have been discussed throughout **Section 5.0** and are addressed in each of the relevant specialist reports included as appendices to this EIS. The key points from these assessments are outlined below.

There are few existing industrial sources which currently impact on the Marulan township. The Marulan Waste Management Facility, Orica Explosives storage depot, the Marulan light industrial area, Johniefelds Quarry and the fertiliser loading facility have potential to cause a cumulative impact. All of these facilities are small and have little potential to significantly contribute to cumulative impacts.

Potential cumulative dust impacts have been assessed finding that existing industrial contributions are minimal and that cumulative dust levels will remain well below the relevant criteria (refer to **Section 5.8**).

Existing industrial noise sources have been measured during baseline monitoring and cumulative noise criteria have been determined. Modelling indicates that cumulative noise criteria will be met at all existing residences and residential locations (refer to **Section 5.9**).

South Marulan Quarry is located approximately 7 kilometres to the southeast of Marulan and does not impact on the local Marulan environment. The only potential cumulative impact therefore relates to traffic generation and associated issues at the Hume Highway-South Marulan Road intersection. The proposed Ardmore Park sand and gravel quarry is also a significant distance from the project area (approximately 18 kilometres) and again, the only potential cumulative impact relates to traffic using the Hume Highway-South Marulan Road intersection. These potential cumulative traffic impacts have been addressed by the proposed construction of the interchange at this location, designed to not only accommodate expected Readymix traffic from the project, but also to provide more than adequate capacity for existing traffic flow through this intersection.

Other potential cumulative impacts relate to impacts on natural environment and heritage values with the key findings of these cumulative impact assessments including:

- the project can demonstrate that it will result in a beneficial effect on water quality. In addition, impacts on surface water flows will not significantly affect flow of water in the Wollondilly River system (reduction of <0.1% of total flows) (refer to **Section 5.6**);

- although the project will result in clearing of native vegetation, there will not be a significant impact on threatened species or other significant species, with the proposed management measures considered to mitigate any loss of ecological values. The impact of the project is not considered to be significant from a regional perspective (refer to **Section 5.7**);

- the project will impact on Aboriginal archaeological and cultural heritage values, however, the most significant sites located within the project area will be unaffected and will be managed for conservation. The majority of sites will remain unaffected and the extent of impact is not considered to be significant from a regional perspective (refer to **Section 5.10.1**);

- the project will also impact on historic heritage values within the project area, although the majority of areas of heritage value will remain unaffected. The disturbance of the remaining heritage sites provides an opportunity to learn more about these sites and the historic use of the area generally, with this potential for increased knowledge considered to offset the damage to these areas (refer to **Section 5.10.2**); and

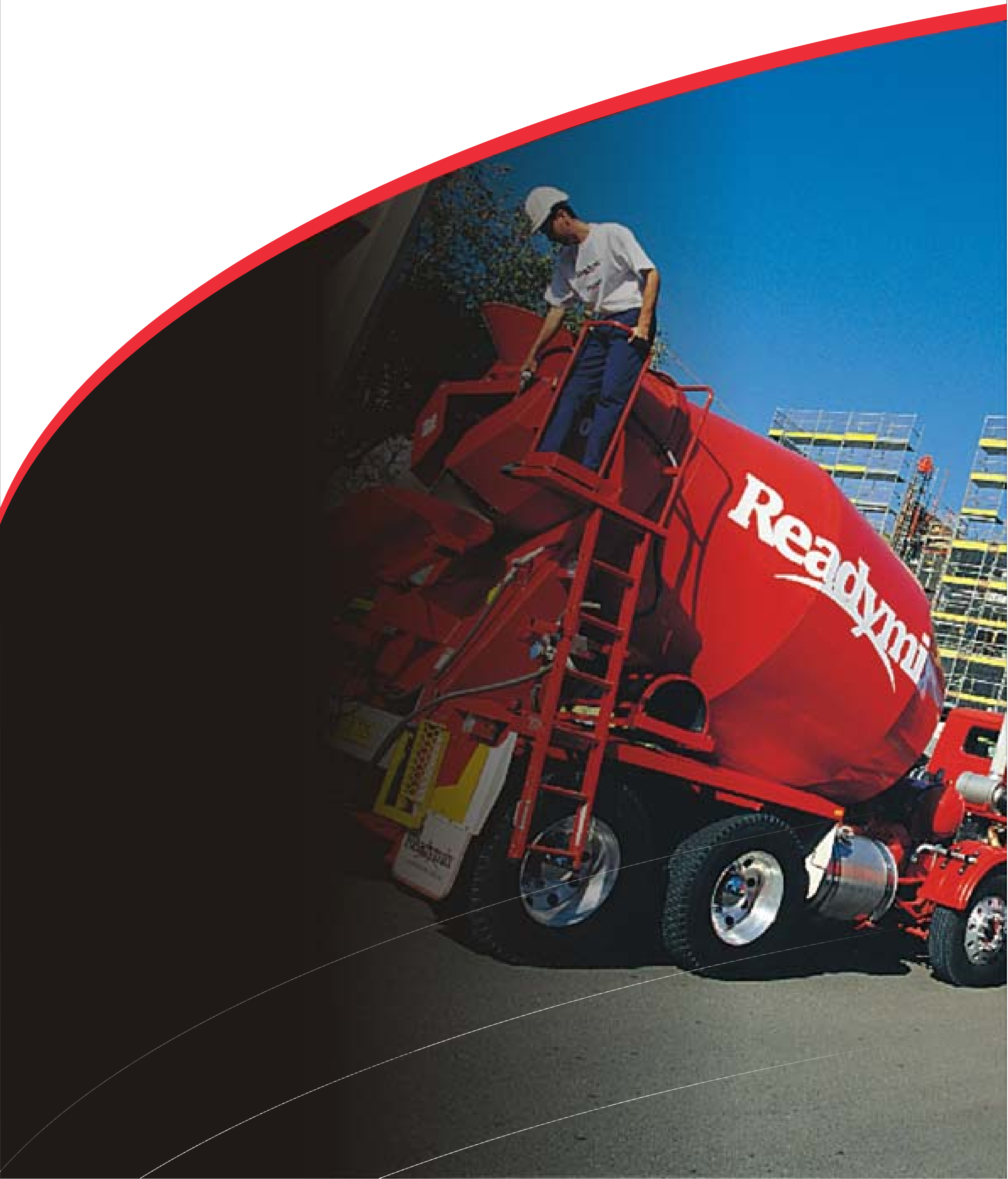
- the visual impacts associated with the project will be minimal from almost all receiver locations and the project is therefore not considered to significantly detract from regional scenic quality (refer to **Section 5.11**).

The comprehensive social impact assessment undertaken for the project also found that the proposed quarry will make a positive economic contribution to the local, regional and State economies and that the project has the strong support of the local community (refer to **Section 5.14**).

Overall, the potential for negative cumulative impacts due to the project, other industrial development and surrounding land use impacts is considered to be low.

SECTION 6

Alternatives & Justification



6.0 Alternatives and Justification

6.1 Alternative Locations and Construction Material Sourcing Options

6.1.1 Alternative Locations Considered

As a major supplier of construction materials, Readymix is investigating potential quarry resources on an ongoing basis. For the Sydney market, these investigations include deposits within 350 kilometres of Sydney, as any greater distance is likely to result in supply to Sydney being uneconomical. Whilst geological deposits that are potentially suitable for generating construction materials are not especially rare, it is difficult to find large deposits that are economically viable and that are not significantly constrained by surrounding land uses.

In order to replace production from the Penrith Lakes Scheme, Readymix requires a large scale resource of 100 Mt plus to ensure long term economic viability. Resources of this scale within the Sydney basin are constrained due the extent of urban development and therefore it is necessary to find a resource that is a viable distance from Sydney. Such resources are typically located at least 100 kilometres from Sydney metropolitan area. At this distance from the target market and due to the volumes of material required to be transported, it becomes necessary to use rail transportation to ensure economic viability and limit environmental impacts. Therefore, any targeted resource must have ready access to the rail network.

Readymix owns the Mt Flora hard rock resource for which development consent was granted in 1995. Whilst this resource was previously considered to have potential to play a key role in replacing Readymix's supply from the Penrith Lakes Scheme, there are a number of key issues which impact on this potential including:

- the Mt Flora approval is only for 1 Mtpa which is not sufficient to replace Readymix's current supply from Penrith Lakes, nor meet future predicted demands;
- transport from the quarry would be via road to a separate rail loading facility for transportation to Sydney;
- production costs per tonne at Mt Flora would be higher than production costs at Lynwood Quarry due to the nature of the resource and transport related costs. The necessary combined use of road then rail haulage at Mt Flora requires double handling of the product.

Readymix has also investigated various other locations to replace supply from the Penrith Lakes Scheme. During such investigations, Readymix has not identified a better high quality, large scale resource with ready access to key transport infrastructure, than the Lynwood site. This location is therefore Readymix's preferred option to provide a long-term supply of construction material into the Sydney market.

6.1.2 Alternative of Expanding Existing Quarries

Instead of opening a new quarry, Readymix investigated the option of expanding its existing quarries or using existing approvals. These investigations found that none of these options would provide sufficient product to replace Penrith Lakes and many had major transportation constraints.

Due to the significant capital costs involved in establishing Lynwood Quarry, Readymix has undertaken an analysis of upgrade potential for all of its quarries within the Sydney and surrounding regions. None of these quarries were able to provide the required yield, many had transportation issues as they involved significant road haulage distances, and many had higher per tonne production costs. Readymix also investigated the option of undertaking numerous small upgrades and supplying its Sydney markets from a number of quarries, however, transportation and production costs made this option uneconomic.

6.1.2.1 Source Supply from non-Readymix Quarries

The option of Readymix sourcing construction material from other non-Readymix quarries has also been considered.

Readymix currently supplies the majority of its concrete and asphalt businesses from its own quarries as well as supplying other markets. The option could theoretically exist to purchase material for these businesses from other suppliers. A review of the current industry status shows that the three major suppliers into the Sydney market all have their major supply coming from the Penrith Lakes Scheme. None of Readymix's competitors therefore have the capacity to supply Readymix with the volumes of material it requires for its concrete and asphalt businesses. Any supplies that they could obtain from these sources would also be at an increased cost from that possible from Lynwood, affecting the viability of Readymix's Sydney metropolitan operations, which currently employ approximately 300 people.

This option would also result in Readymix losing its current share of the construction material market in the Sydney region and is therefore unacceptable from a Readymix corporate viewpoint.

6.1.3 Alternative Sources of Construction Materials

The option of replacing new quarries by recycling used construction and other 'waste' products has also been raised as a potentially viable alternative. There are two potential options: recycled building materials; and blast furnace slag produced by steel mill operations in Wollongong.

Recycled Building Materials

A survey of building material recycling was undertaken by DEC for the 2002-03 financial year (DEC, 2004). This survey found that in NSW, approximately 2.1 Mtpa of brick and concrete material was recycled in 2002-03 (based on available records), of a total of 2.9 Mt total recycled building materials. The quality of this material is highly variable and this places constraints on end use. End uses (based on total recycled building materials) outlined in the DEC survey were approximately:

- 47% for road base;
- 16% for drainage materials;
- 20% for fill and bedding material;
- 5% for concrete and asphalt; and
- 12% for other uses.

The main use of product from the proposed Lynwood Quarry will be for concrete and asphalt and consequently, the available supply of recycled building materials is not sufficient to replace the market intended to be filled by the proposed quarry.

Blast Furnace Slag

Readymix has also investigated the option of using blast furnace slag from the Wollongong region. The current contract for processing blast furnace slag produces approximately 2 Mtpa of material. Readymix understands that much of this product has existing markets and, at best, Readymix might be able to secure about 0.5 Mtpa of this product. This volume would not be sufficient to meet Readymix's demands.

It is therefore considered that use of recycled material is not a viable option for replacement of the proposed Lynwood Quarry.

6.2 Alternative Quarry and Infrastructure Plans

6.2.1 Alternative Quarry Plans

A number of alternative quarry plans were investigated as part of the quarry design and EIA process. Some of these plans were discounted due to geological or economic factors, with others less suitable from an environmental impact perspective. The proposed quarry conceptual plan was found to be the most suitable from a quarry planning, economic, and environmental impact perspective.

Some of the alternative quarry plans considered during the quarry design and EIA phases are shown on **Figure 6.1**. Many of these designs were quickly discounted, however, detailed designs were completed for a number of the quarry plans (including options C, D and E). The rationale as to why the quarry designs shown on **Figure 6.1** were not selected for the initial 30 year plan include:

- Option A – this was the initially proposed quarry pit outline based on early exploration work undertaken on the southern side of the Main Southern Railway. As discussed in **Section 5.1**, this area has a more variable resource than the northern area and was therefore not pursued. In addition, this option would have had greater dust and noise impacts on residences to the south of the project area;

- Option B – this quarry pit involved the opening up of the economic extent of the northern resource area, based on the former Readymix land ownership boundary. This quarry plan had a number of issues including:

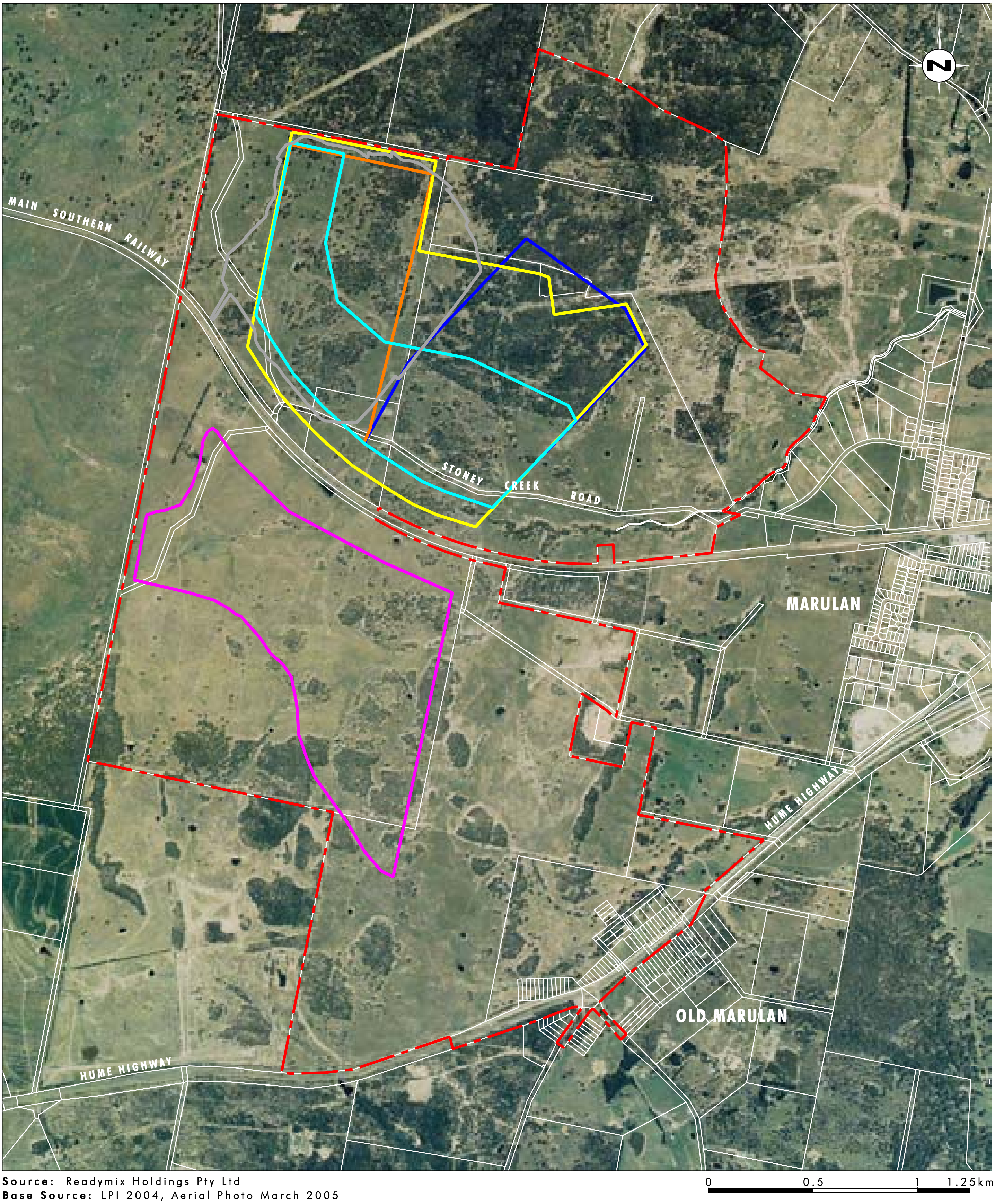
    - for the initial 30 year approval period, it resulted in clearing of a large area and a large shallow quarry pit that would have been susceptible to wind erosion and subsequent dust generation;

    - it was closer to the Main Southern Railway and therefore may have had greater blasting impacts on the railway;

    - as the pit was shallow the quarry would have always had equipment operating near the surface and would therefore have had increased noise impacts due to the lack of shielding;

    - it would have generated significantly greater volumes of overburden with no potential for in-pit dumping without resource sterilisation. This would have resulted in reduced economic viability and an increased disturbance footprint / visual impact due to out-of-pit emplacement areas;

Umwelt
Environmental Consultants



Source: Readymix Holdings Pty Ltd
Base Source: LPI 2004, Aerial Photo March 2005

Legend
- Project Area
- Option A
- Option B
- Option C
- Option D
- Option E
- Proposed 30 Year Quarry Pit

FIGURE 6.1

Selected Alternative 30 Year Quarry Plans

File Name (A4): R03_V1/1829_236.dgn

  - it resulted in increased haul distances for quarry mobile equipment increasing costs and greenhouse gas emissions;

- Option C – involved focussing the initial 30 year quarry pit in the eastern half of the resource. This option increased haul distances to the preferred infrastructure area, was closer to residential receivers increasing noise impacts and resulted in more extensive vegetation clearing, but was otherwise a viable option;

- Option D – is a similar design to the finally selected design, however, it was a smaller and deeper pit. This pit design had significant space issues, including the inability to maintain acceptable grades on haul roads. It would have also made future extensions of the pit more difficult due to haul road configuration constraints; and

- Option E – this pit was designed to follow the topography, plus extend to the north in the area near the primary crusher. This pit was a viable option, however, it did have significant space constraints and associated haul road difficulties. The environmental impacts are largely similar to the current design.

A number of alternative emplacement area designs were also considered as part of the quarry planning and EIA process. The alternatives considered included in-pit dumping, alternative locations and alternative sizes and heights in the finally selected locations. The final emplacement area locations were selected to minimise visual, noise and air quality impacts whilst not resulting in resource sterilisation.

6.2.2 Alternative Quarrying Techniques

Quarrying techniques are relatively standard with possible alternatives generally limited to equipment and operating hours. Readymix originally planned to operate the quarry mobile equipment fleet on a 24 hour per day, seven day per week basis in order to provide maximum operational flexibility. During the EIA process it became apparent, however, that operating the clearing and topsoil stripping, drilling, overburden stripping and emplacement, and primary raw feed load and haul fleets on a 24 hour per day basis (with the sound power levels of currently available equipment) would result in unacceptable noise impacts on some nearby residences. The operating hours of these equipment fleets have therefore been limited to ensure that noise impacts remain within acceptable limits. Other limits placed on operating hours include limiting the number of road haulage trucks used during night-time periods.

The quarry mobile equipment fleet was selected in order to meet Readymix's production requirements and achieve operational efficiencies. Impacts are generally proposed to be managed by limiting operating hours as opposed to changing planned equipment fleets. There have, however, been some limitations placed on the sound power levels of equipment operating in key operational locations (e.g. on the leading edge of the Eastern Overburden Emplacement Area) which will require equipment with appropriate noise attenuation or design in order to ensure noise impacts at the nearest residences remain within acceptable limits (refer to **Section 5.9**).

6.2.3 Alternative Infrastructure Options

A range of alternative infrastructure options was considered during the quarry planning and EIA phases of the project. Some of these options were not pursued due to EIA findings, community issues and/or because they were not operationally favourable. Some of the key alternative infrastructure options considered are outlined below.

6.2.3.1 Alternative Crushing and Screening Plants

During the design process, various locations and layouts were considered for the crushing and screening plant. The over-riding locational factors considered were the need to keep the plant as far as possible from the township of Marulan (to limit potential noise impacts), not to sterilise resources and to locate the product stockpiles in the vicinity of transportation infrastructure to minimise handling costs and energy consumption. The other key location considered during the design phase was to the north of the Main Southern Railway adjacent to the western property boundary (refer to Option B on **Figure 6.2**). This option was discounted as it was located above economic reserves and would result in the medium-term sterilisation of these resources. It also provided less overall space for the plant layout and once the parallel rail siding option was discounted (refer to **Section 6.2.3.3**), was located too far from the rail loadout facility.

Other key alternatives considered in relation to the crushing and screening plant and the reasons that these were not included in the final design included:

- the original crushing and screening plant was not fully enclosed, however, this created additional dust and noise impacts and so enclosure of all crushers and screens was considered necessary (excluding the primary crusher which is below ground and the spalls plant which will only be operated periodically);

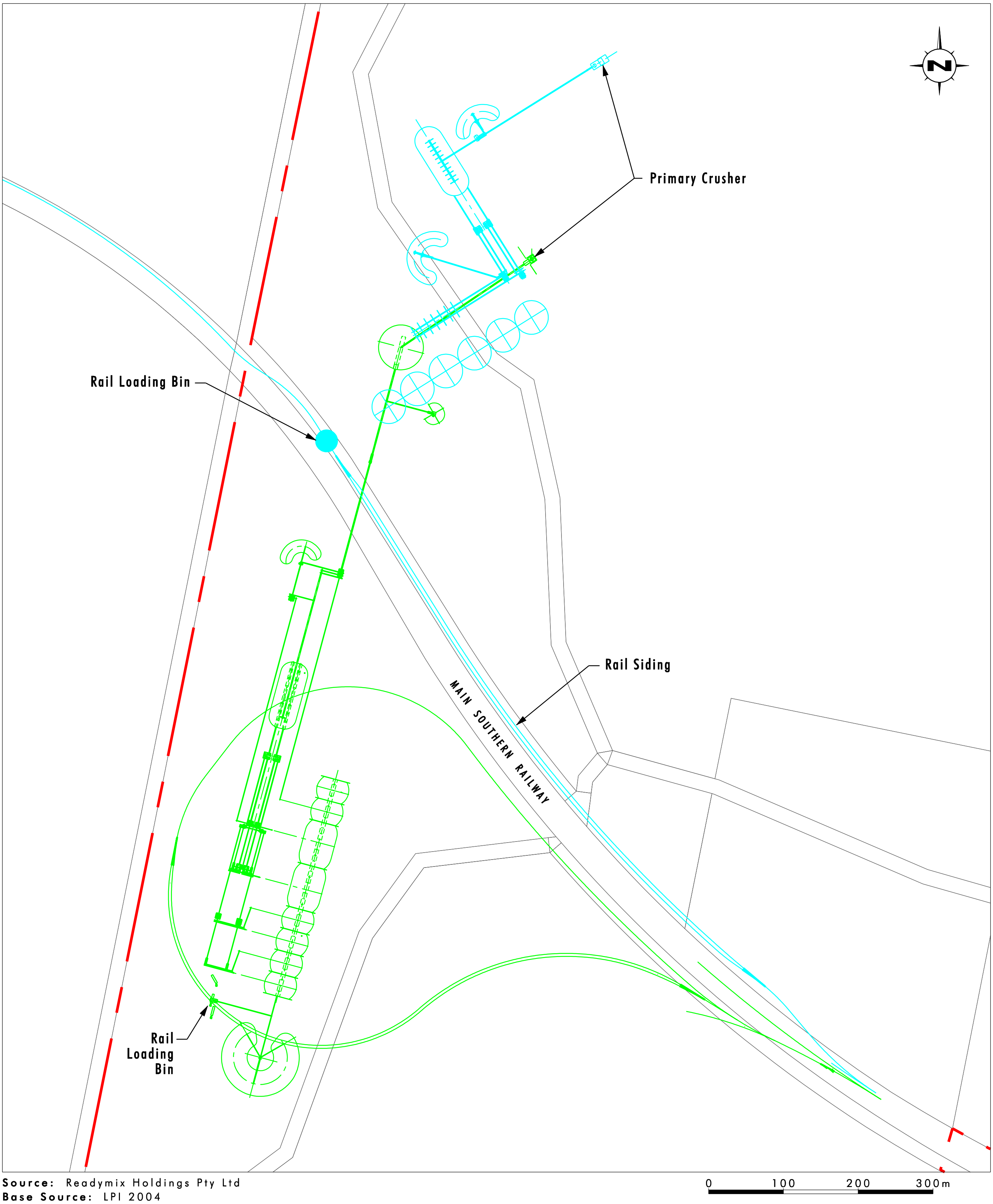
- various locations for the primary crusher were investigated, including the potential to move the primary crusher lower into the pit at a later stage in the quarry life. These investigations considered engineering stability, operational constraints, potential sterilisation of resources, energy efficiency and noise impacts. The final location was suitable from a noise impact perspective, did not sterilise high quality resources and provided a safe, stable substrate into which to construct the crusher. The option of moving the primary crusher lower into the pit was not considered to be operationally advantageous during the initial 30 year quarry period as it would not significantly reduce overall noise impacts, operating costs nor energy consumption, but would require an extended shutdown during the move. Should a future approval be granted to extend the quarry beyond its initial 30 year life, Readymix may elect to move the primary crusher lower into the pit;

- the original plant did not have a fines recovery system and consequently did not recycle as much water. The addition of this system to the plant adds significantly to the cost of the plant, however, it was considered necessary to achieve the increase in water efficiency;

- crushing and screening plants with reduced capacities were considered (e.g. different types of primary crushers, etc.), however, this would require increased operating hours to achieve the required tonnage output and would reduce production flexibility; and

- restricted operating hours for the crushing and screening plant were also considered, however, operation on a 24 hour per day, 7 day per week basis will be required in order to ensure rail product deliveries can occur in the available time slots. Twenty four hour operation also provides operational flexibility to achieve the required production levels. This option was also discounted when noise modelling indicated that restricted plant operating hours were not required to ensure compliance with project noise goals.

Umwelt
Environmental Consultants



Source: Readymix Holdings Pty Ltd
Base Source: LPI 2004

Legend
- Project Area
- Option A
- Option B

FIGURE 6.2

Selected Alternative Infrastructure Designs Considered

6.2.3.2 Alternative Transport Options

During the planning phase a range of transport options were considered. These included:

- delivering all product by road;
- delivering all product by rail; and
- delivering greater volumes by rail.

The reasons why these options were not pursued as part of the final project design are discussed below.

- All product by road – Greater transport by road for this volume of material would not be consistent with current NSW government policy of maximising movement of freight by rail. Rail transport of hard rock quarry products is now more economic over long distances because of competitive changes to rail freight cost arrangements, making transport of product to Sydney by rail a more realistic option than for previous quarry projects.

- All product by rail – This option was not viable as Lynwood Quarry will also deliver product to local and regional markets that are not serviced by rail or which do not have appropriate rail unloading facilities. In addition, some destinations to the south of Sydney may be more economical and energy efficient to reach via truck direct from Lynwood Quarry than by railing into Sydney and then travelling back south by truck.

- Greater volumes by rail – Careful consideration was given to various truck haulage limits during development of the EIS. Factors relevant to these considerations were traffic impacts, customer locations, likely growth in customer demand over the life of the quarry and possible demand increases associated with closure of other regional quarries. The outcome of these considerations was the proposed haulage limit of 1.5 Mtpa. Consideration was given to a reduced haulage limit of 1 Mtpa, however, it was considered likely that only gaining approval for this reduced limit would mean that Readymix may have to seek approval to increase this limit during the initial 30 year life of the quarry in order to meet market demand. The construction of an interchange type intersection for gaining access to the Hume Highway also ensures that the traffic impacts associated with transport of up to 1.5 Mtpa is a safe, viable option, making this limit appropriate for the development.

6.2.3.3 Alternative Rail Facility Options

The rail facility was originally planned to be a parallel siding located on the northern side of the Main Southern Railway (Option B) as opposed to a balloon loop (Option A) (refer to **Figure 6.2**). The parallel siding was cheaper however it had several associated operational and environmental issues. The main issues which resulted in the balloon loop option being selected included:

- the parallel siding would only be able to hold one train at a time providing less flexibility to fit into the available time slots on the Main Southern Railway;

- the siding would have required uncoupling and re-coupling of locomotives to enable them to travel into the siding in one direction and leave in another. This adds to train turn-around time, limiting Readymix's ability to ensure trains would be ready for their allocated time slot on the Main Southern Railway; and

- the siding would have required shunting of train wagons as there would no ability to turn the train around, this would potentially result in greater noise impacts on nearby residences.

The rail loading bins were not originally planned to be lined and the loading points not originally planned to be enclosed as this adds significant cost to the construction of the facility. Despite this, due to potential noise impacts, these controls were included in the final design.

6.2.3.4 Alternative Access Road Options

Two alternative access road options were considered during the initial stages of project planning. These involved the existing access points to the Lynwood site via Stoney Creek Road to the north of the Main Southern Railway and Wilson Road to the south of the Main Southern Railway. Wilson Road also provides access to the Marulan Waste Management Facility. Upgrading these roads for use as permanent access points was briefly considered but discounted due to potential impacts on Marulan of operational phase traffic volumes. Wilson Road will be used as the primary construction access point, with short-term low volume use of Stoney Creek Road also required until the rail overpass is constructed.

6.2.3.5 Alternative Highway Intersection Options

Once the alternative access points to the site discussed above were discounted, it was identified that the only viable option was to construct an intersection directly linking onto the Hume Highway. Various intersection locations and options were considered prior to agreeing on the currently proposed intersection design with the RTA. Selected options are shown on **Figure 6.3** and all options considered are described below with an indication of why these were not considered appropriate:

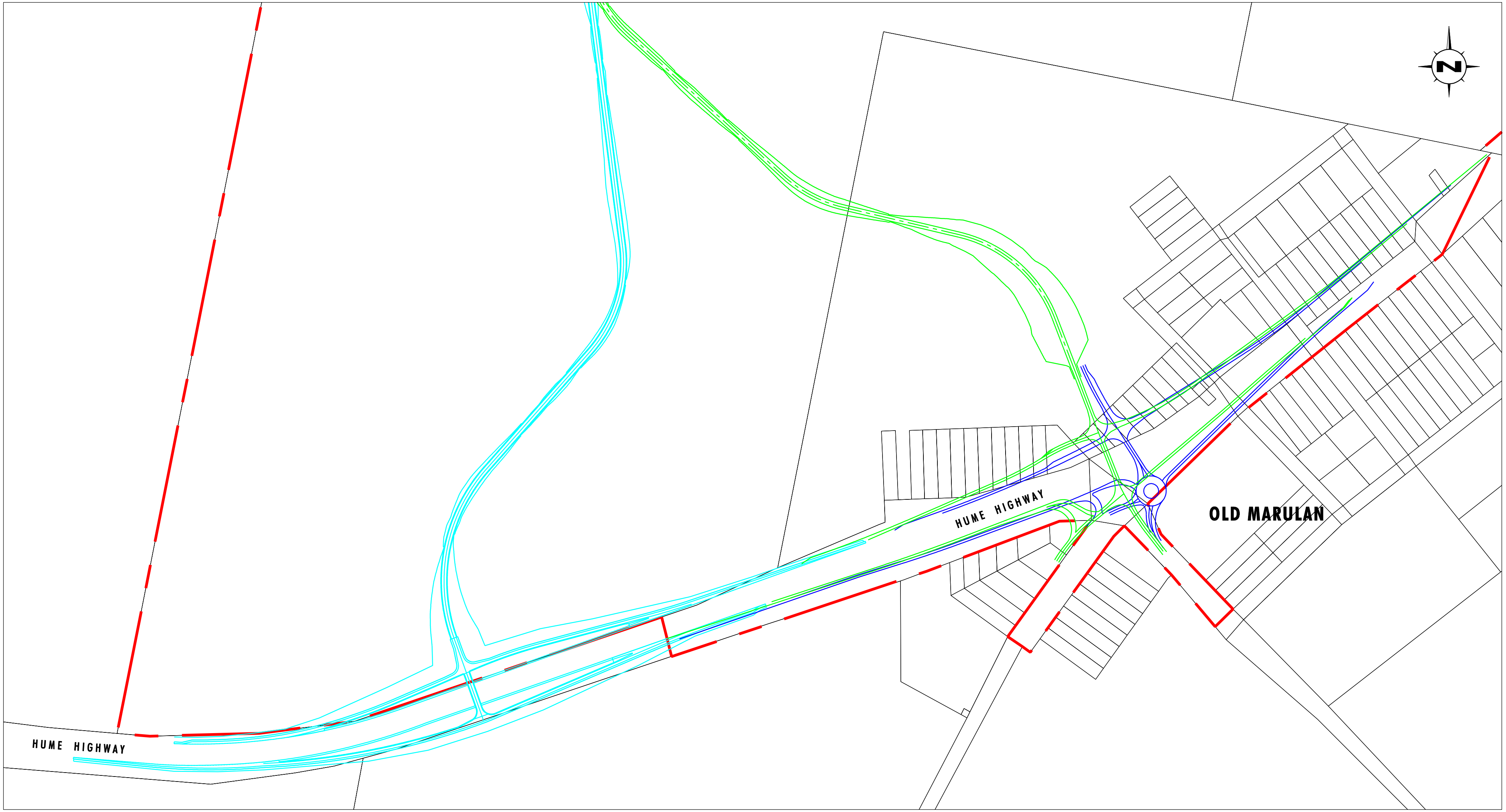
- Option A – this option involved joining onto the Highway at the existing South Marulan Road intersection and utilising the existing cross median access. This option was discounted as the cross-median access has significant safety problems;

- Option B – this option involved establishing a stand-alone intersection for the project to the south of the South Marulan Road intersection (refer to **Figure 6.3**). This option was Readymix's preferred option and involved construction of a flyover to provide access to both north and south bound lanes of the highway. This option provided the necessary level of safety and was significantly cheaper than the finally selected option, but was not preferred by the RTA as it added another intersection to the Highway;

- Option C – this option was considered at the request of Goulburn Mulwaree Council and aimed to link the Lynwood Quarry intersection with a flyover proposed to be established for a residential development to the east of the Hume Highway, opposite the existing Marulan township. This option had several issues including land ownership issues, traffic compatibility issues and the fact that it would have provided an 'in-between' option that was not particularly suitable for either development. This option was not progressed to concept design phase because of these difficulties; and

- Options D and E – these options were located at the same point as the proposed intersection (refer to **Figure 6.3**), however they had different intersection configurations (e.g. one option included a roundabout). The disadvantages of these options were that they would have required acquisition of additional land and would have had a greater impact on the Old Marulan Township State Heritage Register area, with these options not improving the overall level of service to traffic flow at the intersection.

Umwelt
Environmental Consultants



Source: Readymix Holdings Pty Ltd
Base Source: LPI 2004

0 100 200 400m

Legend

- Project Area
- Option B
- Option D
- Option E

FIGURE 6.3

Selected Alternative Hume Highway Intersection Options Considered

6.2.3.6 Alternative Hours of Operation

Hours of operation were originally planned to be 24 hours per day, seven days per week for all quarry activities in order to provide maximum production flexibility. During the EIA process, however, it became evident that conducting some operations during evening and night-time hours may cause noise impacts on nearby residents. Hours of operation were therefore limited for some activities in order to avoid noise sensitive periods (i.e. temperature inversion and air drainage flow conditions that occur at night). The restriction of operating hours impacted on the operational equipment fleet for the quarry, with additional equipment required to be operated for some activities so that they can be completed within the specified working hours. This has also increased project costs.

6.3 Alternative of Not Proceeding

The alternative of not proceeding would result in the loss of the economic and social benefits of the project discussed in this EIS and particularly in **Section 6.4**. Not proceeding with this proposal would:

- result in the loss of potential employment including approximately 115 direct jobs plus approximately 129 flow-on jobs (refer to **Appendix 3**);

- result in the loss of significant contributions to the local, regional and State economies through capital expenditure ($150M to $195M), ongoing operating costs and wages (construction $14.8M per annum; operation $9.1M per annum);

- result in loss of security of economic supply of construction materials to Readymix's Sydney region concrete and asphalt businesses, placing at risk the viability of these operations and job security of the people employed by them; and

- result in the loss of supply of high quality construction materials into the local, regional and Sydney markets, potentially resulting in a significant shortfall of construction material availability.

Not proceeding with the project would also mean that the environmental impacts discussed in **Section 5.0** would not occur, however, these impacts can be managed within current legislative and government policy constraints, and are not considered likely to significantly impact on the surrounding environment or community. The environmental impacts are also considered to be outweighed by the economic and social benefits of the project.

Therefore, the alternative of not proceeding with the project is neither a desirable nor justifiable alternative.

6.4 Justification for the Proposed Development

6.4.1 Need for and Supply of Construction Materials

Construction materials are essential to the building and construction industry and are used in large quantities by modern society (DMR, 2004). Hard rock construction materials are required for concrete, asphalt, gravel, structural rock, rail ballast and manufactured sand among other products, with these materials required on almost all construction sites. The demand for construction materials is particularly high in the Sydney metropolitan area, which is continuing to rapidly expand to satisfy population demands. During 2001-2002, NSW consumed approximately 34 Mt of construction material, worth approximately $394M.

Approximately half of the State's production was consumed in the Sydney-Wollongong-Newcastle region (DMR, 2004).

The NSW construction industry is of vital economic importance both to the State and Australia as a whole. In 2002-03 the construction industry contributed 6.2% to the Gross State Product, making it the fourth largest industry, with a value of $22,098M (ABS, 2004). The construction industry is also one of the largest employing industries in NSW employing approximately 243,000 people in 2002-03, approximately 7.8% of the State's workforce (ABS, 2004). The ongoing economic supply of construction materials to the construction industry is vital to ensure that this significant contribution to the State and Australian economies continues.

6.4.1.1 Predicted Demand for Coarse Aggregate

Numerous studies over the past 20 years have discussed predicted future demand for construction materials in the Sydney region market. Most of these studies related to the concern that land use constraints would impact on the viability of known resources within the Sydney region, with active quarries within the region having only limited resources.

Some of the most recent estimates available on future demand of coarse aggregate are provided by DMR (2000) based on per capita consumption of coarse aggregate products and on past consumption trends. A summary of the estimates is included in **Table 6.1**.

Table 6.1 - Predicted future demand for coarse aggregate based on DMR (2000)

	Short-term 2000-2010	**Medium-term 2000-2020**	**Long-term 2000-2040**
Demand for total period	131.7 to 145.9 Mt	258.2 to 288.2 Mt	539.3 to 617.3 Mt
Approximate annual average consumption	13.9 Mtpa (2000-2010)	13.4 Mtpa (2010-2020)	15.3 Mtpa (2020-2040)

Based on the information contained in **Table 6.1**, it can be seen that the demand for coarse aggregate over the next 35 years is predicted to be in the order of 13 to 14 Mtpa, with increased demand likely to occur in the period 2020 to 2040.

6.4.1.2 Current and Predicted Supplies

The Sydney region has historically been well supplied with construction materials from large, conveniently located deposits of high quality construction materials. This supply regime has been slowly changing since the early 1980s, with the region forced to rely on increasing importation of resources to meet construction and building demands. The region currently imports approximately 13% of its construction sand requirements and 23% of coarse aggregate requirements (DMR, 2004). The DPI (DMR, 2004) considers that there will be an increasing reliance on imports into the future as the largest current sources in the region, Penrith Lakes and Kurnell, are exhausted.

Based on construction material production statistics available from DPI for the 2001-02 period, the top three producing quarries in NSW are the three participants in the Penrith Lakes Scheme (Readymix, Boral and Hanson) (DMR, 2004). As discussed previously, this scheme is currently predicted to be exhausted in around 2010. Production from Kurnell, currently ranked 4th, is expected to cease in the short to medium term due to exhaustion of resources, whilst the 5th ranked quarry by production, Prospect Quarry, also has only limited resources of high quality material remaining. Based on the DPI figures, the approximate combined production from these five operations during 2001-02 totalled 7.7 Mt. Once these operations cease, and if they are not replaced, it will leave a significant shortfall in the supply of coarse aggregate into the Sydney region.

Estimates of coarse aggregate resources remaining in the Sydney basin were published by the DMR in 2000. At the time of this report, it was estimated that there would be only about 70 Mt of coarse aggregate material remaining within the Sydney region at existing quarries after 2010. Based on the demand figures discussed above, this equates to only about five years supply, although it should be recognised that actual annual yields will be unable to meet annual demand. The DMR (2000) therefore concluded that in the medium and long-term (to 2040) there would need to be new quarries developed to meet this demand and that the source of this material was likely to be outside the Sydney region.

Of the identified resource areas with the potential to supply the Sydney region the Wingecarribee/Mulwaree region has by far the highest volume of resource and is expected to be one of the largest suppliers into the Sydney market in the medium and long term (DMR, 2000). As at 1999, however, only 41.2 Mt of resource within this region had development consent granted (DMR, 2000) with new consents therefore required to ensure supply.

A similar supply situation exists for construction sand (fine aggregate), with the major sources of this material in the Sydney Region being the Penrith Lakes Scheme, Kurnell, Maroota, Somersby and Elderslie. Production from Kurnell, which is currently Sydney's main source of fine to medium grained sand, will end in the short to medium term (DMR, 2004). It is considered likely that the demand for construction or manufactured sand will increase in the future, as DPI (DMR, 2004) states that there has been a trend away from the extraction of stream channel and coastal dune deposits because of environmental concerns. There will, therefore, be a need for development of construction sand resources to provide supply to the Sydney market with the likely supply sources for the material in the long-term again being outside the Sydney region.

Sydney Regional Environmental Plan No. 9

Sydney Regional Environmental Plan (SREP) No. 9 – Extractive Industry (No. 2 1995) aims to facilitate the development of extractive resources within proximity of the Sydney Metropolitan Area by protecting resources of regional significance and promoting the development of these resources in an environmentally acceptable manner. The SREP only applies to LGAs within the Sydney Region and is not therefore directly applicable to the project, although it also discusses resources outside this region that may supply the Sydney market.

The planning report prepared for the SREP (NSW Department of Planning, 1993) made a number of recommendations regarding the future extraction of hard rock resources, including "*continued extraction from existing quarries in the Illawarra region and the development of additional resources <u>such as</u> Mt. Misery, Mt. Flora and Rocklow to supply aggregate to the Sydney and local markets subject to environmental and economic constraints*". The additional resources discussed in the SREP planning report are primarily within the Southern Tablelands Region and it is therefore considered that the development of the Lynwood Quarry project is consistent with the broad strategy contained within SREP No. 9 (No. 2 1995). As discussed in **Section 6.1.1**, the Mt Flora resource specifically referred to in the SREP planning report does not have sufficient approved capacity to meet Readymix's current demand and has significant transport constraints when compared to the Lynwood Quarry project.

6.4.2 Justification for Lynwood Quarry

As discussed above, there is a need for ongoing supply of construction materials into the Sydney market and other markets in southern NSW, to provide for the maintenance and ongoing development of our communities. A number of existing quarries supplying these markets will exhaust their resources in the short to medium term, with this deficit unable to be filled by other existing quarries or by use of recycled materials. It is therefore necessary that new quarry resources are identified and developed to meet future demand for construction materials.

The project will provide a high quality, high volume source of construction material for the Sydney and regional markets, with the potential to supply these markets for up to 130 years at a production rate of 5 Mtpa. This supply will assist in meeting current and predicted future demands. The proximity of the resource to major transport infrastructure allows the economic transportation of the material to key markets, with the primary use of rail transportation limiting impacts on road infrastructure, road users and on residents living along transport corridors. Rail transport also limits the production of greenhouse gasses when compared to traditional road transport.

It should also be noted that the Lynwood resource has been identified by DPI as a regionally significant resource in the Department's Section 117 (2) advice to Goulburn Mulwaree Council under the EP&A Act. This advice is intended to ensure that Council considers this resource when making planning decisions, aiming to protect it from potential future land use conflicts and ensuring it is available for development. It is therefore considered that the development of this resource is consistent with DPI planning policy.

The proposed quarry has also been designed to ensure that environmental impacts are reduced as much as practicable and is considered likely to significantly contribute to the local, regional and State economies. Social impacts have also been assessed and it is considered that the social benefits of the project will outweigh any potential negative impacts, with the project having the strong support of the local community.

6.4.2.1 Economic Benefits and Employment

The project will provide direct employment for approximately 115 people at the quarry and provide flow-on employment for an estimated 129 people (refer to **Appendix 3**). This is a significant number of employees for the Marulan area and the Goulburn Mulwaree LGA, particularly considering that the current population of Marulan is in the order of 450 people. The project will also provide security of employment for employees working in Readymix's Sydney region concrete and asphalt businesses, with the ongoing supply of high quality construction materials into the Sydney market also assisting the economic viability of the construction industry as a whole.

The project will involve capital expenditure of between $150M and $195M, much of this during the two year construction phase which will employ up to 140 personnel. Once operational the quarry will continue to contribute to the local economy through annual operational expenditure with the local economic input estimated to be in the order of $10M per annum. This expenditure combined with the direct wages from the operation ($9.1M per annum) and the indirect flow-on wages ($6.7M per annum), will make a significant contribution to the local and regional economies (refer to **Section 5.14**).

Government revenues will be generated at Federal, State and local government levels from taxes and services provided. These sources of income will include:

- corporate taxes;
- personal taxes;
- excise duties;

- import duties on plant and equipment;
- fringe benefits tax;
- fees for licences and permits;
- payroll tax;
- land tax and rates; and
- goods and services tax.

The detailed investigations of the impacts associated with the project have also determined that the project can coexist with surrounding land uses and it is therefore not expected to impact on the economic activities associated with these land uses.

6.4.2.2 Environmental Considerations

This EIS has comprehensively addressed potential environmental impacts associated with the project. Environmental impacts have been addressed for each component as well as the cumulative impacts associated with the project and surrounding industrial developments. The quarry design minimises environmental impacts of the project as a whole, with the retention of buffer land between the quarry and surrounding land use minimising the potential for land use impacts.

The EIA process has identified that there are a number of aspects of the project that will require careful management to minimise environmental impacts. In particular, noise and dust impacts will require ongoing management during the life of the operation. Management principles and strategies proposed to be adopted for the proposed quarry are discussed in **Section 7.0**. Legislative controls are discussed in **Section 4.0**.

6.4.2.3 Social Considerations

The proposed Lynwood Quarry will make a significant economic contribution to Marulan and the region as a whole, and has the strong support of the local community. As discussed in **Section 2.0**, a comprehensive community involvement program was undertaken for the project with the findings demonstrating this strong support. Key findings included:

- the majority of the Marulan community is supportive of the project with approximately 80% of people contacted approving of the proposal (23% strongly approve), whilst only 4.6% disapproved (2.9% disapprove, 1.7% strongly disapprove);
- nearly all people contacted (92%) believed the proposed quarry would make an important contribution to the local economy in the region;
- the majority of people (78%) believed that the project would not detract from the area;
- the majority of people (79%) believed that the benefits a quarry would bring to the area would outweigh any of the disadvantages; and
- over half (55%) of the people contacted indicated that they had no issues of concern associated with the proposal.

In light of this strong support from the local community, it is considered that there is a strong social justification for the project.

6.4.3 Ecologically Sustainable Development

The EP&A Regulation requires an EIS to consider the proposed project in terms of Ecologically Sustainable Development (ESD) Principles. To justify the project with regard to the ESD principles, the benefits of the project in an environmental and socio-economic context should outweigh any negative impacts. The ESD principles encompass the following:

- the precautionary principle;
- inter-generational equity;
- conservation of biological diversity; and
- valuation and pricing of resources.

Essentially, ESD requires that current and future generations should live in an environment that is of the same or improved quality than the one that it inherited.

6.4.3.1 The Precautionary Principle

The EP&A Regulation defines the precautionary principle as:

> Where 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.
>
> In the application of the precautionary principle, public and private decisions should be guided by:
>
> (i) careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment, and
> (ii) an assessment of the risk-weighted consequences of various options.

In order to apply the precautionary principle, a proposal needs to ensure that there has been careful evaluation of all aspects and that every stage in the assessment and decision making process has been transparent. This EIS covers an extensive and careful evaluation of all the project components. Detailed assessment of all potential impacts and necessary management procedures has been conducted and is also comprehensively documented in this EIS.

The existing environment has been scientifically studied and assessed (refer to **Section 5.0**). In addition, engineering and scientific modelling has been utilised to assess and determine potential impacts as a result of the project. To this end, there has been careful evaluation to avoid, where possible, irreversible damage to the environment.

The decision making process for the design, impact assessment and development of management processes has been transparent in the following respects:

1. Government authorities and community and other stakeholders potentially affected by the project were consulted during the EIA process and prior to EIS preparation. This enabled comment and discussion regarding potential environmental impacts and proposed environmental management procedures.

A planning focus meeting was held to facilitate effective government authority consultation. Key issues were discussed at this meeting and were also discussed in further detail with individual authorities as necessary to resolve any outstanding matters.

The community was consulted through the completion of a comprehensive community involvement program including newsletters, individual meetings, presentations to community interest groups and an information day. This program provided community stakeholders with an understanding of the proposed quarry and provided numerous opportunities to provide feedback and comment on the development.

2. The EIA process has been undertaken on the basis of the best available scientific information about the project area. Where uncertainty in the data used in the assessment has been identified, a conservative worst-case analysis has been undertaken and contingency measures have been identified to manage that uncertainty. A validation program has also been proposed to measure predicted against actual impacts of the project (refer to **Section 7.0**), so that contingency measures, if required, can be implemented in a timely and pro-active manner.

3. A comprehensive Environmental Management System (EMS) will be developed and implemented for the proposed Lynwood Quarry in order to ensure effective management of environmental issues and lead to continual improvement in environmental performance. As part of this EMS, an auditing and review process will be implemented to ensure ongoing effective implementation. It is also likely that should development consent be granted for the project, the project will be required to undertake a periodic external audit of its environmental performance, providing for verification of project performance by independent auditors and reporting to relevant government agencies.

6.4.3.2 Intergenerational Equity

The EP&A Regulation defines Intergenerational Equity as:

> Intergenerational equity namely, that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations.

Intergenerational equity refers to equality between generations. It requires that the needs and requirements of today's generations do not compromise the needs and requirements of future generations in terms of health, bio-diversity and productivity.

Social equity involves concepts of justice and fairness so that the basic needs of all sectors of society are met and there is a fairer distribution of costs and benefits to improve the well being and welfare of the community, population or society (DUAP, 1997).

The objectives of the project are to economically develop the hard rock resource whilst conducting operations in a socially and environmentally responsible manner. The design of the quarry and the environmental management measures discussed in **Section 7.0** will minimise the impact on the environment to the greatest extent reasonably possible. The management of environmental issues as outlined in the EIS will maintain the health, diversity and productivity of the environment for future generations. The project will also make a significant economic contribution to the region through the direct and flow-on effects of expenditure and wages and is also of economic importance to the State due to the ongoing need for construction materials.

6.4.3.3 Conservation of Biological Diversity

The conservation of biological diversity refers to the maintenance of species richness, ecosystem diversity and health and the links and processes between them. All environmental components, ecosystems and habitat values potentially affected by the project are described in the EIS. Potential impacts are also outlined, as are management measures to mitigate these impacts (refer to **Section 5.7** and **7.0**).

The detailed ecological assessment undertaken as part of the project found that although there will be some impact on native vegetation communities and native fauna due to clearing associated with the project, this is not likely to significantly impact on any threatened or migratory species or on the integrity of ecological processes and systems. The assessment also identified a number of mitigation measures that will be implemented to further reduce the impacts on ecology, including rehabilitation of disturbed areas, assisted regeneration of remnant native vegetation and enhancement of fauna habitat in areas of retained vegetation. These enhancement measures will include rehabilitation of riparian corridors and implementation of a land use management program to improve the stability and habitat quality of the remainder of the project area. The project is therefore considered unlikely to have a significant impact on biological diversity.

6.4.3.4 Valuation and Pricing of Resources

The goal of improved valuation of natural capital has been included in Agenda 21 of Australia's Intergovernmental Agreement on the Environment. The principle of improved valuation and pricing refers to the need to determine proper values of services provided by the natural environment. The objective is to apply economic terms and values to the elements of the natural environment. This is a difficult task largely due to the intangible comparisons that need to be drawn in order to apply the values.

The project optimises the valuation and pricing of the hard rock resource with minimal impact by:

- optimising use of existing transport infrastructure and primarily using rail transport;

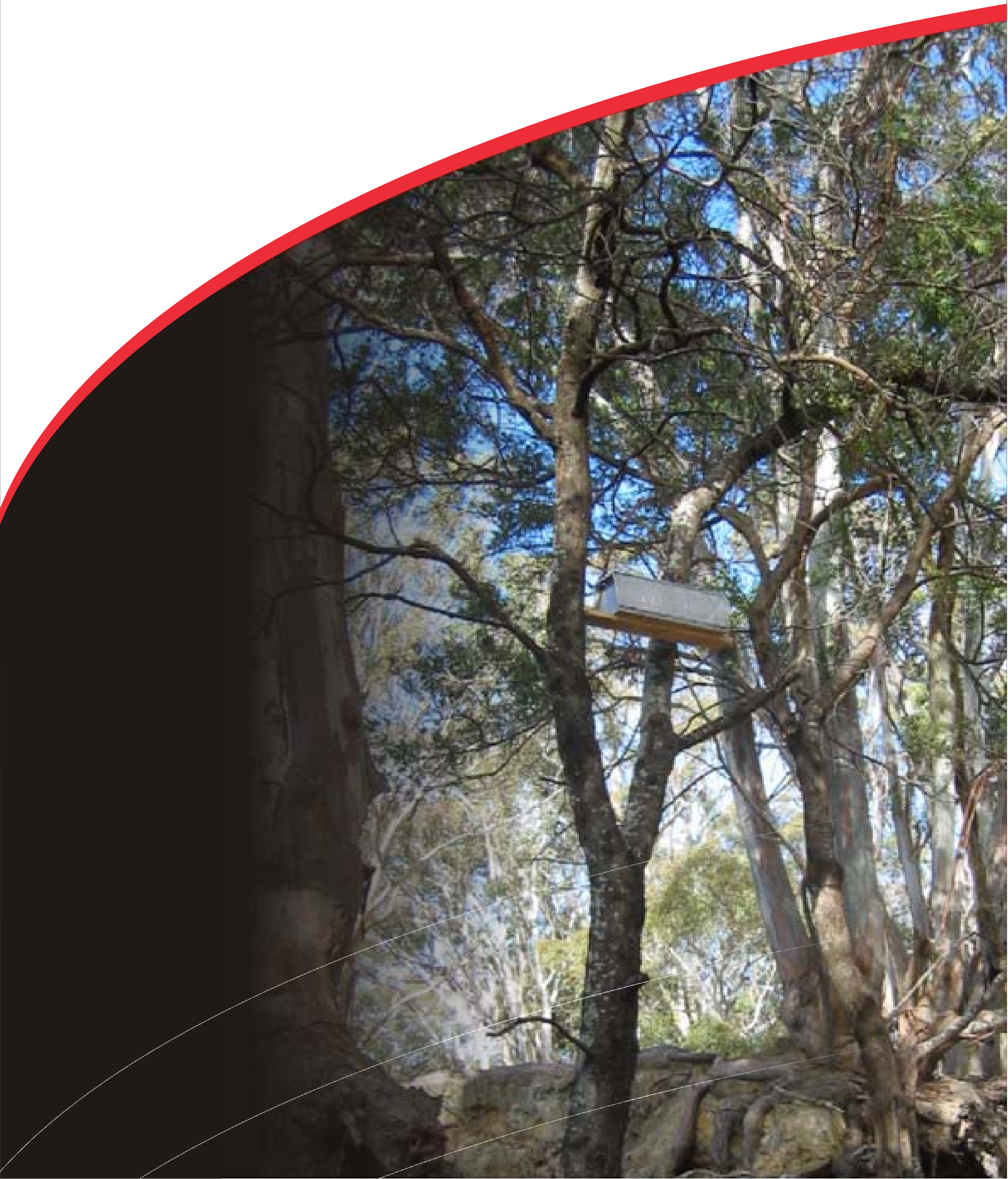
- designing the quarry to maximise resource recovery and providing a modern crushing and screening plant which will ensure maximum product generation from the extracted material; and

- designing the quarry and infrastructure to minimise water use as much as possible.

Project feasibility considerations have included the costs of integration of effective environmental management to minimise potential environmental impacts.

SECTION 7

Environmental Management & Monitoring



7.0 Environmental Management and Monitoring

7.1 Environmental Management System

In order to assist with the ongoing effective management of operations at Lynwood Quarry, Readymix will develop and implement an environmental management system (EMS) generally in accordance with ISO 14001, the international standard for EMSs. The EMS will be developed in accordance the Readymix/Rinker corporate Safety, Health and Environment (SHE) management system, including the:

- SHE Policy;
- SHE Guiding Principles;
- SHE Management Directives; and
- SHE Manual, particularly Standard 4 Risk Management – Environment which sets the minimum environmental management requirements for all Readymix operations.

In accordance with ISO 14001, the Lynwood Quarry EMS will include the following key components:

- policy and commitment – including reference to the Readymix/Rinker SHE system and development of project specific policy as appropriate;
- planning – including:
  - identification and management of legal and other requirements;
  - objectives and targets; and
  - environmental and community programs aimed at achieving ongoing improvement in environmental performance;
- implementation and operation – including:
  - assigning responsibility for implementation of the EMS;
  - training and awareness;
  - communication – including ongoing community consultation and a complaints management system; and
  - operational control including preparation of management plans and operational procedures as appropriate, and incident and emergency response and reporting processes;
- measurement and evaluation – including:
  - environmental monitoring;
  - audits and implementation of corrective actions; and
- management review in order to ensure ongoing effective implementation of the EMS.

Readymix will employ an Environmental Officer to manage environmental and community issues related to the operation, including the implementation of the EMS.

7.1.1 Environmental Management Plans

Readymix will prepare environmental management plans under the Lynwood Quarry EMS as necessary to address key environmental issues or activities. The management plans will be regularly reviewed to ensure they remain current, with performance against the plans also reviewed on a regular basis. During the EIA process, the need for several management plans to address specific issues has been identified. These plans are discussed in **Sections 7.1.1.1** to **7.1.1.3**.

7.1.1.1 Construction Environmental Management Plan

A construction environmental management plan will be prepared to address construction phase environmental issues including:

- water management, particularly sediment and erosion control;
- dust and noise management;
- clearing and rehabilitation;
- traffic management;
- waste management, chemical storage; and
- incident management and emergency response.

This plan will be prepared prior to the commencement of on-site construction works and the key strategies will be included in construction phase induction training.

7.1.1.2 Property Management Plan

A property management plan will be prepared to manage all non-quarrying land use activities within the project area, in addition to ecological and land management issues. The implementation of the plan will be overseen by the Lynwood Quarry Environmental Officer, with the plan addressing the following key issues:

- all non-quarrying land uses including managed grazing;
- rehabilitation of the Readymix land holding not affected by quarrying activities to reduce land degradation;
- rehabilitation of riparian corridors;
- protection and enhancement of remnant vegetation including enhancement of fauna habitat values;
- management of weeds and feral animals;
- bushfire management; and
- identification and protection of other key values of the project area (e.g. historic heritage values).

7.1.1.3 Cultural Heritage Management Plan

A cultural heritage management plan will be prepared to manage the cultural heritage values (including Aboriginal sites) within the project area. This will include the management of the Cultural Heritage Management Area discussed in **Section 5.10.1**. The management plan will be prepared in consultation with the local Aboriginal community and DEC and will have two principal functions:

- to provide an overview of which sites/areas are subject to a Section 90 consent or Section 87 permit, and the status and conditions associated with each of these consents/permits; and
- to provide guidance to quarry personnel about the day to day management of cultural heritage sites/values within the project area, both for known sites and sites that may be encountered during the course of quarrying operations.

The management plan will address the following issues:

- *in situ* management of sites that will not be impacted by quarrying operations including sites within the Cultural Heritage Management Area;
- *in situ* management of sites/areas until they are subject to Section 90 consent/Section 87 permit;
- timing of Section 90 consent applications and compliance during the implementation of Section 90 consent conditions;
- general land management issues to protect cultural heritage sites/values;
- participation in decision making by the Aboriginal community; and
- access and induction issues for the Aboriginal community wishing to visit areas set aside for site conservation (i.e. the Cultural Heritage Management Area).

7.2 Environmental Management Measures

A range of environmental management measures have been identified throughout the EIA process to minimise the impact of the project on the local environment and the surrounding community. These measures have been discussed as relevant throughout this EIS, particularly in **Sections 3.0** and **5.0**, with a summary of the key management measures included in **Sections 7.2.1** to **7.2.12**. These management measures will be incorporated into the Lynwood Quarry EMS as appropriate.

7.2.1 Topsoil Management

As discussed in **Section 5.2.2**, there will be sufficient topsoil to rehabilitate the disturbed areas within the quarry footprint. Topsoil will be stripped in all areas to be disturbed for infrastructure and quarry activities, generally in accordance with the stripping depths discussed in **Section 5.2.2**. Topsoil stripping will be managed to ensure maximum recovery of topsoil. Stripped topsoil will be placed in stockpiles no greater in depth than 3 metres and will be deep ripped and seeded if they are to remain in place for longer than six months. All topsoil stockpiles will be clearly identified so that they are not inadvertently covered with overburden or damaged by other quarry activities.

Where possible, stripped topsoil will be placed immediately onto shaped emplacement areas to ensure best use of soil seed stores and maintenance of soil structure. Fertiliser and other ameliorants (e.g. gypsum) will be added to re-spread topsoil as necessary to ensure effective rehabilitation outcomes (refer to **Appendix 4**).

The topsoil balance will be reviewed on an ongoing basis to ensure that actual topsoil recovery is sufficient to meet rehabilitation requirements.

7.2.2 Roads and Traffic Management

7.2.2.1 Construction Phase

As discussed in **Section 5.5.1**, minor upgrade works will be required along the proposed construction phase access route. The proposed works are discussed in detail in **Appendix 6** and in summary include:

- pavement repairs and increased radius for the left turn from Portland Avenue onto Wilson Drive;
- pavement repairs and widening on curves on Wilson Drive;
- the maintenance of minimum pavement width of 6.2 metres plus 1.0 metre shoulders on the straight sections of Portland Avenue and Wilson Drive;
- provision of delineation along the route; and
- regular maintenance of the western section of Wilson Drive to remove tree debris from the road pavement.

Prior to the commencement of construction, Readymix will discuss these works with Goulburn Mulwaree Council, including undertaking a detailed inspection of the proposed route to establish its baseline condition. Following the completion of construction, another condition assessment will be undertaken and Readymix will contribute to the repair of any pavement damage that has occurred during the construction phase. Following completion of construction, this access point to the project area will be closed.

Construction access along Stoney Creek Road will be limited to the minimum necessary for construction of the rail overpass, with this access point not used for construction traffic after the overpass is complete. All traffic using this route will access Stoney Creek Road via Brayton Road and will not use the Portland Avenue rail level crossing.

All product trucks leaving the site during the construction phase will have their loads covered in order to prevent spillage and dust generation.

The construction phase induction will cover mechanisms to reduce the potential for transport impacts on the Marulan township, including noise minimisation.

7.2.2.2 Operational Phase

As discussed above, all access to the project area during the operational phase will be via the Hume Highway interchange. This access point has been designed to provide safe entry and exit from the Hume Highway for quarry traffic, negating the need for any additional traffic controls.

A wheel wash station will be constructed on the sealed quarry access road to ensure that excessive mud and dust is not tracked out onto public roads. All trucks will also be covered to prevent spillage and dust generation when in transit.

A specific induction training package will be delivered to all Readymix haulage personnel and contract haulage operators regarding good driving practice and minimisation of environmental impacts including dust and noise.

7.2.3 Water Management

The proposed water management system was discussed in detail in **Section 5.6** and in **Appendices 7** and **8**. A summary of the key management measures is included below.

7.2.3.1 Groundwater Management

The groundwater impact modelling has indicated that the volume of groundwater inflow to the quarry will be minimal and the impact of the project on local and regional groundwater levels will be minimal outside the project area. The project is not predicted to impact on any existing groundwater supply bores.

Nevertheless, the following management measures will be implemented to ensure ongoing effective management of groundwater resources:

- all groundwater inflows to the quarry will be retained within the project water management system;
- all potentially contaminating materials used or stored on site during the project, including fuels, lubricants and other chemicals, and wastes generated at the quarry will be appropriately managed and prevented from entering the groundwater system;
- the groundwater monitoring program (refer to **Section 7.3.2**) will be reviewed and revised as appropriate throughout the project, to ensure that any unexpected adverse trends in either groundwater level or groundwater quality impacts are identified; and
- all monitoring piezometers will be constructed with surface seals around the casing to prevent contamination of the groundwater by water penetrating the bore from the surface.

7.2.3.2 Surface Water Management

Construction Phase

Construction phase water management control measures will be developed to satisfy the following objectives:

- comply with appropriate statutory requirements, including the development consent, Environment Protection Licence, SEPP58 and Sustaining the Catchments (Draft REP);
- carry out all construction in accordance with relevant guidelines for erosion and sediment control, including *Managing Urban Stormwater: Soils and Construction* (NSW Department of Housing 1998) (the Blue Book);
- identify and appropriately manage potential erosion and sedimentation impacts that may occur as a result of construction and associated operations; and

- develop effective mechanisms for monitoring and maintenance of erosion and sediment control measures.

The water management measures to be adopted for the construction phase of the project will include:

- construction and regular maintenance of catch drains, silt fences and sedimentation basins to contain sediment downslope of disturbed areas;
- construction of all sediment dams required for the proposal early in the construction period;
- constructing access road and earthworks cut and fill batters at slopes of 1V:3H or less, where possible, to maximise long term stability;
- reshaping, topsoiling and vegetating road and cut and fill batters as soon as practical;
- seeding and controlled fertilising of all disturbed areas to provide for rapid grass cover. Areas will be seeded with an initial cover crop and a species mix specific to the needs of the area;
- development of an inspection, maintenance and management system to ensure that the soil and erosion control measures for the construction phase are performing adequately;
- placement of oil separators downslope of high traffic areas and flotation curtains at the outlets of all dams; and
- maintaining the concrete plant within a bunded area to ensure control and treatment of runoff from the plant area.

Water management for the construction phase will also be addressed in the Construction Environmental Management Plan discussed in **Section 7.1.1.1**.

Operational Phase

Operational phase water management controls are discussed in detail in **Section 5.6.2** and **Appendix 8** and have been developed to satisfy the following objectives:

- comply with appropriate statutory requirements, including the development consent, Environment Protection Licence, SEPP58 and Sustaining the Catchments (Draft REP);
- design and construct all controls in accordance with relevant guidelines including *Managing Urban Stormwater: Soils and Construction* (NSW Department of Housing 1998) (the Blue Book) and Guidelines for Establishing Drainage Lines on Rehabilitated Minesites (Draft) (DLWC, 1999);
- identify potential water quality impacts that may occur as a result of quarrying and associated operations and develop appropriate management and mitigation strategies; and
- develop effective mechanisms for monitoring and maintenance of erosion and sediment control measures.

In addition to these project specific controls, Readymix will also implement a program of rehabilitation works along existing drainage lines to reduce the current extent of bank and bed erosion and associated sediment transport. These works will be addressed by the Property Management Plan discussed in **Section 7.1.1.2**.

Water management measures to be implemented for the project will include:

- clearly identifying and delineating areas required to be disturbed and ensuring that disturbance is limited to those areas;
- limiting the number of roads and tracks established;
- construction of sediment dams to capture and treat runoff from disturbed catchment areas. These dams will be designed with a two cell system to enable flocculation of sediment if required;
- maintenance of these sediment dams in a drawn down state to ensure they have sufficient treatment capacity;
- construction of drains upslope of areas to be disturbed to convey clean runoff away from most disturbed areas;
- constructing access road and earthworks cut and fill batters at slopes of 1V:3H or less, where possible, to maximise long term stability;
- reshaping, topsoiling and vegetating road and cut and fill batters as soon as practical;
- diversion of road runoff away from disturbed areas;
- regular maintenance of all erosion control works and rehabilitated areas;
- prompt revegetation of areas as soon as earthworks are complete;
- placement of oil separators downslope of all high traffic areas and placement of flotation curtains at the outlets of all dams;
- measures to prevent pollution from storage and use of chemicals, including appropriate spill management measures. All bunding will be constructed in accordance with relevant Australian Standards and DEC guidelines and be designed for no-discharge;
- wastewater treatment and re-use on site;
- should re-use of the Marulan Wastewater Treatment Plant effluent be realised, containment of this water as a separate component of the water management system for use only within the quarry pit or as process water;
- regular inspections of the water management system to ensure that it is working effectively, particularly after rain. Regular inspections will also be undertaken of the natural drainage lines within the project area to assess the need for any specific management strategies to be implemented; and
- ongoing monitoring of water use and water quality as discussed in **Section 7.3.2**.

7.2.4 Ecology Management

7.2.4.1 General Ecological Management Strategies

A range of management strategies will be used by Readymix to limit impacts on endemic flora and fauna in the project area. The strategies will include:

- management of noise and dust to minimise impacts to adjoining vegetation communities and fauna as addressed in **Sections 7.2.5** and **7.2.6**;

- feral animal and noxious weed control (refer to **Section 7.1.1.2**);

- management of erosion and sedimentation to ensure that adjoining vegetation communities and aquatic systems are not disturbed as addressed in **Section 7.2.3**;

- management of surface water to ensure that adjoining vegetation communities, aquatic systems and associated fauna are not disturbed as addressed in **Section 7.2.3**; and

- management of fire regimes as addressed in **Section 5.12.2**.

Further specific ecology management measures are outlined in the following sections.

7.2.4.2 Protection and Enhancement of Arboreal Habitat

The protection and enhancement of arboreal habitat is a key component of the management of ecological function within the project area. A number of management strategies will be implemented to ensure there is no net loss of arboreal habitat as a result of the project (refer to **Appendix 9**), including:

- the implementation of a detailed clearing procedure, to minimise injury to arboreal fauna;

- the salvage of suitable tree hollows and ground fauna resources for relocation into adjacent undisturbed habitats;

- replacement of tree hollows at a ratio of 1:1, using salvaged tree hollows and nest boxes; and

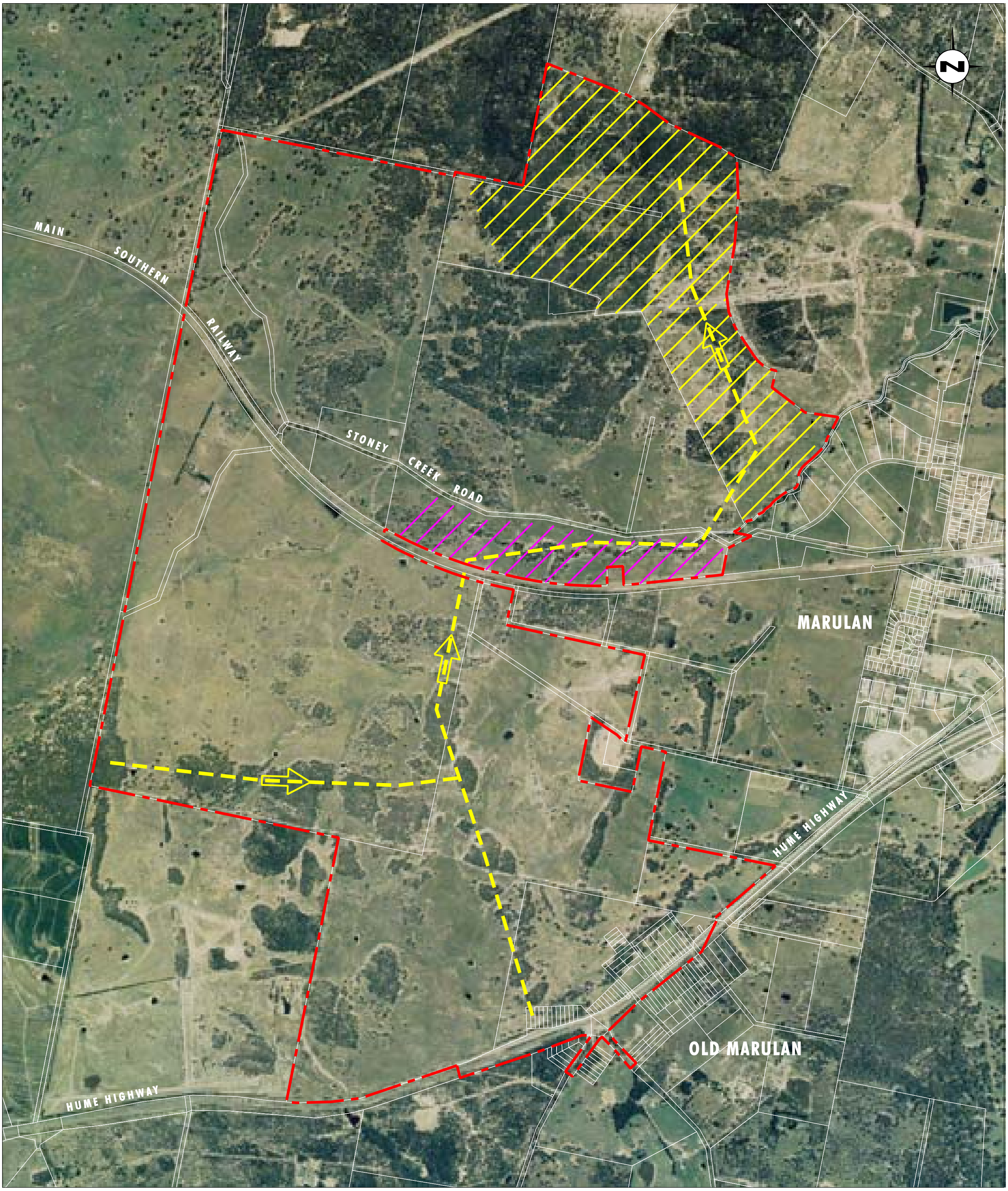
- the restriction of clearing, where practicable, to the months of March, April and May in order to minimise impacts on hollow-dependant fauna, especially threatened fauna.

Enhancement and Protection of Squirrel Glider Habitat

The threatened squirrel glider was identified in remnant vegetation along Lockyersleigh Creek and was also tentatively recorded along Joarimin Creek (refer to **Section 5.7**). Remnant vegetation along Lockyersleigh Creek will be removed as part of the quarrying process. In order to minimise impacts on the squirrel glider, the following habitat enhancement and protection recommendations will be implemented:

- the core riparian zone of Joarimin Creek within the property boundary and north of the Main Southern Railway (refer to **Figure 7.1**) will be fenced off to protect the riparian corridor and encourage natural regeneration (creating a habitat area of approximately 30 hectares). Natural regeneration will be supplemented, where necessary, with plantings of indigenous species to provide future foraging and nesting habitat for the squirrel glider;

Umwelt
Environmental Consultants



Base Source: LPI 2004, Readymix Holdings Pty Ltd (Aerial Photo March 2005)

0 0.5 1 1.25km

Legend

- Project Area
- Proposed Habitat Management Area
- Vegetation Corridor
- Riparian Zone Rehabilitation

FIGURE 7.1

Habitat Management Area and Riparian Zone Rehabilitation

File Name (A4): R03_V1/1829_280.dgn

- nest boxes suitable for squirrel gliders will be placed within the existing riparian corridor along Joarimin Creek and within the Habitat Management Area (refer to **Section 7.2.4.4**). Nest boxes should be positioned 5 to 6 metres high in a sheltered position or with a south-easterly aspect; and

- monitoring of nest boxes established for squirrel gliders will be included in the annual monitoring of nest boxes (refer to **Section 7.3.3**).

7.2.4.3 Habitat Management Area

Readymix will establish a Habitat Management Area to offset the loss of vegetation within the proposed quarry footprint. The Habitat Management Area will be established in the northeast of the project area and will be managed for the conservation of ecological values. The broad location of the proposed Habitat Management Area is shown on **Figure 7.1**. This area is currently zoned for rural residential development and if not purchased by Readymix as buffer land for the proposed quarry, would have been cleared and developed. The proposed Habitat Management Area will contain an area of approximately 130 hectares, of which 105 hectares is presently vegetated.

The Habitat Management Area will be managed to enhance floristic and fauna habitat values through restriction of access, management and general exclusion of stock and the planting or regeneration of indigenous species in appropriate locations to enhance the condition and extent of existing vegetation. Through assisted regeneration and plantings, Readymix will establish an additional area of approximately 25 hectares of native vegetation within the Habitat Management Area. A list of suitable indigenous species for revegetation works in this area is included in **Appendix 9**.

The Habitat Management Area will improve the future viability of indigenous flora, fauna and vegetation communities within the project area and will be linked to remnant woodland vegetation along Joarimin Creek and south of the Main Southern Railway as discussed below. It will also allow the persistence of the *Pomaderris* species, as detailed in **Section 7.2.4.4**.

7.2.4.4 Management of Remnant Woodland

Specific management requirements for woodland remnants including the Habitat Management Area include:

- the general exclusion of stock and prevention of unrestricted access by fencing;

- ongoing management of weeds and pests; and

- management of fire regimes to restrict the occurrence of high intensity burns but to allow infrequent burns of moderate intensity to set seed.

The Property Management Plan will detail how grazing is to be managed in woodland remnants, but in general, stock will only be used to assist in weed management and will be gradually excluded for greater periods of time in the future, until total exclusion is determined to be desirable from an ecological perspective. Where necessary, regeneration will be encouraged around woodland remnants to further enhance their ecological integrity.

Management of weeds and pests will be undertaken in accordance with the Property Management Plan and will include regular monitoring to determine the need for control works.

One of the aims of the Property Management Plan will be to improve connectivity of remnant vegetation patches within the project area, to provide improved habitat corridor function. The general path of this habitat corridor is shown on **Figure 7.1**. The core corridor area will be north of the Main Southern Railway linking the core riparian zone of Joarimin Creek to the vegetated areas to the north. This connection will be improved in the medium-term by rehabilitation of the Eastern Overburden Emplacement Area. The section of the habitat corridor south of the Main Southern Railway will form a “stepping stone” corridor, as it will be crossed by infrastructure in several locations. Despite this, it will form a movement corridor able to be utilised by more mobile species including bats and birds.

The need for fencing and planting to enhance this corridor function will be addressed in the Property Management Plan. Any plantings will be of indigenous species, with encouragement of natural regeneration through improved stock management likely to be the key regeneration method. A list of suitable species for revegetation works is provided in **Appendix 9**. The species have been selected following consideration of the vegetation communities recorded in the project area and the likely former distribution of these communities in cleared areas.

Establishment of *Eucalyptus macarthurii*

An area south of the Main Southern Railway will be revegetated to compensate for the likely loss of Camden Woollybutt Low Open Forest, which is comprised of *Eucalyptus macarthurii*, a ROTAP species. As discussed in **Appendix 9**, an area of at least 0.4 hectare of *Eucalyptus macarthurii* will be established to replace the area of this species removed for the Western Overburden Emplacement Area.

Management of *Pomaderris* species

A small population of what may be an undescribed *Pomaderris* species (refer to **Section 5.7**) is located within the proposed Habitat Management Area (refer to **Section 7.2.4.3**). The Habitat Management Area will encourage the future viability of this species.

7.2.5 Dust Control

A range of engineering controls have been included within the project design to reduce potential dust generation as discussed in **Section 3.0**. Ongoing operational dust management will be required in addition to these engineering controls to ensure effective total dust management. The proposed engineering and operational controls are outlined below.

Engineering Controls

Engineering controls will include:

- enclosing conveyors on the top and on one side;
- use of belt scrapers to clean conveyors and prevent potential dust generation;
- enclosing of the majority of the crushing and screening plant and the fitting of a dust extraction system;
- dust suppression sprays on the primary crusher which will be located below ground level in a box cut but will not be enclosed;
- fitting drills with either water sprays or dry dust collection devices;

- controlling stockpiles of fine material with water sprays;
- reducing the length and number of haul roads to the minimum necessary;
- sealing the quarry access road; and
- installation of a wheel wash station for vehicles leaving the quarry.

Operational Controls

Operational dust controls will include:

- traffic will be confined to identified haul road routes;
- removal and rehabilitation of unnecessary roads;
- timely rehabilitation of disturbed areas;
- exposed areas will be kept to a minimum;
- watering of haul roads and hardstand areas as required;
- cleaning of areas which could become sources of wind eroded dust due to build-up of settled fine material;
- maintaining all equipment in good order to limit exhaust fumes;
- use of adequate stemming in blast holes;
- reviewing meteorological conditions prior to blasting to minimise the exposure of residences to dust emissions;
- regular inspections for excessive visible dust generation and implementation of appropriate controls when such events occur;
- ongoing assessment of meteorological conditions to identify wind conditions that may be conducive to excessive dust generation (e.g. very high winds). During high wind conditions, dust generating operations will be ceased as necessary in order to ensure effective dust control; and
- provision of dust minimisation training during the quarry induction.

As necessary, Readymix will also investigate the potential for use of chemical stabilisers and water extenders on haul roads to assist in minimisation of dust generation and reduction of water demand.

7.2.6 Noise and Blasting Management

7.2.6.1 Noise Management

A range of engineering controls have been included within the project design to assist in the management of noise emissions from the project. Ongoing operational controls will also be required to ensure effective noise management. The proposed engineering and operational controls are outlined below.

Engineering Controls

The following features have been incorporated into the project design:

- all crushing and screening facilities will be enclosed by buildings, except for the primary gyratory crusher and spalls plant;
- the pug mills will be enclosed;
- train and truck loading bins will be lined on the base to reduce impact noise when bins are being loaded from empty;
- trucks dumping the eastern leading row of overburden on the Eastern Overburden Emplacement Area will have attenuation to a maximum sound power level of 111 dBA when dumping; and
- the sound power levels of mobile equipment used at the quarry will be generally in accordance with the levels of the equipment listed in **Section 3.4**.

Operational Controls

Operational controls will include:

- the spalls plant will operate during the daytime only;
- the grader will operate during the daytime only;
- the clearing and topsoil stripping fleet will operate during the daytime only;
- the overburden removal and emplacement fleet will operate during the daytime only;
- when operating on the eastern emplacement areas, the majority of operations occurring on the top of the emplacement areas will occur behind a mound on the eastern edge of the emplacement area created by the first row of dumping;
- the load and haul fleet will operate during the daytime and evening only;
- no dumping on the leading edge of either the Eastern Overburden Emplacement Area or the Eastern Excess Product Emplacement Area will occur while the dozer is operating on the leading face of either of the aforementioned emplacement areas;
- the number of product trucks leaving the quarry at night shall be limited to 32 movements per hour; and
- all equipment will be maintained in good working order.

7.2.6.2 Blasting Management

As discussed in **Section 5.9.2**, Readymix will undertake blast design on a blast by blast basis in order to ensure that the relevant vibration and blast overpressure limits are met. Blasts will be initiated using electronic detonation techniques where necessary to assist in reducing impacts, with blast MIC limited as necessary to ensure compliance with criteria at residential receivers and infrastructure locations.

The Lynwood Quarry Environmental Officer will undertake a pre-blasting review of weather conditions to identify any conditions which may significantly increase blasting impact or dust impacts. A blast clearance will be issued prior to blasts proceeding to indicate that weather conditions are suitable.

Blasting will typically be undertaken between the hours of 10 am and 3 pm Monday to Saturday. No blasts will be undertaken on Sundays or public holidays.

Readymix will consult with residents surrounding the project area prior to the first blast on site and identify those residents that may wish to be notified on an ongoing basis of blasting times. Should any residents wish to be notified of blasting dates and times on an ongoing basis, Readymix will determine in consultation with these residents an appropriate mechanism for undertaking this notification.

7.2.7 Aboriginal Archaeology Management

Management of Aboriginal sites and cultural heritage values is discussed in detail in **Appendix 11** and is summarised below.

Proposed measures to manage Aboriginal archaeology and cultural heritage values include:

- the area containing sites MRN8 to 14 and MRN21 and 22 will be conserved as a Cultural Heritage Management Area (refer to **Section 5.10.1**). This area will be fenced, sign-posted and stock excluded. The relevant site protection measures to be implemented in the Cultural Heritage Management Area will be detailed in the Aboriginal Cultural Heritage Management Plan to be prepared in consultation with the relevant Aboriginal community groups and DEC (refer to **Section 7.1.1.3**);

- the area containing sites MRN20 and 23 will be conserved with an appropriate buffer zone between the sites and the excess product emplacement area to the north and the proposed Country Energy power easement to the south. The area will be fenced, sign-posted and stock excluded. The management of these sites will be detailed in the Aboriginal Cultural Heritage Management Plan;

- the sites outside the proposed development impact area will be managed to conserve their cultural heritage sites/values. The *in situ* management of these sites and areas predicted to have sites (aside from those areas where infrastructure is required) will be detailed in the Aboriginal Cultural Heritage Management Plan;

- application will be made to the Director-General of DEC for a Section 90 consent (without salvage) for site MRN32;

- application will be made to the Director-General of DEC for a Section 90 consent with Salvage (surface collection only) for MRN5 (MQ 2), MRN7, MRN25, MRN26, MRN33, MRN35, MRN36, MRN37, MRN48 and MRN52;

- application will be made to the Director-General of DEC for a Section 90 consent with subsurface salvage for site MRN27; the details of the salvage operation to be determined in consultation with the relevant Aboriginal community groups and DEC;

- application will be made to the Director-General of DEC for a Section 90 consent with salvage (scarred tree removal) for MRN31; the details of the salvage operation to be determined in consultation with the relevant Aboriginal community groups and DEC; and

- application will be made to the Director-General of DEC for a Section 87 Preliminary Research Permit to allow monitoring of initial ground disturbance works in the areas of Joarimin Creek and Marulan Creek to be crossed by the access road; the details of the monitoring program to be determined in consultation with the relevant Aboriginal community groups and DEC.

These proposed management measures are shown on **Figure 5.26** in **Section 5.10.1**.

7.2.8 Historic Heritage

Detailed management recommendations for historic heritage sites identified within the project area, including the Old Marulan Township State Heritage Register area, are included in **Appendix 12** and summarised below.

Prior to commencement of any work which may disturb or destroy heritage items identified in the project area, an application will need to be made to the NSW Heritage Council for Excavation Permits pursuant to Section 57 and Section 140 of the *NSW Heritage Act* 1977. The Section 57 approval will be required for works within the SHR limit and the Section 140 permit will be required for the balance of the sites.

Application to the NSW Heritage Office for the relevant excavation permits will require the preparation of formal research designs which will include the identification of research themes and research questions, and a detailed methodology for the monitoring, recording and management of relics exposed through excavation.

Management recommendations for each of the sites within the project area are included in **Table 7.1**.

Table 7.1 - Management of Historic Sites within the Project Area

Site	Recommendations
Old Marulan Township	Disturbance and excavation within the SHR limits will be subject to an excavation permit under Section 57 of the Heritage Act. An application and detailed research design for this work which specifically covers the construction footprint of the proposed interchange will need to be submitted to the NSW Heritage Office. The remainder of the SHR area on Readymix property will be fenced and signs erected to advise of the presence and significance of the SHR area. The boundary of the SHR area will be clearly delineated on relevant operational plans and in the property management plan.
MRNH1 Circular Sheep Dip	This site will be repaired through the removal of fill and the re-instatement of collapsed brickwork. This work will be addressed in the research design accompanying an application for a permit under Section 57 of the Heritage Act. Once repaired, the site will be fenced and/or covered.
MRNH2 Stone lined cistern/well	This site will be fenced and/or covered.
MRNH3 Potential grave sites	This site will be fenced to prevent inadvertent disturbance/destruction.
MRNH4 Stone line	An application for a permit under Section 140 will be lodged for the site with the NSW Heritage Office. Minimum management requirements for this site would include archival recording prior to disturbance/demolition.

Table 7.1 - Management of Historic Sites within the Project Area (cont)

Site	Recommendations
MRNH5 Homestead	An application for a permit under Section 140 will be lodged for the site with the NSW Heritage Office. As this site will be demolished, a site specific historical study will be prepared as part of the permit application. Minimum heritage management will include full archival recording prior to the commencement of any demolition or construction activities.
MRNH6 Brick clamp	This site will be fenced and appropriate sediment and erosion controls will be implemented to prevent inadvertent disturbance/destruction. Any subsurface investigation at this site would be subject to an excavation permit under Section 140 of the Heritage Act.
MRNH7 Clay pits	There is no direct impact anticipated at this site. No management issues have been identified.
MRNH8 Timber lined cistern/well	An application for a permit under Section 57 of the Heritage Act will be lodged for the site with the NSW Heritage Office. Minimum management at this site will require archival recording and archaeological monitoring.
MRNH9 Sheep dip	An application for a permit under Section 140 of the Heritage Act will be lodged for the site with the NSW Heritage Office. Minimum management requirements for this site will include archival recording prior to disturbance/demolition.

7.2.9 Visual Impact Management and Landscaping

Views of the proposed quarry are largely restricted by surrounding topography and vegetation, except for views of the Eastern Overburden Emplacement Area from rural residences to the northeast and filtered views of the quarry and associated works from one residence to the south. In order to further limit the potential for visual impacts, the following controls will be implemented:

- a screen of native vegetation will be planted in the location shown on **Figure 7.2** in order to assist in the screening of the Eastern Overburden Emplacement Area. Species planted will be as detailed in **Appendix 9**;

- cladding on buildings in the infrastructure area will be coloured in natural tones (primarily green tones) to ensure that it blends in as much as possible with the background;

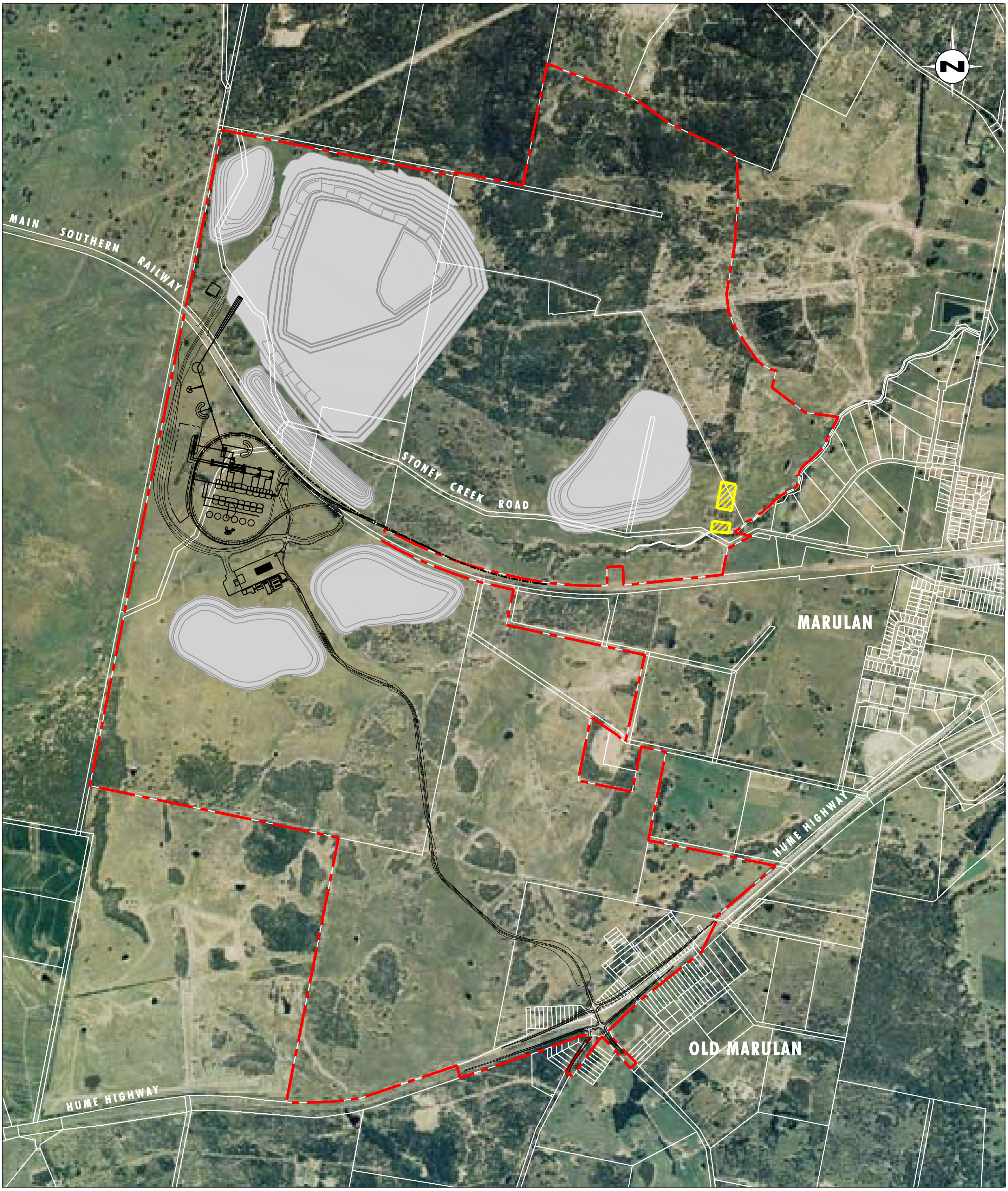
- timely rehabilitation will be undertaken of all disturbed areas in order to minimise visual impacts. Progressive rehabilitation works are discussed in **Section 3.11**; and

- fixed lighting will be designed and located to prevent direct light emission from the project and minimise illumination of the night sky. Lighting will be kept to the minimum necessary for operational needs and safety.

As discussed in **Section 5.11**, Readymix is prepared to undertake reasonable on-site measures to minimise adverse visual impacts on the residence to the south of the project area should the property owner so desire.

All landscaping within the project area, including around the administration buildings, will be undertaken with native species. Landscaped areas will be designed to minimise water usage.

Umwelt
Environmental Consultants



Base Source: LPI 2004, Readymix Holdings Pty Ltd (Aerial Photo March 2005)

0 0.5 1 1.25km

Legend

- Project Area
- Proposed Vegetated Screen

FIGURE 7.2

Proposed Vegetated Screens

File Name (A4): R03_V1/1829_124.dgn

7.2.10 Waste Management

Readymix proposes to implement a total waste management system that both reduces wastes and manages unavoidable wastes in the most responsible manner. Waste management measures to be implemented throughout the life of the project include:

- identification, classification and quantification of waste streams, in accordance with legislative requirements;
- appropriate storage of wastes, including storage of hazardous wastes in secure areas;
- re-use of green waste for rehabilitation, landscaping, and habitat creation;
- collection of waste greases and bulk waste oil in tanks in a bunded area before removal from site by licensed contractors and recycled or disposed of at licensed facilities;
- collection of scrap metal and removal from site by a licensed scrap metal merchant for recycling;
- separation of batteries and tyres from other wastes in safe storage areas, prior to removal from site by licensed contractors;
- treatment of effluent at the sewage treatment plant and re-use on site;
- management of hazardous chemicals according to specifications in the Chemical Control Order for that chemical. Chemicals, including fuels, oils, and solvents will be stored in bunded facilities that meet the relevant Australian Standard and DEC guidelines;
- re-use or recycling of other waste material where possible;
- implementation of cleaner production principles, where practicable, through:
  - the purchase and use of products that generate minimal waste and pollution;
  - the purchase and use of materials that may be less toxic or hazardous, or that can be re-used, recycled or are more readily disposed of; and
  - avoidance of excess wastage associated with oversupply or misuse;
- all waste that cannot be re-used or recycled will be transported off site by an appropriately licensed contractor for disposal at a suitably licensed facility, with the exception of overburden, which will be emplaced on site; and
- as specified under the POEO Act, records will be kept of waste movements relating to generation, storage and disposal of industrial, hazardous, and Class A wastes.

The waste management system will be reviewed on a regular basis to ensure it is operating effectively and will maintain records of waste tracking documentation in accordance with statutory requirements.

7.2.11 Greenhouse Gas Emissions and Energy Use

The quarry infrastructure has been designed to minimise energy use and consequently greenhouse gas emissions. As all infrastructure will be modern and newly constructed, opportunities for minimisation of energy use will not be as great as at older operations.

Readymix will review opportunities for reducing energy consumption on an ongoing basis once the operation has commenced including:

- setting energy use and greenhouse emission reduction targets;
- using energy monitoring and auditing as a management tool;
- providing training on energy management to site personnel;
- monitoring the fuel efficiency of diesel equipment;
- considering the energy efficiency of new equipment when making purchasing decisions; and
- using high efficiency electric motors.

7.2.12 Rehabilitation and Site Decommissioning

Rehabilitation practice and staging will be as discussed in **Section 3.11**, with relevant general principles outlined below:

- erosion and sediment control structures such as contour drains and sedimentation dams will be put in place for all emplacement areas in accordance with relevant industry guidelines (refer to **Section 5.6**);
- shaped overburden will be deep ripped along the contour to allow for the ingress of water and to minimise erosion;
- rehabilitation of disturbed areas will occur as soon as possible, including progressive rehabilitation of all emplacement areas;
- placement of topsoil to an approximate depth of 200 mm on all emplacement areas, sourced directly from areas being stripped as a priority or otherwise from topsoil stockpiles. Mulch from cleared vegetation will also be spread on rehabilitated surfaces;
- revegetation of areas with native species to create vegetation similar in composition and structure to that currently occurring within the project area (refer to **Appendix 9**);
- managed application of fertiliser and surface ameliorants as identified by testing;
- control of weeds by encouraging rapid establishment of vegetative cover and active controls where required; and
- ongoing monitoring of rehabilitation areas to ensure an effective rehabilitation outcome.

A conceptual closure plan was discussed in **Section 3.11**, including discussion of potential final land use. Readymix will review closure planning and costs throughout the life of the project with the aim of identifying future land uses of potential benefit to the local community. When the quarry is five years from closure, a detailed and fully costed closure and decommissioning plan will be prepared for the operation in consultation with relevant government and community stakeholders.

7.3 Environmental Monitoring Program

The baseline monitoring program established for the project was discussed in **Section 5.0** and existing monitoring locations shown on **Figure 5.10**. Proposed future monitoring is discussed in this section, with proposed monitoring locations to be used on an ongoing basis during the quarry operation shown on **Figure 7.3**. These proposed monitoring locations are based on environmental assessment findings. Final monitoring locations will be determined in consultation with DEC and subject to landowner agreement.

Prior to the commencement of construction, Readymix will prepare an Environmental Monitoring Program for the Lynwood Quarry project outlining all environmental monitoring proposed to be undertaken, relevant standards and criteria from any relevant development consent, EPL or licence conditions. This program will be reviewed on an annual basis to ensure that it remains current. Monitoring results will be reviewed on a monthly basis by the Lynwood Quarry Environmental Officer and reported to relevant government agencies on an annual basis.

7.3.1 Meteorological Monitoring

The existing Lynwood Quarry meteorological monitoring station will be retained for the duration of the project, although it will need to be relocated during the life of the project as it is within the footprint of the Eastern Overburden Emplacement Area. The new location for the station will be determined during the preparation of the Environmental Monitoring Program.

7.3.2 Water Monitoring

7.3.2.1 Groundwater

Monitoring of groundwater piezometers will be continued throughout the life of the project, with water levels in all piezometers measured on a three-monthly basis and water samples from all piezometers tested for a broad suite of water quality parameters (as per baseline testing, refer to **Appendix 7**), on a six monthly basis.

As the quarry pit progresses, a number of existing piezometers will be removed and additional piezometers will be established near the northwestern and northeastern boundaries of the project area. The locations in which these piezometers will be installed will be determined in the Environmental Monitoring Program.

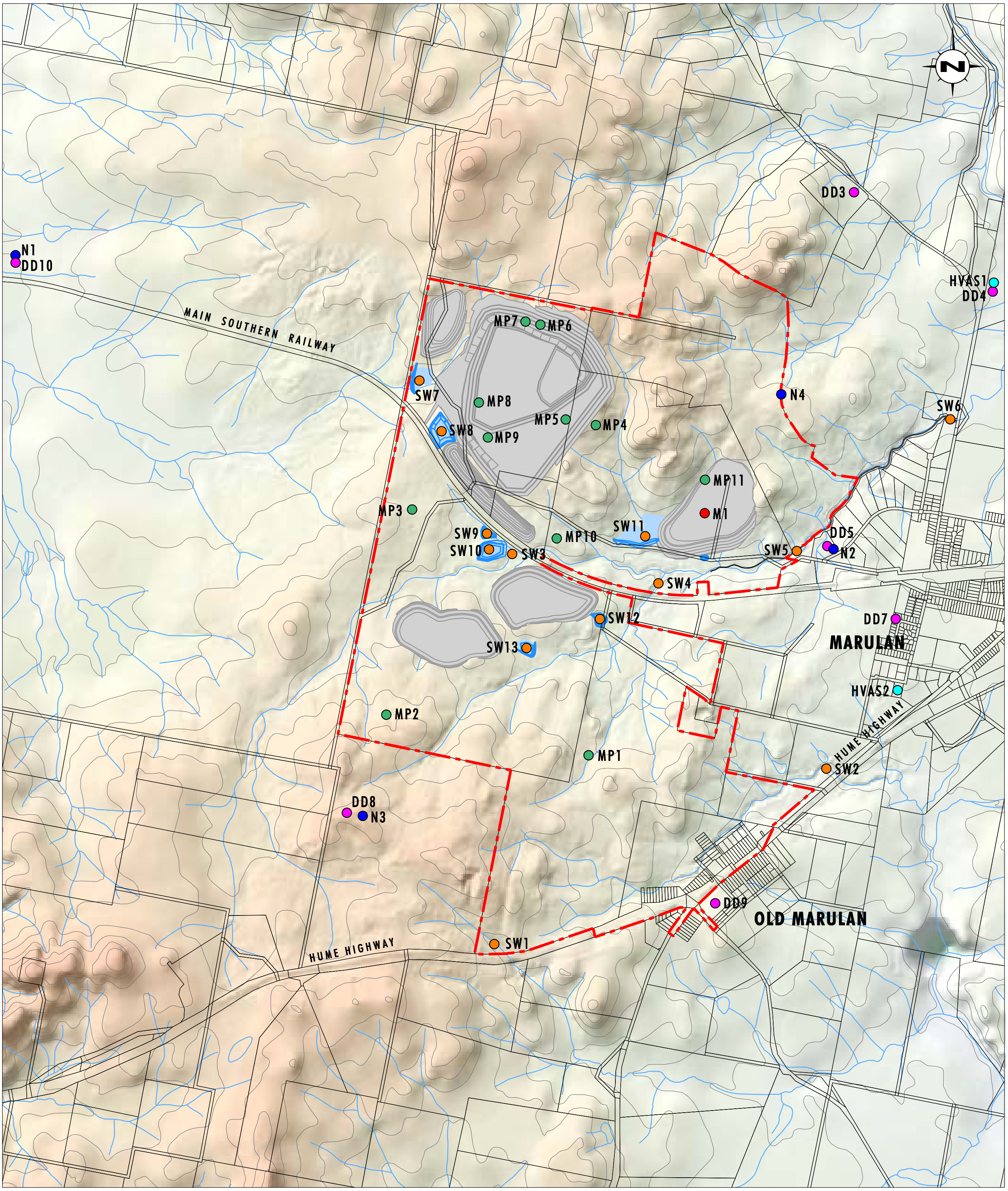
In addition to piezometer testing, testing of pit inflow quality and pumped volume will be completed, measuring both groundwater inflow and pit surface water capture. Water quality testing will include monthly testing of pH, conductivity and total dissolved solids (TDS).

7.3.2.2 Surface Water

The surface water monitoring program will continue throughout the construction and operational phases to monitor water quality at the baseline surface water quality monitoring locations shown on **Figure 3.10**. In addition, all water management dams and pit water will be quality monitored (refer to **Figure 7.3**). Monthly surface water sampling will consist of pH, conductivity, total suspended solids (TSS), TDS, Turbidity (NTU), Total Phosphorus and flow (by observation).

Water usage, external sourcing, rainfall on site, dam volumes and overflows will also be monitored for the total operation to assist in the ongoing effective management of the water management system.

Umwelt
Environmental Consultants



Base Source: LPI 2004

0 0.5 1 1.5km

Legend

- Project Area
- Depositional Dust Monitoring Location
- PM10 Dust Monitoring Location
- Meteorological Station
- Noise Monitoring Location
- Surface Water Monitoring Location
- Groundwater Monitoring Location

FIGURE 7.3

Proposed Monitoring Locations

The results of the surface water monitoring program will be used to review the effectiveness of the Lynwood Quarry water management system on an ongoing basis.

7.3.3 Ecological Monitoring

The ecological monitoring program will monitor the impact of the project on retained vegetation, and progress of revegetation and regeneration areas. The proposed monitoring program is discussed in detail in **Appendix 9** and summarised below.

The program will include the following:

- an assessment of the condition of retained vegetation and revegetated areas to identify any deterioration or improvement in habitat quality;
- a range of fauna survey techniques to determine the ongoing use of fauna habitat within the project area, particularly focussing on the ongoing presence of threatened species. It is proposed that fauna monitoring be undertaken once every three years;
- an assessment of the area containing the *Pomaderris* species (refer to **Section 5.7**) in the Habitat Management Area. Monitoring will be undertaken annually for at least the first three years, or until the taxon has been adequately described, at which time the monitoring plan will be revised;
- nest box monitoring that will be undertaken annually for five years after the first phase of nest box installation, to record the effectiveness of artificial habitat structures; and
- aquatic habitat monitoring within the project area every three years to identify any improvement or deterioration in habitat quality. Ongoing inspections of drainage lines for stability and to identify any erosion control issues will be undertaken regularly in accordance with the property management plan.

Ecological monitoring results will be reported annually. As appropriate, this report will also provide management recommendations to protect and enhance the ecological diversity of the site.

7.3.4 Air Quality

The majority of existing dust monitoring locations will be continued during the construction and operational phases. One of the high volume air samplers will need to be relocated as well as three dust gauges, particularly those located within the project area. The proposed dust monitoring network is shown on **Figure 7.3**.

Dust monitoring and reporting practices to be implemented throughout the life of the project include:

- all dust deposition gauges to be sampled monthly for insoluble matter and ash in accordance with the relevant Australian Standard *(currently 3580.10.1 1991 Deposited Matter – Gravimetric methods for insoluble solids)*;
- HVAS measuring PM_{10} in accordance with the guidelines specified in *"Approved Methods for the Sampling and Analysis of Air Pollutants in NSW"* or its latest version, with samples analysed according to the relevant Australian Standard (currently *AS2724.3-1984*); and
- dust monitoring and control equipment will be inspected and repaired, where required, in accordance with the required standards.

7.3.5 Noise and Blast Monitoring

Noise monitoring during the construction and operational periods will be undertaken at the locations shown on **Figure 7.3** and specified in **Table 7.2**.

Table 7.2 - Proposed Construction and Operation Phases Noise Monitoring Locations

Monitoring Location)	Description
N1	Residence west of the project area
N2	Maclura Drive, Marulan
N3	Residence to the south of the project area
N4	Northeastern boundary of project area at rural residential subdivision

Monitoring will consist of unattended continuous noise logging for one week on a quarterly basis, with operator-attended noise measurements over 15 minute periods also conducted during this quarterly monitoring.

All noise monitoring will be completed in accordance with the requirements of *AS 1055-1997 "Acoustics - Description and Measurement of Environmental Noise"* and the NSW Industrial Noise Policy.

Instrumentation and Measurement Parameters

All acoustic instrumentation employed throughout the monitoring program should be designed to comply with the requirements of *AS 1259.2-1990 "Sound Level Meters"* and carry current NATA or manufacturer calibration certificates. All instrumentation will be programmed to record continuously statistical noise level indices in 15 minute intervals which may include the L_{Amax}, L_{A1}, L_{A5}, L_{A10}, L_{A50}, L_{A90}, L_{A99}, L_{Amin} and the L_{Aeq}.

Instrument calibration will be checked before and after each measurement survey, with the variation in calibrated levels not exceeding ±0.5 dBA.

All noise measurements will be accompanied by both qualitative description (including cloud cover) and quantitative measurements of prevailing local weather conditions throughout the survey period. Quantitative data will be sourced from the Lynwood Quarry meteorological monitoring station.

During the attended noise measurements, the operator will also record any significant quarry generated noise sources (ie. haul trucks, dozers, etc.).

7.3.5.1 Blast Monitoring

A blast monitoring reference location will be established within the project area, with all blasts monitored at this location. These monitoring results will be used to assist in the ongoing refinement of the quarry blast rules and used in the blasting predictive model prepared for each blast. Blasts will also be monitored at the nearest residence to the quarry (adjacent to the eastern project area boundary). This location will also be monitored for each blast.

Blast monitoring instrumentation will be in accordance with relevant Australian Standards and at least meet the specifications contained in **Table 7.3**.

Table 7.3 - Blast Monitor Specifications

Specification	Seismic	Air Blast
Sample Rate	Minimum 1024 samples per second per channel	
Frequency Response	2 Hz to 250 Hz (3 dB points)	
Resolution	0.016 mm/s	0.1 dB
Range	0.1 mm/s to 254 mm/s	88 dB to 148 dB
Accuracy	3% at 15 Hz	0.2 dB at 30 Hz
Communications Link	Keyboard and Modem	
Recording Mode	Full Waveform Recording and archiving	

7.4 Ongoing Community Involvement and Monitoring

Readymix is committed to having an ongoing community involvement program during the life of the project. This program will have three main facets: communication; community contributions; and monitoring. These three components are discussed below.

7.4.1 Community Communication Mechanisms

Readymix will maintain open community communication channels throughout the life of the project, including during the approval process and construction and operational phases. These communication channels will include periodic community newsletters which will provide information about the quarry operations, community involvement programs and environmental performance. A feedback mechanism will be provided with these newsletters.

Readymix has also committed to establishing a process whereby it meets regularly with a group of local community representatives. This process will provide the local community with a mechanism through which to provide feedback, raise any concerns and to provide input into the Lynwood Quarry contributions program (refer to **Section 7.4.2**). The group will also provide a mechanism by which Readymix can provide information about the operation, including environmental performance information, to the local community. Readymix will consult with Goulburn Mulwaree Council regarding the establishment of this group.

Complaints Management

Readymix will establish a free-call community complaints phone line which will be maintained for the duration of the project. This contact point will provide the community with a mechanism by which to raise any concerns that they have with operations at Lynwood Quarry. Lynwood Quarry's Environmental Officer will be responsible for the implementation of the complaints management process and will ensure a timely initial response to any complaints received and then, as appropriate, will provide a more detailed response outlining any complaint investigation findings and corrective actions implemented.

The complaints management system will form part of the Lynwood Quarry EMS.

7.4.2 Community Contributions

Readymix is committed to an ongoing targeted program of local community contributions supported by a clear contributions policy. Readymix will establish funding criteria and define a process to determine local community funding priorities. Local community representatives and Goulburn Mulwaree Council will be consulted during the development of the funding criteria and implementation process. The aim of the program will be to ensure that

Readymix's contributions are used to meet key local community needs and priorities, including contributions to projects such as junior education and junior sporting facilities.

The contributions process will be managed by Lynwood Quarry personnel to ensure that it maintains its local focus.

Readymix is a major sponsor of the Beacon Foundation, a national not-for-profit organisation that seeks to influence the attitudes and culture of young Australians. Although the Beacon Foundation usually operates within high schools, as there is currently no high school in Marulan, Readymix will investigate possible ways for Marulan to benefit from the foundation. These opportunities will be discussed with local community representatives and Goulburn Mulwaree Council.

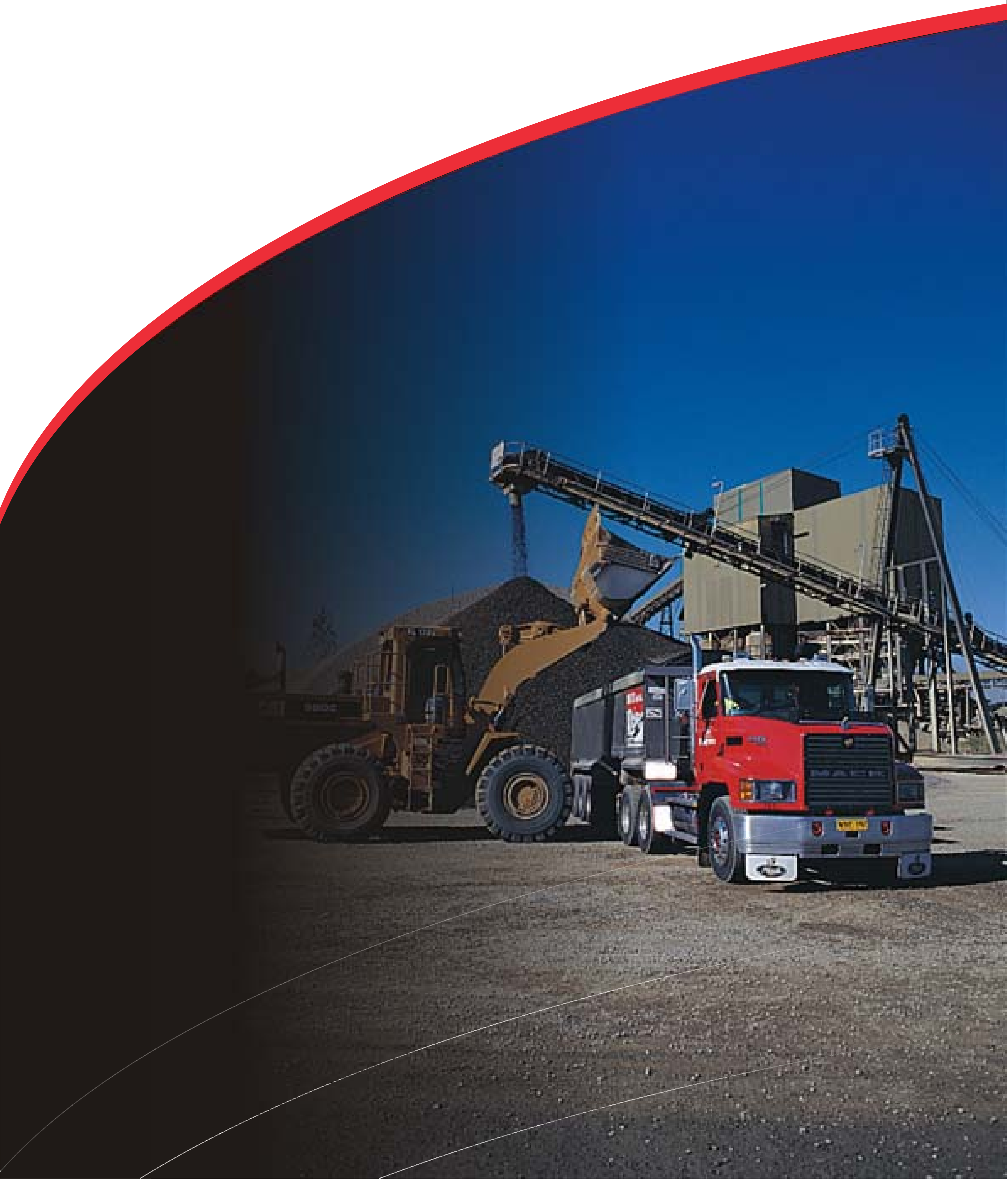
7.4.3 Monitoring

As discussed in **Section 7.3**, Readymix will implement a comprehensive environmental monitoring program for the duration of the project. The key findings of this monitoring program will be provided to the local community through the community consultation mechanisms discussed above, with feedback on environmental performance also gained through these mechanisms. Readymix will monitor community feedback in relation to the environmental performance of the operation. Monitoring of community complaints, including analysis of any complaint trends, will also be undertaken on an ongoing basis.

Readymix will also monitor implementation of the community contributions program, including regular reviews of the suitability of the funding criteria and decision making process. The local community will be provided with feedback on the results of this contribution monitoring program to ensure that the program is transparent.

SECTION 8

Checklist of Agency Requirements



8.0 Checklist of Agency Requirements

The following is a checklist of the Director-General's requirements and where they are addressed in this EIS.

Agency and Requirement	Section of EIS
Department of Infrastructure, Planning and Natural Resources (DIPNR)	
The EIS must include a full description of the proposal, clearly identifying the resource, the proposed site, the proposed works (including any rehabilitation works), and the proposed intensity of operations.	3.0
The EIS must clearly demonstrate the permissibility of the proposal.	4.5
The EIS must include a detailed justification of the proposal.	6.4
The EIS must assess the proposal against relevant environmental planning instruments, including the provision of *State Environmental Planning Policy No. 11 – Traffic Generating Developments; State Environmental Planning Policy No. 33 – Hazardous and Offensive Developments; State Environmental Planning Policy No 44 – Koala Habitat Protection; State Environmental Planning Policy No. 55 – Remediation of Land; State Environmental Planning Policy No. 58 – Protecting Sydney's Water Supply;* draft *Drinking Water Catchments Regional Environmental Plan No. 1 – Sustaining the Catchments; Mulwaree Local Environmental Plan 1995;* and any relevant development control plans and section 94 plans.	4.0
The EIS must assess the proposal against the relevant sections of the *Sydney-Canberra Corridor Strategy,* the draft *Marulan Settlement Strategy* and any other relevant documents.	4.4, 4.5
The EIS must assess the following potential impacts of the proposal during construction and operation, and describe what measures would be implemented to manage, mitigate or off-set these potential impacts:	5.0, 7.0
• surface and groundwater;	5.6, 7.2.10
• air quality;	5.8, 7.2.5
• noise (including off-site rail and road traffic noise);	5.9, 7.2.6
• blasting and vibration;	5.9, 7.2.6
• soil;	5.2.2, 7.2.1
• land use;	5.4
• traffic and transport;	5.5, 7.2.2
• flora and fauna, particularly critical habitats; threatened species, populations or ecological communities, or their habitats;	5.7, 7.2.4
• heritage, both Aboriginal and non-Aboriginal;	5.10, 7.2.8
• visual;	5.11, 7.2.9
• hazards;	5.12
• waste management;	7.2.10
• utilities and services;	5.5
• social; and	5.14, 7.4
• economic (including a benefit-cost analysis).	5.14, 7.4
The EIS must:	
• justify the final land use in relation to the strategic land use objectives for the Marulan area;	3.11
• describe in detail how the site would be progressively rehabilitated; and	3.11

Agency and Requirement	Section of EIS
• describe what measures would be put in place for the ongoing management of the site following cessation of quarrying activities, including consideration of the most appropriate mechanisms for securing sufficient resources for the implementation of these measures in the long term.	3.11, 7.2.12
The EIS must describe in detail how the environmental performance of the proposal would be monitored and managed over time.	7.0
During the preparation of the EIS, the Department requires you to address potential land use conflicts between the proposed quarry and surrounding land uses. This should include consideration of the compatibility of the proposal with the predicted growth of residential and industrial land uses in the Marulan area during the operational life of the quarry and following cessation of quarrying activities.	5.0
Consideration should also be given to measures to minimize and/or avoid any such conflicts (eg. Adoption of appropriate buffer zones).	1.3, 5.0
It is recommended that you discuss this issue in more detail with the Department prior to lodging the DA for the proposal.	Completed
During the preparation of the EIS you should consult the relevant local, State and Commonwealth government authorities, service providers and community groups, and address any issues they may raise in the EIS.	2.0
In particular, you should consult the surrounding landowners and occupiers that are likely to be impacted by the proposal.	2.0
Details of the consultations carried out and issues raised must also be included in the EIS.	2.0
All works proposed within 40 m of the high bank of the creeks that are located on the property needs to be detailed. Creeks of interest are to flow water permanently or intermittently, have defined bed and banks, and be shown on 1:25000 topographic maps.	4.2.2, 5.6.3, Appendix 8
Where possible, all access roads and construction activities should be located a minimum of 40 m from the high bank of any creek, but particularly the main trunk stream of Joarimin Creek. It is recommended that a core riparian zone (CRZ) be established on the more major creeks, a minimum 40 m from both banks measures perpendicular to the flow direction.	4.2.2, 5.6.3, Appendix 8
For all works within 40 m including creek crossings, include characteristics of the creek at those locations:	DIPNR has advised that these requirements can be met more appropriately at permit application phase and are not required in the EIS
• photos looking upstream and downstream;	
• a description of bed and bank material;	
• a description of the vegetation at the site, ie vegetation community, age, evidence of degradation, weeds and predominant species;	
• a description of features of the creek such as weirs, causeways, bed and bank erosion, pools and riffles, habitat values eg large woody debris;	
• height of bank and width of channel at base and from top of bank to top of bank.	
The EIS needs to address the impact of the development on surface and groundwater supplies. All known water licenses within the vicinity of the development on all adjoining properties are to be mapped, and impacts on these determined.	5.6, Appendices 7 & 8
The water cycle management study is to include a water balance, to show the sources of available water and the water requirements of the quarry, during construction and operation of the quarry.	5.6, Appendix 8
The maximum harvestable right dam capacity (MHRDC) is to be calculated for the property, and all harvestable right (HR) creeks are to be marked. These creeks are intermittent first and second order streams. Find information brochures enclosed to assist with the determination of HR streams, and the MHRDC calculation.	Appendix 8

Agency and Requirement	Section of EIS
The total projected area to be cleared for construction and the 30 year quarry operation is to be estimated.	5.7
DIPNR encourages a no net loss principle. Therefore it is recommended that the area of trees planted or conserved is at least equivalent to the total area of trees and other native vegetation that is removed for the life of the quarry. The sites to concentrate natural regeneration, plantings and conservation are along CRZs and important habitat and heritage sites. It is recommended that a Property Vegetation Plan (PVP) be prepared for the site and certified by the Hawkesbury Nepean Catchment Management Authority to determine the best management practices for native vegetation on the site.	5.7, 7.1.1, 7.2.4, Appendix 9
Requirements for the Environmental Impact Statement, should include the following information: 1. Any information with respect to the on-site groundwater resource, including: • water table position and known aquifer zones, plus hydraulic flow data; • water quality data, such as chemical and biological analyses; • water quantity data, such as bore yields, pumping rates, allocation entitlements, and proposed usage rates; • standing water levels of bores and any bore monitoring data collected; • other relevant geological and hydrogeological information such as aquifer storage and predicted drawdown of aquifer over time.	5.6, Appendix 7
2. Discussion of the proposal's perceived impacts on technological groundwater resource, for example: issues such as the proposed water supply, and water quality impacts from both the quarrying and dewatering, etc.	5.6, Appendices 7 & 8
3. Discussion of the potential for groundwater contamination from the development, and the mitigation measures that would be employed to deal with such. This includes operation and ongoing management of the quarrying operations. Due to the depth of the extraction, the water quality of aquifers encountered should be assessed and precaution with construction of monitoring bores should be taken to prevent poorer quality water mixing with good quality water.	5.6, 7.2.3, Appendix 7
4. Outline of the proposed test drilling and bore monitoring programs to be undertaken, including, but not limited to: parameters to be tested, sampling intervals, baseline monitoring prior to and post operations, review period, etc.	7.3.2, Appendix 7
5. Discussion of any environmental impacts on nearby ecosystems, such as watercourses (in particular Joarimin Creek), groundwater fed wetlands, nearby lakes, or neighbouring properties, etc. What mitigation measures will be employed should there be reduction or loss of water supply to these systems?	5.6, Appendices 7 & 8
6. Provide information on the rehabilitation process to be undertaken and the final landform.	3.11
Department of Environment and Conservation	
The EIS will need to consider all air, water, noise, and waste issues and document those environmental protection measures necessary to demonstrate that the quarry operations will achieve contemporary best management environmental standards.	5.0 & 7.0
The proponent advises that a lease arrangement will be entered into for a strip of land to form a buffer to separate the land uses. The EIS should detail this arrangement and how this lease will be managed for the 30 year period especially if the land changes ownership.	1.3

Agency and Requirement	Section of EIS
DEC recommends that further to a standard assessment, a number of additional species listed under the *Threatened Species Conservation Act 1995* be targeted. These include Rosenberg's Goanna (*Varanus rosenbergi*), Hooded Robin (*Melanodryas cucullata cucullata*) and Diamond Firetail (*Stagonopleura guttata*) that are either known from the surrounding areas, habitat exists and/or are likely to occur on the property.	5.7, Appendix 9
Should this species (Squirrel Glider – *Petaurus norfolcencis*) be impacted directly or indirectly by the proposed development, then DEC recommends a targeted survey needs to be undertaken, which could include trapping (a licence from DEC for trapping is required). Denning trees for this species are to be identified, as is identifying their food resources and how they move through the landscape. Not pre-empting the results of the targeted survey and Part 5A assessment, ameliorative measures may also need to be considered. Some measures may include protection of hollow-bearing trees, possible provision of nest boxes, provision of habitat connectivity, exclusion of domestic pets, such as cats and dogs and removing/prohibiting the use of barbed wire, etc.	5.7, 7.2.4, Appendix 9
DEC reminds the proponent that the flora assessment is to include a complete plant list, a full description and map indicating the type, condition and location of existing vegetation, including native understorey species and individual paddock trees. An assessment of the likely impacts of the proposal on flora is required.	5.7, Appendix 9
There are large patches of vegetation surrounding the proposed development, including the Morton National Park and Bungonia State Recreation Area, which are situated approximately seven kilometres southeast of the proposed quarry. The regional context of this proposal should be considered in the EIS, especially in light of wildlife corridors.	5.7, Appendix 9
A full archaeological survey is required. This survey is to be consistent with DEC requirements as outlined in the NPWS Aboriginal Cultural Heritage Guidelines Kit and three copies of that report are to be forwarded to DEC for review prior to its inclusion in the EIS.	5.10.1, Appendix 11
The EIS needs to clearly state:	
2.1 The reasons for the proposed development;	1.1, 6.0
2.2 The expected quantity of materials which will be extracted and processed at the premises;	3.0
2.3 The proposal's relationship and linkages to the existing operations at the quarry;	There are no existing quarry operations in the project area
2.4 The staging and timing of the proposal and any plans for future expansion;	3.0
2.5 The proposal's relationship to any other industry;	3.0, 6.0, 5.4, 5.15
2.6 Whether there are any alternatives to the proposal and the implications of such proposals such as the opportunities to install additional crushers; and	6.0
2.7 Whether there is justifiable demand for the extraction of such quantities of material in terms of natural resource management. (Are there viable alternatives to this material such as slags etc or opportunities to integrate with other resources).	6.0
Provide an overview of the location of the proposed development including the affected environment to place the proposal in its local and regional environmental context including:	1.0, 5.0
3.1.1 Surrounding land uses and any future changes in land uses surrounding the premises (potential synergies and conflicts);	5.4
3.1.2 Surrounding landuses and planning zonings;	5.4, 4.5

Agency and Requirement	Section of EIS
3.1.3 Describe all potential sensitive receptors and locations likely to be affected by activities at the site, such as residential properties, schools, churches and hospitals.	5.4
3.1.4 Define the premises (including any other premises associated with the proposed activity) relevant to the Development Application and details of the land use zoning, and any potentially affected areas. (Note: details will need to be documented on the contractual arrangement between Boral (*Note: Assumed to mean Readymix*) and Rail Infrastructure Corporation (RIC) in relation to use of the RIC land for access and extraction of material. Property details are also required as Boral (*Note: Assumed to mean Readymix*) will be the occupier of this land for the purpose of Environment Protection Authority (EPA licensing);	3.1, 4.2.6, 4.5, 5.0 (Note: There will be no extraction on land owned by ARTC. Not relevant to this project.)
3.1.5 Describe the existing quarrying operations including any existing pollution controls;	There are no existing quarry operations in the project area
3.1.6 Meteorological data (for example, rainfall, temperature and evaporation, wind speed and direction):	5.3
3.1.7 Topography (for example landform element, slope type, gradient and length);	5.2.1
3.1.8 Soil types and properties to assist in understanding and assessing the performance of existing water pollution controls (including erodibility, engineering and structural properties, dispersibility and any soil issues such as acid sulfate soil); and	5.2.2
3.1.9 Availability of services and the accessibility of freight transport.	5.5
Fully scope the development in the EIS including information on:	
3.2.1 The size and type of the operation, the nature of the processes and the products including material handling, by-products and waste produced (both for current operation and proposed future operation);	3.0
3.2.2 All new equipment or activities which will be installed or undertaken at the premises as a result of the proposed development;	3.0
3.2.3 A life cycle approach to the use or management of all materials and products;	3.0, 7.2.10
3.2.4 An overview of actions to achieve cleaner production principles;	3.0
3.2.5 All works associated with the proposal including all linkages with existing activities and processes at the premises, truck cleaning and maintenance areas, storage/stockpile areas etc (a diagram of the layout of the site should also be included in the EIS);	3.0 (Note: There are no existing quarrying activities at the premises.)
3.2.6 All phases of the project cycle including construction, routine operation, start-up operations, etc.	3.0
3.2.7 Any site contamination, treatment and prevention systems;	5.2.2, 3.0, 7.2
3.2.8 Anticipated land contours after mining;	3.11
3.2.9 Potential long-term use of the land after mining operations ceases and its relationship to other lands within the regional context;	3.11, 7.2.12
3.2.10 Any final Mine Closure Plan developed to address needs in accordance with the proposed final land use; and	3.11, 7.2.12
3.2.11 Details on construction timetable and staging; hours of construction, environment protection measures, including water controls, noise mitigation measures, dust control measures and waste management.	3.3, 3.9.1, 5.6, 5.8, 5.9, 7.0
4.1 Provide an overview of the methodology used to identify and prioritise issues. The methodology should take into account: • relevant NSW government policies and guidelines; • industry guidelines;	2.0, 4.0, 5.0

Agency and Requirement	Section of EIS
• relevant research and reference material; • relevant preliminary studies or reports for the proposal; and • consultation with stakeholders.	2.0, 4.0, 5.0
4.2 Provide a summary of the outcomes of the process including: • all issues identified including local, regional and global impacts; • key issues which will require a full analysis (including comprehensive baseline assessment); • issues not needing full analysis though they may be addressed in the mitigation strategy; • justification for the level of analysis proposed (the capacity of the proposal to give rise to high concentrations of pollution compared with the ambient environmental outcomes is an important factor in setting the level of assessment).	5.0
5.1 The EIS must assess the following issues in regard to cumulative impacts:	
• the extent that the receiving environment is already stressed by existing development;	5.15
• infrastructure requirements flowing from the proposal (for example, water and sewerage services, transport infrastructure upgrades);	3.0, 5.5
• likely impacts from such additional infrastructure and measures reasonably available to the proponent to contain such requirements or mitigate their impacts.	5.0
The requirement must be designed, constructed, operated and maintained so that:	
• there is no offensive odour beyond the boundary of the premises.	5.8
In addition, the development must be designed, constructed, operated and maintained to minimise:	
• visible dust emissions from material handling, storage, processing, haul roads, transport and material transfer systems.	5.8, 7.2.5
• Vehicular kilometres traveled	5.13, 6.1, 6.2
The DEC considers that the following policies and guidelines need to be considered when taking into account air quality issues on site: • NSW EPA, 2001*, Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in NSW*. • NSW EPA, 2001, *Approved Methods for the Sampling and Analysis of Air Pollutants in NSW*.	5.8, Appendix 5
The assessment should consider all phases and ancillary activities and identify all activities likely to generate air impacts or have the potential to cause harmful effects on the environment including health and amenity, and all related environmental issues and identify those measures that will ameliorate those impacts. In addition to relevant standards in regulations, for the purpose of assessment the criteria pollutants are dust deposition, TSP and PM10.	5.8, Appendix 5
6.1.1 Describe existing air quality, using existing information and on-site monitoring. Any necessary air monitoring programs should be established as early as possible in the site evaluation and project formulation. This should be considered in developing a baseline monitoring program: • Simultaneous meteorological data collection; • Pollutants to be monitored; • Number and location of sampling sites; • Duration of survey;	5.8, 5.3, Appendix 5

Agency and Requirement	Section of EIS
• Sampling equipment; • Sampling protocols; and • Existing monitoring data.	5.8, 5.3, Appendix 5
6.2.1 The assessment should consider all phases and ancillary activities and identify all activities likely to generate air impacts or have the potential to cause harmful effects on the environment including health and amenity, and all related environmental issues, including those detailed below.	5.8, 5.3, Appendix 5
6.3.1 Details of material handling, storage and transfer system.	3.6, 3.5, 5.8, 7.2.5, Appendix 5
6.3.2 Details of cleaning devices fitted to any conveyor systems.	7.2.5
6.3.3 Details of any pollution controls or mitigation measures and expected performance to suppress dust at transfer points, crushers etc as a result of material being processed and transferred around the premises. Note: all conveyors must be fully enclosed to prevent wind blown dust.	3.5, 5.8, 7.2.5, Appendix 5
6.3.4 Details on any mobile crushing and associated pollution controls to meet the environmental performance objectives.	3.5, 5.8, 7.2.5, Appendix 5
6.3.5 Details on the location and size of any stockpiles including their management to prevent wind blown dust.	3.5, 5.8, 7.2.5, Appendix 5
6.3.6 Details of proposed techniques to suppress wind blown dust especially the quarry site and associated activities.	3.0, 5.8, 7.2.5, Appendix 5
6.3.7 Information should be provided on strategies for dust suppression in relation to high wind early warning management.	5.8, 7.2.5, Appendix 5
6.3.8 Details of spillage response including details of sealed surface management to prevent windblown dust in particular truck and rail loading areas.	5.8, 7.2.5, Appendix 5
6.3.9 Details on truck and rail loading including details on dust suppression during loading operations.	3.5, 5.8, 7.2.5, Appendix 5
6.4.1 Details on location of the haul road including information on its design, construction and management in satisfying the above environmental outcomes.	3.5, 5.8, 7.2.5, Appendix 5
6.5.1 Identify all air pollutants likely to be generated, including but not necessarily restricted to odour, dust, dust deposition, total suspended particulates and PM10: • Provide emission rates for those pollutants for the different activities being undertaken at the premises; • Determine the resulting ground level concentration of pollutants.	5.8, Appendix 5
6.5.2 Determine the effects of pollutant concentrations of the environment including human health and amenity.	5.8, Appendix 5
6.5.3 Provide details of environmental monitoring required to demonstrate impact assessment criteria are not being compromised in the construction and operational phases.	7.3.4
6.5.4 Due to the close proximity of the premises to residential land uses, computer dispersion modelling must be undertaken to predict any impacts as a result of emissions.	5.8, Appendix 5
6.5.5 The assessment must also assess local cumulative impacts and any regional cumulative impacts.	5.8, Appendix 5
6.5.6 The modelling assessment must include information on: • Modelling technique and calibration protocols; • Topography and climatic influences on dispersion;	5.8, Appendix 5

Agency and Requirement	Section of EIS
• Surrounding land uses – if there is the possibility of a health risk, note exact locations of dwellings or other sensitive land uses, provide a perspective view of the study area such as the terrain file used in dispersion models; • All assumptions; • Relationship to air quality standards, goals and guidelines; • Recommendations for future monitoring during construction and operational phases; and • Details on the adequacy of pollution controls or mitigation measures to meet environmental objectives.	5.8, Appendix 5
The facility must be designed, constructed, operated and maintained so that: • There is no pollution of waters (including surface and groundwater) and it complies with Section 120 if the POEO Act at all times. • Polluted water (including process waters, wash down waters, polluted stormwater or sewage) is captured on the site and directed to reticulated sewer where available or else collected, treated and beneficially reused, where this safe and practicable to do so. • Bunding is in accordance with the EPA technical guidelines '*Bunding and Spill Management'* and designed for no-discharge. • There is no inconsistency with any relevant Statement of Joint Intent (SoJI) established by the Healthy Rivers Commission; and • It is acceptable in terms of the achievement or protection of the River Flow Objectives (RFOs) and Water Quality Objectives (WQOs).	5.6, Appendices 8 & 8B
The development must be considered in the context of the proposals location in the Sydney Drinking Water Catchment. The Government has indicted the broad environmental goals and outcomes expected for this catchment in State Environmental Planning Policy (SEPP) 58, as well as in the Statement of Joint Intent (SoJI) in reply to the Healthy Rivers Commission (HRC) report into the Hawkesbury-Nepean River. In developing any water management strategies for the development the proponent should also be mindful that the waters of the Wollondilly River at Marulan are classified "Specially Protected Waters" while the tributaries of the Wollondilly River are classified "Protected Waters" under the POEO Act. The proposal must transparently consider these outcomes, alongside economic, social and other environmental considerations.	5.0 (particularly 5.6), Appendices 8 & 8B
SEPP 58 specifies that in assessing the development, consent and approval authorities must consider the water quality. WQOs and RFOs can be found in the HRC report and SoJI for the Hawkesbury Nepean River (http://www.hrc.nsw.gov.au). The EIS must assess the level and extent of impact against these heads of consideration.	5.6, Appendices 8 & 8B
The EIS must characterize current ambient water quality, river flow and river health, using available data and information (with respect to the WQOs and RFOs). The impact of the proposal on river/stream systems and its water quality should be described and the likely impact (including on WQOs and RFOs) of each option predicted. Option selection should demonstrate which options contribute most effectively to these outcomes and how the preferred option achieves the optimal outcome.	5.6, Appendix 8
Clearly, performance against these requirements cannot be addressed in isolation from the broader environmental goals and outcomes expected in the catchment. This catchment context should be addressed in the EIS.	5.6, Appendices 8 & 8B
The proponent's environmental assessment must:	5.6, Appendices 8 & 8B

Agency and Requirement	Section of EIS
• Predict the ambient water quality outcomes associated with the proposal and demonstrate whether these are acceptable in terms of the achievement or protection of the RFO's and WQO's; • Where WQO's are currently achieved in the ambient waters, will the proposal protect them? • Where WQO's are not currently achieved, does the proposal contribute towards their achievement over time? The proponent must also present information that allows consent and approval authorities, including the EPA to consider the requirements of SEPP58, including neutral or beneficial effect on water quality.	5.6, Appendices 8 & 8B
The WQO's establish the environmental values and human uses for ambient waters. The ANZECC 2000 Australian and New Zealand Guidelines for Fresh and Marine Water Quality are then used to identify the water quality that supports these values including numerical concentrations, biological measures and other water quality descriptors. These are not discharge criteria. The EIS should demonstrate the in-stream result of any discharge will not degrade the water quality objectives and where they are not currently achieved, will contribute towards their achievement. Clearly, where other sources contribute pollutants to the catchment, the proposal should make an appropriate contribution to the water quality objectives but is not solely responsible for their achievement.	5.6, Appendices 8 & 8B
Any proposed techniques for assessment of water impacts, for example, modelling, should be developed in consultation with the Department and should include use of statistically sound data, appropriate choice of a model based on complexity of situation to be modeled, recognised calibration techniques and verification of model results with field data.	5.6, Appendix 8
7.1 Details are required on the surface and groundwater hydrological catchments including the existing water environment.	5.6, Appendices 7 & 8
7.2 Description of the potential sources of pollution and assessment of the pollutant characteristics.	5.6, Appendix 8
7.3 As assessment of the adequacy of the design and management measures to minimise impacts, including those to prevent and control any discharges from the premises.	5.6, Appendix 8
7.4 Details should be provided on the adequacy of surface water pollution controls and the proposed strategy to handle collected waters so that there are: (a) Separate controls for defined dirty and clean areas of the site; and (b) Structures available for any successive rainfall events.	5.6, Appendix 8
7.5 Details of surface water management and anticipated levels of performance for: (a) Any equipment and maintenance areas, including wash down facilities, oil and water separation; (b) Open stockpiles; (c) Extraction areas; (d) Material processing and transfer areas; (e) Loading facilities; (f) Haul roads; and (g) Any associated treatment and reuse systems.	5.6, Appendix 8
The facility must be designed, constructed, operated and maintained so that the facility: • Does not cause intrusive noise at the nearest affected premises. • Does not compromise local planning noise amenity goals.	5.9.1, Appendix 10

Agency and Requirement		Section of EIS
8.1	A blasting impact assessment must be undertaken to assess any impacts to the nearest most affected residences including the identification of measures to prevent impact.	5.9.2, Appendix 10
8.2	Describe the development and its operation identifying all noise sources from the development and proposed mitigation controls. This must include expected noise level and noise character (for example, tonality, impulsiveness, vibration) likely to be generated from noise sources and proposed mitigation measures during: (a) Operational phases including noise impacts associated operation of crushers, material transfer, reversing alarms, pumps, fans, conveyor systems, stockpile operation, transport of goods, product handling, etc. (b) Transport including rail and traffic noise generated by the proposal (Note: In relation to rail activities the impacts associated with night-time activities and shunting need to be assessed); (c) Other services.	5.9.1, Appendix 10
8.3	If night time operation is proposed, specific measures to address noise impact during night time hours will need to be specified in the EIS. In addressing night time activity, sleep disturbance criteria apply.	5.9.1, Appendix 10
8.4	Specify times of operation of rail activities and measure to address any associated noise impacts. (Note: The EIS should also include information regarding discussions with RIC in relation to night time haulage operations and the implications of any potential noise impacts and how these will be addressed.)	5.9.1, Appendix 10
8.5	Specify the times of operation and all noise producing activities including number and times of truck movements and proposed truck routes to and from the proposed development.	3.5, 5.9.1, Appendix 10
8.6	An assessment of cumulative noise impact and the implications of surrounding quarry operations, changes in surrounding land use and future highway upgrade.	5.9.1, Appendix 10
8.7	Details on noise monitoring to assess compliance with the predictions.	7.3.5, Appendix 10
8.8	For projects with a significant potential traffic noise impact provide details of road alignment (include gradients, road surface, topography, bridges, culverts, etc) and land use along the proposed road and measurement locations – diagrams should be to a scale sufficient to delineate individual residential blocks.	3.5, 5.4, 5.9.1, Appendix 10
8.9	Determine the existing background (L_{A90}) and ambient (L_{Aeq}) noise level sin accordance with the NSW Industrial Noise Policy.	5.9.1, Appendix 10
8.10	Determine the existing road traffic noise levels in accordance with the NSW Environmental Criteria for Road Traffic Noise, where road traffic noise impacts may occur.	5.9.1, Appendix 10
8.11	The noise impact assessment report should provide details of all monitoring of existing ambient noise levels including: • Details of the equipment used for the measurements; • A brief description of the dominant and background noise sources at the site; • A statement justifying the choice of monitoring site, including the procedure used to choose the site, having regards to the definition of 'noise sensitive location(s)' and 'most affected location(s)' described in Section 3.1.2 of the NSW Industrial Noise Policy; • Details of the exact location of the monitoring site and a description of land uses in the surrounding areas; • A description of the dominant and background noise sources at the site;	5.9.1, Appendix 10

Agency and Requirement	Section of EIS
• Day, evening and night assessment background levels for each day of the monitoring period; • The final RBL value; • Graphs of the measured noise levels for each day should be provided; • A record of periods of affected data (due to adverse weather and extraneous noise), methods used to exclude invalid data and a statement indicating the need for any re-monitoring under Step 1 in Section B1.3 of the NSW Industrial Noise Policy; and • Determination of L_{Aeq} noise levels from existing industry.	5.9.1, Appendix 10
8.12 Determine the project specific noise levels for the site. For each identified potentially affected receiver, this should include: (a) Determination of the intrusive criterion for each identified potentially affected receiver; (b) Selection and justification of the appropriate amenity category for each identified potentially affected receiver; (c) Determination of the amenity criterion for each receiver; and (d) Determination of the appropriate sleep disturbance limit.	5.9.1, Appendix 10
8.13 Determine expected noise level and noise character (for example: tonality, impulsiveness, vibration, etc.) likely to be generated from noise sources during: (a) Site establishment; (b) Construction; (c) Operational phases; (d) Transport including traffic noise generated by the proposal; and (e) Other services. Note: The noise impact assessment report should include noise source data for each source in 1/1 or 1/3 octave band frequencies including methods or references used to determine noise source levels.	5.9.1, Appendix 10
8.14 Determine the noise and vibration levels likely to be received at the most sensitive locations (these may vary for different activities at each phase of the development.) Potential impacts should be determined for any identified significant adverse meteorological conditions. Predicted noise levels under calm conditions may also aid in quantifying the extent of impact where this is not the most adverse condition.	5.9, Appendix 10
8.15 The noise impact assessment report should include: • A plan showing the assumed location of each noise source for each prediction scenario; • A list of the number and type of noise sources used in each prediction scenario to simulate all potential significant operating conditions on the site; • Any assumptions made in the predictions in terms of source heights, directivity effects, shielding from topography, buildings, or barriers, etc. • Methods used to predict noise impacts including identification of any noise models used. Where modelling approaches other than the use of the ENM or SoundPlan computer models are adopted, the approach should be appropriately justified and validated; • An assessment of appropriate weather conditions for the noise predictions including references to any weather data used to justify the assumed conditions;	5.9, Appendix 10

Agency and Requirement	Section of EIS
• The predicted noise impacts from each source as well as the combined noise level for each prediction scenario under any identified significant adverse weather conditions as well as calm conditions where appropriate; • For developments where a significant level of noise impact is likely to occur, noise contours for the key prediction scenarios should be derived; and • An assessment of the need to include modification factors as detailed in Section 4 of the NSW Industrial Noise Policy.	5.9, Appendix 10
8.16 Discuss the findings from the predictive modelling, and, where relevant noise criteria have not been met, recommend additional mitigation measures.	5.9, Appendix 10
8.17 Where relevant noise/vibration criteria cannot be met after application of all feasible and reasonable mitigation measures the residual level of noise impact needs to be quantified by identifying: • Locations where noise level exceeds the criteria and extent of exceedance; • Numbers of people (or areas) affected; • Times when criteria will be exceeded; • Likely impact on activities (speech, sleep, relaxation, listening, etc.) • Change on ambient conditions; • The result of any community consultation or negotiated agreement.	5.9, Appendix 10
8.18 For the assessment of existing and future traffic noise, details of data for the road should be included such as assumed traffic volume, percentage heavy vehicles by time of day; and details of the calculation process. These details should be consistent with any traffic study carried out in the EIS.	5.9, Appendix 10
8.19 Where blasting is intended, the following details of the blast design should be included in the noise assessment: • Bench height, burden spacing, spacing burden ratio • blast hole diameter, inclination and spacing • Type of explosive, maximum instantaneous charge, initiation, blast block size, blast frequency.	5.9, Appendix 10
The development must be designed, operated and maintained: • In accordance with the principles of the waste hierarchy and cleaner production. • To ensure that the handling, processing, and storage of all materials used at the premises does not have negative environmental or amenity impacts. • The beneficial reuse of all wastes generated at the premises are maximised including but not necessarily limited to slurries, dusts and sludges. • No waste disposal occurs on site except in accordance with an EPA licence. In addition: • *Liquid and non liquid waste residuals should be classified and managed according to the Environmental Guidelines: Assessment, Classification & Management of Liquid & Non-Liquid Wastes (NSW EPA, 1999).*	7.2.10
9.1 Characterisation of all wastes in accordance with relevant guidelines.	7.2.10
9.2 Outline cleaner production actions, including: (a) Measures to minimise waste	3.4, 3.5, 7.2.10

Agency and Requirement	Section of EIS
(b) Proposals for use or recycling of by-products (including recycling of screenings) (c) Proposed long term management methods of solid and liquid waste	3.4, 3.5, 7.2.10
9.3 Provide details of liquid and non-liquid waste management at the facility, including: (a) Identification and scale of all possible waste streams; (b) Methods for handling/transportation of any wastes generated at the premises; (c) Details of any stockpiling or storage of wastes and the time frame for reuse; (d) The method for management of all wastes or recovered materials at the facility; and (e) Characterization and quantities of all wastes, their destinations and management.	7.2.10, 3.5
9.4 Provide details of the type and quantity of any chemical substances to be used or stored and describe arrangements for their safe use and storage.	3.5, 5.12, 7.2.10
9.5 Waste tracking and control. Identify all wastes that cannot be reused including their associated management. In the assessments of these wastes reasons must be provided on why these wastes cannot be reused.	7.2.10
9.6 Clearly detail all environmental impacts associated with waste management.	5.0, 7.2.10
9.7 All other information necessary to demonstrate how the above environmental outcomes and policy requirements will be achieved.	5.0, 7.0
The EIS must show that these objectives will be achieved and in particular, include information concerning the following:	
• Operational procedures to manage air and noise emissions and any potential water discharges.	5.6, 5.8, 5.9, 7.0
• Measures to assess any pollution control failures, including appropriate alarms to alert operators.	7.0
• Reporting procedures for exceedences to the EPA.	7.1
• Details of any monitoring programs.	7.3
• Environment training program.	7.1
• Complaint handling mechanisms.	7.1, 7.4
• Strategies to achieve acceptable emissions in responding to the event of exceedences and emergency management plans.	5.0, 7.0
11.1 Details on progressive mine site rehabilitation (including the existing excavation site and the appropriate landuse for the existing site.)	3.11, 7.1.1, 7.2.12
11.2 Details on any site clearing and management of stripped topsoil to ensure it is available for rehabilitation of the site.	3.4, 5.2.2, 7.2.1
11.3 Details on overburden management including the identification of controls to prevent wind blown dust and contaminated stormwater pollution.	5.8, 5.6, 7.2.5, 7.2.3
11.4 Details on the relocation of the power supply to the site. This information should include whether the power lines are to be overhead or underground? If underground, the proposed route needs to be assessed for its archaeological potential? In addition details should be documented on a program for the rehabilitation of the existing power line route.	3.5.8, 5.5.3, 5.10.1
The EIA documentation should include a report on the flora that includes the following:	5.7, Appendix 9

Agency and Requirement	Section of EIS
• 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 whether they are native or exotic; • A detailed description of vegetation structure (in terms of a scientifically accepted classification system) and spatial distribution (that is, 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 in Schedules 1 & 2 (*Threatened Species Conservation Act 1995)* which might occur at the site. The DEC 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 (for example, 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.	5.7, Appendix 9
The DEC wishes to stress that the proponents will need to consider the provisions of the *Native Vegetation Conservation Act (1997).* If the proposal involves the clearing of native vegetation it may require the consent of the Director-General of the Department of Infrastructure, Planning & Natural Resources.	4.2.14
• Detailed location map and identification of the area surveyed (including the location of photographs, transects, areas of significance, etc);	5.7, Appendix 9
• At least one of the following; a land satellite image, vegetation communities map, aerial photograph, or a remnant vegetation map;	5.7, Appendix 9
• A complete list of all known and likely terrestrial and aquatic species (for example, 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;	5.7, Appendix 9
• Those species which are protected, threatened or listed under any international agreements, as well as introduced species;	5.7, Appendix 9
• Those species known or likely to breed in the area;	5.7, Appendix 9

Agency and Requirement	Section of EIS
• Any species which have specific habitat requirements found within the project area;	5.7, Appendix 9
• Those species or populations which may be near the limit of their geographic range or are a disjunct/isolated population;	5.7, Appendix 9
• 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;	5.7, Appendix 9
• Assessment of the impacts of the proposal on all fauna and its habitat at both the site and at the regional scale;	5.7, Appendix 9
• Identification of any mitigation measures proposed to limit or ameliorate the impact of the proposal;	5.7, Appendix 9
• Detailed methodologies used and a list of the reference literature cited, and	5.7, Appendix 9
• Any other issues that may be considered relevant.	5.7, Appendix 9
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.	4.3.4, 5.7
• Accessing the DEC's Aboriginal Heritage Information Management System (AHIMS) in the initial planning stage.	5.10.1, Appendix 11
• The Aboriginal community (which may include Local Aboriginal Land Councils, Native Title Groups and Elders Groups) needs to be consulted so that they can be advised that there may be impact to sites relevant to their heritage.	5.10.1, Appendix 11, 2.1.2
• An archaeological survey is to be conducted, including an on-the-ground systematic archaeological investigation. If there is a likelihood of buried sits not visible on the surface, a Section 87 Permit from the DEC may be needed for sub-surface testing.	5.10.1, Appendix 11, 2.1.2
• If the study area is considered to have archaeological potential or cultural significance then a survey and assessment should be undertaken by an archaeologist in accordance with NPWS guidelines contained in the "Aboriginal Cultural Heritage: Standards and Guidelines Kit" that has been made widely available to archaeologists -undertaking this work.	5.10.1, Appendix 11, 2.1.2
Greater Argyle Council	
1. The importance of a total water management strategy, which details impacts on existing and potential (eg groundwater) potable water supply for Marulan and water quality generally.	5.6
2. The need to address the issue of compatibility between what is proposed and the future western expansion of Marulan township (as detailed within the Draft Settlement Strategy). Any development buffers should be contained within the proponent's own land.	4.5, 5.4
3. Heavy vehicle movement impacts on Marulan township and the RTA acknowledged unsafe at-grade crossing with the Hume Highway at the southern end of Marulan in the construction and pre-interchange phases.	5.5.1
4. The proponents propose a grade separated interchange at the Marulan South road intersection. While the merits of this are acknowledged the Draft Settlement Strategy also proposed a similar interchange in town to replace the current unsafe at grade crossing. The EIS should address the cost/benefits of one grade separated interchange which addresses all objectives.	6.2.3
5. EIS to include up front management plan/s which detail short, medium and long term recommendations/ actions/monitoring programs, etc. on:	7.0

Agency and Requirement	Section of EIS
• Visual amenity; • Remediation/rehabilitation of quarry site and overburden sites; • Integrated water cycle management; • Dust and noise suppression; • Protection and enhancement of threatened/ endangered flora and fauna; • Protection of identified Aboriginal sites; • Landscaping, etc.	7.0
RTA	
The developer will need to prepare a Traffic Impact Study for the subject development.	5.5.1, Appendix 6
NSW Heritage Office	
• 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.	5.10.2, Appendix 12
• You should consult lists maintained by the NSW National Parks and Wildlife Service, the National Trust, the Commonwealth's Department of the Environment and Heritage and the local council in order to identify items of heritage significance in the area affected by the proposal.	5.10, Appendices 11 & 12
• Non-Aboriginal heritage items within the area affected by the proposal should be identified by field survey. This should include any buildings, works, relics (including relics underwater), gardens, landscapes, views, 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/measures to conserve their heritage significance should be identified. This assessment should be undertaken in accordance with the guidelines in the NSW Heritage Manual. The field survey and assessment should be undertaken by a qualified practitioner/consultant with historic sites experience. The NSW Heritage Office can provide a list of suitable consultants.	5.10.2, Appendix 12
• The proposal should have regard to any impacts on places, items, or relics of significance to Aboriginal people.	5.10, Appendix 12
Sydney Catchment Authority	
1. Consider State Environmental Planning Policy No 58 – Protecting Sydney's Water Supply (noting, in particular, the matters specified in Clauses 11(3) and 11(4) of the SEPP;	4.3, 4.4, 5.6, Appendices 8 & 8B
2. Consider the draft Regional Plan – Sustaining the Catchments;	4.4, 5.6, Appendices 8 & 8B
3. Contain a water cycle management study prepared in respect of the development that addresses the following matters:	5.6, Appendix 8
• Pre-development and post-development run off volumes and pollutant loads from the site of the proposed development;	5.6, Appendix 8
• The assessment of the proposed development against the matters for consideration specified in clause 10 of SEPP 58;	5.6, Appendices 8 & 8B
• The impacts of the development on receiving waters;	5.6, Appendix 8
• The water cycle management strategies and best management practices proposed to be employed to address those impacts; and	5.6, 7.2.3, Appendix 8
• The arrangements to be made for the ongoing maintenance and monitoring of the water cycle management system.	5.6, 7.2.3, Appendix 8

Agency and Requirement		Section of EIS
The water cycle management should: • Address surface and ground waters; • Have regard for periods of wet weather; • Consider the design, construction, operational and decommissioning phases; and • In addressing clause 10(c) have regard to the water quality objectives as detailed in the draft Regional Plan (see Section 3.2.1 of Part 1 and clause 6 of the draft Regional Environmental Plan;		5.6, 7.2.3, Appendices 8 & 8B
4.	Provide details of the proposals to manage waste waters associated with processing quarry materials, general stormwater runoff and human activities;	3.7, 5.6, 7.2.3, Appendix 8
5.	Provide details of and assess the impacts associated with the relocation water resources;	5.6, Appendix 8
6.	Provide details of the practices proposed to ensure materials transported from the site by road and rail do not spill (as solid, liquid or dust); and	3.5.3, 7.2
7.	Assess measures proposed to be adopted to offset impacts associated with construction activities eg. earthworks, vegetation clearing, track construction etc. (these measures could include remediation of existing gully and sheet erosion and improved management of watercourses and related riparian areas).	7.1.1, 7.2
NSW Department of Primary Industries, Mineral Resources Division		
1.	A summary of the regional and local geology including information on the stratigraphic unit or units subject of the proposal.	5.1
2.	The amount of material available for extraction and the method or methods used to determine this amount (eg drilling, trenching, geophysical methods). Plans and cross-sections summarising this data, at a standard scale, showing location of drillholes and/or trenches, and the area proposed for extraction, should be included in the EIS. Relevant supporting documentation such as drill logs should be appended. Major resource proposals should be subject to extensive drilling programs to identify the nature and extent of the resource.	3.2, 5.1 (Note: a separate detailed geological report will be provided to DPI)
3.	Characteristics of the material or materials to be produced:	3.2
4.	For clay/shale extraction proposals, ceramic properties such as plasticity, drying characteristics, (eg dry green strength, linear drying shrinkage,) and firing characteristics (eg shrinkage, water absorption, fired colour) should be addressed.	Not relevant to this project
5.	For sand extraction proposals, properties such as composition, grainsize, grading, clay content, and contaminants should be indicated. The inclusion of indicative grading curves for all anticipated products as well as the overall deposit is recommended.	Not relevant to this project
6.	For hard rock aggregate proposals, information such as grainsize and mineralogy, nature and extent of weathering or alteration, and amount and type of deleterious minerals, if any, should be indicated.	3.2, 5.1 (Note: a separate detailed geological report will be provided to DPI)
7.	For other proposals, properties relevant to the range of uses proposed for the particular material should be indicated.	3.2 (Note: a separate detailed geological report will be provided to DPI)

Agency and Requirement	Section of EIS
8. Details of tests carried out to determine the characteristics of the material should be appended. Such tests should be undertaken by NATA registered testing laboratories.	3.2 (Note: a separate detailed geological report will be provided to DPI)
9. An assessment of the quality of the material and its suitability for the anticipated range of applications should be given.	3.2 (Note: a separate detailed geological report will be provided to DPI)
10. The amount of material anticipated to be produced annually should be indicated. If the proposal includes a staged extraction sequence details of the staging sequence needs to be provided. The intended life of the operation should be indicated.	3.4
11. If the proposal is an extension of an existing operation, any past annual production data (by financial year) for all products should be supplied in support of the proposal.	Not relevant to this project
12. An assessment of alternative sources to the proposal and the availability of these sources. The impact of not proceeding with the proposal should be addressed.	6.0
13. Justification for the proposal in terms of the local, and, if appropriate, the regional context. Identification of the subject site in relevant planning instruments such as regional environmental plans, should be noted.	6.4
14. Information on the location and size of markets to be supplied from the site.	3.2
15. Transport routes for the material to the market.	3.5.3, 5.5
16. Disposal of waste products and the location and size of stockpiles.	3.4, 3.5, 7.2.10
17. Assessment of noise, vibration, dust and visual impacts, and proposed measures to minimise these impacts.	5.9, 5.8, 5.11, 7.0
18. Proposed rehabilitation procedures during, and after completion of, extraction operations, and proposed final use of site.	3.11, 7.2.12
19. Assessment of the ecological sustainability of the proposal.	5.7, 6.4.3
NSW Department of Primary Industries, now incorporating NSW Agriculture	
1. Quarry impacts. The impact of the quarry on surrounding properties will need to be investigated. In particular, the impacts of noise, dust and vibration.	5.0
2. Water. The impacts of the quarry on the quality and quantity of surface and ground water will need to be considered. Water extraction may have some impact on water resources. Any potential impact will need to be identified.	5.6, 3.7
3. Final Site Use. The use of the site when extraction is complete. When and how the quarry be rehabilitated to a landscape of value to the community.	3.11, 7.2.12
4. Storage of topsoil. A plan for effective storage and management of topsoil held for rehabilitation of the quarry should be noted.	3.4, 5.2.2, 7.2.1
5. Weeds. Disturbed ground creates an environment suitable for weeds. A management plan to control the spread of weeds should be developed in the document.	7.1.1
6. Livestock management. If livestock are proposed to be run in the vicinity of the site, the document should indicate how livestock are to be excluded from the quarry, waste water control dams, transport routes and other facilities.	7.1.1

Agency and Requirement	Section of EIS
7. Dust. The control of dust is imperative. Pastures and crops when covered by dust become unpalatable. Prevention of even the slightest dust nuisance is essential.	5.8, 7.2.5
Rail Infrastructure Corporation (now ARTC)	
1. A minor tonnage is predicted for rail haulage, southwards from the project site toward Goulburn. The project should therefore address options in the EIS to accommodate such train movements. Such working may entail sharing the existing ballast siding as a train reversing location when such movements are required.	Not proposed as part of this project.
2. Quarrying will not enter an exclusion zone beneath the rail corridor. Such zones are typically set as an area bounded within 45° outward, downward sloping section starting from the boundary of the rail corridor. Proposed 200 metre wide buffer zone assists in this regard.	200 metre buffer retained 3.4, 5.5
3. The longer term strategy is for the rail corridor height clearances to be increased. Australian Rail Track Corporation (ARTC) will commence lease of this line section from 5 September 2004. Their future height clearance requirements for any bridge or conveyor structure crossing the line should be sought and included in the EIS report.	3.5.6

SECTION 9

References

9.0 References

ANZECC, 1990. *Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration*

ANZECC, 2000. *Australian water quality guidelines for fresh and marine waters*. Australian and New Zealand Environment and Conservation Council, Canberra, Australia.

Armour, Audrey. 1990. *Integrating Impact Assessment into the Planning Process*. Impact Assessment Bulletin 8 (1/2):3-14.

Australian Bureau of Statistics (2001) *Census of Population and Housing.*

Australian Bureau of Statistics, 2004. Website http://www.abs.gov.au/

Australian Greenhouse Office, 2004. *Factors and Methods Workbook*.

Bell Cochrane & Associates, 2004. *Source Rock Investigations & Quarry Development Planning for Proposed Lynwood Quarry, Marulan*.

Briggs JD and Leigh JH, 1996. *Rare or Threatened Australian Plants*. CSIRO, Canberra.

Burdge, Rabel J, 2004. *A Community Guide to Social Impact Assessment*. Third ed. Middleton, Wisconsin: Social Ecology Press.

Bureau of Meteorology, 2004. Bushfire Weather. http://www.bom.gov.au/inside/services_policy/fire_ag/bushfire/bushfire.htm

Department of Environment and Conservation, 2004. *NSW Reprocessing Industries Survey 2001 – 2002 and 2002 – 2003 Combined Summary Report*. Department of Environment and Conservation, Parramatta, Sydney.

Department of Housing, 1998. *Managing Urban Stormwater: Soils and Construction,* Department of Housing, Sydney.

Department of Infrastructure, Planning and Natural Resources, 2003. *Soil Landscapes of the Goulburn Region 1:100 000 Sheet*. Soil Conservation Service of NSW, Sydney.

Department of Land and Water Conservation, 1999. *Draft Guidelines for Designing Stable Drainage Lines on Rehabilitated Mine Sites.*

Department of Mineral Resources, 2000. *Supply and Demand for Coarse Aggregate in the Sydney Planning Region*. NSW Department of Mineral Resources, St Leonards, Sydney.

Department of Mineral Resources, 2004, *Minerals Industry Annual*. NSW Department of Mineral Resources, St Leonards, Sydney.

Department of Planning, 1993. *Sydney Regional Environmental Plan No. 9 Extractive Industry (No.2) Planning Report*.

Department of Planning, 1994. *Applying SEPP 33 Hazardous and Offensive Development Application Guidelines*, New South Wales Government.

Department of Planning, 1995. *Corridor Strategy: Sydney – Canberra Corridor Strategy, Sydney*.

Department of Urban Affairs and Planning, 1997. *Upper Hunter Cumulative Impact Study and Strategy.*

Eddy M, 1985. *Marulan – A Unique Heritage*, 'Marulan 150', Canberra Publishing, Canberra.

Emery KA, 1986. *Rural Land Capability Mapping*. Soil Conservation Service of NSW.

Environment Protection Authority, 1994. *Environmental Noise Control Manual,* Chatswood.

Environment Protection Authority, 1999. *Environmental Criteria for Road Traffic Noise*.

Environment Protection Authority, 2000. *Industrial Noise Policy – Environmental Noise Management*, Chatswood.

Environment Protection Authority, 2001. *Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in NSW*, May 2001.

Houghton PD & Charman PEV, 1986. *Glossary of Terms used in Soil Conservation*. Soil Conservation Service of NSW.

Mulwaree Shire Council, 1995. *Mulwaree Local Environmental Plan*.

Mulwaree Shire Council, 2003. *Mulwaree Shire Council Settlement Strategy*.

Mulwaree Shire Council, 2004. Mulwaree Cultural Map [Internet]. Mulwaree Shire 2004 [cited 2004]. Available from http://www.mulwaree.nsw.gov.au/.

National Parks & Wildlife Service, 2003. *The Bioregions of New South Wales: their biodiversity, conservation and history., Chapter 16: The South Eastern Highlands Bioregion*.

Navin K, 1990. *Archaeological Survey of a Proposed Hard Rock Quarry Site near Marulan, NSW.* Report to Quarry Technology Pty Ltd.

NSW Agriculture, 1988. *Agricultural Suitability Mapping*. NSW Agriculture.

NSW Agriculture, 2002. *Agricultural Land Classification*. NSW Agriculture.

NSW Heritage Office, 1996. *NSW Heritage Manual*.

NSW Rural Fire Service guidelines, *Planning for Bushfire Protection. A Guide for Councils, Planners, Fire Authorities, Developers and Home Owners* (2001).

Sargent C, *The British Garrison in Australia 1788-1841: the great roads. (Military supervision of convict work gangs. Part IV)*, *Sabretache*, December 2003 V44 i4 p 31(5).

SEDA & Planning NSW, 2002. *Guidelines for Energy and Greenhouse and EIA*.

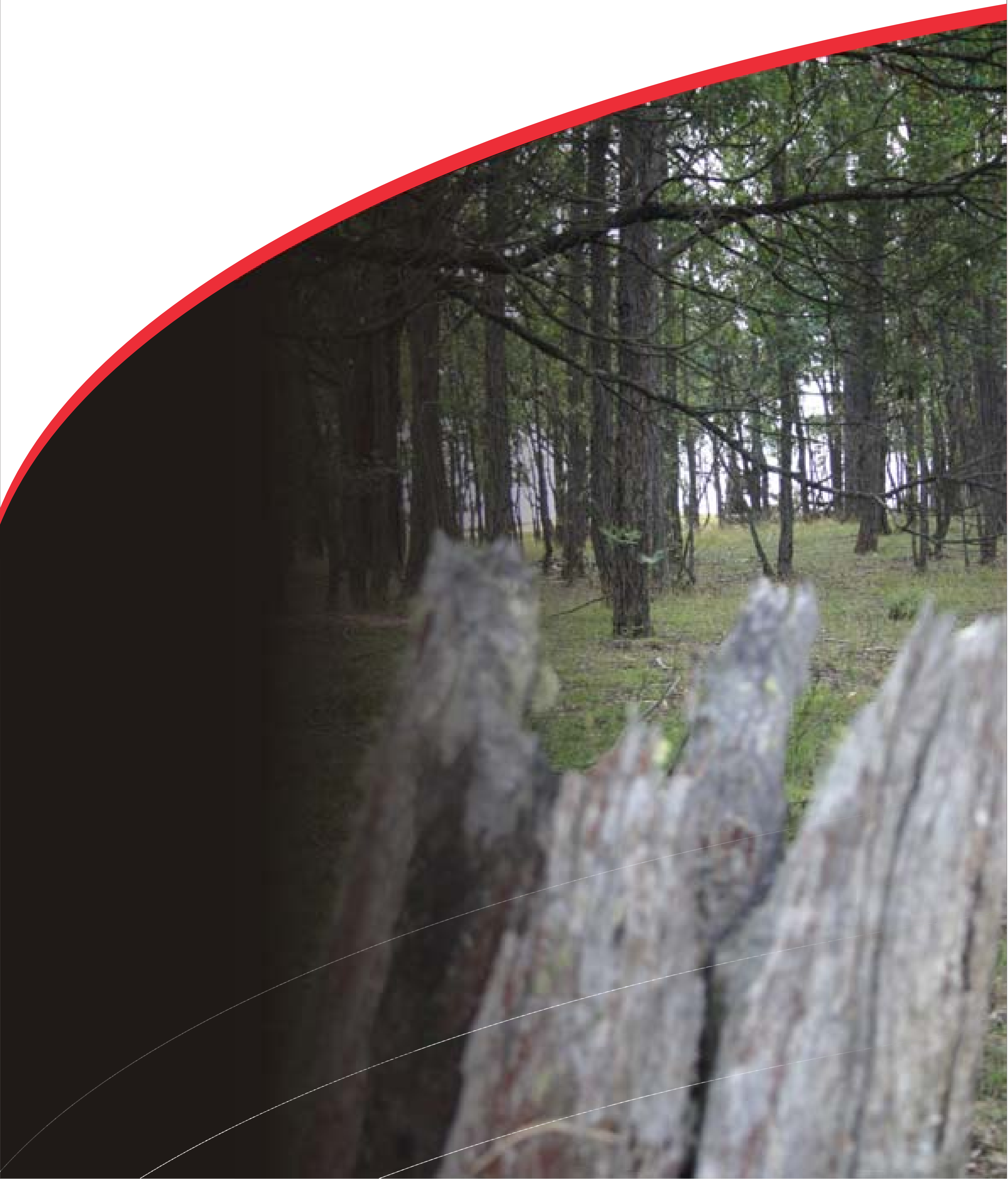
SGE Economics and Planning Pty Ltd, 2003. *Goulburn and Mulwaree Demographic Profile and Projections Report: Goulburn & Mulwaree Local Government Authorities*.

Tindall D, Pennay C, Tozer MG, Turner K, Keith DA, 2004. *Native vegetation map report series. No. 4. Araluen, Batemans Bay, Braidwood, Burragorang, Goulburn, Jervis Bay, Katoomba, Kiama, Moss Vale, Penrith, Port Hacking, Sydney, Taralga, Ulladulla, Wollongong*. NSW Department of Environment and Conservation and NSW Department of Infrastructure, Planning and Natural Resources, Sydney.

World Business Council on Sustainable Development and World Resources Institute, 2004. *The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard* (Revised Edition).

SECTION 10

Abbreviations & Glossary



10.0 Abbreviations and Glossary

10.1 Abbreviations

AHD	Australian Height Datum
AGL	The Australian Gas Light Company Ltd
ARI	Average Recurrence Interval
ARTC	Australian Rail Track Corporation
CCO	Chemical Control Order
DA	Development Application
DCP	Development Control Plan
DEC	Department of Environment and Conservation
DIPNR	Department of Infrastructure, Planning and Natural Resources
DLWC	Department of Land and Water Conservation (former, now DIPNR)
DMR	Department of Mineral Resources (former, now DPI)
DPI	Department of Primary Industries
EAT	Emerson Aggregate Test
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EMS	Environmental Management System
EPA	Environment Protection Authority of NSW (former, now DEC)
EP&A Act	*Environmental Planning and Assessment Act* 1979 (NSW)
EP&A Regulation	*Environmental Planning and Assessment Regulation* 2000 (NSW)
EPBC Act	*Environment Protection and Biodiversity Conservation Act* 1999 (Commonwealth)
EPL	Environment Protection Licence
Filt. Iron	Filterable Iron
ha	hectares
HVAS	high volume air sampler
LEP	Local Environmental Plan

LGA	Local Government Area
m	metres
Mg	magnesium
ML	megalitres
Mt	million tonnes
Mtpa	million tonnes per annum
N	Nitrogen
NPWS	National Parks and Wildlife Service (former, now DEC)
P	Phosphorus
POEO Act	*Protection of the Environment Operations Act* 1997 (NSW)
REP	Regional Environmental Plan
RTA	Roads and Traffic Authority
S	Sulphur
SEPP	State Environmental Planning Policy
SWMOP	State Water Management Outcomes Plan
TDS	Total Dissolved Solids
TSC Act	*Threatened Species Conservation Act* 1995 (NSW)
TSS	Total Suspended Solids
TSP	total suspended particulate matter, usually in the size range of zero to 50 micrometres
Umwelt	Umwelt (Australia) Pty Limited
yr	Year

10.2 Glossary

A1 Horizon:	The uppermost layer of soil generally containing some humus.
Acoustics:	Sound and its characteristics.
AHD:	Australian Height Datum.
Alluvium:	Sediment deposited by a flowing stream, e.g., clay, silt, sand, etc.

Amenities:	Lunch room, showers, toilets.
Amenity:	An agreeable feature, facility or service which makes for a comfortable and pleasant life.
Aquifer:	A water-bearing rock formation.
Arboreal:	Adapted for living and moving around in trees.
Archaeological:	Pertaining to the study of culture and description of its remains.
Attenuation:	The reduction in magnitude of some variable in a transmission system, for example, the reduction of noise with distance as it travels through air.
Average Recurrence Interval (ARI):	The statistically calculated interval likely to be exceeded once in a given period of time. A term used in hydrology, also known as return period.
Background Noise:	Existing noise in the absence of the sound under investigation and all other extraneous sounds.
Baseline Studies:	Studies conducted to establish prevailing environmental conditions.
Batter:	The excavated or constructed face resulting from earthmoving operations.
Catchment Area:	The area from which a river or stream receives its water.
Conservation:	The management of natural resources in a way that will preserve them for the benefit of both present and future generations.
Crumb:	Rounded, soft soil aggregate less than 5 mm in diameter.
Dangerous Goods Act 1975:	Legislation which places controls on the handling of certain goods including explosives, gases, flammable liquids and radioactive substances.
Decibel (dB):	A unit for expressing the relative intensity of sounds on a logarithmic scale from zero (for average least perceptible sound) to about 130 (for the average pain level).
Decibel dB(A):	A modified decibel scale which is weighted to take account of the frequency response of the normal human ear.
Dispersibility:	The proportion of clays and fine silts (defined by having a particle size of less than 0.005 mm) in a soil which can disperse into water on wetting.
Dispersible Soils:	Soils in which the clay fraction forms a suspension on wetting - can lead to tunnelling and gully erosion if not appropriately managed.
Ecology:	The science dealing with the relationships between organisms and their environment.

Ecosystem:	Organisms of a community together with its non-living components through which energy and matter flow.
Effluent:	The liquid waste of sewage and industrial processes.
Electrical Conductivity:	The measure of electrical conduction through water or a soil-water suspension generally measured in millisiemens per centimetre or microsiemens per centimetre. An approximate measure of soil or water salinity.
Environmental Planning and Assessment Act 1979:	NSW Government Act to provide for the orderly development of land in NSW.
Environment Protection and Biodiversity Conservation Act 1999:	Commonwealth legislation that regulates development proposals that have an actual or potential impact on matters of national environmental significance.
Erodibility:	The susceptibility of a soil to undergo erosion, based on the inherent characteristics of the soil.
Evapotranspiration:	The combined loss of water by evaporation from the soil or surface water and by transpiration from plants and animals.
Fauna:	All vertebrate animal life of a given time and place.
Floodplain:	Large flat area of land adjacent to a stream which is inundated during times of high flow.
Flora:	All vascular plant life of a given time and place.
Geology:	Science relating to the earth, the rocks of which it is composed and the changes it undergoes.
Geomorphic Processes:	Processes involved in the formation of the earth's surface features.
Geotechnical:	Relates to the form, arrangement and structure of geology.
Groundwater:	Sub-surface water which is within the saturated zone and can supply wells and springs. The upper surface of this saturated zone is called the water table.
Habitat:	The environment in which a plant or animal lives; often described in terms of geography and climate.
Hydrogeological:	The relation of hydrological phenomena to the surface geology.
Hydrology:	Science that relates to the properties, distribution and circulation of the earth's water.

Igneous: Rock derived from magma which has cooled and solidified closer to the earth's surface (volcanic) or within the earth's crust (plutonic) - forms sills and dykes.

Indigenous: Native to, or originating in, a particular region or country.

***In situ*:** In its original place.

Intrusion: The forcing of extraneous matter, like molten rock, into some other formation.

Kilo Volt (kV): One thousand volts.

L_{A1} Noise Level: The noise level exceeded for one per cent of the time. It is used in assessment of sleep disturbance.

L_{A10} Noise Level: The noise level, measured in dB(A), which is exceeded for 10 per cent of the time, which is approximately the average of the maximum noise levels.

L_{A90} Noise Level: The noise level, measured in dB(A), exceeded for 90 per cent of the time, which is approximately the average of the minimum noise levels. The L_{90} level is often referred to as the "background" noise level and is commonly used to determine noise criteria for assessment purposes.

L_{Aeq} Noise Level: The average noise energy, measured in dB(A), during a measurement period.

L_{AMax} Noise Level: The maximum noise energy, measured in dB(A), during a measurement period.

Land Capability: The ability of a parcel of land to be used in a sustainable manner (that is without permanent damage) for a given land use.

Landform: Sections of the earth's surface which have a definable appearance (e.g. cliff, valley, mountain range, plain, etc).

Leaching: The process of removing soluble matter(s) from soil or rock by water.

Lithotype: Type of lithogy or rock unit.

Mean: The average value of a particular set of numbers.

Measured Resources: Those rock resources for which the density and quality of points of observation are sufficient to allow a reliable estimate of the rock thickness, quality, depth, and *in situ* tonnage and properties of the rock relevant to its proposed usage.

Median Value: A value above and below which there are equal numbers of data values.

Megalitre (ML): One million litres.

Meteorology: Science dealing with atmospheric phenomena and weather.

Mitigate:	To lessen in force, intensity or harshness. To moderate in severity.
Native:	Belonging to the natural flora or fauna in a region.
Outcrop:	Bedrock exposed at the ground surface.
Pan Evaporation:	The rate of evaporation from a standard shallow circular pan. The pan is filled with water and the loss of water is measured once a day.
Particulates:	Fine solid particles which remain individually dispersed in gases.
Peak Discharge:	Maximum discharge down a stream following a storm event.
Permeability:	The capacity of rock or solid to transmit fluids (through pores, bedding planes or joints).
pH:	Scale used to express acidity and alkalinity. Values range from 0-14 with seven representing neutrality. Numbers from seven to zero represent increasing acidity whilst seven to fourteen represent increasing alkalinity.
Piezometer:	A small diameter bore lined with a slotted tube used for determining the standing water level of groundwaters.
Precipitation:	Rain, snow, sleet, dew formed by the condensation of water vapour in the atmosphere.
Protection of the Environment Operations Act 1997:	NSW legislation administered by DEC that regulates discharges to land, air and water.
Rating Background Level (RBL):	A period (day, evening or night) background noise level determined in accordance with chapter 3 of the EPA Industrial Noise Policy (EPA, 2000).
Recycling:	The return of waste materials to the production system so that the need for use of raw materials is reduced.
Rehabilitation:	The process of restoring to a condition of usefulness. In regard to quarrying, relates to restoration of land from a degraded or quarried condition to a stable and vegetated landform.
Revegetation:	The process of re-establishing vegetation cover.
Salinity:	A measure of the concentration of dissolved solids in water.
Sedimentary Rocks:	Any rock formed by the laying down of sediments (includes sandstone, mudstone, siltstone, claystone and conglomerates).
Sedimentation:	Deposition or settling of materials by means of water, ice or wind action.

Sedimentation Dam:	A dam built to retard dirty runoff to allow sediment to settle out before allowing clean water discharge.
Sewage:	Waste matter discharged to a sewer.
Sewerage:	Works for collecting, treating and disposing of sewage.
Slurry:	A fluid composed of part liquid, part solid which can be pumped.
Socio-economic:	Combination of social and economic factors.
Sound Power Level (SWL):	The total sound energy radiated per unit time measured as 10 times a logarithmic scale, the reference power being 12 picowatts.
Sound Pressure Level (SPL):	Fluctuations in pressure measured as 10 times a logarithmic scale, the reference pressure being 20 micropascals.
Subcrop:	A unit of material that occurs just below the soil profile.
Surface Drainage Patterns:	The pattern described by water flowing over the land surface when viewed from above.
Surface Infrastructure:	Any man made object, facility or structure on the surface of the land.
Time of Concentration:	The time required for all parts of a catchment to simultaneously contribute runoff flow to a given outlet point.
Topography:	Description of all the physical features of an area of land and their relative positions, either in words or by way of a map.
Total Dissolved Solids (TDS):	A measure of salinity expressed in milligrams per litre (mg/L).
Total Suspended Particulates (TSP):	A measure of the total amount of un-dissolved matter in a volume of water or air usually expressed in milligrams per litre (mg/L) (for water) or micrograms per cubic metre (ug/m^3) for air.
Turbidity:	A measure of the amount of suspended solids (usually fine clay or silt particles) in water.
Understorey:	Vegetation which grows below the canopy of a forest.
Volatile Matter:	Matter which is readily transformed to a gaseous state.
Woodland:	Land covered by trees that do not form a closed canopy.

Umwelt
Environmental Consultants

Umwelt (Australia) Pty Limited
2/20 The Boulevarde
PO Box 838
Toronto NSW 2283
Ph. 02 4950 5322
Fax 02 4950 5737
www.umwelt.com.au