

Volume

4

Balranald Mineral Sands Project

NSW Environmental Impact Statement

Prepared for Iluka Resources Limited
May 2015

Appendix G - Aboriginal Cultural Heritage Assessment



Volume 1

Table of contents

Part A Introduction, site and context, regulatory framework and consultation

Part B Environmental impact assessment

Part C Commitments and justification

References

Acronyms and abbreviations

Volume 2

Appendix A Secretary's Environmental Impact Assessment Requirements

Appendix B Study Team

Appendix C Agricultural Impact Statement

Appendix D Noise Assessment

Appendix E Air Quality and Greenhouse Gas Assessment

Volume 3

Appendix F Biodiversity Assessment

Volume 4

Appendix G Aboriginal Cultural Heritage Assessment

Volume 5

Appendix H Surface Water Management Report

Appendix I Balranald Mineral Sands Project Groundwater Assessment

Appendix J Groundwater Dependant Ecosystems Assessment Report

Volume 6

Appendix K Water Assessment

Appendix L Soil Resource Assessment

Volume 7

Appendix M Rehabilitation and Closure Strategy

Appendix N Transport Assessment

Appendix O Social Assessment

Volume 8

Appendix P Economic Assessment

Appendix Q Geochemistry Assessment

Appendix R Non-Aboriginal Cultural Heritage Assessment

Appendix S Radiation Risk Assessment

Appendix G

Aboriginal Cultural Heritage Assessment





Balranald Mineral Sands Project

Aboriginal Cultural Heritage Assessment

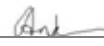
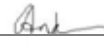

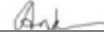
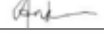
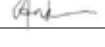
Prepared for Iluka Resources Limited

5 May 2015

Iluka Trim Reference: 1305949

Document control

Project no.:	1720
Project client:	Iluka Resources Limited
Project office:	Parramatta
Document description:	Aboriginal Cultural Heritage Assessment
Project Director:	Jamie Reeves
Project Manager:	Clare Anderson
Authors:	Clare Anderson
Internal review:	5 May 2015
Document status:	For Public Display
Nearest Town:	Balranald
Local Government Area:	Balranald LGA

Author	Revision number	Internal review	Date issued	Signature
Clare Anderson	D01	Jamie Reeves	10 Feb 2015	
Clare Anderson	D02	Jamie Reeves	18 Feb 2015	
Clare Anderson	D03	-	24 Feb 2015	
Clare Anderson	D04		2 April 2015	
Clare Anderson	V005		5 May 2015	
Clare Anderson	V006		7 May 2015	

Niche Environment and Heritage

A specialist environmental and heritage and consultancy.

Head Office

Niche Environment and Heritage
 PO Box W36
 Parramatta NSW 2150
 Email: info@niche-eh.com
 All mail correspondence should be through our Head Office.

Sydney

0488 224 888

Central Coast

0488 224 999

Illawarra

0488 224 777

Armidale

0488 224 094

Newcastle

0488 224 160

Mudgee

0488 224 025

Port Macquarie

0488 774081774 081774081

Brisbane

0488 224 036

Cairns

0488 284 743

© Niche Environment and Heritage, 2015

Copyright protects this publication. Except for purposes permitted by the Australian *Copyright Act 1968*, reproduction, adaptation, electronic storage, and communication to the public is prohibited without prior written permission. Enquiries should be addressed to Niche Environment and Heritage, PO Box W36, Parramatta NSW 2150, Australia, email: info@niche-eh.com.

Any third party material, including images, contained in this publication remains the property of the specified copyright owner unless otherwise indicated, and is used subject to their licensing conditions.

Cover photograph: Proposed West Balranald mine location on the Karra property, 2013

Table of Contents

1. Executive summary	1
2. Introduction	6
2.1 Overview	6
2.2 Approval process	6
2.3 NSW Secretary’s environmental assessment requirements	7
2.4 Commonwealth requirements	7
2.5 Purpose of this report.....	8
3. Site Location and Investigation Area	9
4. Description of the Development Proposal	16
4.1 Proposed Activities	16
4.2 West Balranald and Nepean Mines	16
4.3 Injection borefields.....	16
4.4 Access roads	16
4.5 Accommodation facility.....	17
4.6 Water supply pipeline.....	17
4.7 Gravel extraction	17
4.8 Project schedule	17
5. Aboriginal Community Consultation Process.....	18
5.1 The Consultation Process	18
6. Investigators and Contributors	27
6.1 Research and Reporting	27
6.2 Fieldwork	27
7. Landscape Context	29
7.1 Overview.....	29
7.2 Paleo-environments	29
7.3 Pleistocene Landscape.....	30
7.4 The Holocene Landscape	31
7.5 Summary.....	38
8. Aboriginal Archaeological Context	44
8.1 Heritage Registers	44
8.2 Local Archaeological Investigations.....	48

8.3	Regional Archaeological Studies.....	51
8.4	Ethnography and History.....	55
8.5	Synthesis and Predictive Model	62
9.	Survey and Project Methodology.....	65
10.	Results.....	66
10.1	Cultural Heritage Survey.....	66
10.2	Survey Coverage of the Project Area.....	87
10.3	Aboriginal Cultural Heritage Sites.....	90
11.	Analysis and Discussion	103
11.1	Site and Artefact Distribution.....	103
11.2	Artefact Analysis	104
11.3	Stone Reduction Technology.....	107
11.4	Comparison with other archaeological studies	110
11.5	Aboriginal Archaeological Risk Layer	112
12.	Cultural Heritage Values and Significance Assessment	134
12.1	The Burra Charter	134
12.2	Archaeological (Scientific) Significance Assessment of Aboriginal Heritage Sites	134
12.3	Cultural Significance Assessment of Aboriginal Heritage Sites	225
12.4	Statements of Significance	225
13.	Impact Assessment.....	227
13.1	Overview of Potential Impacts	227
13.2	Potential Impacts from Proposed Activities	227
13.3	Potential Impacts to Sites and Areas of Archaeological Risk within the Disturbance Area	228
13.4	Potential Cumulative Impacts	269
13.5	Potential Impacts on Willandra Lakes Region World Heritage and Natural Heritage Values ...	270
14.	Management and Mitigation Measures	273
14.1	Conservation Principles and Management Framework	273
15.	Conclusion.....	280
16.	Recommendations.....	282
17.	Glossary	286
18.	References	291
	Appendix 1 – Community Consultation Records	295
	Appendix 2 – Notes on the geomorphology of Balranald Project Area	296
	Appendix 3 – AHIMS Search Results	297

Appendix 4 – Project and Survey Methodology	298
Appendix 5 – Transect Data.....	299
Appendix 6 – Aboriginal Site Descriptions	300

List of Figures

Figure 1. Project Area Balranald Mineral Sands Project Aboriginal Heritage	10
Figure 2. Nepean Mine	11
Figure 3. West Balranald Mine	12
Figure 4. Injection borefields.....	13
Figure 5. Gravel extraction areas.....	14
Figure 6. Accommodation Facility and Water Supply Corridor	15
Figure 7. The Project Area in relation to the Willandra Lakes region	40
Figure 8. Hydrology of the Project Area	41
Figure 9. Digital Elevation Model of the Project Area	42
Figure 10. Western NSW Land Systems	43
Figure 11. Previously Recorded Aboriginal Sites in the Project Area – Overview	46
Figure 12. Paika Station c1870 - 1923	59
Figure 13. Survey results: overview.....	68
Figure 14. Survey results: Nepean mine	69
Figure 15. Survey results: West Balranald mine (north)	70
Figure 16. Survey results: West Balranald mine (south)	71
Figure 17. Survey results: Injection borefields overview	72
Figure 18. Survey results: Injection borefield 1.....	73
Figure 19. Survey results: Injection borefields 3 and 4	74
Figure 20. Survey results: Injection borefield 5 (north)	75
Figure 21. Survey results: Injection borefield 5 (south)	76
Figure 22. Survey results: Injection borefield 6.....	77
Figure 23. Survey results: Injection borefield 7.....	78

Figure 24. Survey results: Injection borefield 8.....	79
Figure 25. Survey results: Injection borefield 9.....	80
Figure 26. Survey results: Injection borefield 10.....	81
Figure 27. Survey Results: Gravel extraction locations overview.....	82
Figure 28. Survey results: Gravel extraction area A	83
Figure 29. Survey results: Gravel extraction area B	84
Figure 30. Survey results: Gravel extraction area C	85
Figure 31. Survey results: Accommodation facility and water supply corridor	86
Figure 32. Aboriginal heritage risk layer: overview.....	115
Figure 33. Aboriginal heritage risk: Nepean	116
Figure 34: Aboriginal heritage risk: West Balranald mine (North)	117
Figure 35: Aboriginal heritage risk: West Balranald mine (South)	118
Figure 36. Aboriginal heritage risk: Injection borefields overview.....	119
Figure 37: Aboriginal heritage risk: Injection borefield 1	120
Figure 38: Aboriginal heritage risk: Injection borefield 3 and 4	121
Figure 39: Aboriginal heritage risk: Injection borefield 5 (North)	122
Figure 40: Aboriginal heritage risk: Injection borefield 5 (South)	123
Figure 41: Aboriginal heritage risk: Injection borefield 6	124
Figure 42: Aboriginal heritage risk: Injection borefield 7	125
Figure 43: Aboriginal heritage risk: Injection borefield 8	126
Figure 44: Aboriginal heritage risk: Injection borefield 9	127
Figure 45: Aboriginal heritage risk: Injection borefield 10	128
Figure 46: Aboriginal heritage risk: Gravel extraction locations overview.....	129
Figure 47. Aboriginal heritage risk. Gravel extraction area A	130
Figure 48. Aboriginal heritage risk. Gravel extraction area B.....	131
Figure 49. Aboriginal heritage risk. Gravel extraction area C.....	132
Figure 50. Aboriginal heritage risk. Accommodation Facility and water supply pipeline	133
Figure 51. Significance of individual sites and archaeological risk layer - overview	137
Figure 52. Significance of individual sites and archaeological risk layer - Nepean	138

Figure 53. Significance of individual sites and archaeological risk layer – West Balranald (North)..... 139

Figure 54. Significance of individual sites and archaeological risk layer – West Balranald (South)..... 140

Figure 55. Significance of individual sites and archaeological risk layer – Injection borefields overview 141

Figure 56. Significance of individual sites and archaeological risk layer –Injection borefield 1 142

Figure 57. Significance of individual sites and archaeological risk layer –Injection borefield 3 and 4..... 143

Figure 58. Significance of individual sites and archaeological risk layer –Injection borefield 5 (north) 144

Figure 59. Significance of individual sites and archaeological risk layer –Injection borefield 5 (South)..... 145

Figure 60. Significance of individual sites and archaeological risk layer –Injection borefield 6 146

Figure 61. Significance of individual sites and archaeological risk layer –Injection borefield 7 147

Figure 62. Significance of individual sites and archaeological risk layer –Injection borefield 8 148

Figure 63. Significance of individual sites and archaeological risk layer –Injection borefield 9 149

Figure 64. Significance of individual sites and archaeological risk layer –Injection borefield 10 150

Figure 65. Significance of individual sites and archaeological risk layer –Gravel extraction area overview 151

Figure 66. Significance of individual sites and archaeological risk layer - Gravel extraction area A..... 152

Figure 67. Significance of individual sites and archaeological risk layer –Gravel extraction area B 153

Figure 68. Significance of individual sites and archaeological risk layer –Gravel extraction area C 154

Figure 69. Significance of individual sites and archaeological risk layer – Accomodation Facility and Water supply corridor 155

List of Tables

Table 1: Relevant SEARs for this assessment	7
Table 2: Balranald Project – Project area and disturbance area	9
Table 3: Submissions and Responses to the draft ACHA.....	24
Table 4: 2012 Fieldwork participation.....	27
Table 5: AHIMS Search Results by Land System.....	45
Table 6: Summary of local archaeological investigations.....	48
Table 7: Plant Resource Available in Project Area and associated past Aboriginal use	63
Table 8: Summary of Predicted Aboriginal Sites and Features within the Project Area	64
Table 9: Survey Coverage of project area by Land system.....	87
Table 10: Effective Survey Coverage across Project area by Landsystem.....	88
Table 11: Survey Coverage of Land systems for the Balranald Project	88
Table 12: Summary of Aboriginal Site Types within the Balranald Project Aboriginal Heritage Database.....	91
Table 13: Summary of the number of Aboriginal Sites in the Project Area by Project Element.....	91
Table 14: Land system summary for the Project Area	92
Table 15: Distance from Lakes.....	93
Table 16: Number of Hearths within the Project Area.....	100
Table 17: Number of Hearths by Land system	101
Table 18: Artefact density per ha of surveyed land system in the Balranald Project Aboriginal Heritage Database.....	103
Table 19: Raw Materials Recorded in the Balranald Project Aboriginal Heritage Database.....	106
Table 20: Percentage of Cortex of Raw Materials of Interest	107
Table 21: Artefact Types in the Balranald Project Aboriginal Heritage Database.....	107
Table 22: Core Counts and Raw Material Types in the 2014 survey program	109
Table 23: Core Dimensions from the 2014 survey program	109
Table 24: Archaeological Risk Layer	113
Table 25: Summary of area within project area that falls within each land system and archaeological risk category.....	113

Table 26: Scientific Significance Assessment for sites within the Balranald Project Aboriginal Heritage Database.....	156
Table 27: Summary of Scientific Significance Ratings by project element.....	223
Table 28. Summary of site significance per project element.	224
Table 29: Overview of potential impacts by project element.....	228
Table 30. Summary of archaeological significance and corresponding loss of value through impact across the project area	230
Table 31: Summary of Project Element Area and Percentage of Area within each Risk Layer and disturbance area.....	230
Table 32: Summary of Potential Impacts within the West Balranald Mine Project Element on Aboriginal Heritage Sites.....	232
Table 33: Summary of Type of Harm by Significance Ratings for Sites within the Injection Borefields	238
Table 34: Summary of potential impacts within the injection borefield on Aboriginal heritage sites	239
Table 35: Summary of Potential Impacts within the Nepean access road Project Element on Aboriginal Heritage Sites.....	267
Table 36. Recommended management of risk layers associated with unsurveyed area and known sites. .	279

1. Executive summary

Iluka Resources Limited (Iluka) proposes to develop a mineral sands mine in south-western New South Wales (NSW), known as the Balranald Mineral Sands Project (the Balranald Project). The Balranald Project includes construction, mining and rehabilitation of two linear mineral sand deposits, known as West Balranald and Nepean, located approximately 12 kilometres (km) and 66 km north-west of the town of Balranald, respectively.

In NSW, the Balranald Project requires development consent under Part 4, Division 4.1 of the EP&A Act. Part 4 of the EP&A Act relates to development assessment. Division 4.1 specifically relates to the assessment of development deemed to be significant to the state, known as State significant development (SSD). The Balranald Project is a mineral sands mining development which meets the requirements for SSD.

Niche Environment and Heritage has been commissioned to undertake an Aboriginal Cultural Heritage Assessment report for the SSD application for the Balranald Project. The Aboriginal Cultural Heritage Assessment report has been carried out accordance with the SEARs and with reference to the following standards, guidelines and policies:

- *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (NSW Department of Environment, Climate Change and Water [DECCW] 2010a) (the Code).
- *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (NSW Office of Environment and Heritage [OEH] 2011).
- *Draft Guidelines for Aboriginal Cultural Heritage Assessment and Community Consultation* (NSW Department of Environment and Conservation, 2005).
- *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (the ACHCRs) (DECCW 2010b).

Consultation for the Balranald Project has been undertaken in accordance with the ACHCRs as these meet the fundamental tenants of the Draft Guidelines for Aboriginal Cultural Heritage Assessment and Community Consultation (DEC 2005), while meeting current industry standards for demonstrating effective consultation with Aboriginal communities.

As a result of the above consultation, the following five organisations and persons have become Registered Aboriginal Parties (RAPs) to the Balranald Project for the purposes of the ACHCRs:

- Balranald LALC.
- Kay Dowdy (nee Murray).
- Balranald Aboriginal Health Service (BAHS), Daniel Kelly Snr representing Mutthi-Mutthi Nations.
- Ali Maher National Koorie Site Management.
- Paul Charles Kullila Site Consultants.

The cultural heritage survey for the Balranald Project EIS was conducted over three field programs between 2012 and 2014. The field programs involved a total of 535 person days of survey.

A total of 548 Aboriginal sites were identified across all archaeological investigations for the Balranald Project, including due diligence assessments and the 2012, 2013 and 2014 EIS field programs. These sites were added to the Balranald Project Aboriginal Heritage Database.

Approximately 76% of the identified Aboriginal sites (417) of these sites are located in or within 100 m of the Project Area (Table 12). 383 Aboriginal sites are located within the Project area. 256 Aboriginal sites were located within the disturbance area.

To understand the likelihood of Aboriginal objects being present within the project area an analysis of the Balranald Project Aboriginal Heritage Database was undertaken. This analysis looked at the number and density of sites and artefacts recorded and their proximity and relationship with a number of environmental proxies. Stronger associations with the presence and density of sites were noted with certain landscape features. These associations were then classified into areas of high, moderate and low archaeological risk and visualised in a GIS to form the archaeological risk layer. The archaeological risk layer has been designed to inform management and mitigation responses and suggests the likelihood of Aboriginal objects being present in the project area. Areas of moderate to high archaeological risk were identified in approximately 34.4% of the disturbance area.

An assessment of significance was undertaken for individual sites and the project area. The Project area has social significance to the Aboriginal community because it contains archaeological sites and traditional resources that establish a link between the past and present Aboriginal use of the land.

The project area contains landscapes which have high and moderate archaeological value, but for the most part contains landscapes that are of low archaeological value. The high and moderate value areas include the Box Creek distributary stream of the Lachlan River (at the northern end of the West Balranald mine) and areas of relict lake fringes and depressions associated with the northern injection borefields. These parts of the project area are significant because they may reveal important details about how and when Aboriginal people lived in this area, and how Aboriginal settlement of the area relates to, and informs what is known of Aboriginal history in adjoining areas, including the Willandra Lakes Region World Heritage Area. In particular the areas of high and moderate significance within the project area may provide a story of how people have utilised the area, and how this utilisation relates to the active and inactive phases of Box Creek's history and the episodic filling history of the lakes as the availability of water changed from the terminal Pleistocene to the present. As well as providing information about the chronology and nature of Aboriginal settlement of the region, the project area may also provide additional information on the local and regional use and distribution of resources, such as raw materials for making stone tools.

A copy of the draft Aboriginal Cultural Heritage Assessment was provided to the Registered Aboriginal Parties between 26 February 2015 and 3 March 2015. Between 28 and 34 days were provided for Registered Aboriginal Parties to provide written responses to the draft report. Comments were received from the four groups and incorporated into this document.

An impact assessment was completed for the sites and management and mitigation measures considered. As a result of the archaeological investigation and community consultation the following recommendations were made.

Aboriginal Cultural Heritage Management Plan

1. An Aboriginal Cultural Heritage Management Plan (ACHMP) should be developed for the Project.
2. The ACHMP must articulate the mitigation and management measures presented in this report for the development, operational and decommissioning stages of the Project.
3. The ACHMP should be developed in consultation with the RAPs.

4. The ACHMP must include, but not be limited to the following:
 - a) Protocols that prescribe the involvement of the RAPs in the preparation, implementation and ongoing review and maintenance of the ACHMP.
 - b) Protocols that prescribe the involvement of the RAPs in cultural heritage works conducted under the ACHMP.
 - c) Provisions for the management of culturally sensitive information.
 - d) A communications protocol that describes clear methods of communication, including expectations of suitable notification and response times, between Iluka and the RAPs.
 - e) Procedures to establish and maintain (via frequent scheduled updates) a GIS database of Aboriginal heritage sites, their boundaries, their management status and archaeological risk identified within the Project area (i.e. the Balranald Project Aboriginal Heritage Database).
 - f) A protocol for the protection, storage, management and access arrangements for (short and long-term) salvaged Aboriginal objects informed by the wishes of the RAPs.
 - g) A protocol for the discovery and management of human remains within the Project area, including stop work provisions and notification protocols.
 - h) Procedures for the management and reporting of previously unknown Aboriginal heritage sites that may be identified during the life of the Project, consistent with the management measures described in Section 14 (ie. management measures should give consideration to the site's heritage values).
 - i) Protocols for heritage awareness training to be incorporated into the mine site inductions for both employees and sub-contractors who may be conducting works within the Project area which have the potential to impact on any Aboriginal heritage site or are working in areas of moderate to high archaeological risk.
 - j) A procedure for documenting, communicating and incorporating into the ACHMP a record of authorised impacts to sites, and a record of sites avoided (through detailed design for example).
 - k) Procedures for activities when working in moderate and high archaeological risk layers, including but not limited to:
 - Constraining vehicle and people movements to defined disturbance footprints (to minimize the risk of disturbance outside of the footprints)
 - Implementation and maintenance of controls for sediment, erosion and waterflow through instruments such as the ESCP.I
 - Avoidance of known sites and areas of high risk (via , temporary fencing, signage etc)
5. Procedures for the preparation and staged implementation of the archaeological research and salvage programs (see additional recommendations in recommendations 7 and 8).
6. A regular review process for the ACHMP that:
 - a) Considers operational adequacy and efficacy.
 - b) Updates the management detail of the ACHMP as the project progresses.
 - c) Reviews the compliance of the ACHMP outcomes against the Project approval.

- d) Initiates a mechanism for amendment in accordance with the above protocols.

Additional Recommendations

7. Surface salvage collection and management of areas based on risk rating

A detailed surface salvage collection program for sites directly disturbed as a result of the Project. The scope of the surface salvage collection program will include the following (as described in Section 14.1.3).

- a) Moderate Risk Layer areas
 - Pre-impact block surface clearance and surface salvage of sites within the disturbance area - collection of all visible surface artefacts and collection of dating samples.
- b) High Risk Layer areas
 - Pre-impact block surface clearance and surface salvage of sites within the disturbance area - collection of all visible surface artefacts and collection of dating samples.
- c) Low Risk Layer areas
 - No management

Details of the surface collection program should be contained in the ACHMP.

8. Archaeological research and salvage excavation program

A detailed archaeological research and salvage excavation program for Aboriginal heritage sites and the archaeological risk layers that will be subject to surface disturbance as a result of the final footprint associated with the Project. The research and salvage program must include the detail of the proposed salvage works, including the following (as described in Section 14):

- a) Methods for accurate location recording and surface salvage collection of artefacts.
- b) Methods for accurate location recording and collection of dating samples. Methods for the undertaking of salvage excavations in

up to eight locations within the final disturbance footprint and within landforms within the moderate to high risk layer that are associated with known sites a have the greatest potential to contribute to our understanding of past Aboriginal land use in the project area (areas of research interest) and that include

- c) :
 - Exact and appropriate locations of the proposed excavations, including their nature and size;
 - Justification – both scientific and economic - of appropriate scale and scope of the works;
 - Geomorphic analysis by a qualified geomorphologist;
 - Collection of charcoal and OSL dating samples;
 - Collection of soil samples;

- Collection of artefacts and other cultural materials (if present); and
 - Reporting procedures.
- d) Details of the research and salvage program should be contained in the ACHMP as per recommendation 4.

2. Introduction

2.1 Overview

Iluka Resources Limited (Iluka) proposes to develop a mineral sands mine in south-western New South Wales (NSW), known as the Balranald Mineral Sands Project (the Balranald Project). The Balranald Project includes construction, mining and rehabilitation of two linear mineral sand deposits, known as West Balranald and Nepean, located approximately 12 kilometres (km) and 66 km north-west of the town of Balranald, respectively.

Iluka is seeking development consent under Part 4, Division 4.1 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) for the Balranald Project, broadly comprising:

- Open cut mining of the West Balranald and Nepean deposits, referred to as the West Balranald and Nepean mines, including progressive rehabilitation.
- Processing of extracted ore in the project area to produce heavy mineral concentrate (HMC) and ilmenite.
- Road transport of HMC and ilmenite from the project area to Victoria.
- Backfilling of the mine voids with overburden and tailings, including transport of by-products from the processing of HMC in Victoria back to the project area for backfilling in the mine voids.
- Return of hypersaline groundwater extracted prior to mining to its original aquifer by a network of injection borefields.
- An accommodation facility for the construction and operational workforce.
- Gravel extraction from local sources for construction requirements.
- A water supply pipeline from the Murrumbidgee River to provide fresh water during operation.

Separate approvals, are being sought for:

- The construction of a transmission line to supply power to the Balranald Project; and
- Project components located within Victoria.

2.2 Approval process

The planning approval process for the Balranald Project is complex as it requires a number of approvals in NSW and Victoria, as well as approval from the Commonwealth. In NSW, the Balranald Project requires development consent under Part 4, Division 4.1 of the EP&A Act. Part 4 of the EP&A Act relates to development assessment. Division 4.1 specifically relates to the assessment of development deemed to be significant to the state, known as State significant development (SSD). The Balranald Project is a mineral sands mining development which meets the requirements for SSD.

An application for SSD must be accompanied by an environmental impact statement (EIS), prepared in accordance with the NSW *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation).

An approval under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is required for the Balranald Project (with the exception of the transmission line which will be subject to a separate EPBC Act referral process). A separate EIS will be prepared to support an application in accordance with the requirements of Part 8 of the EPBC Act.

2.3 NSW Secretary’s environmental assessment requirements

This EIS has been prepared to address specific requirements provided in the Secretary’s environmental assessment requirements (SEARs) for the SSD application issued on 2 December 2014.

This Aboriginal Cultural Heritage Assessment report has been prepared to address specific requirements for Heritage in the SEARs.

Table 1: Relevant SEARs for this assessment

Requirement	Section addressed
An Aboriginal Cultural Heritage Assessment (including both cultural and archaeological significance) which must:	
<ul style="list-style-type: none"> Demonstrate effective consultation with Aboriginal communities in determining and assessing impacts and developing and selecting mitigation options and measures 	Section 5
<ul style="list-style-type: none"> Outline any proposed impact mitigation and management measures (including an evaluation of the effectiveness and reliability of the measures) 	Section 13, Section 14

2.4 Commonwealth requirements

The project was referred to the federal Department of Sustainability, Environment, Water, Population and Communities (SEWPaC), now the Department of the Environment, under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act). SEWPaC provided a response to the referral identifying the following key assessment requirements relevant to Aboriginal cultural heritage:

- Impacts on world heritage values of a declared World Heritage property listed under Section 12 and 15A of the [EPBC Act];
- Impacts on the national heritage values of a National Heritage place listed under section 15B and 15C of the [EPBC Act].

In addition SEWPaC identified the following requirements relevant to Aboriginal cultural heritage for consideration in an Environmental Impact Statement (EIS):

- A description of the World Heritage values and National Heritage values of any relevant World Heritage properties or National Heritage places which may be directly or indirectly impacted by the action, including but not limited to the Willandra Lakes Region World Heritage property (National Heritage place).
- A description of the research methodology used to assess impacts to World Heritage and National Heritage values and, if fieldwork was undertaken, details including: the dates the fieldwork was undertaken, the area covered, who undertook the fieldwork and the methods employed.
- Identification of the relevant Indigenous people with rights or interests in the Willandra Lakes Region, and how these people were determined as the relevant Indigenous people.
- A description of the consultation process undertaken to seek active involvement from the relevant Indigenous people with rights or interests. The department strongly encourages the use of Ask First principles and the principle of free prior informed consent when engaging with Indigenous communities.
- A detailed description and assessment of the nature and extent of all relevant impacts, including direct, indirect, facilitated and cumulative impacts at all stages of the action that the action will have or is likely to have in the short-term and long-term on:

- the World Heritage values of a declared World Heritage property listed under Sections 12 and 15A of the EPBC Act;
 - the National Heritage values of a National Heritage place listed under section 15B and 15C of the EPBC Act.
- A description of the research methodology used to assess impacts on World Heritage and National heritage values, including full details of any fieldwork undertaken.
 - Results and conclusions of research undertaken to assess the impacts of the action on the World Heritage and National heritage values of the Willandra Lakes Region, including details of consultation with the relevant Indigenous people with rights or interests in the Willandra Lakes Region.
 - A letter from any relevant Indigenous people who have been involved in a particular study, have asserted a particular view or have provided information that has influenced the findings of the assessment, confirming that they understand what has been written in the relevant parts of the EIS and agree that this is an accurate reflection of their view and/or involvement.
 - Evidence that advice from relevant Indigenous people has been taken into consideration. If you decide not to follow advice given in the interests of the protection of Indigenous heritage values, a robust justification must be provided.
 - For proposed avoidance and mitigation measures relevant to Indigenous heritage values, evidence of consultation with relevant Indigenous people with rights or interest.

2.5 Purpose of this report

Niche Environment and Heritage has been commissioned to undertake an Aboriginal Cultural Heritage Assessment report for the SSD application for the Balranald Project. The Aboriginal Cultural Heritage Assessment report has been carried out accordance with the SEARs and with reference to the following standards, guidelines and policies:

- *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (NSW Department of Environment, Climate Change and Water [DECCW] 2010a) (the Code).
- *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (NSW Office of Environment and Heritage [OEH] 2011).
- *Draft Guidelines for Aboriginal Cultural Heritage Assessment and Community Consultation* (NSW Department of Environment and Conservation, 2005).
- *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (the ACHCRs) (DECCW 2010b).

3. Site Location and Investigation Area

All development for the Balranald Project that is the subject of the SSD application is within the project area (Figure 1, Figure 2, Figure 3, Figure 4, Figure 5 and, Figure 6). The project area is approximately 9,964 ha, and includes the following key project elements:

- West Balranald and Nepean mines;
- West Balranald access road;
- Nepean access road;
- injection borefields;
- gravel extraction;
- water supply pipeline (from the Murrumbidgee River); and
- accommodation facility.

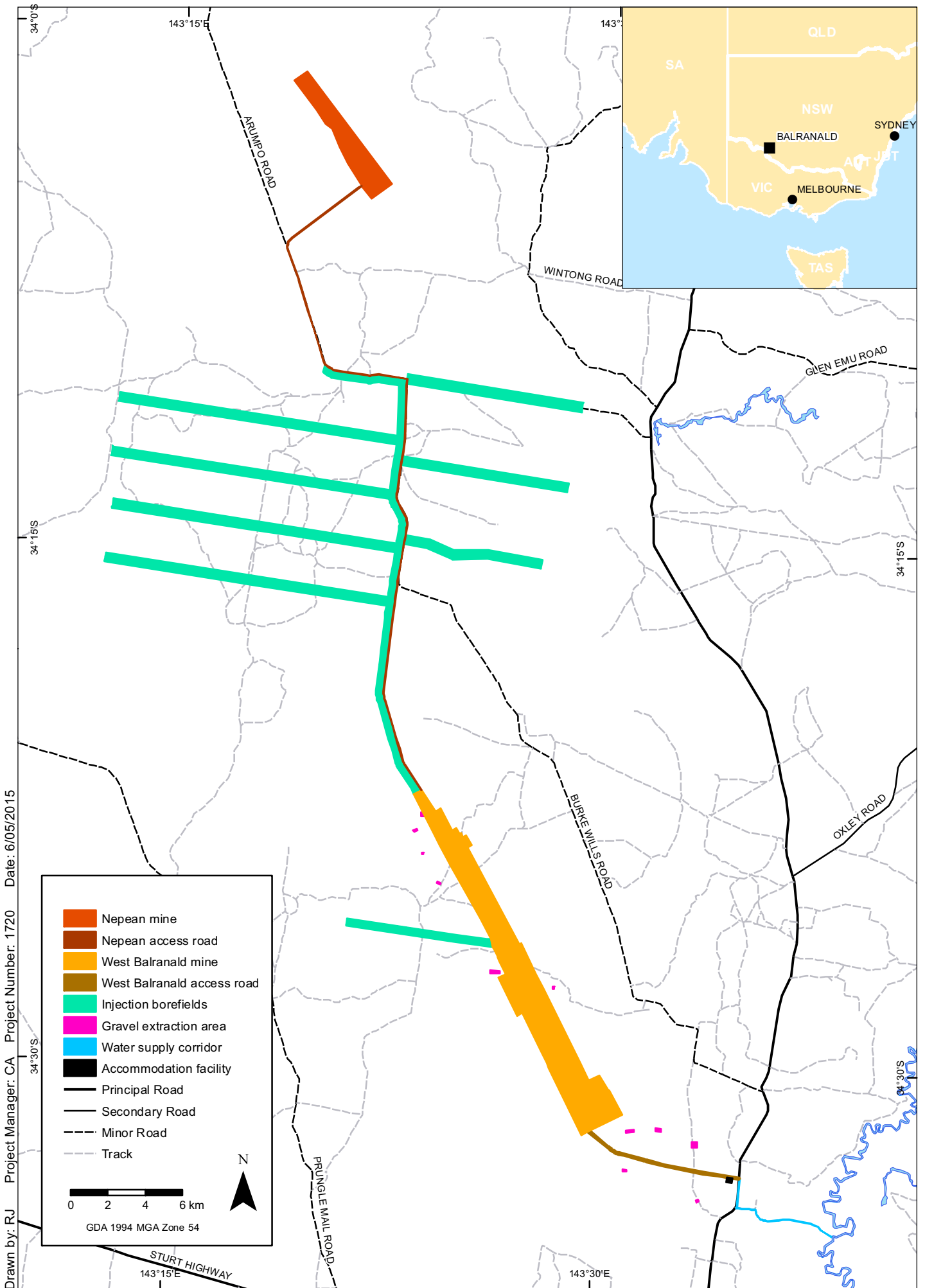
Within the project area, the land directly disturbed for the Balranald Project is referred to as the disturbance area. For some project elements in the project area, a larger area has been surveyed than would actually be disturbed. This enables some flexibility to account for changes that may occur during detailed design and operation. The project area and disturbance area for each project element are in Table 2.

In this report “project area” refers only to the land on which the key project elements are located.

Table 2: Balranald Project – Project area and disturbance area

Project element	Project area (ha)	Disturbance area (ha)
West Balranald mine	3,059	3,059
Nepean mine	805	805
West Balranald access road	128	52 ¹
Nepean access road	173	56 ²
Injection borefields	5,721	1,214 ³
Gravel extraction	42	42 ⁴
Water supply pipeline	29	11
Accommodation facility	7	7
Total	9,964	5,346

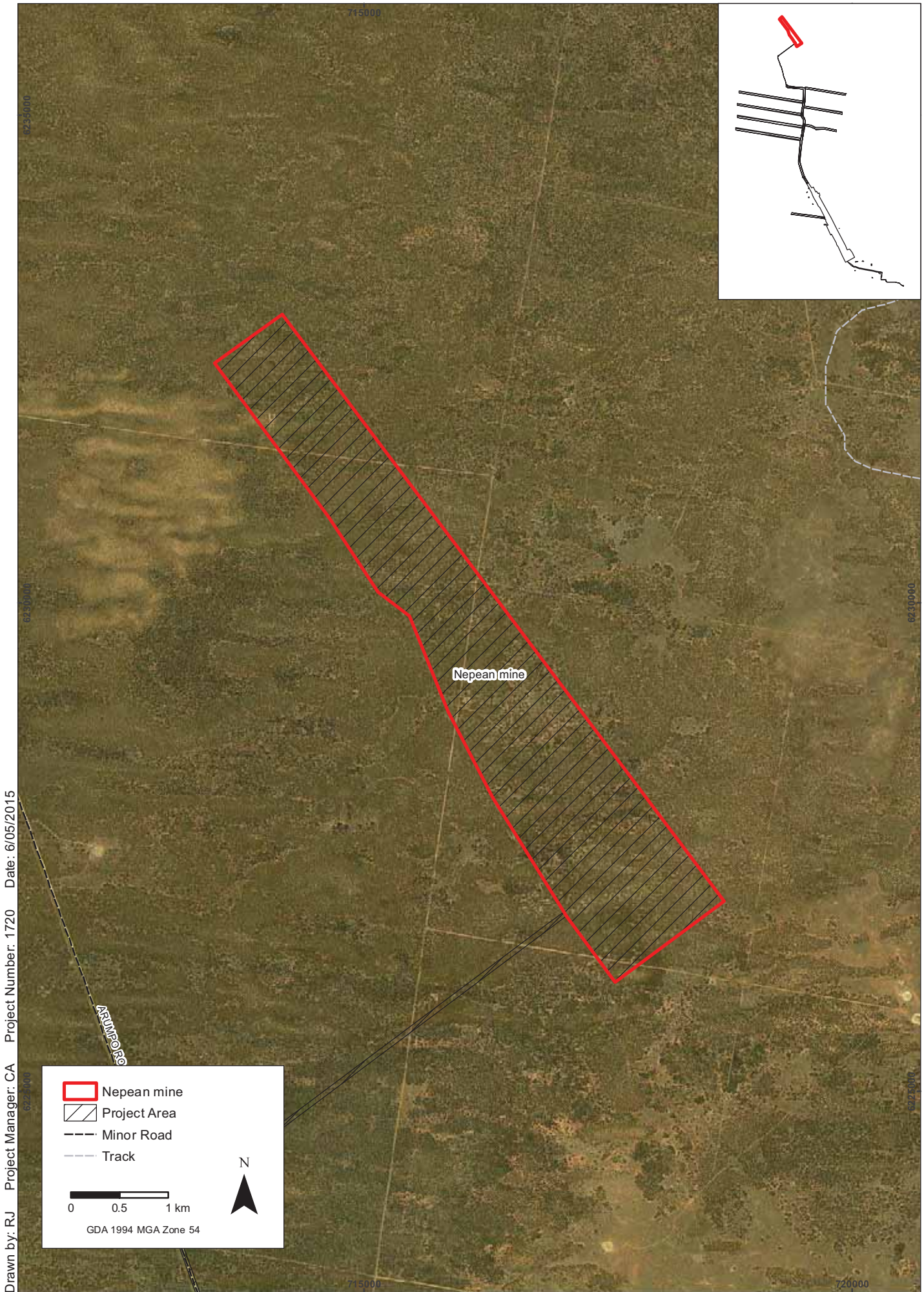
Notes: 1. 60 m wide corridor within project area
 2. 40 m wide corridor within project area
 3. 100 m wide corridors within project area
 4. 15 m wide corridor within project area



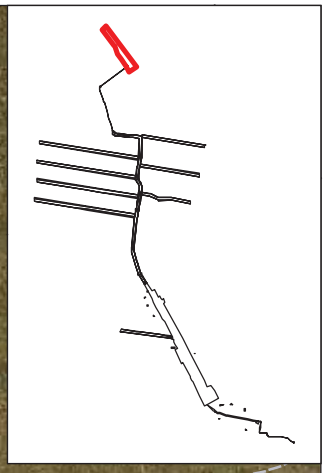
Project Area

Balranald Mineral Sands Project Aboriginal Cultural Heritage

FIGURE 1



Drawn by: RJ Project Manager: CA Project Number: 1720 Date: 6/05/2015

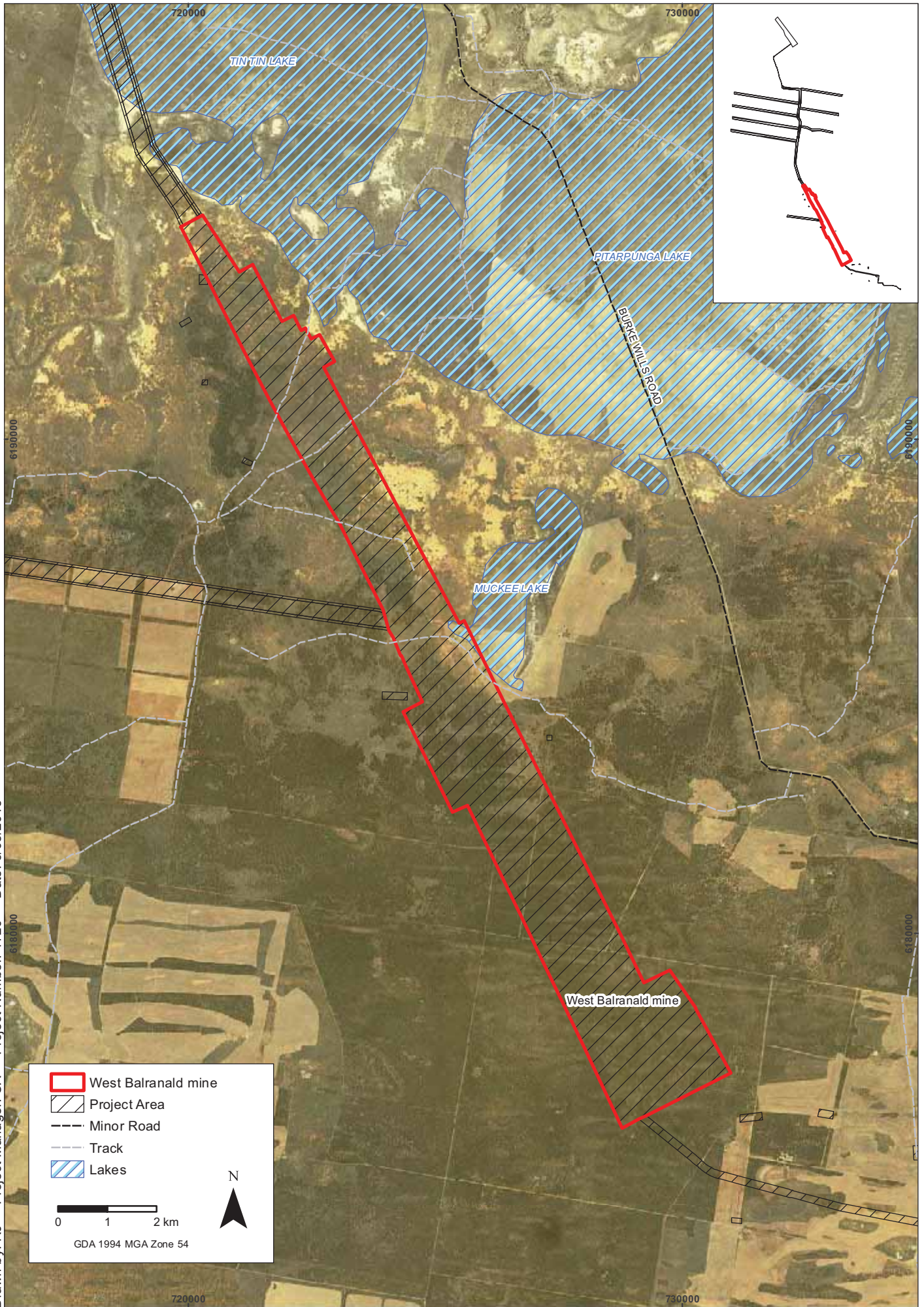


Nepean mine
Balranald Mineral Sands Project Aboriginal Cultural Heritage

FIGURE 2

Imagery: (c) Iluka

Drawn by: RJ Project Manager: CA Project Number: 1720 Date: 6/05/2015



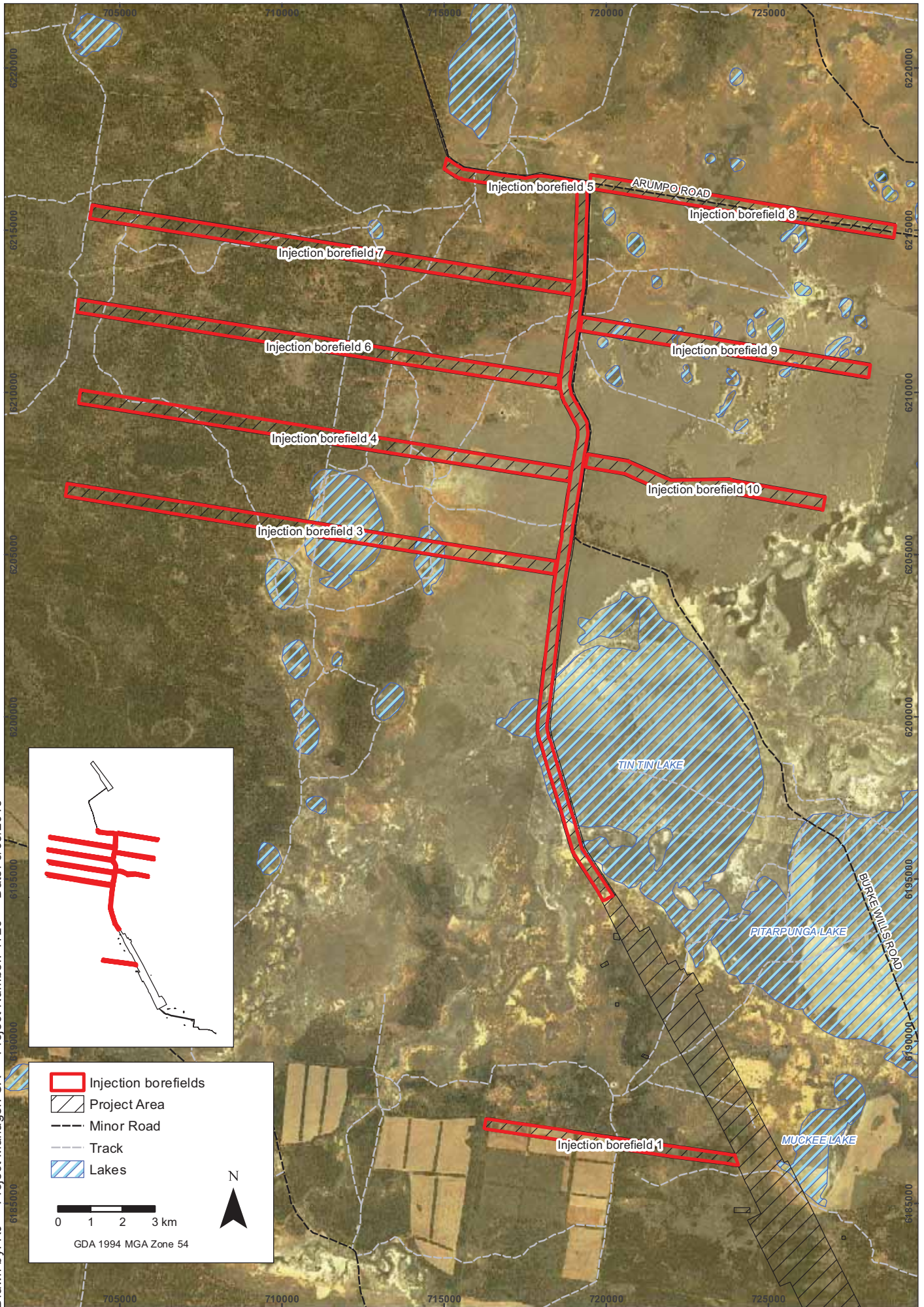
West Balranald mine

Balranald Mineral Sands Project Aboriginal Cultural Heritage

FIGURE 3

Imagery: (c) Iluka

Drawn by: RJ Project Manager: CA Project Number: 1720 Date: 6/05/2015

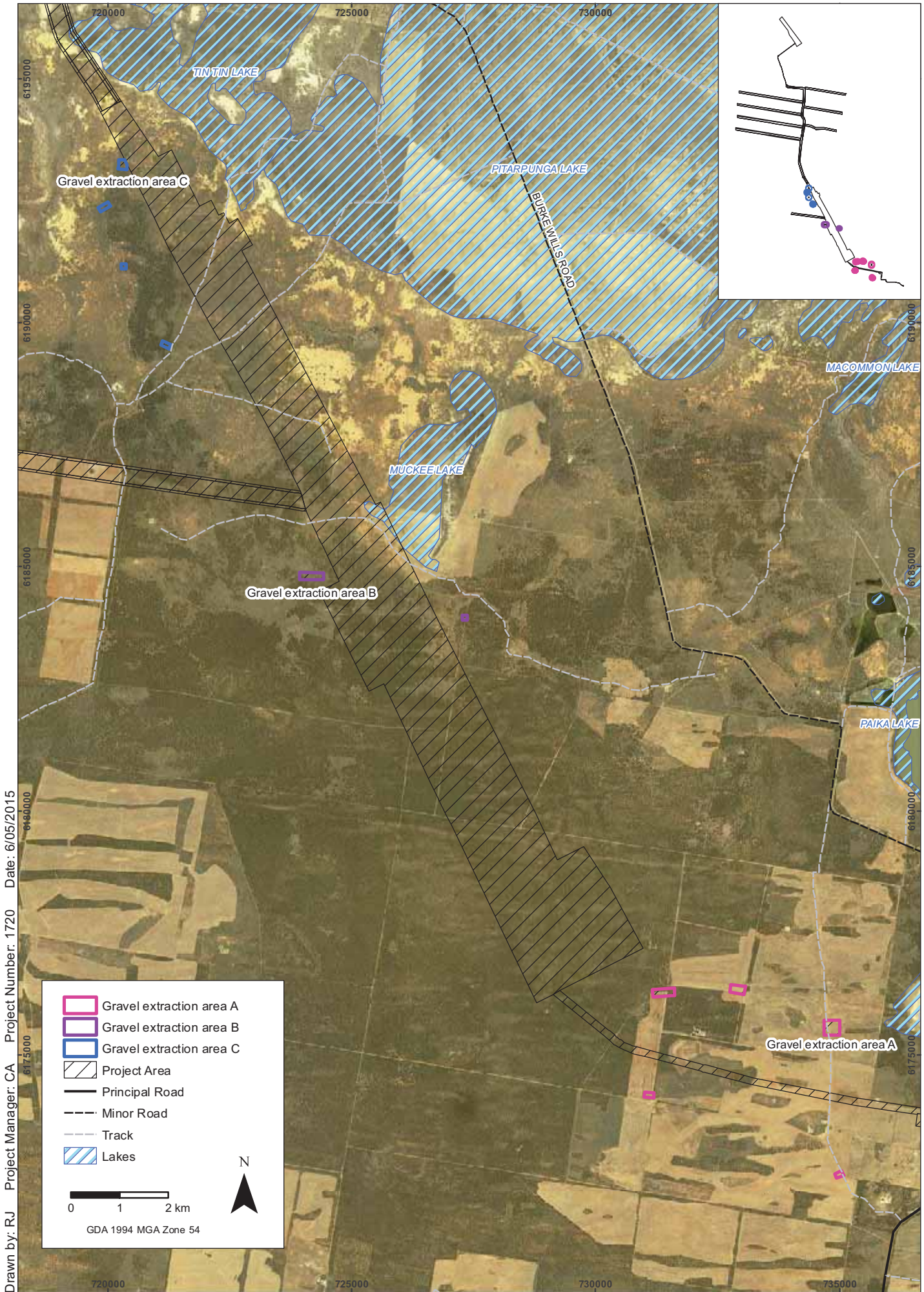


Injection borefields

Balranald Mineral Sands Project Aboriginal Cultural Heritage

FIGURE 4

Imagery: (c) Iluka



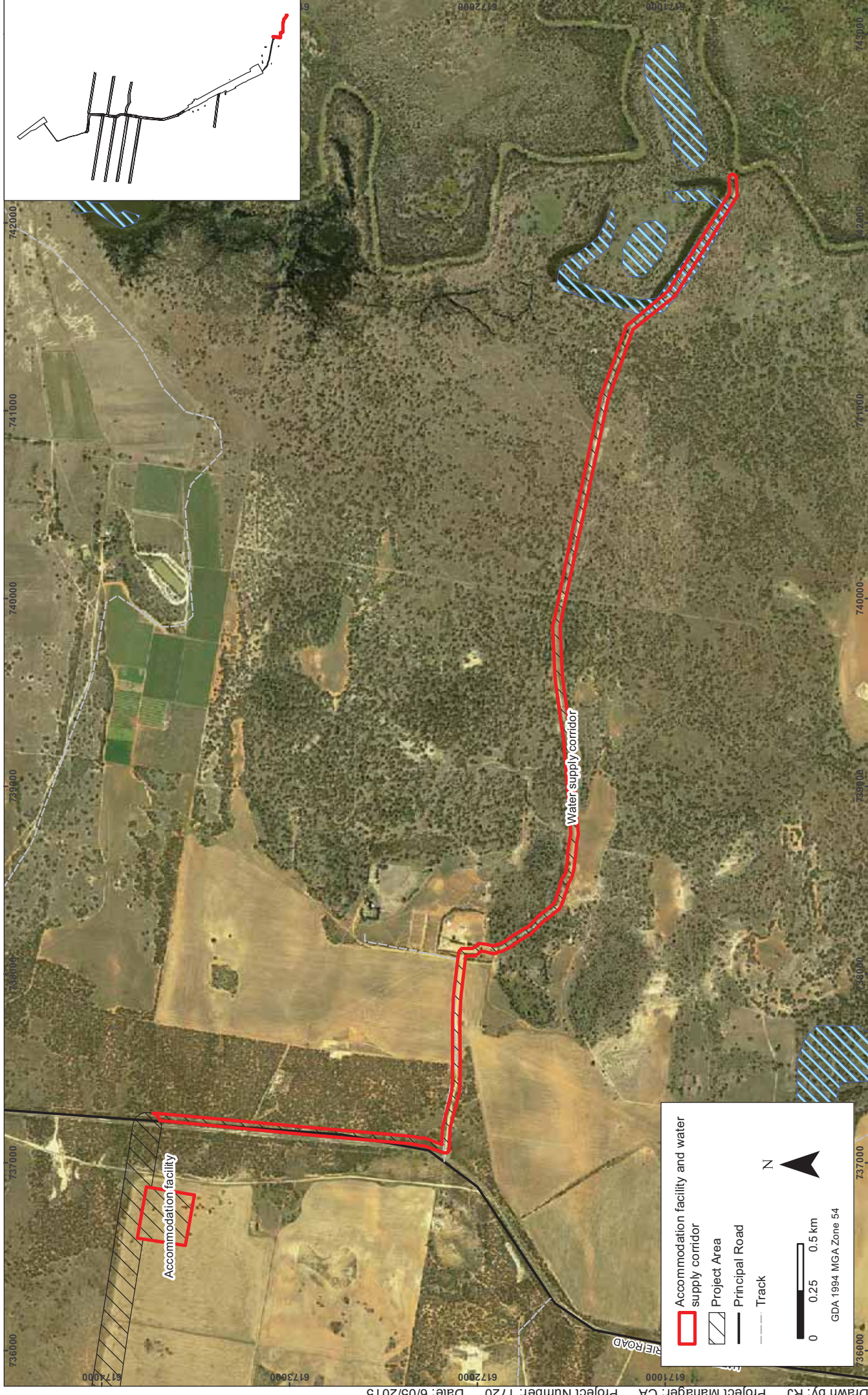
Drawn by: RJ Project Manager: CA Project Number: 1720 Date: 6/05/2015

Gravel extraction areas

Balranald Mineral Sands Project Aboriginal Cultural Heritage

FIGURE 5

Imagery: (c) Iluka



Accommodation facility and water supply corridor

Balranald Mineral Sands Project Aboriginal Cultural Heritage

FIGURE 6

Imagery: (c) Iluka

Path: T:\spatial\projects\1700\1720_Balranald\Maps\report_20150216\1720_Figure_6_WaterSupply.mxd



4. Description of the Development Proposal

4.1 Proposed Activities

The Balranald Project involves the development of mine areas and supporting infrastructure. The key project elements are described in detail below.

4.2 West Balranald and Nepean Mines

The West Balranald and Nepean mines include:

- open cut mining areas (ie pit/mine void) that would be developed using conventional dry mining methods to extract the ore;
- soil and overburden stockpiles;
- ore stockpiles and mining unit plant (MUP) locations;
- a processing area (at the West Balranald mine), including a mineral processing plant, tailings storage facility (TSF), maintenance areas and workshops, product stockpiles, truck load-out area, administration offices and amenities;
- groundwater management infrastructure, including dewatering, injection and monitoring bores and associated pumps and pipelines;
- surface water management infrastructure;
- services and utilities infrastructure (eg electricity infrastructure);
- haul roads for heavy machinery and service roads for light vehicles; and
- other ancillary equipment and infrastructure.

The location of infrastructure at the West Balranald and Nepean mines would vary over the life of the Balranald Project according to the stage of mining.

4.3 Injection borefields

The Balranald Project requires a network of injection borefields in the project area for the return of hypersaline groundwater to the Loxton Parilla Sands aquifer (Figure 4). Within each borefield, infrastructure is generally located in two 50 m wide corridors (approximately 350 m apart) and typically comprises:

- a network of pipelines with a graded windrow on either side;
- access roads for vehicle access during construction and operation;
- rows of injection wells, with wells spaced at approximately 100 m intervals; and
- a series of water storage dams to store water during well development.

4.4 Access roads

There are two primary access roads within the project area to provide access to the Balranald Project (Figure 1):

- West Balranald access road – a private access road to be constructed from the Balranald Ivanhoe Road to the West Balranald mine.
- Nepean access road – a route comprising private access roads and existing public roads. A private access road would be constructed from the southern end of the West Balranald mine to the Burke and Wills Road. The middle section of the route would be two public roads, Burke and Wills Road and Arumpo Road. A private access road would be constructed from Arumpo Road to the Nepean mine.

The West Balranald access road would be the primary access point to the project area, and would be used by heavy vehicles transporting HMC and ilmenite. The Nepean access road would primarily be used by

heavy vehicles transporting ore mined at the Nepean mine to the processing area at the West Balranald mine.

During the initial construction phase, existing access tracks through the project area from the local road network may also be used temporarily until the West Balranald and Nepean access roads and internal access roads within the project are established.

4.5 Accommodation facility

An accommodation facility would be constructed for the Balranald Project workforce. It would operate throughout the construction and operation phases of the project. It would be located adjacent to the West Balranald mine near the intersection of the West Balranald access road with the Balranald Ivanhoe Road (Figure 6).

4.6 Water supply pipeline

A water supply pipeline would be constructed to supply water from the Murrumbidgee River for operation of the Balranald Project (Figure 6).

4.7 Gravel extraction

Gravel would be required during the construction and operational phases of the Balranald Project. Local sources of gravel (borrow pits) have been included in the project area to provide gravel during the construction phase (Figure 5). During the construction phase, gravel would be required for the construction of the West Balranald access road, internal haul roads and service roads, and hardstand areas for infrastructure. Processing operations, such as crushing and screening activities (if required) would also be undertaken at the borrow pits. Gravel for the operational phase would be obtained from external sources.

4.8 Project schedule

The Balranald Project will have a life of approximately 15 years, including construction, mining, backfilling of all overburden material, rehabilitation and decommissioning.

Construction of the Balranald Project will commence at the West Balranald mine, and is expected to take about 2.5 years. Operations will commence at the West Balranald mine in Year 1 of the operational phase, which will overlap with approximately the last six months of the construction. The operational phase would include mining and associated ore extraction, processing and transport activities, and would be approximately nine years in duration. This would include completion of backfilling overburden into the pits at both the West Balranald and Nepean mines. Construction of infrastructure at the Nepean mine will commence in approximately Year 5 of the operational phase, with mining of ore starting in Year 6, and being complete by approximately Year 8.

Rehabilitation and decommissioning is expected to take a further two to five years following Year 9 of the operational phase.

5. Aboriginal Community Consultation Process

5.1 The Consultation Process

In administering its statutory functions under Part 6 of the NSW National Parks and Wildlife Act 1974 (NPW Act), the NSW OEH requires that proponents consult with Aboriginal people about the Aboriginal cultural heritage values (cultural significance) of Aboriginal objects and/or places within any given development area (DECCW, 2010b). The OEH maintains that the objective of consultation with Aboriginal communities about the cultural heritage values of Aboriginal objects and places is to ensure that Aboriginal people have the opportunity to improve Aboriginal cultural heritage assessment outcomes by:

- Providing relevant information about the cultural significance and values of Aboriginal objects and/or places.
- Influencing the design of the method to assess cultural and scientific significance of Aboriginal objects and/or places.
- Actively contributing to the development of cultural heritage management options and recommendations for any Aboriginal objects and/or places within the proposed project area.
- Commenting on draft assessment reports before they are submitted by the proponent to the OEH.

The OEH guidance document the ACHCRs (DECCW 2010a) is designed to assist proponents through the required consultation process. Consultation in the form outlined in the ACHCRs is a formal requirement where a proponent is aware that its development activity has the potential to harm Aboriginal objects or places. The OEH also recommends that these requirements be used when the certainty of harm is not yet established but a proponent has, through some formal development mechanism, been required to undertake a cultural heritage assessment to establish the potential harm a proposal may have on Aboriginal objects and places. It is one of the SEARs and SEWPaC requirements for the project to demonstrate effective consultation with Aboriginal communities in determining and assessing impacts and developing and selecting mitigation options and measures.

Consultation for the Balranald Project has been undertaken in accordance with the ACHCRs as these meet the fundamental tenants of the Draft Guidelines for Aboriginal Cultural Heritage Assessment and Community Consultation (DEC 2005), while meeting current industry standards for demonstrating effective consultation with Aboriginal communities.

The ACHCRs outline a four stage consultation process that includes detailed step-wise guidance as to the aim of the stage, how it is to proceed and what actions are necessary for it to be successfully completed. The four stages are:

- Stage 1 – Notification of project proposal and registration of interest.
- Stage 2 – Presentation of information about the proposed project.
- Stage 3 – Gathering information about the cultural significance.
- Stage 4 – Review of draft cultural heritage assessment report.

The document also outlines the roles and responsibilities of the OEH, Aboriginal Parties including Local and State Aboriginal Land Councils, and proponents throughout the consultation process. To meet the requirements of consultation it is expected that proponents will:

- Bring the registered Aboriginal parties or their nominated representatives together and be responsible for ensuring appropriate administration and management of the consultation process.
- Consider the cultural perspectives, views, knowledge and advice of the registered Aboriginal parties involved in the consultation process in assessing cultural significance and developing any heritage management outcomes for Aboriginal objects(s) and/or places(s).
- Provide evidence to the OEH of consultation by including information relevant to the cultural perspectives, views, knowledge and advice provided by the registered Aboriginal parties.
- Accurately record and clearly articulate all consultation findings in the final cultural heritage assessment report.
- Provide copies of their cultural heritage assessment report to the registered Aboriginal parties who have been consulted.

The following outlines the process and results of the consultation conducted during this assessment to ascertain and reflect the Aboriginal cultural heritage values of the project area. A summary of the consultation process and records are provided in Appendix 1.

5.1.1 Stage 1 – Notifications

In accordance with Section 4.1.2 of the ACHCRs, notifications were sent on 19 December 2011 to:

- Queanbeyan OEH Environmental Protection and Regulation Group Office, Landscape and Aboriginal Heritage Protection (South).
- Balranald Local Aboriginal Land Council (LALC).
- Office of the Registrar, *Aboriginal Land Rights Act 1983* (NSW).
- National Native Title Tribunal (NNTT) South-East & Central Registry.
- Native Title Services Corporation Limited (NTSCORP).
- Balranald Shire Council.
- Lower Murray Darling Catchment Management Authority (Lower Murray Darling CMA)¹.

The purpose of project notification was to identify potential cultural knowledge holders for the project area. Written responses were received from Balranald LALC, Lower Murray Darling CMA, NTSCORP, NNTT and the OEH.

A list of potential cultural knowledge holders was compiled from the information collected above and invited to register an interest in the project on 7 March 2012. An invitation to participate in the project was sent to the Willandra Lakes 2 Traditional Tribal Groups Elders Council on 7 March 2012. Newspaper advertisements were also published in the *Mildura Weekly* on 9 March 2012, the *Riverine Grazier* on 7 March 2012 and in *The Guardian* on 7 March 2012, in accordance with Sections 4.1 and 4.2 of the ACHCRs. The advertisements invited any additional Aboriginal parties to register an interest in the Aboriginal cultural heritage assessment for the Balranald Project.

As a result of the above consultation, the following six organisations and persons have become Registered Aboriginal Parties (RAPs) to the Balranald Project for the purposes of the ACHCRs:

- Balranald LALC.
- Kay Dowdy (nee Murray).

¹ The Lower Murray Darling CMA is now the (NSW Government) Local Land Services Western.

- Balranald Aboriginal Health Service (BAHS), Mr. Daniel Kelly Snr representing Mutthi-Mutthi Nations.
- Yarkuma Aboriginal Support Service.
- Ali Maher National Koori Site Management (National Koori Site Management).
- Paul Charles Kullila Site Consultants (Kullila Site Consultants).

A consultation log detailing all Aboriginal community consultation undertaken for the Balranald Project is provided in Appendix 1. A summary of written correspondence sent to and received from the RAPs is provided in Appendix 1.

5.1.2 Stage 2 - Presentation of Project Information and Gathering Information about Cultural Significance

Multiple stages of project information have been presented to the RAPs. Information has been presented in various formats including information sessions and letters. The following outlines the initial presentation of information to the RAPs.

Following the registration of RAPs, Iluka, in consultation with Niche, invited the RAPs to attend a project information seminar held in Balranald on the 14 June 2012 (letter dated 30 May 2012: See Appendix 1). The purpose of this seminar was to:

- Describe the project, explaining its scope and outlining the project with respect to environmental and Aboriginal cultural heritage impacts.
- Provide information regarding the Aboriginal cultural heritage assessment process including the role and responsibilities of RAPs and cultural knowledge holders.
- Describe the assessment timeframe for the completion of key assessment reports and RAP consultation.
- Provide the proposed methodology for the cultural heritage assessment for comment.
- Seek feedback from RAPs on any aspect of the Aboriginal cultural heritage assessment and engagement of potential services providers.

5.1.3 Stage 3 - Gathering Information about Cultural Significance

Following the 14 June 2012 information session, the RAPs were provided with a letter (dated 14 June 2012) inviting any feedback about the project information provided and the proposed methodology for the Aboriginal Cultural Heritage Assessment in accordance with the ACHCRs (DECCW, 2010b). Twenty-eight days were allowed for RAPs to:

- Suggest any protocols to be adopted into the information gathering process and assessment methodology.
- Highlight any other matters such as issues or areas of cultural significance that might affect, inform or refine the methodology.

Written comments on the proposed methodology were received from Mr. Daniel Kelly Snr (on behalf of the BAHS for the Mutthi Mutthi people). Appendix 1 includes a copy of the proposed methodology that was provided to the RAPs and a full copy of Mr. Kelly's comments. These comments are summarised below.

Mr. Kelly commented that:

- *Aboriginal Cultural Sites of Significance in Area of mining interest: Artefacts- Area has archaeological deposits, Middens, Culturally modified trees, Burials, and stone tools use.*

- *Aboriginal Cultural Landscape Values (EL 7450): Cultural assessments are important and that right through the mining process should be continuous working side by side as mining is a big contribution to our economy and the world.*
- *Cultural knowledge traditional and contemporary to the mining area: Some cultural knowledge is confidential as important to the Mutthi Mutthi people that can be shared with the Archaeologist Aboriginal Cultural Heritage point of view Mutthi Mutthi people to have long term association with the country should be given the upmost priority of being employed as field officer as they have cultural knowledge and keepers shared from old to the young.*
- *Additional information: That all Mutthi Mutthi persons have full participation in all aspects of cultural assessment that will be done.*

No other written comments regarding this stage of the proposed cultural heritage assessment methodology were received from the RAPs (Appendix 1). Expressions of interest to be involved in the Balranald Project's Aboriginal cultural heritage field assessment programme were received from the RAPs (Appendix 1). No response was received from Ms. Kay Dowdy.

Representatives from the following RAPs participated in the Aboriginal cultural heritage field survey:

- Balranald LALC.
- BAHS: Mutthi Mutthi people.
- National Koori Site Management.
- Kullila Site Consultants.

Balranald LALC, BAHS: Mutthi Mutthi people, National Koori Site Management and Kullila Site Consultants participated in an archaeological survey of parts of the project area in July-August 2012, September-October 2013, October and December 2014.

As part of the Stage 3 review process, Iluka in association with Niche invited all RAPs to a review of the results of the Aboriginal cultural heritage field assessment. A seminar was held in Balranald on 16 October 2012 presenting a summary of the results, how the assessment was conducted, what Aboriginal sites and objects were located and what impacts were likely to these Aboriginal sites and objects. Some verbal feedback was received from a number of RAPs representatives present at the meeting, with the main themes of discussion being:

- site avoidance where possible.
- appropriate management of any objects collected.
- the strong desire of the RAPs to remain informed and involved in the decision making processes with regard to Aboriginal cultural heritage matters (Appendix 1).

Contact was lost with Ms. Kay Dowdy from August 2012. Regular attempts were made to contact Ms. Kay Dowdy in writing and by phone but no further responses were received for the duration of the project.

On 14 November 2012, Iluka and Niche received an email from Ms. Whitney Kirby, Manager of Yarkuma Aboriginal Support Service Balranald. In this email Ms. Kirby made the following request:

I would like you to remove Yarkuma as a stakeholder for these meetings effective immediately.

In 2013, revisions to the project area resulted in a need for additional archaeological survey. A project update and invitation to participate in the archaeological survey was distributed to the RAPs. Balranald LALC, BAHS: Mutthi Mutthi people, National Koori Site Management and Kullila Site Consultants participated in the survey which was conducted from 21 October 2013 to 1 November 2013.

In 2014, further revisions to the project area resulted in a need for additional archaeological survey. A project update and invitation to participate in the archaeological survey was distributed to the RAPs. BAHS: Mutthi Mutthi people, National Koori Site Management and Kullila Site Consultants participated in the surveys which took place during:

- 1 to 18 October 2014; and,
- 8 to 20 December 2014.

Balranald LALC was able to participate in the October 2014 portion of the field season but not the December 2014 portion.

During the field program the following information was provided about cultural significance and management of sites:

- The silcrete core at UD 77 was important and should be collected.

5.1.4 Stage 4 – Review of Draft Report

A project update and invitation to attend a consultation meeting was sent to the RAPS on 27 January 2015. The consultation meeting was held on 26 February 2015. In attendance were representatives of Balranald LALC (Nanette Smith, David Edwards, Maxine Kelly), National Koori Site Management (Kyle Denazzi) and Kullila Site Consultants (Geoffery Maher). Apologies were received from BAHS: Mutthi Mutthi people (Mr. Daniel Kelly Snr). Niche Environment and Heritage presented the results of the draft Aboriginal Cultural Heritage Assessment and provided a hard copy and digital copy of the draft report to the attendees with a 28 day timeframe for written responses. The meeting included discussions on the draft management and mitigation measures.

Following from the meeting:

- A hard and digital copy of the draft ACHAR was sent to BAHS: Mutthi Mutthi people by post on 2 March 2015 with 28 days provided for written responses. In addition, a digital copy of the presentation, the draft report and a summary of the outcomes of the project meeting were emailed on the 2 March.
- A digital copy of the presentation given on the 26 February was emailed to all RAPs on the 2 March 2015;
- A hard and digital copy of the draft ACHAR, a hard copy of the presentation and a letter outlining the project timeframes were posted to Ms. Kay Dowdy on 3 March 2015 with 28 days provided for written responses;
- As requested in the meeting, additional hard copies of the ACHAR were sent to Balranald LALC to assist in communication with their members.

Follow up emails and phonecalls were made to all RAPs between 18 March and 27 March.

As a result of the above consultation process, written and verbal feedback on the draft report was provided by:

- Balranald LALC,
- BAHS: Mutthi Mutthi people,
- National Koori Site Management and
- Kullila Site Consultants.

Full copies of written responses are provided in Appendix 1. Responses to each submission received on the draft ACHA and as a result of the consultation meeting are provided in Table 3.

Table 3: Submissions and Responses to the draft ACHA

Submission Number	Date, Registered Aboriginal Party, Method	Comment on Draft ACHA	Response
1	26 February 2015, Balranald LALC, Kullila Site Consultants, National Koori Site Management, meeting discussions	<i>Aboriginal objects must stay on country and there needs to be the respectful treatment of human remains if they are found</i>	An Aboriginal Cultural Heritage Management Plan will be developed in consultation with the RAPs that includes: <ul style="list-style-type: none"> ▪ a protocol for the collection, storage and management (short and long term) of any salvaged material; ▪ a protocol for the return of salvaged materials following the completion of mining; ▪ a protocol for the discovery and management of human remains within the Project area, including stop work provisions and notification protocols; and ▪ procedures for the management and reporting of previously unknown Aboriginal heritage sites that may be identified during the life of the Project, consistent with the management measures described in Section 14 (ie. management measures should give consideration to the site’s heritage values).
2	26 February 2015, Balranald LALC, meeting discussions	<i>Involvement of elders and using the archaeology as educational tools to teach</i>	As detailed in above, an Aboriginal Cultural Heritage Management Plan will be developed in consultation with the RAPs. The plan will include a protocol for the collection, storage and management (short and long term) of any salvaged material
3	26 February 2015, Balranald LALC, meeting discussions	<i>Thanking the ancestors/welcome to country for contractors</i>	An Aboriginal Cultural Heritage Management Plan will be developed in consultation with the RAPs including protocol for heritage awareness. Iluka will also review opportunities to include welcome to country introductions across project activities.
4	27 March 2015, Balranald LALC, Written	<i>“the report indicates consultation with the Mutthi Mutthi clan and as there are descendants from other clans such as the Nari Nari and Yitti Yitti clans living in the Balranald area, representatives of these clans should have been involved in the initial consultation process. However, having said that, is it possible that consultation with the Nari Nari and Yitti Yitti clans was not required as the archaeological site work undertaken was not located within these clan areas?”</i>	Iluka has undertaken the required consultation as per the ACHRs (see Section 5 above). Balranald LALC registered and became a Registered Aboriginal Party (RAP) and has been a primary stakeholder for the duration of the project. Part of their role was to communicate the project to their members, provide information regarding any cultural significance or issues of cultural concern for the project area, nominate and select sites officers to participate in the archaeological fieldwork and have involvement in the development of the management of any Aboriginal heritage values. It is valuable that individuals who identify as Mutthi Mutthi, Ytta Yitta and Nari Nari and who have connection to the project area have now been included by the LALC in the project and have been provided with the opportunity to comment on cultural significance and management of Aboriginal heritage values within the area.

			An Aboriginal Cultural Heritage Management Plan will likely be one of the conditions of any approval for the Balranald project. The Plan will detail management of Aboriginal heritage within the project area. As one of the RAPs, Balranald LALC will be involved in the development and consultation for that document and it would be good to see the LALC to continue to facilitate the involvement of the different clan groups with a connection to the project area in this process.
5	27 March 2015, Balranald LALC, written	<i>Nanette Smith stated that when she spoke to you at the workshop on 26/2/15 it was to invite you to a members meeting to discuss the project. As previously discussed, the date of the next members meeting is in April 2015 which is after the closing date for feedback on the draft report.</i>	Iluka will not be able to attend the LALC meeting (on 22nd April) to discuss wider environmental impacts associated with the project as the EIS will not be finalised for public display. Once finalised and on display, Iluka will be undertaking consultation activities within Balranald and the wider area to present the information in the EIS and answer any questions the community may have regarding the environmental impacts of the project.
6	27 March 2015, Balranald LALC (David Edwards), telephone conversation	<i>What will happen to the ground once the ore has been removed? The ground surface and vegetation should be returned to its natural state.</i>	Iluka have prepared a Rehabilitation and Closure Strategy (EMM 2015) which details the proposed final landform and land use upon closure of the mine. This document will be available in the public display of the EIS. The proposed final landform will be safe, stable and compatible with surrounding topography.
7	27 March 2015 Balranald LALC (David Edwards), telephone conversation	<i>What are the plants in the project area? Who will look after the land management? There are members of the local Aboriginal community that are working towards land management certification.</i>	Iluka have prepared a Biodiversity Assessment (Niche Environment and Heritage 2015) which details the plants in the project area. This document will be available in the public display of the EIS. At this point in time, Iluka has not finalised the workforce requirements for the Balranald Project. Once these requirements are identified and understood, appropriately qualified persons will be considered for all positions.
8	27 March 2015, BAHS, Daniel Kelly, written	<i>that all cultural tools be stored in a safe place and returned to location once the mine ground is closed;</i>	As per Response 1 above, An Aboriginal Cultural Heritage Management Plan will be developed in consultation with the RAPs that includes: <ul style="list-style-type: none"> ▪ a protocol for the collection, storage and management (short and long term) of any salvaged material; and ▪ a protocol for the return of salvaged materials following the completion of mining.
9	27 March 2015, BAHS, Daniel Kelly, written	<i>Mutthi Mutthi field workers who assisted with cultural assessment be employed on site as care takers to look after all cultural tools & artefacts that are kept in storage until such time that the cultural tools and artefacts are return to the ground that they was taken from.</i>	At this point in time, Iluka has not finalised the workforce requirements for the Balranald Project. Once these requirements are identified and understood, appropriately qualified persons will be considered for all positions.
10	27 March 2015, BAHS, Daniel Kelly, written	<i>I recommend that care is taken at all time and that the environment and its habitat will remain a priority during the operation of the mine by Iluka</i>	Iluka have prepared a biodiversity assessment (Niche Environment and Heritage 2015) for the project area and a Rehabilitation and Closure Strategy (EMM 2015) which details the proposed final landform and land use upon closure of the mine. These documents will be available in the public display of the EIS.

			An Aboriginal Cultural Heritage Management Plan will be developed to ensure that cultural heritage aspects of the project are managed in consultation with the RAPs.
11	30 March 2015, National Koori Site Management and Kullila Site Consultants, written	<i>We accept your final draft as a true and correct report, but would like to see, Site officers employed throughout the life of the mine, to oversee that any burials sites be protected.</i>	<p>As per Response 1, an Aboriginal Cultural Heritage Management Plan will be developed in consultation with the RAPs that includes:</p> <ul style="list-style-type: none"> ▪ a protocol for the protection, storage, management and access arrangements for (short and long-term) salvaged Aboriginal objects informed by the wishes of the RAPs; ▪ a protocol for the discovery and management of human remains within the Project area, including stop work provisions and notification protocols; and ▪ procedures for the management and reporting of previously unknown Aboriginal heritage sites that may be identified during the life of the Project, consistent with the management measures described in Section 14 (ie. management measures should give consideration to the site’s heritage values). <p>At this point in time, Iluka has not finalised the workforce requirements for the Balranald Project. Once these requirements are identified and understood, appropriately qualified persons will be considered for all positions.</p>
12	30 March 2015, National Koori Site Management and Kullila Site Consultants, written	<i>Even though there were a lot of surface Artefacts, scarred trees, ovens etc., protecting our Cultural must have high importance.</i>	Agreed. As per Response 1, an Aboriginal Cultural Heritage Management Plan will be developed to ensure that cultural heritage aspects of the project are managed in consultation with the RAPs.
13	30 March 2015, National Koori Site Management and Kullila Site Consultants, written	<i>We would at some stage still like to do a small Dig, just to see what is below the ground.</i>	An Aboriginal Cultural Heritage Management Plan will be developed in consultation with the RAPs and provide detail regarding the proposed collection and salvage activities within the disturbance areas. Further details on the proposed collection and salvage activities proposed are contained in Section 14 and Section 15 (Recommendations 6, 8 and 9).
14	October 2014, National Koori Site Management and Kullila Site Consultants, field notes	<i>The silcrete core at UD 77 was important and should be collected.</i>	An Aboriginal Cultural Heritage Management Plan will be developed in consultation with the RAPs and provide detail regarding the proposed collection and salvage activities within the disturbance areas. Further details on the proposed collection and salvage activities proposed are contained in Section 14 and Section 15 (Recommendations 6, 8 and 9).

6. Investigators and Contributors

6.1 Research and Reporting

The Balranald Project Aboriginal heritage investigation occurred between 2012 and 2015. In 2012 the investigation was led by Giles Hamm (BA Hons) who has 20 years of experience as a professional archaeologist and heritage consultant. Between 2013 and 2015, the investigation was conducted and managed by Clare Anderson (BA Hons) who has seven years experience as a professional archaeologist and heritage consultant, and led by Jamie Reeves (BA Hons), who has 17 years of experience as a professional archaeologist and heritage consultant.

Report writing for the project was conducted in 2012 (culminating in a draft that was not released to the RAPs, due to changes in the project's scope), and then in 2014-2015, culminating in this draft report. This report was written by Clare Anderson and Jamie Reeves. Research, minor report writing and data management assistance was provided by Amanda Atkinson (BA, Grad Dip, 6 years experience), Clair Davey (BA Hons, 5 years experience), Dr. Nicolas Grguric (PhD, 5 years experience), Balazs Hansel (MA, 14 years experience), Jill Reid (BA Hons, 15 years experience), Fiona Leslie (BSc, BA Hons, 13 years experience), Elizabeth Foley (BA Hons, 3 years experience), and Giles Hamm (20 years experience). Mapping was produced by Dr. Ross Jenkins. Geomorphic advice was provided by Dr. Peter Mitchell of Ground Truth Consulting (Appendix 2).

6.2 Fieldwork

As described in Section 5.1.3 above, the fieldwork component of the investigation was completed over three years, with fieldwork programs in 2012, 2013 and 2014. Table 4, list the individuals who contributed to the fieldwork program in various capacities.

Table 4: 2012 Fieldwork participation

Contributor	Affiliation	Role
2012 field program		
Rhys Kelly	BAHS	Survey Field Officer
Danny Kelly Jnr	BAHS	Survey Field Officer
Jason Kelly	BAHS	Survey Field Officer
Ryan Brunton	BAHS	Survey Field Officer
Claude Jackson	Balranald LALC	Survey Field Officer
Ray Murray	Balranald LALC	Survey Field Officer
Ron Murray	Balranald LALC	Survey Field Officer
Willie Murray	Balranald LALC	Survey Field Officer
Dave Williams	Balranald LALC	Survey Field Officer
Henry Charles	Kullila Site Consultants	Survey Field Officer
Steve Kirby	National Koori Site Management	Survey Field Officer
Shaun Adams	Niche	Field Archaeologist
Clare Anderson	Niche	Field Archaeologist
Amanda Atkinson	Niche	Field Archaeologist
Liz Foley	Niche	Field Archaeologist
Giles Hamm	Niche	Field Archaeologist / Team Leader

Contributor	Affiliation	Role
2013 field program		
Rhys Kelly	BAHS	Survey Field Officer
Ryan Bruton	BAHS	Survey Field Officer
Ray Murray	Balranald LALC	Survey Field Officer
Ron Murray	Balranald LALC	Survey Field Officer
Lesley Anderson	Kullila Site Consultants	Survey Field Officer
Ali Maher	National Koori Site Management	Survey Field Officer
Bernadette Allen	Niche	Field Archaeologist
Clare Anderson	Niche	Field Archaeologist / Team Leader
Amanda Atkinson	Niche	Field Archaeologist / Team Leader
Phil Roberts	Niche	Field Archaeologist
2014 field programs		
Rhys Kelly	BAHS	Survey Field Officer
Ryan Bruton	BAHS	Survey Field Officer
Tara Bruton	BAHS	Survey Field Officer
Emily Bruton	BAHS	Survey Field Officer
Paige Bruton	BAHS	Survey Field Officer
Danny Kelly Jnr.	BAHS	Survey Field Officer
Marcus Murray	Balranald LALC	Survey Field Officer
Ron Murray	Balranald LALC	Survey Field Officer
Stephen Kirby	Kullila Site Consultants	Survey Field Officer
Kyle Denazzi	Kullila Site Consultants	Survey Field Officer
Ali Maher	National Koori Site Management	Survey Field Officer
Thomas Dwyer	National Koori Site Management	Survey Field Officer
Dylan	National Koori Site Management	Survey Field Officer
Kane Marr	National Koori Site Management	Survey Field Officer
Clare Anderson	Niche	Field Archaeologist / Team Leader
Amanda Atkinson	Niche	Field Archaeologist / Team Leader
Katie Beu	Niche	Field Archaeologist
Joe Borg	Niche	Field Archaeologist
Clair Davey	Niche	Field Archaeologist
Nicolas Grguric	Niche	Field Archaeologist
Balazs Hansel	Niche	Field Archaeologist / Team Leader
Sharon Lane	Niche	Field Archaeologist
Georgia Roberts	Niche	Field Archaeologist
Bianca Petruzelli	Niche	Field Archaeologist
Jeff Hutton	Iluka	Logistics/Support

7. Landscape Context

Understanding the past and present environmental contexts of an area is requisite in any Aboriginal archaeological and cultural heritage investigation (DECCW 2010a). The nature and distribution of Aboriginal archaeological sites are closely related to the environmental context because the environmental context will have affected when and how Aboriginal people used landscapes in the past, and will also affect how the material remains of past Aboriginal land use are preserved in the archaeological record.

This section provides a broad overview of the environmental setting of the project area, before describing each of the land systems (based on Land Systems of Western New South Wales) that are contained within it (NSW Soil Conservation Service 1991). Land systems, when considered with the levels of past land use and modification, are a useful tool in identifying environmental proxies for the likely preservation and burial of Aboriginal objects in a landscape, and resources that may have been available to Aboriginal people in the past; such as the presence of water, stone for the manufacture of stone tools and distribution of plant and animal species.

7.1 Overview

The present-day climate of the project area is semi-arid. Climate data retrieved from the Bureau of Meteorology's records of the Balranald weather station, approximately 12 km south of the project area, from 1879 to 2011 show an average maximum day-time temperatures in January of 33°C, with an average minimum temperature in July 15.7°C. Average monthly rainfall ranges between 22.1 mm to 31.5 mm and is consistent throughout the year (averaging approximately 325 mm per annum), however the project area has high evaporation rates, with the monthly average evaporation exceeding the monthly average rainfall (http://reg.bom.gov.au/climate/averages/tables/cw_049002.shtml). While a combination of the presence of seasonal resources and water and the non-utilitarian aspects of life—attending ceremonies for example—will determine where and how people used a landscape, the present local climate which has been stable for 5,000 years will have been suitable for year round settlement by Aboriginal people in the past.

The project area is located within the Murray Basin, an extensive intra-cratonic sedimentary basin around 60 million years old. It is overlain with consolidated sand, silt, clay and lime rich sediments formed by marine, deltaic, fluvial and aeolian depositional environments. The Murray Darling Depression Bioregion of the Interim Biogeographic Regionalisation of Australia (IBRA) accounts for approximately 80% of the project area and the Riverina (Murray Riverine Plains) Bioregion accounts for approximately 20% of the project area (OEH 2012). The project area consists of a series of dune fields and sand plains vegetated by mallee communities, and also contains brown soil undulating plains usually vegetated by saltbush, bluebush, belah and rosewood communities. Also present in the project area are swamp depressions and ephemeral small lakes, and a system of a series of large relict lakes and fringing lunette formations.

7.2 Paleo-environments

In order to understand Aboriginal archaeological site distribution in the past, it is important to understand the environment that existed at the time the sites were formed and how the sites will have been affected by the evolution of landforms. These landscape development processes may have been on-going for many thousands of years and may have changed depending on climatic and geological events. The Willandra Lakes Region World Heritage Area (WLRWHA), at the closest point located approximately 15 km west of the project area, derives its significance from the fact that it preserves fragments of past landforms and an archaeological record of human activity within them (Figure 7). Within the project area there are also landforms that have formed in the Pleistocene time period (approximately 2.5 million to 12,000 years ago) and the Holocene (approximately 12,000 years ago to the present) period. Therefore it is of relevance to

the Balranald Project to understand as far as possible the landscape formation of the last 50,000 years—from the late Pleistocene to the current times—when Aboriginal people were occupying the landscape.

7.3 Pleistocene Landscape

Relict landforms from the Pleistocene and early Holocene are archaeologically and culturally important as they have been shown to preserve evidence of very ancient Aboriginal occupation. Pleistocene relict landforms are found in the vicinity of the northern half of the West Balranald mine area near Muckee Lake, Tin Tin Lake and Pitarpunga Lake, while it is highly likely that Pleistocene relict landforms may also be present in some parts of the injection borefields.

The geological history of the Murray Basin has been detailed by Pels (1969), Lawrence (1976) and Brown and Stephenson (1991). The work of geomorphologist Jim Bowler (Bowler 1971, 1976, 1998, Bowler et al 1970, Bowler and Magee 1978, Bowler et al 2012) in particular has led to a detailed understanding concerning the development and history of the lakes. His main work concerns the geomorphic development of the Willandra Lakes system (located approximately 32 km from the West Balranald mine and 19 km from the Nepean mine) and how that relates to past human occupation across the Murray Darling drainage basin. Bowler’s findings show that:

- In the Willandra chain of inter-connected basins, a response to any particular climatic effect involving change in the hydrologic balance will be expressed differently across different basins in the same region. Responses will vary between basins, depending on shape, size and especially position in the drainage chain.
- Basins close to catchments will retain much more water for longer periods than those in more distant regions further down the chain. Basins close to uplands, regions of most available water, or supplied by major rivers remained full even under conditions of glacial maximum aridity (c.27,000–19,000 years ago).
- As an inter-connected but descending basin chain, the Willandra Lakes can be explained by a ‘stairway’ analogy, in which relative positions impose limitations on hydrologic behaviour.

Bowler’s work at Lake Mungo, within the Willandra chain of lakes, was critical in the understanding of the age and stratigraphic relationship between palaeo-environmental conditions, especially in the last 80,000–15,000 years across the Willandra Lakes system and key Aboriginal occupation events during the Pleistocene.

While there have been decades of research effort into understanding the landscape history of the Lake Mungo area, there have been no previous studies conducted on the Pleistocene landscapes within or in the immediate vicinity of the project area. This makes it difficult to understand in detail the availability and nature of resources such as water, plant and animal species over time. The Riverina bioregion includes the alluvial fans of the Murrumbidgee and Lachlan Rivers. The discharge of these systems during the late Pleistocene was thought to have flowed up to eight times the volume of its current regime (Mitchell 1991, Appendix 2). Longitudinal, east-west orientated sand dunes and sandplains along the western edge of the Lachlan fan are thought to have been active around 30,000 years ago (Mitchell 1991, Appendix 2).

Kellet (1989) in Balranald Mineral Sands Project - Water Assessment (EMM 2015) suggests that there was extensive groundwater discharge into the ancient lake systems to the north of Balranald during the Pleistocene. These patterns are not seen today and it is thought that increasing aridity into the mid Holocene resulted in the declining of the groundwater table to a depth where groundwater did not

discharge onto the surface. Studies of lakes within the Willandra lakes and creek system to the north and west of the project area demonstrate a correlation between the changing climate from the Pleistocene to the Holocene, with aridity increasing to the mid-Holocene (approximately 5,000 years ago), at which point the system reaches its current semi-arid status, the climate becoming essentially what it is like today. Changes in the availability of water have also been demonstrated in the archaeological record of Aboriginal use of the Willandra Lakes landscape. The changes in the climate and hydrology that may have effected how and where Aboriginal people used the landscape in the past would have included changes in precipitation (frequency and amount of rainfall) and also channel switching of the Lachlan River further upstream.

7.4 The Holocene Landscape

In the vicinity of the project area, the most dominant Holocene landforms are the linear dune field systems and ephemeral creeks and channels such as Box Creek. Geomorphic work by Bowler and Magee (1978) has described the broad Holocene geomorphic landscape of the Mallee region which includes parts of the project area. Dating of buried soils has shown that this dune system was last active approximately 15,000 years ago (Bowler and Polach 1971).

Holocene stream deposition and activity is comparatively less well understood in the vicinity of the project area and it is likely that Box Creek, which crosses the project area to the north of the West Balranald mine, has not been active in terms of flood deposition for quite some time. Box Creek is an ephemeral watercourse that branches off from the Lachlan River approximately 200 km upstream (north-east) of the project area. It cuts through the north-west corner of the West Balranald mine. Its flow regime is dependent on major flood events in the Lachlan River, as it not fed by local run-off because of the area's low gradients, low rainfall and generally permeable soils. South of Tin Tin and Pitarpunga Lakes, Box Creek is little more than a shallow depression covered in old man saltbush. The creek channel lacks deep waterholes or definite channel incision especially where it crosses the project area (comprising the haul road) to the north of the West Balranald mine (Appendix 1).

In the vicinity of the project area, local drainage is poorly defined with the exception of Muckee, Pitarpunga and Tin Tin lakes, and Box Creek downstream of the confluence with Arumpo Creek. Topography within the project area is typically very flat, with little relief, particularly at the West Balranald mine. Identifying local drainage catchments and flowpaths is complicated due to the dunal landforms, which result in numerous small depression storages and small dry lakes. Under existing conditions it is likely that any runoff from the project area would drain via shallow overland sheet flow, before being captured by the dry lakes or depressions evident in the topography (Figure 9). In the past have filled Anecdotal evidence from local landowners suggests that Box Creek has flowed in 1956, the 1970s and in 2010/11 regional flood events, with the 1956 flood large enough to cause Tin Tin Lake to fill and overflow (WRM 2015). Some larger depressions were anecdotally reported to have held floodwater for eight months (WRM 2015) Flood mapping shows a number of low points and terminal lakes in the project area (Figure 8) (WRM 2015). When filled with water in the past these low points will have served as resource rich locations in the project area that are likely to have been exploited by Aboriginal people in the past, and hence these areas are likely to preserve comparatively large and dense (compared to the continuous background distribution of artefacts) archaeological sites containing stone artefacts, hearths and possibly midden material.

From this Holocene overview, it appears that the development of linear dunes landforms did vary in the Holocene period and that certain dune landforms were more active at certain times corresponding to

variations in regional climatic conditions. Furthermore, water is likely to have been periodically available over time.

7.4.1 Digital Elevation Model

The digital elevation model for the project area is presented in Figure 9 and provides a visual aid to interpreting the current terrain within the project area. Dunes, swales, lunettes, plains and drainage lines are clearly visible. Areas of white indicate elevated land and often represent linear and parabolic dunes while darker areas indicate plains, swales, drainage lines, depressions and dry lakes at lower elevations. The Digital Elevation Model demonstrates numerous phases of landscape formation and a complicated water regime history.

7.4.2 Land systems

Based on land system mapping compiled in “Land Systems of Western New South Wales” (Soil Conservation Service of NSW 1991), ten local land systems have been identified within the project area (Figure 10). These are: Arumpo; Bulgamurra; Condulpe; Guthul; Hatfield; Marma; Rata; Riverland; Wilkurra and Youhl (Soil Conservation Service of NSW 1991). The land systems, when considered with the levels of past land use and modification, are a useful tool in identifying environmental proxies for the likely preservation and burial of Aboriginal objects in a landscape and resources that may have been available to Aboriginal people in the past, such as the presence of water and the vegetation resources. A description of the land systems represented in the project area is provided below.

Arumpo

The Arumpo land system can be found in the Nepean mine and nearby haul road, accounting for the majority of the area of these project components. It is characterised by parallel dunes and sand plain with narrow calcareous swales. Long linear dunes of reworked Aeolian material trend east to west with narrow swales and flats and merge into level sand plains. The dunes typically comprise deep brownish sands while the dune swales comprise highly calcareous solonised brown soils and texture contrast soils. The sandplains comprise solonised brown soils and calcareous red earths. The dunes are often characterised by dense mallee and variable porcupine grass, the swales by belah, rosewood and inedible shrubs. Erosion typically encountered in the Arumpo land system is minor to moderate wind sheeting and drift. An example is shown in Plate 1.



Plate 1: Example of an Arumpo swale

Bulgamurra

This land system accounts for only a very small part of the project area. Examples of the Bulgamurra land system can be found in the haul road, south of the Nepean mine. It is characterised by extensive undulating

sand plain with dunes and open calcareous flats with occasional, scattered depressions and swamps up to 500 m in diameter. The slightly undulating sand plain comprises Aeolian material with areas of east-west trending dunes and rises. Relief in the land system may be up to 6 m. The sandplain typically comprises of solonized brown soils with clumps of belah, rosewood, scattered Wilga and neila; the dunes of deep brownish sands with white cypress pine or mallee and porcupine grass; areas of edible and inedible shrubs, variable speargrass, copper burrs and forbs (Plate 2 and Plate 3).. The depressions are of grey cracking clays with fringing black box. Erosion in the Bulgamurra land system typically involves minor to moderate wind sheeting and drift.



Plate 2: Example of sandplains within the Bulgamurra land system



Plate 3: Example of a sandplain with dunes in the Bulgamurra land system

Condoulpe

The Condoulpe land system accounts for the southern half of the West Balranald mine and can be found in parts in the borefield, gravel extraction areas and access roads. It is a sand plain between dune fields and the Riverine Plain near Balranald (Plate 4). The sand plain comprises Aeolian material with large areas of east-west trending dunes of up to 5 m relief; open flats and terminal drainage basins which are locally depressed to 2m. The plain and flats are predominately solonized soils with areas of red earths; dunes are of a deep brownish sands. These areas typically contain generally dense to scattered belah and mallee with areas of dense edible chenopods. Drainage basins consist of grey cracking clays with vegetation consisting of dense black box with spear grass, annual saltbush and forbs.



Plate 4: Example of the Condoulpe land system with dunes

Gulthul

The Gulthul land system can be found in the borefield west of the West Balranald mine, and the injection borefields between the West Balranald and Nepean mines. This land system is characterised as an extensive plain between the Darling and Murrumbidgee Rivers. It consists of an extensive calcareous quaternary sand plain with scattered low dunes with relief of up to 7 m, flats and sinks. The plains comprise highly calcareous solonized brown soils often with exposed kunkar, travertine or limestone while the dunes comprise dunes of red calcareous sands and brownish sands. Moderately dense mallee, scattered to clumped belah; dense edible saltbushes and bluebushes occur on the plain with areas of dense inedible shrubs and porcupine grass occurring on the dunes (Plate 5). Flats and sinks in the land system comprise red texture contrast soils and grey cracking clays, often fringed by mallee and belah, scattered dillion bush and variable speargrass and forbs. Minor windsheeting erosion occurs on the plain.



Plate 5: Example of the Gulthul land system

Hatfield

Examples of the Hatfield land system are present in the West Balranald mine and the injection borefields (Plate 6). The Hatfield land system is characterised by extensive undulating plains of Quaternary Aeolian material with east west trending dunes and depressions of fine texture alluvium up to 500 m wide. The plains typically comprise solonized brown soils, red brown texture contrast soils and red earths scattered with clumps of rosewood and belah; moderately dense bluebushes and bladder saltbush; the dunes comprise of deep brownish sands with clumps of white cypress pine, prickly wattle and bluebushes. The depressions consist of grey clays with nitre goosefoot, dillion bush and canegrass. There is moderate scalding erosion across the plain.



Plate 6: Example of the Hatfield land system with low dunes, scalds and flats

Marma

The Marma land system occurs in the West Balranald mine and the injection borefields and is characterised by ill-defined scalded drainage tracts associated with the Riverine Plain. Severely scalded levees with relief up to 5 m associated with swamps, pans and lunettes are present (Plate 7). The associated floodplain comprises fine textured quaternary alluvium. Sand plains of Aeolian material may also be present. The levees comprise red and yellow textured contrast soils and grey clacking clays, the sand plains and lunettes of brown solonised soils and the floodplains and grey cracking clays. Scattered to dense bluebush, bladder saltbush and old man saltbush, canegrass and abundant forbs copperburrs may be present. Severe scalding and windsheeting erosion occurs within the land system.



Plate 7: Example of a lake basin depression looking towards a lunette in the Marma land system

Rata

The Rata land system can be found in the northern part of the West Balranald mine, and in the borefields. It is characterised by extensive relict floodplain of grey fine textured Quaternary alluvium with small shallow sub-circular depressions up to 500m wide and with relief of 2 m. Isolated low rises of coarse textured Aeolian material also occur within the land system (Plate 8). The plain consists of grey cracking clays and compact clays with dense stands of bladder saltbush; canegrass and nitre, belah and rosewood on sandy rises, abundant annual saltbushes, copperburrs, annual forbs and greases.



Plate 8: Example of a low, coarse textured rise in a floodplain within the Rata land system

Wilkurra

The Wilkurra land system occurs within a small part of the Nepean Mine and is characterised by level sandplains of Quaternary aeolian material with isolated dunes and rises trending east west with relief to 5 m . Small level swales and flats are present. These plains and flats consist of highly calcareous solonized brown soils while the dunes consist of deep brownish sands. Uniformly dense stands of belah, rosewood, scattered mulga, wilga and inedible shrubs occur in the land system with white cypress pine on sandy occurring on sandy rises and variable spear grasses copperburrs and forbs.

Youhl

The Youhl system can be found in the access road between the West Balranald and Nepean mines, and is characterised by relict lakes adjacent the Riverine plain (Plate 9). The lakes consist of kidney-shaped to sub-circular depressions of fine textured Quaternary alluvium up to 10 km in diameter. Remnant lunettes are present on the eastern margins of the lakes and depressions with relief of up to 5 m. Sandy rises may also be associated with the relict lakes. The lakebeds consist of grey cracking clays and red textured contrast soils, the lunettes of saline or compact clays or calcareous red earths. The lake beds are typically treeless with dense bladder saltbush, blue bush and scattered nitre bush, goosefoot. Scattered bluebush and perennial grasses, copperburrs occur on the lunettes and sandy rises. Erosion in the land system is characterised by severe scalding on the lake beds and gullyng and rilling of the lunettes.



Plate 9: Example of the Youhl land system

Riverland

The water supply corridor crosses the Riverland land system. This land system consists of a floodplain of fine textured Quaternary alluvium (Plate 10). Land units within the system include perennial channels and back channels, billabongs, levees and river side lunettes (source bordering dunes). Vegetation in the Riverland system includes river red gum, black box, river cooba, lignum and abundant grasses and forbs. Scalding levees and lunettes and gullyng of riverside banks are the major forms of erosion.



Plate 10: Example of flooded Riverland land system

7.4.3 Disturbance and Modification

European pastoralism and settlement in the region had an impact on the geomorphology of the landscape within the project area. Sheep and cattle grazing is thought to have begun in the project area in the 1840s, with George Hobler squatting at Paika Station in 1846. The Paika property was subsequently cleared and utilised for grazing.

Elsewhere in the project area, on Tin Tin and Karra pastoral stations, the land was originally grazed and clearing only occurred around the river flats and creek margins. Pastoral use of the 'back blocks' (the unwatered saltbush and mallee plains inland from the rivers) was by necessity limited during the early years. It was not until such time as dams or wells could be put in that these areas became suitable for permanent occupation. This began to occur in the mid-1850s. Dams were used before wells, and were sometimes built by Chinese workers who were plentiful and cheap, and had originally come to Australia during the gold rush of the early 1850s. Wells began to replace dams after 1860, and wire fences arrived (Feldtmann 1976: 16, 100). Prior to the availability of fencing wire, it was only practical to fence the yards close to the stations and huts using post and rail fences which were relatively slow and labour-intensive to construct. Control of the flocks and herds prior to wire fencing was purely done by shepherds and stockmen.

Extensive areas of the mallee have been cleared over the years by pastoralists. One method adopted was to make a roller out of a hollow box wood log approximately 8 feet long (2.4m) and drawn by 12 to 15 bullocks. This could flatten between five and ten acres a day. The flattened mallee was then left for a month or two before being burnt (Feldtmann 1976: 100). Clearing like this has significantly altered the environment in parts of the project area, increasing erosion and affecting the surface hydrology of the area. This in turn can have a detrimental effect on archaeological site visibility and integrity.

Sheep grazing has had considerable impact on local loamy soils especially within the saltbush plains landform with some scalds and clay pans expanding as a result of this sheet erosion.

The period from the 1890s up until federation (1901) saw a dramatic toll taken on the landscape in the area. Initially there was a devastating drought in the 1890s. This was followed by the arrival of rabbits. As rabbits made their way into the back country towards the end of the 19th century, the efforts to eradicate them included Aboriginal workers. Often these would be women, who used their traditional digging sticks as clubs (NSW NPWS 2014: 27). Compounding these damaging factors, falling wool prices from the 1880s

onwards were offset by increasing the number of sheep on pastures. Throughout the region, large areas of saltbush which had been destroyed from the effects of drought and overstocking never recovered. Overstocking resulted in the native vegetation being eaten out and the fragile soils ground to dust (NSW NPWS 2014: 29). Coupled with low rainfall and wind, erosion occurred on a much greater scale than would have occurred through nature alone. Some areas within the project area have also been ploughed for crops. Where this has occurred, all archaeological integrity of the topsoil would have been destroyed.

With the introduction of cropping for cereals in the 1950s the alluvial floodplain land and lake beds were disc ploughed. Some tree clearing did occur for railway sleeper cutting. Sheep and cattle grazing and cropping for oats, wheat and barley were the main land-use activities on Tin Tin and Karra stations. Some invasive woody weeds have taken over parts of the alluvial floodplain as a result of cropping activity and the removal of native vegetation.

Ground surface visibility (how much bare earth is visible) and archaeological exposure (how erosion effects the potential for buried artefacts or deposits to be exposed on the ground surface) are important considerations for the project area. Ground surface visibility varies across the project area.

Significant erosion caused by European farming practices has led to soils on lunette features to be dispersed upon wetting and move downslope. On the back plain landforms sheet erosion has led to the topsoil being stripped and the formation of hard surfaced scalds. Some of these scalds also contain patchy residual soil mounds around their margins. These residual soil mounds may preserve an original soil profile beneath a cap of windblown sediment

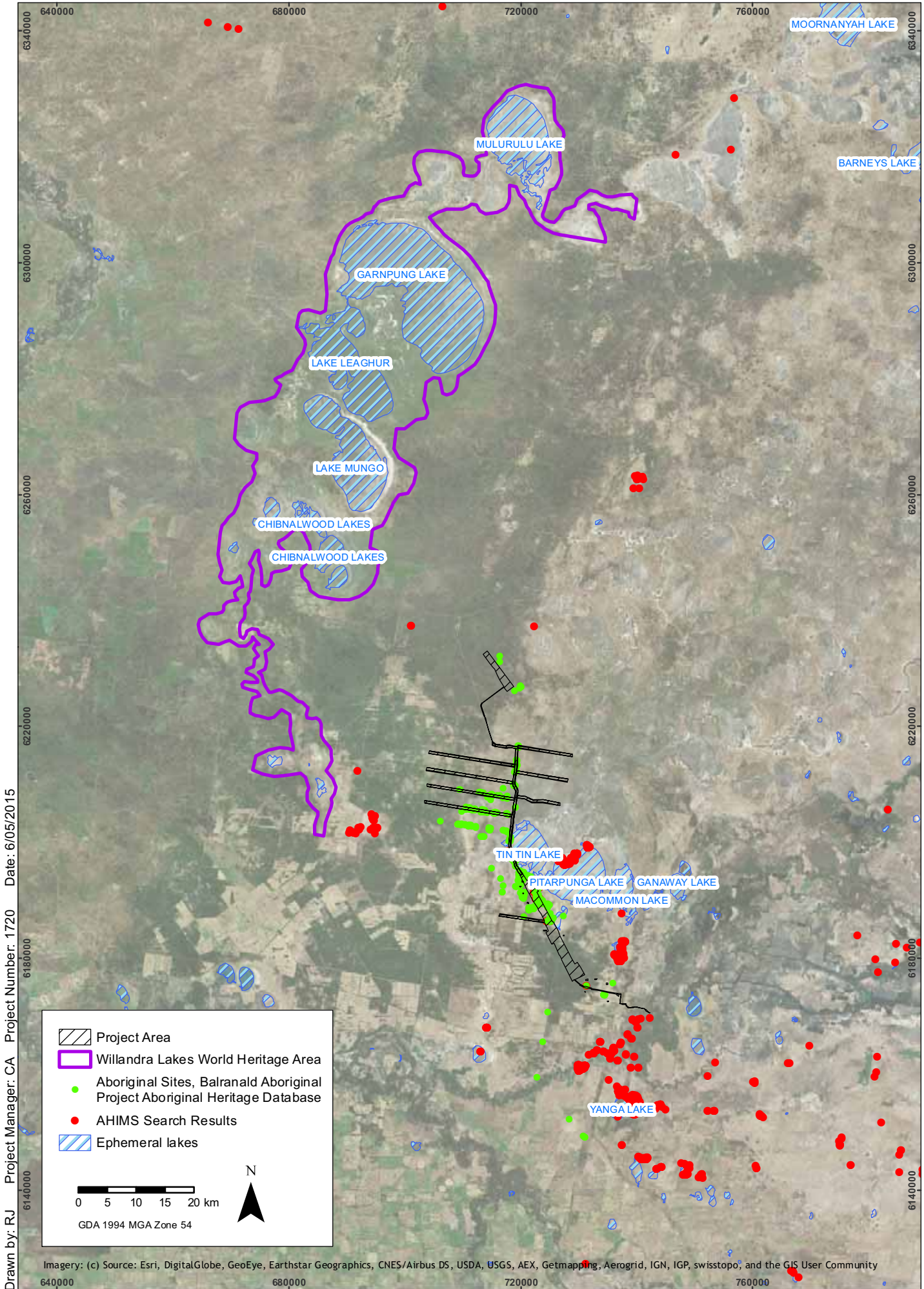
7.5 Summary

The project area is situated in the semi-arid zone of NSW, where there are hot summers and cold winters, and where average monthly rainfall is exceeded by average monthly evaporation. The project area consists of a series of dune fields and sand plains vegetated by mallee communities, and also contains brown soil undulating plains usually vegetated by saltbush, bluebush, belah and rosewood communities. Depressions and ephemeral lakes occur across the region, the land surrounding the project area, and within the project area itself. These lakes can fill with water episodically during local heavy rains and regional flood events. In some cases the lakes can hold water for several months. It is further possible that in the ancient past these lake systems were recharged by groundwater, increasing the stability and availability of the water in the project area. The project area does not contain any perennial watercourses; however Box Creek, an ephemeral tributary of the Lachlan River active during major flood events flows through the project area to the north of the West Balranald mine.

The project area has the potential to contain very ancient Aboriginal cultural sites because as a result of the landforms having formed either in the Pleistocene time period (approximately 2.5 million to 12,000 years ago) and the Holocene (approximately 12,000 years ago to the present) period. In some cases, landforms such as lakeside lunettes and source bordering dunes deposited during the Pleistocene may be present in the project area, may contain ancient Aboriginal sites, potentially with ages similar to those found in the Willandra Lakes Region World Heritage Area. The project elements that may be associated with such landforms are West Balranald mine, Injection borefield 3, Injection borefield 5, Injection borefield 8 and the Nepean access road (Figure 4). During the Pleistocene the lakes would have been fed by ground water, and would have provided a valuable resource rich area for Aboriginal communities during these more arid times. The importance of these ancient lake systems and the lake side landscapes are reflected in the World Heritage Listing of the Willandra Lakes Region World Heritage Area.

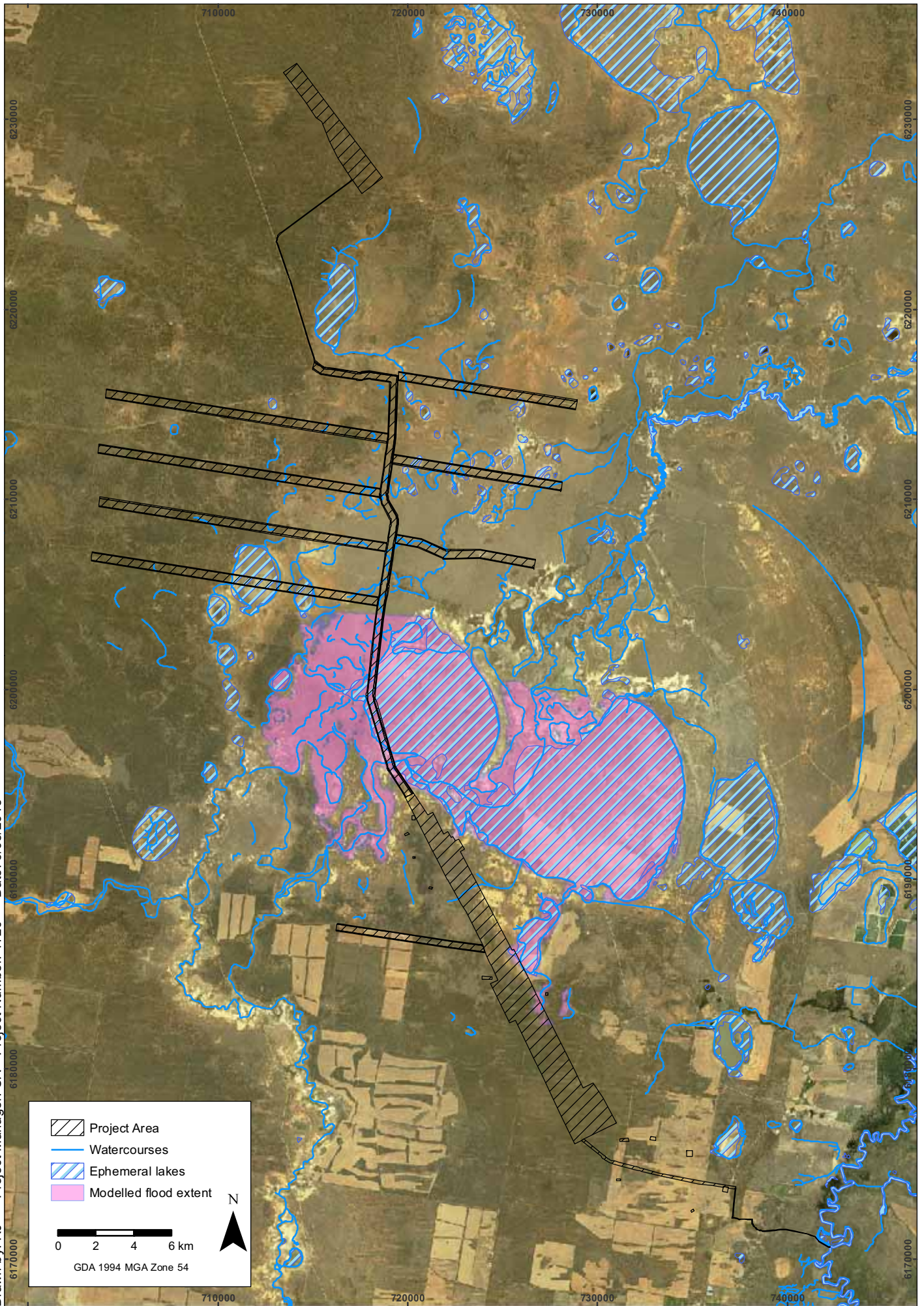
However, for the most part the project area consists of sand plains and dune systems which stabilised around 8,000 – 5,000 years ago. It is assumed that Box Creek has not been an active channel in terms of floodplain deposition for the majority of the Holocene, but prior to this would have actively meandered across the plains. In most cases Aboriginal cultural and archaeological sites are therefore assumed to be Holocene in age, and will be associated with the ephemeral watercourse of Box Creek and the episodic lakes and depressions which fill during local rain events, or major flood events.

The project area has been subject to significant levels of disturbance since European use of the landscape began in the 19th century. Major changes have included the construction of dams, fences and roads and other rural infrastructure, and in particular over stocking of pastoral holdings in the late 1800s, causing severe erosion. In many parts of the project area mallee has been cleared for direct exploitation as a resource, and also to provide land for broad acre dry land crops.



The Project Area in relation to the Willandra Lakes region
 Balranald Mineral Sands Project Aboriginal Cultural Heritage

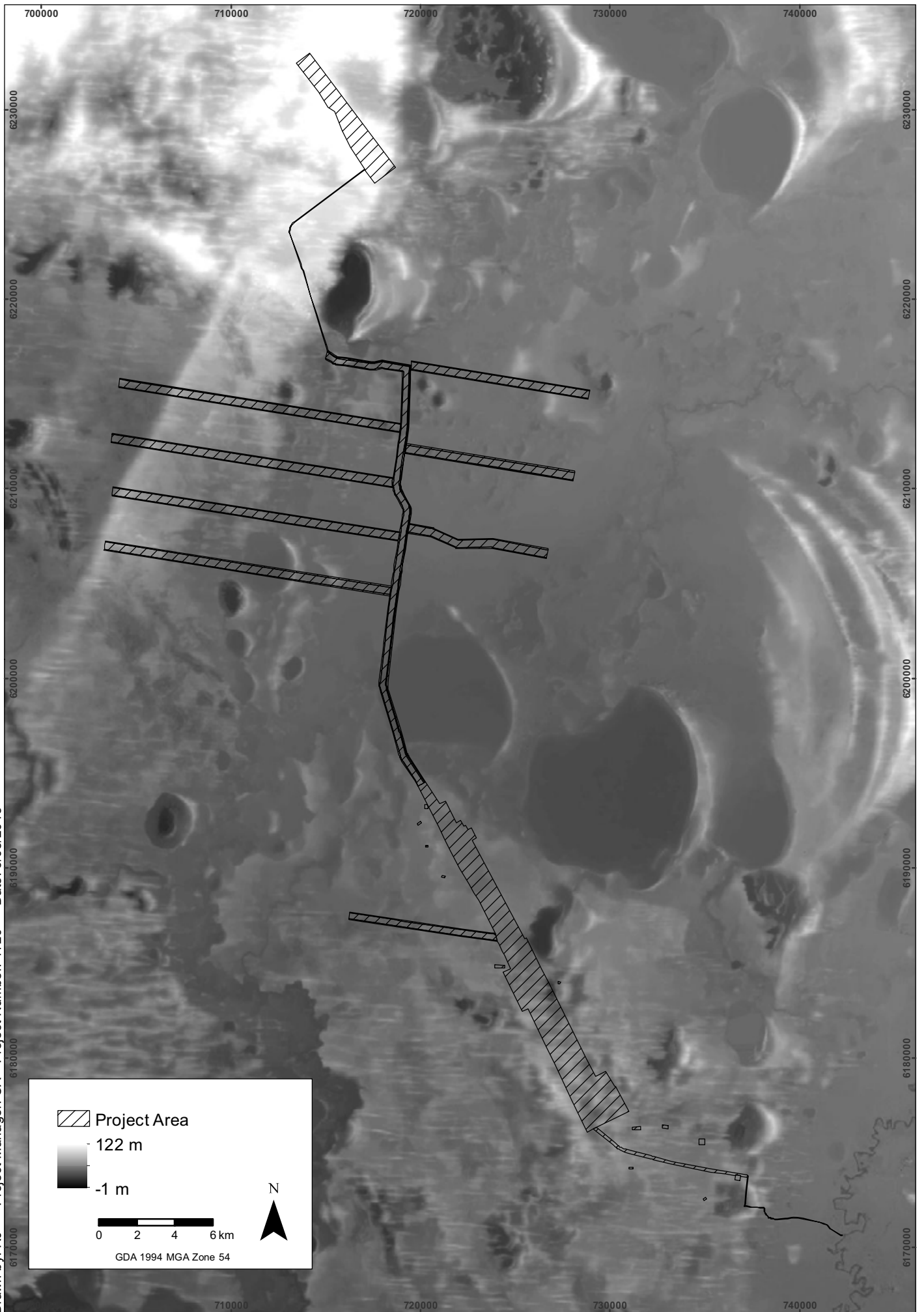
Drawn by: RJ Project Manager: CA Project Number: 1720 Date: 6/05/2015



Hydrology of the Project Area
Balranald Mineral Sands Project Aboriginal Cultural Heritage

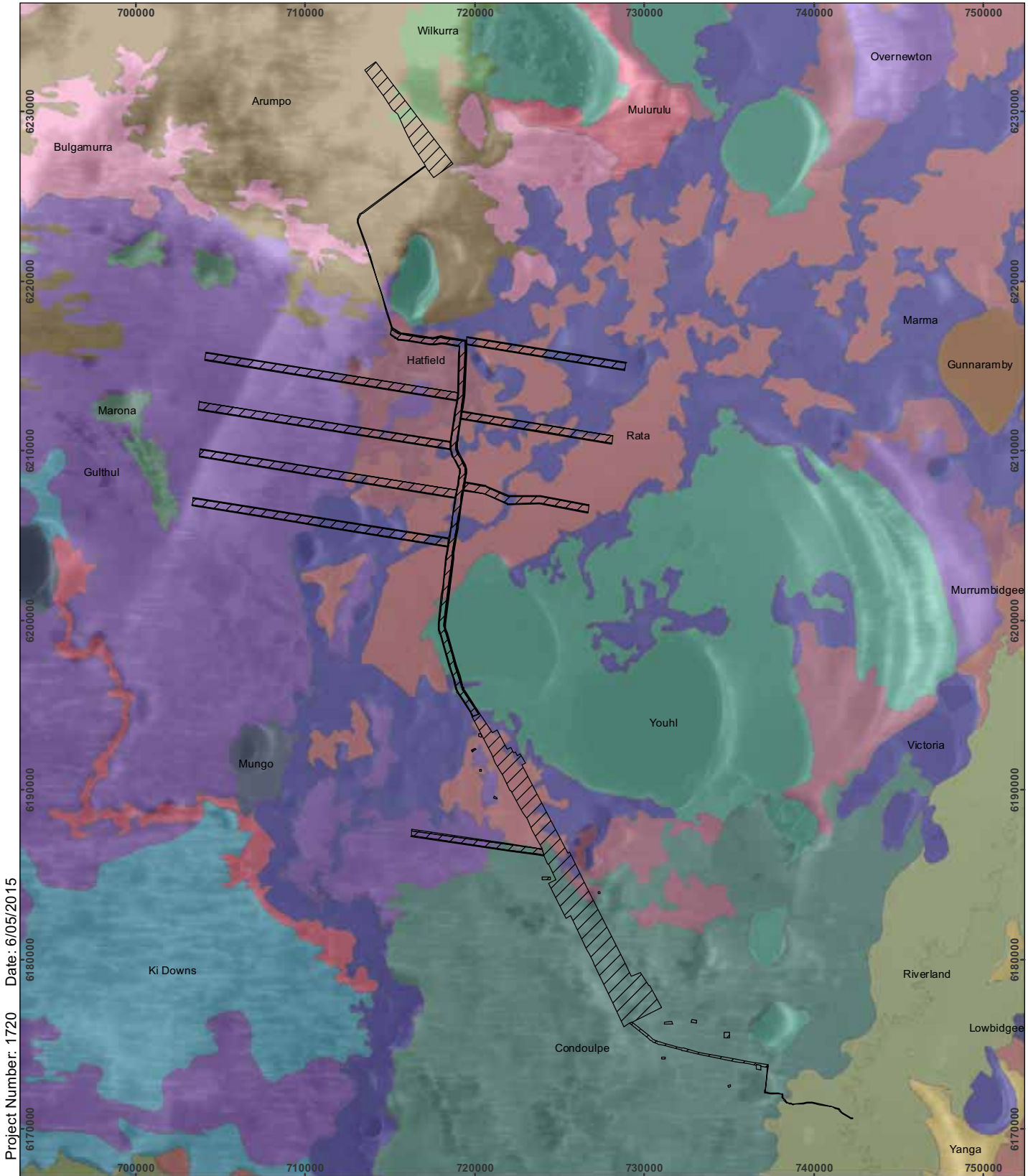
FIGURE 8
Imagery: (c) Iluka

Drawn by: RJ Project Manager: CA Project Number: 1720 Date: 6/05/2015

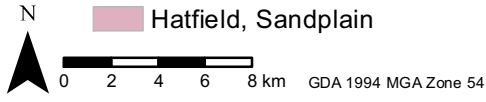


Digital Elevation Model of the Project Area
Balranald Mineral Sands Project Aboriginal Cultural Heritage

FIGURE 9



Drawn by: RJ Project Manager: CA Project Number: 1720 Date: 6/05/2015



Western NSW Land Systems
Balranald Mineral Sands Project Aboriginal Cultural Heritage

FIGURE 10

8. Aboriginal Archaeological Context

It is a requirement under the Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales (DECCW 2010a) that archaeological assessments synthesise available information from previous archaeological and ethno-historical studies to provide a context and baseline for what is known about Aboriginal cultural heritage in the project area. In accordance with the *Code of Practice for Archaeological Investigation in NSW*, this section reviews heritage registers to identify known Aboriginal heritage items (Section 8.1), identifies and describes previous archaeological investigations in the project area, local and wider region (Section 8.2 and Section 8.3), reviews ethnographic and historical studies (Section 8.4) and then synthesises and discusses this information with reference to the landscape context (Section 7) to provide a summary of the main issues and regional character of Aboriginal land-use and its material traces and its likely nature and distribution of within the project area (Section 8.5).

8.1 Heritage Registers

8.1.1 AHIMS Register

Multiple extensive Aboriginal Heritage Information Management System (AHIMS) searches of the project area and surrounds were conducted between 22 May 2012 and 5 October 2014 (AHIMS IDs 70564-706568, 70644, 102938, 128493, 128497, 149923, Appendix 3) in order to include both the project area and an area large enough to allow adequately characterise the local archaeological record.

The searches indicated that no reported archaeological investigations had occurred within the project area prior to the Balranald Project. One Aboriginal site (Karra 1) was registered in AHIMS prior to 2012 and was identified during a due diligence assessment of exploration activities within the project area. An additional 249 Aboriginal sites were registered in AHIMS outside the project area within a 10 km radius.

The nearest archaeological investigations to the project area identified through AHIMS were Sarah Martin's 2010 investigations of Paika Creek and Paika Lake on Paika Station and Box Creek and Geracki Creek on Tin Tin Stations. Sites identified during Martin's survey form the bulk of identified AHIMS sites within the AHIMS searched. The remaining sites in AHIMS were recorded along the Murrumbidgee River and near the town of Balranald.

The distribution of recorded Aboriginal sites indicates there is an abundance of archaeological evidence within the Riverland system and the playas, basins and depressions of the Youhl system. The AHIMS search results reflect an absence of systematic archaeological survey of land systems other than the Riverland and Youhl systems (Table 5).

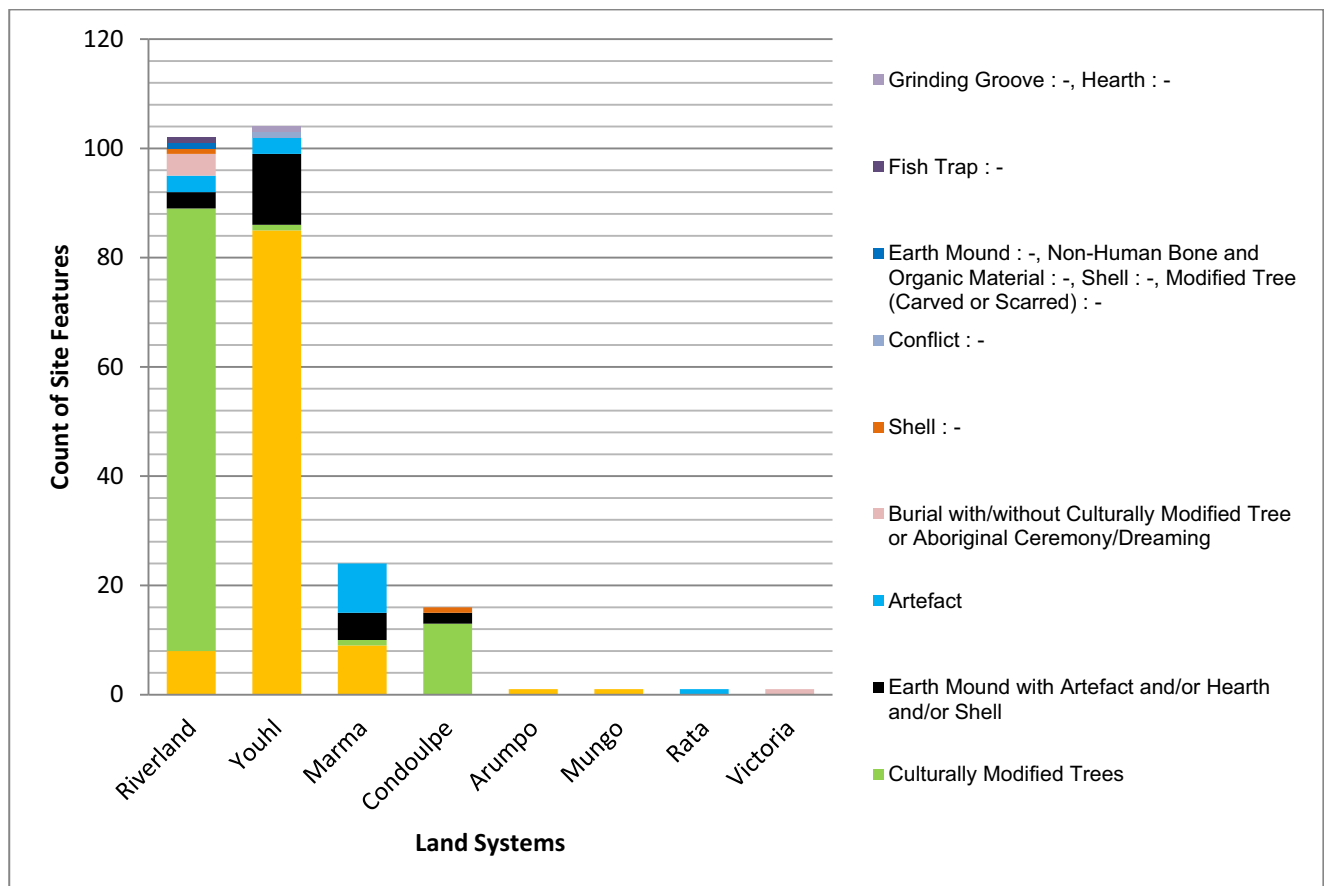
Site features recorded in the AHIMS are stone artefacts and hearths, with occasional occurrences of mounds, shell middens, culturally modified trees, grinding grooves, fish traps and conflict sites (Chart 1, Figure 11). Variation in the frequency of certain site features is evident between the Riverland and Youhl systems, with culturally modified trees and mounds being more frequent in the Riverland system. It is assumed this different relates to the relative preservation and abundance of mature age trees along the river channels.

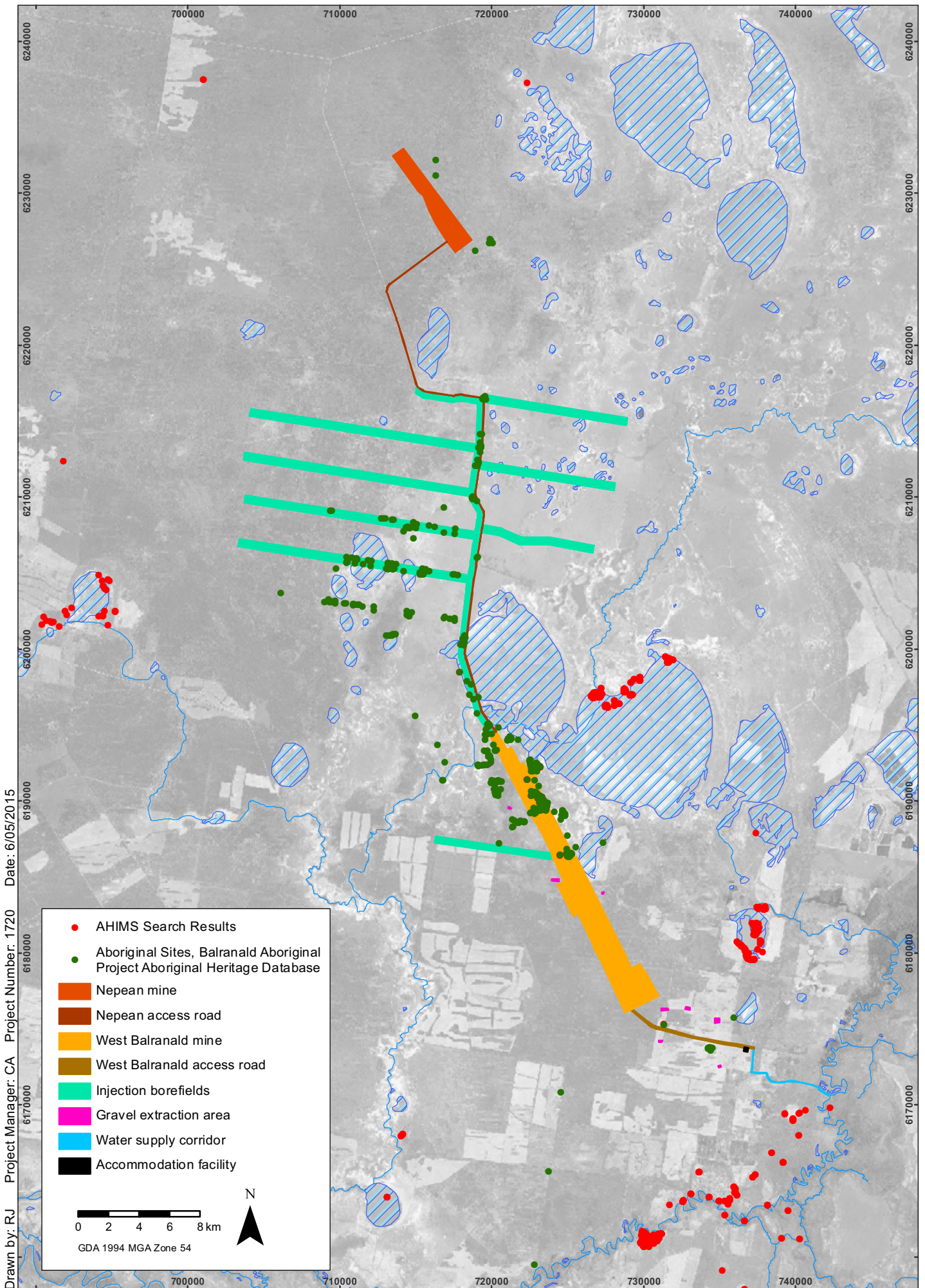
An overview of previously recorded aboriginal sites in the project area on the AHIMS database is provided in Figure 11. Archaeological investigations and site distribution in the local and wider region, including those that have occurred for the Balranald Project are discussed further in Sections 8.2 and Sections 8.3.

Table 5: AHIMS Search Results by Land System.

Land System	Number of Sites	% Of sites
Riverland	102	40.80
Youhl	104	41.60
Marma	24	9.60
Condoulpe	16	6.40
Arumpo	1	0.40
Mungo	1	0.40
Rata	1	0.40
Victoria	1	0.40
Total	250	100.00

Chart 1. AHIMS Results showing the distribution of site features by land systems.





Previously Recorded Aboriginal Sites in the Project Area - Overview
 Balranald Mineral Sands Project Aboriginal Cultural Heritage

8.1.2 Other Registers

Searches of other heritage registers were conducted to identify any other known heritage items within the project area.

Balranald Local Environmental Plan 2010

A search of the Balranald Local Environment Plan was completed on 13 December 2014. There were no items of local heritage value listed within or in close proximity to the project area.

NSW Heritage Database

A search of the Balranald Local Government Area in the NSW Heritage Database was conducted on 13 December 2014. No Aboriginal or non-Aboriginal historical items of local or state value were identified within or in close proximity to the project area.

National and World Heritage List

The Willandra Lakes region is located 32 km from the West Balranald mine, 19 km from the Nepean mine and 15 to 17 km west of project elements Injection Borefields 3, 4, 6 and 7. The Willandra Lakes region is listed on the National and World Heritage List for its unique cultural traditions and outstanding examples of stages of earth's history.

The Willandra Lakes Region demonstrates an exceptional sequence of Aboriginal cultural occupation extending over tens of thousands of years, including an outstanding record of human responses to major changes over time in climate and environments (e.g. due to increasing aridity). The World Heritage List defines its heritage values as:

- Landforms and locations which greatly extend our understanding of Australia's environmental and Aboriginal cultural history, including:
 - Exposures of sedimentary sequences which reveal Pleistocene sedimentary profiles and associated archaeological and palaeontological materials.
 - Extensive intact lakeshore landforms that may contain extensive archaeological and palaeontological materials.
- The remains of hearths, including those with considerable antiquity, which have provided an ideal source for palaeomagnetic measurements.
- Archaeological sites which occur within stratified sedimentary sequences and provide evidence for the antiquity and continuing presence of human occupation.
- Archaeological sites which contain evidence of utilisation of lacustrine resources during lake full phases, and rangeland resources during arid phases.
- Archaeological sites which demonstrate continuity of human occupation for the region through fluctuations in lake levels drying of the system about 15,000 years ago through the Holocene period and up to historic times.
- Archaeological sites which provide outstanding examples of hunting and gathering, a way of life that has dominated the Australian continent up to modern times, including:
 - Evidence of human occupation of, and interaction with, the landscape of lakes, lunettes and sand dunes over time in the form of campsites, middens, fireplaces, quarries, knapping floors and burials.
 - Campsites and fireplaces that reflect people's hunting, gathering and fishing diet.
 - Burial sites which are of global significance for the antiquity of burial practices represented and also for the information they provide on the development of human societies, including Pleistocene and Holocene burial sites.

- Burial sites with associated mortuary goods and evidence of ritual burials which demonstrate the antiquity of particular burial practices and the development of religious beliefs and systems over time.

The nature and distribution of archaeological evidence within the Willandra Lakes region is discussed further in Section 8.3.1 to inform the predictive model for the Balranald Project. The significance and impact of the proposed activities with consideration of the Willandra Lakes Region are discussed further in Sections 12 and 13.

8.2 Local Archaeological Investigations

As noted within the AHIMS search results, there were relatively few archaeological investigations within 10 km of the project area prior to 2012. Since 2012, a number of due diligence assessments have been completed to inform exploration activities. A summary of known archaeological investigations in the local area is presented in Table 6 and the results of these are shown in Figure 11.

Table 6: Summary of local archaeological investigations

Date	Author	Title	Summary	Sites
2014	Niche	Aboriginal Heritage Due Diligence Assessment; Hydrogeological Stage 3 Program Additional Drilling Locations, Balranald Project.	Archaeological due diligence assessment of 49 drill locations. 12 Aboriginal sites were recorded, 9 isolated finds and 3 stone artefact scatters associated with PADs. Two previously recorded sites were re-assessed and had their boundaries extended.	CD 1, CD 2, UD 1, UD 2, UD 3, UD 4, Karra 64, Karra 65, BWR 41, BWR 42, WB 42, WB 46, WB 117, WB 118.
2013 (November)	Niche	Aboriginal Heritage Due Diligence Assessment; Hydrogeological Stage 3 Program Balranald Project.	Archaeological due diligence assessment of three short term pump testing location, one long term pump test location and fourteen air core/sonic drill locations. 30 new Aboriginal sites were located: 18 isolated finds, 7 stone artefact scatters/PAD sites, 3 stone artefact scatters and 2 stone artefact scatter/hearth scatter/PAD sites.	BC IF 1, BWR IF 1, BWR IF 2, K IF 1, TT AS 1 – TT AS 3, TT IF 1 – TT IF 8, WB 67 – WB 81, WB 98, WB 105, WB 106.
2013 (July)	Niche	Aboriginal Heritage Due Diligence Assessment; Borehole Mining Trial.	Archaeological due diligence assessment of a proposed borehole drilling location and associated land disturbance. 20 new Aboriginal sites were identified: 9 isolated finds, 4 stone artefact scatters, 3 hearth scatters, 1 artefact scatter associated with heart scatter, 1 isolated find associated with heart scatter and 1 stone artefact scatter associated with PAD.	WB 82 to WB 97, WB 99 – WB102.
2013 (June)	Niche	Aboriginal Heritage Due Diligence Assessment; Borehole Mining Trial.	Archaeological due diligence assessment of a proposed borehole drilling location and associated land disturbance in an area that had been cleared and ploughed. No Aboriginal archaeological sites were located.	None.
2012	Niche	Summary for Aboriginal Cultural Heritage due diligence of Iluka's gravel test site options: Balranald Mineral Sands Project	Archaeological due diligence assessment of 39 potential gravel test pit sites. One Aboriginal site was identified on the Wintong property; an artefact scatter and hearth site.	W 13

Date	Author	Title	Summary	Sites
2011	Dr. Tim Stone	West Balranald and Nepean Sonic Holes and Tracks Aboriginal Cultural Heritage Due Diligence Assessment	Archaeological due diligence assessment of six proposed sonic holes and vehicle access tracks. One Aboriginal archaeological site – an artefact scatter was identified.	Karra 1 (47-2-0192).
2011	Landskape / Matthew Cupper	West Balranald and Nepean Mineral Sands Deposits Hydrogeological Investigation: Aboriginal Cultural Heritage Due Diligence Assessment	Archaeological due diligence assessment of 72 drill holes for a hydrogeological program. No Aboriginal sites were identified.	None
2010	Sarah Martin	Part of the Recording of Aboriginal Use and Values on the Lowbidgee and Lower Lachlan Rivers wetlands under the NSW Rivers Environmental Restoration Program (RERP).	Archaeological investigation of the Paika Lake and station, Tin Tin Lake, Gorecki Creek and Box Creek locales. Over 300 sites recorded outside the Balranald Project including stone artefacts, hearths, mounds, conflict sites, historical sites, burials and culturally modified trees.	See Appendix 3.
2003	Vanessa Edmonds, Archaeological Consulting Services	Cultural Heritage Assessment for the Balranald Levee, Western NSW.	Archaeological assessment for a proposed levee covering approximately 3400 m along the Murrumbidgee River. 12 new sites were located: 10 culturally modified trees and two shell middens.	BL 1 – BL 8, PP (47-6-0015), PP 1 – PP 3.
1986	Sarah Martin	Archaeological Survey of Proposed Water Treatment Works Sites at Hay, Balranald and Wentworth, South-Western NSW.	Archaeological assessment of proposed water treatment plants, pipe lines and associated infrastructure. No Aboriginal sites were located. Imported material assessed as possible extraction of midden material somewhere from the area was located on the bank of the Murrumbidgee.	None.

8.2.3 Balranald Project Due Diligence Assessments 2011 - April 2014

As noted above, archaeological investigations of the Balranald Project have been ongoing since 2011 and can be divided into two categories; due diligence assessments of exploration activities and fieldwork programs to inform this assessment and the EIS. A summary of the results of the due diligence assessments is provided below. The results of the EIS fieldwork programs are presented in Section 10.

Due Diligence Assessments

The results of the due diligence assessments have been previously published as part of the Review of Environmental Factors (REF) process for the exploration activities (Cupper 2011, Stone 2011, Niche 2013b, Niche 2013c, Niche 2013d, Niche 2014).

In 2011, Dr. Tim Stone surveyed six sonic holes and vehicle access corridors with three members of the Balranald Local Aboriginal Land Council. Thirty-four linear kilometres were surveyed with a team of four at 5 m spacing. Land systems that were surveyed included Rata, Condoulpe and Arumpo. Surface visibility was excellent. One Aboriginal site was located during the survey – Karra 1. Karra 1 was scatter of stone artefacts located within the Rata landsystem. It comprised 16 flaked stone artefacts over 200 m the margin of a former ephemeral waterhole ~2 km west of the relict Pitarpunga Lake. The artefacts were distributed in three distinct clusters and were made predominantly from silcrete (94 %), although one quartz flake (6

%) was also recorded. The site was interpreted as a transient site, presumably occupied during a period of high seasonal rainfall owing to its low artefact density and high visibility.

In 2013, Niche surveyed a proposed disturbance footprint of 25 ha for a borehole mining trial location. The surveyed area was located on the Condoulpe land system and was characterised by ploughed dunefields and sandplains with cleared and regrowth mallee vegetation. Temporary or permanent water sources were not evident, suggesting that the area would only have been sporadically used by Aboriginal people in the past (Niche 2013). No Aboriginal objects were recorded during the due diligence assessment.

An alternative borehole mining trial location was surveyed through the due diligence process in 2013. The alternative location was situated in the Rata land system which comprises extensive salt bush plains associated with small cub circular depressions which may have held water for short periods of time. Twenty new Aboriginal sites were identified: 9 isolated finds, 4 stone artefact scatters, 3 hearth scatters, 1 stone artefact scatter associated with heart scatter, 1 isolated find associated with hearth scatter and 1 stone artefact scatter associated with PAD. These sites are situated within the West Balranald mine project area.

Also in 2013, an archaeological due diligence assessment of three short term pump testing location, one long term pump test location and fourteen air core/sonic drill locations occurred across a range of land systems was undertaken. Thirty new Aboriginal sites were located: 18 isolated finds, 7 stone artefact scatters/PAD sites, 3 stone artefact scatters and 2 stone artefact scatter/hearth scatter/PAD sites.

In 2014, Niche undertook a due diligence investigation for 49 additional drilling locations for the Balranald Project. The bulk of the proposed drilling locations occurred on land systems commonly associated with Aboriginal sites, such as the Rata, Marma, Youhl and Hatfield systems. Altogether 16 Aboriginal sites, including 12 new sites were identified within or in close proximity to the proposed drilling locations. Nine of the identified sites were isolated finds and 3 stone artefact scatters associated with a PAD. Site UD 2 was assessed as having moderate archaeological significance. No other site types were identified during the survey. The results of the investigation reinforced the previous predictive models and archaeological patterns of the wider Balranald Project area.

8.2.4 Archaeological Surveys of Paika Creek, Lake and Station and Box and Geraki Creeks

To the east of the project area (within 5 km), Martin (1986) surveyed a section of Paika Creek and Paika Lake on Paika station, and Box Creek and Geraki Creek on Tin Tin station to the north of Piturpunga Lake (Figure 11). Over 300 new Aboriginal sites were recorded, not all of which fell within the AHIMS search area for the Balranald Project. The investigation recorded a range of archaeological evidence including:

- 1950s historic campsites of Aboriginal families such as the Kellys and Jacksons.
- Hearths of calcrete, baked clay, burnt termite mound heat retainers and ashy deposits occurring individually and in clusters.
- Mounds of ashy deposits, shell, yabby gastrolith and heat retainers ranging in maximum dimension from less than 4 m to 30 m.
- Middens containing shell, lake mussel, freshwater snail shell, cooked large bird bone, egg shell, heat retainers, turtle shell.
- Culturally modified trees, predominately box trees, with a range of scar types including coolamon, shield and canoe scars.
- Artefact assemblages of predominately silcrete with occasional grinding fragments showing evidence of the grinding of grass seeds and maintenance and shaping by pecking.

Archaeological evidence was found in association with Tin Tin and Paika station, in association with Gerakiand Box Creeks, Pitarpunga Lake, Paika Lake and Paika Lake island. Archaeological sites were found on the edge of lakes, on the lake bed, on pelletal clay lunettes.

8.2.5 Balranald Levee

Archaeological Consulting Services was commissioned by Sinclair Knight Merz (now known as Jacobs Group) on behalf of the Balranald Shire Council to prepare a cultural heritage assessment for the proposed Balranald Levee in 2003. The location of the proposed levee was north of Balranald and west of the Murrumbidgee River and stretched approximately 3,371 m along the proposed flood protection systems. The project area was situated on the Condoulpe and Riverland land systems. The predictive model indicated that high banks of the river have the highest archaeological potential followed by the margins between the Condoulpe and Riverland land systems. The most common archaeological sites expected were culturally modified trees and middens associated with camp sites along the river banks. Altogether 12 new sites were identified, including 10 culturally modified trees and 2 shell middens.

8.3 Regional Archaeological Studies

Regional archaeological surveys and predictive modelling has been conducted over a 30 year period (Bowler et al 1998; Klaver 1995, 1998; Littleton 2002; Martin 1988, 2006, 2008 and 2010; Pardoe and Martin 2001; Pardoe 2003; Witter 1992, 1999), and have shown that some riverine landforms and lunette lake systems within the Murray Basin are particularly rich in evidence of Aboriginal occupation spanning a 50,000 year history. This richness of ancient Aboriginal history and culture has led to part of the region being protected as part of the Willandra Lakes Region World Heritage Area, which incorporates Mungo National Park. The Willandra Lakes Region World Heritage Area is located approximately 32 km from the West Balranald mine and 19 km from the Nepean mine (Figure 7).

8.3.1 Willandra Lakes

Climate Change, Availability of Water and Antiquity

The Willandra Lakes consist of a series of 6 large and 13 small lake basins within a dry linear dune system and were occupied by Aboriginal people some 50,000 - 45,000 years ago. At that time the climate was colder and water from the Southern Tablelands flowed along a branch of the Lachlan River (Willandra Creek) to fill the lakes. People camped along the dune (lunette) along the eastern side of Lake Mungo. Archaeological evidence from this period includes burials, shell middens, hearths, stone artefacts and quarries. Conditions and lake levels fluctuated with a substantial drying after 41,000 years ago (Hiscock 2008:38-42). People continued to occupy inland areas as climate continued to dry and become colder. Clarke (1987, in Johnson and Clarke 1998) dated a midden at Garnupung Gogolo to 32,1000 ±950 BP. Similar dates have been obtained from midden sites on Mulurulu Lunette (29,360 ±620 BP), Garnupung Lunette (25,600 ±500 BP) and Garnupung Leaghur (30,300 ±800 BP) (Clarke 1987, in Johnson and Clarke 1998).

Climatic conditions were most extreme between 25,000 and 17,000 years ago, with considerable fluctuation in lake levels and salinity. Melt-water drained from the Great Dividing Range, providing the lacustrine and riverine systems with 20 to 30 times more water than they contain today (Hope et. al. 1983).

Reduced temperatures and water levels in the region made some fish and freshwater mussels locally extinct from 25,000 years ago. Mega fauna disappeared by about 25,000 years ago on the Darling River and Willandra Lakes system (Hope et. al. 1983). Fossil footprints dating to 20,000 years ago were found at Garnupung Lake and demonstrate individuals and family groups hunting and moving through the landscape. The hardpan lies within the swale of low sand dunes, part of an undulating terrain of lunettes and lakebeds.

The 123 x footprints were deeply impressed into the hardpan sediments. A series of Optical Stimulated Luminescence (OSL) dates were taken from the sediments in which the footprints are located. The sediments date to between 23,000 ±1000 BP and 19,200 ±1000 BP (Webb et al. 2006).

Water returned to the Willandra system between about 15,000-16,000 years ago, and episodic flooding continued, at least into the northern lake, through the Holocene (Bowler 1998; Bowler et al. 2003; Hiscock 2008:56-59). Lake Mungo itself dried about 14,500 years ago due to a drainage diversion (Gillespie 1998:178) and the current riverine systems, including the floodplains, developed around 14,000 – 7,000 years ago.

Subsequent periods of Aboriginal occupation of the region encompassing the Willandra Lakes and Willandra Creek have received less research attention. With increased drying of the southern lakes and climate change, Aboriginal people may have developed new dry land economies (Bowler 1998:149; Hiscock 2008:62). The early Holocene was wetter than now, and the climate became drier and more variable with the establishment of El Niño drought events. Droughts were more intense than today and there was increased climate variability; the most intense period of instability was between 5,000-2,000 years ago (Hiscock 2008:140). During the past 1,500-2,000 years the climate again became wetter as the effects of El Niño lessened. In far western NSW an intensive programme of dating hearths on open archaeological sites has shown that most were used within the last 2,000 years or so, suggesting increased occupation of hinterland areas of western NSW in the late Holocene (Rhodes et al. 2009; Shiner 2009).

The project area is situated near Box Creek, a less well-defined distributary stream of the Lachlan River to that of the Willandra Lakes. It would have been impacted differently by changes to water flows within the Lachlan River network, but nevertheless it is hypothesised that some of the broader trends in climate change, patterns of occupation and preservation and erosional qualities may be reflected in the archaeological record of the project area. The Willandra Lakes World Heritage Area demonstrates the potential for archaeological deposits of significant antiquity to be present in lunette deposits.

Site Types and distribution

The bulk of the archaeological record in the Willandra Lakes World Heritage Area is made up of a low density surface scatter of objects eroding from the landscape. Stone artefacts, human and faunal remains, shell middens, clay and stone heat retainers and hearths are the common materials in the area (Tumney 2011). Ceremonial, mythological sites and fossilised footprints also occur within the landscape.

Numerous human burials have been located in the Willandra Lakes area. Littleton's (2007:1015) extensive study of burials in the region has provided a predictive statement about the probable location of burials in the region. Littleton states that in the western half of the region, most burials occur within sand dunes created from paleo-channels; the dunes are located near both permanent and ephemeral water sources and form high points in the landscape. In the eastern areas the floodplain is much flatter and burials are usually found in higher points in the landscape (Littleton 2007:1015).

Interlake and inter and intra site variation has been recorded throughout the Lake Willandra World Heritage area. Preferential selection and discard of different shellfish and faunal resources is found in different locations. Correlations between the discard of certain fish and shellfish and water levels have also been investigated (Tumney 2011: 291).

Artefact Assemblages

The distribution of sites and stone artefacts within the Willandra Lakes World Heritage Area is of relevance to the project area owing to it providing a comparative assemblage as well as potential sources of raw material for the production of stone tools.

Stone artefacts identified in the Willandra Lakes include complete and broken flakes, unmodified cores and flakes, rejuvenation flakes, hammerstones, grindstones and complete and broken modified flakes. Modified flakes included horse hoof cores, steep scrapers, notched scrapers, flat scrapers, straight scrapers, serrated scrapers, miscellaneous scrapers, retouched flakes, flake adzes, backed flakes and fabricators (Hiscock and Allen 2009). Other core types identified by more recent analysis include bifacial, multidirectional, informal single platform, opposed, conical and microblade cores (Tumney 2011:186).

A PhD analysis of three stone artefact assemblages from the Lake Mungo lunette identified the fine grained silcrete was the most commonly utilised raw material (Tumney 2011: 279). This material was at a minimum transported 7-12 km before being discarded. Silcrete was found to be the most commonly occurring raw material used for artefact manufacture within the Lake Mungo lunette (Tumney 2011: 156). The colour range of silcrete identified by Tumney (2011: 157) is also reflected in the Balranald Project's artefact assemblage. The Willandra Lakes World Heritage Area includes a number of silcrete sources and forms a likely source for much of the silcrete contained within the project area, including the quarry on the western side of Lake Mungo, sandstone outcrops within a 30 km of Lake Mungo (Tumney 2011: 160).

The material was interpreted to have been transported to the discard locations in the form of flakes and nodules and showed low levels of reduction and low levels of intensity of use. Some material showed evidence of preliminary working prior to its introduction to the discard locations. Coarse grained silcrete was discarded less often in the assemblage and was also minimally reduced. Some silcrete cobbles showed evidence of being used as a hammerstone. Hammerstones in the assemblages were rare. Core rotation was evident in the assemblage.

Retouched artefacts formed approximately one quarter of each of the fine grained silcrete assemblages at the locations (Tumney 2011: 281). The majority of these showed edge damage or informal retouched.

A range of other raw materials were used in the assemblages; including quartzite, quartz and sandstone. Variation in the dimensions and size range of artefacts manufactured from different raw materials indicating different procurement and flaking strategies.

Like the project area, soil carbonates occur throughout the Lake Mungo area. Carbonate, or calcrete was frequently used as a heat retainer in hearths. Carbonates (Tumney 2011: 156) have on rare occasions been observed to have been transported and used as a grinding slab within the Mungo Lunette (N. Stern, in Tumney 2011: 156). Carbonate nodules have also been used as heat retainers in hearths.

The closest documented quartzite and quartz source to the Willandra Lakes World Heritage Area is the Manfred range, located approximately 150 km from the Balranald Project area. It would be anticipated that quartzite would be less common in the project area. Quartz artefacts were not common in the assemblages analysed by Tumney (2011: 161).

Sandstone was found to be the most commonly used material for ground stone. Sandstone outcrops occur at the Manfred Ranges and in outcrop of Tertiary sands to the west of the Willandra lakes and to the south.

8.3.2 Riverine Plains of the Murrumbidgee and Lowbidgee areas

A range of regional archaeological studies have been completed for the riverine, Murrumbidgee and Lowbidgee region (Witter 1999, Pardoe and Martin 2001, Martin 2010) These studies noted regional differences in the distribution of archaeological evidence.

In 2001, Colin Pardoe and Sarah Martin published an Aboriginal Cultural Heritage Study of the Murrumbidgee Province for NSW National Parks and Wildlife Service. This study provided a descriptive model of a relatively small dataset (647 Aboriginal sites) over three million hectares of the Murrumbidgee Province of the Riverina bioregion and a literature review of ethnographic and historical sources of the region.

The following site types were identified as occurring within the Murrumbidgee Province, on order of frequency:

- Culturally Modified Trees.
- Mounds.
- Open sites.
- Hearths/Ovens.
- Burials.
- Middens.
- Isolated artefacts and dinner camps.
- Historic sites.
- Soaks.
- Mythological sites.
- Bora Rings.

Sites were found in association with coarsely cracking grey and brown clays, scalded red texture contrast soils. Red brown earths, calcareous earths, siliceous dune sands and saline scalded lake bed clays has occasional occurrences of sites, but were far less frequent. Sites were most frequently associated with plains with depressions, scalded plains, plains with drains, channelled plains, plains and plains with channels. A relatively small number of sites were recorded within 650 m of source bordering dunes, less than 650 m from lunettes, swamps, dunefields, alluvial-callocuial slope apron, intermittent lake, lake and other landforms.

The distribution model by Pardoe and Martin differs slightly from Witter's (1999:35) predictive model, which suggested earth mounds were the most common site type within the Riverine Plains bioregion, however they were less common on the Lachlan-Willandra Plains. Witter (1999) suggested that earth mounds usually occurred on the higher ground within floodplains, sand drifts, lake margins and swamps. Another common site type within the Riverine Plains and Lachlan-Willandra Plains is the open camp site, the camp sites are characterised by widespread artefact scatters containing larger sized flaked stone and hearth material. Open camp sites occurred most frequently in scalds and dry clay pans (Witter 1999:45).

Individual burials, along with multiple burials in one deposit and cemetery-like burials, all occur in this region. Witter (1999:35) states that burials are abundant throughout this riverine landscape and this is due to the excellent preservation conditions of the regional environment, such as the highly calcareous soils. Culturally modified trees are abundant in the region, with most tree scars the results of canoe construction.

Scars of containers and roofing slabs also commonly occur. The most common tree species which show cultural scars are black box and yellow box (Witter 1999:35).

In 2010, Martin conducted a large scale survey and assessment of the Lowbidgee region. The survey recorded 1,168 sites which included mounds, ovens, middens, modified trees, ancestral burials, artefacts, ceremony and dreaming (tree rings). The survey also recorded historic Aboriginal sites such as missions and conflict sites (Martin 2010:33). The site types located during the survey were consistent with predictions, however the distribution of some site types was expanded. Martin (2010:38) concluded that heat retainer materials found in hearths vary throughout the region.

In areas of riverine clay, the most common heat retaining material is clay balls. In the Murray, mallee landform termite nest is the most common form of heat retainer material (Martin 2010:38). Mounds were the most common site type recorded during the survey. Modified trees were the second-most common site type observed by Martin (2010). It was suggested that trees had the bark removed to create canoes, coolamons as well as for food extraction (Martin 2010:39). Martin (2010:40) found that stone artefact scatters were common throughout the area. Martin (2010:78) suggests there was a change in occupation patterns in some areas of the Hay Plain during the mid to late Holocene. The archaeological material reflects an increased occupation of permanent wetlands and the food sources contained within these wetlands. Martin also found variation in the spatial distribution of sites throughout the area, suggesting this indicated variation in past Aboriginal activities across the plain.

8.4 Ethnography and History

The first recorded European incursion into the Lower Murrumbidgee area was Charles Sturt's exploratory party of 1829-30. Sturt's expedition explored the course of the Lower Murrumbidgee, and then the Murray to its mouth at Lake Alexandrina in South Australia. Because his expedition was accomplished by navigating the rivers in a whaleboat, Sturt's observations are mainly confined to what he saw in the immediate vicinity of the rivers. Nevertheless, it provides some of the earliest descriptions of the Aboriginal people of the Murrumbidgee and Murray rivers. On the Murrumbidgee, north of Balranald, Sturt's party met a large group of Aboriginal people. He recounts the meeting:

About noon, we fell in with a large tribe of natives, but had great difficulty in bringing them to visit us. If they had *heard* of white men, we were evidently the first they had ever *seen*. They approached us in the most cautious manner, and were unable to subdue their fears as long as they remained with us. Collectively, these people could not have amounted to less than one hundred and twenty in number (Sturt 1833, Vol. II Ch. IV).

Although this first contact with the Aboriginal people living in the vicinity of Balranald was a peaceful one, on his return trip up the Murrumbidgee on the night of 21 March 1833, just to the north of Balranald, two or three Aborigines attempted to sneak up on the explorer's camp. However Sturt was waiting for them and fired two shots towards them which caused them to flee. On the following night a similar attempt was made on the camp, but this too was checked by firing warning shots between them and over their heads (Sturt 1833, Vol. II Ch. VII). Sturt was uncommon amongst explorers in his hesitation to engage in violence, and always managed to avoid bloodshed.

Having explored the Murray from its junction with the Murrumbidgee all the way to its mouth, Sturt's party travelled back up the Murrumbidgee, past the site of the present town of Balranald once more. Here he made some interesting comments on the nature of the pre-pastoral vegetation along the river.

The country, to a considerable distance from the junction on either side the Murrumbidgee, is not subject to inundation. Wherever we landed upon its banks, we found the calistemma in full flower, and in the richest profusion. There was, also, an abundance of grass, where before there had been no signs of vegetation, and those spots which we had condemned as barren were now clothed with a green and luxuriant carpet. So difficult is it to judge of a country on a partial and hurried survey, and so differently does it appear at different periods (Sturt 1833, Vol. II Ch. VII).

Sturt was followed by Mitchell whose exploring party also passed through the Balranald area in 1836. Whilst making his way down the Murrumbidgee between the Lachlan and the Murray, he recorded what is likely to be the earliest description of calcrete ‘heat retainers’ as found in Aboriginal hearths in the study area.

The common process of natives in dressing their provisions is to lay the food between layers of heated stones; but here, where there are no stones, the calcined clay seems to answer the same purpose, and becomes better or harder the more it is used. Hence the accumulation of heaps resembling small hills. Some of them were so very ancient as to be surrounded by circles of lofty trees; others, long abandoned, were half worn away by the river which, in the course of ages, had so far changed its bed that the burnt ashes reached out to mid-channel; others, now very remote from the river, had large trees growing out of them (Mitchell 1838, Vol. 2 Ch. 3.4).

Mitchell reported the same lush, grassy and reedy margins of the Murrumbidgee as Sturt had previously done. However Mitchell also ventured inland to see what the nature of the country was away from the river. Here he found sandhills, expanses of Mallee (*Eucalyptus dumosa*), and prickly bush. He was not impressed with what he saw, writing that “[t]he country we had this day traversed was of so unpromising a description that it was a relief to get even amongst common scrubs, and escape from those of the *Eucalyptus dumosa*” (Mitchell 1839, Vol. 2, Ch. 3.4).

Another observation of archaeological significance Mitchell made was on the way the Aboriginal people of the Murrumbidgee buried their dead. The graves consisted of a burial, over which was erected a small thatched hut which was enclosed by two or three low ridges of dirt in the shape of an ellipse with pointed ends. A close relative would actually sleep inside the hut on bedding of dried grass until the body had completely decomposed to nothing but bones. According to Mitchell, this custom was specific to the Aborigines of the Murrumbidgee and Murray. It is worth quoting Mitchell here at some length as he describes graves of various ages and stages, which is of direct relevance to archaeology:

On the rising ground near our camp were several graves, all inclosed in separate parterres of exactly the same remarkable double or triple ridges as those first seen on the lower part of the Lachlan. There were three of these parterres all lying due east and west. On one, evidently the most recent, the ashes of a hut appeared over the grave. On another, which contained two graves (one of a small child) logs of wood mixed with long grass were neatly piled transversely; and in the third, which was so ancient that the enclosing ridges were barely visible, the grave had sunk into a grassy hollow. I understood from The Widow that such tombs were made for men and boys only, and that the ashes over the most recent one were the remains of the hut which had been burnt and abandoned after the murder of the person whose body was buried beneath had been avenged by the tribe to whom the brother or relative keeping it company above ground had belonged (Mitchell 1839, Vol. 2, Ch. 3.4).

George Hobler, one of the earliest squatters in the area also commented on Aboriginal burial practices on the Murrumbidgee. He described an instance of Aboriginal re-use of an old grave whereby it was opened, and the body of an old man placed in it. The bark was packed upon it and the weeds scraped away for a few

yards around it. Hobler put a load of wood on top of it and burnt it to get rid of the smell of the decomposing body (Hobler, 1825-1871: Entry for 7/3/1847).

Pardoe and Martin (2001) provide an overview of historical sources that describe Aboriginal group affiliation with the country in and near the project area. Robinson (1846) notes that the natives of Lake Tala and Lake Yanga were called “the Watty Watty” with the “Mutte Mutte” lower down the junction of the Murrumbidgee. Robinson described the two groups as speaking the same language. Cameron (1899) suggested that the Wathi Wathi, were located from about Balranald to the junction of the Lachlan with the Murrumbidgee. Pardoe and Martin (2001: 19) interpret the language group boundary as occurring around the present town of Balranald and the two groups most likely amalgamating in the historic period.

In the wake of the explorers came the squatters. As Australia’s wool industry started booming, demand for pasture rapidly outgrew the amount of surveyed land available for purchase or lease. Pastoralists pushed out far beyond the official ‘limits of location’ to find and claim the choicest tracts of land. From the mid-1840s squatters began droving flocks of thousands of sheep and hundreds of cattle from the settled areas of NSW to the Murrumbidgee, and established vast stations along both sides of the river.

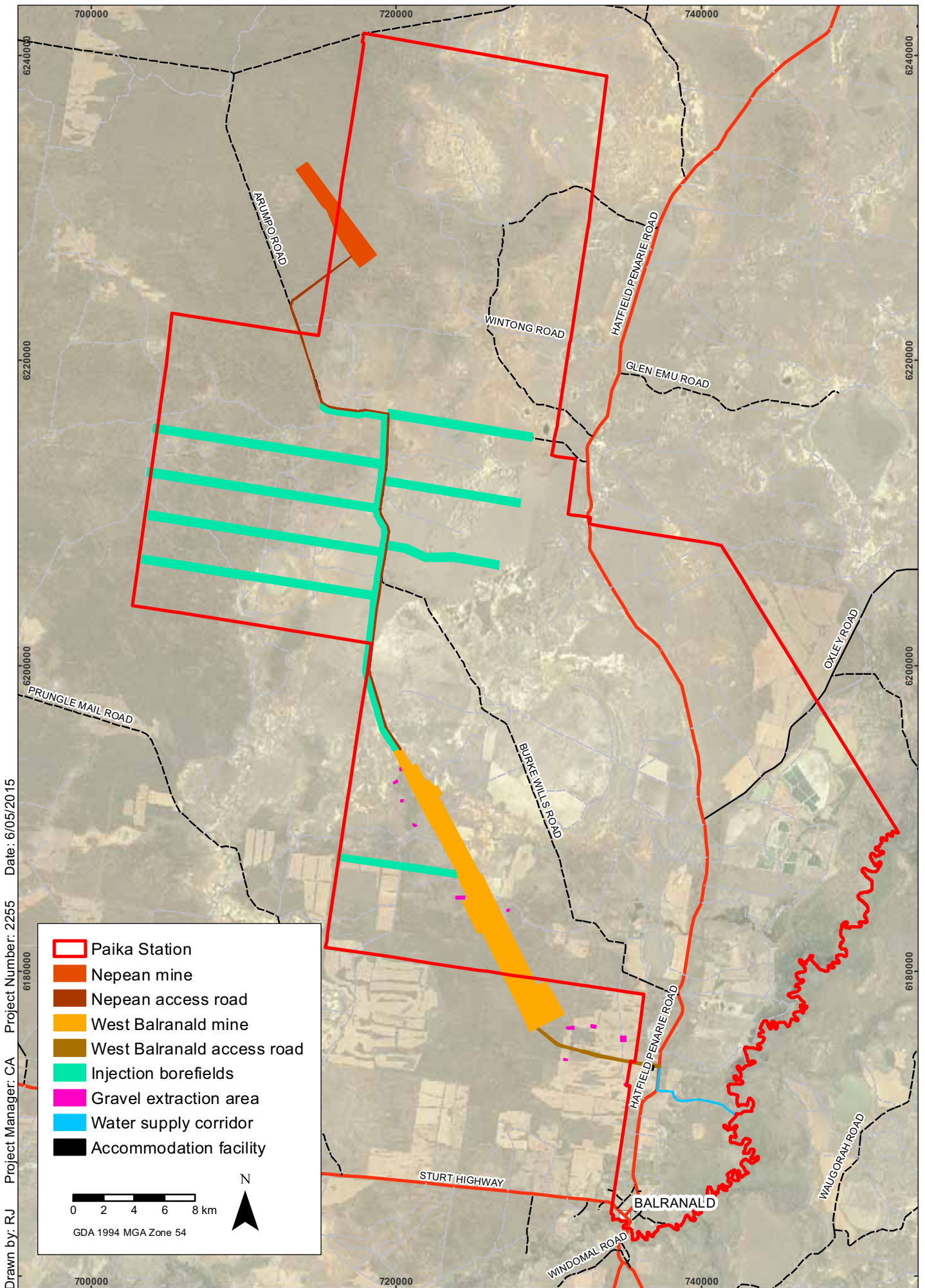
George Hobler, established ‘The Lake’ station (later renamed to Nap Nap) on the southern side of the Murrumbidgee in 1845, and Paika the following year. We are fortunate to have George Hobler’s journal which records in detail his observations and experiences with the Aboriginal people living there at the time of first contact with Europeans. When Hobler had his first meeting with a group of local Aboriginal people soon after arriving, he noted that only one of them had seen a horse or a white man before (Hobler, 1825-1871: Entry for 19/3/1845). Although this first meeting was a peaceful one, once of the first things he did was distribute firearms to his hut-builders and shepherds for self-defence (Hobler, 1825-1871: Entry for 19/3/1845).

Paika station, which in 1851 occupied over 50 km of river frontage (*Argus*, January 1, 1851: 3F), originally encompassed the project area (Figure 12). Hobler was first shown Paika Lake by a local Aboriginal guide he had procured who called it “Pakee” (Hobler, 1825-1871: Entry for 15/5/1846). Hobler then explored the back country (inland towards the current project area) which he described as well-grassed but lacking in any water and therefore better suited to cattle than sheep (Hobler, 1825-1871: Entry for 20/5/1846). His description of the native wildlife present in the area at the time of first settlement is of interest because it provides an insight into the variety of game that would have been available to the Aboriginal people prior to the introduction of European species. A multitude of swans were on Paika Lake, as well as many emus, an abundance of kangaroos, and many bustards (‘bush turkey’) (Hobler, 1825-1871: Entry for 20/5/1846). Added to these food sources were snakes, lizards, grubs and crows (Hobler, 1825-1871: Entry for 31/3/1848). He also found some creatures he was unfamiliar with such as a “...snake about 15 inches long having 4 legs the 2 near the head, little flippers 2 hind ones more perfect” (Hobler, 1825-1871: Entry for 5/9/1846). This may have been a frill-necked lizard. He also scratched out of a hole what he described as:

...a small kind of native cat not above 3 ½ inches long in the body – grey above rusty orange below – it had 12 young ones adhering to it, upon a bare patch between the hind legs no attempt at a pouch – each on its own nipple and though veins and pulsation were quite visible and all the limbs formed, they were not above the size of as many grains of wheat (Hobler, 1825-1871: Entry for 18/9/1846).

He also found a nest of “rats” with rabbit-like ears and no pouch (Hobler, 1825-1871: Entry for 18/9/1846). This may have been some kind of bush rat (*Rattus fuscipes*).

Hobler was also fascinated by the discovery of what was thought to be a bunyp skull on his neighbour's station in 1846, and his men reported sightings of these creatures in Paika Lake itself. He refers to this creature as a "Kinepratie" or "Burryin" and describes its skull as "...a round head like a man with a sort of bill-shaped jaw projecting armed with powerful teeth (Hobler, 1825-1871: Entry for 10/10/1846). The local Aboriginal people certainly believed in the existence of such a creature (Hobler, 1825-1871: Entry for 10/10/1846).



Lake Paika Station c. 1870 - 1923

Balranald Mineral Sands Project Aboriginal Cultural Heritage

FIGURE 12

The local Aboriginal people made cloaks of possum skins. They prepared the skins by scraping them with mussel shells (Hobler, 1825-1871: Entry for 22/7/1847). The Europeans brought new materials with them. Those which could be incorporated into traditional Aboriginal society were eagerly adopted. In particular demand were iron items (such as small axes/hatchets), and glass bottles, which when knapped like stone held an edge sharper than the poor quality silcrete and quartzite usually used.

Of particular relevance here is Hobler's description of the tribe who inhabited the extensive inland plains between the Murrumbidgee and the Darling (including much of the study area). He calls them the Larche Larche. About 20 of them were obliged to come to the Lachlan for water. This group were unacquainted with Europeans, wore no clothing whatsoever and could not swim (which was seen as evidence of the dry nature of their country). These inland people would deepen the depressed areas in the Mallee plains and depended entirely on surface water. They carried water by making a water bag out of a possum skin from which they had drawn all the flesh out through the neck and tied up the legs to make it water tight (Hobler, 1825-1871: Entry for 31/3/1848).

There are limited historical sources on how Aboriginal people utilised the back plains more than 20 km from the river (Pardoe and Martin 2001: 36). William Wells (Pardoe and Martin 2001: 36), in his diary of 1860, noted that Aboriginal people on the plains to the west of the lower Murrumbidgee "retire to the Murrumbidgee and Lachlan Rivers as soon as the water drives up on the plains".

It soon became clear to the local people that the Europeans intended to stay with their huts and their stock, monopolising all the best water sources, depleting the natural game, and ignoring Aboriginal laws of reciprocity. In October 1846, five Aboriginal warriors watched two stockmen ride away from the hut at Paika station, and then burst in the door and started taking away all the clothes and bedding they could find, as well as flour, after wasting a considerable quantity they couldn't carry. Inside the hut was one of the stockmen's wives who started ringing an alarm bell which had been set up for that purpose. This caused the raiders to flee and brought the stockmen back (Hobler, 1825-1871: Entry for 3/10/1846). Two days later, five of Hobler's men set out to Paika with the intention of "punishing" the Aborigines who had robbed the hut. They had two Aboriginal trackers with them, one of whose wife was kidnapped by the Mutta Mutta (Muthi Muthi) previously, from which tribe the raiders were thought to belong (Hobler, 1825-1871: Entry for 5/10/1845). After five days searching, the punitive party was unsuccessful at finding the raiders, who were thought to have escaped across the river into Taila (Tala) station. Hobler concludes the episode with "...we must be quiet 'till the stolen property makes known the thieves" (Hobler, 1825-1871: Entry for 10/10/1846).

This raid frightened Hobler's people on Paika station so much that they fled at nightfall, leaving everything behind. Hobler sent them back the next day with a dray to collect all the tools and stores. On account of his men's fears, he was forced to abandon the hut until he could find some men who would be willing to work there (Hobler, 1825-1871: Entry for 15/10/1846). The station was subsequently abandoned for seven months. If we recognise this as guerilla warfare, this represents a significant, albeit transient Aboriginal victory.

In March a group of around twenty Aboriginal warriors made a raid on the flock of one of Hobler's shepherds in the mallee. They succeeded in killing ten or eleven sheep before the shepherd came upon the raiders in a little clearing, they were huddled in a group as if they were trying to conceal the carcasses of the sheep and hide the faces of two of their number whom the shepherd recognised. However being so outnumbered, the shepherd thought it prudent to retire to his flock after a little talk with them (Hobler, 1825-1871: Entry for 25/3/1847). Hobler and his son Frank rode out with their guns but were unable to get sight of any of them, they having deserted the neighbourhood after a raid as was their usual tactic. Hobler

put the word out that he would shoot any Aborigine who came on “this” side of the river. To reinforce this point he decided to ride up the river armed twice a week, and to “increase their panic” if he had the chance (Hobler, 1825-1871: Entry for 25/3/1847).

This seems to have had its desired effect, and from then on there are no more reports of conflict between the Aborigines and Hobler. In May 1847, Paika is reoccupied and the local Aborigines there are described as “...very timid when approaching as if doubtful of the reception they are to have” (Hobler, 1825-1871: Entry for 31/5/1847).

Once the conflict ended, the Aboriginal people and the Europeans settled into a period of dual occupation of the land. By June 1847, for example, Hobler was ‘employing’ a team of six Aboriginal men and three boys to strip bark off trees and other jobs in return for food (Hobler, 1825-1871: Entry for 28/6/1847). He also opened a trade with the local people, trading fish hooks for possum skins (Hobler, 1825-1871: Entry for 11/7/1847).

By the mid-1850s the use of Aboriginal people as station workers was becoming more common. One of the catalysts for this was the Victorian gold rush, which drew a vast number of white station workers from their jobs to the goldfields, creating a sudden labour shortage. Aboriginal men proved excellent stockmen, shepherds and shearers. Local Aboriginal groups established camps near the station homesteads and to a large extent were able to maintain their connection with the land and their cultural obligations (NSW NPWS 2014: 9).

The droughts and depressions of the 1890s and later the 1930s had a profound effect on the Aboriginal people of the area. The NSW Aboriginal Protection Board report from 1895 noted:

The year has been an unfavourable one for Aborigines in the interior, the drought having rendered their means of subsistence more than usually precarious.

Native game has now become scarce in a great many districts – in some extinct; and by the discontinuance of rabbiting on nearly all sheep-stations the Aborigines have lost one of their main sources of employment (NSW NPWS 2014: 27).

As times became hard, many pastoralists abandoned their holdings or shrank their workforce, in which case the Aboriginal workers were the first to go. As a result, Aboriginal workers and their families were forced off stations (NSW NPWS 2014: 27).

In an effort to address the destitution and vulnerability Aboriginal people were suffering from in the late 19th and into the 20th century, reserves were established by the government, and Aboriginal families were encouraged to move into them. Three reserves once existed in the Balranald area (Thinee & Bradford 1998: 341-2). One of these, consisting of 142 acres was on the Murrumbidgee River at the western end of the town, and included a Mission church. In 1963 there were 70 Aboriginal residents there, in 1964 the population had fallen to 31, and by 1976 there were only 2 people left in residence (Feldtmann 1976: 17).

In 2006, the census noted 167 individuals who identified as Aboriginal and Balranald as their place of residence.

8.5 Synthesis and Predictive Model

8.5.1 Antiquity

The majority of soils in the project area will have been subject to reworking and disturbance from windblown sediments and the impacts of grazing. Many of the sites within these soils will have deflated from their original context, making it difficult to establish the antiquity of these sites.

It is assumed that Box Creek has not been an active channel in terms of floodplain deposition for the majority of the Holocene, but prior to this would have actively meandered across the plains. In most cases Aboriginal cultural and archaeological sites are therefore assumed to be Holocene in age, and will be associated with the ephemeral watercourse of Box Creek and the episodic lakes and depressions which fill during local rain events, or major flood events. The extent of erosion and likely disturbance within the West Balranald mine, injection borefields and Nepean mine landscapes and surrounding landforms observed during the preliminary results of the Balranald Project during 2012 and 2013 suggests that most open sites recorded are probably not more than 500–3,000 years old.

Within the Box Creek catchment there is likely to be some alluvial soil development. Past Aboriginal land use was likely to be concentrated within a certain distance from swamp, creek and lake margins, meaning in these areas (as opposed to the sand plains) there is some potential for buried rich open archaeological deposits which could have remained relatively undisturbed. There is some potential in areas of deeper soil accumulation (lunettes and deeper alluvium in particular) for burials to be present.

Evidence of much older occupation may also be possible within the project area, as indicated by the presence of a 17,000 year old date recovered from burnt emu egg shell to the east of the Balranald Project area from site WB 66 on the eastern Muckee Lake lunette.

The project area may also have a range of site features and landscape features that may be directly dated through radiocarbon or OSL dating or indirectly dated through environmental proxies to provide a chronology of Aboriginal land use in the project area.

The A2 horizon is the base of the top soil and the B horizon is the subsoil – the B horizon being generally more compact than the top soil is resistant to erosion, and in semi-arid environments often becomes an exposed surface onto which stone artefacts will accumulate

8.5.2 Raw Material Sources

The most common hard rock outcrops observed within the project area are calcrete or carbonate nodule deposits. These have been observed within the project area exposed on low relief ridges and sand hills. This material is used locally for heat retainers but it is unlikely to have been used as a raw material for flaked stone tools, though some cases are known to have occurred in the Willandra Lakes World Heritage Area. Many of the potential stone raw material supplies in the project area (silcrete) are likely to have been extracted from sources to the north of the project area such as the Willandra Lakes system near Lake Mungo (Bowler 1998:150-1). There are no known quarries of stone suitable for artefact manufacture located in or near the project area.

Table 7: Plant Resource Available in Project Area and associated past Aboriginal use

Resource	Traditional Uses	Location	Seasonal Availability
Belah	Good cooking wood, leaves used to flavour some meats	A very common tree on the outer sand plains on brown to reddish loam soils	Year round
Wilga	Seeds can processed to make flour	A very common tree on the outer sand plains on brown to reddish loam soils	Year round
White Cypress Pine	The sap has antiseptic properties.	Common tree on the sandplains	Year round
Bush banana/Bush Pear	Fruit, seeds and roots eaten	Occur in the mallee sand plains.	November to April
Bulrush	Roots can be eaten	In waterways	Year round
Mallee fringe lily	Yam-like root can be eaten raw	Occurs in the sand plains.	Leaves annual, very short flowering period in spring.
Rosewood	Fruit can be eaten raw. Seed can be processed into flour.	Present on the sandplains, often in groves in belah/pine country	Year round
Inland Pig Face	Edible succulent	Not uncommon on shallow, rocky or deep sandy soils in Mallee communities.	Flowers in spring and summer.
Snotty gobble	Fruit eaten raw	Abundant in sand dunes and sand plains.	Flower and fruits in summer.
Ruby saltbush	Fruit eaten raw	Common on well drained sandy landforms.	Flowers in spring and early summer
Old man's beard	Medicine plant	Common vine on sandplains, generally on hard red soils	Year round.
Spinifix (Porcupine grass).	Gum from seeds used for hafting tools	Very common on sand dunes	Year round, especially abundant after rainfall.
Yam	Yam root can be eaten raw and a good source of moisture	Found to be present in sandy areas	Mostly year round, more abundant in spring and summer.
Emu	Eggs and meat cooked and eaten	Common across project area	Year round, breeding season December and January.
Mallee fowl	Eggs cooked eaten	Present in sand dunes, currently very rare.	Eggs available February to April
Kangaroo	Meat cooked and eaten	Common across project area	Year round
Ducks	Eggs and meat cooked and eaten	Common in the riverine environment	September to November
Heron	Meat cooked and eaten	Common in the riverine environment	October to December
Pelican	Meat cooked and eaten	Common in the riverine environment	Late spring throughout summer.

8.5.3 Site Types and Features

Table 12 synthesis Sections 8.1, 8.2 and 8.3 and summarises the possible and known site types and site features that might occur within the project area, their associated activities and material traces and the

landscape features that they might be associated with. Stone artefacts and hearths will comprise the majority of Aboriginal sites within the project area.

Table 8: Summary of Predicted Aboriginal Sites and Features within the Project Area

Site Features	Behaviour and Activities	Material Traces	Potential to Occur in the Project Area	Landscape features
Mounds	Cooking ovens, habitation site, plant processing.	Burnt and/or ashy sediment, heat retainers, raised earth, ashy, animal bones Oyster, Freshwater mussel, Turtle shell, fish bones, water fowl bones, animal bones.	Unlikely to occur within the project area due to distance from rivers.	Rivers
Hearths	Cooking, food selection, habitation.	Heat retainers of burnt clay, burnt termite mound, calcrete, stone. Burnt sediment. Charcoal. Animal bones, stone artefacts.	Likely to occur. See distribution model for more details.	Anywhere
Middens	Cooking, disposal, food selection, habitation.	Oyster, Freshwater mussel, Turtle shell, fish bones, water fowl bones, animal bones.	Occasionally in association with lunettes and source bordering dunes.	Lunettes, source bordering dunes, rivers
Culturally Modified Trees	Bark removal for shelters, canoes, shields, coolamons, food, grub or possums hunting, burial huts.	Box trees. Stone or steel hatchet marks. Shape, height. Age of tree.	Occasionally will occur in project area where mature age trees are still present.	Shallow groundwater, available surface water
Burials	Treatment of the dead.	Raised earth mounds, raised ridges of earth, grave cut depressions, ashy or burnt sediment, calcified bone, bone.	Occasionally may occur in the project area.	Lunettes, source bordering dunes, levees, lakes but could occur anywhere.
Stone artefacts	Technological choices, movement through the landscape, food processing, day to day activities.		Likely to occur anywhere, see artefact distribution model for more details.	All

9. Survey and Project Methodology

A number of field programs of archaeological survey were completed for the project.

A proposed survey and project methodology for the Project ACHA was presented to the RAPs on 14 September 2012. A copy of the proposed methodology is presented in Appendix 4. The proposed methodology follows the:

- Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation (DEC, 2005).
- ACHCRs (DECCW, 2010a).

As part of the development of the proposed methodology, a sampling strategy for any archaeological survey of the project area was developed. The aim of the survey sample strategy was to collect sufficient information to characterise the archaeological record and archaeological potential of the project area so as to enable the development of appropriate management recommendations.

At the beginning of each field program, a broad layout of project elements was provided, and it was this footprint that dictated the initial parameters of the survey area for each survey program. These areas tended to be larger than the area that would actually be disturbed to enable flexibility for changes that may occur during detailed design and operation.

The survey area was then divided into the Western NSW land systems. A sample of each of the land systems was then surveyed. A proportional emphasis was placed on alluvial plains, playas and basins, based on the results of other archaeological surveys in the wider region. Less emphasis was placed on sand plains, sand dunes and areas with reduced archaeological visibility.

Survey teams walked a series of transects through the survey area and land systems. All survey transects were conducted on foot. The number of participants in a transect ranged between six and 16 individuals. Survey participants were generally spaced between 10 m and 20 m apart. These were labelled and recorded on transect recording forms. Environmental variables such as overall land system, landform, disturbance, slope, distance from water, exposure, visibility, soils, vegetation and representative photographs were recorded for the survey units. These units were recorded as polygons with a start and finish point in a GIS to form a survey coverage dataset (Appendix 5). In most cases GPS track logs were also collected. The boundaries of transects were defined by landforms, project elements and other arbitrary termination points such as property boundaries, roads, fencelines and the timing of progress.

Survey participants flagged any suspected archaeological material and Aboriginal objects. Individuals were encouraged to fully search areas with the greatest exposure, such as scalds and eroded surfaces, openings in vegetation and cuttings. Sites were recorded on pre-prepared forms and handheld GPS with an average accuracy of ± 7 m. To define the boundary of a site, a distance of 40 m between visible Aboriginal objects was arbitrarily selected. In some cases, landform features were used to define site boundaries. Site data was then added to a GIS to form a point and polygon dataset (Appendix 6).

Basic attribute recording of artefacts was completed in line with the AHIMS Site Recording Forms for a sample of up to 300 artefacts per site. Where artefacts exceeded the 300 artefact sampling, a rough estimate or count was taken for the remainder of the site. Artefact data was then recorded in a GIS to form a dataset of features within sites. In some cases, sample areas were selected and the artefacts within these recorded (e.g. at Aboriginal site WB 40).

The GIS datasets of transect, Aboriginal site and artefact data were then incorporated into a series of GIS datasets to form the basis of the Iluka Balranald Project Aboriginal Heritage Database. The database consists of the location of Aboriginal sites, Aboriginal site boundaries and past archaeological survey transects for all archaeological investigations in the project area including the EIS field programs, the due diligence assessments and the AHIMS results. The database provides the most up-to-date account of Aboriginal sites in the project area as a large number of Aboriginal sites within the Balranald Project area were submitted to AHIMS, but are yet to be accessioned into the register.



Plate 11: Example of participant spacing during survey of transects



Plate 12: Examples of survey participant spacing

10. Results

10.1 Cultural Heritage Survey

The cultural heritage survey for the Balranald Project EIS was conducted over three field programs between 2012 and 2014. The field programs involved a total of 535 person days of survey. Survey conditions across all field programs were excellent, with the exception of approximately five high temperature and high wind days. Figures detailing the results are provided in Figure 13 to Figure 31.

10.1.1 2012 EIS Field Program

The 2012 EIS field program was conducted over a 25 day period during July and October 2012 and was led by Giles Hamm. The field team comprised three archaeologists and five Aboriginal sites officers from the RAPs. The investigation area comprised 10,137 ha and included a preliminary, now superseded, footprint for the West Balranald and Nepean mines and access roads. Priority was given to those areas within the West Balranald and Nepean mine footprint and to areas expected to have greater than 20% visibility. 628 ha were surveyed.

10.1.2 2013 EIS Field Program

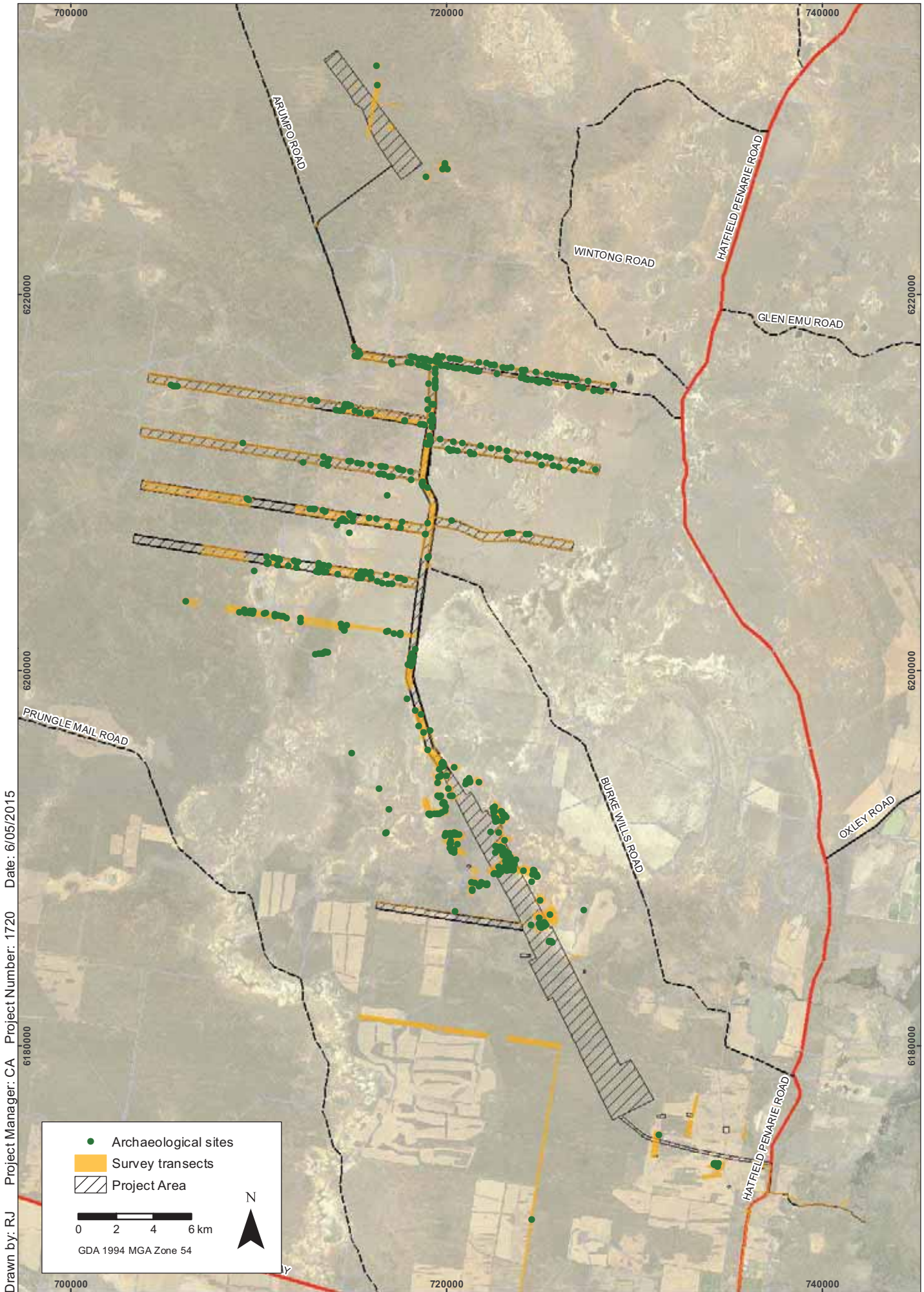
The 2013 EIS field program occurred over 12 days from 21 October 2013 to 1 November 2013 and was led by Clare Anderson and Amanda Atkinson. The field team comprised four archaeologists and six Aboriginal sites officers from the RAPs. The investigation area was a 4000 ha area which included footprints for a now superseded accommodation facility option, injection borefield location options, Nepean access road intersection upgrade, pipeline corridor options and preliminary, now superseded, footprints for gravel extraction areas. 963 ha were surveyed.

10.1.3 2014 EIS Field Programs

The 2014 EIS field programs were conducted over two periods.

The first occurred between the 7 and 18 October 2014 and was led by Clare Anderson. The field team comprised four archaeologists and six Aboriginal sites officers from the RAPs. The investigation area provided was 2600 ha in area and included additional injection borefield locations, the accommodation facility and options for a water supply pipeline from the Murrumbidgee. 841 ha were surveyed.

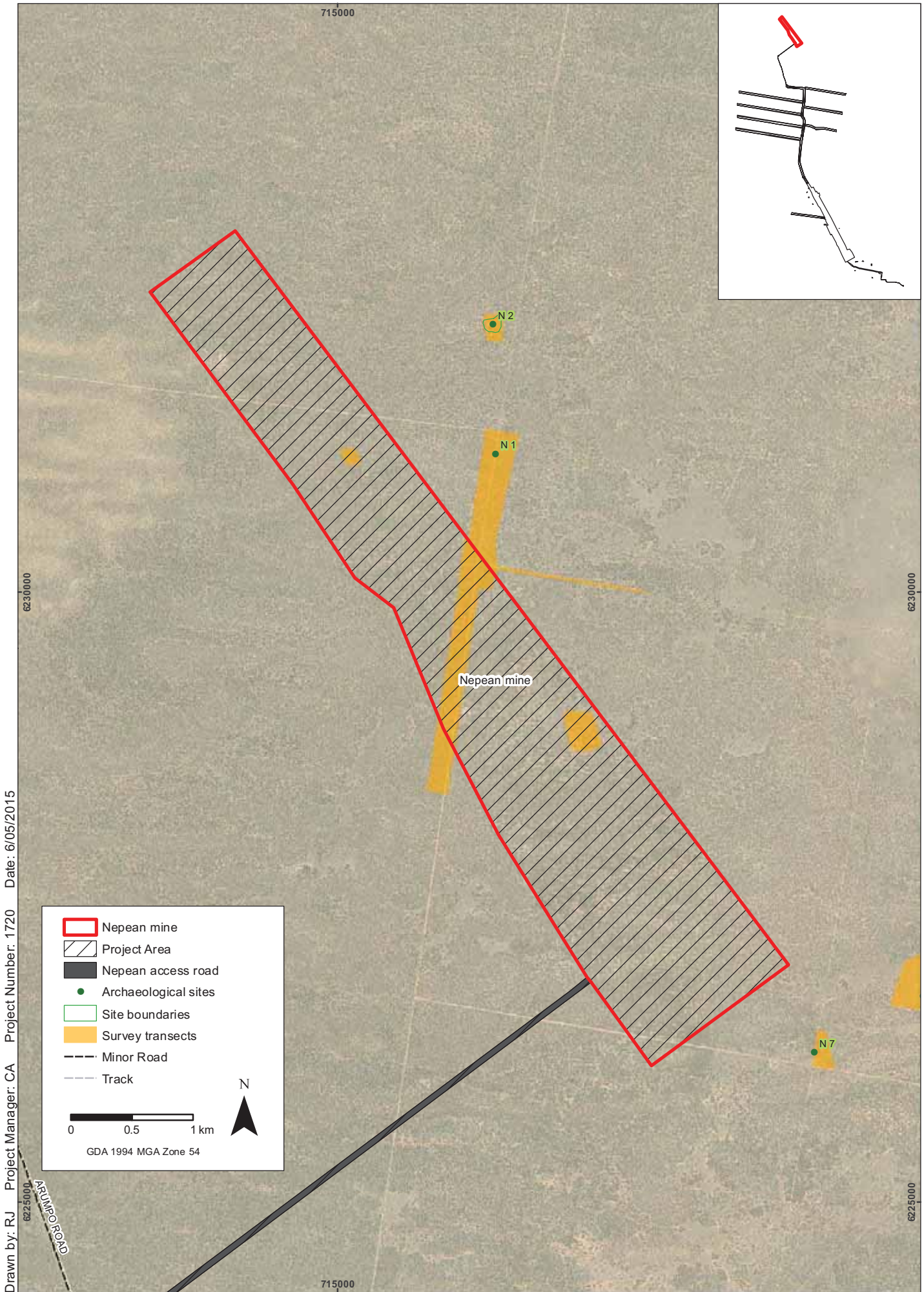
The second occurred between 8 and 20 December 2014. The field team included eight archaeologists and eight Aboriginal sites officers from the Registered Aboriginal Parties. The investigation area provided was 3300 ha with an expected disturbance area of 660 ha and consisted of additional injection borefield areas. 1125 ha were surveyed.



Survey Results: Overview
 Balranald Mineral Sands Project Aboriginal Cultural Heritage

FIGURE 13

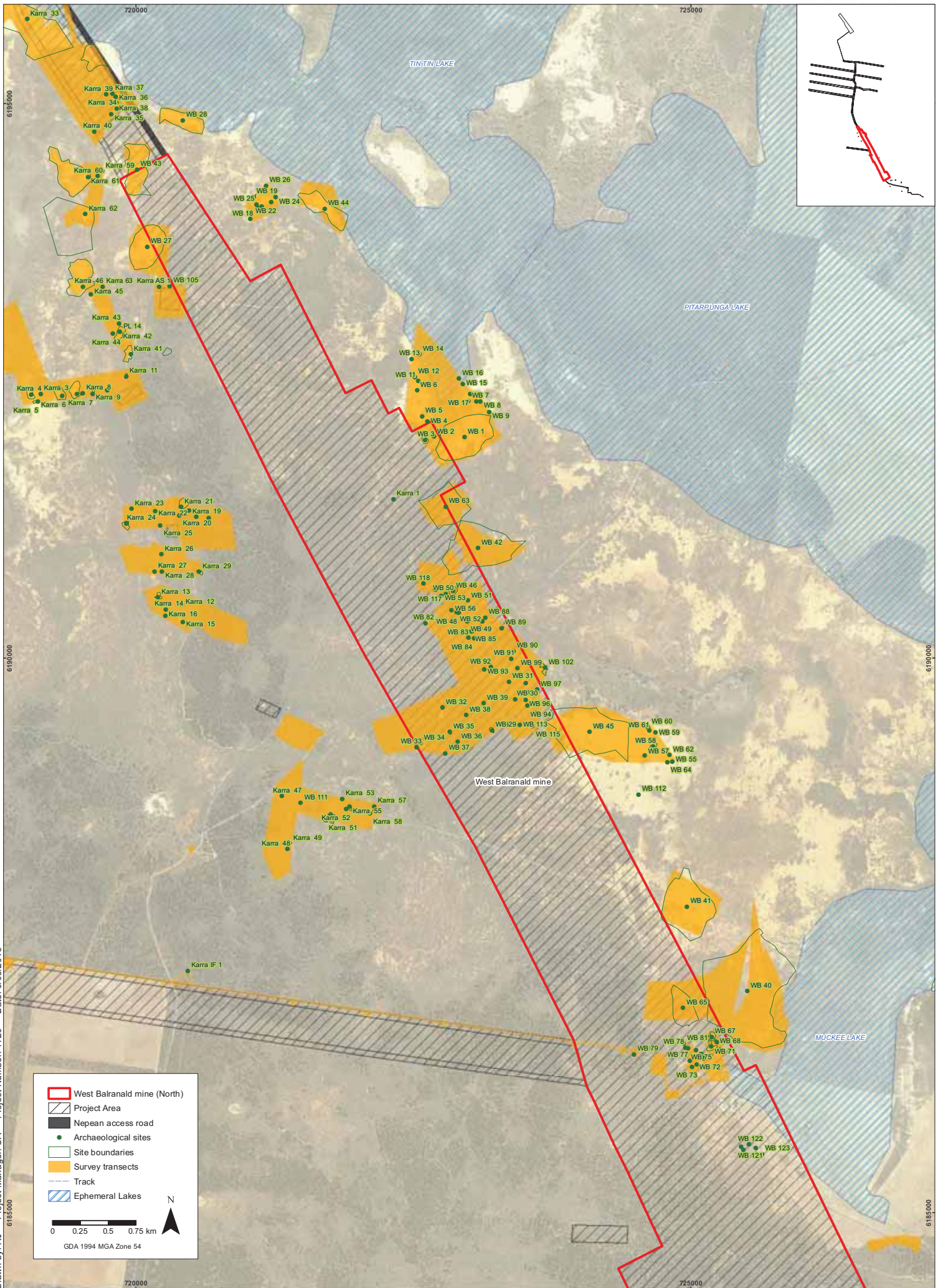
Imagery: (c) Iluka



Survey results: Nepean mine
Balranald Mineral Sands Project Aboriginal Cultural Heritage

FIGURE 14

Imagery: (c) Iluka



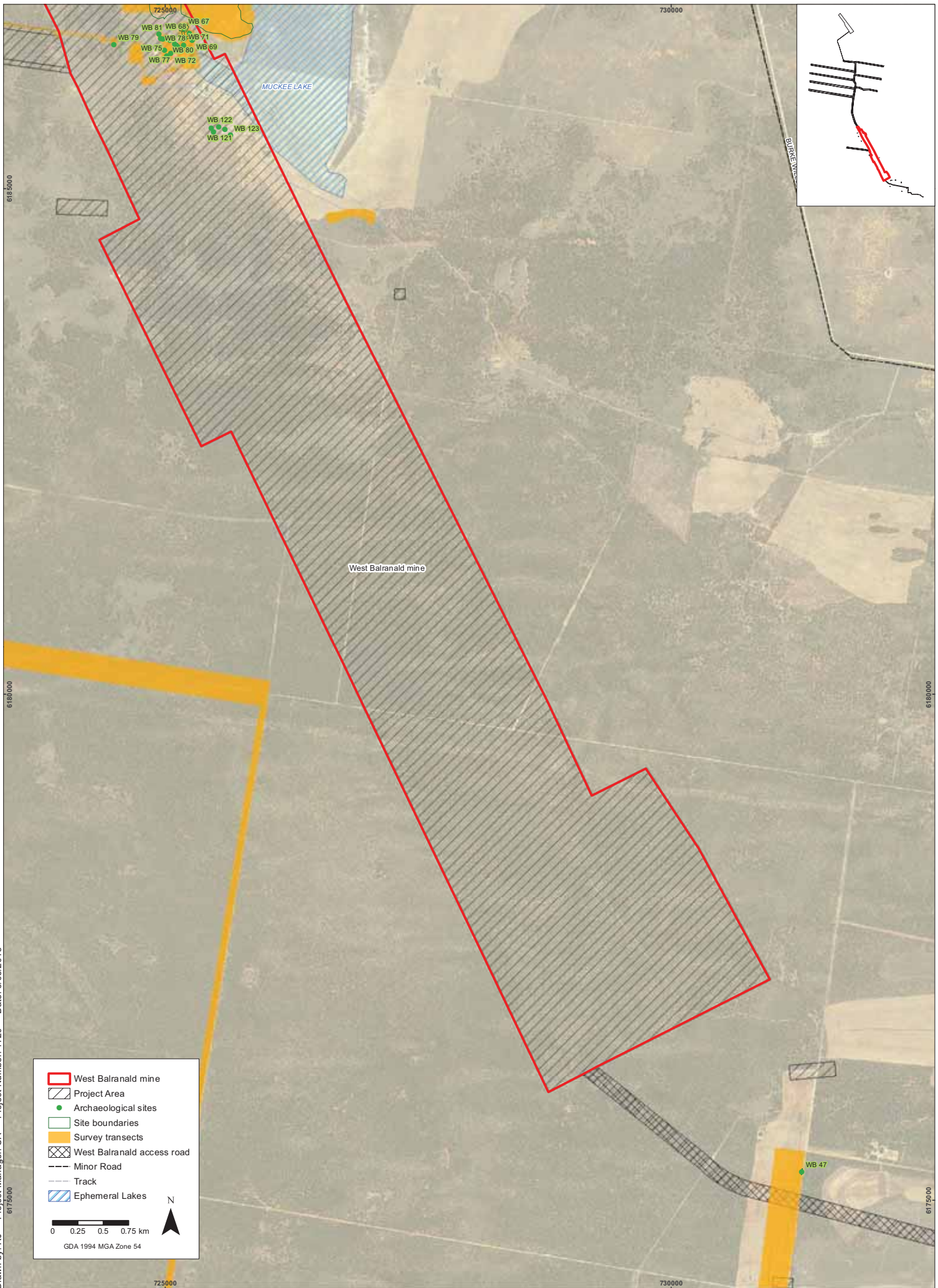
Drawn by: R.J. Project Manager: CA Project Number: 1720 Date: 6/05/2015

Survey results: West Balranald mine (North)

Balranald Mineral Sands Project Aboriginal Cultural Heritage

FIGURE 15

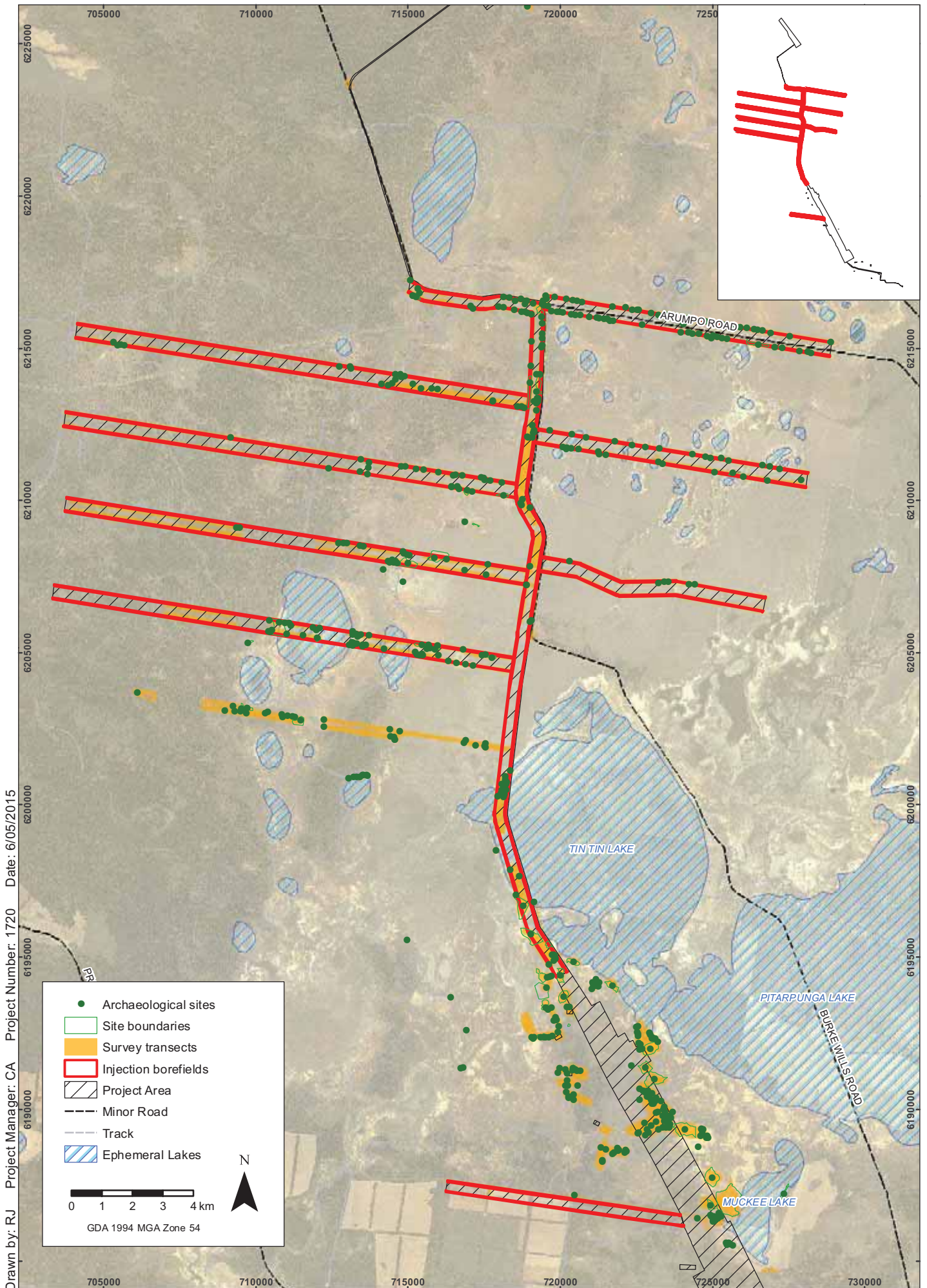
Imagery: (c) Iluka



Drawn by: R.J. Project Manager: CA Project Number: 1720 Date: 6/05/2015

Survey results: West Balranald mine (South)
Balranald Mineral Sands Project Aboriginal Cultural Heritage

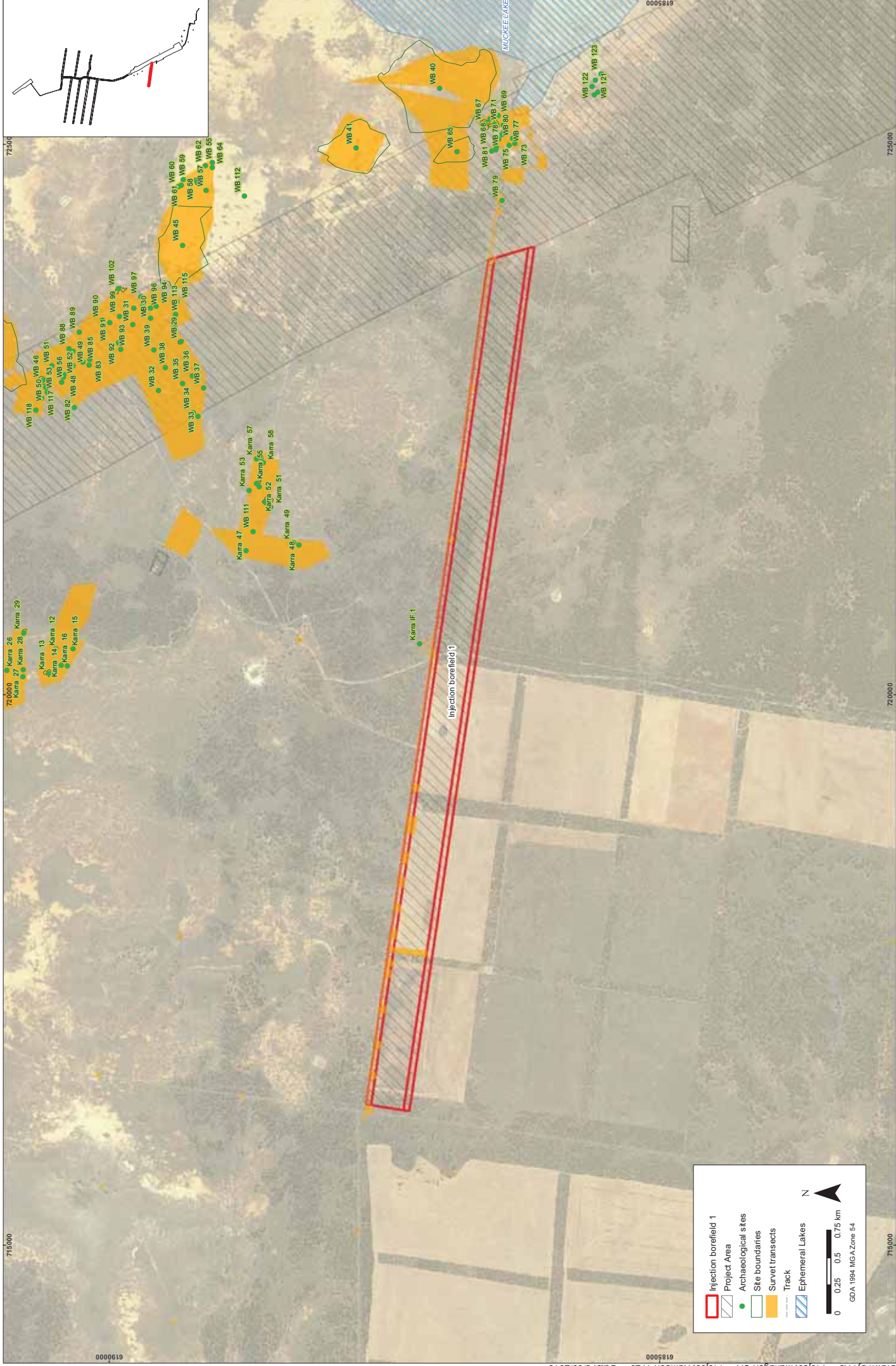
FIGURE 16
Imagery: (c) Iluka



Survey results: Injection borefields overview
 Balranald Mineral Sands Project Aboriginal Cultural Heritage

FIGURE 17

Imagery: (c) Iluka



Drawn by: RJ Project Manager: CA Project Number: 1720 Date: 6/05/2015

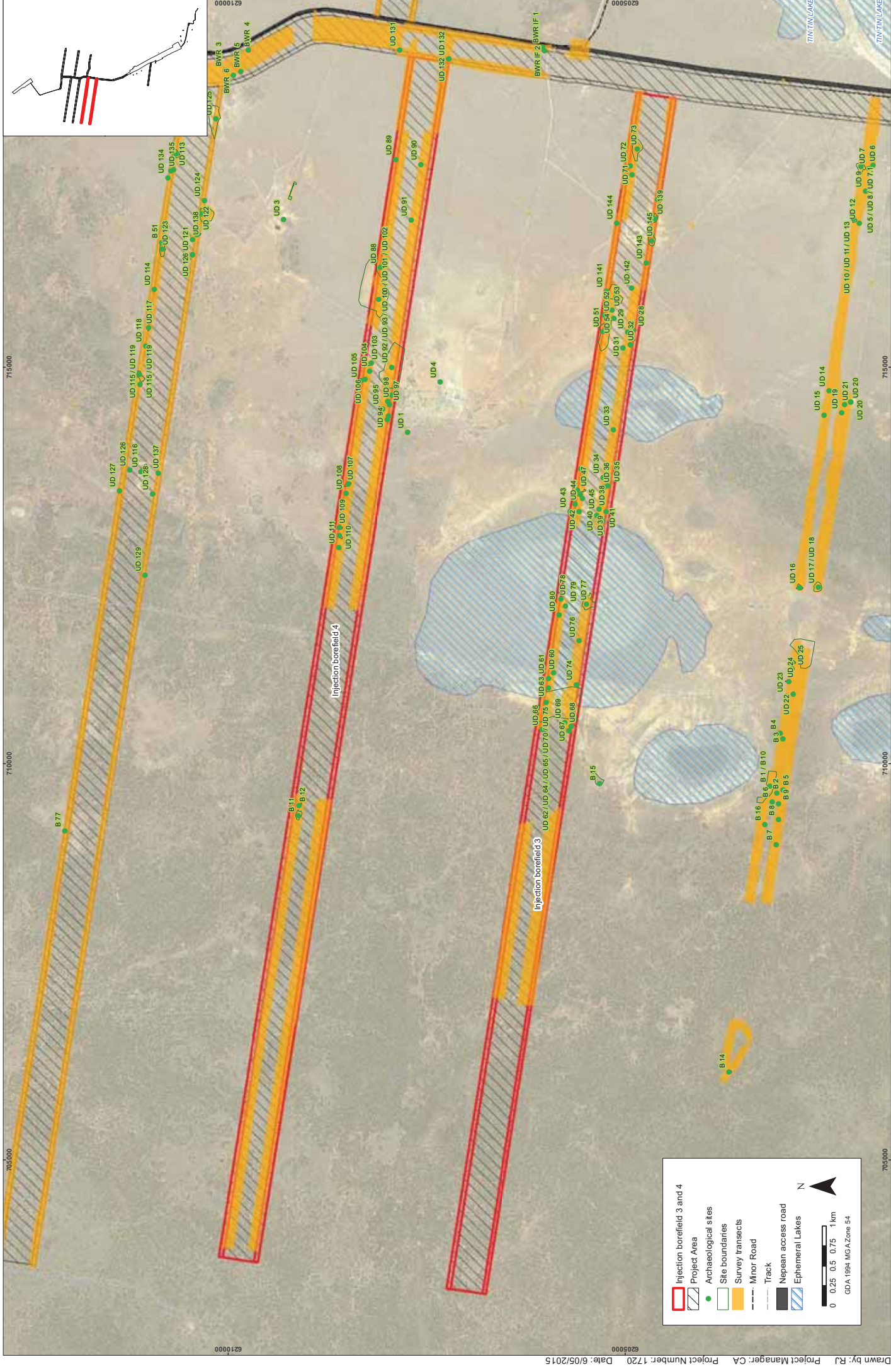
Injection borefield 1

Balranald Mineral Sands Project Aboriginal Cultural Heritage

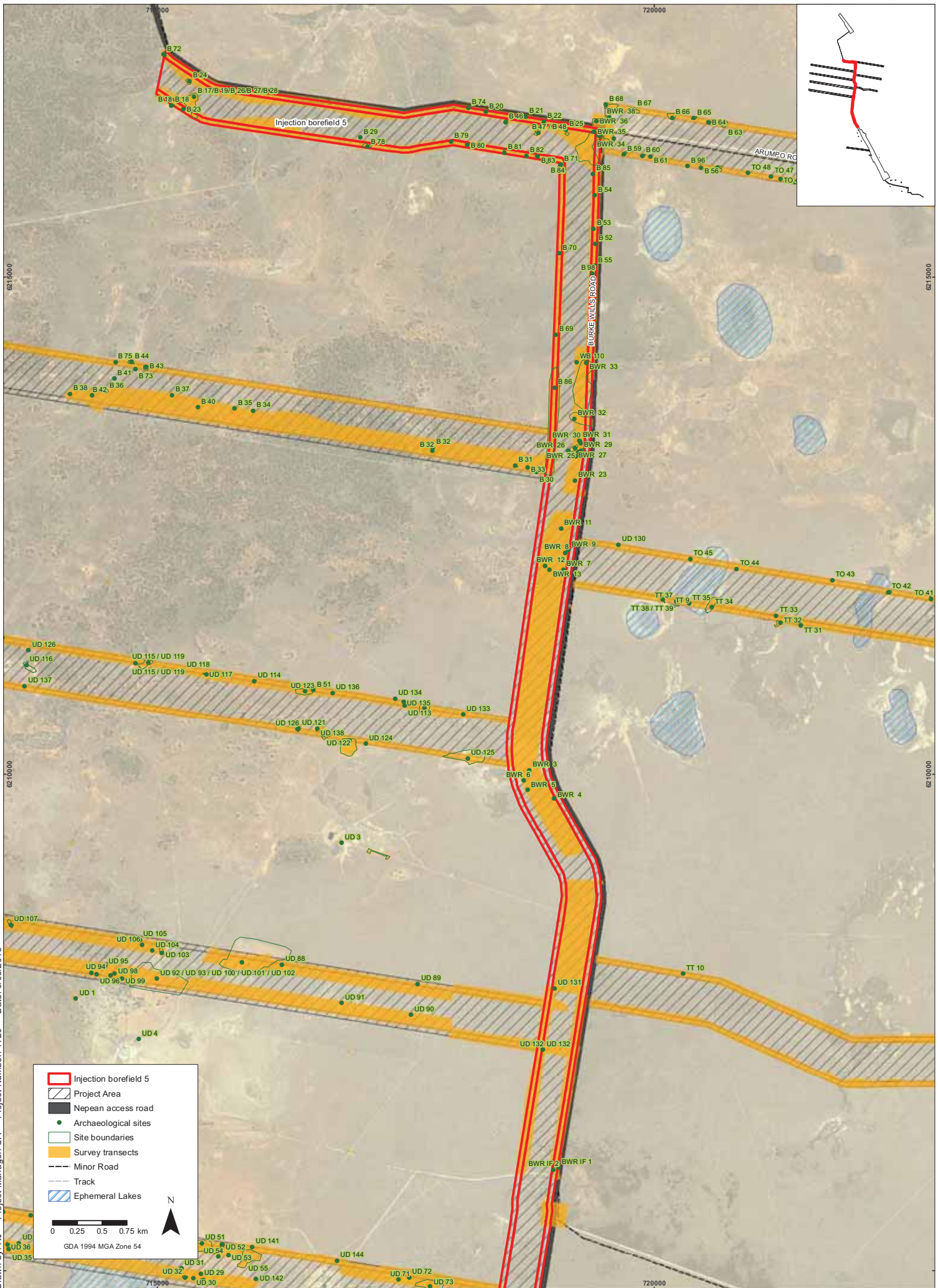
FIGURE 18

Imagery: (C) Iluka

Path: T:\spatial\projects\1700\1720_Balranald\Maps\report_20150216\1720_Figure_18_Results\Injection1.mxd

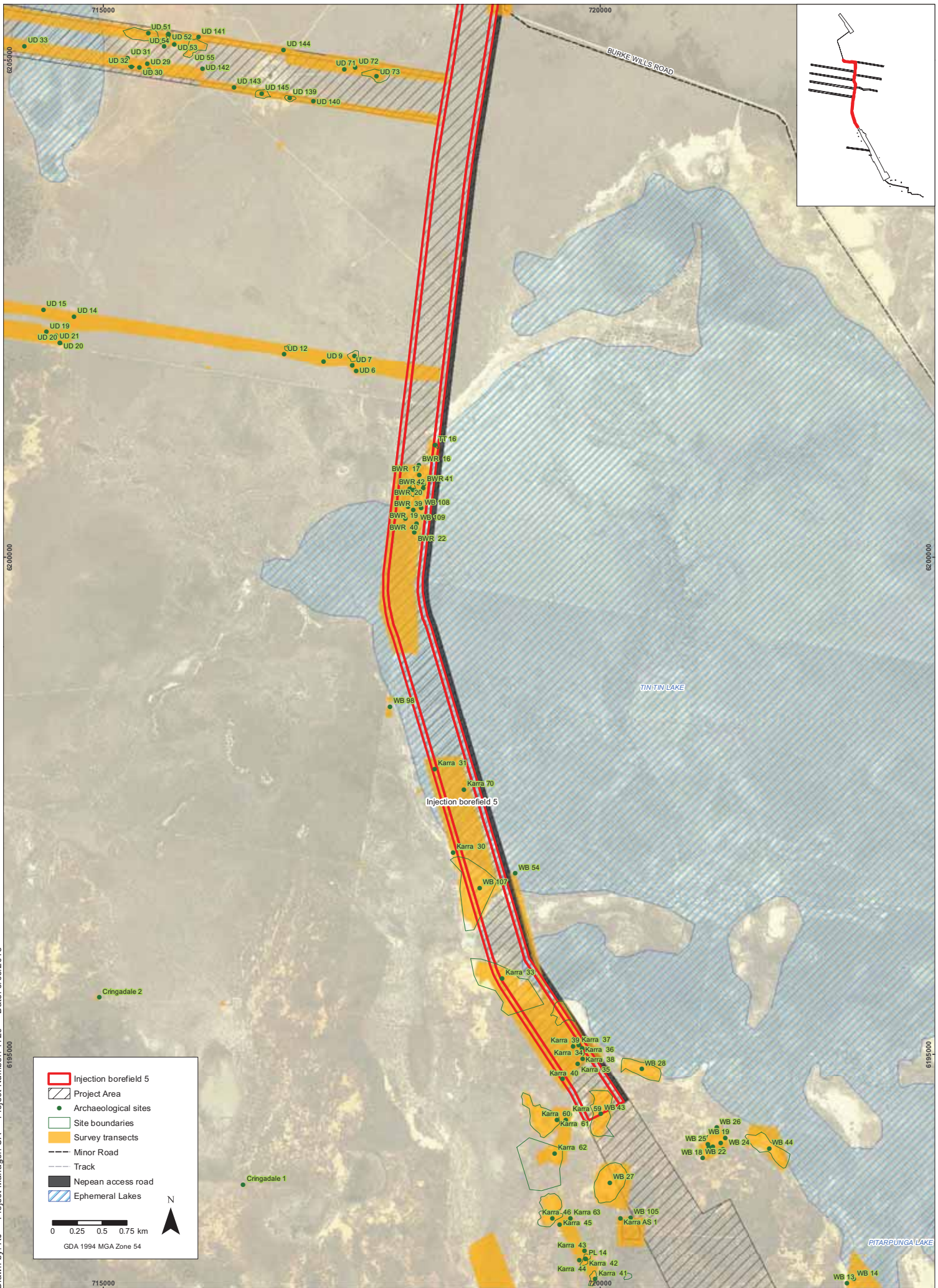


Survey results: Injection borefields 3 and 4
 Balranald Mineral Sands Project Aboriginal Cultural Heritage
FIGURE 19
 Imagery: (C) Iluka



Drawn by: R.J. Project Manager: CA Project Number: 1720 Date: 6/05/2015

Survey results: Injection borefield 5 (North)
Balranald Mineral Sands Project Aboriginal Cultural Heritage



Drawn by: R.J. Project Manager: CA Project Number: 1720 Date: 6/05/2015

Survey results: Injection borefield 5 (South)
Balranald Mineral Sands Project Aboriginal Cultural Heritage

FIGURE 21
Imagery: (c) Iluka



	Injection borefield 6
	Project Area
	Archaeological sites
	Site boundaries
	Survey transects
	Minor Road
	Track
	Nepean access road
	Ephemeral Lakes

0 0.25 0.5 0.75 km
 GDA 1984 MGA Zone 54

Drawn by: RJ Project Manager: CA Project Number: 1720 Date: 6/05/2015



705000 710000 715000 6215000 6210000 6210000 705000 710000 715000

Injection borefield 7

- Project Area
- Archaeological sites
- Site boundaries
- Survey transects
- Minor Road
- Track
- Nepean access road
- Ephemeral Lakes

0 0.25 0.5 0.75 1 km
GDA 1984 MGA Zone 54

Drawn by: RJ Project Manager: CA Project Number: 1720 Date: 6/05/2015

Survey results: Injection borefield 7

Bairnald Mineral Sands Project Aboriginal Cultural Heritage

FIGURE 23

Imagery: (C) Iluka





Drawn by: RJ Project Manager: CA Project Number: 1720 Date: 6/05/2015

Survey results: Injection borefield 8

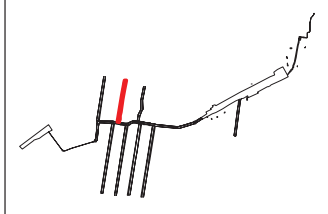
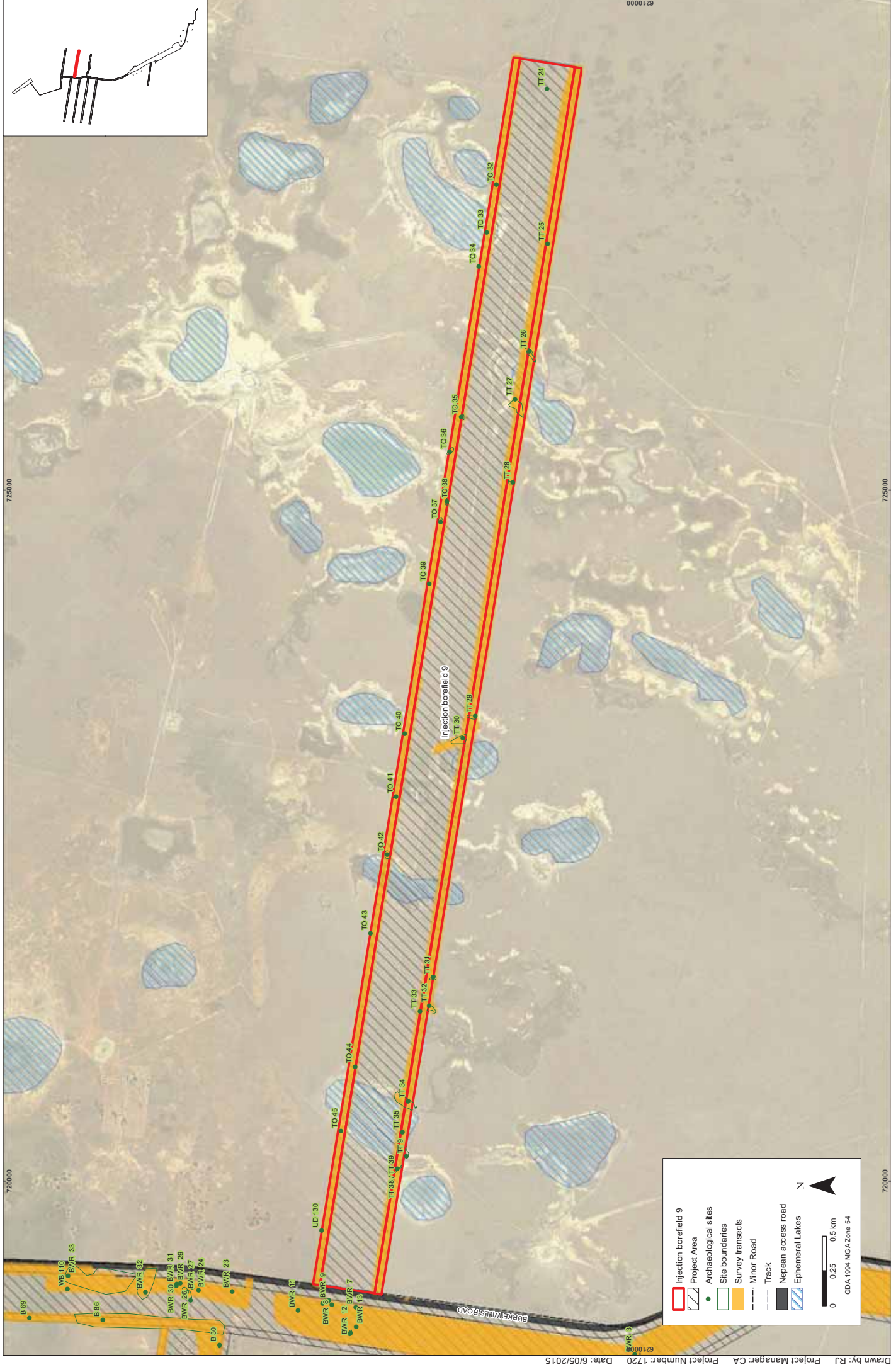
Balranald Mineral Sands Project Aboriginal Cultural Heritage

FIGURE 24

Imagery: (C) Iluka



Path: T:\spatial\projects\1700\1720_Balranald\Maps\report_20150216\1720_Figure_24_ResultsInjection8.mxd



Survey results: Injection borefield 9
Balranald Mineral Sands Project Aboriginal Cultural Heritage
FIGURE 25
Imagery: (C) Iluka

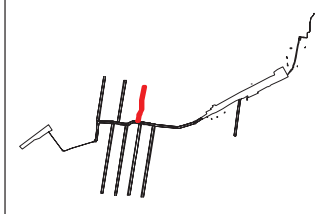




Injection borefield 10

- Injection borefield 10
- Project Area
- Archaeological sites
- Site boundaries
- Survey transects
- Minor Road
- Track
- Nepean access road
- Ephemeral Lakes

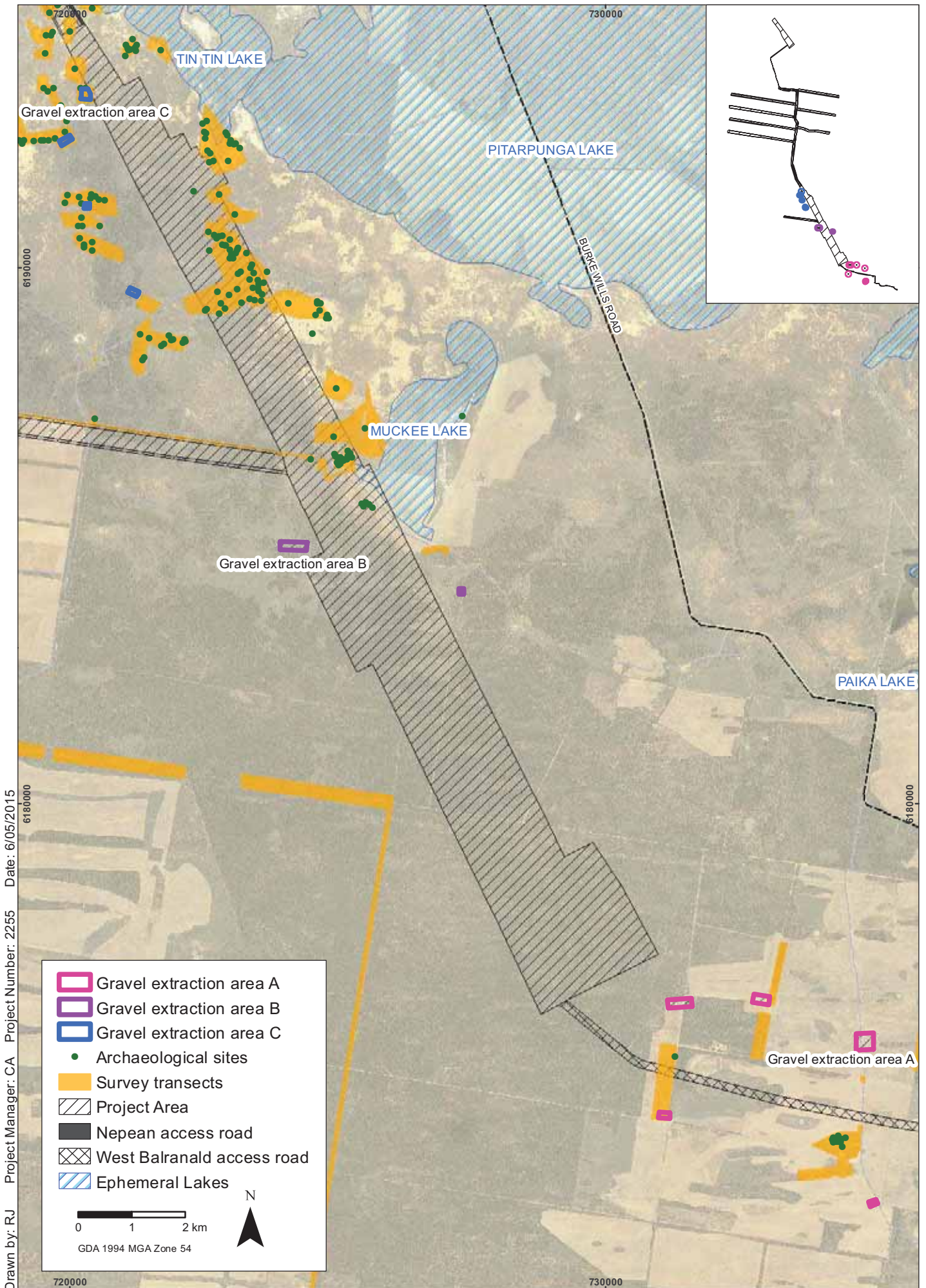
0 0.25 0.5 km
GDA 1994 MGA Zone 54



Drawn by: RJ Project Manager: CA Project Number: 1720 Date: 6/05/2015



Path: T:\spatial\projects\1700\1720_Balranald\Maps\report_20150216\1720_Figure_26_ResultsInjection10.mxd



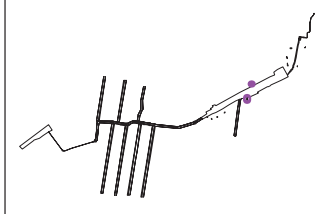
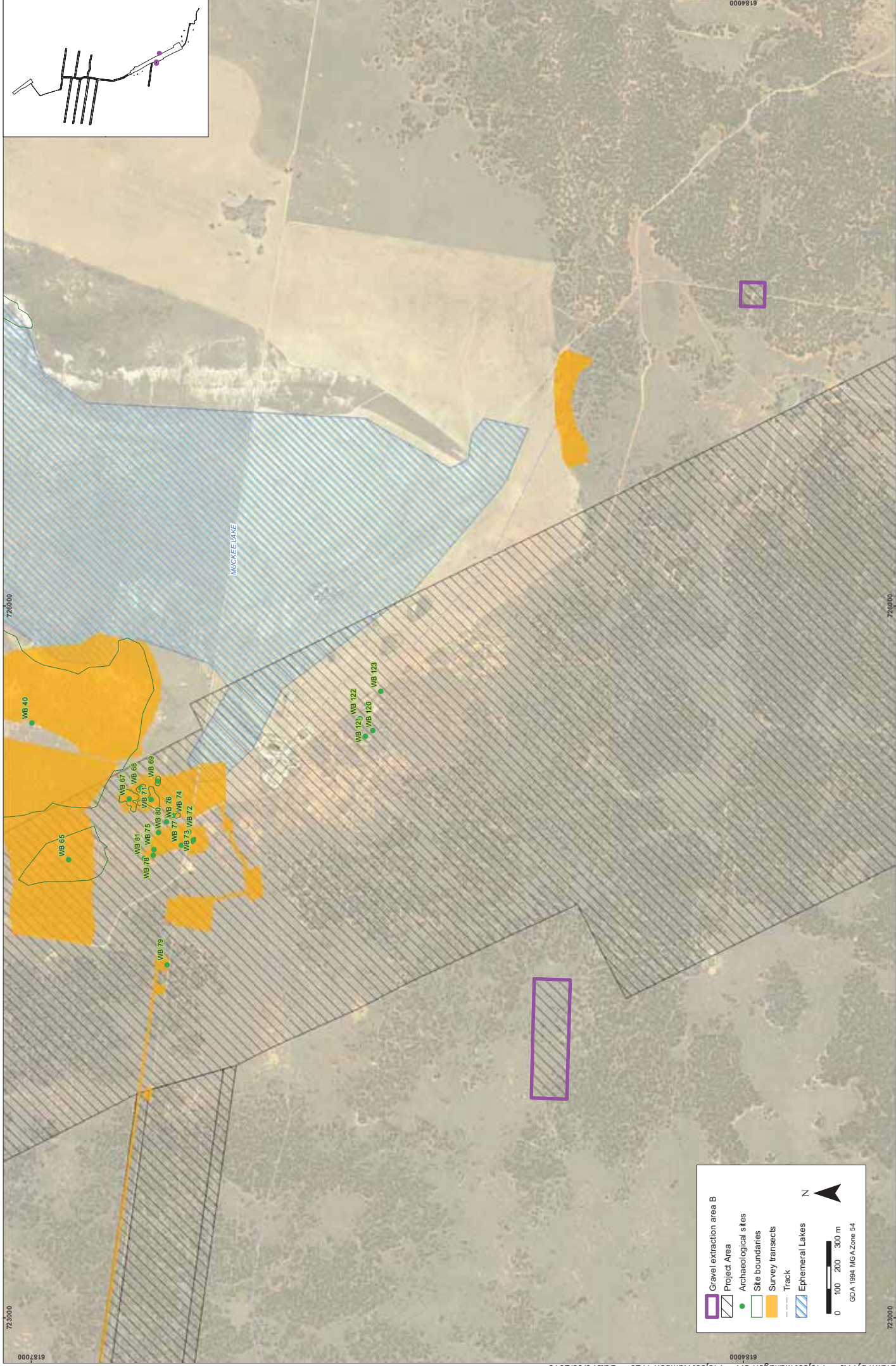
Survey Results: Gravel extraction locations overview
Balranald Mineral Sands Project Aboriginal Cultural Heritage

FIGURE 27

Imagery: (c) Iluka



Survey results: Gravel extraction area A
 Balranald Mineral Sands Project Aboriginal Cultural Heritage
FIGURE 28
 Imagery: (C) Iluka



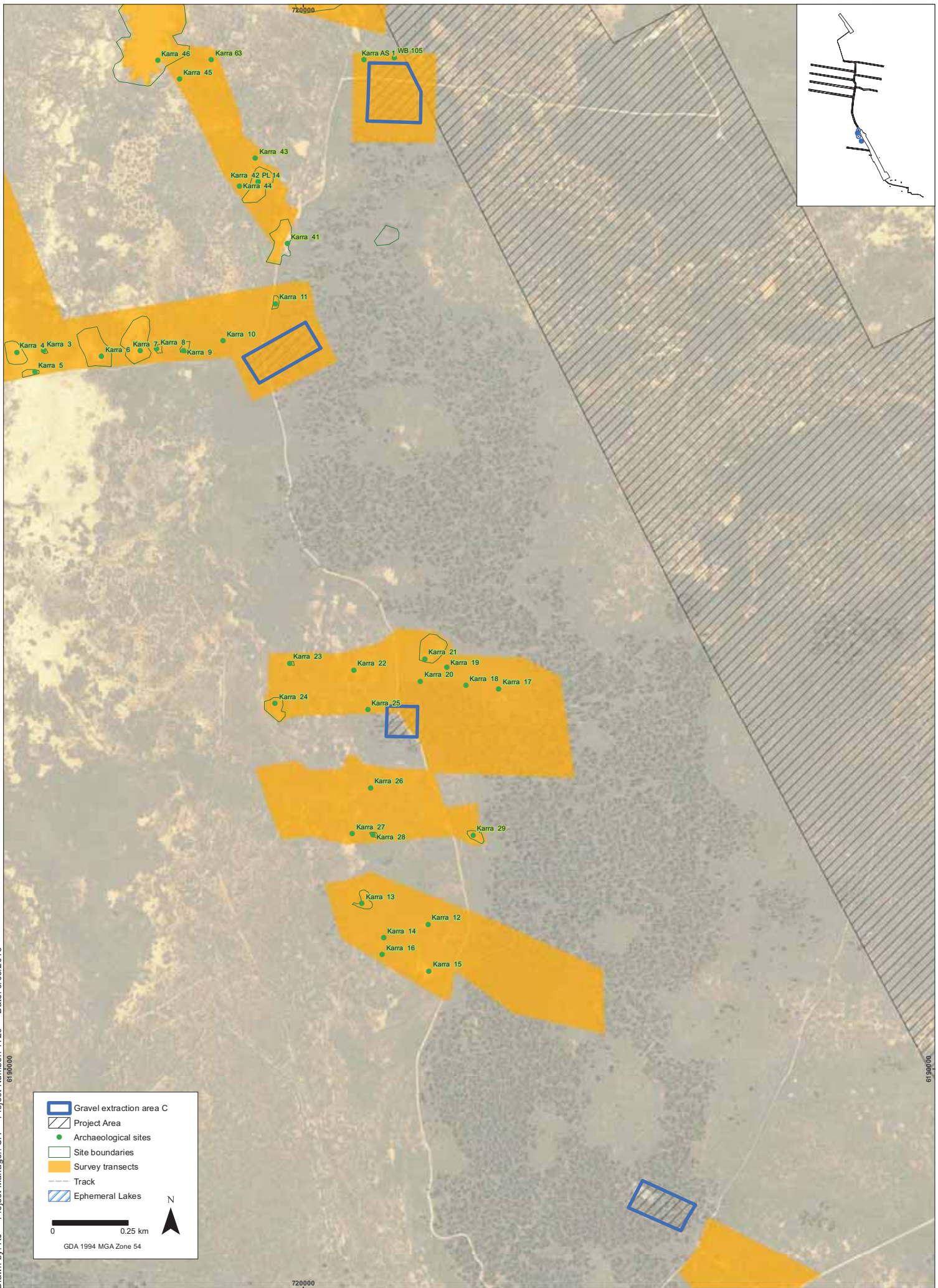
Gravel extraction area B
 Project Area
 Archaeological sites
 Site boundaries
 Survey transects
 Track
 Ephemeral Lakes

0 100 200 300 m
 GDA 1984 MGA Zone 54

N

Survey results: Gravel extraction area B
 Balranald Mineral Sands Project Aboriginal Cultural Heritage
FIGURE 29
 Imagery: (C) Iluka

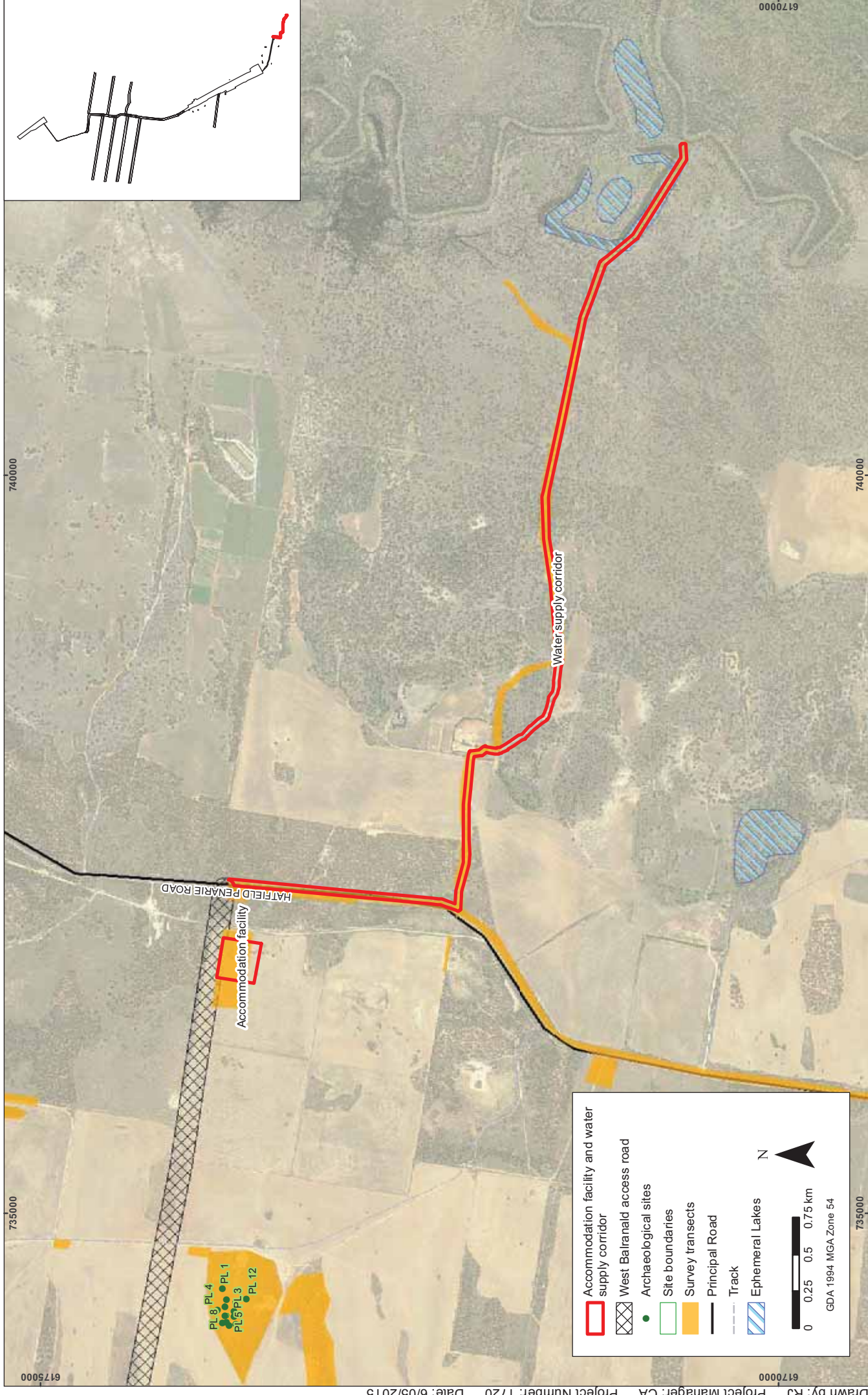




Drawn by: R.J. Project Manager: CA Project Number: 1720 Date: 6/05/2015

Survey results: Gravel extraction area C
 Balranald Mineral Sands Project Aboriginal Cultural Heritage

FIGURE 30
 Imagery: (c) Iluka



Survey results: Accommodation facility and water supply corridor
Balranald Mineral Sands Project Aboriginal Cultural Heritage

FIGURE 31
Imagery: (c) Iluka

10.2 Survey Coverage of the Project Area

10.2.1 Survey Coverage Overview

Across the three field programs approximately 2119.9 ha of the 9,964 ha of the total project area was surveyed. This coverage equates to a representative sample of 21.3% of the Project Area. Greater sample weighting was given to those land systems within the project area that had a higher likelihood of containing Aboriginal objects. Survey coverage of land systems within the Project Area such as Gulthul, Hatfield, Marma, Rata, Riverland, and Youhl was between 32% and 64%. In the process of footprint revisions and refinement of investigation areas an additional 1436.9 ha was surveyed beyond and immediately adjacent the project area across all land systems, including Arumpo, Bulgamurra, Condoulpe, Mungo, Perekertin, Rata, Riverland and Wilkurra.

The methodology utilised and survey coverage obtained is considered to have achieved a strong representative sample of the landscape and is appropriate to characterise the archaeological risk and the nature of archaeological material within the project area.

Visibility across transects ranged from 10% in vegetated areas to 100% in scalds and pans. On average visibility across all transects and land systems was between 50% and 60%. Exposures of the A2 and B soil horizons were typically visible in tracks, scalds, pans, gullies, channels, eroded dune slopes, drains, stock pads, ranged from 5% to 80% in transects. These exposures were reflective of the primary geomorphic processes in the project area; erosion from sheetwash, wind, stock movement and earthworks associated with pastoral infrastructure. Effective survey coverage was typically around 21%. The eroding environment of the project area meant that many sites were visible because they had eroded or deflated to an A2 or B soil horizon.

A summary of survey coverage by land system is presented in Table 9, Table 10 and Table 11. Note that while data was collected for individual transects, the tables presented below aggregate the transects by land system, to avoid presenting a table that would contain hundreds of units. Transect data is presented in Appendix 5.

Table 9: Survey Coverage of project area by Land system

Landsystem	Area (ha) in Project Area	Area (ha) Surveyed in Project Area	Land system in project area surveyed (%)
Arumpo	773	9.9	1.28
Bulgamurra	2.0	0	0.00
Condoulpe	2058.4	26.5	1.29
Gulthul	1965.3	526.2	26.77
Hatfield	976.1	331.3	33.94
Marma	1262.2	347.8	27.55
Rata	2560.4	722.0	28.20
Riverland	17.8	10.8	60.55
Wilkurra	75.2	7.6	10.16
Youhl	274.2	137.8	50.28
Total	9964.5	2119.9	21.27

Table 10: Effective Survey Coverage across Project area by Landsystem

Landsystem	Area (ha)	Area (ha) Surveyed in Project area	Average Visibility (%)	Average Exposure (%)	Effective Coverage Area (ha)	Effective Coverage (%)
Arumpo	773	9.9	66.0	34.0	2.2	22.4
Bulgamurra	2.0	0.0	60.0	40.0	0.0	0.0
Condoulpe	2058.4	26.5	55.7	35.4	5.2	19.7
Gulthul	1965.3	526.2	60.7	30.0	95.8	18.2
Hatfield	976.1	331.3	61.9	41.8	85.7	25.9
Marma	1262.2	347.8	60.8	39.6	83.7	24.1
Rata	2560.4	722.0	53.8	34.9	135.4	18.8
Riverland	17.8	10.8	60.0	40.0	2.6	24.0
Wilkurra	75.2	7.6	60.0	40.0	1.8	24.0
Youhl	274.2	137.8	61.0	29.5	24.8	18.0
Total	9964.5	2119.9	57.9	35.8	439.4	20.7

Table 11: Survey Coverage of Land systems for the Balranald Project

Land system	Land system area in Project area (ha)	Area Surveyed for the Balranald project (ha)	Average of Visibility (%)	Average of Exposure (%)	Effective Coverage Area (ha)	Effective Coverage (%)
Arumpo	773	16.7	66.0	34.0	3.8	22.4
Bulgamurra	2.0	7.9	60.0	40.0	1.9	24.0
Condoulpe	2058.4	606.0	55.7	35.4	119.5	19.7
Gulthul	1965.3	667.6	60.7	30.0	121.6	18.2
Hatfield	976.1	347.5	61.9	41.8	89.9	25.9
Marma	1262.2	605.6	60.8	39.6	145.7	24.1
Mungo*	0.0	0.0	30.0	20.0	0.0	6.0
Perekertin*	0.0	36.2	60.0	40.0	8.7	24.0
Rata	2560.4	1037.6	53.8	34.9	194.6	18.8
Riverland	17.8	19.4	60.0	40.0	4.6	24.0
Wilkurra	75.2	13.8	60.0	40.0	3.3	24.0
Youhl	274.2	198.4	61.0	29.5	35.7	18.0
Total	9964.5	3556.8	59.9	34.2	727.5	20.5

* surveyed in 2012 and 2013 survey programs located outside the final project area

10.2.2 West Balranald Mine

The West Balranald mine was surveyed during the 2012 field program and during the due diligence program. As a result of these programs, 188.9 ha of the West Balranald mine has been subject to survey. An additional 224 ha was surveyed but subsequently excised from the West Balranald mine footprint.

Ground visibility within the West Balranald project area was on average between 25-50%. The highest concentration of erosion occurred within a series of claypans/shallow lake basins in the northern half of the West Balranald mine. Where channel incision and sheet erosion have occurred livestock traffic assisted in the removal of A1 and A2 soil horizons. Artefacts are commonly seen eroding from the A2 soil horizon.

10.2.3 Nepean Mine

The Nepean mine was surveyed during the 2012 field program. An area of approximately 38.5 ha of land was surveyed on foot. A little over half the surveyed area was subsequently excised from the project element footprint. 17 ha of the surveyed land is situated in the current footprint for the Nepean mine. Ground visibility within the surveyed area was on average between 0-25%. The highest concentration of erosion occurs within swales whose surface has been exposed as a result of belah and rosewood vegetation cover. The poorest visibility was found in areas containing mallee vegetation, spear grasses and sand dunes. Additional visibility was found where feral goats have increased sheet erosion around shallow depressions that might hold surface water. Artefacts were found on the surface in association with swales and depressions.

10.2.4 Access Roads

Less emphasis was placed on the survey of the West Balranald Access Road due to its history of past land use and disturbance from vegetation clearance and ploughing, the low visibility and sandplain land systems. Approximately 6.1 ha of the West Balranald Access Road has been surveyed.

Similarly, the Nepean access road was subject to less emphasis in the survey programs due to the bulk of the road corridor comprising existing roads – Burke and Wills Road and Box Creek / Arumpo Road with graded table drains. 14.8 ha of this project element was subject to survey. Where channel incision and sheet erosion have occurred livestock traffic has assisted in the removal of A1 and A2 soil horizons. Artefacts were commonly seen eroding from the A2 soil horizon.

10.2.5 Injection Borefields

Ten injection borefields were surveyed for the project. Injection borefield 1 and the bulk of injection borefield 5 were surveyed in 2013. The design layout for these borefields was refined to two 50 m disturbance area corridors approximately 350 m apart. The remainder of the injection borefields were surveyed in 2014, including an extension of injection borefield 5. Emphasis was placed on higher survey coverage within all injection borefield disturbance areas with the exception of injection borefield 1. Less survey emphasis was placed on Injection borefield 1 as it was noted to have been subject to pastoral activities and past land use disturbance and was within sandplain and dunefield landscapes.

Visibility and exposures within the injection borefields were high and consistent with the Marma, Hatfield and Youhl landsystems contained within them.

10.2.6 Accommodation Facility

The accommodation facility is situated within the Condoulpe land system in a cleared, ploughed and cropped area. Ground visibility was typical for a ploughed area. A total of 5.37 ha of the accommodation facility was subject to survey, as well as additional land immediately adjacent to the project element.

10.2.7 Gravel Extraction Areas A, B and C.

Gravel extraction areas A, B and C were surveyed during the October 2013 field program. A total of 2 ha of land have been surveyed in gravel extraction areas A and B. Gravel Extraction area C contains 7.2 ha of surveyed land. Where channel incision and sheet erosion has occurred in these areas, livestock traffic has assisted in the removal of A1 and A2 soil horizons.

10.2.8 Water Supply Corridor

The water supply corridor assessment had high visibility, averaging between 50 and 100%, due to current land uses such as grazing and the use of access tracks. Discussions with the landowner indicated that access tracks at the eastern end of the water supply corridor had been raised above the level of the floodplain by excavating soil immediately adjacent. Mature aged trees had been cleared from the corridor. A total of 18.9 ha of the water supply corridor was subject to survey.

10.3 Aboriginal Cultural Heritage Sites

A total of 548 Aboriginal sites were identified across all archaeological investigations for the Balranald Project, including due diligence assessments and the 2012, 2013 and 2014 EIS field programs (Table 12). These sites were added to the Balranald Project Aboriginal Heritage Database.

In the 2012 EIS field season, 81 new Aboriginal sites were identified. In the 2013 EIS field season, 139 new Aboriginal sites were identified. Between October and December 2014, 266 new Aboriginal sites were identified and several site boundaries of existing sites were extended. Sixty-two new Aboriginal sites were identified as a result of due diligence assessments (in 2012 and 2013) and some existing sites had their site boundaries extended. A table of all sites, site features, their transects and landscape data is presented in Appendix 6.

Approximately 76% of the identified Aboriginal sites (417) of these sites are located in or within 100 m of the Project Area (Table 12). 383 Aboriginal sites are located within within 10 m of the Project area². 256 Aboriginal sites were located wholly within the disturbance area. A breakdown of the number of Aboriginal sites per project element is presented in Table 13. Of all the sites identified within the project area 89.8% contained a single site feature (i.e. they only comprised of stone artefacts or only comprised of hearths). 10.2% of the sites identified within the project area contained two or more site features (i.e hearths and artefacts or hearths, artefacts, culturally modified tree and PAD). Stone artefacts, both as isolated occurrences and open artefact scatters, were the most common site type and the most frequent site feature. Hearths, both as isolated occurrences and clusters of hearths, were the second most frequent site

² For the purposes of this assessment, any site within 10 m of the project area or disturbance area is considered within the project area or disturbance area to account for any locational errors from GPS recording. Differences in total site counts in tables represent different querying logic of the database and hand based corrections where sites fell outside or within the project area but within 10 m of a disturbance area or fell across multiple disturbance areas and project areas.

type and site feature. One culturally modified tree and shell scatter was identified as part of the much larger site of West Balranald 40.

Table 12: Summary of Aboriginal Site Types within the Balranald Project Aboriginal Heritage Database

Site Type	Sites in Balranald Aboriginal Heritage Database		Sites within project area		Sites within the disturbance area	
	Number	%	Number	%	Number	%
Artefacts	230	41.97	162	42.30	114	44.53
Isolated Artefact	246	44.89	166	43.34	94	26.72
Artefacts and Hearth	42	7.66	34	8.88	30	11.72
Hearth	22	4.01	16	4.18	14	5.47
Hearth and Isolated Artefact	5	0.91	4	1.04	3	1.17
Artefacts, Hearth, Culturally modified tree, Shell and PAD	1	0.18	1	0.26	1	0.26
Artefacts, Mound, Mound Scatter, Hearth, Hearth Scatter and PAD	1	0.18	0	0	0	0
Culturally Modified Tree	1	0.18	0	0	0	0
Total	548	100.00	383	100.00	256	100.00

Table 13: Summary of the number of Aboriginal Sites in the Project Area by Project Element

Project element	Figures	Number of sites	Percentage of sites in project area (%)	Number of sites in disturbance area	Percentage of sites in disturbance area (%)
Injection borefield 3	Figure 19	50	9.16	15	5.86
Injection borefield 4	Figure 19	23	4.21	7	2.73
Injection borefield 5	Figure 20, Figure 21	88	16.1	34	13.28
Injection borefield 5 and Nepean access road	Figure 20, Figure 21	7	1.28	7	2.73
Injection borefield 6	Figure 22	23	4.21	20	7.81
Injection borefield 7	Figure 23	22	4.03	11	4.30
Injection borefield 8	Figure 24	59	10.81	55	21.48
Injection borefield 9	Figure 25	31	5.68	29	11.33
Injection borefield 10	Figure 26	7	1.28	5	1.95
Gravel Extraction Area C	Figure 30	1	0.18	1	0.39
Injection borefield 8 and Nepean access road	Figure 24	1	0.18	1	0.39
Nepean access road	Figure 14, Figure 20, Figure 21, Figure 24	1	0.18	1	0.39
Outside Project Area but within 100 m	-	31	6.23	0	0

Outside Project Area	-	134	24.54	0	0
West Balranald mine	Figure 15, Figure 16	70	12.82	70	27.34
Total		548	100	256	100

Table 14: Land system summary for the Project Area

	Area (ha) surveyed in Project area	Effective coverage area (ha)	Effective coverage (%)	Number of sites	Number of site features
Arumpo	9.93	2.23	22.44	0	0
Bulgamurra	0.00	0.00	0.00	0	0
Condoulpe	26.54	5.23	19.72	1	1 stone artefact
Gulthul	526.19	95.80	18.21	14	99 stone artefacts, 1 hearth
Hatfield	331.26	85.68	25.86	70	1098 stone artefacts, 8 hearths
Marma	347.77	83.67	24.06	115	4970 stone artefacts, 36 hearths, 1 culturally modified tree
Rata	721.98	135.43	18.76	156	1359 stone artefacts, 50 hearths
Riverland	10.76	2.58	24.00	0	0
Wilkurra	7.64	1.83	24.00	0	0
Youhl	137.84	24.80	18.00	27	612 artefacts, 5 hearths
Total	2119.89	439.43	20.73	383	8139 stone artefacts, 100 hearths

10.3.1 Site Condition

Four categories of site condition were used in the assessment process. These are explained below:

Excellent: A site is in pristine condition and is unaffected by natural erosion or man-made land-use impacts in the preservation of its contents and structure.

Good: A site's condition has only been slightly affected by erosion or man-made impacts and its contents and structure are probably more than 70% intact.

Fair: A site's condition has been affected by erosion or man-made impacts and its contents and structure are probably less than 50% intact.

Poor: A site's condition has been severely affected by erosion or man-made impacts and its contents and structure are probably less than 25% intact.

The bulk of the sites fell within the poor to fair site condition categories and is reflective of the impacts of grazing and historic land use within the project area.

10.3.2 Artefact Sites and Isolated Finds

Artefact sites occurred on level to gently inclined land to a maximum of 4.48 degrees. The average and median slope on which sites were situated was very gently inclined (between 0.55 degrees and 0.78 degrees). Sites occurred between 58.86 m in elevation and 79.37 m elevation with an average and median

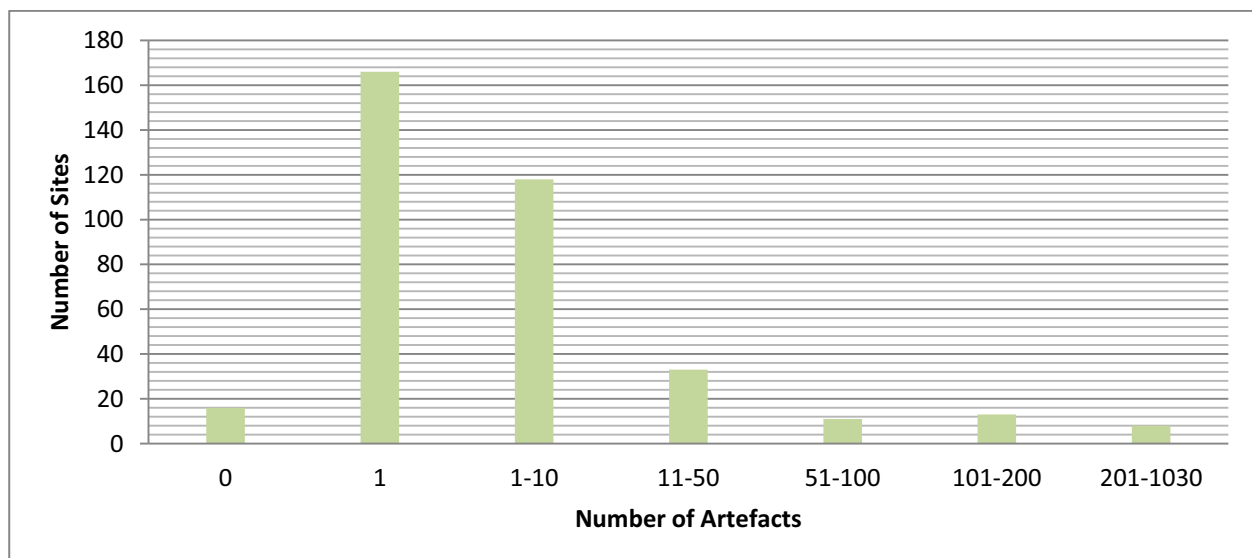
of 63 m. The median distance of sites to a non-perennial lake was 1263 m; the average distance was 1460 m. The average distance of sites to a lake that is currently classified as a perennial lake source was 6593 m. There was a strong correlation between the location of sites and Aboriginal objects and dunes, rises, lunettes, exposures associated with depressions or decreases in elevation in the landscape, most likely relating to the visibility and the availability of water over time.

Table 15: Distance from Lakes

Lake Permanency	Number of Sites	Minimum Distance (m)	Maximum Distance (m)	Average Distance (m)	Median Distance (m)
Non-perennial	541	0	5518	1460.39	-
Perennial	7	5816	9399	6593.14	-
Grand Total	548	0	9399	1525.84	1263

The majority of Aboriginal archaeological sites within the Balranald Project Aboriginal Heritage database contained between one and ten stone artefacts. Fewer than 10% of sites contained between 11 and 50 Aboriginal stone artefacts (118 sites). 11 sites contained between 50 and 100 artefacts. 13 sites contained between 100 and 200 artefacts. Eight sites contained more than 200 artefacts. The eight largest sites are described within this section of the report. Site descriptions for all sites are available in Appendix 6.

Chart 2. Number of artefacts per site



UD26

UD 26 is located outside the Project Area and will not be impacted (Figure 19). UD 26 is a moderate density artefact scatter that is predicted to extend beyond the site boundary. Artefact numbers at the site were estimated to be approximately 300. 51 artefacts were sampled for analysis. The site is situated on a sandplain adjacent to a remnant lunette dune system. Artefacts observed in a wash feature include retouched flakes including scrapers, cores, complete and broken flakes and angular fragments.



Plate 13: UD 26 general location looking away from dune



Plate 14: UD 26 example of artefact

UD 62 / UD 64 / UD 65 / UD 70 / UD 75

This clustering of Aboriginal objects is located within and adjacent injection borefield 3 (Figure 19). Originally the artefact clusters were recorded as separate entities but due to their proximity to one another they were aggregated into one site known as UD 62 / UD 64 / UD 65 / UD 70 / UD 75. The survey was limited to injection borefield 3 and as a result, the exact extent of the site is unknown - there is high probability it extends beyond its current site boundary. Site dimensions were recorded as 500 m x 350 m. UD 62 / UD 64 / UD 65 / UD 70 / UD 75 is a moderate to high density artefact scatter spread over two sample areas. 860 artefacts were counted in the two sample areas and 600 were sampled for analysis. The artefacts were observed eroding from the western shoreline and source bordering dune of a relict lake basin. Two hearths in fair to good condition were identified in the sample areas, including one containing burnt emu shell. The range of activities evident at this group of sites includes wood working evidenced by burren production, food processing evidenced by grinding implements and periods of occupation at the place evidenced by hearths. The density of artefacts at this group of sites means that the sites have the potential to reveal detailed information via future analysis of the full stone artefact assemblage about past Aboriginal use of this location. A range of local and exotic stone material suggests whilst people were sourcing materials locally, non local materials were either transported or traded into the region. The site contains intact, stabilised dunes which may contain buried Aboriginal objects. Materials suitable for archaeological dating (eg termite heat retainers /charcoal in hearths, and burnt emu shell) exist at this site.

Portions of the lunette on the western shoreline outside the project area have gullying and sheetwash erosion. Pelletal clay is evident in these locations and may be indicative of a Pleistocene landscape. Site UD 62 / UD 64 / UD 65 / UD 70 / UD 75 and its surrounding landforms have research potential.



Plate 15: UD65 Site



Plate 16: UD65 Hearth



Plate 17 UD72 Stone Artefact (Burren)



Plate 18: UD72 Burnt Emu Egg fragments

UD 77

UD 77 is located within injection borefield 3 (Figure 19). The survey was limited to injection borefield 3 and as a result, the exact extent of the site is unknown - there is high probability it extends beyond its current site boundary. UD77 is a moderate to high density artefact scatter located in a depression in a lake basin. 461 stone artefacts were counted at the site. 263 stone artefacts were sampled for analysis.

The stone artefact assemblage consists of angular fragments, backed geometric microliths, fragments of grinding stones and one of the largest cores recorded in the project area. Many artefacts were partially buried. The dominant raw material is silcrete. The presence of backed artefacts and geometric microliths with core and a high number of angular fragments suggest in situ artefact manufacture (often referred to as knapping floors or knapping events) occurred in this area. This site had one of the highest frequency of backed artefacts across all field programs. The density of artefacts at this site means that the site has the potential to reveal detailed information via future analysis of the full stone artefact assemblage about past Aboriginal use of this location. The ephemeral nature of water in this lake basin suggests this place may have been used when water resources were scarce in the landscape and when considered with the presence of backed artefacts indicates a Holocene period use. The large core has the potential for chemical analysis to determine the source of the raw material and if it has any connection to quarries within the WLRWHA.



Plate 19: UD 77 Site



Plate 20: Large Core (Significant Artefact)

B 33

B 33 is located in injection borefield 7 (Figure 23). B33 has high potential to contain an intact knapping floor, as evidenced by a partially buried large silcrete cores. The site is situated near a track on the lower portion of a dune slope. The site is in close proximity to a nearby hearth, which contains material suitable for dating. Glass bottles and tins were also observed in the nearby area.

W 2

W 2 is located within injection borefield 8 (Figure 24). W2 is a moderate to low density artefact scatter of 250 stone artefacts situated on and extending up slope and over a dune. Only the visible portions of the site were recorded; and artefacts are considered to be continuously dispersed throughout the scalds and bare patches of soils in the Rata system. Hearths in disturbed and partially exposed states were present. The surrounding dune systems may be PADs.



Plate 21: General location of W 2



Plate 22: Retouched artefact at W 2

BWR 32

BWR 32 is located within injection borefield 5 and near Nepean access road (Figure 20). BWR32 is one of the highest density artefact scatters in the Project Area (290 artefacts) with a hearth feature situated within a dune blow out of an east-west running dune running through a large depression and is in proximity to a number of depressions with source bordering dunes. The stone artefact assemblage consists of silcrete flakes, cores, retouched tools; anvils; hammerstone; broken grinding fragments; chert and quartzite flakes and the highest frequency of backed artefacts observed during the 2013 field season. The density of

artefacts at this site means that the site has the potential to reveal detailed information via future analysis of the full stone artefact assemblage about past Aboriginal use of this location. Intact portions of the dune are likely to be PADs.



Plate 23: Dune overlooking BWR 32



Plate 24: Stone artefact at BWR 32

WB 40

WB 40 is partially located within the disturbance area for the West Balranald mine (Figure 15, Figure 16). WB 40 is a high density archaeological complex with a high frequency and diversity of stone artefacts (1030 artefacts), hearths, a culturally modified tree and PAD. It is situated nearby Muckee Lake which has visual and aesthetic value and is likely interconnected with other recorded sites in the vicinity. The density of artefacts at this site means that the site has the potential to reveal detailed information (via future analysis of the full stone artefact assemblage) about past Aboriginal use of this location. This site represents the most intense and diverse assemblage in the project area. The presence of Pleistocene and Holocene sediments combined with the large volume of stone artefacts, the culturally modified tree and hearths containing material suitable make this one of the most significant sites in the project area.



Plate 25. Part of site WB 40 looking west across the site showing an eroding termite nest hearth



Plate 26: Example of artefacts at WB 40

Karra 33

Karra 33 is located within injection borefield 5 (Figure 21). Karra 33 is an extensive occupation complex situated across a pan and slight rise overlooking Pitarpunga Lake and remnant drainage channels. As a small portion of the site was surveyed, the exact extent of the site is unknown - but there is high probability it extends beyond its current site boundary. Artefact densities across the pan range from 0.5 artefacts per m² to 20 artefacts per m². The frequency of artefacts located near eroding sediments within the pan suggests it is highly probable that further artefacts of moderate density exist within the site boundary. In addition to a large stone artefact assemblage, deflated hearths were identified.

The stone artefact assemblage (449 artefacts) consists of silcrete, quartz, quartzite, sandstone, chert and rhyolite materials with artefact classes including broken grinding stone fragments, retouched flakes, flakes, cores, anvils and hammerstones. The density of artefacts at this site means that the site has the potential to reveal detailed information (via future analysis of the full stone artefact assemblage) about past Aboriginal use of this location. Residual soils and rills indicate soil deposits exceeding 40 cm are likely to be PADs. The site is associated with WB 107.



Plate 27: Karra 33



Plate 28: Stone artefact at Karra 33



Plate 29: Soil profile showing aeolian deposits in Karra 33



Plate 30: Rill erosion and soil profile at Karra 33

WB 107

WB 107 is located within injection borefield 5 (Figure 21). WB 107 is a low to moderate density artefact scatter of 115 artefacts with 4 deflated hearth features located on a dune overlooking a relict lake and creek system. The frequency of artefacts located near eroding sediments within the pan suggests it is highly probable that further artefacts of moderate density exist within the site boundary. The stone artefact assemblage consists of silcrete, quartz, quartzite, and rhyolite materials with artefact classes including broken grinding stone fragments, retouched flakes, flakes, cores, anvils and hammerstones. The density of artefacts at this site means that the site has the potential to reveal detailed information (via future analysis of the full stone artefact assemblage) about past Aboriginal use of this location. Residual soils and rills indicate soil deposits exceeding 40 cm are likely to be PADs.



Plate 31: WB 107 Site



Plate 32: WB 107 example of artefact

TO 2 / TO 20

TO 2 / TO 20 is located injection borefield 8 (Figure 24). TO 2 /TO 20 is a low density artefact scatter consisting of 403 artefacts with one deflated hearth feature with approximately 30 fragments located on the eastern side of a dune/lunette, extending towards a crest to the west. The scatter spreads from the crest of a lunette, down the slope to the east of the lunette and onto the scalded plains. Portions of the lunette are vegetated and do not have clear visibility. Artefacts were identified in wind deflated areas amongst blue bush/saltbush on residual soil. The stone artefact assemblage consists of silcrete, quartz chert and quartzite materials with artefact classes including retouched flakes, flakes and cores. There are residual soils present, and these are likely to be PADs.



Plate 33. Overview site TO2/TO20



Plate 34. Hearth at site TO2/TO20

10.3.3 Hearth Sites

Sixty-three Aboriginal sites within the project area have been recorded as containing hearths. Over a hundred hearth features within these sites have been identified. There are approximately 70 hearths with fair to excellent dating potential within the Balranald Project Aboriginal heritage Database. The identification of hearths in the landscape is problematic due to the history of vegetation clearance through fire and the use of termite mounds as heat retainers. Many of the sites containing heat affected material had a close association with woodland vegetated area and stands of box trees. It is not clear whether this is a corollary of human behaviour or natural decay processes. Buried and partially exposed heat retainers that have been identified as hearths may be evidence of natural fire events or decay events or be the result of more recent human agency. A precautionary approach was taken when identifying hearth, fire impacted material and heat retainer material.

Recording of hearths distinguished between partially exposed or buried, intact, disturbed, scattered and remnant hearths. Partially buried and intact hearths offer excellent dating potential while disturbed hearths still have a central concentration of heat retainers. Scattered hearths have lost the central concentration and do not have a clear focal point. Remnant hearths are doughnut shaped with no central focus. Both scattered and remnant hearths have limited to no dating potential.

Heat retainers were most often of burnt clay and sediment, heated termite mound and calcrete. Occasionally burnt nodules of silcrete would be located in hearths or near hearths and were possibly used as heat retainers. Most hearths occurred individually rather than as clusters of multiple hearths. Sites with multiple hearths tend to be associated with a greater frequency and density of stone artefacts. WB 40 in association with Muckee Lake was found to have the greatest concentration of intact hearths and hearth scatters. West Balranald mine contained the greatest number of hearth features, most in association with a stand of box trees and old man bush near a terminal wetland associated with Pitarpunga Lake. Many of these were partially exposed or buried, making it difficult to determine if they were natural or cultural features.

Table 16: Number of Hearths within the Project Area

Project Element	Sites	Sites with Hearths	Hearth Count
Injection borefield 3	50	4	2
Injection borefield 4	23	7	14
Injection borefield 5 and Injection borefield 5 / Nepean access road	95	12	17
Injection borefield 6	23	5	6
Injection borefield 7	22	1	1
Injection borefield 8 and Injection borefield 8 / Nepean access road	60	5	13
Injection borefield 9	31	1	1
Injection borefield 10	7	0	0
Gravel Extraction Area C	1	0	0
Nepean access road	1	0	0
West Balranald mine	70	28	46
Grand Total	383	63	100

Table 17: Number of Hearths by Land system

Row Labels	Sites	Sites with Hearths	Hearth Count
Condoulpe	1		0
Gulthul	14	2	1
Hatfield	70	6	8
Marma	115	15	36
Rata	156	38	50
Youhl	27	2	5
Grand Total	383	63	100



Plate 35: Example of a disturbed hearth at WB 29



Plate 37: Disturbed hearth at UD 82



Plate 36: Example of a partially exposed hearth beginning to erode from residual soil at WB 32



Plate 38: Disturbed hearth at UD 103

10.3.4 Culturally Modified Trees

Three culturally modified trees were identified in the Balranald Project Aboriginal Heritage Sites Database. A culturally modified tree at WB 40 is situated outside the disturbance area but a portion of the WB 40 site

complex will be impacted by the proposed activities. At least two culturally modified box trees are present at a billabong outside the project area in B 15. In some instances, box trees are considered a groundwater sensitive species.



Plate 39: Culturally modified tree at WB 40



Plate 40: Culturally modified tree at B 15

11. Analysis and Discussion

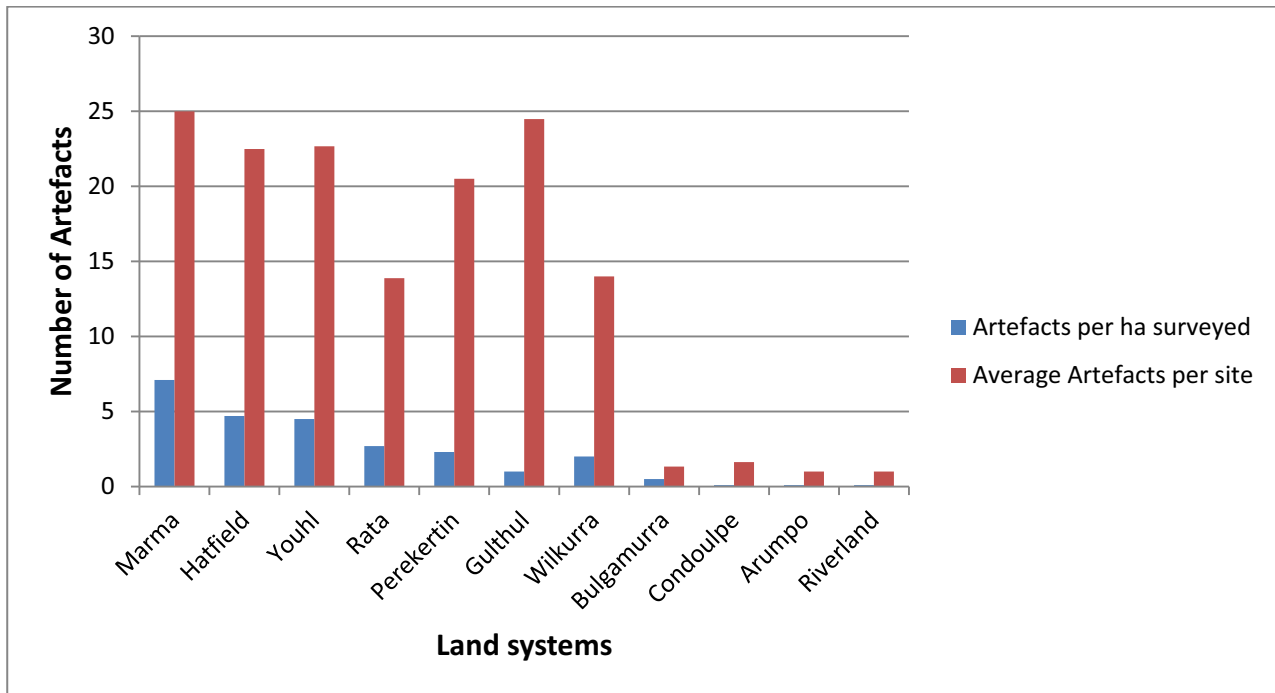
11.1 Site and Artefact Distribution

Artefacts identified per hectare of land system surveyed, and artefacts recorded per site per land system were calculated. This information is summarised in Table 18 and Chart 3. The Marma land system is shown to have the greatest number of artefacts per hectare surveyed and the highest average number of artefacts per site. The Hatfield and Youhl land systems have roughly equivalent frequency and density of artefacts and sites. Rata and Perekertin land systems have a similar frequency of artefact occurrences – artefacts occur less frequently in these land systems when compared with the Marma, Hatfield and Youhl land systems, but where sites are present these tend to contain a reasonably high average number of artefacts. The sample size for the remaining land systems was relatively low. In the cases of Wilkurra, Bulgamurra and Arumpo the results still reflect an overall trend reported in local and regional archaeological assessments of fewer sites and less frequent occupation (Section 8).

Table 18: Artefact density per ha of surveyed land system in the Balranald Project Aboriginal Heritage Database

Land system	All recorded/estimated artefacts In the Balranald Project Aboriginal Heritage Database (ha)	Surveyed land system (ha)	Artefacts per hectare of land system surveyed
	Artefact count	Transect ha	Artefact/ha
Arumpo	2	16.7	0.1
Bulgamurra	4	7.9	0.5
Condoulpe	31	606.0	0.1
Gulthul	661	667.6	1.0
Hatfield	1619	347.5	4.7
Marma	4299	605.6	7.1
Perekertin	82	36.2	2.3
Rata	2777	1037.6	2.7
Riverland	1	19.3	0.1
Wilkurra	28	13.8	2.0
Youhl	884	198.4	4.5
Total	10388	3556.2	

Chart 3: Artefacts per ha surveyed and average artefacts per site



11.2 Artefact Analysis

11.2.1 Site Chronology

A useful guide for assessing site age is the presence or absence of backed artefacts. These artefacts are typically only found in mid to late Holocene sites (<5000 years bp) throughout most of Australia (Hiscock 2008). The presence of backed artefacts at a site indicates that the site may include Holocene-dated activity but it does not preclude the possibility that evidence of older occupation may also be present at the same site. Sites which do not contain backed artefacts may also be dated to the Holocene or earlier.

For the purposes of this discussion, preference was given to the presentation of the artefact assemblages recorded in 2013 and 2014. Twenty-two sites recorded between 2013 and 2014 contained backed artefacts - BWR 18, BWR 32, BWR 33, BWR 37, Karra 6, Karra 46, Karra 62, WB 111, WB 70, WB 79, B 11, UD 107, UD 27, UD 51, UD 62/UD64/UD65/UD70/UD75, UD 73, UD 77, UD 78, UD81/UD83/UD84/UD85/UD86/UD87, UD 92/UD93/UD100/UD101/UD102, UD 95. These sites are associated with a range of landscape features geographically spread from the mid-section of West Balranald mine to the northern end of Injection borefield 5. The landscape features include dunes associated with alluvial plains, lake basins, lunette and lake shorelines, scalds and pans overlooking drainage channels. Backed artefacts tend to be present in sites with larger, more dense artefact assemblages.

One site, UD 77, was located next to a slight depression in the middle of a lake basin and contained evidence of backed artefact production. This is interesting as the site was clearly used at a time when there was little water available in the lake.

11.2.2 Stone Procurement

No raw material sources aside from calcrete (carbonate nodules) were identified in the project area. No stones or gravels of any kind of stone were present in the soils. All stone material in the project area was considered exotic – it had to have been transported into the project area by some means. On occasion, rounded, worn pebbles between 1 and 3 cm in size were observed in the project area. These pebbles had

no identifiable pitting, ground surfaces or any indications of use. Other stone objects were so water and desert worn that, though they were likely Aboriginal objects, they were no longer diagnostic.

Twelve stone raw material types recorded within the Balranald Project Aboriginal Heritage Database (Table 19).

Silcrete dominates the assemblage, accounting for 93.5% of the recorded assemblage. The dominance of silcrete in the assemblage is not surprising given the regional trends discussed in Section 8.2 and Section 8.3. Some of the nearest known stone sources of any kind are silcrete and occur approximately 65 km north of the project area in the WLWHA. It is however likely that different silcrete sources may have been used for the manufacture of the stone artefacts recorded in the project area, indicated by the quality of the silcrete artefacts and the colour range of silcrete artefacts. Silcrete artefacts ranged from very fine grained to coarse grained. Examples of granular silcrete were also observed. There was a broad range of coloured silcrete in the assemblage (Plate 41). As with the Lake Mungo assemblages, greys, greenish greys, creams and pale yellow were the most common colours of silcrete, with pinks, reds and yellows also being common (Tumney 2011: 157). Identifying silcrete sources being utilised in the local region, the project area and their relationship to the WLWHA is a potential avenue for research.



Plate 41: Examples of silcrete within the Project Area

Quartzite, which can be problematic to distinguish from some silcreted, was the second most common raw material utilised in the assemblage and accounted for 2.75% of the assemblage. The nearest known source of quartzite is the Manfred Ranges, 150 km north-east of the project area. Other fine grained siliceous materials such as quartz, crystal quartz, chert, chalcedony, and agate accounted for less than 1% of the assemblage. Potential stone sources for these materials are yet to be identified.

Volcanic material such as rhyolite, granite, basalt made up 0.45% of the assemblage. Sandstone formed 0.29% of the assemblage. A very small number of artefacts were made of glass or ochre. Two shell artefacts were identified as cultural material or manuports on the basis of their proximity to other Aboriginal objects. The presence of exotic volcanic material is of interest due to the distance this material would have had to have travelled or be traded to be discarded in the project area. Observations by individual archaeologists in the field suggest similarities between the rhyolite material recorded in the project area and other rhyolite observed in the Lachlan Ford belt (Plate 42).



Plate 42: Example of rhyolite

Avenues for exploring the distance artefacts might have been transported from their source include the amount of cortex on the stone artefact and the size of flakes and cores (Hiscock and Mitchell 1993:12-17). A high percentage of cortex on an artefact indicates that the source of stone was nearby while artefacts with less cortex or no cortex were transported further from the source. Equally, as cores are transported away from the source they are typically highly reduced and the resulting flakes are also smaller.

The bulk of artefacts within the assemblage have no cortex. For the purposes of this discussion, a sample of the total recorded assemblage was utilised. Twenty-four sites contain artefacts with 75% or more cortex. BWR 23, BWR 33, BWR 37, Karra 24, Karra 33, UD 103, UD 17 / UD 18, UD 20, UD 46, UD 48, UD 51, UD 55, UD 62/UD64/UD65/UD70/UD75, UD 68, UD 73, UD 77, UD 78, UD81/ UD83/UD84/UD85/UD86/UD87, UD 92/UD93/UD100/UD101/UD102, UD 95, UD 103, B 5, B 9, B1 /B 10.

A preliminary breakdown of the percentage of cortex of four raw material types of interest; silcrete, quartzite, quartz and rhyolite indicate that there is variation in how raw materials were procured, their distances from sources and how they were discarded in the project area (Table 22 and Table 23).

Table 19: Raw Materials Recorded in the Balranald Project Aboriginal Heritage Database

Raw Material	Number of Artefacts	Artefacts in Assemblage (%)
Silcrete	7305	93.50%
Quartzite	215	2.75%
Quartz	109	1.40%
Chert	58	0.74%
Unknown	38	0.49%
Volcanics	35	0.45%
Sandstone	23	0.29%
Glass	7	0.09%
Chalcedony	6	0.08%
FGS	6	0.08%
Calcrete	4	0.05%
Agate	2	0.03%

Raw Material	Number of Artefacts	Artefacts in Assemblage (%)
Crystal Quartz	2	0.03%
Shell	2	0.03%
Ochre	1	0.01%
Total	7813*	100.00%

*This number represents the total sum of artefacts that had attribute recording completed, not the total number of artefacts counted in the database.

Table 20: Percentage of Cortex of Raw Materials of Interest

% Cortex	Raw Materials				Total
	Quartz	Quartzite	Rhyolite	Silcrete	
0	85.71%	63.83%	75.00%	87.26%	86.66%
1-25	7.14%	2.13%	0.00%	4.58%	4.53%
25-50	0.00%	12.77%	0.00%	3.57%	3.76%
50-75	0.00%	10.64%	25.00%	2.61%	2.83%
75-100	7.14%	10.64%	0.00%	1.97%	2.22%
Total	100.00%	100.00%	100.00%	100.00%	100.00%

11.3 Stone Reduction Technology

The types of artefacts and their characteristics are used to establish how sources were worked, used and discarded on-site. Stone artefacts were classified as cores, flakes (complete or broken {proximal, distal, medial, longitudinal split}, retouched flakes / tools, grinding, hammerstones, anvil, multipurpose tools (a combination of core, tool, hammerstone, anvil or grinding). Stone artefacts that were not diagnostic but were most likely by products of flaking were classified as angular fragments. Stone artefacts that were not diagnostic but unlikely to be biproducts of flaking were considered to be manuports.

Assemblage composition

The bulk of the stone artefact assemblage comprised complete and broken flakes and angular fragments (Table 21). Retouched flakes or tools formed 7.9% of the assemblage. Within the retouched flake / tool category, a range of artefact types were identified including burins, burrens, piecers and assorted scrapers. Cores, single or multiplatform, formed 4.25% of the assemblages. Multipurpose tools, such as cores that had been used as a grinding mortar or anvil or hammerstone, were a small but not uncommon portion of the assemblage. Grinding technology was not common across the Project area but was noted in each of the programs. Hammerstones without multiple functions were uncommon. Examples of some of the stone artefacts recorded in the Balranald Project Aboriginal Heritage database are presented in Plate 43, Plate 44, Plate 45 and Plate 46.

Table 21: Artefact Types in the Balranald Project Aboriginal Heritage Database

Artefact Type	Artefact Count	Artefacts in Assemblage (%)
Complete flake	2917	37.34%
Broken flake	2624	33.59%
Angular Fragment	1197	15.32%
Complete and Broken Retouched Flakes / Tools	617	7.90%
Cores	332	4.25%

Artefact Type	Artefact Count	Artefacts in Assemblage (%)
Manuport	54	0.69%
Grinding stones and mortars	34	0.44%
Multipurpose Tools	17	0.22%
Hammerstone	6	0.08%
Redirecting Flake	3	0.04%
Unknown	3	0.04%
Anvil	2	0.03%
Axe fragment	1	0.01%
Burin Spall	1	0.01%
Cobble	1	0.01%
Heat Fragment	1	0.01%
Shell	1	0.01%
Total	7811*	100.00%

*The difference in total artefacts between Table 17 and Table 20 owes to differences in sampling strategies – the difference between artefacts counted and artefacts that were sampled for attribute recording



Plate 43: Example of a grinding dish located at WB 40



Plate 44: Example of a multipurpose tool with heat fracturing



Plate 45: Example of a silcrete retouched flake



Plate 46: Example of a burren

Cores

A total of 332 cores were identified in the Balranald Project Aboriginal Heritage Database. A sample of 215 cores, recorded during the 2014 field program, were selected for further discussion. 182 of the cores were silcrete while quartz, quartzite, rhyolite, chert and chalcedony cores were also present (Table 22). 69 cores were identified as having a single platform or multiplatform. Multidirectional, unidirectional and bidirectional flaking were noted in the assemblage. In general, cores were highly reduced with the mean length, width and thickness of the cores being less than 30 mm (Table 23). This result is not unexpected given the distance of the project area to any known sources. Silcrete cores demonstrated the greatest range in dimensions with cores ranging in length from 13 mm to 110 mm. Silcrete cores also demonstrated higher number of artefacts with cortex compared to other raw material types, again not surprising given the dominance of the raw material type and the hypothesised distance relationship between silcrete and sources. Of interest is the presence of cortex on cores of quartz and rhyolite, indicating these were transported as cobbles from their sources then flaked in the project area. Further opportunities exist to explore the relationships between stone procurement, use and discard in the Balranald Project Aboriginal Heritage Database.

Table 22: Core Counts and Raw Material Types in the 2014 survey program

	Raw Material							Total
	Chalcedony	Chert	Quartz	Quartzite	Rhyolite	Silcrete	Unknown	
<i>Bipolar Core</i>	0	0	0	0	0	2	0	2
<i>Core (non specified)</i>	1	2	4	9	1	122	6	145
<i>Core fragment</i>	0	0	0	0	0	1	0	1
<i>Multi Platform Core</i>	0	1	2	4	0	42	0	49
<i>Single Platform Core</i>	0	0	1	2	0	15	0	18
Total	1	3	7	15	1	182	6	215

Table 23: Core Dimensions from the 2014 survey program

	Minimum	Maximum	Mean	Std. Deviation
Length	7	101	30.29	15.840
Width	1	78	26.72	12.612
Thickness	3	60	17.95	10.155
Valid N (listwise)				

11.4 Comparison with other archaeological studies

Comparisons with the previous work (Allen 1974; Bowler et al 2012, Gillespie; Holdaway, Fanning and Shiner 2002; Hope et al 1983; 1998; Martin 1988, 2006, 2008, 2010, 2011; Pardoe 2003; Pardoe and Martin 2001; Niche 2012; Witter 1992, 1999) show that sites recorded within the project area are well represented in the existing archaeological record of the region. With the exception of the extensive archaeological work undertaken at Lake Mungo and elsewhere in the Willandra Lakes Region World Heritage Area (located approximately 32 km from the West Balranald mine and 19 km from the Nepean mine), dated archaeological sites in the local region are rare.

Across different landscape units, newly recorded sites within the project area fall within two main site categories:

- *Short-term occupation or single activity sites.* These are usually represented by a single site or several discard events such as where hunters may be preparing or repairing their weapons ready for or after use near a hunting ground (isolated find discarded after use), removing bark to make dishes or canoes or tool preparation areas such as grinding axes and thus creating groove sites. The location of these sites is likely to be more random in the landscape depending on historical land-use strategies.
- *Specific long-term seasonal nodal sites.* These display a range of human activities, including tool preparation and manufacture, exploitation of seasonal wetland plant resources, ceremonial activity where stone arrangements are created or trees are carved, open space occupation centred around a number of key seasonal resources (protected raised valleys overlooking hunting sites, lake or creek margins, clay pans, springs, soaks or wetlands). The location of these sites is likely to be more predictable even with varying historical land-use patterns.

In excavation work on large earth mound sites on the Hay Plains, Martin (2006) has shown that on the Murray Riverine Plain, 'earth mounds' or 'oven mounds', clearly represent the second site type category described above. Martin's (2006) excavations of two large earth mounds on a distributary of the Lower Murrumbidgee River demonstrated unique past wetland environments and human exploitation of them. The excavation results showed that some of the mounds had in fact been in use for at least 6,000 years. Macroscopic charcoal, pollen and plant imprints from the mounds suggest that the ethno-historically observed baking/steaming of wetland plant foods such as *Typha*, *Bolboschoenus* and *Triglochin* in baked clay heat retainer ovens on mounds had its origins during the mid-Holocene. The consistent amounts of wetland faunal bone and shell show the clustered spatial patterning of mounds around specific types of current and former 'reed-beds', swamps and lakes, also provided evidence of a mid to late Holocene focus on wetland environments. Recent archaeological survey work in the Low Bidgee floodplain by Martin (2010: 21,24) shows that; different site types are found in specific localities that have a certain level of predictability within both major landforms, landform units and soil types:

- Lakes and their associated lunettes contain a disproportionate number of middens and burials.
- Mounds follow soil distribution very closely, as do burials.
- On scalded red contrast soils of the plains, open sites (35 %) and hearths (72%) are far more likely to be seen than mounds (20 %) and ovens (27%).
- Archaeological material is found on a range of minor landforms with a strong tendency to be located on slightly raised sandier paleochannel features. However some sites have been recorded on the low side of swamps and lakes or in floodways, in some cases on the black clay soils.
- There is a tendency for a high density and diversity of archaeological material in areas where modern hydrology and paleochannel features combine to create more diverse landscape features and a range of different types of wetlands.

Archaeological sites that are less predictable in a surface survey may have a combination of site formation factors to consider. For instance, mound sites may be present around certain swamps or lakes (such as Paika Lake and Piturpunga Lake) but totally absent from other lakes such as Muckee Lake depending on what type of local wetland is present and whether it is fed by internal or connected drainage. Sub-surface sites such as those associated with Pleistocene occupation may only be found where lake lunettes that have been heavily eroded (Muckee Lake Lunette) are present. As noted above, the lunettes also contain a disproportionate number of burials and middens in the region.

The project area contains an archaeological record that has the ability to provide a new archaeological model of the Aboriginal land use in the back plains between the Low Bidgee/Murrumbidgee riverine landforms and that of the Willandra Lakes system.

There is also a variability of changing climatic regimes that are documented by certain lake systems and their lunette histories found in parts of the project area. Muckee Lake is one of these examples and it may contain evidence on its eastern lunette outside the project area (i.e. where site WB 66 is located) that provides a unique insight into a changing Holocene-Pleistocene land-use pattern.

Site WB 66 contained 13 stone artefacts made from silcrete and calcrete. The site was located outside of the project area but was useful in assessing the archaeological potential and sensitivity of the southern portion of the lunette which was, at the time, part of the investigation area but had no archaeological exposure or visibility. The lunette was subsequently excised from the project area as an avoidance measure during mine planning. It comprises a series of calcrete hearth scatters which are interpreted to be eroding from a Pleistocene lunette deposit. The site was approximately 800 m N/S x 80 m E/W in area. Submission of fragments of burnt emu eggshell found eroding near the calcrete hearth scatters were dated by AMS radiocarbon by Giles Hamm. Its uncalibrated age was 14,341 ±48 years BP and returned a calibrated date of approximately 17,000 years calBP (Wk: 35436). This date suggests that the exposed lunette unit is probably part of the Zanci geomorphic unit, which also occurs at Lake Mungo in the WLRWHA (Bowler et al 2012).

Similarly the eastern and western lunettes and source bordering dunes of the unnamed lunettes in injection borefield 3, the source bordering dunes of Pitarpunga Tin Tin Lake at the southern end of injection borefield 5 have the potential to provide evidence of changing climate regimes and Pleistocene to Holocene land use patterns.

Ross (1998: 156, 160) investigated an area in north-west Victoria (part of the Mallee- Murray Basin, and approximately 120 km from both the project area) dominated by east-west trending linear dunes interspersed with irregular dunes, parabolic dunes, dry lakes, and wet lakes. Her results showed that sites were typically Surface scatters of stone artefacts found on dune blowouts, on lake-side sediments or on aeolian ridges around salinas where grass cover is thin. Ross concluded that on archaeological and geomorphological evidence it would appear that if occupation of the Mallee other than Raak Plains had occurred prior to 4,500 years ago, it was most probably a small scale event which is now not archaeologically visible. It may be that the recent Mallee sites do indicate a later occupation and that the absence of early material is real.

Other research relevant to the current study concerns site location modelling and whether the current survey results are a true reflection of site patterning. Witter (1999:44-45) argues that for the Lachlan-Willandra Plains, which includes the project area:

- Reliability of statements (archaeology) about the system are poor.

- Camp sites also can be found on scalded lag surfaces such as red paleochannel levees around source bordering dunes or eroding lunettes.
- Main channels, levees and floodplain. Mussel shell and stone artefacts occur on levees. Apparently the mounds also are located in this context.
- Minor channels and paleochannels, levees, floodplains, swamps and source bordering dunes. Camp sites on scalds and clay pans, burials in sand bodies.
- Sand plain. There are patches of sand which has blown over the alluvial surface and there is no archaeology known on them.

Since these statements were made, additional archaeological work has been undertaken in this region. However for the sand plain landforms there is very limited information concerning site patterning and site location predictability. The site location model posed for this study does hold up in terms of types of sites predicted, however the model has some limitations when comparing overlapping site histories for the lunette lake systems. Here the pattern is highly variable due to the fact that Aboriginal occupation is not well dated, and there is no chronology to form the basis of comparisons between occupation in different time periods (i.e. between the Holocene and Pleistocene).

11.5 Aboriginal Archaeological Risk Layer

To understand the likelihood of Aboriginal objects being present within the project area an analysis of the Balranald Project Aboriginal Heritage Database was undertaken. This analysis looked at the number and density of sites and artefacts recorded and their proximity and relationship with a number of environmental proxies discussed previously in the Landscape and Archaeological Context of this report (Section 7 and Section 8). It utilised a series of digital datasets including the Western NSW land systems mapping, the NSW hydrology and drainage mapping, a Digital Elevation Model, vegetation mapping collected for the Balranald Project and aerial imagery. Consideration was given to the number of sites, artefacts and the density of sites and artefacts in relationship to the:

- Western NSW land systems;
- Distance from permanent and temporary water sources or vegetation like old man bitterbush and black box which indicate the presence of water;
- Changes in landform and elevation that indicated either built up areas of sediment which may contain subsurface archaeological deposit (such as dunes and lunettes) and/or depressions which may indicate areas where water could be found temporarily.

Correlations and relationships between the presence and density of sites and artefacts and certain environmental proxies were noted. Stronger associations with the presence and density of sites were noted with certain landscape features. These associations were then classified into areas of high, moderate and low archaeological risk and visualised in a GIS to form the archaeological risk layer. Table 36 defines the character of each of the levels of archaeological risk (i.e. the risk/likelihood that Aboriginal objects are present in the area). The risk layers are graphically presented in Figure 32 to Figure 50.

The archaeological risk layer has been designed to inform management and mitigation responses. It classifies broad areas of landscapes by positing expectations about the nature and value of archaeology that might be present within them.

In addition to the archaeological risk layer, a series of landscape features and areas of moderate to high archaeological risk that are associated with known Aboriginal sites within the project area have been

identified as having research interest. These landscape features in areas of moderate to high archaeological risk and associated with known Aboriginal sites have meaningful surface densities of Aboriginal objects and are likely to contain subsurface archaeological deposits. They are landscapes or areas with the potential to contain occupation sequences either individually or collectively that provide detailed information about Aboriginal past land use and have not been investigated previously.

Eight locations of research interest within the project area have been identified

- Location 1: Low and eroding source bordering dunes associated with wetland features and Aboriginal sites TO 2 / TO 20 and W 2;
- Location 2: A series of dunes associated with known Aboriginal sites BWR 32, BWR 44, B 81;
- Location 3: A series of sand hills and source bordering dunes associated with alluvial plains and known Aboriginal sites UD 81 to UD 106;
- Locations 4, 5 and 6: Relict lunette and source bordering dunes associated with relict lakes associated with known Aboriginal sites UD 34 to UD 80;
- Location 7: The western shoreline and source bordering dunes of Pitarpunga Lake, in proximity to overflows of Box Creek and associated with known Aboriginal sites WB 107 and Karra 33;
- Location 8: The margins of the western lunette and dune deposit of Muckee Lake associated with WB 40 and WB 67 to WB 81.

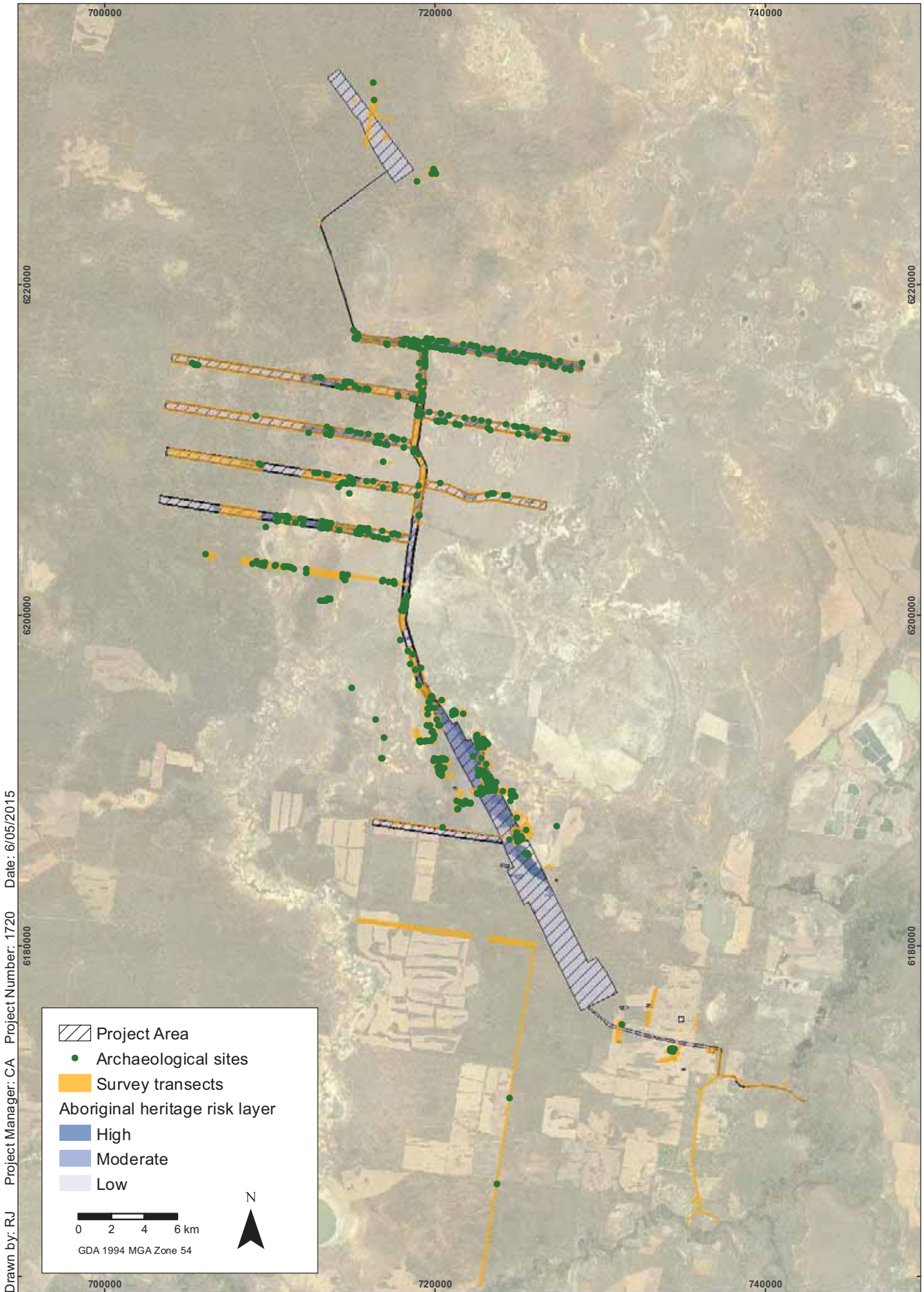
Table 24: Archaeological Risk Layer

Risk Layer Rating	Character of Risk Layer Rating
High	Landscape features associated with sites of moderate to high significance and frequent low density sites of low significance. These landscape features may be lunettes, dunes, scalds and pans associated with depressions, relict lakes, relict creeks and vegetation suggesting shallow water tables. Land systems such as Marma, Hatfield, Youhl, Rata and Peretkin frequently contain these features.
Moderate	Landscape features associated with frequent isolated and low density sites, often of low significance. The landscape features may be dunes, scalds or pans and differ from the high risk rating due to their increasing distance from water or resource and/or the limited nature of that resource. Land systems such as Marma, Hatfield, Youhl, Rata and Peretkin frequently contain these features.
Low	Landscape features associated with low archaeological potential or infrequent, isolated Aboriginal objects of low significance. These landscape features are typically characterised by disturbed land or limited temporary or permanent water sources, mallee dunefields, calcareous rises or saltbush plains with few pan, scalds, soaks and depressions. Land systems such as Arumpo, Bulgamarra, Condoulpe and Gulthul often contain these landscape features.

Table 25: Summary of area within project area that falls within each land system and archaeological risk category

Land system	Area (ha) in Archaeological Risk Layer within Project Area			Total
	High	Moderate	Low	
Arumpo	0	0	773.0	773.0
Bulgamarra	0	0	2.0	2.0

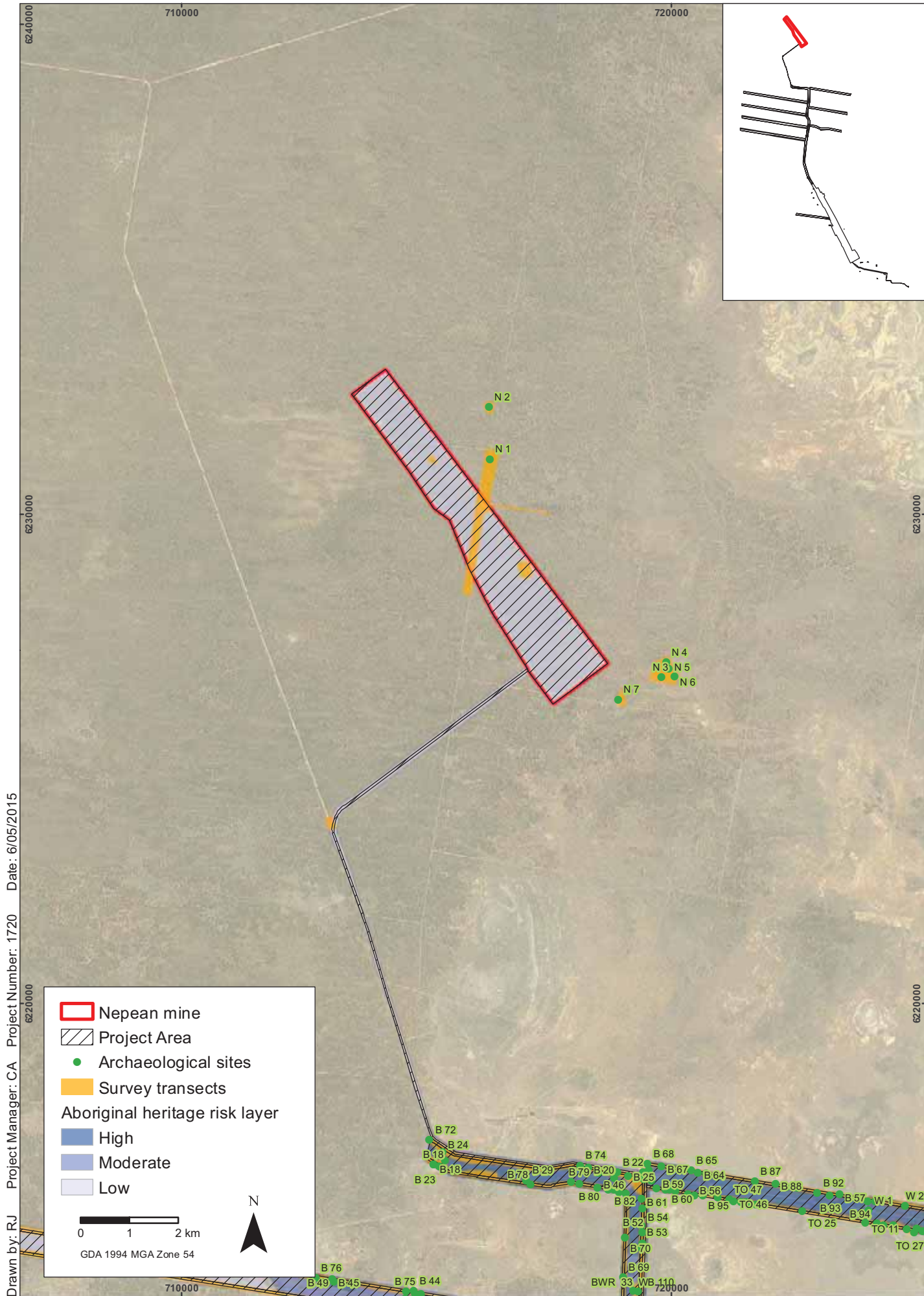
<i>Condoulpe</i>	0.5	128.8	1929.1	2058.4
<i>Gulthul</i>	26.8	221.5	1711.5	1959.8
<i>Hatfield</i>	401.6	449.0	123.0	973.6
<i>Marma</i>	903.0	238.0	124.6	1265.6
<i>Rata</i>	588.8	909.6	1072.6	2571.0
<i>Riverland</i>	0	0	17.8	17.8
<i>Wilkurra</i>	0	0	75.2	75.2
<i>Youhl</i>	81.2	118.7	74.3	274.2
Total	2001.9	2065.7	5903.2	9970.7588



Aboriginal heritage risk layer: overview
Balranald Mineral Sands Project Aboriginal Cultural Heritage

FIGURE 32

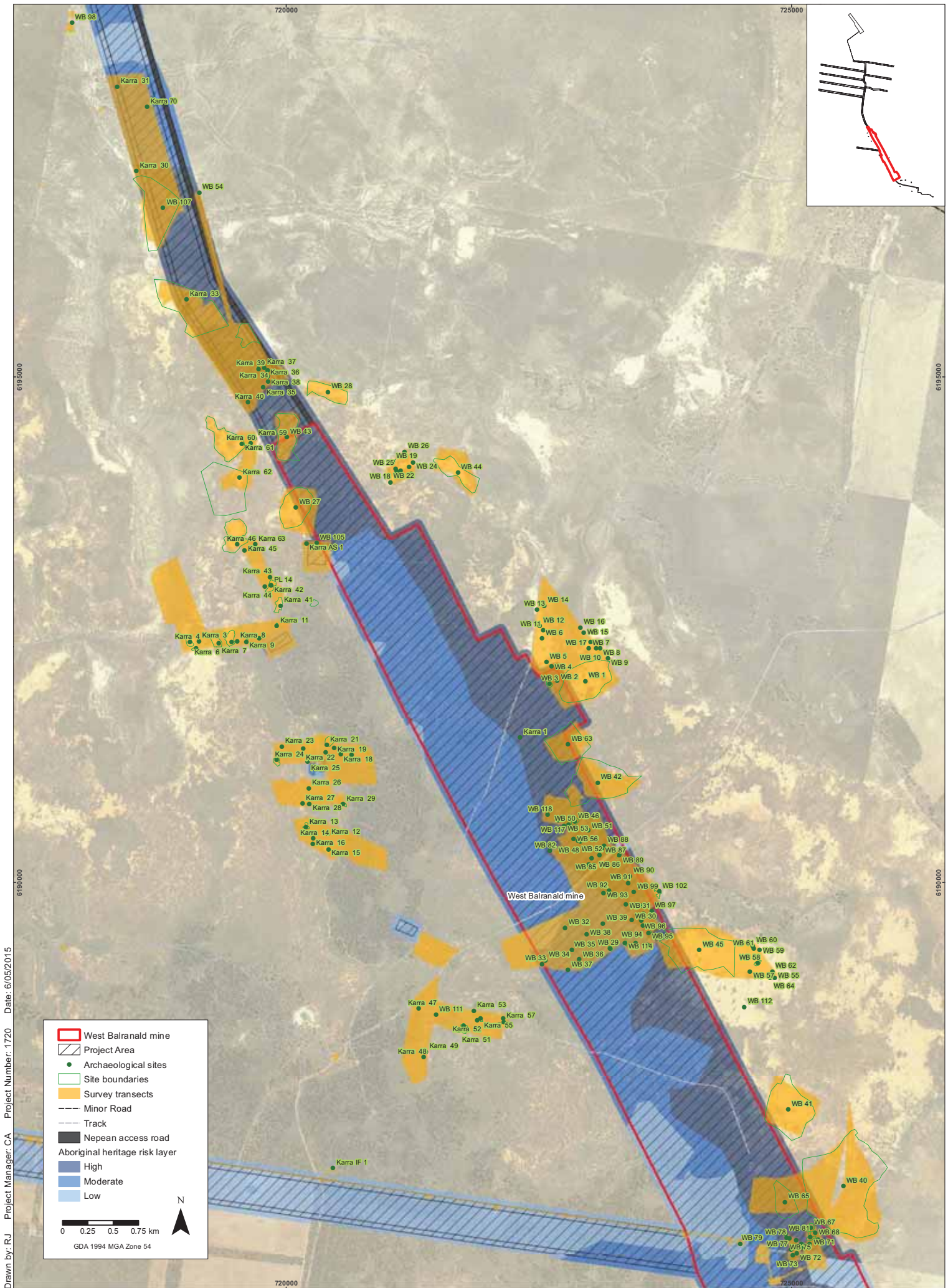
Imagery: (c) Iluka



Aboriginal Heritage Risk Layer: Nepean Mine
Balranald Mineral Sands Project Aboriginal Cultural Heritage

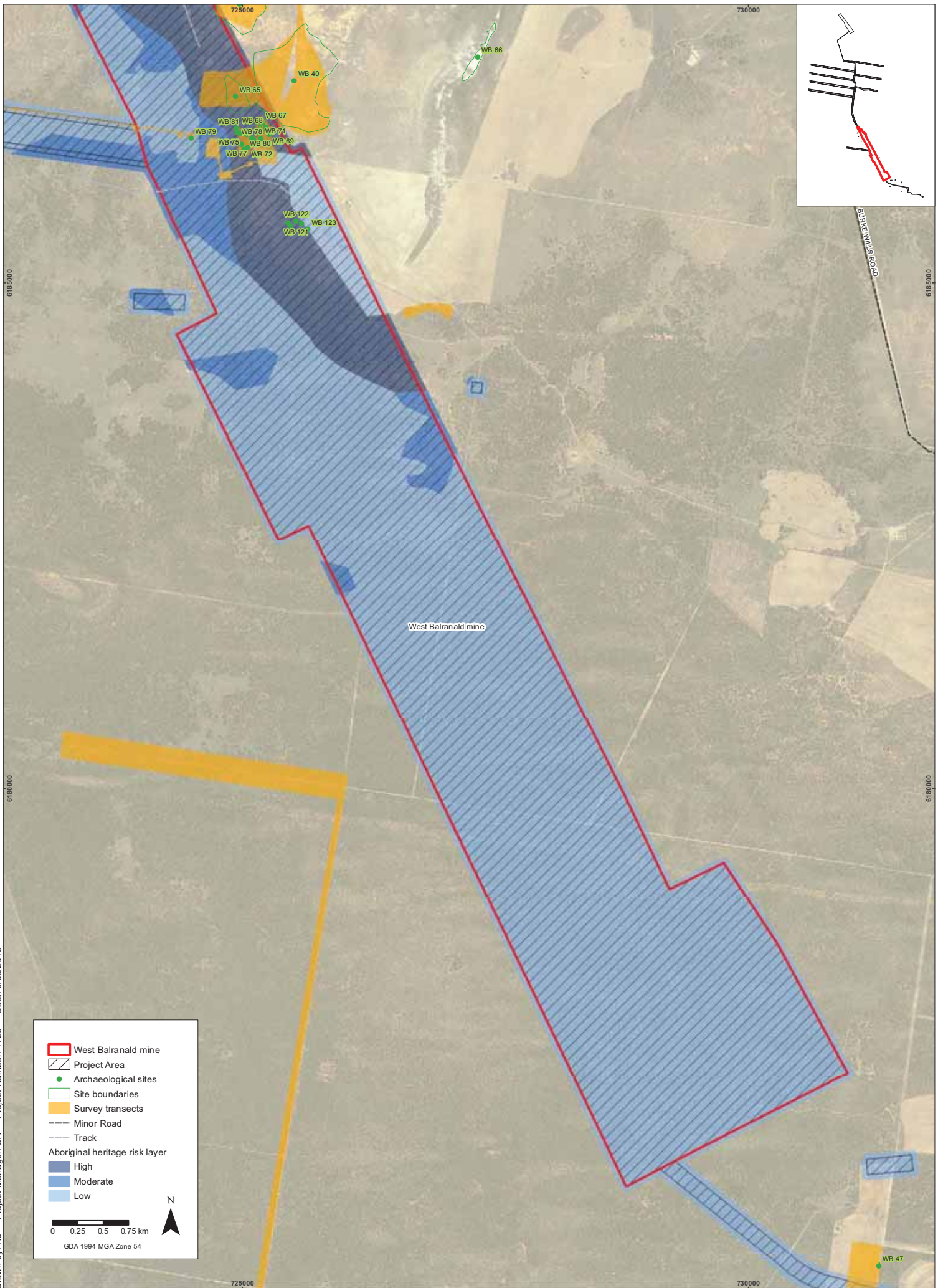
FIGURE 33

Drawn by: RJ Project Manager: CA Project Number: 1720 Date: 6/05/2015



Drawn by: R.J. Project Manager: CA Project Number: 1720 Date: 6/05/2015

Survey results: West Balranald mine (North)
Balranald Mineral Sands Project Aboriginal Cultural Heritage

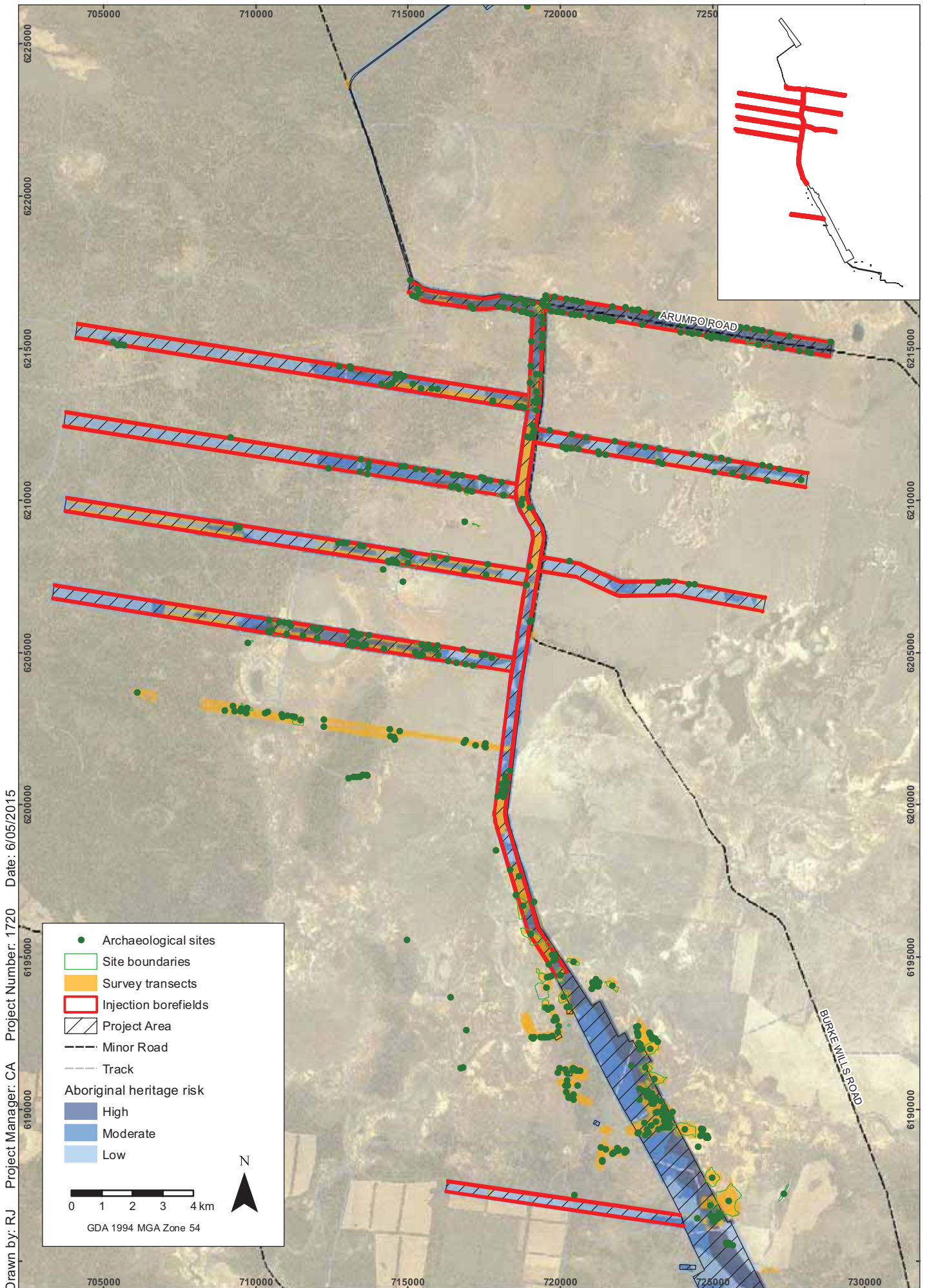


Drawn by: R.J. Project Manager: CA Project Number: 1720 Date: 6/05/2015

Survey results: West Balranald mine (south)
Balranald Mineral Sands Project Aboriginal Cultural Heritage

FIGURE 35

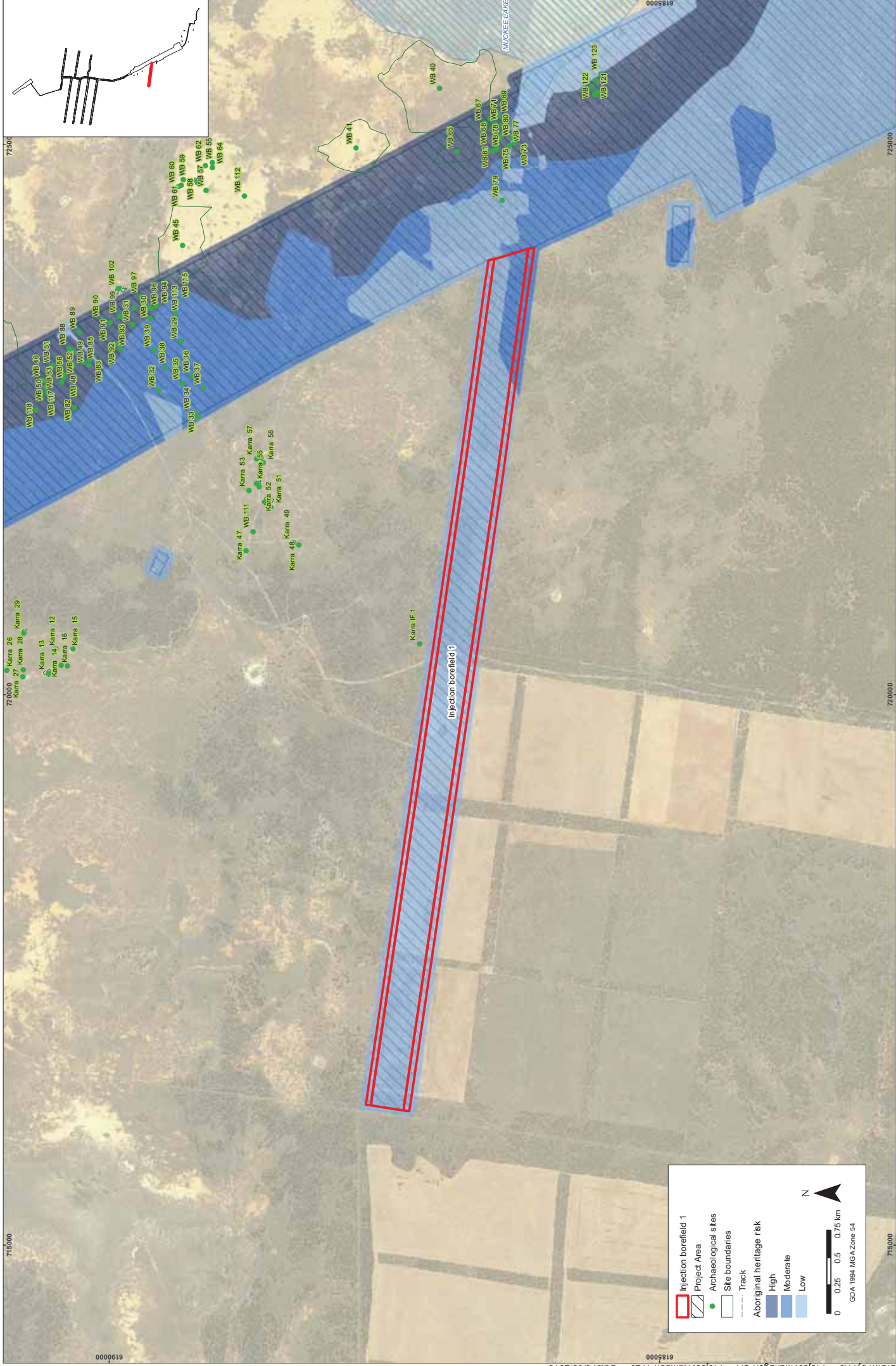
Imagery: (c) Iluka



Aboriginal heritage risk: Injection borefields overview
 Balranald Mineral Sands Project Aboriginal Cultural Heritage

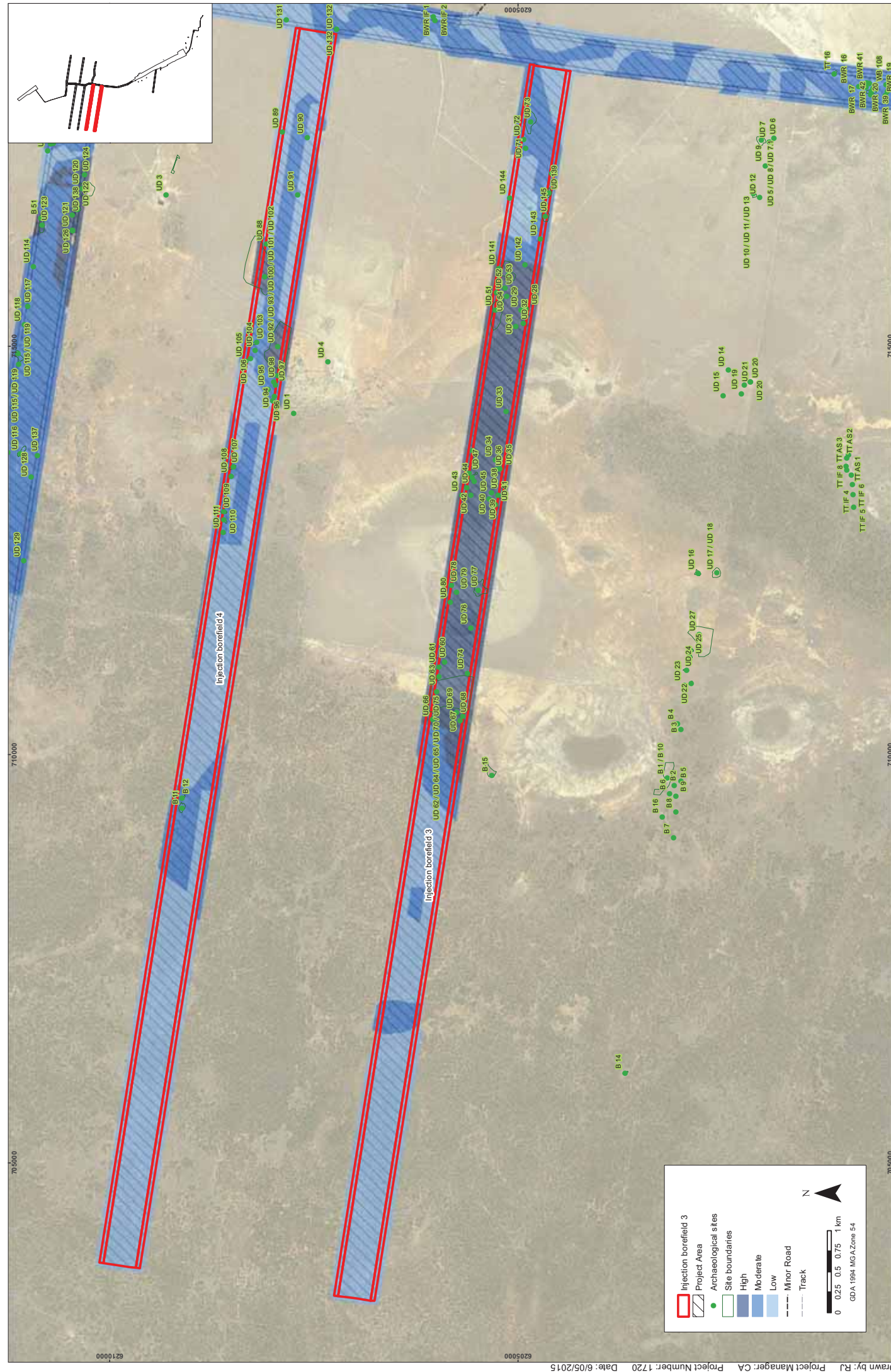
FIGURE 36

Imagery: (c) Iluka



Drawn by: RJ Project Manager: CA Project Number: 1720 Date: 6/05/2015

Aboriginal heritage risk: Injection borefield 1
 Balranald Mineral Sands Project Aboriginal Cultural Heritage



Aboriginal heritage risk: Injection borefields 3 and 4
 Balranald Mineral Sands Project Aboriginal Cultural Heritage

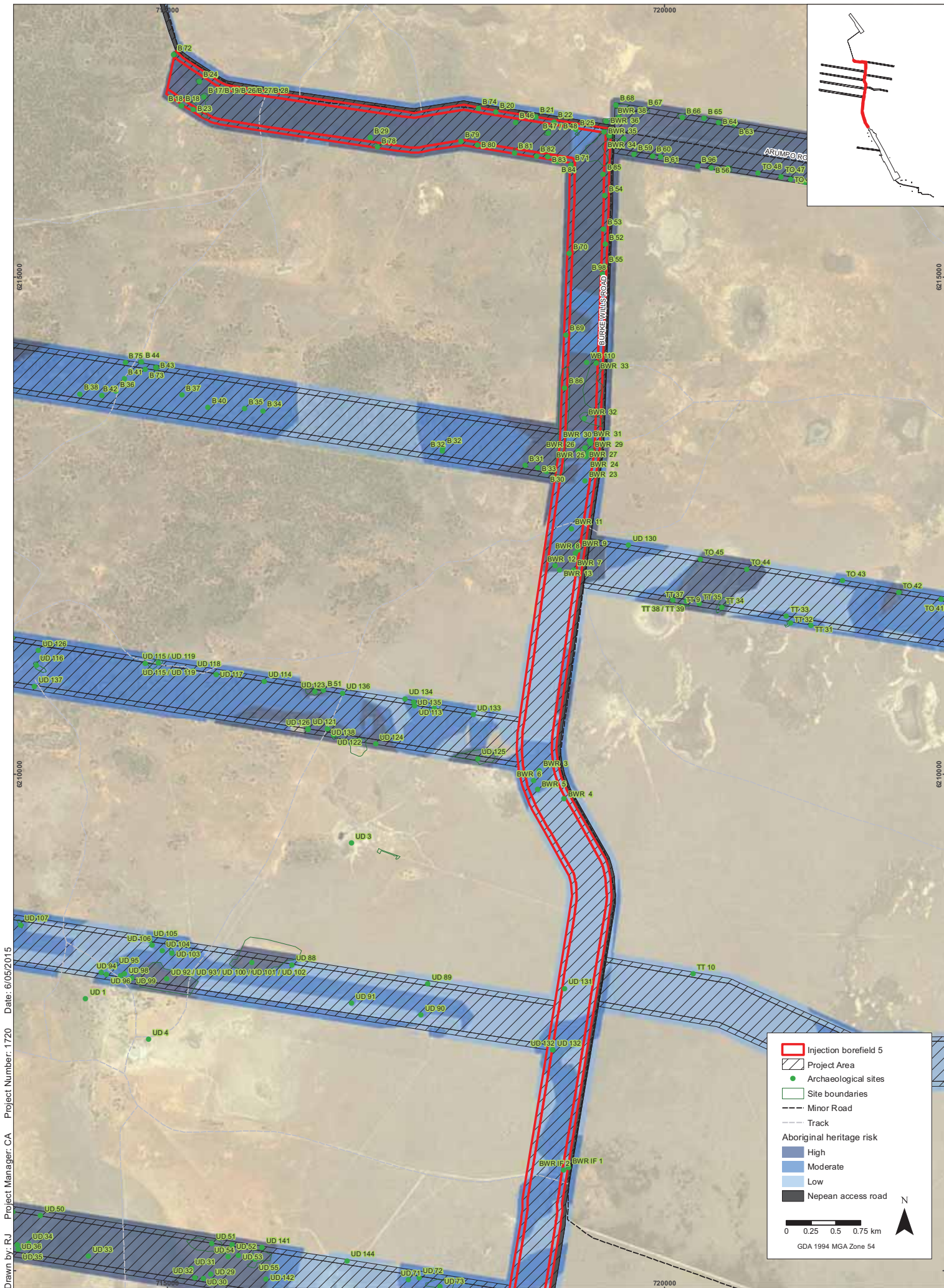
FIGURE 38
 Imagery: (C) Iluka



Injection borefield 3

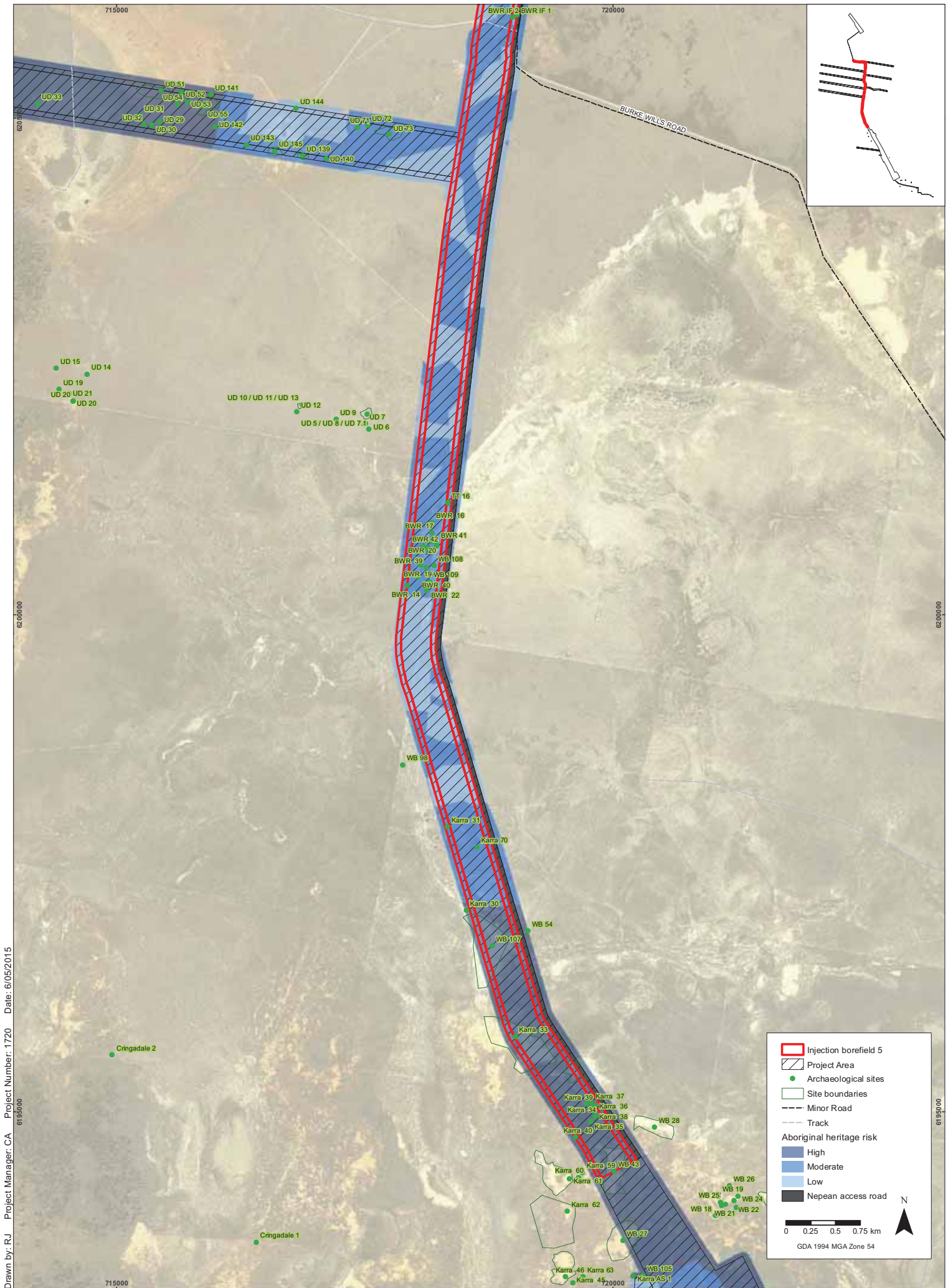
- Project Area
- Archaeological sites
- Site boundaries
 - High
 - Moderate
 - Low
- Minor Road
- Track

0 0.25 0.5 0.75 1 km
 GDA 1984 MGA Zone 54



Drawn by: R.J. Project Manager: CA Project Number: 1720 Date: 6/05/2015

Aboriginal heritage risk: Injection borefield 5 (North)
Balranald Mineral Sands Project Aboriginal Cultural Heritage



Drawn by: R.J. Project Manager: CA Project Number: 1720 Date: 6/05/2015

Aboriginal heritage risk: Injection borefield 5 (South)
Balranald Mineral Sands Project Aboriginal Cultural Heritage



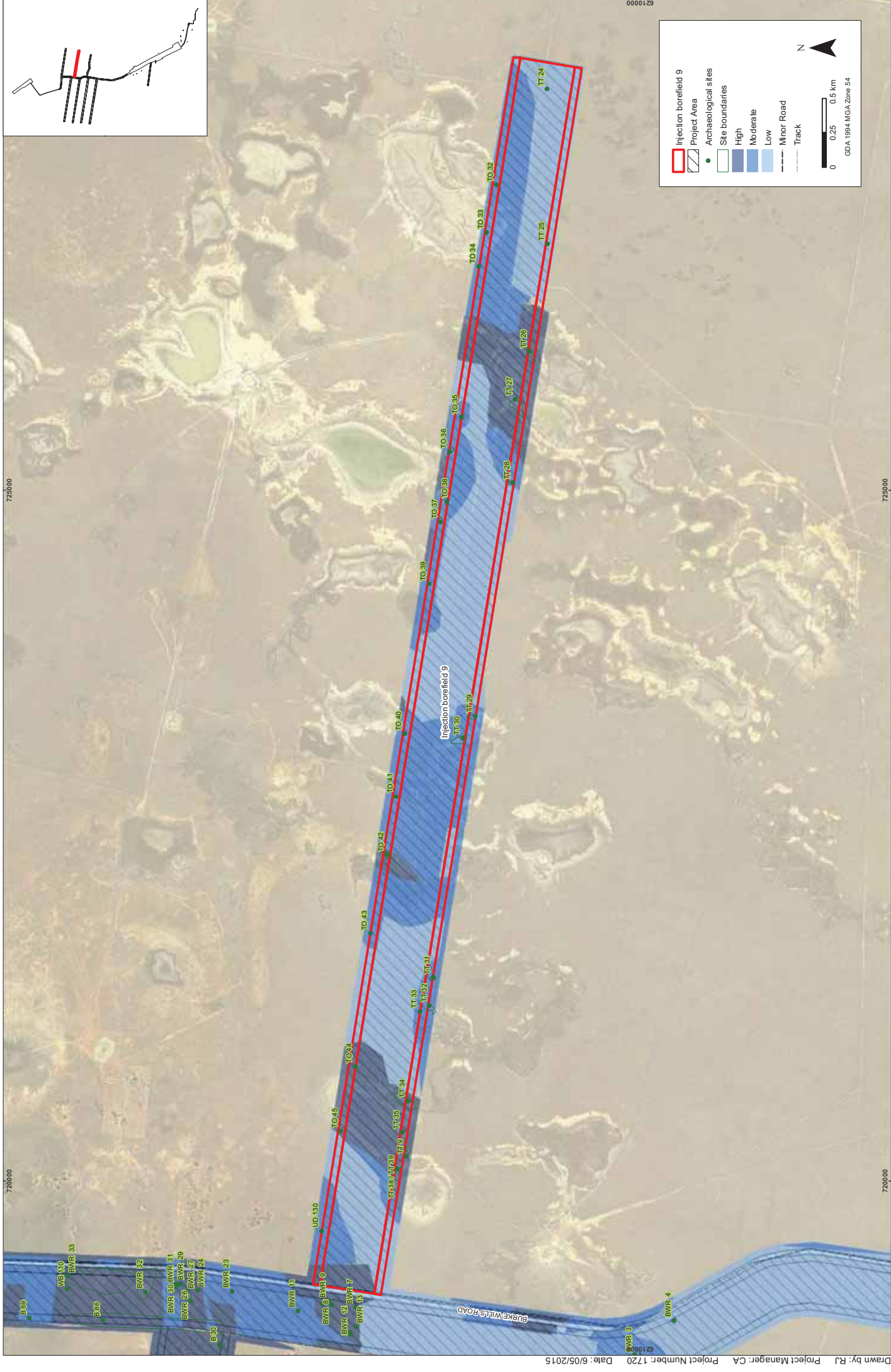
720000 725000 720000 725000

Aboriginal heritage risk: Injection borefield 8
Balranald Mineral Sands Project Aboriginal Cultural Heritage

FIGURE 43

Imagery: (C) Iluka





Aboriginal heritage risk: Injection borefield 9
Balranald Mineral Sands Project Aboriginal Cultural Heritage

FIGURE 44
Imagery: (C) Iluka

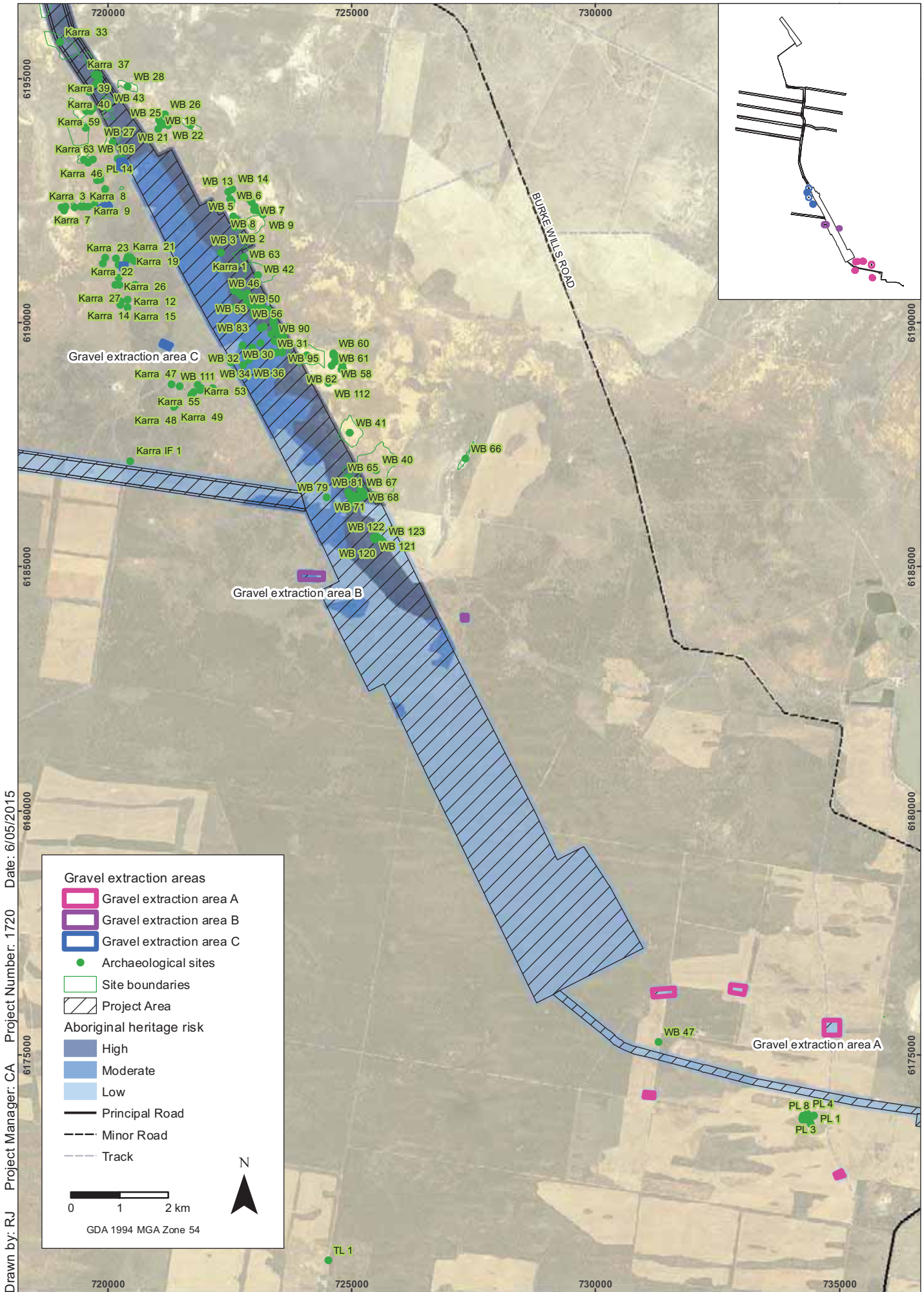


Drawn by: RJ Project Manager: CA Project Number: 1720 Date: 6/05/2015

Aboriginal heritage risk: Injection borefield 10
 Balranald Mineral Sands Project Aboriginal Cultural Heritage

FIGURE 45
 Imagery: (C) Iluka





Drawn by: RJ Project Manager: CA Project Number: 1720 Date: 6/05/2015

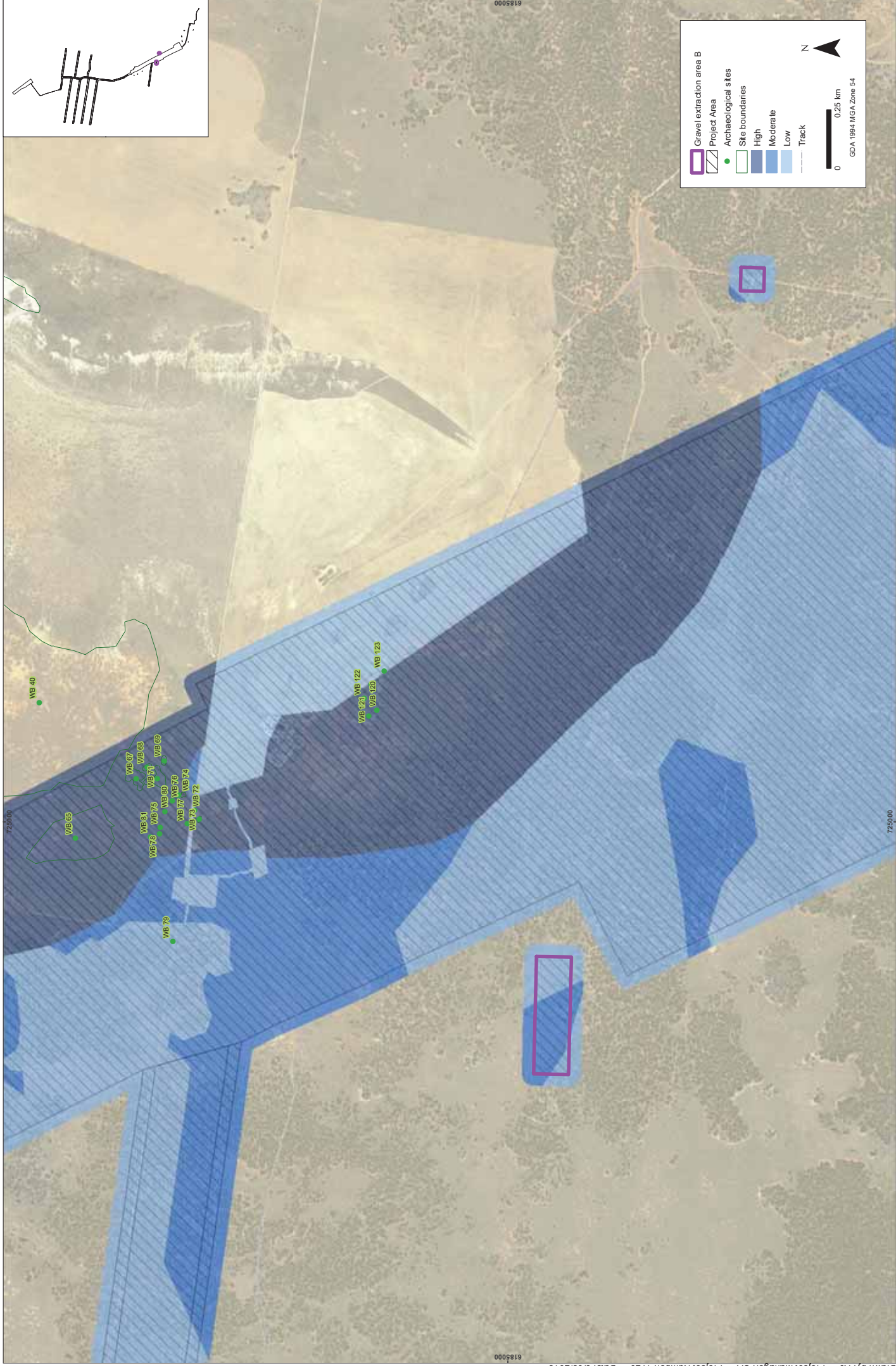
Aboriginal heritage risk: Gravel extraction area overview
Balranald Mineral Sands Project Aboriginal Cultural Heritage

FIGURE 46



Aboriginal heritage risk: Gravel extraction area A
 Balranald Mineral Sands Project Aboriginal Cultural Heritage

FIGURE 47
 Imagery: (C) Iluka

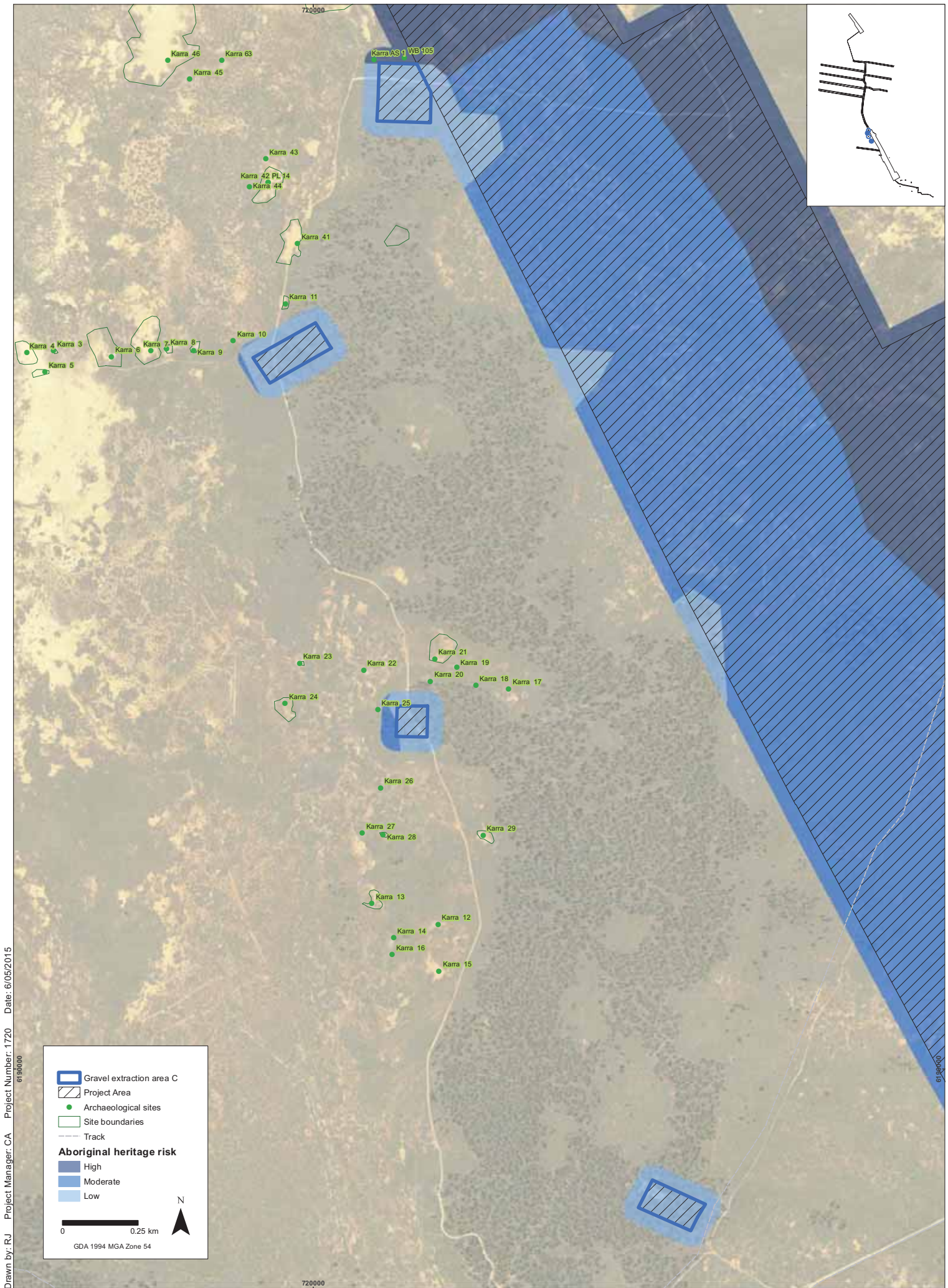


Drawn by: RJ Project Manager: CA Project Number: 1720 Date: 6/05/2015

Aboriginal heritage risk: Gravel extraction area B
Balranald Mineral Sands Project Aboriginal Cultural Heritage

FIGURE 48
Imagery: (C) Iluka

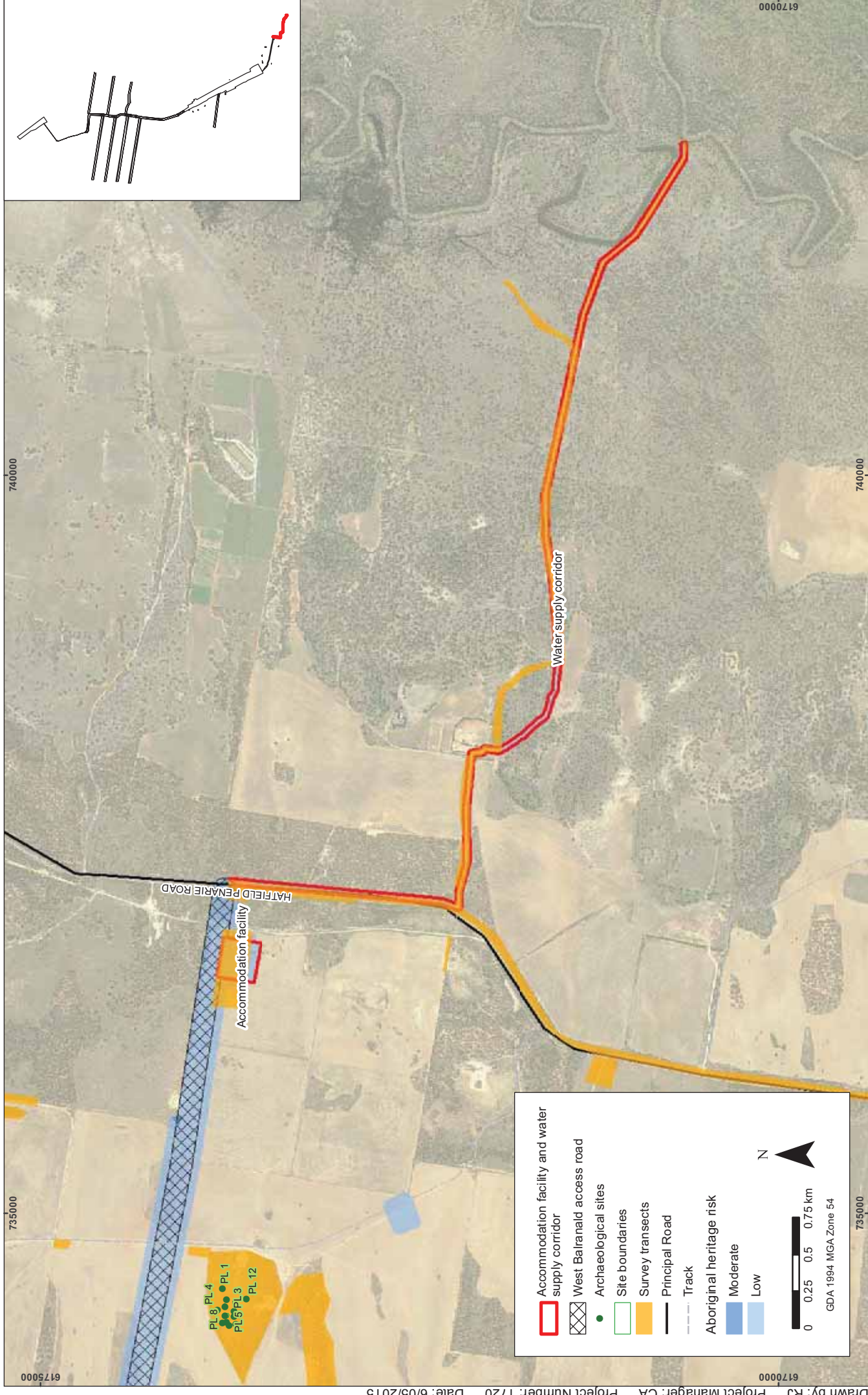




Aboriginal heritage risk: Gravel extraction area C
Balranald Mineral Sands Project Aboriginal Cultural Heritage

FIGURE 49

Imagery: (c) Iluka



Drawn by: RJ Project Manager: CA Project Number: 1720 Date: 6/05/2015

Aboriginal heritage risk: Accommodation facility and water supply corridor
Balranald Mineral Sands Project Aboriginal Cultural Heritage

FIGURE 50
Imagery: (c) Iluka

12. Cultural Heritage Values and Significance Assessment

12.1 The Burra Charter

The *Burra Charter* (Australia ICOMOS 2013) defines the basic principles and procedures to be observed in the conservation of important heritage places. It provides a primary and ‘best-practice’ framework within which decisions about the management of heritage sites in Australia should be made. The *Burra Charter* and the OEH policy *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (OEH, 2011) define cultural significance as being derived from the following four values:

Aesthetic Value: This value includes aspects of sensory perception for which criteria can and should be stated. Such criteria may include consideration of the form, scale, colour, texture and material of the fabric; the smells and sounds associated with the place and its use.

Historic Value: This value encompasses the history of aesthetics, science and society, and therefore to a large extent underlies all of the terms set out in this section. A place may have historic value because it has influenced, or has been influenced by, an historic figure, event, phase or activity. It may also have historic value as the site of an important event. For any given place the significance will be greater where evidence of the association or event survives in situ, or where the settings are substantially intact, than where it has been changed or evidence does not survive. However, some events or associations may be so important that the place retains significance regardless of subsequent treatment.

Scientific Value: The scientific or research value of a place will depend upon the importance of the data involved, on its rarity, quality or representativeness, its integrity and on the degree to which the place may contribute further substantial information.

Social Value: This value embraces the qualities for which a place has become a focus of spiritual, political, national or other cultural sentiment to a majority or minority group.

12.2 Archaeological (Scientific) Significance Assessment of Aboriginal Heritage Sites

The NSW Aboriginal cultural heritage regulatory framework supports the significance assessment of Aboriginal archaeological sites and provides guidelines for this Aboriginal Cultural Heritage Assessment within the *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (OEH 2011). (It outlines two main themes in the overall Aboriginal cultural heritage significance assessment process, namely, the identification of the cultural/social significance of Aboriginal objects and/or places to Aboriginal people and the identification of the scientific (archaeological) significance to the scientific/research community. These themes encapsulate those aspects of the *Burra Charter* that are of particular relevance to Aboriginal objects and places. The guidelines specify that information about scientific values will be gathered through archaeological investigation carried out according to the *Code of Practice for Archaeological Investigation of Aboriginal Object in New South Wales* (DECCW 2010b). The *Code of Practice for Archaeological Investigation of Aboriginal Object in New South Wales* (DECCW 2010b) itself does not specify criteria for assessment of Aboriginal objects, but rather suggests to “identify the archaeological values and assess their significance ...”. The assessment must be supportable and the assessment criteria must reflect best practice assessment processes as set out in the *Burra Charter*.

Notwithstanding the circularity of this advice, the scientific values described in the *Burra Charter* (above) were considered further by the then NSW National Parks and Wildlife Service in their *Aboriginal Cultural Heritage Standards and Guidelines Kit* (NSW NPWS 1997).

In lieu of specific criteria, the advice from the Aboriginal Cultural Heritage Standards and Guidelines Kit (NSW NPWS 1997) is summarised and paraphrased below to provide guidance to the assessment of scientific values presented below:

Research Potential: It is the potential to elucidate past behaviour which gives significance under this criterion rather than the potential to yield collections of artefacts. Matters considered under this criterion include the intactness of a site, the potential for the site to build a chronology and the connectedness of the site to other sites in the archaeological landscape.

Representativeness: As a criterion, representativeness is only meaningful in relation to a conservation objective. Presumably all sites are representative of those in their class or they would not be in that class. What is at issue is the extent to which a class of sites is conserved and whether the particular site being assessed should be conserved in order to ensure that we retain a representative sample of the archaeological record as a whole. The conservation objective which underwrites the ‘representativeness’ criteria is that such a sample should be conserved (NSW NPWS 1997: 7-9).

Rarity: This criterion cannot easily be separated from that of representativeness. If a site is ‘distinctive’ then by definition, it will be part of the variability which a representative sample would represent. The criterion might best be approached as one which exists within the criterion of representativeness, giving a particular weighting to certain classes of site. The main requirement for being able to assess rarity is to determine what is common and what is unusual in the archaeological record, as well the way that archaeology confers prestige on certain sites because of their ability to provide certain information. The criterion of rarity may be assessed at a range of levels including local, regional, state, national and global (NSW NPWS 1997: 10).

Educational Potential: This criterion relates to the ability of the cultural heritage item or place to inform and/or educate people about one or other aspects of the past. It incorporates notions of intactness, relevance, interpretative value and accessibility. Where archaeologists or others carrying out cultural heritage assessments are promoting/advocating the educational value of a cultural heritage item or place it is imperative that public input and support for this value is achieved and sought. Without public input and support the educative value of the items/places is likely to not ever be fully realised (NSW NPWS 1997: 10).

Aesthetics: In relation to heritage places, aesthetic significance is generally taken to mean the visual beauty of the place. Aesthetic value is not inherent in a place but arises in the sensory response people have to it. The guidelines provide no expectation for archaeologists to consider aesthetic values, it is often the case that the aesthetics including the physical setting of an archaeological site or a landscape contributes to its cultural heritage significance. Examples of archaeological sites that may have high aesthetic values include rock art sites or sites located in environments that evoke strong sensory responses (NSW NPWS 1997: 11).

12.2.1 Grading Values and Significance

In assessing the archaeological values of the sites recorded during this project model statements of significance were developed to allow the significance to be described and compared within a regional approach. In this framework examples such as the ancient sites and ancestral remains present at Lake Mungo were considered as the example of what is high value.

Low

The site or object contains only a single or limited number of features, and has no potential to meaningfully inform our understanding of the past beyond what it contributes through its current recording (i.e. no or

low research potential). The site or object is a representative but unexceptional example of the most common class of sites or objects in the region. Many more similar examples can be confidently predicted to occur within the project area, and in the region.

Moderate

The site or object derives value because it contains features, both archaeological and contextual, which through further investigation may contribute to our understanding of the local past. These features include, but are not limited to: the relationship with landscape features or other Aboriginal archaeological sites or areas of identified heritage importance; diagnostic archaeological or landscape features that inform a chronology; and a relatively large assemblage of stone artefacts. The presence of a diverse artefact and feature assemblage, and connectedness with landscape features and other notable sites provide relatively higher representative and rarity values than sites of low significance.

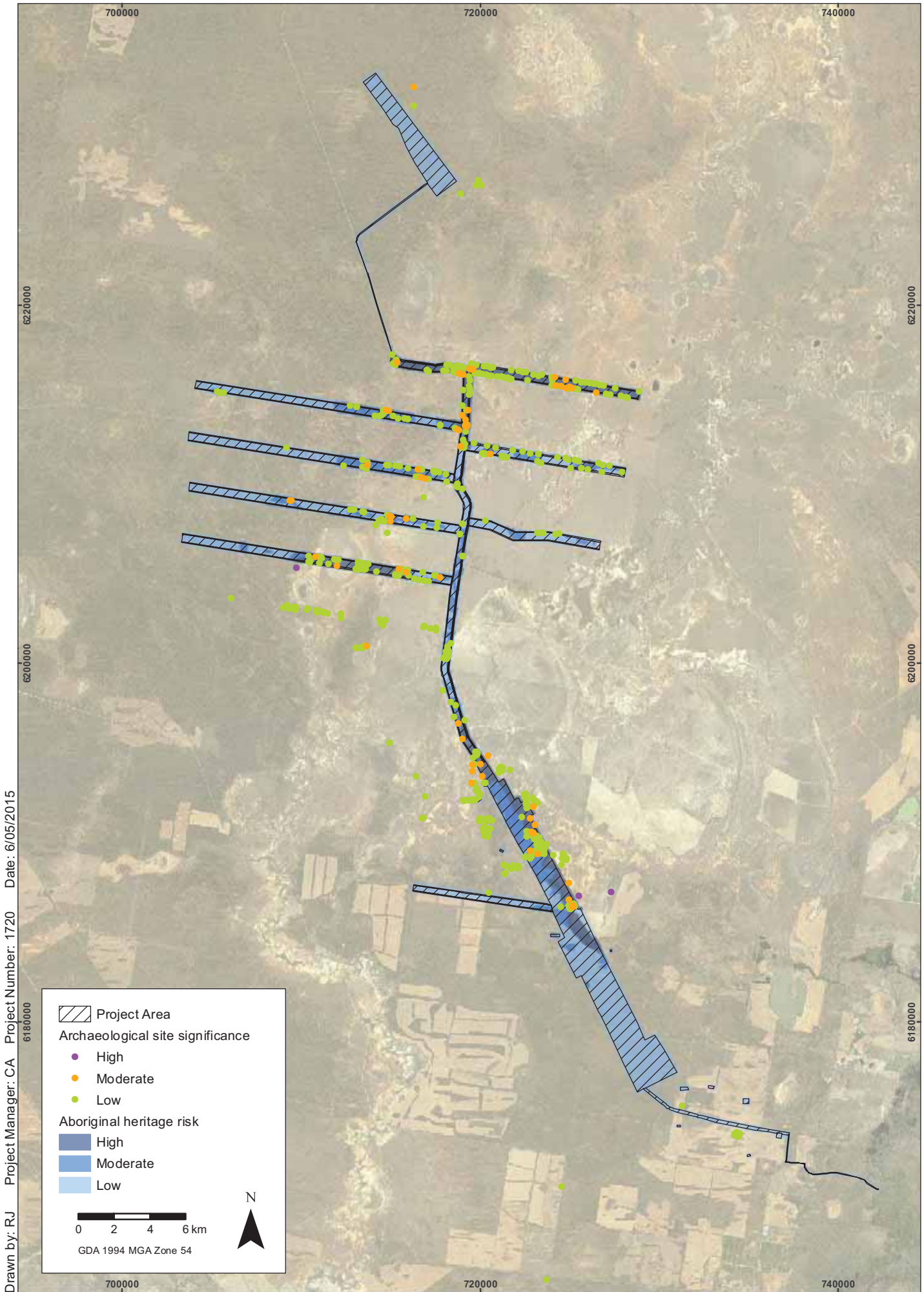
High

The site or object has value because it contains archaeological and/or contextual features which through further investigation may significantly contribute to our understanding of the past, both locally and on a regional scale. These features include, but are not limited to: Aboriginal ancestral remains; the site's relationship with landscape features or other Aboriginal archaeological sites or areas of identified heritage importance; diagnostic archaeological or landscape features that inform a chronology; and a very large assemblage of stone artefacts associated with other features such as oven remains or shell midden. Such sites will be relatively rare, and will be representative of a limited number of similar sites that make up this class; hence they derive high representative and rarity values.

12.2.2 Assessment of Significance

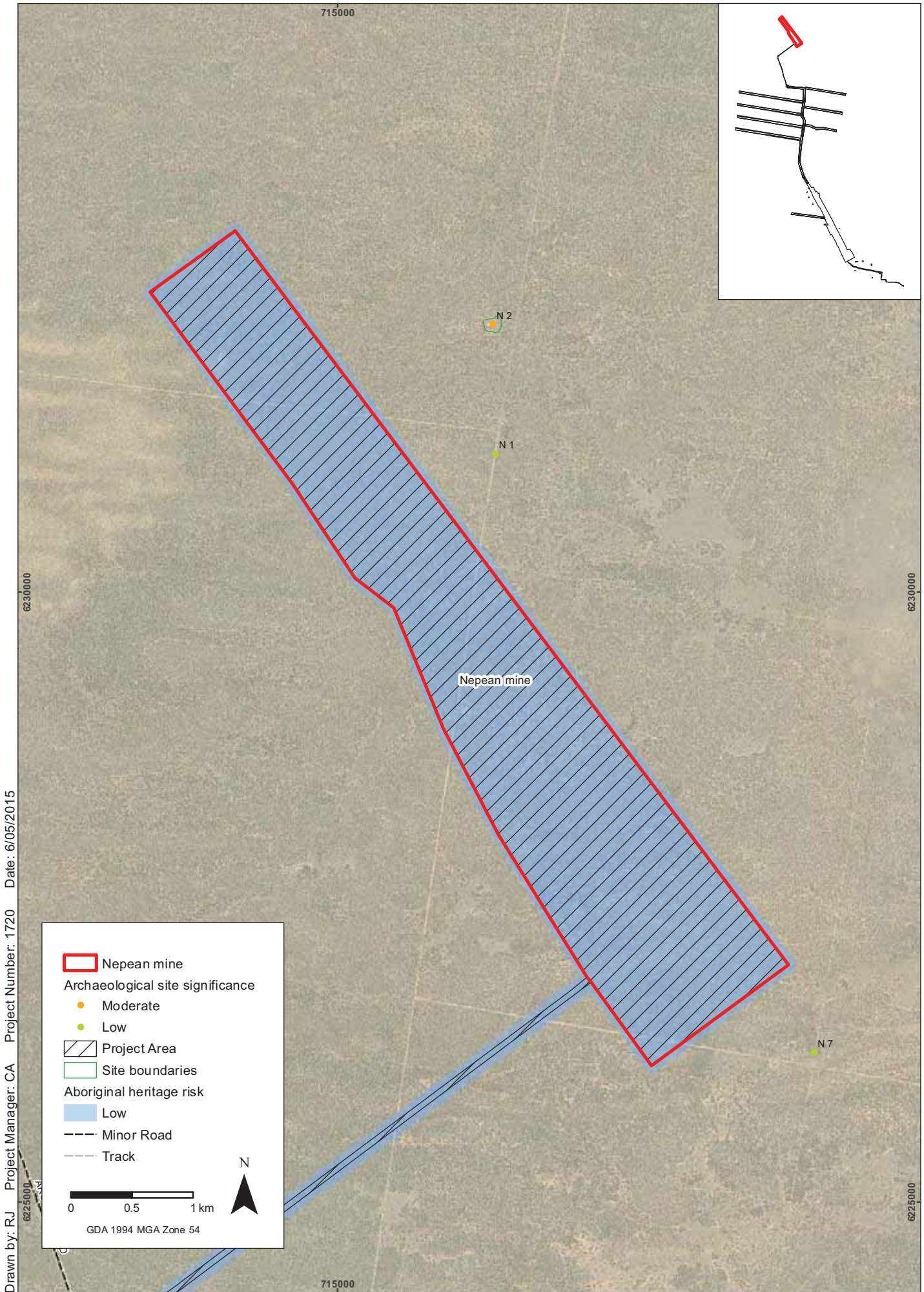
The scientific significance assessments for all the sites recorded during the 2012, 2013 and 2014 field programs (this includes sites since excluded from the project area by detailed mine planning) are presented in Table 26. A summary identifying which sites are within the project area is provided in Table 27. Educational potential and aesthetic values are not considered to be criteria against which scientific values and significance can be assessed. Aesthetic values should be considered as a distinct category (rather than a criteria that contributes to scientific value) in accordance with the *Burra Charter* and the Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW (OEH 2011). Educational potential is considered to be a criterion that contributes to social value, rather than scientific value, and hence this is considered below in the overall cultural significance assessment.

Figures depicting the significance for each project element are provided in Figure 51 to Figure 69.



Drawn by: RJ Project Manager: CA Project Number: 1720 Date: 6/05/2015

Significance and impact assessment overview
Balranald Mineral Sands Project Aboriginal Cultural Heritage

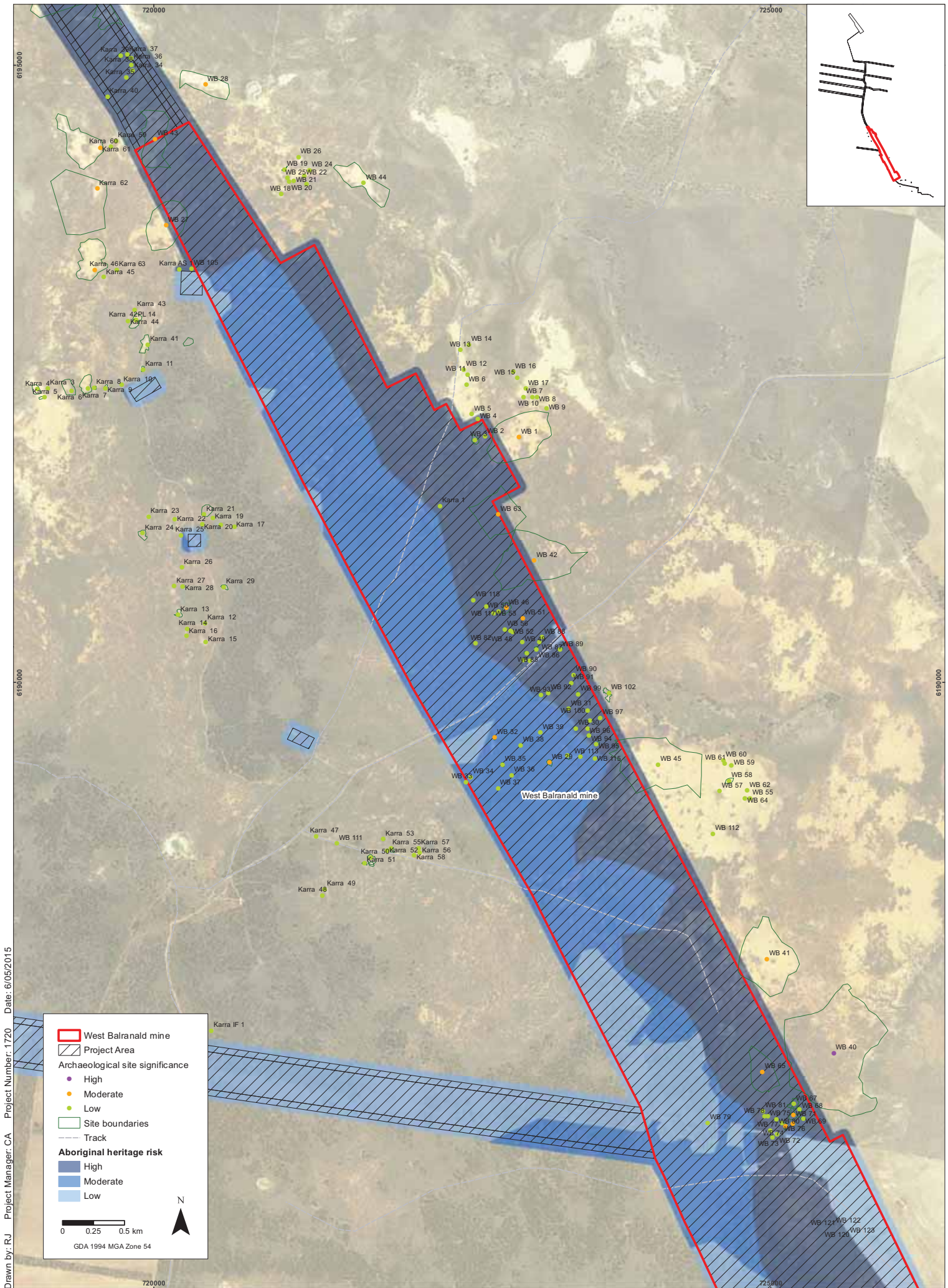


Drawn by: RJ Project Manager: CA Project Number: 1720 Date: 6/05/2015

Significance and impact assessment: Nepean mine
Balranald Mineral Sands Project Aboriginal Cultural Heritage

FIGURE 52

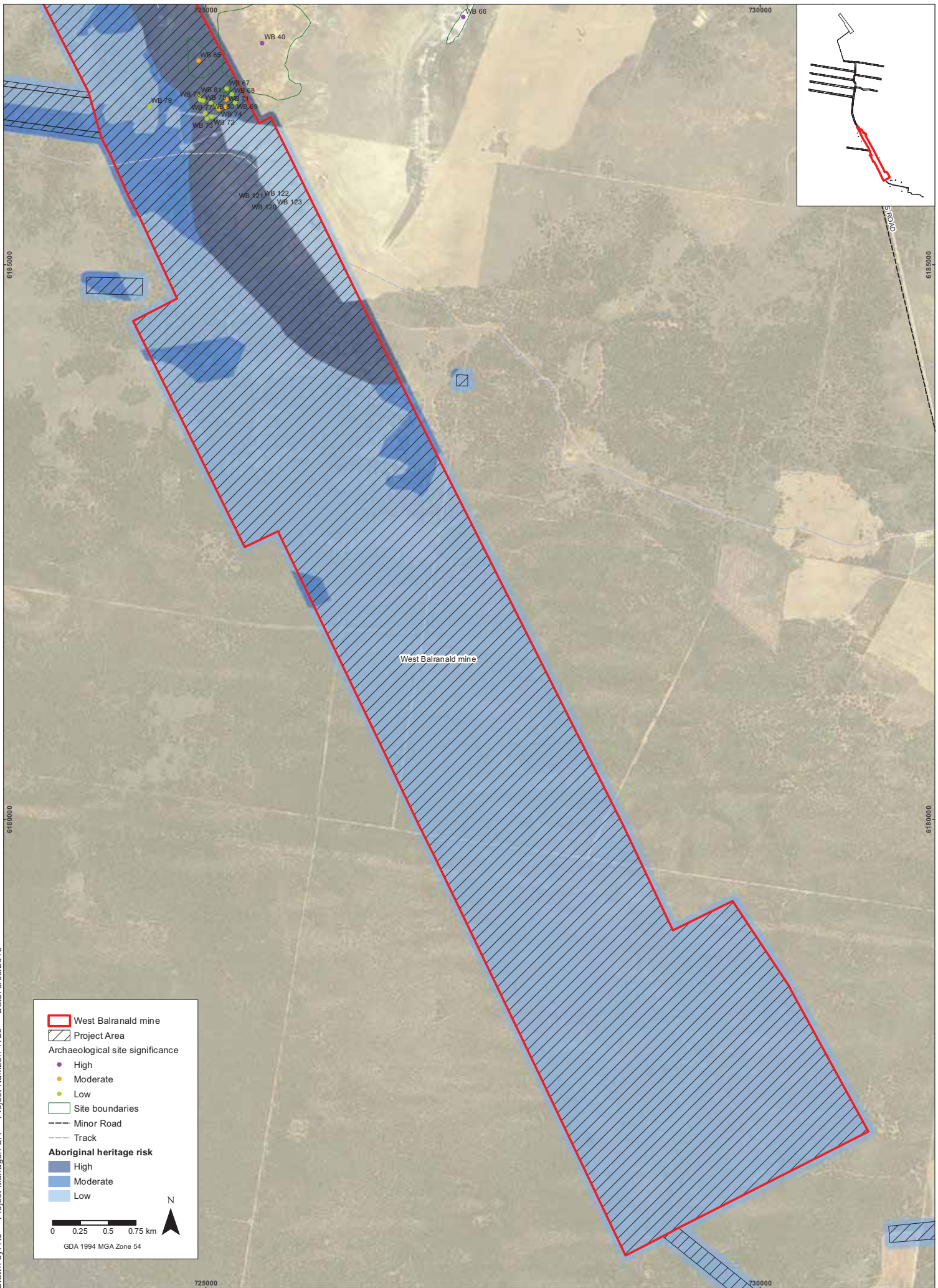
Imagery: (c) Iluka



Significance and impact assessment: West Balranald mine (north)
Balranald Mineral Sands Project Aboriginal Cultural Heritage

FIGURE 53

Imagery: (c) Iluka

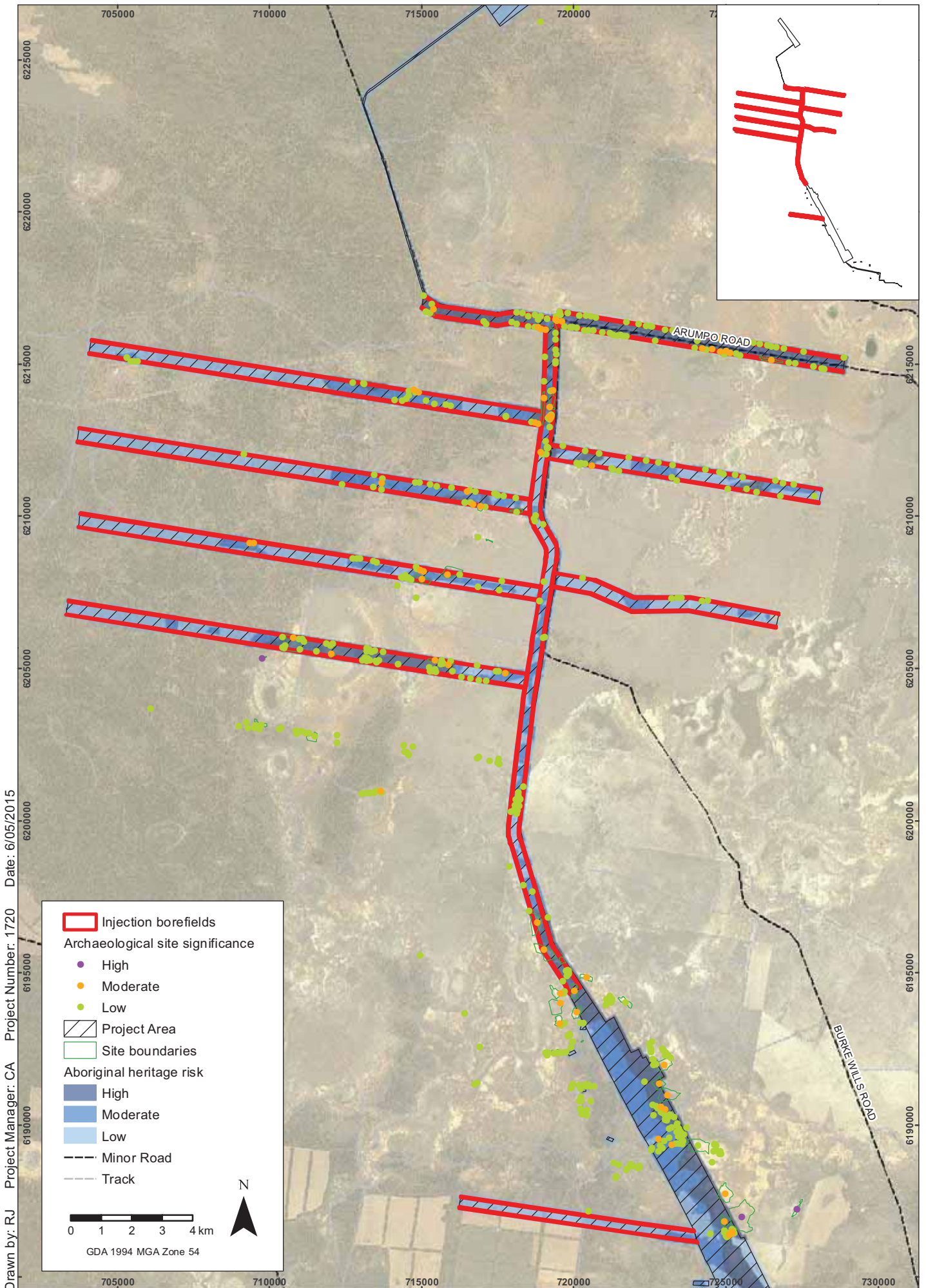


Drawn by: R.J. Project Manager: CA Project Number: 1720 Date: 6/05/2015

Significance and impact assessment: West Balranald mine (south)
Balranald Mineral Sands Project Aboriginal Cultural Heritage

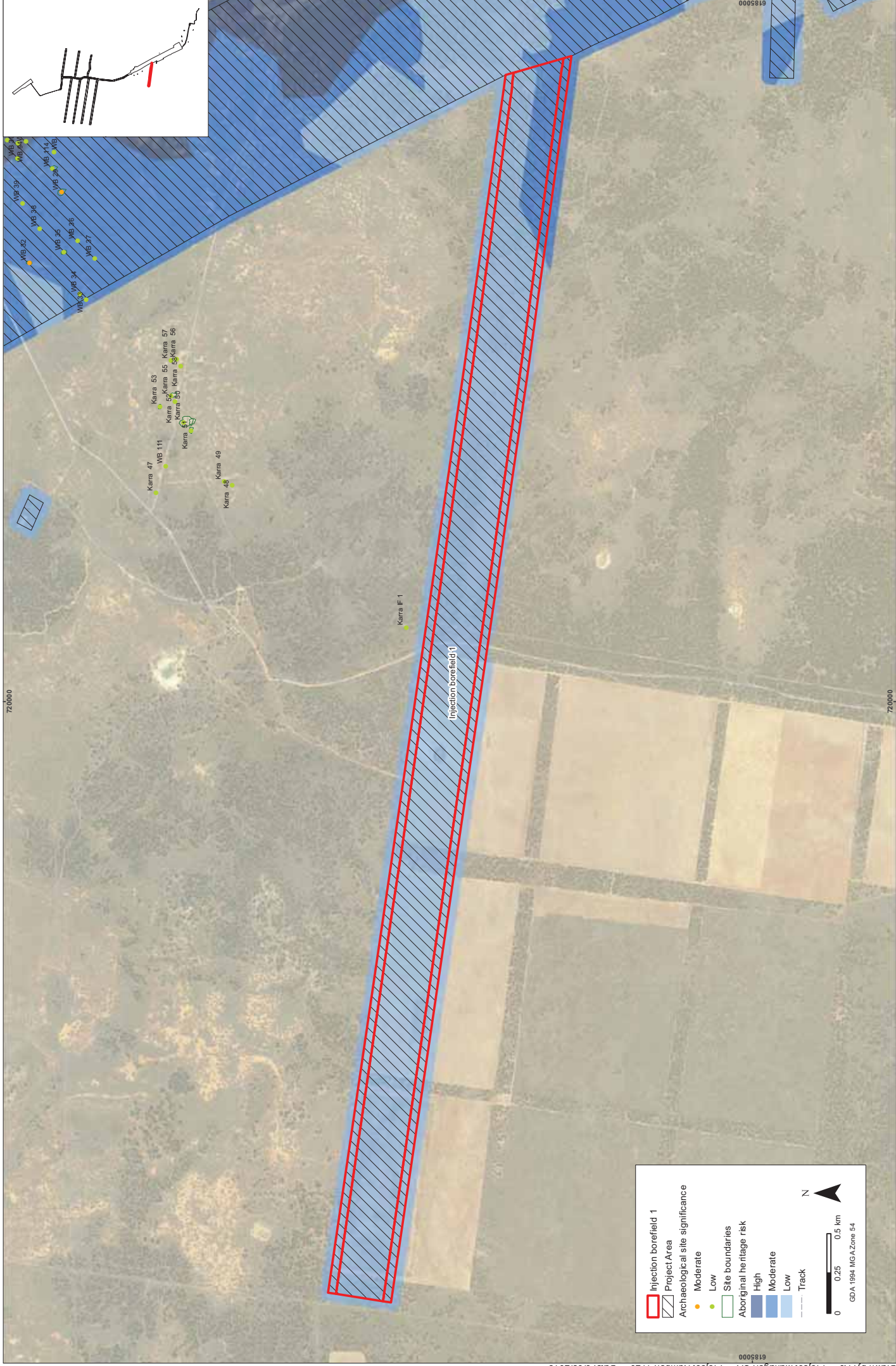
FIGURE 54

Imagery: (c) Iluka



Significance and impact assessment: Injection borefields overview
 Balranald Mineral Sands Project Aboriginal Cultural Heritage

FIGURE 55



Drawn by: RJ Project Manager: CA Project Number: 1720 Date: 6/05/2015

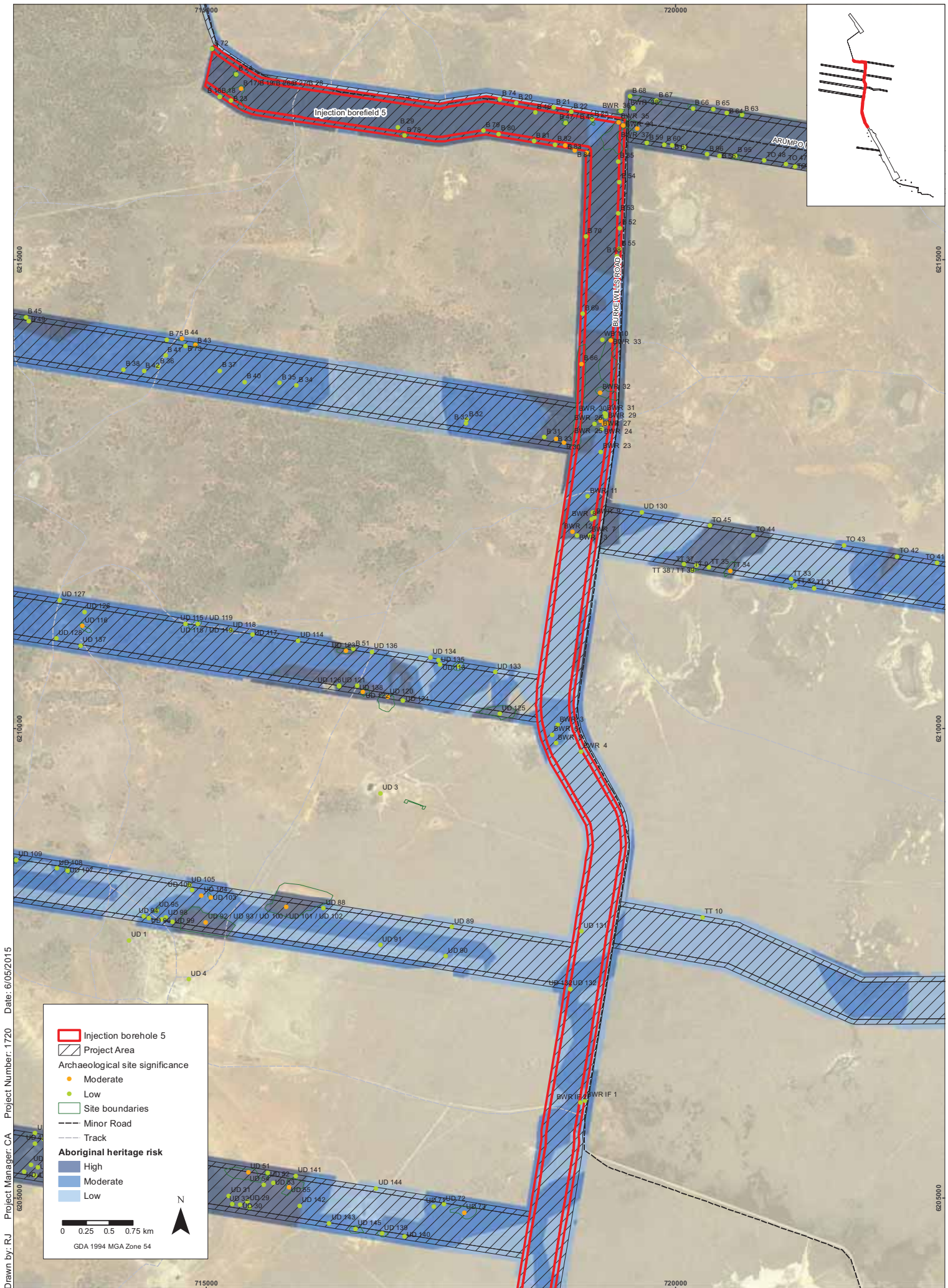
Significance and impact assessment: Injection borefield 1
Balranald Mineral Sands Project Aboriginal Cultural Heritage

FIGURE 56
Imagery: (C) Iluka



Significance and impact assessment: Injection borefield 3
Balranald Mineral Sands Project Aboriginal Cultural Heritage

FIGURE 57
Imagery: (C) Iluka



Drawn by: R.J. Project Manager: CA Project Number: 1720 Date: 6/05/2015

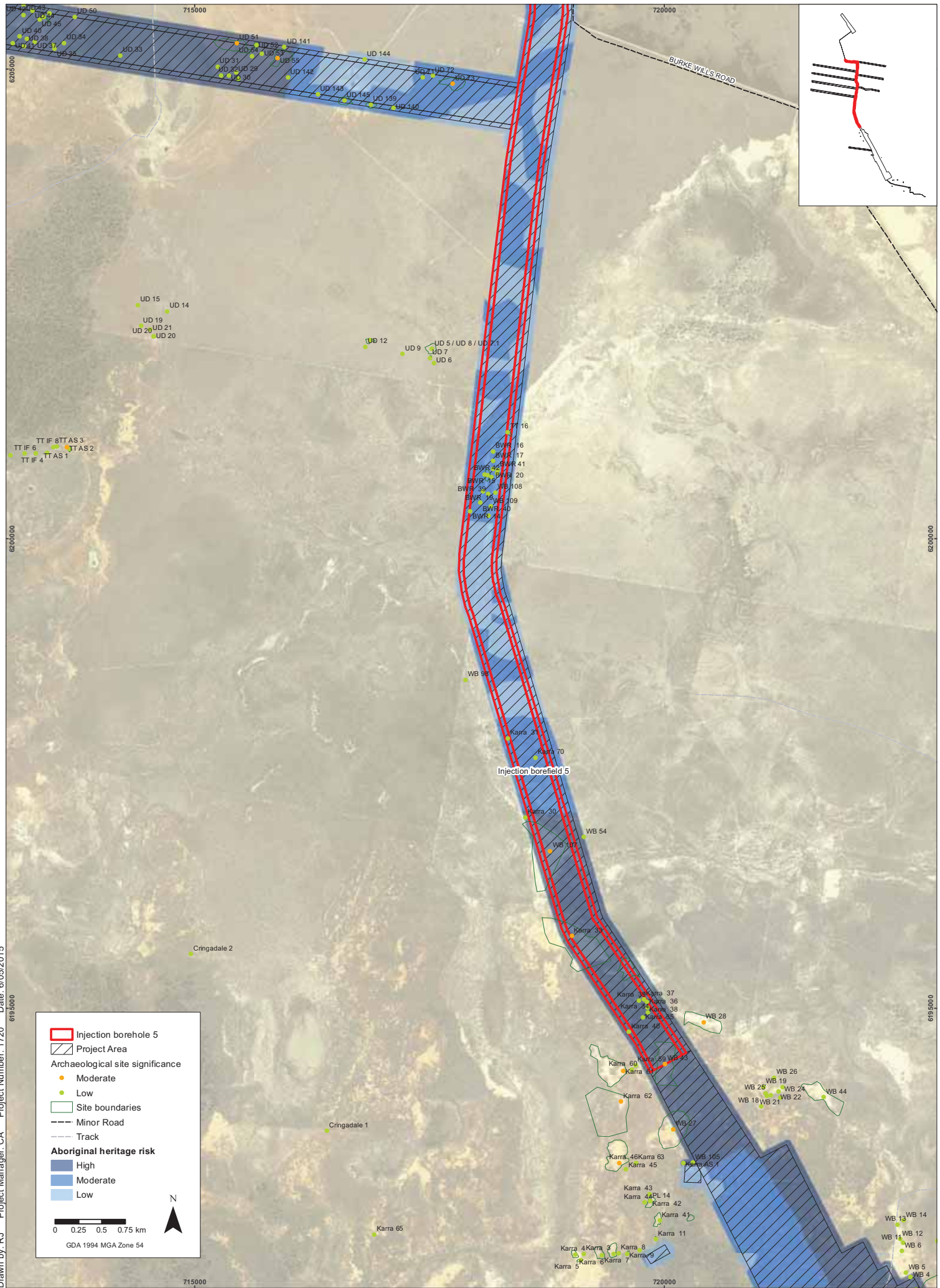
Significance and impact assessment: Injection borefield 5 (North)
Balranald Mineral Sands Project Aboriginal Cultural Heritage



FIGURE 58

Imagery: (c) Iluka

Path: T:\spatial\projects\1700\1720_Balranald\Maps\report_20150216\1720_Figure_58_SigInjectionSig5N.mxd



Drawn by: R.J. Project Manager: CA Project Number: 1720 Date: 6/05/2015

Significance and impact assessment: Injection borefield 5 (south)
Balranald Mineral Sands Project Aboriginal Cultural Heritage

FIGURE 59

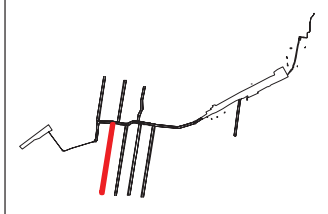
Imagery: (c) Iluka



Significance and impact assessment: Injection borefield 6
Balranald Mineral Sands Project Aboriginal Cultural Heritage

FIGURE 60
Imagery: (C) Iluka





Significance and impact assessment: Injection borefield 7
 Balranald Mineral Sands Project Aboriginal Cultural Heritage

FIGURE 61
 Imagery: (C) Iluka

	Injection borefield 7
	Project Area
	Archaeological site significance
	Moderate
	Low
	Site boundaries
	Aboriginal heritage risk
	High
	Moderate
	Low
	Minor Road
	Track

0 0.25 0.5 0.75 1 km
 GDA 1984 MGA Zone 54

N





Injection borefield 8

Injection borefield 9

Project Area

Archaeological site significance

- Moderate
- Low

Site boundaries

Aboriginal heritage risk

- High
- Moderate
- Low

Minor Road

Track

0 0.25 0.5 km

GDA 1994 MGA Zone 54

725000

720000

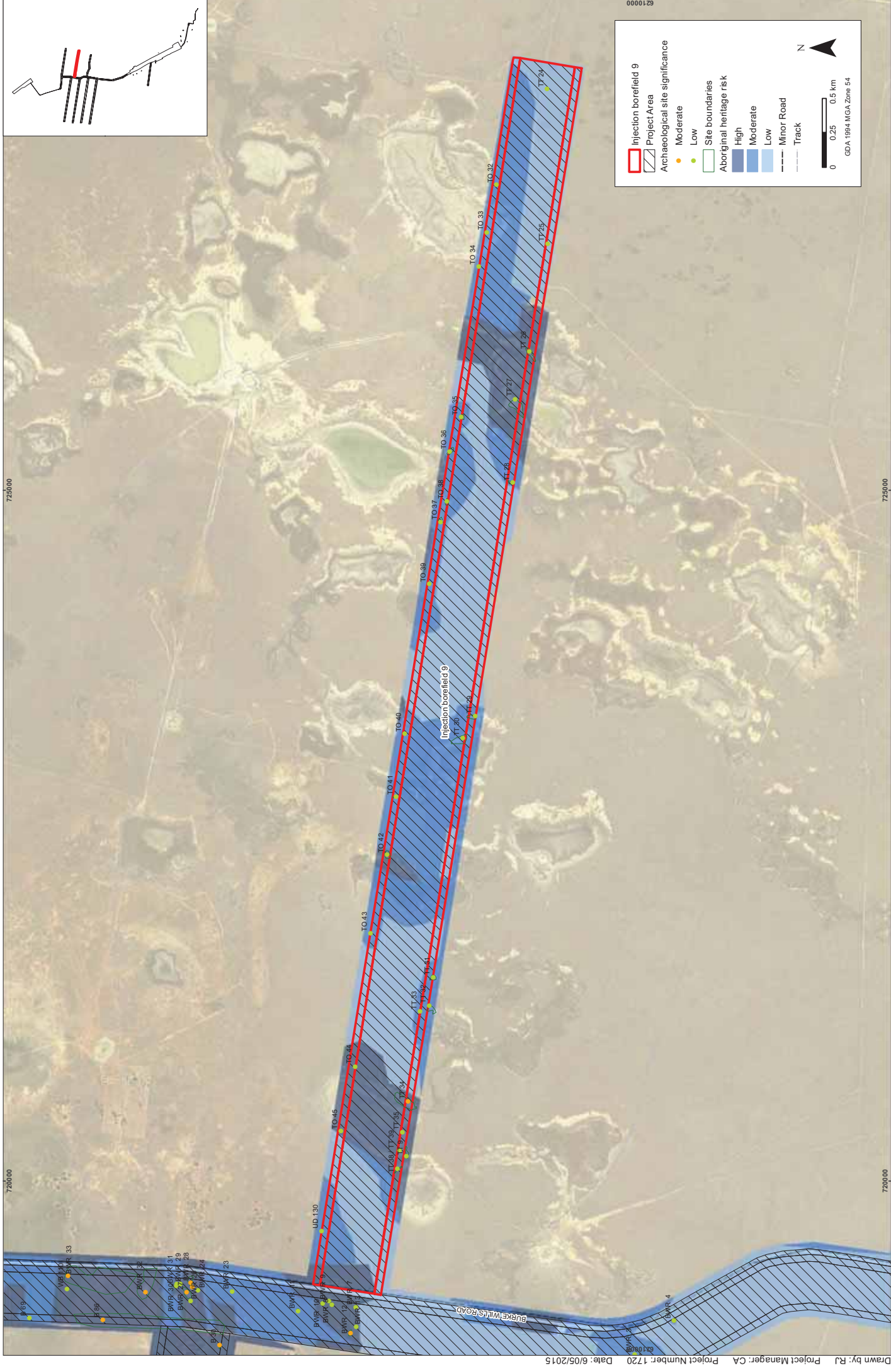
725000

720000

Significance and impact assessment: Injection borefield 8
 Balranald Mineral Sands Project Aboriginal Cultural Heritage

FIGURE 62
 Imagery: (C) Iluka





Drawn by: RJ Project Manager: CA Project Number: 1720 Date: 6/05/2015

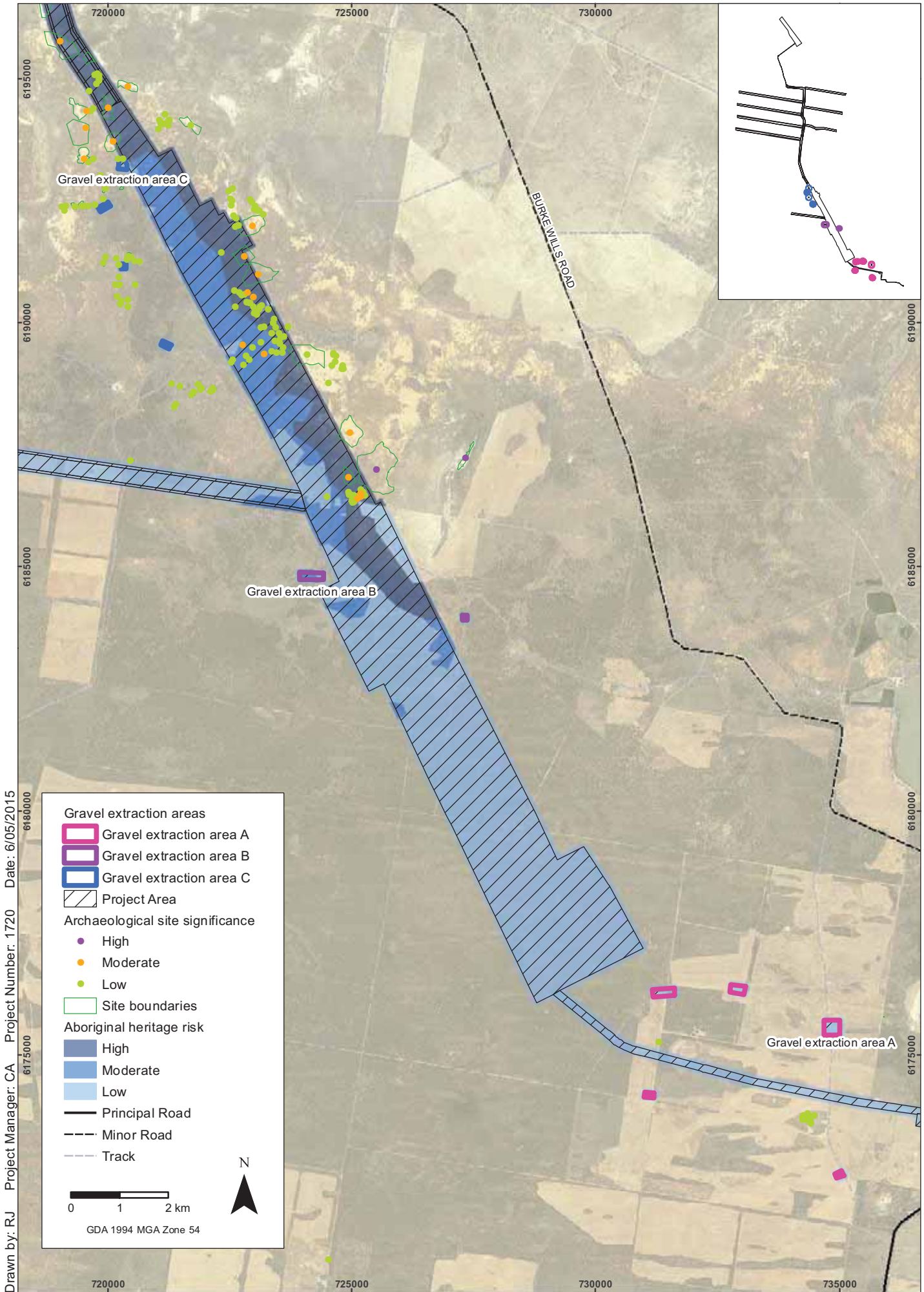
Significance and impact assessment: Injection borefield 9
 Balranald Mineral Sands Project Aboriginal Cultural Heritage



Significance and impact assessment: Injection borefield 10
Balranald Mineral Sands Project Aboriginal Cultural Heritage

FIGURE 64

Imagery: (C) Iluka



Significance and impact assessment: Gravel extraction area overview
Balranald Mineral Sands Project Aboriginal Cultural Heritage

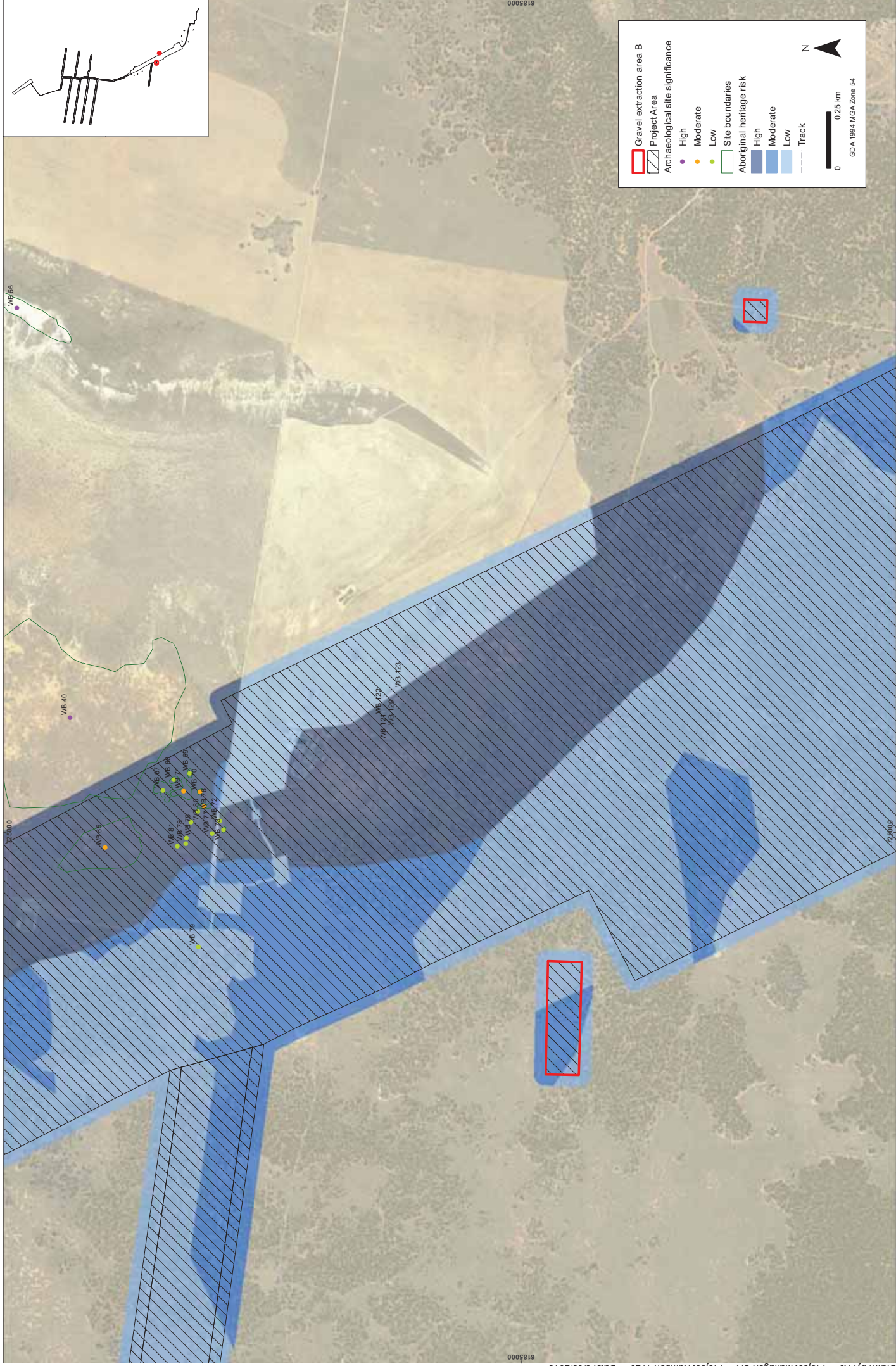
FIGURE 65

Imagery: (c) Iluka



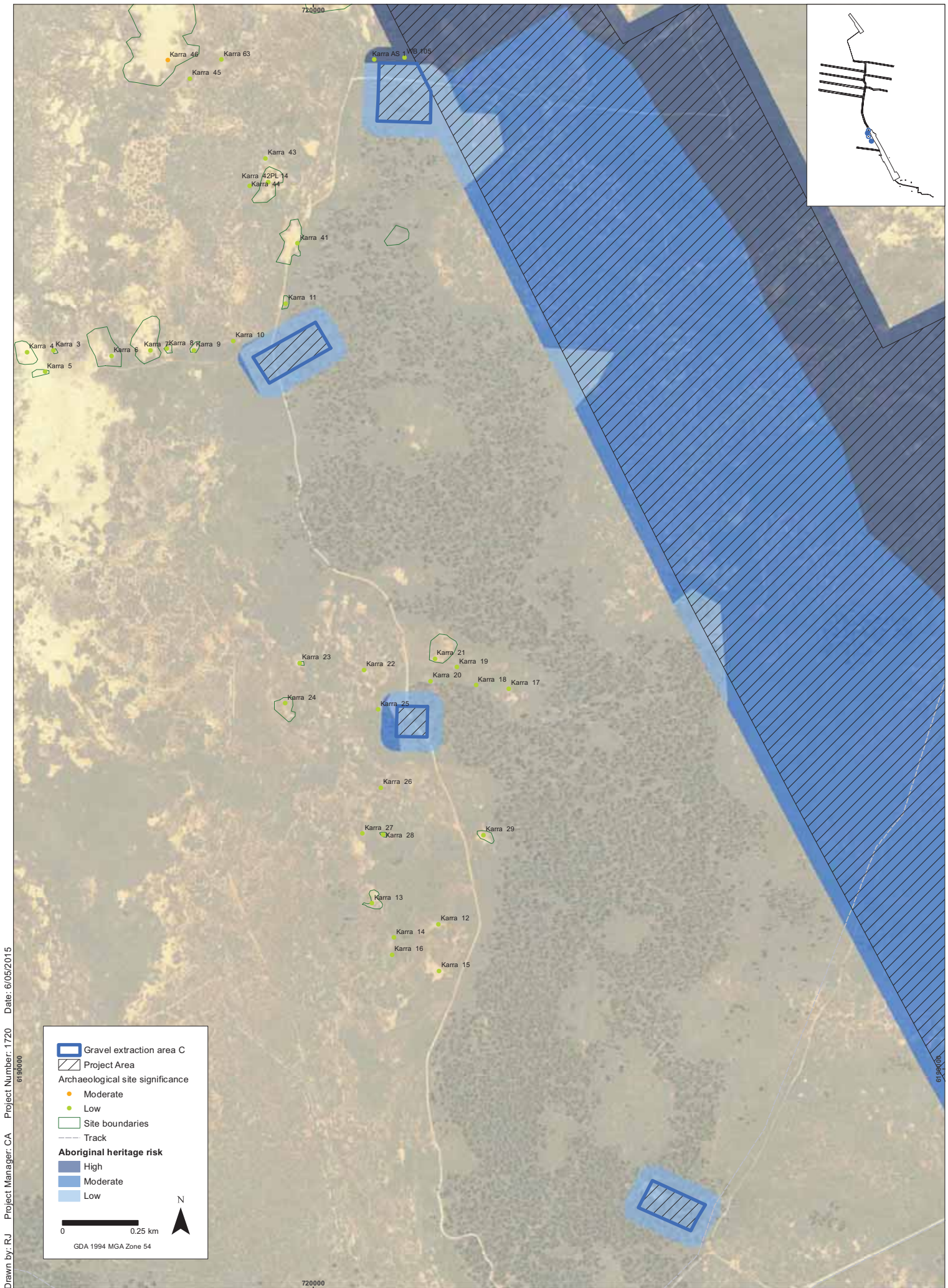
Significance and impact assessment: Gravel extraction area A
Balranald Mineral Sands Project Aboriginal Cultural Heritage

FIGURE 66
Imagery: (C) Iluka



Significance and impact assessment: Gravel extraction area B
 Balranald Mineral Sands Project Aboriginal Cultural Heritage

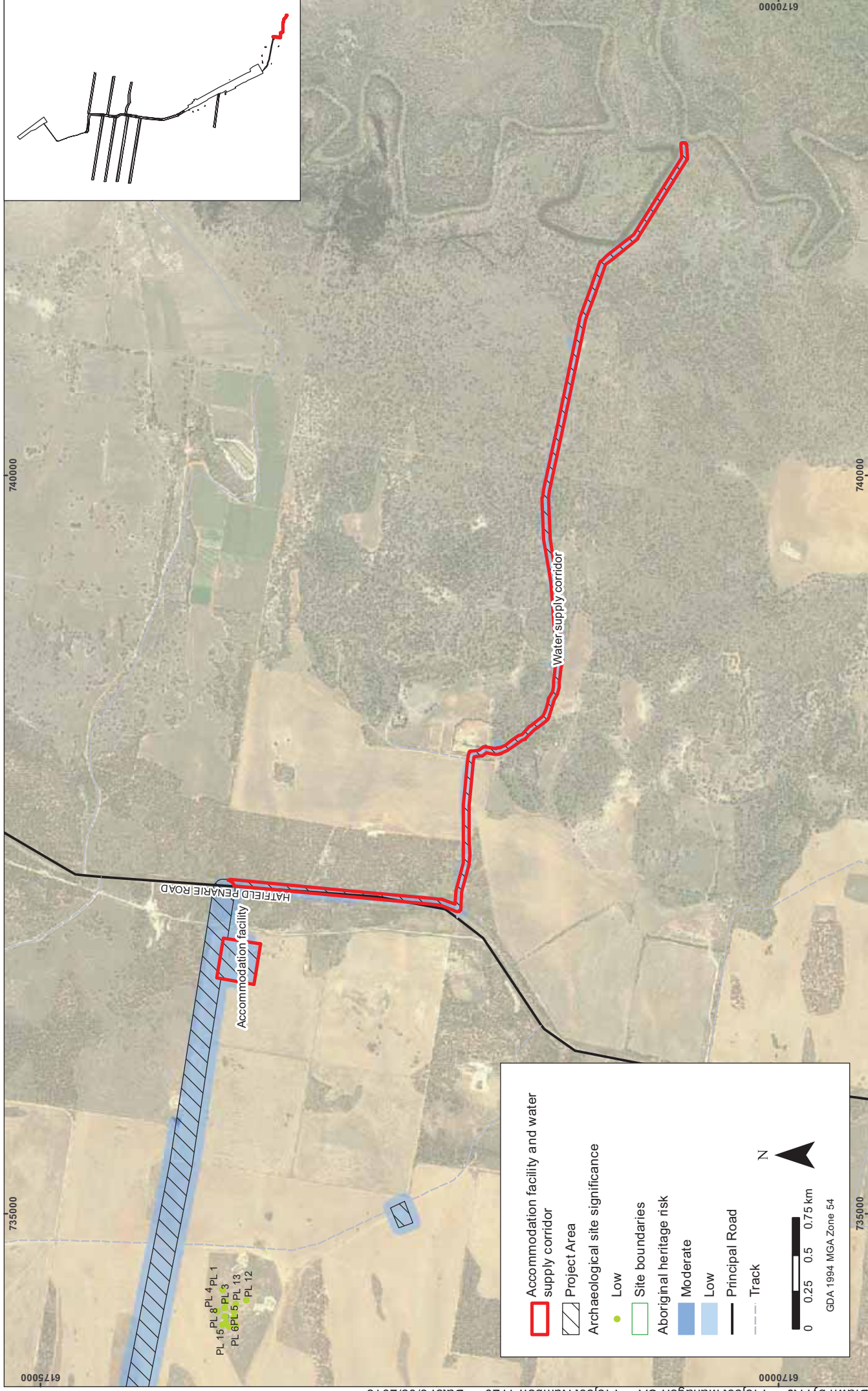
FIGURE 67
 Imagery: (C) Iluka



Significance and impact assessment: Gravel extraction area C
Balranald Mineral Sands Project Aboriginal Cultural Heritage

FIGURE 68

Imagery: (c) Iluka



Significance and impact assessment: Accommodation facility and water supply corridor
Balranald Mineral Sands Project Aboriginal Cultural Heritage

FIGURE 69
Imagery: (c) Iluka

Table 26: Scientific Significance Assessment for sites within the Balranald Project Aboriginal Heritage Database

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
B 1 / B 10	Artefacts	B1/10 is a typical, low density artefact scatter within this landform. The raw material and artefact classes are all common and not exceptionally diverse within the project area. It is highly likely that further undisturbed subsurface deposits are present in non-deflated parts of the landform; however based on the level of exposure available in the transect, these deposits are unlikely to provide sufficient quantities of artefacts to substantially inform our understanding of the local past. There may be unrecorded focal points of activity in the same landform which may provide more suitable testing locations.	Low	Low	Low	Low
B 11	Artefacts	B11 is a small low density artefact scatter in a dunefield. Though the site and artefact classes within the site are common and well represented in the project area this site is in an uncommon landscape setting - it is eroding from a mallee dunefield into a dune swale 2.5 km from the nearest known water source. Fine, grey ashy sediment was also observed - this may be indicative of mallee clearing or of other fire events. If intact and sufficiently deep soil profiles are present at or near the site may provide information on a different kind of occupation in the project area. The site is closely related to B 12 and both these sites are considered to be of moderate scientific significance.	Low	Low	Moderate	Moderate
B 12	Artefacts	B12 is a small low density artefact scatter in a dunefield. Though the site and artefact classes within the site are common and well represented in the project area this site is in an uncommon landscape setting - it is eroding from a mallee dunefield into a dune swale 2.5 km from the nearest known water source. Fine, grey ashy sediment was also observed - this may be indicative of mallee clearing or of other fire events. If intact and sufficiently deep soil profiles are present at or near the site may provide information on a different kind of occupation in the project area. The site is closely related to B 11 and both these sites are considered to be of moderate scientific significance.	Low	Low	Moderate	Moderate
B 14	Artefacts	B 14 is a small low density surface artefact scatter associated with a soak in mallee dunefields. The site and artefact class is common and well represented in the local and regional landscape. Though sites are uncommon in the mallee dunefields, this site appears to be a surface discard and no subsurface potential is expected at the site so there is limited potential to further our understanding of the past at this site. The site therefore meets the criteria for low significance.	Low	Low	Low	Low
B 15	Culturally Modified Tree	This is a rare site type within the project area and is associated with an interesting landscape feature (billabong and drainage channel between two relict lake basins and lunettes). If epicormic stems are present, the tree offers dating potential and the soil profile may contain the potential to demonstrate how water availability has changed in the project	Moderate	Moderate	Moderate	Moderate

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
		area				
B 16	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
B 17 / B 19 / B 26 / B 27 / B 28	Artefacts	The site is considered to have moderate significance due to the presence of likely archaeological deposits in residual soils at the centre of the site. If in situ, these deposits may help inform our understanding of the local past. Note this site is at the lower end of moderate.	Moderate	Low	Low	Moderate
B 18	Artefacts	The site and artefact class is common and well represented in the project area and region. The site meets the criteria for low significance.	Low	Low	Low	Low
B 2	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
B 20	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
B 21	Artefacts	The site and artefact class is common and well represented in the project area and region. The site meets the criteria for low significance.	Low	Low	Low	Low
B 22	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
B 23	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
B 24	Artefacts	The artefact scatter is common, well represented in the local and regional area and in a disturbed setting.	Low	Low	Low	Low
B 25	Artefacts	The site and artefact classes are common and well represented in the project area and	Low	Low	Low	Low

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
		region and are in a disturbed eroded context. The site meets the criteria for low significance.				
B 29	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
B 3	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
B 30	Hearth, Isolated Artefact	This site contains a hearth feature with fair dating potential and may inform our understanding of the chronology of human occupation in the local area. The longevity of this site is limited. The site is therefore considered to have moderate scientific significance.	Moderate	Low	Low	Moderate
B 31	Artefacts	The artefact scatter is common, well represented in the local and regional area and in a disturbed setting.	Low	Low	Low	Low
B 32	Artefacts	The artefact scatter is common, well represented in the local and regional area and in a disturbed setting.	Low	Low	Low	Low
B 33	Artefacts	This site offers excellent potential to contain an intact knapping floor, with a large core of silcrete and other cores in close proximity. The presence of a nearby hearth also offers dating potential. The site has good potential to increase our understanding of raw material use and occupation in the local region.	Moderate	Low	Low	Moderate
B 34	Artefacts	The site and artefact classes are common and well represented in the project area and region and are in a disturbed eroded context. The site meets the criteria for low significance.	Low	Low	Low	Low
B 35	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
B 36	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
B 37	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
B 38	Artefacts	The site and artefact classes are common and well represented in the project area and region and are in a disturbed eroded context. The site meets the criteria for low significance.	Low	Low	Low	Low
B 39	Artefacts	The site and artefact class is common and well represented in the project area and region and are in a disturbed eroded context. The site meets the criteria for low significance.	Low	Low	Low	Low
B 4	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
B 40	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
B 41	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
B 42	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
B 43	Artefacts	The site and artefact class is common and well represented in the project area and region. The site however contains a moderate to high density of artefacts and the surrounding intact soils may contain further Aboriginal objects of equal or unknown value.	Moderate	Low	Low	Moderate
B 44	Artefacts	The site and artefact class is common and well represented in the project area. Many more Aboriginal objects of equal value can be expected in the landscape surrounding the site. The site most likely represents a continuation of the scatter observed at B 43, B 73 and B 75. Due to its proximity to B 43 and the reduced visibility between these exposures, the site is considered to have the same value as the larger B 43 site.	Moderate	Low	Low	Moderate

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
B 45	Artefacts	The site and artefact class is common and well represented in the project area and region. The site meets the criteria for low significance.	Low	Low	Low	Low
B 46	Artefacts	The site and artefact class is common and well represented in the project area and region . The site meets the criteria for low significance.	Low	Low	Low	Low
B 47 / B 48	Artefacts	The site and artefact class is common and well represented in the project area and region and are in a disturbed eroded context. The site meets the criteria for low significance.	Low	Low	Low	Low
B 49	Artefacts	The site and artefact class is common and well represented in the project area and region and are in a disturbed eroded context. The site meets the criteria for low significance.	Low	Low	Low	Low
B 5	Artefacts	This site is a low density artefact scatter. The site and artefact class are common and well represented in the project area and local region. The site meets the criteria for low significance.	Low	Low	Low	Low
B 50	Artefacts	This site is a low density artefact scatter located in eroded flats. The site and artefact class are common and well represented in the project area and wider region. The site meets the criteria for low scientific value.	Low	Low	Low	Low
B 51	Artefacts and Hearth	This site consists of a two stone artefacts. The site type is common and well represented and many more can be expected in the project area and the wider region. There is limited information that can be gained from the site beyond the existing recording. The site is therefore considered to have low scientific value.	Low	Low	Low	Low
B 52	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
B 53	Isolated Artefact	B 53 is a non diagnostic, small manuport of an unidentified stone material. It is considered to be of low scientific value as it cannot be confirmed to be cultural.	Low	Low	Low	Low
B 54	Isolated artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
B 55	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
B 56`	Artefacts	B 56 is a low density artefact scatter. It is a common site and artefact type within the project area and local region. Many more are known to occur within the local area. The site meets the criteria for low scientific significance	Low	Low	Low	Low
B 57	Artefacts	B 57 is an isolated, common site and artefact type within the project area and local region. Many more are known to occur within the local area.	Low	Low	Low	Low
B 58 / B 62	Artefacts	B 58 is a low density artefact scatter. It is a common site and artefact type within the project area and local region. Many more are known to occur within the local area. The site meets the criteria for low scientific significance	Low	Low	Low	Low
B 59	Artefacts	B 59 is a low density artefact scatter. It is a common site and artefact type within the project area and local region. Many more are known to occur within the local area. The site meets the criteria for low scientific significance	Low	Low	Low	Low
B 6	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
B 60	Artefacts	This site is a low density artefact scatter located in a scald within scalded plains. Further surface and subsurface artefacts are likely to be present in the residual soils, however the depth of the residual soils and the low density of artefact scatters in the surrounds indicate that the value of the unidentified material would have limited ability to inform our understanding of the past.	Low	Low	Low	Low
B 61	Artefacts	This site is a low density dispersed artefact scatter and is a site and artefact class which is typical and well represented in the local and wider region. Many more can be expected to be found in the wider region. The site meets the criteria for low significance.	Low	Low	Low	Low
B 63	Artefacts	This site is a low density dispersed artefact scatter and is a site and artefact class which is typical and well represented in the local and wider region. Many more can be expected to be found in the wider region. The site meets the criteria for low significance.	Low	Low	Low	Low
B 64	Artefacts	This site is a low density dispersed artefact scatter and is a site and artefact class which is typical and well represented in the local and wider region. Many more can be expected to be found in the wider region. The site meets the criteria for low significance.	Low	Low	Low	Low
B 65	Artefacts	This site consists of a two stone artefacts. The site type is common and well represented and many more can be expected in the project area and the wider region. There is limited information that can be gained from the site beyond the existing recording. The site is	Low	Low	Low	Low

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
		therefore considered to have low scientific value.				
B 66	Artefacts	This site is a low density artefact scatter of 56 artefacts located in scalded plains. The site type is common and well represented and many more can be expected in the project area and the wider region. There is limited information that can be gained from the site beyond the existing recording. The site is therefore considered to have low scientific value.	Low	Low	Low	Low
B 67	Artefacts	This site is a low density dispersed artefact scatter and is a site and artefact class which is typical and well represented in the local and wider region. Many more can be expected to be found in the wider region. The site meets the criteria for low significance.	Low	Low	Low	Low
B 68	Artefacts	This site is a low density dispersed artefact scatter and is a site and artefact class which is typical and well represented in the local and wider region. Many more can be expected to be found in the wider region. The site meets the criteria for low significance.	Low	Low	Low	Low
B 69	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
B 7	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
B 70	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
B 71	Artefacts and Hearth	This site is a low density stone artefact scatter with a hearth in good condition. The site forms part of a continuous artefact scatter within this landform and is in close proximity to BWR 34 and B 84. The site is considered to have moderate potential due to the potential for buried archaeological deposits, the ability of the hearth to provide chronological information and the number of artefacts across BWR 34 and B 71 to provide a sample of artefacts of sufficient number.	Moderate	Low	Low	Moderate
B 72	Artefacts	This site is a low density dispersed artefact scatter and is a site and artefact class which is typical and well represented in the local and wider region. Many more can be expected to be found in the wider region. The site meets the criteria for low significance.	Low	Low	Low	Low

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
B 73	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
B 74	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
B 75	Artefacts	The site is a small, low density artefact scatter and is common and well represented in the local and wider region. Many more examples can be expected to be found. The site meets the criteria for low significance.	Low	Low	Low	Low
B 76	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
B 77	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
B 78	Artefacts	This site is a low density dispersed artefact scatter and is a site and artefact class which is typical and well represented in the local and wider region. Many more can be expected to be found in the wider region. The site meets the criteria for low significance.	Low	Low	Low	Low
B 79	Isolated Artefact	The site is a low density artefact scatter representing a visible portion of the low density, continuous and dispersed artefact scatter exposed within scalds and bare patches of soil in the scalded plains of the Rata system. It is common and well represented and many more can be expected in the project area and the wider region. The site is therefore considered to have low scientific value.	Low	Low	Low	Low
B 8	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
B 80	Artefacts	The site is a low density artefact scatter representing a visible portion of the low density, continuous and dispersed artefact scatter exposed within scalds and bare patches of soil in	Low	Low	Low	Low

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
		the scalded plains of the Rata system. It is common and well represented and many more can be expected in the project area and the wider region. The site is therefore considered to have low scientific value.				
B 81	Artefacts	The site is a low density artefact scatter representing a visible portion of the low density, continuous and dispersed artefact scatter exposed within scalds and bare patches of soil in the scalded plains of the Rata system. It is common and well represented and many more can be expected in the project area and the wider region. The site is therefore considered to have low scientific value.	Low	Low	Low	Low
B 82	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
B 83	Artefacts and Hearth	This site is a low density dispersed artefact scatter with a intact hearth and is a site and artefact class which is typical and well represented in the local and wider region. The hearth has excellent potential to be dated and thus inform our understanding of the chronology of land use in the local area.	Moderate	Low	Low	Moderate
B 84	Artefacts and Hearth	This site is a low density dispersed artefact scatter with a hearth and is a site and artefact class which is typical and well represented in the local and wider region. The hearth has fair potential to be dated and thus inform our understanding of the chronology of land use in the local area. The site can be considered part of the same continuous scatter across the landform and has close proximity to B 71 and BWR 34. The site is considered to have moderate significance due to its connection with these sites and its potential to provide chronological information.	Moderate	Low	Low	Moderate
B 85	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
B 86	Artefacts	This site is a low density stone artefact scatter but was not subject to full recording due to time constraints. The site is considered to have moderate significance due to the absence of full recording, the site sharing the same landform characteristics and having close proximity to moderate to high density sites like BWR 32 and BWR 33. Portions of B 86, particularly in the south may have relatively intact archaeological deposits in the dunes. Avoidance of the site is not warranted due to the high likelihood that further Aboriginal objects of equal or unknown value both within and beyond the disturbance footprint.	Moderate	Low	Low	Moderate

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
B 87	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
B 88	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
B 89	Artefacts	This site consists of a two stone artefacts. The site type is common and well represented and many more can be expected in the project area and the wider region. There is limited information that can be gained from the site beyond the existing recording. The site is therefore considered to have low scientific value.	Low	Low	Low	Low
B 9	Artefacts	This site is a low density artefact scatter. The site and artefact class are common and well represented in the project area and local region. There is limited information that can be gained from the site beyond the current recording. The site meets the criteria for low significance.	Low	Low	Low	Low
B 90	Artefacts	This site is a moderate to high density site located with a defined depression and scald. Though an area of higher than average density, the site and artefact classes are well represented in the project area and local region and has limited ability to inform our understanding of the past beyond what has already been recorded. There is a high likelihood of further Aboriginal objects being present both within and beyond the disturbance footprint.	Low	Low	Low	Low
B 91	Artefacts	This site consists of a two stone artefacts. The site type is common and well represented and many more can be expected in the project area and the wider region. There is limited information that can be gained from the site beyond the existing recording. The site is therefore considered to have low scientific value.	Low	Low	Low	Low
B 92	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
B 93	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria	Low	Low	Low	Low

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
		for low scientific significance.				
B 94	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
B 95	Artefact	This site is a low density artefact scatter. The site and artefact class are common and well represented in the project area and local region. The site meets the criteria for low significance.	Low	Low	Low	Low
B 96	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
B 97	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
B 98	Artefacts	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
Box Creek IF 1	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
BWR 10	Isolated Artefact	The site is a single silcrete flake located in saltbush plains. The artefact class is common and well represented in the local and regional landscape. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
BWR 11	Possible Hearth	BWR 11 is a possible hearth scatter located within saltbush plains and requires further investigation to determine the scatter is natural or cultural	Low	Low	Low	Low
BWR 12	Artefacts and Hearth	BWR 12 consists of four silcrete flake, a silcrete retouched flake and a possible hearth of burnt termite heat retainers with the potential for intact subsurface material. Currently this site is assessed as having low scientific significance but this may increase to moderate if the possible hearth is determined to be cultural and to contain datable material which can	Moderate	Low	Low	Moderate

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
		provide and indication of occupation of the local landscape				
BWR 13	Isolated Artefact	The site is a single silcrete flake located in saltbush plains. The artefact class is common and well represented in the local and regional landscape. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
BWR 14	Isolated Artefact	The site is a single quartzite flake located in saltbush plains. The artefact class is common and well represented in the local and regional landscape. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
BWR 15	Isolated Artefact	The site is a single silcrete flake located in saltbush plains. The artefact class is common and well represented in the local and regional landscape. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
BWR 16	Isolated Artefact	The site is a single silcrete flake located in saltbush plains. The artefact class is common and well represented in the local and regional landscape. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
BWR 17	Artefacts	The site consists of silcrete and a quartzite flake situated in a pan. The artefact classes are common and well represented in the local and regional landscape. The site meets the criteria for low scientific significance	Low	Low	Low	Low
BWR 18	Artefacts	The site consists of seven silcrete flakes and a chert backed flake in a pan. The artefact classes are not uncommon and are well represented in the local and regional landscape. The artefact scatter is a low density scatter and though further artefacts may be present in residual soils of the same landform they are likely to be of a frequency that offers little research potential. The site meets the criteria for low scientific significance	Low	Low	Low	Low
BWR 19	Artefacts	The site consists of two silcrete flakes in a pan. The artefact classes are common and well represented in the local and regional landscape. The site meets the criteria for low scientific significance	Low	Low	Low	Low
BWR 20	Isolated Artefact	The site consists of a single silcrete flake visible on a bare patch of soil within saltbush plains. The artefact class is common and well represented in the local and regional landscape. The site meets the criteria for low scientific significance	Low	Low	Low	Low
BWR 21	Isolated Artefact	The site consists of a single silcrete flake visible on a bare patch of soil within saltbush plains. The artefact class is common and well represented in the local and regional landscape. The site meets the criteria for low scientific significance	Low	Low	Low	Low
BWR 22	Isolated Artefact	The site consists of a single silcrete flake visible on a bare patch of soil within saltbush plains. The artefact class is common and well represented in the local and regional	Low	Low	Low	Low

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
		landscape. The site meets the criteria for low scientific significance				
BWR 23	Artefacts	The site consists of two silcrete flakes and a silcrete retouched flake in a patch of bare soil in saltbush plains. The artefact classes are common and well represented in the local and regional landscape. Further artefacts may be present in residual soils within the same landform. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
BWR 24	Isolated Artefact	The site consists of a single silcrete flake visible on a bare patch of soil within saltbush plains. The artefact class is common and well represented in the local and regional landscape. The site meets the criteria for low scientific significance	Low	Low	Low	Low
BWR 25	Artefacts	The site consists of three silcrete flakes and a silcrete retouch flake in a sand dune blowout. Further artefacts are likely to be present in the surrounding residual soils. The site has moderate densities of artefacts and where dune blow outs were noted on the same landform in close proximity to this site further artefacts were present in moderate densities (BWR 27, BWR 29) . Though the artefact classes within this site are common and well represented in the landscape, the landform is assessed to have moderate significance due to the moderate densities of artefacts likely to be present in the dune and residual soils and the sites connectivity to BWR 27 and BWR 28. Furthermore, dunes further to the north of this site (BWR 32, BWR 33, BWR 37) have been shown to have very high densities and differing activities to the other parts of the project area.	Moderate	Low	Low	Moderate
BWR 26	Isolated Artefact	The site is a single silcrete flake located in dune blow out. The artefact class is common and well represented in the local and regional landscape. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
BWR 27	Artefacts	The site consists of 29 stone artefacts and a hearth scatter across a 17 m x 12 m dune blow out. The site has moderate densities of artefacts and where dune blow outs were noted on the same landform in close proximity to this site further artefacts were present in moderate densities (BWR 27, BWR 29) . Though the artefact classes within this site are common and well represented in the landscape, the landform is assessed to have moderate significance due to the moderate densities of artefacts likely to be present in the dune and residual soils, the sites connectivity to BWR 27 and BWR 28 and the presence of hearth material which may, depending on further investigation, have the capacity to provide chronological information about past land use in the local area. Furthermore, dunes further to the north of this site (BWR 32, BWR 33, BWR 37) have been shown to have very high densities and differing activities to the other parts of the project area.	Moderate	Low	Low	Moderate
BWR 28	Artefacts	The site consists of 17 silcrete flakes. Though the artefact classes within this site are common and well represented in the landscape, the landform is assessed to have moderate	Moderate	Low	Low	Moderate

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
		significance due to the moderate densities of artefacts likely to be present in the dune and residual soils and the sites connectivity to BWR 25 and BWR 28. It is thought that this site is simply an exposed portion of the same site. Furthermore, dunes further to the north of this site (BWR 32, BWR 33, BWR 37) have been shown to have very high densities and differing activities to the other parts of the project area.				
BWR 29	Isolated Artefact	The site is a single silcrete flake located in saltbush plains. The artefact class is common and well represented in the local and regional landscape. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
BWR 3	Isolated Artefact	The site is a single silcrete flake located in saltbush plains. The artefact class is common and well represented in the local and regional landscape. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
BWR 30	Isolated Artefact	The site is a single silcrete flake located in saltbush plains. The artefact class is common and well represented in the local and regional landscape. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
BWR 31	Isolated Artefact	The site is a single silcrete flake located in saltbush plains. The artefact class is common and well represented in the local and regional landscape. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
BWR 32	Artefacts and PAD	BWR 32 consists of a scatter of 290 stone artefacts and a hearth scatter within a dune blow out of an east-west running dune. The dune runs east west through a large depression and is in proximity to a number of depressions with source bordering dunes. Stone artefacts within the site include silcrete flakes, silcrete cores, silcrete retouched tools, anvils, hammerstone, broken grinding fragments, chert flakes and quartzite flakes. The site demonstrated higher percentages of backed artefacts and retouched flakes compared with other recorded sites in the most recent EA survey work. The site is one of the highest density sites in the project area. Not all of the dune has eroded and further artefacts may be present in high densities within residual soils.	Moderate	Low	Low	Moderate
BWR 33	Artefacts	BWR 33 consists of a continuous dispersed scatter of 99 stone artefacts including silcrete cores, flake, retouched flakes across a saltbush plain and east-west dune., Tool types include backed flakes and burrens. The site is north of BWR 32. BWR 33 has moderate to high densities of artefacts and potential for further artefacts of moderate to high densities to be present within intact dune deposits. Like BWR 32, BWR 33 has high percentages of backed artefacts and in addition has a relatively high number of burrens when compared with other sites across the project area. The site is considered to have moderate scientific significance for its connectivity with the surrounding landscape and its research potential	Moderate	Low	Low	Moderate

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
		for comparative analysis between other sites in the project area.				
BWR 34 / BWR 35	Artefacts	This site is a low to moderate density artefact scatter with hearth with good dating potential	Moderate	Low	Low	Moderate
BWR 36	Artefacts	The site consists of eight silcrete flakes located in a bare patch of soil within saltbush plains. The artefact classes are common and well represented in the local and regional landscape. Further artefacts may be present in residual soils of the same landform. The site meets the criteria for low scientific significance	Low	Low	Low	Low
BWR 37	Artefacts	e site consists of a scatter of 76 stone artefacts including silcrete flakes, silcrete retouched flakes, silcrete cores and quartzite flakes located within a pan. Tool types included burrens and backed flakes. Coarse-grained poor quality yellow silcrete of similar appearance to silcrete recorded in Ivanhoe was observed at this site, which has the potential to demonstrate networks for the transport of certain stone raw materials across the landscape. Like other dune sites (BWR 32, BWR 33), BWR 37 has a higher ratio of retouched flakes and tools such as burrens when compared with other sites in the project area. Further artefacts of moderate densities are likely to be present in residual soils within the same landform in and adjacent the pan. The site is considered to have moderate potential for its moderate densities, its connectivity with other dune sites along Burke and Wills Road, potential for further artefacts of moderate densities and its potential to provide a sample to compare different occupation and technology patterns across the project area.	Moderate	Low	Low	Moderate
BWR 38	Artefacts	The site consists of five silcrete flakes and two silcrete retouched flakes in exposures within saltbush plains. The artefact classes are common and well represented in the local and regional landscape the site meets the criteria for low scientific significance.	Low	Low	Low	Low
BWR 39	Isolated Artefact	The site is a single silcrete flake located in saltbush plains. The artefact class is common and well represented in the local and regional landscape. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
BWR 4	Isolated Artefact	The site is a single silcrete flake located in saltbush plains. The artefact class is common and well represented in the local and regional landscape. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
BWR 40	Isolated Artefact	The site is a single silcrete flake located in saltbush plains. The artefact class is common and well represented in the local and regional landscape. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
BWR 5	Isolated	The site is a single silcrete retouched flake located in saltbush plains. The artefact class is	Low	Low	Low	Low

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
	Artefact	not uncommon and well represented in the local and regional landscape. The site meets the criteria for low scientific significance.				
BWR 6	Isolated Artefact	The site is a single silcrete flake located in saltbush plains. The artefact class is common and well represented in the local and regional landscape. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
BWR 7	Isolated Artefact	The site is a single rhyolite flake located in saltbush plain. The artefact class is uncommon in the local landscape and may demonstrate trade, social or mobility networks in the region. As the site consists of an isolated artefact only and other examples of rhyolite flakes exist within the project area, the site meets the criteria for low scientific significance as the site has limited research potential beyond what it contributes through its current recording	Low	Low	Low	Low
BWR 8	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
BWR 9	Artefacts	BWR 9 consists of five silcrete flakes and one silcrete retouched flake in an exposure within a saltbush plain. The artefact classes are common and well represented in the landscape. Further artefacts may be present within residual soils in close proximity to the site but the landform has low research potential due to the shallow nature of the deposits and the low densities of artefacts. The site meets the criteria for low scientific significance	Low	Low	Low	Low
BWR 34 / BWR 35	Artefacts	This site consists of previous recordings BWR 34 and BWR 35. The site consists of six silcrete flakes and a silcrete retouched flake located in a bare patch of soil within saltbush plains. The artefact classes are common and well represented in the local and regional landscape. Further artefacts may be present in residual soils of the same landform. The site meets the criteria for low scientific significance	Moderate	Low	Low	Moderate
BWR 41	Isolated Artefact	BWR 41 is a single silcrete flake located on a scalded dune overlooking Pitarpunga Lake. The artefact class is common and well represented in the local and regional landscape. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
BWR 42	Isolated Artefact	BWR 42 is a single silcrete flake located on a scalded dune overlooking Pitarpunga Lake. The artefact class is common and well represented in the local and regional landscape. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
BWR IF 1	Isolated Artefact	BWR IF 1 is a single silcrete flake is visible in a bare patch of soil in saltbush plains. The artefact class is common and well represented in the local and regional landscape. The site meets the criteria for low scientific significance.	Low	Low	Low	Low

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
BWR IF 2	Isolated Artefact	BWR IF 2 is a single silcrete flake located in an exposure adjacent small soaks in saltbush plains. The artefact class is common and well represented in the local and regional landscape. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
Cringadale 1	Artefacts and PAD	Cringadale 1 is a small artefact scatter located in a scald midslope on a source bordering dune. It is highly likely further artefacts are located in the surrounding landscape and further survey and sampling is needed to fully assess the significance of this site. Based on the limited information available, the site has been interpreted on a preliminary basis as having low significance due to the common and well represented artefact classes within the site	Low	Low	Low	Low
Cringadale 2	Isolated Artefact	Cringadale 2 is a single silcrete flake is visible in a bare patch of soil in saltbush plains. The artefact class is common and well represented in the local and regional landscape. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
Karra 10	Artefacts	The site consists of two silcrete flakes eroding from shallow residual soil. The artefact classes are common and well represented in the local and regional landscape. The residual soils are shallow indicating that though further artefacts at low densities may be present. Potential Archaeological Deposit is limited and would not substantially inform our understanding of the past.	Low	Low	Low	Low
Karra 11	Artefacts	The site consists of two silcrete flakes eroding from residual soils onto a pan associated with a vehicle track. The artefact classes are common and well represented in the local and regional landscape. Further low density artefacts may be present within adjacent residual soils however it is anticipated that the low density of artefacts within residual soils would not contribute substantially to our understanding of the past.	Low	Low	Low	Low
Karra 12	Artefacts	The site consists of two silcrete flakes situated on a pan. The artefact classes are common and well represented in the local and regional landscape. Few residual soils are present within the pan. Further low density artefacts may be present within adjacent residual soils however it is anticipated that the low density of artefacts within residual soils would not contribute substantially to our understanding of the past.	Low	Low	Low	Low
Karra 13	Artefacts and Hearth	The site consists of silcrete artefacts and a hearth scatter. Artefact classes within the site include silcrete flakes and a silcrete core and a dispersed hearth scatter. These classes are common and well represented in the local and regional landscape. The hearth scatter is not a good candidate for dating. Further low density artefacts may be present in residual soils within and adjacent the pan but are unlikely to substantially inform our understanding of the past due to artefact densities of less than 0.5 artefacts per square metre.	Low	Low	Low	Low

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
Karra 14	Isolated Artefact	The site consists of a single silcrete flake within a patch of bare soil. The artefact classes are common and well represented in the local and regional landscape. The site meets the criteria of low significance.	Low	Low	Low	Low
Karra 15	Isolated Artefact	The site consists of a single silcrete flake within a patch of bare soil. The artefact classes are common and well represented in the local and regional landscape. The site meets the criteria of low significance.	Low	Low	Low	Low
Karra 16	Isolated Artefact	The site consists of a single silcrete retouched flake. The artefact classes are common and well represented in the local and regional landscape. The site meets the criteria of low significance.	Low	Low	Low	Low
Karra 17	Isolated Artefact	The site consists of a single silcrete flake located on a bare patch of soil. The artefact class is common and well represented in the local and regional landscape. The site meets the criteria of low significance.	Low	Low	Low	Low
Karra 18	Isolated Artefact	The site consists of a single silcrete flake located on a bare patch of soil. The artefact class is common and well represented in the local and regional landscape. The site meets the criteria of low significance.	Low	Low	Low	Low
Karra 19	Isolated Artefact	The site consists of a single silcrete flake located on a bare patch of soil. The artefact class is common and well represented in the local and regional landscape. The site meets the criteria of low significance.	Low	Low	Low	Low
Karra 20	Isolated Artefact	The site consists of a single, exhausted multifacial core located within a bare patch of soil. The artefact class is not uncommon and other examples can be expected within the local and regional landscape within a more informative context. The site meets the criteria for low significance.	Low	Low	Low	Low
Karra 21	Artefacts	The site consists of thirteen silcrete flakes and one silcrete core fragment in a deflated pan in proximity to Karra 20. The artefact classes are common and are well represented in the local and regional landscape. Further low density artefacts may be present within the surrounding shallow residual soils but due to the shallow nature of the residual soils and the low density of artefacts located, it is unlikely that any further artefacts will be of high research value. The site meets the criteria for low significance.	Low	Low	Low	Low
Karra 22	Isolated Artefact	The site consists of a single silcrete flake in a deflated pan. The artefact class is common and well represented in the landscape. Further low density artefacts may be located in nearby shallow residuals however no PAD is present within the site boundaries. The site meets the criteria for low significance.	Low	Low	Low	Low

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
Karra 23	Artefacts	The site consists of two silcrete flakes situated on a pan. The artefact classes are common and well represented in the local and regional landscape. Few residual soils are present within the pan. Further low density artefacts may be present within adjacent residual soils however it is anticipated that the low density of artefacts within residual soils would not contribute substantially to our understanding of the past.	Low	Low	Low	Low
Karra 24	Artefacts	The site consists of 24 silcrete stone artefacts and one chert stone artefact. Artefact types include retouched flakes, core and core fragments and flakes. The artefact classes within the site are not uncommon and are a well represented in the local and regional landscape. The residual soils within and adjacent the site are shallow and while further artefacts may be present within them, the deposits are unlikely to contain substantial research potential. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
Karra 25	Isolated Artefact	The site consists of a single silcrete flake located on a bare patch of soil. The artefact class is common and well represented in the local and regional landscape. The site meets the criteria of low significance.	Low	Low	Low	Low
Karra 26	Isolated Artefact	The site consists of a single silcrete flake located on a bare patch of soil. The artefact class is common and well represented in the local and regional landscape. The site meets the criteria of low significance.	Low	Low	Low	Low
Karra 27	Isolated Artefact	The site consists of a single silcrete flake located on a bare patch of soil. The artefact class is common and well represented in the local and regional landscape. The site meets the criteria of low significance.	Low	Low	Low	Low
Karra 28	Artefacts	The site consists of a four silcrete flakes located on a bare patch of soil. The artefact classes are common and well represented in the local and regional landscape. The site meets the criteria of low significance.	Low	Low	Low	Low
Karra 29	Artefacts	The site consists of three silcrete flakes and one silcrete retouched flake located within a pan. The artefact classes are common and well represented in the local and regional landscape. Further artefacts may be present in residual soils adjacent the pan but are unlikely to be at a density which would provide substantial information about the past. The site meets the criteria of low significance.	Low	Low	Low	Low
Karra 3	Artefacts	Site consists of two distal silcrete flakes. The artefacts are a common, well represented class in the local and wider region. The artefacts are located eroding from a small residual soil mound and although Potential Archaeological Deposit exists, this PAD is also well represented in the local and wider region and due to its small size would not offer a sufficient sample to contribute substantially to our understanding of the past.	Low	Low	Low	Low

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
Karra 30	Isolated Artefact	The site consists of a single silcrete flake located on a bare patch of soil. The artefact class is common and well represented in the local and regional landscape. The site meets the criteria of low significance.	Low	Low	Low	Low
Karra 31	Artefacts	The site consists of three silcrete flakes located within a pan. The artefact classes are common and well represented in the local and regional landscape. Further artefacts may be present in residual soils adjacent the pan but are unlikely to be at a density which would provide substantial information about the past. The site meets the criteria of low significance.	Low	Low	Low	Low
Karra 33	Artefacts, Hearth, PAD	Karra 33 is an extensive occupation complex situated across a pan and slight rise overlooking Pitarpunga Lake and remnant drainage channels. The site contains stone artefacts of silcrete, quartz, quartzite, sandstone, chert and rhyolite, and a deflated hearth scatters. Artefact types include broken grinding stone fragments, retouched flakes, flakes, cores, anvils and hammerstones. Artefact densities across the pan range from 0.5 artefacts per square metre to 20 artefacts per square metre. Only a sample of the visible pan was surveyed and recorded and is highly likely that further artefacts of moderate density will be present across the pan and landform as archaeological material is visible on the surface of a pan and eroding from residuals soils along the margins of the pans. Residual soils and rills indicate soil deposits exceeding 40 cm. The site and adjacent landforms contain research value under a number of criteria: connectivity with other sites located in association with Pitarpunga Lake and relict drainage channels, datable material in the form of remnant hearth and sandy soil profiles exceeding 40 cm, which depending on further investigation of the geomorphic agents responsible for land formation, may help contribute to a chronology of land use and occupation in the local region; potential for further surface and subsurface artefacts of moderate densities beyond the sampled boundaries of the site, densities of artefacts sufficient to provide comparisons between technological choices and site activities across the local area. The site has further archaeological value as an example of mobility or social networks in the wide region due to the presence of uncommon artefacts of rhyolite which are theorised to have travelled or have been traded from the Lachlan Shire through the Lachlan River Catchment. The site meets the criteria for moderate scientific significance. Surface and subsurface investigation of this site and the landform in which it is situated is warranted to determine whether further chronological information can be gained.	Moderate	Low	Low	Moderate
Karra 34	Isolated Artefact	The site consists of a single silcrete flake located on a bare patch of soil. The artefact class is common and well represented in the local and regional landscape. The site meets the criteria of low significance.	Low	Low	Low	Low

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
Karra 35	Artefacts	The site consists of two silcrete flakes located on a bare patch of soil. The artefact class is common and well represented in the local and regional landscape. The site meets the criteria of low significance.	Low	Low	Low	Low
Karra 36	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
Karra 37	Artefacts	The site consists of three silcrete flakes located in a sand dune blow out. The artefact classes are common and are well represented in the local and regional landscape. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
Karra 38	Isolated Artefact	The site consists of a single silcrete flake located on a bare patch of soil. The artefact class is common and well represented in the local and regional landscape. The site meets the criteria of low significance.	Low	Low	Low	Low
Karra 39	Artefacts	The site consists of a silcrete flake and a quartz flake in a sand dune blowout. The artefact classes are not uncommon and are well represented in the local and regional landscape. The site falls within the low scientific significance rating.	Low	Low	Low	Low
Karra 4	Artefacts	Site consists of eight silcrete flakes and angular fragments. The artefact classes are well represented in the local and regional environment. Some Potential Archaeological Deposit is present in residual soils within and on the margins of the pan on which the site however given the depth of the erosion and the low density of artefacts present on the pan it is unlikely the PAD in the residual will offer substantial information about the past.	Low	Low	Low	Low
Karra 40	Isolated Artefact	The site consists of a single silcrete flake located on a bare patch of soil. The artefact class is common and well represented in the local and regional landscape. The site meets the criteria of low significance	Low	Low	Low	Low
Karra 41	Artefacts	The site consists of nine silcrete flakes, one silcrete retouched flake and one quartz flake eroding from residual soils along the margins of a pan. The artefact classes within the site are common and well represented in the local and regional landscape. Further artefacts may be present eroding from residual soils in the same landform but as the soils are shallow any buried artefacts are unlikely to provide substantial information about the past. The site meets the criteria for low significance.	Low	Low	Low	Low
Karra 42	Artefacts	The site consists of 17 silcrete flakes in a deflated bare patch of soil. The artefact classes present are common and well represented in the local and regional landscape. There may be further artefact present in residual soils within the same landform but these artefacts	Low	Low	Low	Low

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
		are unlikely to contribute substantially to our understanding of the past due the shallow nature of those residuals. The site meets the criteria for low significance.				
Karra 43	Isolated Artefact	The site consists of a single silcrete flake located on a bare patch of soil. The artefact class is common and well represented in the local and regional landscape. The site meets the criteria of low significance.	Low	Low	Low	Low
Karra 44	Isolated Artefact	The site consists of a single silcrete retouched tool. The artefact class is not uncommon and is well represented in the local and regional landscape. The site meets the criteria for low significance.	Low	Low	Low	Low
Karra 45	Isolated Artefact	The site consists of a single silcrete core located on a bare patch of soil. The artefact class is not uncommon and is well represented in the local and regional landscape. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
Karra 46	Artefacts	The site consists of 84 stone artefacts including silcrete flakes, silcrete retouched tools, silcrete cores, quartz and quartzite flakes and a rhyolite core distributed across the margins and floor of a pan. The artefact classes are predominately common and well represented across the local and regional landscape however a rhyolite core recorded at the site is an uncommon raw material type for the region and may demonstrate trading, social or mobility networks in the Lachlan River catchment. Artefact densities are moderate across the pan and further artefacts of moderate densities may be present in residual soils within and adjacent the recorded site. The site is considered to have moderate research potential due to the moderate densities of artefacts, the potential for the rhyolite artefact to inform discussions of mobility or trade across the region and the connectivity of the site to other sites in the project area.	Moderate	Low	Low	Moderate
Karra 47	Isolated Artefact	The site consists of a single silcrete core located on a bare patch of soil. The artefact class is not uncommon and is well represented in the local and regional landscape. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
Karra 48	Isolated Artefact	The site consists of a single silcrete core located on a bare patch of soil. The artefact class is not uncommon and is well represented in the local and regional landscape. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
Karra 49	Isolated Artefact	The site consists of a single silcrete core located on a bare patch of soil. The artefact class is not uncommon and is well represented in the local and regional landscape. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
Karra 5	Artefacts	Site consists of two silcrete flakes and a silcrete core within a large pan. The artefact classes are well represented in the local and regional landscape and no residual soils which may	Low	Low	Low	Low

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
		contain Potential Archaeological Deposit are present within the site boundaries.				
Karra 50	Artefacts	The site consists of five silcrete flakes and a retouched silcrete flake in pan. The artefact classes are well represented in the local and regional area. Further artefacts may be present in low densities in residual soils however due to the low densities and shallowness of the residual soils, it is probable that the scientific value of further artefacts would be low. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
Karra 51	Artefacts	The site consists of three silcrete flakes and one silcrete retouched flake located within a pan. The artefact classes are common and well represented in the local and regional landscape. Further artefacts may be present in residual soils adjacent the pan.	Low	Low	Low	Low
Karra 52	Isolated Artefact	The site consists of a single silcrete flake located on a bare patch of soil. The artefact class is common and well represented in the local and regional landscape. The site meets the criteria of low significance.	Low	Low	Low	Low
Karra 53	Artefacts	The site consists of three silcrete flakes in a bare patch of soil. The artefact classes are common and well represented in the local and regional landscape. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
Karra 55	Artefacts	The site consists of two silcrete flakes eroding from residual soils in an exposure adjacent an access track. The artefact classes are common and well represented in the local and regional landscape. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
Karra 56	Isolated Artefact	The site consists of a single silcrete flake located on a bare patch of soil. The artefact class is common and well represented in the local and regional landscape. The site meets the criteria of low significance.	Low	Low	Low	Low
Karra 57	Hearth	Site consists of a possible hearth scatter.	Low	Low	Low	Low
Karra 58	Isolated Artefact	The site consists of a single silcrete flake located on a bare patch of soil. The artefact class is common and well represented in the local and regional landscape. The site meets the criteria of low significance.	Low	Low	Low	Low
Karra 59	Artefacts	The site consists of three silcrete flakes visible in a bare patch of soil. The artefact classes are common and well represented in the local and regional landscape. Further artefacts may be present across the landform in low densities however it is unlikely that these artefacts will be of sufficient density or integrity to substantially inform our understanding of the past. The site meets the criteria for low significance.	Low	Low	Low	Low
Karra 6	Artefacts and PAD	The site consists of 19 stone artefacts of silcrete, quartz, quartzite and chert. The assemblage comprises predominately broken flakes. One backed flake is present. These	Low	Low	Low	Low

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
		artefact classes are well represented in the local and regional landscapes. Potential Archaeological Deposit is present in residual and windblown soils within the pan and on the margins of the pan in which the site was located. The visible artefacts indicate the density of artefacts in the residual soils is likely to be less than 0.5 artefacts per square metre and will therefore no contribute a significant sample to inform the research. The site is considered to have low archaeological value.				
Karra 60	Isolated Artefact	The site consists of a single silcrete flake located on a bare patch of soil. The artefact class is common and well represented in the local and regional landscape. The site meets the criteria of low significance.	Low	Low	Low	Low
Karra 61	Artefacts and PAD	The site consists of a low density artefact scatter of 46 stone artefacts across a pan; including silcrete flakes, silcrete retouched flakes, silcrete cores and quartz flakes. The site demonstrates different occupation patterns to those observed at Karra 62 which is 160 m to the south of Karra 61. The low densities of less than 0.1 artefact per square metre is surprising given the sites position in the landscape - a pan in a dune rise overlooking a relict channel of Box Creek, and when compared with Karra 62 which is on a slightly higher rise but similar position in the landscape and has higher densities and greater archaeological potential. The site is noted for the presence of coarse grained, poor quality, yellow silcrete cores which have also been observed in sites around Ivanhoe and may demonstrate trade, social or mobility networks in the region. The site has low research value due to the low densities of artefacts across the pan but moderate scientific significance due to its connectivity in the landscape to Karra 62, Box Creek and other associated sites and its comparative value for demonstrating different occupation activities across the project area.	Moderate	Low	Low	Moderate
Karra 62	Artefacts and PAD	The site consists of silcrete and quartz stone artefacts and a hearth across a dune rise providing a good view over a remnant channel of Box Creek and a pan at the base of the rise. Artefact classes include flakes, retouched flakes and cores. The hearth is in good condition with concentrated charcoal and burnt stone eroding from residual soil on the pan. The site has good potential for intact deposits within the dune and is considered to have moderate archaeological and research value due to its position in the landscape, the potential for intact deposits, the presence of datable material in the form of burnt sediment and sandy soils and the sites connectivity with Box Creek and other sites in the immediate vicinity. The site may also contain comparative value to demonstrate differing activity and occupation patterns across the project area.	Moderate	Low	Low	Moderate
Karra 7	Artefacts, Hearth and PAD	The site consists of ten silcrete flakes, one potential hearth scatter and one hearth scatter. The artefact classes are common and well represented in the local and regional landscape. Hearth scatters and potential hearth scatters are present however these scatters are	Low	Low	Low	Low

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
		dispersed and are not good candidates for dating. Potential archaeological deposit exists within residual soils in and adjacent the pan. It is likely that any subsurface deposits are of low archaeological significance due to the low density of artefacts present on the pan.				
Karra 8	Artefacts	The site consists of two silcrete flakes in a deflated pan. The artefact classes are common and well represented in the landscape. Further artefacts may be located in nearby residuals however no PAD is present within the site boundaries.	Low	Low	Low	Low
Karra 9	Artefacts	The site consists of two silcrete flakes eroding from shallow residual soils at the margins of a pan. The artefact classes are common and well represented in the local and regional landscape. Further artefacts may be present in the adjacent residual soils but it is estimated that the deposit would be less than 10 cm in depth and artefact density within those residuals would be less than 0.5 artefacts a square metre and would therefore not contribute significantly to our understanding of the local past.	Low	Low	Low	Low
Karra 1	Isolated Artefact	The site consists of a single quartz flake. The artefact class is common and well represented in the local and regional landscape. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
Karra 63	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
Karra 64	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
Karra 65	Artefacts and PAD	This site is a low density artefact scatter. The site and artefact class are common and well represented in the project area and local region. There is limited information that can be gained from the site beyond the current recording. The site meets the criteria for low significance.	Low	Low	Low	Low
Karra 70	Isolated Artefact	The site consists of a single silcrete flake located on a bare patch of soil. The artefact class is common and well represented in the local and regional landscape. The site meets the criteria of low significance.	Low	Low	Low	Low
Karra AS 1	Artefacts	Karra AS 1 is a low density artefact scatter consisting of two silcrete flakes eroding from residual soils. The artefact classes are common and well represented in the local and regional landscape. Further artefacts may be present in the adjacent residual soils but it is estimated that the deposit would be less than 10 cm in depth and artefact density within	Low	Low	Low	Low

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
		those residuals would be less than 0.5 artefacts a square metre and would therefore not contribute significantly to our understanding of the local past.				
Karra IF 1	Isolated Artefact	The site consists of a single silcrete flake located on a bare patch of soil. The artefact class is common and well represented in the local and regional landscape. The site meets the criteria of low significance.	Low	Low	Low	Low
N 1	Isolated Artefact and PAD	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
N 2	Artefacts, Hearth and PAD	This site is a low density artefact scatter but located in an unusual landscape setting with datable hearths.	Moderate	Low	Moderate	Moderate
N 3	Artefacts	This site is a low density artefact scatter. The site and artefact class are common and well represented in the project area and local region. There is limited information that can be gained from the site beyond the current recording. The site meets the criteria for low significance.	Low	Low	Low	Low
N 4	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
N 5	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
N 6	Hearth	N 6 is a scattered hearth. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
N 7	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
PL 1	Artefacts	The site consists of two silcrete flakes visible on a bare patch of soil. The artefact classes are common and well represented in the local and regional landscape. The site meets the	Low	Low	Low	Low

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
		criteria for low scientific significance				
PL 10	Isolated Artefact	The site consists of a single silcrete flake located on a bare patch of soil. The artefact class is common and well represented in the local and regional landscape. The site meets the criteria of low significance.	Low	Low	Low	Low
PL 12	Artefacts	The site consists of a two silcrete flakes located on a bare patch of soil. The artefact class is common and well represented in the local and regional landscape. The site meets the criteria of low significance.	Low	Low	Low	Low
PL 13	Isolated Artefact	The site consists of a single silcrete flake located on a bare patch of soil. The artefact class is common and well represented in the local and regional landscape. The site meets the criteria of low significance.	Low	Low	Low	Low
PL 14	Isolated Artefact	The site consists of a single silcrete flake located on a bare patch of soil. The artefact class is common and well represented in the local and regional landscape. The site meets the criteria of low significance.	Low	Low	Low	Low
PL 15	Isolated Artefact	The site consists of a single silcrete flake in an exposure. The artefact class is common and well represented in the local and regional landscape. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
PL 16	Isolated Artefact	The site consists of a single silcrete flake visible in a bare patch of soil. The artefact class is common and well represented in the local and regional landscape. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
PL 2	Artefacts	The site consists of two silcrete flakes visible on a bare patch of soil. The artefact classes are common and well represented in the local and regional landscape. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
PL 3	Artefacts	The site consists of a silcrete flake and a silcrete core fragment visible on a bare patch of soil. The artefact classes are common and well represented in the local and regional landscape. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
PL 4	Isolated Artefact	The site consists of a single silcrete flake located on a bare patch of soil. The artefact class is common and well represented in the local and regional landscape. The site meets the criteria of low significance.	Low	Low	Low	Low
PL 5	Artefacts	The site consists of two silcrete flakes, a silcrete core and a glass retouched flake in an exposure. The glass artefact represents an uncommon artefact type while the silcrete artefacts are common and well represented in the local and regional landscape. The glass artefact, while representing post-contact knapping activities, was limited to a single item	Low	Low	Low	Low

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
		and has limited research potential beyond the attribute recording already undertaken. The site has therefore meets the criteria for low scientific significance.				
PL 6	Isolated Artefact	The site consists of a single silcrete flake located on a bare patch of soil. The artefact class is common and well represented in the local and regional landscape. The site meets the criteria of low significance	Low	Low	Low	Low
PL 7	Artefacts	The site consists of a silcrete flake and a silcrete core in an exposure. The artefact classes are common and well represented in the local and regional landscape. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
PL 8	Isolated Artefact	The site consists of a single silcrete flake located on a bare patch of soil. The artefact class is common and well represented in the local and regional landscape. The site meets the criteria of low significance.	Low	Low	Low	Low
PL 9	Isolated Artefact	The site consists of a single silcrete flake located on a bare patch of soil. The artefact class is common and well represented in the local and regional landscape. The site meets the criteria of low significance	Low	Low	Low	Low
TL 1	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
TL 2	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
TL 3	Hearth	This site has moderate significance due to its research value.	Moderate	Moderate	Moderate	Moderate
TL 4	Hearth	This site has moderate significance due to its research value.	Moderate	Moderate	Moderate	Moderate
TL 5	Hearth and Hearth	This site has moderate significance due to its research value.	Moderate	Moderate	Moderate	Moderate
TL 6	Hearth and PAD	This site has moderate significance due to its research value.	Moderate	Moderate	Moderate	Moderate
TL 7	Artefacts, Mound, Mound Scatter,	This site has moderate significance due to its research value.	Moderate	Low	Low	Moderate

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
	Oven, Oven Scatter and PAD					
TL 8	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
TO 1	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
TO 11	Isolated Artefact	The site is a single silcrete flake located in saltbush plains. The artefact class is common and well represented in the local and regional landscape. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
TO 12	Artefacts	This site is a moderate density stone artefact scatter with a broad range of artefact types and a number of relatively rare artefact types (grinding, ochre). The site has a range of artefact types and has a sufficient number of artefacts. Further Aboriginal objects associated or connected with this site are likely to exist on the surface and in subsurface contexts both within and beyond the disturbance footprint. The site is considered to have moderate significance due to its ability to inform us of technological use in the local area.	Moderate	Low	Low	Moderate
TO 13	Isolated Artefact	This site is an isolated stone artefact and dispersed hearth scatter. The site and artefact class are common and well represented in the project area and local region. The site meets the criteria for low significance.	Low	Low	Low	Low
TO 14	Artefacts and Hearth	This site is a moderate density artefact scatter with intact hearths. The site and artefact class are common and well represented in the project area and local region. The site is in close proximity to sites TO 15 TO 15, TO 16, TO 27 and TO 17 and should be considered part of the same continuous artefact scatter with focal points of higher densities in association with a wetland and eroding dune feature. There are sufficient densities of artefacts to provide useful statistic samples. The hearths have good potential to provide chronological information about past land use. The site is therefore considered to have moderate significance due to its interconnection with other sites and landscape features and ability to inform our understanding of the past.	Moderate	Low	Low	Moderate

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
TO 15	Artefacts	This site is a moderate density artefact scatter. The site and artefact class are common and well represented in the project area and local region. The site is in close proximity to sites TO 14, TO 15, TO 16, TO 27 and TO 17 and should be considered part of the same continuous artefact scatter with focal points of higher densities in association with a wetland and eroding dune feature. There are sufficient densities of artefacts to provide useful statistic samples. The site is therefore considered to have moderate significance due to its interconnection with other sites and landscape features and ability to inform our understanding of the past.	Moderate	Low	Low	Moderate
TO 16	Artefacts	This site is a moderate density artefact scatter. The site and artefact class are common and well represented in the project area and local region. The site is in close proximity to sites TO 14, TO 15, TO 16, TO 27 and TO 17 and should be considered part of the same continuous artefact scatter with focal points of higher densities in association with a wetland and eroding dune feature. There are sufficient densities of artefacts to provide useful statistic samples. The site is therefore considered to have moderate significance due to its interconnection with other sites and landscape features and ability to inform our understanding of the past.	Moderate	Low	Low	Moderate
TO 17	Artefacts	This site is a moderate density artefact scatter. The site and artefact class are common and well represented in the project area and local region. The site is in close proximity to sites TO 14, TO 15, TO 16, TO 27 and TO 17 and should be considered part of the same continuous artefact scatter with focal points of higher densities in association with a wetland and eroding dune feature. There are sufficient densities of artefacts to provide useful statistic samples. The site is therefore considered to have moderate significance due to its interconnection with other sites and landscape features and ability to inform our understanding of the past.	Moderate	Low	Low	Moderate
TO 18	Artefacts	This site is a low density artefact scatter in a series of scalds and forms part of the continuous artefact scatter recorded in TO 14, TO 15, TO 16 and TO 17. This visible portion of the scatter has a lower density and has thus considered to have low significance.	Low	Low	Low	Low
TO 19	Artefacts	This site is a low density artefact scatter in a series of scalds and forms part of the continuous artefact scatter recorded in TO 14, TO 15, TO 16 and TO 17. This visible portion of the scatter has a lower density and has thus considered to have low significance.	Low	Low	Low	Low
TO 2 / TO 20	Artefacts and Hearth	This site is a low to moderate density artefact scatter that spreads from the crest of a lunette, down the slope to the east of the lunette and onto the scalded plains. Portions of the lunette are vegetated and do not have clear visibility. The site is considered to have moderate scientific value for its potential to provide datable stratigraphy, the potential for	Moderate	Low	Low	Moderate

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
		buried archaeological deposits, the potential for surface and subsurface features such as hearths and for the volume and density of Aboriginal objects which may provide statistically useful samples for analysis.				
TO 21	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
TO 22 / 23	Artefacts	This site is a low density dispersed stone artefact. The site and artefact class are common and well represented in the project area and local region. The site meets the criteria for low significance.	Low	Low	Low	Low
TO 24	Artefacts and Hearth	This site is a low density dispersed stone artefact and hearth. The site and artefact class are common and well represented in the project area and local region. The site meets the criteria for low significance.	Low	Low	Low	Low
TO 25	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
TO 26	Artefacts	This site is a low density dispersed stone artefact. The site and artefact class are common and well represented in the project area and local region. The site meets the criteria for low significance.	Low	Low	Low	Low
TO 27	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
TO 28	Artefacts	This site consists of a two stone artefacts. The site type is common and well represented and many more can be expected in the project area and the wider region. There is limited information that can be gained from the site beyond the existing recording. The site is therefore considered to have low scientific value.	Low	Low	Low	Low
TO 29	Artefacts	This site consists of a two stone artefacts. The site type is common and well represented and many more can be expected in the project area and the wider region. There is limited information that can be gained from the site beyond the existing recording. The site is therefore considered to have low scientific value.	Low	Low	Low	Low

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
TO 30 / TO 31	Artefact	The site is a low density artefact scatter representing a visible portion of the low density, continuous and dispersed artefact scatter exposed within scalds and bare patches of soil in the scalded plains of the Rata system. It is common and well represented and many more can be expected in the project area and the wider region. The site is therefore considered to have low scientific value.	Low	Low	Low	Low
TO 32	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
TO 33	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
TO 34	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
TO 35	Artefacts	This site is a low density dispersed stone artefact. The site and artefact class are common and well represented in the project area and local region. The site meets the criteria for low significance.	Low	Low	Low	Low
TO 36	Artefacts	This site is a low density dispersed stone artefact. The site and artefact class are common and well represented in the project area and local region. The site meets the criteria for low significance.	Low	Low	Low	Low
TO 37	Artefacts	This site is a low density dispersed stone artefact. The site and artefact class are common and well represented in the project area and local region. The site meets the criteria for low significance.	Low	Low	Low	Low
TO 38	Artefacts	This site consists of a two stone artefacts. The site type is common and well represented and many more can be expected in the project area and the wider region. There is limited information that can be gained from the site beyond the existing recording. The site is therefore considered to have low scientific value.	Low	Low	Low	Low
TO 39	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria	Low	Low	Low	Low

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
		for low scientific significance.				
TO 40	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
TO 41	Artefacts	This site is a low density dispersed stone artefact. The site and artefact class are common and well represented in the project area and local region. The site meets the criteria for low significance.	Low	Low	Low	Low
TO 42	Artefacts	This site consists of a two stone artefacts. The site type is common and well represented and many more can be expected in the project area and the wider region. There is limited information that can be gained from the site beyond the existing recording. The site is therefore considered to have low scientific value.	Low	Low	Low	Low
TO 43	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
TO 44	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
TO 45	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
TO 46	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
TO 47	Artefacts	This site consists of a two stone artefacts. The site type is common and well represented and many more can be expected in the project area and the wider region. There is limited information that can be gained from the site beyond the existing recording. The site is therefore considered to have low scientific value.	Low	Low	Low	Low

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
TO 48	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
TO 49	Artefacts	This site is a low density artefact scatter. The site and artefact class are common and well represented in the project area and local region. There is limited information that can be gained from the site beyond the current recording. The site meets the criteria for low significance.	Low	Low	Low	Low
TT 10	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
TT 11	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
TT 12	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
TT 13	Artefacts	This site is a low density artefact scatter. The site and artefact class are common and well represented in the project area and local region. There is limited information that can be gained from the site beyond the current recording. The site meets the criteria for low significance.	Low	Low	Low	Low
TT 14	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
TT 15	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
TT 16	Artefacts	This site is a low density artefact scatter. The site and artefact class are common and well	Low	Low	Low	Low

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
		represented in the project area and local region. There is limited information that can be gained from the site beyond the current recording. The site meets the criteria for low significance.				
TT 24	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
TT 25	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
TT 26	Artefacts	This site is a low density dispersed stone artefact. The site and artefact class are common and well represented in the project area and local region. The site meets the criteria for low significance.	Low	Low	Low	Low
TT 27	Artefacts	This site is a low density dispersed stone artefact. The site and artefact class are common and well represented in the project area and local region. The site meets the criteria for low significance.	Low	Low	Low	Low
TT 28	Artefacts	This site is a low density dispersed stone artefact. The site and artefact class are common and well represented in the project area and local region. The site meets the criteria for low significance.	Low	Low	Low	Low
TT 29	Artefacts	This site is a low density dispersed stone artefact with the potential for buried artefacts. The site and artefact class are common and well represented in the project area and local region. The site meets the criteria for low significance.	Low	Low	Low	Low
TT 30	Artefacts	This site is a low density dispersed stone artefact with the potential for buried artefacts. The site and artefact class are common and well represented in the project area and local region. The site meets the criteria for low significance.	Low	Low	Low	Low
TT 31	Artefacts	This site is a low density dispersed stone artefact. The site and artefact class are common and well represented in the project area and local region. The site meets the criteria for low significance.	Low	Low	Low	Low
TT 32	Artefacts	This site is a low density dispersed stone artefact. The site and artefact class are common and well represented in the project area and local region. The site meets the criteria for low significance.	Low	Low	Low	Low

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
TT 33	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
TT 34	Artefacts	This site may contain archaeological deposits both within and beyond the surveyed areas along the dune of the lake bed	Moderate	Low	Low	Moderate
TT 35	Artefacts	This site is a low density dispersed stone artefact. The site and artefact class are common and well represented in the project area and local region. The site meets the criteria for low significance.	Low	Low	Low	Low
TT 36	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
TT 37	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
TT 38 / TT 39	Artefacts	This site is a low density artefact scatter. The site and artefact class are common and well represented in the project area and local region. The site meets the criteria for low significance.	Low	Low	Low	Low
TT 9	Artefacts	This site is a low density artefact scatter.	Low	Low	Low	Low
TT AS 1	Artefacts and PAD	This site has moderate significance due to its research value.	Moderate	Low	Low	Low
TT AS 2	Artefacts, Hearth and PAD	This site has moderate significance due to its research value.	Moderate	Low	Low	Moderate
TT AS 3	Artefacts	This site is a low density artefact scatter. The site and artefact class are common and well represented in the project area and local region. There is limited information that can be gained from the site beyond the current recording. The site meets the criteria for low significance.	Low	Low	Low	Low
TT IF 4	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute	Low	Low	Low	Low

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
		to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.				
TT IF 5	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
TT IF 6	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
TT IF 7	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
TT IF 8	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
UD 1	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
UD 10 / UD 11 / UD 13	Artefacts	This site is a low density artefact scatter located in a scald within scalded plains. Further surface and subsurface artefacts are likely to be present in the residual soils, however the depth of the residual soils and the low density of artefact scatters in the surrounds indicate that the value of the unidentified material would have limited ability to inform our understanding of the past.	Low	Low	Low	Low
UD 103	Artefacts and Hearth	This site is considered to be of moderate scientific significance due to the presence of multiple hearths which offer an excellent opportunity to date and provide a chronology of occupation of the local area.	Moderate	Low	Low	Moderate
UD 104	Artefacts and Hearth	This site is considered to be of moderate scientific significance due to the presence of a hearth which offers a good opportunity to date and provide a chronology of occupation of the local area.	Moderate	Low	Low	Moderate

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
UD 105	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
UD 106	Possible Hearth	This site is a possible hearth scatter. It was no evident from the exposed material whether this was a natural or cultural fire event and warrants further investigation to determine the significance of the site	Low	Low	Low	Low
UD 107	Artefacts	UD 107 is a low density artefact scatter eroding from residual soils. The artefact classes are common and well represented in the local and regional landscape. Further artefacts may be present in the adjacent residual soils but it is estimated that the deposit would be less than 10 cm in depth and artefact density within those residuals would be less than 0.5 artefacts a square metre and would therefore not contribute significantly to our understanding of the local past	Low	Low	Low	Low
UD 108	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
UD 109	Artefacts	UD 109 is a low density artefact scatter eroding from residual soils. The artefact classes are common and well represented in the local and regional landscape. Further artefacts may be present in the adjacent residual soils but it is estimated that the deposit would be less than 10 cm in depth and artefact density within those residuals would be less than 0.5 artefacts a square metre and would therefore not contribute significantly to our understanding of the local past	Low	Low	Low	Low
UD 110	Artefacts	UD 110 is a low density artefact scatter eroding from residual soils. The artefact classes are common and well represented in the local and regional landscape. Further artefacts may be present in the adjacent residual soils but it is estimated that the deposit would be less than 10 cm in depth and artefact density within those residuals would be less than 0.5 artefacts a square metre and would therefore not contribute significantly to our understanding of the local past	Low	Low	Low	Low
UD 111	Artefacts	UD 111 is a low density artefact scatter eroding from residual soils. The artefact classes are common and well represented in the local and regional landscape. Further artefacts may be present in the adjacent residual soils but it is estimated that the deposit would be less than 10 cm in depth and artefact density within those residuals would be less than 0.5 artefacts a square metre and would therefore not contribute significantly to our understanding of	Low	Low	Low	Low

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
		the local past				
UD 112	Artefacts	This site is a low density dispersed artefact scatter and is a site and artefact class which is typical and well represented in the local and wider region. Many more can be expected to be found in the wider region. The site meets the criteria for low significance.	Low	Low	Low	Low
UD 113	Isolated Artefact	UD 113 is a low density artefact scatter located in scalded plains. It contains common and well represented artefacts in the project area and many more can be predicted to occur in the local region. The site therefore meets the criteria for low scientific significance	Low	Low	Low	Low
UD 114	Isolated Artefact	This site is a retouched silcrete complete flake. The site and artefact class are common and well represented in the project area and local region and many more can confidently be predicted. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
UD 115 / UD 119	Artefacts and Hearth	This site is a low density artefact scatter and scattered hearth. The site, artefact and hearth class are common and well represented in the project area and wider region and offer limited research value beyond what has already been recorded at the site. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
UD 116	Artefacts	This site is considered to be of moderate significance due to the number of artefacts present within the site as this may provide a statistically useful sample of artefacts and the likelihood that further Aboriginal objects of unknown value may be present in intact residual soils immediately adjacent the visible boundaries of the site which may provide dates and improve our understanding of the local past.	Moderate	Low	Low	Moderate
UD 117	Artefacts	UD 117 is a low density artefact scatter eroding from residual soils. The artefact classes are common and well represented in the local and regional landscape. Further artefacts may be present in the adjacent residual soils but it is estimated that the deposit would be less than 10 cm in depth and artefact density within those residuals would be less than 0.5 artefacts a square metre and would therefore not contribute significantly to our understanding of the local past.	Low	Low	Low	Low
UD 118	Artefacts	This site is a low density artefact scatter located in a disturbed context. The site and artefact classes are common and well represented in the project area and wider region. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
UD 12	Isolated Artefact	This site consists of a single silcrete flake located in a scald. It is a common and well represented site type and artefact class in the local and wider region. It therefore meets the criteria for low significance.	Low	Low	Low	Low
UD 120	Artefacts	UD 120 is a moderate to highly dense artefact scatter with hearths in a sand dune deposit associated with shallow drainage channels in the alluvial plains. This site meets the criteria	Moderate	Low	Low	Moderate

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
		for moderate significance due to its ability to provide chronology, spatial and technological information on how Aboriginal people have used the landscape in the past. The site has not been fully recorded due to its visible boundaries extending outside the project area.				
UD 121	Artefacts	This site is a low density artefact scatter and is a typical and well represented site in the local area.	Low	Low	Low	Low
UD 122	Artefacts	UD 122 is considered to have moderate significance due to its shared landform and proximity to UD 120, another moderate to highly dense artefact scatter in a sand dune deposit associated with a wetland feature in the alluvial back meander channels of a relict drainage system. The site is likely to extend beyond the visible boundaries of the site into the vegetated surrounds.	Moderate	Low	Low	Moderate
UD 123	Artefacts	This site is a moderate density artefact scatter in excellent condition with a hearth feature with excellent dating potential. The site is considered to have moderate significance due to its ability to inform a chronology of the local area.	Moderate	Low	Low	Moderate
UD 124	Artefacts	This site consists of a two stone artefacts. The site type is common and well represented and many more can be expected in the project area and the wider region. There is limited information that can be gained from the site beyond the existing recording. The site is therefore considered to have low scientific value.	Low	Low	Low	Low
UD 125	Artefacts	This site is a low density artefact scatter in a scald near a soak and drainage feature. The site type is common and well represented and many more can be expected in the project area and the wider region. There is limited information that can be gained from the site beyond the existing recording. The site is therefore considered to have low scientific value.	Low	Low	Low	Low
UD 126	Isolated Artefact	This site consists of a single silcrete flake located in a scald. It is a common and well represented site type and artefact class in the local and wider region. It therefore meets the criteria for low significance.	Low	Low	Low	Low
UD 127	Artefacts	This site consists of a two stone artefacts. The site type is common and well represented and many more can be expected in the project area and the wider region. There is limited information that can be gained from the site beyond the existing recording. The site is therefore considered to have low scientific value.	Low	Low	Low	Low
UD 128	Artefacts	UD 128 is a low density artefact scatter in a disturbed context. The site and artefact class are well represented in the local and regional area and many more can be expected to be predicted in the surrounding landscape. The site meets the criteria for low scientific significance.	Low	Low	Low	Low

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
UD 129	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
UD 130	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
UD 131	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
UD 132	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
UD 133	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
UD 134	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
UD 135	Artefacts	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
UD 136	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
UD 137	Isolated	This site is an isolated stone artefact, a common and well represented site and artefact type	Low	Low	Low	Low

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
	Artefact	in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.				
UD 138	Artefacts	The site is considered to be of low significance due to its disturbed context. The site and artefact class are common in the area and many more Aboriginal objects of equal or unknown value can be expected in the surrounding landscape.	Low	Low	Low	Low
UD 139	Artefacts	This site is a low density, dispersed artefact scatter located in a scald within a drainage depression which is heavily disturbed from stock and the construction of a dam. This site and artefact types are common and well represented in the landscape. The site meets the criteria for low significance.	Low	Low	Low	Low
UD 14	Isolated Artefact	This site consists of a single silcrete flake located in a scald. It is a common and well represented site type and artefact class in the local and wider region. It therefore meets the criteria for low significance.	Low	Low	Low	Low
UD 140	Artefacts	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
UD 141	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
UD 142	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
UD 143	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
UD 144	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
UD 145	Artefacts	This site is a low density, dispersed artefact scatter located in a scald within a drainage depression with is heavily disturbed from stock and the construction of a dam. This site and artefact types are common and well represented in the landscape. The site meets the criteria for low significance.	Low	Low	Low	Low
UD 15	Isolated Artefact	This site consists of a single silcrete flake located in a scald. It is a common and well represented site type and artefact class in the local and wider region. It therefore meets the criteria for low significance.	Low	Low	Low	Low
UD 16	Artefacts and Hearth	This site contains 31 stone artefacts and 3 possible hearths. The site type and artefact classes are not uncommon in the project area.	Low	Low	Low	Low
UD 17 / UD 18	Artefacts and Hearth	This site contains 28 stone artefacts and 1 possible hearths. The site type and artefact classes are not uncommon in the project area.	Low	Low	Low	Low
UD 19	Artefacts	This site is a low density artefact scatter. The site and artefact class are common and well represented in the project area and local region. There is limited information that can be gained from the site beyond the current recording. The site meets the criteria for low significance.	Low	Low	Low	Low
UD 20	Artefacts	This site is a low density artefact scatter. The site and artefact class are common and well represented in the project area and local region. There is limited information that can be gained from the site beyond the current recording. The site meets the criteria for low significance.	Low	Low	Low	Low
UD 20	Artefacts	This site is a low density artefact scatter. The site and artefact class are common and well represented in the project area and local region. There is limited information that can be gained from the site beyond the current recording. The site meets the criteria for low significance.	Low	Low	Low	Low
UD 21	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
UD 22	Artefacts	This site is a low density artefact scatter. The site and artefact class are common and well represented in the project area and local region. There is limited information that can be gained from the site beyond the current recording. The site meets the criteria for low significance.	Low	Low	Low	Low
UD 23	Artefacts	This site is a low density artefact scatter. The site and artefact class are common and well	Low	Low	Low	Low

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
		represented in the project area and local region. The site meets the criteria for low significance.				
UD 24	Artefacts	This site is a low density artefact scatter. The site and artefact class are common and well represented in the project area and local region. The site meets the criteria for low significance.	Low	Low	Low	Low
UD 25	Artefacts	This site is a low density artefact scatter. The site and artefact class are common and well represented in the project area and local region. The site meets the criteria for low significance.	Low	Low	Low	Low
UD 26	Artefacts	This site is a low density artefact scatter. The site and artefact class are common and well represented in the project area and local region. The site meets the criteria for low significance.	Low	Low	Low	Low
UD 27	Artefacts	This site is a moderate density artefact scatter that is highly likely to extend beyond the surveyed area and contain further archaeological deposits of value	Low	Low	Low	Low
UD 28	Artefacts	UD 28 is a low density artefact scatter eroding from a lunette. The artefact classes are common and well represented in the local and regional landscape. Based on the surface manifestation of the site, UD 28 meets the criteria for low scientific significance. The depth of the archaeological deposit is unknown and it is possible that further Aboriginal Objects of moderate significance may be present in the surrounding landform within the high risk layer.	Low	Low	Low	Low
UD 29	Artefacts	UD 29 is a low density artefact scatter eroding from a lunette. The artefact classes are common and well represented in the local and regional landscape. Based on the surface manifestation of the site, UD 29 meets the criteria for low scientific significance. The depth of the archaeological deposit is unknown and it is possible that further Aboriginal Objects of moderate significance may be present in the surrounding landform within the high risk layer.	Low	Low	Low	Low
UD 3	Isolated Artefact	UD 3 is a single silcrete flake located in an area disturbed by stock movement. The site and artefact class is common and well represented in the local and regional landscape. The site is therefore assessed to be of low archaeological significance.	Low	Low	Low	Low
UD 30	Artefacts	UD 30 is a low density artefact scatter located on the slopes of a lunette.	Low	Low	Low	Low
UD 31	Isolated Artefact	UD 31 is a single silcrete Aboriginal object located at the eroding base of a lunette. This site is common and well represented in the local and region and meets the criteria for low scientific significance due to its disturbed nature.	Low	Low	Low	Low

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
UD 32	Artefacts	UD 32 is a low density artefact scatter located in a scald between two access tracks. The site and artefact classes are common and well represented in the local area and region. The site therefore meets the criteria for low significance.	Low	Low	Low	Low
UD 33	Isolated Artefact	UD 33 is a single isolated silcrete flake located within a lake basin on the margins of a soak with old man saltbush. The site is common and well represented in the local and regional landscape and meets the criteria for low scientific significance.	Low	Low	Low	Low
UD 34	Isolated Artefact	UD 34 is a single silcrete artefact located on the footslopes of an eroding lunette. It is a common and well represented site and artefact class and meets the criteria for low scientific significance.	Low	Low	Low	Low
UD 35	Artefacts	UD 35 is a low density artefact scatter on the slopes of an eroding lunette. It is a common and well represented site and artefact class and meets the criteria for low scientific significance however the surrounding landform does have the potential to contain archaeological deposits of moderate significance.	Low	Low	Low	Low
UD 36	Artefacts	UD 36 is a low density artefact scatter on the slopes of an eroding lunette. It is a common and well represented site and artefact class and meets the criteria for low scientific significance however the surrounding landform does have the potential to contain archaeological deposits of moderate significance.	Low	Low	Low	Low
UD 37	Isolated Artefact	UD 37 is an isolated stone artefact on the slopes of an eroding lunette. It is a common and well represented site and artefact class and meets the criteria for low scientific significance however the surrounding landform does have the potential to contain archaeological deposits of moderate significance.	Low	Low	Low	Low
UD 38	Isolated Artefact	UD 38 is an isolated stone artefact on the slopes of an eroding lunette. It is a common and well represented site and artefact class and meets the criteria for low scientific significance.	Low	Low	Low	Low
UD 39	Isolated Artefact	UD 39 is located on the footslopes of an eroding lunette. It meets the criteria for a low scientific significance as it is of a common and well represented class and would most likely have an insufficient depth of deposit to warrant excavation.	Low	Low	Low	Low
UD 4	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
UD 40	Isolated Artefact	UD 40 is an isolated stone artefact located in a scald in a lake basin at the base of the footslopes of a lunette. The site and artefact class are common and well represented in the	Low	Low	Low	Low

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
		local and regional landscape. The site meets the criteria for low scientific significance.				
UD 41	Isolated Artefact	UD 41 is located in a scald in a lake basin at the base of a lunette. The site and artefact class is common and well represented in the local and wider region. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
UD 42	Artefacts	UD 42 is located in a scald in a lake basin at the base of a lunette. The site and artefact class is common and well represented in the local and wider region. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
UD 43	Artefacts	UD 43 is located in a scald in a lake basin at the base of a lunette. The site and artefact class is common and well represented in the local and wider region. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
UD 44	Isolated Artefact	UD 44 is located in a scald in a lake basin at the base of a lunette. The site and artefact class is common and well represented in the local and wider region. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
UD 45	Isolated Artefact	UD 45 is an isolated stone artefact on the slopes of an eroding lunette. It is a common and well represented site and artefact class and meets the criteria for low scientific significance however the surrounding landform does have the potential to contain archaeological deposits of moderate significance.	Low	Low	Low	Low
UD 46 / UD 48 / UD 49	Artefacts	UD 46 / UD 48 / UD 49 is a low density small artefact scatter on the slopes of an eroding lunette. It is a common and well represented site and artefact class and meets the criteria for low scientific significance however the surrounding landform does have the potential to contain archaeological deposits of moderate significance.	Low	Low	Low	Low
UD 47	Isolated Artefact	UD 47 is an isolated stone artefact on the crest of a lunette. The site and artefact class is common and well represented in the local and wider region and the site is therefore considered to be of low scientific significance. The lunette on which the site is situated however is considered to have high risk for further Aboriginal objects to be present and these lunette deposits may have moderate significance.	Low	Low	Low	Low
UD 5 / UD 8 / UD 7.1	Artefacts	UD 5/ UD 8 /UD 7.1 is a low density small artefact scatter located in an alluvial plain and shallow drainage system. It is a common and well represented site with common and well represented artefact classes. There is limited additional information which the site can provide about our understanding of the past. The site therefore meets the criteria for low significance	Low	Low	Low	Low
UD 50	Artefacts	UD 50 is a low density artefact scatter located on the slopes of a lunette in a lake basin. The site and artefact classes are common and well represented in the local and regional	Low	Low	Low	Low

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
		landscape. The site meets the criteria for low scientific significance.				
UD 51	Artefacts	UD 51 is a low density artefact scatter located on the slopes and crests of a lunette. It is possible that the lunette crest and slope contains intact archaeological deposits which may help inform our understanding of Aboriginal occupation of the landscape. For this reason, the site is considered to have moderate scientific value.	Moderate	Low	Low	Moderate
UD 52	Artefacts	UD 52 is a low density artefact scatter located on the slopes and crests of a lunette. It is possible that the lunette crest and slope contains intact archaeological deposits which may help inform our understanding of Aboriginal occupation of the landscape. The visible portion of site UD 52 is considered to be of low scientific value due to it containing common and well represented artefact classes.	Low	Low	Low	Low
UD 53	Artefacts	UD 53 is a low density artefact scatter located on the slopes and crests of a lunette. It is possible that the lunette crest and slope contains intact archaeological deposits which may help inform our understanding of Aboriginal occupation of the landscape. The visible portion of site UD 53 is considered to be of low scientific value due to it containing common and well represented artefact classes.	Low	Low	Low	Low
UD 54	Isolated Artefact	UD 54 is an isolated stone artefact located on the slopes and crests of a lunette. It is possible that the lunette crest and slope contains intact archaeological deposits which may help inform our understanding of Aboriginal occupation of the landscape. The visible portion of site UD 54 is considered to be of low scientific value due to it containing common and well represented artefact classes.	Low	Low	Low	Low
UD 55	Artefacts	UD 55 is a low density artefact scatter located on the slopes and crests of a lunette. It is possible that the lunette crest and slope contains intact archaeological deposits which may help inform our understanding of Aboriginal occupation of the landscape. For this reason, the site is considered to have moderate scientific value.	Moderate	Low	Low	Moderate
UD 6	Isolated Artefact	UD 6 is an isolated stone artefact located in alluvial plains near shallow drainage channels. The site and artefact class are common and well represented in the local and wider region. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
UD 60	Isolated Artefact	UD 60 is an isolated stone artefact located on the alluvial plains at the base of the eroding western shoreline of a relict lake. The site and artefact class is common and well represented in the local and regional landscape. Any archaeological deposit in residual soils in the landform are likely to be shallow and limited. Accordingly the site is considered to be of low scientific value.	Low	Low	Low	Low
UD 61	Isolated	UD 61 is an isolated stone artefact located on the alluvial plains at the base of the eroding	Low	Low	Low	Low

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
	Artefact	western shoreline of a relict lake. The site and artefact class is common and well represented in the local and regional landscape. Any archaeological deposit in residual soils in the landform are likely to be shallow and limited. Accordingly the site is considered to be of low scientific value.				
UD 62 / UD 64 / UD 65 / UD 70 / UD 75	Artefacts and Hearth	UD 62 / UD 64 / UD 65 / UD 70 / UD 75 is a moderate to high density artefact scatter eroding from the western shoreline of a relict lake basin. The site represents a place where a range of activities including burren production, grinding and hearths occurred. A range of local and exotic stone material is present at the site, representing potential trading practice beyond the local region. The site contains intact, stabilised dunes which may contain intact archaeological deposits. The site contains dateable material in the form of hearths and burnt emu shell. The site also contains sufficient densities of artefacts to assist in characterising lithic production in this part of the project area. The site is therefore considered to have moderate scientific value for its ability to inform our understanding of the chronology of past Aboriginal occupation in the local landscape and to inform our understanding of the range of activities occurring in the landscape.	Moderate	Low	Low	Moderate
UD 63	Isolated Artefact	UD 63 is an isolated stone artefact located at the base of the eroding western shoreline of a relict lake, 40 m east of UD 62 /UD 64/ UD 65/ UD 70 /UD 75. The site and artefact class is common and well represented in the landscape and meets the criteria for low scientific significance. It is most likely an outlier of the larger site.	Low	Low	Low	Low
UD 66	Artefacts	UD 66 is a low density artefact scatter in the stabilised dune or western shoreline of a relict lake basin. It is visible in an exposure by a fence line, indicating the potential for further subsurface Aboriginal objects to be present in this landform. The visible portion of the site and artefact classes are common and well represented in the local and wider region and meet the criteria for low scientific significance.	Low	Low	Low	Low
UD 67	Isolated Artefact	UD 67 is an isolated stone artefact in a small wash exposure in a stabilised dune on the western shoreline of a relict lake. It is visible in a wash exposure, indicating the potential for further subsurface Aboriginal objects to be present in this landform. The visible portion of the site and artefact classes are common and well represented in the local and wider region and meet the criteria for low scientific significance.	Low	Low	Low	Low
UD 68	Artefacts	UD 68 is a low density stone artefact scatter in a small exposure in a stabilised dune on the western shoreline of a relict lake. Its location indicates the potential for further subsurface Aboriginal objects to be present in this landform. The visible portion of the site and artefact classes are common and well represented in the local and wider region and meet the criteria for low scientific significance.	Low	Low	Low	Low

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
UD 69	Isolated Artefact	UD 69 is an isolated stone artefact in a scald exposure in a stabilised dune on the western shoreline of a relict lake. It is visible in a scald indicating the potential for further subsurface Aboriginal objects to be present in this landform. The visible portion of the site and artefact classes are common and well represented in the local and wider region and meet the criteria for low scientific significance.	Low	Low	Low	Low
UD 7	Artefacts	UD 7 is a low density artefact scatter in a series of exposures in an alluvial plain. The site and artefact classes are well represented in the local and wider region and the site meets the criteria for low scientific significance/	Low	Low	Low	Low
UD 71	Isolated Artefact	UD 71 is an isolated stone artefact in a scald in an alluvial plain. The site and artefact class is common and well represented in the local and wider region. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
UD 72	Artefacts	UD 72 is a low density artefact scatter located in a scald in an alluvial plain. The site and artefact class is common and well represented in the local and wider region. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
UD 73	Artefacts and Hearth	UD 73 is a moderate to high density artefact scatter located in a series of scalds in an alluvial plain. It offers higher densities than typically found in this landform. The site likely represents one or more knapping events and contains a hearth which offers an opportunity to provide a chronological understanding of Aboriginal occupation in the local landscape. Accordingly the site is considered to be of moderate scientific value.	Moderate	Low	Low	Moderate
UD 74	Isolated Artefact	UD 74 is an isolated stone artefact located at the base of the eroding western shoreline of a relict lake, 30 m east of UD 62 /UD 64/ UD 65/ UD 70 /UD 75. The site and artefact class is common and well represented in the landscape and meets the criteria for low scientific significance. It is most likely an outlier of the larger site.	Low	Low	Low	Low
UD 76	Artefacts	UD 76 is a low density artefact scatter located in a scald in a soak within a relict lake basin. The site and artefact class is common and well represented in the local and wider region. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
UD 77	Artefacts	UD 77 is a moderate to high density artefact scatter. The scatter contains a high volume of angular fragments, backed geometric microliths of the same raw material and one of the largest silcrete cores recorded in the project area. The site is considered to be an example of one or more knapping events for the production of backed blades. The site also demonstrates occupation of the lake basin when there was less water available in the landscape. The site contains research potential through chemical analysis of the core to see whether the core was sourced from the Mungo quarries. The RAP Site Officers indicated	Moderate	Low	Low	Moderate

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
		that they believed the core was of importance. Accordingly the site is accorded moderate scientific significance.				
UD 78	Isolated Artefact	UD 78 is an isolated stone artefact of the same raw material as UD 77, located in a scald in a lake basin. The site and artefact class are common and well represented in the local landscape and the site is considered to be of low scientific value.	Low	Low	Low	Low
UD 79	Isolated Artefact	UD 79 is an isolated stone artefact of the same raw material as UD 77, located in a scald in a lake basin. The site and artefact class are common and well represented in the local landscape and the site is considered to be of low scientific value.	Low	Low	Low	Low
UD 80	Isolated Artefact	UD 79 is an isolated stone artefact of the same raw material as UD 80, located in a scald in a lake basin. The site and artefact class are common and well represented in the local landscape and the site is considered to be of low scientific value.	Low	Low	Low	Low
UD 88	Isolated Artefact	UD 88 is an isolated stone artefact in an alluvial plain at the base of a sand hill. The site is most likely an outlier of UD 81 / UD 82/ UD 83/ UD 84/ UD 85/ UD 86 / UD 87 having eroded downslope from the sand hill. The site and artefact class is common and well represented. The site is considered of low significance.	Low	Low	Low	Low
UD 89	Isolated Artefact	UD 89 is an isolated stone artefact in an alluvial plain. The site and artefact class is common and well represented. The site is considered of low significance.	Low	Low	Low	Low
UD 9	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
UD 90	Isolated Artefact	UD 90 is an isolated stone artefact in an alluvial plain. The site and artefact class is common and well represented. The site is considered of low significance.	Low	Low	Low	Low
UD 91	Artefacts	UD 91 is a typical low density stone artefact in an alluvial plain. The site and artefact classes are common and well represented. The site is considered of low significance.	Low	Low	Low	Low
UD 92 / UD 93 / UD 100 / UD 101 / UD 102	Artefacts and Hearth	This site is a complex, large low to moderate density artefact scatter with a number of intact or disturbed hearths which offer fair to good potential for dating. The site also has a higher ratio of grinding fragments than other sites in the project area and intact deposits may or may not be present in the dunes. The site also shows multiple periods of occupation with dumps of European material from the 60s to present to the south of the disturbance area.	Moderate	Low	Low	Moderate
UD 94	Isolated	UD 94 is an isolated stone artefact in a dune system. The site and artefact class is common	Low	Low	Low	Low

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
	Artefact	and well represented. The site is considered of low significance.				
UD 95	Artefacts	UD 95 is a low density artefact scatter in a dune system. The site and artefact class is common and well represented. The site is considered of low significance.	Low	Low	Low	Low
UD 96	Hearth	UD 96 comprises partially exposed heat hardened clay, sediment and visible charcoal in a discrete location in a dune system. The site requires further testing to determine if the material is a hearth or occurred as a result of a natural fire event.	Low	Low	Low	Low
UD 97	Hearth	UD 97 comprises partially exposed heat hardened clay and sediment and visible charcoal in a discrete location with eroding heat retainers near a small depression in a dune system. The site requires further testing to determine if the material is a hearth or occurred as a result of a natural fire event.	Low	Low	Low	Low
UD 98	Isolated Artefact	UD 98 is an isolated stone artefact in a dune system. The site and artefact class is common and well represented. The site is considered of low significance.	Low	Low	Low	Low
UD 99	Isolated Artefact	UD 99 is an isolated stone artefact in a dune system. The site and artefact class is common and well represented. The site is considered of low significance.	Low	Low	Low	Low
UD81 / UD82 / UD83 / UD84 / UD85 / UD86 / UD87	Artefacts and Hearth	This site is a low to moderately dense artefact scatter in an eroding dune / sand and carbonate rise fringed with box trees in an alluvial plain. It contains a number of hearths with dating potential and an unusual hardened sediment feature with artefacts and patches of ash. The site offers some moderate research potential for its ability to inform our understanding of the chronology of occupation in the local region. It may be appropriate to avoid.	Moderate	Low	Low	Moderate
W 1	Isolated Artefact	This site is an isolated stone artefact. The site and artefact class are common and well represented in the project area and local region. The site meets the criteria for low significance.	Low	Low	Low	Low
W 10	Artefacts	This site is a low density artefact scatter. The site and artefact class are common and well represented in the project area and local region. The site meets the criteria for low significance.	Low	Low	Low	Low
W 11	Artefacts	This site is a low density artefact scatter. The site and artefact class are common and well represented in the project area and local region. The site meets the criteria for low significance.	Low	Low	Low	Low
W 12	Artefacts	The site is a low density artefact scatter representing a visible portion of the low density, continuous and dispersed artefact scatter exposed within scalds and bare patches of soil in	Low	Low	Low	Low

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
		the scalded plains of the Rata system. It is common and well represented and many more can be expected in the project area and the wider region. The site is therefore considered to have low scientific value.				
W 2	Artefacts and Hearth	The site is a low density artefact scatter representing a visible portion of the low density, continuous and dispersed artefact scatter exposed within scalds and bare patches of soil in the scalded plains of the Rata system. It is common and well represented and many more can be expected in the project area and the wider region. It contains a sufficient volume of artefacts to assist in characterising technological behaviour the local area and a hearth feature which may provide chronological information. The site is therefore considered to have moderate scientific value.	Moderate	Low	Low	Moderate
W 2	Artefacts	This site has moderate significance due to the presence of five hearths which may offer viable dating to provide a chronology of the local area. The dune deposits may also contain buried archaeological deposits.	Moderate	Low	Low	Moderate
W 3	Artefacts	The site is a low density artefact scatter representing a visible portion of the low density, continuous and dispersed artefact scatter exposed within scalds and bare patches of soil in the scalded plains of the Rata system. It is common and well represented and many more can be expected in the project area and the wider region. The site is therefore considered to have low scientific value.	Low	Low	Low	Low
W 4	Artefacts	This site consists of a two stone artefacts. The site type is common and well represented and many more can be expected in the project area and the wider region. There is limited information that can be gained from the site beyond the existing recording. The site is therefore considered to have low scientific value.	Low	Low	Low	Low
W 5	Artefacts	This site is a low density artefact scatter. The site and artefact class are common and well represented in the project area and local region. There is limited information that can be gained from the site beyond the current recording. The site meets the criteria for low significance.	Low	Low	Low	Low
W 6	Isolated Artefact	This site is an isolated stone artefact. The site and artefact class are common and well represented in the project area and local region. The site meets the criteria for low significance.	Low	Low	Low	Low
W 7	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
W 8	Artefacts	The site is a low density artefact scatter representing a visible portion of the low density, continuous and dispersed artefact scatter exposed within scalds and bare patches of soil in the scalded plains of the Rata system. It is common and well represented and many more can be expected in the project area and the wider region. The site is therefore considered to have low scientific value.	Low	Low	Low	Low
W 9	Artefacts	The site is a low density artefact scatter representing a visible portion of the low density, continuous and dispersed artefact scatter exposed within scalds and bare patches of soil in the scalded plains of the Rata system. It is common and well represented and many more can be expected in the project area and the wider region. The site is therefore considered to have low scientific value.	Low	Low	Low	Low
WB 1	Artefacts, Hearth, and PAD	This site is considered to have moderate significance due to the presence of a datable hearth which can inform our understanding of the chronology of occupation in the local area and the presence of an artefact assemblage which exceeds 100 artefacts, though this assemblage is relatively low density compared with other sites in the project area and wider region. The site and artefact classes however are not rare or uncommon and many more examples can be predicted to occur within the project area and local region. Residual soils in and near the site are likely to contain further surface and subsurface artefacts.	Moderate	Low	Low	Moderate
WB 10	Isolated Artefact	This site is an isolated stone artefact located in the transitional zone between the Marma and Youhl land systems. It is a common and well represented site and artefact class in the local area. It meets the criteria for low scientific significance.	Low	Low	Low	Low
WB 100	Isolated Artefact	WB 100 is an isolated stone artefact located in the scalded plains of the Rata land system. It is a common and well represented site and artefact class. Many more examples can be predicted in the project area and the wider region. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
WB 101	Isolated Artefact	WB 101 is an isolated stone artefact located in the scalded plains of the Rata land system. It is a common and well represented site and artefact class. Many more examples can be predicted in the project area and the wider region. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
WB 102	Artefacts and PAD	WB 102 is a low density, small artefact scatter located on a slight rise in the scalded plains of the Rata land system. Further surface and subsurface artefacts are likely to be present in the residual soils. The site and artefact classes are common and well represented in the local and wider region. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
WB 105	Isolated	This site is an isolated stone artefact. The site and artefact class are common and well	Low	Low	Low	Low

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
	Artefact	represented in the project area and local region. The site meets the criteria for low significance.				
WB 107	Artefacts and Hearth	The site consists of a scatter of 115 stone artefacts and deflated hearth scatters. Artefact classes include silcrete, quartz, quartzite, rhyolite flakes, silcrete retouched flakes, silcrete and quartzite cores, grinding fragments, hammerstone and anvils. Artefact densities were low to moderate across the site and further artefacts may be present of similar densities within residuals soils within the pan and in adjacent residuals across the same landform. The site is located on a dune overlooking a relict lake and creek system and any intact subsurface deposits may provide valuable information regarding the land formation, availability of water and chronology of Aboriginal occupation in the local area.	Moderate	Low	Low	Moderate
WB 108	Isolated Artefact	The site consists of a single silcrete flake in a pan on a dune overlooking a relict lake system. The artefact class is common and well represented in the local and regional landscape. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
WB 109	Isolated Artefact	The site consists of a single silcrete flake in a pan on a dune overlooking a relict lake system. The artefact class is common and well represented in the local and regional landscape. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
WB 11	Isolated Artefact	This site consists of a single stone artefact located in a pan. It meets the criteria for low scientific significance due to its common and well represented site and artefact class.	Low	Low	Low	Low
WB 110	Isolated Artefact	The site consists of a single silcrete flake located on a bare patch of soil. The artefact class is common and well represented in the local and regional landscape. The site meets the criteria of low significance	Low	Low	Low	Low
WB 111	Isolated Artefact	The site consists of a single retouched silcrete flake located within a pan. The artefact class is not uncommon and is well represented in the local and regional landscape. The site meets the criteria for low scientific significance	Low	Low	Low	Low
WB 112	Isolated Artefact	The site consists of a single silcrete flake visible in a bare patch of soil. The artefact class is common and well represented in the local and regional landscape. The site meets the criteria for low scientific significance	Low	Low	Low	Low
WB 113	Artefacts	This site is a low density artefact scatter located in a scald within scalded plains. Further surface and subsurface artefacts are likely to be present in the residual soils, however the depth of the residual soils and the low density of artefact scatters in the surrounds indicate that the value of the unidentified material would have limited ability to inform our understanding of the past.	Low	Low	Low	Low

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
WB 114	Artefacts	This site is a low density artefact scatter located in a scald within scalded plains. Further surface and subsurface artefacts are likely to be present in the residual soils, however the depth of the residual soils and the low density of artefact scatters in the surrounds indicate that the value of the unidentified material would have limited ability to inform our understanding of the past.	Low	Low	Low	Low
WB 115	Isolated Artefact	This site is a single isolated artefact located in a scald within scalded plains. Further surface and subsurface artefacts are likely to be present in the residual soils, however the depth of the residual soils and the low density of artefact scatters in the surrounds indicate that the value of the unidentified material would have limited ability to inform our understanding of the past.	Low	Low	Low	Low
WB 117	Isolated Artefact	This site is a single isolated artefact located in a scald within scalded plains. Further surface and subsurface artefacts are likely to be present in the residual soils, however the depth of the residual soils and the low density of artefact scatters in the surrounds indicate that the value of the unidentified material would have limited ability to inform our understanding of the past.	Low	Low	Low	Low
WB 118	Isolated Artefact	This site is a single isolated artefact located in a scald within scalded plains. Further surface and subsurface artefacts are likely to be present in the residual soils, however the depth of the residual soils and the low density of artefact scatters in the surrounds indicate that the value of the unidentified material would have limited ability to inform our understanding of the past.	Low	Low	Low	Low
WB 12	Artefacts	This site is a low density artefact scatter located in a scald within scalded plains. Further surface and subsurface artefacts are likely to be present in the residual soils, however the depth of the residual soils and the low density of artefact scatters in the surrounds indicate that the value of the unidentified material would have limited ability to inform our understanding of the past.	Low	Low	Low	Low
WB 13	Isolated Artefact	This site consists of a single stone artefact located in a pan. It meets the criteria for low scientific significance due to its common and well represented site and artefact class.	Low	Low	Low	Low
WB 14	Isolated Artefact	This site is a low density artefact scatter located in a scald within scalded plains. Further surface and subsurface artefacts are likely to be present in the residual soils, however the depth of the residual soils and the low density of artefact scatters in the surrounds indicate that the value of the unidentified material would have limited ability to inform our understanding of the past.	Low	Low	Low	Low
WB 15	Isolated	This site consists of a single stone artefact located in a pan. It meets the criteria for low	Low	Low	Low	Low

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
	Artefact	scientific significance due to its common and well represented site and artefact class.				
WB 16	Artefacts	This site is a low density artefact scatter located in a scald within scalded plains. Further surface and subsurface artefacts are likely to be present in the residual soils, however the depth of the residual soils and the low density of artefact scatters in the surrounds indicate that the value of the unidentified material would have limited ability to inform our understanding of the past.	Low	Low	Low	Low
WB 17	Artefacts	This site is a low density artefact scatter located in a scald within scalded plains. Further surface and subsurface artefacts are likely to be present in the residual soils, however the depth of the residual soils and the low density of artefact scatters in the surrounds indicate that the value of the unidentified material would have limited ability to inform our understanding of the past.	Low	Low	Low	Low
WB 18	Isolated Artefact	This site consists of a single stone artefact located in a pan. It meets the criteria for low scientific significance due to its common and well represented site and artefact class.	Low	Low	Low	Low
WB 19	Artefacts and PAD	This site is a low density artefact scatter located in a scald within scalded plains. Further surface and subsurface artefacts are likely to be present in the residual soils, however the depth of the residual soils and the low density of artefact scatters in the surrounds indicate that the value of the unidentified material would have limited ability to inform our understanding of the past.	Low	Low	Low	Low
WB 2	Isolated Artefact	This site is a low density artefact scatter located in a scald within scalded plains. Further surface and subsurface artefacts are likely to be present in the residual soils, however the depth of the residual soils and the low density of artefact scatters in the surrounds indicate that the value of the unidentified material would have limited ability to inform our understanding of the past.	Low	Low	Low	Low
WB 20	Isolated Artefact	This site consists of a single stone artefact located in a pan. It meets the criteria for low scientific significance due to its common and well represented site and artefact class.	Low	Low	Low	Low
WB 21	Isolated Artefact	This site consists of a single stone artefact located in a pan. It meets the criteria for low scientific significance due to its common and well represented site and artefact class.	Low	Low	Low	Low
WB 22	Artefacts and PAD	This site is a low density artefact scatter located in a scald within scalded plains. Further surface and subsurface artefacts are likely to be present in the residual soils, however the depth of the residual soils and the low density of artefact scatters in the surrounds indicate that the value of the unidentified material would have limited ability to inform our understanding of the past.	Low	Low	Low	Low

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
WB 23	Artefacts and PAD	This site is a low density artefact scatter located in a scald within scalded plains. Further surface and subsurface artefacts are likely to be present in the residual soils, however the depth of the residual soils and the low density of artefact scatters in the surrounds indicate that the value of the unidentified material would have limited ability to inform our understanding of the past.	Low	Low	Low	Low
WB 24	Artefacts and PAD	This site is a low density artefact scatter located in a scald within scalded plains. Further surface and subsurface artefacts are likely to be present in the residual soils, however the depth of the residual soils and the low density of artefact scatters in the surrounds indicate that the value of the unidentified material would have limited ability to inform our understanding of the past.	Low	Low	Low	Low
WB 25	Isolated Artefact	This site consists of a single stone artefact located in a pan. It meets the criteria for low scientific significance due to its common and well represented site and artefact class.	Low	Low	Low	Low
WB 26	Isolated Artefact	This site is a low density artefact scatter located in a scald within scalded plains. Further surface and subsurface artefacts are likely to be present in the residual soils, however the depth of the residual soils and the low density of artefact scatters in the surrounds indicate that the value of the unidentified material would have limited ability to inform our understanding of the past.	Low	Low	Low	Low
WB 27	Artefacts, Hearth, and PAD	This site is a low to moderate density artefact scatter located in a pan within scalded plains. Further surface and subsurface artefacts are highly likely in residual soils surrounding the pan. The site is considered to have moderate scientific value due to the presence of hearth material which can be dated to provide a chronology of Aboriginal occupation in the region, the slightly elevated nature of the residual soils offering potentially deeper soil profiles and the potential for more intact archaeological deposits and an artefact assemblage over 100 artefacts.	Moderate	Low	Low	Moderate
WB 28	Artefacts and PAD	This site is a low to moderate density artefact scatter located on a pan adjacent a relict water source. Residual soils at the site offer potential archaeological deposits.	Moderate	Low	Low	Moderate
WB 29	Artefacts and Hearth	This site is a low density artefact scatter with partially exposed heat-affected clay and sediment in a slight depression with box trees and old man bush. The potential heat retainers would need investigating to determine if they were cultural or nature.	Moderate	Low	Low	Moderate
WB 3	Artefacts, Hearth and PAD	This site is a moderate density artefact scatter with a scattered heat retainers. Residual soils within and adjacent the site are likely to contain further surface and subsurface Aboriginal objects. The site and artefact classes are common and well represented in the project area and wider region and has limited ability to inform our understanding of the local past. The	Low	Low	Low	Low

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
		site meets the criteria for low scientific significance.				
WB 30	Isolated Artefact and Hearth	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
WB 31	Isolated Artefact	This site is an isolated stone artefact, a common and well represented site and artefact type in the local and regional area. There is little additional information this site can contribute to our understanding of the past beyond its current recording. The site meets the criteria for low scientific significance.	Low	Low	Low	Low
WB 32	Isolated Artefact, Hearth, and PAD	This site contains an intact hearth with good dating potential and has the capacity to help inform our understanding of the chronology of human occupation of this landscape. The site has been considered to have moderate scientific significance for this reason.	Moderate	Low	Low	Moderate
WB 33	Hearth and PAD	This site contains a dispersed potential hearth eroding near a residual and it is possible that further hearth material may be buried in nearby residual soils. The site is considered to have low scientific value due to the dispersed nature of the hearth.	Low	Low	Low	Low
WB 34	Hearth	This site contains dispersed potential hearth heat retainers. Due to the dispersed nature of the heat retainers, the site is unlikely to provide sufficient data to inform our understanding of the local past and is therefore considered to have low scientific value.	Low	Low	Low	Low
WB 35	Hearth and PAD	This site has been reassessed to be of low scientific significance due to the dispersed nature of the visible heat retainers. It is highly likely that further surface and subsurface Aboriginal objects are present in residual soils.	Low	Low	Low	Low
WB 36	Hearth	This site consists of a partially exposed, potential hearth of termite heat retainers with fair dating potential and has the capacity to help inform our understanding of the chronology of human occupation of this landscape. It is necessary to excavate the material to determine if the heat retainers relate to a cultural fire event or a natural fire event. The site has been considered to have low significance until such time as its status as a cultural fire event is confirmed.	Low	Low	Low	Low
WB 37	Artefacts and Hearth	This site is a low density artefact scatter with scattered heat retainers located in a scald within scalded plains. Further surface and subsurface artefacts are likely to be present in the residual soils, however the depth of the residual soils and the low density of artefact scatters in the surrounds indicate that the value of the unidentified material would have limited ability to inform our understanding of the past.	Low	Low	Low	Low

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
WB 38	Hearth and PAD	This site contains dispersed potential hearth heat retainers. Due to the dispersed nature of the heat retainers, the site is unlikely to provide sufficient data to inform our understanding of the local past and is therefore reassessed to have low scientific value.	Low	Low	Low	Low
WB 39	Artefacts	This site is a low density artefact scatter located in a scald within scalded plains. Further surface and subsurface artefacts are likely to be present in the residual soils, however the depth of the residual soils and the low density of artefact scatters in the surrounds indicate that the value of the unidentified material would have limited ability to inform our understanding of the past.	Low	Low	Low	Low
WB 4	Isolated Artefact	This site consists of a single stone artefact located in a pan. It meets the criteria for low scientific significance due to its common and well represented site and artefact class.	Low	Low	Low	Low
WB 40	Artefacts, Hearth, Culturally modified tree and PAD	WB 40 is a high density archaeological complex with a high volume and range of stone artefacts, hearths, a culturally modified tree and Potential Archaeological Deposit. The site is assessed to have a high scientific and research value due to the presence of datable hearths and archaeological deposits, its proximity to Muckee Lake and the potential for deposits of Holocene to Pleistocene age and its ability to provide a statistically useful sample and range of stone artefacts. The site has visual and aesthetic value and is likely to be interconnected with a number of other sites associated with Muckee Lake.	High	Moderate	Moderate	High
WB 41	Artefacts, Hearth and PAD	The site is considered to have moderate significance due to the low to moderate densities of the artefact assemblage at the site, the number of artefacts in the assemblage and the interrelationship of the landscape setting with WB 40.	Moderate	Low	Low	Moderate
WB 42	Artefacts, Hearth, and PAD	The site represents a continuous low density artefact scatter exposed in scalds and bare patches of soil and is considered to have moderate significance due to the presence of multiple intact hearths in good condition which can inform our understanding of the chronology of past Aboriginal occupation in the local region.	Moderate	Low	Low	Moderate
WB 43	Artefacts, Hearth and PAD	The site is considered to have moderate significance due to the low to moderate densities of the artefact assemblage at the site and the number of artefacts in the site. The surrounding landscape is highly likely to contain further surface and subsurface Aboriginal objects in residual soils.	Moderate	Low	Low	Moderate
WB 44	Artefacts, Hearth and PAD	This site is a low density artefact scatter in a large open deflated scald. There is limited information that it can provide beyond its current recording.	Low	Low	Low	Low
WB 45	Artefacts, Hearth and	This site has been reassessed to be of low scientific significance due to the density of the site, the dispersed nature of heat retainers reducing the potential for the site to be dated	Low	Low	Low	Low

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
	PAD	and to inform our understanding of the chronological occupation of the project area.				
WB 46	Artefacts, Hearth, and PAD	The site represents a continuous low density artefact scatter exposed in scalds and bare patches of soil and is considered to have moderate significance due to the presence of multiple intact hearths in good condition which can inform our understanding of the chronology of past Aboriginal occupation in the local region.	Moderate	Low	Low	Moderate
WB 47	Artefacts and PAD	This site is a low density artefact scatter located in a highly disturbed cleared and ploughed paddock which has altered the natural land system setting of the site. The disturbed nature of the site places the site in the low scientific significance category.	Low	Low	Low	Low
WB 48	Isolated Artefact	The site is an isolated stone artefact representing a visible portion of the low density, continuous and dispersed artefact scatter exposed within scalds and bare patches of soil in the scalded plains of the Rata system. It is common and well represented and many more can be expected in the project area and the wider region. The site is therefore considered to have low scientific value.	Low	Low	Low	Low
WB 49	Hearth	This site is a dispersed hearth scatter and no longer contains datable material. The site is therefore considered to have low scientific value.	Low	Low	Low	Low
WB 5	Artefacts	This site consists of a low density stone artefact located in a pan. It meets the criteria for low scientific significance due to its common and well represented site and artefact class.	Low	Low	Low	Low
WB 50	Hearth	This site is a dispersed hearth scatter and no longer contains datable material. The site is therefore considered to have low scientific value.	Low	Low	Low	Low
WB 51	Hearth, and PAD	This site contains an intact hearth with good dating potential and has the capacity to help inform our understanding of the chronology of human occupation of this landscape. The site has been considered to have moderate scientific significance.	Moderate	Low	Low	Moderate
WB 52	Hearth	This site is a dispersed hearth scatter and no longer contains datable material. The site is therefore considered to have low scientific value.	Low	Low	Low	Low
WB 53	Isolated Artefact	The site is an isolated stone artefact representing a visible portion of the low density, continuous and dispersed artefact scatter exposed within scalds and bare patches of soil in the scalded plains of the Rata system. It is common and well represented and many more can be expected in the project area and the wider region. The site is therefore considered to have low scientific value.	Low	Low	Low	Low
WB 54	Isolated Artefact	The site is an isolated stone artefact representing a visible portion of the low density, continuous and dispersed artefact scatter exposed within scalds pans associated with the dunes bordering Pitarpunga Lake. It is common and well represented and many more can	Low	Low	Low	Low

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
		be expected in the project area and the wider region. The site is therefore considered to have low scientific value.				
WB 55	Artefacts and PAD	The site is a low density artefact scatter representing a visible portion of the low density, continuous and dispersed artefact scatter exposed within pans and scalds and within scalded plains. It is common and well represented and many more can be expected in the project area and the wider region. The site is therefore considered to have low scientific value.	Low	Low	Low	Low
WB 56	Isolated Artefact	The site is an isolated stone artefact representing a visible portion of the low density, continuous and dispersed artefact scatter exposed within scalds and bare patches of soil in the scalded plains of the Rata system. It is common and well represented and many more can be expected in the project area and the wider region. The site is therefore considered to have low scientific value.	Low	Low	Low	Low
WB 57	Isolated Artefact	The site is an isolated stone artefact representing a visible portion of the low density, continuous and dispersed artefact scatter exposed within scalds and bare patches of soil in the scalded plains of the Rata system. It is common and well represented and many more can be expected in the project area and the wider region. The site is therefore considered to have low scientific value.	Low	Low	Low	Low
WB 58	Artefacts	The site is a low density artefact scatter representing a visible portion of the low density, continuous and dispersed artefact scatter exposed within scalds and bare patches of soil in the scalded plains of the Rata system. It is common and well represented and many more can be expected in the project area and the wider region. The site is therefore considered to have low scientific value.	Low	Low	Low	Low
WB 59	Isolated Artefact	The site is an isolated stone artefact representing a visible portion of the low density, continuous and dispersed artefact scatter exposed within scalds and bare patches of soil in the scalded plains of the Rata system. It is common and well represented and many more can be expected in the project area and the wider region. The site is therefore considered to have low scientific value.	Low	Low	Low	Low
WB 6	Isolated Artefact	The site is an isolated stone artefact representing a visible portion of the low density, continuous and dispersed artefact scatter exposed within a pan. It is common and well represented and many more can be expected in the project area and the wider region. The site is therefore considered to have low scientific value.	Low	Low	Low	Low
WB 60	Artefacts and PAD	The site is a low density artefact scatter representing a visible portion of the low density, continuous and dispersed artefact scatter exposed within scalds and bare patches of soil in	Low	Low	Low	Low

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
		the scalded plains of the Rata system. It is common and well represented and many more can be expected in the project area and the wider region. The site is therefore considered to have low scientific value.				
WB 61	Isolated Artefact	The site is an isolated stone artefact representing a visible portion of the low density, continuous and dispersed artefact scatter exposed within a pan. It is common and well represented and many more can be expected in the project area and the wider region. The site is therefore considered to have low scientific value.	Low	Low	Low	Low
WB 62	Artefacts	The site is a low density artefact scatter representing a visible portion of the low density, continuous and dispersed artefact scatter exposed within scalds and bare patches of soil in the scalded plains of the Rata system. It is common and well represented and many more can be expected in the project area and the wider region. The site is therefore considered to have low scientific value.	Low	Low	Low	Low
WB 63	Artefacts, Hearth, and PAD	This site is a low density artefact scatter with three hearths which contain fair to good dating potential. The site is considered to have moderate scientific significance due to its research value in having the potential to provide chronological information about past occupation of the landscape.	Moderate	Low	Low	Moderate
WB 64	Isolated Artefact and PAD	The site is an isolated stone artefact representing a visible portion of the low density, continuous and dispersed artefact scatter exposed within a pan. It is common and well represented and many more can be expected in the project area and the wider region. The site is therefore considered to have low scientific value.	Low	Low	Low	Low
WB 65	Artefacts, Hearth and PAD	This site is a moderate density artefact scatter with scattered heat retainers. It is likely to contain further surface and subsurface artefacts both within and beyond the surveyed portions of the site. It is considered to have moderate research value due to its proximity and shared landforms with WB 40.	Moderate	Low	Low	Moderate
WB 66	Artefacts, Hearth and PAD	This is a highly significant site due to the age of its archaeological deposits and its ability to provide information regarding early Holocene Aboriginal occupation of the landscape. The full extent of visible Aboriginal objects of this lunette is not yet determined.	High	High	High	High
WB 67	Artefacts and PAD	This site is a low to moderate density artefact scatter located on the eroding slopes on the western source bordering dune of Muckee Lake. It represents the visible portions of a continuous, moderate density artefact scatter associated with WB 40. Further surface and subsurface Aboriginal object are highly probably in residual soils and buried deposits.	Low	Low	Low	Low
WB 68	Artefacts and PAD	This site is a low to moderate density artefact scatter located on the eroding slopes on the western source bordering dune of Muckee Lake. It represents the visible portions of a	Low	Low	Low	Low

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
		continuous, moderate density artefact scatter associated with WB 40. Further surface and subsurface Aboriginal object are highly probably in residual soils and buried deposits.				
WB 69	Artefacts and PAD	This site is a low to moderate density artefact scatter located on the eroding slopes on the western source bordering dune of Muckee Lake. It represents the visible portions of a continuous, moderate density artefact scatter associated with WB 40. Further surface and subsurface Aboriginal object are highly probably in residual soils and buried deposits.	Low	Low	Low	Low
WB 7	Artefacts	This site consists of a two stone artefacts. The site type is common and well represented and many more can be expected in the project area and the wider region. There is limited information that can be gained from the site beyond the existing recording. The site is therefore considered to have low scientific value.	Low	Low	Low	Low
WB 70	Artefacts and PAD	This site is a low to moderate density artefact scatter located on the eroding slopes on the western source bordering dune of Muckee Lake. It represents the visible portions of a continuous, moderate density artefact scatter associated with WB 40. Further surface and subsurface Aboriginal object are highly probably in residual soils and buried deposits. It has been assessed as having moderate value due to its connection with WB 40	Moderate	Low	Low	Moderate
WB 71	Artefacts, Hearth and PAD	This site is a low to moderate density artefact scatter located on the eroding slopes on the western source bordering dune of Muckee Lake. It represents the visible portions of a continuous, moderate density artefact scatter associated with WB 40. Further surface and subsurface Aboriginal object are highly probably in residual soils and buried deposits. It has been assessed as having moderate value due to its connection with WB 40	Moderate	Low	Low	Moderate
WB 72	Artefacts	This site is a low to moderate density artefact scatter located on the eroding slopes on the western source bordering dune of Muckee Lake. It represents the visible portions of a continuous, moderate density artefact scatter associated with WB 40. Further surface and subsurface Aboriginal object are highly probably in residual soils and buried deposits. It has been assessed as having low scientific value due to past land use disturbance.	Low	Low	Low	Low
WB 73	Artefacts and PAD	This site is a low to moderate density artefact scatter located on the eroding slopes on the western source bordering dune of Muckee Lake. It represents the visible portions of a continuous, moderate density artefact scatter associated with WB 40. Further surface and subsurface Aboriginal object are highly probably in residual soils and buried deposits. It has been assessed as having low scientific value due to past land use disturbance.	Low	Low	Low	Low
WB 74	Artefacts and PAD	This site is a low to moderate density artefact scatter located on the eroding slopes on the western source bordering dune of Muckee Lake. It represents the visible portions of a continuous, moderate density artefact scatter associated with WB 40. Further surface and	Moderate	Low	Low	Moderate

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
		subsurface Aboriginal object are highly probably in residual soils and buried deposits. It has been assessed as having moderate value due to its connection with WB 40				
WB 75	Isolated Artefact	This site is a single stone artefact located on the eroding slopes on the western source bordering dune of Muckee Lake. It represents the visible portions of a continuous, moderate density artefact scatter associated with WB 40. Further surface and subsurface Aboriginal object are highly probably in residual soils and buried deposits. It has been assessed as having low scientific value due to past land use disturbance.	Low	Low	Low	Low
WB 76	Isolated Artefact	This site is a single stone artefact located on the eroding slopes on the western source bordering dune of Muckee Lake. It represents the visible portions of a continuous, moderate density artefact scatter associated with WB 40. Further surface and subsurface Aboriginal object are highly probably in residual soils and buried deposits. It has been assessed as having low scientific value due to past land use disturbance.	Low	Low	Low	Low
WB 77	Isolated Artefact	This site is a single stone artefact located on the eroding slopes on the western source bordering dune of Muckee Lake. It represents the visible portions of a continuous, moderate density artefact scatter associated with WB 40. Further surface and subsurface Aboriginal object are highly probably in residual soils and buried deposits. It has been assessed as having low scientific value due to past land use disturbance.	Low	Low	Low	Low
WB 78	Isolated Artefact	This site is a single stone artefact located on the eroding slopes on the western source bordering dune of Muckee Lake. It represents the visible portions of a continuous, moderate density artefact scatter associated with WB 40. Further surface and subsurface Aboriginal object are highly probably in residual soils and buried deposits. It has been assessed as having low scientific value due to past land use disturbance.	Low	Low	Low	Low
WB 79	Isolated Artefact	This site is an isolated stone artefact in the transition from alluvial plains to dunefields. It is assessed as having low scientific significance.	Low	Low	Low	Low
WB 8	Artefacts and Hearth	This site is a low density artefact scatter visible in scalds within a scalded plain. It is typical and well represented site and artefact classes and is assessed as having low scientific value.	Low	Low	Low	Low
WB 80	Isolated Artefact	This site is a single stone artefact located on the eroding slopes on the western source bordering dune of Muckee Lake. It represents the visible portions of a continuous, moderate density artefact scatter associated with WB 40. Further surface and subsurface Aboriginal object are highly probably in residual soils and buried deposits. It has been assessed as having low scientific value due to past land use disturbance.	Low	Low	Low	Low
WB 81	Isolated Artefact	This site is a single stone artefact located on the eroding slopes on the western source bordering dune of Muckee Lake. It represents the visible portions of a continuous,	Low	Low	Low	Low

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
		moderate density artefact scatter associated with WB 40. Further surface and subsurface Aboriginal object are highly probably in residual soils and buried deposits. It has been assessed as having low scientific value due to past land use disturbance.				
WB 82	Hearth	This site is a dispersed hearth scatter and no longer contains datable material. The site is therefore considered to have low scientific value.	Low	Low	Low	Low
WB 83	Isolated Artefact	The site is an isolated stone artefact representing a visible portion of the low density, continuous and dispersed artefact scatter exposed within scalds and bare patches of soil in the scalded plains of the Rata system. It is common and well represented and many more can be expected in the project area and the wider region. The site is therefore considered to have low scientific value.	Low	Low	Low	Low
WB 84	Isolated Artefact	The site is an isolated stone artefact representing a visible portion of the low density, continuous and dispersed artefact scatter exposed within scalds and bare patches of soil in the scalded plains of the Rata system. It is common and well represented and many more can be expected in the project area and the wider region. The site is therefore considered to have low scientific value.	Low	Low	Low	Low
WB 85	Artefacts	The site is a low density artefact scatter representing a visible portion of the low density, continuous and dispersed artefact scatter exposed within scalds and bare patches of soil in the scalded plains of the Rata system. It is common and well represented and many more can be expected in the project area and the wider region. The site is therefore considered to have low scientific value.	Low	Low	Low	Low
WB 86	Artefacts and Hearth	The site is a low density artefact scatter representing a visible portion of the low density, continuous and dispersed artefact scatter exposed within scalds and bare patches of soil in the scalded plains of the Rata system. It is common and well represented and many more can be expected in the project area and the wider region. The site is therefore considered to have low scientific value.	Low	Low	Low	Low
WB 87	Artefacts	The site is a low density artefact scatter representing a visible portion of the low density, continuous and dispersed artefact scatter exposed within scalds and bare patches of soil in the scalded plains of the Rata system. It is common and well represented and many more can be expected in the project area and the wider region. The site is therefore considered to have low scientific value.	Low	Low	Low	Low
WB 88	Hearth	This site is a dispersed hearth scatter and no longer contains datable material. The site is therefore considered to have low scientific value.	Low	Low	Low	Low
WB 89	Artefacts	The site is a low density artefact scatter representing a visible portion of the low density,	Low	Low	Low	Low

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
		continuous and dispersed artefact scatter exposed within scalds and bare patches of soil in the scalded plains of the Rata system. It is common and well represented and many more can be expected in the project area and the wider region. The site is therefore considered to have low scientific value.				
WB 9	Isolated Artefact and Hearth	This site is a stone artefact and dispersed hearth scatter. The site type is common and well represented in the project area and region and meets the criteria for low scientific significance.	Low	Low	Low	Low
WB 90	Isolated Artefact	The site is an isolated stone artefact representing a visible portion of the low density, continuous and dispersed artefact scatter exposed within scalds and bare patches of soil in the scalded plains of the Rata system. It is common and well represented and many more can be expected in the project area and the wider region. The site is therefore considered to have low scientific value.	Low	Low	Low	Low
WB 91	Hearth	This site is a dispersed hearth scatter and no longer contains datable material. The site is therefore considered to have low scientific value.	Low	Low	Low	Low
WB 92	Isolated Artefact	The site is an isolated stone artefact representing a visible portion of the low density, continuous and dispersed artefact scatter exposed within scalds and bare patches of soil in the scalded plains of the Rata system. It is common and well represented and many more can be expected in the project area and the wider region. The site is therefore considered to have low scientific value.	Low	Low	Low	Low
WB 93	Artefacts	The site is a low density artefact scatter representing a visible portion of the low density, continuous and dispersed artefact scatter exposed within scalds and bare patches of soil in the scalded plains of the Rata system. It is common and well represented and many more can be expected in the project area and the wider region. The site is therefore considered to have low scientific value.	Low	Low	Low	Low
WB 94	Isolated Artefact	The site is an isolated stone artefact representing a visible portion of the low density, continuous and dispersed artefact scatter exposed within scalds and bare patches of soil in the scalded plains of the Rata system. It is common and well represented and many more can be expected in the project area and the wider region. The site is therefore considered to have low scientific value.	Low	Low	Low	Low
WB 95	Artefacts	The site is a low density artefact scatter representing a visible portion of the low density, continuous and dispersed artefact scatter exposed within scalds and bare patches of soil in the scalded plains of the Rata system. It is common and well represented and many more can be expected in the project area and the wider region. The site is therefore considered	Low	Low	Low	Low

Site Name	Site Type	Significance Statement	Research Potential	Representativeness	Rarity	Significance Rating
		to have low scientific value.				
WB 96	Isolated Artefact	The site is an isolated stone artefact representing a visible portion of the low density, continuous and dispersed artefact scatter exposed within scalds and bare patches of soil in the scalded plains of the Rata system. It is common and well represented and many more can be expected in the project area and the wider region. The site is therefore considered to have low scientific value.	Low	Low	Low	Low
WB 97	Isolated Artefact	The site is an isolated stone artefact representing a visible portion of the low density, continuous and dispersed artefact scatter exposed within scalds and bare patches of soil in the scalded plains of the Rata system. It is common and well represented and many more can be expected in the project area and the wider region. The site is therefore considered to have low scientific value.	Low	Low	Low	Low
WB 98	Isolated Artefact	This site is an isolated stone artefact. The site and artefact class are common and well represented in the project area and local region. The site meets the criteria for low significance.	Low	Low	Low	Low
WB 99	Isolated Artefact, Hearth	This site is an isolated stone artefact and dispersed hearth scatter. The site and artefact class are common and well represented in the project area and local region. The site meets the criteria for low significance.	Low	Low	Low	Low

Table 27: Summary of Scientific Significance Ratings by project element

Disturbance Area	Site	Sites
West Balranald mine	70	
Low	56	Karra 1, WB 100, WB 101, WB 113, WB 114, WB 115, WB 117, WB 11, WB 2, WB 3, WB 30, WB 31, WB 33, WB 34, B 35, WB 36, WB 37, WB 38, WB 39, WB 4, WB 45, WB 48, WB 49, WB 50, WB 52, WB 53, WB 56, WB 67, WB 68, WB 69, WB 72, WB 73, WB 75, WB 76, WB 77, WB 78, WB 79, WB 80, WB 81, WB 82, WB 83, WB 84, WB 85, WB 86, WB 87, WB 88, WB 89, WB 90, WB 91, WB 92, WB 93, WB 94, WB 95, WB 96, WB 97, WB 99
Moderate	13	WB 1, WB 27, WB 29, WB 32, WB 41, WB 42, WB 46, WB 51, WB 63, WB 65, WB 70, WB 71, WB 74
High	1	WB 40
Injection borefield 3	50	
Low	45	UD 139 , UD 140, UD 143, UD 145, UD 141, UD 144, UD 43, UD 44, UD 47, UD 50, UD 52, UD 78, UD 142, UD 28, UD 29, UD 30, UD 31, UD 32, UD 33, UD 34, UD 35, UD 36, UD 37, UD 38, UD 39, UD 40, UD 41, UD 42, UD 45, UD 46 / UD 48 / UD 49, UD 53, UD 54, UD 60, UD 61, UD 63, UD 66, UD 67, UD 68, UD 69, UD 71, UD 72, UD 74, UD 76, UD 79, UD 80
Moderate	5	UD 62 / UD 64 / UD 65 / UD 70 / UD 75, UD 51, UD 55, UD 77, UD 73
Injection borefield 4	23	
Low	17	UD 96, UD 97, UD 99, , UD 105, UD 106, UD 107, UD 108, UD 109, UD 110, UD 111, UD 88, UD 90, UD 91, UD 94, UD 95, UD 98, UD 121
Moderate	6	UD 92 / UD 93 / UD 100 / UD 101 / UD 102, UD81 / UD82 / UD83 / UD84 / UD85 / UD86 / UD87, B 11, B 12, UD 103, UD 104
Injection borefield 5	88	
Low	72	B 18, B 23, B 25, B 69, B 70, B 78, B 79, B 80, B 81, B 82, B 88, Karra 31, Karra 40, B 20, B 21, B 52, B 53, B 54, B 55, B 74, B 98, BWR IF 2, Karra 37, B 72, B 51, B 24, B 29, B 46, B 47 / B 48, B 85, BWR 10, BWR 11, BWR 13, BWR 14, BWR 15, BWR 16, BWR 17, BWR 18, BWR 19, BWR 20, BWR 21, BWR 22, BWR 23, BWR 24, BWR 26, BWR 29, BWR 3, BWR 30, BWR 31, BWR 39, BWR 4, BWR 40, BWR 5, BWR 6, BWR 7, BWR 8, BWR 9, BWR 41, BWR 42, Karra 30, Karra 34, Karra 35, Karra 36, Karra 38, Karra 39, Karra 70, UD 131, UD 132, WB 108, WB 109, WB 110
Moderate	16	B 17 / B 19 / B 26 / B 27 / B 28, B 71, B 83, B 84, B 86, Karra 33, Karra 61 WB 107, BWR 28, BWR 32, BWR 33, BWR 34 / BWR 35WB 43, BWR 12, BWR 25, BWR 27,
Injection borefield 5 and Nepean access road	7	
Low	3	B 22, Karra 13, TT 16
Moderate	4	BWR 32, BWR 33, BWR 34, BWR 35
Injection borefield 6	23	
Low	19	UD 124, UD 125, UD 129, UD 137, B 77, UD 112, UD 113, UD 114, UD 115 / UD 119, UD 117, UD 118, UD 127, UD 133, UD 134, UD 135, UD 136, UD 126, UD 128, UD 138
Moderate	4	UD 120, UD 122, UD 123, UD 116
Injection borefield 7	22	
Low	18	B 38, B 39, B 50, B 97, B 45, B 49, B 73, B 75, B 31, B 32, B 34, B 35, B 36, B 37, B 40, B 41, B 42, B 76
Moderate	4	B 43, B 44, B 30, B 33
Injection borefield 8	59	
Low	52	B 57, B 63, B 64, B 65, B 66, B 67, B 68, B 87, B 89, B 90, B 91, B 92, B 93, B 94, W 10, W 11, W 12, W 3, W 4, W 5, W 6, W 7, W 8, W 9, B 56, B 58 / B 62, B 59, B 60, B 61, B 95, B 96, TO 1, TO 11, TO 13, TO 18, TO 19, TO 21, TO 22 / 23, TO 24, TO 25, TO 26, TO 27, TO 28, TO 29, TO 30 / TO 31, TO 46, TO 47, TO 48, TO 49, TT 24, BWR 38, W 1
Moderate	7	W 2, TO 12, TO 14, TO 15, TO 17, TO 2 / TO 20, TO 16
Injection borefield 9	31	
Low	30	TO 32, TO 33, TO 34, TO 35, TO 36, TO 37, TO 38, TO 39, TO 40, TO 41, TO 42, TO 43, TO 44, TO 45, UD 130, TT 25, TT 26, TT 27, TT 28, TT 29, TT 30, TT 31, TT 32, TT 33, TT 35, TT 37, TT 38 / TT 39, TT 9, TT 36,
Moderate	1	TT 34
Injection borefield 10	7	

Disturbance Area	Site	Sites
Low	7	TT 10, TT 12, TT 13, TT 14, TT 15, TT 11
Injection Borefield 8 and Nepean access road	1	
Moderate	1	BWR 37
Nepean access road	1	
Low	1	BWR IF 1
Gravel Extraction Area C	1	
Low	1	WB 105
Total	383	

Table 28. Summary of site significance per project element.

Significance Rating and Project Element	Site Count	Percentage of Sites
High	1	0.26%
West Balranald mine	1	0.26%
Moderate	61	15.93%
Injection Borefield 3	5	1.31%
Injection Borefield 4	6	1.57%
Injection Borefield 5	16	4.18%
Injection borefield 5 and Nepean access road	4	1.04%
Injection borefield 6	4	1.04%
Injection borefield 7	4	1.04%
Injection borefield 8	7	1.83%
Injection Borefield 9	1	0.26%
Injection Borefield 8 and Nepean access road	1	0.26%
West Balranald mine	13	3.39%
Low	321	83.81%
Injection Borefield 3	45	11.75%
Injection Borefield 4	17	4.44%
Injection Borefield 5	72	18.80%
Injection borefield 5 and Nepean access road	3	0.78%
Injection borefield 6	19	4.96%
Injection borefield 7	18	4.70%
Injection borefield 8	52	13.58%
Injection Borefield 9	30	7.83%
Injection borefield 10	7	1.83%
Gravel Extraction Area C	1	0.26%
Nepean access road	1	0.26%
West Balranald mine	56	14.62%
Total	383	100.00%

12.3 Cultural Significance Assessment of Aboriginal Heritage Sites

The *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (OEH 2011: 18) requires that a “clear description of the heritage values present across the area of the proposed activity” be presented, and be articulated back to the information collected during the assessment process, in particular to any submissions received from RAPs. The *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (OEH 2011: 18) also advises that “the assessment of values is a discussion of what is significant and why”. The purpose of the statement of significance is to create a comprehensive assessment of values and significance by considering and stating the values identified under each of the value categories defined by the *Burra Charter*, namely, social values, historic values, scientific values, and aesthetic values. The *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (OEH 2011:10) states:

“The assessment and justification in the statement of significance must discuss whether any value meets the following criteria (NSW Heritage Office 2001):

- *does the project area have a strong or special association with a particular community or cultural group for social, cultural or spiritual reasons? – social value*
- *is the project area important to the cultural or natural history of the local area and/or region and/or state? – historic value*
- *does the project area have potential to yield information that will contribute to an understanding of the cultural or natural history of the local area and/or region and/or state? – scientific (archaeological) value*
- *is the project area important in demonstrating aesthetic characteristics in the local area and/or region and/or state? – aesthetic value.*

Assessment of each of the criteria (above) should be graded in terms that allow the significance to be described and compared; for example, as high, moderate or low. In applying these criteria, consideration should also be given to:

- **Research potential:** *does the evidence suggest any potential to contribute to an understanding of the area and/or region and/or state’s natural and cultural history?*
- **Representativeness:** *how much variability (outside and/or inside the subject area) exists, what is already conserved, how much connectivity is there?*
- **Rarity:** *is the subject area important in demonstrating a distinctive way of life, custom, process, land-use, function or design no longer practised? Is it in danger of being lost or of exceptional interest?*
- **Education potential:** *does the subject area contain teaching sites or sites that might have teaching potential?”*

12.4 Statements of Significance

12.4.1 Social Value

The Project area has social significance to the Aboriginal community because it contains archaeological sites and traditional resources that establish a link between the past and present Aboriginal use of the land.

12.4.2 Aesthetic Value

The project area has low aesthetic value. The project area generally consists of undifferentiated plains and dunes of chenopod shrub and Mallee lands respectively. In many areas natural landscapes have been highly modified by over stocking and land clearing for pastoralism and broad acre grain crops.

12.4.3 Historic Value

The Project area has no identified historic values.

12.4.4 Scientific (Archaeological) Value

The project area contains landscapes which have high and moderate archaeological value, but for the most part contains landscapes that are of low archaeological value. The high and moderate value areas include the Box Creek distributary stream of the Lachlan River (at the northern end of the West Balranald mine) and areas of relict lake fringes and depressions associated with the northern injection borefields. These parts of the project area are significant because they may reveal important details about how and when Aboriginal people lived in this area, and how Aboriginal settlement of the area relates to, and informs what is known of Aboriginal history in adjoining areas, including the Willandra Lakes Region World Heritage Area. In particular the areas of high and moderate significance within the project area may provide a story of how people have utilised the area, and how this utilisation relates to the active and inactive phases of Box Creek's history and the episodic filling history of the lakes as the availability of water changed from the terminal Pleistocene to the present. As well as providing information about the chronology and nature of Aboriginal settlement of the region, the project area may also provide additional information on the local and regional use and distribution of resources, such as raw materials for making stone tools.

13. Impact Assessment

13.1 Overview of Potential Impacts

The *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (OEH 2011) requires that both direct and indirect harm to Aboriginal objects and Aboriginal places be considered. Generally, direct harm refers to occasions where an activity physically impacts a site or objects and therefore affects the heritage values of the site or objects. Indirect harm is usually taken to mean harm stemming from secondary consequences of the activity, and may affect sites or objects as an indirect consequence of the activity. Examples of such indirect harm are increased visitors to a site, or increased erosion in an area as a result of an activity.

This impact assessment distinguishes between the project area and a disturbance area. For the purposes of this assessment it is assumed that the development of surface infrastructure for the Balranald Project would be wholly within the disturbance area and would be of a nature that would cause direct harm to any Aboriginal objects or areas of cultural value. Those sites that will be directly impacted are located within the disturbance area. Those sites that have the potential to be indirectly impacted are located within the project area but outside of the disturbance area.

As described in Section 10.3, a total of 417 Aboriginal sites were identified within 100 m of the project area. Of these sites, 383 are situated within 10 m the project area and have the potential to be directly or indirectly impacted by the Balranald Project. 256 Aboriginal sites are located within the disturbance area. This section details potential impacts from the Balranald Project (Section 13.2) and provides an impact assessment of the Aboriginal heritage sites located within the project and disturbance areas (Section 13.3). Section 13.4 considers potential cumulative impacts on Aboriginal heritage sites and Section 13.5 considers potential impacts of the project on the WLRWHA.

13.2 Potential Impacts from Proposed Activities

A detailed description of components of the Balranald Project is provided in Section 4 of this report. Disturbance and potential impacts associated with the project will be restricted to the project area, however not all areas within the project area would be subject to disturbance. For the purposes of this Assessment it is therefore assumed that the development of surface infrastructure for the Balranald Project would be wholly within the disturbance area and would be of a nature that would cause direct harm to any Aboriginal objects or areas of cultural value. Table 29 provides an overview of potential impacts for each of the project components.

Direct Harm

The direct harm associated with surface disturbance activities is anticipated to cause either a total or partial loss of heritage value at affected sites, and would have a cumulative or landscape impact of partial loss of values for the area as a whole. The activities within the project area that may cause harm to Aboriginal objects or areas of cultural value would include:

- Disturbance of the ground surface or soil units (e.g. vegetation clearance and topsoil stripping, soil removal and excavations) in areas with Aboriginal objects on the surface or within the soil profile.
- Changes to a site or place's context that has secondary impacts to the site or place, resulting in the loss of cultural values.

As previously discussed, direct harm will only occur within the disturbance area.

Indirect Harm

Potential indirect harm that the proposed activities include but are not limited to:

- Increased visitor traffic;
- Erosion;
- Changes to the groundwater levels which may affect the longevity of specific Aboriginal site types that are groundwater dependent (eg. Culturally modified trees).

The project environment is highly susceptible to erosion and there is a reasonable risk that without management and mitigation measures that the proposed works could change surface run off and water flow and increase the risk of exposure of buried or unidentified surface Aboriginal objects in and adjacent to the disturbance area.

Increased erosion risks are specifically related to the following:

- Site clearing and earthworks
- Changes to site drainage and surface water flows.

Common tree species culturally modified by Aboriginal people in the past include box trees and cypress pines. In some areas, these species fall within the category of groundwater dependent ecosystems. Outside the major river floodplains, groundwater dependent species may be susceptible to changes in the groundwater conditions, as well as to non-project related influences such as drought, grazing, clearing, irrigation and upstream water regime changes. These changes have the ability to impact on the health and survival of culturally modified trees.

Table 29: Overview of potential impacts by project element.

Project element	Project area (ha)	Disturbance area (ha)	Potential Impacts
West Balranald mine	3,059	3,059	<ul style="list-style-type: none"> ▪ Ground disturbance and earthworks ▪ Changes to groundwater ▪ Changes to surface water flow ▪ Increased erosion ▪ Increased traffic ▪ Visual changes to landscape
Nepean mine	805	805	
West Balranald access road	128	52	
Nepean access road	173	156	
Injection borefields	5,721	1,214	
Gravel extraction	42	42	
Water supply pipeline	29	11	
Accommodation facility	7	7	

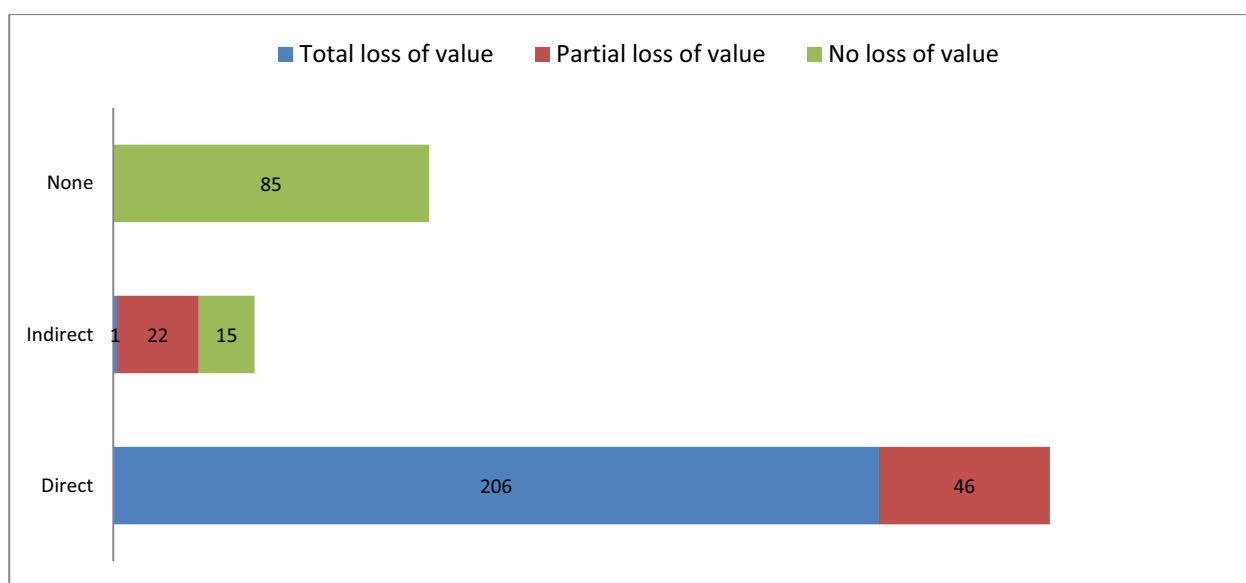
13.3 Potential Impacts to Sites and Areas of Archaeological Risk within the Disturbance Area

This section of the report summarises potential impacts to areas of archaeological risk within the disturbance area and to known Aboriginal sites. A summary of the number of Aboriginal sites in the Project area by project element is presented in Table 13. As required by the *Code of Practice for the Archaeological Investigation of Aboriginal Objects in NSW* (DECCW 2010b), the likely impacts, type and degree of harm to

Aboriginal heritage sites and archaeological risk as a result of the Project is presented in Chart 3, Table 30, Table 31, Table 32, Table 33, Table 34 and Table 35.

For the purposes of this impact assessment, where a portion of a site falls within the disturbance area, that portion of the site is considered to be directly impacted while the remaining portion of the site is considered to be indirectly impacted. Any direct impact to a site is considered to result in a loss of value. Any site that is directly impacted will therefore be considered to have resulted in, at minimum, a partial loss of value. Where helpful to the impact assessment, a calculation of the percentage of the visible surface area of the site that will be directly impacted has been presented. Where 50% or less of a site will be directly impacted by the Project, the loss of value to the site is considered partial. Where more than 50% of a site will be directly impacted, the loss of value is considered to be total.

Chart 4. Summary of Type of Harm and Consequence of harm to known aboriginal sites in project area



The project will cause the loss of heritage values to sites of high, moderate and low archaeological significance. Table 30 summarises the expected loss of value (total, partial or none – as required by the *Code of practice for the archaeological investigation of Aboriginal objects in NSW*) for sites in the project area based on their archaeological significance.

One site of high archaeological significance (WB 40) will suffer a partial loss of value from the proposed activities associated with the project. Sites of low archaeological significance will suffer the greatest relative total loss of values, while sites of moderate significance will suffer proportionally higher partial loss of value than the sites of low significance. This is because the sites of low significance are generally smaller in area than the sites of moderate significance, and because efforts have been made to avoid the sites of moderate and high significance as far as possible, hence resulting in partial, rather than total, loss of value.

Table 30. Summary of archaeological significance and corresponding loss of value through impact across the project area

Archaeological Significance	Total loss of value	Partial loss of value	No loss of value	Total number of sites
High	0	1	0	1
Moderate	18	32	7	57
Low	188	35	93	316
Total	206	68	100	374

13.3.1 Aboriginal Heritage Risk Layer

The project has the potential to directly impact 957.4 ha of land that falls within the high archaeological risk and 921.1 ha of land that falls within the moderate archaeological risk. This equates to just over 34.4% of the total disturbance area. A breakdown of the archaeological risk layer areas that correspond to the disturbance areas for each project element is presented in Table 31. As noted above, for the purposes of this ACHA it is assumed that the development of the Project would be wholly within the defined disturbance area and would be of a nature that would cause direct harm to any Aboriginal objects or areas of cultural value

Owing to the archaeological character of the moderate to high risk layers, any project activity in this area has the potential to impact on Aboriginal objects and management and mitigation measures will be required.

Table 31: Summary of Project Element Area and Percentage of Area within each Risk Layer and disturbance area

Project Element	High		Moderate		Low		Total Area (ha)
	Area (ha)	% of Project Element	Area (ha)	% of Project Element	Area (ha)	% of Project Element	
Accommodation facility	0.0	0.0%	0.0	0.0%	7.1	100.0%	7.1
Gravel extraction area A	0.0	0.0%	0.0	0.0%	24.9	100.0%	24.9
Gravel extraction area B	0.0	0.0%	4.5	53.1%	4.0	46.9%	8.5
Gravel extraction area C	<0.1	0.2%	<0.1	0.2%	8.4	99.6%	8.5
Injection borefield	297.9	24.5%	290.9	24.0%	625.6	51.5%	1214.4
injection borefield 1	0.0	0.0%	6.2	7.9%	72.2	92.1%	78.4
Injection borefield 3	60.6	39.7%	24.1	15.8%	67.9	44.5%	152.5
Injection borefield 4	5.9	3.8%	40.7	26.5%	107.1	69.7%	153.7
Injection borefield 5	102.4	37.5%	76.7	28.1%	93.8	34.4%	273.0
Injection borefield 6	7.9	5.3%	52.2	35.0%	89.2	59.8%	149.2
Injection borefield 7	11.3	7.6%	50.7	34.1%	86.9	58.4%	149.0
Injection borefield 8	94.4	100.0%	0.0	0.0%	0.0	0.0%	94.4
Injection borefield 9	15.5	17.3%	40.1	44.9%	33.8	37.8%	89.3
Injection borefield 10	0.0	0.0%	0.3	0.4%	74.7	99.6%	75.0
Nepean access road*	24.6	14.2%	27.4	15.8%	121.1	70.0%	173.1

Nepean mine	0.0	0.0%	0.0	0.0%	805.1	100.0%	805.1
Water supply corridor*	0.0	0.0%	0.0	0.0%	29.4	100.0%	29.4
West Balranald access road*	0.0	0.0%	0.1	0.1%	128.1	99.9%	128.2
West Balranald mine	634.9	20.8%	598.1	19.6%	1825.8	59.7%	3058.8
Grand Total	957.4	17.5%	921.1	16.9%	3579.5	65.6%	5458.0

*The disturbance area is less for these project elements but owing to how the data was collected and processed, this distinction has not been made for this table.

13.3.2 West Balranald and Nepean mines

Seventy Aboriginal sites are situated within the West Balranald Mine and have the potential to be impacted by the Project.

One high significance site (WB 40) will be directly impacted by the Project. Only a small portion – approximately 1 ha (2%)—of the surface area of the recorded site will be directly impacted.

A little over 40% of land within the West Balranald mine footprint falls within the moderate to high archaeological risk layer. The consequence of this is that any consideration given to avoiding known sites must take into account the likelihood that this will result in impact to areas or Aboriginal objects of equal or greater value beyond the surveyed boundaries of a known site. Table 32 summarises the type of impact and nature of harm and provides an impact assessment for each site.

All of the land contained with the Nepean mine is categorised as having low archaeological risk. No known Aboriginal sites have been identified in the Nepean mine. Aboriginal sites may occur in this area but they will most likely be infrequent, small, fall within the low significance category and represent occasional discard rather than frequent or long term occupation of the area.

Table 32: Summary of Potential Impacts within the West Balranald Mine Project Element on Aboriginal Heritage Sites

Site Name	Site Type	Significance Rating	Type of Harm (Direct/ Indirect/ None)	Degree of Harm (Total/ Partial/ None)	Consequences of Harm (Total Loss of Value/Partial Loss of Value/No Loss of Value)	Impact Assessment
WB 1	Artefacts and Hearth	Moderate	Direct	Partial	Partial loss of value	Approximately 13% of WB 1 will be directly impacted by the Project. The remainder of the site may be indirectly impacted through changes to the visual setting and character of the site and at risk of erosion uncovering further artefacts present in residual soils.
WB 27	Artefacts and Hearth	Moderate	Direct	Partial	Partial loss of value	Approximately 35% of WB 27 falls within the mine disturbance area and will be directly impacted by the Project. Aboriginal objects are likely to be present beyond the surveyed boundaries of the site. The portion of the site beyond the disturbance area may be indirectly impacted by changes to the visual setting of the site and changes to surface water flows and erosion rates without appropriate management and mitigation measures.
WB 4	Isolated Artefact	Low	Indirect	Partial	Partial loss of value	This site is located 20 m from the West Balranald mine and may be indirectly impacted by the Project through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.
WB 40	Artefacts and Hearth, Culturally modified tree and PAD	High	Direct	Partial	Partial loss of value	Approximately 1.5% of the visible extent of WB 40 falls within the disturbance area for the West Balranald mine and will be directly impacted. The culturally modified tree will not be directly impacted. This landform is highly likely to contain further surface and subsurface artefacts that may not have been identified. The portion of the site that falls outside the disturbance boundary may also be indirectly impacted by changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.
WB 41	Artefacts and Hearth	Moderate	Direct	Partial	Partial loss of value	Approximately 1% of the visible extent of WB 41 will be directly impacted by the Project. It is highly likely that further surface and subsurface Aboriginal objects are present beyond the surveyed area of the site. The Project will result in partial loss of value to the site. The portion of the site that falls outside the disturbance boundary may be indirectly impacted by changes to the visual setting of the site and changes to surface water flows and erosion rates without appropriate management and mitigation measures.
WB 42	Artefacts and Hearth	Moderate	Direct	Partial	Partial loss of value	Approximately 35% of WB 41 will be directly impacted by the Project, including a number of moderate value hearths, resulting in a total loss of value to this proportion of the site. The portion of the site that falls outside the disturbance boundary may be indirectly impacted by changes to the visual setting of the site and changes to surface water flows and erosion rates without appropriate management and mitigation measures.

Site Name	Site Type	Significance Rating	Type of Harm (Direct/ Indirect/ None)	Degree of Harm (Total/ Partial/ None)	Consequences of Harm (Total Loss of Value/Partial Loss of Value/No Loss of Value)	Impact Assessment
WB 45	Artefacts and Hearth	Low	Direct	Partial	Partial loss of value	Approximately 13% of WB 45 falls within the mine disturbance area and will be directly impacted by the Project with a total loss of value. The portion of the site that falls outside the disturbance boundary may be indirectly impacted by changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented. This site is likely to represent an exposed portion of a continuous dispersed artefact scatter within the top 20 cm of deposit and likely extends beyond the visible boundary of the site.
WB 63	Artefacts and Hearth,	Moderate	Direct	Partial	Partial loss of value	Approximately 56% of this site is located within the mine disturbance area and would be directly impacted by the Project, resulting in the total loss of value to this portion of the site. The remaining proportion of the site may be indirectly impacted by the Project through, changes to the visual setting of the site and changes to surface water flows and erosion rates without appropriate management and mitigation measures.
Karra 1	Isolated Artefact	Low	Direct	Total	Total loss of value	These sites are located wholly within the mine disturbance area and will be directly impacted by the Project with a total loss of value.,
WB 100	Isolated Artefact	Low	Direct	Total	Total loss of value	
WB 101	Isolated Artefact	Low	Direct	Total	Total loss of value	
WB 113	Artefacts	Low	Direct	Total	Total loss of value	
WB 114	Artefacts	Low	Direct	Total	Total loss of value	
WB 115	Isolated Artefact	Low	Direct	Total	Total loss of value	
WB 117	Isolated Artefact	Low	Direct	Total	Total loss of value	
WB 118	Isolated Artefact	Low	Direct	Total	Total loss of value	
WB 2	Isolated Artefact	Low	Direct	Total	Total loss of value	
WB 29	Artefacts and Hearth	Moderate	Direct	Total	Total loss of value	
WB 3	Artefacts and Hearth	Low	Direct	Total	Total loss of value	These sites are located wholly within the mine disturbance area and will be directly impacted by the Project with a total loss of value.,
WB 30	Isolated Artefact and Hearth	Low	Direct	Total	Total loss of value	
WB 31	Isolated Artefact	Low	Direct	Total	Total loss of value	

Site Name	Site Type	Significance Rating	Type of Harm (Direct/ Indirect/ None)	Degree of Harm (Total/ Partial/ None)	Consequences of Harm (Total Loss of Value/Partial Loss of Value/No Loss of Value)	Impact Assessment
WB 32	Isolated Artefact, Hearth	Moderate	Direct	Total	Total loss of value	This site is located wholly within the mine disturbance area and will be directly impacted with a total loss of value. The site has moderate value due to the presence of a hearth but has limited conservation value due to the short lifespan of the site feature due to its susceptibility to erosion. There is limited value in avoiding impact to this site.
WB 33	Hearth	Low	Direct	Total	Total loss of value	This site is located within 5 m of the West Balranald Mine and therefore been assessed as being within the disturbance area. The site may be directly or indirectly impacted by the Project through the construction of the mine and may be indirectly impacted by the Project through, changes to the visual setting of the site and changes to surface water flows and erosion rates without appropriate management and mitigation measures.
WB 34	Hearth	Low	Direct	Total	Total loss of value	
WB 35	Hearth	Low	Direct	Total	Total loss of value	
WB 36	Hearth	Low	Direct	Total	Total loss of value	
WB 37	Artefacts and Hearth	Low	Direct	Total	Total loss of value	
WB 38	Hearth	Low	Direct	Total	Total loss of value	
WB 39	Artefacts	Low	Direct	Total	Total loss of value	
WB 46	Artefacts and Hearth	Moderate	Direct	Total	Total loss of value	This site is located wholly within the mine disturbance area and will be directly impacted with a total loss of value.
WB 48	Isolated Artefact	Low	Direct	Total	Total loss of value	These sites are located wholly within the mine disturbance area and will be directly impacted by the Project with a total loss of value.
WB 49	Hearth	Low	Direct	Total	Total loss of value	
WB 50	Hearth	Low	Direct	Total	Total loss of value	
WB 51	Hearth	Moderate	Direct	Total	Total loss of value	This site is located wholly within the mine disturbance area and will be directly impacted with a total loss of value.
WB 52	Hearth	Low	Direct	Total	Total loss of value	These sites are located wholly within the mine disturbance area and will be directly impacted by the Project with a total loss of value.
WB 53	Isolated Artefact	Low	Direct	Total	Total loss of value	
WB 56	Isolated Artefact	Low	Direct	Total	Total loss of value	
WB 65	Artefacts and Hearth	Moderate	Direct	Total	Total loss of value	This site is located wholly within the mine disturbance area and will be directly impacted with a total loss of value.

Site Name	Site Type	Significance Rating	Type of Harm (Direct/ Indirect/ None)	Degree of Harm (Total/ Partial/ None)	Consequences of Harm (Total Loss of Value/Partial Loss of Value/No Loss of Value)	Impact Assessment
WB 67	Artefacts	Low	Direct	Total	Total loss of value	These sites are located wholly within the mine disturbance area and will be directly impacted by the Project with a total loss of value.
WB 68	Artefacts	Low	Direct	Total	Total loss of value	
WB 69	Artefacts	Low	Direct	Total	Total loss of value	
WB 70	Artefacts	Moderate	Direct	Total	Total loss of value	This site is located wholly within the mine disturbance area and will be directly impacted with a total loss of value.
WB 71	Artefacts and Hearth	Moderate	Direct	Total	Total loss of value	This site is located wholly within the mine disturbance area and will be directly impacted with a total loss of value.
WB 72	Artefacts	Low	Direct	Total	Total loss of value	These sites are located wholly within the mine disturbance area and will be directly impacted by the Project with a total loss of value.
WB 73	Artefacts	Low	Direct	Total	Total loss of value	
WB 74	Artefacts	Moderate	Direct	Total	Total loss of value	This site is located wholly within the mine disturbance area and will be directly impacted with a total loss of value.
WB 75	Isolated Artefact	Low	Direct	Total	Total loss of value	These sites are located wholly within the mine disturbance area and will be directly impacted by the Project with a total loss of value.
WB 76	Isolated Artefact	Low	Direct	Total	Total loss of value	
WB 77	Isolated Artefact	Low	Direct	Total	Total loss of value	
WB 78	Isolated Artefact	Low	Direct	Total	Total loss of value	
WB 79	Isolated Artefact	Low	Direct	Total	Total loss of value	
WB 80	Isolated Artefact	Low	Direct	Total	Total loss of value	
WB 81	Isolated Artefact	Low	Direct	Total	Total loss of value	
WB 82	Hearth	Low	Direct	Total	Total loss of value	
WB 83	Isolated Artefact	Low	Direct	Total	Total loss of value	
WB 84	Isolated Artefact	Low	Direct	Total	Total loss of value	
WB 85	Artefacts	Low	Direct	Total	Total loss of value	
WB 86	Artefacts and Hearth	Low	Direct	Total	Total loss of value	
WB 87	Artefacts	Low	Direct	Total	Total loss of value	

Site Name	Site Type	Significance Rating	Type of Harm (Direct/ Indirect/ None)	Degree of Harm (Total/ Partial/ None)	Consequences of Harm (Total Loss of Value/Partial Loss of Value/No Loss of Value)	Impact Assessment
WB 88	Hearth	Low	Direct	Total	Total loss of value	These sites are located wholly within the mine disturbance area and will be directly impacted by the Project with a total loss of value.
WB 89	Artefacts	Low	Direct	Total	Total loss of value	
WB 90	Isolated Artefact	Low	Direct	Total	Total loss of value	
WB 91	Hearth	Low	Direct	Total	Total loss of value	
WB 92	Isolated Artefact	Low	Direct	Total	Total loss of value	
WB 93	Artefacts	Low	Direct	Total	Total loss of value	
WB 94	Isolated Artefact	Low	Direct	Total	Total loss of value	
WB 95	Artefacts	Low	Direct	Total	Total loss of value	
WB 96	Isolated Artefact	Low	Direct	Total	Total loss of value	
WB 97	Isolated Artefact	Low	Direct	Total	Total loss of value	
WB 99	Isolated Artefact, Hearth	Low	Direct	Total	Total loss of value	

13.3.3 Injection borefields

There are 303 Aboriginal sites within the injection borefields. The proposed activities within the injection borefields have the potential to impact 182 Aboriginal sites directly and 36 sites indirectly (Table 33). Approximately 85 Aboriginal sites will not be impacted by the Project, provided management and mitigation measures are implemented. Forty-four of the 303 Aboriginal sites within the injection borefields fall within the moderate significance category.

There is the potential for optimisation of the injection borefields through the placement of pipelines, access tracks, turkeys nests, pumps etc. Any optimisation should consider that approximately 48% of the land within the injection borefields falls within the moderate to high archaeological risk layer (Table 32). The consequence of this is that any consideration given to avoiding known sites must take into account the likelihood that this will result in impact to areas of equal or greater value beyond the surveyed boundaries of a known site.

Table 33: Summary of Type of Harm by Significance Ratings for Sites within the Injection Borefields

Significance Rating	Number of sites per type of harm			Total number of sites
	Direct	Indirect	None	
Low	149	32	78	259
Moderate	33	4	7	44
Total	182	36	85	303

Table 34: Summary of potential impacts within the injection borefield on Aboriginal heritage sites

Site Name	Site Type	Significance Rating	Injecti on borefie Id	Type of Harm (Direct/ Indirect/ None)	Degree of Harm (Total/ Partial/ None)	Consequences of Harm (Total Loss of Value/ Partial Loss of Value/ No Loss of Value)	Impact Assessment
UD 139	Artefacts	Low	3	Direct	Total	Total loss of value	These sites are located almost entirely within the disturbance area and will be directly impacted by the Project resulting in total loss of value.
UD 140	Artefacts	Low	3	Direct	Total	Total loss of value	
UD 143	Isolated Artefact	Low	3	Direct	Total	Total loss of value	UD 143 is located entirely within the disturbance area and will be directly impacted by the Project.
UD 145	Artefacts	Low	3	Direct	Total	Total loss of value	UD 145 is located almost wholly within the disturbance area and will be directly impacted by the Project.
UD 62 / UD 64 / UD 65 / UD 70 / UD 75	Artefacts and Hearth	Moderate	3	Direct	Partial	Partial loss of value	UD 62 / UD 64 / UD 65 / UD 70 / UD 75 is located within and beyond the disturbance area. The Project will directly impact to 20% of the recorded extent of the site and indirectly impact the remainder resulting in a partial loss of value. . The survey was limited to injection borefield 3 and as a result, the exact extent of the site is unknown - but is highly likely to extend beyond the surveyed area and include potential archaeological deposits. The Project will indirectly impact the remaining portions of the site through changes to the visual setting of the site and changes to surface water flows and erosion rates without appropriate management and mitigation measures.
UD 51	Artefacts	Moderate	3	Direct	Partial	Partial loss of value	UD 51 is located within and beyond the disturbance area. The extent of the site was not identified during the survey but is likely to extend beyond the surveyed area across the same lunette crest and slope landforms. The Project will directly impact UD 51 and the surrounding areas of resulting in the loss of 25% of the known extent of UD 51. The Project will indirectly impact the site through changes to the visual setting of the site and changes to surface water flows and erosion rates without appropriate management and mitigation measures.
UD 52	Artefacts	Low	3	Direct	Partial	Partial loss of value	UD 52 is located within and beyond the disturbance area. This site is likely an exposed portion of a continuous artefact scatter (constituted of UD 51, 52, 53, 54 and 55) and is likely to extend beyond the surveyed area across the same lunette crest and slope landforms. The Project will directly impact UD 52 and the surrounding areas of high risk and result in the loss of 50% of the known extent of UD 52. The Project will indirectly impact the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.

Site Name	Site Type	Significance Rating	Injecti on borefie Id	Type of Harm (Direct/ Indirect/ None)	Degree of Harm (Total/ Partial/ None)	Consequences of Harm (Total Loss of Value/ Partial Loss of Value/ No Loss of Value)	Impact Assessment
UD 73	Artefacts and Hearth	Moderate	3	Direct	Partial	Partial loss of value	UD 73 is located within and immediately south of the disturbance area. The extent of the site was not fully determined due to time constraints in the field but is highly likely to extend beyond the surveyed area. The Project will directly impact the site and result in the loss of approximately <5% of the known site. The Project will indirectly impact the remaining site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.
UD 141	Isolated Artefact	Low	3	Direct	Total	Total loss of value	These sites are located wholly within the disturbance area and will be directly impacted by the Project resulting in a total loss of value.
UD 144	Isolated Artefact	Low	3	Direct	Total	Total loss of value	
UD 43	Artefacts	Low	3	Direct	Total	Total loss of value	
UD 44	Isolated Artefact	Low	3	Direct	Total	Total loss of value	
UD 47	Isolated Artefact	Low	3	Direct	Total	Total loss of value	
UD 50	Artefacts	Low	3	Direct	Total	Total loss of value	
UD 78	Isolated Artefact	Low	3	Direct	Total	Total loss of value	
UD 92 / UD 93 / UD 100 / UD 101 / UD 102	Artefacts and Hearth	Moderate	4	Direct	Partial	Partial loss of value	The Project will directly impact the site resulting in a partial loss of value. The Project will indirectly impact the remaining portions of the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.
UD 96	Hearth	Low	4	Indirect	Partial	Partial loss of value	The Project will indirectly impact the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.
UD 97	Hearth	Low	4	Indirect	Partial	Partial loss of value	UD 97 is located on the boundary of the southern disturbance area. The Project will indirectly impact the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.
UD 99	Isolated Artefact	Low	4	Direct	Total	Total loss of value	The Project will directly impact the site resulting in a partial loss of value.
UD81 / UD82 / UD83 / UD84 /	Artefacts and Hearth	Moderate	4	Direct	Partial	Partial loss of value	The Project will directly impact a portion of the site resulting in a partial loss of value. The Project will indirectly impact the remaining portions of the site through

Site Name	Site Type	Significance Rating	Injecti on borefie Id	Type of Harm (Direct/ Indirect/ None)	Degree of Harm (Total/ Partial/ None)	Consequences of Harm (Total Loss of Value/ Partial Loss of Value/ No Loss of Value)	Impact Assessment
UD85 / UD86 / UD87							changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.
UD 105	Isolated Artefact	Low	4	Direct	Total	Total loss of value	These sites are located wholly within the disturbance area and will be directly impacted by the Project resulting in a total loss of value.
UD 89	Isolated Artefact	Low	4	Direct	Total	Total loss of value	
B 88	Isolated Artefact	Low	5	Indirect	None	No loss of value	The site is located within 10 m of the disturbance area. The Project may indirectly impact the site through changes to the visual setting of the site and changes to surface water flows and erosion rates without appropriate management and mitigation measures.
B 17 / B 19 / B 26 / B 27 / B 28	Artefacts	Moderate	5	Direct	Partial	Partial loss of value	Approximately 20% of the visible surface area of this site will be directly impacted by the Project, resulting in partial loss of value to the site. The Project will indirectly impact the remaining portions of the site through changes to the visual setting of the site and changes to surface water flows and erosion rates without appropriate management and mitigation measures.
B 18	Artefacts	Low	5	Direct	Partial	Partial loss of value	Approximately 40% of the visible surface area of this site will be directly impacted by the Project and result in a partial loss of value. The Project will indirectly impact the remaining portions of the site through changes to the visual setting of the site and changes to surface water flows and erosion rates without appropriate management and mitigation measures.
B 25	Artefacts	Low	5	Direct	Partial	Partial loss of value	Approximately 7% of the visible surface area of B 25 will be directly impacted by the Project and result in a partial loss of value. The Project will indirectly impact the remaining portions of the site through changes to the visual setting of the site and changes to surface water flows and erosion rates without appropriate management and mitigation measures.
B 71	Artefacts and Hearth	Moderate	5	Direct	Partial	Partial loss of value	Approximately 50% of the visible surface area of the site is situated within the disturbance area and will be directly impacted by the Project, resulting in a partial loss of value. The Project will indirectly impact the remaining portions of the site through changes to the visual setting of the site and changes to surface water flows and erosion rates without appropriate management and mitigation measures.
B 84	Artefacts and Hearth	Moderate	5	Direct	Partial	Partial loss of value	This site is partially located within the disturbance area and will be directly impacted by the Project with loss of approximately 50% of the visible surface area of the site.

Site Name	Site Type	Significance Rating	Injecti on borefie Id	Type of Harm (Direct/ Indirect/ None)	Degree of Harm (Total/ Partial/ None)	Consequences of Harm (Total Loss of Value/ Partial Loss of Value/ No Loss of Value)	Impact Assessment	
							The Project will indirectly impact the remaining portions of the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.	
Karra 33	Artefacts, Hearth, PAD	Moderate	5	Direct	Partial	Partial loss of value	The Project will directly impact the site resulting in a partial loss of value. The Project will indirectly impact the remaining portions of the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.	
WB 107	Artefacts and Hearth	Moderate	5	Direct	Partial	Partial loss of value	The Project will directly impact the site resulting in a partial loss of value. The Project will indirectly impact the remaining portions of the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.	
B 23	Isolated Artefact	Low	5	Direct	Total	Total loss of value	These sites are located wholly within the disturbance area and will be directly impacted by the Project resulting in a total loss of value.	
B 69	Isolated Artefact	Low	5	Direct	Total	Total loss of value		
B 70	Isolated Artefact	Low	5	Direct	Total	Total loss of value		
B 78	Artefacts	Low	5	Direct	Total	Total loss of value		
B 79	Isolated Artefact	Low	5	Direct	Total	Total loss of value		
B 80	Artefacts	Low	5	Direct	Total	Total loss of value		
B 81	Artefacts	Low	5	Direct	Total	Total loss of value		
B 82	Isolated Artefact	Low	5	Direct	Total	Total loss of value		
B 83	Artefacts and Hearth	Moderate	5	Direct	Total	Total loss of value		This site is located wholly within disturbance area and will be directly impacted by the Project resulting in a total loss of value.
B 86	Artefacts	Moderate	5	Direct	Total	Total loss of value		This site is located wholly within the disturbance area and will be directly impacted by the Project resulting in a total loss of value.
Karra 31	Artefacts	Low	5	Direct	Total	Total loss of value	These sites are located wholly within the disturbance area and will be directly impacted by the Project resulting in a total loss of value.	
Karra 40	Isolated Artefact	Low	5	Direct	Total	Total loss of value		
B 74	Isolated Artefact	Low	5	Direct	Direct	Total loss of value		
BWR 28	Artefacts	Moderate	5	Direct	Partial	Partial loss of value	Approximately 40% of the visible surface area of this site will be directly impacted by	

Site Name	Site Type	Significance Rating	Injection borefield	Type of Harm (Direct/ Indirect/ None)	Degree of Harm (Total/ Partial/ None)	Consequences of Harm (Total Loss of Value/ Partial Loss of Value/ No Loss of Value)	Impact Assessment
							the Project. The Project will indirectly impact the remaining portions of the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.
B 20	Isolated Artefact	Low	5	Direct	Total	Total loss of value	These sites are located wholly within the disturbance area and will be directly impacted by the Project resulting in a total loss of value.
B 21	Artefacts	Low	5	Direct	Total	Total loss of value	
B 52	Isolated Artefact	Low	5	Direct	Total	Total loss of value	
B 53	Isolated Artefact	Low	5	Direct	Total	Total loss of value	
B 54	Isolated artefact	Low	5	Direct	Total	Total loss of value	
B 55	Isolated Artefact	Low	5	Direct	Total	Total loss of value	
B 98	Artefacts	Low	5	Direct	Total	Total loss of value	
BWR IF 2	Isolated Artefact	Low	5	Direct	Total	Total loss of value	
BWR 32	Artefacts and PAD	Moderate	5 and Nepean access road	Direct	Partial	Partial loss of value	BWR 32 is a large, high density artefact scatter located in a dune and visible in the dune blow out. The site extends to Burke Wills Road and will be directly impacted by the widening of the Burke Wills Road and the disturbance area in injection borefield 5, resulting in a loss of a portion of the site. The Project will indirectly impact the remaining portions of the site through changes to the visual setting of the site and changes to surface water flows and erosion rates without appropriate management and mitigation measures. The site is located adjacent a public access road and management and mitigation measures should consider the potential for impacts through increased pedestrian traffic and unexpected vehicle stops.
BWR 33	Artefacts	Moderate	5 and Nepean access road	Direct	Partial	Partial loss of value	BWR 33 includes a low density artefact scatter situated in flat swale and a moderate density artefact scatter located in a dune. The site extends to Burke Wills Road and will be directly impacted by the widening of the Burke Wills Road and the disturbance area in injection borefield 5, resulting in a loss of a portion of the site. The Project will indirectly impact the remaining portions of the site through changes to the visual setting of the site and changes to surface water flows and erosion rates without appropriate management and mitigation measures. The site is located adjacent a public access road and management and mitigation measures should consider the potential for impacts through increased pedestrian traffic and

Site Name	Site Type	Significance Rating	Injection borefield Id	Type of Harm (Direct/ Indirect/ None)	Degree of Harm (Total/ Partial/ None)	Consequences of Harm (Total Loss of Value/ Partial Loss of Value/ No Loss of Value)	Impact Assessment
							unexpected vehicle stops.
BWR 34	Artefacts	Moderate	5 and Nepean access road	Direct	Partial	Partial loss of value	The site extends to Burke Wills Road and will be directly impacted by the widening of the Burke Wills Road and the disturbance area in injection borefield 5, resulting in a loss of a portion of the site. The Project will indirectly impact the remaining portions of the site through changes to the visual setting of the site and changes to surface water flows and erosion rates without appropriate management and mitigation measures. The site is located adjacent a public access road and management and mitigation measures should consider the potential for impacts through increased pedestrian traffic and unexpected vehicle stops.
BWR 35	Artefacts	Moderate	5 and Nepean access road	Indirect	Partial	Partial loss of value	This site is 25 m south and 45 m west from the proposed disturbance area. The Project may indirectly impact the remaining portions of the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.
Karra 13	Artefacts and Hearth	Low	5 and Nepean access road	Direct	Partial	Total loss of value	These sites are located wholly within the disturbance area and will be directly impacted by the Project resulting in a total loss of value.
B 22	Isolated Artefact	Low	5 and Nepean access road	Direct	Total	Total loss of value	
TT 16	Artefacts	Low	5 and Nepean access road	Direct	Total	Total loss of value	
B 72	Artefacts	Low	5	Direct	Partial	Partial loss of value	Approximately 30% of the visible surface area is situated within the disturbance area and will be directly impacted by the Project resulting in a partial loss of value. The Project may indirectly impact the remaining portions of the site through changes to

Site Name	Site Type	Significance Rating	Injecti on borefie Id	Type of Harm (Direct/ Indirect/ None)	Degree of Harm (Total/ Partial/ None)	Consequences of Harm (Total Loss of Value/ Partial Loss of Value/ No Loss of Value)	Impact Assessment
							the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented..
UD 120	Artefacts	Moderate	6	Direct	Partial	Partial loss of value	These sites are partially located in the disturbance area and will be directly impacted by the Project resulting in a partial loss of value. The Project may indirectly impact the remaining portions of the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.
UD 125	Artefacts	Low	6	Direct	Partial	Partial loss of value	
UD 122	Artefacts	Moderate	6	Direct	Total	Total loss of value	These sites are located wholly within the disturbance area and will be directly impacted by the Project resulting in a total loss of value.
UD 124	Artefacts	Low	6	Direct	Total	Total loss of value	
UD 129	Isolated Artefact	Low	6	Direct	Total	Total loss of value	
UD 137	Isolated Artefact	Low	6	Direct	Total	Total loss of value	
UD 112	Artefacts	Low	6	Direct	Partial	Total loss of value	
B 77	Isolated Artefact	Low	6	Direct	Total	Total loss of value	These sites are located wholly within the disturbance area and will be directly impacted by the Project resulting in a total loss of value.
UD 114	Isolated Artefact	Low	6	Direct	Total	Total loss of value	
UD 115 / UD 119	Artefacts and Hearth	Low	6	Direct	Total	Total loss of value	
UD 127	Artefacts	Low	6	Direct	Total	Total loss of value	
UD 133	Isolated Artefact	Low	6	Direct	Total	Total loss of value	
UD 134	Isolated Artefact	Low	6	Direct	Total	Total loss of value	
UD 135	Artefacts	Low	6	Direct	Total	Total loss of value	
UD 136	Isolated Artefact	Low	6	Direct	Total	Total loss of value	

Site Name	Site Type	Significance Rating	Injecti on borefie Id	Type of Harm (Direct/ Indirect/ None)	Degree of Harm (Total/ Partial/ None)	Consequences of Harm (Total Loss of Value/ Partial Loss of Value/ No Loss of Value)	Impact Assessment
B 39	Artefacts	Low	7	Direct	Partial	Total loss of value	Approximately 65% of this site will be directly impacted by the Project. As the proportional loss of the sites is over 50%, the loss of value is considered total. The Project may indirectly impact the remaining portions of the site through changes to the visual setting of the site and changes to surface water flows and erosion rates without appropriate management and mitigation measures.
B 38	Artefacts	Low	7	Indirect	Partial	Partial loss of value	This site is located 45 m north of the southern disturbance area. The Project may indirectly impact the remaining portions of the site through changes to the visual setting of the site and changes to surface water flows and erosion rates without appropriate management and mitigation measures.
B 50	Artefacts	Low	7	Direct	Total	Total loss of value	These sites are located wholly within the disturbance area and will be directly impacted by the Project resulting in a total loss of value.
B 97	Isolated Artefact	Low	7	Direct	Total	Total loss of value	
B 75	Artefacts	Low	7	Direct	Direct	Total loss of value	
B 44	Artefacts	Moderate	7	Direct	Partial	Partial loss of value	Approximately 30% of B44 will be directly impacted by the Project resulting in a partial loss of value. The Project may indirectly impact the remaining portions of the site through changes to the visual setting of the site and changes to surface water flows and erosion rates without appropriate management and mitigation measures
B 49	Artefacts	Low	7	Direct	Partial	Partial loss of value	Approximately 20% of the visible surface area of this site will be directly impacted by the Project, resulting in partial loss of value to the site. The Project may indirectly impact the remaining portions of the site through changes to the visual setting of the site and changes to surface water flows and erosion rates without appropriate management and mitigation measures.
B 43	Artefacts	Moderate	7	Direct	Total	Total loss of value	These sites are located wholly within the disturbance area and will be directly impacted by the Project resulting in a total loss of value.
B 45	Artefacts	Low	7	Direct	Total	Total loss of value	
B 73	Isolated Artefact	Low	7	Direct	Total	Total loss of value	This site is located on the margins of the disturbance area and for the purposes of the impact assessment has been assumed to be directly impacted by the Project. The impacts will result in a total loss of value.
B 90	Artefacts	Low	8	Direct	Partial	Total loss of value	Approximately 80% of the site is located within the disturbance area and will be directly impacted by the Project. As the proportional loss of the site is over 50%, the loss of value is considered total. The Project may indirectly impact the remaining

Site Name	Site Type	Significance Rating	Injecti on borefie Id	Type of Harm (Direct/ Indirect/ None)	Degree of Harm (Total/ Partial/ None)	Consequences of Harm (Total Loss of Value/ Partial Loss of Value/ No Loss of Value)	Impact Assessment
							portions of the site through changes to the visual setting of the site and changes to surface water flows and erosion rates without appropriate management and mitigation measures.
B 57	Artefacts	Low	8	Direct	Total	Total loss of value	These sites are located wholly within the disturbance area and will be directly impacted by the Project resulting in a total loss of value.
B 63	Artefacts	Low	8	Direct	Total	Total loss of value	
B 64	Artefacts	Low	8	Direct	Total	Total loss of value	
B 65	Artefacts	Low	8	Direct	Total	Total loss of value	
B 66	Artefacts	Low	8	Direct	Total	Total loss of value	
B 67	Artefacts	Low	8	Direct	Total	Total loss of value	
B 68	Artefacts	Low	8	Direct	Total	Total loss of value	
B 87	Isolated Artefact	Low	8	Direct	Total	Total loss of value	
B 89	Artefacts	Low	8	Direct	Total	Total loss of value	
B 91	Artefacts	Low	8	Direct	Total	Total loss of value	
B 92	Isolated Artefact	Low	8	Direct	Total	Total loss of value	
B 93	Isolated Artefact	Low	8	Direct	Total	Total loss of value	
B 94	Isolated Artefact	Low	8	Direct	Total	Total loss of value	
W 10	Artefacts	Low	8	Direct	Total	Total loss of value	
W 11	Artefacts	Low	8	Direct	Total	Total loss of value	
W 4	Artefacts	Low	8	Direct	Total	Total loss of value	
W 5	Artefacts	Low	8	Direct	Total	Total loss of value	
W 6	Isolated Artefact	Low	8	Direct	Total	Total loss of value	
W 12	Artefacts	Low	8	Direct	Total	Total loss of value	
W 2	Artefacts and Hearth	Moderate	8	Direct	Total	Total loss of value	
W 3	Artefacts	Low	8	Direct	Total	Total loss of value	These sites are located wholly within the disturbance area and will be directly

Site Name	Site Type	Significance Rating	Injecti on borefie Id	Type of Harm (Direct/ Indirect/ None)	Degree of Harm (Total/ Partial/ None)	Consequences of Harm (Total Loss of Value/ Partial Loss of Value/ No Loss of Value)	Impact Assessment
W 7	Isolated Artefact	Low	8	Direct	Total	Total loss of value	impacted by the Project resulting in a total loss of value.
W 8	Artefacts	Low	8	Direct	Total	Total loss of value	
W 9	Artefacts	Low	8	Direct	Total	Total loss of value	
TO 27	Isolated Artefact	Low	8	Indirect	None	No loss of value	This site is located on the margins of the disturbance area and has spatial relationship to other sites. The Project may indirectly impact the remaining portions of the site through changes to the visual setting of the site and changes to surface water flows and erosion rates without appropriate management and mitigation measures.
TO 12	Artefacts	Moderate	8	Direct	Partial	Partial loss of value	Approximately 40% of the visible surface area of this site will be directly impacted by the Project resulting in a partial loss of value. The Project may indirectly impact the remaining portions of the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented..
TO 14	Artefacts and Hearth	Moderate	8	Direct	Partial	Partial loss of value	A portion of this site is located within the 50 m corridor and to the north across the dune in the borefield. The site contains a number of sensitive features which have a limited lifespan due to their susceptibility to erosion and will be directly impacted by the Project. The Project may indirectly impact the remaining portions of the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented..
TO 18	Artefacts	Low	8	Direct	Partial	Partial loss of value	Approximately 50% of this site is located within the disturbance area and will be directly impacted by the Project resulting in a partial loss of value. The Project may indirectly impact the remaining portions of the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.
B 56`	Artefacts	Low	8	Direct	Total	Total loss of value	These sites are located wholly within the disturbance area and will be directly impacted by the Project resulting in a total loss of value.
B 58 / B 62	Artefacts	Low	8	Direct	Total	Total loss of value	
B 59	Artefacts	Low	8	Direct	Total	Total loss of value	

Site Name	Site Type	Significance Rating	Injecti on borefie Id	Type of Harm (Direct/ Indirect/ None)	Degree of Harm (Total/ Partial/ None)	Consequences of Harm (Total Loss of Value/ Partial Loss of Value/ No Loss of Value)	Impact Assessment
B 60	Artefacts	Low	8	Direct	Total	Total loss of value	
B 61	Artefacts	Low	8	Direct	Total	Total loss of value	
B 95	Artefact	Low	8	Direct	Partial	Total loss of value	Over 80% of B 95 is located within the disturbance area and will be directly impacted by the Project. As the proportional loss of the site is over 50%, the loss of value is considered total. The Project may indirectly impact the remaining portions of the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented..
B 96	Isolated Artefact	Low	8	Direct	Total	Total loss of value	These sites are located wholly within the disturbance area and will be directly impacted by the Project resulting in a total loss of value.
TO 1	Isolated Artefact	Low	8	Direct	Total	Total loss of value	
TO 11	Isolated Artefact	Low	8	Direct	Total	Total loss of value	
TO 13	Isolated Artefact	Low	8	Direct	Total	Total loss of value	
TO 15	Artefacts	Moderate	8	Direct	Partial	Partial loss of value	Approximately 50% of this site is located within the disturbance area and will be directly impacted by the Project resulting in a partial loss of value. The Project may indirectly impact the remaining portions of the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented..
TO 17	Artefacts	Moderate	8	Direct	Total	Total loss of value	This site is located wholly within the disturbance area and will be directly impacted by the Project with a total loss of value.
TO 19	Artefacts	Low	8	Direct	Total	Total loss of value	This site is located wholly within the disturbance area and will be directly impacted by the Project resulting in a total loss of value.
TO 2 / TO 20	Artefacts and Hearth	Moderate	8	Direct	Total	Total loss of value	This site is located in and extends beyond the disturbance area and will be directly impacted by the Project resulting in a total loss of value to a site of moderate significance. Management and mitigation measures are required. The site is likely to extend beyond the surveyed boundaries of the site and the Project may indirectly impact these areas through changes to the visual setting of the site and changes to surface water flows and erosion rates without appropriate management and mitigation measures.
TO 21	Isolated Artefact	Low	8	Direct	Total	Total loss of value	These sites are located wholly within the disturbance area and will be directly

Site Name	Site Type	Significance Rating	Injecti on borefie Id	Type of Harm (Direct/ Indirect/ None)	Degree of Harm (Total/ Partial/ None)	Consequences of Harm (Total Loss of Value/ Partial Loss of Value/ No Loss of Value)	Impact Assessment
TO 22 / 23	Artefacts	Low	8	Direct	Total	Total loss of value	impacted by the Project resulting in a total loss of value.
TO 24	Artefacts and Hearth	Low	8	Direct	Total	Total loss of value	
TO 25	Isolated Artefact	Low	8	Direct	Total	Total loss of value	
TO 26	Artefacts	Low	8	Direct	Total	Total loss of value	
TO 28	Artefacts	Low	8	Direct	Total	Total loss of value	
TO 29	Artefacts	Low	8	Direct	Total	Total loss of value	
TO 30 / TO 31	Artefact	Low	8	Direct	Total	Total loss of value	This site is located within the disturbance area and will result in the direct impact to over 75% of the visible surface area of the site. As the proportional loss of the site is over 50%, the loss of value is considered total. The Project may indirectly impact the remaining portions of the site through changes to the visual setting of the site and changes to surface water flows and erosion rates without appropriate management and mitigation measures.
TO 46	Isolated Artefact	Low	8	Direct	Total	Total loss of value	These sites are located wholly within the disturbance area and will be directly impacted by the Project resulting in a total loss of value.
TO 47	Artefacts	Low	8	Direct	Total	Total loss of value	
TO 48	Isolated Artefact	Low	8	Direct	Total	Total loss of value	
TO 49	Artefacts	Low	8	Direct	Total	Total loss of value	
TO 34	Isolated Artefact	Low	9	Direct	Total	Total loss of value	This site is within 3 m of the disturbance footprint and for the purposes of this assessment has been considered to be part of the disturbance area. The Project will directly impact the site with a total loss of value to the site.
TO 35	Artefacts	Low	9	Direct	Partial	Partial loss of value	Approximately 40% of the visible surface area of this site will be directly impacted by the Project resulting in a partial loss of value. The Project may indirectly impact the remaining portions of the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented..
TO 32	Isolated Artefact	Low	9	Direct	Total	Total loss of value	These sites are located wholly within the disturbance area and will be directly impacted by the Project resulting in a total loss of value.
TO 33	Isolated Artefact	Low	9	Direct	Total	Total loss of value	

Site Name	Site Type	Significance Rating	Injecti on borefie Id	Type of Harm (Direct/ Indirect/ None)	Degree of Harm (Total/ Partial/ None)	Consequences of Harm (Total Loss of Value/ Partial Loss of Value/ No Loss of Value)	Impact Assessment
TO 36	Artefacts	Low	9	Direct	Total	Total loss of value	Approximately 66% of the visible area of the site will be directly impacted by the Project. As the proportional loss of the site is over 50%, the loss of value is considered total. The Project may indirectly impact the remaining portions of the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented..
TO 37	Artefacts	Low	9	Direct	Total	Total loss of value	These sites are located wholly within the disturbance area and will be directly impacted by the Project resulting in a total loss of value.
TO 38	Artefacts	Low	9	Direct	Total	Total loss of value	
TO 39	Isolated Artefact	Low	9	Direct	Total	Total loss of value	
TO 40	Isolated Artefact	Low	9	Direct	Total	Total loss of value	
TO 41	Artefacts	Low	9	Direct	Total	Total loss of value	
TO 42	Artefacts	Low	9	Direct	Total	Total loss of value	
TO 43	Isolated Artefact	Low	9	Direct	Total	Total loss of value	
TO 44	Isolated Artefact	Low	9	Direct	Total	Total loss of value	
TO 45	Isolated Artefact	Low	9	Direct	Total	Total loss of value	
UD 130	Isolated Artefact	Low	9	Direct	Total	Total loss of value	
TT 9	Artefacts	Low	9	Indirect	None	No loss of value	This site is located adjacent the margin of the disturbance area . The Project may indirectly impact the remaining portions of the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented..
TT 30	Artefacts	Low	9	Direct	Partial	Partial loss of value	Approximately 10% of this site is located within the disturbance area and will be directly impacted by the Project resulting in a partial loss of value. The Project may indirectly impact the remaining portions of the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.
TT 33	Isolated Artefact	Low	9	Indirect	Partial	No loss of value	This site is located on the boundary of the disturbance area. The Project may indirectly impact the remaining portions of the site through changes to the visual

Site Name	Site Type	Significance Rating	Injecti on borefie Id	Type of Harm (Direct/ Indirect/ None)	Degree of Harm (Total/ Partial/ None)	Consequences of Harm (Total Loss of Value/ Partial Loss of Value/ No Loss of Value)	Impact Assessment
							setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.
TT 34	Artefacts	Moderate	9	Direct	Partial	Partial loss of value	A portion of this site is located within the 50 m corridor and to the north across the dune in the borefield. The site will be directly impact by the Project and result in a partial loss of value. The Project may indirectly impact the remaining portions of the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.
TT 25	Isolated Artefact	Low	9	Direct	Total	Total loss of value	These sites are located wholly within the disturbance area and will be directly impacted by the Project resulting in a total loss of value.
TT 26	Artefacts	Low	9	Direct	Total	Total loss of value	
TT 27	Artefacts	Low	9	Direct	Total	Total loss of value	
TT 28	Artefacts	Low	9	Direct	Total	Total loss of value	
TT 29	Artefacts	Low	9	Direct	Partial	Total loss of value	Approximately 85% of this site is located wholly within the disturbance footprint and will be directly impacted by the Project. As the proportional loss of the site is over 50%, the loss of value is considered total. The Project may indirectly impact the remaining portions of the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.
TT 31	Artefacts	Low	9	Direct	Total	Total loss of value	This site is located wholly within the disturbance area and will be directly impacted with a total loss of value.
TT 32	Artefacts	Low	9	Indirect	None	No loss of value	This site is located immediately to the south of the disturbance area and will not be directly impacted by the Project. The Project may indirectly impact the site through changes to the visual setting of the site and changes to surface water flows and erosion rates without appropriate management and mitigation measures
TT 35	Artefacts	Low	9	Direct	Total	Total loss of value	These sites are located wholly within the disturbance area and will be directly impacted by the Project resulting in a total loss of value.
TT 37	Isolated Artefact	Low	9	Direct	Total	Total loss of value	
TT 38 / TT 39	Artefacts	Low	9	Direct	Total	Total loss of value	
TT 14	Isolated Artefact	Low	10	Indirect	None	No loss of value	This site is located within 10 m of the disturbance area and will not be directly impacted by the Project. The Project may indirectly impact the site through changes

Site Name	Site Type	Significance Rating	Injecti on borefie Id	Type of Harm (Direct/ Indirect/ None)	Degree of Harm (Total/ Partial/ None)	Consequences of Harm (Total Loss of Value/ Partial Loss of Value/ No Loss of Value)	Impact Assessment
							to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.
TT 10	Isolated Artefact	Low	10	Direct	Total	Total loss of value	These sites are located wholly within the disturbance area and will be directly impacted by the Project resulting in a total loss of value.
TT 12	Isolated Artefact	Low	10	Direct	Total	Total loss of value	
TT 13	Artefacts	Low	10	Direct	Total	Total loss of value	
TT 15	Isolated Artefact	Low	10	Direct	Total	Total loss of value	
TT 11	Isolated Artefact	Low	10	Direct	Total	Total loss of value	
UD 29	Artefacts	Low	3	None	None	No loss of value	UD 29 is located 70 m north of the disturbance area. The site will not be impacted by the Project.
UD 31	Isolated Artefact	Low	3	None	None	No loss of value	UD 31 is located 100 m north of the disturbance area. The site will not be impacted by the Project.
UD 33	Isolated Artefact	Low	3	None	None	No loss of value	UD 33 is located 75 m north of e disturbance area. The site will not be impacted by the Project.
UD 34	Isolated Artefact	Low	3	None	None	No loss of value	UD 34 is located 125 m north of the disturbance area. The site will not be impacted by the Project.
UD 36	Artefacts	Low	3	None	None	No loss of value	UD 36 is located 70 m north of the disturbance area. The site will not be directly impacted
UD 37	Isolated Artefact	Low	3	None	None	No loss of value	UD 37 is an isolated stone artefact 65m north of a disturbance area. The site will not be impacted by the Project.
UD 38	Isolated Artefact	Low	3	None	None	No loss of value	UD 38 is an isolated stone artefact located on the footslopes of an eroding lunette. It is 85m north of Injection borefield 3. It will not be impacted by the Project.
UD 40	Isolated Artefact	Low	3	None	None	No loss of value	UD 40 is located 100 m north of a disturbance area. The site will not be impacted by the Project.
UD 41	Isolated Artefact	Low	3	Indirect	None	No loss of value	UD 41 is located 25 m north of the disturbance area. The site will not be directly impacted. By the Project. The Project may indirectly impact the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.

Site Name	Site Type	Significance Rating	Injecti on borefie Id	Type of Harm (Direct/ Indirect/ None)	Degree of Harm (Total/ Partial/ None)	Consequences of Harm (Total Loss of Value/ Partial Loss of Value/ No Loss of Value)	Impact Assessment
UD 42	Artefacts	Low	3	Indirect	None	No loss of value	UD 42 is located 55 m south of the disturbance area. The Project may indirectly impact the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.
UD 45	Isolated Artefact	Low	3	None	None	No loss of value	UD 45 is located 75 m south of the disturbance area. The site will not be impacted by the Project.
UD 53	Artefacts	Low	3	None	None	No loss of value	UD 53 is a located 75m south of the disturbance area. The site will not be impacted by the Project.
UD 54	Isolated Artefact	Low	3	None	None	No loss of value	UD 54 is a located 110m south of the disturbance area. The site will not be impacted by the Project.
UD 60	Isolated Artefact	Low	3	None	None	No loss of value	UD 60 is located 55 m south of the disturbance area. The site will not be impacted by the Project
UD 63	Isolated Artefact	Low	3	Indirect	None	No loss of value	UD 63 is located 45 m south of the disturbance area. The Project may indirectly impact the site through changes to the visual setting of the site and changes to surface water flows and erosion rates without appropriate management and mitigation measures
UD 67	Isolated Artefact	Low	3	Indirect	None	No loss of value	UD 67 is located 35 m north of the disturbance area. The Project may indirectly impact the site through changes to the visual setting of the site and changes to surface water flows and erosion rates without appropriate management and mitigation measures
UD 69	Isolated Artefact	Low	3	None	None	No loss of value	UD 69 is located 85 m north of the disturbance area. The site will not be impacted by the Project.
UD 71	Isolated Artefact	Low	3	None	None	No loss of value	UD 71 is located 50 m south of the disturbance area. The site will not be impacted by the Project.
UD 74	Isolated Artefact	Low	3	Indirect	None	No loss of value	UD74 is located 30 m north of the disturbance area. The Project may indirectly impact the site through changes to the visual setting of the site and changes to surface water flows and erosion rates without appropriate management and mitigation measures
UD 76	Artefacts	Low	3	None	None	No loss of value	UD 76 is located 75 m north of the disturbance area and will not be impacted by the

Site Name	Site Type	Significance Rating	Injecti on borefie Id	Type of Harm (Direct/ Indirect/ None)	Degree of Harm (Total/ Partial/ None)	Consequences of Harm (Total Loss of Value/ Partial Loss of Value/ No Loss of Value)	Impact Assessment
							Project.
UD 79	Isolated Artefact	Low	3	None	None	No loss of value	UD 79 is located 65 m south of the disturbance area and will not be impacted by the Project.
UD 28	Artefacts	Low	3	Indirect	Partial	Partial loss of value	UD 28 is located immediately north of the disturbance area. The Project may indirectly impact the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.
UD 30	Artefacts	Low	3	Indirect	None	No loss of value	UD 30 is located immediately 30 m north of the disturbance area. The Project may indirectly impact the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.
UD 32	Artefacts	Low	3	Indirect	None	No loss of value	UD 32 is located immediately 20 m north of the disturbance area. The Project may indirectly impact the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.
UD 35	Artefacts	Low	3	Indirect	None	No loss of value	UD 35 is located 45 m north of the disturbance area. The Project may indirectly impact the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.
UD 39	Isolated Artefact	Low	3	Indirect	None	No loss of value	UD 39 is an isolated stone artefact located 5 m north of the disturbance area . The Project may indirectly impact the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.
UD 46 / UD 48 / UD 49	Artefacts	Low	3	Indirect	None	No loss of value	UD 46 / UD 48 / UD 49 is located 35 m south of the disturbance area. The Project may indirectly impact the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.
UD 55	Artefacts	Moderate	3	Direct	Partial	Partial loss of value	UD 55 is located within and beyond disturbance area in injection borefield 3. This site is likely to be an exposed portion of a continuous artefact scatter (constituted of UD 51, 52, 53, 54 and 55) and is likely to extend beyond the surveyed area across the same lunette crest and slope landforms, The Project will directly impact UD 55

Site Name	Site Type	Significance Rating	Injecti on borefie Id	Type of Harm (Direct/ Indirect/ None)	Degree of Harm (Total/ Partial/ None)	Consequences of Harm (Total Loss of Value/ Partial Loss of Value/ No Loss of Value)	Impact Assessment
							and result in the loss of less than 10% of the known extent of UD 55 resulting in a partial loss of value. The Project may indirectly impact the remaining portions of the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.
UD 61	Isolated Artefact	Low	3	Indirect	None	No loss of value	UD 61 is located 5 m south of disturbance area in injection borefield 3. The Project may indirectly impact the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.
UD 66	Artefacts	Low	3	Indirect	None	No loss of value	UD 66 is located 20 m south of disturbance area in Injection Borefield 3. The Project may indirectly impact the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.
UD 68	Artefacts	Low	3	Direct	Total	Total loss of value	UD 68 is a located 3 m north of disturbance area and for the purposes of this assessment is considered within the disturbance area. The Project will directly impact the site resulting in a total loss of value.
UD 72	Artefacts	Low	3	Indirect	None	No loss of value	UD 72 is located 12 m south of disturbance area in injection borefield 3. The Project may indirectly impact the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.
UD 77	Artefacts	Moderate	3	Direct	Partial	Partial loss of value	UD 77 is located within and beyond disturbance area in injection borefield 3. The extent of the site is highly likely to extend beyond the surveyed boundary. The Project will directly impact the site and result in the proportional loss of 30% of the site. The Project may indirectly impact the remaining portions of the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented. Registered Aboriginal Parties have requested management and mitigation measures for this site.
UD 80	Isolated Artefact	Low	3	Indirect	None	No loss of value	UD 80 is located 5 -15 m south of disturbance area in Injection Borefield 3. The Project may indirectly impact the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate

Site Name	Site Type	Significance Rating	Injecti on borefie Id	Type of Harm (Direct/ Indirect/ None)	Degree of Harm (Total/ Partial/ None)	Consequences of Harm (Total Loss of Value/ Partial Loss of Value/ No Loss of Value)	Impact Assessment
							management and mitigation measures are not implemented.
UD 142	Isolated Artefact	Low	3	None	None	No loss of value	This site will not be impacted by the Project.
UD 90	Isolated Artefact	Low	4	None	None	No loss of value	UD 90 is located 100m north of the southern disturbance area in injection borefield 4. It will not be directly impacted by the Project.
UD 91	Artefacts	Low	4	None	None	No loss of value	UD 91 is a low density artefact scatter located 100 m north of the southern disturbance area in injection borefield 4. No direct impacts are proposed.
UD 95	Artefacts	Low	4	None	None	No loss of value	UD 95 is a low density artefact scatter located 65 m north of the southern disturbance area in injection Borefield 4. It will not be impacted by the Project.
UD 98	Isolated Artefact	Low	4	Indirect	None	No loss of value	UD 98 is located 30 m north of disturbance area in injection borefield 4. The Project may indirectly impact the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.
B 11	Artefacts	Moderate	4	Indirect	None	No loss of value	The Project will occur 30 m north of B 11 and will be visible from B 11. The Project may indirectly impact the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.
B 12	Artefacts	Moderate	4	None	None	No loss of value	The Project will occur 50 m north of B 12 and will be visible from B 12. The Project will not impact the site.
UD 103	Artefacts and Hearth	Moderate	4	Indirect	Partial	Partial loss of value	UD 103 is located 30 m south of the disturbance area. The Project may indirectly impact the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.
UD 104	Artefacts and Hearth	Moderate	4	None	None	No loss of value	UD 103 is located 60 m south of the disturbance area and will not be impacted by the Project.
UD 106	Possible Hearth	Low	4	Indirect	None	No loss of value	UD 106 is located 30 m south of disturbance area. The Project may indirectly impact the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.
UD 107	Artefacts	Low	4	Direct	Partial	Partial loss of value	UD 107 is located within and south of the disturbance area. The extent of the site is

Site Name	Site Type	Significance Rating	Injecti on borefie Id	Type of Harm (Direct/ Indirect/ None)	Degree of Harm (Total/ Partial/ None)	Consequences of Harm (Total Loss of Value/ Partial Loss of Value/ No Loss of Value)	Impact Assessment
							highly likely to extend beyond the surveyed boundary. The Project will directly impact the site and result in the partial loss of the site and value.. The Project may indirectly impact the remaining portions of the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.
UD 108	Isolated Artefact	Low	4	Indirect	None	No loss of value	UD 108 is located 25 m south of disturbance area. The Project may indirectly impact the site through changes to the visual setting of the site and changes to surface water flows and erosion rates without appropriate management and mitigation measures
UD 109	Artefacts	Low	4	Direct	Partial	Partial loss of value	UD 109 is located within and south of the disturbance area. The site will have direct impacts to a portion of the site resulting in a partial loss of value. The Project may indirectly impact the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.
UD 110	Artefacts	Low	4	Direct	Partial	Partial loss of value	UD 110 is located 2 m south of the disturbance area and for the purposes of this assessment is considered to be situated partially within the disturbance area. The site will be directly impacted by the Project to a portion of the site resulting in a partial loss of value. The Project may indirectly impact the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.
UD 111	Artefacts	Low	4	Indirect	None	No loss of value	UD 111 is located 25 m south of the disturbance area. The Project may indirectly impact the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.
UD 88	Isolated Artefact	Low	4	Indirect	None	No loss of value	UD 88 is located 4 m south of the disturbance area. The Project may indirectly impact the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.
UD 94	Isolated Artefact	Low	4	Indirect	None	No loss of value	UD 94 is a low significance isolated artefact located 8 m from the southern disturbance area. The Project may indirectly impact the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if

Site Name	Site Type	Significance Rating	Injecti on borefie Id	Type of Harm (Direct/ Indirect/ None)	Degree of Harm (Total/ Partial/ None)	Consequences of Harm (Total Loss of Value/ Partial Loss of Value/ No Loss of Value)	Impact Assessment
							appropriate management and mitigation measures are not implemented.
B 24	Artefacts	Low	5	None	None	No loss of value	This site will not be impacted by the Project.
B 29	Isolated Artefact	Low	5	None	None	No loss of value	
B 46	Artefacts	Low	5	Indirect	None	No loss of value	The site is located within 10 m of a disturbance area. The Project may indirectly impact the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.
B 47 / B 48	Artefacts	Low	5	None	None	No loss of value	This site is located 50 m south of the disturbance area. The site will not be directly impacted by the Project.
B 85	Isolated Artefact	Low	5	Indirect	None	No loss of value	This site is located within 10 m of a disturbance area. The Project may indirectly impact the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.
BWR 10	Isolated Artefact	Low	5	None	None	No loss of value	These sites will not be impacted by the Project.
BWR 11	Possible Hearth	Low	5	None	None	No loss of value	
BWR 12	Artefacts and Hearth	Moderate	5	None	None	No loss of value	
BWR 13	Isolated Artefact	Low	5	None	None	No loss of value	
BWR 15	Isolated Artefact	Low	5	None	None	No loss of value	
BWR 16	Isolated Artefact	Low	5	None	None	No loss of value	
BWR 17	Artefacts	Low	5	None	None	No loss of value	
BWR 18	Artefacts	Low	5	None	None	No loss of value	
BWR 19	Artefacts	Low	5	None	None	No loss of value	
BWR 20	Isolated Artefact	Low	5	None	None	No loss of value	
BWR 21	Isolated Artefact	Low	5	None	None	No loss of value	
BWR 22	Isolated Artefact	Low	5	None	None	No loss of value	

Site Name	Site Type	Significance Rating	Injecti on borefie Id	Type of Harm (Direct/ Indirect/ None)	Degree of Harm (Total/ Partial/ None)	Consequences of Harm (Total Loss of Value/ Partial Loss of Value/ No Loss of Value)	Impact Assessment
BWR 23	Artefacts	Low	5	None	None	No loss of value	
BWR 24	Isolated Artefact	Low	5	None	None	No loss of value	
BWR 25	Artefacts	Moderate	5	None	None	No loss of value	
BWR 26	Isolated Artefact	Low	5	None	None	No loss of value	
BWR 27	Artefacts	Moderate	5	None	None	No loss of value	
BWR 29	Isolated Artefact	Low	5	None	None	No loss of value	
BWR 3	Isolated Artefact	Low	5	None	None	No loss of value	
BWR 30	Isolated Artefact	Low	5	None	None	No loss of value	
BWR 31	Isolated Artefact	Low	5	None	None	No loss of value	
BWR 39	Isolated Artefact	Low	5	None	None	No loss of value	
BWR 4	Isolated Artefact	Low	5	None	None	No loss of value	
BWR 40	Isolated Artefact	Low	5	None	None	No loss of value	
BWR 5	Isolated Artefact	Low	5	None	None	No loss of value	
BWR 6	Isolated Artefact	Low	5	None	None	No loss of value	
BWR 7	Isolated Artefact	Low	5	None	None	No loss of value	
BWR 8	Isolated Artefact	Low	5	None	None	No loss of value	
BWR 9	Artefacts	Low	5	None	None	No loss of value	
Karra 34	Isolated Artefact	Low	5	None	None	No loss of value	Karra 34 is located 50m east of the disturbance area. This site will not be impacted by the Project.
Karra 35	Artefacts	Low	5	None	None	No loss of value	Karra 35 is located in the injection borefield outside the disturbance area. This site will not be impacted by the Project.
Karra 38	Isolated Artefact	Low	5	Indirect	None	No loss of value	Karra 38 is located 30 m west of the disturbance area. The Project may indirectly impact the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.

Site Name	Site Type	Significance Rating	Injecti on borefie Id	Type of Harm (Direct/ Indirect/ None)	Degree of Harm (Total/ Partial/ None)	Consequences of Harm (Total Loss of Value/ Partial Loss of Value/ No Loss of Value)	Impact Assessment
Karra 39	Artefacts	Low	5	None	None	No loss of value	Karra 39 is located 60 m west of the disturbance area. This site will not be impacted by the Project.
Karra 70	Isolated Artefact	Low	5	None	None	No loss of value	Karra 70 is located 105m west of the disturbance area and will not be impacted by the Project.
UD 131	Isolated Artefact	Low	5	Indirect	None	No loss of value	UD 131 is located 20 m east of the disturbance area and will not be directly impacted by the Project. The Project may indirectly impact the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.
UD 132	Isolated Artefact	Low	5	Indirect	None	No loss of value	UD 131 is located within 10 m from the disturbance area and will not be directly impacted by the Project. The Project may indirectly impact the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.
WB 108	Isolated Artefact	Low	5	None	None	No loss of value	WB 108 is located 65 m west of disturbance area and will not be impacted by the Project.
WB 109	Isolated Artefact	Low	5	None	None	No loss of value	WB 109 is located 65 m west of disturbance area and will not be impacted by the Project.
WB 110	Isolated Artefact	Low	5	None	None	No loss of value	This site will not be impacted by the Project.
BWR 14	Isolated Artefact	Low	5	Direct	Total	Total loss of value	B14 is located 4 m east of disturbance and for the purposes of this assessment is considered to be located within the disturbance area. The site will be directly impacted by the Project and result in a total loss of value.
BWR 41	Isolated Artefact	Low	5	Indirect	None	No loss of value	BWR 41 is located 48 m west of the disturbance area. The Project may indirectly impact the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.
BWR 42	Isolated Artefact	Low	5	Indirect	None	No loss of value	BWR 42 is located 45 m west of the disturbance area. The Project may indirectly impact the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.
Karra 30	Isolated Artefact	Low	5	Indirect	None	No loss of value	Karra 30 is located 35 m west of disturbance area. The Project may indirectly impact the site through changes to the visual setting of the site and changes to surface

Site Name	Site Type	Significance Rating	Injecti on borefie Id	Type of Harm (Direct/ Indirect/ None)	Degree of Harm (Total/ Partial/ None)	Consequences of Harm (Total Loss of Value/ Partial Loss of Value/ No Loss of Value)	Impact Assessment
							water flows and erosion rates if appropriate management and mitigation measures are not implemented.
Karra 37	Artefacts	Low	5	Direct	Partial	Partial loss of value	Karra 37 is located on the margins of the disturbance area and for the purposes of this assessment is considered to be situated in the disturbance area. A portion of the site will be directly impacted by the Project resulting in a partial loss of value. The Project may indirectly impact the remaining portions of the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.
WB 43	Artefacts, Hearth and PAD	Moderate	5	Direct	Partial	Partial loss of value	Approximately 50% of WB 43 is situated within the West Balranald Mine disturbance area and will be directly impacted, resulting in a partial loss of value to the resource within this area. The remaining 50% of the WB 43 is situated within project element injection borefield 5 but not within the disturbance area. It is likely that WB 43 extends beyond the surveyed area and previously unidentified portions of the site are located within disturbance areas. The Project may indirectly impact the remaining portions of the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.
Karra 36	Isolated Artefact	Low	5	Direct	Total	Total loss of value	Karra 36 is located 2m east of the disturbance area and is considered for the purposes of this assessment to be within the disturbance area. The site will be directly impacted by the Project and result in a total loss of value.
UD 116	Artefacts	Moderate	6	None	None	No loss of value	The site will not be impacted by the Project.
UD 126	Isolated Artefact	Low	6	None	None	No loss of value	UD 126 is located 50 m south of disturbance area. The site will not be impacted by the Project.
UD 128	Artefacts	Low	6	Indirect	None	No loss of value	UD 128 is located 15 m north of the disturbance area. The Project may indirectly impact the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.
UD 117	Artefacts	Low	6	Direct	Partial	Partial loss of value	UD 117 is located within and to the south of the disturbance area in the borefield. A portion of the site would be directly impacted by the Project resulting in a partial loss of value. The Project may indirectly impact the remaining portion of the site

Site Name	Site Type	Significance Rating	Injecti on borefie Id	Type of Harm (Direct/ Indirect/ None)	Degree of Harm (Total/ Partial/ None)	Consequences of Harm (Total Loss of Value/ Partial Loss of Value/ No Loss of Value)	Impact Assessment
							through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.
UD 113	Isolated Artefact	Low	6	Direct	Total	Total loss of value	UD 113 is located within the disturbance area and will be directly impacted by the Project resulting in a total loss of value.
UD 118	Artefacts	Low	6	Direct	Partial	Total loss of value	UD 118 is located partially within the disturbance area and on an existing access track. As the proportional loss of this site is over 50%, the site will be directly impacted with a total loss of value. The Project may indirectly impact the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.
UD 123	Artefacts	Moderate	6	Direct	Partial	Partial loss of value	UD 123 is partially located within the disturbance area and will be directly impacted by the Project resulting in a partial loss of value. The Project may indirectly impact the remaining portions of the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.
UD 138	Artefacts	Low	6	Indirect	None	No loss of value	The site occurs within 10 m of the disturbance area in an existing access track. The Project may indirectly impact the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.
B 31	Artefacts	Low	7	Indirect	None	No loss of value	The site is located 35 m north of the disturbance area. The Project may indirectly impact the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.
B 32	Artefacts	Low	7	Indirect	None	No loss of value	The site is located 15 m north of the disturbance area. The Project may indirectly impact the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.
B 33	Artefacts	Moderate	7	Indirect	None	No loss of value	The site is located 30 m north of the disturbance area. The Project may indirectly impact the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation

Site Name	Site Type	Significance Rating	Injecti on borefie Id	Type of Harm (Direct/ Indirect/ None)	Degree of Harm (Total/ Partial/ None)	Consequences of Harm (Total Loss of Value/ Partial Loss of Value/ No Loss of Value)	Impact Assessment
							measures are not implemented.
B 34	Artefacts	Low	7	None	None	No loss of value	These sites will not be impacted by the Project.
B 35	Isolated Artefact	Low	7	None	None	No loss of value	
B 36	Isolated Artefact	Low	7	None	None	No loss of value	
B 37	Isolated Artefact	Low	7	None	None	No loss of value	
B 40	Isolated Artefact	Low	7	None	None	No loss of value	
B 41	Isolated Artefact	Low	7	None	None	No loss of value	
B 42	Isolated Artefact	Low	7	None	None	No loss of value	
B 76	Isolated Artefact	Low	7	Indirect	None	No loss of value	This site is located within 5 m of the disturbance area. The Project may indirectly impact the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.
B 30	Hearth, Isolated Artefact	Moderate	7	Direct	Partial	Partial loss of value	This site is located 2 m north of disturbance area. For the purposes of this assessment it is considered to be partially located within the disturbance area and will be directly impacted by the Project, resulting in a partial loss of value. The Project may indirectly impact the remaining portion of the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.
BWR 38	Artefacts	Low	8	None	None	No loss of value	BWR 38 is 70 m north-east of the Nepean access road and would not be impacted by the Project.
W 1	Isolated Artefact	Low	8	None	None	No loss of value	This site was located on the Wintong property boundary fenceline and will not be impacted by the Project.
TO 16	Artefacts	Moderate	8	Indirect	Partial	Partial loss of value	This site is located on the margins of the disturbance area. The Project may indirectly impact the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented. Due to the Project's proximity to the site, there may be partial loss of the value of the site.

Site Name	Site Type	Significance Rating	Injection borefield	Type of Harm (Direct/ Indirect/ None)	Degree of Harm (Total/ Partial/ None)	Consequences of Harm (Total Loss of Value/ Partial Loss of Value/ No Loss of Value)	Impact Assessment
BWR 37	Artefacts	Moderate	8 and Nepean access road	Direct	Partial	Partial loss of value	BWR 37 is a large, moderate artefact scatter located in scalds and eroding from residual soils. The site extends to Burke Wills Road and the disturbance area in injection borefield 8 and will be directly impacted by the Project, resulting in a partial loss of value. The Project may indirectly impact the remaining portions of the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.
BWR IF 1	Isolated Artefact	Low	Nepean access road	Direct	Total	Total loss of value	BWR IF 1 falls within the Nepean access road disturbance area and will be directly impacted by the Project resulting in a total loss of value.
TT 36	Isolated Artefact	Low	9	Direct	Total	Total loss of value	These sites are located within the disturbance area and will be directly impacted by the Project resulting in a total loss of value.
B 51	Artefacts and Hearths	Low	7	Direct	Total	Total loss of value	
TT 24	Isolated Artefact	Low	8	Direct	Total	Total loss of value	
UD 121	Artefacts	Low	4	Direct	Total	Total loss of value	
W 2	Artefacts and Hearths	Moderate	8	Direct	Total	Total loss of value	

13.3.4 Access roads

Nine known sites will be impacted by the Nepean access road. Four of the sites are of moderate scientific significance and five of low scientific significance. Refer to Table 34 for details.

No known sites will be impacted by the West Balranald Access Road.

Table 35: Summary of Potential Impacts within the Nepean access road Project Element on Aboriginal Heritage Sites

Note: Some sites appear more than once in the impact summary tables. This is due to their site boundaries extending across multiple project elements.

Site Name	Site Type	Significance Rating	Type of Harm (Direct/ Indirect/ None)	Degree of Harm (Total/ Partial/ None)	Consequences of Harm (Total Loss of Value/ Partial Loss of Value/ No Loss of Value)	Impact Assessment
B 22	Isolated Artefact	Low	Direct	Total	Total loss of value	This site is located within the disturbance area and will be directly impacted by the Project resulting in a total loss of value.
BWR 32	Artefacts and PAD	Moderate	Direct	Partial	Partial loss of value	This site extends to Burke Wills Road and will be directly impacted by the widening of the Burke Wills Road and the disturbance area in injection borefield 5, resulting in a loss of a portion of the site. The Project will indirectly impact the remaining portions of the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented. The site is located adjacent a public access road and management and mitigation measures should consider the potential for impacts through increased pedestrian traffic and unexpected vehicle stops.
BWR 33	Artefacts	Moderate	Direct	Partial	Partial loss of value	BWR 33 includes a low density artefact scatter situated in flat swale and a moderate density artefact scatter located in a dune. The site extends to Burke Wills Road and will be directly impacted by the widening of the Burke Wills Road and the disturbance area in injection borefield 5, resulting in a loss of a portion of the site. The Project will indirectly impact the remaining portions of the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented. The site is located adjacent a public access road and management and mitigation measures should consider the potential for impacts through increased pedestrian traffic and unexpected vehicle stops.
BWR 34	Artefacts and Hearth	Moderate	Direct	Partial	Partial loss of value	The site extends to Burke Wills Road and will be directly impacted by the widening of the Burke Wills Road and the disturbance area in injection borefield 5, resulting in a loss of a portion of the site. The Project will indirectly impact the remaining portions of the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented. The site is located adjacent a public access road and management and mitigation measures should consider the potential for impacts through increased pedestrian traffic and unexpected vehicle stops.
BWR 35	Artefacts and Hearth	Low	Indirect	None	No loss of value	This site is 25 m south and 45 m west from the proposed disturbance area. The Project may indirectly impact the remaining portions of the site through changes to the visual setting of

Site Name	Site Type	Significance Rating	Type of Harm (Direct/ Indirect/ None)	Degree of Harm (Total/ Partial/ None)	Consequences of Harm (Total Loss of Value/ Partial Loss of Value/No Loss of Value)	Impact Assessment
						the site and changes to surface water flows and erosion rates without appropriate management and mitigation measures
BWR 37	Artefacts	Low	Direct	Partial	Partial loss of value	BWR 37 is a large, moderate artefact scatter located in scalds and eroding from residual soils. The site extends to Burke Wills Road and the disturbance area in injection borefield 8 and will be directly impacted by the Project, resulting in a partial loss of value. The Project may indirectly impact the remaining portions of the site through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.
BWR IF 1	Isolated Artefact	Low	Direct	Total	Total loss of value	BWR IF 1 falls within the Nepean access road disturbance area and will be directly impacted by the Project resulting in a total loss of value.
Karra 13	Artefacts and Hearth	Moderate	Direct	Partial	Total loss of value	A portion of this site will be directly impacted by the Project. As the proportional loss of the site is greater than 50%, the impact is determined to result in a total loss of value to the site. The Project may indirectly impact the remaining portions of the site through changes to the visual setting of the site and changes to surface water flows and erosion rates without appropriate management and mitigation measures
TT 16	Artefacts	Low	Direct	Total	Total loss of value	This site is located across two disturbance areas and will be directly impacted by the Project resulting in a total loss of value.

13.3.5 Accommodation facility

No known Aboriginal sites will be impacted by the accommodation facility. The archaeological risk for unknown Aboriginal objects to be present within and adjacent the accommodation facility is considered low due to ground disturbance from cropping, agriculture and duplex soils.

13.3.6 Water supply pipeline

No known Aboriginal sites will be impacted by the water supply pipeline. The archaeological risk for unknown Aboriginal objects to be present within the proposed water supply pipeline disturbance footprint is for the most part considered low due to the levels of land use and disturbance including access tracks and vegetation clearance.

13.3.7 Gravel extraction

No known Aboriginal sites will be impacted by the proposed gravel extraction areas. There are several sites located in close proximity to Gravel extraction area C, including WB 105. The Project may indirectly impact these sites through changes to the visual setting of the site and changes to surface water flows and erosion rates if appropriate management and mitigation measures are not implemented.

Gravel extraction area A is situated within the moderate archaeological risk layer. Gravel extraction area B contains areas of moderate and low archaeological risk. A very small portion (0.05%) of Gravel extraction area C falls within the high archaeological risk layer while the bulk of the gravel extraction area falls within the moderate archaeological risk layer.

13.4 Potential Cumulative Impacts

Cumulative impacts are the successive, incremental and combined impacts of one or more activities on the environment, including cultural heritage values. Taken in context with pre-existing development and conservation in the region, the Balranald Project would have some effect on the cumulative impact on the Aboriginal cultural heritage of the local area and region. Pre-existing impacts in the region include land clearing and agricultural activities, and the recently approved Atlas-Campaspe Mineral Sands Project near Hatfield (approximately 14 km north-east of the Project area). Pre-existing conservation areas in the local area include the WLRWHA (including Mungo National Park) and lands under Southern Mallee Conservation Agreements.

The pre-existing disturbance to the landscape within the Project area and region represent significant ground surface modification, and given that the majority of the archaeological record is found on deflated surface in the Project area and surrounds it is reasonable to suggest that there are high levels of pre-existing harm to the archaeological record, and to the cultural heritage of the region. In conservation areas this harm from land clearing and agricultural activities such as over grazing has been arrested, and in the WLRWHA, managed to conserve heritage values.

The dominant character of the archaeological record of the local area was previously not well known. The results of the current assessment indicates that the Project area generally contains surface stone artefact sites with most having very low numbers of artefacts. For the most part these sites are interpreted to be Holocene in age. In some places, such as the lunettes and dunes in Injection borefield 3 for example, the Project area has the potential to contain both larger and/or older sites, although these are very unlikely to be as significant as the sites in the WLRWHA due to the comparative size of sites in the project area and the scale of the landforms such as lunettes. The scale of the development of the Project is unprecedented in the local area and region, with the largest comparative development being the Atlas-Campaspe Mineral Sands Project). For the most part the potential impacts of the Project involve the harm of relatively high

numbers of low value archaeological sites. This is not considered a significant cumulative impact because the results of this assessment indicate that similar archaeological sites, of similar value will be present in commensurate environmental contexts immediately adjacent to the Project area, and throughout the local area and region. Some areas of high and moderate archaeological sensitivity will be impacted by the Project, however such areas will also occur adjacent in the local area, and throughout the region.

When considered in context of the large areas of land that have been subject to agricultural activities in the region, areas of conservation that are already present within the region, and the relatively confined nature and flexibility of some parts of the Project, and for the reasons stated above, the cumulative impact of the Project on Aboriginal cultural heritage is considered to be low and within acceptable limits.

13.5 Potential Impacts on Willandra Lakes Region World Heritage and Natural Heritage Values

This part of the impact assessment considers any potential impacts on the World Heritage and Natural Heritage values that relate to the WLRWHA (Figure 1). These values are defined by the Commonwealth government in relation to the gazettal of the WLRWHA. The WLRWHA was inscribed on the World Heritage List in 1981 and further refined and endorsed by the World Heritage Committee in 1995. The WLRWHA was one of the first Australian sites to achieve World Heritage status, with the Great Barrier Reef and Kakadu also being nominated and accessioned to the World Heritage List in 1981.

The WLRWHA has been defined using the following World Heritage values:

Natural

- as an outstanding example representing the major stages in the earth's evolutionary history; and
- as an outstanding example representing significant ongoing geological processes.

Cultural

- bearing an exceptional testimony to a past civilisation.

In 2007, the (then) Commonwealth Department of Environment and Water Resources provided a determination regarding World Heritage Places in the National Heritage List. The Schedule (Schedule 3) of the *Environment and Heritage Legislation Amendment Act (No 1) 2003*, sets out what properties shall be included in the National Heritage List for those heritage values that the World Heritage Committee has identified the property as having. As a consequence of this instrument, criteria for World Heritage Values and Corresponding National Heritage Criteria have been brought into alignment.

Following the above Schedule, the criteria for World Heritage Values listed for the WLRWHA are set out below:

- (iii) to bear a unique or at least exceptional testimony to a cultural tradition or to a civilization which is living or which has disappeared;*
- (viii) to be outstanding examples representing major stages of earth's history, including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features.*

The corresponding National Heritage Criteria which defines National Heritage Values for the WLRWHA are also set out below:

- (a) *the place has outstanding heritage value to the nation because of the place's importance in the course, or pattern, of Australia's natural or cultural history;*
- (b) *the place has outstanding heritage value to the nation because of the place's possession of uncommon, rare or endangered aspects of Australia's natural or cultural history;*
- (c) *the place has outstanding heritage value to the nation because of the place's potential to yield information that will contribute to an understanding of Australia's natural or cultural history; and*
- (g) *the place has outstanding heritage value to the nation because of the place's strong or special association with a particular community or cultural group for social, cultural or spiritual reasons.*

Further cultural heritage values and criteria for the inscription of the WLRWHA into the National heritage List are also listed by the Commonwealth government and are summarised below. Broadly these criteria can be described as landforms and locations which greatly extend our understanding of Australia's environmental and Aboriginal cultural history, including:

- *exposures of sedimentary sequences which reveal Pleistocene sedimentary profiles and associated archaeological and paleontological materials;*
- *extensive intact lakeshore landforms that may contain extensive archaeological and paleontological materials;*
- *the remains of hearths, including those with considerable antiquity, which have provided an ideal source for palaeomagnetism measurements;*
- *archaeological sites which occur within stratified sedimentary sequences and provide evidence for the antiquity and continuing presence of human occupation;*
- *archaeological sites which contain evidence of utilisation of lacustrine resources during lake full phases, and rangeland resources during arid phases;*
- *archaeological sites which demonstrate continuity of human occupation for the region through fluctuations in lake levels drying of the system about 15,000 years ago through the Holocene period and up to historic times;*
- *archaeological sites which provide outstanding examples of hunting and gathering, a way of life that has dominated the Australian continent up to modern times, including:*
- *evidence of human occupation of, and interaction with, the landscape of lakes, lunettes and sand dunes over time in the form of campsites, middens, fireplaces, quarries, knapping floors and burials; and*
- *campsites and fireplaces that reflect people's hunting, gathering and fishing diet;*
- *burial sites which are of global significance for the antiquity of burial practices represented and also for the information they provide on the development of human societies, including Pleistocene and Holocene burial sites; and*
- *burial sites with associated mortuary goods and evidence of ritual burials which demonstrate the antiquity of particular burial practices and the development of religious beliefs and systems over time.*

Given the above criteria and previously listed values, an assessment of whether the Balranald Project affects these values was undertaken.

The Balranald Project is located (Figure 1, Figure 7) to the east and south-east of the WLRWHA. There are no development activities proposed for the Balranald Project that will directly or indirectly affect the cultural heritage values contained within the WLRWHA. The closest point of the project area to the WLRWHA boundary is the western injection bore fields which lie between 15 km and 16 km from the eastern boundary of the WLRWHA. At its closest point the Nepean mine area is approximately 22 km south-east of the WLRWHA boundary. The West Balranald mine is located approximately 34 km from the eastern

boundary of the WLRWHA. All proposed access roads and other bore fields are located well to the east (at least 25 km) of the nearest WLRWHA boundary.

In summary the location of the project area is distant enough from the WLRWHA for there to be no foreseeable direct or indirect physical impacts on the WLRWHA, and hence there are no apparent impacts to the identified World Heritage or National Heritage values from the proposed Balranald Project.

In addition to the above impact review, based on current archaeological and geomorphic evidence, including extensive field survey during this assessment, there are no identified outstanding examples of landscapes or geomorphic features located in the project area that have similar values to the WLRWHA (i.e. World Heritage Values criteria iii & iiiv). According to current evidence and known Aboriginal cultural knowledge, there are no places or sites located within the project area that represent exceptional testimony to a cultural tradition or to a civilisation which is living or which has disappeared. To date no raw material sources have been identified within the Project area but it is possible that material sourced from silcrete quarries in the WLRWHA were discarded in the Project area. However there has been little dedicated research to inform such knowledge in the local area.

Similarly, comparing the cultural heritage resource recorded within the project area to the National Heritage Values (a), (b), (c) and (g) listed by the Commonwealth, there are no recorded Aboriginal sites or places of cultural significance that have outstanding heritage values significant to the nation identified within the project area. There are some sites recorded within or just outside the project area that do contain important archaeological evidence of comparatively ancient Aboriginal occupation, but none are considered to have the same scientific significance of sites or places recorded in the WLRWHA.

14. Management and Mitigation Measures

14.1 Conservation Principles and Management Framework

The scale and geographical dispersal of the archaeological resource within the project area is large. In the areas that have been classified as high archaeological risk layers, there is a near continuous distribution of Aboriginal objects. These objects are located in a challenging depositional context affected by changing climate, environmental conditions, drainage regimes and landscape formation. A detailed understanding of how Aboriginal people have utilised this landscape in the past (beyond just the presentation of the location and contents of sites) requires a concerted and multifaceted approach, and would represent a serious investment to obtain detailed information. The question becomes how best to manage the archaeological resource given its abundance, scale and the challenges it presents to interpretation. This is a matter of the prioritisation of opportunities that best mitigate harm through the provision of information about the past that is both scientifically relevant, and culturally fulfilling to the Aboriginal community, based on their advice.

The two founding principles behind the *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (OEH 2011:12) are ecologically sustainable development and intergenerational equity. These principles hold that “the present generation should make every effort to ensure the health, diversity and productivity of the environment – which includes cultural heritage – is available for the benefit of future generations”.

The strong emphasis, as in the Burra Charter, is to quantify and understand the heritage values of a place, a site, or an object and exhaust avenues of avoiding harm to those values. If harm cannot be avoided then there must be consideration and implementation of strategies to minimise and mitigate harm (OEH 2011: 13).

It follows that the hierarchy for consideration in regards to management strategies available for surface stone artefacts and subsurface stone artefacts and areas of archaeological potential, fall into four general categories, in order of preference from a conservation perspective:

- Avoidance and in-situ conservation.
- Partial avoidance and partial in-situ conservation (includes partial harm).
- Harm caused with mitigating circumstances such as collection or salvage.
- Unmitigated harm.

The four general management strategies categories (described above) have been considered in the following subsections with regard to both direct impacts (e.g. surface disturbance) and indirect impacts (e.g. increased erosion, unintentional increase in traffic). Specifically for the Balranald Project the following hierarchy of mitigation and management has been pursued:

- Avoidance of known sites/high risk areas during mine plan development (to be ongoing during further detailed design).
- For unavoidable impacts, mitigation via:
 - salvage excavation and landscape characterisation of areas of research interest;
 - salvage surface collection in high and moderate risk layers;
 - unmitigated harm in low risk layer.

14.1.1 Avoidance of known sites and high risk areas during mine plan development

The Project design has been in development for a number of years. The results of the 2012 and 2013 field programs, including due diligence assessments, have been used to help inform mine design decisions. The location of all known sites and draft versions of the archaeological risk layer were provided to Iluka mine designers with a brief to avoid (where feasible) high risk layers and known sites.

Examples of mine design changes which have reduced the overall impact to known Aboriginal sites via this process include:

- The reduction of the Nepean mine site footprint resulting in the avoidance of Aboriginal sites N1, N3 and N7;
- The reduction of the West Balranald disturbance areas thereby:
 - avoiding the western lunette of Muckee Lake;
 - reducing the area of impact to high significance site WB 40; and,
 - avoidance of a large number of sites to the east of the mine disturbance area.
- Inclusion of gravel extraction areas in locations that have previously been disturbed by ploughing and cropping or that fall within the low archaeological risk layer; and,
- Adoption of a water supply corridor within land that is substantially disturbed.

There may be further opportunities for avoidance of known Aboriginal objects and areas of moderate to high archaeological risk throughout the lifespan of the project. Iluka will continue to optimise the mine plan through the detailed design phase of the Balranald Project, including minimising the disturbance of land with high environmental and heritage values. These will be identified and managed within an Aboriginal Cultural Heritage Management Plan (ACHMP).

14.1.2 Avoidance of known sites and high risk areas throughout the project lifespan

Where there is opportunity to avoid identified Aboriginal objects and archaeological risk in proximity to proposed activities, appropriate precautionary measures should be implemented. These should be identified as early as possible and by appropriate internal mechanisms, for example using ground disturbance permits and take into consideration the archaeological risk layer and known sites.

Archaeological Risk Layer – High Risk

In areas of high risk there is a high probability that Aboriginal objects are present.

All opportunities should be taken where possible to reduce impact to areas of high archaeological risk.

Where possible, on principle, sites and sensitive landscape features such as lunettes and source-bordering dunes should be avoided to minimise the risk of disturbing either known or unidentified surface and subsurface Aboriginal objects. Management and mitigation measures should be employed such as:

- Establishment of vehicle and pedestrian exclusion (“no-go”) zones for sites and high risk areas
- effective communication to employees and site visitors;
- Effective management of erosion and sedimentation through the preparation and implementation of an Erosion and Sediment Control Plan (ESCP).

Archaeological Risk Layer - Moderate Risk

In areas of moderate risk there is a reasonable probability that Aboriginal objects are present.

Where possible all opportunities should be taken to reduce impact to areas of moderate archaeological risk.

On principle, sites should be avoided where possible, but this risk layer should not be considered a major constraint to works, as long as the mitigation measures described are implemented.

Archaeological Risk Layer - Low Risk

In areas of low risk, occasional Aboriginal objects of low significance may be present.

Subsurface archaeological deposits will most likely be limited, shallow and disturbed and generally contain few artefacts.

Where possible, on principle, sites should be avoided. There is however limited economic or scientific imperative to avoid sites within the low risk layer due to their low scientific value, their limited ability to inform our understanding of the past and the comparatively rich opportunity the moderate to high risk layers have to improve our understanding of past Aboriginal land use in the local area. In terms of scientific value, unmitigated harm is an acceptable management measure for Aboriginal objects within the low risk area.

Known Sites

Where known Aboriginal sites can be avoided management and mitigation measures such as exclusion (“no-go”) zones should be utilised.

Exclusion zones should be considered for sites within 100 m of proposed activities. The size of the exclusion zone should include a buffer of the known Aboriginal site. The size of the buffer and exclusion zone should reflect the scale of the site, its significance and the intensity of the development nearby. As a general rule, buffer zones should be no less than 10 m but should be as large as practicable. Exclusion zones should consider the use of temporary fencing, flagging or bunting to prevent accidental traffic and harm to sites.

Known sites and their immediate landscape are also at risk of erosion and all activities should be undertaken with consideration to minimising the effects of erosion on sites.

14.1.3 Where sites and archaeological risk cannot be avoided

For the Project to proceed, it will be necessary to harm areas of moderate and high archaeological risk and sites of moderate significance. Unmitigated harm cannot be justified in these portions of the project area on the grounds that:

- Aboriginal objects and past landscapes hold cultural value to the Registered Aboriginal parties;
- The project area represents a geographically large and relatively under investigated landscape between the Murrumbidgee, Lachlan Rivers and the Willandra Lakes World Heritage Area; and,
- Given the above, the project area holds significant potential to inform the contemporary community about past Aboriginal land use of this area which is adjacent to regions of well documented Aboriginal cultural heritage value.

The aim of mitigation through salvage, given that harm cannot be avoided, should be to save a representative sample of information for future generations and to maintain or improve intergenerational equity and social capital.

One of the main values of managing the archaeological resource and mitigation through salvage is to gain a story that gives information back to the Aboriginal community about their ancestors, and increasing the overall awareness in the wider community of how Aboriginal people have used this changing landscape and

its resources over time. Due to the complicated depositional history of the environment, it is not simply a matter of collecting objects from the surface and expecting these to be able to tell that story.

Research program to mitigate loss of archaeological and cultural resource

A research program would assist in characterizing the moderate to high risk archaeological layers and assist to mitigate the potential harm from the Project through the provision of new or additional knowledge about past Aboriginal land use in the area. The acquisition of this knowledge would provide a more detailed understanding of how this area, adjacent to the WLRWHA, was used in relation to surrounding areas, providing a more holistic history of south-western NSW.

The significance assessment identified that the primary research question and scientific value of the archaeological resource in the project area was the story of the Box Creek distributary streams of the Lachlan River and how people have utilised it and the project area’s lakes as the availability of water changed from the terminal Pleistocene to the present. Were people using this area at different times and in different ways to the adjacent Willandra Lakes World Heritage Area and the Lachlan River?

To answer this question the following questions need to be asked:

- When were people occupying the landscape?
- Are there buried and dateable archaeological deposits in the project area?
- How and when was the landscape formed?
- When was water available in the landscape?
- How were people utilising the landscape and what activities were they undertaking?
- How were people utilising stone raw materials in the project area and is there a connection to the tone sources in the WLRWHA?

Not all areas within the project area have the ability to answer these questions and investment in time and energy should focus on those areas where impact cannot be avoided and have the greatest likelihood of adding to the primary values of the project area. Areas that have the potential to provide the most relevant information to the above question include:

- Relict lake beds, wetlands, dunes and lunettes which can be sampled for changes in soil conditions and other environmental proxies.
- Sites which contain dateable hearths;
- Sites which contain sufficient artefact assemblages to inform how people were utilising the landscape and what activities they were undertaking – typically sites of moderate to high significant sites; and
- Landforms associated with sites that contain potential dateable archaeological deposits, potential information about how the landscape was formed and artefact assemblages of sufficient size to inform how people were utilising the landscape for example:
 - Low and eroding source bordering dunes associated with wetland features and Aboriginal sites TO 2 / TO 20 and W 2;
 - A series of dunes associated with known Aboriginal sites BWR 32, BWR 44, B 81;
 - A series of sand hills and source bordering dunes associated with alluvial plains and known Aboriginal sites UD 81 to UD 106;
 - Relict lunette and source bordering dunes associated with relict lakes associated with known Aboriginal sites UD 34 to UD 80;
 - The western shoreline and source bordering dunes of Pitarpunga Lake, in proximity to overflows of Box Creek and associated with known Aboriginal sites WB 107 and Karra 33;

- The margins of the western lunette and dune deposit of Muckee Lake associated with WB 40 and WB 67 to WB 81.

To achieve the aims of the research program, a combined surface collection, archaeological salvage excavation of a sample of areas of research interest that fall within the final disturbance footprint and geomorphology investigation would be required, and is proposed.

Surface Collection

In addition to the dedicated excavations in the areas of high information potential surface collection is proposed for all areas of the moderate and high archaeological risk layers that will be impacted by the proposed development.

The surface collection should include the accurate provenance of each artefact using a differential GPS, and the collection of dating samples from hearths. Combined with information from the areas of high information potential and the relevant geomorphological landscape characterisation this information can be interpreted to construct a history of past Aboriginal land use. This history would provide a valuable addition to the well known Aboriginal heritage of the region at Lake Mungo and the WLRWHA.

Archaeological Research and Salvage Program

It is envisaged that any such salvage program would involve at a minimum:

- Justification both scientific and economic of appropriate scale and scope
- The development of a suitable a research plan and salvage excavation methodology that:
 - Identifies suitable and reasonable sample locations for the excavation within the final disturbance footprint within areas of research interest, collection and analysis of Aboriginal objects by suitably qualified individuals
 - Considers stratigraphic trenches at the locations to identify whether archaeological deposits were present and to take soil and OSL dating samples
 - Geomorphic analysis by a qualified geomorphologist of the selected locations;

Summary

Table 36. Recommended management of risk layers associated with unsurveyed area and known sites.

Risk Layer	Unsurveyed Area	Known Sites
High	<ul style="list-style-type: none"> ▪ Avoidance where possible, where not possible: <ul style="list-style-type: none"> ○ Staged block pre-impact surface collection and clearance of the disturbance area with point provenance of artefacts ○ Collection of dating samples from hearths 	<ul style="list-style-type: none"> ▪ Avoidance of High Significance Sites <ul style="list-style-type: none"> ○ Avoidance where possible, where not possible: ○ Selection of a sample of landscapes associated with known moderate and high significance sites and key focus research areas for salvage excavation ○ Pre-impact surface collection/clearance point provenance of artefacts ○ Collection of dating samples from hearths
Moderate	<ul style="list-style-type: none"> ▪ Avoidance where possible, where not possible: <ul style="list-style-type: none"> ○ Staged block pre-impact surface collection and clearance of the disturbance area with point provenance of artefacts ▪ Collection of dating samples from hearths 	<ul style="list-style-type: none"> ▪ Avoidance where possible, where not possible: <ul style="list-style-type: none"> ○ Pre-impact surface collection/clearance point provenance of artefacts ○ Selection of a sample of landscapes associated with known moderate significance sites and key focus research areas for salvage excavation ○ Collection of dating samples from hearths
Low	<ul style="list-style-type: none"> ▪ No management and mitigation measures 	<ul style="list-style-type: none"> ▪ Avoidance where possible. Where not possible, no management and mitigation measures

Management of unexpected finds other than stone artefacts and/or hearths

Culturally Modified Trees

Culturally modified trees are rare within the project area. In the unlikely event that a mature age tree with suspected cultural scarring is located during pre-impact surface collection and clearance; a suitably qualified individual should assess whether the tree is of Aboriginal origin. An assessment should be made to determine if impact to the tree can be avoided. Protocol should be developed for the management of culturally modified trees if they cannot be avoided.

Middens and Mound

Middens and mounds are rare site types within the project area and have only been identified in one location outside of the disturbance footprint. In the unlikely event that a midden or mound is identified during pre-impact surface collection and clearance, an assessment should be made if the impact to the midden or mound can be avoided. Protocol should be developed for the management of middens or mounds if they are identified and cannot be avoided.

Human Remains

Though no human remains were identified during the assessment process, burials are known to occur within lunettes, source bordering dunes, levees associated with water courses within the wider region. In the case of human remains, all work should stop and the police be notified in accordance with current regulation.

15. Conclusion

The assessment utilised a sampling strategy that provided sufficient information to characterise the archaeological resource of the project area. As a result of the assessment, 548 Aboriginal sites were identified and areas of low, moderate and high likelihood of containing Aboriginal objects were identified and visualised in a GIS database. Of the 548 Aboriginal sites identified, 383 were located within the project area and 256 were located in the disturbance area. A significance assessment and an impact assessment was completed for each of the sites.

The Project area has social significance to the Aboriginal community because it contains archaeological sites and traditional resources that establish a link between the past and present Aboriginal use of the land.

The project area contains landscapes which have high and moderate archaeological value, but for the most part contains landscapes that are of low archaeological value. The high and moderate value areas include the Box Creek distributary stream at the northern end of the West Balranald mine and areas of relict lake fringes and depressions at the northern injection borefields and Muckee Lake. These parts of the project area are significant because they may reveal important details about how and when Aboriginal people lived in this area, and how Aboriginal settlement of the area relates to, and informs what is known of Aboriginal history in adjoining areas, including the Willandra Lakes Region World Heritage Area. In particular the areas of high and moderate significance within the project area may provide a story of how people have utilised the area and how this relates to the active and inactive phases of Box Creek's history, and the episodic filling history of the lakes as the availability of water changed from the terminal Pleistocene to the present. As well as providing information about the chronology and nature of Aboriginal settlement of the region, the project area may also provide additional information on the local and regional use and distribution of resources, such as raw materials for making stone tools.

Management and mitigation measures were formulated and discussed with the Registered Aboriginal Parties in accordance with the *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (OEH 2011:12) and *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010 (the ACHCRs)* (DECCW 2010b).

The management and mitigation measures recommended in this report are based on the two founding principles behind the *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (OEH 2011:12): ecologically sustainable development and intergenerational equity. These principles hold that "the present generation should make every effort to ensure the health, diversity and productivity of the environment – which includes cultural heritage – is available for the benefit of future generations".

The strong emphasis, as in the Burra Charter, is to quantify and understand the heritage values of a place, a site, or an object and exhaust avenues of avoiding harm to those values. If harm cannot be avoided then there must be consideration and implementation of strategies to minimise and mitigate harm (OEH 2011: 13).

Four general management strategies were considered and have been pursued for the Balranald Project with regard to both direct impacts (e.g. surface disturbance) and indirect impacts to Aboriginal sites (e.g. increased erosion, unintentional increase in traffic):

- Avoidance of known sites/high risk areas during mine plan development (to be ongoing during further detailed design).
- For unavoidable impacts, mitigation via:
 - salvage excavation and landscape characterisation of a sample of areas of research interest;
 - salvage surface collection in high and moderate risk layers;
 - unmitigated harm in low risk layer.

The managementt recommendations pursuant to this Aboriginal cultural heritage assessment are presented in Section 16.

By undertaking the above process, this Aboriginal Cultural Heritage Assessment report has been carried out in accordance with the SEARs and with reference to the following standards, guidelines and policies:

- *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (NSW Department of Environment, Climate Change and Water [DECCW] 2010a) (the Code).
- *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (NSW Office of Environment and Heritage [OEH] 2011).
- *Draft Guidelines for Aboriginal Cultural Heritage Assessment and Community Consultation* (NSW Department of Environment and Conservation, 2005).
- *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (the ACHCRs) (DECCW 2010b).

16. Recommendations

Based on the scientific significance of the Aboriginal heritage sites presented in Section 12, the impact assessment presented in Section 13 and the suggested management and mitigation measures outlined in Section 14, the following recommendations are made regarding the management of Aboriginal cultural heritage values and sites within the project area.

Aboriginal Cultural Heritage Management Plan

1. An Aboriginal Cultural Heritage Management Plan (ACHMP) should be developed for the Project.
2. The ACHMP must articulate the mitigation and management measures presented in this report for the development, operational and decommissioning stages of the Project.
3. The ACHMP should be developed in consultation with the RAPs.
4. The ACHMP must include, but not be limited to the following:
 - a) Protocols that prescribe the involvement of the RAPs in the preparation, implementation and ongoing review and maintenance of the ACHMP.
 - b) Protocols that prescribe the involvement of the RAPs in cultural heritage works conducted under the ACHMP.
 - c) Provisions for the management of culturally sensitive information.
 - d) A communications protocol that describes clear methods of communication, including expectations of suitable notification and response times, between Iluka and the RAPs.
 - e) Procedures to establish and maintain (via frequent scheduled updates) a GIS database of Aboriginal heritage sites, their boundaries, their management status and archaeological risk identified within the Project area (i.e. the Balranald Project Aboriginal Heritage Database).
 - f) A protocol for the protection, storage, management and access arrangements for (short and long-term) salvaged Aboriginal objects informed by the wishes of the RAPs.
 - g) A protocol for the discovery and management of human remains within the Project area, including stop work provisions and notification protocols.
 - h) Procedures for the management and reporting of previously unknown Aboriginal heritage sites that may be identified during the life of the Project, consistent with the management measures described in Section 14 (ie. management measures should give consideration to the site's heritage values).
 - i) Protocols for heritage awareness training to be incorporated into the mine site inductions for both employees and sub-contractors who may be conducting works within the Project area which have the potential to impact on any Aboriginal heritage site or are working in areas of moderate to high archaeological risk.
 - j) A procedure for documenting, communicating and incorporating into the ACHMP a record of authorised impacts to sites, and a record of sites avoided (through detailed design for example).

5. Procedures for activities when working in moderate and high archaeological risk layers, including but not limited to:
 - a. Constraining vehicle and people movements to defined disturbance footprints (to minimize the risk of disturbance outside of the footprints) ;
 - b. Implementation and maintenance of controls for sediment, erosion and waterflow through instruments such as the Environmental Sediment Control Plan; and
 - c. Avoidance of known sites and areas of high risk (via , temporary fencing, signage etc)
6. Procedures for the preparation and staged implementation of the archaeological research and salvage programs (see additional recommendations in recommendations 8 and 9).
7. A regular review process for the ACHMP that:
 - a) Considers operational adequacy and efficacy.
 - b) Updates the management detail of the ACHMP as the project progresses.
 - c) Reviews the compliance of the ACHMP outcomes against the Project approval.
 - d) Initiates a mechanism for amendment in accordance with the above protocols.

Additional Recommendations

8. Surface salvage collection and management of areas based on risk rating

A detailed surface salvage collection program for sites directly disturbed as a result of the Project. The scope of the surface salvage collection program will include the following (as described in Section 14.1.3.

- a) Moderate Risk Layer areas
 - Pre-impact block surface clearance and surface salvage of sites within the disturbance area - collection of all visible surface artefacts and collection of dating samples.
- b) High Risk Layer areas
 - Pre-impact block surface clearance and surface salvage of sites within the disturbance area - collection of all visible surface artefacts and collection of dating samples.
- c) Low Risk Layer areas
 - No management

Details of the surface collection program should be contained in the ACHMP.

9. Archaeological research and salvage excavation program

A detailed archaeological research and salvage excavation program for Aboriginal heritage sites and the archaeological risk layers that will be subject to surface disturbance as a result of the final footprint associated with the Project. The research and salvage program must include the detail of the proposed salvage works, including the following (as described in Section 14):

- e) Methods for accurate location recording and surface salvage collection of artefacts.
- f) Methods for accurate location recording and collection of dating samples. Methods for the undertaking of salvage excavations in

up to eight locations within the final disturbance footprint and within landforms within the moderate to high risk layer that are associated with known sites a have the greatest potential to contribute to our understanding of past Aboriginal land use in the project area (areas of research interest) and that include

- g) :
 - Exact and appropriate locations of the proposed excavations, including their nature and size;
 - Justification – both scientific and economic - of appropriate scale and scope of the works;
 - Geomorphic analysis by a qualified geomorphologist;
 - Collection of charcoal and OSL dating samples;
 - Collection of soil samples;
 - Collection of artefacts and other cultural materials (if present); and
 - Reporting procedures.
- h) Details of the research and salvage program should be contained in the ACHMP as per recommendation 4.

17. Glossary

Term	Definition
Aboriginal cultural heritage	The tangible (objects) and intangible (dreaming stories, legends and places) cultural practices and traditions associated with past and present day Aboriginal communities.
Aboriginal object(s)	The legal definition for tangible aspects of Aboriginal cultural heritage under the NSW <i>National Parks and Wildlife Act 1974</i> .
Aboriginal stakeholders	Members of a local Aboriginal land council, registered holders of Native Title, Aboriginal groups or other Aboriginal people who may have an interest in the Project.
ACHA	Aboriginal Cultural Heritage Assessment.
ACHMP	Aboriginal Cultural Heritage Management Plan.
ACHCRs	<i>Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010</i> .
Adze	A retouched artefact used to process wood/bone. Australian Aboriginal adzes are often called Tula.
AHIMS	NSW Aboriginal Heritage Information Management System.
Angular Fragment	An artefact clearly derived from cultural activity that lacks diagnostic features used to classify into core, flake or retouched flake categories.
Anvil	A stone (fixed or portable) used to stabilise a core during manufacture.
Archaeological deposit	A layer of sediment known to contain archaeological material.
Archaeological investigation	The process of assessing the archaeological potential of an area by a qualified archaeologist.
Archaeological risk layer	A GIS dataset designed to predict the likelihood of the presence of Aboriginal objects in a landscape.
Archaeological site	A location preserving material evidence of past human activity.
Archaeology	The scientific study of human history, particularly the cultural remains of the distant past.
Artefact	Any object made by humans (e.g. stone artefacts).
Assemblage	Assemblage can be used to define: <ul style="list-style-type: none"> ▪ A group of stone artefacts found in close association with one another; or ▪ Any group of items designated for analysis - without any assumptions of chronological or spatial relatedness.
Avoidance	A management strategy which protects Aboriginal sites within an impact area by avoiding them totally in development.
Axe Fragment	A stone fragment detached from an axe identified by the presence of a ground surface
Backed Artefact	A retouched artefact with steep bidirectional retouch along one margin. This retouch, called backing creates a greater surface area on the flake, assisting hafting mastic (resins) in composite tool technologies.
BAHS	Balranald Aboriginal Health Service.
Bora Rings	Sites of Aboriginal cultural significance, containing a ring of depressed/raised earth or stone. Used for ceremonial activities. Multiple rings can occur in one place.
Borehole	A hole produced in the ground by drilling for the investigation and assessment of soil

Term	Definition
	and rock profiles.
Burial	Location of human burial.
Burin	A technological class of artefact, a burin is created by striking a flake from each margin of a flake (resulting in Burin Spalls) that creates a stout edge suitable for drilling.
Burin Spall	A flake detached from the margin of the flake during production of a burin.
Burren	A retouched artefact with steep stepped retouch around all flake margins. Retouch is generally unifacial and the artefact is generally rectangular in shape.
Catchment	The area from which a surface watercourse or a groundwater system derives its water.
Cemetery	Location of multiple human burials.
Continuous Scatter	Aboriginal objects present (either surface or subsurface) separated by less than 40 m.
Core	An artefact from which flakes are detached that preserves only negative flake scars. Core types can include Single Platform, Multiplatform, Bipolar etc.
Core Tool	A core that has been used as a tool.
Culturally Modified Trees	Trees preserving evidence of human alteration. Examples include bark removal for: <ul style="list-style-type: none"> ▪ shelters; ▪ canoes; ▪ shields; ▪ coolamons; ▪ food; ▪ grub or possums hunting; ▪ burial huts etc.
Cumulative impacts	Combination of individual effects of the same kind due to multiple actions from various sources over time.
DECCW	NSW Department of Environment Climate Change and Water.
Discontinuous	Areas with diameters of 50 m or greater that do not contain Aboriginal objects. This definition is further divided into two categories: <p>Frequent but discontinuous artefact scatters: The occurrence of many sites that are more than 40 m apart and have definable boundaries and are unlikely to be connected by buried artefacts</p> <p>Infrequent and discontinuous artefact scatters: The occasional occurrence of a site with clearly definable boundaries.</p>
Disturbance Area	Land directly disturbed for the Balranald Project.
Drainage	Natural or artificial means for the interception and removal of surface or subsurface water.
EIS	Environmental Impact Statement.
EP&A Act	<i>Environment Planning and Assessment Act 1979.</i>
EP&A Regulation	<i>Environment Planning and Assessment Regulation 2000.</i>
EPBC	<i>Environment Protection and Biodiversity Conservation Act 1999.</i>
Flake	A piece of stone detached from a core by human action. Diagnostic features include a bulb of percussion, ripples and fissures on the ventral surface, a striking platform and dorsal features that may include evidence of prior flake removal.

Term	Definition
GIS	Geographic Information System.
Grinding (stone)	A stone preserving evidence of grinding (processing plant material, grinding ochre, production of edge ground axes etc.)
Hammerstone	A stone used to detach flakes from a core.
Harm	With regard to Aboriginal objects this has the same meaning as the NSW <i>National Parks and Wildlife Act 1974</i> .
Hearth	Material evidence of surface fire features and fires that were dug into the ground. Hearths were recorded using the definition by Fanning, Holdaway and Phillips in “ <i>Heat-retainer hearth identification as a component of archaeological survey in western NSW, Australia</i> ”
Heat Fragment	Stone (artefact) broken by heat. Can be intentionally heated (heat treatment) or accidental (bushfire; artefact thrown into fire etc.)
HMC	Heavy Mineral Concentration.
IBRA	Interim Biogeographic Regionalisation of Australia.
ICOMOS	International Council on Monuments and Sites.
Iluka	Iluka Resources Limited.
Impact	Influence or effect exerted by a project or other activity on the natural, built and community environment.
<i>In situ</i>	Latin words meaning ‘on the spot, undisturbed’.
Isolated find	A single artefact found in an isolated context, being at least 40 m from other artefacts.
LALC	Local Aboriginal Land Council.
Land unit	An area of common landform, and frequently with common geology, soils and vegetation types, occurring repeatedly at similar points in the landscape over a defined region. It is a constituent part of a land system.
Landform	Any one of the various features that make up the surface of the earth.
Landscape character	The aggregate of built, natural and cultural aspects that make up an area and provide a sense of place. Includes all aspects of a tract of land – built, planted and natural topographical and ecological features.
Management plans	Conservation plans which identify short and long term management strategies for all known sites recorded within a (usually approved) Study area.
Manuport	An unmodified non local stone transported to a location by human activity.
Methodology	The procedures used to undertake an archaeological investigation.
Midden	The accumulation of shell, bone, stone artefacts and other materials related to selection of, cooking and disposal of food.
Mitigation	To address the problem of conflict between land use and site conservation.
Mounds	The accumulation of debris from cooking ovens, habitation site, plant processing etc.
Muller	Interchangeable with top stone: a hand held stone used during grinding activities.
MUP	Mining Unit Plan.
Mythological Sites	Sites of cultural significance that may or may not contain tangible evidence of occupation/use/visitation.

Term	Definition
NNTT	National Native Title Tribunal.
NPW Act	<i>NSW National Parks and Wildlife Act 1974.</i>
NTSCORP	Native Title Services Corporation Limited.
OEH	Office of Environment and Heritage.
Open camp site	An archaeological site situated within an open space (e.g. archaeological material located on a creek bank, in a forest, on a hill, etc.).
OSL	Optically Stimulated Luminescence. A method of dating sediments in archaeological sites.
PAD	Potential Archaeological Deposit. A location considered to have a potential for subsurface archaeological material.
Piercer	A flake used to pierce materials (skins, hides etc).
RAP	Registered Aboriginal Party.
Redirecting Flake	A flake that preserves a portion of a core, detached in order to create a new surface from which to continue flaking. Redirecting flakes are very reliable indicators of technological systems in stone reduction.
REF	Review of Environmental Factors.
Retouched Flake	A flake with secondary flakes scars that impact on or originates from the ventral surface. Retouch can exist on the ventral, dorsal or platform surface of the flake.
Scraper	A retouched artefact with evidence of use in scraping tasks.
SEARs	Secretary's Environmental Assessment Requirements.
Site	A location preserving material evidence of past human activity.
Site Boundary	<p>Defined by the presence of <i>visible</i> Aboriginal objects:</p> <ul style="list-style-type: none"> ▪ separated by a distance of 40 m; ▪ may have an additional 5-10 m buffer; and ▪ can also be defined by landscape feature such as a dune, sand hill or pan. <p>There is always potential for further Aboriginal objects to exist immediately adjacent to a defined site boundary and/or beyond a surveyed area.</p>
Site recording	The systematic process of collecting archaeological data for an archaeological investigation.
SSD	State Significant Development.
Stone Tools	Interchangeable with stone artefacts.
Survey coverage	A graphic and statistical representation of how much of an impact area was actually surveyed and therefore assessed.
The Balranald Project	Balranald Sands Mineral Project.
The Code	<i>Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales 2010.</i>
TSF	Tailing Storage Facility.
WLRWHA	Willandra Lakes Region World Heritage Area.

18. References

Archaeological Consulting Services 2003. Cultural Heritage Assessment for the Balranald Levee, Western NSW. Report prepared for Sinclair Knight Merz.

Australia ICOMOS 2004 *The Illustrated Burra Charter: Good Practice for Heritage Places*, Deakin University, Burwood, Victoria.

Bowler, J.M., 1998. Willandra Lakes revisited: environmental framework for human occupation. *Archaeol in Oceania* 33, 120-155.

CDM Smith Australia Pty Ltd (CDM Smith), 2015, Balranald Mineral Sands Project Groundwater Dependent Ecosystems Assessment Report. Prepared by CDM Smith on behalf of Iluka Resources Pty Ltd.

Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*

Department Environment, Climate Change and Water NSW, 2010a. Archaeological Investigation of Aboriginal Objects in New South Wales: *Part 6 of the National Parks and Wildlife Act 1974*. Department of Environment, Climate Change and Water NSW. Available online at <http://www.environment.nsw.gov.au/resources/cultureheritage/10783FinalArchCoP.pdf>

Department Environment, Climate Change and Water NSW, 2010b. Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010 (the ACHCRs)

Department of Environment and Conservation, 2005 Draft Guidelines for Aboriginal Cultural Heritage Assessment and Community Consultation. NSW Department of Environment and Conservation.

Department Environment, Climate Change and Water NSW 2010b Aboriginal Cultural Heritage Consultation Requirements for Proponents: *Part 6 of the National Parks and Wildlife Act 1974*. Department of Environment, Climate Change and Water NSW. Available online at <http://www.alc.org.au/media/43239/1004%20deccw%20community%20consultation%20requirements.pdf>

EMGA Mitchell McLennan Pty Ltd (EMM), 2015, Balranald Mineral Sands Project Rehabilitation and Closure Strategy. Prepared by EMM on behalf of Iluka Resources Pty Ltd.

EMGA Mitchell McLennan Pty Ltd (EMM), 2015, Balranald Mineral Sands Project Soil Resources Assessment. Prepared by EMM on behalf of Iluka Resources Pty Ltd.

Feldtmann, A. 1976 *The Balranald Story*. Independently published for the Balranald 'Back To' celebration.

Hobler, G. 1825-1871 "George Hobler Journal". Manuscript held in the State Library New South Wales.

Jacobs Group (Australia) Pty Limited (Jacobs), 2015, Balranald Project DFS1 Groundwater Modelling. Prepared by Jacobs on behalf of Iluka Resources Pty Ltd.

Kellet, J.R 1989 The Ivanhoe Block-its structure, hydrogeology and effect on groundwaters of the Riverine Plain of New South Wales.. *BMR Journal of Australian Geology and Geophysics* 11:2-3:333-353. Bureau of Mineral Resources, Geology and Geophysics, Canberra.

Landskape Natural and Cultural Heritage Management (Landskape), 2012, Non-Aboriginal Cultural Heritage Assessment. Prepared by Landskape on behalf of Iluka Resources Pty Ltd.

Martin, S. 1986. Archaeological Survey of Proposed Water Treatment Works Sites at Hay, Balranald and Wentworth, South-Western NSW.

Mitchell P.B. 1991. Historical perspectives on some vegetation and soil changes in semi-arid New South Wales. *Vegetation*91: 169-182

Mitchell, T. 1839 *Three Expeditions into the Interior of Eastern Australia*. Accessed online 5/11/14 at <http://gutenberg.net.au/ebooks/e00036.html>

Niche Environment and Heritage. 2013. Aboriginal Heritage Due Diligence Assessment; Hydrogeological Stage 3 Program Additional Drilling Locations, Balranald Project. Report Prepared for Iluka Resources.

Niche Environment and Heritage. 2013 (June). Aboriginal Heritage Due Diligence Assessment; Borehole Mining Trial. Report Prepared for Iluka Resources.

Niche Environment and Heritage. 2013 (July). Aboriginal Heritage Due Diligence Assessment; Borehole Mining Trial. Report Prepared for Iluka Resources.

Niche Environment and Heritage. 2013. Balranald Mineral Sands Project Aboriginal Cultural Heritage Assessment. Report Prepared for Iluka Resources.

Niche Environment and Heritage. 2014. Aboriginal Heritage Due Diligence Assessment; Hydrogeological Stage 3 Program Additional Drilling Locations, Balranald Project. Report Prepared for Iluka Resources.

Niche Environment and Heritage, 2015, Balranald Mineral Sands Project Biodiversity Assessment. Prepared by Niche Environment and Heritage on behalf of Iluka Resources Pty Ltd.

NSW Environmental Planning and Assessment Regulation 2000

NSW Heritage Office (2001) Assessing heritage significance. A NSW Heritage Manual Update.

NSW NPWS. 1997. Aboriginal Cultural Heritage Standards and Guidelines Kit. Available online at <http://publicationsregister.planning.nsw.gov.au/WebForms/SearchResult.aspx?CategoryID=443&PubStatus=1&TopicID=576>

NSW National Parks & Wildlife Service 2014 *Mungo 1788-1901*. PDF booklet accessed online 10/11/14 at <http://www.visitmungo.com.au/pastoral-history>

NSW Soil Conservation Service, 1991. Land Systems of Western NSW Maps and Report Available on line at the Office of Environment and Heritage website <http://mapdata.environment.nsw.gov.au/geonetwork/srv/en/main.home>

Office of Environment and Heritage. 2011. Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW : *Part 6 of the National Parks and Wildlife Act 1974*. NSW Office of Environment and Heritage. Available online at <http://www.environment.nsw.gov.au/resources/cultureheritage/20110263ACHguide.pdf>

Office of Environment and Heritage. 2012. *Murray Darling Depression Bioregion*. Available online at <http://www.environment.nsw.gov.au/bioregions/MurrayDarlingDepressionBioregion.htm>

Sturt, C. 1833 *Two expeditions into the interior of southern Australia, during the years 1828, 1829, 1830, and 1831: with observations on the soil, climate, and general resources of the Colony of New South Wales*.

First published by Smith, Elder, London, 1833. Accessed online 5/11/14 at <http://www.gutenberg.org/files/4330/4330-h/4330-h.htm>

Thinee, K. and T. Bradford 1998 *Connecting Kin*. NSW Department of Community Services. PDF booklet accessed online 10/11/14 at http://www.community.nsw.gov.au/DOCSWR/assets/main/documents/connectkin_guide.pdf

Tumney, J. 2011. *Environment, landscape and stone technology at Lake Mungo, southwest New South Wales, Australia*. Doctor of Philosophy Thesis. School of Historical and European Studies. Faculty of Humanities and Social Sciences. La Trobe University.

WRM Water & Environment Pty Ltd (WRM), 2015, Balranald Mineral Sands Project Surface Water Management Report. Prepared by WRM on behalf of Iluka Resources Pty Ltd.

Appendix 1 – Community Consultation Records

Due to print size restrictions this appendix has been removed from this printed copy of the Aboriginal cultural heritage assessment. It is available in the electronic copy on CD. To request a copy, please contact Iluka Resources on (08) 8300 200.

Appendix 2 – Notes on the geomorphology of Balranald Project Area

Peter B Mitchell

ABN: 66 179 449 249

Dr P.B. Mitchell OAM.

P.O. Box 515,

GLADESVILLE 1675

Phone: + 02 9817 4859

groundtruth@optusnet.com.au

Notes on the geomorphology of Balranald Project Area.

Revised 7 December 2012

These notes relate to the landscape patterns around Tin Tin and Pitarpunga Lakes approximately 25km north of Balranald in western NSW. They were originally prepared by Dr Peter Mitchell in October 2012 and are based on existing maps, Google Earth imagery, available literature, and two brief field visits. Changes in this revised version are mainly editorial.

Conditions of use

Dr Mitchell retains intellectual property rights to the content of this document but permits the use of this information by Niche Environment and Heritage P/L and their clients on the condition that a full copy of these notes are included as an appendix to Niche reports. All other potential users should seek permission from Dr Mitchell and acknowledge this source as 'Mitchell pers. com'.

Limitations of available data

Researchers working in western NSW face a paucity of recorded data. The area is so large that almost all mapping has been conducted at 1:250,000 scale and most natural boundaries have been derived by interpretation of air photos with limited field checking. Some of the base mapping was done in the 1960s and has not been updated. Across the Balranald study area the most detailed mapping is of the Land Systems (Eldridge circa 1972) and vegetation by Scott (1992). Geology maps have only been produced at 1:1m scale (Brown *et al.*, 1991) and although the geomorphic mapping of Butler *et al.*, (1973) was extremely valuable in establishing a framework for the Riverina this work was produced at 1:500,000 scale and can be difficult to relate to topography in the field.

In recent years topographic data has been produced at a more useful scale of 1:50,000 but even on these maps confirmed levels (spot heights) are sparse and many former drainage channels that are important features in the topography have not been depicted.

Land systems by definition can be subdivided into smaller units such as land classes and land components that are identified in the text accompanying the Land System map sheets but they have never been mapped. The Soil Conservation Service land systems (along with other data) were used by Sahukar *et al.*, (2003) as surrogates for ecosystems across western New South Wales. They were also used by the Service in the preparation of property management plans in the 1970s and 1980s. At those scales and for grazing management they proved to be a useful landscape descriptor but at the scale required for archaeological site survey such as on the Iluka project near Balranald they have little value and individual map polygons should not be expanded to project scale. Mapped boundaries are only accurate to +/-250 metres, they will not register correctly in any GIS system, and can be very misleading on the ground.

The most useful basic data source is Google Earth imagery. Depending on the Google version and the computer used the image can be enlarged to about 1:200 scale and will resolve details about 3m across. This imagery can also be interrogated for elevation which is derived by averaging spot heights sampled on a 90m grid. These figures are not accurate but in country with low relief like this study area they are sufficiently reliable to determine relative heights of features and directions of ground slope.

Geomorphic background

The geomorphology of the Balranald Project Area cannot be understood without placing the Iluka mine lease in the larger context of the lower reaches of the Lachlan and Murrumbidgee Rivers. The best primary guide to this is the work of Butler *et al.*, (1973). Since that was published others have expanded the framework and filled in more detail. The following is a general account pertaining to the study area.

The Riverina extends across the lower reaches of three very large, extremely low angle, alluvial fans of the Murray, Murrumbidgee and Lachlan Rivers (Butler *et al.*, 1973, O'Brien and Burne, 1994, Capon *et al.*, 2008). During the late Pleistocene discharge in these streams has varied with climatic change so that the streams have sometimes carried flows as much as eight times that of the present. In response to changing discharge the river channels have meandered across the width of the fans variously depositing sand, silt and clay at different distances downstream from the fan apex. All three fans overlap and their distal gradients can be as low as 1:5,000. The western edge of the Lachlan fan is overlain by longitudinal aeolian sand dunes oriented approximately west to east carrying mallee scrub, and sand sheets that more often carry chenopods and belah. The dunes and sand sheets are believed to have last been active about 30,000 years ago.

The river channels on the fans have changed in width and meander wavelength depending on the dominant discharge regime at any one time and a broad chronology of change has been established for the Murray and Murrumbidgee (Schumm 1968, Page and Nanson 1996, Page, Nanson and Price 1996, and Page *et al.*, 2001).

The Lachlan fan has not been studied geomorphically but the chronology of hydrologic change and human occupation at Lake Mungo and Lake Mulurulu near the end of Willandra Ck is quite detailed (Bowler 1998, Bowler *et al.*, 2003, and Kelly *et al.*, 2012). Generally the changes in channel form and the temporal patterns of full lake or dry lake periods have been correlated with climate change through the Pleistocene and Holocene, and the general trend has been for increasing aridity (as judged from stream flow) to about the mid-Holocene (Hesse *et al.*, 2004). However without collaborative evidence Box Ck should not be assumed to have an identical chronology as Willandra Ck as other factors, such as possible channel switching at the apex of the fan near Hillston need to be considered.

Geomorphically the following fluvial, lacustrine, and sand dune/sheet landscapes can be seen along all of the streams on the riverine plain.

1. Meandering channels with different wavelengths and channel widths, lined by river red gum, generally fringed by low levees and often with channel beds close to the same level as their adjacent backplain. Flood waters reach the backplain through crevasse splays (breaches in the channel bank and levee).

2. The channels are set within a wide meander plain (floodplain) containing abandoned channels (billabongs), and occasional source bordering sand dunes. The plain is usually covered by black box woodlands on heavy grey clay. Swamps support either lignum (infrequent wetting) or common reed (frequent wetting and standing water).

3. Beyond the meander plain and typically 1 to 2m lower in elevation an extensive backplain occurs which is sometimes treeless and was dominated by chenopods and grasses in pre-European times. Swamps and marshes occur on the backplain and may carry black box or river red gum woodland or large areas of common reed. Fine dendritic channel networks cross the marshes along with areas of open water. Soils in the marshes and swamps are predominantly deep organic grey to black clays that shrink and crack when dry. Swamps and lake beds (clay pans or playas) on this feature are more commonly covered in canegrass. Gilgai of various sorts occur on the backplain and these micro-topographic features can hold standing water as temporary wetlands.

4. Lakes of many different sizes are found throughout the landscape but are best represented on the backplains. There are two kinds of lakes; freshwater lakes or clay pans (playas) that are filled from the river channels during floods and that drain back to the streams as river levels fall, and salt water lakes or saltpans (saline playas) that are groundwater evaporation basins (groundwater windows). Salt lake systems are less common in NSW than in northern Victoria. The largest freshwater lakes are connected to the Murrumbidgee River and these can retain water for a number of years. The largest clay pans (playas) occur on the distal parts of the Lachlan fan and are normally dry. Saline lake beds are rare on the Lachlan fan although many of the clay pans have clay pellet lunettes indicating that the lake surface has been influenced by solutes at some time in the past.

5. Nearly all lakes and clay pans have a lunette on the eastern shores that has formed over time as sediments worked across the lake floor by shallow waves to accumulate in a crescent shaped dune on the eastern shore. The sediments in the lunette may be dominated by aeolian sand or clay and in some cases alternating sand and pelleted clay. Beach facies are usually present along the lake shore. The lunettes preserve an excellent stratigraphic record of change in lake and stream hydrology and have the potential to contain a rich archaeological record as recorded at Lake Mungo. Clay lunettes are formed as the lake beds dry out and surface mud is flocculated by salts. They represent intermediate hydrological conditions between permanent fresh lakes and dry, stable playas. Tin Tin and Pitarpunga Lakes are now dry clay plains that have been partly cultivated since the 1970s. No beaches are evident and there is only slight sheet and gully erosion on the lunettes.

6. Away from the fluvial and lacustrine sediments and landforms the country is covered in red and yellow-red sand formed in longitudinal dunes that stand two to six metres above the swales. In a few places these dunes have passed over old lake beds and in other places the dune morphology is flattened or eroded to the extent that the landscape is better described as a sand sheet.

The dunes and the sand sheets have a core of sand cemented by a calcium carbonate pan (caliche or kunkar) that can be solid rock or an aggregate of pisolitic carbonate

nodules in the B and C-horizons of the natural soil. This material is often quarried for use as road gravel and it was also used as heat retainers in Aboriginal hearths and ovens. In the sand sheet country erosion sometimes exposes the kunkar as low stony ridges from which a limited amount of surface water may drain in exceptionally wet periods. This sheet flow is weakly channelled and moves down gradient into floodout or run-on areas that are characterised by brown sandy clay soil often colonised by old man saltbush. Gilgai may occur in these areas and may hold surface water for some months after exceptional rain. Once flooded the gilgai ponds support ephemeral wetland vegetation including rushes and nardoo and could have provided important resources for Aboriginal people. Occupation of the back country, away from the lakes and rivers may have depended on sufficiently heavy rain to flood the gilgai.

Geomorphology near the proposed mine

The Iluka mine lease and ore deposits lie beneath a veneer of lacustrine, fluvial and aeolian sediments immediately southwest of Lake Tin Tin and Lake Pitarpunga and the lease covers part of Muckee Lake. All of these lakes are dry clay pans (playas) and it is likely that they have rarely filled in the last few hundreds to thousands of years. They originally functioned as overflow lakes fed by a Lachlan River distributary stream known as Box Creek. These lakes are not linked to the Murrumbidgee River.

The Box Creek channel leaves the Lachlan River as Marrowie Creek near the apex of the alluvial fan upstream of Hillston. In this area it is one of four distributary channels that all take some of the higher Lachlan River flows and spread the water across the lower fan (Figure 1). At the present time the main channel (the Lachlan River) carries most of the flow but under most discharge conditions so much water is lost to evaporation and infiltration that flows only rarely pass Booligal or Oxley and the river normally terminates in the Lachlan and Great Cumbung Swamps (inland deltas).

The Great Cumbung Swamp is usually considered to be the terminus of the Lachlan River (O'Brien and Burne 1994) although Lachlan River water did reach the Murrumbidgee during the floods of 1956 (Harrison 1957). Today Marrowie Creek terminates in a floodout and swamp country near Tarwong and its extension channel (Box Creek), has only been known to flow in the extreme flood of 1956. No reference to Box Creek entering or filling Lakes Tin Tin and Pitarpunga during that or any other historic flood has yet been found.

Where Box Ck enters Pitarpunga Lake the channel is little more than a shallow depression covered with old man saltbush. There is barely any levee and there are no black box trees anywhere along the channel. The channel has a meandering form with an average wavelength of about 200m and channel width of 40m. Numerous partial palaeo-channels can be traced across the lake beds and in some places through the sand sheet south of the lake. These channels have meander wavelengths of 600 to 1,000m and widths in the range 50 to 100m. Such channels are clear evidence of large changes in flow regime in the Box Ck system during the Pleistocene.

Below the lakes where Box Ck crosses the Sturt Highway the channel is much larger, well defined and lined with old box trees. This is the reach where the creek flowed in the last two years and the difference is that this part of the creek also includes the catchment of Arumpo Ck and apparently the total catchment is sufficient to create local flow with exceptional local rain.

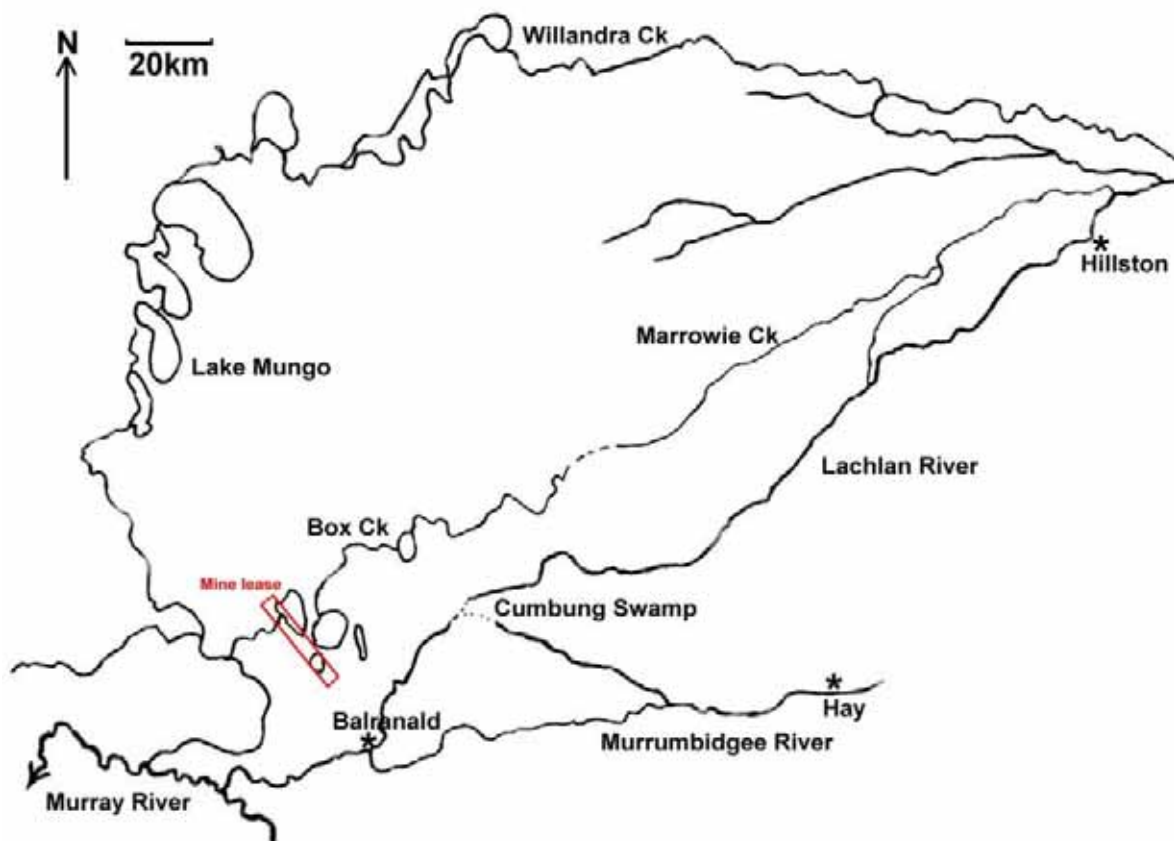


Figure 1. Map of the Lachlan River fan showing the broad pattern of distributary streams flowing across the fan from its apex upstream of Hillston.

Examination of Google Earth images suggests that all of the lakes north of the mine lease may have originally been one large lake of at least twice the total area of the present lake beds (Figure 2). This feature is roughly defined by one or perhaps two higher lunettes on the eastern edge adjacent to the Murrumbidgee backplain. It is not known when the mega-lake was active, nor is it known when the present lakes were last regularly filled but all the field indications suggest that Tin Tin and Pitarpunga Lakes have gone through a drying phase over the late Pleistocene and Holocene that is probably comparable to the hydrologic story revealed in the lower Murrumbidgee and in Lake Mungo (Box).

This suggestion is supported by the fact that the three smaller lunettes (Figure 3) on each of the present lakes (Tin Tin, Pitarpunga, and Maccommon) have surface layers that are composed of wind-blown clay pellets that are known to form during lake drying phases when clay pellets are blown from the exposed dry lake floor under slightly saline conditions. Whilst this material can be matched to the sediment in the Zanci Unit at Lake Mungo it may or may not be of an equivalent age.

Box: Generalised chronology of changing conditions in the lower Murrumbidgee and Lachlan rivers.

Palaeo-hydrologic conditions in the Murrumbidgee have been deciphered and dated by Page and Nanson (1996), Page, Nanson and Price (1996), and Page *et al.*, (2001).

Colleambally phase 105,000 to 80,000 years ago the Murrumbidgee had bankfull discharge about five times the Holocene level (ie., modern level).

Kerarbury phase 55,000 to 35,000 years ago the Murrumbidgee had bankfull discharge about eight times the Holocene level.

Gum Ck phase 35,000 to 25,000 years ago the Murrumbidgee had bankfull discharge about 4.5 times the Holocene level. The Gum Creek palaeochannel carried large volumes of sand bedload but no source bordering dunes are associated with this landscape.

Yanco phase 20,000 to 13,000 years ago last glacial maximum, stream flow was reduced.

Present conditions established by 12,000 years ago.

Lake Mungo chronology (Bowler 1998, Bowler *et al.*, 2003)

Pre-Mungo red soil was developed on clayey sands by 70,000 years ago when lake levels alternated between full and empty.

The Mungo Unit is divided into upper and lower horizons, blown sand and pelleted clay from the lake floor accumulated between 40,000 and 25,000 years ago and was cut by waves (with beach facies of carbonate gravel and reed rhizomorphs) during periods of high lake levels.

During the LGM starting at about 25,000 years ago the lake was generally shallow and dry although Lakes Arumpo and Leaghur both have shell lenses containing fish bones dating to 24,000 and 26,000 years ago.

The last stages of Lake Mungo wetting are represented by sediments of pelleted saline mud and clay of the Zanci Unit.

By 15,000 years ago the lake dried permanently, lunette building ceased and the landscape was stabilised until Europeans arrived and sheep overgrazed the country. Lakes Menindee and Tandou still contained water after 15,000 reflecting the differences in stream connection between the Darling and the Lachlan. There may also have been changes in the dominant river path on the Lachlan River when flows may have switched from Willandra Ck to Marrowie Ck and/or the present Lachlan River channel.

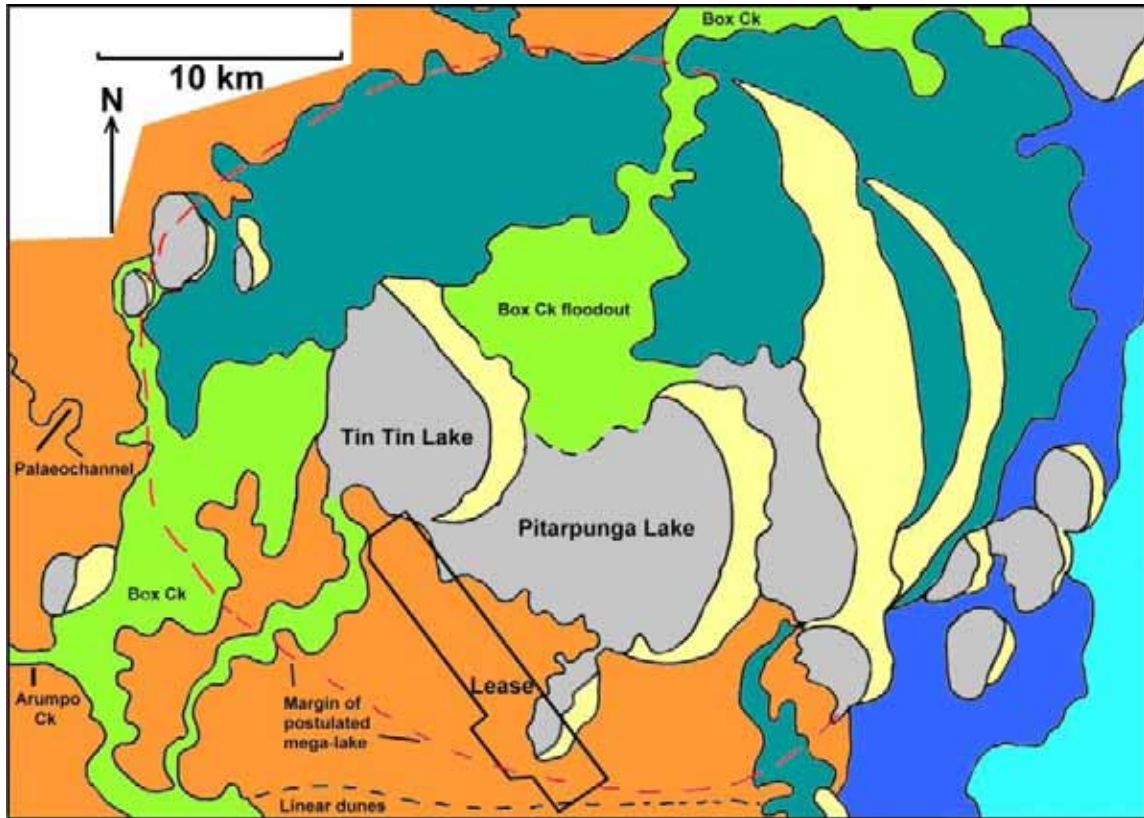


Figure 2. Sketch map of the landscapes in the area around the mine lease based on Google earth images.



Figure 3. View west from the crest of the lunette on Tin Tin Lake showing the grey clay soil and chenopod plain of the dry lake bed.

Archaeologically these suggestions are important because they indicate that the lunettes of these lakes may contain an archaeological record similar to that at Lake Mungo. No exposed sections were seen in the lunettes but given that the lakes must once have been filled then beach facies of some sort (possibly shell or rounded carbonate nodules) can be expected, a wet phase soil must exist within the lunette, and these units must be buried by the dry phase clay pellet layer that is visible over most of the surface. The surface of the lunettes today have been degraded by post-European wind-blown fine sand, silt and clay and the lake margin where the beach should be is covered by clays eroded from the lunette slope. This event/material sequence is summarised in Figure 4 Note that this figure has not been confirmed but it does provide a strategy for searching for older Aboriginal sites that may be expected in/on the surface of the wet phase soil.

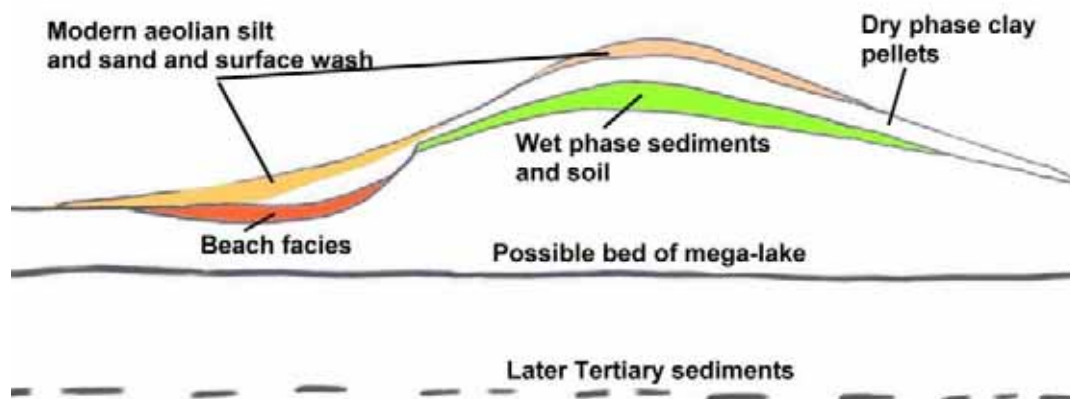


Figure 4. Schematic stratigraphy predicted for the lunettes. The most likely material to contain old Aboriginal archaeology is the wet phase sediment and soil (pale green).

Landscape and vegetation change after 150 years of European management

To assist understanding of land use patterns reflected in the Aboriginal archaeology it is necessary to appreciate the extent of change induced by European land management in the past 150 years. The broad picture for western NSW has been outlined by Mitchell (1991) and more detail concerning the effects of grazing on individual plants and vegetation associations can be found in Beadle (1948).

Broadly the vegetation can be divided into three main groups depending on the response of particular species to heavy grazing pressure.

- Palatable plants, particularly softer herbs, nutritious grasses and some of the annual saltbushes are rapidly consumed, set seed less frequently and decrease in abundance over time.
- Less nutritious and less palatable plants, and those with some form of defence such as prickles or toxic components are not grazed so heavily and these tend to increase in abundance. Most of the bluebushes are in this category and their present abundance on the sandplain country is a measure of change from the natural condition where grasses and annual herbs would originally have been dominant.
- The third group of plants in the rangeland is also composed of increaser species and these are the exotics (invasive weeds) that are particularly successful as colonizers of bare soil. They are usually prickly, unpalatable to stock, and/or toxic.

In addition to changed vegetation cover the soil itself has been modified by stock trampling causing the destruction of biological soil crusts (Figure 5) of algae, lichens and bryophytes. The loss of surface crusts exposes the soil to erosion (Eldridge and Tozer 1997).

The clay soils on lunettes are particularly susceptible to water erosion as the clay is easily dispersed on wetting and moves downslope in turbid water. In the sandplain country sheet erosion has stripped all topsoil and exposed large areas of clay B-horizon to form extensive hard surfaced scalds (Figure 6). Such scalds (sometimes called claypans but not to be confused with playas) often have large numbers of stone artefacts and dispersed hearth material on their surface. The total number of visible artefacts provides a rough measure of the density of artefacts in the original topsoil but most of the archaeological context of these items has been lost.

In some places scalds have patchy vegetation mounds on their margin or scattered across the eroded surface (Figures 7 and 8). Such mounds can preserve an original natural soil profile beneath a cap of wind-blown sediment that has been trapped in a clump of bluebush or other vegetation. Vegetation mounds may contain relatively undisturbed archaeology but to reveal it would require excavation.



Figure 5. Typical biological crust in good condition. Composed of algae, lichens and bryophytes these crusts reduce natural rates of soil erosion but are easily destroyed by stock trampling.

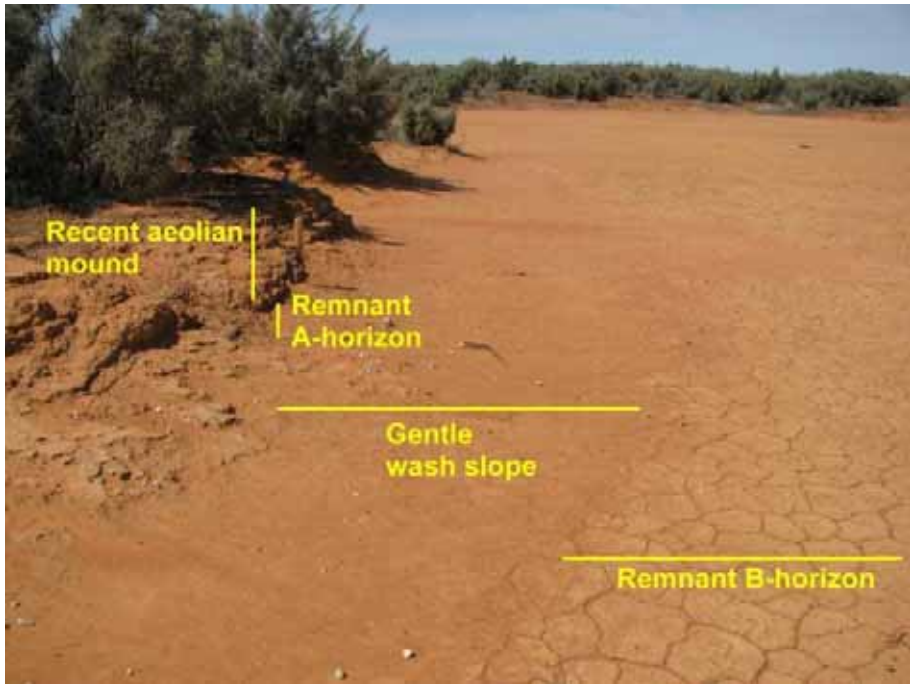


Figure 6. T14 showing a typical scald margin with the exposed B-horizon forming the scald surface, and a low mound of recent drift sand preserving some A-horizon in which the Aboriginal material is located.



Figure 7. Larger vegetation mound as seen on T14 and elsewhere on scalded surfaces.



Figure 8. Close up of laminated aeolian sand trapped in the vegetation mound shown in Figure 7.

Lake dynamics

Muckee Lake is smaller version of Pitarpunga Lake and functioned as an overflow lake when water levels in Pitarpunga reach a threshold of about 60m ASL. The lowest point in the bed of Pitarpunga is about 58m ASL and the lowest part of Muckee Lake is about 55m ASL. Muckee Lake is connected to Pitarpunga by a shallow meandering channel with scalded levees at its north eastern corner. No box trees occur along this channel and there is no sign of any recent flow.

In a lake filling event water would enter Pitarpunga through the Box Ck floodout (Figure 2) and there would be some 2m of water in Pitarpunga before water flowed into Tin Tin and Muckee Lakes. In a major flood Muckee Lake would have a maximum depth of about 8m. This would be quite sufficient for waves to develop and for a beach to form at the base of the lunette. The southern half of Muckee Lake has been cultivated but in the northern half poorly defined vegetated strand lines are visible on the imagery that were probably formed on the last occasion that the lake retained any water, although this was probably only from local rainfall. Similar strand lines can be seen in Pitarpunga Lake. On the bed of Tin Tin Lake a line of scattered black box trees can be seen near the eastern edge. These trees are all estimated to be at least 100 years old and they stand about 200m into the lake from the edge of the lunette. Box trees elsewhere in Tin Tin and Pitarpunga are larger and apparently older and there are no younger cohorts that would have been established if the lake had filled at any time in the last century.

On most of the lakes of western NSW archaeological traces of human occupation are found in the lunette but examination of the lunettes in this system revealed very little archaeology (but see WB66 below). There are four probable reasons for this;

1. The clay lunettes are not attractive campsites when the ground is wet as the clay surface is so sticky.

2. There are no trees on the lunettes and therefore fuel for campfires is limited.
3. During dry lake conditions the lunette is not likely to have been occupied without other local sources of water being available.
4. Hunting conditions on the open plain would be challenging.

Comment on particular Aboriginal sites.

WB40 and 41

Beyond the western shore of Muckee Lake there is an extensive low density site (WB40 and WB41) with hearths, scattered flakes and a small number of grindstone pieces. Exposed artefacts have been winnowed from the natural soil by wind and water erosion leaving a scalded and gullied surface (Figure 9) and the artefacts are widely dispersed. It is unlikely that many artefacts have been collected from this site and therefore the total artefact exposure gives a good indication of artefact density in the natural soil.



Figure 9. General view of the partly scalded and eroded surface of WB40. Trees in the background are belah woodland that once would have been more extensive.

WB40 is exposed on the gentle slopes draining toward Muckee Lake. During the early stages of scald formation (probably during the 1895 to 1902 drought) drift sand was trapped in shrubby vegetation (mainly bluebush) to form vegetation mounds constructed of bedded aeolian sand. Some of these mounds are up to 1m thick and as much as 8m long. They sit unconformably on natural soil that has a texture contrast profile with a subtle bleach in the A₂-horizon and a B-horizon of grey brown clay (Figure 10).

Prior to the arrival of sheep this site would have had a soft sandy surface with a well formed biological crust and carrying more nutritious grasses, and annual saltbush in an open belah community. In contrast to the lunette on the other side of Muckee Lake this would have been a more attractive camp site. Today the area is in a recovery phase after severe degradation and is now dominated by bluebush and annual grasses with much of the belah dead and fallen.

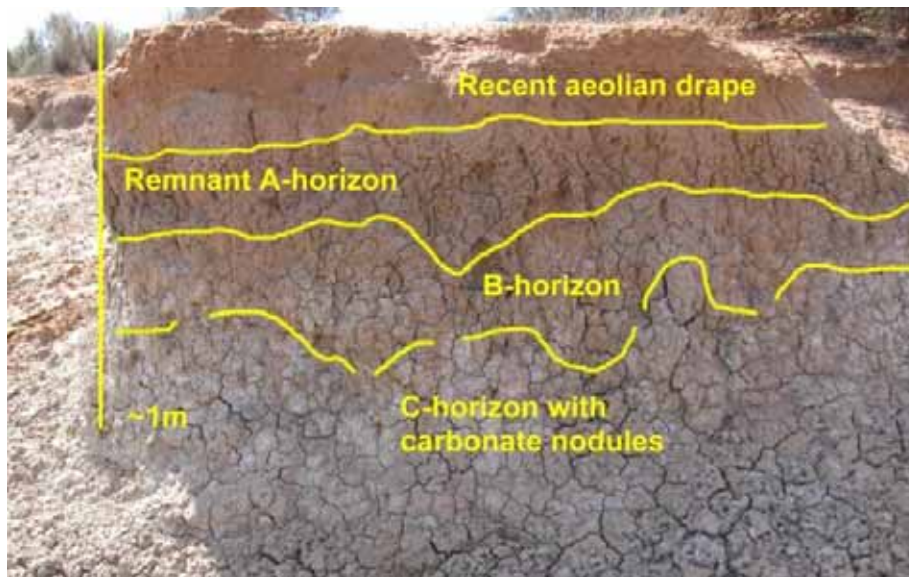


Figure 10.
Exposed soil profile in a gully face on WB40. The grey clay C-horizon may be part of an old lake floor.

Belah country on heavy soil often features gilgai micro-topography and this location is no exception (Figure 11). Depressions up to 1m deep and 15 to 20m in diameter are common west and southwest of WB40. After heavy local rain these depressions would hold water for at least some weeks and would support green grass, nardoo and in a few cases *Juncus* rush.

Gilgai are poorly understood micro-topographic landforms that are common on the western plains but are also found in areas of higher rainfall such as the Darling Downs and in the brigalow belt of Queensland (Paton 1974). They are often associated with cracking clay soils where repeated shrinking and swelling is believed to form a network of low ridges and central depressions. In other cases they are attributed to layered clays with different bearing capacity that overturn when the deeper and weaker clay is saturated. A third probable cause of the landform is that they are a form of clay based karst topography where clays in the subsoil are perverted to deeper layers or moved laterally to other locations. At WB40 this last mechanism seems more likely as prominent 'swallow holes' (a form of tunnel erosion) are present in the floor of the depressions (Figure 12).

The mechanics of gilgai formation are not important archaeologically but the presence of gilgai is as they become temporary wetlands that retain surface water in otherwise dry country for some weeks to perhaps months after exceptional local rain. It seems probable that occupation of WB40/41 was not focussed on Muckee Lake but on the occasional exploitation of gilgai and the surrounding country in good seasons. If this scenario is correct then dates on hearths from WB40/41 are likely to be late Holocene to 'modern' and would not be expected to have any clear link to dates on Muckee Lake lunette.



Figure 11. Gilgai depression near WB40. Note the green centre and *Juncus* clumps on the margin.



Figure 12. Another gilgai near WB40 with open swallow holes on the floor.

T7 WB42

The site WB42 on T7 presented difficulty in the interpretation of the landform. On the imagery it appears to be a sub-circular depressed feature defined by old man saltbush in grey brown clay with gilgai and swallow holes some of which have nardoo growing in them. The edge of the larger depression seemed to match a circle of dead box trees and there is a sharp 1m rise on the southern edge and a more gentle 1m rise on the northern edge. Both sides are in a brown texture contrast soil. Overall there is little erosion across this feature and the numerous hearths located are fairly intact. These parameters suggest it was a box swamp or perhaps a small lake form but neither explanation was a comfortable fit and an alternative model of the site being located on a palaeo-channel was considered.

However there is no evidence of any sinuous pattern that would be expected of a channel and closer examination showed that T7 was isolated from a recognisable channel adjacent to T10 by a calcrete cored ridge and therefore the site had to be considered as a distinctive feature.

After tracing some of the gilgai it became evident that these had a linear pattern like a discontinuous surface channel (creek line) and that the box trees tended to be found on the margins of this pattern. After checking elevations on Google Earth it was concluded that WB42 was a small floodout or run-on zone receiving surface water from the carbonate cored ridge to the south and from a longer slope to the northwest.

The focus for Aboriginal occupation was apparently the same as at WB40 in that the gilgai were important as temporary wetlands and water sources. Water would only be available after heavy rain and then only for a matter of weeks. As the water soaked away supplies might be extended for a short period by excavation but the gilgai would not function as a groundwater resource that could be tapped in dry times.

It is probable that the present domination of the site by old man saltbush is itself an artefact of past grazing regimes and during Aboriginal times it may have been a more open grassland community with living black box.

WB45 T10

WB45 is a large site exposed on an extensive severe scald located on a levee on the flank of a palaeo-channel. Attempts have been made to stabilise the scald by cutting a coarse pattern of ditches to trap sediment, water and seeds. This was unsuccessful and many ditches have become rills. Present day drainage feeds water from the scald surface into a canegrass/*Juncus* swamp on the palaeo-channel (Figure 13). The swamp has a margin of black box and also grows beds of nardoo. The swamp was moist and green at the time of inspection but did not contain any surface water.

Little of WB45 is intact and this area may not justify more archaeological work although a dating program would be informative.



Figure 13.
Large swamp in a palaeo-channel adjacent to WB45.

This area now receives more water from the scalded slope than it may have during Aboriginal times.

WB66

This site is located on the lunette of Muckee Lake and is the only substantive site yet found on any of the lunettes. It was located in the last days of the site survey and the following comments are based on photographs as it was not seen by this author.

The site contains scattered heat retainers of caliche, artefacts including one made of mussel shell and a fragment of burnt *Genyornis* egg shell. These materials appear to have eroded from a buried soil in the lunette that may be the first identified site where the wet phase sediment and soil predicted in Figure 4 has been located.

Initial interpretation is that this site is very likely to be of Pleistocene age and it is therefore potentially very important archaeologically.

Ovens/earth mounds on the power line.

Large mounds of heat retainers were located on the present power line about 13.5km south west of Balranald. On Google imagery the location is on the edge of a cultivated paddock in a small triangle of land that has not been cultivated and that contains a clump of black box trees. Soil in the paddock is grey sandy clay and there is a vague sinuous feature running to the north that may be a palaeo-channel and levees of the Murrumbidgee River or one of its distributaries.

In the field it was immediately evident that this Aboriginal site was based on a large gilgai set. The biggest gilgai depression in the box trees has been modified by the land holder by diverting surface flow into the pond and perhaps by deepening the pond. Smaller gilgai depressions surround the main pond and these are about 20 to 25m in diameter and over 1m deep (Figure 14).



Figure 14.
Prominent gilgai depression in black box on the power line route.

Carbonate nodules and rhizomorphs derived from the subsoil are found on the ridges around the gilgai depression indicating that this gilgai was formed when two layers of clay with different bearing capacity were naturally overturned. The depressions are larger than average and would hold much more water than those seen at WB40 and elsewhere. Today the site has

been modified by drainage ditches and the scalded surface may yield more runoff than the site originally had and this is all channelled into the main depression. In the past all of the gilgai on this site may have flooded with heavy local rain and the waterholes may have had sufficient longevity to support water plants such as *Typha* that may have been the main attraction for Aboriginal people.

The oven mounds (Figure 15) are all composed of burnt clay nodules and range in size from a normal hearth to a very large feature estimated as 25m long and 18m across with an average height of 40cm and a peak (of the most recent oven) about 80cm high (Figure 16). The function of the mounds is unknown and further investigation should be guided by the work of Martin (2011) done elsewhere on the Lachlan and lower Murrumbidgee.

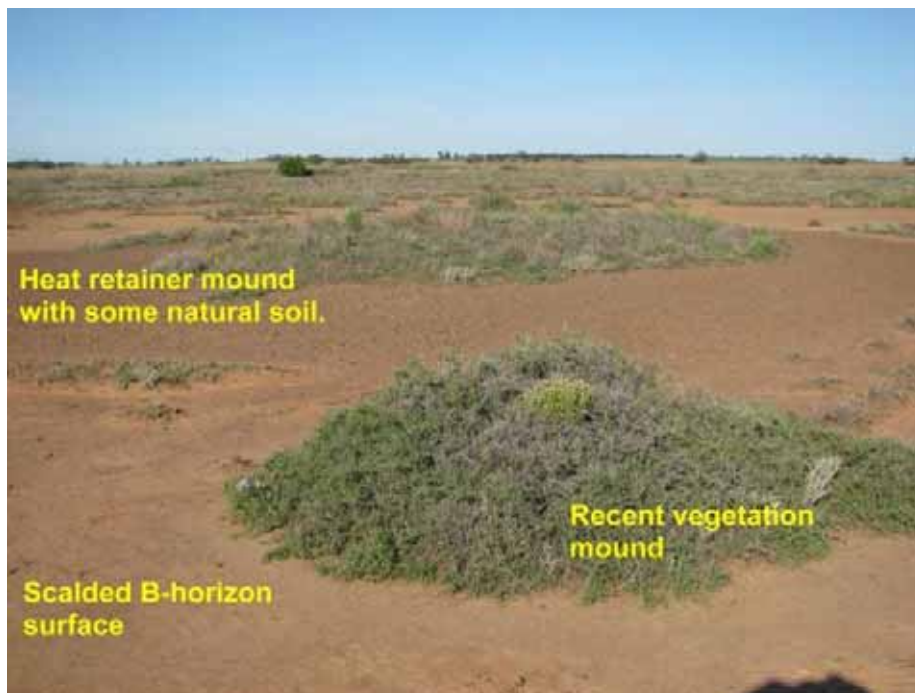


Figure 15. Large oven mound and recent vegetation mound on the scalded surface near the gilgai on the power line route.



Figure 16. Very large, intact oven mound adjacent to the gilgai on the power line route.

Survival of this cluster of mounds and the associated gilgai in a landscape dominated by cultivation for wheat crops has been by chance. Other dark areas of soil exposed in cultivated paddocks are visible on Google images along the palaeo-channel and in adjacent paddocks, notably 500m east and 1.4km northwest of this site but if mounds were associated with any of these they have probably been destroyed. The land holder has used the gilgai as a convenient water source but most other similar areas have been ploughed out and if oven mounds were associated with them they have probably been destroyed.

More gilgai and perhaps associated mounds may be preserved along the stock route on the Kyalite-Balranald road about 4km east of the site.

Given the extent of cultivation in this landscape it appears that this mound and gilgai complex may be one of the last that is reasonably intact and in that case its future management and preservation will depend on the land holder. It would be desirable to avoid any site modification and the easiest way this could be achieved would be to fence the site from traffic, cultivation and stock.

Conclusions

Within the vicinity of the mine lease there is a complex fluvial and lacustrine landscape the history of which extends through the Pleistocene and has a similar story of increasing aridity and changing human occupation as known at Lake Mungo. The sequence of declining river flow and drying lakes however may not be in phase with Lake Mungo if channel switching was an important part of the geomorphic processes operating on the Lachlan alluvial fan.

Three different patterns of human occupation may be evident:

1. Pleistocene occupation of the lunettes during lake full periods.
2. Construction of large oven mounds on large gilgai at an unknown time.
3. Dispersed and episodic occupation of the sand plain country based on smaller gilgai after the lakes dried up.

Probably the oldest site is WB65 on the lunette of Muckee Lake. This seems to be located in the predicted wet phase sediments and soil (Figure 4) and the presence of burnt *Genyornis* egg shell indicates that it is of Pleistocene age. The potential importance of this site to Australian pre-history cannot be over-emphasised. An approach to the further investigation of this site would be to examine it stratigraphically and to date the enclosing sediments using OSL or TL. Detailed archaeological investigation may be warranted.

The oven mounds on the gilgai along the power line are an unusual form of Aboriginal land use. They may once have been more common but modern cultivation for wheat crops has probably destroyed most others although a search for similar features along the stock route may reveal more. Further disturbance of this site can probably be avoided during power line construction but its future management depends on the land holder. The mounds themselves could be further investigated to determine their age and function.

After the lakes dried permanently Aboriginal people apparently used the landscape quite differently and WB40/41 and WB42 are examples of this form of land use. This was a dispersed occupation of the sand plain country based on ephemeral water supplies and wetlands provided by flooded gilgai. Little is known of this pattern of activity and these sites provide an opportunity for OSL or TL dating of the sediments and archaeological investigation of the deposits.

With the exception of WB42 these sand plain sites are all at least partly scalded and therefore much of the archaeological integrity has been destroyed by erosion. However reasonably intact hearths can be dated, surface collection of artefacts may be warranted, and there may be opportunity to investigate *in situ* deposits beneath vegetation mounds if such features can be located. Further work on the very large scalded sites such as at T1 and T14 is probably not warranted.

References

Beadle NCW 1948. *The vegetation and pastures of western New South Wales with special reference to soil erosion*. Dept. of Conservation, Government Printer 281p

Bowler, J.M., 1998. Willandra Lakes revisited: environmental framework for human occupation. *Archaeol in Oceania* 33, 120-155.

Bowler, J.M., Johnston, H., Olley, J.M., Prescott, J.R., Roberts, R.G., Shawcross, W., and Spooner, N.A., 2003. New ages for human occupation and climatic change at Lake Mungo, Australia. *Nature* 421, 837-840.

Brown C.M. and Stephenson A.E. 1991. Geology of the Murray Basin [southeastern Australia] (1:1 000 000 scale map). Bureau of Mineral Resources, Australia, Canberra. 1:1m scale digital data.

Butler B.E., Blackburn G., Bowler J.M., Lawrence C.R., Newell J.W. and Pels J. 1973. *Geomorphic map of the Riverine Plain of South-Eastern Australia*. 1; 500,000 Transverse Mercator projection. Australian National University Press.

Capon, S., Reid, M., Thoms, M., and Parsons, M. 2008. *Ecological Character Description of the Lower Lachlan Floodplain Wetlands*. (Riverine Landscapes Laboratory, University of Canberra) 115pp

Eldridge, D.J. circa 1972 *Land Systems of the Balranald Sheet SI54-12*. 1:250,000 scale. Soil Conservation Service of NSW.

Eldridge, D.J. and Tozer, M.E. 1997. *A Practical Guide to Soil Lichens and Bryophytes of Australia's Dry Country*. Department of Land and Water Conservation, Sydney. 80p

Harrison, G.L. 1957. Report on the River Murray floor problem, with particular reference to the 1956 flood prepared by under the direction of the River Murray Commission. 47p

Hesse, P.P., Magee, J.W. and van der Kaars, S. 2004. Late Quaternary climates of the Australian arid zone: a review *Quaternary International* 118–119: 87-102

Kelly, T.E., Grün, R., Moffat, I., Fitzsimmons K., and Williams, I. 2012. Landscape evolution and palaeoenvironment reconstruction of the Lake Mulurulu lunette, Willandra Lakes World Heritage Area, NSW. Research School of Earth Sciences, The Australian National University, Canberra, ACT 0200, Australia. <http://rses.anu.edu.au/research/research-highlights/landscape-evolution-and-palaeoenvironment-reconstruction-lake-mulurulu>

Martin, S. 2011 Palaeoecological evidence associated with earth mounds of the Murray Riverine Plain, south-eastern Australia. *Environmental Archaeology* 16(2): 162-172

Mitchell P.B. 1991. Historical perspectives on some vegetation and soil changes in semi-arid New South Wales. *Vegetatio* 91: 169-182

O'Brien and Burne, 1994. The Great Cumbung Swamp -terminus of the low-gradient Lachlan River, eastern Australia. *AGSO Journal of Australian Geology and Geophysics*, 15: 223 - 233.

Page, K.J., and Nanson, G.C., 1996, Stratigraphic architecture resulting from late Quaternary evolution of the Riverine Plain, south-eastern Australia: *Sedimentology*, 43:927-945.

Page, K., Nanson, G., and Price, D., 1996, Chronology of Murrumbidgee River palaeochannels on the Riverine Plain, southeastern Australia: *Journal of Quaternary Science*, 11: 311-326

Page, K.J., Dare-Edwards, A.J., Owens, J.W., Frazier, P.S., Kellett, J., and Price, D.M. 2001. TL chronology and stratigraphy of riverine source bordering sand dunes near Wagga Wagga, New South Wales, Australia. *Quaternary International* 83-85:

Paton,T.R. 1974. Origin and terminology of gilgai in Australia. *Geoderma* 11: 221-242

Sahukar R., Gallery C., Smart J., and Mitchell P. 2003. *The bioregions of New South Wales, their biodiversity, conservation and history*. NSW Nat. Parks and Wildlife Service 287p

Schumm, S.A., 1968, River adjustment to altered hydrologic regimen - Murrumbidgee River and paleochannels, Australia: *U.S. Geological Survey Professional Paper* 598, 65 p.

Scott, J.A. 1992. *Natural vegetation of the Balranald – Swan Hill (New South Wales) 1:250,000 map sheet*. Royal Botanic Gardens Sydney. See also *Cunninghamia* 2 (4).

Appendix 3 – AHIMS Search Results

Due to print size restrictions this appendix has been removed from this printed copy of the Aboriginal cultural heritage assessment. It is available in the electronic copy on CD. To request a copy, please contact Iluka Resources on (08) 8300 200.

Appendix 4 – Project and Survey Methodology

Balranald Mineral Sands Project EL 7450

Aboriginal Cultural Heritage Assessment Questionnaire

1. Your name or Organisation / Cultural Grouping you identify with and are representing (i.e. Balranald Local Aboriginal Land Council, Muthi Muthi , Bakindji, Barindji etc.)

.....

2. Are you aware of any Aboriginal sites or areas of Aboriginal cultural significance near (within 5 km) or within the Balranald Mineral Sands Project EL 7450?

.....

.....

.....

.....

3. Do you regard any part of the Balranald Mineral Sands Project EL 7450 as having aboriginal cultural landscape values?

.....

.....

.....

.....

4. Do you have any traditional, historic or contemporary cultural knowledge that may provide information about the Aboriginal cultural significance of the Balranald Mineral Sands Project EL 7450?

Yes No (Go to question 5)

If yes, is this knowledge of a confidential nature or can it be made public in an Environmental Assessment document?

Confidential Not Confidential

5. Do you have any specific advice or information about how the Balranald Mineral Sands Project EL 7450 should be assessed from an Aboriginal cultural heritage point of view?

.....

.....

.....

.....

6. Any additional information

.....

.....

.....

.....

Contact Details

Title (Prof, Dr, Mr, Mrs, Ms, etc.) _____ Surname _____

Given Names _____ Email _____

Postal Address _____

Suburb z _____ State _____ Postcode _____

Phone _____ Mobile _____

Signature _____ Date _____

FIELD OFFICERS SURVEY AGREEMENT

Iluka Resources Limited

[]

9 July 2012

TABLE OF CONTENTS

Parties.....	2
Background.....	3
1. Services.....	3
1.1 Personnel.....	3
1.2 Survey Services at the Project Area.....	3
1.3 Review of the Report.....	4
2. Term.....	4
2.1 Commencement and Duration.....	4
2.2 Extending the duration of Survey Services.....	4
2.3 Variation.....	4
2.4 Completion.....	4
3. Payment.....	5
3.1 Survey Services.....	5
3.2 Timesheets & Payment.....	5
4. General Matters.....	5
4.1 Site Induction.....	5
4.2 Operational Health and Safety.....	5
4.3 Protective Clothing, Water and Food.....	5
4.4 Relationship.....	6
4.5 Obligation to Follow Directions.....	6
4.6 Intellectual Property Rights and Confidentiality.....	6
SCHEDULE 1.....	7
FEES PAYABLE.....	7
EXECUTED as an Agreement.....	Error! Bookmark not defined.

Parties

Iluka Resources Limited

Registered Aboriginal Stakeholder Organisation

Niche Environment & Heritage Pty Ltd

Nominated Field Officer

Background

- Iluka is developing the Balranald project (the Project).
- As part of the development of the Project, Iluka is required to prepare and submit a Cultural Heritage Assessment Report (the Report).
- Iluka has engaged Niche Environment & Heritage Pty Ltd to prepare the Report on its behalf (Niche).
- Iluka requires (Field Officers) to provide the Survey Services set out in this Agreement to assist Iluka and Niche in the preparation of the Report.
- Registered Aboriginal Stakeholder Organisations are required to be a Registered Iluka Vendor and responsible for preparation of invoices and payments on behalf of nominated Field Officers.

1. Services

1.1 Personnel

The Field Officer will provide the Survey Services under the direction Niche who is authorised to undertake all matters under this Agreement.

1.2 Survey Services at the Project Area

- (a) The Field Officers will, in accordance to Niche's directions, identify 'aboriginal objects', as the term is defined in Section 5 of the *National Parks and Wildlife Act* 1974 (NSW) (Aboriginal Object).
- (b) If the Field Officer identifies an Aboriginal Object, the Field Officer must immediately inform the Niche and follow any directions given by the Niche to that Aboriginal Object.
- (c) If the Field Officer has cultural knowledge of the area this information is to be conveyed to the Niche during the course of the survey.

1.3 Review of the Report

- (a) Niche will prepare and provide the Registered Stakeholder Organisations a draft copy of the Report within 30 days from the completion of the Survey Services at the Project Area.
- (b) The Registered Stakeholder Organisations are to provide this to Field Officers for review and advise the Niche in writing of any comments with respect to the Report within 30 days of receipt.

2. Term

2.1 Commencement and Duration

Field Officers will provide the Survey Services at the Project Area:

- (a) From 23rd July or such other date as determined by the Niche during a period of 12 weeks. Field officers days of survey work will be determined by a roster as determined by the Niche.

2.2 Extending the duration of Survey Services

- (a) Where the performance of the Survey Services is delayed by reason of unforeseen delays, including inclement weather, the Niche may by written notice to the Field Officer extend the duration of Survey Services for such period as is reasonably necessary for the completion of the Survey Services.
- (b) If the duration of the Survey Services is extended by Clause 2.2(a), the Field Officer must continue to provide the Survey Services for the extended duration.

2.3 Variation

Iluka may, at its sole discretion, by written notice to the Field Officer's vary the scope of the Survey Services, including extending the Agreement to other parts of the Project, including but not limited to the surveying of land over which electricity infrastructure will be built and the location of water bore holes to be drilled.

2.4 Completion

Except where this Agreement is extended by clause 2.3, the Agreement will, unless terminated earlier, terminate upon the nominated Field Officer returning the report to the Niche in accordance with clause 1.3(b).

3. Payment

3.1 Survey Services

Iluka will pay the Registered Aboriginal Stakeholder Organisation on behalf of the field officers:

- (a) The daily rate set out in Schedule 1 for each hour that the Field Officer provides the Survey Services at the Project Area;
- (b) Travel, accommodation and meal allowances will be paid directly by Niche.

3.2 Timesheets & Payments

Prior to receiving any payment the nominated Field Officer must:

- (a) On the timesheets provided by Niche, record the times that they have spent performing the Survey Services and any travel, accommodation and meal allowances they wish to claim. The time sheets must be submitted to the Niche for approval at the end of each day; and

Prior to receiving any payment the Registered Aboriginal Stakeholder Organisation must:

- (b) Submit a tax invoice for the Field Officer services, with signed timesheet authorised by Niche by email to Iluka's nominated person for authorisation.
- (c) Iluka request that invoices be submitted on Mondays, for works completed the previous week. Where an invoice is not submitted on a Monday the submission date will be adjusted to the following Monday. Invoices will be paid the first Friday after submission date.

4. General Matters

4.1 Site Induction

Prior to commencing the performance of the Survey Services and accessing the Project Area, the Field Officer must attend a site induction provided by the Nice.

4.2 Operational Health and Safety

The Field Officer must comply with all operational health and safety policies and procedures relevant to the Project Area, including those directed by the Nice.

4.3 Protective Clothing, Water and Food

While in the Project Area Field Officers must provide their own protective clothing, including:

- (i) enclosed boots;
- (ii) PPE safety vest;
- (iii) long sleeve shirts;
- (iv) sunglasses and
- (v) hats and sunscreen;

4.4 Relationship

The parties' relationship is one of principal and independent contractor, not employer and employee, principal and agent or partnership. No contractual or employment relationship will arise between the Field Officer and Niche or Iluka as a result of this Agreement.

4.5 Obligation to Follow Directions

- (a) Niche is authorised by Iluka to give directions and orders on its behalf in relation to this Agreement. The Field Officer must, at all times, comply with any direction or order given by the Niche.
- (b) Niche may at any time direct the Field Officer to leave the Project Area where the Field Assistant has failed to comply with clause 4.5(a) or is, in the Niche reasonable opinion, incompetent, negligent, under the influence of drugs or alcohol or guilty of misconduct.
- (c) Iluka may at any time terminate this Agreement where the Niche has issued a direction under clause 4.5(b).

4.6 Intellectual Property Rights and Confidentiality

- (a) The Field Officer's agrees to assign to Iluka all intellectual property rights, including all copyright which may arise in respect of, or as a result of, the performance of its obligations under this Agreement.
- (b) Each party shall keep confidential all information provided to it by the other party, except where the information is:
 - 1) required for the Report;
 - 2) required to be disclosed by law; or
 - 3) disclosed to a party's professional advisor for the purposes of the Project.

SCHEDULE 1

FEES PAYABLE

Iluka Resources will pay the Field Officer's Registered Aboriginal Stakeholder Organisation the rate of \$600 per full day or \$300 for each half day that the Field Officer is engaged for the performance of the Survey Services at the project Areas, as shown in the timesheets submitted and approved by the Niche.

All amounts in the Schedule are exclusive of GST.

EXECUTED as an Agreement

Iluka Resources Limited ACN 008 675 018

Full Name of Authorised Officer

Signature of Authorised Officer

Full Name of Witness

Signature of Witness

/ /2012

(Registered Aboriginal Stakeholder Organisation) ABN -----

Full Name of Authorised Officer

Signature of Authorised Officer

Full Name of Witness

Signature of Witness

/ /2012

Nominated Field Officer

Full Name of Authorised Officer

Signature of Authorised Officer

Full Name of Witness

Signature of Witness

/ /2012

Niche Environment, Heritage Pty Ltd ACN -----

Full Name of Authorised Officer

Signature of Authorised Officer

Full Name of Witness

Signature of Witness

/ /2012

Iluka Resources Limited

Balranald Mineral Sands Project EL 7450

Registered Aboriginal Stakeholder Consultation Meeting No 1 Presentation

2.00pm 14th June 2012
Balranald

Overview of Presentation

- Introduction & Welcome : Andrew Minns & Anna Bryant Iluka Resources Limited
- Project Scope: Andrew Minns Iluka Resources Limited.
- Assessment Process . Giles Hamm, Niche Environment & Heritage Pty Ltd.
- Aboriginal Stakeholder Consultation Process: Giles Hamm.
- Landscape features of the study area: Giles Hamm
- Cultural background and archaeological aspects of the study area: Giles Hamm.
- Archaeological survey design and Registered Aboriginal stakeholder involvement.
- Expression of interest and engagement of survey team (written feedback to notification, merit assessment). Proof of insurances and assessment skills.

Project Scope

Project Approval requirements

NSW

- Development Consent being sought under NSW Environmental Planning and Assessment Act 1979.
- Project has been declared State Significant Development.
- Environmental Impact Statement currently being prepared.
- Project is exempt from Aboriginal Heritage Impact Permits.

Federal

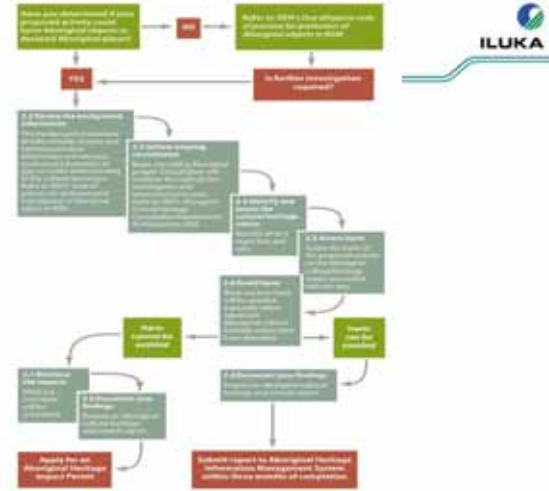
- May require approval under Environment Protection, Biodiversity and Conservation Act 1999.
- Referral to Department of Sustainability, Environment, Water, Population and Communities (SEWPAC) to determine approval requirements.

Assessment Process

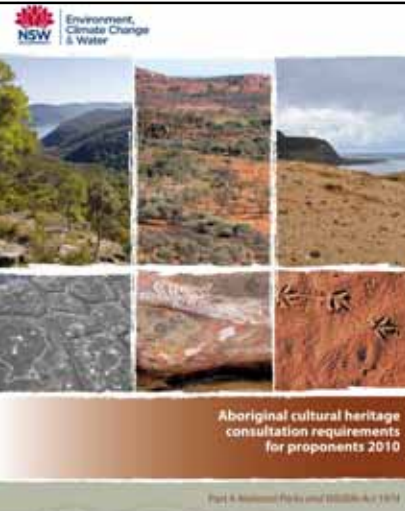


- NSW Office Environment & Heritage (OEH) issued Aboriginal consultation guidelines in 2010 as a process to advise developers, consultants and Aboriginal communities about how Aboriginal sites and objects should be dealt with under Part 6 of the *NPW Act 1974* or under State Significant Development under Section 89C(2) of the *E & A Act 1979* through the NSW Department of Planning and Infrastructure (DoPI).
- Iluka Resources Limited will be using these OEH consultation guidelines and other OEH Codes of Practices as a basis for the Aboriginal cultural heritage assessment of its Balranald Mineral Sands Project.

Balranald Project Induction, Date of Issue: 16/09/2011



Balranald Project Induction, Date of Issue: 16/09/2011



Balranald Project Induction, Date of Issue: 16/09/2011

Registered Aboriginal Stakeholder Consultation Process



Proponent is Iluka Resources Limited (can also be a Company acting for a developer)

- Initiates the proposal;
- Seeks the views of the registered Aboriginal stakeholders about methodologies;
- In consultation with registered Aboriginal stakeholders, gathers cultural and archaeological information;
- Uses this information to assess the scientific and cultural significance of EL 7450;
- Undertakes assessment of potential impact;
- Gathers the views of the registered Aboriginal stakeholders about the project, potential impacts and the mitigation measures; and
- Provides the results to DoPI and OEH in a report to accompany applications for development approval.

Balranald Project Induction, Date of Issue: 16/09/2011

Registered Aboriginal Stakeholder Role



- Members of the Aboriginal community are the primary determinants of the significance of their heritage;
- They may participate in the process through comment on the assessment methodology, assisting with field assessments, contributing cultural knowledge and commenting on cultural significance of potential impacts and/or mitigation measures; and
- This consultation opportunity is provided through the assessment process conducted by the proponent (i.e. Iluka Resources Limited).

Bakaramid Project Induction, Date of Issue: 16/09/2011

OEH and DoPI Roles



- Are the decision-makers;
- Review information from the proponents, including information about the views and knowledge provided by registered Aboriginal stakeholders; and
- Make decisions whether to grant or not grant development approval (with or without conditions).

Bakaramid Project Induction, Date of Issue: 16/09/2011

Service Providers (includes both Aboriginal & non-Aboriginal consultants)



- Various parties with specialist skills or knowledge who can be engaged by proponents to help them fulfil their responsibilities.
- Services provided can include Aboriginal assessment and advisory services and archaeological services (i.e. Niche Environment & Heritage Pty Ltd).
- My background. Professional Archaeologist over 20 years experience.

Bakaramid Project Induction, Date of Issue: 16/09/2011

Aboriginal stakeholder registration and written responses



- Iluka Resources Limited has developed a Aboriginal stakeholder register and consultation log process.
- As the DoPI /OEH process requires written proof of consultation at all stages of the assessment; Iluka Resources Limited will always request registered Aboriginal stakeholders to respond in writing to all notifications concerning the project's assessment.

Bakaramid Project Induction, Date of Issue: 16/09/2011

Registered Stakeholder Consultation Process



- Requests for Aboriginal stakeholder consultation meetings will be officially notified in writing and a period of time up to 28 days will be given for written requests or responses to review for example assessment reports or survey research designs.
- Failure to respond to official notifications within a reasonable time frame (either through letter, email or fax) will mean 'that a no response' was recorded.
- Consultation meetings concerning the project will be held with all Registered Aboriginal Stakeholder groups present.

Balranald Project Induction, Date of Issue: 16/09/2011

Landscape and Environmental Features of the study area



- The study area is located close to the centre of the Murray Basin in south-western New South Wales, which is a large structurally controlled depression which has filled with Tertiary marine and non-marine sediments. This sequence has subsequently been overlain by Quaternary aged aeolian, fluvial and lacustrine sediments.
- The study area is located within the Riverine Plain Landsystem.
- The study area lies roughly between the town of Balranald in the south and the village of Hatfield in the north and is made up of the *Nepean* and *West Balranald* mineral deposits.

Balranald Project Induction, Date of Issue: 16/09/2011

Fig. 4.1 The Riverine Plain



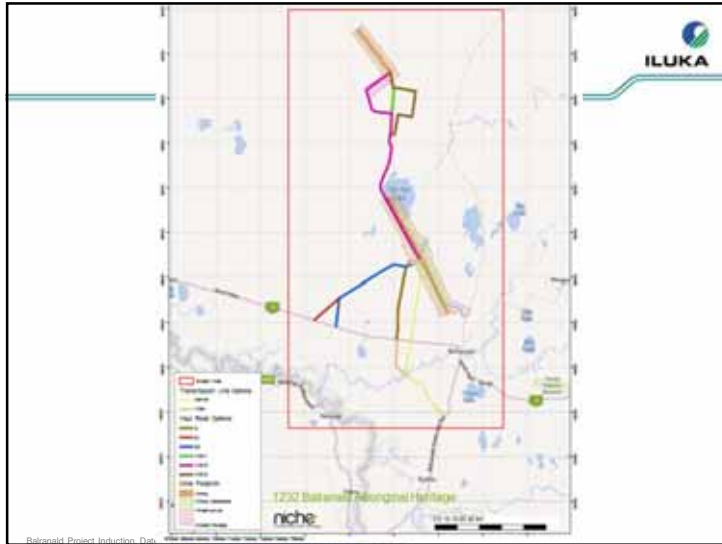
Balranald Project Induction, Date of Issue: 16/09/2011



BALRANALD PROJECT
Proposed Transmission Line
and Haul Road Options

FIGURE 1

Balranald Project Induction, Date of Issue: 16/09/2011

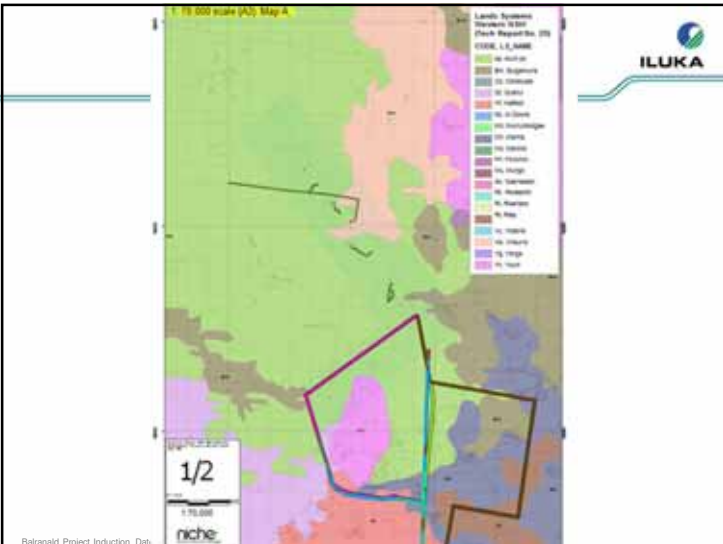


Landscape and Environmental Features of the study area

- Both deposits are located on Exploration Licence EL 7450 which was granted to Iluka Resources Limited in February 2010. The tenement was formed from the amalgamation of four previous licences (EL6478, EL6816, EL6669 and EL6970).
- The Nepean deposit is located approximately 67 kilometres north-northwest of Balranald, and is contained within two Western Lands Leases, 'Wintong' and 'Wampo'. A Private Conservation Reserve exists on Wampo Station in the northern half of the Nepean deposit. This private reserve was established in 1999 and covers an area of approximately 17,890 hectares (43,961 acres).

Landscape and Environmental Features of the study area

- The Nepean deposit is located within the Arumpo Land System (*Soil Conservation Service of NSW 1991*). The soils within this land system comprise fine sandy loams and light sandy – clay loam. These broad soil types comprise varying amounts of coarse cracking grey/brown clays, calcareous sands and yellow / red textured contrast soils.
- The Nepean Deposit is located on the edge of a topographic ridge known as the Iona Ridge.
- The landscape is dominated by parallel east – west trending sand dunes dominated by mallee vegetation with an understorey of spinifex. The associated interdune swales and plains are dominated by Chenopod Mallee and Belah Rosewood (Ogyris and Wildlife Profiles, 2007).



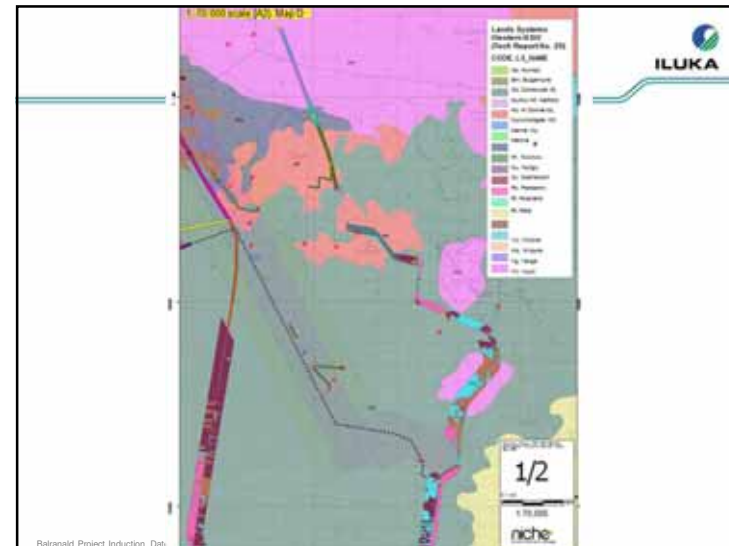


Landscape and Environmental Features of the study area



- The West Balranald Deposit is situated within the Balranald Land System (*Soil Conservation Service of NSW 1991*). The sandy surfaces sediments have been extensively reworked into dunes and sand plains. The surrounding rivers and streams in the Riverina have cut through the sands and constructed numerous overflow lakes and abandoned Pleistocene channels and basins.
- Saline ground waters have formed salt basins in many places where the sand plain or dune topography intersects the water table. Soils and vegetation differ accordingly to the landform.
- On the dune fields red, brown and yellow calcareous sands occur with more clayey materials in the swales. On sand plains the soil tends to be heavier with brown gradational or texture contrast profiles, and mallee is found only on sandy rises (Iluka Resources Limited 2010).

Balranald Project Induction, Date of Issue: 16/09/2011



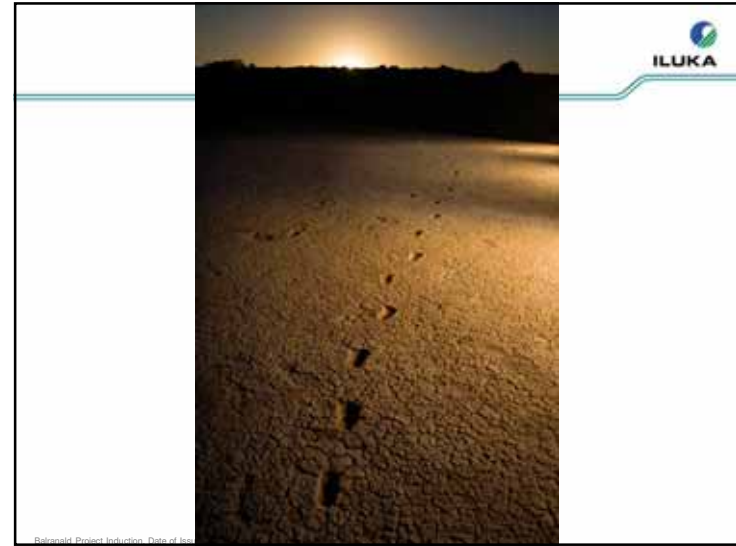


Cultural background and archaeological aspects of the study area



- The project area is defined culturally as Muthi Muthi with some overlap with Yita Yita country (see map).
- Study area covers approximately 121 sqkm and is approximately 8 kms north-west of Balranald.
- General landscapes surrounding the study area are rich in evidence of Aboriginal occupation going back to 45,000 years BP (i.e. see Willandra Lakes World Heritage area).
- Important cultural landscape features would be the Tin Tin Lake, Pitarpunga Lake and Box Creek.







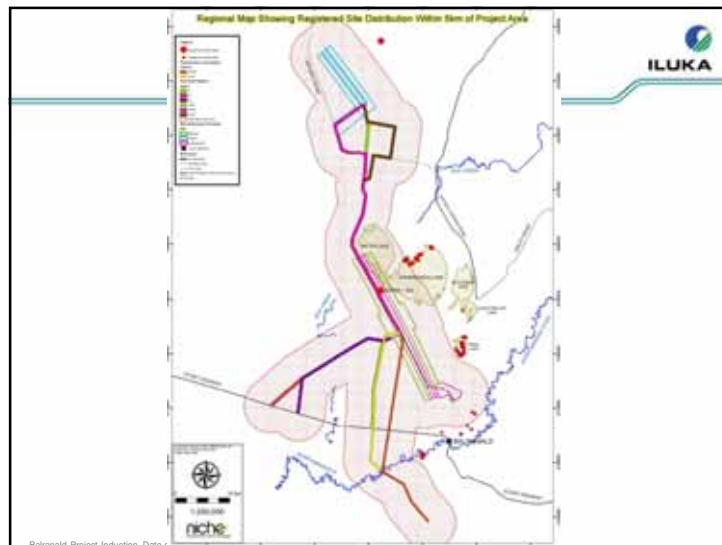
What type of Aboriginal sites and objects are likely in the study area?



Based on previous work on the Bemax project and other assessments undertaken by Sarah Martin and Badjar Bates, Dan Witter Aboriginal sites have already been identified in parts of the study area.

Likely to find the following site types:

- Artefact scatters.
- Isolated finds.
- Hearths
- Hearth Scatters
- Shell Middens
- Potential Archaeological Deposits
- Burials.
- Scarred Trees.
- Earth Mounds.







Iluka Site Type Predictions

Land Unit	Site Type	Site Frequency	Raw Material Types
Arumpo	Isolated finds	Isolated find may occur infrequently	Silcrete, quartz.
Condoule	Isolated finds	Isolated find may occur infrequently	Silcrete, quartz.
Gulthul	Isolated finds	Isolated find may occur infrequently	Silcrete, quartz.
Hatfield	Isolated finds, artefact scatters, hearths, PADS, culturally modified trees.	Artefact scatters, PADS and hearths may occur frequently on scalds and clay pans. Culturally modified trees may occur in black box communities.	Silcrete, quartz, quartzite, chert.
Ki Downs	Isolated finds	Isolated find may occur infrequently	Silcrete, quartz.
Marma	Isolated finds, artefact scatters, hearths, PADS, culturally modified trees, middens, burials	Artefact scatters, PADS and hearths may occur frequently on scalds and clay pans. Culturally modified trees may occur in black box communities. Burials may occur in sand bodies.	Silcrete, quartz, quartzite.

Bakaramid Project Induction. Date of Issue: 16/09/2011

Rata	Isolated finds, artefact scatters, hearths, PADS, culturally modified trees, burials.	Artefact scatters, PADS and hearths may occur frequently on scalds and clay pans. Isolated finds may occur infrequently. Culturally modified trees may occur in black box communities.	Silcrete, quartz.
Riverland	Isolated finds, artefact scatters, hearths, PADS, culturally modified trees, middens, burials, earth mounds.	Artefact scatters, PADS and hearths may occur frequently on scalds and clay pans. Isolated finds may occur infrequently. Culturally modified trees may occur in black box communities. Middens may occur on levees and lunettes. Burials may occur in sand bodies.	Silcrete, quartz.
Wilkurra	Isolated finds.	Isolated find may occur infrequently	Silcrete, quartz.
Youhi	Isolated finds, artefact scatters, PADS, culturally modified trees, middens, burials, earth mounds.	Artefact scatters, PADS and hearths may occur frequently on scalds and clay pans. Isolated finds may occur infrequently. Culturally modified trees may occur in black box communities. Middens may occur on levees and lunettes. Burials may occur in sand bodies.	Silcrete, quartz, quartzite.

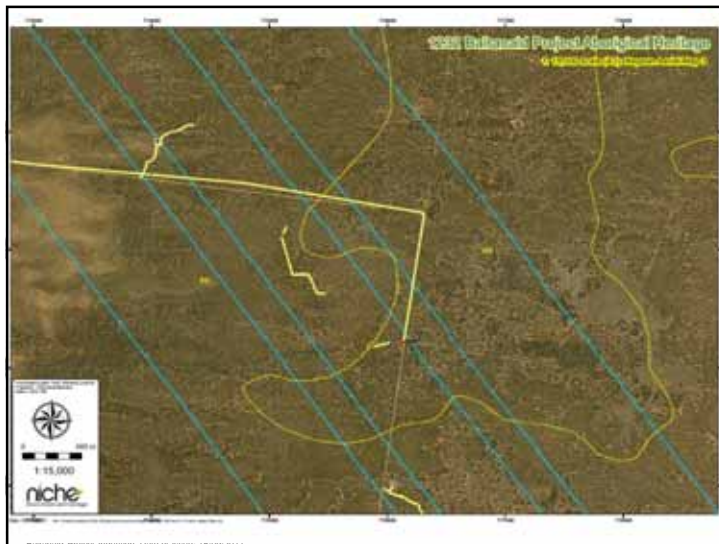
Bakaramid Project Induction. Date of Issue: 16/09/2011

Balranald Mineral Sands Project EL 7450 archaeological survey will be designed based on:

- Previous scientific research;
- Input from registered Aboriginal stakeholder groups & individuals, including identifying culturally sensitive landscapes;
- Land unit distribution and level of surface ground disturbance;
- Visibility of exposed land surfaces;
- Age of soil types and subsoil potential; and
- Distribution of natural resources (i.e. Box swamps, Lake margins, Box Creek drainage, pale-ochannels from lakes, claypan areas and Murrumbidgee floodplain units).

- The archaeological survey will be carried out using a selective sampling approach with survey areas chosen based on the potential of finding Aboriginal sites or objects.
- Areas of high potential such as those located around existing claypan and drainage features (i.e. Lake margins and old paleo-channels) will be targeted for survey assessment.
- Areas of low potential such as the Mallee woodlands (especially ploughed) will not be targeted for survey assessment.

Balranald Project Induction, Date of Issue: 10/09/2011



How can registered Aboriginal stakeholders be a part of the field assessment?



- Providing evidence of assessment experience, cultural knowledge and professional qualifications;
- Providing assistance with the design of the archaeological survey;and
- Providing cultural information about the significance of the study area (i.e. through our written questionnaire).

Aboriginal Cultural Heritage Assessment Questionnaire



1. Your name or Organisation / Cultural Grouping you identify with (i.e. Muthi Muthi, Bakindji, Barindji etc.)
2. Are you aware of any sites or areas of cultural significance near (within 10km) or within the Balranald Mineral Sands Project EL 7450 ?
3. Do you regard any part of the Balranald Mineral Sands Project EL 7450 area as having aboriginal cultural landscape values?
4. Do you have any traditional, historic or contemporary cultural knowledge that may provide information about the cultural significance of a Balranald Mineral Sands Project EL 7450 area? If yes, is this knowledge of a confidential nature or can it be made public in an Environmental Assessment document?
5. Do you have any specific advice or information about how the Balranald Mineral Sands Project EL 7450 area should be assessed from a cultural heritage point of view?
6. Any additional information

Balranald Project Induction, Date of Issue: 10/03/2011

Engagement of Survey Team



- Engagement of the field officers will be managed using a field services agreement.
- Five people will be selected by Iluka Resources Ltd to assist in the field assessment.
- Engagement will be based on having the best field officers for the assessment. Individuals will be selected rather than groups.
- Need fit people who can work a solid 8 hour day.
- People will be selected on merit.
- This could mean that three different groups are selected to do the survey.
- Niche Environment & Heritage will supervise the survey team and individuals will be accountable to me as the Supervisor.

Survey Assessment



- Looking at a period of 25 days for the field assessment(i.e. July - August 2012).
- Fees will be \$600/day.
- Food, water and transport will be provided to and from the worksite.
- Work will be paid on completion of daily or half daily tasks.
- Sign In and Sign Out sheets will be maintained.
- Rain delays will be paid if client cannot give the field workers 24 hours prior notice.
- Field Officers will have to provide: own ABN, Personal Protective Equipment (i.e. work boots, high visibility vests)
- Field Officers will need to have Workers Compensation Insurance and Public Liability cover.

Expression of Interest



- Following this meeting, Iluka Resources Ltd will write to registered Aboriginal stakeholders inviting them to register an interest in being a part of the field assessment work.
- Iluka Resources Ltd will need to see the following within 28 days of this written invitation:
 - Up to date Workers Compensation and Public Liability insurances and ABN;
 - Evidence of cultural knowledge, assessment skills and experience;and
 - Availability to undertake work in July-August 2012.

Thank You

Bakasatli Project Induction, Date of Issue: 10/03/2011




Balranald Mineral Sands Project

Iluka Resources

Aboriginal Heritage Survey Meeting


Balranald
14 June 2012


Presentation outline

- Introduction
- Mining
- Mineral processing
- Infrastructure
- Transportation
- Project Schedule

2



Iluka's Australian operations



- Murray Basin, Victoria/NSW**
 - Major rutile and zircon production province
 - Separation plant - Hamilton
 - Economic life to 2023+
- Eucla Basin, South Australia**
 - Globally significant zircon production source
 - Mine life 10 years+
- Western Australia**
 - Processing hub for Jacinth-Ambrosia concentrate
 - 4 synthetic rutile kilns (2 idled)
 - Limited internal feed source to kilns
- Virginia, United States**
 - High quality zircon and ilmenite production serving domestic US market

3



Murray Basin projects



4

Project location



- Located within exploration license EL7450
- West Balranald deposit located NNW of Balranald township
- Nepean deposit located a further 30 km north
- Access via Ivanhoe Road & Tin Tin Bidura (Burke & Wills) Road



5

Project history



- 1998 - discovery of West Balranald
- 2002 - discovery of Nepean
- 18 Feb 2010 - EL7450 granted
- Aug 2010 - scoping study completed
- Jan 2011 - pre-feasibility study commenced
- 2011 - community & Government consultation
- 2011 - hydro geological and sonic drilling programs
- 2011 - baseline environmental studies commenced
- Feb 2012 - appointment of EMGA Mitchell McLennan
- April 2012 – Application for DGR's



6

Project Concept



- 7 to 10 year mine life (depending on final mining rate)
- relocate existing plant from WRP to West Balranald
- processing at mine site
- up to 500,000 tpa heavy mineral concentrate (HMC)
- heavy mineral concentrate (HMC) transport by road / rail to Hamilton
- up to 600,000 tpa ilmenite
- ilmenite transport to Capel WA, or direct to customer
- approximately 5,000 hectare mine & infrastructure footprint
- power from substation south of Balranald
- accommodation village in Balranald

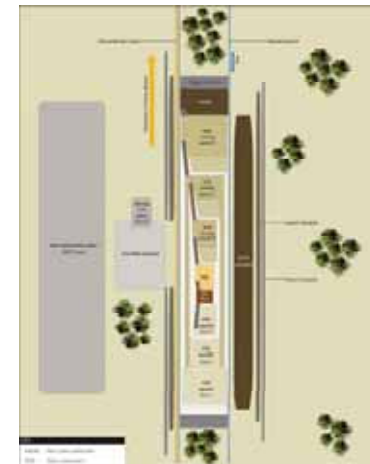
7

Mining

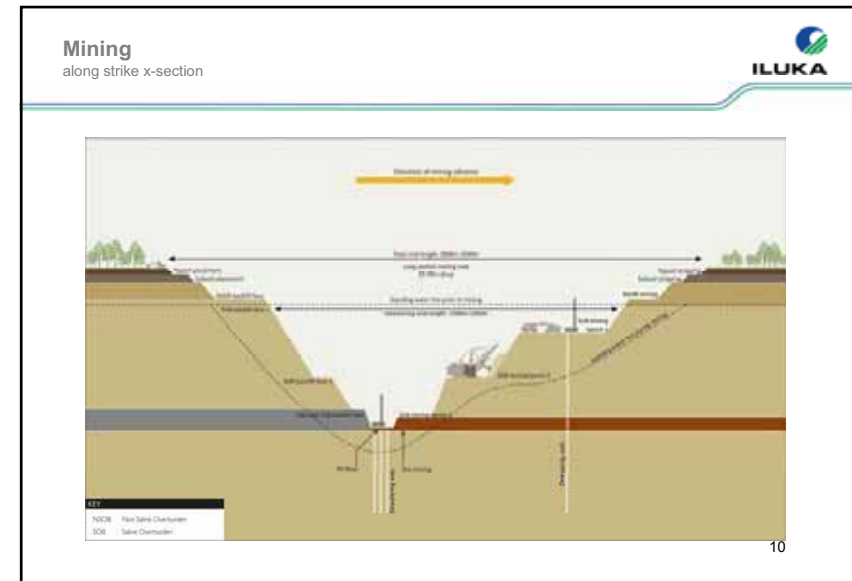
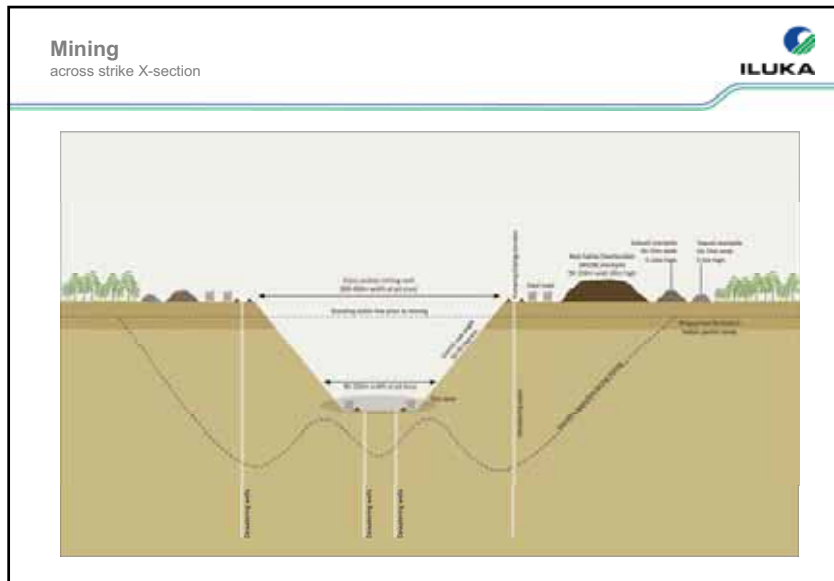
key challenges



- Mining methods considered:
- Dredging (rejected)
 - Bucket wheel excavator & conveyors (rejected)
 - Dragline (rejected)
 - Hydraulic Mining (rejected)
 - Truck & shovel (preferred)



8



Mineral Processing

Existing plants likely to be relocated from WRP Mine:

- MUP (Mining Unit)
- Feed preparation & Pre concentrator plant
- Wet concentrator plant
- WHIMS circuit
- (ilmenite dry separation plant)

Options for simplification and mobility are under investigation.

A 3D perspective rendering of several industrial processing units, likely for mineral processing, arranged in a row. The units are depicted in various colors (blue, green, orange) and are situated on a flat, brownish ground surface.

Power Supply & Communications

network power supply

- 22/66kV Step up transformer at the Essential Energy substation south of Balranald
- ~40km of 66kV overhead line to the mine
- 66/22kV Step down transformer at the mine

A photograph of an electrical substation. It features several tall metal towers supporting power lines, with various electrical equipment and structures visible in the background. The sky is clear and blue.

Road Access

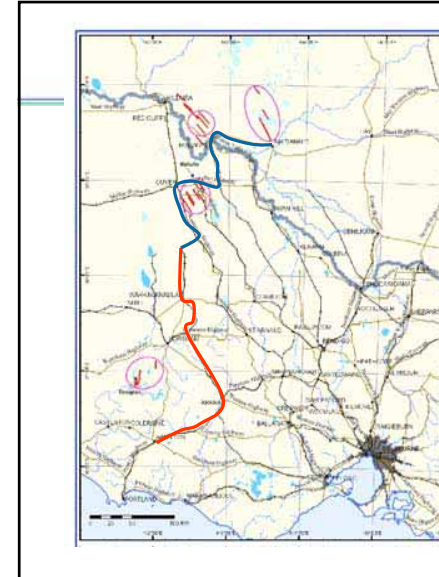


HMC / ilmenite haulage route to Sturt Hwy

- Preferred haul route is from the process plant in the centre of the mine strike heading South West to the Sturt Highway
- Several options of haul routes between West Balranald and Nepean deposits being assessed
- Investigation into local sources of road construction material

Light Vehicle Access

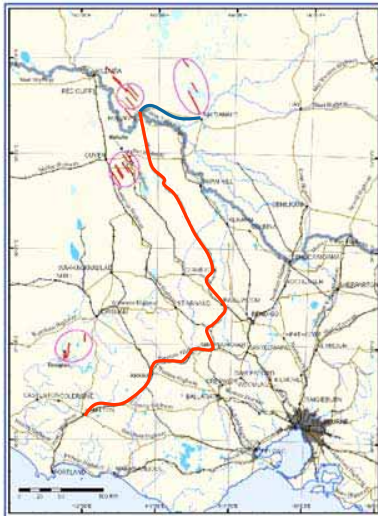
- A separate LV access road connecting to the Balranald-Ivanhoe road is being assessed



HMC (Base Case)
road/rail (std gauge)



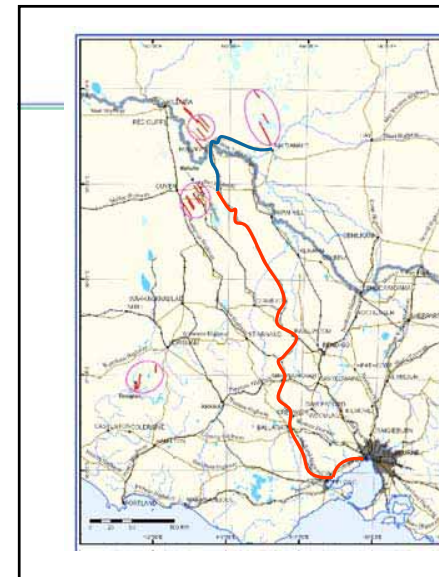
Via Hopetoun



HMC (Preferred Case)
road/rail (std gauge)



Via Robinvale




Ilmenite (Base Case)
road/rail (broad gauge)




Via Manangatang

Ilmenite (Preferred Case)
road/rail (std gauge)




Via Robinvale



17

Transportation
Road transport statistics




HMC

- 32 B-Double return trips per day
- B-Doubles on road:
 - 16 (Base Case – Hopetoun)
 - 7 (Preferred Case – Robinvale)


Ilmenite

- 40 B-Double return trips per day
- B-Doubles on road:
 - 12 (Base Case – Manangatang)
 - 8 (Preferred Case – Robinvale)



18

Project schedule & next steps



Activity	Date
Pre-feasibility study commencement	January 2011
Complete evaluation of mining options	January 2012
Submit DA and Preliminary Environmental Assessment	April 2012
Planning focus meeting	May 2012
Complete pre-feasibility study	December 2012
Submit EIS	January 2013
Iluka Board Decision	March 2013
Development consent	December 2013
Commence site construction	March 2014
Receipt of all approvals to operate	July 2014
Commence operations	Mid 2015

19

Appendix 5 – Transect Data

Appendix 6 – Aboriginal Site Descriptions

Due to print size restrictions this appendix has been removed from this printed copy of the Aboriginal cultural heritage assessment. It is available in the electronic copy on CD. To request a copy, please contact Iluka Resources on (08) 8300 200.

Niche Environment and Heritage

A specialist environmental and heritage consultancy.

Head Office

Niche Environment and Heritage
PO Box W36 Parramatta NSW 2150
Email: info@niche-eh.com

All mail correspondence should be through our Head Office





www.emgamm.com

SYDNEY
Ground Floor, Suite 1, 20 Chandos Street
St Leonards NSW 2065
T 02 9493 9500 F 02 9493 9599

NEWCASTLE
Level 5, 21 Bolton Street
Newcastle NSW 2300
T 02 4927 0506 F 02 4926 1312

BRISBANE
Suite 1, Level 4, 87 Wickham Terrace
Spring Hill Queensland 4000
T 07 3839 1800 F 07 3839 1866

