EXPLANATORY NOTE – PLANNING PROPOSAL

Planning Proposal (PP_2020_DREGI_001_00) to amend the Dubbo Local Environmental Plan 2011 – Part Lot 501 DP 1255115, Boundary Road, Dubbo.

This document addresses the key components of the subject Planning Proposal with the aim to provide additional clarity and understanding throughout the public exhibition process.

1. Planning Proposal

a) Location of Subject Land

A Planning Proposal request was lodged with Council on 20 March 2020 by Maas Group Properties, which sought to amend the Dubbo Local Environmental Plan 2011 (LEP). The Planning Proposal applies to Part Lot 501 DP 1255115, Boundary Road, Dubbo as identified in **Figure 1**.



Figure 1. Subject Land Subject Allotment (Lot 501 DP 1255115)

b) Intention of Planning Proposal

The subject land is currently zoned B1 Neighbourhood Centre zone under the provisions of the Dubbo Local Environmental Plan 2011. The zoning provisions pursuant to the LEP do not currently permit development for the purposes of a pub on the subject site.

The Planning Proposal seeks to amend Schedule 1(5) under the provisions of the Dubbo LEP 2011 to allow an additional permitted use of pub on Part Lot 501 DP 1255115, Boundary Road,

Dubbo. To ensure accuracy and consistency is maintained, an additional administrative amendment will also be undertaken to the property details under Schedule 1(5) to reflect the correct Lot and Deposited Plan number.

The proposed development is intended to be in the format of a gastropub with the focus on offering both quality food and drink as opposed to the standard expectation of a regular pub setting. The proposed gastropub will be situated within the existing B1 zone and provide appropriate synergies alongside future commercial development of the surrounding neighbourhood centre.

The Applicant has provided the following information explaining the anticipated development typologies on the land:

"It is anticipated that a varied mix of small-scale retail, business and community uses would continue to be provided within the proposed shopping centre site.

It is proposed the site would facilitate a neighbourhood supermarket as well as specialty & general merchandise store such as a pub, newsagency, post office, dry cleaning facility, etc.

The gross floor area of the proposed gastropub is approximately 580m² and is identified as 'Restaurant Café' on the proposed neighbourhood centre design shown in **Figure 2**.

THE CENTRE



9

Figure 2. Indicative Site Plan (Neighbourhood Centre)

2. Consideration by Council

Council has undertaken assessment of the Planning Proposal to ensure consistency with the Department of Planning, Industry and Environment's, 'A guide to preparing planning proposals'.

Council at its meeting on 28 September 2020, considered a report in respect of the Planning Proposal and resolved as follows:

- "1. That the Planning Proposal, as provided by the Proponent and included as Appendix 1 to the report of the Manager Growth Planning dated 29 June 2020, be endorsed.
- 2. That Council support a minimum 28 day public exhibition period for the Planning Proposal.
- 3. That Council not use its delegation under Section 59 of the Environmental Planning and Assessment Act, 1979 to draft the amendments to the Dubbo Local Environmental Plan 2011.
- 4. That following the completion of the public exhibition period, a further report be provided to Council detailing the results of public exhibition and for further consideration of the Planning Proposal."

3. Gateway Determination

Council on 16 November 2020, received a Gateway Determination from the Department of Planning and Environment. The conditions of the Gateway Determination are as follows:

- *"1. Prior to undertaking community consultation, the following is required:*
 - (a) update the planning proposal to include reference to the correct property description (Part Lot 501 DP 1255115), and
 - (b) amend the planning proposal to include the intent to amend the existing property description in Schedule 1(5) to reflect the correct Lot and DP.
 - (c) Public exhibition is required under section 3.34(2)(c) and schedule 1 clause 4 of the Act as follows:
 - (d) The planning proposal must be made publicly available for a minimum of 28 days; and
 - (e) The planning proposal authority must comply with the notice requirements for public exhibition of planning proposals and the specifications for material that must be made publicly available along with planning proposals as identified in section 6.5.2 of A guide to preparing local environmental plans (Department of Planning and Environment, 2018).
 - (f) No consultation is required to be held into the matter by any person or body under section 3.34(2)(e) of the Act.
 - (g) A public hearing is not required to be held into the matter by any person or body under section 3.34(2)(e) of the Act. This does not discharge Council from

any obligation it may otherwise have to conduct a public hearing (for example, in response to a submission or if reclassifying land).

- (h) The planning proposal authority is authorised as the local plan-making authority to exercise the functions under section 3.36(2) of the Act subject to the following:
- (i) The planning proposal authority has satisfied all the conditions of the Gateway determination;
- (j) The planning proposal is consistent with section 9.1 Directions or the Secretary has agreed that any inconsistencies are justified; and
- (*k*) There are no outstanding written objections from public authorities.
- (I) The timeframe for completing the LEP is to be 6 months following the date of the Gateway determination."

4. List of supporting Information

Attachment A – Council reports and minutes in respect of the Planning Proposal

Attachment B – Department of Planning, Industry and Environment's Gateway Determination

Attachment C – Planning Proposal and associated documentation

Attachment D – A guide to preparing planning proposals

Attachment E – A guide to preparing local environmental plans





PLANNING PROPOSAL



ADDITIONAL PERMITTED USE





Lot 407 in DP 1248682 Southlakes Estate, Dubbo

March 2020



Contents

EXECUTIVE SUMMARY	4
BACKGROUND	5
1.1 INTRODUCTION	5
1.2 SCOPE OF REPORT	6
1.3 STRUCTURE	6
OVERVIEW	7
2.1 THE SUBJECT SITE	7
2.1.1 SITE DESCRIPTION AND LOCATION	7
2.2 BACKGROUND	8
2.3 DEVELOPMENT INTENT	8
2.2.1 EXISTING LAND ZONING AND LOCALITY	9
2.2.3 PROPOSED ADDITIONAL PERMITTED USE	9
2.2.4 ANTICIPATED DEVELOPMENT TYPOLOGIES	
2.2.5 PROPOSED DEVELOPMENT OBJECTIVES	
2.2.6 SERVICES	
2.2.8 TRAFFIC & TRANSPORT CONSIDERATION	11
2.2.7 CONSISTENCY WITH EXISTING COUNCIL DECISIONS AND POLICIES	11
2.3 ENVIRONMENTAL CONSIDERATION	
2.3.1 TOPOGRAPHY & SOILS	11
2.3.2 SALINITY & GROUNDWATER	
2.3.3 FLORA & FAUNA	
2.3.4 BUSHFIRE	
2.3.5 FLOODING	13
2.3.6 CONTAMINATION	13
2.3.7 ACOUSTIC REVIEW	
2.4 SOCIAL AND CULTURAL CONSIDERATIONS	
2.4.1 ABORIGINAL ARCHAEOLOGY	
2.4.2 EUROPEAN HERITAGE	
DEVELOPMENT INTENT AND PROVISIONS	
3.1 OBJECTIVE	
3.2 EXPLANATION OF PROVISIONS	
JUSTIFICATION	



4.1 NEED FOR THE PLANNING PROPOSAL	16
Is the proposal the result of any strategic study or report?	16
Is the proposal the best means of achieving the objectives or intended outcomes, or is there a l 17	petter way?
4.2 RELATIONSHIP TO STRATEGIC PLANNING FRAMEWORK	17
Is the proposal consistent with the objectives and actions or any applicable regional or s	ub-regional
strategy?	17
Is the proposal consistent with Council's local strategy or other local strategic plan?	
Consistent with applicable State Environmental Planning Policies (SEPP)	20
4.2.1 Consistent with the applicable Part 9.1 (2) Ministerial Directions?	
4.3 ENVIRONMENTAL, SOCIAL AND ECONOMIC IMPACT	24
Is there a likelihood that critical habitat or threatened species, populations or ecological com	munities or
their habitats, will be adversely affected as a result of the proposal?	24
Are there any other likely environmental effects as a result of the PP and how are they prop	osed to be
managed?	24
Has the PP adequately addressed any social and economic effects?	24
4.4 STATE AND COMMONWEALTH INTERESTS	24
Is there adequate public infrastructure for the PP?	24
What are the views of state and commonwealth public authorities consulted in accordance with the	ne Gateway
determination?	24
COMMUNITY CONSULTATION	
5.1 TYPE OF COMMUNITY CONSULTATION REQUIRED	25

APPENDICIES

- A. Site Plan, prepared by Maas Group Properties
- B. Design Intent, prepared by Maas Group Properties Pty Ltd
- C. Servicing Strategy, prepared by Geolye Pty Ltd
- D. Traffic Study, prepared by Geolyse Pty Ltd
- E. Groundwater and Salinity Study, prepared by Envirowest Pty Ltd
- F. Ecological Assessment, prepared by OzArk Environmental and Heritage Management Pty Ltd
- G. Contamination Investigation, prepaed by Envirowest Pty Ltd
- H. Road Traffic Noise Assessment, Muller Acoustic Consulting
- I. Aboriginal Archaeological Assessment, prepared by OzArk Environmental and Heritage Management Pty Ltd
- J. Employment Lands Strategy, prepaed by Dubbo Regional Council
- K. Economic Impact Analysis, prepared by PPM Consulting
- L. Social Impact Assessment, prepared by Umwelt (Australia) Pty Ltd



EXECUTIVE SUMMARY

This document is to provide an outline of the development intention for the land identified within the Southlakes Estate Residential Urban Release Area known as The Southlakes Shopping Centre upon Pt. Lot 407 in DP 1248682. The proposal seeks an amendment to the *Dubbo Local Environmental Plan 2011* (DLEP) Schedule 1 Additional Permitted Use cl 5 Use of Land at Boundary Road, Dubbo to allow for development for the purposes of a pub and/or retail premises as permitted with development consent.

This PP has been prepared in accordance with the NSW Department of Planning and Environment's (DPE) advisory documents 'A Guide to Preparing Local Environmental Plans' and 'A Guide to Preparing Planning Proposals'.

The intention of this PP is to include a gastronomic pub (gastropub) within Southlake's neighbourhood centre precinct that will be focused on providing a space for community interaction and dining for the current and future residents of the Southlake's Estate and members of the Dubbo Community.

It is anticipated that this PP would facilitate:

- A range of small-scale retail, business and community uses that serve the needs of people who live in or work in the surrounding neighbourhood and;
- Continued economic growth and development of Southlakes Estate neighbourhood centre to be consistent with the commercial hierarchy of the City of Dubbo.



BACKGROUND

1.1 INTRODUCTION

The Southlakes Estate Master Plan includes establishment of a neighbourhood centre precinct in the centre of the estate to provide community services such as a supermarket, space for specialty stores, restaurants and cafes.

A Planning Proposal (PP) that sought to rezone land at Boundary road to facilitate the development of the neighbourhood centre was approved by Dubbo Regional Council in February 2018 and the Local Environmental Plan was subsequently amended in June 2018 to include this precinct.

Maas Group Properties Pty Ltd have prepared this PP to support a proposed amendment to DLEP Schedule 1 Additional Permitted Use cl 5 Use of Land at Boundary Road, Dubbo to allow for development for the purposes of a pub as defined in the DLEP as a *"licensed premises under the* Liquor Act 2007 *the principal purpose of which is the retail sale of liquor for consumption on the premises, whether or not the premises include hotel or motel accommodation and whether or not food is sold or entertainment is provided on the premises"*.

It is anticipated that this PP would facilitate:

- A range of small-scale retail, business and community uses that serve the needs of people who live in or work in the surrounding neighbourhood and;
- Continued economic growth and development of Southlakes Estate neighbourhood centre to be consistent with the commercial hierarchy of the City of Dubbo.

Details of the proposal's compliance with relevant strategic, regional, and local planning instruments, state environmental planning policies, and ministerial directions are contained in the following sections.



1.2 SCOPE OF REPORT

This PP has been prepared in accordance with the NSW Department of Planning's advisory documents 'A Guide to Preparing Local Environmental Plans' and 'A Guide to Preparing Planning Proposals'. The latter document requires the PP to be provided in five (5) parts, those being;

- Part 1 A statement of the objectives or intended outcomes of the proposed LEP;
- Part 2 An explanation of the provisions that are to be included in the proposed LEP;
- *Part 3* The justification for those objectives, outcomes, and provisions and the process for their implementation;
- Part 4 Mapping, and;
- Part 5 Details of the community consultation that is to be undertaken on the Planning Proposal.

It is noted that Part 4 would be confirmed following a Gateway Determination of this Planning Proposal by the NSW Department of Planning and Environment.

1.3 STRUCTURE

This PP is provided in the following structure;

- Section 2 provides an overview of the subject site; the development intent; and development constraints;
- Section 3 provides a statement of the objective and explanation of provisions of the PP;
- **Section 4** provides justification regarding the need for the PP; outlines its relationship to strategic planning strategies; and overviews the environmental, economic, and social impacts of the proposal;
- Section 5 provides the proposed mapping amendments relating to the Planning Proposal area; and
- Section 6 details how community consultation is to be undertaken with respect to the PP; and



OVERVIEW

2.1 THE SUBJECT SITE

2.1.1 SITE DESCRIPTION AND LOCATION

The subject site is known as Pt. Lot 407 in DP 1248682 and is within the south-eastern Residential Urban Release Area. The site is bounded by future Boundary Road extension to the north, Southlakes drainage corridor to the east and land zoned for future residential development to the west and south.

This land is nearing readiness for development as the existing ongoing residential estate development progresses east, within the Urban Release Area (URA).

Figure 1 below provides an aerial view of the land relative to the existing Southlakes residential estate, future growth and immediate surrounding locality.



Source: NearMaps May 2019

FIGURE 1: Aerial view of subject site & Locality



2.2 BACKGROUND

The subject site is situated within the identified URA for future residential subdivision in the south-east sector of the Dubbo LGA. Maas Group Properties Southlakes Pty Ltd owns the subject land on which the future commercial hub is to be developed, being an englobo allotment for future subdivision. Maas Group Properties has been undertaking residential development within this subject area since circa 2015, currently developing the wider Southlakes Residential Estate, Lakeview Estate, Magnolia Estate and Keswick on the Park Estate. A plethora of development consents have been obtained over land in the subject area, including general residential and medium density subdivisions and their associated development. For example, there is a current Development Application (DA) lodged with Council seeking a 101-lot residential subdivision immediately west of the subject site pertaining to this PP, Council's reference D2020-5 (Pt 1).

It is Maas Group Properties ongoing development within this south-east sector of the Dubbo urban area, passion for the growth and development of regional cities and financially vested interest that will see this immediate area of Dubbo encompass a population of approximately 10,000 residents by circa 2028. The ongoing Southlakes Estate residential subdivision development will account for a projected 2,080 allotments, being home to in excess of 6,500 residents.

2.3 DEVELOPMENT INTENT

The intent of this PP is to provide an additional permitted use on the subject site, specifically the additional permitted use of a gastropub on the subject land that is proposed for a commercial neighbourhood centre. The additional permitted use is to provide a supplementary land use within the neighbourhood centre precinct as a point of difference, that will focus on providing a space for community interaction and dining for the current and future residents of the Southlakes Estate and wider south-east sector of the Dubbo urban area.

A gastropub is defined as a pub or tavern that offers meals of high quality, notable for the focus on food rather than dining. It is proposed that the gastropub be developed within the neighbourhood centre alongside the proposed supermarket with construction planned to commence in mid-2021. This PP will continue to establish Southlake's as a neighbourhood centre that can provide for a range of small-scale retail, business and community uses that serve the needs of its residents.

It is intended to amend Schedule 1 – Additional Permitted Uses of the DLEP to permit a gastronomic pub land use to occur on the subject site, forming part of the neighbourhood centre. A Development Application would therefore utilise Clause 2.5 – Additional Permitted Uses for Particular land, of the DLEP to carry out the development specified.



2.2.1 EXISTING LAND ZONING AND LOCALITY

The land immediately around the site is generally residential in zoning, however, physically is characterised as existing cleared agricultural grazing land. Existing, and ongoing residential development is located to the west of the subject site, that continues to develop in an eastern direction toward the urban fringe.

As represented below in **Figure 2**, in accordance with Land Zoning Map – Sheet LZN_008B of the DLEP, the surrounding land is predominantly zoned either R1 – General Residential or R2 – Low Density Residential. Whereas the subject site is identified as the B1 – Neighbourhood Centre land zone. It is also witnessed that some RE1 – Public Recreation land zoning is in relatively close proximity to the site.



Source: Dubbo LEP 2011

FIGURE 2: Land Zoning Map

2.2.3 PROPOSED ADDITIONAL PERMITTED USE

The intent of this PP is to provide an additional permitted use on the subject site, specifically the additional permitted use of a gastropub on the subject land that is proposed for a commercial neighbourhood centre. The amendment to Schedule 1 in the DLEP, additional permitted uses on certain land, must be amended to permit a *pub* land use to be developed and operate on the subject site.

Pubs are currently listed as prohibited in the DLEP B1 land use zone. This PP seeks to amend Schedule 1 clause 5 of the DLEP to include the following:

- (3) Development for the purposes of a pub is permitted with development consent.



The proposed additional permitted use of a pub within certain land at Boundary Road is sought to ensure the continued economic growth and development of Southlakes Estate Residential Urban Release Area consistent with the objectives in the LEP B1 land zone, by providing an additional retail use to the shopping centre that would service the amenity needs for the immediate residents.

The proposed development and use of a pub within Southlakes will facilitate a functional mixed-use neighbourhood centre that will provide for a variety of uses to serve the surrounding neighbourhood and greater Dubbo community.

2.2.4 ANTICIPATED DEVELOPMENT TYPOLOGIES

It is anticipated that a varied mix of small-scale retail, business and community uses would continue to be provided within the proposed shopping centre site.

It is proposed the site would facilitate a neighbourhood supermarket as well as specialty & general merchandise stores such as a pub, newsagency, post office, dry cleaning facility, etc.

A proposed indicative Site Plan of the neighbourhood centre is illustrated at Appendix A.

The indicative design intent of the gastropub is illustrated at Appendix B.

2.2.5 PROPOSED DEVELOPMENT OBJECTIVES

The subject site that forms part of this PP, and the proposed additional permitted use on the site are to be developed and operated generally in accordance with the following objectives:

- To enable the legal development of a pub on the subject site
- To integrate suitable small-scale business, retail, community uses and food and drink to serve the needs of people who live or work in the surrounding neighbourhood
- To encourage employment opportunities
- To ensure economic growth within Dubbo, and surrounding localities
- Additional retail uses that support the residential amenity of the surrounding estate

2.2.6 SERVICES

No Council services (reticulated water, reticulated sewer and stormwater infrastructure) are situated to service the subject site at this current point in time. However, a *Servicing Strategy* prepared by Geolyse dated June 2017 includes the provision of future local roads, water, sewer, and stormwater mains infrastructure to support the future development consistent with required service providers design requirements and that of surrounding arrangements. The Servicing Strategy is provided at **Appendix C**.

In general, telecommunications, roads, power and water service mains are being constructed/extended from the existing mains located to the west with sewer and stormwater being extended and augmented from their respective downstream mains in the south. It is anticipated that the mains would be primarily located within the road network and along and across common boundaries where necessary.



The proposed additional use is not considered to compromise the adopted servicing strategy for this land and remains unchanged from that previously supported with the adoption of the neighbourhood centre zoning by Council previously.

2.2.8 TRAFFIC & TRANSPORT CONSIDERATION

The supporting *Traffic Study* prepared by Geolyse dated June 2017 and provided at **Appendix D** calculates the predicted traffic generation rates for the estate once developed in accordance with that indicated upon the masterplan plan.

Once fully constructed, the proposed residential estate would be provided with east/west and north/south local collector/spine roads that link to the surrounding local collector roads of Boundary Road, Hennessy Drive and Sheraton Road

The study identifies that the additional vehicle trips are not considered to have an adverse impact upon traffic congestion within the surrounding road network and generally result in service levels of A and B for the roads of Boundary Road, Sheraton Road and their inclusive intersections as modelled using SIDRA.

Should future development be considered to generate traffic at a higher rate than that identified within the supporting traffic impact assessment report such development would be required at the development application stage to demonstrate it would be suitable within the surrounding road network.

2.2.7 CONSISTENCY WITH EXISTING COUNCIL DECISIONS AND POLICIES

The existing 'Southlakes' development has been a fixture within the Dubbo landscape since 2010. Since that time, Council has supported low and medium residential development of single and dual occupancy dwellings, real estate display village, childcare centre and proposed shopping centre within the Southlakes neighbourhood centre. The development intent is simply to continue the successful execution of Southlakes Estate Residential Urban release area to continue to provide for residential and economic growth within the Dubbo community.

2.3 ENVIRONMENTAL CONSIDERATION

2.3.1 TOPOGRAPHY & SOILS

The subject site is predominately cleared of native vegetation and is maintained for agricultural grazing. The subject land is located within the Talbragar Valley Subregion of the Brigalow Belt South Bioregion. Within this subregion Morgan and Terrey (1992) describe the soil environment as;

"Thin stony loams and texture contrast soils over most of the landscape with deeper sands and brown earths on valley floors".

This soil type is consistent with being able to sustain urban development subject to design improvements to ensure soil salinity and erosion impact are minimised as detailed below.



2.3.2 SALINITY & GROUNDWATER

A *Groundwater and Salinity Study* dated 8 September 2016 prepared by Envirowest Consulting has been prepared for the Southlakes Estate Residential Urban Release Area and is provided at **Appendix E**.

The objective of this report was to provide detailed information on potential impacts and mitigation options (if required) in relation to dryland and urban salinity processes and groundwater. The report assesses the existing salinity conditions of the soil and groundwater and determines the impact of the development on groundwater.

Generally, the report concludes that the intended development is suitable for the site and is of a scale and location in the landscape that is not considered to be high risk with recommendations to ensure intended development mitigates any potential adverse impacts.

It is noted this report was adopted upon gazettal of the change in zoning to a neighbourhood centre and that the abovementioned additional permitted use does not change the findings of this report.

2.3.3 FLORA & FAUNA

As described within the supporting *Ecological Assessment* prepared by Ozark Pty Ltd dated May 2015 and provided at **Appendix F**, the site is completely cleared, ploughed and disturbed due to agricultural purposes.

No known threatened species or ecologically endangered communities have been identified as being present on the site. In this regard, having considered the ecology within the subject site, the report concludes that the development of the site is:

- Unlikely to significantly affect any of the listed threatened species, fauna populations or communities.
- Unlikely to augment or significantly contribute to any of the National or State listed Key Threatening Processes, if the appropriate safeguards regarding the control of potential vertebrate pests are effectively applied.
- Unlikely to significantly affect any RAMSAR wetland or CAMBA, ROKAMBA or JAMBA listed species;
- Unlikely to significantly affect local hydrology.
- Consistent with ESD principles with regard to fauna, would not adversely affect the local biodiversity and that no issue of intergenerational or value-added matters are relevant in this instance.

The report concluded that the proposed activity should not be considered to constitute a significant impact and, as such, no Species Impact Statement (SIS) is warranted. No Koala Habitat Management Plan pursuant to SEPP 44 is required (as above).

2.3.4 BUSHFIRE

Reference is made to Dubbo City Council's *Bushfire Prone Land Map* which indicates the level of fire risk for properties. In accordance with this Map, the subject land is not identified as being located on bush fire prone land. In this regard, no further investigation for this PP has been undertaken.



2.3.5 FLOODING

The subject site is not within land identified in DLEP *Flood Planning Map* as flood prone. In this regard, no further investigation for this PP has been undertaken.

2.3.6 CONTAMINATION

The soils contained in the area of land proposed for urban and residential development are of similar quality to that present within the bounds of the existing Southlakes Estate. Each of these sites have previously been assessed and considered as suitable for residential and recreational use and development by Council.

Notwithstanding, a *Contamination Investigation Study* prepared by Envirowest Consulting dated June 2019 and provided at **Appendix G** was conducted for the land to ensure the land is suitable for its intended use. The contamination investigation was prepared in accordance with the Contaminated Land Management Guidelines referenced by *State Environmental Planning Policy No. 55 - Remediation of Land*. The conclusion of the Contamination Investigation Report is as follows:

- The site has a land-use history of grazing;
- There is no evidence of potentially contaminating land uses or activities on the site;
- The contamination status of the site was assessed through a soil sampling and laboratory analysis
 program. The soil sampling program did not detect elevated levels of the analysed metals, OCP or TRH.
 The levels of all substances evaluated were below the EPA investigation threshold for residential and
 recreational land-use with access to soil. Therefore, no contamination was found;
- Several stockpiles of soil, timber and trace general refuse were located across the site. No asbestos
 was identified in the stockpiles on site.

The subject site and surrounding area is therefore suitable for the future residential and urban land uses.

2.3.7 ACOUSTIC REVIEW

An acoustic report of cumulative noise for the intended use of the subject site would be prepared by a qualified consultant and provided to Council subject to a future development application. The noise impact assessment would be site and use specific and address relevant LEP and DCP objectives.

It should be noted a *Road Traffic Noise Assessment* prepared by Muller Acoustic Consulting dated July 2019 was carried out as part of PP1 and PP2 for the Southlakes URA and is provided at **Appendix H**.

The assessment details the adjoining quarry and road traffic noise emissions from the proposed Southern Distributor including the preparation of an acoustic impact map.

The findings of this review identified that the distributor is the acoustically dominant source of noise, the overall increase in cumulative noise is less than 1dB and generally this would not be perceptible by residents as quarry noise would be masked by road noise from the distributor and potentially inaudible.



2.4 SOCIAL AND CULTURAL CONSIDERATIONS

2.4.1 ABORIGINAL ARCHAEOLOGY

Ozark Environmental Management and Heritage conducted an *Aboriginal Archaeological Assessment* (of the land) to determine the presence and potential impact of the proposal upon aboriginal heritage significance of the area, dated June 2015. The assessment is provided at **Appendix I**.

The assessment report identified additional items of low heritage significance noting they had been disturbed and damaged from past agricultural uses. In this respect and having regard to the indicative lot layout and likely servicing strategy, the existing items are likely to require removal through the issue of an AHIP.

It should be noted that should, during the further development of the site, any artefact, potential site or objects of Aboriginal Cultural Heritage Significance be uncovered, works would cease immediately pending referral for an investigation by the NSW Office of Environment and Heritage in accordance with *the National Parks and Wildlife Act 1974*.

2.4.2 EUROPEAN HERITAGE

The subject site does not contain any locally listed European heritage items as identified by the DLEP. In this regard, no further investigation for this PP has been undertaken.



DEVELOPMENT INTENT AND PROVISIONS

3.1 OBJECTIVE

The objective of this Planning Proposal (PP) is to enable a gastronomic pub (gastropub) on the subject land that is proposed for a commercial neighbourhood centre. The gastropub would provide a supplementary land use within the neighbourhood centre precinct as a point of difference, that will focus on providing a space for community interaction and dining for the current and future residents of the Southlakes Estate and wider south-east sector of the Dubbo urban area.

The PP seeks the Additional Permitted Use on the subject site to include a 'pub' land use.

3.2 EXPLANATION OF PROVISIONS

The PP affects the Additional Permitted Uses (APU) Map APU_008B of the *Dubbo Local Environmental Plan* 2011 (LEP). This PP seeks to allow the APU of a 'pub' land use on the subject site.

A "pub" is to be defined in accordance with the Standard Instrument as a "licensed premises under the Liquor Act 2007 the principal purpose of which is the retail sale of liquor for consumption on the premises, whether or not the premises include hotel or motel accommodation and whether or not food is sold or entertainment is provided on the premises".



JUSTIFICATION

The overarching principles that guide the preparation of PP's are:

- The level of justification should be proportionate to the impact the PP would have;
- It is not necessary to address a question if it is not considered relevant to the PP; and
- The level of justification should be sufficient to allow a Gateway determination to be made with confidence that the LEP can be finalised within the timeframe proposed.

The following justification addresses each relevant question applicable to this PP to ensure confidence can be given at the Gateway determination.

4.1 NEED FOR THE PLANNING PROPOSAL

Is the proposal the result of any strategic study or report?

This PP aligns with the principles of Dubbo Regional Councils (DRC) Employment Lands Strategy 2019, attached at **Appendix J**, by establishing a local neighbourhood centre in Southlake's that can provide for future growth and employment opportunities servicing the day to day needs of Southlakes residents and members of the Dubbo community.

Findings from DRC Employments Land Strategy reveal the following:

- Dubbo has a steady population growth over a long period;
- Dubbo has a low unemployment rate, high self-sufficiently rate and high self-contentment rate which demonstrates Dubbo's ability to generate employment opportunities for residents living in Dubbo whilst also attracting residents from other LGAs;
- Dubbo is a major service centre for regional NSW highlighted by three largest employment sectors in health care and social assistance, retail trade and education and training.

It is considered that the level of future economic growth and development in the area of Dubbo necessitates the future provision of a neighbourhood shopping centre. The Southlake's neighbourhood centre will have an approximate trade area of 10,000 residents by 2031 (DRC Employment Lands Strategy p. 53). The proposal to include a gastro pub within the neighbourhood centre precinct will continue to implement the planning principles of the DRC Employments Land Strategy by providing opportunities that:

- Encourage the appropriate development of the neighbourhood centre in terms of built form, scale and design that compliments the adjoining residential estate;
- Allow accessibility for the surrounding community. It is intended that the gastro pub would be accessible via Boundary Road with car parking provided at the neighbourhood centre; and
- Manage land-use conflicts by providing a functional mixed-use neighbourhood centre that will deliver a variety of uses to serve the surrounding neighbourhood and greater Dubbo community.

An Economic Impact Assessment (EIA) prepared by PPM Consulting (attached as **Appendix K**), is an independent assessment of the economic impacts and net community benefits relating to a gastronomic pub (gastropub) proposed to be located within the planned neighbourhood centre in the Southlakes Estate located in East Dubbo, NSW. The EIA undertook an analysis of the DRC employment strategy for the LGA, of which represents a current shortage of 3,991m² of GFA for restaurants, liquor, take-aways, hotels and clubs. It is forecast that this shortage is expected to increase to 7,185m² in 2031. Following the establishment of the proposed gastropub, there would still be a floorspace shortage in the sector of over 6,500m².

In addition, there are no pubs, clubs, restaurants or packaged alcohol venues within a 15-minute walk of the proposed gastropub. In this sense, the proposed gastropub will be a local offering. The analysis provided in this report suggests that not only is the proposed gastro pub not likely to adversely affect current businesses, it will have a positive overall effect on the Dubbo economy.



Is the proposal the best means of achieving the objectives or intended outcomes, or is there a better way?

The proposed site is zoned B1 – Neighbourhood Centre. The objectives of this PP continue to align the Land Use Zoning provisions by:

- Providing for a range of small-scale retail, business and community uses that service the needs of people who live or work in the surrounding neighbourhood;
- Ensuring the growth of the neighbourhood centre is consistent with the commercial hierarchy of the City of Dubbo.

The proposal to include a pub within the neighbourhood centre precinct seeks to continue with the Southlakes Master Plan to provide for additional retail amenity needs of its residents and to strengthen the centre as a meeting / local point for the community.

The submission of a PP to amend Schedule 1 clause 5 of the DLEP represents the best method of achieving the desired outcome. Noting this has been the previous approval pathway for stage 1 and stage 2 of Southlakes Estate.

4.2 RELATIONSHIP TO STRATEGIC PLANNING FRAMEWORK

Is the proposal consistent with the objectives and actions or any applicable regional or sub-regional strategy?

Central West and Orana Regional Plan 2036

The role of the Plan is to guide the NSW Government's land use planning priorities and decisions over the years, leading in to 2036. It provides an overarching framework to guide subsequent and more detailed land use plans, development proposals and infrastructure funding decisions.

An implementation Plan accompanies this Plan and includes priority actions, as well as medium to long term actions to coincide with population and economic change.

This PP is consistent with the objectives of this Plan, especially Goal 1 of the Plan, *The Most Diverse Regional Economy in NSW* and specifically *Direction 10: Promotes Business and Industrial Activities in Employment Lands*, and associated action 10.6.

10.6 Accommodate future commercial and retail activity in existing commercial centres, unless there is a demonstrated need or social and economic benefits to locating this activity elsewhere.

The proposed gastropub would be established within the identified and appropriately zoned neighbourhood centre commercial site of the Southlakes Estate residential area. This is not an existing commercial centre, however there would be a social and economic benefit for the gastropub to be established in this location.

The Social Impact Assessment (SIA) prepared by UMWELT (attached as **Appendix L**), provides an assessment of the potential social impacts associated with the addition of the gastro pub to the neighbourhood shopping centre in the Southlakes Estate. Specifically, assessing the impact on people's way of life (how they live, work, play and interact with one another on a day to day basis), the culture of the affected community (its shared beliefs, customs and values) and the nature of the affected community (its cohesion, interactions, stability, character, services and facilities) (Dubbo Regional Council, 2013).

The SIA establishes that the development:

- Is consistent with the regulatory and business development framework, including state government legislation and the Dubbo Regional Council's strategic plans;
- Is an appropriate development in relation to the projected changes to population, largely due to the continuing development of Southlakes Estate, and the demographics in the region;
- Is unlikely to have an impact on the social amenity of the community in the construction or operational phase;



- Is unlikely to have an impact on the cultural heritage or community significance in the area;
- Will create access to dining facilities and encourage community networking through acting as a centre for community interaction;
- Would be a benefit contributing to the overall sense of place and community sustainability of the Dubbo South community;
- Will have a positive impact on the economy and employment opportunities in the region.

In addition to the social impacts, there are also economic benefits that would occur. The neighbourhood centre site and gastropub would service the growing, surrounding residential area. This area, being the south-east sector of Dubbo would encompass a population of approximately 1,000 residents by circa 2028. The immediate Southlakes Estate residential subdivision development will account for a projected 2,080 allotments, being home to in excess of 6,500 residents.

The EIA prepared by PPM Consulting (Appendix K), as previously mentioned, also concluded that:

- The proposed gastro pub at Southlakes would add to the Dubbo restaurant, hotel and gaming sector, as well as provide a local outlet for package alcohol.
- At the local level, the proposal would service the 5,200 new local residents in the Southlakes Estate but would also be accessible by car within a 15 minute drive from most of the Dubbo city centre.
- There is a large shortage of floorspace for restaurants, liquor, take-aways, hotels and clubs in Dubbo. As the proposed gastro pub would only be small as far as gross floorspace is concerned (580m2 including restaurant, bar, gaming venue and packaged alcohol sales), it would only have a very small impact on reducing that under-supply.
- Due to the relatively small size of the proposed gastro pub, the large shortage of floorspace and the relatively small increase in the number of EGMs, it is very unlikely that currently existing venues would be adversely affected by the operation of the proposal.
- The analysis provided in this report suggests that not only is the proposed gastro pub not likely to adversely affect current businesses, it will have a positive overall effect on the Dubbo economy.

Is the proposal consistent with Council's local strategy or other local strategic plan?

South East Dubbo Residential Urban Release Area Structure Plan

The role of the Plan is to set the overall direction for development in the south east Residential Urban Release Area, inform land use decisions in the LEP and allow the developers of the Southlakes Estate to pursue the continued development of the Estate having regard to overall infrastructure and servicing constraints.

The Plan provides four (4) 'Strategic Residential Growth Principles' which have been considered during the preparation of this PP. The principles and a comment having regard to the PP is provided within the following table:

Strategic Residential Growth Principles	Comment
Any future amendment to the Dubbo Local	DLEP Part 7.12 and 7.12A stipulate limitations to
Environmental Plan 2011 to introduce a commercial	gross floor area applicable to the subject site.
zoning to facilitate a neighbourhood centre be	
required to include a maximum floorspace limitation	
to limit the size and configuration of any commercial	
development to a neighbourhood scale.	
Any Planning Proposal to introduce a commercial	The EIA, prepared by PPM Consulting is attached to
zone to allow for neighbourhood centre development	this report, provided at Appendix K. The report
will be required to provide an economic impact	presents findings supportive of this PP.
assessment which provides an assessment of such a	
proposal on the Dubbo Central District, the Orana	
Mall Marketplace and other neighbourhood centres.	



A variety of access provisions are to be provided to	Access to the proposed pub within the Southlakes
any neighbourhood centre development including	neighbourhood centre precinct would be via
facilities for walking, cycling onsite public transport	Boundary Road and Stream Avenue with car parking
provision and suitable parking for private cars.	provided at the neighbourhood centre to allow
	accessibility for the surrounding community.
	Similarly, pedestrian access would be facilitated by a
	number of paths and a bridge link to the residential
	area to the east of the centre.
Any neighbourhood centre development will be of a	This will be determined as part of a separate
local scale which will not impact the residential	development application with DRC. It is envisaged
amenity of development.	that building heights of residential area would be
	respected and sufficient setbacks provided.

Having regard to the above consideration of the Strategic Residential Growth Principles this PP is considered to be consistent with those of the Structure Plan.

Dubbo City Planning & Transportation Strategy 2036

The Dubbo City Planning and Transportation Strategy 2036 has been designed to provide guidance regarding the construction of roads and pedestrian pathways in Dubbo City. The 'Context' of the Plan states that the Strategy is to be considered in future strategic land use planning decisions.

Part 2.3.1 identifies community business as an "all-encompassing name for activities that are compatible with residential activities and that generate pedestrian activity. These activities attract pedestrians, and not trucks, operate only during the day and are therefore quiet at night. Limiting the size of a development in this category limits the scale of traffic generation and therefore the impact on local streets" (p.18).

The recommendation from the report is that community businesses must be located along streets where buildings front the street edge and parking is located at the rear of the buildings. It is intended that access to the gastro pub would be via Boundary Road with car parking provided at the neighbourhood centre to allow accessibility from the surrounding community. In this regard, this PP is considered to be consistent with Part 2.3.1 of the Dubbo City Planning and Transportation Strategy.



State Environmental Planning Policy	Comment
<u>State Environmental Planning Policy No.</u> <u>44 – Koala Habitat Protection</u>	An Ecological Assessment provided at Appendix F has been prepared which assesses the impact of the proposal upon ecological communities and or their habitats. The report concluded that the proposed activity should not be considered to constitute a significant impact and, as such, no Species Impact Statement (SIS) is warranted and no Koala Habitat Management Plan pursuant to SEPP 44 should be required. In this respect the suitability of this site for residential and
<u>State Environmental Planning Policy No.</u> <u>55 – Remediation of Land</u>	Clause 6 of SEPP 55 – Remediation of Land requires the issue of contamination and remediation to be considered in zoning or rezoning proposals. A contamination investigation has been prepared for the subject land which found the land to be suitable for its intended development. In this respect the suitability of this site for residential purposes is considered suitable.
<u>State Environmental Planning Policy No.</u> <u>64 – Advertising and Signage</u>	The change in zoning would enable limited business uses subject to development consent from Council. If signage were to form part of a future development application the provisions of <i>SEPP 64 – Advertising and Signage</i> would apply and the development and would need to ensure the relevant provisions of the policy are achieved. This PP does not include provisions that contradict or hinder the application of this policy.
<u>State Environmental Planning Policy</u> (Exempt and Complying Development Codes) 2008	The provisions of <i>SEPP (Exempt and Complying Development Codes) 2008</i> would continue to apply to the land generally consistent with that achievable under the current land zoning. This PP does not include provisions that contradict or hinder the application of this policy.
<u>State Environmental Planning Policy</u> (Infrastructure) 2007	The provisions of <i>SEPP (Infrastructure) 2007</i> would continue to apply consistent with that achievable under the current zoning. This PP does not include provisions that contradict or hinder the application of this policy.

Consistent with applicable State Environmental Planning Policies (SEPP)



State Environmental Planning Policy	The site is not located within any identified resource
(Mining, Petroleum Production and	areas, potential resource areas or transitional areas.
Extractive Industries) 2007	There are adjacent extractive industries to the east of
	Sheraton Road. The adjacent industries are provided
	with landscaped managed setbacks to Sheraton Road
	and the future residential land which are also limited
	via respective development consents and mining
	leases. An acoustic modelling report and mapping is
	provided at Appendix H. Given existing development
	on the site and within the immediate locality this PP
	would be of minor significance and would not further
	restrict development potential or create land use
	conflict beyond existing arrangements.



4.2.1 Consistent with the applicable Part 9.1 (2) Ministerial Directions?

The Minister for Planning and Infrastructure, under Part 9 of the EP&A Act 1979 issues directions that local Councils must follow when preparing PP's for new Local Environmental Plans. The directions cover the following broad categories:

- 1. Employment and Resources
- 2. Environment and Heritage
- 3. Housing, Infrastructure and Urban Development
- 4. Hazard and Risk
- 5. Regional Planning
- 6. Local Plan Making

The following table provides an assessment of this PP against the relevant Part 9.1 directions.

Ministerial Direction	Comment
Direction 1.1 – Business and	This direction is applicable as the PP is within land zoned B1 -
Industrial Zones	Neighbourhood Centre. The objectives of this direction are to
	encourage employment growth in suitable locations, protect
	employment land in business and industrial zones and support
	the viability of identified strategic centres.
Direction 1.3 – Mining, Petroleum	This direction is applicable as the PP is adjacent to operative
Production and Extractive Industries	basalt quarries located upon the eastern side of Sheraton Road.
	The PP is not considered to prohibit the winning or obtaining of
	extractive materials or restricting their potential development of
	such by permitting a land use that is likely to be incompatible
	with such development as sufficient buffer is provided between
	land uses, landscaped setbacks are maintained and provided
	within the front setbacks of the quarries and Sheraton Road, and
	Development consent D2016-482 issued by the JRPP approved
	the most recent quarry having regard to the cumulative
	environmental impact assessment upon surrounding land uses,
	including conditions of consent requiring the extraction regime
	to be undertaken in a co-ordinated manner to maintain
	residential amenity.
	It is noted that the PP's subject land is currently zoned for
	neighbourhood centre use and provides a residential land use
	buffer as well as the road corridor of Sheraton Road.
Direction 2.1 – Environment	This direction does not apply to this PP as mapped by the DLEP
Protection Zones	Natural Resource Biodiversity Map NRB_008 as being of 'high'
	biodiversity significance. The area is not known to contain an
	Endangered Ecological Community (EEC). This PP is not
	considered to adversely affect the EEC.



Direction 2.3 – Heritage Conservation	This direction is not applicable as the PP affected land does not
	include known items, areas, objects and places of
	environmental heritage significance and indigenous heritage
	significance.
	Notwithstanding, an Environmental Heritage Report and
	Aboriginal Archaeological report has been prepared for the site.
	The reports conclude the land is suitable for future development.
Direction 3.1 – Residential Zones	This direction is not applicable as the PP is not in relation to any
	residentially zoned land.
Direction 4.3 – Flood Prone Land	This direction is applicable as the very southern extent of the
	current lot is slightly mapped as being identified as flood prone
	land by the DLEP.
	The subject proposal and identified particular portion of land is
	not impacted by flooding, and the subject PP is for a 'use' within
	an existing commercial zone.
Direction 6.1 – Approval and Referral	This direction applies to all PPs forwarded for Gateway
<u>Requirements</u>	Determination by a local authority.
	The proposed APU includes provisions that would not trigger a
	need for concurrence, consultation, or referral to the State
	Government.
Direction 6.3 – Site Specific	This direction applies to the subject PP as the PP is for the APU
Provisions	of a pub land use on the subject site.



4.3 ENVIRONMENTAL, SOCIAL AND ECONOMIC IMPACT

Is there a likelihood that critical habitat or threatened species, populations or ecological communities

or their habitats, will be adversely affected as a result of the proposal?

An Ecological Assessment provided at **Appendix D** was prepared and assessed under a previous PP for the subject land and wider area, which resulted in the land obtaining its commercial zoning. The report concluded that the proposed activity should not be considered to constitute a significant impact and, as such, no Species Impact Statement (SIS) is warranted. No Koala Habitat Management Plan pursuant to SEPP 44 should be required.

This PP does not affect the existing DLEP 'Additional Local Provisions' for consideration of Natural Resource – biodiversity and Groundwater vulnerability.

Are there any other likely environmental effects as a result of the PP and how are they proposed to be

managed?

The parcel of land subject to this PP largely consist of vacant grassland of no particular environmental value. No known threatened species or ecological communities are present on each site. Any future development of these areas would require due consideration of relevant environmental impacts be undertaken during a development application.

Has the PP adequately addressed any social and economic effects?

The proposed additional permitted use on the site would have minimal social and/or economic impacts on the surrounding locality.

4.4 STATE AND COMMONWEALTH INTERESTS

Is there adequate public infrastructure for the PP?

The subject site and subject area for the proposed additional permitted use does not currently feature infrastructure connections. However, the site is identified within the Servicing Strategy (**Appendix C**) which represents how the site will be provided with reticulated water and sewer, as well as appropriate stormwater drainage infrastructure.

In addition, vehicle, pedestrian and public transport access would service the site via the Boundary Road extension which would front the site, as well as the adjacent road running along the western boundary of the site.

What are the views of state and commonwealth public authorities consulted in accordance with the

Gateway determination?

The views of State and commonwealth public authorities would be ascertained during the formal consultation phase of this PP assessment in accordance with the Gateway Determination.



COMMUNITY CONSULTATION

5.1 TYPE OF COMMUNITY CONSULTATION REQUIRED

Section 5.5.2 of 'A Guide to Preparing Local Environmental Plans' identifies two different exhibition periods for community consultation;

- Low Impact Proposals 14 days; and
- All other Planning Proposals (including any proposal to reclassify land) 28 days.

The Guide describes Low Impact Proposals as having the following attributes;

- A 'low' impact planning proposal is a planning proposal that, in the opinion of the person making the gateway determination, is;
 - Consistent with the pattern of surrounding land use zones and/or land uses;

The proposed additional permitted use on the subject site accords with Council's local strategies and policies as detailed above and would be consistent with the commercially zoned portion of land and proposed development of the site.

o Consistent with the strategic planning framework;

Responses have been provided within Section 4.2 of this report detailing the proposal's compliance with relevant local, regional and state planning strategies, policies, and ministerial directions.

o Presents no issues with regard to infrastructure servicing;

The proposed use and any potential future development of the site would have access to future sewer, water, stormwater, electricity and telecommunication services and facilities in the area.

• Not a principle LEP; and

Not relevant.

• Does not reclassify public land.

The PP does not seek to reclassify existing public land.

In accordance with the responses to the above 'Low Impact Proposals' guide, the PP is considered to be of low impact. Respectfully, it is therefore requested that a community consultation period of 14 days be applied to the exhibition of this PP.



APPENDIX A – Indicative Site Plan (Neighbourhood Centre)

THE CENTRE





southlakes



APPENDIX B – Design Intent (Gastropub)







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APPENDIX C – Servicing Strategy, prepared by Geolyse Pty Ltd

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SERVICING STRATEGY SOUTHLAKES ESTATE DUBBO

PREPARED FOR MAAS GROUP PROPERTIES PTY LTD

JUNE 2017



• Civil, Environmental & Structural Engineering • Surveying • Environmental • Planning • Architecture

SERVICING STRATEGY

SOUTHLAKES ESTATE DUBBO

PROPOSED RESIDENTIAL SUBDIVISION LOT 12 IN DP1207280, LOT 399 IN DP1199356 AND LOT 2 IN DP880413

PREPARED FOR:

MAAS GROUP PROPERTIES NO. 2 PTY LTD

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Report Title:	Servicing Strategy
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Geolyse Pty Ltd and the authors responsible for the preparation and compilation of this report declare that we do not have, nor expect to have a beneficial interest in the study area of this project and will not benefit from any of the recommendations outlined in this report.

The preparation of this report has been in accordance with the project brief provided by the client and has relied upon the information, data and results provided or collected from the sources and under the conditions outlined in the report.

All information contained within this report is prepared for the exclusive use of Maas Group Properties No. 2 Pty Ltd to accompany this report for the land described herein and is not to be used for any other purpose or by any other person or entity. No reliance should be placed on the information contained in this report for any purposes apart from those stated therein.

Geolyse Pty Ltd accepts no responsibility for any loss, damage suffered or inconveniences arising from, any person or entity using the plans or information in this study for purposes other than those stated above.



TABLE OF CONTENTS

EXECUT	IVE SUMMARY	1
1.1 1.2 1.3 1.4 1.5 1.6	INTRODUCTION SEWERAGE RETICULATION WATER RETICULATION INDICATIVE SERVICING PLANS STORMWATER DRAINAGE CONCLUSION	1 3 3 3 4
INTROD	UCTION	5
2.1 2.2 2.3	BACKGROUND SITE LOCATION STUDY METHODOLOGY	5 5 6
PROPOS	SED DEVELOPMENT AND DESIGN LOADINGS	7
3.1 3.2	PROPOSED DEVELOPMENT	7 7
	 3.2.1 SOUTHLAKES ESTATE SEWAGE GENERATION	7 8 8 8
3.3	WATER DEMAND CRITERIA	9
PROPOS	SED SERVICING INFRASTRUCTURE	10
4.1 4.2 4.3 4.4	SEWERAGE RETICULATION. WATER RETICULATION. INDICATIVE SERVICING PLANS. STORMWATER DRAINAGE.	10 11 11 12
REFERE	NCES	13

DRAWINGS

Drawing D001	Site Locality
Drawing D002	Concept Master Plan
Drawing D003	Dubbo Regional Council Future Southlakes Estate Water Model
Drawing C001	Title Sheet and Site Locality
Drawing C002	Sewer Reticulation Servicing Plan
Drawing C003	Concept Sewer Main Alignment for Connection to the Keswick SPS
Drawing C004	Concept 600mm Diameter Sewer Main Longitudinal Section
Drawing C005	Water Reticulation Servicing Plan

APPENDICES

APPENDIX A

Stormwater Management Strategy Prepared by Geolyse



Executive Summary

1.1 INTRODUCTION

Maas Group Properties intends to develop a residential subdivision on land to the east of the existing Southlakes Estate subdivision. The extension to Southlakes Estate will also incorporate the land further to the east known as Ringlands and the overall development will complement the existing Southlakes subdivision and have major access points connecting via Azure Avenue and Argyle Avenue to Wheelers Lane and future connections to the extension of Boundary Road and to Sheraton Road and to the wider road network.

It is intended that approximately 2,080 dwelling sites be created in the overall extension to Southlakes Estate and will comprise residential allotments and medium density allotments.

This Servicing Strategy will assess the overall development of the extension of Southlakes Estate and also make provisions for the extension of the sewerage reticulation to the north and east of Southlakes to allow the future development of adjoining lands contained within the sewerage catchment.

The objective for preparing the Servicing Strategy is to determine an economic means of providing the required infrastructure to the subdivision area to allow the development of the land for residential and commercial purposes.

The Servicing Strategy will assess the provision of sewerage reticulation and the water reticulation network necessary to service the approximately 2,080 dwelling sites within the overall subdivision.

A separate Stormwater Drainage Report has been prepared and is appended to this Servicing Strategy Report to assess the drainage requirements of the subdivision particularly in relation to the trunk drainage corridor through the subdivision and discharging to the proposed detention basin to be constructed on the southern side of Hennessy Drive.

1.2 SEWERAGE RETICULATION

It is intended that approximately 2,080 dwelling sites be created in the overall subdivision comprising residential allotments and medium density allotments.

In general, the dwelling sites will comprise the following allocations:

Residential allotments	1,314 lots
Medium density dwelling units	766 units
Total dwelling sites	2,080 dwellings

Based on the criteria outlined in the *NSW Public Works Department Manual of Practice Sewer Design*, the estimated sewage generation from the extension to Southlakes Estate can be calculated as approximately 1,697 ET.

An allowance has also be made to account for the future development of the neighbourhood precinct in the northern section of the site and an allocation of 20 ET's will be made and thus the total estimated sewage generation from the subdivision is approximately 1,717 ET.

Many of the proposed dwelling lots that are located along the eastern extents of the existing Southlakes Estate can be serviced by the extension of existing gravity sewerage mains from the current subdivision. Approximately 250 dwelling lots can be serviced in this way.

The servicing of the remaining sewage generated from the overall extension of Southlakes Estate will require the provision of a major gravity sewerage main connecting to the Keswick Sewage Pump



Station. The gravity connection to the sewage pump station will service approximately 1,467 ET. In order to provide a buffer for the possible increase of dwelling density within the proposed subdivision, an additional approximate 10% allowance should be added to the estimated ET's connecting to the Keswick Sewage Pump Station.

Therefore, the total ET allocation from the overall extension of Southlakes Estate draining to the Keswick pump station should be increased to approximately 1,614 ET.

Also located within the sewage catchment draining to the Keswick Sewage Pump Station is Dubbo Regional Council's Keswick Estate that is located to the north of the extension to Southlakes Estate and sewage generated by the future development of this land will drain through the Southlakes sewerage reticulation system to the Keswick pump station.

Discussions with Council staff indicate that approximately 650 lots can be developed and an allowance of 720 ET will be made for the future development of the section of Keswick Estate within the sewage catchment.

There is an additional parcel of land to the north east of Southlakes Estate situated at the intersection of Sheraton Road and the extension of Boundary Road owned by Mr Neil O'Connor. Based on an assessment of the expected lot yield from this parcel of land, an allowance of 60 ET will be made.

On the basis of the overall sewage catchment draining to the Keswick Sewage Pump Station, the reticulation mains within the extension of Southlakes Estate and the Keswick pump station will need to cater for the following sewage loadings:

Southlakes Estate extension	1,614 ET
Future Keswick subdivision	720 ET
Future O'Conner subdivision	60 ET
Total Sewage Loading	2,394 ET

In general, 150mm diameter, 225mm diameter and 300mm diameter sewer mains will be provided in the southern section of the subdivision draining from east to west to cater for the majority of the future development of land at the eastern extents of the subdivision and the development within the southern section of the extension to Southlakes Estate.

The major gravity sewer main draining from north to south will comprise a 300mm diameter connection to the land to the north of Boundary Road (Keswick) subsequently increasing downstream to 375mm diameter, 450mm diameter and 525mm diameter sewer mains.

The 300mm diameter and 525mm diameter trunk sewer mains join at the southern end of the subdivision. When the trunk mains combine, the gravity connection to the inlet manhole at the Keswick pump station will require the construction of a 600mm diameter sewer main to transfer the expected 2,394 ET's generated from within the overall sewage catchment to the pump station.

The 600mm diameter sewer main is required due to grade limitations from the invert level of the inlet manhole and the provision of cover where the trunk sewer main crosses the eastern and western drainage channels within the drainage corridor.

All gravity sewer mains within the subdivision will be designed in accordance with Council's design criteria in terms of minimum depth, sewer main grading and ET capacity.



1.3 WATER RETICULATION

For the expected development of 2,080 dwellings in the overall extension to Southlakes Estate, the following water demands can be estimated:

Peak Instantaneous Demand	208 L/s
Peak Daily Demand	4.71 ML

Dubbo Regional Council has carried out a WATSYS analysis on the overall water reticulation network for the greater south eastern section of the area encompassing Southlakes Estate, the proposed extension of Southlakes Estate, Holmwood Estate, Magnolia Estate and Macquarie View Estate.

Council's most recent WATSYS analysis of the area was carried out in May 2016.

Whilst Council's reticulation model indicates the use of water mains with a minimum size of 150mm diameter, Council has advised that the minimum water main size that may be used in selected cul-de-sacs within the subdivision is 100mm diameter.

The water reticulation network to service the extension of Southlakes Estate has been determined generally in accordance with Council's WATSYS model with the general minimum size of the water reticulation mains to be 150mm diameter as modelled by Council, with the exception of the nominated cul-de-sacs where 100mm diameter reticulation mains have been used.

1.4 INDICATIVE SERVICING PLANS

Indicative servicing plans for sewerage and water reticulation to service the extension of Southlakes Estate have been prepared and are indicated on **Drawings C001 to C005** located in the **Drawings** Section of this Report.

1.5 STORMWATER DRAINAGE

The Stormwater Management Strategy presents an assessment of the proposed stormwater management strategy for the overall development of the Southlakes Estate residential subdivision proposed by Maas Group Properties. The stormwater assessment also includes development of the land known as Ringlands. The results show that the proposed stormwater management system results in a peak discharge from the site at Hennessy Road that matches that provided by Cardno.

It is proposed to construct a minor/major drainage system for overall development of Southlakes Estate with the minor system consisting of stormwater pits and pipes and open channels that would convey minor flows to the drainage reserve running through the site. Major flows would be conveyed along road reserves and drainage easements to the drainage reserve running through the site.

In accordance with the overall stormwater strategy for the catchment, on-site detention is proposed upstream of Hennessy Road within Southlakes Estate to control peak flows. All system components would be subject to further detailed assessment and design during the engineering design phase, based on the principles outlined in this assessment.

The stormwater modelling carried out for the preparation of this Report forms the basis of the design parameters to be adopted for the detailed engineering design of the eastern drainage channel and is accordance with the requirements outlined in Condition No. 2 from D2017-57.



1.6 CONCLUSION

This Servicing Strategy has determined the infrastructure requirements necessary for the proposed extension of Southlakes Estate. The Servicing Strategy has determined the overall framework for the effective provision of services to the subdivision.

The Servicing Strategy has provided the design guidelines for the provision of services to the subdivision in a staged manner and forms the basis for the future detailed design of the services for the extension to Southlakes Estate.



Introduction

2.1 BACKGROUND

Maas Group Properties intends to develop a residential subdivision on land to the east of the existing Southlakes Estate subdivision. The extension to Southlakes Estate will also incorporate the land further to the east known as Ringlands and the overall development will complement the existing Southlakes subdivision and have major access points connecting via Azure Avenue and Argyle Avenue to Wheelers Lane and future connections to the extension of Boundary Road and to Sheraton Road and to the wider road network.

It is intended that approximately 2,080 dwelling sites be created in the overall extension to Southlakes Estate and will comprise residential allotments and medium density allotments.

An open space corridor will be created along the central drainage line that separates the subdivision generally from the north east to the southwest of the site. The drainage corridor will be embellished with a series of decorative lakes similar to the lakes that have been developed along the existing drainage corridor in Southlakes Estate.

The drainage corridor within the extension to Southlakes Estate is known as the eastern channel whilst the drainage corridor within the existing Southlakes Estate is known as the western channel.

This Servicing Strategy will assess the overall development of the extension of Southlakes Estate and also make provisions for the extension of the sewerage reticulation to the north and east of Southlakes to allow the future development of adjoining lands contained within the sewerage catchment.

The objective for preparing the Servicing Strategy is to determine an economic means of providing the required infrastructure to the subdivision area to allow the development of the land for residential and commercial purposes.

The Servicing Strategy will assess the provision of sewerage reticulation and the water reticulation network necessary to service the approximately 2,080 dwelling sites within the subdivision.

A separate Stormwater Drainage Report has been prepared and is appended to this Servicing Strategy Report to assess the drainage requirements of the subdivision particularly in relation to the trunk drainage corridor through the subdivision and discharging to the proposed detention basin to be constructed on the southern side of Hennessy Drive.

2.2 SITE LOCATION

The Hillview property is located approximately 4km south east of the Dubbo central business district and is accessed from the north via Cobra Street and Wheelers Lane and the south via Hennessy Drive and Wheelers Lane. The Ringlands site is located to the east of the Hillview property.

The Hillview subdivision site is described as Lot 12 in DP1207280 and Lot 399 in DP1199356. The Ringlands subdivision site is described as Lot 2 in DP880413. Lot 12 has an area of approximately 2.27ha, Lot 399 has an area of approximately 128.5ha and Lot 2 has an area of approximately 48.95ha for a total development area of approximately 179.72ha.

The site is bounded by Southlakes Estate to the west, Boundary Road and Sheraton Road to the north, Hennessy Drive to the south and privately owned land to the east.

Boundary Road to the east of Wheelers Lane is currently unformed and Dubbo Regional Council proposes to extend Boundary Road to the east to connect with Sheraton Road whilst Hennessy Drive will be extended to provide a freight corridor extending further to the east and connecting to the Mitchell Highway via Basalt Drive.



Currently the site is accessed from Wheelers Lane via Azure Avenue through Southlakes Estate and crossing the western channel via a culverted bridge. A second culverted bridge and again crossing the western channel provides for an extension to Argyle Avenue to the Hillview property.

The location of the proposed extension to Southlakes Estate is indicated on **Drawing D001** located in the **Drawings** Section of this Report.

2.3 STUDY METHODOLOGY

In order to prepare the Servicing Strategy for the provision of infrastructure for the extension of Southlakes Estate, the following worktasks will be carried out:

- Determination of development densities in the nominated land use zones to assess loading demands for sewage equivalent tenements (ET's) with expected water usage demands for the subdivision.
- ii) Determination of additional sewage ET allowances to be made for the future development of lands to the north of the extension of Southlakes Estate.
- iii) Determination of the sewerage catchment limits based on depth limitations for connection of a gravity main to the Keswick Sewage Pump Station to service the subdivision.
- iv) Determination of a gravity sewerage reticulation system to service the subdivision lot layout and the adjoining lands draining to the Keswick Sewage Pump Station.
- v) Determine the water usage demands for the various areas of the Southlakes subdivision to estimate the total peak instantaneous demand required to service the subdivision.
- vi) Determine a water reticulation layout to service the subdivision generally in accordance with the WATSYS reticulation modelling previously carried out by Dubbo Regional Council for the greater south eastern section of the area encompassing Southlakes Estate, the proposed extension of Southlakes Estate, Holmwood Estate, Magnolia Estate and Macquarie View Estate.
- vii) Preparation of the Servicing Strategy Report to document the investigations carried out to determine the infrastructure requirements for the proposed extension to Southlakes Estate. The Servicing Strategy will provide sufficient design guidelines for the future provision of services in a staged manner and will form the basis of the future detailed design of each service.

In summary, the Servicing Strategy will determine the overall framework for the effective provision of services to the subdivision with the required sewerage and water supply networks.



Proposed Development and Design Loadings

3.1 PROPOSED DEVELOPMENT

The site for the overall extension of the Southlakes Estate subdivision comprises Lot 12 in DP1207280, Lot 399 in DP1199356 and Lot 2 in DP880413. Lot 12 has an area of approximately 2.27ha, Lot 399 has an area of approximately 128.5ha and Lot 2 has an area of approximately 48.95ha for a total development area of approximately 179.72ha.

It is intended that approximately 2,080 dwelling sites be created in the overall subdivision comprising residential allotments and medium density allotments.

In general, the dwelling sites will comprise the following allocations:

Residential allotments	1,314 lots
Medium density dwelling units	766 units
Total dwelling sites	2.080 dwellings

The concept Master Plan for the proposed extension to Southlakes Estate is indicated on **Drawing D002** located in the **Drawings** Section of this Report.

3.2 SEWAGE DESIGN CRITERIA

3.2.1 SOUTHLAKES ESTATE SEWAGE GENERATION

The estimated sewage generation from the expected 2,080 dwellings to be developed within the subdivision can be determined based on the design criteria outlined in the *NSW Public Works Department Manual of Practice Sewer Design* and Council's policies where the following generation rates will apply:

Residential dwelling house 1 ET per dwelling

Medium density dwelling unit 0.5 ET per unit

Based on this criteria, the estimated sewage generation from development of 2,080 dwellings in the overall extension to Southlakes Estate can be calculated as approximately 1,697 ET.

An allowance should also be made to account for the future development of the neighbourhood precinct in the northern section of the site and an allocation of 20 ET's will be made and thus the total estimated sewage generation from the subdivision is approximately 1,717 ET.

Many of the proposed dwelling lots that are located along the eastern extents of the existing Southlakes Estate can be serviced by the extension of existing gravity sewerage mains from the current subdivision. Approximately 250 dwelling lots can be serviced in this way.

The servicing of the remaining sewage generated from the overall extension of Southlakes Estate will require the provision of a major gravity sewerage main connecting to the Keswick Sewage Pump Station. The gravity connection to sewage pump station will service approximately 1,467 ET. In order to provide a buffer for the possible increase of dwelling density within the proposed subdivision, an additional approximate 10% allowance should be added to the estimated ET's connecting to the Keswick Sewage Pump Station.



Therefore, the total ET allocation from the overall extension of Southlakes Estate draining to the Keswick pump station should be increased to approximately 1,614 ET.

3.2.2 ADDITIONAL SEWAGE CATCHMENTS

Also located within the sewage catchment draining to the Keswick Sewage Pump Station is Dubbo Regional Council's Keswick Estate that is located to the north of the extension to Southlakes Estate and sewage generated by the future development of this land will drain through the Southlakes sewerage reticulation system to the Keswick pump station.

Discussions with Council staff indicate that approximately 650 lots can be developed and an allowance of 720 ET will be made for the future development of the section of Keswick Estate within the sewage catchment.

There is also an additional parcel of land to the north east of Southlakes Estate situated at the intersection of Sheraton Road and the extension of Boundary Road owned by Mr Neil O'Connor.

Based on an assessment of the expected lot yield from this parcel of land, an allowance of 60 ET will be made.

3.2.3 TOTAL CATCHMENT SEWAGE GENERATION

On the basis of the overall sewage catchment draining to the Keswick Sewage Pump Station, the reticulation mains within the extension of Southlakes Estate and the Keswick pump station will need to cater for the following sewage loadings:

Southlakes Estate extension	1,614 ET
Future Keswick subdivision	720 ET
Future O'Conner subdivision	60 ET
Total Sewage Loading	2.394 ET

3.2.4 INDUSTRIAL CANDIDATE AREA NO. 1

In 1997, Terra Sciences (now Geolyse) prepared a servicing strategy on behalf of Dubbo City Council for an industrial precinct known as Industrial Candidate Area No. 1.

Industrial Candidate Area No. 1 is located to the south east of the urban area of Dubbo and comprises a total area of approximately 750 ha. The site is bounded by the Mitchell Highway to the north, Eulomogo Creek to the south and a portion of Sheraton Road to the west.

At the time of the preparation of the servicing strategy in 1997, the Industrial Candidate Area was to contain approximately 108 industrial lots ranging in size from 3,000m² up to approximately 7.0 ha. The section of the land to be developed in the Industrial Candidate Area was located closer to and was to have access from the Mitchell Highway and fell within three distinct catchments in terms of the provision of sewerage infrastructure.

Approximately one third of the developable area in the northwest section of the site was to be serviced by a gravity sewer main connecting to an existing Council sewer main located on the eastern side of Sheraton Road in the general vicinity of the former Caravan Park located in Sheraton Road and St Johns Primary School.

The remainder of the developable land within the Candidate Area was to be serviced by two (2) small sewage pump stations that discharged into the end of the gravity sewerage network connecting to the Sheraton Road sewer main.

To date, the Sheraton Road sewer main has been extended eastwards in association with the development of Bunnings on Sheraton Road and into the subdivision known as the Blueridge



Business Park. The Blueridge development generally encompasses the initial section of Industrial Candidate Area No. 1 that was capable of being serviced by a gravity sewer main.

At this point in time, the remainder of the Industrial Candidate Area can be serviced in accordance with the original 1997 servicing strategy with the provision of sewerage reticulation and infrastructure independent to the proposed development of the extension of Southlakes Estate.

3.3 WATER DEMAND CRITERIA

The water demand criteria normally used for the design of water reticulation systems to service subdivisions is based on standard criteria outlined in the *NSW Public Works Department Water Supply Investigation Manual*, namely:

Peak Instantaneous Demand0.15 L/s/tenementPeak Daily Demand5,000 L/day/tenement

However, in Dubbo Regional Council's *AUSPEC-1 Part D11 Water Reticulation*, the Peak Instantaneous Demand is taken to be 0.10 L/s/tenement.

Additionally, water supply authorities are moving away from the adoption of a peak daily demand of 5,000 L per day per tenement. Peak Daily Demands in the range of 2,000 L per day to 3,000 L per day are commonly used.

For the assessment of the Peak Daily Demand for the overall extension to Southlakes Estate a demand of 3,000 L/day/resident tenement and 1,000 L/day/medium density unit will be adopted.

For the expected development of 2,080 dwellings in the overall extension of Southlakes Estate, the following water demands can be estimated:

Peak Instantaneous Demand	208 L/s
Peak Daily Demand	4.71 ML

It should be noted that the irrigation of the landscaped areas of the subdivision, particularly the drainage corridors will be assumed to occur at night or at other off peak times and thus the irrigation demand is not included in the Peak Instantaneous Demand calculated for the subdivision.



Proposed Servicing Infrastructure

4.1 SEWERAGE RETICULATION

The overall extension of Southlakes Estate will be serviced by gravity sewerage reticulation mains connecting to either extensions of the existing sewerage reticulation from within Southlakes Estate to the west or by draining via trunk sewerage mains to the Keswick Sewage Pump Station located in Hennessy Road to the south west of the subdivision.

As indicated previously, the Southlakes sewerage reticulation mains will also be sized to cater for the expected development of land located to the north (Keswick and O'Connor) of the extension of Southlakes Estate. To enable these land parcels to be serviced by gravity reticulation to the Keswick pump station, the sewerage mains within the extension of Southlakes will need to be increased in size to cater for the additional sewage generation.

The following components of the sewerage reticulation will be required:

- In general, 150mm diameter, 225mm diameter and 300mm diameter sewer mains will be provided in the southern section of the subdivision draining from east to west to cater for the majority of the future development of land at the eastern extents of the subdivision and the development within the southern section of the extension to Southlakes Estate.
- The major gravity sewer main draining from north to south will comprise a 300mm diameter connection to the land to the north of Boundary Road (Keswick) subsequently increasing downstream to 375mm diameter, 450mm diameter and 525mm diameter.
- The 300mm diameter and 525mm diameter trunk sewer mains join at the southern end of the Southlakes subdivision. Where the trunk mains combine, the gravity connection to the inlet manhole at the Keswick pump station will require the construction of a 600mm diameter sewer main to transfer the expected 2,394 ET's generated from within the overall sewage catchment to the pump station.
- The 600mm diameter sewer main is required due to grade limitations from the invert level of the inlet manhole and the provision of cover where the trunk sewer main crosses the eastern and western drainage channels within the drainage corridor.

An alignment for the 600mm diameter sewer main has been determined and a preliminary longitudinal section of the sewer main prepared to account for the sewage generation from development within the various sewage catchments.

Following discussions with Council's staff it has been confirmed that the original design of the Keswick Sewage Pump Station allowed for the development of the Hillview land and other land within the sewage catchment and can cater for the additional loading generated by approximately 2,394 ET's from within the catchment.

With regards to the filling of the area in the southern section of the extension to Southlakes Estate to allow the provision of gravity sewerage reticulation, the following information is provided:

- All lots that are to be filled are to filled and compacted as controlled or engineered fill in accordance with the requirements outlined in AS 3798 – 2007 *Guidelines on Earthworks for Commercial and Residential Developments.*

Specific Sections of AS 3798 that would apply include, but are not limited to, Section 4 - Materials, Section 5 - Compaction Criteria, Section 6 - Construction, Section 7 - Methods of Testing and Section 8 - Inspection and Testing.



With regards to Inspection and Testing, it is noted that the placement of all controlled fill shall be subject to Level 1 Inspection and Testing.

- The construction of gravity sewer mains within the area of controlled fill shall be carried out in accordance with the requirements of the Water Services Association of Australia *Gravity Sewerage Code of Australia WSA 02 – 2014*.

Specific Sections of WSA 02 that would apply include, but are not limited to, Section 9.6 – Geotechnical Considerations and Section 9.6.2 Pipelines in Engineered or Controlled Fill.

It should be noted that only 150mm diameter sewer mains are planned to be constructed within the area of controlled fill with all sewer mains sized 225mm diameter and above are to be constructed and laid in natural ground.

Based on the assessments carried out, the southern section of Southlakes Estate can be control filled and gravity sewer reticulation provided to ensure this area of the subdivision can be serviced with sewage discharged by gravity to the Keswick Sewage Pump Station.

Details of the overall sewerage reticulation and the 600mm diameter trunk sewerage main are indicated on **Drawing C002**, **Drawing C003** and **Drawing C004** located in the **Drawings** Section of this Report.

The provision of the sewerage infrastructure to service the overall Southlakes Estate subdivision and the connections external to the site will be subject to detailed engineering design at the appropriate phase of the project.

4.2 WATER RETICULATION

Dubbo Regional Council has carried out a WATSYS analysis on the overall water reticulation network for the greater south eastern section of the area encompassing Southlakes Estate, the proposed extension of Southlakes Estate, Holmwood Estate, Magnolia Estate and Macquarie View Estate.

Council's most recent WATSYS analysis of the area was carried out in May 2016.

The water reticulation network for the development area determined by Council is indicated on **Drawing D003** located in the **Drawings** Section of this Report.

Whilst Council's reticulation model indicates the use of water mains with a minimum size of 150mm diameter, Council has advised that the minimum water main size that may be used in selected cul-de-sacs within the subdivision is 100mm diameter.

The water reticulation network to service the extension of Southlakes Estate has been determined generally in accordance with Council's WATSYS model with the general minimum size of the water reticulation mains to be 150mm diameter as modelled by Council, with the exception of the nominated cul-de-sacs where 100mm diameter reticulation mains have been used.

4.3 INDICATIVE SERVICING PLANS

Indicative servicing plans for sewerage reticulation and water reticulation to service the extension of Southlakes Estate have been prepared and are indicated on **Drawings C001 to C005** located in the **Drawings** Section of this Report.

The sewerage reticulation plans provide for the future servicing of lands located to the north of the overall extension of Southlakes Estate and provide a gravity trunk sewerage main connecting to the Keswick Sewage Pump Station.



4.4 STORMWATER DRAINAGE

A Stormwater Management Strategy for the proposed subdivision has been prepared and is attached in **Appendix A.**

The Report presents an assessment of the proposed stormwater management strategy for the Southlakes Estate residential subdivision proposed by Maas Group Properties. The stormwater assessment also includes development of the land known as Ringlands. The results show that the proposed stormwater management system results in a peak discharge from the site at Hennessy Road that matches that provided by Cardno.

It is proposed to construct a minor/major drainage system for overall development of Southlakes Estate with the minor system consisting of stormwater pits and pipes and open channels that would convey minor flows to the drainage reserve running through the site. Major flows would be conveyed along road reserves and drainage easements to the drainage reserve running through the site.

In accordance with the overall stormwater strategy for the catchment, on-site detention is proposed upstream of Hennessy Road within Southlakes Estate to control peak flows. All system components would be subject to further detailed assessment and design during the engineering design phase, based on the principles outlined in this assessment.

The stormwater modelling carried out for the preparation of this Report forms the basis of the design parameters to be adopted for the detailed engineering design of the eastern drainage channel and is accordance with the requirements outlined in Condition No. 2 from D2017-57.



References

NSW Public Works Department Manual of Practice Sewer Design NSW Department of Public Works

NSW Public Works Department Manual of Practice Sewer Pump Station Design NSW Department of Public Works

NSW Public Works Department Water Supply Investigation Manual NSW Department of Public Works

Drawings



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NOTE

1. INFORMATION SHOWN IS FOR DEVELOPMENT APPLICATION PURPOSES ONLY.

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SOUTHLAKES ESTATE EXTENSION PROPOSED RESIDENTIAL SUBDIVISION MAAS GROUP PROPERTIES No. 2 PTY LTD SERVICING STRATEGY PLANS FOR SEWER & WATER RETICULATION

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 C001
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 C002
 SEWER RETICULATION SERVICING PLAN

 C003
 CONCEPT SEWER MAIN ALIGNMENT FOR CONNECTION TO THE KESWICK SPS

 C004
 CONCEPT 600mm Ø SEWER MAIN LONGITUDINAL SECTION

 C005
 WATER RETICULATION SERVICING PLAN



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STORMWATER MANAGEMENT STRATEGY SOUTHLAKES ESTATE DUBBO

PREPARED FOR MAAS GROUP PROPERTIES PTY LTD

JUNE 2017



• Civil, Environmental & Structural Engineering • Surveying • Environmental • Planning • Architecture

STORMWATER MANAGEMENT STRATEGY

SOUTHLAKES ESTATE DUBBO

PROPOSED RESIDENTIAL SUBDIVISION LOT 12 IN DP1207280, LOT 399 IN DP1199356 AND LOT 2 IN DP880413

PREPARED FOR:

MAAS GROUP PROPERTIES NO. 2 PTY LTD

JUNE 2017



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Geolyse Pty Ltd and the authors responsible for the preparation and compilation of this report declare that we do not have, nor expect to have a beneficial interest in the study area of this project and will not benefit from any of the recommendations outlined in this report.

The preparation of this report has been in accordance with the project brief provided by the client and has relied upon the information, data and results provided or collected from the sources and under the conditions outlined in the report.

All information contained within this report is prepared for the exclusive use of Maas Group Properties No. 2 Pty Ltd to accompany this report for the land described herein and is not to be used for any other purpose or by any other person or entity. No reliance should be placed on the information contained in this report for any purposes apart from those stated therein.

Geolyse Pty Ltd accepts no responsibility for any loss, damage suffered or inconveniences arising from, any person or entity using the plans or information in this study for purposes other than those stated above.



TABLE OF CONTENTS

INTF	RODU	ICTION		.1
	1.1 1.2 1.3 1.4	BACKGI SITE LO PURPO REPOR	ROUND CATION SE OF REPORT T STRUCTURE	1 1 1 1
BAG	CKGF	ROUND	INFORMATION	2
	2.1 2.2 2.3	PROPO EXISTIN SYSTEN	SED DEVELOPMENT IG STORMWATER DRAINAGE I MODELLING	2 2 2
		2.3.1 2.3.2	EXISTING STUDY STORMWATER QUANTITY	2 2
STO	DRMV	VATER	MANAGEMENT STRATEGY	5
	3.1	CONCE	PTUAL STORMWATER MANAGEMENT STRATEGY	5
		3.1.1 3.1.2	STORMWATER MANAGEMENT OBJECTIVES	5 5
	3.2	STORM	WATER MODELLING RESULTS	6
		3.2.1 3.2.2	PEAK SITE DISCHARGE DRAINAGE RESERVE CHANNEL	6 7
CO	NCLU	ISION	1	0
REF	ERE	NCES	1	1
DRA	WING	GS		
Draw Draw Draw	ing 114 ing 114 ing 114	4135_06_ 4135_06_ 4135_06	C001 – Proposed Site Layout C002 – Catchment Boundaries C003 – Concept Drainage Reserve Channel	

FIGURES

Figure 1:	Concept HEC RAS Hydraulic Profile	8
-----------	-----------------------------------	---

TABLES

Table 3.1 – Preliminary Culvert Crossing Sizing	6
Table 3.2 – Required Detention Volumes	6
Table 3.3 – Peak 100 year ARI flows at Hennessy Road	7
Table 3.4 – Peak 100 year ARI flows South East catchment outlet	7



Introduction

1.1 BACKGROUND

Geolyse Pty Ltd has been commissioned by Maas Group Properties to prepare a Stormwater Management Strategy to accompany a Development Application (DA) for a proposed Residential Subdivision over land described as Lot 12 in DP 1207280, Lot 399 in DP 1199356 and Lot 2 in DP 880413 at 'Southlakes Estate', Dubbo.

1.2 SITE LOCATION

The site is described as Lot 12 in DP 1207280, Lot 399 in DP 1199356 and Lot 2 in DP 880413 and is located at 'Southlakes Estate' approximately 4 kilometres south east of the Dubbo Central Business District. Including the land known as Ringlands, the site has a total combined area of approximately 179.72 hectares. The subject land is bounded by the future extension of Boundary Road and Sheraton Road to the north, Hennessy Road and its future extension to the south and the eastern extent of the existing 'Southlakes Estate' to the west.

The subject area is largely cleared of native vegetation, featuring open grasslands and gentle slopes. Other features on the site include three existing stock dams.

1.3 PURPOSE OF REPORT

The purpose of this report is to outline the proposed stormwater management strategy for the development of the overall Southlakes Estate residential subdivision. It also presents preliminary design and sizing information for key components of the water management strategy for the development of the residential subdivision.

1.4 REPORT STRUCTURE

This report is presented in four sections:

- Section 1 provides a brief background and presents the report objectives;
- Section 2 provides background information and details the assessment methodology;
- Section 3 presents the results of the system and modelling and an outline of the major system components; and
- Section 4 presents the conclusions and recommendations.



Background Information

2.1 PROPOSED DEVELOPMENT

The subject site has been identified by the developer as a suitable location for the development of a neighbourhood centre, R2 general residential lots, R1 low density residential lots, and public recreation areas.

Vehicular access will be available from Azure Avenue, Argyle Avenue, the future extension of Boundary Road, Sheraton Road and the future extension of Hennessy Road.

The overall layout of the proposed development is indicated on Drawing No. 114135_06_C001.

2.2 EXISTING STORMWATER DRAINAGE

The site lies within the catchment of the Eulomogo Creek which ultimately drains to the Macquarie River south of the site. The site is at the lower end of the catchment and as a result stormwater flows from the catchment upstream of the site need to be managed as they pass through the site. The internal catchment boundaries are indicated in **Drawing No. 114135_06_C002.** Further details on these catchments are outlined in **Section 2.3.2 – Sub Catchment Definition**.

A drainage reserve has been created across the site that runs from the intersection of Boundary and Sheraton Roads in the north east corner to the south west corner at Hennessy Road. The current development layout also includes an area in the south east corner that drains to the south, ultimately discharging directly to Eulomogo Creek. This area was modelled separately to the area of the development that drains via the drainage reserve. The site is currently undeveloped with only 3 farm dams and associated contour banks influencing the natural flows across the site.

2.3 SYSTEM MODELLING

2.3.1 EXISTING STUDY

Cardno prepared the *Keswick Drainage Review- Assessment of Trunk Drainage Requirements* report in 2010 for Dubbo City Council. The Cardno report modelled the entire catchment upstream of Hennessy Road, including the extension to the Southlakes Estate site. The Cardno report provided peak flows at the outlet of the Southlakes Estate site for the existing and post development scenarios (including stormwater detention basins immediately upstream of the Southlakes Estate extension site).

Cardno kindly provided hydrograph and peak flow data to enable Geolyse to replicate their modelling and factor in the expected flows from the upstream catchment.

The Cardno report looked at the trunk drainage requirements for the whole catchment which included a detention basin on the south side of Hennessy Road and detention basins immediately upstream of the Southlakes Estate site north of the extension of Boundary Road. Council provided the design drawings for the proposed Hennessy Road detention basin which were also prepared by Cardno. The Cardno report did not include any detention basins within the Southlakes Estate site and as a result detention within the Southlakes Estate site was not modelled by Cardno.

2.3.2 STORMWATER QUANTITY

The performance of the proposed stormwater management system was assessed using the XP-RAFTS hydrological model. This model is able to:

Model spatial and temporal variations in storm rainfall across the catchment;



- Model variations in catchment characteristics;
- Model storage routing effects in drainage lines and basins; and
- Calculate discharge hydrographs at any required location in the catchment.

The analytical technique used in XP-RAFTS involves the division of the catchment into a number of sub-catchments. Sub-catchment outlets are located at the junction of drainage lines, at the site of dams or retarding basins, at points corresponding to significant changes in catchment characteristics, or at any other point of interest.

Data is required on the area and connection sequence of the sub-catchments, together with average catchment slopes, the impervious percentage, and the rainfall data for the design storm being modelled. Additional data is required to model rainfall losses and channel or pipe flow. This information is entered in several different forms depending on the data availability and the degree of refinement desired for the analysis. For this assessment the rainfall losses were modelled as initial and continuing losses.

Model Scenarios

Three catchment models were developed:

- Scenario 1- Post-development- 50% impervious for developed areas within the Southlakes Estate extension (as modelled in the Cardno report)
- Scenario 2- Post-development 60% impervious for R2 low density residential and 80% impervious for R1 general residential within the Southlakes Estate extension.
- Scenario 3- Post-development 60% impervious for R2 low density residential and 80% impervious for R1 general residential within the Southlakes Estate extension with on-site detention within the Southlakes catchments.

Sub-Catchment Definition

For each scenario the site was split into the catchments shown in **Drawing No. 114135_06_C002.** Catchment parameters were determined from available contour plans.

Cardno provided 100 year ARI hydrographs for the outlets of the proposed detention basins upstream of the Southlakes Estate extension (Sheraton Basin and Boundary Road Basin). The hydrographs were loaded into the model to represent the expected flows from upstream of the site.

Channel Routing

Channel lagging was adopted to model travel times between sub-catchments. The lag time was estimated by considering the distance travelled and adopting an average velocity of 1m/s for developed areas and 0.75m/s for open channels.

Rainfall Losses

The following initial and continuing losses (as adopted in the Cardno report) were used in the model:

Pervious	Initial loss	16.5 mm
	Continuing loss	5.5 mm/hr
Impervious	Initial loss	1.0 mm
	Continuing loss	0 mm/hr



Design Storms

The catchment was modelled for the 100yr Average Recurrence Interval (ARI) design storm. Design rainfall intensity/frequency/duration (IFD) data and storm temporal patterns were derived using the procedures set out in Australia Rainfall and Runoff (Institution of Engineers Australia, 1987).

Design storm durations from 30 minutes to 12 hours were modelled to determine the critical storm duration. (i.e. the storm that produced the highest peak flow) for both undeveloped and developed cases.


Stormwater Management Strategy

3.1 CONCEPTUAL STORMWATER MANAGEMENT STRATEGY

3.1.1 STORMWATER MANAGEMENT OBJECTIVES

The objectives adopted for stormwater management at the site are to:

- provide safe and efficient stormwater conveyance through the Southlakes Estate extension; and
- protect downstream drainage systems against construction and long term impacts.

3.1.2 CONCEPTUAL LAYOUT

The conceptual stormwater management system for the site is shown on **Drawing 114135_06_C003**. Preliminary sizing of the main system components has been undertaken to demonstrate that it can meet the proposed stormwater management objectives. The final system is subject to further detailed assessment during the detailed design stage to ensure it complements the proposed development layout.

The drainage channel catchment drains generally in a south westerly direction with developed areas discharging to the drainage reserve at road crossings or other locations determined by the existing contours. The south east catchment drains in a southerly direction with developed areas discharging to the proposed Hennessy Road extension and ultimately to Eulomogo Creek.

The conceptual stormwater management system includes the following major components.

Pipe and Open Drain System

The stormwater conveyance system would comprise of pipes and open drains. Generally, pipes would be used for the interlot drainage system and road drainage where kerb and guttering is proposed. Discharge from the pipe system would generally be directly into the drainage reserve.

Some sections of the development have a proposed inverted crown road design with an open channel in the centre of the road reserve. The open channel will have a low flow pipe installed beneath the channel.

The drainage reserve was also modelled as an open channel similar in cross section to that designed for the existing Southlakes Estate to the west of the site. Decorative lakes were also included in the model at key locations. A HEC-RAS model was created to confirm that the expected flows in the channel would be contained within the channel.

Pipes would be used as required to convey flow beneath roads. The interlot and roadway pipe/open channel systems would be designed to convey peak discharge for a 1 in 10 year ARI storm in accordance with Council requirements. Open drains would be designed to convey overland flow at a safe depth and velocity and with a minimum freeboard of 500 mm.

Three culvert crossings under Azure Avenue, Argyle Avenue and an unnamed road (below Argyle Ave) will also be required. **Table 3.1** gives the preliminary sizing of these culverts to ensure they can convey the expected 100 year ARI peak storm flows without overtopping the roads.



Table 3.1 – Preliminary Culvert Crossing Sizing

Crossing Location	Culvert Size
Azure Avenue	3 x 2.1m x 1.2m Reinforced Concrete Box Culvert
Argyle Ave	5 x 2.4m x 1.2m Reinforced Concrete Box Culvert
Unnamed Road (below Argyle Ave)	5 x 2.4m x 1.2m Reinforced Concrete Box Culvert

On-site Detention

Preliminary modelling showed that the developed flows from the overall Southlakes Estate extension would result in peak flows at Hennessy Road above that reported in the Cardno report. As a result onsite detention has been modelled in the R1 areas to ensure that peak flows at Hennessy Road are no greater than the Cardno report flows. The current development layout also includes an area in the south east corner that drains directly to the south and is not part of the drainage reserve catchment. This area was modelled separately to confirm required detention volumes.

A summary of the required detention basin volumes in the R1 areas is provided below in **Table 3.2**. The required detention volumes will need to be refined during the detailed design phase.

Catchment	Required Detention Volume (m ³)
W1	2,000
W2	7,000
W3	5,000
W6	1,000
E3	3,000
E4	5,000
E5	1,000
Eul1	12,500

Table 3.2 - Required Detention Volumes

Based on the results outlined in **Table 3.2**, the total detention volume to be provided within the extension of Southlakes Estate amounts to 24,000m³ distributed between the 7 nominated sub catchments, whilst the Eulomogo Basin is to have a volume of 12,500m³.

3.2 STORMWATER MODELLING RESULTS

3.2.1 PEAK SITE DISCHARGE

Peak flows discharging from the site were compared to the peak flows provided by Cardno. A summary of the peak flows estimated by Cardno and the scenarios modelled by Geolyse for the main drainage channel catchment are provided in **Table 3.3** below.

The final configuration of the proposed stormwater management system is subject to detailed design at which stage some adjustment to the design levels may occur. The design objectives would however remain unchanged.

T-LL- O	2 DI.	400			. D
lable 3.	3 – Peak	100 vea	r ARI flows	at Henness	/ Koad

Cardno Report (m³/s)	Geolyse Scenario 1	Geolyse Scenario 2	Geolyse Scenario 3
	(m³/s)	(m³/s)	(m³/s)
21.72	22.80	26.80	21.72

A summary of peak flows for the southeast Eulomogo catchment are provided below in Table 3.4.

Table 3.4 – Peak 100 year ARI flows South East catchment outlet

Pre-development (m ³ /s)	Post-development (m³/s)
5.55	4.65

The figures in **Table 3.3** show that the Geolyse Scenario 1 model correlates well with the figure provided by Cardno (both assume 50% impervious for developed areas). The peak flow reported for Geolyse Scenario 2 shows an increase of 4 m³/s (17.5%) over Geolyse Scenario 1 and an increase of 5.08 m³/s (23%) over the Cardno report figure. The peak flow for Geolyse scenario 3 shows that with on-site detention provided upstream in Southlakes Estate, the peak flows at Hennessy Road match the Cardno report figure.

The figures in **Table 3.4** show that with on-site detention provided the peak flows discharging from the south east Eulomogo catchment are below pre-development levels.

3.2.2 DRAINAGE RESERVE CHANNEL

A concept design of the proposed drainage reserve channel was prepared using available digital elevation data to allow preliminary hydraulic modelling and channel sizing to be undertaken. The concept channel design was based on the channel design prepared for the existing Southlakes Estate to the west of the Southlakes Estate extension. A typical section of the concept drainage reserve channel is shown on **Drawing 114135_06_C003**.

A HEC RAS model was prepared based on the concept design of the drainage reserve channel to allow preliminary hydraulic modelling of the expected flows to be undertaken. The HEC RAS model assumed a minimum downstream water level of 264.34m AHD as this is the 1 in 100 year ARI design peak Hennessy Road basin water level as shown on the Cardno drawing 4937-CD076 Rev 01.

The hydraulic profile of the expected 100 year ARI flow within the concept drainage reserve channel design is shown below in **Figure 1**.



Figure 1: Concept HEC RAS Hydraulic Profile

Depths of flow in the drainage reserve channel ranged from 0.73 m to 1.59 m with a minimum freeboard of 500 mm maintained throughout. Peak velocities ranged from 0.62 - 2.73 m/s.

The preliminary hydraulic modelling showed that the expected flows from Scenario 3 were contained within the concept design drainage reserve channel and the culverts were not overtopped.

3.2.3 DESIGN DETAILS OF THE DRAINAGE RESERVE CHANNEL

Dubbo Regional Council has issued Development Consent for the eastern drainage channel through Southlakes Estate (Reference D2017-57 dated 30 May 2017).

Specifically, Consent Condition No. 2 relates to the future detailed design of the drainage channel and states:

- (2) A Stormwater Drainage Management Report, including the Flood Modelling Report and Creek design, shall be provided to Council for approval prior to the issue of the Construction Certificate for the Drainage Reserve works. The Report shall include the following:
 - Outlet flows to Hennessy Drive shall be no greater than the calculated amount as shown in Cardno "Keswick Drainage Review", Report No. W823-1 dated August 2010;
 - All construction work shall be in accordance with Cardno "Keswick Drainage Review", Report No. W823-1 dated August 2010;
 - The channel adjacent to the Boundary Road/Sheraton Road intersection needs to be designed to match with Dubbo Regional Council's Boundary Road Design, and shall liaise with Council's Technical Services Division;
 - All proposed outlet pipe levels should be determined to ensure that they are free outfalls up to and including the 10 year event. This is to ensure that there is adequate clearance for outflows as well as the prevention of backflow into upstream systems;
 - Upper channel at Sheraton Road to be designed to match proposed future intersection arrangement, and shall liaise with Council's Technical Services Division;
 - Future road crossing culverts, which cross the proposed channel are to be designed to accommodate 100 year ARI;
 - Depth and velocity product information shall be submitted with the Construction Certificate; and



• Details of the 100 year ARI flood line within the drainage reserve and adjoining property.

All works are to be undertaken in accordance with Council's adopted AUS-SPEC #1 Development Specification Series – Design and Construction, with detailed engineering plans being submitted to, and approved by Council prior to any construction works commencing.

The stormwater modelling carried out for the preparation of this Report forms the basis of the design parameters to be adopted for the detailed engineering design of the eastern drainage channel and is accordance with the requirements outlined in Condition No. 2 from D2017-57.



Conclusion

This report presents an assessment of the proposed stormwater management strategy for the overall development of the Southlakes Estate residential subdivision proposed by Maas Group Properties. The stormwater assessment also includes development of the land known as Ringlands. The results show that the proposed stormwater management system results in a peak discharge from the site at Hennessy Road that matches that provided by Cardno.

It is proposed to construct a minor/major drainage system for overall development of Southlakes Estate with the minor system consisting of stormwater pits and pipes and open channels that would convey minor flows to the drainage reserve running through the site. Major flows would be conveyed along road reserves and drainage easements to the drainage reserve running through the site.

In accordance with the overall stormwater strategy for the catchment, on-site detention is proposed upstream of Hennessy Road within Southlakes Estate to control peak flows. All system components would be subject to further detailed assessment and design during the engineering design phase, based on the principles outlined in this assessment.

The stormwater modelling carried out for the preparation of this Report forms the basis of the design parameters to be adopted for the detailed engineering design of the eastern drainage channel and is accordance with the requirements outlined in Condition No. 2 from D2017-57.



References

Institute of Engineers, 1987 Australian Rainfall and Runoff Volume 1

Cardno, 2010. Keswick Drainage Review-Assessment of Trunk Drainage Requirements (Report No. W4823-1)

Drawings







SJH 29/06

SURVEYING APPROVAL

SCALE 1:6000 (A3)

DO NOT SCALE FROM THESE DRAWINGS: ALL MEASUREMENTS SHALL BE CONFIRMED ON SITE AND WITH GEOLYSE PTY, LTD, PRIOR TO CONSTRUCTION

ROAD	
SHERATON ROAD	
LOCATION	
LEGEND CONCEPT DRAINAGE RESERVE CHANNEL CONCEPT CHANNEL CENTRELINE HILLVIEW ESTATE BOUNDARY	
CONCEPT DRAINAGE RESERVE CHANNEL	
PROJECT NUMBER 114135 DRAWING FILE 114135_06C_C001-C003.dwg SIZE A1	-
STREET SURVEY MARK _ RL _ DATUM A.H.D. SET	
9 STATUS FOR REPORT SHEET C003 OF C003	

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SOUTHLAKES ESTATE EXTENSION



APPENDIX D – Traffic Study, prepared by Geolyse Pty Ltd

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TRAFFIC STUDY SOUTHLAKES ESTATE DUBBO

PREPARED FOR MAAS GROUP PROPERTIES PTY LTD

JUNE 2017



• Civil, Environmental & Structural Engineering • Surveying • Environmental • Planning • Architecture

TRAFFIC STUDY

SOUTHLAKES ESTATE DUBBO

PROPOSED RESIDENTIAL SUBDIVISION LOT 12 IN DP1207280, LOT 399 IN DP1199356 AND LOT 2 IN DP880413

PREPARED FOR:

MAAS GROUP PROPERTIES NO. 2 PTY LTD

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Report Title:	Traffic Study
Project:	Southlakes Estate Dubbo
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TABLE OF CONTENTS

EXECUT	IVE SI	UMMARY	1
1.1 1.2 1.3 1.4 1.5 1.6	INTRO TRAF EXIST PROF TRAF TRAF	DDUCTION FIC STUDY FING TRAFFIC VOLUMES POSED DEVELOPMENT FIC GENERATION FIC IMPACT SUMMARY	1 1 2 2 3
	1.6.1 1.6.2 1.6.3	TRAFFIC GENERATION AND ROADWAY CAPACITY INTERSECTION MODELLING CONCLUSION	3 4 4
INTROD	истю	ON	5
2.1 2.2 2.3 2.4	BACK SITE TRAF TRAF	GROUND LOCATION FIC STUDY FIC STUDY METHODOLOGY	5 5 6 6
CONSID	ERAT	ION OF SEPP (INFRASTRUCTURE) 2007	8
EXISTIN	G TR	AFFIC CONDITIONS	9
4.1 4.2 4.3 4.4 4.5 4.6	Road Exist Exist Avail Annu Peak) NETWORK HIERARCHY FING ROAD CONDITIONS FING ROADWAY CAPACITY ABLE TRAFFIC DATA JAL AVERAGE DAILY TRAFFIC CHOUR TRAFFIC	9 10 14 15 15 16
TRAFFIC		ACT OF THE PROPOSED DEVELOPMENT	17
5.1 5.2	PROF TRAF	POSED SUBDIVISION	17 17
	5.2.1 5.2.2	DAILY TRAFFIC GENERATION PEAK HOUR TRAFFIC GENERATION	18 18
5.3 5.4	TRAF IMPA	FIC DISTRIBUTION CT OF GENERATED TRAFFIC	19 20
	5.4.1 5.4.2 5.4.3 5.4.4 5.4.5	PROPOSED ROAD UPGRADES TRAFFIC VOLUME INTERSECTION ASSESSMENT LOCAL AREA TRAFFIC MANAGEMENT TRAFFIC IMPACT SUMMARY	20 21 23 27 27
RECOM	MEND	ATIONS	29
REFERE	NCES		31
DRAWIN	GS		
Drawing TS Drawing TS Drawing TS Drawing TS	501 502 503 504	Site Locality Concept Master Plan External Traffic Distribution Intersection Turning Movements at Wheelers Lane and Argyle Avenue Intersection	ection

- Drawing TS05 Intersection Turning Movements at Wheelers Lane and Azure Avenue Intersection Drawing TS06 Intersection Turning Movements at Boundary Road and Access Road Intersection
- Drawing TS07 Intersection Turning Movements at Boundary Road and Sheraton Road
- Drawing TS08 Local Area Road Traffic Management Plan
- Drawing TS09 Local Area Pedestrian Management Plan



PLATES

APPENDICES

APPENDIX A

SIDRA Modelling Results

TABLES

Table 4.1 – Existing Road Classification	. 9
Table 4.2 – Roadway Capacity and Level of Service	14
Table 5.1 – Traffic Volume Distribution to the External Road Network	20
Table 5.2 – Comparison of Existing and Post Development Traffic Volumes	21
Table 5.3 – Post Development Peak Hour Capacity	23
Table 5.4 – Wheelers Lane and Argyle Avenue Intersection Operating Parameters	24
Table 5.5 – Wheelers Lane and Azure Avenue Intersection Operating Parameters	24
Table 5.6 – Boundary Road and Access Road Intersection Operating Parameters	25
Table 5.7 – Boundary Road, Sheraton Road and Access Road Roundabout Operating Parameters	26



Executive Summary

1.1 INTRODUCTION

Maas Group Properties intends to develop a residential subdivision on land to the east of the existing Southlakes Estate subdivision. The extension to Southlakes Estate will also incorporate the land further to the east known as Ringlands and the overall development will complement the existing Southlakes subdivision. The overall subdivision will have major access points connecting via Azure Avenue and Argyle Avenue to Wheelers Lane and future connections to the extension of Boundary Road and to Sheraton Road and to the wider road network.

It is intended that approximately 2,080 dwelling sites be created in the overall extension to Southlakes Estate and will comprise residential allotments and medium density allotments.

The Hillview property is located approximately 4km south east of the Dubbo central business district and is accessed from the north via Cobra Street and Wheelers Lane and the south via Hennessy Drive and Wheelers Lane. The Ringlands site is located to the east of the Hillview property.

The Hillview subdivision site is described as Lot 12 in DP1207280 and Lot 399 in DP1199356. The Ringlands subdivision site is described as Lot 2 in DP880413. Lot 12 has an area of approximately 2.27ha, Lot 399 has an area of approximately 128.5ha and Lot 2 has an area of approximately 48.95ha for a total development area of approximately 179.72ha.

The overall development site is bounded by Southlakes Estate to the west, Boundary Road and Sheraton Road to the north, Hennessy Drive to the south and privately owned land to the east.

1.2 TRAFFIC STUDY

Under State Environmental Planning Policy SEPP (Infrastructure) 2007, the proposed subdivision for the extension of Southlakes Estate is classified in accordance with the requirements set out in Schedule 3 of Clause 104 of the SEPP.

On this basis, a Traffic Study will need to be prepared to assist in the planning approval process for the development.

This Traffic Study will address the following issues:

- Traffic generated by the development of the overall extension of Southlakes Estate
- Access to and from the subdivision via existing roads, new roads and the connection of the subdivision roads to the wider road network
- Impact on the operation, safety and amenity of the surrounding road network
- Recommendations for the implementation of Local Area Traffic Management (LATM) devices throughout the subdivision

The Traffic Study will be prepared in accordance with the requirements outlined in the NSW Roads and Traffic Authority's (RTA) *Guide to Traffic Generating Developments*.

1.3 EXISTING TRAFFIC VOLUMES

The estimated Year 2026 AADT traffic volumes on the subject roads are summarised below:

•	Wheelers Lane north of Boundary Road	9,678 vehicles per day	
	Wheelers Lane south of Boundary Boad	0 108 vohicles per day	



- Boundary Road west of Wheelers Lane
- 6,555 vehicles per day

1,204 vehicles per hour

896 vehicles per hour

511 vehicles per hour

The estimated Year 2026 peak hour traffic volumes on the subject roads are summarised below:

- Wheelers Lane north of Boundary Road
- Wheelers Lane south of Boundary Road
 992 vehicles per hour
- Boundary Road west of Wheelers Lane
- Boundary Road east of Wheelers Lane
 - Sheraton Road south of the Mitchell Highway 1,024 vehicles per hour

1.4 PROPOSED DEVELOPMENT

The site for the overall extension of the Southlakes Estate subdivision comprises Lot 12 in DP1207280, Lot 399 in DP1199356 and Lot 2 in DP880413. Lot 12 has an area of approximately 2.27ha, Lot 399 has an area of approximately 128.5ha and Lot 2 has an area of approximately 48.95ha for a total development area of approximately 179.72ha.

It is intended that approximately 2,080 dwelling sites be created in the overall subdivision comprising residential allotments and medium density allotments.

In general, the dwelling sites will comprise the following allocations:

Residential allotments	1,314 lots
Medium density dwelling units	766 units
Total dwelling sites	2,080 dwellings

1.5 TRAFFIC GENERATION

The daily traffic generated by the overall extension of Southlakes Estate can be estimated as set out below:

Number of residential dwellings:	1,314 dwellings
Daily vehicle trips:	11 per dwelling
Number of residential daily trips:	14,454 trips per day
Number of medium density dwellings:	766 dwellings
Daily vehicle trips:	6 per dwelling
Number of medium density daily trips:	4,596 trips per day
Total daily vehicle trips:	14,454 trips + 4,596 trips = 19,050 trips per day

Not all trips generated by the proposed extension to Southlakes Estate will be external to the subdivision. A proportion of the generated trips will be for internal travel purposes such as visiting friends or neighbours, recreation areas or a potential commercial precinct.

The RTA estimate that approximately 25% of daily and peak hour vehicle trips are internal to the subdivision (RTA, 1993) and therefore the adjusted external daily vehicle trips generated by the subdivision is:

External daily vehicle trips: 19,050 trips x 0.75 = 14,288 trips per day.

The external trip generation of 14,288 trips per day has been used to assess the potential impacts of the development of the subdivision on the surrounding road network.



The peak hour traffic generated by the overall extension of Southlakes Estate can be estimated as set out below:

Number of residential dwellings:	1,314 dwellings
Peak hour vehicle trips:	1 per dwelling
Number of residential peak hour trips:	1,314 trips per hour
Number of medium density dwellings:	766 dwellings
Peak hour vehicle trips:	0.5 per dwelling
Number of medium density peak hour trips:	383 trips per day
Total peak hour vehicle trips:	1,314 trips + 383 trips = 1,697 trips per hour

As with the daily trip generation, the RTA estimate that 25% of the peak hour trip generation are internal to the subdivision. Therefore, the adjusted external peak hour trips generated by the subdivision is:

External peak hour trips: 1,697 trips x 0.75 = 1,272 trips per hour.

The external trip generation of 1,272 trips per hour has been used to assess the potential impacts of the development of the subdivision on the surrounding road network.

1.6 TRAFFIC IMPACT SUMMARY

The impact of the additional traffic generated by the overall extension of Southlakes Estate on the surrounding road network has been assessed in terms of:

- i) Traffic Volume for both the Daily and Peak Hour traffic generation;
- ii) Intersection Operation; and
- iii) Road Safety.

SIDRA modelling has been undertaken to assess the operation of various intersections on the surrounding road network.

1.6.1 TRAFFIC GENERATION AND ROADWAY CAPACITY

The estimated external daily traffic generation from the overall extension to Southlakes Estate is 14,288 trips per day and the external peak hour traffic generation is 1,272 trips per hour.

The increase in daily traffic volumes on Wheelers Lane north and Wheelers Lane south is 53% and 71% respectively.

The increase in peak hour traffic volumes on Wheelers Lane north and Wheelers Lane south is 38% and 58% respectively.

The increase in daily traffic volumes on Boundary Road west is 33%.

The increase in peak hour traffic volumes on Boundary Road west is 21%.

The increase in peak hour traffic volumes on Sheraton Road south of the Mitchell Highway is 25%.

The operational capacity of Wheelers Lane north following the development of the extension of Southlakes Estate is 46%, for Wheelers Lane south the operational capacity is 87%, for Boundary Road west is 95% and for Sheraton Road is 35%.

All roads are operating below the operational capacity at a Level of Service B and the impact of the additional traffic generated by the overall extension of Southlakes Estate in the Year 2026 is not



significant in terms of the volume of post development traffic using Wheelers Lane and Boundary Road, noting that the existing estimated traffic volumes on the subject roads do not take into account redistribution of traffic patterns once the connection of Boundary Road through to Sheraton Road is constructed.

1.6.2 INTERSECTION MODELLING

The operation of the following intersections have been assessed using the SIDRA computer modelling program:

- Wheelers Lane and Argyle Avenue
- Wheelers Lane and Azure Avenue
- Boundary Road the north south access road
- Boundary Road and Sheraton Road with the north south road connecting to Azure Avenue.

The SIDRA modelling determined that all movements at each intersection were operating at a Level of Service A.

1.6.3 CONCLUSION

The implementation of the recommendations of this Traffic Study during the approval and development of the overall extension of Southlakes Estate will see the operation of the development with the integration of the generated traffic into the existing and planned surrounding road network.



Introduction

2.1 BACKGROUND

Maas Group Properties intends to develop a residential subdivision on land to the east of the existing Southlakes Estate subdivision. The extension to Southlakes Estate will also incorporate the land further to the east known as Ringlands and the overall development will complement the existing Southlakes subdivision. The overall subdivision will have major access points connecting via Azure Avenue and Argyle Avenue to Wheelers Lane and future connections to the extension of Boundary Road and to Sheraton Road and to the wider road network.

It is intended that approximately 2,080 dwelling sites be created in the overall extension to Southlakes Estate and will comprise residential allotments and medium density allotments.

An open space corridor will be created along the central drainage line that separates the subdivision generally from the north east to the southwest of the site. The drainage corridor will be embellished with a series of decorative lakes similar to the lakes that have been developed along the existing drainage corridor in Southlakes Estate. The drainage corridor within the extension to Southlakes Estate is known as the eastern channel whilst the drainage corridor within the existing Southlakes Estate is known as the western channel.

As Development Applications for various stages of the extension of Southlakes Estate are prepared and submitted for Council's approval, reference can be made to this Traffic Study to assess the stage of the development in the context of the overall development of the extension of Southlakes Estate.

Therefore Council will have a single Traffic Study relating to the development of the overall subdivision rather than separate traffic studies addressing separate stages and the balance of the subdivision individually.

2.2 SITE LOCATION

The Hillview property is located approximately 4km south east of the Dubbo central business district and is accessed from the north via Cobra Street and Wheelers Lane and the south via Hennessy Drive and Wheelers Lane. The Ringlands site is located to the east of the Hillview property.

The Hillview subdivision site is described as Lot 12 in DP1207280 and Lot 399 in DP1199356. The Ringlands subdivision site is described as Lot 2 in DP880413. Lot 12 has an area of approximately 2.27ha, Lot 399 has an area of approximately 128.5ha and Lot 2 has an area of approximately 48.95ha for a total development area of approximately 179.72ha.

The overall development site is bounded by Southlakes Estate to the west, Boundary Road and Sheraton Road to the north, Hennessy Drive to the south and privately owned land to the east.

Boundary Road to the east of Wheelers Lane is currently unformed and Dubbo Regional Council proposes to extend Boundary Road to the east to connect with Sheraton Road whilst Hennessy Drive will be extended to provide a freight corridor extending further to the east and connecting to the Mitchell Highway via Basalt Drive.

Currently the site is accessed from Wheelers Lane via Azure Avenue through Southlakes Estate and crossing the western channel via a culverted bridge. A second culverted bridge again crossing the western channel provides for an extension of Argyle Avenue to the Hillview property.

The location of the proposed extension to Southlakes Estate is indicated on **Drawing TS01** located in the **Drawings** Section of this Report.



2.3 TRAFFIC STUDY

Under State Environmental Planning Policy SEPP (Infrastructure) 2007, the proposed subdivision for the extension of Southlakes Estate is classified in accordance with the requirements set out in Schedule 3 of Clause 104 of the SEPP.

On this basis, a Traffic Study will need to be prepared to assist in the planning approval process for the development.

This Traffic Study will address the following issues:

- Traffic generated by the development of the overall extension of Southlakes Estate
- Access to and from the subdivision via existing roads, new roads and the connection of the subdivision roads to the wider road network
- Impact on the operation, safety and amenity of the surrounding road network
- Recommendations for the implementation of Local Area Traffic Management (LATM) devices throughout the subdivision

The Traffic Study will be prepared in accordance with the requirements outlined in the NSW Roads and Traffic Authority's (RTA) *Guide to Traffic Generating Developments*.

The methodology for the preparation of the Traffic Study is outlined in the following Section of the Report.

2.4 TRAFFIC STUDY METHODOLOGY

In carrying out the preparation of the Traffic Study, three (3) broad issues will need to be addressed as outlined below:

- (a) Existing Site and Traffic Conditions
 - Subdivision location;
 - Road network hierarchy surrounding the development;
 - Existing site access;
 - Existing roadway capacity; and
 - Existing traffic flow
- (b) Proposed Subdivision
 - Residential subdivision development concepts;
 - Internal and external traffic design principles; and
 - Connectivity to the surrounding road network.
- (c) Traffic Impact of the Proposed Subdivision
 - Traffic generation from the proposed subdivision;
 - Traffic distribution within and external to the subdivision and the connection to Wheelers Lane, Boundary Road, Sheraton Road and Hennessy Drive;
 - Impact of the traffic generated from the subdivision on existing traffic parameters; and
 - Local area traffic management.



In order to satisfactorily address all the relevant traffic issues for the proposed subdivision, the following work tasks will need to be carried out:

- 1. Review all available background data, community concerns and traffic history relating to the area around the subdivision site.
- 2. Determine the traffic generating potential of the proposed subdivision, calculation of peak hour and daily traffic volumes and the distribution of the generated traffic within the subdivision and onto the surrounding road network to determine post development traffic volumes on the road network.
- Assessment of the impact of the additional traffic generated by the development of the subdivision on the surrounding road network. The traffic impact assessment will carried out in terms of:
 - Road capacity;
 - Road safety;
 - Intersection operation; and
 - Access requirements.
- 4. Determination of a schedule of required works that may be necessary to alleviate any potential impacts caused to the surrounding road network by the development of the subdivision.

In summary, this Traffic Study will assess the existing traffic movements on the road network surrounding the development site, the expected traffic volumes generated by the proposed subdivision of the Hillview and Ringlands properties, the effect of the generated traffic on the surrounding road network and the determination of a safe and efficient means of providing access to the subdivision to cater for the additional traffic volume.



Consideration of SEPP (Infrastructure) 2007

Schedule 3 of State Environmental Planning Policy (Infrastructure) 2007 classifies developments based upon the potential to generate additional traffic onto the surrounding road network.

Developments listed in Schedule 3 of SEPP (Infrastructure) require referral to the Roads and Maritime Services (RMS) by the consent authority. The consent authority is required to take into consideration any submission that the RMS provides in response to the notice of the development.

In addition, the consent authority must consider, pursuant to Clause 104 (3) of SEPP (Infrastructure), the accessibility of the site and any potential traffic safety, road congestion or parking implications of the proposed development.

Based on Schedule 3, the classification of the proposed extension to the Southlakes subdivision is outlined in Column 2 and states:

Subdivision of Land

200 or more allotments where the subdivision includes the opening of a public road

As the proposed extension to the Southlakes subdivision will generate approximately 2,080 dwelling sites, Dubbo Regional Council will need to refer the application to the RMS as part of the development approval process.



Existing Traffic Conditions

4.1 ROAD NETWORK HIERARCHY

The Roads and Traffic Authority (1984) proposes four basic road classes as the basis for the functional hierarchy of a road network.

A functional classification take into account the relative balance of the traffic mobility function and amenity/access functions of streets and roads and defines the purpose of a road within the context of a road network.

The four road classes are arterial, sub-arterial, collector and local roads and are defined below.

Arterial Roads

Roads whose main function is to carry through traffic from one region to another forming the principal means of communication for major traffic movements.

Sub-Arterial Roads

Those roads which supplement the arterial roads in providing for through traffic movement to an individually determined limit that is sensitive to both roadway characteristics and adjoining land uses.

Collector Roads

Roads that distribute traffic between the arterial roads and the local street system and provide access to adjoining property.

Local Roads

Subdivisional roads whose main traffic function is to provide access to adjoining property.

An assessment of the classification of the roads leading to and surrounding the development site is indicated in **Table 4.1**.

Road	Classification	
Wheelers Lane north of Boundary Road	Sub – Arterial Road	
Wheelers Lane south of Boundary Road	Sub – Arterial Road	
Boundary Road west of Wheelers Lane	Sub – Arterial Road	
Boundary Road east of Wheelers Lane	Not currently classified	
Sheraton Road north of the future Boundary Road	Collector Road	
Hennessy Drive west of Wheelers Lane	Collector Road	
Hennessy Drive east of Wheelers Lane	Not currently classified	
Azure Avenue	Local Road	
Argyle Avenue	Local Road	

Table 4.1 – Existing Road Classification



4.2 EXISTING ROAD CONDITIONS

The existing configuration, conditions and intersection facilities of the road network leading to and surrounding the development site are outlined in this Section of the Traffic Study.

Wheelers Lane North of Boundary Road

Wheelers Lane north of the intersection with Boundary Road comprises two (2) configurations as outlined below:

- From the intersection of Boundary Road to the northern boundary of the Dawson Park Greyhound Racing Complex Wheelers Lane has kerb and gutter on the western side of the road and is unkerbed on the eastern side of the road. The roadway comprises two (2) southbound lanes each a minimum of 3.5m wide, two (2) northbound lanes each a minimum of 3.5m wide and a 4m wide parking lane on the western side of the road.
- From the northern boundary of Dawson Park Wheelers Lane is kerb and guttered on both sides of the road. The roadway comprises two (2) southbound lanes each a minimum of 3.5m wide, two (2) northbound lanes each a minimum of 3.5m wide and a 4m wide parking lane on the both the eastern and western sides of the road.

From south of the intersection of Wheelers Lane and Kingfisher Street the roadway transitions to the northbound and southbound carriageways separated by a wide concrete median. The concrete median allows for protected right turns at a number of intersections along Wheelers Lane.

Wheelers Lane is speed limited at 60km/hr.

Wheelers Lane South of Boundary Road

Wheelers Lane to the south of the intersection with Boundary Road transitions to a southbound lane and a northbound lane. On the eastern side of Wheelers Lane is a central drainage/landscaped area separating the service road providing access to the allotments in Southlakes Estate fronting the Wheelers Lane road reserve.

The western side of Wheelers Lane is kerb and guttered along the frontage of Magnolia Estate and Holmwood Estate. When the Mary's Veil subdivision is developed, the western side of Wheelers Lane will be kerb and guttered on the western side for its full length between Boundary Road and Hennessy Drive.

The Wheelers Lane carriageway along the frontage of Holmwood Estate comprises a 6m wide travel lane and parking lane on the western side (for northbound traffic) and a 4m wide travel lane on the eastern side (for southbound traffic).

At the approach to the intersection with Hennessy Drive, Wheelers Lane transitions to a unkerbed carriageway with a 3.5m wide travel lane in each direction.

Wheelers Lane is speed limited at 60km/hr.

Boundary Road

Boundary Road east of the Dubbo to Molong rail crossing has kerb and gutter on the northern side with sections of kerb and gutter recently having been constructed along the frontage of Magnolia Estate on the southern side of Boundary Road. East of Magnolia Estate, the southern side of Boundary Road is also kerb and guttered.

The main section of the carriageway in Boundary Road is approximately 16m wide. The carriageway comprises a parking/bicycle lane 3m wide, an eastbound and westbound travel lane each 3.5m wide and a central turning median at 3.0m wide.



Boundary Road west of the Dubbo to Molong rail crossing is kerb and guttered both sides with a bitumen sealed width of approximately 14m. The carriageway comprises an eastbound and westbound travel lane each of approximately 3.5m with a parking lane/bicycle lane approximately 3.5m each side.

Boundary Road is speed limited at 50km/hr.

Boundary Road east of Wheelers Lane is an unformed road.

Hennessy Drive

Hennessy Drive west of the intersection with Wheelers Lane is a two lane two way carriageway with a bitumen seal width of approximately 8m. The road is centreline marked and also has considerable sections of the roadway with double barrier lines to prevent overtaking.

The recently developed Macquarie View Estate incorporates a new intersection of Holmwood Drive and Hennessy Drive consisting of a left turn lane for eastbound traffic and a right turn for westbound traffic in Hennessy Drive to access the subdivision.

A service road parallel to Hennessy Drive on the northern side provides access to lots in Holmwood Estate and Macquarie View Estate that front Hennessy Drive.

Hennessy Drive is speed limited at 60km/hr.

Hennessy Drive east of the intersection with Wheelers Lane is bitumen sealed to a width of 6m and apart from the area around the intersection with Wheelers Lane is not line marked.

Azure Avenue

Azure Avenue provides a major connection through the northern section of the existing Southlakes Estate to the land to be developed to the east.

Azure Avenue has a variable pavement width along it length comprising in general:

- Kerb and guttered both sides with a 6.2m wide parking and travel lane for both eastbound and westbound traffic separated by a 5m wide landscaped median.
- A bridge over the creek line with a sealed width of 8m kerb to kerb.

Each side of the bridge, the roadway transitions from the wider sections through the narrowing at the bridge.

The configuration of the Azure Avenue carriageway provides a high standard roadway with separated travel lanes capable of catering for increased traffic volumes accessing the extension of Southlakes Estate.

Argyle Avenue

Argyle Avenue provides a major connection through the southern section of the existing Southlakes Estate to the land to be developed to the east.

Argyle Avenue has a variable pavement width along it length comprising in general:

- Kerb and guttered both sides with a 6.2m wide parking and travel lane for both eastbound and westbound traffic separated by a 5m wide landscaped median.
- A bridge over the creek line with a sealed width of 8m kerb to kerb.

Each side of the bridge, the roadway transitions from the wider sections through the narrowing at the bridge.



The configuration of the Argyle Avenue carriageway provides a high standard roadway with separated travel lanes capable of catering for increased traffic volumes accessing the extension of Southlakes Estate.

Sheraton Road

The southern section of Sheraton Road adjacent to the Ringlands site is a two lane two way carriageway with a bitumen sealed width of approximately 7.2m. The roadway is not line marked and has narrow unsealed shoulders. This section of the roadway is speed limited at 100km/hr.

There are a series of 90° bends in the road alignment with the southernmost section of the road providing access to the Holcim Quarry. The quarrying operations produce basalt products that are trucked off site using Sheraton Road to travel northwards connecting to the Mitchell Highway at its intersection with Sheraton Road.

The northern section of Sheraton Road (providing frontage to a number of schools and Bunnings) comprises a dual carriageway with two lanes in each direction together with a parallel parking lane. The carriageway in each direction is separated by a central concrete median. Each travel lane is approximately 3.5m wide and the carriageway in line marked and edgeline marked denoting the parallel parking lane.

There are a number of breaks in the central median to allow buses to turn and access and exit the student drop off and pick up facilities for the schools. Passenger vehicles in general cannot make U-turns during school hours.

There are two on grade school crossing points along Sheraton Road fronting the schools and these are manned and operated before and after school. Sheraton Road is currently speed limited to 60km/hr with a 40km/hr School Zone speed limit applying between 8.00am to 9.30am and 2.30pm to 4.00pm each school day.

Intersection of Wheelers Lane and Boundary Road

The intersection of Wheelers Lane and Boundary Road is controlled by a Give Way sign on the Boundary Road leg of the intersection with a concrete median island providing separation of the traffic streams. Whilst the intersection technically is a four way intersection, the eastern leg of Boundary Road is poorly formed and not currently in regular use. The intersection currently operates as a Tee intersection with the Wheelers Lane traffic having the right of way.

For eastbound traffic in Boundary Road a dedicated left turn lane and right turn lane is provided to access Wheelers Lane.

For northbound traffic in Wheelers Lane a dedicated left turn lane is provided to access Boundary Road.

For southbound traffic in Wheelers Lane a dedicated right turn lane is provided to access Boundary Road whilst there is a separate southbound lane for through traffic.

Intersection of Wheelers Lane and Southlakes Parade

The intersection of Wheelers Lane and Southlakes Parade forms a standard Tee intersection and is controlled by a Give Way sign on the Southlakes Parade leg of the intersection with the Wheelers Lane traffic having the right of way.

The threshold of the Southlakes Parade leg of the intersection is paved. The service road parallel to Wheelers Lane is also accessed to the south from this intersection.

Intersection of Wheelers Lane and Magnolia Boulevard

The intersection of Wheelers Lane and Magnolia Boulevard is controlled by a concrete median on the Magnolia Boulevard leg of the intersection and complies with the give way priorities at a Tee intersection with the Wheelers Lane traffic having the right of way.



Intersection of Wheelers Lane and Azure Avenue

The intersection of Wheelers Lane and Azure Avenue forms a standard Tee intersection and complies with the give way priorities at a Tee intersection with the Wheelers Lane traffic having the right of way.

Whilst the intersection pavement in Azure Avenue is wide, the central median is located beyond the paved threshold on the Azure Avenue leg of the intersection and a double barrier line extends from the paved threshold into the intersection. The service road parallel to Wheelers Lane is also accessed to the south from this intersection.

Intersection of Wheelers Lane and Holmwood Drive

The intersection of Wheelers Lane and Holmwood Drive is controlled by a double barrier line on the Holmwood Drive leg of the intersection and complies with the give way priorities at a Tee intersection with the Wheelers Lane traffic having the right of way.

Intersection of Wheelers Lane and Argyle Avenue

The intersection of Wheelers Lane and Argyle Avenue forms a standard Tee intersection and complies with the give way priorities at a Tee intersection with the Wheelers Lane traffic having the right of way.

Whilst the intersection pavement in Argyle Avenue is wide, the central median is located beyond the threshold on the Azure Avenue leg of the intersection and a double barrier line is to be extended from the median into the intersection when the bridge over the creek line is opened to traffic. The service road parallel to Wheelers Lane is also accessed to the south from this intersection.

Intersection of Wheelers Lane and Shindys Road

The intersection of Wheelers Lane and Shindys Road is controlled by a double barrier line on the Shindys Road leg of the intersection and complies with the give way priorities at a Tee intersection with the Wheelers Lane traffic having the right of way

Intersection of Wheelers Lane and Hennessy Drive

The intersection of Wheelers Lane and Hennessy Drive comprises a swept 90 degree bend. The roadway in both Wheelers Lane and Hennessy Drive is centreline marked with a double barrier line and the roadways are edgeline marked.

The eastern leg of Hennessy Drive intersects the main intersection at an approximate angle of 90 degrees at the apex of the curve of the Wheelers Lane intersection.

Intersection of Azure Avenue and Southlakes Parade

The intersection of Azure Avenue and Southlakes Parade is controlled by a roundabout. The roundabout has single approach and departure lanes on all legs of the intersection with concrete splitter islands incorporated into the main central medians of both roads.

Intersection of Sheraton Road and the Mitchell Highway

The major intersection of Sheraton Road and the Mitchell Highway is controlled by a large diameter roundabout with a speed limit of 70km/hr applying along the Mitchell Highway. The roundabout comprises 2 approach lanes and 2 departure lanes for each leg of the roundabout.

Just west of the roundabout is a set of manually activated traffic signals controlling a crossing point for pedestrians. The pedestrian crossing point is located within the concrete splitter island on the western leg of the roundabout.

Various photographs of the roads described in this Section of the Traffic Study and contained in the **Plates** Section of this Report.



4.3 EXISTING ROADWAY CAPACITY

The provision of roads within an urban area provides four main functions:

- i) to cater for moving vehicles;
- ii) to cater for parked vehicles;
- iii) to cater for pedestrians and bicycle traffic; and
- iv) to allow for development and to provide access to adjoining property.

In carrying out the above functions, a road must also be capable of handling the traffic demands placed on it. Roads have varying capacities dependent on the function they are performing. The United States Highway Capacity Manual defines capacity as follows:

"Capacity is the maximum number of vehicles which has a reasonable expectation of passing over a given section of a lane or roadway in one direction (or in both directions for a two-lane or three-lane highway) during a given time period under prevailing roadway and traffic conditions."

The physical characteristics of a roadway such as lane width, alignment, frequency of intersections etc make up the prevailing roadway conditions.

Based upon its capacity and a driver's expectations of the operational characteristics of a traffic stream is a qualitative measure denoted as the level of service of a road.

Level of service definitions combine such factors as speed, travel time, safety, convenience and traffic interruptions and fall into six levels of service categories ranging from A down to F.

The AUSTROADS Guide to Traffic Engineering Practice describes Level of Service A as:

"A condition of a free flow in which individual drivers are virtually unaffected by the presence of others in the traffic stream. Freedom to select desired speeds and to manoeuvre within the traffic stream is extremely high and the general level of comfort and convenience provided is excellent."

The AUSTROADS Guide to Traffic Engineering Practice describes Level of Service B as:

"A condition of stable flow and drivers still have reasonable freedom to select their desired speed and to manoeuvre within the traffic stream, although the general level of comfort and convenience is a little less than with Level of Service A"

The categories are graduated from Level of Service A down through six levels to Level of Service F that is a zone of forced flow. The amount of traffic approaching the point under consideration exceeds that which can pass it. Flow breakdowns occur and queuing and delays result.

Based on the physical configurations of the surrounding road network, observations of traffic movements and the methodology outlined in Part 2 *Roadway Capacity* of *AUSTROADS Guide to Traffic Engineering Practice*, the capacity and Level of Service of the surrounding roads can be determined as indicated in **Table 4.2**.

Road	Level of Service	Two Way Hourly Capacity
Wheelers Lane north of Boundary Road	Level of Service B	3,600 veh/hour
Wheelers Lane south of Boundary Road	Level of Service B	1,800 veh/hour
Boundary Road	Level of Service B	1,200 veh/hour

Table 4.2 – Roadway Capacity and Level of Service



Road	Level of Service	Two Way Hourly Capacity
Azure Avenue	Level of Service B	1,200 veh/hour
Argyle Avenue	Level of Service B	1,200 veh/hour
Hennessy Drive	Level of Service B	1,200 veh/hour
Sheraton Road (southern section)	Level of Service B	1,200 veh/hour
Sheraton Road (dual carriageway section)	Level of Service B	3,600 veh/hour

Table 4.2 – Roadway Capacity and Level of Service

4.4 AVAILABLE TRAFFIC DATA

Site specific traffic data was not collected on roads surrounding the Southlakes Subdivision for the preparation of this Traffic Study. However, a number of sources were used to collate the available traffic data for use in determining potential impacts on the surrounding road network, including:

- i) Traffic Impact Assessment for Southlakes DA4 (Geolyse, July 2012)
- ii) Dubbo City Council hourly traffic volumes for the modelled road network
- iii) South Keswick Quarry Traffic Impact Assessment (Barnson, October 2016)

The available traffic data for the Annual Average Daily Traffic and Peak Hour Traffic will be outlined in the following Sections of this Report.

4.5 ANNUAL AVERAGE DAILY TRAFFIC

The Geolyse July 2012 Traffic Report assessed the development of an additional 224 lots in Southlakes Estate and distributed the generated traffic volumes onto the surrounding road network. Turning movement counts were undertaken at the intersection of Wheelers Lane and Boundary Road and the proportional volumes at the intersection were used to distribute the additional traffic onto the road network.

The July 2012 Traffic Report determined the following post development AADT traffic volumes on the subject roads:

•	Wheelers Lane north of Boundary Road	7,335 vehicles per day
•	Wheelers Lane south of Boundary Road	6,903 vehicles per day
•	Boundary Road west of Wheelers Lane	4,968 vehicles per day

As the post development traffic volumes were determined for the Year 2012 and the expected completion date for the full development of the extension to Southlakes Estate may take 10 years, it would be reasonable to carry out the assessment of the impact on the surrounding road network for the Year 2026.

On this basis, the Year 2012 traffic volumes shall be adjusted by the application of a growth factor of 2% per annum to account for the increase in traffic volumes over time.

The estimated Year 2026 AADT traffic volumes on the subject roads are summarised below:

•	Wheelers Lane north of Boundary Road	9,678 vehicles per day
•	Wheelers Lane south of Boundary Road	9,108 vehicles per day

Boundary Road west of Wheelers Lane
 6,555 vehicles per day



It should be noted that the estimated Year 2026 AADT traffic volumes based on the July 2012 Traffic Report do not take into account the redistribution of traffic patterns following the extension of Boundary Road through to Sheraton Road.

However, the estimated AADT provides a basis for the further assessment of the potential impacts of traffic generated by the proposed extension to Southlakes Estate.

4.6 PEAK HOUR TRAFFIC

The Geolyse July 2012 Traffic Report determined post development peak hour traffic volumes generated from Southlakes Estate on the surrounding road network.

The July 2012 Traffic Report determined the following post development peak hour traffic volumes on the subject roads:

•	Wheelers Lane north of Boundary Road	912 vehicles per hour
•	Wheelers Lane south of Boundary Road	752 vehicles per hour
•	Boundary Road west of Wheelers Lane	679 vehicles per hour

Similarly, the Year 2012 traffic volumes shall be adjusted by the application of a growth factor of 2% per annum to account for the increase in traffic volumes over time.

The estimated Year 2026 peak hour traffic volumes on the subject roads are summarised below:

•	Wheelers Lane north of Boundary Road	1,204 vehicles per hour
•	Wheelers Lane south of Boundary Road	992 vehicles per hour
•	Boundary Road west of Wheelers Lane	896 vehicles per hour

It should be noted that the estimated Year 2026 peak hour traffic volumes based on the July 2012 Traffic Report do not take into account the redistribution of traffic patterns following the extension of Boundary Road through to Sheraton Road.

However, the estimated peak hour traffic volumes provides a basis for the further assessment of the potential impacts of traffic generated by the proposed extension to Southlakes Estate.

The traffic data provided by Council assesses the peak hour traffic volume on the extension of Boundary Road through to Sheraton Road. For the Year 2026, the estimated peak hour traffic volume between Wheelers Lane and Alexandrina Avenue is approximately 511 vehicles per hour.

The Barnson Traffic Report prepared for the proposed South Keswick Quarry determined peak hour traffic volumes on Sheraton Road (south and north of the Mitchell Highway) and on the Mitchell Highway for existing conditions and for future developments in the area such as the Quarry and the connection of Boundary Road through to Sheraton Road.

The Barnson Report determine the following peak hour traffic volumes as applicable to the Year 2026:

- Sheraton Road south of the Mitchell Highway 1,024 vehicles per hour
- Boundary Road west of Sheraton Road
 268 vehicles per hour

The traffic volume in Boundary Road west of Sheraton Road is approximately 50% of the traffic volume estimated by Council, therefore the higher traffic volume of 511 vehicles per hour will be adopted for the assessment of the extension of Boundary Road through to Sheraton Road.



Traffic Impact of the Proposed Development

5.1 PROPOSED SUBDIVISION

The site for the overall extension of the Southlakes Estate subdivision comprises Lot 12 in DP1207280, Lot 399 in DP1199356 and Lot 2 in DP880413. Lot 12 has an area of approximately 2.27ha, Lot 399 has an area of approximately 128.5ha and Lot 2 has an area of approximately 48.95ha for a total development area of approximately 179.72ha.

It is intended that approximately 2,080 dwelling sites be created in the overall subdivision comprising residential allotments and medium density allotments.

In general, the dwelling sites will comprise the following allocations:

Residential allotments	1,314 lots
Medium density dwelling units	766 units
Total dwelling sites	2,080 dwellings

The concept Master Plan for the proposed overall extension to Southlakes Estate is indicated on **Drawing TS02** located in the **Drawings** Section of this Report.

5.2 TRAFFIC GENERATION

The Roads and Traffic Authority's *Guide to Traffic Generating Developments* publishes data on the traffic generating potential of various developments ranging from residential subdivisions, commercial premises, retail premises and industrial developments.

For residential subdivisions, the *Guide to Traffic Generating Developments* indicates that the following range of traffic generation for daily vehicle trips and weekday peak hour vehicle trips as indicated below:

- Dwelling Houses
 Daily vehicle trips = 9 per dwelling
 Weekday peak hour vehicle trips = 0.85 per dwelling
- Medium Density Residential Dwellings Smaller units and flats (up to 2 bedrooms)
 Daily vehicle trips = 4 to 5 per dwelling

Larger units and townhouses (3 or more bedrooms) Daily vehicle trips = 5 to 6.5 per dwelling Weekday peak hour vehicle trips = 0.5 to 0.65 per dwelling

Dubbo Regional Council has had discrete traffic assessment carried out on selected streets within the City by TEC Pty Ltd that indicates the traffic generation rates attributable to dwelling houses in Dubbo are higher than the generation rates determined by the RTA.

The applicable traffic generation rates to be used in this Traffic Study are summarised below:

Dwelling Houses Daily vehicle trips = 11 per dwelling Weekday peak hour vehicle trips = 1.0 per dwelling



Medium Density Residential Dwellings
 Daily vehicle trips = 6 per dwelling
 Weekday peak hour vehicle trips = 0.5 per dwelling

Based on the adopted traffic generation rates and the proposed dwelling sites throughout the subdivision, the daily and peak hour traffic generation for the overall extension of Southlakes Estate is set out in the following Section of this Report.

5.2.1 DAILY TRAFFIC GENERATION

The daily traffic generated by the overall extension of Southlakes Estate can be estimated as set out below:

Number of residential dwellings:	1,314 dwellings
Daily vehicle trips:	11 per dwelling
Number of residential daily trips:	14,454 trips per day
Number of medium density dwellings:	766 dwellings
Daily vehicle trips:	6 per dwelling
Number of medium density daily trips:	4,596 trips per day
Total daily vehicle trips:	14,454 trips + 4,596 trips = 19,050 trips per day

Not all trips generated by the proposed extension to Southlakes Estate will be external to the subdivision. A proportion of the generated trips will be for internal travel purposes such as visiting friends or neighbours, recreation areas or a potential commercial precinct.

The RTA estimate that approximately 25% of daily and peak hour vehicle trips are internal to the subdivision (RTA, 1993) and therefore the adjusted external daily vehicle trips generated by the subdivision is:

External daily vehicle trips: 19,050 trips x 0.75 = 14,288 trips per day.

The external trip generation of 14,288 trips per day will be used to assess the potential impacts of the development of the subdivision on the surrounding road network.

5.2.2 PEAK HOUR TRAFFIC GENERATION

The peak hour traffic generated by the overall extension of Southlakes Estate can be estimated as set out below:

Number of residential dwellings:	1,314 dwellings
Peak hour vehicle trips:	1 per dwelling
Number of residential peak hour trips:	1,314 trips per hour
Number of medium density dwellings:	766 dwellings
Peak hour vehicle trips:	0.5 per dwelling
Number of medium density peak hour trips:	383 trips per day
Total peak hour vehicle trips:	1,314 trips + 383 trips = 1,697 trips per hour

As with the daily trip generation, the RTA estimate that 25% of the peak hour trip generation are internal to the subdivision. Therefore, the adjusted external peak hour trips generated by the subdivision is:

External peak hour trips: 1,697 trips x 0.75 = 1,272 trips per hour.



The external trip generation of 1,272 trips per hour will be used to assess the potential impacts of the development of the subdivision on the surrounding road network.

5.3 TRAFFIC DISTRIBUTION

Traffic generated by the development of the overall extension to Southlakes Estate will access the subdivision via the following external road connections:

- Wheelers Lane and Azure Avenue
- Wheelers Lane and Argyle Avenue
- The future extension of Boundary Road and Alexandrina Avenue
- The future extension Boundary Road and the main north south internal road linking Argyle Avenue and Azure Avenue
- The future extension of Boundary Road and the intersection with Sheraton Road and the north south internal road linking Azure Avenue through to the new Boundary Road and Sheraton Road intersection.
- Argyle Avenue and a new road connection to the future extension of Hennessy Drive

The travel paths taken by the future residents of the overall subdivision to access the external road network are subjective and will be dependent on trip destination and purpose.

Major attractors for the residential traffic generated by the subdivision are the CBD area of Dubbo for work and shopping purposes, Orana Mall for shopping purposes and once the extension of Boundary Road is completed, the school precinct in Sheraton Road and Bunnings will be a major attractor.

A subjective assessment of the traffic distribution external to the subdivision via the various connections to the external road network is set out below in estimated percentage terms of the total traffic generation from the subdivision, noting that the assumption is made that all extensions to the surrounding road network have been completed:

•	Wheelers Lane and Azure Avenue	25%
•	Wheelers Lane and Argyle Avenue	20%
•	Boundary Road and Alexandrina Avenue	10%
•	Boundary Road and north south road	15%
•	Boundary Road and Sheraton Road	20%
•	Argyle Avenue through to Hennessy Drive	10%

Based on the estimated percentages, the daily traffic and peak hour traffic volumes distributed to the surrounding road network is set out in **Table 5.1**.


Road	Percentage Distribution	Daily Traffic Volume (trips per day)	Peak Hour Traffic Volume (trips per hour 318	
Wheelers Lane and Azure Avenue	25%	3,572		
Wheelers Lane and Argyle Avenue	20%	2,858	255	
Boundary Road and Alexandrina Avenue	10%	1,429	127	
Boundary Road and north south road	15%	2,142	190	
Boundary Road and Sheraton Road	20%	2,858	255	
Argyle Avenue to Hennessy Drive	10%	1,429	127	
Totals	100%	14,288	1,272	

Table 5.1 – Traffic Volume Distribution to the External Road Network

The distribution of the traffic volumes onto the external road network is indicated on **Drawing TS03** located in the **Drawings** Section of this Report.

5.4 IMPACT OF GENERATED TRAFFIC

The impact of the additional traffic generated by the overall extension of Southlakes Estate on the surrounding road network will be assessed in terms of:

- i) Traffic Volume for both the Daily and Peak Hour traffic generation;
- ii) Intersection Operation; and
- iii) Road Safety.

SIDRA modelling will be undertaken to assess the operation of various intersections on the surrounding road network.

5.4.1 PROPOSED ROAD UPGRADES

Discussions have been held with staff of Dubbo Regional Council regarding the proposed road upgrades that are to be carried out on the surrounding road network.

The proposed road upgrades will include:

- Construction of a roundabout at the intersection of Wheelers Lane and Boundary Road.
- Extension of Boundary Road through to Sheraton Road.
- Construction of a roundabout at the intersection of Boundary Road and Alexandrina Avenue.
- Construction of a Tee intersection at the intersection of Boundary Road and the main north south access road from the Southlakes subdivision.
- Construction of a roundabout at the four way intersection of Boundary Road, Sheraton Road the access road from the Southlakes subdivision.

The general details of the proposed road upgrades are summarised below.

 The roundabout to be constructed at the intersection of Wheelers Lane and Boundary Road is a large diameter roundabout with 2 circulating lanes within the roundabout. Each approach leg to the roundabout will comprise 2 lanes whilst the departure legs to Boundary Road will comprise a single lane. The departure legs to Wheelers Lane will comprise 2 lanes.



Concrete splitter islands will be provided on each leg to separate the approach and departure lanes of the roundabout.

2. The upgrade of Boundary Road between Wheelers Lane and Alexandrina Avenue will comprise a single lane in each direction, will include an on road cycle lane and a concrete separation median between the travel lanes. In general, no access will be available to land fronting this section of Boundary Road following the upgrade.

From the intersection of Alexandrina Avenue through to Sheraton Road, Boundary Road will be upgraded to a rural road standard with a single lane in each direction and tabledrains outside the carriageway of the road.

3. The roundabout to be constructed at the intersection of Boundary Road and Alexandrina Avenue is a large diameter roundabout with 1 circulating lane within the roundabout. The approach leg to the roundabout from the western end of Boundary Road will comprise 2 lanes whilst all other approach and departure legs to the roundabout will comprise a single lane.

Concrete splitter islands will be provided on each leg to separate the approach and departure lanes of the roundabout.

- 4. The intersection of Boundary Road and the main subdivision north south access road will comprise a standard Tee configuration controlled by Give Way signs with Boundary Road traffic having priority.
- 5. The roundabout to be constructed at the intersection of Boundary Road, Sheraton Road the access road from the subdivision will be a large diameter roundabout with 1 circulating lane within the roundabout. The approach and departure legs to the roundabout will comprise a single lane.

Concrete splitter islands will be provided on each leg to separate the approach and departure lanes of the roundabout.

5.4.2 TRAFFIC VOLUME

Based on the Average Daily Traffic and Peak Hour traffic volumes on Wheelers Lane and Boundary Road as outlined in **Section 4.5** and **Section 4.6**, the impacts of the traffic generated by the extension of Southlakes Estate has been assessed.

A comparison of the existing daily and peak hour traffic volumes on the subject roads and the post development traffic volumes is indicated in **Table 5.2**.

Road	Estimated Year 2026 Traffic Volume	Post Development Traffic Volume	Percentage Increase
Wheelers Lane north of Boundary Road – Daily Traffic Volume	9,678 trips per day	14,822 trips per day	53%
Wheelers Lane north of Boundary Road – Peak Hour Traffic Volume	1,204 trips per hour	1,662 trips per hour	38%
Wheelers Lane south of Boundary Road – Daily Traffic Volume	9,108 trips per day	15,538 trips per day	71%
Wheelers Lane south of Boundary Road – Peak Hour Traffic Volume	992 trips per hour	1,565 trips per hour	58%

 Table 5.2 – Comparison of Existing and Post Development Traffic Volumes

Road	Estimated Year 2026 Traffic Volume	Post Development Traffic Volume	Percentage Increase
Boundary Road west of Wheelers Lane – Daily Traffic Volume	6,555 trips per day	8,697 trips per day	33%
Boundary Road west of Wheelers Lane – Peak Hour Traffic Volume	896 trips per hour	1,086 trips per hour	21%
Boundary Road east of Wheelers Lane – Daily Traffic Volume	NA	3,571 trips per day	NA
Boundary Road east of Wheelers Lane – Peak Hour Traffic Volume	510 trips per hour	827 trips per hour	62%
Sheraton Road at future intersection with Boundary Road – Daily Traffic Volume	NA	2,858 trips per day	NA
Sheraton Road at future intersection with Boundary Road – Peak Hour Traffic Volume	510 trips per hour	765 trips per hour	50%
Sheraton Road south of the Mitchell Highway – Peak Hour Traffic Volume	1,024 vehicles per hour	1,279 vehicles per hour	25%
Hennessy Drive – Daily Traffic Volume	NA	1,429 trips per day	NA
Hennessy Drive – Peak Hour Traffic Volume	NA	127 trips per hour	NA

Table 5.2 – Comparison of Existing and Post Development Traffic Volumes

The increase in daily traffic volumes on Wheelers Lane north and Wheelers Lane south is 53% and 71% respectively.

The increase in peak hour traffic volumes on Wheelers Lane north and Wheelers Lane south is 38% and 58% respectively.

The increase in daily traffic volumes on Boundary Road west is 33%.

The increase in peak hour traffic volumes on Boundary Road west is 21%.

The increase in peak hour traffic volumes on Sheraton Road south of the Mitchell Highway is 25%.

A comparison will be made with the post development peak hour traffic volumes on each road with the actual traffic volume capacity of the road in its current configuration.

Based on the roadway capacities determined in **Section 4.3** of this Traffic Study, a comparison of the post development peak hour traffic volume and the actual road capacity is indicated in **Table 5.3**. The operational capacity is the percentage of actual volume capacity that the road is functioning at.



Road	Post Development Peak Hour Capacity Year 2026	Road Capacity at a Level of Service B (Refer to Section 3.3)	Operational Capacity
Wheelers Lane north	1,662 vehicles per hour	3,600 vehicles per hour	46%
Wheelers Lane south	1,565 vehicles per hour	1,800 vehicles per hour	87%
Boundary Road west	1,086 vehicles per hour	1,200 vehicles per hour	91%
Sheraton Road	1,279 vehicles per hour	3,600 vehicles per hour	35%

Table 5.3 - Post Development Peak Hour Capacity

The operational capacity of Wheelers Lane north following the development of the extension of Southlakes Estate is 46%, for Wheelers Lane south the operational capacity is 87%, for Boundary Road west is 91% and for Sheraton Road is 35%.

All roads are operating below the operational capacity at a Level of Service B and the impact of the additional traffic generated by the overall extension of Southlakes Estate in the Year 2026 is not significant in terms of the volume of post development traffic using Wheelers Lane and Boundary Road, noting that the existing estimated traffic volumes on the subject roads do not take into account redistribution of traffic patterns once the connection of Boundary Road through to Sheraton Road is constructed.

5.4.3 INTERSECTION ASSESSMENT

The operation of the following intersections will be assessed using the SIDRA computer modelling program:

- Wheelers Lane and Argyle Avenue
- Wheelers Lane and Azure Avenue
- Boundary Road and the north south access road
- Boundary Road and Sheraton Road with the north south road connecting to Azure Avenue.

It is proposed that the intersection of Boundary Road, Sheraton Road and the north south road connecting to Azure Avenue is to be constructed as a four way roundabout.

The operation of the intersections of Wheelers Lane and Boundary Road and Boundary Road and Alexandrina Avenue will not be assessed for this Traffic Study as Council has had extensive modelling of the operation of these intersections carried out in developing the detailed design of the roundabouts to be constructed at these intersections.

5.4.3.1 Wheelers Lane and Argyle Avenue

The operation of the intersection of Wheelers Lane and Argyle Avenue will be assessed for the nominal peak hour using the SIDRA modelling program.

The intersection turning movements for the peak hour traffic generated from the overall extension of Southlakes Estate are indicated on **Drawing TS04** in the **Drawings** Section of this Report.

A summary of the SIDRA modelling for the operation of the intersection on Wheelers Lane is indicated in **Table 5.4**.

The SIDRA modelling results for the assessment of this intersection are included in Appendix A.



Scenario	Vehicles on Movement	Average Delay (seconds)	95% Queue Length (metres)	Overall Level of Service (LOS)
Nominal Peak Ho	ur			
Argyle Avenue Westb	ound			
Left Turn into Wheelers Lane	33 vehicles per hour	5.3	5.0	LOS A
Right Turn into Wheelers Lane	135 vehicles per hour	6.4	5.0	LOS A
Wheelers Lane Northb	ound			
Right Turn into Argyle Avenue	33 vehicles per hour	6.3	2.0	LOS A
Straight Through Northbound	100 vehicles per hour	0.3	2.0	LOS A
Wheelers Lane South	bound		, t .	
Left Turn into Argyle Avenue	135 vehicles per hour	5.6	0.0	LOS A
Straight Through Southbound	100 vehicles per hour	0.3	0.0	LOS A

Table 5.4 – Wheelers Lane and Argyle Avenue Intersection Operating Parameters

All movements at the intersection operate at a Level of Service A and thus the intersection will operate satisfactorily for the development of the overall extension to Southlakes Estate.

5.4.3.2 Wheelers Lane and Azure Avenue

The operation of the intersection of Wheelers Lane and Azure Avenue will be assessed for the nominal peak hour using the SIDRA modelling program.

The intersection turning movements for the peak hour traffic generated from the overall extension of Southlakes Estate are indicated on **Drawing TS05** in the **Drawings** Section of this Report.

A summary of the SIDRA modelling for the operation of the intersection on Wheelers Lane is indicated in **Table 5.5**. The SIDRA modelling results for the assessment of this intersection are included in **Appendix A**.

Scenario	Vehicles on Movement	Average Delay (seconds)	95% Queue Length (metres)	Overall Level of Service (LOS)	
Nominal Peak Ho	ur				
Azure Avenue Westbo	ound				
Left Turn into Wheelers Lane	44 vehicles per hour	6.7	13.0	LOS A	
Right Turn into Wheelers Lane	215 vehicles per hour	9.2	13.0	LOS A	
Wheelers Lane North	oound				
Right Turn into Azure Avenue	44 vehicles per hour	7.1	3.0	LOS A	
Straight Through Northbound	180 vehicles per hour	0.5	3.0	LOS A	

Table 5.5 – Wheelers Lane and Azure Avenue Intersection Operating Parameters



Scenario	Vehicles on Movement	Average Delay (seconds)	95% Queue Length (metres)	Overall Level of Service (LOS)	
Wheelers Lane South	bound				
Left Turn into Azure Avenue	215 vehicles per hour	5.6	0.0	LOS A	
Straight Through Southbound	180 vehicles per hour	0.0	0.0	LOS A	

Table 5.5 – Wheelers Lane and Azure Avenue Intersection Operating Parameters

All movements at the intersection operate at a Level of Service A and thus the intersection will operate satisfactorily for the development of the overall extension to Southlakes Estate.

5.4.3.3 Boundary Road and the North South Access Road

The operation of the intersection of Boundary Road and the north south access road will be assessed for the nominal peak hour using the SIDRA modelling program.

The intersection turning movements for the peak hour traffic generated from the overall extension of Southlakes Estate are indicated on **Drawing TS06** in the **Drawings** Section of this Report.

A summary of the SIDRA modelling for the operation of the intersection on Wheelers Lane is indicated in **Table 5.6**.

The SIDRA modelling results for the assessment of this intersection are included in Appendix A.

Scenario	Vehicles on Movement	Average Delay (seconds)	95% Queue Length (metres)	Overall Level of Service (LOS)
Nominal Peak Ho	ur			
Access Road Northbo	ound			
Left Turn into Boundary Road	48 vehicles per hour	5.8	3.0	LOS A
Right Turn into Boundary Road	48 vehicles per hour	8.6	3.0	LOS A
Boundary Road Eastb	ound			
Right Turn into Access Road	48 vehicles per hour	6.7	3.0	LOS A
Straight Through Eastbound	255 vehicles per hour	0.3	3.0	LOS A
Boundary Road Westl	bound		e fa	
Left Turn into Access Road	48 vehicles per hour	5.6	0.0	LOS A
Straight Through Westbound	255 vehicles per hour	0.0	0.0	LOS A

Table 5.6 – Boundary Road and Access Road Intersection Operating Parameters

All movements at the intersection operate at a Level of Service A and thus the intersection will operate satisfactorily for the development of the overall extension to Southlakes Estate.



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5.4.3.4 Boundary Road and Sheraton Road Roundabout

The operation of the intersection of Boundary Road, Sheraton Road and the north south subdivision access road will be assessed as a roundabout for the nominal peak hour using the SIDRA modelling program.

The intersection turning movements for the peak hour traffic generated from the overall extension of Southlakes Estate are indicated on **Drawing TS07** in the **Drawings** Section of this Report.

A summary of the SIDRA modelling for the operation of the intersection on Wheelers Lane is indicated in **Table 5.7**.

The SIDRA modelling results for the assessment of this intersection are included in Appendix A.

Scenario	Movement	(seconds)	Length (metres)	Service (LOS)	
Nominal Peak Ho	ur				
Access Road Northbo	ound				
Left Turn into Boundary Road	1 vehicles per hour	6.3	5.0	LOS A	
Right Turn into Sheraton Road	1 vehicles per hour	10.2	5.0	LOS A	
Straight Through Northbound	128 vehicles per hour	6.6	5.0	LOS A	
Boundary Road Easth	ound				
Right Turn into Access Road	1 vehicles per hour	9.1	13.0	LOS A	
Straight Through Eastbound	7 vehicles per hour	6.9	13.0	LOS A	
Left Turn into Sheraton Road	335 vehicles per hour	5.2	13.0	LOS A	
Sheraton Road Westb	ound			•	
Left Turn into Access Road	1 vehicles per hour	6.7	2.0	LOS A	
Straight Through Westbound	7 vehicles per hour	9.3	2.0	LOS A	
Right Turn into Sheraton Road	15 vehicles per hour	12.8	2.0	LOS A	
Sheraton Road South	bound			•	
Right Turn into Boundary Road	335 vehicles per hour	8.3	14.0	LOS A	
Straight Through Southbound	128 vehicles per hour	4.7	14.0	LOS A	
Left Turn into Sheraton Road	15 vehicles per hour	5.1	14.0	LOS A	

Table 5.7 – Boundary Road, Sheraton Road and Access Road Roundabout Operating Parameters

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All movements at the roundabout operate at a Level of Service A and thus the intersection will operate satisfactorily for the development of the overall extension to Southlakes Estate.



5.4.4 LOCAL AREA TRAFFIC MANAGEMENT

The proposed subdivision for the overall extension of Southlakes Estate will extend the design concepts included in the development of the subdivision to date. The design of the subdivision has incorporated various influencing factors relating to topography, drainage and connection to the existing road network.

The need to provide safe and efficient traffic movement within the subdivision coupled with the amenity of the residential areas is of importance in developing the subdivision layout.

The Traffic Authority of NSW (1985) states that the main traffic related principles to be observed in the design of a residential subdivision are:

- To provide a safe environment for pedestrians, cyclists and motorists;
- To ensure convenient vehicular access to properties for residents, visitors, service and emergency vehicles;
- To reduce traffic conflicts, both vehicular and pedestrian;
- To give priority to through traffic on major roads, segregated where possible from pedestrian activity;
- To ensure that the road layout will accommodate public transport; and
- To provide a suitable residential environment. This includes limitation of noise generated by traffic and the provision of landscaping that does not compromise safety nor impede traffic movement.

The lot layout and road pattern developed for the extension of Southlakes Estate provides many residential areas that form quiet neighbourhood precincts consisting of cul-de-sacs running off roadways linking the main thoroughfares through the site.

Intersections have been predominantly designed as T-junctions and will be subject to the usual Give Way priority for the through traffic. A large roundabout will be provided at the 4-way intersection created at the eastern end of Azure Avenue. Similarly, a large roundabout will be provided at the 4-way intersection created at the eastern end of Argyle Avenue. Two smaller roundabouts are to be provided at four way intersections in the southern section of the subdivision.

The major thoroughfares through the subdivision will include central medians to provide separation of the travel lanes and to control the turning movements of vehicles into and out of the side street network.

Good sight distance is provided at all intersections and the design geometry of the roads will ensure that both the vertical and horizontal alignment provides for the safety of both vehicular traffic and pedestrians.

A series of paved footpaths will be provided throughout the subdivision to provide pedestrian refuges at the crossing points of the roads and to provide linkages to the cycleway network along the creekline within the subdivision.

The Local Area Management Plans for both Traffic and Pedestrians are indicated on **Drawing TS08** and **Drawing TS09** located in the **Drawings** Section of this Report.

5.4.5 TRAFFIC IMPACT SUMMARY

The impact of the additional traffic generated by the overall extension of Southlakes Estate on the surrounding road network has been assessed in terms of:

- i) Traffic Volume for both the Daily and Peak Hour traffic generation;
- ii) Intersection Operation; and
- iii) Road Safety.



SIDRA modelling has been undertaken to assess the operation of various intersections on the surrounding road network.

5.4.5.1 Traffic Generation and Roadway Capacity

The estimated external daily traffic generation from the overall extension to Southlakes Estate is 14,288 trips per day and the external peak hour traffic generation is 1,272 trips per hour.

The increase in daily traffic volumes on Wheelers Lane north and Wheelers Lane south is 53% and 71% respectively.

The increase in peak hour traffic volumes on Wheelers Lane north and Wheelers Lane south is 38% and 58% respectively.

The increase in daily traffic volumes on Boundary Road west is 33%.

The increase in peak hour traffic volumes on Boundary Road west is 21%.

The increase in peak hour traffic volumes on Sheraton Road south of the Mitchell Highway is 25%.

The operational capacity of Wheelers Lane north following the development of the overall extension of Southlakes Estate is 46%, for Wheelers Lane south the operational capacity is 87%, for Boundary Road west is 91% and for Sheraton Road is 35%.

All roads are operating below the operational capacity at a Level of Service B and the impact of the additional traffic generated by the overall extension of Southlakes Estate in the Year 2026 is not significant in terms of the volume of post development traffic using Wheelers Lane and Boundary Road, noting that the existing estimated traffic volumes on the subject roads do not take into account redistribution of traffic patterns once the connection of Boundary Road through to Sheraton Road is constructed.

5.4.5.2 Intersection Modelling

The operation of the following intersections have been assessed using the SIDRA computer modelling program:

- Wheelers Lane and Argyle Avenue
- Wheelers Lane and Azure Avenue
- Boundary Road the north south access road
- Boundary Road and Sheraton Road with the north south road connecting to Azure Avenue

The SIDRA modelling determined that all movements at each intersection were operating at a Level of Service A.



Recommendations

The impact of the additional traffic generated by the overall extension of Southlakes Estate on the surrounding road network has been assessed in terms of:

- i) Traffic Volume for both the Daily and Peak Hour traffic generation;
- ii) Intersection Operation; and
- iii) Road Safety.

SIDRA modelling has been undertaken to assess the operation of various intersections on the surrounding road network.

The estimated external daily traffic generation from the overall extension to Southlakes Estate is 14,288 trips per day and the external peak hour traffic generation is 1,272 trips per hour.

The increase in daily traffic volumes on Wheelers Lane north and Wheelers Lane south is 53% and 71% respectively.

The increase in peak hour traffic volumes on Wheelers Lane north and Wheelers Lane south is 38% and 58% respectively.

The increase in daily traffic volumes on Boundary Road west is 33%.

The increase in peak hour traffic volumes on Boundary Road west is 21%.

The increase in peak hour traffic volumes on Sheraton Road south of the Mitchell Highway is 25%.

In completing the assessment of the impact of the additional traffic generated by the extension of Southlakes Estate, the following recommendations are made:

- The increase in traffic volumes on the roads surrounding Southlakes Estate will not change the classifications of the roads under a functional road hierarchy.
- The post development peak hour traffic on Wheelers Lane north is 46% of the operational capacity of the road at a Level of Service B
- The post development peak hour traffic on Wheelers Lane south is 87% of the operational capacity of the road at a Level of Service B.
- The post development peak hour traffic volume on Boundary Road west is 91% of the operation capacity of the road at a Level of Service B.
- The post development peak hour traffic on Sheraton Road south of the Mitchell Highway is 35% of the operational capacity of the road at a Level of Service B.
- The intersection of Wheelers Lane and the Boundary Road is to be developed as a major roundabout in accordance with the construction plans prepared by Council.
- The intersection of Boundary Road and Alexandrina Avenue is to be developed as a roundabout in accordance with the construction plans prepared by Council.
- The intersection of Boundary Road and Sheraton Road is to be developed as a roundabout.
- The intersections modelled using SIDRA all operate at a Level of Service A.
- Local Area Traffic Management facilities for vehicles and pedestrians are to be installed as outlined in **Section 5.4.4** of this Traffic Study.
- The design and construction of all recommended facilities are to be carried out in accordance with the appropriate standards, codes and requirements of Dubbo Regional Council.



The implementation of the recommendations of this Traffic Study during the approval and development of the overall extension of Southlakes Estate will see the operation of the development with the integration of the generated traffic into the existing and planned surrounding road network.



References

AUSTROADS (1988) Guide to Traffic Engineering Practice. Part 2. Roadway Capacity.

AUSTROADS (1988) Guide to Traffic Engineering Practice. Part 3. Traffic Studies.

AUSTROADS (1988) Guide to Traffic Engineering Practice. Part 5. Intersections at Grade.

AUSTROADS (1988) Guide to Traffic Engineering Practice. Part 10 Local Area Traffic Management.

Ogden, K.W. and Bennett, D.W. (Eds) 1984) Traffic Engineering Practice. Third Edition. Dept of Civil Engineering Monash University.

Roads and Traffic Authority (1993) Guide to Traffic Generating Developments.

Traffic Authority of NSW (1985) Policies Guidelines and Procedures for Traffic Generating Developments. Part F.

Traffic Authority of NSW (1985b) Policies Guidelines and Procedures for Traffic Generating Developments. Part B.

Roads and Traffic Authority Road Design Guide 1991 Section 4 - Intersections at Grade.

Queensland Streets - Design Guidelines for Subdivisional Streetworks IMEA (Qld) 1993.

Dubbo City Road Hierarchy and Truck Route Network. TEC Consulting Pty Ltd 1991.

Dubbo Urban Area Traffic Management and Road Contribution Study. TEC Consulting Pty Ltd 1993.

Dubbo Expanded Urban Area Traffic Management & Road Contribution Study - Final Report. PPK Environment & Infrastructure Pty Ltd.

Proposed South Keswick Quarry – Traffic Impact Assessment October 2016. Barnson.

Drawings



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TS09



AT WHEELERS LANE AND ARGYLE AVENUE INTERSECTION DATE: 27/06/2017 REF: 114135_15D_TS01-TS09.dwg



AT WHEELERS LANE AND AZURE AVENUE INTERSECTION DATE: 27/06/2017 REF: 114135_15D_TS01-TS09.dwg









DRAWING TS07 INTERSECTION TURNING MOVEMENTS AT BOUNDARY ROAD AND SHERATON DATE: 27/06/2017 REF: 114135_15D_TS01-TS09.dwg





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					ENGINEERING/ SURVEYING APPROVAL		SJH	29/06/17		SOUTHLAKES ESTATE EXTENSION PROPOSED RESIDENTIAL SUBDIVISION	dubbo@geolyse.com Dut www.geolyse.com Fav	P.O. BOX 1842 DUBBO, NSW 283 Ph. (02) 6887 450 Fax: (02) 6887 459

Plates





Plate 1: Wheelers Lane southbound approaching the intersection with Boundary Road



Plate 2: Intersection of Wheelers Lane and Boundary Road





Plate 3: Intersection of Wheelers Lane and Boundary Road



Plate 4: Boundary Road westbound





Plate 5: Boundary Road eastbound



Plate 6: Left turn lane from Wheelers Lane into Boundary Road





Plate 7: Intersection of Wheelers Lane and Magnolia Boulevard



Plate 8: Intersection of Wheelers Lane and Southlakes Parade





Plate 9: Intersection of Wheelers Lane and Azure Avenue



Plate 10: Service road parallel to Wheelers Lane





Plate 11: Intersection of Wheelers Lane and Holmwood Drive



Plate 12: Wheelers Lane southbound at the approach to the intersection with Shindys Road





Plate 13: Intersection of Wheelers Lane and Argyle Avenue



Plate 14: Intersection of Wheelers Lane and Hennessy Drive





Plate 15: Hennessy Drive east of Wheelers Lane



Plate 16: Hennessy Drive east at intersection with Wheelers Lane



Plate 17: Hennessy Drive westbound



Plate 18: Roundabout at the intersection of Azure Avenue and Southlakes Parade





Plate 19: Bridge over the creek line on Azure Avenue



Plate 20: Typical road carriageway in Azure Avenue





Plate 21: Typical road carriageway in Argyle Avenue



Plate 22: Bridge ov

Bridge over the creek line in Argyle Avenue





Plate 23: Sheraton Road at future intersection with Boundary Road



Plate 24: Sheraton Road northbound





Plate 25: Sheraton Road looking south over the Ringlands site.



Plate 26: Sheraton Road northbound approaching dual carriageway.




Plate 27: Sheraton Road dual carriageway northbound.



Plate 28: Sheraton Road dual carriageway southbound.





Plate 29: Sheraton Road northbound on approach to the Mitchell Highway roundabout.



Plate 30: Sheraton Road and Mitchell Highway roundabout.

Appendix A SIDRA MODELLING RESULTS

SITE LAYOUT

▽ Site: 1 [Post Development - 27 JUNE 2017]

WHEELERS LANE - ARGYLE AVE INTERSECTION Giveway / Yield (Two-Way)



INPUT VOLUMES

Vehicles and pedestrians per 60 minutes

∇ Site: 1 [Post Development - 27 JUNE 2017]

WHEELERS LANE - ARGYLE AVE INTERSECTION Giveway / Yield (Two-Way)

Volume Display Method: Total and %







	All MCs	Light Vehicles (LV)	Heavy Vehicles (HV)
S: Wheelers Lane South	133	132	1
E: Argyle Ave	168	166	2
N: Wheelers Lane North	235	233	2
Total	536	531	5

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LANE LEVEL OF SERVICE

Lane Level of Service

V Site: 1 [Post Development - 27 JUNE 2017]

WHEELERS LANE - ARGYLE AVE INTERSECTION Giveway / Yield (Two-Way)

All Movement Classes

	South	East	North	Intersection
LOS	NA	А	NA	NA



Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

DELAY (CONTROL)

Average control delay per vehicle, or average pedestrian delay (seconds)

V Site: 1 [Post Development - 27 JUNE 2017]

WHEELERS LANE - ARGYLE AVE INTERSECTION Giveway / Yield (Two-Way)

All Movement Classes

	South	East	North	Intersection
Delay (Control)	1.8	6.2	3.2	3.8
LOS	NA	А	NA	NA





LOS A	LOS B	LOS C	LOS D	LOS E	LOS F
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Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

QUEUE DISTANCE (%ILE)

Largest 95% Back of Queue Distance for any lane used by vehicle movement (metres)

V Site: 1 [Post Development - 27 JUNE 2017]

WHEELERS LANE - ARGYLE AVE INTERSECTION Giveway / Yield (Two-Way)

All Movement Classes

	South	East	North	Intersection
Vehicle Queue (%ile)	2	5	0	5



Wheelers Lane North



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SITE LAYOUT

♥ Site: 1 [Post Development -27 JUNE 2017]

WHEELERS LANE - AZURE AVE INTERSECTION Giveway / Yield (Two-Way)



INPUT VOLUMES

Vehicles and pedestrians per 60 minutes

∇ Site: 1 [Post Development -27 JUNE 2017]

WHEELERS LANE - AZURE AVE INTERSECTION Giveway / Yield (Two-Way)

Volume Display Method: Total and %







	All MCs	Light Vehicles (LV)	Heavy Vehicles (HV)
S: Wheelers Lane South	224	222	2
E: Azure Ave	259	256	3
N: Wheelers Lane North	395	391	4
Total	878	869	9

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LANE LEVEL OF SERVICE

Lane Level of Service

V Site: 1 [Post Development -27 JUNE 2017]

WHEELERS LANE - AZURE AVE INTERSECTION Giveway / Yield (Two-Way)

All Movement Classes

	South	East	North	Intersection
LOS	NA	А	NA	NA



Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

DELAY (CONTROL)

Average control delay per vehicle, or average pedestrian delay (seconds)

V Site: 1 [Post Development -27 JUNE 2017]

WHEELERS LANE - AZURE AVE INTERSECTION Giveway / Yield (Two-Way)

All Movement Classes

	South	East	North	Intersection
Delay (Control)	1.8	8.8	3.0	4.4
LOS	NA	А	NA	NA





LOSA	LOS B	LOS C	LOS D	LOS E	LOS F

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

QUEUE DISTANCE (%ILE)

Largest 95% Back of Queue Distance for any lane used by vehicle movement (metres)

V Site: 1 [Post Development -27 JUNE 2017]

WHEELERS LANE - AZURE AVE INTERSECTION Giveway / Yield (Two-Way)

All Movement Classes

	South	East	North	Intersection
Vehicle Queue (%ile)	3	13	0	13



Wheelers Lane North



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SITE LAYOUT

♥ Site: 1 [Post Development - 27 JUNE 2017]

BOUNDARY ROAD - SITE ACCESS ROAD INTERSECTION Giveway / Yield (Two-Way)



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INPUT VOLUMES

Vehicles and pedestrians per 60 minutes

▽ Site: 1 [Post Development - 27 JUNE 2017]

BOUNDARY ROAD - SITE ACCESS ROAD INTERSECTION Giveway / Yield (Two-Way)

Volume Display Method: Total and %



	All MCs	Light Vehicles (LV)	Heavy Vehicles (HV)
S: Site Access Rd	96	95	1
E: Boundary Road East	303	300	3
W: Boundary Road West	303	300	3
Total	702	695	7

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LANE LEVEL OF SERVICE

Lane Level of Service

V Site: 1 [Post Development - 27 JUNE 2017]

BOUNDARY ROAD - SITE ACCESS ROAD INTERSECTION Giveway / Yield (Two-Way)

	South	East	West	Intersection
OS	Δ	NA	NA	NA



SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

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DELAY (CONTROL)

Average control delay per vehicle, or average pedestrian delay (seconds)

V Site: 1 [Post Development - 27 JUNE 2017]

BOUNDARY ROAD - SITE ACCESS ROAD INTERSECTION Giveway / Yield (Two-Way)

All Movement Classes

	South	East	West	Intersection
Delay (Control)	7.2	0.9	1.3	1.9
LOS	A	NA	NA	NA



SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

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QUEUE DISTANCE (%ILE)

Largest 95% Back of Queue Distance for any lane used by vehicle movement (metres)

V Site: 1 [Post Development - 27 JUNE 2017]

BOUNDARY ROAD - SITE ACCESS ROAD INTERSECTION Giveway / Yield (Two-Way)

All Movement Classes

	South	East	West	Intersection
Vehicle Queue (%ile)	3	0	3	3



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SITE LAYOUT

Ø Site: [Post Development - 27 JUNE 2017]

BOUNDARY ROAD - SHERATON ROAD ROUNDABOUT Roundabout



INPUT VOLUMES

Vehicles and pedestrians per 60 minutes

𝒞 Site: [Post Development - 27 JUNE 2017]

BOUNDARY ROAD - SHERATON ROAD ROUNDABOUT Roundabout

Volume Display Method: Separate



	All MCs	Light Vehicles (LV)	Heavy Vehicles (HV)
S: Site Access Rd	130	130	0
E: Sheraton Rd East	23	8	15
N: Sheraton Rd North	478	468	10
W: Boundary Rd West	343	338	5
Total	974	944	30

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LANE LEVEL OF SERVICE

Lane Level of Service

Site: [Post Development - 27 JUNE 2017]

BOUNDARY ROAD - SHERATON ROAD ROUNDABOUT Roundabout



Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

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DELAY (CONTROL)

Average control delay per vehicle, or average pedestrian delay (seconds)

Site: [Post Development - 27 JUNE 2017]

BOUNDARY ROAD - SHERATON ROAD ROUNDABOUT Roundabout

All Movement Classes

	South	East	North	West	Intersection
Delay (Control)	6.6	11.5	7.2	5.3	6.5
LOS	A	А	A	A	A





Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

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QUEUE DISTANCE (%ILE)

Largest 95% Back of Queue Distance for any lane used by vehicle movement (metres)

𝒞 Site: [Post Development - 27 JUNE 2017]

BOUNDARY ROAD - SHERATON ROAD ROUNDABOUT Roundabout

All Movement Classes

	South	East	North	West	Intersection
Vehicle Queue (%ile)	5	2	14	13	14





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APPENDIX E – Groundwater and Salinity Study, prepared by Envirowest Pty Ltd

www.maasgroupproperties.com.au PO Box 404, Dubbo NSW 2830 sales@maasgroup.com.au 6881 9364 Sales Office: 28 Azure Avenue, Southlakes Estate, Dubbo NSW 2830

Groundwater and salinity study

Hillview Estate Lot 399 DP1199356 & Lot 503 DP1152321 Dubbo NSW



Ref: R5737s3 Date: 8 September 2016

Envirowest Consulting Pty Ltd ABN 18 103 955 246 • 9 Cameron Place, PO Box 8158, Orange NSW 2800 • Tel (02) 6361 4954 •

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Environmental Geotechnical Asbestos Services



Client:	Maas Group c/- Geolyse Pty Ltd PO Box 1842 Dubbo NSW 2830
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Checked by:	Leah Desborough BEnvSc Senior Environmental Scientist
Authorising Officer:	Greg Madafiglio PhD Senior Environmental Scientist
Report number:	R5737s3
Date:	8 September 2016

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Executive summary Background

A residential subdivision is proposed for *Hillview Estate* Lot 399 DP1199356 and Lot 503 DP1152321 Dubbo NSW. The subdivision design will include residential lots, access roads and parklands with ponds and waterways. A groundwater salinity assessment is required as part of the development process.

Objectives of the investigation

A site investigation was undertaken to assess the existing salinity conditions of the soil and groundwater and determine the impact of the development on groundwater.

Investigation

A soil and groundwater investigation was undertaken of the site. An initial investigation and desktop review was undertaken to collect existing information on groundwater on and around the site and the likelihood of salinity across the site. A detailed investigation was undertaken on 23 and 24 April and 7 and 8 May 2015.

The detailed site investigation included landscape description, soil investigation, laboratory analysis and groundwater investigation. The soil profile investigation was undertaken by constructing 69 boreholes up to 12m in depth. Representative soil samples were collected and analysed for pH, electrical conductivity, colour, dispersion, texture, chlorides and exchangeable sodium percentage.

The investigation results and proposed development were evaluated to identify impacts and recommend management outcomes to minimise impact on salinity occurrence. Soil moisture levels under land-use scenarios were modelled using rainfall data to estimate infiltration. Soil moisture and infiltration was simulated by the CLASS U3M-1D model with daily rainfall inputs from 1980 to 2014. Surface water flow containing sediment, nitrogen and phosphorus were modelled using Chafer (2003).

The impact of the development on water infiltration on the site was discussed and best practice procedures recommended which will minimise the effects on groundwater.

Conclusions

The site had a pasture grazing land-use. No bare areas resulting from sheet erosion or salinity were identified. The risk of erosion is low

Soils on the site comprised topsoil of dark brown to brown silty clay to sandy clay loam. Subsoils were yellowish red to reddish brown fine sandy clay loam, sandy clay, light to medium clay to silty sand with increasing weathered basalt cobble and weathered rock with depth. Basalt cobbles and weathered rock consisting of quartz sandstone and olive basalt were encountered from varying depths over the site between 0.2 to 12.0m. The Dubbo (LEP) maps indicate the site is located within a vulnerable groundwater area.

The majority of the site is located within the Old Dubbo Road Hydrogeological Landscape (HGL). Lithology of the Old Dubbo Road HGL consists of Napperby Formation comprising siltstone thinly interbedded with fine to medium grained lithic quartz and minor conglomerates. This has been overlaid by colluvial and alluvial weathered basalt. The Old Dubbo Road HGL is generally non-saline.

An area in the north eastern section of the site is located in the Dubbo Basalt HGL. Lithology of the Dubbo Basalt HGL consists of Cainozoic basalt comprising in situ Olivine rich alkali basalt with

some colluvial material and quartzite derived from the underlying sandstone and siltstone. The investigation identified saline strata in the Dubbo Basalt HGL.

A small hillock is located within the north eastern section. The hillock comprises rounded quartz sandstone with hematite cementing and is expected to be part of the Purlawaugh Formation which is mapped to the north east of the site. The sandstone provides a geological contrast with the overlaying basalt and may provide potential sites for salt discharges at the sandstone/basalt interface.

Subsoils in the majority of the site were classified as non-saline to slightly saline. These areas correspond with the Old Dubbo Road HGL. Saline subsoils were identified in two boreholes (BH20 and BH8) located in the north eastern section at depths greater than 1m. Soil electrical conductivity generally increased with depth in the north east section. The location of saline soil corresponds with the Dubbo Basalt HGL.

Infiltration of groundwater over most of the site will not result in mobilisation of salts. Groundwater was encountered in MW1 located in the north eastern section of the site from 8.12m. Electrical conductivity of groundwater taken from MW1 was 4.6dS/m which under the Dubbo City Urban Salinity Implementation Plan is classed as moderately saline. No groundwater was identified in MW2 and MW3 to a depth of 10m on light clay.

No groundwater discharge areas were identified on the site. Potable and stock supply bores have been constructed in the locality. Bores in the locality generally have water bearing zones greater than 10m in gravels and sands. The majority of Dubbo City Council monitoring bores have been dry since the start of monitoring. Highly saline groundwater has been identified in one groundwater monitoring bore located west of the site.

Modelling of soil moisture levels over the past 34 years indicated variations in infiltration occur with the amount of rainfall pre and post development. Most land uses do not contribute to groundwater recharge in the CLASS U3M model. Overwatering of lawn has potential to increase recharge. The amount of irrigated lawn will be small over the area and quantity will not be significant. Over the site the infiltration will be reduced in the development. Reduced soil moisture is a result of the increase in runoff due to impermeable areas (roads, roofs, driveways) and increase in deep rooted vegetation extracting soil moisture from depth. The establishment of trees in strategic areas will offset any additional infiltration from lawn over watering.

The risk of groundwater contamination from the proposed land-use is equal or lower to the current land-use. Nitrogen contributions will decrease as a result of smaller available areas for fertilisation and a decrease in animal waste; domestic pet waste will generally be disposed off-site. Phosphorous and sediment contributions will also decrease and reduce the impact on site. Washing of cars on permeable areas will not be a significant contributor to nutrient levels. Reuse of greywater will be small volumes of unregulated use or larger volumes which require specific conditions or use of regulation by Council. Conditions of use and regulation will ensure overwatering does not occur.

No impact on groundwater including contamination and changed groundwater levels is expected from the development if recommendations are adopted. The development will not impact on quantity or quality of both unconfined and confined aquifers.

Recommendations

An Electromagnetic survey of the north eastern section of the site will provide data on the location of the sandstone/basalt interface. The location of the geological interface should be used to incorporate the planting of deep rooted vegetation into the final design of the subdivision.

Planning and development controls are recommended to prevent mobilisation of salt in the soil and groundwater resulting in on and off-site impacts. Controls include:

- Planting of trees in areas of lithological/hydrological interfaces as identified by the electromagnetic (EM) survey to minimise mobilisation of salt in the soil by rising groundwater tables.
- Establishment of parkland areas with native species which do not require irrigation
- Plantings of deep rooted vegetation along roads
- Plantings of deep rooted vegetation throughout the parkland
- Piping of surface water off-site
- Stormwater retention basins lined with an impermeable layer
- Design road levels similar to natural soil levels to minimise excavations
- Earthworks comprising cut should be minimised
- Excavated material with elevated salinity should be backfilled, utilised as fill under roads or disposed to landfill

Contents

page

Exec	cutive summary	. 3
1.	Introduction	. 7
2.	Scope of work	. 7
З.	Site identification	. 7
4.	Proposed development	. 7
5.	Site condition and surrounding environment	. 8
6.	Groundwater and soil salinity investigation	. 9
7.	Results and discussion	14
8.	Soil and water impact assessment	25
9.	Management recommendation	30
10.	Conclusions	31
11.	Report limitations and intellectual property	34
12.	References	35
<u>-</u> .		20
Figu	res	30
Figu	re 2. Site plan	
Figu	re Z. Sile pidit re 3. Hydro geological Landscape plan	
Figu	re J. Frydro-geological Landscape plan re 4. Groundwater vulnerability map _ DECCW/	
Figu	re 5 Groundwater vulnerability map _ DCC	
Figu	re 6. Initial investigation locations	
Figu	re 7. Detailed investigation locations	
Figu	re 8. Lithology of the site	
Figu	re 9. Location of groundwater bores within 2km of the site	
Figu	re 10. Dubbo City Council Salinity Network	
Figu	re 11. Soil analysis results for salinity	
Figu	re 12. Soil moisture at 1m	
Figu	re 13. Soil moisture at 3m	
Figu	re 14. Photographs of the site	
i igu		
Арре	endices	51
Арре	endix 1. Nutrient and sediment modelling	
Арре	endix 2. Aggressive soils, extract from Australia Standards, AS 2870-2011, 2011	
Арре	endix 3. Details of registered bores within 1km of the site – NSW Department of Prima	ary
Indu	stries	
Арре	endix 4. Salinity results from the Dubbo City Council Salinity Network	
Арре	endix 5. Initial site investigation characteristics	
Арре	endix 6. Field and laboratory sheets	
Appe	endix 7. Reference methods for soil testing	
Appe	endix 8. ALS laboratory report ES1520581 and chain of custody form	

1. Introduction

A residential subdivision is proposed for *Hillview Estate* Lot 399 DP1199356 and Lot 503 DP1152321 Dubbo NSW. The subdivision will include residential lots, access roads and parklands with settling ponds and waterways. A groundwater and salinity assessment is required as part of the development process.

2. Scope of work

Envirowest Consulting Pty Ltd was commissioned by Geolyse on the behalf of the Maas Group, to undertake a groundwater investigation and salinity study of Lot 399 DP1199356 and Lot 503 DP1152321 Dubbo NSW. The objective was to assess the existing conditions and possible future impact of the proposed development on soil, groundwater and salinity.

Address	Lot 399 DP1199356 and Lot 503 DP1152321 Dubbo NSW		
Client c/ Geolyse PO Box 1842 Dubbo NSW 2830			
Deposited plans	Lot 399 DP1199356 and Lot 503 DP1152321		
Universal grid reference	UTM Zone 55H, E654135m, N6427637m		
Locality map	Figure 1		
Site plan	Figure 2		
Photographs	Figure 14		
Area	Approximately 136 hectares		
Dates of inspection and assessment	23 and 24 April and 7 and 8 May 2015		

3. Site identification

4. Proposed development

The proposed development is a residential subdivision. The subdivision design has not been finalised. The proposed lots will have hard surface areas comprising roofs and driveways where rainfall will run-off into stormwater pipes and permeable areas comprising lawns and gardens where less infiltration into the soil will occur. Roads, footpaths and a stormwater system will be constructed throughout the estate. The dwellings will be serviced by town sewer. The existing dams on the property will be remediated and a new drainage line and retention basins created to transfer stormwater off the estate to Eulomogo Creek.

5. Site condition and surrounding environment

5.1 Land-use

The current land-use is stock grazing on semi-improved pasture. The site is currently vacant.

5.2 Vegetation

The site has been cleared of native tree species. Eucalypts occur along the northern boundary and pepper tree, white cedar trees and casuarina trees have generally been planted as isolated species across the site. A small exotic tree nursery for landscaping on the adjoining subdivision. Pasture species are native grasses and legumes with weeds. The weed species include Paterson's curse, cat head, fleabane, clover, saffron thistle, couch grass, flatweed and khaki weed.

5.3 Topography

The site is predominantly located on a mid-slope. A basalt ridge occurs in the north western section. A hillock is located in the north eastern section. Aspect is predominantly south east and slopes are gently inclined and generally less than 6%. Elevation ranges between 268 and 289 metres above sea level. The lowest elevation occurs on the southern boundary where Eulomogo Creek traverses the site. No groundwater seepage or discharge areas were observed on the site.

5.4 Soils and geology

The majority of the site is located within the Bunglegumbie Soil Landscape. The north eastern section of the site is located within the Wongarbon Soil Landscape (Murphy *et al.* 1998).

Soil in the Bunglegumbie landscape consists of red podzolic soils, non-calcic brown soils and yellow podzolic soils. Soils typically comprise dark reddish brown sandy loam over a yellowish red light sandy clay loam. Soil in the Wongarbon Soil Landscape (Muphy *et al.* 1998) consists of Euchrozems and red and brown cracking clays.

Lithology of the majority of the site is Napperby Formation comprising siltstone thinly interbedded with fine-medium grained lithic quartz sandstone with minor conglomerate. Lithology of the north eastern section is Cainozoic Basalt comprising tholeiite, alkali basalt and alkali ultramafic (Colquhoun *et al.* 1997). The site inspections and borehole construction identified the hillock in the north eastern section comprised of rounded quartz sandstone with strong hematite cementing possibly reworked volcanic. The sandstone is expected to be part of the Purlawaugh Formation which has been mapped north east of the site. The hillock is expected to be an isolated plug that provides a geological contrast for groundwater movement.

Soils on the site comprised topsoil of dark brown to brown silty clay to sandy clay loam. Subsoils were yellowish red to reddish brown fine sandy clay loam, sandy clay, light to medium clay to silty sand with increasing weathered basalt cobble and weathered rock with depth. Basalt cobbles and weathered rock consisting of quartz sandstone and olive basalt were encountered from varying depths over the site between 0.2 to 12.0m.

5.5 Surface water

Two dams have been formed within the site and are fed by the natural slope of the site forming a shallow drainage line running north to south-south west. Contour banks formed across the site direct surface water flows into the drainage line. Surface water over the site predominantly flows south east and into the Eulomogo Creek.

The Eulomogo Creek empties into the Macquarie River approximately 1.1km west of the site.

5.6 Groundwater

The Australian Natural Resources Atlas identifies the site within the Upper Macquarie Alluvium Groundwater Management Unit. The management unit has an area of 414km² with approximately 17.95 GL consumed per year. Average salinity levels are greater than 1500mg/L.

Two bores are located on the site. The bores have been constructed to depths greater than 15m.

A search of the NSW DPI groundwater database located 71 bores within 2km of the site. These bores are predominantly located to the south and south west. A number of bores are licensed for monitoring and form part of the Dubbo City Council salinity network. The DCC monitoring bores are located in unconfined clay to sandy clays to depths of less than 15m. Other bores are licensed for domestic, stock and public/municipal supplies and have water bearing zones at depths greater than 15m.

Public/municipal bores and a domestic bore are located adjacent the Macquarie River. The groundwater in these bores is influence by flows from the Macquarie River.

6. Groundwater and soil salinity investigation

The groundwater and soil salinity investigation comprised a desktop study, field assessment and soil analysis. The desktop study included a review of soil landscape maps, hydro-geological landscapes and groundwater databases. Soil moisture modelling was also undertaken.

The field assessment included an initial site investigation and detailed profile descriptions and soil analysis in a grid pattern over the site. The soil and landscape information collected provided an adequate description of the physical processes on the site to enable salinity issues to be identified and managed. The frequency of tests undertaken was in accordance to the frequency in Table 1 of Lillicrap and McGhie (2002) for moderately intensive construction.

6.1 Soil landscape maps

Soil landscape data was reviewed for information regarding soil types in the locality, occurrence of salinity, erosion and sodic soils.

6.2 Hydro-geological landscapes

Dubbo City Council (2013c) has developed hydro-geological landscapes for the locality. Hydrogeological landscape data (Figure 3) was reviewed for information regarding the groundwater aquifer including lithology, aquifer type, recharge and discharge characteristics.

6.3 Groundwater

Shallow groundwater has been identified on the site in MW1 at a depth greater than 8m. The deep groundwater within the Upper Macquarie Alluvium Groundwater Management Unit is at a depth of greater than 15m in a confined aquifer.

An investigation of registered bores in the area was undertaken to determine the depth and salinity of the groundwater. Groundwater information was found from a review of the NSW Primary Industries website and Dubbo City Council Salinity Network.

The groundwater was divided into deep and shallow groundwater. Deep groundwater is located in river gravels and sands at depths greater than 15 metres. The shallow groundwater is expected to generally be unconfined in a local aquifer controlled by drainage lines and/or lithological contrasts within the site.

Water criteria for salinity are presented in Tables 1 and 2. The conversion from EC (dS/m) to total dissolved solids or TDS (mg/L) is undertaken by applying the conversion factor of 640 for an average concentration of salts present (Lillicrap and McGhie 2002).

Table	1 Drinking	water	criteria	for	salinity	(ADWG 2004)	١
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Criteria	EC (dS/m)	Total dissolved solids -Salinity (mg/L)
Good quality drinking water	0.78	500
Acceptable based on taste	0.78-1.56	500-1000
Unsatisfactory taste	1.56	Greater than 1000
Seawater	Greater than 55	-

Table 2a. Total dissolved solids of water for agricultural use (Reid 1990)

Class	Description	Total dissolved solids -Salinity
		(mg/L)
1	Low salinity	0-175
2	Medium salinity	175-500
3	High salinity	500-1500
4	Very high salinity	1500-3500
5	Extremely high salinity	>3500

Table 2b Guidelines on salinity class determination (Dubbo City Council Urban Salinity) Plan)

Electrical conductivity (dS/m)	Salinity class
>15	Extreme
6-15	High
2-6	Moderate
0-2	Low

6.4 DLWC groundwater vulnerability mapping

The NSW Department of Land and Water Conservation have undertaken groundwater vulnerability mapping of the Dubbo locality (Piscope and Dwyer 2001). The vulnerability mapping utilises the DRASTIC technique which is a composite description of all the major geologic and hydro-geologic factors that affect and control groundwater movement into, through and out of an area. It involves the overlaying of various hydro-geological settings via a Geographical Information System (GIS). Each hydro-geological setting describes topography, soil type, bedrock type, estimate of rainfall and net recharge depth to watertable (DTWT), aquifer yield, relative conductivity and any particular features associated with the setting that are available. Groundwater vulnerability is classified into high, moderately high, moderate, low moderate and low (Figure 4).

6.5 Dubbo LEP (2011) groundwater vulnerability map

The Dubbo LEP (2011) Natural Resource – Groundwater vulnerability map describes the areas within the Dubbo City Council area where groundwater is considered vulnerable to depletion and contamination as a result of development (Figure 5).

Under the Dubbo City Urban Salinity Implementation plan the site is located in the Old Dubbo Road and Dubbo Basalt hydro-geological landscape which have been classed respectively with an overall salinity hazard of low to moderate.

6.6 Hydraulic model

An unsaturated moisture movement model is appropriate to evaluate the hydraulic flows of the existing and proposed land-use. The moisture model selected was CLASS U3M-1D as released by CRC Catchment Hydrology (Vaze *et al.* 2004).

6.6.1 Inputs

The model inputs are daily rainfall and evaporation. The model used climate data from 1980 to 2014 (SILO) under pre and post land-use scenarios (Table 3) to predict soil moisture and excess soil moisture. The pre development land-use of the development area is comprised of improved pasture. The post development land-use comprised residential lots, roadways and vegetated areas in road reserves. The vegetated areas will be planted to trees as offset for possible over irrigation of lawns.

The model input data was rainfall and evaporation for the inferred climate at Hennessy Road as obtained from SILO. Six land-use scenarios (Table 3) were applied across the time period for pre and post development scenarios in the land-use areas.

Land-use	Pre development <i>(</i> ha)	Post development (ha)	Rainfall parameter
Improved grazing	131	0	100% Rainfall
Urban (Lawns)	0	23	Evaporation plus 1mm/day
Road verges	0	12.6	Rainfall (allowance for road runoff)
Roads	0	25	Run off site
Urban-open space (parkland)	0	58	100% Rainfall in permeable areas
Tree areas	0	12.4	Rainfall plus 1mm/day (allowance for Iawn overwatering)
Total	131	131	

Table 3. Land-use in the soil moisture model

Other parameters applied in the model are soil type and depth and default values (Table 4).

Table 4. Model paramet	iers
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Parameter	Data/description
Soil profile	Layer 1 1600-3000
	Layer 2 900-1600
	Layer 3 300-900
	Layer 4 0-300 (topsoil)
Land-use	Pasture, lawn, verges – pasture, default climate
Soil hydraulic parameters	Layer 1 Sandy clay
	Layer 2 Light day
	Layer 3 Sandy clay
	Layer 4 Silty clay loam (topsoil)
	CLASS U3M-1D
Time step	Default
Root distribution	Default

6.6.2 Outputs

The outputs from the model are soil moisture and excess soil moisture by layer in 10 cm increments. Excess soil moisture is the lateral drainage component and is the difference between available moisture and saturated soil moisture.

6.6.3 Nutrient model

A simulation model was developed to predict surface runoff, sediment loss, nitrogen and phosphorus export, pre and post development. Land-use of the site was divided into pasture, sealed roads, residential and road verges. The area for each land-use pre and post development was estimated from site walkover, topographical map, subdivision plans and an aerial photograph. The site was classified into the different land-use areas pre and post development. These areas are summarised in Table 5.

Land-use areas (ha)	Pre	Post
Improved grazing	110	0
Disturbed landscapes	19.9	0
Remediated gullies	0	0
Roads (earth)	0.5	0
Roads (sealed)	0	25
Lawns (irrigated)	0	23
Urban	0	58
Road verges	0	12.6
Trees	0	12.4
Total	131	131

Table 5. Land use areas	s for nutrient model
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Land-use on site are as follows;

- *Improved grazing* is the main pre-development land-use. Superphosphate is regularly applied and clovers and other pasture species sown to improve pasture. The pasture area is assumed to be improved for sediment loss and feed.
- *Disturbed landscapes* refers to the drainage line that has been established with addition of contour banks and minimal earthworks.
- *Remediated gullies* is the section along the drainage line which will be improved post development.
- *Roads (earth)* is a calculation of farm tracks and roads that have been created on site pre development.
- Roads (sealed) is a calculation of culverted roads that will be on-site post development.
- *Lawns* were calculated estimating average lot size. Building lots were estimated to have an area of 0.06 ha, it was therefore estimated that on average there could potentially be 0.02 ha of lawn.
- Urban refers to community areas or parks.
- Road verges were estimated to be approximately 5m wide.
- Trees refers to vegetation cover over the site which is recommended.

Sediment, nitrogen and phosphorus export was estimated for low, median and high scenarios for each land-use class as detailed in Appendix 1 (Chafer 2003).
An initial site investigation was conducted by collecting information on vegetation, slope, bare areas and other indicators of salinity at 184 locations across the site (Figure 6). This density is in accordance with the recommendations by Lillicrap and McGhie (2002).

6.8 Detailed profile descriptions and laboratory analysis

Sixty-nine boreholes were constructed with an EVH truck mounted hydraulic drilling rig with solid auger on 23 and 24 April and 7 and 8 May 2015 to provide information on the soil profiles and enable sampling. The boreholes were constructed at various local elevations on the site (Figure 7). Deep boreholes were constructed along the drainage line to a depth of 12m (MW1) and 10m (MW2 and MW3). The deep boreholes were located to intercept shallow groundwater. A 50mm diameter monitoring well was installed in BH20 (MW1), BH44 (MW2) and BH56 (MW3). Five boreholes were drilled up to a depth of 9 metres. Soil samples were collected from eight boreholes at 100mm, 200mm, 300mm, 500mm, and 500mm intervals to the depth of the borehole and are expected to provide an adequate description of subsoil salinity conditions.

The soil profile was described for colour, texture and moisture. Representative soil samples were analysed for pH, electrical conductivity and dispersion. Two representative topsoil and two representative subsoil samples were analysed for chlorides and exchangeable sodium percentage.

Soil electrical conductivity (EC) results of the 1:5 (soil:water suspension) were converted to saturated extracts (ECe). EC values are converted to ECe by using a multiplier factor (Charman and Murphy, 1991), which is dependent on the soil texture (Table 6). Saline soils are defined as those with an electrical conductivity (ECe) greater than 4 dS/m (Charman and Murphy, 2001). Soil salinity ratings and effects on plant growth are presented in Table 7.

Table 9: Loe texture based conversion factors (onalman and map)	19 2001)
Soil texture	Conversion factor
Loamy sand, clayey sand, sand	23
Sandy loam, fine sandy loam, light sandy clay loam	14
Loam, loam fine sandy, silt loam, sandy clay loam	9.5
Clay loam, silty clay loam, fine sandy clay loam	8.6
Sandy clay, silty clay, light clay	7.5
Light medium clay, medium clay, heavy clay	5.8

Table 6. ECe texture based conversion factors (Charman and Murphy 2001)

Table 7.	Soil	salinity	ratings	based	on	FCe	readings
	001	Summy	ruungo	bubbu	UI1	200	rouungo

Table II dell'dalling raange s		3-
Salinity rating	ECe (dS/m)*	Effects on Plants
Non saline (NS)	0-2	Salinity effects negligible
Slightly saline (SS)	2-4	Very salt sensitive plant growth restricted
Moderately saline (MS)	4-8	Salt sensitive plant growth restricted
Highly saline (HS)	8-16	Only salt tolerant plants unaffected
Extremely saline (ES)	>16	Only extremely tolerant plants unaffected

*ECe - Electrical conductivity of a saturated extract

Soil with ECe below 2 dS/m will have negligible effects on plant growth and soil stability. Soil with ECe of between 2 and 4 dS/m may restrict very salt sensitive plant growth. Soil with ECe between 4 and 8 dS/m will restrict the growth of salt sensitive plants.

Samples were analysed for dispersion using the Emerson aggregate test. Table 8 details the eight dispersion classes.

Table 8. Emerson dispersion classes

Class	Description
1	Highly dispersive (slakes, complete dispersion)
2	Moderately dispersive, slakes, some dispersion
3	Slightly dispersive, slakes, some dispersion after remoulding
4	Non-dispersive, slakes, carbonate or gypsum present
5	Non-dispersive, slakes, dispersion in shaken suspension
6	Non-dispersive, slakes, flocculates in shaken suspension
7	Non-dispersive, no slaking, swells in water
8	Non-dispersive, no slaking, does not swell in water

Representative soil samples were collected from the topsoil and subsoil and analysed for chloride and sodicity. Chloride criteria for corrosiveness to building material are presented in Table 9 and are an extract from AS2159-1995 Piling – design and installation.

Aggressive soils criteria for salinity and sulfate impacts on building structures are presented in Australia Standard AS2870-2011 (Appendix 2). The AS2870 standard also describes requirements to mitigate salinity and sulphate on footings.

Table 9. Chloride corrosiveness to building materials (AS2159-1995 Piling – design and installation)

C	oncrete piles	Steel piles			
Chlorides in water	Soil conditions for low	Chlorides in water Soil conditions for	low		
(mg/kg)	permeability soils or all soils	s (mg/kg) permeability soils or all			
	above groundwater	above groundwater			
<2,000	Non-aggressive	<1,000 Non-aggressive			
2,000-6,000	Non-aggressive	1,000-10,000 Non-aggressive			
6,000-12,000	Mild	10,000-20,000 Mild			
12,000-30,000	Moderate	>20,000 Moderate			
>30,000	Severe				

Sodicity is expressed as a percentage of the cation exchange capacity or exchangeable sodium percentage (ESP). Ranking of sodicity is presented in Table 10 (Lillicrap and McGhie 2002). An ESP of less than 5% indicates a non-sodic soil, ESP of between 5 and 15% indicates a sodic soil and an ESP of greater than 15% indicates a highly sodic soil.

 Table 10. Ranking of exchangeable sodium percentage

J J	
Exchangeable sodium percentage	Ranking
<5%	Non-sodic
5-15%	Sodic
>15%	Highly sodic

7. Results and discussion

7.1 Soil landscape maps

The majority of the site is located within the Bunglegumbie Soil Landscape. The north eastern section of the site is located within the Wongarbon Soil Landscape (Murphy *et al.* 1998).

Soil in the Bunglegumbie landscape consists of red podzolic soils, non-calcic brown soils and yellow podzolic soils. Parent material is relatively old and weathered alluvium. Soil salinity problems are absent. Erosion hazard is low on slopes less than 3%.

Soil in the Wongarbon landscape consists of euchrozems and red and brown cracking clays. Parent material is basalt. Soil salinity occurs as isolated areas along drainage lines, depression and footslopes. Soils are slightly to moderately erodible with erosion hazard increasing on slopes of 3 to 8% when cultivated or surface cover is low.

7.2 Hydro-geological landscapes

The majority of the site is located within the Old Dubbo Road Hydro-geological Landscape with the north eastern section with the Dubbo Basalt Hydro-geological Landscape (DCC2013c). The site and associated hydro-geological landscapes are depicted in Figure 3.

Lithology of the Old Dubbo Road Hydro-geological Landscape consists of Napperby Formation comprising siltstone thinly interbedded with fine to medium grained lithic quartz and minor conglomerates. This is overlaid by colluvial and alluvial weathered basalt. The Old Dubbo Road HGL is generally non-saline. Small areas of salinity which do occur are transient as water flows remove salt that may accumulate from adjacent hydro-geological landscapes. Groundwater flow is unconfined to semi-confined flows in consolidate rock and unconfined flow in unconsolidated colluvium. Water electrical conductivity is low.

An area in the north eastern section of the site is located in the Dubbo Basalt Hydro-geological Landscape. Lithology of the Dubbo Basalt Hydro-geological Landscape consists of Cainozoic basalt consisting of in situ Olivine rich alkali basalt with some colluvial material and quartzite derived from the underlying sandstone and siltstone. Soil salinity is isolated at areas along drainage lines, at the intersection with the Purlewaugh formation depressions and footslopes. Saline soils also occur due to local perching of the water table. Groundwater flow is unconfined to semi-confined in consolidated fractured rock. Groundwater salinity is fresh to marginal.

A sandstone horizon was identified as a hillock within the Dubbo Basalt Hydro-geological Landscape during the site inspection and borehole construction (Figure 8). The sandstone comprised rounded quartz sandstone with a strong hematite cementing possible reworked volcanic. Purlawaugh Formation comprising siltstone, mudstone, sandstone and ironstone has been mapped north east of the site. The lithology of the hillock is expected to be part of the Purlawaugh Formation. The sandstone unit and mapped basalt provides a geological contrast for groundwater movement.

7.3 Groundwater

7.3.1 OEH registered bores

Seventy one registered water abstraction bores were identified within a 2km radius of the site on the NSW Government Department of Primary Industries website (2015) (Figure 8). Data known about each bore from the Department of Primary Industries website is summarised in Appendix 3. Bores are predominantly located to the south and south west of the site.

Eighteen bores form part of the Dubbo City Council salinity network and as such have been constructed to intersect shallow unconfined groundwater. The characteristics of these bores are discussed in Section 7.4. The remainder of the bores are licenced for domestic, stock, public/municipal and monitoring.

Water-bearing zones (WBZ's) and standing water levels were recorded for approximately 45 bores. The Department of Primary Industries website shows that SWL's and WBZ's in bores (for which data was recorded) were at depths greater than 10m (Appendix 3 and Figure 9). The water bearing zones are located in gravel, sand, silt and clay.

A salinity description was recorded for fourteen bores. All were considered to contain non-saline water, with descriptions of 'good', '0-500ppm' and 'fresh'. '

7.3.2 Dubbo City Council salinity network

Eight Dubbo City Council (DCC) monitoring bores are located at less than 1km from the site and ten are located between 1 and 2km west to north of the site (Figure 10 and Appendix 4). Bore depths ranged from 3m to 15m with water bearing zones located in unconfined regolith comprising clay. The majority of bores have been dry since monitoring begun in March 2005. Bores containing water at the time of sampling had low to extremely high levels of total dissolved solids with levels ranging between 192mg/L to 16128mg/L (Appendix 4).

The closest bores to the site are identified as DCC19, DCC20 and DCC115 (Figure 10). DCC19 is located on the north eastern boundary corner of the site and has a depth of 3m. DCC20 is located on the south west boundary of the site and has a depth of 15m. DCC115 is located to the north west of the site and has a depth of 9m. DCC19 and DCC20 have generally been dry or too shallow to bail since monitoring began in March 2005 indicating groundwater in the north eastern section of the site is greater than 3m and in the south western section greater than 15m. Standing water levels in DCC115 has ranged from 5.4m to dry. Electrical conductivity was less than 0.5dS/m with total dissolved solids at less than 320mg/L. DCC115 has not been monitored since February 2012 due to access restrictions.

Standing water levels in Dubbo City Council (DCC) monitoring bores within 2km of the site in October to December 2014 ranged between 1.41m and 8.54m and more than half were dry (Tables 11 and Figure 10). Electrical conductivity of groundwater ranged from moderate (DCC64, November 2014) to very high (DCC62, December 2014).

7.3.3 On-site groundwater

Groundwater was encountered in MW1 at a depth of 8.6 metres in extremely weathered rock. The standing water level was 8.12m and total electrical conductivity of 4.64 dS/m (2,969mg/L) which is considered moderately saline.

MW1 was located in the northern section of the site (Figure 7) adjacent the shallow drainage line which flows through the site north to south- south west. It is expected to be near the lithological contact between the medium-grained lithic sandstone and tertiary basalt.

MW2 was located in the south western section of the site within the shallow drainage line. Groundwater was not encountered to the drilling depth of 10m. MW3 was located in the central section of the site (Figure 7). Groundwater was not encountered to the drilling depth of 10m.

Unconfined groundwater may occur along the drainage line following periods of high rainfall.

7.4 Groundwater vulnerability

The Department of Land and Water Conservation (Piscope and Dwyer 2001) identifies the majority of the site as having a moderately high groundwater vulnerability rating (Figure 4). The southern section of the site and land to the south and along the Macquarie River have a high groundwater vulnerability rating. Land adjacent the north eastern boundary has a low groundwater vulnerability rating.

7.5 Dubbo LEP (2011) groundwater vulnerability map

The Dubbo LEP (2011) identifies the site in a moderately high groundwater vulnerability area (Figure 5). Areas to the south west and along the Macquarie River have a high groundwater vulnerability rating. No groundwater vulnerability rating applies to land to the north east.

Sampling location (see Figure 10)	Depth (m)	Date sampled	Standing water level (m)	EC dS/m	Total dissolved solids (EC x 640) mg/L
DCC18	15	Oct-14	Dry	-	_
		Nov-14	4.87	1.57	1,004
		Dec-14	4.51	1.70	1,088
DCC19	3	Oct-14	Dry	-	-
		Nov-14	2.85	TSTB	-
		Dec-14	2.80	TSTB	-
DCC20	15	Oct-14	Dry	-	-
		Nov-14	Dry	-	-
		Dec-14	Drv	-	_
DCC21	15	Oct-14	Drv	-	_
		Nov-14	Drv	-	-
		Dec-14	Dry	-	_
DCC42	2	Oct-14	Dry	_	_
00012	2	Nov-14	Dry	_	_
			Dry	_	_
	6	Oct-14	Dry		_
00044	0	Nov 14	Dry	-	-
		NOV-14	Diy Dir	-	-
DOCIE	0	Dec-14 Opt 14	Dry	-	-
00040	9	Out-14		-	-
		INOV-14	7.90	1.30	004
00010	45	Dec-14	7.90	1.34	808
DCC49	15	Oct-14	Dry	-	-
		NOV-14	Dry	-	-
DOO 50		Dec-14	Dry	-	-
DCC53	9	Oct-14	Dry	-	-
		Nov-14	8.84	TSTB	-
		Dec-14	8.54	1.87	1,197
DCC58	15	Oct-14	Dry	-	-
		Nov-14	Dry	-	-
		Dec-14	Dry	-	-
DCC59	3	Oct-14	Dry	-	-
		Nov-14	1.41	0.73	467
		Dec-14	1.36	0.60	384
DCC62	9	Oct-14	2.70	4.63	2,963
		Nov-14	2.45	4.81	3,078
		Dec-14	2.34	4.89	3,130
DCC64	3	Oct-14	Drv	-	-
		Nov-14	1.84	0.49	313
		Dec-14	1 73	0.54	345
DCC87	6	Oct-14	Drv	-	-
	-	Nov-14	Dry	_	_
		Dec-14	Dry	-	_
DCC111	6	Oct-14	Dry	_	_
bootti	0	Nov-14	Dry	_	_
		Dog 14	Dny	-	-
	0	Det-14 Opt 14	Diy No occore	-	-
	Э	Out-14 Nov 14	NU autess	-	-
		NOV-14 Dec 44	INO access	-	-
000140	2.5	Dec-14	UFY	-	-
DCC116	3.5	Oct-14	No access	-	-
		Nov-14	No access	-	-
		Dec-14	Dry	-	-
DCC124	15	Oct-14	Dry	-	-
		Nov-14	Dry	-	-
		Dec-14	Drv	-	-

 Table 11. Dubbo City Council salinity network

TSTB- too shallow to bail

7.6 Initial site investigation

The initial site investigation was conducted on an 80m x 80m grid across the site (Figure 6 and Appendix 5).

The site has a historical land-use of grazing. Minor amounts of cropping are expected to have occurred on the mid to lower slopes of the site.

Scattered eucalypts occur along the northern boundary of the site on the neighbouring property. Isolated pepper tree, white cedar and casuarina are located in the paddocks. A small tree nursery providing trees for landscaping on the adjoining subdivision has been established in the central western section of the site. Pasture species are exotic grasses and legumes with weeds. The weed species include Paterson's curse, cat head, fleabane, clover, saffron thistle, couch grass, flatweed and khaki weed. Vegetation cover was greater than 80% across the majority of the site. Bare areas were due to farm tracks and desiccation resulting from low rainfalls.

The majority of the site was very gently inclined with slopes ranging from 0 to 2%. Slope increased to 8% in the north eastern section.

Many basalt cobbles were identified in the north eastern and eastern sections of the site.

No indicators of salinity were observed.

7.7 Soil characteristics

Boreholes were constructed to depths of 1.5m, 3m 10m or drill refusal. Drill refusal due to rock at depths less than 1,000mm was encountered in several boreholes constructed in the north western and north eastern sections of the site. Borelogs are presented in Appendix 6.

7.7.1 Texture and colour

Soils on the site comprised topsoil of dark brown to brown silty clay to sandy clay loam (Table 12). Subsoils were yellowish red to reddish brown fine sandy clay loam, sandy clay, light to medium clay to silty sand with increasing weathered basalt cobble and weathered rock with depth. Basalt cobbles and weathered rock consisting of quartz sandstone in the north east and basalt in the west were encountered from varying depths over the site between 0.2 to 12.0m (Appendix 6).

The soil was generally dry to moist throughout the profile. Wet soil was identified in Borehole 20 from 3.5 to 4.0m. No free water was identified in any borehole.

7.7.2 Salinity (electrical conductivity)

All topsoils samples were determined to be non-saline. Subsoils in the majority of the site were classified as non-saline (BH33, BH44, BH53, BH59 and BH62) with electrical conductivity of less than 1dS/m (Figure 11).

The electrical conductivity of subsoils samples collected between 6.5m and 9.5m in BH56 ranged from 2.03 to 3.91dS/m and are considered slightly saline. The remainder of the samples collected from BH56 were non-saline.

Subsoils samples collected from two boreholes (BH8 and BH20) constructed in the north eastern section of the site contained moderately to highly saline subsoils from 1m and highly to extremely saline subsoils from 2.5m (Table 12).

Table 12. Soil colour, textur	e, pH, EC and ECe	(detailed profile	descriptions)
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Borehole No -					F0-	Emerson
deptn (mm) (monitoring	Soil colour	Soil texture	рН	EC1:5	ECe (dS/m)	aggregate
(monitoring well)					(uoiiii)	1631
20-100 (MW1)	Dark brown	Silty clay loam	4.51	0.15	1.29	2
20-200 (MW1)	Dark brown	Siltý claý	4.79	0.10	0.75	2
20-300 (MW1)	Dark brown	Sandy clay	5.45	0.04	0.30	2
20-500 (MW1)	Dark brown	Sandy clay	6.26	0.06	0.45	1
20-1000 (MW1)	Dark brown	Sandy clay	7.67	0.13	0.98	1
20-1500 (MW1)	Dark brownish red	Sandy clay with gravel	7.91	0.36	2.70	1
20-2000 (MW1)	Light brownish grey	Light clay	8.34	0.32	2.40	2
20-2500 (MW1)	Greyish brown	Light clay	7.98	0.93	6.98	5
20-3000 (MW1)	Greyish brown	Light clay	8.19	0.95	7.13	2
20-3500 (MW1)	Brown	Sandy clay	8.30	0.90	6.75	2
20-4000 (MW1)	Greyish brown	Sandy clay with grave	8.59	1.00	7.50	2
20-4500 (MW1)	Light greyish brown	Sandy clay with gravel	8.65	1.03	7.73	2
20-5000 (MW1)	Pale brown	Clayey sand	8.97	1.02	23.5	2
20-5500 (MW1)	Pale brown	Clayey sand	8.92	0.95	21.8	2
20-6000 (MW1)	Pale brown	Clayey sand	9.05	0.72	16.6	2
20-6500(MW1)	Pale brown	Clayey sand	9.02	0.65	14.9	2
20-7000 (MW1)	Pale yellowish grey	Clayey sand	9.13	0.53	12.2	2
20-7500 (MW1)	Pale yellowish grey	Clayey sand	9.04	0.59	13.0	2
20-8000 (MWVI)	Pale yellowish grey	Clayey sand	9.14	0.50	11.0 11.2	2
20-6300 (MWV1)	Pale yellowish grey	Clayey sand	9.11	0.49	11.3	2
20-9000 (MWVT)	Light grey	Clayey sand	0.90	0.02	0.40	2
20-9500 (IVIVIT) 20.10000 (MIM/1)	Light grov	Silty clay	0.01	0.29	Z. 10 2.10	2
20-10000 (101001)	Light grey	Siny Gay	0.04	0.20	2.10	۷
44-100 (MW2)	Dark brown	Sandy clay loam	5.02	0.10	0.95	3
44-200 (MW2)	Dark brown	Sandy clay loam	6.58	0.03	0.29	3
44-300 (MW2)	Reddish brown	Sandy clay	6.24	0.04	0.30	3
44-500 (MW2)	Yellowish red	Fine sandy clay loam	6.60	0.05	0.43	3
44-1000 (MW2)	Yellowish red	Fine sandy clay loam	7.25	0.07	0.60	5
44-1500 (MW2)	Yellowish red	Fine sandy clay loam	7.10	0.07	0.60	5
44-2000 (MW2)	Yellowish red	Fine sandy clay loam	7.36	0.06	0.52	3
44-2500 (MW2)	Yellowish brown	Light clay	7.27	0.04	0.30	2
44-3000 (MW2)	Yellowish brown	Sandy clay with gravel	7.08	0.04	0.30	2
44-3500 (MW2)	Yellowish brown	Sandy clay	7.22	0.05	0.38	2
44-4000 (MW2)	Yellowish brown	Sandy clay	6.99	0.04	0.30	2
44-4500 (MW2)	Yellowish brown	Sandy clay	6.66	0.06	0.45	2
44-5000 (MVV2)	Yellowish brown	Sandy clay	6.48	0.07	0.52	2
44-5500 (MVV2)	Yellowish brown	Sandy clay with gravel	6.53	0.08	0.60	2
44-6000 (MVV2)	Brown	Sandy clay	6.55	0.07	0.52	2
44-6500 (MWZ)	Brown	Sandy clay	6.41	0.08	0.60	2
44-7000 (MWZ)	Yellowish brown	Sandy clay	7.10	0.08	0.00	1
44-7300 (MVVZ)	reliowish brown	Light medium day	0.74	0.07	0.41	1
44-0000 (IVIVVZ)	Crovich brown	Light medium day with	0.07	0.07	0.41	2
44-0000 (191992)	Greyisti brown	dravel	0.00	0.00	0.40	3
44-9000 (MW2)	Yellowish brown	Light medium clay with	6.70	0.09	0.52	3
		gravel	0.10	0.00	0.02	Ū
44-9500 (MW2)	Brown	Light clay with gravel	6.95	0.10	0.75	1
44-10000 (MW2)	Brown	Light clay with gravel	6.93	0.08	0.60	1
CO 400 (1950)	Deale ha	Citerater		0.07	0.00	
56-100 (MW3)	Dark brown	Sility clay loam	6.62	0.07	0.60	2
00-200 (IMW3)	Dark prown	Sinty day toam Sondy alog	0.4ð	0.04 0.05	0.30	2
56-500 (MW3)	Dark prowite Vollowich rod	Sandy day	0.01	0.00	0.30	∠ 1
56 1000 (IVIVIS)	Vellowish red	Sanuy ulay Sandu day	0.04	0.02	0.10	1
56-1500 (MM3)	Yellowish red	Sandy day	0.90 7 <u>4</u> 2	0.04	0.00	1
	1 OILOWIGHT FOU	Sundy Suy	1.74	0.00	U. TU	I

Book Section Sandy day 8.14 0.34 2.52 1 56-8000 (MW3) Light brownish grey Sandy day 8.24 0.29 2.18 1 56-9500 (MW3) Light brownish grey Light lay 8.30 0.29 2.18 1 56-1000 (MW3) Light brownish grey Light lay 8.13 0.25 1.88 1 8-100 Dark brown Sandy day loarm 6.35 0.05 0.48 1 8-200 Dark brown Sandy day loarm 6.35 0.05 0.48 1 8-300 Dark brown Sandy day 8.25 0.48 3.60 2 8-1000 Reddsh brown Sandy day 8.54 0.60 4.50 2 8-2000 Brown Sandy day with gravel 8.53 0.65 4.88 2 8-2500 Brown Sandy day with gravel 8.36 0.50 3.75 2 8-4000 Yellowish brown Sandy day with gravel 8.64 0.40 3.	56-2000 (MW3) 56-2500 (MW3) 56-3500 (MW3) 56-3500 (MW3) 56-4500 (MW3) 56-5500 (MW3) 56-5500 (MW3) 56-6500 (MW3) 56-6500 (MW3) 56-7500 (MW3) 56-7500 (MW3)	Yellowish brown Yellowish brown Yellowish brown Dark yellowish brown Dark yellowish brown Dark yellowish brown Dark yellowish brown Dark yellowish brown Yellowish brown Greyish brown Brown	Sandy clay Sandy clay with gravel Sandy clay with gravel Sandy clay with gravel Light clay with gravel Light clay with gravel Light clay with gravel Sandy clay with gravel Sandy clay with gravel Sandy clay with gravel Sandy clay	6.66 8.02 8.07 8.12 7.92 7.78 7.52 7.50 7.45 7.82 7.80 8.23 8.16	0.02 0.19 0.21 0.26 0.20 0.22 0.26 0.23 0.18 0.17 0.22 0.36 0.27	0.15 1.43 1.58 1.95 1.50 1.65 1.95 1.73 1.35 3.91 1.65 2.70 2.03	2 2 2 2 2 2 1 1 1 2 2 2 2 2
565-0000 (MW3) Light brownish grey Light day 8.30 0.29 2.18 1 56-9500 (MW3) Light brownish grey Light day 8.13 0.25 1.88 1 56-1000 (MW3) Light brownish grey Light day 8.13 0.29 2.18 1 8-100 Dark brown Sandy day learn 6.35 0.05 0.48 1 8-300 Dark brown Sandy day learn 7.01 0.10 0.95 1 8-500 Brown Sandy day 8.25 0.48 1 3.60 2 8-1500 Reddsh brown Sandy day with gravel 8.54 0.60 4.50 2 8-2000 Brown Sandy day with gravel 8.54 0.64 4.58 2 8-2000 Brown Sandy day with gravel 8.54 0.64 3.00 2 8 3.00 2 8 3.00 2 8 3.60 2 8 4 4.64 2.37 2 8	56-8500 (MW3)	Light brownish grey	Sandy clay	8.14	0.34	2.55	1
56-500 (MW3) Light brownish grey Light day 8.30 0.29 2.18 1 56-1000 (MW3) Light brownish grey Light day 8.13 0.25 1.88 1 8-100 Dark brown Sandy day loam 5.75 0.04 0.38 1 8-200 Dark brown Sandy day loam 6.35 0.05 0.44 1 8-300 Dark brown Sandy day loam 7.96 0.18 1.35 1 8-500 Reddsh trown Sandy day 7.98 0.48 3.60 2 8-1000 Reddsh trown Sandy day with gravel 8.54 0.60 4.50 2 8-2000 Brown Sandy day with gravel 8.64 0.40 3.00 2 8-3000 Brown Sandy day with gravel 8.66 0.50 3.75 2 8-4500 Yellowish brown Sandy day with gravel 8.64 0.99 2.07 3 8-5000 Yellowish brown Sandy day with gravel 8.64 <td>56-9000 (MW3)</td> <td>Light brownish grey</td> <td>Sandy clay</td> <td>8.28</td> <td>0.29</td> <td>2.18</td> <td>1</td>	56-9000 (MW3)	Light brownish grey	Sandy clay	8.28	0.29	2.18	1
56-1000 (MW3) Light brownish grey Light lay 8.13 0.25 1.88 1 8-100 Dark brown Sandy day loam 5.75 0.04 0.38 1 8-200 Dark brown Sandy day loam 6.35 0.05 0.48 1 8-300 Dark brown Sandy day 7.98 0.18 1.35 1 8-500 Brown Sandy day 8.25 0.48 3.60 2 8-1500 Reddish brown Sandy day 8.54 0.60 4.50 2 8-2000 Brown Sandy day with gravel 8.44 0.61 4.56 2 8-3000 Brown Sandy day with gravel 8.04 0.40 3.00 2 8-4000 Yellowish brown Sandy day with gravel 8.69 0.31 2.33 3 8-5000 Yellowish brown Sandy day with gravel 8.64 0.09 2.07 3 8-5000 Yellowish brown Sandy day with gravel 8.64 0.16 <td>56-9500 (MW3)</td> <td>Light brownish grey</td> <td>Light clay</td> <td>8.30</td> <td>0.29</td> <td>2.18</td> <td>1</td>	56-9500 (MW3)	Light brownish grey	Light clay	8.30	0.29	2.18	1
8-100 Dark brown Sandy day loam 5.75 0.04 0.33 1 8-200 Dark brown Sandy day loam 6.35 0.05 0.48 1 8-300 Dark brown Sandy day 7.98 0.18 1.35 1 8-1000 Reddish brown Sandy day 8.25 0.48 3.60 2 8-1500 Reddish brown Sandy day with gravel 8.53 0.60 4.50 2 8-2000 Brown Sandy day with gravel 8.54 0.60 4.50 2 8-2000 Brown Sandy day with gravel 8.04 0.61 4.53 2 8-3000 Drown Sandy day with gravel 8.04 0.40 3.00 2 8-4000 Yellowish brown Sandy day with gravel 8.60 0.50 3.75 2 8-4000 Yellowish brown Sandy day with gravel 8.66 0.31 2.33 3 8-5500 White Sandy day with gravel 8.66 0.15<	56-1000 (MW3)	Light brownish grey	Light clay	8.13	0.25	1.88	1
8-100 Dark brown Sandy day loam 5.75 0.04 0.38 1 8-200 Dark brown Sandy day loam 7.01 0.10 0.95 1 8-300 Dark brown Sandy day loam 7.01 0.10 0.95 1 8-500 Brown Sandy day 8.25 0.48 3.60 2 8-1000 Reddish brown Sandy day with gravel 8.53 0.65 4.88 2 8-2000 Brown Sandy day with gravel 8.44 0.61 4.58 2 8-3000 Brown Sandy day with gravel 8.04 0.40 3.00 2 8-3000 Vellowish brown Sandy day with gravel 8.69 0.48 3.60 2 8-4000 Yellowish brown Sandy day with gravel 8.66 0.31 2.33 3 8-5000 Yellowish brown Sandy day with gravel 8.64 0.16 1.20 2 8-6000 White Sandy day with gravel 8.56 <td< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td></td<>							
8-200 Dark brown Sandy day loam 6.35 0.05 0.48 1 8-300 Dark brown Sandy day 7.98 0.18 1.35 1 8-500 Brown Sandy day 8.25 0.48 3.60 2 8-1500 Reddish brown Sandy day with gravel 8.54 0.60 4.50 2 8-2500 Brown Sandy day with gravel 8.44 0.61 4.58 2 8-3000 Brown Sandy day with gravel 8.04 0.40 3.00 2 8-3500 Yellowish brown Sandy day with gravel 8.36 0.50 3.75 2 8-4000 Yellowish brown Sandy day with gravel 8.64 0.09 2.07 3 8-5000 Wellowish brown Sandy day with gravel 8.66 0.11 2.33 3 8-6000 White Clayey sand 8.18 0.05 1.15 3 8-7500 White Sandy day with gravel 8.66 0.18	8-100	Dark brown	Sandy clay loam	5.75	0.04	0.38	1
a-stol Dark prown Sandy day (barm 7,01 0,10 0,95 1 8-500 Brown Sandy day 7,98 0,18 1,35 1 8-1000 Reddish brown Sandy day 8,25 0,44 3,60 2 8-1500 Reddish brown Sandy day with gravel 8,53 0,65 4,88 2 8-2000 Brown Sandy day with gravel 8,04 0,40 300 2 8-3500 Yellowish brown Sandy day with gravel 8,06 0,50 3,75 2 8-4000 Yellowish brown Sandy day with gravel 8,66 0,31 2,33 3 8-5000 Yellowish brown Sandy day with gravel 8,86 0,31 2,33 3 8-5000 White Clargey sand with gravel 8,86 0,31 2,33 3 8-5000 White Sandy day with gravel 8,48 0,16 1,20 2 8-7000 Pale brown Sandy day with gravel 8,34	8-200	Dark brown	Sandy clay loam	6.35	0.05	0.48	1
o-SU0 Er/With Sandry day 7.39 0.10 1.30 1 8-1000 Reddish brown Sandry day 8.25 0.48 3.60 2 8-2000 Brown Sandry day with gravel 8.53 0.65 4.88 2 8-2500 Brown Sandry day with gravel 8.44 0.61 4.58 2 8-3500 Yellowish brown Sandry day with gravel 8.04 0.40 3.00 2 8-4000 Yellowish brown Sandry day with gravel 8.66 0.50 3.75 2 8-5000 Yellowish brown Sandry day with gravel 8.66 0.31 2.33 3 8-5500 White Clayey sand with gravel 8.66 0.18 1.35 2 8-6000 White Sandry day with gravel 8.66 0.18 1.35 2 8-7000 Pale brown Sandry day with gravel 8.66 0.18 1.35 2 8-7000 White Clayey sand 8.18	8-300	Dark brown	Sandy clay loam	7.01	0.10	0.95	1
b-1000 Redust ID Will Sandy day 0.23 0.40 3.00 2 8-1500 Brown Sandy day with gravel 8.53 0.65 4.88 2 8-2500 Brown Sandy day with gravel 8.44 0.61 4.58 2 8-3000 Brown Sandy day with gravel 8.04 0.40 40 3.00 2 8-3000 Yellowish brown Sandy day with gravel 8.69 0.48 3.60 2 8-4500 Yellowish brown Sandy day with gravel 8.69 0.48 3.60 2 8-4500 Yellowish brown Sandy day with gravel 8.66 0.31 2.33 3 8-5500 White Clayey sand with gravel 8.64 0.09 2.07 3 8-6000 White Sandy day with gravel 8.48 0.16 1.20 2 8-7500 White Clayey sand 8.34 0.12 2.76 3 8-8000 Very pale brown Sandy day	8-000 8-1000	Brown Boddich brown	Sandy clay	7.90	U. 10 0.49	1.30	1
B-1000 Brown Sandy day with gravel 8.53 0.65 4.80 2 8-2000 Brown Sandy day with gravel 8.44 0.61 4.58 2 8-3000 Brown Sandy day with gravel 8.04 0.40 3.00 2 8-3000 Yellowish brown Sandy day with gravel 8.04 0.40 3.00 2 8-4000 Yellowish brown Sandy day with gravel 8.66 0.50 3.75 2 8-4500 Yellowish brown Sandy day with gravel 8.66 0.31 2.33 3 8-5500 White Clayey sand with gravel 8.66 0.28 2.10 2 8-6500 White Sandy day with gravel 8.66 0.28 2.10 2 8-6500 White Sandy day with gravel 8.66 0.28 2.10 2 8-7000 Pale brown Sandy day 8.56 0.18 1.35 2 8-8000 Very pale brown Sandy day 8.34	8-1500	Reddish brown	Sandy day	0.2J 8.54	0.40	3.00	2
B-2000 Brown Sandy day with gravel 8.44 0.61 4.58 2 8-3500 Brown Sandy day with gravel 8.04 0.61 4.58 2 8-3500 Yellowish brown Sandy day with gravel 8.06 0.50 3.75 2 8-4000 Yellowish brown Sandy day with gravel 8.69 0.48 3.60 2 8-4500 Yellowish brown Sandy day with gravel 8.69 0.48 3.60 2 8-5000 White Sandy day with gravel 8.64 0.09 2.07 3 8-6000 White Sandy day with gravel 8.64 0.49 2.07 3 8-6000 White Sandy day with gravel 8.64 0.18 1.35 2 8-7500 White Sandy day with gravel 8.48 0.16 1.20 2 3-750 White Clayey sand 8.18 0.05 1.15 3 3-750 Brown Sandy day 4.33 0.02	8-2000	Brown	Sandy clay with gravel	8.53	0.00	4.88	2
8-3000 Brown Sandy day with gravel 8.04 0.40 3.00 2 8-3000 Yellowish brown Sandy day with gravel 8.36 0.50 3.75 2 8-4000 Yellowish brown Sandy day with gravel 8.69 0.48 3.60 2 8-4500 Yellowish brown Sandy day with gravel 8.70 0.50 3.75 2 8-5000 Yellowish brown Sandy day with gravel 8.64 0.09 2.07 3 8-5000 White Clayey sand with gravel 8.64 0.11 2.23 3 8-6000 White Sandy day with gravel 8.64 0.16 1.20 2 8-6500 White Sandy day with gravel 8.48 0.16 1.20 2 8-7500 White Clayey sand 8.18 0.05 1.15 3 8-8000 Very pale brown Clayey sand 8.34 0.12 2.76 3 3-300 Brown Sandy day loam 4.35	8-2500	Brown	Sandy clay with grave	8 44	0.60	4 58	2
8.3500 Yellowish brown Sandy day 8.36 0.50 3.75 2 8.4000 Yellowish brown Sandy day with gravel 8.69 0.48 3.60 2 8.4500 Yellowish brown Sandy day with gravel 8.70 0.50 3.75 2 8.4500 Yellowish brown Sandy day with gravel 8.66 0.31 2.33 3 8.5500 White Sandy day with gravel 8.66 0.09 2.07 3 8.6000 White Sandy day with gravel 8.56 0.18 1.35 2 8.7000 Pale brown Sandy day with gravel 8.56 0.18 1.35 2 8.7000 White Clayey sand 8.18 0.05 1.15 3 8.800 Very pale brown Clayey sand 8.34 0.12 2.76 3 3.400 Brown Sandy day loam 4.35 0.02 0.15 3 3.300 Brown Sandy day 6.32 0.04	8-3000	Brown	Sandy clay with gravel	8.04	0.40	3.00	2
8-4000 Yellowish brown Sandy day with gravel 8.69 0.48 3.60 2 8-4500 Yellowish brown Sandy day with gravel 8.70 0.50 3.75 2 8-5000 Yellowish brown Sandy day with gravel 8.86 0.31 2.33 3 8-5000 White Clayey sand with gravel 8.64 0.09 2.07 3 8-6000 White Sandy day with gravel 8.56 0.28 2.10 2 8-6000 White Sandy day with gravel 8.56 0.18 1.35 2 8-7500 White Clayey sand 8.18 0.05 1.15 3 8-8000 Very pale brown Clayey sand 8.34 0.12 2.76 3 3-300 Brown Sandy day loam 4.35 0.02 0.19 3 33-300 Brown Sandy day loam 4.35 0.02 0.15 3 33-300 Brown Sandy day 5.34 0.02 <t< td=""><td>8-3500</td><td>Yellowish brown</td><td>Sandy clay</td><td>8.36</td><td>0.50</td><td>3.75</td><td>2</td></t<>	8-3500	Yellowish brown	Sandy clay	8.36	0.50	3.75	2
8-4500 Yellowish brown Sandy day with gravel 8.70 0.50 3.75 2 8-5000 Yellowish brown Sandy day with gravel 8.86 0.31 2.33 3 8-5500 White Clayey sand with gravel 8.64 0.09 2.07 3 8-6000 White Sandy day with gravel 8.64 0.09 2.07 3 8-6000 White Sandy day with gravel 8.48 0.16 1.20 2 8-6000 White Sandy day 8.56 0.18 1.35 2 8-7500 White Clayey sand 8.18 0.05 1.15 3 8-8000 Very pale brown Clayey sand 8.34 0.12 2.76 33-100 Brown Sandy day loam 4.63 0.02 0.19 3 33-500 Brown Sandy day 6.34 0.02 0.15 3 33-1000 Yellowish red Sandy day 6.22 0.02 0.15 3 <	8-4000	Yellowish brown	Sandy clay with gravel	8.69	0.48	3.60	2
8-5000 Yellowish brown Sandy clay with gravel 8.86 0.31 2.33 3 8-5500 White Clayey sand with gravel 8.64 0.09 2.07 3 8-6000 White Sandy clay with gravel 8.58 0.28 2.10 2 8-6500 White Sandy clay with gravel 8.48 0.16 1.20 2 8-7000 Pale brown Sandy clay 8.56 0.18 1.35 2 8-7000 White Clayey sand 8.18 0.05 1.15 3 8-8000 Very pale brown Clayey sand 8.34 0.12 2.76 3 8-8000 Pale yellow Sandy clay loam 4.63 0.03 0.29 3 33-100 Brown Sandy clay loam 4.63 0.02 0.15 3 33-500 Brown Sandy clay 6.34 0.02 0.15 3 33-1000 Yellowish red Sandy clay 6.26 0.02 0.15	8-4500	Yellowish brown	Sandy clay with gravel	8.70	0.50	3.75	2
8-5500 White Clayey sand with gravel 8.64 0.09 2.07 3 8-6000 White Sandy clay with gravel 8.58 0.28 2.10 2 8-6500 White Sandy clay with gravel 8.48 0.16 1.20 2 8-7000 Pale brown Sandy clay 8.56 0.18 1.35 2 8-7500 White Clayey sand 8.18 0.05 1.15 3 8-8000 Very pale brown Clayey sand 8.34 0.12 2.76 3 8-8500 Pale yellow Sandy clay 8.52 0.16 1.20 2 33-100 Brown Sandy clay loam 4.63 0.03 0.29 3 33-300 Brown Sandy clay 4.83 0.02 0.15 3 33-1000 Yellowish red Sandy clay 6.82 0.04 0.30 6 33-1500 Yellowish red Sandy clay 7.27 0.04 0.30 2	8-5000	Yellowish brown	Sandy clay with gravel	8.86	0.31	2.33	3
8-6000 White Sandy clay with gravel 8.58 0.28 2.10 2 8-6500 White Sandy clay with gravel 8.48 0.16 1.20 2 8-7000 Pale brown Sandy clay 8.56 0.18 1.35 2 8-7500 White Clayey sand 8.18 0.05 1.15 3 8-8000 Very pale brown Clayey sand 8.34 0.12 2.76 3 8-800 Pale yellow Sandy clay 8.52 0.16 1.20 2 33-100 Brown Sandy clay loam 4.63 0.03 0.29 3 33-200 Brown Sandy clay 4.83 0.02 0.15 3 33-300 Brown Sandy clay 6.26 0.02 0.15 6 33-1500 Yellowish red Sandy clay 6.82 0.04 0.30 2 33-3500 Red Sandy day 7.12 0.04 0.30 2	8-5500	White	Clayey sand with gravel	8.64	0.09	2.07	3
8-6500 White Sandy clay with gravel 8.48 0.16 1.20 2 8-7000 Pale brown Sandy clay 8.56 0.18 1.35 2 8-7500 White Clayey sand 8.18 0.05 1.15 3 8-8000 Very pale brown Clayey sand 8.34 0.12 2.76 3 8-8500 Pale yellow Sandy clay 8.52 0.16 1.20 2 33-100 Brown Sandy clay loam 4.63 0.03 0.29 3 33-200 Brown Sandy clay 4.83 0.02 0.15 3 33-300 Brown Sandy clay 6.34 0.02 0.15 3 33-1000 Yellowish red Sandy clay 6.82 0.04 0.30 6 33-1000 Yellowish red Sandy clay with gravel 7.00 0.4 0.30 3 33-2500 Red Sandy clay with gravel 7.00 0.04 0.30 2 <	8-6000	White	Sandy clay with gravel	8.58	0.28	2.10	2
8-7000 Pale brown Sandy clay 8.56 0.18 1.35 2 8-7500 White Clayey sand 8.18 0.05 1.15 3 8-8000 Very pale brown Clayey sand 8.34 0.12 2.76 3 8-8500 Pale yellow Sandy clay 8.52 0.16 1.20 2 33-100 Brown Sandy clay loam 4.63 0.02 0.19 3 33-200 Brown Sandy clay 4.35 0.02 0.15 3 33-300 Brown Sandy clay 5.34 0.02 0.15 3 33-500 Brown Sandy clay 6.26 0.02 0.15 6 33-1500 Yellowish red Sandy clay 6.82 0.04 0.30 6 33-2000 Red Sandy clay 6.72 0.04 0.30 2 33-3000 Yellowish red Sandy clay 6.72 0.04 0.30 2 33-3000 </td <td>8-6500</td> <td>White</td> <td>Sandy clay with gravel</td> <td>8.48</td> <td>0.16</td> <td>1.20</td> <td>2</td>	8-6500	White	Sandy clay with gravel	8.48	0.16	1.20	2
8-7500 White Clayey sand 8.18 0.05 1.15 3 8-8000 Very pale brown Clayey sand 8.34 0.12 2.76 3 8-8500 Pale yellow Sandy day 8.52 0.16 1.20 2 33-100 Brown Sandy day loam 4.63 0.03 0.29 3 33-200 Brown Sandy day loam 4.63 0.03 0.29 3 33-300 Brown Sandy day 4.83 0.02 0.15 3 33-500 Brown Sandy day 5.34 0.02 0.15 3 33-1000 Yellowish red Sandy day 6.26 0.02 0.15 6 33-1500 Yellowish red Sandy day with gravel 7.00 0.04 0.30 2 33-2000 Red Sandy day 6.72 0.04 0.30 2 33-3000 Yellowish red Sandy day 6.72 0.04 0.30 1 <	8-7000	Pale brown	Sandy clay	8.56	0.18	1.35	2
8-8000 Very pale brown Clayey sand 8.34 0.12 2.76 3 8-8500 Pale yellow Sandy day 8.52 0.16 1.20 2 33-100 Brown Sandy day loam 4.35 0.02 0.19 3 33-200 Brown Sandy day loam 4.63 0.03 0.29 3 33-300 Brown Sandy day 4.83 0.02 0.15 3 33-500 Brown Sandy day 5.34 0.02 0.15 6 33-1000 Yellowish red Sandy day 6.82 0.04 0.30 6 33-1500 Yellowish red Sandy day with gravel 7.00 0.04 0.30 3 33-2000 Red Sandy day with gravel 7.27 0.04 0.30 2 33-3000 Yellowish red Sandy day with gravel 6.26 0.02 0.30 2 33-3000 Yellowish red Sandy day 6.72 0.04 0.30 1 <td>8-7500</td> <td>White</td> <td>Clayey sand</td> <td>8.18</td> <td>0.05</td> <td>1.15</td> <td>3</td>	8-7500	White	Clayey sand	8.18	0.05	1.15	3
8-8300 Pale yellow Sandy clay 8.52 0.16 1.20 2 33-100 Brown Sandy clay loam 4.35 0.02 0.19 3 33-200 Brown Sandy clay loam 4.63 0.02 0.15 3 33-300 Brown Sandy clay 4.83 0.02 0.15 3 33-500 Brown Sandy clay 5.34 0.02 0.15 3 33-1000 Yellowish red Sandy clay 6.82 0.04 0.30 6 33-1500 Yellowish red Sandy clay 6.82 0.04 0.30 3 33-2000 Red Sandy clay with gravel 7.00 0.04 0.30 2 33-3000 Yellowish red Sandy clay 7.12 0.04 0.30 2 33-3000 Yellowish red Sandy clay with gravel 6.50 0.03 0.30 1 33-4000 Yellowish red Sandy clay with gravel 6.27 0.03 0.30	8-8000	Very pale brown	Clayey sand	8.34	0.12	2.76	3
33-100 Brown Sandy day loam 4.35 0.02 0.19 3 33-200 Brown Sandy day loam 4.63 0.03 0.29 3 33-300 Brown Sandy day 4.83 0.02 0.15 3 33-500 Brown Sandy day 5.34 0.02 0.15 3 33-1000 Yellowish red Sandy day 6.26 0.02 0.15 6 33-1500 Yellowish red Sandy day 6.82 0.04 0.30 6 33-2000 Red Sandy day with gravel 7.00 0.04 0.30 2 33-3000 Yellowish red Sandy day 6.72 0.04 0.30 2 33-3000 Yellowish red Sandy day 6.72 0.04 0.30 2 33-3000 Yellowish red Sandy day with gravel 6.50 0.03 0.30 1 33-4000 Yellowish red Sandy day with gravel 6.27 0.03 0.30 1 <td>8-8500</td> <td>Pale yellow</td> <td>Sandy clay</td> <td>8.52</td> <td>0.16</td> <td>1.20</td> <td>2</td>	8-8500	Pale yellow	Sandy clay	8.52	0.16	1.20	2
33-100 Brown Sandy day loam 4.33 0.02 0.13 3 33-200 Brown Sandy day loam 4.63 0.03 0.29 3 33-300 Brown Sandy day 4.83 0.02 0.15 3 33-500 Brown Sandy day 5.34 0.02 0.15 3 33-1000 Yellowish red Sandy day 6.82 0.04 0.30 6 33-2000 Red Sandy day with gravel 7.00 0.04 0.30 3 33-2000 Red Sandy day with gravel 7.27 0.04 0.30 2 33-3000 Yellowish red Sandy day 6.72 0.04 0.30 2 33-3000 Yellowish red Sandy day with gravel 6.50 0.03 0.30 1 33-4000 Yellowish red Sandy day with gravel 6.50 0.03 0.30 1 33-4500 Yellowish red Light day with gravel 6.27 0.03 0.30 1 33-5000 Yellowish red Light day 6.56 0	33 100	Brown	Sandy day loam	1 35	0.02	0.10	3
33-300 Brown Sandy day 4.83 0.02 0.15 3 33-300 Brown Sandy day 5.34 0.02 0.15 3 33-500 Brown Sandy day 6.26 0.02 0.15 3 33-1000 Yellowish red Sandy day 6.82 0.04 0.30 6 33-2000 Red Sandy day with gravel 7.00 0.04 0.30 3 33-2500 Red Sandy day with gravel 7.27 0.04 0.30 2 33-3000 Yellowish red Sandy day 6.72 0.04 0.30 2 33-3000 Yellowish red Sandy day 6.72 0.04 0.30 1 33-4000 Yellowish red Sandy day with gravel 6.50 0.03 0.30 1 33-4500 Yellowish red Light day with gravel 6.40 0.04 0.23 1 33-6000 Yellowish red Light day 6.56 0.05 0.29 1 </td <td>33-200</td> <td>Brown</td> <td>Sandy clay loam</td> <td>4.55</td> <td>0.02</td> <td>0.19</td> <td>3</td>	33-200	Brown	Sandy clay loam	4.55	0.02	0.19	3
33-500 Brown Sandy day 5.34 0.02 0.15 3 33-1000 Yellowish red Sandy day 6.26 0.02 0.15 6 33-1000 Yellowish red Sandy day 6.82 0.04 0.30 6 33-1000 Red Sandy day 6.82 0.04 0.30 6 33-2000 Red Sandy day with gravel 7.00 0.04 0.30 2 33-2000 Red Sandy day with gravel 7.27 0.04 0.30 2 33-3000 Yellowish red Sandy day 6.72 0.04 0.30 2 33-3500 Yellowish red Sandy day with gravel 6.50 0.03 0.30 1 33-4500 Yellowish red Sandy day with gravel 6.27 0.03 0.30 1 33-5000 Yellowish red Light day with gravel 6.40 0.04 0.23 1 33-6000 Yellowish red Sandy day 6.42 0.05 0.38<	33-300	Brown	Sandy day	4.83	0.00	0.25	3
33-1000 Yellowish red Sandy day 6.26 0.02 0.15 6 33-1500 Yellowish red Sandy day 6.82 0.04 0.30 6 33-2000 Red Sandy day with gravel 7.00 0.04 0.30 3 33-2500 Red Sandy day with gravel 7.27 0.04 0.30 2 33-3000 Yellowish red Sandy day 6.72 0.04 0.30 2 33-3000 Yellowish red Sandy day 6.72 0.04 0.30 2 33-3000 Yellowish red Sandy day with gravel 6.72 0.04 0.30 1 33-3000 Yellowish red Sandy day with gravel 6.50 0.03 0.30 1 33-4500 Yellowish red Sandy day with gravel 6.27 0.03 0.30 1 33-500 Yellowish red Light day 6.56 0.05 0.29 1 33-6500 Yellowish red Sandy day 6.42 0.05 0.38 1 33-6500 Reddish brown Sandy day	33-500	Brown	Sandy day	5.34	0.02	0.10	3
33-1500 Yellowish red Sandy clay 6.82 0.04 0.30 6 33-2000 Red Sandy clay with gravel 7.00 0.04 0.30 3 33-2500 Red Sandy clay with gravel 7.27 0.04 0.30 2 33-3000 Yellowish red Sandy clay 7.12 0.04 0.30 2 33-3000 Yellowish red Sandy clay 7.12 0.04 0.30 2 33-3000 Yellowish red Sandy clay 6.72 0.04 0.30 1 33-4000 Yellowish red Sandy clay with gravel 6.50 0.03 0.30 1 33-4500 Yellowish red Light clay with gravel 6.27 0.03 0.30 1 33-5500 Yellowish red Light clay 6.56 0.05 0.29 1 33-6500 Reddish yellow Sandy clay 6.63 0.03 0.23 1 33-7500 Reddish brown Sandy clay 6.18 0.04 0.30 1 33-8000 Yellowish brown Light clay	33-1000	Yellowish red	Sandy clay	6.26	0.02	0.15	6
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33-4500 Yellowish red Sandy clay with gravel 6.27 0.03 0.30 1 33-5000 Yellowish red Light clay with gravel 6.40 0.04 0.23 1 33-5000 Yellowish red Light clay 6.56 0.05 0.29 1 33-5000 Yellowish red Light clay 6.42 0.05 0.38 1 33-6000 Yellowish red Sandy clay 6.63 0.03 0.23 1 33-6500 Reddish yellow Sandy clay 6.63 0.03 0.23 1 33-7000 Reddish brown Sandy clay 6.18 0.04 0.30 1 33-7500 Reddish brown Light clay 6.37 0.03 0.17 1 33-8000 Yellowish brown Light clay 6.57 0.04 0.23 1 33-8500 Yellowish brown Light clay 6.03 0.05 0.29 1 33-9000 Yellowish brown Light clay 6.38 0.04 </td <td>33-4000</td> <td>Yellowish red</td> <td>Sandy clay with gravel</td> <td>6.50</td> <td>0.03</td> <td>0.30</td> <td>1</td>	33-4000	Yellowish red	Sandy clay with gravel	6.50	0.03	0.30	1
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33-5000 Yellowish red Light day 6.56 0.05 0.29 1 33-6000 Yellowish red Sandy day 6.42 0.05 0.38 1 33-6500 Reddish yellow Sandy day 6.63 0.03 0.23 1 33-7000 Reddish brown Sandy day 6.18 0.04 0.30 1 33-7500 Reddish brown Light day 6.37 0.03 0.17 1 33-8000 Yellowish brown Light day 6.57 0.04 0.23 1 33-8500 Yellowish brown Light day 6.03 0.05 0.29 1 33-9000 Yellowish brown Light day 6.38 0.04 0.23 1	33-5000	Yellowish red	Light clay with gravel	6.40	0.04	0.23	1
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33-7000 Reddish prown Sandy clay 6.63 0.03 0.23 1 33-7000 Reddish brown Sandy clay 6.18 0.04 0.30 1 33-7500 Reddish brown Light clay 6.37 0.03 0.17 1 33-8000 Yellowish brown Light clay 6.57 0.04 0.23 1 33-8500 Yellowish brown Light clay 6.03 0.05 0.29 1 33-9000 Yellowish brown Light clay 6.38 0.04 0.23 1	33-0UUU 22 6500	reliowish red	Sandy clay	6.42 6.60	0.05	0.38	1
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33-9000 Yellowish brown Light day 6.38 0.04 0.23 1	33-8500	Yellowish brown	Light day	6.03	0.04	0.20	1
	33-9000	Yellowish brown	Light day	6.38	0.04	0.23	1

53-100	Brown	Sandy clay loam	6.06	0.06	0.57	3
53-200	Brown	Sandy clay loam	6.31	0.07	0.67	2
53-300	Brown	Sandy Ioam	6.35	0.08	1.12	2
53-500	Reddish brown	Sandy Ioam	6.70	0.06	0.84	3
53-1000	Reddish brown	Sandy clay	6.87	0.05	0.38	2
53-1500	Yellowish red	Sandy clay with gravel	6.80	0.07	0.52	1
53-2000	Yellowish red	Sandy clay with gravel	679	0.07	0.52	1
53-2500	Yellowish brown	Sandy clay with gravel	6 45	0.04	0.23	1
53-3000	Brown	Sandy day with grave	6.03	0.04	0.23	3
53-3500	Brown	Sandy day with grave	6.00	0.05	0.29	3 3
53-4000	Brown	Sandy day with grave	6.12	0.05	0.29	3
53-4500	Brown	Sandy day with grave	630	0.00	0.20	Ğ
53-5000	Brown	Sandy day with grave	6.66	0.00	0.73	3
	DIOWII	Sandy day with grave	0.00	0.04	0.25	5
59-100	Brown	Sandy clay loam	5.68	0.04	0.38	3
59-200	Reddish brown	Fine sandy clay loam	5 15	0.04	0.00	2
59-200	Red	Sandy day loan	5.85	0.05	0.38	2
59-500	Red	Sandy day	6.15	0.00	0.00	2
59-500	Reddich brown	Sandy day	7.00	0.00	0.45	3
50 1500	Reduisti bi own	Sandy day	7.09	0.00	0.40	3
59-1000	Reduisti bi own	Salluy day	7.39	0.13	0.90	5
59-2000	Pale brown	Sandy clay	0.20	0.20	1.00	5
59-2500	Pale prown	Sandy clay	0.11	0.17	1.20	3
59-3000	Yellowish brown	Sandy clay	7.68	0.15	1.13	2
59-3500	Yellowish brown	Sandy clay with grave	8.13	0.22	1.65	3
59-4000	Yellowish brown	Sandy clay with grave	8.02	0.21	1.58	2
59-4500	Yellowish brown	Sandy clay with gravel	8.03	0.11	0.83	2
59-5000	Yellowish brown	Sandy clay with gravel	7.88	0.12	0.90	2
59-5500	Brown	Sandy clay with gravel	8.11	0.16	1.20	2
59-6000	Brown	Sandy clay with gravel	8.04	0.14	1.05	2
59-6500	Yellowish brown	Light clay	7.80	0.12	0.90	2
59-7000	Yellowish brown	Light clay	7.83	0.17	1.28	2
59-7500	Yellowish brown	Light clay	7.60	0.14	1.05	2
59-8000	Yellowish brown	Light clay	7.90	0.12	0.90	2
59-8500	Yellowish brown	Light clay	7.59	0.14	1.05	2
59-9000	Yellowish brown	Light clay	7.60	0.16	1.20	2
62-100	Brown	Sandy clay loam	5.50	0.02	0.19	2
62-200	Brown	Sandy clay loam	5.22	0.01	0.09	2
62-300	Yellowish brown	Sandy clay loam	5.41	0.01	0.09	2
62-500	Dark brown	Sandy clay	6.53	0.03	0.23	3
62-1000	Dark brown	Sandy clay	6.76	0.02	0.15	3
62-1500	Dark brown	Sandy clay	6.47	0.03	0.23	3
62-2000	Brown	Sandy clay with gravel	6.32	0.03	0.23	3
62-2500	Brown	Sandy clay with gravel	6.52	0.03	0.23	3
62-3000	Reddish brown	Sandy clay with gravel	7.36	0.12	0.90	3
62-3500	Brown	Sandy clay with gravel	6.92	0.40	3.0	2
		, ,			-	-

7.7.3 рН

The topsoil was slightly acidic (Table 12). The pH generally increased with increasing depth. Subsoil was generally strongly acidic to slightly alkaline.

7.7.4 Emerson aggregate test

Topsoil and subsoil on the site was highly dispersive to slightly dispersive (Table 12).

7.7.5 Chlorides

Levels of chlorides in the samples analysed were less than 2,000mg/kg and considered non-aggressive soils for concrete and steel piles (Table 13).

Table 13. Soil results for chlorides and exchangeable sodium percentage (ESP) (Appendix 7)

		<u> </u>	0 (/(1 1 /
Sample ID	Borehole and depth	Chlorides (mg/kg)	ESP (%)	Total cations
	(mm) (Figure 5)			(meq/100g)
20(100) (MW1)	20-100	80	7.8	6.4
20(1500) (MW1)	20-1500	1,750	22.6	21.2
56(100) (MW3)	56-100	740	0.6	16.3
56(1000) (MW3)	56-1000	20	0.7	15.1
ND Not detected at	the leberator (limite			

ND – Not detected at the laboratory limits

7.7.6 Exchangeable sodium percentage

Exchangeable sodium percentage for samples collected from Borehole 20 located in the north eastern section of the site were 8% and 23% and are considered highly sodic. Exchangeable sodium percentage for samples collected from Borehole 56 located in the south western section of the site was less than 5% and were non-sodic (Table 13).

7.8 Indicators of salinity

7.8.1 Bare soil

No bare soil resulting from sheet erosion or salinity were present on site

7.8.2 Salt crystals

No salt crystals present on site.

7.8.3 Vegetation indicators

No highly salt tolerant plant species are present on site.

7.8.4 Die back

No vegetation or tree die back was observed on or surrounding the site.

7.8.5 Effects on buildings

The existing dwelling located west of the site has no evidence of salinity impact.

7.8.6 Conditions of roads

No evidence of surface undulations or break-up of bitumen on the roads surrounding the site.

7.9 Soil moisture model

The soil moisture varies with rainfall in all land-use scenarios of the CLASS U3M model. Soil moisture at 1m depth under all land-uses are saturated seasonally or under periods of high rainfall (Figure 12). At the 3 metres soil depth in the pasture, road verges and trees land-uses the soils not saturated in the simulation period. (Figure 13). Lawn land-use scenario has saturated soil at 3 metres as the model simulates overwatering by 1mm/day. The scenario of trees plus 1mm/day does not have saturated soil at 3m depth.

No excess soil moisture is observed at 3m depth in pasture, road verges, trees and trees plus 1mm/day land-uses (Table 14). Lawn has excess soil moisture which will be utilised by the additional capacity of the trees as demonstrated in the trees+1mm/day scenario (Table 14). It is a reasonable assumption that lateral moisture movement will occur on the clayey subsoils of low permeability and unsaturated flows will be utilized by trees located in buffer areas.

Management of areas with elevated salinity with permanent vegetation will prevent mobilization of salts in the surface or subsurface.

Table 14. Excess soil moisture at 3m depth from the simulation

Land-use	Total excess moisture at 3m 1980 to 2014 (m/m ³)
Pasture	0
Lawn	0.005 (0.5%)
Road verges	0
Trees	0
Trees plus 1mm/day	0

7.10 Nitrogen

Nitrogen soil levels in the grazing system are typically low with concentrated areas around animal wastes. Nitrogen fertilisers are also used in cropping operations and biological synthesis occurs in legumes. Off-site movement occurs from sediment loss. Water soluble nitrogen has potential to leach into the groundwater.

Post development sources of nitrogen are from fertilisers applied to lawns. Post development fertilisation will only occur in a small proportion of the site that is lawns and gardens. Nitrogen fertilisation is not expected to occur on the road verge. Nitrogen fertiliser will not be required in native gardens. The impact from lawn fertilisers will be less than the impact of animal wastes. Maintained gardens and lawns will have the capacity to utilise the nitrogen applied. The impact of nitrogen fertiliser post development will be reduced.

The nutrient balance indicates the development will reduce nitrogen export by 657 kg/year under the median scenarios (Table 15). Reduced pasture area has resulted in a decrease in the nitrogen loss.

Land-use areas	Pre-development	Post-development	Impact
Native bushlands	0.00	29.76	-29.76
Disturbed landscapes	238.80	0.00	238.80
Remediated gullies	0.00	45.00	-45.00
Improved pasture	984.28	0.00	984.28
Unimproved pasture	0.00	0.00	0.00
Roads (sealed)	0.00	150.60	-150.60
Roads (earth)	1.12	0.00	1.12
Urban (lawns)	0.00	140.30	-140.30
Urban (open space)	0.00	201.60	-201.60
TOTAL	1,224.19	567.26	656.93

Table 15. Land-use nitrogen export pre and post development (kg/year)

7.11 Phosphorus

The main phosphorus sources pre-development are from animal waste and fertilisers. Cattle are currently grazed on the site. Off-site movement of phosphorus will occur in sediments and susceptible times are when vegetation cover is low.

Stock numbers will decrease in the post development land-use. Domestic pet numbers on the site are expected to increase. The majority of domestic pet scats are expected to be disposed to landfill by collection of the scats by owners or removal with kitty litter. The result will be a decrease contribution of phosphorus on the site.

Phosphorus binds to soil and the primary method of movement is in sediments. Vegetation cover is expected to be higher post development resulting in filtering of runoff, reduced sediment loads exported and consequently lower phosphorus export.

The nutrient balance indicates the development will decrease phosphorus export by 71 kg/year under the median scenarios (Table 16). Riparian planting and wetland design can reduce phosphorus levels at stormwater discharge areas.

Table To. Land-use phosphorus exports pre and post development (kg/year)			
Land-use areas	Pre-development	Post-development	Impact
Native bushlands	0.00	1.61	-1.61
Disturbed landscapes	24.68	0.00	24.68
Remediated gullies	0.00	4.65	-4.65
Improved pasture	149.30	0.00	149.30
Unimproved pasture	0.00	0.00	0.00
Roads (sealed)	0.00	45.18	-45.18
Roads (earth)	0.87	0.00	0.87
Urban (lawns)	0.00	41.86	-41.86
Urban (open spaces)	0.00	10.71	-10.71
TOTAL	174.85	104.01	70.84

Table 16. Land-use phosphorus exports pre and post development (kg/year)

7.12 Sediment

The nutrient balance indicates the development will reduce sediment by 36,784 kg/year under the median scenario (Table 17). Sediments are reduced due to the decrease in contribution from the pasture area.

Table 17. Land-use sediment export pre and post development (kg/yea	ar)
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Land-use areas	Pre-development	Post-development	Impact
Native bushlands	0.00	496.00	-496.00
Disturbed landscapes	17313.00	0.00	17313.00
Remediated gullies	0.00	3262.50	-3262.50
Improved pasture	57508.36	0.00	57508.36
Unimproved pasture	0.00	0.00	0.00
Roads (sealed)	0.00	4769.00	-4769.00
Roads (earth)	70.98	0.00	70.98
Urban (lawns)	0.00	6900.00	-6900.00
Urban (open spaces)	0.00	22680.00	-22680.00
TOTAL	74,892.34	38,107.50	36,784.84

7.13 Garden fertilisers and chemicals

Minor usage of herbicides may occur post development on lawns. All fertilisers and agricultural chemicals will be utilised by the vegetation or degrade rapidly in the environment. No impact on surface water or groundwater will occur.

No industrial activities including bulk storage or use of chemicals will occur in the development.

7.14 Other contaminants

7.14.1 Greywater reuse

NSW Health approves the following methods for greywater reuse:

- Bucketing: Generally only small volumes of greywater are reused and the action is unlikely to occur during wet weather. Risk of overwatering and therefore impact on groundwater is low.
- Greywater diversion devices: Does not require Council approval if conditions relating to
 installation and use are met. Conditions include undertaking checks and maintenance of
 the irrigation system, use biodegradable detergents low in phosphorus, sodium, boron and
 chloride, no irrigation during rain, undertake a water balance prior to installation, monitor
 soil and plant response to irrigation, do not overwater and notify the local water utility of the

device. Notification to the local water utility (Dubbo City Council) ensures Council is aware the system is in place and can check on compliance. Conditions ensure the water is used sustainably with minimal impact on the groundwater.

• Greywater treatment system: Requires approval from Council. Council can regulate the suitability and number of systems in the locality and check on the satisfactory operation of the system. Regulation of the system ensures minimal impact on groundwater.

7.14.2 Car washing

Minor washing of cars by householders is expected to be undertaken post development. Most car owner clean cars in commercial washing bays. Small numbers of cars will be washed either on permeable areas resulting in infiltration or non-permeable areas with water moving into the reticulated stormwater system and off-site. Water and detergents infiltrating permeable areas will be utilised by vegetation. Some deeper infiltration may occur but volumes are not expected to be significant. Car washing is not expected to occur during rain.

8. Soil and water impact assessment

8.1 Soil

Surface soil was non-saline. Subsoils in the majority of the site were classified as non-saline to slightly saline. Moderate to extremely saline subsoil were identified in the north east corner of the assessment area at a depth greater than 1.0m. The moderate to extremely saline subsoils are associated with the sandstone lithology. Excavation works from the development are not expected to intercept the saline subsoil, following adoption of the recommendations in this report

8.2 Water

8.2.1 Surface water

Runoff will be directed into a piped stormwater system. The pipes will discharge into the drainage line which will be modified to form a stormwater management system. The existing dams located on site which are fed by contour banks will be decommissioned. Lakes will be constructed to form the basis for the stormwater management system. Lakes will be lined and vegetation planted to minimise the interaction between the groundwater and stormwater management system.

8.2.2 Groundwater

8.2.2.1 Recharge

Groundwater recharge has potential to increase as a result of irrigation of lawns. Modelling has shown under a number of scenarios that soil moisture increases will not be significant and the proposed planting of deep-rooted vegetation as street trees, parkland and along the drainage lines will aid in the extraction of soil moisture within the profile and reduce the occurrence of deep infiltration. The increase in infiltration in the north-east area from lawn areas will be utilized by trees planted downslope along the drainage line.

Additional infiltration in the non-saline areas from possible over irrigation of lawn will not contribute to salinity. Large areas of impervious surface (roads and roof areas) will increase in rainfall runoff and reduce infiltration. Deep infiltration of groundwater within the area is expected to be similar pre and post development. Groundwater levels are not expected to rise as a result of the development and groundwater levels across most of the upper Macquarie Alluvium groundwater management area have shown steady term decline over the Hennessey Road (Smithson, 2010).

8.2.2.2 Discharge

No shallow groundwater discharge areas were identified on the site. It is possible the drainage line in the north of the site is a drainage area at times of high rainfall. Discharge has potential to occur at the boundary between the basalt and sandstone lithology in the north eastern section.

8.2.2.3 Clause 7.5 of the Dubbo LEP 2011

(1) The objective of this clause is to maintain the hydrological functions of key groundwater systems and to protect vulnerable groundwater resources from depletion and contamination as a result of inappropriate development.

Response: The development and groundwater at the site is described in the Groundwater and Salinity report prepared by Envirowest Consulting Pty Ltd (Report number R5737s3).

(2) This clause applies to the land identified as "Groundwater vulnerability" on the Natural Resources – Groundwater Vulnerability Map.

Response: The south western section of the site is located in a mapped high groundwater vulnerability area. The remainder of the site has a moderately high groundwater vulnerability.

(3) Before determining a development application for development on land to which this clause applies, the consent authority must consider:

(a) whether the development (including any on-site storage or disposal of solid or liquid waste chemicals) will cause any groundwater contamination or any adverse effect on groundwater dependent ecosystems.

Response:

The development has a low potential to adversely affect groundwater and groundwater dependent ecosystems. Groundwater and groundwater dependent ecosystems may be impacted by use of fertilisers on lawns and gardens, greywater reuse and car washing. The post development impact is expected to be similar or less than under the pre-development agricultural land-use.

Post development lawn inputs will only occur in a small proportion of the site that is lawns and gardens. Nitrogen fertiliser will not be required in native gardens. The impact from lawn fertilisers will be managed by riparian vegetation and stormwater design which will removed any potential increase in nitrogen rich fertilizers. Maintained gardens and lawns will have the capacity to utilise the nitrogen applied. The impact of nitrogen inputs post development will be reduced.

The post development scenario is expected to result in a decrease in contribution of phosphorus, nitrogen and suspended sediments. Fertilizer use in the residential subdivision with be less than the agricultural land-use. Stock numbers will decrease in the post development land-use while domestic pet numbers on the site are expected to increase. The majority of domestic pet scats are expected to be disposed to landfill by collection of the scats by owners or removal with kitty litter disposed as refuse to landfill.

Minor usage of herbicides may occur post development on lawns. All fertilisers and agricultural chemicals are not residual and will be utilised by the vegetation or degrade rapidly in the environment. No impact on surface water or groundwater will occur.

NSW Health approves the following methods for greywater reuse:

- Bucketing: Generally only small volumes of greywater are reused and the action is unlikely to occur during wet weather. Risk of overwatering and therefore impact on groundwater is low.
- Greywater diversion devices: Does not require Council approval if conditions relating to
 installation and use are met. Conditions include undertaking checks and maintenance of
 the irrigation system, use biodegradable detergents low in phosphorus, sodium, boron and
 chloride, no irrigation during rain, undertake a water balance prior to installation, monitor
 soil and plant response to irrigation, do not overwater and notify the local water utility of the
 device. Notification to the local water utility (Dubbo City Council) ensures Council is aware
 the system is in place and can check on compliance. Conditions ensure the water is used
 sustainably with minimal impact on the groundwater.
- Greywater treatment system: Requires approval from Council. Council can regulate the suitability and number of systems in the locality and check on the satisfactory operation of the system. Regulation of the system ensures minimal impact on groundwater.

Minor washing of cars by householders is expected to be undertaken post development. Most car owners clean cars in commercial washing bays. Small numbers of cars will be washed either on permeable areas resulting in infiltration or non-permeable areas with water moving into the reticulated stormwater system and off-site. Water and detergents infiltrating permeable areas will be utilised by vegetation. Some deeper infiltration may occur but volumes are not expected to be significant. Car washing is not expected to occur during rain.

No industrial activities including bulk storage or use of chemicals will occur in the development.

(b) The cumulative impact (including the impact on nearby groundwater extraction for potable water supply or stock water supply) of the development and any other existing development on groundwater.

Response:

Impact on groundwater from nitrogen contamination is expected to be less post development compared to pre-development due to lower contributions from animals and fertilisers. Other contaminates such as greywater reuse and car washing are expected to have a negligible impact on groundwater quality due to low risk of overwatering resulting in deep infiltration and regulation. The cumulative impact of the development and adjacent existing development on groundwater quality is expected to be negligible.

(4) Development consent must not be granted to development on land to which this clause applies unless the consent authority is satisfied that:

- (a) The development is designed, sited and will be managed to avoid any significant adverse environmental impact, or
- (b) If that impact cannot be avoided by adopting feasible alternatives the development is designed, sited and will be managed to minimise that impact, or
- (c) If that impact cannot be minimised the development will be managed to mitigate that impact.

No impacts from the development are expected if additional implementations are adopted. Offset contingences have also been proposed to provide additional assurance.

Mitigation measures will be adopted within the development to off-set the unlikely impacts on groundwater quality. The mitigation measures will comprise planting of deep-rooted vegetation off-

sets in proposed open space adjacent the development and along proposed stormwater wetlands. The vegetation will intercept groundwater and nutrients and will reduce the potential impact on groundwater quality.

Deep-rooted vegetation comprising native species selected from the species list provided in DCC Water Wise and Salt Tolerant Plants list (no date) will be planted in proposed open space. Trees will also be planted along road verges as part of the street scaping which will additionally mitigate any impact.

8.3 Vegetation

Most of the site contains annual species which are shallow rooted. No impact from saline soils and groundwater on the vegetation was observed.

Pasture grasses will be replaced with introduced garden species including deep rooted perennials. Garden species to be planted will be shallow rooted or salt tolerant and no impact on growth is expected. Trees will be planted in the proposed parkland. The proposed residential development will contain irrigated and unirrigated lawns with plantings of shrubs and trees. Ecowise gardens of native and drought tolerant species will be promoted in the development. Costs associated with irrigation will ensure overwatering and leaching does not occur. On-site shallow groundwater is not expected to be a viable source of irrigation water due to the unreliable shallow groundwater aquifer. The deeper confined aquifer has been proven as a reliable source however recent reports suggest licences may be difficult due to groundwater decline within the upper Macquarie groundwater management area. The use of fertiliser and herbicides on lawn will be utilised by plants and will not move out of the rooting zone.

The new land-use will contain a mix of shallow and deep rooted vegetation. Species planted in lawns will utilise soil moisture all year round compared to the current pasture species mix which are mostly summer active only. Trees will be planted along roadways and garden areas.

8.4 Infrastructure

Non to slightly saline soils were identified to a depth of 1.0m across the majority of the site which is below the footing depth for residential buildings. Moderately to extremely saline soils were identified from 1.0m in the north east corner of the assessment area. Excavations that are required to be at depths greater than 1.0m in the north east section of the assessment area should be consider salt protected materials for services and be undertaken in accordance with building in saline areas. Groundwater is present at depths greater than building depths. No special construction requirements addressing salinity are expected to be required for infrastructure including roads and buildings in the remainder of the site.

8.5 Pollution risk control

The subsoil is clay with depth of greater than 8 metres to groundwater. The soil layer provides significant filtration and absorption capacity to reduce contamination loading.

Occasional fertilizer and chemical use is expected from the residential land-use. Fertilisers will be utilised by plants. All agricultural chemicals degrade rapidly in the environment. No impact on surface water or groundwater will occur.

The site currently has a grazing land-use. Waste from the animals contains significant nutrients and pathogens which has potential to move in surface water flows.

Stock will be excluded in the post development land-use. Domestic pet numbers on the site are expected to increase. The majority of domestic pet scats are expected to be disposed to landfill by collection of the scats by owners or removal with kitty litter. The result will be a decrease contribution by animals to nutrients on the site.

Vegetation cover around the dwellings and in the nature strips will provide a biofilter resulting in reduced sediment loads exported. Nutrient impact on surface water will be reduced post development.

The site area is considered important as it forms part of the Macquarie River catchment. ANZECC (2000) has determined water quality indicators for river systems in regard to various environmental values (Table 18). The environmental values relate to the protection of:

- aquatic ecosystems
- aquatic foods
- primary contact recreation
- secondary contact recreation
- drinking water
- visual amenity
- irrigation water supplies
- homestead water supplies
- livestock water supplies
- human consumption of fish

The irrigation water quality indicators are considered appropriate for the catchment. The potential impact of the development on each water quality indicator has been assessed (Table 18). Potential issues relate to current and future land-use and management of the site.

The impact of the development on each water quality indicator will be negligible.

8.6 Earthworks

Moderate earthworks are expected for the development. Excavations in the northeast section of the site should be restricted to depths of less than 1m reducing the risk of exposure of saline subsoils. The roads will be designed to ensure road levels are as close as possible to the existing natural levels to ensure saline-subsoils are not exposed. Subsoils in the majority of the site were classified as non-saline to slightly saline.

8.7 Other impacts of the development

Nil

Indicator	Objective	Impact of development
Nitrogen	5 mg/L	Nitrogen may be applied to the site as fertilisers. Nitrogen will be used by plants, digested by microbes or volatilised into the atmosphere. Infiltration for nitrogen into the subsoil and impact on groundwater systems will not occur.
		Maintenance of groundcover by minimal cultivation and no grazing are important factors in reducing nitrogen export.
		Nutrient modelling indicates nitrogen will decrease on site.
Faecal coliform	<10 cfu/100mL to 10,000cfu/100mL	The site will be serviced by the town sewer. No impact on faecal coliform levels is expected to result from the development.
Aluminium	5 mg/L	No impact.
Iron	0.2 mg/L	No impact.
Manganese	0.2 mg/L	No impact.
Dissolved oxygen	>6.5 mg/L	No effluent applied to the site. Vegetated areas are expected to be managed. No impact.
Phosphorus	0.05mg/L	Phosphorus may be applied to the site as fertilisers or in domestic pet scats. Domestic pet scats are expected to be removed by collection by owners or disposal of kitty litter and will not significantly contribute to phosphorus levels on the site. Phosphorus will be used by plants and absorbed in the soil. Groundcover will be enhanced in the development resulting in reduced sediment and phosphorus export. Post development fertiliser application rates will be reduced and the effect on phosphorus less. Nutrient modelling indicates phosphorous will decrease on site post development. Riparian planting and will additionally reduce phosphorus levels at stormwater discharge areas.
рН	between 6.0 and 8.5	Fertilisers have a declining influence on pH and effects off-site will be negligible.
Cyanobacteria	-	Cyanobacteria are dependent on the levels of nitrogen, phosphorus and water temperature. The development will not increase nitrogen and phosphorus therefore will have negligible impact.
		No cyanobacteria are present in tertilisers.
Conductivity	-	Exposure of saline soils and off-site movement will be minimised by adoption of recommendations including minimising depth of cut and implementation of erosion and sediment control plans. No impact expected.
Turbidity	-	Negligible impact due to small size of the development and the absence of any disturbed areas on site.

Table 18. Impacts of development on water quality (Environmental objectives)

9. Management recommendation

9.1 Design

An Electromagnetic survey of the north eastern section of the site will provide data on the location of the sandstone/basalt interface. Construction of additional boreholes and analysis of soil samples will confirm the presence of saline soils. The location of the geological interface should be used to incorporate the planting of deep rooted vegetation into the final design of the subdivision.

The development water and soil design will include:

- Establishment of parkland areas with native species which do not require irrigation
- Promote plantings of deep rooted vegetation along roads and public space
- Additional plantings of deep rooted vegetation throughout the parkland. The trees should be planted with 20m spacings (25 trees/ha).
- Planting of trees in expected areas of lithological/hydrological interfaces to minimise saline soils/groundwater
- Piping of surface water off-site
- Stormwater retention basins lined with an impermeable layer
- Design road levels similar to natural soil levels to minimise excavations
- Earthworks comprising cut should be minimised
- Excavated material with elevated salinity should be backfilled, utilised as fill under roads or disposed to landfill

9.2 Buildings

Soil saturated extract electrical conductivity (EC_e) was determined to be less than 1.35 dS/m in the soil samples tested within the expected footing depth range of 0.6m (exposure classification B2). The lowest soil pH was 4.4 (exposure classification B1). Design characteristic strength for concrete is a minimum 32MPa and minimum curing requirement is continuous curing for at least 7 days will be required for the most aggressive sites (Appendix 2). Minimum reinforcement cover for concrete in soils is 55mm (Appendix 2). Site specific testing should be undertaken to classify the soil for footing design and construction in accordance with AS2870-2011 and confirm exposure classification (Appendix 2).

9.3 Exposure classification for concrete

Soil saturated extract electrical conductivity (EC_e) was determined to be <4dS/m in the soil samples tested (Table 13). The soil pH ranged between 4.4 and 9.1. Exposure classification for concrete is B1. Minimum design characteristic strength for concrete is 32MPa and minimum curing requirement is continuous curing for at least 7 days (Appendix 2). Minimum reinforcement cover for concrete in soils is 55mm (Appendix 2).

10. Conclusions

The site had a pasture grazing land-use. No bare areas resulting from sheet erosion or salinity were identified. The risk of erosion is low

Soils on the site comprised topsoil of dark brown to brown silty clay to sandy clay loam. Subsoils were yellowish red to reddish brown fine sandy clay loam, sandy clay, light to medium clay to silty sand with increasing weathered basalt cobble and weathered rock with depth. Basalt cobbles and weathered rock consisting of quartz sandstone and olive basalt were encountered from varying depths over the site between 0.2 to 12.0m. The Dubbo (LEP) maps indicate the site is located within a vulnerable groundwater area.

The majority of the site is located within the Old Dubbo Road Hydrogeological Landscape (HGL). Lithology of the Old Dubbo Road HGL consists of Napperby Formation comprising siltstone thinly interbedded with fine to medium grained lithic quartz and minor conglomerates. This has been overlaid by colluvial and alluvial weathered basalt. The Old Dubbo Road HGL is generally non-saline.

An area in the north eastern section of the site is located in the Dubbo Basalt HGL. Lithology of the Dubbo Basalt HGL consists of Cainozoic basalt comprising in situ Olivine rich alkali basalt with

some colluvial material and quartzite derived from the underlying sandstone and siltstone. The investigation identified saline strata in the Dubbo Basalt HGL.

A small hillock is located within the north eastern section. The hillock comprises rounded quartz sandstone with hematite cementing and is expected to be part of the Purlawaugh Formation which is mapped to the north east of the site. The sandstone provides a geological contrast with the overlaying basalt and may provide potential sites for salt discharges at the sandstone/basalt interface.

Subsoils in the majority of the site were classified as non-saline to slightly saline. These areas correspond with the Old Dubbo Road HGL. Saline subsoils were identified in two boreholes (BH20 and BH8) located in the north eastern section at depths greater than 1m. Soil electrical conductivity generally increased with depth in the north east section. The location of saline soil corresponds with the Dubbo Basalt HGL.

Infiltration of groundwater over most of the site will not result in mobilisation of salts. Groundwater was encountered in MW1 located in the north eastern section of the site from 8.12m. Electrical conductivity of groundwater taken from MW1 was 4.6dS/m which under the Dubbo City Urban Salinity Implementation Plan is classed as moderately saline. No groundwater was identified in MW2 and MW3 to a depth of 10m on light clay.

No groundwater discharge areas were identified on the site. Potable and stock supply bores have been constructed in the locality. Bores in the locality generally have water bearing zones greater than 10m in gravels and sands. The majority of Dubbo City Council monitoring bores have been dry since the start of monitoring. Highly saline groundwater has been identified in one groundwater monitoring bore located west of the site.

Modelling of soil moisture levels over the past 34 years indicated variations in infiltration occur with the amount of rainfall pre and post development. Most land uses do not contribute to groundwater recharge in the CLASS U3M model. Overwatering of lawn has potential to increase recharge. The amount of irrigated lawn will be small over the area and quantity will not be significant. Over the site the infiltration will be reduced in the development. Reduced soil moisture is a result of the increase in runoff due to impermeable areas (roads, roofs, driveways) and increase in deep rooted vegetation extracting soil moisture from depth. The establishment of trees in strategic areas will offset any additional infiltration from lawn over watering.

The risk of groundwater contamination from the proposed land-use is equal or lower to the current land-use. Nitrogen contributions will decrease as a result of smaller available areas for fertilisation and a decrease in animal waste; domestic pet waste will generally be disposed off-site. Phosphorous and sediment contributions will also decrease and reduce the impact on site. Washing of cars on permeable areas will not be a significant contributor to nutrient levels. Reuse of greywater will be small volumes of unregulated use or larger volumes which require specific conditions or use of regulation by Council. Conditions of use and regulation will ensure overwatering does not occur.

No impact on groundwater including contamination and changed groundwater levels is expected from the development if recommendations are adopted. The development will not impact on quantity or quality of both unconfined and confined aquifers.

11. Recommendations

An Electromagnetic survey of the north eastern section of the site will provide data on the location of the sandstone/basalt interface. The location of the geological interface should be used to incorporate the planting of deep rooted vegetation into the final design of the subdivision.

Planning and development controls are recommended to prevent mobilisation of salt in the soil and groundwater resulting in on and off-site impacts. Controls include:

- Planting of trees in areas of lithological/hydrological interfaces as identified by the electromagnetic (EM) survey to minimise mobilisation of salt in the soil by rising groundwater tables.
- Establishment of parkland areas with native species which do not require irrigation
- Plantings of deep rooted vegetation along roads
- Plantings of deep rooted vegetation throughout the parkland
- Piping of surface water off-site
- Stormwater retention basins lined with an impermeable layer
- Design road levels similar to natural soil levels to minimise excavations
- Earthworks comprising cut should be minimised
- Excavated material with elevated salinity should be backfilled, utilised as fill under roads or disposed to landfill

11. Report limitations and intellectual property

This report has been prepared for the use of the client to achieve the objectives given the clients requirements. The level of confidence of the conclusion reached is governed by the scope of the investigation and the availability and quality of existing data. Where limitations or uncertainties are known, they are identified in the report. No liability can be accepted for failure to identify conditions or issues which arise in the future and which could not reasonably have been predicted using the scope of the investigation and the information obtained.

The investigation identifies the actual subsurface conditions only at those points where samples are taken, when they are taken. Data derived through sampling and subsequent laboratory testing is interpreted by geologists, engineers or scientists who then render an opinion about overall conditions, the nature and extent of likely impacts of the proposed development, and appropriate remediation measures. Actual conditions may differ from those inferred to exist, because no professional, no matter how well qualified, and no sub surface exploration program, no matter how comprehensive, can reveal what is hidden by earth, rock or time. The actual interface between materials may be far more gradual or abrupt than a report indicates. Actual conditions in areas not sampled may differ from predictions. It is thus import to understand the limitations of the investigation and recognise that we are not responsible for these limitations.

This report, including data contained, its findings and conclusions, remain the intellectual property of Envirowest Consulting Pty Ltd. A licence to use the report for the specific purpose identified is granted for the persons identified in that section after full payment for the services involved in preparation of the report. This report should not be used by persons or for purposes other than those stated, and not reproduced without the permission of Envirowest Consulting Pty Ltd.

12. References

Bureau of Meteorology (1975) Climatic Averages New South Wales, Dubbo

Chafer CJ (2003) Modelling Diffuse Source Pollutants in the Sydney Catchment Authorities Catchments Final Draft (SCA)

Charman PE and Murphy BW (2001) Soils: Their Properties and Management (Oxford University Press, South Melbourne)

Colquhoun GP, Meakin NS, Morgan EJ, Raymond OL, Scott MM, Watkins JJ *et al.* (1997) *Dubbo 1:250,000 Geological Sheet SI/55-04, 2nd Edition* (Geological Survey of New South Wales Sydney NSW)

DCC (2013a) Old Dubbo Road Estate Hydro-geological landscape (Dubbo City Council)

DCC (2013b) Dubbo Basalt Hydro-geological landscape (Dubbo City Council)

DCC (2013c) Dubbo City Urban Salinity Management Strategy (Dubbo City Council)

Humphries E (2000) Salinity Risk Assessment for the Central West Catchment (Macquarie, Castlereagh and Bogan Rivers) (A joint initiative of the Central West Catchment Committee and the Department of Land and Water Conservation, Wellington NSW)

Lillicrap A and McGhie S (2002) Site Investigation for Urban Salinity (Department of Land and Water Conservation, Sydney)

McGhie S (2003) *Building in a Saline Environment* (Department of Infrastructure, Planning and Natural Resources, Sydney)

Murphy BW and Lawrie JW (1998) Soil Landscapes of the Dubbo 1:250 000 Sheet Report, Department of Land and Water Conservation of NSW, Sydney

National Health and Medical Research Council & Agriculture and Resource Management Council of Australia and New Zealand (1996) *Australian Drinking Water Guidelines* (National Water Quality Management Strategy, Australia)

NSW Department of Primary Industries (2015) Continuous water monitoring network http://www.allwaterdata.water.nsw.gov.au/water

Piscope G and Dwyer J (2001) *Groundwater Vulnerability Map Series Macquarie Catchment* (Department of Land and Water Conservation)

Reid RL (1990) The Manual of Australian Agriculture (Butterworths, Sydney)

SaveWater (accessed 12 June 2014) www.savewater.com.au/hot-to-save-water/in-the-home/outdorr-and-vehicle-cleaning

Smithson, A (2010) Upper Macquarie Alluvium- Groundwater Management Area 009; Groundwater Status Report- 2010 (NSW Office of Water, Sydney)

Vaze J, Tuteja NK, Teng J (2004) CLASS U3M-1D (www.toolkit.net.au/class)

Figures

Figure 1. Locality map

Figure 2. Site plan

Figure 3. Hydro-geological Landscape plan

Figure 4. Groundwater vulnerability map - DECCW

Figure 5. Groundwater vulnerability map - DCC

Figure 6. Initial investigation locations

Figure 7. Detailed investigation locations

Figure 8. Lithology of the site

Figure 9. Location of groundwater bores within 2km of the site

Figure 10. Dubbo City Council Salinity Network

Figure 11. Soil analysis results for salinity

Figure 12. Soil moisture at 1m

Figure 13. Soil moisture at 3m

Figure 14. Photographs of the site









DUBBO GROUNDWATER VULNERABILITY MAP









Legenu Napporby Formation (siltatono)	Approximate Scale 1: 9,500
	U 90 190 380M
	Lot 399 DP1199356 and Lot 503 DP1152321 Dubbo NSW
Sandstone	
	Job: R5737c Drawn by: LD Date: 30/06/2015



		3 7		
Job – R5737s3	Drawn by: DL	Date: 30/06/2015		





Soil moisture (%) 0.22 0.24 0.26 0.34 0.36 0.38 0.28 0.32 0.3 1/01/1980 1/01/1981 1/01/1982 1/01/1983 1/01/1984 1/01/1985 1/01/1986 1/01/1987 1/01/1988 1/01/1989 Lawn 1/01/1990 1/01/1991 1/01/1992 pasture Soil Moisture at 1m 1/01/1993 1/01/1994 1/01/1995 trees 1/01/1996 1/01/1997 1/01/1998 verges 1/01/1999 1/01/2000 1/01/2001 1/01/2002 trees+1mm 1/01/2003 1/01/2004 Lots 1 and 3 DP1054104 Newell Highway, Dubbo NSW 1/01/2005 1/01/2006 Figure 12. Soil Moisture at 1m 1/01/2007 1/01/2008 1/01/2009 1/01/2010 1/01/2011 1/01/2012 1/01/2013 1/01/2014

Job - R5737s3

Drawn by: DL

Date: 30/06/2015

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Page 48
Figure 13. Soil moisture at 3m





Figure 14. Photographs of the site



Looking north east across paddocks

North over central section of the site



Looking south over wet area

Looking south west over the site

Appendices

Appendix 1. Nutrient and sediment modelling

Appendix 2. Aggressive soils, extract from Australia Standards, AS 2870-2011, 2011

Appendix 3. Details of registered bores within 1km of the site - NSW Department of Primary Industries

Appendix 4. Salinity results from the Dubbo City Council Salinity Network

Appendix 5. Initial site investigation characteristics

Appendix 6. Field and laboratory sheets

Appendix 7. Reference methods for soil testing

Appendix 8. ALS laboratory report ES1520581 and chain of custody form

Appendix 1. Nutrient and sediment modelling

Land-use export rates for sediments, nitrogen and phosphorus mg/kg/year (Chafer 2003)

	Suspended sediment (kg/na/yr)	
Land use class	Low	Median	High
Native bushland	20	40	60
Disturbed landscapes	330	870	2290
Remediated gullies	165	435	1145
Cropped	420	570	720
Pine plantations	65	380	680
Improved pasture	140	520	870
Unimproved pasture	140	190	230
Roads (sealed)	140	190	230
Roads (earth)	25	140	500
Urban	30	300	1200
Urban (open space)	160	360	1000
Rural residential	140	190	230
Industrial	180	200	4800
Commercial	180	200	4800
Golf course	0	10	20
Orchard	490	680	870

Land use classLowMedianHighNative bushland0.92.44Disturbed landscapes4.21220Remediated gullies2.1610Cropped4.28.913.5Pine plantations0.82.98.3Improved pasture4.28.913.5Unimproved pasture1.33.25.1Roads (sealed)2610Roads (earth)1.32.23.1Urban2.26.110
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Roads (earth) 1.3 2.2 3.1 Urban 2.2 6.1 10 Urban 2.2 5.1 5.1
Urban 2.2 6.1 10
Urban (open space) 1.3 3.2 5.1
Rural residential 2.2 6.1 10
Industrial 4 7.4 10
Commercial 4 7.4 10
Golf course 0 3.2 5
Orchard 1.7 8.9 5

Total Phosphorus			
Land use class	Low	Median	High
Native bushland	0.01	0.13	0.25
Disturbed landscapes	0.3	1.24	2.2
Remediated gullies	0.15	0.62	1.1
Cropped	0.5	1.35	2.2
Pine plantations	0.1	1.16	2.5
Improved pasture	0.5	1.35	2.2
Unimproved pasture	0.1	0.17	0.25
Roads (sealed)	0.3	1.8	3.4
Roads (earth)	0.3	1.72	3.2
Urban	0.2	1.82	3.6
Urban (open space)	0.1	0.17	0.25
Rural residential	0.2	1.72	3.6
Industrial	1.4	1.82	2.2
Commercial	1.4	1.8	2.2
Golf course	0	0.3	3.6
Orchard	0.1	0.3	0.5

Sediment export kg/yr

LOW	PRE	POST	IMPACT
Native bushland	0.00	248.00	-248.00
Disturbed landscapes	6567.00	0.00	6567.00
Remediated gullies	0.00	1237.50	-1237.50
Cropped	0.00	0.00	0.00
Pine plantations	0.00	0.00	0.00
Improved pasture	15483.02	0.00	15483.02
Unimproved pasture	0.00	0.00	0.00
Roads (sealed)	0.00	3514.00	-3514.00
Roads (earth)	12.68	0.00	12.68
Urban	0.00	690.00	-690.00
Urban (open space)	0.00	10080.00	-10080.00
Rural residential	0.00	0.00	0.00
Industrial	0.00	0.00	0.00
Commercial	0.00	0.00	0.00
Golf course	0.00	0.00	0.00
Orchard	0.00	0.00	0.00
TOTAL	22062.70	15769.50	6293.20

MEDIAN	PRE	POST	IMPACT
Native bushland	0.00	496.00	-496.00
Disturbed landscapes	17313.00	0.00	17313.00
Remediated gullies	0.00	3262.50	-3262.50
Cropped	0.00	0.00	0.00
Pine plantations	0.00	0.00	0.00
Improved pasture	57508.36	0.00	57508.36
Unimproved pasture	0.00	0.00	0.00
Roads (sealed)	0.00	4769.00	-4769.00
Roads (earth)	70.98	0.00	70.98
Urban	0.00	6900.00	-6900.00
Urban (open space)	0.00	22680.00	-22680.00
Rural residential	0.00	0.00	0.00
Industrial	0.00	0.00	0.00
Commercial	0.00	0.00	0.00
Golf course	0.00	0.00	0.00
Orchard	0.00	0.00	0.00
TOTAL	74892.34	38107.50	36784.84

HIGH	PRE	POST	IMPACT
Native bushland	0.00	744.00	-744.00
Disturbed landscapes	45571.00	0.00	45571.00
Remediated gullies	0.00	8587.50	-8587.50
Cropped	0.00	0.00	0.00
Pine plantations	0.00	0.00	0.00
Improved pasture	96215.91	0.00	96215.91
Unimproved pasture	0.00	0.00	0.00
Roads (sealed)	0.00	5773.00	-5773.00
Roads (earth)	253.50	0.00	253.50
Urban	0.00	27600.00	-27600.00
Urban (open space)	0.00	63000.00	-63000.00
Rural residential	0.00	0.00	0.00
Industrial	0.00	0.00	0.00
Commercial	0.00	0.00	0.00
Golf course	0.00	0.00	0.00
Orchard	0.00	0.00	0.00
TOTAL	142040.41	105704.50	36335.91

Total Nitrogen kg/yr			
LOW	PRE	POST	IMPACT
Native bushland	0.00	0.00	0.00
Disturbed landscapes	83.58	0.00	83.58
Remediated gullies	0.00	15.75	-15.75
Cropped	0.00	0.00	0.00
Pine plantations	0.00	0.00	0.00
Improved pasture	464.49	0.00	464.49
Unimproved pasture	0.00	0.00	0.00
Roads (sealed)	0.00	50.20	-50.20
Roads (earth)	0.66	0.00	0.66
Urban	0.00	50.60	-50.60
Urban (open space)	0.00	81.90	-81.90
Rural residential	0.00	0.00	0.00
Industrial	0.00	0.00	0.00
Commercial	0.00	0.00	0.00
Golf course	0.00	0.00	0.00
Orchard	0.00	0.00	0.00
TOTAL	548.73	198.45	350.28
MEDIAN	PRE	POST	IMPACT
Native bushland	0.00	29.76	-29.76
Disturbed landscapes	238.80	0.00	238.80
Remediated gullies	0.00	45.00	-45.00
Cropped	0.00	0.00	0.00
Pine plantations	0.00	0.00	0.00
Improved pasture	984.28	0.00	984.28
Unimproved pasture	0.00	0.00	0.00
Roads (sealed)	0.00	150.60	-150.60
Roads (earth)	1.12	0.00	1.12
Urban	0.00	140.30	-140.30
Urban (open space)	0.00	201.60	-201.60
Rural residential	0.00	0.00	0.00
Industrial	0.00	0.00	0.00
Commercial	0.00	0.00	0.00
Golf course	0.00	0.00	0.00
Orchard	0.00	0.00	0.00
TOTAL	1224.19	567.26	606.93
нен	DRE	POST	IMPACT
Native bushland	0.00	49.60	
Disturbed landscapes	398.00		398.00
Remediated gullies	0.00	75.00	-75.00
Cronned	0.00	0.00	0.00
Pine plantations	0.00	0.00	0.00
Improved pasture	1493.01		1493.01
Unimproved pasture	0.00	0.00	0.00
Roads (sealed)	0.00	251.00	-251.00
Roads (earth)	1 57	<u>201.00</u> Ω ΩΩ	-201.00
Urban	0.00	230.00	-230.00
Urban (open space)	0.00	321 30	-321 30
Rural residential	0.00	021.00	-021.00 0.00
Industrial	0.00		0.00
Commercial	0.00	0.00	0.00
Golf course	0.00	0.00	0.00
Orchard	0.00	0.00	0.00
ΤΟΤΔΙ	1892 58	926.90	965.68

Total Phosphorus kg/yr			
LOW	PRE	POST	IMPACT
Native bushland	0.00	0.12	-0.12
Disturbed landscapes	5.97	0.00	5.97
Remediated gullies	0.00	1.13	-1.13
Cropped	0.00	0.00	0.00
Pine plantations	0.00	0.00	0.00
Improved pasture	55.30	0.00	55.30
Unimproved pasture	0.00	0.00	0.00
Roads (sealed)	0.00	7.53	-7.53
Roads (earth)	0.15	0.00	0.15
Urban	0.00	4.60	-4.60
Urban (open space)	0.00	6.30	-6.30
Rural residential	0.00	0.00	0.00
Industrial	0.00	0.00	0.00
Commercial	0.00	0.00	0.00
Golf course	0.00	0.00	0.00
Orchard	0.00	0.00	0.00
TOTAL	61.42	19.68	41.74
MEDIAN	PRE	POST	IMPACT
Native bushland	0.00	1.61	-1.61
Disturbed landscapes	24.68	0.00	24.68
Remediated gullies	0.00	4.65	-4.65
Cropped	0.00	0.00	0.00
Pine plantations	0.00	0.00	0.00
Improved pasture	149.30	0.00	149.30
Unimproved pasture	0.00	0.00	0.00
Roads (sealed)	0.00	45.18	-45.18
Roads (earth)	0.87	0.00	0.87
Urban	0.00	41.86	-41.86
Urban (open space)	0.00	10.71	-10.71
Rural residential	0.00	0.00	0.00
Industrial	0.00	0.00	0.00
Commercial	0.00	0.00	0.00
Golf course	0.00	0.00	0.00
Orchard	0.00	0.00	0.00
TOTAL	174.85	104.01	70.84
HIGH	PRE	POST	IMPACT
Native bushland	0.00	3.10	-3.10
Disturbed landscapes	43.78	0.00	43.78
Remediated gullies	0.00	8.25	-8.25
Cropped	0.00	0.00	0.00
Pine plantations	0.00	0.00	0.00
Improved pasture	243.30	0.00	243.30
Unimproved pasture	0.00	0.00	0.00
Roads (sealed)	0.00	85.34	-85.34
Roads (earth)	1.62	0.00	1.62
Urban	0.00	82.80	-82.80
Urban (open space)	0.00	15.75	-15.75
Rural residential	0.00	0.00	0.00
Industrial	0.00	0.00	0.00
Commercial	0.00	0.00	0.00
Golf course	0.00	0.00	0.00
Orchard	0.00	0.00	0.00
ΤΟΤΑΙ	288.71	195.24	93.47

Appendix 2. Aggressive soils, extract from Australian Standards, AS 2870-2011, 2011

Exposure classification for concrete in saline	SOIIS	
Saturated extract electrical conductivity (ECe),	Exposure classification	
dS/m		
<4	A1	
4-8	A2	
8-16	B1	
>16	B2	

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Notes:

1. Guidance on concrete in saline soils can be found in CCAA T56

2. Exposure classifications are from AS 3600

3. The currently accepted method of determining the salinity level of the soil is by measuring the extract electrical conductivity (EC) of a soil and water mixture in deciSiemens per metre (dS/m) and using conversion factors that allow for the soil texture, to determine the saturated extract electrical conductivity (ECe)

4. The division between a non-saline and saline soil is generally regarded as an EC, value of 4dS/m, therefore no increase in the minimum concrete strength is required below this value

Exposure classification for concrete in sulfate soils

Exposure conditions		Exposure classification		
Sulfates (e:	xpressed as SO ₄)*	рН	Soil conditions	Soil conditions
In soil (ppm)	In groundwater (ppm)		A**	B†
<5,000	<1,000	>5.5	A2	A1
5,000-10,000	1,000-3,000	4.5-5.5	B1	A2
10,000-20,000	3,000-10,000	4-4.5	B2	B1
>20,000	>10,000	<4	C2	B2

Approximately 100ppm SO₄ = 80ppm SO₃

** Soil conditions A - high permeability soils (e.g. sands and gravels) that are in groundwater

† Soil conditions B - low permeability soils (e.g. silts and clays) or all soils above groundwater

Minimum design characteristic strength (f_c) and curing requirements for concrete

assification Minimum f_c MPa Minimum	n initial curing requirement
1 20 Cure cent	inuquely for at least 2 days
2 25 Cule cont	indusivitor at least 5 days
1 32	
2 40 Cure o	continuously for at least
1 ≥50	7 days
2 ≥50	

Minimum reinforcement cover for concrete

Exposure classification	Minimum cover in saline soils * mm	Minimum cover in sulfate soils ** (mm)
A1	See Clause 5.3.2	40
A2	45	50
B1	50	60
B2	55	65
C1	†	70
C2	†	85

* Where a damp-proofing membrane is installed, the minimum reinforcement cover in saline soils may be reduced to 30mm.

** Where a damp-proofing membrane is installed, the minimum reinforcement cover in sulfate soils may be reduced by 10mm.

Saline soils have a maximum exposure classification of B2. †

Appendix 3. Details of registered bores within 1km of the site – NSW Department of Primary Industries.

Bore record No. (Figure 9)	Eastings	Northings	Drilled / Completed depth (m)	Salinity description	Water bearing zones (m)	Standing water level (m)	Date drilled and or tested	Purpose
GW802625	654071	6429259	3.5	-	2.5-3.5	-	2006	Monitoring
GW802554	654491	6428905	9	-	6.5-7.5	-	2004	Monitoring
GW801343	654944	6428486	59	-	-	-	1992	Unknown
GW801344	655053	6428466	32	-	-	-	1992	Unknown
GW801345	655153	6428459	34	-	-	-	1992	Unknown
GW044627	655566	6428489	68.6	-	-	-	1975	Domestic / Stock
GW802528	654952	6428393	3	-	2-3	2.9	2004	Monitoring
GW005558	654961	6428252	57.9	-	26.2-33.8	18.3	1959	Stock
GW801338	654839	6428083	149	-	-	-	1992	Unknown
GW801339	655140	6428060	29	-	-	-	1992	Unknown
GW011014	655192	6428002	67.1	-	57.9-60.9	-	1954	Stock
GW801341	655069	6427708	83	-	-	-	1992	Unknown
GW066591	654792	6427484	93	-	-	-	1990	Domestic/ Stock
GW801342	654991	6427237	72	-	-	-	1991	Unknown
GW055351	654606	6427302	-	-	-	-	-	Stock
GW801337	654636	6426994	65	-	-	-	1992	Unknown
GW801340	654937	6426884	53	-	-	-	1992	Unknown
GW060589	654612	6425978	12.5	-	-	-	-	Stock
GW037126	654588	6426101	57.9	-	16.7-20.6	6	1973	Public/ test
GW042708	654431	6426104	49.3	Good	7-23.7	6.7	1974	Town water supply
GW801334	654198	6426159	46	-	13-35	12.9	2001	Town water supply
GW043755	654223	6426199	61	Good	7.9-20.7	6	1973	Test
GW035817	653989	6426295	54.8	-	6-25.2	5.1	1973	Test
GW043754	654147	6426385	76.2	-	40.8-46.8	6	1973	Test
GW042707	653923	6426548	46.6	0-500ppm	41.1-46.5	7	1974	Town water
GW096140	653928	6426550	48	-	41.2-47	15.9	2003	Town water
GW043753	654020	6426603	68.5	-	15.2-22.8	7.2	1973	Test bore
GW043756	653652	6426516	44.5	-	26.5-37.1	6.2	1973	Public
GW034418	653391	6426551	-	-	12.2-21.3	7	1971	Test
GW034419	653260	6426553	-	-	14.3-24.3	7	1971	Test
GW034417	653181	6426523	-	-	8.5-16.1	6.9	1971	Town water
GW025041	653261	6426614	25.9	0-500ppm	-	-	1967	Monitoring
GW061110	652814	6426436	19.6	-	9.1-19.8	7.6	1985	Stock/ Domestic
GW800145	653525	6426734	52	Good	18-21	-	1995	Irrigation
GW803538	653432	6426838	48	-	25-34	18.9	2005	Irrigation
GW805136	652978	6426719	32	Good	20-23	16.4	2013	Domestic
GW800933	652895	6426766	36.9	-	-	-	1993	Domestic
GW008319	652662	6426777	21.6	-	16.5-18.9	13.1	1952	Stock/ Domestic
GW060587	653031	6426957	33	-	15.5-15.7	14	1986	Stock/ Domestic
GW034416	653112	6427140	-	-	12.2-14.9	-	1971	Town water
GW025415	652987	6427191	59.2	-	18-20.4	17.7	1970	Town water
GW025413	652905	6427222	64.6	0-500ppm	6.7-11	-	1969	Monitoring

Bore record No. (Figure 9)	Eastings	Northings	Drilled / Completed depth (m)	Salinity description	Water bearing zones (m)	Standing water level (m)	Date drilled and or tested	Purpose
GW034415	652694	6427208	-	-	24.7-25.6	22.9	1971	Town water
GW018573	652404	6427028	22.9	-	18.3-22.9	9.1	1961	Stock/ Domestic
GW060620	652405	6427029	12.2	-	-	-	1884	Domestic
GW803561	652676	6427357	50	-	32-37	35.7	2008	Domestic
GW803584	652868	6427344	60	-	38-44	32	2008	Stock/ Domestic
GW802721	652959	6427398	58	Good	38-44.5	-	2003	Domestic
GW803562	652845	6427430	60	-	38-44	32	2008	Domestic
GW803657	652622	6427371	63	Good	45.5-61.5	35.7	2008	Domestic
GW804247	652248	6427461	9	-	-	-	2010	Monitoring
GW042221	652124	6427586	21.3	Good	-	-	-	Domestic
GW802965	652672	6427483	67	-	46-52	32	2005	Domestic
GW804246	652562	6427707	9	0-500ppm	-	-	2010	Monitoring
GW021498	652883	6427575	74.7	-	30.8-52.7	-	1967	Monitoring
GW802596	653119	6427476	6	-	3.5-5	-	2006	Monitoring
GW802529	653402	6427335	15	-	12-13	14.72	2004	Monitoring
GW058296	653743	6427346	29.5	-	19.8-29.5	19.8	1983	Stock/ Domestic
GW055350	653851	6427529	21.6	-	-	-	-	Stock/ Domestic
GW043751	653118	6427541	59.1	Good	29.8-49	15.2	1973	Test
GW030056	653095	6427726	79.2	-	39.9-46.3	14.6	1970	Test
GW021496	653093	6427603	-	-	-	-	1967	Monitoring
GW802620	653174	6427798	6	-	5-6	5.47	2005	Monitoring
GW802622	6528240	6428144	8	-	-	-	2005	Monitoring
GW003918	652944	6428129	45.4	Fresh	44.2-43	28.7	-	Stock/ Domestic
GW804712	653140	6428170	52	Good	42-49	32.8	2011	Domestic
GW055352	653469	6428244	-	-	-	-	-	Stock
GW060617	652921	6428375	33.5	-	-	-	1884	Stock/ Domestic
GW801091	653375	6428652	36	-	-	-	-	Industrial/ Irrigation
GW802624	653684	6428788	9	-	7-9	-	2005	Monitoring
GW042218	653505	6428921	18.3	-	-	-	1953	Stock/ Domestic

Dubbo City Council Salinity Network site number		DCC18	DCC19	DCC20	DCC21	DCC42	DCC44	DCC45	DCC49	DCC53	DCC58	DCC59	DCC62	DCC64	DCC87	DCC111	DCC115	DCC116	DCC124
(Figure 10) Sampling date	Drilled depth (m)	15	3	15	15	2	6	9	15	9	15	3	9	3	6	6	9	3.5	15
Mar-05	EC(dS/m)	-	TSTB	TSTB	-	-	-	-	-	-	-	-	0.10	-	-	-	-	-	-
	SWL (m)	DRY	2.9	14.72	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	5.06	DRY	DRY	5.46	DRY	DRY	DRY
Apr-05	EC(dS/m) SWL (m)	- 5.91	TSTB 2.83	- 14.57	- DRY	- 0.2	TSTB 6	0.3 6.8	- DRY	- DRY	- DRY	TSTB 3	25.20 4.80	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY
May-05	EC(dS/m) SWL (m)	DRY	- DRY	- 14.9	- DRY	- DRY	- DRY	0.3 5.87	- DRY	- DRY	- DRY	- DRY	12.10 4.85	- DRY	DRY	- DRY	- DRY	- DRY	DRY
Jun-05	EC(dS/m)	-	-	-	-	-	-	1.4	-	-	-	-	11.40	-	-	-	-	-	-
	SWL (m)	DRY	DRY	DRY	DRY	DRY	DRY	5.95	DRY	DRY	DRY	DRY	4.75	DRY	DRY	DRY	DRY	DRY	DRY
Jul-05	EC(dS/m)	-	-	-	-	-	-	1.3	-	-	-	-	11.40	-	-	-	0.3	-	-
	SWL (m)	DRY	DRY	DRY	DRY	DRY	DRY	6.9	DRY	DRY	DRY	DRY	4.76	DRY	DRY	DRY	7.01	DRY	DRY
Aug-05	EC(dS/m)	-	-	-	-	-	-	1.3	-	-	-	-	11.30	-	-	-	0.4	-	-
	SWL (m)	DRY	DRY	DRY	DRY	DRY	DRY	7.4	DRY	DRY	DRY	DRY	4.77	DRY	DRY	DRY	8.0	DRY	DRY
Sep-05	EC(dS/m)	-	-	-	-	-	-	-	-	-	-	-	10.90	-	-	-	0.1	-	-
	SWL (m)	DRY	DRY	DRY	DRY	DRY	DRY	8.76	DRY	DRY	DRY	DRY	4.88	DRY	DRY	DRY	5.87	DRY	DRY
Oct-05	EC(dS/m)	-	-	-	-	-	-	0.9	-	-	-	-	11.10	-	-	-	0.2	0.7	0.3
	SWL (m)	DRY	DRY	DRY	DRY	DRY	DRY	7.45	DRY	DRY	DRY	DRY	4.89	2.75	DRY	DRY	6.37	2.44	14.3
Nov-05	EC(dS/m) SWL (m)	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- 7.4	- DRY	- DRY	- DRY	- DRY	10.60 4.40	- DRY	DRY	1.00 3.81	0.2 6.4	- DRY	- DRY
Dec-05	EC(dS/m)	-	-	-	-	-	-	DRY	-	-	-	-	10.40	-	-	0.80	-	-	-
	SWL (m)	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	4.22	DRY	DRY	3.71	DRY	DRY	DRY
Jan-06	EC(dS/m)	-	-	-	-	-	-	DRY	-	-	-	-	9.80	-	-	0.90	0.3	-	-
	SWL (m)	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	4.10	DRY	DRY	4.04	8.0	DRY	DRY
Feb-06	EC(dS/m) SWL (m)	- DRY	- DRY	TSTB	- DRY	- DRY	- DRY	TSTB 8.75	- DRY	- DRY	- DRY	- DRY	10.30 3.90	- DRY	- DRY	0.90 3.80	TSTB 8.5	TSTB 3.26	- DRY
Mar-06	EC(dS/m) SWL (m)	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	DRY DRY	- DRY	- DRY	- DRY	- DRY	10.80 3.89	- DRY	DRY	0.90 4.00	- DRY	- DRY	DRY
Apr-06	EC(dS/m) SWL (m)	- DRY	DRY	- DRY	DRY	- DRY	- DRY	0.9 4.6	- DRY	- DRY	- DRY	- DRY	10.10 3.85	- DRY	DRY	1.40 4.53	DRY	- DRY	- DRY

Appendix 4. Salinity and Standing Water Level (SWL) data from Dubbo City Council Salinity Network

Dubbo City Council Salinity Network site number (Figure 10)		DCC18	DCC19	DCC20	DCC21	DCC42	DCC44	DCC45	DCC49	DCC53	DCC58	DCC59	DCC62	DCC64	DCC87	DCC111	DCC115	DCC116	DCC124
Sampling date	Drilled depth (m)	15	3	15	15	2	6	9	15	9	15	3	9	3	6	6	9	3.5	15
May-06	EC(dS/m)	-	-	-	-	-	-	0.7	-	-	-	-	10.40	-	-	1.10	-	TSTB	-
	SWL (m)	DRY	DRY	DRY	DRY	DRY	DRY	3.29	DRY	DRY	DRY	DRY	3.95	DRY	DRY	4.98	DRY	3.26	DRY
Jun-06	EC(dS/m)	-	-	-	-	-	-	1.0	-	-	-	-	11.20	-	-	1.00	-	TSTB	-
	SWL (m)	DRY	DRY	DRY	DRY	DRY	DRY	4.25	DRY	DRY	DRY	DRY	4.17	DRY	DRY	5.30	DRY	3.3	DRY
Jul-06	EC(dS/m)	-	-	-	-	-	-	0.9	-	-	-	-	4.56	-	-	TSTB	0.1	-	-
	SWL (m)	DRY	DRY	DRY	DRY	DRY	DRY	2.87	DRY	DRY	DRY	DRY	10.20	DRY	DRY	5.81	5.75	DRY	DRY
Aug-06	EC(dS/m)	-	-	-	-	-	-	0.8	-	-	-	-	9.90	-	-	-	0.3	-	-
	SWL (m)	DRY	DRY	DRY	DRY	DRY	DRY	7.42	DRY	DRY	DRY	DRY	4.56	DRY	DRY	DRY	7.59	DRY	DRY
Sep-06	EC(dS/m)	-	-	-	-	-	-	0.9	-	-	-	-	10.20	-	-	-	-	-	-
	SWL (m)	DRY	DRY	DRY	DRY	DRY	DRY	8.45	DRY	DRY	DRY	DRY	4.65	DRY	DRY	DRY	DRY	DRY	DRY
Oct-06	EC(dS/m)	-	-	-	-	-	-	-	-	-	-	-	10.80	-	-	-	-	-	-
	SWL (m)	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	4.52	DRY	DRY	DRY	DRY	DRY	DRY
Nov-06	EC(dS/m)	-	-	-	-	-	-	-	-	-	-	-	10.90	-	-	-	-	-	-
	SWL (m)	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	4.42	DRY	DRY	DRY	DRY	DRY	DRY
Dec-06	EC(dS/m)	-	-	-	-	-	-	-	-	-	-	-	11.50	-	-	-	-	-	-
	SWL (m)	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	4.40	DRY	DRY	DRY	DRY	DRY	DRY
Jan-07	EC(dS/m)	-	-	-	-	-	-	0.8	-	TSTB	-	-	13.60	-	-	-	-	TSTB	TSTB
	SWL (m)	DRY	DRY	DRY	DRY	DRY	DRY	7.5	DRY	8 80	DRY	DRY	4.16	DRY	DRY	DRY	DRY	3 29	14 83
Feb-07	EC(dS/m)	- DRY	- DRY		- DRY			0.9	- DRY	TSTB 8.82	- DRY		10.90 4 43	- DRY	- DRY		- DRY	TSTB 33	TSTB 14 74
Mar-07	EC(dS/m)						- DRY	0.8		TSTB 8 75			13.20				- DRY		TSTB 14 76
Apr-07	EC(dS/m)							1.8		TSTB 8 81			13.60					TSTB	TSTB
May-07	EC(dS/m)	- -	- -	- -	-	-		0.8		TSTB		- -	13.50	-			TSTB	TSTB	TSTB
Jun-07	EC(dS/m) SWL (m)	TSTB 4.59	TSTB 2.79	- DRY	DRY	- DRY	- DRY	0.7 7.47	- DRY	0.02 TSTB 8.85	- DRY	- DRY	4.20 11.00 3.85	- DRY	- DRY	- DRY	- 5.47	3.3 TSTB 3.32	TSTB 14.65

Dubbo City Council Salinity Network site number (Figure 10)		DCC18	DCC19	DCC20	DCC21	DCC42	DCC44	DCC45	DCC49	DCC53	DCC58	DCC59	DCC62	DCC64	DCC87	DCC111	DCC115	DCC116	DCC124
Sampling date	Drilled depth (m)	15	3	15	15	2	6	9	15	9	15	3	9	3	6	6	9	3.5	15
Jul-07	EC(dS/m)	-	-	-	-	-	-	0.9	-	-	-	-	13.10	-	-	-	-	TSTB	TSTB
	SWL (m)	DRY	DRY	DRY	DRY	DRY	DRY	7.62	DRY	DRY	DRY	DRY	4.10	DRY	DRY	DRY	DRY	3.25	14.79
Aug-07	EC(dS/m)	1.7	TSTB	1.00	-	-	-	0.9	-	TSTB	-	-	8.30	-	-	1.00	-	-	-
	SWL (m)	4.52	2.69	14.36	DRY	DRY	DRY	7.31	DRY	8.61	DRY	DRY	3.60	DRY	DRY	7.53	DRY	DRY	DRY
Sep-07	EC(dS/m)	TSTB	TSTB	-	-	-	-	0.9	-	TSTB	-	-	8.70	-	-	1.00	-	-	-
	SWL (m)	5.85	2.75	17.61	DRY	DRY	DRY	7.33	DRY	8.68	DRY	DRY	3.35	DRY	DRY	4.86	DRY	DRY	DRY
Oct-07	EC(dS/m)	-	-	-	-	-	-	TSTB	-	-	-	-	8.80	-	-	-	-	-	-
	SWL (m)	DRY	DRY	DRY	DRY	DRY	DRY	8.69	DRY	DRY	DRY	DRY	3.87	DRY	DRY	DRY	DRY	DRY	DRY
Nov-07	EC(dS/m)	-	-	-	-	-	-	TSTB	-	-	-	-	13.10	-	-	-	-	-	-
	SWL (m)	DRY	DRY	DRY	DRY	DRY	DRY	8.74	DRY	DRY	DRY	DRY	3.83	DRY	DRY	DRY	DRY	DRY	DRY
Dec-07	EC(dS/m)	-	-	-	-	-	-	TSTB	-	-	-	-	13.70	-	-	-	-	-	-
	SWL (m)	DRY	DRY	DRY	DRY	DRY	DRY	8.28	DRY	DRY	DRY	DRY	4.34	DRY	DRY	DRY	DRY	DRY	DRY
Jan-08	EC(dS/m)	-	-	-	-	-	-	TSTB	-	TSTB	-	-	13.50	-	-	-	-	TSTB	-
	SWL (m)	DRY	DRY	DRY	DRY	DRY	DRY	7.79	DRY	8.80	DRY	DRY	4.17	DRY	DRY	DRY	DRY	3.29	DRY
Feb-08	EC(dS/m)	-	-	-	-	-	-	DRY	-	-	-	-	7.90	-	-	0.90	-	-	-
	SWL (m)	DRY	DRY	DRY	DRY	DRY	3.06	DRY	DRY	3.16	DRY	DRY	DRY						
Mar-08	EC(dS/m)	-	-	-	-	-	-	0.5	,≂))	-	-	-	7.20	2	-	0.90	-	-	-
	SWL (m)	DRY	DRY	DRY	DRY	DRY	DRY	7.44	≂1	DRY	DRY	DRY	3.14	2	DRY	3.44	DRY	DRY	DRY
Apr-08	EC(dS/m) SWL (m)	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	DRY DRY		- DRY	- DRY	- DRY	7.60 3.20)=))#)	- DRY	0.90 4.00	- DRY	- DRY	- DRY
May-08	EC(dS/m) SWL (m)	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	DRY DRY		- DRY	- DRY	- DRY	7.70 3.45		- DRY	0.90 4.70	- DRY	- DRY	- DRY
Jun-08	EC(dS/m) SWL (m)	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	DRY DRY		- DRY	- DRY	- DRY	7.70 3.65	-	- DRY	0.90 5.05	- DRY	- DRY	- DRY
Jul-08	EC(dS/m) SWL (m)	- DRY	=:	- DRY	- DRY	- DRY	7.65 3.04	19 19	- DRY	1.10 5.00	- DRY	- DRY	- DRY						
Aug-08	EC(dS/m) SWL (m)	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	7.9 6.25		- DRY	- DRY	- DRY	7.50 3.51	-	- DRY	0.85 5.00	- DRY	- DRY	- DRY

Dubbo City Council Salinity Network site number (Figure 10)		DCC18	DCC19	DCC20	DCC21	DCC42	DCC44	DCC45	DCC49	DCC53	DCC58	DCC59	DCC62	DCC64	DCC87	DCC111	DCC115	DCC116	DCC124
Sampling date	Drilled depth (m)	15	3	15	15	2	6	9	15	9	15	3	9	3	6	6	9	3.5	15
Sep-08	EC(dS/m) SWL (m)	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	0.9 6.56		- DRY	- DRY	- DRY	7.90 3.83	-	- DRY	- DRY	0.2 6.2	- DRY	- DRY
Oct-08	EC(dS/m) SWL (m)	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	-	- DRY	- DRY	- DRY	7.65 3.05	-	- DRY	1.10 5.01	- DRY	- DRY	- DRY
Nov-08	EC(dS/m) SWL (m)	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	0.7 7.4		- DRY	- DRY	- DRY	10.00 3.28	ж ж	- DRY	- DRY	0.2 6.08	- DRY	- DRY
Dec-08	EC(dS/m) SWL (m)	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	1.0 8.47	-	- DRY	- DRY	- DRY	9.60 3.62	-	- DRY	- DRY	0.5 7.32	- DRY	- DRY
Jan-09	EC(dS/m)	-	-	-	-	-	-	-	New	-	-	-	9.20	New	-	-	-	-	-
	SWL (m)	DRY	DRY	DRY	DRY	DRY	DRY	DRY	bore	DRY	DRY	DRY	3.60	bore	DRY	DRY	DRY	DRY	DRY
Feb-09	EC(dS/m) SWL (m)	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	DRY	- DRY	- DRY	- DRY	- DRY	9.30 3.55	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY
Mar-09	EC(dS/m)	-	-	-	-	-	-	1.01	TSTB	TSTB	-	-	8.63	TSTB	-	1.16	-	-	TSTB
	SWL (m)	DRY	DRY	DRY	DRY	DRY	DRY	6.6	11.38	8.70	DRY	DRY	3.53	2.45	DRY	4.15	DRY	DRY	14.74
Apr-09	EC(dS/m)	-	-	-	-	-	-	1.14	-	-	-	-	8.41	-	-	1.16	-	-	-
	SWL (m)	DRY	DRY	DRY	DRY	DRY	DRY	7.41	DRY	DRY	DRY	DRY	3.62	DRY	DRY	4.15	DRY	DRY	DRY
May-09	EC(dS/m)	-	-	TSTB	-	-	-	-	-	-	-	-	8.84	-	-	1.15	-	-	-
	SWL (m)	DRY	DRY	14.61	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	3.75	DRY	DRY	4.35	DRY	DRY	DRY
Jun-09	EC(dS/m)	-	-	-	-	-	-	-	-	-	-	-	8.60	-	-	-	-	-	-
	SWL (m)	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	3.81	DRY	DRY	DRY	DRY	DRY	DRY
Jul-09	EC(dS/m)	-	-	TSTB	-	-	-	0.96	-	-	-	-	8.87	-	1.99	1.02	-	-	-
	SWL (m)	DRY	DRY	14.70	DRY	DRY	DRY	7.35	DRY	DRY	DRY	DRY	4.00	DRY	4.88	4.56	DRY	DRY	DRY
Aug-09	EC(dS/m)	-	-	TSTB	-	-	-	1.08	-	TSTB	-	-	9.72	-	2.47	1.19	-	-	-
	SWL (m)	DRY	DRY	14.78	DRY	DRY	DRY	7.96	DRY	8.72	DRY	DRY	4.08	DRY	5.13	4.70	DRY	DRY	DRY
Sep-09	EC(dS/m)	-	-	-	-	-	-	1.23	-	-	-	-	9.54	-	2.69	1.26	-	-	-
	SWL (m)	DRY	DRY	DRY	DRY	DRY	DRY	8.15	DRY	DRY	DRY	DRY	4.24	DRY	5.37	4.86	DRY	DRY	DRY
Oct-09	EC(dS/m)	-	-	TSTB	-	-	-	TSTB	-	-	-	-	9.94	-	2.41	1.11	0.52	-	-
	SWL (m)	DRY	DRY	14.77	DRY	DRY	DRY	8.79	DRY	DRY	DRY	DRY	4.15	DRY	4.64	4.81	7.38	DRY	DRY
Nov-09	EC(dS/m) SWL (m)	- DRY	- DRY	TSTB 14.78	- DRY	- DRY	- DRY	1.5 8.52	- DRY	- DRY	- DRY	- DRY	9.67 4.10	- DRY	- DRY	1.53 5.01	DRY	- DRY	DRY

Dubbo City Council Salinity Network site number (Figure 10)		DCC18	DCC19	DCC20	DCC21	DCC42	DCC44	DCC45	DCC49	DCC53	DCC58	DCC59	DCC62	DCC64	DCC87	DCC111	DCC115	DCC116	DCC124
Sampling date	Drilled depth (m)	15	3	15	15	2	6	9	15	9	15	3	9	3	6	6	9	3.5	15
Dec-09	EC(dS/m) SWL (m)	- DRY	- DRY	TSTB 14 68	- DRY	- DRY	- DRY	1.33 7.83	- DRY	- DRY	- DRY	- DRY	8.91 3.98	- DRY	2.09 4.53	1.40 4.69	- DRY	- DRY	- DRY
Jan-10	EC(dS/m) SWL (m)	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	DRY	8.85 3.36	- DRY	2.69	TSTB 5.17	- DRY	TSTB 3.41	- DRY
Feb-10	EC(dS/m) SWL (m)	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	TSTB 8.74	1.34 10.47	- DRY	- DRY	1.14 2.28	6.75 2.16	1.47 2.20	2.36 4.49	1.06 5.24	-	0.4 2.33	TSTB 14.75
Mar-10	EC(dS/m) SWL (m)	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	1.68 10.89	- DRY	- DRY	- DRY	7.21 2.64	- DRY	2.58 4.67	TSTB 5.78	0.4 7.47	- DRY	- DRY
Apr-10	EC(dS/m) SWL (m)	- DRY	TSTB 2.87	- DRY	- DRY	- DRY	- DRY	TSTB 8.95	- DRY	- DRY	- DRY	- DRY	6.59 2.92	- DRY	3.07 4.92	TSTB 5.58	==)) ==)	0.31 1.43	- DRY
May-10	EC(dS/m) SWL (m)	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	6.43 3.07	- DRY	3.19 4.86	- DRY	DRY DRY	0.51 1.57	- DRY
Jun-10	EC(dS/m) SWL (m)	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	6.30 3.00	- DRY	2.62 5.07	- DRY	128 128	0.47 0.44	- DRY
Jul-10	EC(dS/m) SWL (m)	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	6.04 2.81	- DRY	2.49 4.84	TSTB 5,79		0.62	- DRY
Aug-10	EC(dS/m) SWL (m)	- DRY	- DRY	- DRY	DRY	DRY	- DRY	0.87	- DRY	- DRY	- DRY	1.29	4.84	0.80	1.79 3.65	TSTB 5.82	-1 -));	0.78	DRY
Sep-10	EC(dS/m) SWL (m)	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	0.75 7.36	- DRY	- DRY	- DRY	1.42 1.1	4.97 1.12	0.68	1.70 3.60	- DRY	-20 120	0.67	DRY
Oct-10	EC(dS/m) SWL (m)	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	TSTB 2.82	4.21 1.85	- DRY	- DRY	1.10 5.29	B	0.32	- DRY
Nov-10	EC(dS/m) SWL (m)	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	0.38	- DRY	- DRY	- DRY	0.98	4.59 1.49	0.34	0.85	0.55	-0	-	- DRY
Dec-10	EC(dS/m) SWL (m)			- DRY	DRY	- DRY	- DRY	0.56		DRY	- DRY	0.49	4.07	0.60	1.24	0.70	-	0.74	
Jan-11	EC(dS/m)		- DRY	- DRY			- DRY	0.75	- DRY	- DRY	- DRY	- DRY	3.54	0.86	1.63	0.85	2		
Feb-11	EC(dS/m) SWL (m)	- DRY	- DRY	- DRY	DRY	- DRY	- DRY	1.06 8.21	DRY	- DRY	- DRY	- DRY	3.48 2.15	TSTB 2.89	TSTB 5.48	0.69	DRY	- DRY	- DRY

Dubbo City Council Salinity Network site number (Figure 10)		DCC18	DCC19	DCC20	DCC21	DCC42	DCC44	DCC45	DCC49	DCC53	DCC58	DCC59	DCC62	DCC64	DCC87	DCC111	DCC115	DCC116	DCC124
Sampling date	Drilled depth (m)	15	3	15	15	2	6	9	15	9	15	3	9	3	6	6	9	3.5	15
Mar-11	EC(dS/m)	-	-	-	-	-	-	-	-	-	-	-	3.29	-	-	0.74	-	-	-
	SWL (m)	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	2.95	DRY	DRY	4.20	DRY	DRY	DRY
Apr-11	EC(dS/m)	-	-	-	-	-	-	-	-	-	-	-	3.11	-	-	1.08	-	-	-
	SWL (m)	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	2.51	DRY	DRY	5.59	DRY	DRY	DRY
May-11	EC(dS/m)	-	-	-	-	-	-	-	-	-	-	-	2.86	-	-	-	-	-	-
	SWL (m)	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	2.38	DRY	DRY	DRY	DRY	DRY	DRY
Jun-11	EC(dS/m)	-	-	-	-	-	-	-	-	-	-	-	3.01	-	-	TSTB	-	-	-
	SWL (m)	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	2.58	DRY	DRY	5.82	DRY	DRY	DRY
Jul-11	EC(dS/m) SWL (m)	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	DRY	3.56 2.80	- DRY	- DRY	- DRY	- DRY	- DRY	DRY
Aug-11	EC(dS/m)	-	-	-	-	-	-	-	-	-	-	-	4.33	-	-	-	-	-	-
	SWL (m)	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	3.04	DRY	DRY	DRY	DRY	DRY	DRY
Sep-11	EC(dS/m)	-	-	-	-	-	-	-	-	-	-	-	4.30	-	-	TSTB	-	-	-
	SWL (m)	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	3.10	DRY	DRY	5.80	DRY	DRY	DRY
Oct-11	EC(dS/m)	-	-	-	-	-	-	-	-	-	-	-	3.94	-	-	-	-	-	-
	SWL (m)	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	2.84	DRY	DRY	DRY	DRY	DRY	DRY
Nov-11	EC(dS/m)	-	TSTB	-	-	-	-	-	-	6.25	-	-	3.71	0.23	0.72	-	-	2.47	-
	SWL (m)	DRY	2.93	DRY	DRY	DRY	DRY	DRY	DRY	8.60	DRY	DRY	2.04	1.47	4.60	DRY	DRY	1.23	DRY
Dec-11	EC(dS/m)	-	-	-	-	-	-	1.14	-	-	-	0.28	4.25	4.28	-	-	-	1.56	-
	SWL (m)	DRY	DRY	DRY	DRY	DRY	DRY	7.44	DRY	DRY	DRY	1.82	1.84	2.50	DRY	DRY	DRY	0.95	DRY
Jan-12	EC(dS/m)	-	-	-	-	-	-	1.22	-	-	-	TSTB	4.52	-	-	-	-	-	-
	SWL (m)	DRY	DRY	DRY	DRY	DRY	DRY	7.48	DRY	DRY	DRY	2.62	1.91	DRY	DRY	DRY	DRY	DRY	DRY
Feb-12	EC(dS/m) SWL (m)	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	1.31 7.4	- DRY	- DRY	- DRY	0.26 0.59	4.93 0.65	0.26 1.00	- DRY	- DRY	-1 -);	-	- DRY
Mar-12	EC(dS/m) SWL (m)	1.43	TSTB 2.82	- DRY	- DRY	- DRY	- DRY	1.88	- DRY	- DRY	- DRY	- DRY	5.15 1.90	0.89	- DRY	- DRY		-	- DRY
Apr-12	EC(dS/m)	2.01	- DRY	- DRY	- DRY	- DRY		2.14	- DRY		- DRY		5.04	- DRY	- DRY		1	8	- DRY
May-12	EC(dS/m) SWL (m)	2.24 4.83	- DRY	DRY	- DRY	- DRY	- DRY	- DRY	DRY	- DRY	- DRY	- DRY	4.84	- DRY	- DRY	- DRY		-	- DRY

Dubbo City Council Salinity Network site number (Figure 10)		DCC18	DCC19	DCC20	DCC21	DCC42	DCC44	DCC45	DCC49	DCC53	DCC58	DCC59	DCC62	DCC64	DCC87	DCC111	DCC115	DCC116	DCC124
Sampling date	Drilled depth (m)	15	3	15	15	2	6	9	15	9	15	3	9	3	6	6	9	3.5	15
Jun-12	EC(dS/m) SWL (m)	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	0.1 0.7	4.90 2.50	- DRY	- DRY	- DRY	-	-	- DRY
Jul-12	EC(dS/m) SWL (m)	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	0.89 1.47	5.21 2.94	- DRY	- DRY	- DRY	-	- Tati	- DRY
Aug-12	EC(dS/m) SWL (m)	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	0.5 1.07	5.03 2.70	- DRY	- DRY	- DRY	-		- DRY
Sep-12	EC(dS/m) SWL (m)	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	1.04 7.5	- DRY	TSTB 8.73	- DRY	0.67 1.09	5.10 2.70	- DRY	- DRY	- DRY			- DRY
Oct-12	EC(dS/m) SWL (m)	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	TSTB 8.80	- DRY	- DRY	5.00 2.65	- DRY	- DRY	- DRY		- 12 2-13	- DRY
Nov-12	EC(dS/m) SWL (m)	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	4.70 2.35	- DRY	- DRY	- DRY	-	-)	- DRY
Dec-12	EC(dS/m) SWL (m)	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	TSTB 8.89	- DRY	- DRY	4.90 2.53	- DRY	- DRY	- DRY	-		
Jan-13	EC(dS/m) SWL (m)	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	1.31 7.53	- DRY	- DRY	- DRY	- DRY	4.31 2.80	- DRY	- DRY	- DRY		್ಷಣೆಗೆ	1070
Feb-13	EC(dS/m) SWL (m)	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	TSTB 8.71	- DRY	- DRY	5.47 2.94	- DRY	- DRY	- DRY	-	- DRY	
Mar-13	EC(dS/m) SWL (m)	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	TSTB 8.89	- DRY	- DRY	6.20 2.80	- DRY	- DRY	- DRY	-	0.54 1.58	TSTB 14.75
Apr-13	EC(dS/m) SWL (m)	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	6.01 6.74	- DRY	- DRY	- DRY	20 	0.44 1.63	
May-13	EC(dS/m) SWL (m)	1.12 2.42	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	5.43 2.55	- DRY	- DRY	- DRY	-	- DRY	-
Jun-13	EC(dS/m) SWL (m)	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	6.20 2.85	- DRY	- DRY	- DRY	-	- DRY	- DRY
Jul-13	EC(dS/m) SWL (m)	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	5.57 2.50	- DRY	- DRY	- DRY	-	- DRY	- DRY
Aug-13	EC(dS/m) SWL (m)	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	0.25 0.54	5.30 2.60	- DRY	- DRY	- DRY	-		- DRY

Dubbo City Council Salinity Network site number (Figure 10)		DCC18	DCC19	DCC20	DCC21	DCC42	DCC44	DCC45	DCC49	DCC53	DCC58	DCC59	DCC62	DCC64	DCC87	DCC111	DCC115	DCC116	DCC124
Sampling date	Drilled depth (m)	15	3	15	15	2	6	9	15	9	15	3	9	3	6	6	9	3.5	15
Sep-13	EC(dS/m) SWL (m)	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	TSTB 8.68	- DRY	- DRY	- DRY	0.43 0.79	4.87 2.56	- DRY	- DRY	- DRY	-		- DRY
Oct-13	EC(dS/m) SWL (m)	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	TSTB 8.68	- DRY	- DRY	- DRY	0.43 0.79	4.87 2.56	- DRY	- DRY	- DRY	1773) 1779	450 1975	- DRY
Nov-13	EC(dS/m) SWL (m)	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	0.98 1.57	4.85 2.50	- DRY	- DRY	- DRY		12 12	- DRY
Dec-13	EC(dS/m) SWL (m)	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	1.05 7.98	- DRY	- DRY	- DRY	0.67 1.47	4.76 2.31	- DRY	- DRY	- DRY			- DRY
Jan-14	EC(dS/m) SWL (m)	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	1.24 5.60	- DRY	- DRY	- DRY	- DRY	6.15 2.60	- DRY	- DRY	TSTB 5.30	.=.) =:	(m) (20)	- DRY
Feb-14	EC(dS/m) SWL (m)	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	1.09 5.42	- DRY	- DRY	- DRY	- DRY	5.82 2.50	- DRY	- DRY	1.17 5.18	=3 =3	-	- DRY
Mar-14	EC(dS/m) SWL (m)	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	1.25 6.08	- DRY	- DRY	- DRY	- DRY	6.04 2.61	- DRY	- DRY	1.22 5.00	-		- DRY
Apr-14	EC(dS/m) SWL (m)	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	1.11 6.24	- DRY	- DRY	- DRY	- DRY	6.00 2.71	- DRY	- DRY	1.11 5.09	-	(3 8) 1991	- DRY
May-14	EC(dS/m) SWL (m)	1.02 2.59	- DRY	- DRY	- DRY	- DRY	- DRY	0.94 5.98	- DRY	- DRY	- DRY	- DRY	5.62 2.60	- DRY	- DRY	- DRY	=:		- DRY
Jun-14	EC(dS/m) SWL (m)	1.14 2.78	- DRY	- DRY	- DRY	- DRY	- DRY	0.99 6.03	- DRY	- DRY	- DRY	- DRY	5.80 2.65	- DRY	- DRY	- DRY			- DRY
Jul-14	EC(dS/m) SWL (m)	1.25 2.91	- DRY	- DRY	- DRY	- DRY	- DRY	1.03 6.20	- DRY	- DRY	- DRY	- DRY	5.64 2.51	- DRY	- DRY	- DRY	10 -		- DRY
Aug-14	EC(dS/m) SWL (m)	1.09 4.21	- DRY	- DRY	- DRY	- DRY	- DRY	1.19 6.89	- DRY	- DRY	- DRY	- DRY	5.24 2.58	- DRY	- DRY	- DRY	-	*	- DRY
Sep-14	EC(dS/m) SWL (m)		-	-		-				-	-	-	-		-	-	-	-	-
Oct-14	EC(dS/m) SWL (m)	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	- DRY	DRY	4.63 2.70	- DRY	- DRY	- DRY	- -		- DRY
Nov-14	EC(dS/m) SWL (m)	1.57 4.87	TSTB 2.85	- DRY	- DRY	- DRY	DRY	1.35 7.95	- DRY	TSTB 8.84	- DRY	0.73 1.41	4.81 2.45	0.49 1.84	- DRY	- DRY	-	-	- DRY

Dubbo City Council Salinity Network site number (Figure 10)		DCC18	DCC19	DCC20	DCC21	DCC42	DCC44	DCC45	DCC49	DCC53	DCC58	DCC59	DCC62	DCC64	DCC87	DCC111	DCC115	DCC116	DCC124
Sampling date	Drilled depth (m)	15	3	15	15	2	6	9	15	9	15	3	9	3	6	6	9	3.5	15
Dec-14	EC(dS/m) SWL (m)	1.70 4.51	TSTB 2.80	- DRY	- DRY	- DRY	- DRY	1.34 7.90	- DRY	1.87 8.54	- DRY	0.60 1.36	4.89 2.34	0.54 1.73	- DRY	- DRY	-	-	- DRY

Appendix 5. Initial site investigation characteristics

Location	Vegetation	Slope (%)	Bare areas	Indicators	Surface rocks	Trees (within 50m)
(Figure 6)				of salinity		
A2	Windmill khaki week, love grass, paspalum and red grass	1% W	Nil	Nil	Nil	Nil
A3	Windmill khaki week, love grass,	1% W	Nil	Nil	Nil	Nil
A6	Windmill khaki week, love grass,	1% W	Nil	Nil	Nil	Nil
A7	Windmill, fleabane, red grass and paspalum	2% S	Tracks/ Nil	Nil	Nil	Nil
A8	Windmill, fleabane, red grass and paspalum	2% S	Tracks/ Nil	Nil	Nil	Nil
A9	Windmill, fleabane, red grass and paspalum	2% S	Tracks/ Nil	Nil	Nil	Nil
A10	Windmill, fleabane, red grass and paspalum	2% S	Tracks/ Nil	Nil	Nil	Nil
A16	Paspalum, red grass and shepherds	0-1% S	Nil	Nil	Nil	Nil
A17	Paspalum, red grass and shepherds	0-1% S	Nil	Nil	Nil	Nil
B1	Windmill, khaki week, love grass, paspalum and red grass	0-1% W	Nil	Nil	Few	Nil
B2	Windmill, khaki week, love grass,	0-1% W	Nil	Nil	Few	Nil
B3	Windmill, khaki week, love grass, paspalum and red grass	0-1% W	Nil	Nil	Few	Nil
B6	Fleabane, shepherds purse, khaki	0-2% S	Tracks/ Nil	Nil	River gravel	Nil
B7	Windmill, fleabane, red grass and paspalum	2% S	Tracks/ Nil	Nil	Nil	Nil
B8	Windmill, fleabane, red grass and paspalum	2% S	Tracks/ Nil	Nil	Nil	Nil
B9	Windmill, fleabane, red grass and paspalum	2% S	Tracks/ Nil	Nil	Nil	Nil
B10	Windmill, fleabane, red grass and paspalum	2% S	Tracks/ Nil	Nil	Nil	Nil
B11	Windmill, fleabane, red grass and paspalum	2% S	Tracks/ Nil	Nil	Nil	Nil
B12	Windmill, fleabane, red grass and paspalum	2% S	Tracks/ Nil	Nil	Nil	Nil
B13	Windmill grass, paspalum, khaki weeds	0-1%S	Stockpiles to the west , area under	Nil	Nil	Nil
B14	Windmill, fleabane, red grass and	2% S	Tracks/ Nil	Nil	Nil	Nil
B15	Paspalum, red grass	0-1% S	Stockpiles	Nil	Nil	White cedar tree
C1	purse	0.3% E	l NII N lil	Nil	Surface	Nii
	grass, paspalum, red grass	0-370 E	I NII	I NII N G	cobbles	
02	windmill grass, knaki weed, love grass, paspalum, red grass	U-2%0 W	NII		Sunace cobbles	NII
C3	vvindmill knaki week, love grass, paspalum and red grass	1% W	NII	NII	INII	
C4	Windmill khaki week, love grass, paspalum and red grass	1% W	Nil	NI	River gravels	NI
C5	Red grass, shepherds purse, khaki weed	1% S	Nil	Nil	Trace surface rocks	Nil
C6	Fleabane, shepherds purse, khaki weed, paspalum, red grass	2% S	Tracks/ Nil	Nil	Nil	Nil

C7	7	Windmill, fleabane, red grass and	2% S	Tracks/ Nil	Nil	Nil	Nil
C8	3	Windmill, fleabane, red grass and	2% S	Tracks/ Nil	Nil	Nil	Nil
C9)	Windmill, fleabane, red grass and	2% S	Tracks/ Nil	Nil	Nil	Nil
C1	0	Windmill, fleabane, red grass and	2% S	Tracks	Nil	Nil	Nil
C1	1	Windmill, fleabane, red grass and	2% S	Tracks/ Nil	Nil	Nil	Nil
C1	2	Windmill, fleabane, red grass and paspalum	2% S	Tracks/ Nil	Nil	Nil	Nil
C1	3	Windmill grass, paspalum, khaki weeds	0-1% S	Stockpiles to the west , area under development	Nil	Nil	Nil
C1	4	Windmill, fleabane, red grass and paspalum	2% S	Tracks/ Nil	Nil	Nil	Nil
C1	5	Paspalum, red grass, shepherds purse	0-1% S	Nil	Nil	Nil	Nil
C1	6	Paspalum, red grass, shepherds purse	0-1% S	Nil	Nil	Nil	Nil
C1	7	, Paspalum, red grass, shepherds purse	0-1% S	Nil	Nil	Nil	Nil
D1		Shepherds purse, khaki weed	0-1% S	Nil	Nil	Surface cobbles	Nil
D2	2	Windmill grass, khaki weed, love grass, paspalum	3% E	Nil	Nil	Surface cobbles	Nil
D3	3	Windmill grass, khaki weed, love grass, paspalum	3% E	Nil	Nil	Surface cobbles	Nil
D4	Ļ	Windmill grass, khaki weed, love grass, paspalum	2% E	Nil	Nil	Surface cobbles	Nil
D5	5	Khaki weed, paspalum	2% E	Some bare areas	Nil	Surface cobbles	Nil
D6	6	Fleabane, shepherds purse, khaki weed, paspalum, red grass	2% S	Some bare areas/ tracks	Nil	Surface cobbles	Nil
D7	7	Windmill, fleabane, red grass and paspalum	2% S	Tracks/ Nil	Nil	Nil	Nil
D8	3	Windmill, fleabane, red grass and paspalum	2% S	Tracks/ Nil	Nil	Nil	Nil
D9)	Windmill, fleabane, red grass and paspalum	2% S	Tracks/ Nil	Nil	Nil	Nil
D1	0	Windmill, fleabane, red grass and paspalum	2% S	Tracks/ Nil	Nil	Nil	Nil
D1	1	Windmill, fleabane, red grass and paspalum	2% S	Tracks/ Nil	Nil	Nil	Nil
D1	2	Khaki weed, red grass	2% S	Tracks	Nil	Nil	Pepper trees
D1	3	Khaki weed	2% S	Tracks	Nil	Nil	Pepper trees
D1	4	Windmill, fleabane, red grass and paspalum	0-1% S	Tracks/ Nil	Nil	Nil	Nil
D1	5	Paspalum, red grass, shepherds purse	0-1% S	Nil	Nil	Nil	Nil
D1	6	Paspalum, red grass, shepherds purse	0-1% S	Nil	Nil	Nil	Nil
D1	17	Paspalum, red grass, shepherds purse, khaki weed	0-1% S	Nil	Nil	Nil	Nil
E1		Windmill grass, khaki weed, love grass, paspalum	3% S	Nil	Nil	Surface cobbles	Eucalypt, white cedder
E2	2	Shepherds purse, red grass, sheep's burr	0-1% S	Nil	Nil	Nil	Nil
E3	}	Shepherds purse, red grass, sheep's burr	0-1% E	Nil	Nil	Nil	Nil

E4	Shepherds purse, red grass, sheep's	0-1% E	Nil	Nil	Nil	Nil
	burr, red grass	o 404 E	N 11	N 11		N 12
E5	Shepherds purse, red grass, sheep's burr, khaki weed	0-1%E	Nil	NI	Surface cobbles	Nil
E6	Sparse vegetation	0-1% E	Gate way, stock traverse	Nil	River gravel	Nil
E7	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress	0-1% S	Nil	Nil	Nil	Nil
E8	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper	0-1% S	Nil	Nil	Nil	Nil
E9	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress	0-1% S	Nil	Nil	Nil	Nil
E10	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress	0-1% S	Nil	Nil	Nil	Nil
E11	Paspalum, red grass, shepherds	0-1%S	Nil	Nil	Nil	Nil
E12	Paspalum, red grass, shepherds	0-1%S	Tracks	Nil	Nil	White cedar
E13	Near tree lot	0-1% S	Nil	Nil	Nil	Cedar trees
E14	Sparse vegetation	0-1% S	Nil	Bare areas due to fill	Nil	Nil
E15	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress	0-1% S	Nil	Nil	Nil	Nil
E16	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper	0-1% S	Nil	Nil	Nil	Nil
E17	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper	0-1% S	Nil	Nil	Nil	Nil
F1	Shepherds purse, red grass, sheep's	0-1%S	Nil	Nil	Nil	Nil
F2	Shepherds purse, red grass, sheep's	0-1% S	Nil	Nil	Nil	Nil
F3	Shepherds purse, red grass, sheep's burr. Khaki weed.	0-1% E	Nil	Nil	Surface cobbles	Nil
F4	Shepherds purse, red grass, sheep's burr	0-1%S	Nil	Nil	Nil	Nil
F5	Shepherds purse, red grass, sheep's burr	0-1%S	Nil	Nil	Nil	Nil
F6	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress, cat head	0-1% S	Nil	Nil	Nil	Nil
F7	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper	0-1% S	Nil	Nil	Nil	Nil
F8	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper	0-1% S	Nil	Nil	Nil	Nil
F9	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper	0-1% S	Nil	Nil	Nil	Nil
F10	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress, cat head	0-1% S	Nil	Nil	Nil	Nil

F11	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress	0-1% S	Nil	Nil	Nil	Nil
F12	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress, cat head	0-1% S	Nil	Tracks	Nil	Nil
E13	Near tree lot	0.1% \$	Nil	Nii	Nii	Codar troos
F14	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress	0-1%S	Nil	Nil	Nil	Nil
F15	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress	0-1% S	Nil	Nil	Nil	Nil
F16	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress	0-1% S	Nil	Nil	Nil	Nil
F17	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress	0-1% SE	Nil	Nil	Nil	Nil
G1	Shepherds purse, red grass, sheep's burr	0-1% S	Nil	Nil	Nil	Nil
G2	Shepherds purse, red grass, sheep's burr	0-1% S	Nil	Nil	Nil	Nil
G3	Shepherds purse, red grass, sheep's	0-1% E	Nil	Nil	Surface	Nil
G4	Shepherds purse, red grass, sheeps	0-1% S	Nil	Nil	Nil	Nil
G5	Shepherds purse, red grass, sheeps burr	0-1% S	Nil	Nil	Nil	Nil
G6	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress, cat head	0-1% S	Nil	Nil	Nil	Nil
G7	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress, cat head	0-1% S	Nil	Nil	Nil	Nil
G8	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress, cat head	0-1%S	Nil	Nil	Nil	Nil
G9	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress, cat head	0-1% S	Nil	Nil	Nil	Nil
G10	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress, cat head	0-1% S	Nil	Nil	Nil	Nil
G11	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress	0-1% S	Nil	Nil	Nil	Nil
G12	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress, cat heads	0-1% S	Nil	Tracks	Nil	Nil
G13	Near tree lot	0-1% S	Nil	Nil	Nil	Cedar trees
G14	Sparse vegetation	0-1% S	Nil	Bare areas due to fill	Nil	Nil
G15	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress	0-1% S	Nil	Nil	Nil	Nil
G16	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress	0-1% S	Nil	Nil	Nil	Nil
G17	Paspalum, red grass, shepherds purse, pepper grass	0-1% S	Nil	Nil	Nil	Nil

H1	Shepherds purse, red grass, sheep's Burr	0-1% S	Nil	Nil	Nil	Nil
H2	Shepherds purse, red grass, sheep's burr	0-1% S	Nil	Nil	Nil	Nil
H3	Shepherds purse, red grass, sheep's	0-1% E	Nil	Nil	Surface	Nil
H4	Shepherds purse, red grass, sheep's	0-1% S	Nil	Nil	Nil	casuarina
H5	Shepherds purse, red grass, sheep's	0-1% S	Nil	Nil	Nil	casuarina
H6	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper	0-1% S	Nil	Nil	Nil	Nil
H7	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper	0-1% S	Nil	Nil	Nil	Nil
H8	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress	0-1% S	Nil	Nil	Nil	Nil
H9	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress	0-1% S	Nil	Nil	Nil	Nil
H10	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress	0-1% S	Nil	Nil	Nil	Nil
H11	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress	0-1% S	Nil	Nil	Nil	Nil
H12	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress	0-1%S	Tracks	Nil	Nil	Nil
H13	Trace vegetation	0-1% S	Bare areas due to fill	Nil	Nil	Nil
H14	Trace vegetation	0-1% S	Bare areas due to fill	Nil	Nil	Nil
H15	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress	0-1% S	Nil	Nil	Nil	Nil
H16	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress	0-1% S	Nil	Nil	Nil	Nil
H17	Paspalum, red grass, shepherds	0-1% S	Nil	Nil	Nil	Nil
11	Shepherds purse, red grass, sheep's burr	0-1% S	Nil	Nil	Nil	Eucalypt
12	Shepherds purse, red grass, sheep's burr	0-1% S	Nil	Nil	Nil	Nil
13	Shepherds purse, red grass, sheep's	0-1% S	Nil	Nil	Nil	Nil
14	Shepherds purse, red grass, sheep's	0-1% SE	Nil	Nil	Nil	Nil
15	Shepherds purse, red grass, sheep's	0-1% W	Nil	Nil	Nil	Nil
16	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress	0-1% S	Nil	Nil	Nil	Nil
17	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress	0-1% S	Nil	Nil	Nil	Nil
18	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress	0-1% S	Nil	Nil	Nil	Nil

19	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress	0-1% S	Nil	Nil	Nil	Nil
110	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress	0-1% S	Nil	Nil	Nil	Nil
111	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress	0-1% S	Nil	Nil	Nil	Nil
112	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress	0-1% S	Nil	Nil	Nil	Nil
113	Trace vegetation	0-1% S	Bare areas due to fill	Nil	Nil	Nil
114	Trace vegetation	0-1% S	Bare areas due to fill	Nil	Nil	Nil
115	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress	0-1% S	Nil	Nil	Nil	Nil
116	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress	0-1% S	Nil	Nil	Nil	Nil
117	Paspalum, red grass, shepherds	0-1% S	Nil	Nil	Nil	Nil
J1	Shepherds purse, red grass, sheep's burr	0-1% S	Nil	Nil	Nil	Nil
J2	Shepherds purse, red grass, sheep's burr	0-1% S	Nil	Nil	Nil	Nil
J3	Shepherds purse, red grass, sheep's burr	0-1% S	Nil	Nil	Nil	Nil
J4	Shepherds purse, red grass, sheep's burr	0-1% SE	Nil	Nil	Nil	Nil
J5	Shepherds purse, red grass, sheep's burr	0-1% SE	Nil	Nil	Nil	Eucalypt
J6	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress	0-1% S	Nil	Nil	Nil	Nil
J7	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress	0-1% S	Nil	Nil	Nil	Nil
J8	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress	0-1% S	Nil	Nil	Nil	Nil
J9	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress	0-1% S	Nil	Nil	Nil	Nil
J10	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress	0-1% S	Nil	Nil	Nil	Nil
J11	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress	0-1% S	Nil	Nil	Nil	Nil
J12	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress	0-1% S	Nil	Nil	Nil	Nil
J13	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress	0-1% S	Nil	Nil	Nil	Nil
J14	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress	0-1% S	Nil	Nil	Nil	Nil

J15	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress	0-1% S	Nil	Nil	Nil	Nil
J16	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress	0-1% S	Nil	Nil	Nil	Nil
J17	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress	0-1% S	Nil	Nil	Nil	Nil
K1	Shepherds purse, red grass, sheep's	0-1% S	Nil	Nil	Nil	Nil
K2	Shepherds purse, red grass, sheep's	0-1% S	Nil	Nil	Nil	Nil
К3	Shepherds purse, red grass, sheep's	0-1% S	Nil	Nil	Nil	Nil
K4	Shepherds purse, red grass, sheep's	0-1% S	Nil	Nil	Nil	Nil
K5	Shepherds purse, red grass, sheep's	0-1% SE	Nil	Nil	Nil	Nil
K6	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress	0-1% S	Nil	Nil	Nil	Nil
K7	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress	0-1% S	Nil	Nil	Nil	Nil
K8	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress	0-1% S	Nil	Nil	Nil	Nil
K9	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress	0-1% S	Nil	Nil	Nil	Nil
K10	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress	0-1% S	Nil	Nil	Nil	Nil
K11	Paspalum, red grass, shepherds	0-1% S	Nil	Nil	Nil	Nil
K12	Paspalum, red grass, shepherds	0-1% S	Tracks	Nil	Nil	Nil
K13	Paspalum, red grass, shepherds	0-1% S	Nil	Nil	Nil	Nil
K14	Paspalum, red grass, shepherds	0-1% S	Nil	Nil	Nil	Nil
K15	Paspalum, red grass, shepherds	0-1% S	Nil	Nil	Nil	Nil
K16	Paspalum, red grass, shepherds	0-1% S	Nil	Nil	Nil	Nil
K17	Paspalum, red grass, shepherds	0-1% S	Nil	Nil	Nil	Nil
L1	Red grass, couch, short windmill, browns love, clover	2-3% SW	Minor	Nil	Basalt cobbles	Eucalypt
L2	Red grass, couch, short windmill, browns love, clover	2-3% SW	Minor	Nil	Basalt	Nil
L3	Red grass, couch, short windmill, browns love, clover	0-1% SW	Minor	Nil	Basalt	Nil
L4	Shepherds purse, red grass, sheep's burr	0-1% S	Nil	Nil	Nil	Nil
L5	Shepherds purse, red grass, sheep's	0-1% SE	Nil	Nil	Nil	Nil
L6	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress	0-1%S	Nil	Nil	Nil	Nil

L7	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper	0-1% S	Nil	Nil	Nil	Nil
L8	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper	0-1% S	Nil	Nil	Nil	Nil
L9	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress	0-1% S	Nil	Nil	Nil	Nil
L10	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress	0-1% S	Nil	Nil	Nil	Nil
L11	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress	0-1% S	Nil	Nil	Nil	Nil
L12	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress	0-1% S	Nil	Nil	Nil	Nil
L13	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress	0-1% S	Nil	Nil	Nil	Nil
L14	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress	0-1% S	Nil	Nil	Nil	Nil
L15	Shepherds purse, red grass, sheep's	0-1% SE	Nil	Nil	Nil	Nil
L16	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper	0-1% S	Nil	Nil	Nil	Nil
L17	Khaki weed, cat head, paspalum, red grass, shepherds purse, pepper cress	0-1% S	Nil	Nil	Nil	Nil
M1	Red grass, couch, short windmill, browns love, clover	0-1% SW	Minor	Nil	Basalt cobbles	Eucalypt
M2	Red grass, couch, short windmill,	0-1% SW	Minor	Nil	Basalt	Nil
M3	Red grass, couch, short windmill, browns love, clover	0-1% SW	Minor	Nil	Basalt	Nil
M4	Red grass, couch, short windmill,	0-1% SW	Minor	Nil	Basalt	Nil
M5	Red grass, couch, short windmill,	0-1% SW	Minor	Nil	Basalt	Nil
M6	Red grass, couch, short windmill,	0-6% S	Minor	Nil	Basalt	Nil
M7	Red grass, couch, short windmill,	0-6% W	Minor	Nil	Basalt	Nil
M8	Red grass, couch, short windmill,	0-6% W	Minor	Nil	Basalt	Nil
M9	Red grass, couch, short windmill,	0-1% SW	Minor	Nil	Nil	Nil
M10	browns love, clover, paspalum Red grass, couch, short windmill, browns love, clover, paspalum	0-1% SW	Minor	Nil	Nil	Nil
M11	Red grass, couch, short windmill,	0-1% SW	Minor	Nil	Nil	Nil
M12	Red grass, couch, short windmill,	Flat	Soil stockpilos	Nil	River gravel	Nil
M13	Red grass, couch, short windmill,	3% S	Minor	Nil	Surface	Nil
M14	Red grass, couch, short windmill,	3% S	Minor	Nil	coddies Surface	Nil
M15	prowns love, clover, paspalum Red grass, couch, short windmill, browns love, clover, paspalum	5% E	Minor	Nil	cobbles Nil	Nil

M16 Red grass, couch, short windmill, browns love, dover, paspalum 3% S Ni Ni Surface Ni M17 Red grass, couch, short windmill, browns love, dover, paspalum 2.3% SW Minor Ni Baselt Eucalypt cobbles N1 Red grass, couch, short windmill, browns love, dover, paspalum 2.3% SW Minor Ni Baselt Ni N2 Red grass, couch, short windmill, browns love, dover, paspalum, Shepherds purse 0.1% SW Minor Ni Baselt Ni N3 Red grass, couch, short windmill, browns love, dover, paspalum, Shepherds purse 0.1% SW Minor Ni Baselt Ni N4 Red grass, couch, short windmill, browns love, dover, paspalum, Shepherds purse 0.1% SW Minor Ni Baselt Ni N5 Red grass, couch, short windmill, browns love, dover, paspalum, Shepherds purse 0.1% SW Minor Ni Baselt Ni N6 Red grass, couch, short windmill, browns love, dover, paspalum, Shepherds purse 0.4% SW Minor Ni Baselt Ni N7 Red grass, couch, short windmill, browns love, dover, paspalum, Shepherds purse 0.4% SW Minor Ni Baselt Ni N8 Red grass, couch, short windmill, browns love, dover, paspalum, Shepherds purse 0.4% SW							
browns low, dover, paspalum, trowns low, dover, paspalum, browns low, dover, paspalum, shepherds purse Flat Nil Nil Surface Nil 11 Red grass, couch, short windmill, browns low, dover, paspalum, shopherds purse 2-3% SW Minor Nil Basalt Eucalypt 12 Red grass, couch, short windmill, browns low, dover, paspalum, shopherds purse 3% S Minor Nil Basalt Nil 13 Red grass, couch, short windmill, browns low, dover, paspalum, shopherds purse 0-1% SW Minor Nil Basalt Nil 14 Red grass, couch, short windmill, browns low, dover, paspalum, shopherds purse 0-1% SW Minor Nil Basalt Nil 15 Red grass, couch, short windmill, browns low, dover, paspalum, shopherds purse 0-1% SW Minor Nil Fees wrantl Nil 16 Rod grass, couch, short windmill, browns low, dover, paspalum, shopherds purse 6% W Minor Nil Basalt Nil 17 Red grass, couch, short windmill, browns low, dover, paspalum, shopherds purse 6% W Minor Nil Basalt Nil 18 Red grass, couch, short windmill, browns low, dover, paspalum, shopherds purse 6% W Minor Nil Surface Nil 19 Red grass, couch, short windmill, browns low, dover, pasp	M16	Red grass, couch, short windmill,	3% S	Nil	Nil	Surface	Nil
M17 Red grass, couch, short windmill, browns love, dover, paspalum Flat Nil Nil Surface Nil N1 Red grass, couch, short windmill, browns love, dover, paspalum 2-3% SW Minor Nil Basalt Eucalypt cobbles N2 Red grass, couch, short windmill, browns love, dover, paspalum, Shepherds purse 3% S Minor Nil Basalt Nil N3 Red grass, couch, short windmill, browns love, dover, paspalum, Shepherds purse 0-1% SW Minor Nil Basalt Nil N4 Red grass, couch, short windmill, browns love, dover, paspalum, Shepherds purse 0-1% SW Minor Nil Easalt Nil N5 Red grass, couch, short windmill, browns love, dover, paspalum, Shepherds purse 0-1% SW Minor Nil Fee small Nil N6 Red grass, couch, short windmill, browns love, dover, paspalum, Shepherds purse 4% W Minor Nil Easalt Nil N7 Red grass, couch, short windmill, browns love, dover, paspalum, Shepherds purse 6% W Minor Nil Basalt Nil N8 Red grass, couch, short windmill, browns love, dover, paspalum, Shepherds purse 2% SW Minor Nil Sufface Nil N1 Easalt Nil Cobbles Cobbles Cob		browns love, clover, paspalum				cobbles	
browns love, dover, paspalum, trowns love, dover, paspalum, shapherds purse, couch, short windmill, trowns love, dover, paspalum, shapherds purse, advect, paspalum, trowns love, dover, paspalum, shapherds purse, advect, paspalum, shapherds purse, advect, paspalum, shapherds purse, advect, paspalum, shapherds purse, advect, paspalum, shapherds purse, trowns love, dover, paspalum, shapherds purse 0-196 SW Minor Ni Basalt Nil N4 Red grass, couch, short windmill, trowns love, dover, paspalum, shapherds purse 0-196 SW Minor Ni Basalt Nil N5 Red grass, couch, short windmill, trowns love, dover, paspalum, shapherds purse 0-196 SW Minor Ni Fee small Nil N6 Red grass, couch, short windmill, trowns love, dover, paspalum, shapherds purse 0-196 SW Minor Ni Trace surface Nil N7 Red grass, couch, short windmill, trowns love, dover, paspalum, shapherds purse 0-496 SW Minor Ni Basalt Nil N8 Red grass, couch, short windmill, trowns love, dover, paspalum, shapherds purse 0-496 SW Minor Ni Basalt Nil N8 Red grass, couch, short windmill, trowns love, dover, paspalum, shapherds purse 0-496 SW Minor Nil Surface Nil N1 Red grass, couch, short windmill, trowns love, dover, paspalum, shapherds purse 0-496 SW Minor Nil Nil <tr< td=""><td>M17</td><td>Red grass, couch, short windmill,</td><td>Flat</td><td>Nil</td><td>Nil</td><td>Surface</td><td>Nil</td></tr<>	M17	Red grass, couch, short windmill,	Flat	Nil	Nil	Surface	Nil
N1 Red grass, couch, short vincimili, browns love, dover, paspalum, short, wincimili, browns love, dover, paspalum, short vincimili, browns love, dover, paspalum, shor		browns love, clover, paspalum				cobbles	
brownistlow, dower, paspelum 3% S Minor Ni Bassit Ni N3 Red grass, couch, short windmill, browns love, dower, paspelum, Shepherds parse 0-1% SW Minor Ni Bassit Ni N4 Red grass, couch, short windmill, browns love, dower, paspelum, Shepherds parse 0-1% SW Minor Ni Bassit Ni N5 Red grass, couch, short windmill, browns love, dower, paspelum, Shepherds parse 0-1% SW Minor Ni Few small Ni N5 Red grass, couch, short windmill, browns love, dower, paspelum, Shepherds parse 0-1% SW Minor Ni Trace surface Ni N6 Red grass, couch, short windmill, browns love, dower, paspelum, Shepherds parse 0-4% SW Minor Ni Bassit Ni N7 Red grass, couch, short windmill, browns love, dower, paspelum, Shepherds parse 0-4% SW Minor Ni Bassit Ni N8 Red grass, couch, short windmill, browns love, dower, paspelum, Shepherds parse 0-4% SW Minor Ni Bassit Ni N9 Red grass, couch, short windmill, browns love, dower, paspelum, Shepherds parse 0-4% SW Minor Ni Surface Ni N11 Red grass, couch, short windmill, browns love, dower, paspelum, Shepherds parse 0-4% SW Minor	N1	Red grass, couch, short windmill,	2-3% SW	Minor	Nil	Basalt	Eucalypt
N2 Red grass, couch, short windmill, browns love, dover, paspalum, Shepherds purse O 196 SW Minor Nil Basalt Nil N3 Red grass, couch, short windmill, browns love, dover, paspalum, Shepherds purse O 196 SW Minor Nil Basalt Nil N4 Red grass, couch, short windmill, browns love, dover, paspalum, Shepherds purse O 196 SW Minor Nil Basalt Nil N5 Red grass, couch, short windmill, browns love, dover, paspalum, Shepherds purse O 196 SW Minor Nil Basalt Nil N6 Red grass, couch, short windmill, browns love, dover, paspalum, Shepherds purse O 196 SW Minor Nil Basalt Nil N8 Red grass, couch, short windmill, browns love, dover, paspalum, Shepherds purse O 496 SW Minor Nil Basalt Nil N8 Red grass, couch, short windmill, browns love, dover, paspalum, Shepherds purse O 496 SW Minor Nil Surface Nil N10 Red grass, couch, short windmill, browns love, dover, paspalum, Shepherds purse 1% S Minor Nil Surface Nil N11 Red grass, couch, short windmill, browns love, dover, paspalum, Shepherds purse 1% S Nil Nil Nil N12 Red grass, couch, short windmill, browns love, dover, paspalum, She		browns love, clover, paspalum				cobbles	21
Inc. browns love, dover, paspalum, Second mill, Browns love, dover, paspalum, Shepherds purse 0.195 SW Minor Nil Basait Nil NA Red grass, couch, short windmill, Browns love, dover, paspalum, Shepherds purse 0.196 SW Minor Nil Basait Nil NA Red grass, couch, short windmill, Browns love, dover, paspalum, Shepherds purse 0.196 SW Minor Nil Basait Nil N5 Red grass, couch, short windmill, Browns love, dover, paspalum, Shepherds purse 0.196 SW Minor Nil Few small Nil N6 Red grass, couch, short windmill, Browns love, dover, paspalum, Shepherds purse 0.496 W Minor Nil Trace surface Nil N7 Red grass, couch, short windmill, Browns love, dover, paspalum, Shepherds purse 0.496 W Minor Nil Basait Nil N8 Red grass, couch, short windmill, Browns love, dover, paspalum, Shepherds purse 296 SW Minor Nil Basait Nil N9 Red grass, couch, short windmill, Browns love, dover, paspalum, Shepherds purse 296 SW Minor Nil Surface Nil N10 Red grass, couch, short windmill, Browns love, dover, paspalum, Shepherds purse 196 S Nil Nil Nil N11 Red grass, couch, short windmill, Browns love, do	N2	Red grass couch short windmill	3%5	Minor	Nil	Basalt	Nil
N3 Red grass, couch, short windmil, browns love, dover, paspalum, Shepherds purse 0-1% SW Minor Ni Basalt Ni N4 Red grass, couch, short windmil, browns love, dover, paspalum, Shepherds purse 0-1% SW Minor Ni Basalt Ni N5 Red grass, couch, short windmil, browns love, dover, paspalum, Shepherds purse 0-1% SW Minor Ni Few smalt Ni N6 Red grass, couch, short windmil, browns love, dover, paspalum, Shepherds purse 0-1% SW Minor Ni Trace surface Ni N7 Red grass, couch, short windmil, browns love, dover, paspalum, Shepherds purse 0-4% SW Minor Ni Basalt Ni N8 Red grass, couch, short windmill, browns love, dover, paspalum, Shepherds purse 0-4% SW Minor Ni Basalt Ni N9 Red grass, couch, short windmill, browns love, dover, paspalum, Shepherds purse 0-4% SW Minor Ni Surface Ni N10 Red grass, couch, short windmill, browns love, dover, paspalum, Shepherds purse 1% S Minor Ni Surface Ni N11 Red grass, couch, short windmill, browns love, dover, paspalum, Shepherds purse 1% S Ni Ni Ni N11 Red grass, couch, short windmill, browns love, dover, paspalum, Shepherds purse	142	browns love clover paspalum	0,00	Million		cobbles	
No. Problem Subset, Observer, papagelum, Shepheris purse Outbies N4 Red grass, couch, short windmill, browns love, dover, papaglum, Shepheris purse 0-1% SW Minor Nil Basait Nil N5 Red grass, couch, short windmill, browns love, dover, papaglum, Shepheris purse 0-1% SW Minor Nil Few small Nil N6 Red grass, couch, short windmill, browns love, dover, papaglum, Shepheris purse 0-1% SW Minor Nil Few small Nil N7 Red grass, couch, short windmill, browns love, dover, papaglum, Shepheris purse 0-4% SW Minor Nil Basait Nil N8 Red grass, couch, short windmill, browns love, dover, papaglum, Shepheris purse 0-4% SW Minor Nil Basait Nil N8 Red grass, couch, short windmill, browns love, dover, papaglum, Shepheris purse 0-4% SW Minor Nil Basait Nil N9 Red grass, couch, short windmill, browns love, dover, papaglum, Shepheris purse 96 SW Minor Nil Surface Nil N11 Red grass, couch, short windmill, browns love, dover, papaglum, Shepheris purse 1% So Nil Nil Nil N11 <td< td=""><td>NO</td><td>Bod gross souch chart windmill</td><td>0 104 514</td><td>Minor</td><td>NB</td><td>Decolt</td><td>NII</td></td<>	NO	Bod gross souch chart windmill	0 104 514	Minor	NB	Decolt	NII
Norms Dive, dover, paspalum, browns love, dover, paspalum, Shepherds purse 0-196 SW Minor Nil Basalt Nil N5 Red grass, couch, short windmil, browns dove, dover, paspalum, Shepherds purse 0-196 SW Minor Nil Few smail Nil N6 Red grass, couch, short windmil, browns love, dover, paspalum, Shepherds purse 4% W Minor Nil Few smail Nil N6 Red grass, couch, short windmil, browns love, dover, paspalum, Shepherds purse 6% W Minor Nil Basalt Nil N7 Red grass, couch, short windmil, browns love, dover, paspalum, Shepherds purse 6% W Minor Nil Basalt Nil N8 Red grass, couch, short windmil, browns love, dover, paspalum, Shepherds purse 0-4% SW Minor Nil Basalt Nil N8 Red grass, couch, short windmil, browns love, dover, paspalum, Shepherds purse 2% SW Minor Nil Surface Nil N10 Red grass, couch, short windmil, browns love, dover, paspalum, Shepherds purse 1% S Minor Nil Nil Nil N11 Red grass, couch, short windmil, browns love, dover, paspalum, Shepherds purse 1% S Nil Nil Nil N11 Red grass, couch, short windmil, browns love, dover, paspalum, Shepherds purse 3% S	NO	heuraleve dever neendum	0-170 344		I NII	Dasali	I NII
N4 Red grass, couch, short windmill, browns love, dover, paspalum, Shepherds purse 0-1% SW Minor Nil Basalt Nil N5 Red grass, couch, short windmill, browns love, dover, paspalum, Shepherds purse 0-1% SW Minor Nil Few small Nil N6 Red grass, couch, short windmill, browns love, dover, paspalum, Shepherds purse 4% W Minor Nil Few small Nil N7 Red grass, couch, short windmill, browns love, dover, paspalum, Shepherds purse 6% W Minor Nil Easatt Nil N8 Red grass, couch, short windmill, browns love, dover, paspalum, Shepherds purse 0-4% SW Minor Nil Statast Nil N8 Red grass, couch, short windmill, browns love, dover, paspalum, Shepherds purse 0-4% SW Minor Nil Statast Nil N9 Red grass, couch, short windmill, browns love, dover, paspalum, Shepherds purse 1% S Minor Nil Statast Nil N11 Red grass, couch, short windmill, browns love, dover, paspalum, Shepherds purse 1% S Nil Nil Nil N11 Red grass, couch, short windmill, browns love, dover, paspalum, Shepherds purse 9% S Nil Nil Surface Nil N11 Red grass, couch, short windmill, browns love, dover, paspalum, Shepherds pur		browns love, clover, paspalum,				copples	
NA Red grass, couch, short windmil, browns love, dover, paspalum, Shepherds purse O-1% SW Minor Nil Beast browns love, dover, paspalum, cobbles N5 Red grass, couch, short windmil, browns love, dover, paspalum, Shepherds purse 0-1% SW Minor Nil Few small Nil N6 Red grass, couch, short windmil, browns love, dover, paspalum, Shepherds purse 4% W Minor Nil Trace surface Nil N7 Red grass, couch, short windmil, browns love, dover, paspalum, Shepherds purse 6% W Minor Nil Basalt Nil N8 Red grass, couch, short windmil, browns love, dover, paspalum, Shepherds purse 0-4% SW Minor Nil Basalt Nil N9 Red grass, couch, short windmil, browns love, dover, paspalum, Shepherds purse 2% SW Minor Nil Basalt Nil N10 Red grass, couch, short windmil, browns love, dover, paspalum, Shepherds purse 1% S Minor Nil Nil Nil N11 Red grass, couch, short windmil, browns love, dover, paspalum, Shepherds purse 1% S Nil Nil Nil N11 Red grass, couch, short windmil, browns love, dover, paspalum, Shepherds purse 3% S Nil		Snepheras purse					
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browns love, clover, paspalum, and small amaranth, sheep sorrel cobbles	03	Rea grass, couch, short windmill,	2-3% SW	winor	INII	LOT OT DASAIT	INII
amaranth, sheep sorrel cobbles		prowns love, clover, paspalum,				and small	
		amaranth, sheep sorrel				cobbles	

04	Red grass, couch, short windmill, browns love, clover, paspalum,	2-4% SW	Nil	Nil	Lot of basalt and small	Nil
O5	Red grass, couch, short windmill, browns love, clover, paspalum,	2-4% SW	Nil	Nil	Lot of basalt and small	Nil
O6	Red grass, couch, short windmill, browns love, clover, paspalum,	5% W	Nil	Nil	Surface cobbles	Nil
07	Red grass, couch, short windmill, browns love, clover, paspalum, amaranth, sheep sorrel	0-8% S	Nil	Nil	Rock outcrop and surface cobbles	Nil
08	Red grass, couch, short windmill, browns love, clover, paspalum, amaranth, sheep sorrel	0-8% S	Nil	Nil	Rock outcrop and surface	Nil
O9	Red grass, couch, short windmill, browns love, clover, paspalum, Shepherds purse	2% SW	Nil	Nil	Surface cobbles	Nil
010	Red grass, couch, short windmill, browns love, clover, paspalum, Shepherds purse	1% SW	Nil	Nil	Nil	Nil
011	Red grass, couch, short windmill, browns love, clover, paspalum, Shepherds purse	1% SW	Nil	Nil	Nil	Nil
012	Red grass, couch, short windmill, browns love, clover, paspalum, Shepherds purse	Flat	Soil stockpil <i>e</i> s	Nil	River gravels	Nil
013	Red grass, couch, short windmill, browns love, clover, paspalum, Shenherds purse	Flat	Soil stockpil <i>e</i> s	Nil	River gravels	Nil
O14	Red grass, couch, short windmill,	3% S	Nil	Nil	Surface	Nil
O15	Red grass, couch, short windmill,	Flat	Nil	Nil	Surface	Nil
O16	Red grass, couch, short windmill,	Flat	Nil	Nil	Surface	Nil
O17	Red grass, couch, short windmill,	Flat	Nil	Nil	Surface	Nil
P1	browns love, clover, paspalum Red grass, couch, short windmill, browns love, clover	2-3% SW	Minor	Nil	cobbles Basalt cobbles	Eucalypt
P2	Red grass, couch, short windmill,	2-3% SW	Minor	Nil	Basalt	Nil
P3	Patterson's curse, cat head, amaranth, windmill grass	2-3% SW	Minor	Nil	Basalt	Nil
P4	Patterson's curse, cat head,	2-3% SW	Minor	Nil	Basalt	Nil
P5	Patterson's curse, cat head,	5-6% SW	Minor	Nil	Basalt	Nil
P6	Patterson's curse, cat head,	4% W	Minor	Nil	Surface	Nil
P7	amaranth, windmill grass Patterson's curse, cat head,	Flat	Minor	Nil	cobbles Surface	Nil
P8	amaranth, windmill grass Patterson's curse, cat head,	4% S	Minor	Nil	cobbles Rock outcrop	Nil
P9	amaranth, windmill grass Patterson's curse, cat head, amaranth, windmill grass	2% SW	Nil	Nil	Rock outcrop	Nil
P10	Patterson's curse, cat head,	1% S	Nil	Nil	Nil	Nil
P11	amaranth, windmill grass, paspalum Patterson's curse, cat head, amaranth, windmill grass, paspalum	1% S	Nil	Nil	Nil	Nil
P12	Amaranin, which in grass, paspalum Patterson's curse, cat head, amaranth, windmill grass, paspalum	Flat	Soil stockpile <u>s</u>	Nil	River gravels	Nil

P13Patterson's curse, cat nead, amaranth, windmill grass, paspalum, clover3% SSoliNilSurface cobblesP14Red grass, couch, short windmill, browns love, clover, paspalum3% SMinorNilSurface cobblesP15Red grass, couch, short windmill, browns love, clover, paspalum, amaranth, sheep sorrel, Galvanised burrFlatNilNilSurface cobblesP16Red grass, couch, short windmill, browns love, clover, paspalum, amaranth, sheep sorrel, Galvanised burrFlatNilNilSurface cobblesP17Red grass, couch, short windmill, browns love, clover, paspalum, amaranth, sheep sorrel, Galvanised burrFlatNilNilSurface cobblesP17Red grass, couch, short windmill, browns love, clover, paspalum, amaranth, sheep sorrel, GalvanisedFlatNilNilSurface cobblesP17Red grass, couch, short windmill, browns love, clover, paspalum, amaranth, sheep sorrel, GalvanisedFlatNilNilSurface cobbles	Nil Nil Nil
 P14 Red grass, couch, short windmill, 3% S Minor Nil Surface cobbles P15 Red grass, couch, short windmill, Flat Nil Nil Surface cobbles P15 Red grass, couch, short windmill, Flat Nil Nil Surface cobbles P16 Red grass, couch, short windmill, sheep sorrel, Galvanised burr P16 Red grass, couch, short windmill, sheep sorrel, Galvanised burr P17 Red grass, couch, short windmill, sheep sorrel, Galvanised burr 	Nil Nil Nil
P14Red grass, couch, short windmill, browns love, clover, paspalum3% SMinorNilSurface cobblesP15Red grass, couch, short windmill, browns love, clover, paspalum, amaranth, sheep sorrel, Galvanised burrFlatNilNilSurface cobblesP16Red grass, couch, short windmill, burrFlatNilNilSurface cobblesP16Red grass, couch, short windmill, browns love, clover, paspalum, amaranth, sheep sorrel, Galvanised burrFlatNilNilSurface cobblesP17Red grass, couch, short windmill, 	Nil Nil Nil
P14 Red grass, couch, short windmill, 3% S Winor Nil Surface cobbles P15 Red grass, couch, short windmill, sheep sorrel, Galvanised burr Flat Nil Nil Surface cobbles P16 Red grass, couch, short windmill, sheep sorrel, Galvanised burr Flat Nil Nil Surface cobbles P16 Red grass, couch, short windmill, sheep sorrel, Galvanised burr Flat Nil Nil Surface cobbles P17 Red grass, couch, short windmill, sheep sorrel, Galvanised burr Flat Nil Nil Surface cobbles P17 Red grass, couch, short windmill, sheep sorrel, Galvanised burr Flat Nil Nil Surface cobbles P17 Red grass, couch, short windmill, sheep sorrel, Galvanised Flat Nil Nil Surface cobbles P17 Red grass, couch, short windmill, amaranth, sheep sorrel, Galvanised Flat Nil Nil Surface cobbles P17 Red grass, couch, short windmill, amaranth, sheep sorrel, Galvanised Flat Nil Nil Surface cobbles	Nil Nil
P15Red grass, couch, short windmill, browns love, clover, paspalum, amaranth, sheep sorrel, Galvanised burrFlatNilSurface cobblesP16Red grass, couch, short windmill, browns love, clover, paspalum, amaranth, sheep sorrel, Galvanised burrFlatNilNilSurface cobblesP16Red grass, couch, short windmill, browns love, clover, paspalum, 	Nil Nil
P15 Red grass, couch, short windmill, Flat Nil Surface browns love, clover, paspalum, cobbles amaranth, sheep sorrel, Galvanised burr P16 Red grass, couch, short windmill, Flat Nil Surface browns love, clover, paspalum, cobbles amaranth, sheep sorrel, Galvanised cobbles browns love, clover, paspalum, cobbles amaranth, sheep sorrel, Galvanised burr P17 Red grass, couch, short windmill, Flat maranth, sheep sorrel, Galvanised cobbles amaranth, sheep sorrel, Galvanised cobbles	Nil
browns love, clover, paspalum, cobbles amaranth, sheep sorrel, Galvanised burr P16 Red grass, couch, short windmill, Flat Nil Surface browns love, clover, paspalum, cobbles amaranth, sheep sorrel, Galvanised cobbles burr P17 Red grass, couch, short windmill, Flat Nil Surface P17 Red grass, couch, short windmill, Flat Nil Surface browns love, clover, paspalum, cobbles cobbles amaranth, sheep sorrel, Galvanised surface cobbles	Nil
amaranth, sheep sorrel, Galvanised burr P16 Red grass, couch, short windmill, Flat Nil Nil Surface browns love, clover, paspalum, cobbles amaranth, sheep sorrel, Galvanised burr P17 Red grass, couch, short windmill, Flat Nil Nil Surface browns love, clover, paspalum, cobbles amaranth, sheep sorrel, Galvanised	Nil
burr P16 Red grass, couch, short windmill, Flat Nil Nil Surface browns love, clover, paspalum, cobbles amaranth, sheep sorrel, Galvanised burr P17 Red grass, couch, short windmill, Flat Nil Nil Surface browns love, clover, paspalum, cobbles amaranth, sheep sorrel, Galvanised	Nil
P16 Red grass, couch, short windmill, Flat Nil Surface browns love, clover, paspalum, cobbles amaranth, sheep sorrel, Galvanised burr P17 Red grass, couch, short windmill, Flat Nil Surface P17 Red grass, couch, short windmill, Flat Nil Surface P17 Red grass, couch, short windmill, Flat Nil Surface browns love, clover, paspalum, cobbles cobbles amaranth, sheep sorrel, Galvanised maranth, sheep sorrel, Galvanised cobbles	Nil
browns love, clover, paspalum, cobbles amaranth, sheep sorrel, Galvanised burr P17 Red grass, couch, short windmill, Flat Nil Nil Surface browns love, clover, paspalum, cobbles amaranth, sheep sorrel, Galvanised	
amaranth, sheep sorrel, Galvanised burr 217 Red grass, couch, short windmill, Flat Nil Nil Surface browns love, clover, paspalum, cobbles amaranth, sheep sorrel, Galvanised	
burr P17 Red grass, couch, short windmill, Flat Nil Nil Surface browns love, clover, paspalum, cobbles amaranth, sheep sorrel, Galvanised	
P17 Red grass, couch, short windmill, Flat Nil Nil Surface browns love, clover, paspalum, cobbles amaranth, sheep sorrel, Galvanised	
browns love, clover, paspalum, cobbles amaranth, sheep sorrel, Galvanised	Nil
amaranth, sheep sorrel, Galvanised	
burr	
Q1 Red grass, couch, short windmill, 2-3% SW Minor Nil Basalt	Eucalypt
browns love, clover cobbles	VI
Q2 Red grass, couch, short windmill, 2-3% SW Minor Nil Basalt	Eucalvpt
browns love, dover cobbles	
23 Pattersons's curse, cat head. 2-4% SW Minor Nil Basalt	Nil
amaranth windmill grass	
Q4 Pattersons's curse cat head 2-3% SW Minor Nil Basalt	Nil
amaranth windmill grass	
25 Red grass couch short windmill 1-2% SW Minor Nil Basalt	NII
browns love clover cobbles	
Construction Const	Nii
browns love dover cohbles	1 111
77 Red grass couch short windmill 2-3% SW Minor Nil Basalt	Nii
brownelove clover	1 11
Definition of the start windmill 1% SE Minor Nil Basalt	Nii
ao Neu yrass, couch, short windhill, 1703 E Milliol Nil Dasait	I NII
Di Owins Tove, ciovel couldes 20 Red grace coulch chortwindmill 204 SE Minor Nil Surface	Nii
29 Neu grass, couch, short williumii, 2703E Willion Nii Sullace	I NII
Diowits love, gover, pasparum couples	NG
210 Red grass, couch, short windhill, 2703E Nill Nill Sundce	INII
Diowiistove, uovel, pasparum counces	NG
and Red grass, couch, short windhill, 1765 windor Nil Sunace	INII
browns rove, crover, pasparum coopres	N EI
arz Red grass, couch, short windmilli, 3% 5 Millior INII Surface	INII
browns rove, dover, pasparum coopies	N EI
213 Red grass, couch, short windmill, 3% S Minor Nil Surface	INII
browns love, dover, paspalum, cobbies	
Snepheras purse	K PI
214 Red grass, couch, short windmill, Flat Minor Nil Surface	NII
browns love, clover, paspalum, cobbles	
amaranth, sheep sorrel, Galvanised	
burr	
Q15 Red grass, couch, short windmill, Flat Minor Nil Surface	Nil
browns love, clover, paspalum, cobbles	
amaranth, sheep sorrel, Galvanised	
burr	
ג16 Red grass, couch, short windmill, Flat Minor Nil Surface	Nil
browns love, clover, paspalum, cobbles	
amaranth, sheep sorrel, Galvanised	
burr	
ହୀ7 Red grass, couch, short windmill, Flat Minor Nil Surface	Nil
browns love, clover, paspalum, cobbles	
clover, wild sage	

Appendix 5. Field and laboratory sheets

Salinity assessment						
Client: c/- Geolyse			Job no:	5737	Date:	8/05/2015
		Ц		H		
Address:	Lot 399 DP1199356 & Lot 5	503 DP115	2321 Henness	sy Road, Dub	bo NSW	
Borehole:	1	GPS:	55H 653 82	4mE 6428 2	257mN	

Surface description

Slope:	1%	Aspect:	West			
Morphological type:	Mid-slope					
Land-use:	Grazing					
Disturbance:	High					
Erosion:	Nil	Nil				
Coarse fragments:	Basalt float					
Surface cover:	Windmill grass,	khaki weed, love g	rass, paspalum, red grass			
% surface cover	90%. Bare areas due to stock compaction					
Salinity:	Nil					

Sample metho	d: EVH	Logged by: DL					
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots, structure)	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate test
0 to 350	Dark brown silty sand with increasing basalt cobbles		D				
350	End of hole, refusal on basalt cobbles						
Notes: Nil							

Salinity assessment Client: c/- Geolyse Job no: 5737 Date: 8/05/2015 Address: Lot 399 DP1199356 & Lot 503 DP1152321 Hennessy Road, Dubbo NSW Some State Some State

Surface description

Slope:	2%	Aspect:	East
Morphological type:	Upper-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Basalt float		
Surface cover:	Windmill grass, k	khaki weed, love g	rass, paspalum, red grass
% surface cover	95%		
Salinity:	Bare areas due t	o stock compactio	n

Sample method	Sample method: EVH		Logged by: DL					
Depth (mm)	Soil description (texture, colour, coarse	Sample	M/D	pH (1:5	EC	ECe	Emerson	
	fragments, mottles, roots, structure)			water)	(dS/m)	U	aggregate test	
0 to 500	Dark brown silty sand with increasing		D	1. I.				
	basalt cobbles							
500								
	End of hole, refusal on basalt cobbles							
Notes: Nil								

Salinity assessment Client: c/- Geolyse Job no: 5737 Date: 8/05/2015 Address: Lot 399 DP1199356 & Lot 503 DP1152321 Hennessy Road, Dubbo NSW Some State Some State

Surface description

Slope:	1%	Aspect:	South
Morphological type:	Mid-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Basalt float		
Surface cover:	Windmill grass, I	khaki weed, love g	rass, paspalum, red grass
% surface cover	100%		
Salinity:	Nil		

Sample method: EVH		Logged by	y: DL		_		
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots, structure)	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate test
0 to 300	Dark red silty gravel with basalt cobbles		D				
300 to 800	Light grey silty sand with extremely weathered rock		D				
800	End of hole, refusal on weathered rock						
Notes:	1	1		1	1	1	1

Salinity assessment

Client: c/- Geolyse			Job no:	5737	Date:	7/05/2015
Address:	Lot 399 DP1199356 & Lot 5	503 DP115	2321 Henness	y Road, Dul	bo NSW	
Borehole:	4	GPS:	55H 654 207	′mE 6428 ′	183mN	

Surface description

Slope:	1%	Aspect:	South
Morphological type:	Mid-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Nil		
Surface cover:	Windmill grass,	khaki weed, love g	rass, paspalum, red grass
% surface cover	70%		
Salinity:	Bare areas due	to soil nearby soil	and refuse stockpiles

Sample method	EVH	Logged by: DL					
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots, structure)	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate test
0 to 500	Dark brown silty clay loam		М				
500 to 1300	Dark grey silty clay		М				
1300 to 1600	Dark grey sandy clay		М				
1600 to 1800	Light grey gravelly clay with basalt cobbles		D				
1800	End of hole, refusal on basalt cobbles						
Notes:	1				1		1

Salinity assessment

Client: c/- Geolyse			Job no:	5737	Date:	7/5/2015
Address:	Lot 399 DP1199356 & Lot 5	503 DP115	2321 Hennessy	Road, Dub	bo NSW	
Borehole:	5	GPS:	55H 654 357	mE 6428 1	183mN	

Surface description

Slope:	1%	Aspect:	North east
Morphological type:	Mid-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Nil		
Surface cover:	Windmill grass,	khaki weed, love g	rass, paspalum, red grass
% surface cover	98% due to vege	etation shading	
Salinity:	Nil		

Sample method:	EVH	Logged b	y: DL				
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots, structure)	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate test
0 to 200	Brown silty clay loam		М				
200 to 500	Dark brown silty clay		М				
500 to 1600	Dark brown lean clay with trace gravel		D				
1600 to 2000	Dark brown sandy clay		D				
2000	End of hole	-		- 1			
Notes:							

Salinity assessment

Client: c/- Geolyse			Job no:	5737	Date:	24/04/2015
Address:	Lot 399 DP1199356 & Lot 5	503 DP115	2321 Henness	y Road, Duk	bo NSW	
Borehole:	6	GPS:	55H 654 476	6428 ômE 6428 ôm	142mN	

Surface description

Slope:	1%	Aspect:	West					
Morphological type:	Mid-slope							
Land-use:	Grazing							
Disturbance:	High							
Erosion:	Nil							
Coarse fragments:	Nil							
Surface cover:	Windmill grass, khaki weed, love grass, paspalum, red grass, couch, clover							
% surface cover	100%							
Salinity:	Nil							

Sample method: EVH		Logged by: DL						
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots, structure)	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate test	
0 to 600	Dark brown, silty clay loam		М					
600 to 1700	Dark brown silty clay with trace gravel		D					
1700 to 3000	Dark brown light medium clay with trace gravel		D					
3000	End of hole							
Notes:						1	1	
Client: c/- Geolyse			Job no:	5737	Date:	24/04/2015		
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Address:	Lot 399 DP1199356 & Lot 5	503 DP115	2321 Hennessy	Road, Dub	bo NSW			
Borehole:	7	GPS:	55H 654 591	mE 6428 1	128mN			

Surface description

Slope:	1%	Aspect:	North
Morphological type:	Mid-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Nil		
Surface cover:	Windmill grass,	khaki weed, love g	rass, paspalum, red grass, couch, clover
% surface cover	100%		
Salinity:	Nil		

Sample method: EVH		Logged by: DL					
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots, structure)	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate test
0 to 400	Dark brown silty clay loam		М				
400 to 1100	Light reddish brown silty clay with trace gravel		D				
1100 to 2000	Dark red light medium clay with trace gravel		D				
2000	End of hole						
Notes:	1						1

Client: c/- Geolyse			Job no:	5737	Date:	24/04/2015
Address:	Lot 399 DP1199356 & Lot 5	503 DP115	2321 Hennessy	Road, Dub	bo NSW	
Borehole:	8	GPS:	55H 654 740	mE 6428 1	11mN	

Surface description

Slope:	1%	Aspect:	North
Morphological type:	Mid-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Surface rock		
Surface cover:	Windmill grass, k	haki weed, love g	rass, paspalum, red grass, couch, clover
% surface cover	100%		
Salinity:	Nil		

Sample method: EVH Logged by: DL							
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots, structure)	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate test
0 to 450	Dark brown sandy clay loam	X X	M M				
450 to 1400	Dark red silty clay	XX	M				
1400 to 2800	Dark brown sandy clay with trace ironstone nodules	X X	M M				
2800 to 4800	Light grey sandy clay	X X V	M M				
4800 to 8800	White silty sand with extremely weathered rock	X X	D D				
8800	End of hole, refusal on weathered rock	Х	D				
Notes:							

Client: c/- Geolyse			Job no:	5737	Date:	8/05/2015
		11		1		
Address:	Lot 399 DP1199356 & Lot 5	503 DP115	2321 Hennessy	/ Road, Dub	bo NSW	
Borehole:	9	GPS:	55H 653 802	mE 6428 1	28mN	

Surface description

Slope:	1%	Aspect:	North west
Morphological type:	Mid-slope		
Land-use:	Grazing		
Disturbance:	High- soil stock	piles to the east	
Erosion:	Nil		
Coarse fragments:	Basalt float		
Surface cover:	Windmill grass	, khaki weed, love g	rass, paspalum, red grass, couch, clover
% surface cover	90%		
Salinity:	Nil		

Sample method	Logged b	y: DL					
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots, structure)	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate test
0 to 300	Dark brown silty sand loam		D				
300 to 1200	Brown sandy clay		D				
1200 to 2000	Light yellow silty clay with trace gravel		D				
2000 to 2700	Light yellowish brown silty sand with moderate weathered rock and trace clay		D				
2700 to 3000	White silty sand, extremely weathered rock		D				
3000	End of hole						
Notes:	1				1	land land	1

Client: c/- Geolyse			Job no:	5737	Date:	8/05/2015
		1				
Address:	Lot 399 DP1199356 & Lot 5	503 DP115	2321 Henness	y Road, Dub	bo NSW	
Borehole:	10	GPS:	55H 653 927	mE 6428 1	l22mN	

Surface description

Slope:	2%	Aspect:	East
Morphological type:	Upper-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Surface float		
Surface cover:	Windmill grass, k	haki weed, love g	rass, paspalum, red grass
% surface cover	90%		
Salinity:	Nil		

Sample method: EVH		Logged by: DL					
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots, structure)	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate test
0 to 200	Dark brown silty sand with basalt cobbles		D				
200	End of hole, refusal on basalt cobbles						
Notes:							

Client: c/- Geolyse			Job no:	5737	Date:	7/05/2015
Address:	Lot 399 DP1199356 & Lot 503 DP1152321 Hennessy Road, Dubbo NSW					
Borehole:	11	GPS:	55H 654 084	mE 6428 ()79mN	

Surface description

Slope:	0-1%	Aspect:	North east
Morphological type:	Mid-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Basalt cobbles		
Surface cover:	Windmill grass, k	khaki weed, love g	rass, paspalum, red grass, couch, clover
% surface cover	90%		
Salinity:	Nil		

Sample method	EVH	Logged by	y: DL				
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots, structure)	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate test
0 to 300	Dark brownish red, silty clay loam		М				
300 to 600	Dark brown silty clay trace cobbles		D				
600 to 2100	Light grey silty gravel, with moderate weathered rock		D				
2100	End of hole					- 1	
Notes:	<u>.</u>						

Client: c/- Geolyse			Job no:	5737	Date:	7/05/2015
Address:	Lot 399 DP1199356 & Lot 5	03 DP115	2321 Hennessy	Road, Dub	bo NSW	
Borehole:	12	GPS:	55H 654 211	mE 6428 ()64mN	

Surface description

Slope:	1%	Aspect:	South
Morphological type:	Mid-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Nil		
Surface cover:	Windmill grass,	khaki weed, love g	rass, paspalum, red grass, couch, clover
% surface cover	100%		
Salinity:	Nil		

Sample method: EVH Logged by: DL							
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots, structure)	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate test
0 to 500	Dark red silty clay loam		М				
500 to 900	Light brown silty gravel with trace river gravel		D				
900 to 1600	Light orange silty sand with moderate weathered rock and trace river gravel		D				
1600 to 3000	Dark red silty sand with trace clay		D				
3000	End of hole	-				- 1	
Notes:	I				1	1	1

Client: c/- Geolyse			Job no:	5737	Date:	7/05/2015
Address:	Lot 399 DP1199356 & Lot 5	503 DP115	2321 Henness	y Road, Dub	bo NSW	
Borehole:	13	GPS:	55H 654 340) mE 6428 ()26mN	1

Surface description

Slope:	1%	Aspect:	South
Morphological type:	Mid-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Nil		
Surface cover:	Shepherds purs	e, red grass, shee	os burr
% surface cover	100%		
Salinity:	Nil		

Sample method:	EVH	Logged by: DL					
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots, structure)	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate test
0 to 300	Dark brown red silty clay loam		М				
300 to 700	Dark red sandy clay with trace gravel		D				
700 to 1600	Orange silty gravel with trace river gravel		D				
1600 to 2600	Light grey silty gravel with weathered rock and trace clay		D				
2600-3000	Dark grey clayey gravel		М				
3000	End of hole	1 11					
Notes:	<u>.</u>			·			

Client: c/- Geolyse			Job no:	5737	Date:	7/05/2015
Addross:	Lat 200 DD1100256 8 Lat 6		2221 Uonnooov	Pood Duk	bo NSW	
Address.	LUI 399 DF 1199330 & LUI 3	000 DE 110.	ZJZT HEIIIESSY	Ruau, Dur	1121100	
Borehole:	14	GPS:	55H 654 211r	nE 642 80)64mN	1

Surface description

Slope:	1%	Aspect:	South
Morphological type:	Mid-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Nil		
Surface cover:	Shepherds purse	e, red grass, shee	os burr
% surface cover	100%		
Salinity:	Nil		

Sample method:	EVH	Logged by	y: DL				
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots, structure)	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate test
0 to 500	Dark red silty clay loam		М				
500 to 900	Light brown silty gravel with trace river gravel		D				
900 to 1600	Light orange silty sand with moderate weathered rock and trace river gravel		D				
1600 to 3000	Dark red silty sand with trace clay		D				
3000	End of hole						-
Notes:					1	1	1

Client: c/- Geolyse			Job no:	5737	Date:	24/04/2015
				11		
Address:	Lot 399 DP1199356 & Lot 5	503 DP115	2321 Hennessy	Road, Dub	bo NSW	
Borehole:	14	GPS:	55H 654 464r	nE 6428 C	224mN	

Surface description

Slope:	1%	Aspect:	South
Morphological type:	Mid-slope		1
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Nil		
Surface cover:	Shepherds purs and clover	e, red grass, shee	os burr, couch, short windmill, browns love
% surface cover	95%		
Salinity:	Nil		

Sample method	: EVH	Logged by	/: DL				
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots, structure)	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate test
0 to 300	Dark brown silty clay loam		М				
300 to 600	Reddish brown silty clay		D				
600 to 3000	Light brown light clay with increasing gravel content		D				
3000	End of hole					19. II	
Notes:							

Client: c/- Geolyse			Job no:	5737	Date:	24/04/2015
				11		
Address:	Lot 399 DP1199356 & Lot 5	503 DP115	2321 Hennessy	Road, Dub	bo NSW	
Borehole:	15	GPS:	55H 654 571r	nE 6427 9	94mN	1

Surface description

Slope:	1%	Aspect:	West
Morphological type:	Mid-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Trace		
Surface cover:	Shepherds purse and clover	e, red grass, shee	os burr, couch, short windmill, browns love
% surface cover	95%		
Salinity:	Nil		

Sample method:	EVH	Logged by: DL					
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots, structure)	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate test
0 to 400	Dark brown silty clay loam		М				
400 to 1200	Dark reddish brown silty clay with fine gravel		D				
1200 to 3000	Dark reddish brown light clay with increasing gravel content		D				
3000	End of hole				- 11 - 11		
Notes:	·	· · · · · · ·					

Client: c/- Geolyse			Job no:	5737	Date:	24/04/2015
				11		
Address:	Lot 399 DP1199356 & Lot 5	503 DP115	2321 Hennessy	Road, Dub	bo NSW	
Borehole:	16	GPS:	55H 654 211r	nE 642 80	64mN	

Surface description

Slope:	0-2%	Aspect:	West
Morphological type:	Mid-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Surface rocks		
Surface cover:	Shepherds purse and clover	e, red grass, shee	os burr, couch, short windmill, browns love
% surface cover	90%		
Salinity:	Nil		

Sample method:	EVH	Logged b	y: DL				
Depth (mm)	Soil description (texture, colour, coarse fragments mottles roots	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate
	structure)	2 B			(a- 8	test
0 to 300	Dark brown sandy clay loam		М				
300 to 600	Dark red sandy clay with cobbles		D				
600 to 1300	Dark red silty clay		D				
1300 to 1500	Light brown light clay with increasing gravel		D				
1500	End of hole						
Notes:	·						
							1

Client: c/- Geolyse			Job no:	5737	Date:	8/05/2015
Address:	Lot 399 DP1199356 & Lot 503 DP1152321 Hennessy Road, Dubbo NSW					
Borehole:	17	GPS:	55H 653 923r	nE 6427 9	94mN	

Surface description

Slope:	0-2%	Aspect:	East
Morphological type:	Mid-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Surface rocks		
Surface cover:	Windmill grass, k	haki weed, love g	rass, paspalum, red grass, couch, clover
% surface cover	90%		
Salinity:	Nil		

Sample method:	EVH	Logged by	y: DL			_	
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots, structure)	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate test
0 to 300	Dark brown silty sand loam		М	2			
300 to 600	Dark grey silty gravel with trace clay		D				
600 to 2000	Light grey silty sand with moderate weathered rock		D				
2000 to 3000	White silty sand, extremely weathered rock		D				
3000	End of hole						
Notes:						1	

Client: c/- Geolyse			Job no:	5737	Date:	7/05/2015
				ц	_	
Address:	Lot 399 DP1199356 & Lot 5	503 DP115	2321 Hennessy	Road, Dub	bo NSW	
Borehole:	18	GPS:	55H 654 063r	nE 6427 9)68mN	1

Surface description

Slope:	0-1%	Aspect:	East
Morphological type:	Mid-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Trace cobbles		
Surface cover:	Windmill grass, kh	naki weed, love g	rass, paspalum, red grass, couch, clover
% surface cover	90%		
Salinity:	Nil		

Sample method: EVH		Logged b	y: DL				
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots, structure)	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate
0 to 350	Dark brownish red silty clay loam		М				1051
350 to 1400	Brown light clay with trace gravel		D				
1400 to 2000	Light grey silty sand with moderate weathered rock		D				
3000	End of hole						
Notes:						1	

Client: c/- Geolyse			Job no:	5737	Date:	7/05/2015
Address:	Lot 399 DP1199356 & Lot 5	503 DP115	2321 Hennessy	Road, Dub	bo NSW	
Borehole:	19	GPS:	55H 654 183r	nE 6427 9)39mN	1

Surface description

Slope:	0-1%	Aspect:	North east
Morphological type:	Mid-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Nil		
Surface cover:	Windmill grass, k	haki weed, love g	rass, paspalum, red grass, couch, clover
% surface cover	90%		
Salinity:	Nil		

Sample method:	EVH	Logged by	/: DL				
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots, structure)	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate test
0 to 200	Dark red brown silty clay loam		М				
200 to 700	Dark reddish brown silty clay with trace gravel		М				
700 to 2000	Light orange silty sand with trace weathered rock and river gravel		D				
2000	End of hole						
Notes:	<u>.</u>	·			•		

Client: c/- Geolyse			Job no:	5737	Date:	7/05/2015
Address:	Lot 399 DP1199356 & Lot 5	503 DP115	2321 Hennessy	Road, Dub	bo NSW	
Borehole:	20	GPS:	55H 654 380r	nE 6427 9)26mN	

Surface description

Slope:	0-1%	Aspect:	North east
Morphological type:	Mid-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Nil		
Surface cover:	Couch, windmill	grass, clover, barl	ey grass
% surface cover	80%		
Salinity:	Nil		

Sub-surface description

Sample method:	EVH	Logged by: DL					
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots, structure)	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate test
0 to 300	Black silty clay loam		М				
300 to 500	Dark brown sandy clay		М				
500 to 1200	Brown silty clay		D				
1200 to 3500	Grey brown silty clay with trace gravel and mottles		D				
3500 to 5800	Grey silty clay with trace river gravel						
5800 to 8500	Whitish grey silty loam (extremely weathered rock) with trace white mottles and gravel						
8500 to 12000	White silty loam (extremely weathered rock)						
12000	End of hole						~ ~
Notes:	1						1

Notes:

Client: c/- Geolyse			Job no:	5737	Date:	24/04/2015
Address:	Lot 399 DP1199356 & Lot 5	503 DP115	2321 Hennessy	Road, Dub	bo NSW	
Borehole:	21	GPS:	55H 654 436r	nE 6427 8	92mN	1

Surface description

Slope:	0-1%	Aspect:	South
Morphological type:	Mid-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Nil		
Surface cover:	Shepherds purse	e, red grass, shee	os burr
% surface cover	90%		
Salinity:	Nil		

Sample method: EVH Logged by: DL							
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots, structure)	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate test
0 to 500	Dark brown silty clay loam		М				
500 to 1000	Dark red silty sand with trace gravel		D				
1000 to 2000	Dark red light clay with trace gravel		D				
2000	End of hole					-	- 1
Notes:		· · · · ·			<u>.</u>		

Client: c/- Geolyse			Job no:	5737	Date:	24/04/2015
Address:	Lot 399 DP1199356 & Lot 5	503 DP115	2321 Hennessy	Road, Dub	bo NSW	
Borehole:	22	GPS:	55H 654 548r	nE 6427 8	71mN	1

Surface description

Slope:	0-1%	Aspect:	West
Morphological type:	Mid-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Surface float		
Surface cover:	Shepherds purse	, red grass, shee	ps burr
% surface cover	90%		
Salinity:	Nil		

Sample method: EVH Logged by: DL							
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots, structure)	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate test
0 to 300	Dark brown silty clay loam		М				C
300 to 500	Dark red silty clay		М				
500 to 1400	Dark red light clay with trace gravel		D				
1400 to 2000	White silty sand with trace weathered rock		D				
2000	End of hole						
Notes:	·			I		I	

Client: c/- Geolyse			Job no:	5737	Date:	24/04/2015
Address:	Lot 399 DP1199356 & Lot 5	503 DP115	2321 Hennessy	Road, Dub	bo NSW	
Borehole:	23	GPS:	55H 654 706r	nE 6427 8	51mN	

Surface description

Slope:	0-1%	Aspect:	North east
Morphological type:	Upper-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Large cobbles		
Surface cover:	Shepherds purse, red	grass, sheep	os burr
% surface cover	90%		
Salinity:	Nil		

Sample method: EVH		Logged by: DL					
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots, structure)	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate test
0 to 400	Dark brown silty clay loam		М				
400 to 1000	Dark brown gravelly clay with moderate cobbles		D				
2000	End of hole					- 1	
Notes:							

Client: c/- Geolyse			Job no:	5737	Date:	7/05/2015
Address:	Lot 399 DP1199356 & Lot 5	503 DP115	2321 Hennessy	Road, Dub	bo NSW	
Borehole:	24	GPS:	55H 653 746r	nE 6427 8	375mN	

Surface description

Slope:	0-1%	Aspect:	South east
Morphological type:	Mid-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Nil		
Surface cover:	Red grass, couch	n, short windmill, b	prowns love, clover
% surface cover	90%		
Salinity:	Nil		

Sample method:	EVH	Logged by	/: DL				
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots, structure)	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate test
0 to 300	Dark brownish red silty clay loam		М				
300 to 900	Dark brown light clay with trace cobbles		М				
900 to 2000	Dark brownish red light clay with trace cobbles		D				
2000	End of hole			e	-		
Notes:	<u>.</u>	·		•		•	

Client: c/- Geolyse			Job no:	5737	Date:	7/05/2015
Address:	Lot 399 DP1199356 & Lot 5	503 DP115	2321 Hennessv	Road, Dub	bo NSW	
Borehole:	25	GPS:	55H 653 886r	nE 6427 8	356mN	

Surface description

Slope:	0-1%	Aspect:	South east
Morphological type:	Mid-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Nil		
Surface cover:	Red grass, couch	n, short windmill, b	prowns love, clover
% surface cover	90%		
Salinity:	Nil		

Sample method:	EVH	Logged b	y: DL				
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots,	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate
	structure)	-				-	test
0 to 300	Dark brown silty clay loam		М				
300 to 800	Dark brown silty clay		М				
800 to 2300	Dark brownish red light clay with trace gravel		D				
2300 to 3000	Dark brown light clay with trace basalt cobbles		D				
3000	End of hole			-		- 1	
Notes:							ĥ
							E.

Client: c/- Geolyse			Job no:	5737	Date:	7/05/2015
Address			0201 Jannasay	Dood Dub		
Address.	LOI 399 DP 1 199330 & LOI 3	003 DP 110.	ZSZT Hennessy	Road, Duc	VVEN OD	
Borehole:	26	GPS:	55H 654 040r	nE 6427 8	318mN	1

Surface description

Slope:	0-1%	Aspect:	North east
Morphological type:	Mid-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Nil		
Surface cover:	Paspalum, red gr	rass, shepherds p	urse, khaki weed, peppercress
% surface cover	90%		
Salinity:	Nil		

Sample method: EVH		Logged by	y: DL				
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots, structure)	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate test
0 to 500	Dark brownish red silty clay loam	S- 74	М				
500 to 2000	Dark red light clay with trace gravel		D				
2000	End of hole				2- 13	- 1	
Notes:							

Client: c/- Geolyse			Job no:	5737	Date:	7/05/2015
Address:	Lot 399 DP1199356 & Lot 5	503 DP115	2321 Hennessy	Road, Dub	bo NSW	
Borehole:	27	GPS:	55H 654 163r	nE 6427 7	88mN	1

Surface description

Slope:	0-1%	Aspect:	South
Morphological type:	Mid-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Nil		
Surface cover:	Paspalum, red gr	rass, shepherds p	urse, khaki weed, peppercress
% surface cover	90%		
Salinity:	Nil		

Sample method:	EVH	Logged b	y: DL				1
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots, structure)	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate test
0 to 200	Dark reddish brown silty clay Ioam		М				
200 to 400	Dark brown silty clay with trace river gravel		Μ				
400 to 800	Med brown lean clay		D				
800 to 1400	Brownish red light clay with trace river gravel		D				
1400 to 2000	Dark brown light clay with trace river gravel		Μ				
2000 to 2200	Dark grey light clay with moderate river gravel		D				
2200	End of hole, drill refusal						
Notes:							

Client: c/- Geolyse			Job no:	5737	Date:	7/05/2015
Address:	Lot 399 DP1199356 & Lot 5	503 DP115	2321 Hennessy	Road, Dub	bo NSW	
Borehole:	28	GPS:	55H 654 163r	nE 6427 7	'88mN	1

Surface description

Slope:	0-1%	Aspect:	South east
Morphological type:	Mid-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Nil		
Surface cover:	Paspalum, red gra	ss, shepherds p	urse, khaki weed, peppercress
% surface cover	90%		
Salinity:	Nil		

Sample method: EVH Logged by: DL							
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots,	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate
-	structure)	8	_				test
0 to 500	Dark red brown silty clay loam	A 5	М				
500 to 1000	Light brown sandy gravel		D				
1000 to 1500	Light brown silty gravel with moderate river gravel		D				
1500 to 2000	Dark reddish brown silty sand with weathered rock		D				
2000	End of hole						
NL 6			_				
Notes:							

Client: c/- Geolyse			Job no:	5737	Date:	24/04/2015
				11		
Address:	Lot 399 DP1199356 & Lot 5	503 DP115	2321 Hennessy	Road, Dub	bo NSW	
Borehole:	29	GPS:	55H 654 417r	nE 6427 7	'48mN	

Surface description

Slope:	0-1%	Aspect:	North
Morphological type:	Mid-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Nil		
Surface cover:	Paspalum, red g	rass, shepherds p	urse, khaki weed, peppercress
% surface cover	90%		
Salinity:	Nil		

Sample method: EVH Logged by: DL							
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots, structure)	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate test
0 to 500	Dark brown sandy clay loam		М				
500 to 900	Dark red sitly clay with trace gravel		D				
900 to 1800	Light red light clay with increasing gravel		D				
1800 to 2000	Light reddish brown silty sand with cobbles		D				
2000	End of hole, drill refusal						
						- 1	
Notes:							

Client: c/- Geolyse			Job no:	5737	Date:	24/04/2015
Address:	Lot 399 DP1199356 & Lot 503 DP1152321 Hennessy Road, Dubbo NSW					
Borehole:	30	GPS:	55H 654 534	lmE 6427 7	730mN	

Surface description

Slope:	0-3%	Aspect:	West
Morphological type:	Mid-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Basalt cobbles		
Surface cover:	Paspalum, red gr	rass, shepherds p	urse, khaki weed, peppercress
% surface cover	90%		
Salinity:	Nil		

Sample method: EVH Logged by: DL							
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots, structure)	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate test
0 to 200	Dark brown silty clay loam		М				
200 to 800	Dark brown red sandy clay with trace cobbles		D				
800 to 1400	Light brown grey silty sand with trace gravel		D				
1400 to 3000	White silty sand with trace gravel		D				
3000	End of hole						
Notes:				F			

Client: c/- Geolyse			Job no:	5737	Date:	24/04/2015
Address:	Lot 399 DP1199356 & Lot 503 DP1152321 Hennessy Road, Dubbo NSW					
Borehole:	31	GPS:	55H 654 679	mE 6427 7	705mN	

Surface description

Slope:	0-2%	Aspect:	South
Morphological type:	Mid-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Basalt cobbles		
Surface cover:	Paspalum, red gr	ass, shepherds p	urse, khaki weed, peppercress
% surface cover	90%		
Salinity:	Nil		

Sample method:	ple method: EVH Logged by: DL						
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots, structure)	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate test
0 to 200	Dark brown red silty clay loam		М				
200 to 300	Dark brown gravelly clay with basalt cobbles		D				
300	End of hole, drill refusal						
-				P		04	
Notes:							

Client: c/- Geolyse			Job no:	5737	Date:	7/05/2015
Address:	Lot 399 DP1199356 & Lot 5	503 DP115	2321 Hennessy	Road, Dub	bo NSW	
Borehole:	32	GPS:	55H 653 679r	nE 6427 7	'05mN	1

Surface description

Slope:	0-1%	Aspect:	South
Morphological type:	Mid-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Basalt cobbles		
Surface cover:	Windmill grass, fle	eabane, red gras	s, paspalum
% surface cover	90%		
Salinity:	Nil		

Sample method: EVH Logged by: DL							
Depth (mm)	Soil description (texture, colour,	Sample	M/D	pH (1:5	EC	ECe	Emerson
	coarse fragments, mottles, roots,			water)	(dS/m)		aggregate
	structure)					-	test
0 to 200	Dark brown red silty clay loam		M				
200 to 600	Dark brown red silty clay		D				
600 to 3000	Dark reddish brown light clay with trace gravel		D				
3000	End of hole, drill refusal						
Notes:							
-							

Client: c/- Geolyse			Job no:	5737	Date:	7/05/2015
Address:	Lot 399 DP1199356 & Lot 5	503 DP115	2321 Hennessy	Road, Dub	bo NSW	
Borehole:	34	GPS:	55H 653 009r	nE 6427 6	572N	

Surface description

Slope:	0-1%	Aspect:	South
Morphological type:	Mid-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Nil		
Surface cover:	Windmill grass, f	leabane, red gras	s, paspalum
% surface cover	95%		
Salinity:	Nil		

Sample method: EVH Logged by: DL							
Depth (mm)	Soil description (texture, colour,	Sample	M/D	pH (1:5	EC	ECe	Emerson
	coarse fragments, mottles, roots,			water)	(dS/m)		aggregate
	structure)	1					test
0 to 200	Dark brown red silty clay loam		М				
200 to 900	Dark brown silty clay		М				
900 to 2000	Dark red light clay with trace gravel		D				
2000	End of hole						
-				2			
Notes:							
-							

Client: c/- Geolyse			Job no:	5737	Date:	7/05/2015
			-	Ц	-	
Address:	Lot 399 DP1199356 & Lot 5	503 DP115	2321 Hennessy	Road, Dub	bo NSW	
Borehole:	35	GPS:	55H 654 143r	nE 6427 6	641N	

Surface description

Slope:	0-1%	Aspect:	South
Morphological type:	Mid-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Nil		
Surface cover:	Windmill grass, f	leabane, red gras	s, paspalum
% surface cover	95%		
Salinity:	Nil		

Sample method	EVH	Logged by	/: DL				
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots, structure)	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate test
0 to 300	Dark brown red silty clay loam		М				
300 to 500	Dark red silty clay		D				
500 to 1100	Dark reddish brown light clay with trace gravel		D				
1100 to 2000	Light brown light clay with trace gravel		D				
2000	End of hole						
Notes:	1	11		1		1	

Client: c/- Geolyse			Job no:	5737	Date:	7/05/2015
Address:	Lot 399 DP1199356 & Lot 5	503 DP115	2321 Hennessy	Road, Dub	bo NSW	
Borehole:	36	GPS:	55H 654 260r	nE 6427 6	510N	

Surface description

Slope:	0-1%	Aspect:	South east
Morphological type:	Mid-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Nil		
Surface cover:	Windmill grass, fl	eabane, red gras	s, paspalum
% surface cover	95%		
Salinity:	Nil		

Sample method	VH Logged by: DL						
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots, structure)	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate test
0 to 300	Dark reddish brown red silty clay loam		М				
300 to 400	Dark red silty clay		М				
400 to 2500	Dark reddish brown light clay with trace gravel		D				
2500 to 3000	Dark brown light clay with increasing gravel		D				
2000	End of hole						2-
Notes:	1	1		1	I.	1	1

Client: c/- Geolyse			Job no:	5737	Date:	24/04/2015
				H		
Address:	Lot 399 DP1199356 & Lot 5	503 DP115	2321 Hennessy	Road, Dub	bo NSW	
Borehole:	37	GPS:	55H 654 403r	nE 6427 5	596N	1

Surface description

Slope:	0-1%	Aspect:	North
Morphological type:	Mid-slope		I
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Nil		
Surface cover:	Short windmill g clover	rass, paspalum, re	d grass, couch, short windmill, browns love
% surface cover	95%		
Salinity:	Nil		

Sample method:	EVH	Logged by: DL					
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots, structure)	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate test
0 to 300	Dark brown sandy clay loam		М				
300 to 600	Light brown silty clay		D				
600 to 1400	Light brown light clay with trace gravel		D				
1400 to 2000	Light grey light clay with increasing gravel		D				
2000	End of hole			B			
Notes:	1	1					1

Client: c/- Geolyse			Job no:	5737	Date:	24/04/2015
				14		
Address:	Lot 399 DP1199356 & Lot 5	503 DP115	2321 Hennessy	Road, Dub	bo NSW	
Borehole:	38	GPS:	55H 654 518r	nE 6427 5	58mN	1

Surface description

Slope:	0-4%	Aspect:	West
Morphological type:	Mid-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Basalt cobbles		
Surface cover:	Short windmill gr clover	rass, paspalum, re	d grass, couch, short windmill, browns love
% surface cover	80%		
Salinity:	Nil		

Sample method: EVH Logged by: DL							
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots, structure)	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate test
0 to 250	Brown silty clay loam		М				
250 to 800	Dark reddish brown silty clay		D				
800 to 2000	White silty sand (weathered rock) with trace		D				
1400 to 2000	Light grey light clay with increasing gravel		D				
2000	End of hole						
Notes:	1	1				1	1

Client: c/- Geolyse			Job no:	5737	Date:	24/04/2015
Address:	Lot 399 DP1199356 & Lot 5	503 DP115	2321 Hennessy	Road, Dub	bo NSW	
Borehole:	39	GPS:	55H 654 673r	nE 6427 5	64mN	

Surface description

Slope:	0-5%	Aspect:	South
Morphological type:	Upper-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Basalt cobbles a	nd subcrop	
Surface cover:	Short windmill gr clover	ass, paspalum, re	d grass, couch, short windmill, browns love
% surface cover	80%		
Salinity:	Nil		

Sample method: EVH		Logged by	y: DL				
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots, structure)	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate test
0 to 450	Dark reddish brown silty clay loam		М				
450 to 600	Dark red gravelly clay with increasing basalt cobbles		D				
600	End of hole, drill refusal						
Notes:	1	1			1	1	1

Client: c/- Geolyse			Job no:	5737	Date:	7/05/2015
Address:	Lot 399 DP1199356 & Lot 5	503 DP115	2321 Hennessy	Road, Dub	bo NSW	
Borehole:	40	GPS:	55H 653 705r	nE 6427 5	74mN	

Surface description

Slope:	0-1%	Aspect:	South
Morphological type:	Mid-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Nil		
Surface cover:	Windmill grass, f	leabane, red gras	s, paspalum
% surface cover	90%		
Salinity:	Nil		

Sample method:	Logged b	y: DL					
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots, structure)	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate test
0 to 200	Dark brown silty clay loam		М				
200 to 800	Dark brown sandy clay		М				
800 to 2000	Dark brownish red light clay with trace gravel		D				
2000	End of hole						
Notes:	·					·	

Client: c/- Geolyse			Job no:	5737	Date:	7/05/2015
Address:	Lot 399 DP1199356 & Lot 5	503 DP115	2321 Hennessy	Road, Dub	bo NSW	
Borehole:	41	GPS:	55H 653 837r	nE 6427 5	50mN	1

Surface description

Slope:	0-1%	Aspect:	South
Morphological type:	Mid-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Nil		
Surface cover:	Windmill grass, fl	leabane, red gras	s, paspalum
% surface cover	90%		
Salinity:	Nil		

Sample method:	Logged by	y: DL					
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots, structure)	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate test
0 to 300	Dark reddish brown silty clay loam		М				
300 to 600	Dark brown sandy clay		М				
600 to 2800	Dark brownish red light clay with trace gravel		D				
2800	End of hole, drill refusal						
Notes:	1	· · · · · ·		1		1	1

Client: c/- Geolyse			Job no:	5737	Date:	7/05/2015
A 11			000411			
Address:	LOT 399 DP1199356 & LOT 5	003 DP115	2321 Hennessy	Road, Dub	DDO INSVV	
Borehole:	42	GPS:	55H 653 975r	nE 6427 5	527mN	1

Surface description

Slope:	0-1%	Aspect:	North east
Morphological type:	Mid-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Nil		
Surface cover:	Windmill grass, fl	eabane, red gras	s, paspalum
% surface cover	90%		
Salinity:	Nil		

Sample method:	ble method: EVH Logged by: DL						
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots, structure)	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate test
0 to 350	Dark reddish brown silty clay Ioam		М	6 8			
350 to 1200	Dark brown light clay with trace gravel		D				
1200 to 2500	Dark reddish brown light clay with trace gravel		D				
2500 to 3000	Light greyish brown light clay with increasing gravel		D				
3000	End of hole	-		- 1		- 1	-
Notes:					1.		1
Client: c/- Geolyse			Job no:	5737	Date:	7/05/2015	
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Address:	Lot 399 DP1199356 & Lot 5	503 DP1152	2321 Hennessy	Road, Dub	bo NSW		
Borehole:	43	GPS:	55H 654 121r	nE 6427 4	97mN	1	

Surface description

Slope:	0-1%	Aspect:	North east
Morphological type:	Mid-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Nil		
Surface cover:	Windmill grass, fl	eabane, red gras	s, paspalum
% surface cover	90%		
Salinity:	Nil		

Sample method: EVH Logged by: DL							
Depth (mm)	Soil description (texture, colour,	Sample	M/D	pH (1:5	EC	ECe	Emerson
	coarse fragments, mottles, roots,			water)	(dS/m)		aggregate
-	structure)						test
0 to 300	Dark reddish brown silty clay		М	5 A			5 m
	loam						
300 to 1000	Light brown silty clay with trace		D				
	gravel						
1000 to 2000	Light brown light clay with trace		D				
	gravel						
2000	End of hole		D				
- D		- L				- 0	
Notes:	1						

Client: c/- Geolyse			Job no:	5737	Date:	24/04/2015
Address:	Lot 399 DP1199356 & Lot 5	503 DP115	2321 Hennessy	Road, Dub	bo NSW	
Borehole:	45	GPS:	55H 654 379r	nE 6427 4	-54mN	

Surface description

Slope:	0-1%	Aspect:	South
Morphological type:	Mid-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Nil		
Surface cover:	Windmill grass, fl	eabane, red gras	s, paspalum
% surface cover	90%		
Salinity:	Nil		

Sample method: EVH Logged by: DL							
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots, structure)	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate test
0 to 300	Dark brown sandy clay loam		М			5 N	S- 7
300 to 1200	Dark red silty clay with trace gravel		М				
1200 to 2300	Dark brown light clay with trace gravel		D				
2300 to 3000	Dark grey/ brown light clay with increasing gravel		D				
3000	End of hole	-				-	
Notes:							

Client: c/- Geolyse			Job no:	5737	Date:	24/04/2015
Address:	Lot 399 DP1199356 & Lot 5	03 DP115	2321 Hennessy	Road, Dub	bo NSW	
Borehole:	46	GPS:	55H 654 489r	nE 6427 4	29mN	

Surface description

Slope:	0-1%	Aspect:	South
Morphological type:	Mid-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Basalt float		
Surface cover:	Paspalum, red gr	ass, shepherds p	urse, khaki weed, peppercress
% surface cover	90%		
Salinity:	Nil		

Sample method: EVH Logged by: DL							
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots, structure)	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate test
0 to 300	Brown silty clay loam		М				
300 to 1000	Reddish brown silty clay with trace gravel		Μ				
1000 to 1700	Reddish brown light clay with trace gravel		D				
1700 to 3000	Light brown silty sand		D				
3000	End of hole						
Notes:							

Client: c/- Geolyse			Job no:	5737	Date:	24/04/2015
Address:	Lot 399 DP1199356 & Lot 5	503 DP115	2321 Hennessy	Road, Dub	bo NSW	
Borehole:	47	GPS:	55H 654 635r	nE 6427 4	22mN	1

Surface description

Slope:	0-2%	Aspect:	South
Morphological type:	Mid-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Basalt float		
Surface cover:	Windmill grass, fle	eabane, red gras	s, paspalum
% surface cover	90%		
Salinity:	Nil		

Sample method:	EVH	Logged b	y: DL				
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots, structure)	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate test
0 to 450	Brown silty clay loam	1	М	S			
450 to 800	Light brown silty sand with trace gravel		D				
800 to 2400	Light brownish red light clay with trace gravel		D				
2400 to 3000	Light grey brown silty clay		D				
3000	End of hole			2			
Notes:					1	1	

Client: c/- Geolyse			Job no:	5737	Date:	7/05/2015
Address:	Lot 399 DP1199356 & Lot 5	503 DP115	2321 Hennessy	Road, Dub	bo NSW	
Borehole:	48	GPS:	55H 653 673r	nE 6427 4	201mN	

Surface description

Slope:	0-1%	Aspect:	North east
Morphological type:	Mid-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Nil		
Surface cover:	Windmill grass, fl	eabane, red gras	s, paspalum
% surface cover	90%		
Salinity:	Nil		

Sample method: EVH		Logged b	y: DL				
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots, structure)	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate test
0 to 300	Dark brown silty clay loam		М				
300 to 2000	Dark brown light clay with trace gravel		D				
2000	End of hole						
Notes:							

Client: c/- Geolyse			Job no:	5737	Date:	7/05/2015
Adduces			0201	Deed Duk		
Address:	LOI 399 DP I 199330 & LOI 3	003 DP 115.	2321 Hennessy	Road, Dub		
Borehole:	49	GPS:	55H 653 792r	nE 6427 3	865mN	

Surface description

Slope:	0-1%	Aspect:	North east
Morphological type:	Mid-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Nil		
Surface cover:	Windmill grass, fl	eabane, red gras	s, paspalum
% surface cover	90%		
Salinity:	Nil		

Sample method	: EVH	Logged by	/: DL				
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots, structure)	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate test
0 to 600	Dark brown/red silty clay loam		М				
600 to 800	Dark grey silty clay		D				
800 to 2000	Dark grey light clay with trace gravel		D				
2000	End of hole						
Notes:	<u>.</u>				•		

Client: c/- Geolyse			Job no:	5737	Date:	7/05/2015
Address:	Lot 399 DP1199356 & Lot 5	503 DP115	2321 Hennessy	Road, Dub	bo NSW	
Borehole:	50	GPS:	55H 653 958r	nE 6427 3	346mN	1

Surface description

Slope:	0-1%	Aspect:	North east
Morphological type:	Mid-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Nil		
Surface cover:	Windmill grass, fl	eabane, red gras	s, paspalum
% surface cover	90%		
Salinity:	Nil		

Sample method:	Logged by	y: DL					
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots, structure)	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate test
0 to 400	Dark brown/red silty clay loam		М				
400 to 600	Dark brown silty clay		М				
600 to 2400	Dark brownish red light clay with trace gravel		D				
2400 to 3000	Dark grey light clay with trace gravel		D				
3000	End of hole						
Notes:		· I				1	

Client: c/- Geolyse			Job no:	5737	Date:	7/05/2015
Address:	Lot 399 DP1199356 & Lot 5	503 DP115	2321 Hennessy	Road, Dub	bo NSW	
Borehole:	51	GPS:	55H 654 091	mE 6427 3	309mN	1

Surface description

Slope:	0-1%	Aspect:	South
Morphological type:	Mid-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Nil		
Surface cover:	Windmill grass, fl	eabane, red gras	s, paspalum
% surface cover	70%		
Salinity:	Nil		

Sample method: EVH		Logged by	/: DL				
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots, structure)	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate test
0 to 300	Dark brown silty clay loam		М				
300 to 2000 2000	Brownish red light clay with fine gravel End of hole		Μ				
Notes:							

Client: c/- Geolyse			Job no:	5737	Date:	7/05/2015
Address:	Lot 399 DP1199356 & Lot 5	503 DP115	2321 Hennessy	Road, Dub	bo NSW	
Borehole:	52	GPS:	55H 654 209r	nE 6427 2	299mN	

Surface description

Slope:	0-1%	Aspect:	North east
Morphological type:	Mid-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Nil		
Surface cover:	Oxalis, Paterson	's curse, capewee	d, wattle, wild sage, rye grass
% surface cover	90%		
Salinity:	Nil		

Sample method: EVH Logged by: D							
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots,	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate
Harris Ha	structure)						test
0 to 200	Dark red silty clay loam		М				
200 to 600	Dark red silty clay		М				
600 to 1400	Dark reddish brown light clay with fine gravel		D				
1400 to 3000	Dark grey light clay with increasing gravel		М				
3000	End of hole			-			
Notes:	1	1 1			1		
							L

Client: c/- Geolyse			Job no:	5737	Date:	24/04/2015
				14		
Address:	Lot 399 DP1199356 & Lot 5	503 DP115	2321 Hennessy	Road, Dub	bo NSW	
Borehole:	54	GPS:	55H 654 463r	nE 6427 2	246mN	

Surface description

Slope:	0-1%	Aspect:	South
Morphological type:	Mid-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Nil		
Surface cover:	Paspalum, red g	rass, shepherds p	urse, khaki weed, peppercress
% surface cover	90%		
Salinity:	Nil		

Sample method:	EVH	Logged by	/: DL				
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots, structure)	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate test
0 to 300	Dark brown sandy clay loam		М				
300 to 1200	Dark red silty clay with trace gravel		М				
1200 to 1700	Brown light clay with increasing gravel		М				
1700	End of hole					- 1	
Notes:	<u>.</u>						

Client: c/- Geolyse			Job no:	5737	Date:	24/04/2015
Address:	Lot 399 DP1199356 & Lot 5	503 DP115	2321 Hennessy	Road, Dub	bo NSW	
Borehole:	55	GPS:	55H 654 600r	nE 6427 2	238mN	1

Surface description

Slope:	0-2%	Aspect:	South
Morphological type:	Mid-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Basalt cobbles		
Surface cover:	Paspalum, red grass,	shepherds p	urse, khaki weed, peppercress
% surface cover	90%		
Salinity:	Nil		

Sample method: EVH Logged by: DL							
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots, structure)	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate test
0 to 500	Dark brown silty clay loam		М				C
500 to 900	Dark brownish red silty clay with trace gravel		М				
900 to 2100	Dark brown light clay with trace gravel		М				
2100 to 2900	Light brown light clay with trace gravel and increasing basalt cobbles		Μ				
2900	End of hole, drill refusal						-
Notes:		1 1		1	1		1

Client: c/- Geolyse			Job no:	5737	Date:	7/05/2015
Address:	Lot 399 DP1199356 & Lot 5	503 DP115	2321 Hennessy	Road, Dub	bo NSW	
Borehole:	57	GPS:	55H 653 781r	nE 6427 2	10mN	

Surface description

Slope:	0-1%	Aspect:	South
Morphological type:	Lower-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Nil		
Surface cover:	Paspalum, red gra	ass, shepherds p	urse
% surface cover	90%		
Salinity:	Nil		

Sample method:	EVH	Logged b	y: DL				1
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots, structure)	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate test
0 to 400	Dark red brown silty clay loam		М				
400 to 600	Dark brown silty clay		D				
600 to 1700	Dark brown red light clay with trace gravel		D				
1700 to 3000	Dark grey light clay with increasing river gravel and basalt cobbles		D				
3000	End of hole						
Notes:				I		I	1

Client: c/- Geolyse			Job no:	5737	Date:	7/05/2015
Address:	Lot 399 DP1199356 & Lot 5	503 DP115	2321 Hennessy	Road, Dub	bo NSW	
Borehole:	58	GPS:	55H 653 936r	nE 6427 1	91mN	

Surface description

Slope:	0-1%	Aspect:	South
Morphological type:	Mid-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Nil		
Surface cover:	Paspalum, red gra	ass, shepherds p	urse
% surface cover	90%		
Salinity:	Nil		

Sample method: EVH		Logged by	y: DL				
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots, structure)	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate test
0 to 400	Dark red brown silty clay loam		М				
400 to 600	Medium brown silty clay		М				
600 to 2000	Brownish red light clay with trace gravel		D				
2000	End of hole			ē	P		8
Notes:							

Client: c/- Geolyse			Job no:	5737	Date:	7/05/2015
Address:	Lot 399 DP1199356 & Lot 5	503 DP115	2321 Hennessy	Road, Dub	bo NSW	
Borehole:	60	GPS:	55H 654 197r	nE 6427 1	42mN	

Surface description

Slope:	0-1%	Aspect:	South
Morphological type:	Mid-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Nil		
Surface cover:	Paspalum, red gr	ass, shepherds p	urse
% surface cover	90%		
Salinity:	Nil		

Sample method: EVH		Logged by	y: DL			_	
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots, structure)	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate test
0 to 600	Brown silty clay loam		М				
600 to 2000	Dark red light clay with increasing gravel		М				
2000	End of hole					- 1	-
Notes:							

Client: c/- Geolyse			Job no:	5737	Date:	24/04/2015
Address:	Lot 399 DP1199356 & Lot 5	503 DP115	2321 Hennessy	Road, Dub	bo NSW	
Borehole:	61	GPS:	55H 654 320r	nE 6427 1	14mN	1

Surface description

Slope:	0-1%	Aspect:	East
Morphological type:	Lower-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Basalt cobbles		
Surface cover:	Paspalum, red gra	ss, shepherds p	urse
% surface cover	85%		
Salinity:	Nil		

Sample method:	EVH	Logged by	y: DL				
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots, structure)	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate test
0 to 300	Brown silty clay loam		М				5- 7
300 to 500	Dark red light clay with increasing gravel		D				
500 to 2500	Dark red silty clay with trace gravel		D				
2500 to 2800	Dark reddish brown light clay with increasing basalt cobbles		D				
2800	End of hole, drill refusal					-	
Notes:				1	<u>1</u> 92	1	
-							

Client: c/- Geolyse			Job no:	5737	Date:	24/04/2015
Address:	Lot 399 DP1199356 & Lot 5	503 DP115	2321 Hennessv	Road Dub	bo NSW	
Borehole:	62	GPS:	55H 654 425r	nE 6427 C	87mN	

Surface description

Slope:	0-1%	Aspect:	NW
Morphological type:	Lower-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Nil		
Surface cover:	Clover, couch, bar	ley grass, daisy	
% surface cover	80%		
Salinity:	Nil		

Sample method:	EVH	Logged by	y: DL			_	
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots, structure)	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate test
0 to 300	Black silty clay loam		М	2			
300 to 2500	Brown silty clay with trace gravel		D				
2500 to 3600	Dark red clayey gravel with basalt cobbles and extremely weathered alluvial		D				
3600	End of hole, drill refusal		D				
-							
Notes:							

Client: c/- Geolyse			Job no:	5737	Date:	24/04/2015
Address:	Lot 399 DP1199356 & Lot 5	503 DP115	2321 Hennessy	Road, Dub	bo NSW	
Borehole:	63	GPS:	55H 654 589r	nE 6427 0	71mN	

Surface description

Slope:	0-1%	Aspect:	North east
Morphological type:	Lower-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Basalt cobbles		
Surface cover:	Short windmill, pas	plaum, clover	
% surface cover	90%		
Salinity:	Nil		

Sample method: EVH Logged by: DL							
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots, structure)	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate test
0 to 500	Dark brown sandy clay loam		М	S			
500 to 1200	Dark red silty clay with trace gravel		D				
1200 to 1600	Dark brown silty gravel with increasing gravel		D				
1600	End of hole, drill refusal						
Notes:				1	1	1	

Client: c/- Geolyse			Job no:	5737	Date:	24/04/2015
Address:	Lot 399 DP1199356 & Lot 5	503 DP115	2321 Hennessy	Road, Dub	bo NSW	
Borehole:	64	GPS:	55H 654 559r	mE 6426 9	48mN	

Surface description

Slope:	0-1%	Aspect:	South
Morphological type:	Lower-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Basalt cobbles		
Surface cover:	Short windmill, pa	splaum, clover	
% surface cover	90%		
Salinity:	Nil		

Sample method: EVH Logged by: DL							
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots, structure)	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate test
0 to 450	Dark brown sandy clay loam		D				
450 to 1000	Dark grey silty clay with trace gravel		D				
1000 to 2000	Dark brown/ grey silty gravel with increasing gravel		D				
2000	End of hole						
						-	
Notes:							

Client: c/- Geolyse			Job no:	5737	Date:	24/04/2015
				14		
Address:	Lot 399 DP1199356 & Lot 5	503 DP115	2321 Hennessy	Road, Dub	bo NSW	
Borehole:	65	GPS:	55H 654 418r	nE 6426 9	65mN	

Surface description

Slope:	0-1%	Aspect:	South
Morphological type:	Lower-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Basalt cobbles		
Surface cover:	Short windmill, pas	plaum, clover	
% surface cover	90%		
Salinity:	Nil		

Sample method: EVH Logged by: DL							
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots, structure)	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate test
0 to 200	Brown sandy clay loam		М				
200 to 500	Dark brown silty clay		D				
500 to 2000	Dark grey silty clay with trace gravel		D				
2000 to 2500	Dark grey brown light clay with trace basalt cobbles		D				
2500	End of hole, drill refusal						
Notes:	1	1			1	1	1

Client: c/- Geolyse			Job no:	5737	Date:	24/04/2015
Address:	Lot 399 DP1199356 & Lot 5	503 DP115	2321 Hennessy	Road, Dub	bo NSW	
Borehole:	66	GPS:	55H 654 296r	nE 6426 9	88mN	1

Surface description

Slope:	0-1%	Aspect:	South
Morphological type:	Lower-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Basalt cobbles		
Surface cover:	Short windmill, pas	plaum, clover	
% surface cover	90%		
Salinity:	Nil		

Sample method:	Logged by	/: DL					
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots, structure)	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate test
0 to 350	Brown sandy clay loam		М				
350 to 500	Brown sandy clay		М				
500 to 1300	Brown silty clay with trace gravel		М				
1300 to 2000	Dark brown silty gravel with increasing basalt cobbles		М				
2000	End of hole						
Notes:							
							L.

Client: c/- Geolyse			Job no:	5737	Date:	24/04/2015			
Address:	Lot 399 DP1199356 & Lot 5	Lot 399 DP1199356 & Lot 503 DP1152321 Hennessy Road, Dubbo NSW							
Borehole:	67	GPS:	55H 654 191r	nE 6427 0	28mN	1			

Surface description

Slope:	0-1%	Aspect:	South
Morphological type:	Lower-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Basalt cobbles		
Surface cover:	Short windmill, pas	plaum, clover	
% surface cover	90%		
Salinity:	Nil		

Sample method:	EVH	Logged by: DL					
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots,	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate
	structure)	-	-			- 1	test
0 to 200	Brown silty clay loam		М	- n			5
200 to 700	Dark red sandy clay		М				
700 to 2000	Light brown silty clay with trace gravel		D				
2000 to 2500	Light brown light clay with fine gravel		D				
2500 to 3000	Light brownish red silty sand with trace gravel		D				
3000	End of hole			- 1			
Notes:							
							H

Client: c/- Geolyse			Job no:	5737	Date:	7/05/2015			
Address:	Lot 399 DP1199356 & Lot 5	Lot 399 DP1199356 & Lot 503 DP1152321 Hennessy Road, Dubbo NSW							
Borehole:	68	GPS:	55H 654 050r	nE 6427 0	28mN	1			

Surface description

Slope:	0-1%	Aspect:	South
Morphological type:	Mid-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Nil		
Surface cover:	Short windmill, pa	asplaum, clover	
% surface cover	90%		
Salinity:	Nil		

Sample method: EVH		Logged by: DL					
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots, structure)	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate test
0 to 500	Brown silty clay loam		М				5- A
500 to 900	Light grey sandy silt		D				
900 to 2000	Light brown light clay with trace gravel		D				
3000	End of hole						-
Notes:					~		

Client: c/- Geolyse			Job no:	5737	Date:	7/05/2015			
Address:	Lot 399 DP1199356 & Lot 5	Lot 399 DP1199356 & Lot 503 DP1152321 Hennessy Road, Dubbo NSW							
Borehole:	69	GPS:	55H 653 880r	nE 6427 C	46mN				

Surface description

Slope:	0-1%	Aspect:	South
Morphological type:	Mid-slope		
Land-use:	Grazing		
Disturbance:	High		
Erosion:	Nil		
Coarse fragments:	Nil		
Surface cover:	Short windmill, pa	splaum, clover	
% surface cover	90%		
Salinity:	Nil		

Sample method:	Logged b	y: DL					
Depth (mm)	Soil description (texture, colour, coarse fragments, mottles, roots, structure)	Sample	M/D	pH (1:5 water)	EC (dS/m)	ECe	Emerson aggregate test
0 to 300	Brown silty clay loam		М				
300 to 800	Light grey sandy silt		М				
800 to 2500	Light brown light clay with trace gravel		D				
2500 to 3000	Dark grey light clay with increasing gravel		D				
3000	End of hole						
Notes:				1	1	1	

Appendix 7. Reference methods for soil testing

Reference Methods:

Colour: Munsell (2000) In 'Munsell Soil Colour Charts' (Gretag Macbeth: NY)

Field texture: McDonald RC, Isbell RF, Speight JG, Walker, Hopkins MS (1990) Australian Soil and Land Survey Field Handbook pp.115-124 (Inkata Press: Melbourne)

PH: AS1289.4.3.1-1997 Method of testing soil for engineering purposes – Soil Chemical Tests-Determination of the pH value of a soil – Electrometric method

Salinity: Rayment GE and Higginson FR (1992) Australian Laboratory Handbook of Soil and Water Chemical Methods (Method 3A1, pp.15-16) (Inkata Press Melbourne) Electrical conductivity of saturated extract is based on conversions of EC (1:5) and soil texture class, to give a more accurate assessment of soil salinity hazard (Salavich PG and Peterson GH (1993) Estimating the electrical conductivity of soil paste extracts from 1:5 soil water suspensions and texture. Australian Journal of Soil Research 31, 3-81)

Appendix 8. ALS laboratory report ES1520581 and chain of custody form



APPENDIX F – Ecological Assessment, prepared by OzArk Environmental and Heritage Management Pty Ltd

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Environmental and Heritage Management P/L

Eulomogo Creek in the Subject Site

ECOLOGICAL ASSESSMENT: SUBDIVISION OF LOT 399 DP 1199356 AND LOT 503 DP1152321, BOUNDARY ROAD, DUBBO, NSW.

DUBBO CITY COUNCIL LOCAL GOVERNMENT AREA

MAY 2015

Report Prepared by

OzArk Environmental & Heritage Management Pty Ltd

For

Geolyse Pty Ltd

On behalf of

MAAS Group Properties Pty Ltd

OzArk EHM

145 Wingewarra St (PO Box 2069) Dubbo NSW 2830

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Inquiries would be addressed to OzArk Environmental & Heritage Management Pty Ltd.

EXECUTIVE SUMMARY

OzArk Environmental & Heritage Management (OzArk) was commissioned by Geolyse Pty Ltd on behalf of MAAS Group Properties (MAAS) to undertake ecological assessment of Lot399 DP1199356 and Lot503 DP1152321 (the 'Subject Site'). It is proposed to subdivide this 60 hectare lot of semi-rural land located in Dubbo NSW, into a low density housing development named "Keswick Estate - Hill View."

This investigation has been completed to fulfil the requirements of Part 4 of the Environmental Planning and Assessment Act 1979 (EP&A Act), to take into account all matters affecting or likely to affect the environment as a result of the proposal.

Field assessment of the Subject Site was undertaken by Phillip Cameron (Principle Ecologist of Ozark) on Thursday 16 April 2015.

The Subject Site is completely cleared, ploughed and disturbed with few isolated trees. Despite continuous grazing and a history of ploughing in the Subject Site, native grasses in most cases prevail. Vegetation present is characterised by *Biometric* community ID CW130 'Derived tussock grasslands of the central western plains and lower slopes of NSW (Benson 250)'. Prior to grazing pressures (**Figure 4-2**), the subject site would have been derived from three TSC listed EECs (**Figures 4-3** and **4-4**), being:

- Biometric community ID CW144 Inland Grey Box Poplar Box White Cypress Pine tall
 woodland on red loams mainly of the eastern Cobar Peneplain Bioregion (Benson 82)
- Biometric community ID CW213 White Box White Cypress Pine Inland Grey Box woodland on the western slopes of NSW (Benson 267)
- Biometric community ID CW138 Fuzzy Box Inland Grey Box on alluvial brown loam soils of the NSW South Western Slopes Bioregion and southern BBS Bioregion (Benson 201)

Eulomogo Creek forms part of the FM Act listing for the 'aquatic ecological community in the natural drainage system of the lowland catchment of the Lachlan River.' The creek is in poor condition however provides connectivity to the Macquarie River. This creek will not be directly impacted by the activity.

No threatened species, populations or terrestrial endangered ecological communities were recorded in the Subject Site. However, as noted above, all vegetation in the Subject Site is likely to have been derived from one of three EECs listed under the TSC Act. Thus, in consistency with the TSC Act, the 'precautionary principle' has been adopted and an Assessment of Significance has been completed for each to characterise the potential impacts.

On the basis of regional records, reports and the presence of suitable habitat, 15 threatened items listed in the schedules of the TSC Act and / or EPBC Act were assessed as likely to occur or have habitat in the Subject Site and be affected by the Proposal (**Table 4-7**). Assessments of

significance were conducted for these species (**Appendix 5**). Having given consideration to the ecology within the Subject Site, it is apparent that the Proposal is:

- unlikely to significantly affect any of the listed threatened species, fauna populations or communities.
- unlikely to augment or significantly contribute to any of the National or State listed Key Threatening Processes, if the appropriate safeguards regarding the control of potential vertebrate pests are effectively applied.
- unlikely to significantly affect any Ramsar wetland or any CAMBA, ROKAMBA or JAMBA listed species;
- unlikely to significantly affect local hydrology.
- consistent with ESD principles with regard to fauna, would not adversely affect the local biodiversity and no issue of inter-generational or value added matters are relevant in this instance.

The proposed activity should not be considered to constitute a significant impact and, as such, no Species Impact Statement (SIS) is warranted. No Koala Habitat Management Plan pursuant to SEPP 44 should be required.

CONTENTS

1	Intr	oduction	9
	1.1	The Project	9
	1.2	Location	9
	1.1	Legislative Context	
	1.1.1	Environmental Planning and Assessment Act 1979	9
	1.1.2	Environment Protection and Biodiversity Conservation Act 1999	
	1.1.3	Study Aims	
2	Met	hodology	17
	2.1	Personnel	17
	2.1.1	Field assessment	17
	2.1.2	Reporting	
	2.1.3	Database searches and literature reviews	
	2.3	Predictive Model For Threatened Species Detection.	19
	24	Field survey	20
	241	General survey methodology	20
	2.4.2	Floristic survey methods.	
	2.4.3	Fauna survey methods and habitat assessment	21 21
	2.5	Survey effort	
	2.6	Limitations	22
3	Exis	sting Environment	
	3.1	Landscape context	
	3.2	Climate of the Subject Site	
	3.3	Topography and geology	
	3.4	Vegetation	
	3.5	Ground water dependent communities	23
	3.6	Mitchell Landscapes and Soil of the Subject Site	24
	3.7	Hydrology of the Subject Site	
	3.8	Land-use	
	3.9	Biodiversity links (Wildlife connectivity corridors)	
4	Res	ults	
	4.1	Database and Literature Results	27
	4.1.1	NSW OEH Listed items	27
	4.1.2	Threatened species and endangered populations within 10 kilometres of the Subject Site	27 30
	4.1.4	Local context (Biodiversity impact assessments)	
	4.1.5	Predictive model for threatened species detection	
	4.2	Field Survey Results	
	4.2.1	Vegetation communities and habitat Flora species	
	4.2.3	Fauna species	
	4.2.4	Fauna habitat Protected Matters - Migratory and marine species	37 30
	4.2.6	Key Threatening Processes	
	4.3	Summary	41
5	Imp	acts	42
	5.1	Terrestrial Flora And Ecological Communities	42

5.2	Terrestrial Fauna and Fauna Habitat	
5.2.	1 Wildlife Corridors and Connectivity	
5.2.2 5.3	2 Critical habitat	
5.4	Invasive Species	
5.5	Noise/Vibration	
5.6	Traffic Impacts	43
5.7	Dust/Erosion	43
5.8	Matters of National Environmental Significance	44
6 Sig	nificance assessments	45
6.1	Affected species	
6.2	Significant communities, populations or species within the Subject Site	
7 Red	commendations	
8 Co	nclusion	
9 Ref	erences	53
10 Pla	tes	
Append	lix 1: Terms And Abbreviations	
Append	lix 2: Database Search Results	
Deskto	on database search results	64
OFH 1	Threatened Species Database Results	
DoF P	Protected Matters	68
BirdLif	e International-Important Bird Areas	
Atlas o	of Living Australia	
Atlas (Of Groundwater Dependent Ecosystems	83
Dubbo	City Council Noxious Weed List	84
Append	lix 3: Assessment of Likelihood of threatened species, communi	ities and
populat	ions	91
Append	lix 4: Survey Results	123
Append	lix 5: Assessments of Significance	136
7-Part	Test Criteria	137
DoE A	ssessments of Significance - migratory species	142

FIGURES

Figure 1-1: Location Map and Subject Site	9
Figure 3-1: Aerial view of Subject Site	. 23
Figure 3-2: Mitchell's Landscapes in the Subject Site	. 25
Figure 4-1: OEH Bionet records of threatened flora and fauna within 10km of the Subject	Site
(Data Source: NSW OEH 26 March 2015)	. 29
Figure 4-2: Vegetation plots and grazing pressures mapped in the Subject Site.	. 34
Figure 4-3: Areas formally EEC in the Subject Site.	. 35

Figure 4-4: Grazing pressures overlaid on areas formally considered EECs in the Subject Site.

TABLES

Table 1-1: Environmental considerations	11
Table 1-2: Summary of other relevant legislation, licensing and approval required	11
Table 2-1: Summary of OzArk qualifications	17
Table 2-2: Habitat value and constraints of trees.	21
Table 3-1: Biodiversity links	26
Table 4-1: NSW OEH Listed items predicted to occur in the Central West CMA Talbragar V	/alley
subregion	27
Table 4-2: Threatened species, extinct and endangered populations within 10 kilometres of	of the
Subject Site	28
Table 4-3: Protected matters with potential to occur in the Subject Site	31
Table 4-4: Summary of native species recorded by plot.	36
Table 4-5: Summary of stratum details by plot	36
Table 4-5: Summary of water condition and aquatic habitat in Eulomogo Creek.	38
Table 4-7: Threatened species known to occur or have potential occur in the Subject Site	41
Table 5-1: Matters of National Environmental Significance	44
Table 6-1: Summary of the assessment of significance and seven-part tests	46

1 INTRODUCTION

1.1 THE PROJECT

OzArk Environmental & Heritage Management (OzArk) was commissioned by Geolyse Pty Ltd on behalf of MAAS Group Properties (MAAS) to undertake ecological assessment of Lot399 DP1199356 and Lot503 DP1152321 (the 'Subject Site'). It is proposed to subdivide this 60 hectare lot of semi-rural land located in Dubbo NSW, into a low density housing development named "Keswick Estate - Hill View."

This investigation has been completed to fulfil the requirements of Part 4 of the Environmental Planning and Assessment Act 1979 (EP&A Act), to take into account all matters affecting or likely to affect the environment as a result of the proposal.





1.2 LOCATION

The Subject Site is located in Dubbo in Central West NSW. Specifically the Subject Site is located on Lot399 DP1199356 and Lot503 DP1152321 (a drainage corridor) bordered by Boundary Road to the north and Hennesy Road to the south.

1.1 LEGISLATIVE CONTEXT

1.1.1 Environmental Planning and Assessment Act 1979

The Environmental Planning and Assessment Act 1979 (EP&A Act) is the principal planning legislation for the state, providing a framework for the overall environmental planning and

assessment of development proposals. Under the EP&A Act there are three distinctive processes, which are:

- Part 3.1 (Previously Part 3A) 'State Significant Infrastructure', which regulates specific types of 'Infrastructure' and requires an Environmental Assessment report to be prepared and submitted to the Department of Planning and Infrastructure for the Minister's approval;
- Part 4, which regulates 'development' requires a development application to be accompanied by an Environmental Impact Statement 'prepared by or on behalf of the applicant in the form prescribed by the regulations.'
- Part 5, which regulates 'activities' and requires a REF for determination by a state selfdetermining authority.

The proposal is to be undertaken by MASS, under Part 4 of the Act. This ecological assessment and report will support a Development Application to Dubbo City Council for Approval.

1.1.2 Environment Protection and Biodiversity Conservation Act 1999

The *Environmental Protection and Biodiversity Conservation Act 1999* protects nationally and internationally important flora, fauna, ecological communities and heritage places, which are defined in the EPBC Act as matters of national environmental significance. Matters of national environmental significance relevant to biodiversity are:

- Wetlands of international importance.
- Nationally threatened species and ecological communities.
- Migratory species.
- Commonwealth marine areas.

Significance of impacts is determined in accordance with the *Significance impact guidelines 1.1–matters of national environmental significance* (Department of Environment, Water, Heritage and the Arts, 2006).

Where a proposal is likely to have a significant impact on a matter of national environmental significance, the proposal is referred to the Commonwealth Environment Minister via the Department of the Environment (DoE). The Minister then determines whether the proposal is a 'controlled action'. If a proposal is declared a controlled action, an assessment of the action is carried out and the Minister makes a decision to approve, approve with conditions, or not approve the proposed action. Further information on the referral and approval process is available at <u>Assessment and approval process - EPBC Act</u>. A requirement for biodiversity offsetting is triggered in controlled actions.
1.1.3 Other Relevant legislation, Plans and Policies

A summary of applicable environmental legislation have been provided in Table 1-1.

Environmental considerations	Comment
An area reserved or dedicated under the National Parks and Wildlife Act 1974?	No
Is the proposal located within land reserved or dedicated within the meaning of the Crown Lands Act 1989 for preservation of other environmental protection purposes?	No
A World Heritage Area?	No
Environmental Protection Zones in environmental planning instruments?	No
Lands protected under SEPP 14 – Coastal Wetlands?	No
Lands protected under SEPP 26 – Littoral Rainforests?	No
Lands protected under SEPP 71 – Coastal Protection?	No
ands protected under SEPP 44 – Koala Protection?	No
_ands protected under SEPP - Sydney's drinking water?	No
Land identified as wilderness under the Wilderness Act 1987 or declared as wilderness under the National Parks and Wildlife Act 1974?	No
Aquatic reserves dedicated under the Fisheries Management Act 1994?	No
Wetland areas dedicated under the Ramsar Wetlands Convention?	No
Land subject to a conservation agreement under the National Parks and Wildlife Act 1974?	No
and identified as State Forest under the Forestry Act 1916?	No
Western Lands Lease	No
Freehold or Crown Land. If Crown Land, what type?	Freehold
_and within a mining subsidence district?	No
Acid sulphate area?	No
Protected riparian habitat?	No
Critical habitat NSW?	No
Critical habitat nationally?	No

Table 1-1: Environmental considerations.

 Table 1–2 summarises relevant ecological approvals or licenses required from State or National bodies prior to undertaking the works.

Table 1-2: Summary	v of other relevant	legislation.	licensing and	approval	reauired.

Act	Authority	Requirements
NSW Threatened Species Conservation Act 1995 (TSC Act)	Office of Environment & Heritage (OEH)	This act aims to conserve biological diversity, promote ecologically sustainable development, prevent extinctions and promote recovery of threatened entities, protect critical habitat, assess the impacts of actions on, and encourage the conservation of, threatened entities. An assessment of the potential impacts of the Proposal on threatened species, populations, ecological communities and critical habitat listed on the TSC Act must be undertaken in

Act	Authority	Requirements
		accordance with section 5A of the EP&A Act (7-part test).Where a significant impact is likely to occur a Species Impact Statement (SIS) must be prepared for projects assessed under Part 4 and Part 5 of the EP&A Act. The content of a SIS is outlined in Sections 110–112 of the Threatened Species Conservation Act 1995 (TSC Act) and includes requesting Director-General's requirements.
Native Vegetation Act 1997 (NV Act)	OEH	The Native Vegetation Act 2003 (NV Act) regulates the clearing of native vegetation on all land in NSW. The NV Act requires development approval from the Central West Local Land Services for the clearing of any native vegetation. Currently, it is illegal to remove or damage vegetation, without a permit, from within 40 metres of the banks of nominated waterways in NSW (Category B Riparian Land, State Protected Land or SPL). As this project will be assessed under Part 4 of the EP&A Act, the NVA Act applies.
		The Noxious Weeds Act 1993 (NW Act) guides the management of declared noxious weeds within Local Government Areas (LGAs) and provides for a coordinated approach to the removal and control of scheduled noxious weeds across the State. Individual land holders and managers are required under the NW Act to control noxious weeds declared for their area according that have been proclaimed under the NW Act. A list of declared noxious weeds for the Dubbo LGAs is provided in Appendix 1 .
Noxious Weeds Act 1993 (NW Act)	NSW Department of Primary Industries (NSW DPI)	In addition to the NW Act, an effort to gain control of weeds in Australia led to the development of a National Weeds Strategy. The strategy was first developed in 1997 and further refined in 2007 by the Commonwealth of Australia and issued under the authority of the National Resource Management Ministerial Council. Detailed management procedures have been outlined under the strategy and published for the control of 21 of the 32 recognised Weeds of National Significance (WoNS). WoNS are recognised as having potential to cause a significant impact upon natural values including: threats to human health and safety; threats to pastoral and agricultural industries; threats to water quality and supply; threats to indigenous flora; and threats to biodiversity and cultural values. A list of WoNS known or predicted to occur in the Subject Site has been provided in the Appendices.
Fisheries Management Act 1994 (FM Act)	DPI and OEH	The objective of the Fisheries Management Act 1994 Act (FM Act) is to conserve, develop and share the fishery resources of the State for the benefit of present and future generations. The developer will need to obtain a 'whole of project permit' to engage in a dredging (trenching) and reclamation activity (section 199, Part 7, Div 3 of the FM Act 1994) for the purpose of rehabilitation within the banks of the Eulomogo Creek in Subject Site. Under the 'integrated development' provisions of the <i>NSW Environmental Planning and Assessment Act 1979.</i> The developer will need to seek approval from DPI for a permit to temporarily or permanently block fish passage (section 219, of the FM Act 1994). If required, allow eight weeks to obtain this permit.
NSW National Parks and Wildlife Act 1974 (NP&W Act)	OEH	The NP&W Act aims to conserve nature, habitat, ecosystems, ecosystem processes and biological diversity at the community, species and genetic levels. Under this Act all native fauna is protected, threatened or otherwise. Schedule 13 of the act lists protected plants which shall not be harmed or picked on any land either on or off National Park estate. With regard to threatened species a person must not:

Act	Authority	Requirements
		 a) harm any animal that is of, or is part of, a threatened species, an endangered population or an endangered ecological community, or b) use any substance, animal, firearm, explosive, net, trap, hunting device or instrument or means whatever for the
		purpose of harming any such animal.
Water Management 2000 (WM Act)	NSW Office of Water (NoW)	The WM Act provides for the protection of river and lakeside land in NSW and aims to provide for the sustainable management of the water sources throughout NSW. All controlled development on or under waterfront land is regulated by the Act. The Act aims to minimise impacts on waterfront land and water courses and requires buffer zone, called the riparian corridor, between the waterfront and the adjacent development. NoW administers the WM Act and is required to assess the impact of any proposed controlled activity to ensure that no more than minimal harm will be done to waterfront land as a consequence of carrying out the controlled activity. Waterfront land includes the bed and bank of any river, lake or estuary and all land within 40 metres of the highest bank of the river, lake or estuary. The Subject Site borders Eulomogo Creek and may require a permit under WM Act. A water access licence may be required under the WM Act prior to commencement of works if water is to be sourced from a creek or a river (for water trucks etcetera). Allow a minimum of 28 days prior to the commencement of the works.
Water Act 1912	NoW	There are still some provisions in the Water Act 1912 that are yet to be incorporated into the WM Act. Under Part 8 of the Act, approval is required for a "controlled work". A "controlled work" is defined as an earthwork, embankment or levee or any work proposed to be constructed, on land that form part of a bank of a river or is within a designated floodplain and that is declared by order of the Ministerial Corporation published in the Gazette to be a controlled work. The subdivision will occur on the edges of the Macquarie River floodplain. Under Part 4 of the EPA Act, the developer may be required to submit a Controlled Works Application to NoW. Seek further advice from this department.
Rural Fires Act 1997	Rural Fire Service	The Rural Fires Act, 1997 (RF Act) requires public authorities and owners/occupiers of land to take all practicable steps to prevent the occurrence of bushfires and to minimise the danger of the spread of bushfires on or from that land. In accordance with the Rural Fire Services guidelines, Planning for Bushfire Protection (RFS 2006), a bushfire risk assessment must be undertaken and appropriate mitigation measures devised for Class 1, 2 or 3 buildings located on Bushfire Prone Land, as defined by Local Council or Rural Fire Service Bush Fire Prone Land Maps. Under the specifications of the Act, Dubbo City Council will ensure the works take all precautions against causing fire and must comply with the provisions and regulations of the Act.
Waste Avoidance and Resource Recovery Act 2001	NSW Environment Protection Authority (EPA)	The purpose of this Act is to minimise the consumption of resources and to control the management and disposal of any waste materials through waste avoidance, re-use and recycling in accordance with the principles of Ecologically Sustainable Development. Dubbo City Council are therefore required to consider the waste management hierarchy referred to in the Act.

Act	Authority	Requirements
Protection of the Environment Operations Act 1997 (POEO Act)	NSW Environment Protection Authority (EPA)	Environmental protection licenses (EPLs) are issued under the POEO Act for various scheduled developments and activities.
SEPP44 – Koala Habitat Protection	NSW Planning & Environment	 This Policy aims to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline: by requiring the preparation of plans of management before development consent can be granted in relation to areas of core koala habitat, and by encouraging the identification of areas of core koala habitat, and by encouraging the inclusion of areas of core koala habitat in environment protection zones. SEPP 44 aims to identify areas of potential and core Koala habitat. These are described as follows: Core Koala Habitat is defined as an area of land with a resident population. Potential Koala Habitat is defined as areas of native vegetation where the trees listed in Schedule 2 of SEPP 44 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component. SEPP 44 does not apply to the Dubbo Local Government area, however Koala habitat still requires consideration.
ISEPP – Infrastructure SEPP	NSW Planning & Environment	State Environmental Planning Policy (Infrastructure) 2007 (ISEPP) aims to facilitate the effective delivery of infrastructure across the State.As the proposal is for a subdivision and is to be carried out by a private developer it can be assessed under Part 4 of the EP&A Act. Development consent is required from Council.
Local Environment Plan	Dubbo City Council	The Subject Site is zoned as R2 (Low density residential) with the small strip of land dividing the lots as RE1 (Public Recreation). The application of ISEPP does not override the need to consider zoning controls under a LEP.
National Wildlife Corridors Plan	DoE	Works have been assessed against the types of biodiversity links (wildlife corridors) defined in of the National Wildlife Corridors Plan. Mitigation and redesign in sensitive ecological areas would be recommended to avoid large scale clearing. Offsets and rehabilitation will be consistent with this plan.

Biodiversity offsetting policies

Biodiversity offsets may be required as a condition of approval or a concurrence under the NSW EP&A Act or the EPBC Act. Both State and National levels of government aim to 'maintain, enhance or improve biodiversity', through the developer.

Following consultation with DCC, offsetting is required by Council.

DCC are currently developing offsetting policies. To ensure offsetting is consistent with Councils requirements this chapter was written taking into consideration their feedback to date.

Offsets would demonstrate an 'improve or maintain' outcome. Offsets are best directed at improving the habitat for all threatened species and connectivity to remnants. Plants used for revegetation would be consistent with those locally occurring in the Subject Site and would improve Eulomogo Creek bank stability, address erosion and assist in managing salinity.

DCC Offsetting Objectives

To meet offsetting requirements the offsetting package would:

- improve creek structural stability, and the condition and extent of native vegetation suitable for listing as a NSW EEC (Box-gum Woodland and Inland Grey Box Woodland). The Water Management Act 2000 Guidelines for controlled activities (2008) would be used as a guide for works within the proposed waterway the end result.
- maintain or improve the extent, distribution and condition of the existing native vegetation in the offset area.
- support the recovery of priority fauna populations, and threatened species, populations and communities.

DCC Offsetting Principles

The following principles would be considered when developing biodiversity offsets:

- 1. Offsets will be used as a last resort, after consideration of alternatives to avoid and/or mitigate impacts.
- Offset areas be kept within the Dubbo Local Government Area (either wholly or in part as a contiguous area of native vegetation).
- 3. Council stipulate the offset area will be publically accessible.
- 4. Offsets must be of the same vegetation type and be at least the size, equivalent biodiversity value and configuration of the vegetation lost through development and be additional to existing native vegetation areas.
- 5. Offsetting must achieve biodiversity benefits in perpetuity and be registered on title.
- 6. Offset conditions must be monitored, enforceable, clearly mapped, recorded and publicly available.
- 7. An offset area, once designated, cannot be used for offsetting of subsequent developments in future.

1.2 STUDY AIMS

The purpose of this Biodiversity Assessment to determine the terrestrial biodiversity values of the Subject Site and the ecological constraints of the proposal. The scope and aims of this report are to: Determine biodiversity values of the Subject Site including identifying protected and threatened flora and fauna species, populations and ecological communities and their habitats.

Identify the ecological constraints of the proposal.

- Identify the impacts of the proposed activity on flora and fauna species, populations, ecological communities and critical habitat.
- Address the requirements of the relevant legislation including the EP&A Act, the TSC Act and the EPBC Act.
- Assess the significance of the impact of the proposed activities on species, ecological communities and populations listed under the TSC Act and EPBC Act.
- Propose environmental management measures to minimise, mitigate and if necessary offset impacts.

2 METHODOLOGY

The flora and fauna assessment has been completed in accordance with Section 5a of the EP&A Act and the EPBC Act for threatened species populations and ecological communities potentially affected by the proposal.

The methodology employed for this report consisted of:

- A desktop and literature review of ecological databases and literature sources as direct references for the survey undertaken.
- A field survey of the Subject Site.

2.1 PERSONNEL

2.1.1 Field assessment

Field assessment of the Subject Site was undertaken by Phillip Cameron (Principle Ecologist of Ozark) on Thursday 16 April 2015.

2.1.2 Reporting

Reporting components were completed by:

- Main Authors: Heidi Kolkert
- Reviewer: Phillip Cameron
- Editor: Jane Book

2.1.3 Licensing and qualifications

OzArk operates under NSW Department of Primary Industries (DPI) Ethics Approval No 11/5475 and NSW Scientific Research License 101087. Key details of scientific personnel from OzArk EHM are provided in **Table 2–1**.

Name	Position	CV Details
Heidi Kolkert	Senior Ecologist	 PhD in progress (current). University of New England. BSc (Hons). Reproduction and Endocrinology. University of Tasmania. BA-BSc. Major Zoology and Geography. University of Tasmania. Over 13 years of wildlife related experience. 8 years with OzArk. OEH BioBanking accredited assessor number 0127. Listed on OzArk scientific license and NSW DPI ethics approval. WHS White Card Practicing member of the NSW Ecological Consulting Association Practicing member of the Environment Institute of Australia and New Zealand (EIANZ). Australian Bird and Bat Banding Scheme (C Class banding license) Member of: Ecological Society of Australia. Australasian Bat Society.

Table 2-1: Summary of OzArk qualifications.

Name	Position	CV Details
		 Australian Mammal Society, Royal Zoological Society, Birdlife Australia, Bat Conservation International, Citizens for Wildlife Corridors (Armidale) Apply First Aid (Red Cross) and Remote Area First Aid (St John) - all current.
Phil Cameron	Principal Ecologist Senior Project Manager	 BSc. Major in Biology. Macquarie University. Ass Dip App Sci. University of Queensland. Certified Environmental Practitioner (EIANZ). Lean Six Sigma Certificate (Sydney Uni) OEH BioBanking and Bio-certification Assessor: accreditation number 0117 OEH Scientific License: 101087. NSW DPI Ethics Approval 11/5475. Practicing member of the NSW Ecological Consulting Association. Practicing member of the Environment Institute of Australia and New Zealand (EIANZ) Member. National Railtrack Safety Induction (ARTC and John Holland Inductions). WHS White Card and Blue Card. Apply First Aid (Parasol) ID: 6007221.
Rowan Murphy	Environmental Scientist	 Bachelor of Environmental Science/Bachelor of Law, University of New England. Listed on scientific license and NSW DPI ethics approval. WHS White Card and Blue Card. National Railtrack Safety Induction (ARTC and John Holland Inductions). Associate member of the NSW Ecological Consulting Association. Practicing member of the Environment Institute of Australia and New Zealand (EIANZ) Member Cert 4 in 4WD training (Nationally recognised training). Roads and Maritime Worker on Foot training.
Jane Book	Environmental Scientist	 Masters of Environmental and Business Management (Newcastle Uni) Graduate Certificate in Environmental and Business Management Bachelor of Applied Science (Hons) Member Royal Zoological Society, National Trust, NSW Ecological Consulting Association

2.2 DATABASE SEARCHES AND LITERATURE REVIEWS

Preliminary assessments drew on a number of information sources including previous preliminary reporting and information held on government databases and archives. Data gathered during preliminary assessments was used to assist in identifying distributions, suitable habitats and known records of threatened species so that field investigations could more efficiently focus survey effort. Preliminary assessment utilised a number of information sources as follows:

- Aerial Photograph Interpretation (API) of the landscape and previous vegetation maps.
- Literature reviews to determine vegetation and species habitat(s) within the proposed Subject Site and environs.

- Review of flora and fauna records contained in the OEH Threatened Species Database, EPBC Protected Matters Search and DPI Records Viewer.
- NSW Wildlife Atlas/Bionet GIS data request and website search.
- Australia Museum records.
- Royal Botanical Gardens (Plantnet NSW Flora Online).
- NSW Atlas of Living Australia records.
- Birds Australia Atlas.

2.3 PREDICTIVE MODEL FOR THREATENED SPECIES DETECTION

The concepts of the modelling formed the basis of the methodology designed for the current assessment. These reflect the predominant patterns of threatened species distribution as elicited from prior survey work.

Remnant patch size is the primary factor appearing to determine the location of threatened plants and animals in the region and to a lesser degree in disturbed habitats proximity to a permanent water supply. Predictive modelling for EECs in the locality is fairly straight forward as it can be summarised as likely to be any native vegetation left in the valley floor and on the undulating hills which is suitable for cropping or grazing agriculture.

An assessment of likelihood of occurrence was made for threatened species of flora, fauna, populations, ecological communities and migratory species identified from the database searches identified in **Section 2.2**. Five terms for the likelihood of occurrence of species are used in this report. This assessment was based on database or other records, presence or absence of suitable habitat, features of the proposal site, results of the field survey and professional judgement. The terms for likelihood of occurrence are defined below:

- "Yes" = the species was or has been observed on the site.
- "Likely" = a medium to high probability that a species uses the site.
- "Potential" = suitable habitat for a species occurs on the site, but there is insufficient information to the species as likely to occur, or unlikely to occur.
- "Unlikely" = a very low to low probability that a species uses the site.
- "No" = habitat on-site and in the vicinity is unsuitable for the species.

The background searches detailed in **Section 2.2 (Appendix 2)** enabled a predictive model of threatened flora and fauna occurrence to be developed for the Subject Site (**Section 4.1.5**).

The ecology and habitat requirements of threatened species, populations, and endangered ecological communities and the likelihood of those occurring within the Project Area are detailed in **Appendix 3**.

2.4 FIELD SURVEY

2.4.1 General survey methodology

The survey methods employed during the field investigations in the Subject Site were based on relevant recovery and threat abatement plans and the following documents:

- Threatened Species Survey And Assessment: Guidelines for Developments and Activities- Working Draft (DEC 2004).
- Field Survey Methods (DECCW 2009).
- Survey guidelines for Australia's threatened birds: Guidelines for detecting birds listed as threatened under the EPBC Act (DEWHA 2010a).
- Survey guidelines for Australia's threatened bats: Guidelines for detecting bats listed as threatened under the EPBC Act (DEWHA 2010b).
- Survey guidelines for Australia's threatened mammals: Guidelines for detecting mammals as threatened under the EPBC Act. (DEWHA 2010c).
- Survey guidelines for Australia's threatened frogs: Guidelines for detecting frogs listed as threatened under the EPBC Act (DEWHA 2010d).

2.4.2 Floristic survey methods

Seven vegetation plots were undertaken according the Biobanking Methodology for the purpose mapping vegetation quality, condition and assigning vegetation to a *Biometric* community. Plot details are as follows:

- Plot 1 (GDAz55 6540118E 6427567N).
- Plot 2 (GDAz55 654335E 6427696N).
- Plot 3 (GDAz55 654060E 6428165N).
- Plot 4 (GDAz55 654725, 6427899).
- Plot 5 (GDAz55 654741E 6427821N).
- Plot 6 (GDAz55 654469E 6426914N).
- Plot 7 (GDAz55 653814, 6427059).

Additional survey of the Subject Site followed the "Random Meander Technique" described by Cropper (1993). Special consideration was given to locating rare or threatened plants identified in database searches and literature review as having the potential to occur (**Appendix 2**).

Plant Identification

Plant identification followed nomenclature in Harden 1990–2002, Cunningham et al. 1992, Royal Botanic Gardens (RBG 2014a), and PlantNet NSW Flora Online (RBG 2014b). The national conservation significance of flora was determined by referencing *Rare or Threatened* Australian Plants (ROTAP) (Briggs and Leigh 2006) and the Schedules associated with the TSC Act or the EPBC Act.

2.4.3 Fauna survey methods and habitat assessment

Identification of the species present, and their diversity, can indicate the type of habitat that is present within the Subject Site. Habitat present also dictates which threatened species, although extant, may utilise the area. The likely impacts of development can be addressed through this process.

A general habitat assessment was carried out to assess habitat features such as the presence of hollow bearing trees, logs and the potential for suitable habitat to provide breeding, nesting, feeding and roosting resources for native species.

Opportunistic fauna observations and targeted searches were carried out during the field survey to identify cryptic species in the Subject Site. Fauna identification was achieved via:

- Identification of scats, diggings, tracks and other traces.
- Direct observation: ie bird watching.
- Ground, leaf litter and other refuge searches.
- Searches for indirect evidence of mammals (vocalisation, tracks, scats, burrows etc.).
- Targeted assessment Pink-tailed Worm Lizard

Fauna species identification

All fauna was readily identified through the use of available standard references (Strahan, R. [ed.] 1983 Groves *et al.* 2005).

2.4.4 Hollow bearing trees

Habitat values of trees assessed in the Subject Site were considered for their potential to provide habitat for the regions hollow dependent threatened fauna (**Table 2–2**).

No.	Habitat value and constraint for removal.
3	High habitat value and highest level of constraint: ie tree is a threatened species, provides known breeding/roosting habitat for a threatened species or possesses unique or rare habitat values within the landscape (such as large hollows suitable for forest owls). Occasionally 3 is used where one tree possesses several large tree hollows suitable for breeding owls.
2	Moderate habitat value and medium level of constraint: ie tree has potential to provide breeding or roosting habitat for a threatened species but is located in an environment where this is unlikely, but not out of the question. Tree may also possess hollows or other habitat values that are limited in the local environment such as moderate sized hollows or moderate volumes of decorating bark etc.
1	Low habitat value and low level of constraint: ie tree is very unlikely to provide breeding or roosting sites for threatened species and it possesses common habitat elements for the environment such as a tree without hollows that provides nectar/insects as a resource.
0	No constraint.

Table 2-2: Habitat value and constraints of trees.

2.5 SURVEY EFFORT

The Subject Site was assessed in entirety by vehicle and on foot. All trees with hollows inside the Subject Site were manually assessed.

Where ground debris or rocks were present they were overturned to search for frogs and reptiles in these areas. A targeted Pink-tailed Worm-Lizard search was undertaken in the area mapped as former White Box Woodland (**Figure 4-1**) characterised by basalt outcrops and suitable surface rocks. Approximately 300 rocks were overturned in this area as per EPBC Act survey guidelines for this species.

All trees, native planted or non-native were assessed for evidence of Koala use.

2.6 LIMITATIONS

Not all animals and plants can be fully accounted for within any given Subject Site. The presence of threatened species is not static. It changes over time, often in response to longer term natural forces that can, at any time, be dramatically influenced by man-made disturbance. In order to overcome some of these limitations, database searches were conducted for threatened species, populations and ecological communities known to occur within the region as well as consultation with landowners. As such, the 'precautionary approach' for species occurrence has been adopted where required.

The western portion of the Subject Site (west of fence line near vegetation Plot 1) was not ecologically assessed due to active machinery and the construction of houses. Furthermore trees removed to allow for the placement of two major stockpiles were also not ecologically assessed. One stockpile, consisting of soil, spoil construction concrete waste is located south of Vegetation Plot 1 near the old nursery (about 100x20m wide) and the other east of vegetation plot 3 (100x10m wide). It has not been ascertained whether a previous DA approved the removal of vegetation and the storage of this construction material.

The above-mentioned constraints are not considered to compromise the scientific rigour of the field assessment

This report is based upon data acquired from recent and current surveys, however, it should be recognised that the data gathered is indicative of the environmental conditions of the site at the time the report was prepared.

3 EXISTING ENVIRONMENT

3.1 LANDSCAPE CONTEXT

The majority of land incorporated in the Subject Site and locality is subject to continued or historical agricultural practices, infrastructure provision and low density rural housing, and as such would be expected to exhibit a wide range of land-use associated disturbance levels. Satellite imagery of the Subject Site (**Figure 3-1**) appears to demonstrate moderate levels of broad scale disturbance associated with agricultural land clearance for grazing and cropping. Further afield large tracts of remnant vegetation and conservation networks occur.



Figure 3-1: Aerial view of Subject Site.

3.3 TOPOGRAPHY AND GEOLOGY

Low hills with long slopes characterise the locality. The Subject Area is located on the undulating plain above the Macquarie River floodplain at approximately 280m Australian Height Datum (AHD) in the north to 270m AHD in the south of the property.

3.4 VEGETATION

Grey Box (*Eucalyptus microcarpa*), Yellow Box (*E. melliodora*) and Rough-barked Apple (*Angophora floribunda*) occur on valley floors, while River Red Gum (*E. camaldulensis*) lines the Macquarie River and River Oak (*Casuarina cunninghamiana*) the tributaries. Fuzzy Box (*E. conica*) is also known to occur along footslopes and alluvial areas near the Macquarie River.

3.5 GROUND WATER DEPENDENT COMMUNITIES

Areas mapped in the Subject Site are considered as having a moderate potential for groundwater interaction.

3.6 MITCHELL LANDSCAPES AND SOIL OF THE SUBJECT SITE

Mitchells Landscapes classification of the landscape upon which the Subject Site falls predominately within "Goonoo Slopes" (**Figure 3-2**) which are characterised by: Extensive undulating to stepped low hills with long slopes on sub-horizontal Triassic/Jurassic quartz sandstone, conglomerates, siltstone, shale and some coal. Stony yellow earths with sandstone outcrop on ridgelines to yellow harsh texture-contrast soils in shallow valleys (Mitchell 2002).

The northern tip of the "Subject Site" is within Dubbo Basalts, with the southern portion falls within the "Macquarie Alluvial Plans."

3.7 HYDROLOGY OF THE SUBJECT SITE

The Subject Site is within the Talbragar Valley sub region of the Central West Catchment Management Area (CMA) situated within the larger Brigalow Belt South Bioregion (BBSB) (Thackway and Cresswel 2000). Eulomogo Creek intercepts the south-eastern portion of the Subject Site. Two small dams also exist on the northern portion of the Subject Site. All surface water drains south into adjoining agricultural / disturbed land and into the Macquarie River approximately 1.2 kilometres to the south.



Figure 3-2: Mitchell's Landscapes in the Subject Site

3.8 LAND-USE

The Subject Site is characterised as highly disturbed footslopes associated with the Macquarie River floodplain. After European occupation it was cleared, grazed and ploughed regularly in seasonally favourable conditions. Ploughing ceased on the property approximately 10 years ago, likewise, grazing also ceased one year prior. It is uncertain whether soils in the Subject Site have been 'pasture improved' apart from Lucerne being actively sown. Additionally, council has constructed drainage channels within the property. Apart from isolated trees there are no relatively undisturbed vegetated areas in the Subject Site

3.9 BIODIVERSITY LINKS (WILDLIFE CONNECTIVITY CORRIDORS)

Biodiversity link nomenclature used in this section follows OEH Biodiversity Certification Assessment Methodology (2011: 23, Table 3-1).

Fauna wildlife corridors are usually associated with waterways, wetlands and riverine environments or specific continuous habitats (for example escarpments, woodlands).

The Subject Site is situated central to several protected forests and reserves including Beni State Conservation Area, Cobbora State Forest, Goonoo National Park, Goonoo State Conservation Area (SCA), Yarindury State Forest. Regionally the habitat surrounding within the Subject Site is likely to provide a movement pathway or stepping stone habitat between these reserves and the Macquarie River.

Goonoo SCA is recognised as an Important Bird Area (IBA) by Birdlife International (http://www.birdlife.org/worldwide/index.html). It is the core conservation area of the Mallee Fowl, Ground Cuckoo-shrike, Gilberts Whistler, Chestnut-rumped Heathwren, Spotted Quail-Thrush, Glossy Black Cockatoo and one of only two known populations of Eastern Pygmy Possum on public land in the region. Goonoo is also a regional stronghold of the vulnerable Greater Long-eared Bat (Ellis & Turbill, 2002).

Consequently, Goonoo SCA is considered a significant environmental feature of the Central West, and arguably one of the more significant environmental features of inland NSW. It provides connectivity for migrating birds between the semi-arid lands to the west and hinterland (and coast) to the east.

Connectivity	BCAM (2012) Defining criteria	Comment
State Biodiversity Link	An area identified as being part of a state biodiversity corridor and in a plan approved by the Director General OR A riparian buffer 40 metres either side of a major river	No areas are identified as being part of a state biodiversity corridor and in a plan approved by the Director General. The Macquarie River is situated within 1.2 km from the Subject Site.
Regional Biodiversity Link	An area identified as being part of a regional biodiversity corridor and in a plan approved by the Director General OR A riparian buffer 30 metres either side of a minor river or major creek	No areas are identified as being part of a regional biodiversity corridor and in a plan approved by the Director General The Subject Site traverses riparian areas of minor creeks.
Local Biodiversity Link	Links areas of native vegetation in moderate to good condition greater than 30 hectares AND Width of vegetation in moderate to good condition is greater than 30 metres AND/OR A riparian buffer 20 metres either side of a minor creek or 10 metres either side of minor watercourse	

Table 3-1: Biodiversity links.

4 RESULTS

4.1 DATABASE AND LITERATURE RESULTS

Appendix 1 provides a complete list of database searches and lists of threatened flora, fauna and ecological communities identified through the background searches and annotated with the potential to be recorded in the Subject Site. A map displaying threatened flora and fauna records for the Subject Site can be seen on **Figure 4-1**.

4.1.1 NSW OEH Listed items

A search of the NSW OEH Threatened Species Profiles using Central West CMA Talbragar Valley subregion predicts 98 listed items as having potential to be present in the Subject Site.

Table 4-1: NSW OEH Listed items predicted to occur in the Central West CMA Talbragar Valley subregion.

NSW OEH Threatened Species	Known	Predicted	Grand Total
Animal > Amphibians		1	1
Animal > Bats	3	1	4
Animal > Birds	29	9	38
Animal > Marsupials	4	2	6
Animal > Reptiles		1	1
Community > Threatened Ecological Communities	3		3
Plant > Epiphytes and Climbers	1		1
Plant > Herbs and Forbs	2	1	3
Plant > Orchids	1		1
Plant > Shrubs	6		6
Threat > Disease		3	3
Threat > Habitat Loss/Change		9	9
Threat > Other Threat		1	1
Threat > Pest Animal		14	14
Threat > Weed		7	7
Grand Total	49	49	98

4.1.2 Threatened species and endangered populations within 10 kilometres of the Subject Site

A total of 81 records of 30 threatened species have been previously recorded within a ten kilometre radius of the Subject Site (Bionet: search date 26 March 2015) (**Table 4-2**). As can be seen from **Figure 4-1**, many of these records are around the urban environs of Dubbo.

Table 4-2: Threatened species, extinct and endangered populations within 10 kilometres of theSubject Site.

Row Labels	Number of records
Australian Painted Snipe Rostratula australis	2
Barking Owl Ninox connivens	5
Bilby Macrotis lagotis	1
Black Falcon Falco subniger	1
Black-chinned Honeyeater (eastern subspecies) Melithreptus gularis gularis	1
Brown Treecreeper (eastern subspecies) Climacteris picumnus victoriae	1
Commersonia procumbens	3
Corben's Long-eared Bat Nyctophilus corbeni	1
Flame Robin Petroica phoenicea	1
Glossy Black-Cockatoo Calyptorhynchus lathami	2
Glossy Ibis Plegadis falcinellus	1
Grey-crowned Babbler (eastern subspecies) Pomatostomus temporalis temporalis	16
Homoranthus darwinioides	1
Koala Phascolarctos cinereus	1
Leafless Indigo Indigofera efoliata	8
Little Eagle Hieraaetus morphnoides	4
Little Lorikeet Glossopsitta pusilla	2
Magpie Goose Anseranas semipalmata	2
Marsh Sandpiper Tringa stagnatilis	1
Mauve Burr-daisy Calotis glandulosa	2
Pine Donkey Orchid Diuris tricolor	3
Rainbow Bee-eater Merops ornatus	5
Red-tailed Tropicbird Phaethon rubricauda	1
Regent Honeyeater Anthochaera phrygia	7
Ruff Philomachus pugnax	1
Sharp-tailed Sandpiper Calidris acuminata	1
Speckled Warbler Chthonicola sagittata	1
Spotted Harrier Circus assimilis	3
Superb Parrot Polytelis swainsonii	2
White-fronted Chat Epthianura albifrons	1
Grand Total	81



Figure 4-1: OEH Bionet records of threatened flora and fauna within 10km of the Subject Site (Data Source: NSW OEH 26 March 2015).

4.1.3 EPBC Protected Matters Report

The DoE Protected Maters report predicts the following protected matters that may or are likely to occur in the Subject Site.

- 5 EECs.
- 14 Listed threatened species.
- 10 migratory species.
- 11 Marine species
- 6 Commonwealth Lands

The Regent Honeyeater, Superb Parrot, South-eastern Long-eared Bat, White-throated Needletail and Rufous Fantail are known to occur or have habitat in the Subject Site.

4.1.4 Local context (Biodiversity impact assessments)

Many ecological surveys have taken place in proximity to the Subject Site. The largest and most relevant ecological survey was undertaken by OzArk (2013) as part of the approval process for the Dubbo Zirconium Project. Other relevant surveys include:

- Tree Assessment: Lot G DP417757, 411 Macquarie Street Dubbo, NSW. Report to Geolyse (OzArk 2014).
- Ecological Assessment: Keswick Stage 5 Residential subdivision (52.5 ha) (OzArk 2013).
- Ecological Assessment: LH Ford Bridge. Report to Dubbo City Council OzArk (2013).
- Biodiversity Assessment for the Dubbo Zirconium Project. Report to Alkane Resources (OzArk 2013).
- Ecological Assessment: Dubbo to Wellington 66kv Powerline Upgrade. Report to Essential Energy. August 2012 (OzArk 2012);
- Ecological Assessment: Proposed recycled water reticulation scheme in three areas within the village of Wongarbon. Report to Dubbo City Council (OzArk 2010).
- Ecological Assessment: Golden Highway/Boothenba Road realignment and intersection improvements. Report to the Roads and Traffic Authority (OzArk 2010)
- Dubbo Bird List. Prepared by the Dubbo Field Naturalist Society (Hosking et al. 2010);
- Status of Vertebrate Fauna And Their Habitat In The Central West Catchment (Goldney, Kerle and Fleming 2007);
- Ecological Overview of Three Reserves: Jones Creek Reserve, Cumboogle Flora Reserve and Wongarbon Tank Reserve. Dubbo Local Government Area, NSW (OzArk 2009);
- Ecological and Archaeological Assessment: Proposed Wongarbon Sewerage Scheme (WSS) including the Wongarbon Sewerage Treatment Plant (STP) and the associated reticulation scheme within the village of Wongarbon. Report to Dubbo City Council (OzArk (2006).
- Ecological and Archaeological Assessment: 2.4 km Road Rehabilitation and Minor Alignment Shift, c. 16 km Southeast of Dubbo, NSW. Report to Dubbo City Council. (OzArk 2005).

- Community Data Search And Biodiversity Survey Of The Brigalow Belt South Bioregion Stage 1 (NSW NPWS 2002); and
- Report On Preliminary Fauna Survey Of The Pilliga And Goonoo Forests. November 1999 to January 2000 (NSW NPWS 2000).

The research indicates that woodlands dominated by Fuzzy Box (*Eucalyptus conica*) Inland Grey Box (*E. microcarpa*) and White Box (*E. albens*) dominate the Dubbo LGA. These woodlands are all listed as Endangered Ecological Communities (EECs) or Threatened Ecological Communities (TECs) under the TSC Act and/or the EPBC Act. Threatened species such as the Black-chinned Honeyeater, Brown Treecreeper, Diamond Firetail, Grey-crowned Babbler, Speckled Warbler, Little Eagle are commonly recorded in these remnant woodlands in Dubbo. To a lesser extent the Hooded Robin and Varied Sittella are known to occur. Migratory species (EPBC Act) known to occur in the area include the Swift Parrot, Superb Parrot and Rainbow Bee-eater. Although Koalas have been recorded in the locality, they are not a common sighting and it is suggested that riparian areas such as the Macquarie River provide a highway for Koalas to move to more suitable habitat and climatic conditions. The Barking Owl is also known to occur along the Macquarie River. Due to the ease in identifying microbats from echolocation recordings, several species of threatened microbat are also known from the area. These include the Yellow-bellied Sheath-tailed Bat, Greater long-eared Bat, Little Pied Bat and Large-eared Pied Bat.

4.1.5 Predictive model for threatened species detection

As a result of the background searches and literature review, 91 protected matters listed in the schedules of the FM and/and TSC or/and EPBC Act have been previously identified as having habitat present or occurring in the locality.

Of these, 45 protected matters are considered to have potential to occur in the Subject Site (**Table 4-3**). Further details regarding these species can be found in **Appendix 3**.

	Common Name	Common Name Scientific Name		EPBC Act Status	Potential to occur in Subject Site
1	Ausfeld's Wattle	Acacia ausfeldii	V		Potential
2	Barking Owl	Ninox connivens	V		Likely
3	Black Falcon	Falco subniger	V		Potential
4	Black-breasted Buzzard	Hamirostra melanosternon	V		Potential
5	Black-chinned Honeyeater (eastern subspecies)	Melithreptus gularis gularis	V		Potential
6	Brown Treecreeper (eastern subspecies)	Climacteris picumnus victoriae	v		Likely
7	Cattle Egret	Ardea ibis		М	Potential
8	Diamond Firetail	Stagonopleura guttata	V		Likely
9	Flame Robin	Petroica phoenicea	V		Potential

Table 4-3: Protected matters with potential to occur in the Subject Site

	Common Name	Scientific Name	TSC Act	EPBC Act Status	Potential to occur in Subject Site
10	Fork-tailed Swift	Apus pacificus		М	Potential
11	Fuzzy Box Woodland on alluvial Soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions	Fuzzy Box Woodland on alluvial Soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions	EEC		Yes
12	Glossy Black-cockatoo	Calyptorhynchus lathami	V		Potential
13	Great Egret,			М	Potential
14	Greater Long-eared Bat	Nyctophilus timoriensis/corbeni (South-eastern form)	V	E	Potential
15	Grey Falcon	Falco hypoleucos	E		Potential
16	Grey-crowned Babbler (eastern subspecies)	Pomatostomus temporalis temporalis	V		Yes
17	Homoranthus darwinioides	Homoranthus darwinioides	V	V	Potential
18	Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions/Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of		EEC	E	Yes
19	Koala	Phascolarctos cinereus	V		Potential
20	Little Eagle	Hieraaetus morphnoides	V		Potential
21	Little Lorikeet	Glossopsitta pusilla	V		Potential
22	Little Pied Bat	Chalinolobus picatus	V		Potential
23	Major Mitchell's Cockatoo	Lophochroa leadbeateri	V		Potential
24	Masked Owl	Tyto novaehollandiae	V		Potential
25	Painted Honeyeater	Grantiella picta	V		Potential
26	Pine Donkey Orchid	Diuris tricolor	V		Likely
27	Rainbow Bee-eater	Merops ornatus		М	Potential
28	Regent Honeyeater	Anthochaera phrygia	CE	Е	Likely
29	Rufous Fantail			М	Potential
30	Satin Flycatcher			М	Potential
31	Scant Pomaderris	Pomaderris queenslandica	E		Potential
32	Scarlet Robin	Petroica boodang	V		Potential
33	Speckled Warbler	Pyrrholaemus saggitatus	V		Yes
34	Spotted Harrier	Circus assimilis	V		Potential
35	Spotted-tailed Quoll	Dasyurus maculatus	V	E	Potential
36	Square-tailed Kite	Lophoictinia isura	V		Potential
37	Superb Parrot	Polytelis swainsonii	V	V	Likely
38	Swift Parrot	Lathamus discolor	E	E	Potential
39	Turquoise Parrot	Neophema pulchella	V		Potential
40	Varied Sittella	Daphoenositta chrysoptera	V		Likely
41	White Box-Yellow Box-Blakely's Red Gum Grassy		EEC	CE TEC	Yes
42	White-throated Needletail	Hirundapus caudacutus		Listed	Potential
43	Yellow-bellied Sheathtail-bat	Saccolaimus flaviventris	V		Potential
44		Tylophora linearis	V	E	Potential
45	Aquatic Ecological Community in the		EEC		Yes

	Common Name	Scientific Name	TSC Act	EPBC Act Status	Potential to occur in Subject Site
	Natural Drainage System of the Lowland Catchment of the Lachlan River EEC (NSW FM Act).		(TSC Act)		
E- Endangered. EP- Endangered Population. EEC- Endangered Ecological Community.		V- Vulnerable M- Migratory or Marir CE- Critically Endang	ne (EPBC Act	t)	

CEEC- Critically Endangered Ecological Community TEC – Threatened Ecological Community

4.2 FIELD SURVEY RESULTS

4.2.1 Vegetation communities and habitat

The Subject Site is completely cleared, ploughed and disturbed with few isolated trees. Despite continuous grazing and a history of ploughing, native grasses in most cases prevail in the Subject Site. Vegetation present is characterised by *Biometric* community ID CW130 '*Derived* tussock grasslands of the central western plains and lower slopes of NSW (Benson 250)'. Prior to grazing pressures (**Figure 4-2**), the subject site would have been derived from three TSC listed EECs (**Figures 4-3** and **4-4**), being:

- Biometric community ID CW144 Inland Grey Box Poplar Box White Cypress Pine tall
 woodland on red loams mainly of the eastern Cobar Peneplain Bioregion (Benson 82)
- Biometric community ID CW213 White Box White Cypress Pine Inland Grey Box woodland on the western slopes of NSW (Benson 267)
- Biometric community ID CW138 Fuzzy Box Inland Grey Box on alluvial brown loam soils of the NSW South Western Slopes Bioregion and southern BBS Bioregion (Benson 201)

The long-term viability of *Biometric* community ID CW130 in recovering to a pre-European state has been compromised by routine agricultural activities and stockpiling. Ploughing and grazing impedes the recruitment of trees and shrubs, and reduces groundcover diversity and abundance, particularly native grasses and forbs. Reduced groundcovers on erodible soils increase water erosion, which is evident in the degree of erosion on the banks of Eulomogo Creek. However like most surrounding areas, all have the potential to recover.

Eulomogo Creek forms part of the FM Act listing for the 'aquatic ecological community in the natural drainage system of the lowland catchment of the Lachlan River.' The creek is in poor condition however provides connectivity to the Macquarie River.

Threatened and endangered ecological communities

No threatened or endangered ecological communities were recorded in the Subject Site. However, as noted above, all vegetation in the Subject Site is likely to have been derived from one of three EECs listed under the TSC Act. Thus, in consistency with the TSC Act, the 'precautionary principle' has been adopted and an Assessment of Significance has been completed for each to characterise the potential impacts.



Figure 4-2: Vegetation plots and grazing pressures mapped in the Subject Site.



Figure 4-3: Areas formally EEC in the Subject Site.

Figure 4-4: Grazing pressures overlaid on areas formally considered EECs in the Subject Site.



4.2.2 Flora species

76 species of vascular flora was recorded during the assessment (**Table 4-4** and **4-5**). All plots recorded a high incidence of non-native plant species, indicative the disturbed nature of the ground surface. No plots recorded a native upper stratum, also suggestive of historic clearing and recent ploughing and grazing. Flora species were noted and enabled the vegetation community of the Subject Site to be aligned to a *Biometric* vegetation community.

Plot number		1	2	3	4	5	6	7
TOTAL species / plot		30	27	27	25	28	41	29
Total species	76							
Native Plant Species	44	16	14	12	13	18	19	21
Non-native sp.	46	14	13	15	12	10	22	8
% Native Plant Species	57.89	53.3%	51.9%	44.4%	52.0%	64.3%	46.3%	72.4%
% non-native	60.53	46.7%	48.1%	55.6%	48.0%	35.7%	53.7%	27.6%

Table 4-4: Summary of native species recorded by plot.

Table 4-5: Summary of stratum details by plot.

STRATUM DETAILS	PLOT 1	PLOT 2	PLOT 3	PLOT 4	PLOT 5	PLOT 6	PLOT 7
Native Upper stratum Native Lower stratum	0	0	0	0	0	0	0
Native Mid stratum	0	1	0	0	3	4	1
Native Lower stratum (not grass)	8	6	6	1	4	4	9
Native Lower stratum (grasses)	8	7	6	12	11	8	11
No. of exotic grasses	2	3	4	3	1	6	0

Threatened and endangered flora

No species of listed threatened flora were recorded or considered likely to occur in the Subject Site.

Exotic and noxious flora

Two species of Class 4 'Locally Controlled Weeds' declared in the Local Control Authority area of Dubbo City Council were recorded in the Subject Site. These include; Prickly Pear (*Opuntia stricta*) and African Boxthorn (*Lycium ferocissimum*) - see **Appendix 2** for complete DCC Noxious weed listings. Both species are additionally listed as a Weeds of National Significance (WoNs). Management of these weeds requires coordination among all levels of government, organisations and individuals with weed management responsibilities.

4.2.3 Fauna species

31 species of fauna recorded during the assessment. This includes one mammal, 5 reptile, 2 frog and 23 bird species. The targeted survey for the Pink-tailed work lizard did not reveal any individuals or suitable habitat. As the Subject Site does not contain a trachite deposit (known

Pink-tailed Worm Lizard habitat in the locality) geologically it is not considered to be prime habitat.

Threatened species

No species of threatened fauna were recorded in the Subject Site. The lack of diverse, quality habitat in the Subject Site reduces the potential of many threatened species known for the locality having habitat present in the Subject Site or occurring. However, due to known survey limitations (Section 2.6), some threatened species are considered likely to occur or have habitat in the Subject Site based on available habitat and previous records. These are listed in Section 4.3.

Endangered populations

No endangered fauna populations considered likely to occur within the Subject Site.

4.2.4 Fauna habitat

<u>General fauna habitat</u>

Fauna habitat in the Subject Site is restricted to derived grassland with the odd isolated eucalypt. Open/disturbed areas favours common generalist species which are capable of utilising open ground for foraging and common disturbance-tolerant species which are ubiquitous in modified habitats.

Isolated trees within the cleared/disturbed areas are known to contribute to the viability of wildlife populations in agricultural mosaic landscapes by maintaining connectivity between larger patches of remnant vegetation (Gibbons 2000).

<u>Koala habitat</u>

State Environmental Planning Policy (SEPP) 44 does not apply to the Dubbo LGA. Potential Koala habitat still requires management under the EPBC Act. The Approved Recovery Plan for the Koala (DECC 2008) provides lists of koala food trees categorised as primary, secondary and supplementary within Koala Management Areas (KMAs). Primary food trees exhibit a level of use that is significantly higher than that of other Eucalyptus species and is independent of tree density. The Dubbo LGA is within KMA 6: Western Slopes. Large populations of koalas occur on the western slopes and plains, in particular the Pilliga region (Kavanagh and Barrott 2001) and in Gunnedah (Smith 1992) and Walgett LGAs (J. Callaghan, Australian Koala Foundation, pers. comm.). In the south of this KMA, a population of koalas occurs along the Murrumbidgee River at Narrandera. River Red Gum is listed as primary food source, Yellow Box and White Box are listed as a secondary food source and Red Stringybark is listed as a supplementary food source.

The Subject Site is considered "potential koala habitat". Koalas are known to be a transient species in the locality, specifically along the Macquarie River. The lack of records in the Subject

Site is not considered to represent the absence of koalas, rather that habitat away from the riverine environment is not considered to be core koala habitat. As such, the Subject Site is considered 'potential' Koala habitat (as Koalas will move through cleared paddocks to access suitable habitat) as no resident population or breeding females are considered to occur in the Subject Site.

Critical habitat

There are four declared critical habitats in NSW and three recommendations for critical habitat status in NSW.

Five Commonwealth critical habitats are listed in the EPBC Act.

None of these identified areas of critical habitat are located within the boundaries of the Subject Site.

Aquatic habitat

Aquatic habitat in the Subject Site is poor with a high nutrient loading (**Table 4-5**). Although some aquatic habitat such as grasses, rushes and sedges are present and provide refuge for a variety of species, cattle has impacted the quality and suitability of this habitat. Eulomogo Creek and various dams in the Subject Site provide suitable foraging areas and habitat for water birds, waders and migratory birds as well as habitat for aquatic species such as frogs, turtles and fish. The creek is in poor condition and is unlikely to provide habitat for threatened fish species.

Although emergent aquatic vegetation increases the possibility that threatened birds would breed in this area, the lack of terrestrial vegetation cover and impacts by cattle reduce this potential. Furthermore, the majority of migratory waders do not breed in Australia.

	Eulomogo Creek				
Filamentous algae		Yes			
Water weeds (Azola / S	Nater weeds (Azola / Salvinia)				
Weeds on banks	Yes				
Cumbungi, reeds, bullru	Yes				
Native tree death	No				
Bad smells from the wa	Yes				
Surface scum	Yes				
Stock refusing to drink	No				
	High (7/9)				
	Macro-invertebrate pollution tolerance	data			
Rating of water	Sensitivity	Present			
1	very sensitive organisms				
	stonefly nymphs				
4 = Excellent	mayfly nymphs				
	freshwater shrimp				

Table 4-6: Summary of	f water condition	and aquatic habita	t in Fulomogo Creek
Table 4-0. Outliniary c	water contaition	i and aquatic nabite	a in Euromogo oreen.

	freshwater crayfish	x
1	sensitive organisms	- T - T
	dobonsonflys (alderflies)	
	mussels	
	freshwater prawns	
3 or > = Good	freshwater crayfish	x
	dragonfly nymphs	
	damselfly nymphs	
	caddisfly nymphs	
	water mites	
	tolerant organisms	
	beetle (Coleoptera)	x
	true bugs (Hemiptera)	
2 or > = Fair	leech	
	freshwater snail	
	flatworm	
	very tolerant organisms	- F 11
	black fly larvae	x
	mosquito larvae	x
1 or > = Poor	fly larvae	x
	non-biting midges (including bloodworms)	x
	freshwater worms	
Overall rating		Poor
Habitat Features		
	Habitat Type	Permanent water
	Pool Size	4m wide, 200m long
	Bank Slope	40 to 90 degrees
	Depth (Max Av)	0.5m
	Substrate type	sand and basalt rock
	Downstream connectivity	good / continuous
	Waterway Condition	Poor
	Contributions to cover	NIL
	Submerged physical	NIL
	Submerged biological	NIL
	Emergent reeds / plants	Bull rush, water ribbons (all impacted by cattle)
	Canopy % over water (50m)	20%
	General terrestrial veg cover	Derived Grassland (formerly Fuzzy Box Woodland)
	Temperature (10cm)	21 degrees Celsius

4.2.5 Protected Matters - Migratory and marine species

Background searches revealed the potential presence of several migratory species in the locality. The Fork-tailed Swift and White-throated Needletail are almost exclusively aerial (including foraging) and as such can be recorded over many habitats. The Rainbow Bee-eater is known to have breeding habitat in sandy areas near the Macquarie River in Dubbo and has

potential to occur in the Subject Site. Likewise the Satin Flycatcher, Rufous Fantail (seasonal migrants) are likely to occur and forage in riverine environments including Eulomogo Creek. However, a lack of perching opportunities decreases the likelihood that these species would be recorded in the Subject Site. The Superb Parrot, Regent Honeyeater and Swift Parrot are unlikely to have foraging resources in the Subject Site during the non-breeding period due to a lack of flowering resources. Furthermore a lack of flowering species in the Subject Site, deplete the potential for most winter migrants to occur in the Subject Site.

4.2.6 Key Threatening Processes

Key threatening processes are threatening processes that, in the opinion of the relevant Scientific Committee, adversely affect threatened species populations or ecological communities, or could cause species, populations or ecological communities that are not threatened to become threatened

Of the 36 Key Threatening Processes (KTP) listed in the schedules of the TSC Act, five are currently operating in the Subject Site. These include:

- Competition and grazing by the feral European rabbit (Oryctolagus cuniculus).
- Predation by the European red fox (Vulpes vulpes).
- Predation by the feral cat (Felis catus).
- Removal of dead wood and dead trees.
- Removal of hollow bearing trees.

Of the 20 Key Threatening Processes (KTP) listed in the schedules of the EPBC Act, eight are currently operating in the Subject Site. These include:

- Competition and land degradation by rabbits.
- Land clearance.
- Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants.
- Loss of climatic habitat caused by anthropogenic emissions of greenhouse gases.
- Novel biota and their impact on biodiversity.
- Predation by European red fox.
- Predation by feral cats.
- Psittacine Circoviral (beak and feather) Disease affecting endangered psittacine species.

4.3 SUMMARY

On the basis of regional records, reports and the presence of suitable habitat, 15 threatened items listed in the schedules of the TSC Act and / or EPBC Act were assessed as likely to occur or have habitat in the Subject Site and be affected by the Proposal (**Table 4-7**). Assessments of significance were conducted for these species (**Appendix 5**).

	Common Name	Scientific Name	TSC Act	EPBC Act	Potential to occur in Subject Site	Significance Assessment
1	Barking Owl	Ninox connivens	v		Likely hunting grounds	7-Part Test (TSC Act)
2	Black Falcon	Falco subniger	V		Potential hunting grounds	7-Part Test (TSC Act)
3	Cattle Egret	Ardea ibis		м	Potential to occur	Assessment of Significance (EPBC Act)
4	Fork-tailed Swift	Apus pacificus		М	Potential foraging area	Assessment of Significance (EPBC Act)
5	Fuzzy Box Woodland on alluvial Soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions		EEC		Precautionary Principle	7-Part Test (TSC Act)
6	Great Egret			M	Potential	Assessment of Significance (EPBC Act)
7	Grey Falcon	Falco hypoleucos	E		Potential hunting grounds	7-Part Test (TSC Act)
8	Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions		EEC	TEC	Precautionary Principle	7-Part Test (TSC Act)
9	Little Eagle	Hieraaetus morphnoides	V		Potential hunting grounds	7-Part Test (TSC Act)
10	Rainbow Bee-eater	Merops ornatus		М	Potential breeding habitat and foraging habitat	Assessment of Significance (EPBC Act)
11	Spotted Harrier	Circus assimilis	V		Potential hunting grounds	7-Part Test (TSC Act)
12	Square-tailed Kite	Lophoictinia isura	V		Potential hunting grounds	7-Part Test (TSC Act)
13	White Box-Yellow Box-Blakely's Red Gum Grassy		EEC	CE TEC	Precautionary Principle	7-Part Test (TSC Act)
14	White-throated Needletail	Hirundapus caudacutus		М	Potential foraging area	Assessment of Significance (EPBC Act)
15	Aquatic Ecological Community in the Natural Drainage System of the Lowland Catchment of the Lachlan River EEC (NSW FM Act).		EEC		Eulomogo Creek forms part of the listing for this EEC.	7-Part Test (TSC Act)

Table 4-7: Threatened species known to occur or have potential occur in the Subject Site.

E - Endangered.

V- Vulnerable

EEC - Endangered Ecological Community.

CE- Critically Endangered

CEEC- Critically Endangered Ecological Community TEC – Threatened Ecological Community M- Migratory or Marine (EPBC Act)

5 IMPACTS

5.1 TERRESTRIAL FLORA AND ECOLOGICAL COMMUNITIES

It is anticipated that 200 hectares will be directly activity affected by the activity in the Subject Site. This will impact derived grassland community within a highly disturbed, cleared and ploughed landscape.

5.2 TERRESTRIAL FAUNA AND FAUNA HABITAT

It is unlikely that fauna species would be directly impacted in the Subject Site as a result of the Proposal. Fauna may be impacted by:

- Vegetation removal for the establishment of the residential infrastructure.
- Disturbance associated with machinery (noise, dust vibration).
- Collisions with vehicles.
- Impact to grassy habitat.

The potential loss of cleared and disturbed habitat represents an insignificant loss of habitat for native fauna.

Hollow dependent fauna would not be impacted as no hollow bearing trees will be removed.

Assessments of Significance for those threatened species considered likely to be affected by the Proposal (**Section 6**) determined that the Proposal would have no significant impact. Suitable high quality habitat for threatened species will exist adjacent to the Subject Site and will remain undisturbed.

5.2.1 Wildlife Corridors and Connectivity

Impact to already cleared and disturbed tussock grasslands will not fragment an existing remnant nor affect a wildlife corridor.

5.2.2 Critical habitat

No areas defined as critical habitat in NSW or in the Commonwealth will be affected by the activity.

5.3 KEY THREATENING PROCESSES

A number of Key Threatening Processes (KTP) listed on the schedules of the TSC Act may be exacerbated by the Proposal. These KTP's include:

- Anthropogenic climate change (TSC Act)
- Clearing of native vegetation (TSC Act);

- Invasion of native plant communities by exotic perennial grasses (TSC Act).
- Land clearance (EPBC Act).

The clearing of native vegetation is a major contributor to the loss of biodiversity. In the determination, the NSW Scientific Committee found that 'clearing of any area of native vegetation, including areas less than two hectares in extent, may have significant impacts on biological diversity'.

5.4 INVASIVE SPECIES

Ground disturbing activities may:

- Increase weed invasion. The spread of noxious weeds may occur during construction within the Subject Site given the weedy environments within the larger area.
- Increase opportunities for feral animals. The proposed works may improve habitat conditions for pests that thrive on disturbed and cleared environments. There is some potential for construction workers to leave food scraps and debris that may encourage these animals. It is unlikely that local populations would increase as a result of the activity.
- Introduce pests and pathogens. No known plant pathogens are likely to be introduced into the area during construction work.

5.5 NOISE/VIBRATION

Construction associated with the subdivision is unlikely to affect any native fauna given the disturbed cleared nature of the Subject Site. Within semi-urban areas, noise and vibration is unlikely to increase above background traffic noise.

While impacts are likely, it is anticipated that any sensitive mobile fauna utilising the area would be able to migrate to surrounding areas of similar habitat such as riparian habitat (Macquarie River) or nearby reserves and conservation networks for the duration of the works.

5.6 TRAFFIC IMPACTS

Light and heavy vehicle movements within the Subject Site would be required during the construction of the subdivision infrastructure. The majority of fauna are mobile and will have a chance to disperse to adjacent riparian habitat.

5.7 DUST/EROSION

Construction activities would increase dust levels. However revegetation activities associated within improving the condition of Eulomogo Creek would improve dust and erosion on site.

5.8 MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

The EPBC Act provides a mechanism for assessing the environmental impact of activities and developments, where 'Matters of National Environmental Significance' (MNES) may be affected by the proposed activities. Impacts to Matters of National Environmental Significance are listed in **Table 5–1**.

Matter of NES	Impact
Any environmental impact on a World Heritage property	No
Any impacts on wetlands of international importance	No. The proposal would not impact on any water quality or flows of the area. Due to the distance from wetland areas it is considered that the works would have no significant impacts.
Any environmental impact on Commonwealth listed threatened species or ecological communities	 Threatened Ecological Communities (TECs) - No Commonwealth listed TECs are within the Subject Site. Fauna – The majority of fauna species are mobile species and in most instances are capable of migrating away from the proposed Subject Site. Noise and vibration associated with the proposal is likely to disturb birds or terrestrial fauna briefly, however none of the migratory species potentially occurring in the locality is likely to have 'important habitat' in the Subject Site. Flora - No listed commonwealth flora was considered likely to occur in the Subject Site.
Any environmental impact on Commonwealth listed migratory species	Migratory birds are mobile species and in most instances are capable of migrating away from the proposed Subject Site. The Subject Site represents potential, yet unlikely habitat for many of the identified migratory species.
Does the project affect any national heritage places	No
Does any part of the proposal involve a nuclear action?	No
Any environmental impact on Commonwealth marine area?	No
Any direct or indirect effect on Commonwealth land?	No

Table 5-1: Matters of National Environmental Significance.

6 SIGNIFICANCE ASSESSMENTS

The appropriate management of ecological items is usually determined on the basis of their assessed significance as well as the likely impacts of any Proposal. Significance of a species, population or community is determined by appointed NSW and National Scientific Committees. Cultural and public significance are considerations within the significance determination process. Within the framework of an impact assessment, impacts to listed significant item must be assessed at a State (under the TSC Act) or National (under the EPBC Act) level – even if it is the same species. The following sections identify State or nationally listed threatened (significant) species then determines if impacts are 'significant'.

Significant can be defined as: there is a real chance/greater than 50 per cent chance, that the action (direct or indirect) will cause <u>a viable local population</u> to go extinct.

6.1 AFFECTED SPECIES

It should be noted that in the *Threatened species assessment guidelines: The assessment of significance* (DECC 2007), a species does not have to be considered as part of the assessment of significance if adequate surveys or studies have been carried out that clearly show that the species, population or community:

- does not occur in the Subject Site, or
- will not use on-site habitats on occasion, or
- Will not be influenced by off-site impacts of the proposal.

Otherwise all species likely to occur in the Subject Site (based on general species distribution information) and known to use that type of habitat, would be considered in the rationale that determines the list of threatened species, populations and ecological communities for the assessment of significance.

6.2 SIGNIFICANT COMMUNITIES, POPULATIONS OR SPECIES WITHIN THE SUBJECT SITE

There are 11 fauna species and four EECs identified as being affected by the Proposal (**Table 4-7**). Consideration of the type and scale of habitat to be removed has resulted in the conclusion that no threatened species would be significantly affected by the Proposal (**Table 6**–1). The preparation of a Species Impact Statement will not be required for the Project.

Appendix 5 provides detailed assessment of affected species and full version of seven-part tests and assessments of significance.

TSC Act significance a	ssessn	nent	5						
Threatened species, or communities	7-Part Test Quest				Ques	tion	s	Likely significant impact?	
	a	b	С	d	е	f	g		
Barking Owl	N	I X	N	Y	X	Y	Y	No	
Black Falcon	N	I X	N	Y	X	Y	Y	No	
Little Eagle	N	I X	N	Y	X	Y	Y	No	
Grey Falcon	N	I X	N	Y	X	Y	Y	No	
Spotted Harrier	N	I X	N	Y	X	Y	Y	No	
Square-tailed Kite	N	X	N	Y	X	Y	Y	No	
White Box-Yellow Box-Blakely's Red Gum Grassy		X	Y	Y	X	Y	Y	No	
Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions			Y	Y	x	Y	Y	No	
Fuzzy Box Woodland on alluvial Soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions		x	Y	Y	x	Y	Y	No	
Aquatic Ecological Community in the Natural Drainage System the Lowland Catchment of the Lachlan River EEC (NSW FM Ac	of x	×	Y	Y	x	Y	Y	No	
EPBC Act Assessm	ents ^{2,3,}	4,5							
Threatened species, or communities Important population			atior	n Likely significant impact?					
White-throated Needletail	ated Needletail No		No					No	
Rainbow Bee-eater	No							No	
Cattle Egret	No					No			
Fork-tailed Swift		No	í.			No			
Great Egret		No					No		

Table 6-1: Summary of the assessment of significance and seven-part tests

Notes: Y= Yes (negative impact), N= No (no or positive impact), X= not applicable, ?= unknown impact.

- 1. Significance Assessment Questions as set out in the *Threatened Species Conservation Act* 1995/ Environmental Planning and Assessment Act 1979.
 - a in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,
 - **b** in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,
 - **c** in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
 - (i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
 - (ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,
 - \mathbf{d} in relation to the habitat of a threatened species, population or ecological community:
 - (i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
 - (ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
 - (iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,
 - whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),
 - f whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,
 - **g** whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.
- 2. Refer to DEWHA 2013 for significant impact criteria.

e

- 3. Important Population as determined by the *Environment Protection and Biodiversity Conservation Act 1999*, is one that for a vulnerable species:
 - a is likely to be key source populations either for breeding or dispersal
 - b is likely to be necessary for maintaining genetic diversity
 - c is at or near the limit of the species range.
- 4. A 'population of a species' is defined under the EPBC Act as an occurrence of the species in a particular area. In relation to critically endangered, endangered or vulnerable threatened species, occurrences include but are not limited to:
 - a a geographically distinct regional population, or collection of local populations, or
- a population, or collection of local populations, that occurs within a particular bioregion.
 Population' as defined under the EPBC Act, in relation to migratory species, means the entire population or any geographically separate part of the population of any species or lower taxon of wild animals, a significant proportion of whose members cyclically and predictably cross one or more national jurisdictional boundaries including Australia. 5.

7 RECOMMENDATIONS

The following mitigation measures have been made in regards to the Proposal.

- 1. Areas to be cleared in the Subject Site should be clearly marked with high visibility nightline to ensure that approved boundary clearing creep does not occur.
- 2. Any change in design outside the assessed impact footprint within the Subject Site will require further ecological survey.
- 3. The Subject Site is not considered 'core' Koala habitat and a SEPP 44 plan of management is not required.
- 4. All food scraps and rubbish are to be appropriately disposed of in sealed receptacles to prevent foraging habitats for foxes, rats, dogs and cats.
- An Erosion and Sediment Control Plan (ESCP), shall be prepared for the works and would be in line with Landcom's Managing Urban Stormwater, Soils & Construction Guidelines (The Blue Book) (Landcom 2004).
 - Erosion and sedimentation control measures would be installed around Eulomogo Creek and not be removed until disturbed areas have stabilised.
 - Maintenance and checking of the erosion and sedimentation controls would be undertaken on a regular basis and records kept and provided at any time upon request.
 - Sediment would be cleared from behind barriers on a regular basis and all controls would be managed in order to work effectively at all times.
- A Dust Management Plan (DMP) should be implemented in-line with the requirements of the Protection of the Environment Operations Act (POEO) 1999 and Conditions of Approval on Development Applications administered by Bathurst Regional Council.
- Best practice weed management should be in place to prevent the transfer of weed seeds and vegetative materials, including the washdown of vehicles entering or leaving the worksite.
- 8. Ongoing weed control should be undertaken in the Subject Site.
 - As per the Noxious Weeds Act, Class 4 Noxious Weeds must be managed in a manner that continuously inhibits the ability of the plant to spread and the plant must not be sold, propagated or knowingly distributed.
 - Ensure all seed and seed head is collected and disposed of.
- 9. Stockpiles in the Project Site in their present state are likely to provide refuge for invasive

species and should be refined and reduced.

- 10. Under the NV Act, a permit from the Central West Local Land Services is required to clear within 40 metres of Eulomogo Creek. The current project will not impact within 40 metres of this waterway. Should the project need to impact within 40 metres of this waterway (even for rehabilitation / revegetation) then further advice from this department should be sought.
- 11. Under the FM Act, a permit from DPI is required for any rehabilitation, reclamation or dredging work within the banks of the Eulomogo Creek. Should the project need to impact within 40 metres of this waterway (even for rehabilitation / revegetation) then further advice from this department should be sought.
- 12. Under the 'integrated development' provisions of the NSW EPA Act, MASS may require approval from DPI for a permit to temporarily or permanently block fish passage (if Eulomogo Creek is to be blocked). The current proposal does not require the creek to be blocked.
- 13. Under the WM Act MASS will require a controlled activity approval for the Proposal if works are to occur within 40 metres of Eulomogo Creek. Should the project need to impact within 40 metres of this waterway (even for rehabilitation / revegetation) then further advice from this department should be sought.
- 14. Under the RF Act, as the activity is being assessed under Part 4 of the EPA Act, a Development Application is required which will detail fire risk.
- 15. Rehabilitation and revegetation efforts should be directed at restoring the Eulomogo Creek riparian zone. This would include maintaining a 40 metre buffer (at least) from the edge of the banks. Connectivity within this riparian zone to the existing Keswick Estate Green Corridor (Macquarie River to Orana Mall) is recommended. Figure 7-1 provides guidance for rehabilitation along the creek and additional information had been provided below for species slection.



Figure 7-1: Proposed cross section showing revegetation of the creek.

Adapted from Rivercare: Guidelines for Ecological Sustainable Management of Rivers and Riparian Vegetation: Raine, A.W & Gardiner, J.N. (1995), LWRRDC, Canberra.

- The proposed species list for areas requiring planting is:
 - Upper stratum (on the Upper Creek Bank, see Figure 7-1)
 - White Box (Eucalyptus albens) / Yellow Box (Eucalyptus melliodora) / Fuzzy Box (Eucalyptus connnica) at 30 metre spacing.
 - Inland Grey Box (Eucalyptus microcarpa) at 50 metre spacing
 - Mid stratum (on the Middle Creek Bank, see Figure 7-1)
 - Acacia hakeoides, Acacia pycnantha, Acacia decora, Dodonaea viscosa subsp. cuneata, Western Boobialla (Myoporum montanum), Pittosporum angustifolium, Silver Cassia (Senna form taxon 'artemisioides') at 30 metre spacing.
 - Lower stratum (on the Toe Creek Bank, see Figure 7-1)
 - Grasses Austrostipa bigeniculata, Austrodanthonia caespitosa, Kangaroo Grass (Themeda australis), Redleg Grass (Bothriochloa macra), Chloris truncata, Austrostipa scabra, Dicanthium sericeum, Enteropogon acicularis, Panicum effusum.
 - The grass species can be commercially purchased, the remaining species are likely to recover unassisted. The recommended sowing rate is 0.25kg / hectare and the seed supplier will provide instructions on how to prepare the area.
 - Other Dichopogon strictus, Hydrocotyle laxiflora, Podolepis jaceoides, Vittadinia cuneata, Wahlenbergia luteola, Atriplex semibaccata, Lomandra filiformis subsp. coriacea.
 - Lower stratum (in the Creek bed and walls, see Figure 7-1)

Lomandra filiformis subsp. coriacea, Lomandara longifolia, Carex appressa, Cypress excellatus, Phragmities australis and Juncus spp. The recommended planting rate is one plant per metre square of the final creek bed area of extent and walls of ponds.

8 CONCLUSION

Having given consideration to the ecology within the Subject Site, it is apparent that the Proposal is:

- unlikely to significantly affect any of the listed threatened species, fauna populations or communities.
- unlikely to augment or significantly contribute to any of the National or State listed Key Threatening Processes, if the appropriate safeguards regarding the control of potential vertebrate pests are effectively applied.
- unlikely to significantly affect any Ramsar wetland or any CAMBA or JAMBA listed species;
- unlikely to significantly affect local hydrology.
- consistent with ESD principles with regard to fauna, would not adversely affect the local biodiversity and no issue of inter-generational or value added matters are relevant in this instance.

The proposed activity should not be considered to constitute a significant impact and, as such, no Species Impact Statement (SIS) is warranted. No Koala Habitat Management Plan pursuant to SEPP 44 should be required.

9 REFERENCES

Australian Conservation Foundation (year unknown). New data reveal Australian Landclearing rates 22% worse. Accessed on 16.10.14. BOM (2014). Commonwealth Bureau of Meteorology: www.bom.gov.au. Benson et al. (2006). Benson, J.S., Allen, C.B., Togher, C.& Lemmon, J. (2006). New South Wales Vegetation Classification and Assessment: Part 1 Plant Communities of the NSW Western Plains. Cunninghamia 9(3): 383-450. New South Wales Vegetation Classification and Assessment: Part 2 Plant Benson (2008) communities of the NSW South-western Slopes Bioregion and update of NSW Western Plains plant communities, Version 2 of the NSWVCA database. Briggs and Leigh (1996) Briggs, J.D. and Leigh, J.H. Rare or threatened Australian Plants. Revised edition, CSIRO, Melbourne. Churchill (1998). Churchill, S. Australian Bats. Reed - New Holland, Frenchs Forest. Cropper (1993). Cropper, S. Management of Endangered Plants. CSIRO, Melbourne. CSUJC-EC (2006) Ecological Assessment for the Hera Gold Project . Charles Sturt University Johnstone Centre – Environmental Consulting. DEC (2006) The Vegetation of the Western Blue Mountains. Unpublished report funded

- DEC (2006) The Vegetation of the Western Blue Mountains. Unpublished report funded by the Hawkesbury – Nepean Catchment Management Authority. Department of Environment and Conservation, Hurstville.
- DECC (2004). Threatened Species Survey and Assessment: Guidelines for Developers and Activities – Working Draft (2004) or the
- DECC (2007). Threatened Species Assessment Guidelines: The Part 5A of the EP&A Act 7-part Assessment of Significance (DECC 2007)
- DECC (2008) Approved Recovery Plan Recovery plan for the koala (Phascolarctos cinereus)
- DECC (2009). Threatened species survey and assessment guidelines: field survey methods for fauna: Amphibians (2009).
- DECCW (2009). OEH Field Survey Methods, DECCW 2009.
- DEWHA (2010a). Survey guidelines for Australia's threatened birds: Guidelines for detecting birds listed as threatened under the EPBC Act
- DEWHA (2010b). Survey guidelines for Australia's threatened bats: Guidelines for detecting bats listed as threatened under the EPBC Act
- DEWHA (2010c). Survey guidelines for Australia's threatened mammals: Guidelines for detecting mammals as threatened under the EPBC Act.
- DEWHA (2010d). Survey guidelines for Australia's threatened frogs Guidelines for detecting frogs listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999.

Gibbons <i>et al.</i> (2008).	Gibbons P, Briggs SV, Ayers DA, Doyle S, Seddon J, McElhinny C, Jones N, Sims R, Doody JS. 2008. Rapidly quanitfying reference conditions in modified landscapes. Biological conservation, 141,2483-2493.
Goldney et al. (2007)	Goldney, D, Kerle, A and Fleming, M. Western Research Institute. <i>Status Of Vertebrate Fauna And Their Habitat In The Central West Catchment.</i> October 2007
Goldney, Kerle and Fleming	(2007).Status of vertebrate fauna and their habitat in the Central West Catchment
Hosking et al (2010).	<i>Bird List of the Dubbo Area</i> . Tim Hosking, Janis Hosking, David Geering and Craig Arms, October 2010.
Hosking (2012).	Flora List of the Dubbo Area and Central Western Slopes. Janice Hosking for the Dubbo Field Naturalist and Conservation Society Inc. Version: June 2012 www.dubbofieldnats.org.au
Harden (1990).	Harden, G.J. (ed) Flora of New South Wales. Volume 1. Royal Botanic Gardens: Sydney. New South Wales University Press.
Harden (1992).	Harden, G.J. (ed) Flora of New South Wales. Volume 3. Royal Botanic Gardens: Sydney. New South Wales University Press.
Harden (1993).	Harden, G.J. (ed) Flora of New South Wales. Volume 4. Royal Botanic Gardens: Sydney. New South Wales University Press.
Harden (2002).	Harden, G.J. (ed) Flora of New South Wales. Volume 2. Revised Edition. Royal Botanic Gardens: Sydney. New South Wales University Press.
Mitchell (2002).	NSW ecosystems study: background and methodology. Unpublished report to the NSW National Parks and Wildlife Service, Hurstville.Eco Logical Australia, (2008). Editing Mitchell Landscapes, Final Report. A Report prepared for the Department of Environment and Climate Change.
Keith (2004).	Keith, D. Ocean Shores to Desert Dunes—the native vegetation of New South Wales and the ACT. Department of Environment and Conservation (NSW) Hurstville.
Morgan and Terrey (1992).	Nature conservation in western New South Wales. National Parks Association, Sydney.
NSW NPWS 2000.	Report on preliminary fauna survey of the Pilliga and Goonoo Forests November 1999 to January 2000.
NSW NPWS 2002.	Community data search and biodiversity survey of the Brigalow Belt South Bioregion Stage 1.
OEH (2014a)	Office of Environment and Heritage. NSW Wildlife Atlas (data licence agreement No. CON99042).
OEH (2014b)	Office of Environment and Heritage. Threatened Species Web Site. http://www.environment.nsw.gov.au/threatenedspecies.
OzArk (2014).	Tree Assessment: Lot G DP417757, 411 Macquarie Street Dubbo, NSW. Report to Geolyse.
OzArk (2013).	Ecological Assessment: LH Ford Bridge. Report to Dubbo City Council.

- OzArk (2013b). Ecological Assessment: Keswick Stage 5 Residential subdivision (52.5 ha).
- OzArk (2013c). Biodiversity Assessment for the Dubbo Zirconium Project. Report to Alkane Resources.
- OzArk (2012). Ecological Assessment: Dubbo to Wellington 66kv Powerline Upgrade. Report to Essential Energy. August 2012.
- OzArk (2010). Ecological Assessment: Proposed recycled water reticulation scheme in three areas within the village of Wongarbon. Report to Dubbo City Council.
- OzArk (2010b). Ecological Assessment: Golden Highway/Boothenba Road realignment and intersection improvements. Report to the Roads and Traffic Authority.
- OzArk (2009). Ecological Overview of Three Reserves: Jones Creek Reserve, Cumboogle Flora Reserve and Wongarbon Tank Reserve. Dubbo Local Government Area, NSW.
- OzArk (2006). Ecological and Archaeological Assessment: Proposed Wongarbon Sewerage Scheme (WSS) including the Wongarbon Sewerage Treatment Plant (STP) and the associated reticulation scheme within the village of Wongarbon. Report to Dubbo City Council.
- OzArk (2005). Ecological and Archaeological Assessment: 2.4 km Road Rehabilitation and Minor Alignment Shift, c. 16 km Southeast of Dubbo, NSW. Report to Dubbo City Council.
- NSW NPWS (2000). Report on preliminary fauna survey of the Pilliga and Goonoo Forests November 1999 to January 2000
- NSW NPWS (2002). Community data search and biodiversity survey of the Brigalow Belt South Bioregion Stage 1
- Thackway & Cresswell (1995). Thackway, R., & Cresswell 1995 (eds). 'An interim biogeographic regionalisation of Australia: a framework for establishing the national system of reserves.' (Australian Nature Conservation Agency: Canberra).

10 PLATES

Plate 1: <i>Biometric</i> plot 1.
Plate 2: <i>Biometric</i> plot 2.
Plate 3: <i>Biometric</i> plot 3.





APPENDIX 1: TERMS AND ABBREVIATIONS

Terminology	Abbreviation	Description
Activity		Has the same meaning as in the EP&A Act, ie the nature of the proposed activity is described in Section 1.1 . The EP&A Act definition refers to physical 'activity' in relation to land that is specified by a regulation to be a work for the purposes of the Act
Australian Bureau of Meteorology	вом	
Australian Height Datum	AHD	
Catchment Management Authority	СМА	Thirteen CMAs have been established, the specific functions of CMAs are described in the <i>Catchment Management Authorities Act 2003.</i> The CMAs are responsible for managing natural resources at the catchment scale. Key roles include preparing Catchment Action Plans (CAPs) and managing incentive programs to implement the plans. CMA's have now been superseded by Local Land Services (LLS), however the boundaries still apply for ecological database searches.
Core Koala Habitat		State Environmental Planning Policy (SEPP) 44: core koala habitat means an area of land with a resident population of koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings of and historical records of a population.
Dubbo City Council	Council	
Ecologically Sustainable Development.	ESD	 The EPBC Act sets out the principles of ecologically sustainable development which apply to certain decisions made under the Act. These principles are: The need to integrate economic, environmental, social and equitable considerations. The precautionary principle. The principle of inter-generational equity. The conservation of biological diversity. and Improved valuation, pricing and incentive mechanisms.
Endangered Ecological Community	EEC	An ecological community specified in Part 3 of Schedule 1 of the TSC Act or within the schedules of the EPBC Act.
Endangered population		Population specified in Part 2 of Schedule 1 of the TSC Act.
Environmental Impact Statement	EIS	Describes the positive and negative environmental effects of a proposed action and provides potential management measures to ameliorate these impacts.
Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth).	EPBC Act	Provides for the protection of the environment, especially matters of national environmental significance, and provides a national assessment and approvals process.
Environmental Planning and Assessment Act 1979 (NSW).	EP&A Act	Provides the legislative framework for land use planning and development assessment in NSW.

Terminology	Abbreviation	Description
Fisheries Management Act 1994 (NSW).	FM Act	Administered by the Minister for Primary Industries, except Part 7 (Division 2), which is administered jointly by the Minister for Minister for the Environment and the Minister for Heritage and the Minister Assisting the Minister for Minister for the Environment and the Minister for Heritage.
Ground Water Dependent Ecosystems	GDEs	Groundwater Dependent Ecosystems (GDEs) are ecosystems that are partially or completely dependent on underground water for their existence or health.
Interim Biogeographic Regionalisation for Australia	IBRA	IBRA is a biogeographic regionalisation of Australia developed by the Australian Government's Department of Sustainability, Environment, Water, Population and Communities. It was developed for use as a planning tool, for example for the establishment of a National Reserve System.
Impact Footprint		Areas that will be physically disturbed during the process of implementing the proposal.
Likely		Taken to be a real chance or possibility (NPWS 1996).
Local Environmental Plan	LEP	A type of planning instrument made under Part 3 of the EP&A Act.
Local Government Area	LGA	
Local population		The population that occurs within a given Subject Site, unless the existence of contiguous or proximal occupied habitat and the movement of individuals or exchange of genetic material across the boundary can be demonstrated (NPWS 1996). In this instance a local population are those that occur within the Subject Site.
Low condition/Moderate to Good Condition (as per BBAM 2008).	Low Condition Moderate to Good Condition	Native woody vegetation is in low condition if: The over-storey per cent foliage cover is <25% of the lower value of the over-storey per cent foliage cover benchmark for that vegetation type AND <50% of groundcover vegetation is indigenous species, or >90% of the area is ploughed or fallow, or 90% of the groundcover vegetation is regrowth but not protected regrowth. Remnant native vegetation and protected regrowth cannot be cleared if it is a vegetation type that is >70% cleared and NOT in low condition (ie Moderate to Good).
Locality		Area within a 50km radius of the Subject Site.
Matters of national en∨ironmental significance.	MNES	Refers to the seven matters of national environmental significance as defined by the EPBC Act.
National Parks and Wildlife Act 1974 (NSW)	NPW Act	Under the National Parks and Wildlife Act, the Director-General of the NPWS is responsible for the care, control and management of all national parks, historic sites, nature reserves, reserves, Aboriginal areas and state game reserves. State conservation areas, karst conservation reserves and regional parks are also administered under the Act. The Director-General is also responsible under this legislation for the protection and care of native fauna and flora, and Aboriginal places and objects throughout NSW.

Terminology	Abbreviation	Description
Native Vegetation Act 2003 (NSW)	NV Act	 The native vegetation legislation was introduced in 2005. The Native Vegetation Act 2003 (NV Act) and Native Vegetation Regulation 2005 (NV Regulation) has delivered: the Government's commitment to end broad scale clearing, to protect the health of our land, rivers and wildlife investment security and increased flexibility for farmers new powers to local catchment management authorities (CMAs) to make decisions in the best interests of the community.
Noxious Weeds Act 1993 (NSW)	Noxious Weeds Act	An Act to provide for the identification, classification and control of noxious weeds.
NSW Office of Water	NOW	
Office of Environment and Heritage	OEH	Formally known as the Department of the Environment, Climate Change and Water (DECCW).
Potential Koala Habitat		SEPP 44: potential koala habitat means areas of native vegetation where the trees of the types listed in Schedule 2 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component.
Regional Environmental Plan	REP	A type of planning instrument made under Part 3 of the EP&A Act.
Regional Vegetation Community	RVC	Regionally, a vegetation map for the Namoi CMA has been produced (ELA 2009a). This mapping product is underpinned by a Regional Vegetation Community (RVC) classification which is linked to the vegetation type classification in the <i>Biometric</i> Vegetation Types Database.
Rural Fires Act 1997 (NSW)	RF Act	
State Environmental Planning Policy (Infrastructure) 2007.	Infrastructure SEPP	 The Infrastructure SEPP has specific planning and approval provisions for 25 types of infrastructure or facilities such as education, hospitals, roads, railways, emergency services, water supply and electricity generation and transmission. The SEPP assists the NSW Government agencies, local government, other private infrastructure providers and the communities they support by simplifying the planning process and by providing consistent planning provisions across all local government areas in NSW. The SEPP contains planning provisions including: where the infrastructure facilities are permissible what infrastructure development can be assessed and approved by a public authority under Part 5 of the Environmental Planning and Assessment (EP&A) Act 1979 what infrastructure development requires consent under Part 4 of the EP&A Act what infrastructure development is exempt or complying development.

Terminology	Abbreviation	Description
	SEPP 44	This Policy aims to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline:
State Environmental Planning Policy No.44 –		(a) by requiring the preparation of plans of management before development consent can be granted in relation to areas of core koala habitat, and
Koala Habitat		(b) by encouraging the identification of areas of core koala habitat, and
		(c) by encouraging the inclusion of areas of core koala habitat in environment protection zones.
		Applicable for projects determined under Part 4 and 5 of the EP&A Act.
State Environmental Planning Policy	SEPP	A type of planning instrument made under Part 3 of the EP&A Act.
Strahler stream order		Strahler stream order and are used to define stream size based on a hierarchy of tributaries.
Subject Site		The Subject Site is the area that was targeted for ecological assessment and encompasses all aspects of the Proposal.
The Proposal		The proposed activity to be carried out by the Proponent as detailed in Section 1.1 of this report.
Threatened species		A species specified in Schedule 1 Part 1 (endangered species), Part 4 (presumed extinct) and Schedule 2 (vulnerable species) of the TSC Act, within the schedules of the FM Act or within the Schedules of the EPBC Act.
		The objects of this Act are as follows:
		(a) to conserve biological diversity and promote ecologically sustainable development, and
		(b) to prevent the extinction and promote the recovery of threatened species, populations and ecological communities, and
Threatened Species		(c) to protect the critical habitat of those threatened species, populations and ecological communities that are endangered, and
(NSW)	150 Act	(d) to eliminate or manage certain processes that threaten the survival or evolutionary development of threatened species, populations and ecological communities, and
		(e) to ensure that the impact of any action affecting threatened species, populations and ecological communities is properly assessed, and
		(f) to encourage the conservation of threatened species, populations and ecological communities by the adoption of measures involving co-operative management.

APPENDIX 2: DATABASE SEARCH RESULTS

DESKTOP DATABASE SEARCH RESULTS

A summary of databases searches indicated for TSC and EPBC listed species, ecological communities and populations. Copies of the OEH threatened species database search (TSC Act), NSW DPI records viewer (FM Act) and DoE Protected Matters (EPBC Act) threatened species database searches have been provided in the following table.

Name of database searched	Date of search	Type of search	Comment
DoE Register of Critical Habitat http://www.environment.g ov.au/cgi- bin/sprat/public/publicregi sterofcriticalhabitat.pl	26.3.15	Subject Site	No critical habitat area registered in the Subject Site.
Department of Sustainability, Environment, Water, Population and Communities (DoE) Protected Matters (EPBC Act) Database. http://www.environment.g ov.au/erin/ert/epbc/index. html	25.3.15	Subject Site including 5km buffer	Listed Threatened Ecological Communities: 5 Listed Migratory Species: 14 Listed Threatened Species: 10 Listed Marine Species:11 Commonwealth Lands: 6 Places on the RNE: 13 Invasive Species: 26 Several species listed are known to occur or have habitat in the Subject Site.
Office of Environment and Heritage (OEH) Threatened Species online database: http://www.environment.n sw.gov.au/threatenedspe cies/	26.3.15	Combined geographic and habitat search in Central West (Talbragar Valley)	A search of the NSW OEH Threatened Species Profiles using Central West CMA Talbragar Valley subregion predicts 98 listed items as having potential to be present in the Subject Site.
BioNet Atlas of NSW Wildlife 2014. Data License agreement	Report generated on 26/03/2015 11:21 AM.	Licensed Report of all Valid Records of Threatened (listed on TSC Act 1995) ,Commonwealth listed ,CAMBA listed ,JAMBA listed or ROKAMBA listed Entities in selected area [North: - 32.21 West: 148.57 East: 148.67 South: - 32.31]	Search returned a total of 81 records of 30 species.
Department of Primary Industries Noxious Weeds http://weeds.dpi.nsw.gov. au/WeedDeclarations/Re sults	26.4.15	Dubbo LGA	109 Noxious Weeds are listed as occurring in the Dubbo LGA. Many have the potential to occur in the Subject Site.
SEPP 44: Koala Habitat Protection http://www.legislation.nsw .gov.au/fragview/inforce/e pi%2B5%2B1995%2Bcd %2B0%2BN?	26.3.15	Dubbo LGA	Wellington LGA is not listed in SEPP Schedule 1 of the SEPP. Thus, SEPP 44 does not apply. Koalas are, however, known to occur in the Dubbo LGA and Fuzzy Box are Schedule 2 listed feed tree species. As such, SEPP 44 does not apply, however, koala habitat will be considered.
Office of Environment and Heritage (OEH) Key Threatening Processes. http://www.environment.n	26.3.15		37 KTPs are currently listed under the TSC Act.

Name of database searched	Date of search	Type of search	Comment
sw.gov.au/threatenedspe cies/aboutKTPSinNSW.ht m			
Department of Sustainability, Environment, Water, Population and Communities (DoE) Key Threatened Processes http://www.environment.g ov.au/biodiversity/threate ned/ktp.html	26.3.15		19 KTPs are currently listed under the EPBC Act.
Bird Life Australia (Important Bird Areas: IBA) http://www.birdlife.org/dat azone/site/search	26.3.15	Subject Site	No IBA is located within the Subject Site. The Subject Site is situated directly south of the Goonoo IBA.
DPI Records Viewer http://www.dpi.nsw.gov.a u/fisheries/species- protection/records/viewer	26.3.15	Wellington LGA	 Three species of fish have been previously recorded in the Dubbo LGA. Including the: Freshwater catfish population Murray Cod Trout Cod None of these species are likely to occur or have important habitat in the Subject Site. They all are likely to occur in the Macquarie River in Dubbo.
Atlas of Living Australia http://biocache.ala.org.au /explore/your-area	16.9.14	10.0 km of point (- 32.274452,148.63289	519 records of 51 species - State Conservation Endangered. No threatened species have been previously recorded in the Subject Site however this does not mean that they do not have habitat in the Subject Site. The Little Eagle, Grey-crowned Babbler and Speckled Warbler are the closest threatened species records.

OEH THREATENED SPECIES DATABASE RESULTS

CMA Sub Region & Profiles Report

18/09/2014

CMA Sub-Region



Profile ID	Scientific Name	Common Name	Occurrence
Central Wes	st - Talbragar Valley		
10056	Anseranas semipalmata	Magpie Goose	Known
10105	Botaurus poiciloptilus	Australasian Bittern	Predicted
10113	Burhinus grallarius	Bush Stone-curlew	Known
10116	Lophochroa leadbeateri	Major Mitchell's Cockatoo	Predicted
10140	Calyptorhynchus lathami	Glossy Black-Cockatoo	Known
10155	Cercartetus nanus	Eastern Pygmy-possum	Predicted
10157	Chalinolobus dwyeri	Large-eared Pied Bat	Predicted
10159	Chalinolobus picatus	Little Pied Bat	Known
10171	Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	Known
10207	Dasyurus maculatus	Spotted-tailed Quoll	Predicted
10221	Dichanthium setosum	Bluegrass	Predicted
10243	Diuris tricolor	Pine Donkey Orchid	Known
10259	Liopholis whitii	White's Skink	Predicted
10275	Ephippiorhynchus asiaticus	Black-necked Stork	Predicted
10330	Falco hypoleucos	Grey Falcon	Known
10335	Fuzzy Box Woodland on alluvial Soils of the South Western Slopes, Darling Riverine	Fuzzy Box Woodland on alluvial Soils of the South Western Slopes,	Known
	Plains and Brigalow Belt South Bioregions	Darling Riverine Plains and Brigalow Belt South Bioregions	
10354	Goodenia macbarronii	Narrow Goodenia	Predicted
10382	Grus rubicunda	Brolga	Predicted
10395	Hamirostra melanosternon	Black-breasted Buzzard	Predicted
10412	Hoplocephalus bitorguatus	Pale-headed Snake	Predicted
10455	Lathamus discolor	Swift Parrot	Predicted
10459	Leipoa ocellata	Malleefowl	Predicted
10479	Limosa limosa	Black-tailed Godwit	Predicted
10495	Lophoictinia isura	Square-tailed Kite	Known
10519	Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	Known
10523	Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	Known
10555	Neophema pulchella	Turquoise Parrot	Known
10561	Ninox connivens	Barking Owl	Known
10568	Nyctophilus corbeni	Corben's Long-eared Bat	Known
10580	Oxyura australis	Blue-billed Duck	Known
10582	Pachycephala inornata	Gilbert's Whistler	Predicted
10604	Petaurus norfolcensis	Squirrel Glider	Known
10616	Phascolarctos cinereus	Koala	Known
10621	Philotheca ericifolia	Philotheca ericifolia	Known
10645	Polytelis swainsonii	Superb Parrot	Known

Page 1 of 3

Dealite ID.	Calcality Manual		0
Profile ID	Scientific Name	Common Name	Occurrent
10050	Pomaderns queensiandica	Scant Pomaderns	Predicted
10660	Pomatostomus temporalis temporalis	Grey-crowned Babbier (eastern subspecies)	Known
10722	Chthonicola sagittata	Speckled Warbler	Known
10734	Rostratula australis	Australian Painted Snipe	Known
10735	Rulingia procumbens	Rulingia procumbens	Known
10741	Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	Known
10759	Sminthopsis macroura	Stripe-faced Dunnart	Predicted
10768	Stagonopleura guttata	Diamond Firetail	Known
10771	Stictonetta naevosa	Freckled Duck	Predicted
10783	Swainsona sericea	Silky Swainson-pea	Known
10815	Tylophora linearis	Tylophora linearis	Known
10820	Tyto novaehollandiae	Masked Owl	Predicted
10837	White Box Yellow Box Blakely's Red Gum Woodland	White Box Yellow Box Blakely's Red Gum Woodland	Known
10841	Anthochaera phrygia	Regent Honeyeater	Known
10857	Zieria ingramii	Keith's Zieria	Known
20001	Alteration of habitat following subsidence due to longwall mining	Alteration of habitat following subsidence due to longwall mining	Predicte
20002	Alteration to the natural flow regimes of rivers and streams and their floodplains and	Alteration to the natural flow regimes of rivers and streams and their	Predicte
	wetlands	floodplains and wetlands	
20003	Infection by Psittacine Circoviral (beak and feather) Disease affecting endangered	Infection by Psittacine Circoviral (beak and feather) Disease affecting	Predicte
	nsittacine species and nonulations	endangered psittacine species and populations	
20004	Competition from feral honey bees. Anis mellifera I	Competition from feral honey bees. Apis mellifera L	Predicte
20005	Introduction of the Large Earth Bumblebee Bombus terrestris (L)	Introduction of the Large Earth Bumblehee Bombus terrestris (L.)	Predicte
20006	Bushrock removal	Bushrock removal	Predicte
20007	Loss or degradation (or both) of sites used for hill-topping by butterflies	Loss or degradation (or both) of sites used for hill-topping by butterflies	Predicte
20008	Predation by the Feral Cat Felis catus (Linnaeus, 1758)	Predation by the Feral Cat Felis catus () innaeus 1758)	Predicte
20009	Infection of frons by amphibian chytrid causing the disease chytridiomycosis	Infection of frons by amphibian chytrid causing the disease	Predicte
20000	meeter of rege by unprison onlying and decomplication of the	chytridiomycosis	Treatere
20010	Invasion of the Yellow Crazy Ant, Anoptolepis gracilipes (Fr. Smith) into NSW	Invasion of the Yellow Crazy Ant, Anoplolepis gracilipes (Fr. Smith) into	Predicte
		NSW	
20011	Removal of dead wood and dead trees	Removal of dead wood and dead trees	Predicte
20012	Herbivory and environmental degradation caused by feral deer	Herbivory and environmental degradation caused by feral deer	Predicte
20014	High frequency fire resulting in the disruption of life cycle processes in plants and	High frequency fire resulting in the disruption of life cycle processes in	Predicte
	animals and loss of vegetation structure and composition	plants and animals and loss of vegetation structure and composition	
20015	Predation by the European Red Fox Vulnes Vulnes (Linnaeus, 1758)	Predation by the European Red Fox Vulnes Vulnes (Linnaeus, 1758)	Predicter
20016	Predation by Gambusia holbrooki Girard, 1859 (Plaque Minnow or Mosquito Fish)	Predation by Gambusia holbrooki Girard, 1859 (Plaque Minnow or	Predicte
		Mosquito Fish)	
20017	Competition and habitat degradation by Feral Goats, Capra hircus Linnaeus 1758	Competition and habitat degradation by Feral Goats, Capra hircus	Predicter
20018	Investes of active start communities by quette susceptial process	Linnaeus 1/58	Draditte
20018	Invasion of nauve plant communities by exotic perennial grasses	Invasion of hadve plant communities by exotic perennial grasses	Predicter
20020	Predation, nabitat degradation, competition and disease transmission by Feral Pigs,	Predation, nabitat degradation, competition and disease transmission	Predicter
	Sus scrota Linnaeus 1758	by Feral Figs, Sus scrota Linnaeus 1758	
20021	Importation of Red Imported Fire Ants Solenopsis invicta Buren 1972	Importation of Red Imported Fire Ants Solenopsis invicta Buren 1972	Predicter
20023	Clearing of native vegetation	Clearing of native vegetation	Predicte

Page 2 of 3

CMA Sub-Region

Frome ID	Scientific Indine	Common Name	Occurrence
20024	Competition and grazing by the feral European Rabbit, Oryctolagus cuniculus (L.)	Competition and grazing by the feral European Rabbit, Oryctolagus cuniculus (L.)	Predicted
20025	Anthropogenic Climate Change	Anthropogenic Climate Change	Predicted
20026	Infection of native plants by Phytophthora cinnamomi	Infection of native plants by Phytophthora cinnamomi	Predicted
20027	Invasion of native plant communities by Chrysanthemoides monilifera	Invasion of native plant communities by Chrysanthemoides monilifera	Predicted
20043	Invasion and establishment of the Cane Toad (Bufo marinus)	Invasion and establishment of the Cane Toad (Bufo marinus)	Predicted
20044	Invasion, establishment and spread of Lantana (Lantana camara L. sens. Lat)	Invasion, establishment and spread of Lantana (Lantana camara L. sens. Lat)	Predicted
20052	Invasion and establishment of exotic vines and scramblers	Invasion and establishment of exotic vines and scramblers	Predicted
20061	Acacia ausfeldii	Ausfeld's Wattle	Known
20065	Invasion and establishment of Scotch Broom (Cytisus scoparius)	Invasion and establishment of Scotch Broom (Cytisus scoparius)	Predicted
20072	Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar	Inland Grey Box Woodland in the Riverina, NSW South Western	Known
	Peneplain, Nandewar and Brigalow Belt South Bioregions	Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions	
20079	Loss of Hollow-bearing Trees	Loss of Hollow-bearing Trees	Predicted
20088	Crinia sloanei	Sloane's Froglet	Predicted
20108	Forest eucalypt dieback associated with over-abundant psyllids and Bell Miners	Forest eucalypt dieback associated with over-abundant psyllids and Bell Miners	Predicted
20111	Glossopsitta pusilla	Little Lorikeet	Known
20116	Predation and hybridisation by Feral Dogs, Canis lupus familiaris	Predation and hybridisation by Feral Dogs, Canis lupus familiaris	Predicted
20129	Petroica phoenicea	Flame Robin	Known
20131	Hieraaetus morphnoides	Little Eagle	Known
20133	Petroica boodang	Scarlet Robin	Known
20134	Circus assimilis	Spotted Harrier	Known
20135	Daphoenositta chrysoptera	Varied Sittella	Known
20143	Epthianura albifrons	White-fronted Chat	Known
20153	Invasion of native plant communities by African Olive Olea europaea subsp. cuspidata (Wall. ex G. Don) Cif.	Invasion of native plant communities by African Olive Olea europaea subsp. cuspidata (Wall. ex G. Don) Cif.	Predicted
20240	Bothriochloa biloba	Lobed Bluegrass	Known
20265	Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants	Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants	Predicted
20271	Aggressive exclusion of birds from woodland and forest habitat by abundant Noisy Miners Manorina melanocephala	Aggressive exclusion of birds from woodland and forest habitat by abundant Noisy Miners Manorina melanocephala	Predicted
	Miners Manorina melanocephala	abundant Noisy Miners Manorina melanocephala	

Page 3 of 3

DOE PROTECTED MATTERS



Australian Government Department of the Environment

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 25/03/15 16:24:54

Summary Details Matters of NES Other Matters Protected by the EPBC Act Extra Information Caveat Acknowledgements



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Coordinates Buffer: 5.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the <u>Administrative Guidelines on Significance</u>.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Areas:	None
Listed Threatened Ecological Communities:	5
Listed Threatened Species:	14
Listed Migratory Species:	10

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As <u>heritage values</u> of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate.

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

A <u>permit</u> may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	6
Commonwealth Heritage Places:	None
Listed Marine Species:	11
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

Place on the RNE:	13	
State and Territory Reserves:	None	23
Regional Forest Agreements:	None	The second se
Invasive Species:	26	
Nationally Important Wetlands:	None	0
Key Ecological Features (Marine)	None	

Details

Matters of National Environmental Significance

Listed Threatened Ecological Communities		[Resource Information]
For threatened ecological communities where the dis recovery plans, State vegetation maps, remote sensi ecological community distributions are less well know data are used to produce indicative distribution maps	tribution is well known, map ng imagery and other sourc vn, existing vegetation maps	es are derived from es. Where threatened and point location
Name	Status	Type of Presence
Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions	Endangered	Community may occur within area
Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eactern Australia	Endangered	Community likely to occur within area
Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland	Critically Endangered	Community may occur within area
Weeping Myall Woodlands	Endangered	Community may occur within area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community likely to occur within area
Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Anthochaera phrygia		
Regent Honeyeater [82338]	Endangered	Species or species habitat known to occur within area
Lathamus discolor		
Swift Parrot [744]	Endangered	Species or species habitat likely to occur within area
Leipoa ocellata		
Malleefowl [934]	Vulnerable	Species or species habitat may occur within area
Polytelis swainsonii		0.00
Superb Parrot [738]	Vulnerable	Species or species habitat known to occur within area
Rostratula australis		
Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area

Name	Status	Type of Presence
Fish		
Bidyanus bidyanus Silver Perch, Bidyan [76155]	Critically Endangered	Species or species habitat may occur within area
Maccullochella macquariensis Trout Cod [26171]	Endangered	Species or species habitat may occur within area
Maccullochella peelii Murray Cod [66633]	Vulnerable	Species or species habitat may occur within
Mammals		
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat likely to occur within area
Nyctophilus corbeni South-eastern Long-eared Bat [83395]	Vulnerable	Species or species habitat known to occur within area
Phascolarctos cinereus (combined populations of Qlo Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	d, NSW and the ACT) Vulnerable	Species or species habitat may occur within area
Plants		
Androcalva procumbens [87153]	Vulnerable	Species or species habitat likely to occur within area
Tylophora linearis [55231]	Endangered	Species or species habitat may occur within area
Reptiles		
Aprasia parapulchella Pink-tailed Worm-lizard, Pink-tailed Legless Lizard [1665]	Vulnerable	Species or species habitat may occur within area
listed Migraton, Species		[Resource Information
* Species is listed under a different esigntific name or	the EDBC Act. Threatene	d Species list
Species is listed under a different scientific name or	Threatened	Type of Presence
Migratory Marine Birds	medicileu	Type of Presence
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur
Migratory Terrestrial Species		within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat known to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat may occur within area
<u>Rhipidura rufifrons</u> Rufous Fantail [592]		Species or species habitat known to occur within area

Name	Status	Type of Presence
Fish		
Bidyanus bidyanus		
Silver Perch, Bidyan [76155]	Critically Endangered	Species or species habitat may occur within area
Maccullochella macquariensis		
Trout Cod [26171]	Endangered	Species or species habitat may occur within area
Macculochella peelli Murray Cod [66633]	Vulnerable	Species or species habitat may occur within
Mammals		u.ou
Chalinolobus dwyeri		
Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat likely to occur within area
Nyctophilus corbeni		
South-eastern Long-eared Bat [83395]	Vulnerable	Species or species habitat known to occur within area
Phascolarctos cinereus (combined populations of Qlo	I, NSW and the ACT)	
Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat may occur within area
Plants		
Androcalva procumbens [87153]	Vulnerable	Species or species habitat likely to occur within area
Tylophora linearis		
[55231]	Endangered	Species or species habitat may occur within area
Reptiles		
Aprasia parapulchella Pink-tailed Worm-lizard, Pink-tailed Legless Lizard [1665]	Vulnerable	Species or species habitat may occur within area
Listed Migratory Species		[Resource Information]
 Species is listed under a different scientific name or 	the EPBC Act - Threatene	d Species list.
Name Name	Threatened	Type of Presence
Anus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Haliaeetus leucogaster		
White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Mite threated Needletail (692)		Species of species
white-throated Needletall [682]		habitat known to occur within area
Reinhow Receptor (670)		Species of species
Muiagra guapolousa		habitat may occur within area
Satin Flycatcher [612]		Species or species habitat may occur within area
Rhipidura rufifrons Rufous Fantail (592)		Species or species habitat known to occur within area
Migratory Wetlands Species		within alea

Endangered

OzArk Environmental & Heritage Management

Name	Threatened	Type of Presence
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat likely to occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Gallinago hardwickii		
Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato)		
Painted Snipe [889]	Endangered*	Species or species habitat may occur within area
Other Matters Protected by the EPBC Act		
Commonwealth Land		[Resource Information
The Commonwealth area listed below may indicate th vicinity. Due to the unreliability of the data source, all impacts on a Commonwealth area, before making a government land department for further information.	e presence of Commo proposals should be ch lefinitive decision. Cont	nwealth land in this hecked as to whether it tact the State or Territory

Name

Commonwealth Land -Commonwealth Land - Australian Postal Commission Commonwealth Land - Australian Telecommunications Commission Commonwealth Land - Commonwealth Bank of Australia Defence - DUBBO - HUTTED CAMP SITE Defence - DUBBO TRAINING DEPOT

Listed Marine Species

Listed Marine Species		[Resource Information]
* Species is listed under a different	scientific name on the EPBC Act - Threa	tened Species list.
Name	Threatened	Type of Presence
Birds		

Apus pacificus Fork-tailed Swift [678]

Ardea alba Great Egret, White Egret [59541]

Ardea ibis Cattle Egret [59542]

Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]

Haliaeetus leucogaster White-bellied Sea-Eagle [943]

Hirundapus caudacutus White-throated Needletail [682]

Lathamus discolor Swift Parrot [744]

Species or species habitat likely to occur within area

Species or species habitat likely to occur within area

Species or species habitat may occur within area

Species or species habitat may occur within area

Species or species habitat likely to occur within area

Species or species habitat known to occur within area

Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Merops ornatus		
Rainbow Bee-eater [670]		Species or species habitat may occur within area
Myiagra cyanoleuca		
Satin Flycatcher [612]		Species or species
		habitat may occur within
		area
Rhipidura rufifrons		
Rufous Fantail [592]		Species or species
		habitat known to occur within area
Rostratula benghalensis (sensu lato)		
Painted Snipe [889]	Endangered*	Species or species habitat may occur within
		area

Extra Information

Places on the RNE		[Resource Information]
Note that not all Indigenous sites may be listed.		
Name	State	Status
Historic		
Dubbo High School Main Building	NSW	Indicative Place
Dubbo Pioneer Cemetery	NSW	Indicative Place
Dubbo Showground Grandstand	NSW	Indicative Place
Eastonville	NSW	Indicative Place
Salvation Army Citadel (former)	NSW	Indicative Place
Dubbo Courthouse	NSW	Registered
Dundullimal Homestead and Stone Barn	NSW	Registered
Gaol (former) and Residence	NSW	Registered
Lands Board Office Building	NSW	Registered
Police Inspectors Residence	NSW	Registered
Public School	NSW	Registered
RAAF Base Dubbo (former)	NSW	Registered
Talbragar Shire Council Chambers (former)	NSW	Registered

Invasive Species [Resource Information] Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis		
Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Anas platyrhynchos		
Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis		
European Goldfinch [403]		Species or species

Species or species habitat likely to occur within area Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]

Passer domesticus House Sparrow [405]

Name

Streptopelia chinensis Spotted Turtle-Dove [780]

Sturnus vulgaris Common Starling [389]

Turdus merula Common Blackbird, Eurasian Blackbird [596]

Mammals Bos taurus Domestic Cattle [16]

Canis lupus familiaris Domestic Dog [82654]

Felis catus Cat, House Cat, Domestic Cat [19]

Lepus capensis Brown Hare [127]

Mus musculus House Mouse [120]

Oryctolagus cuniculus Rabbit, European Rabbit [128]

Rattus rattus Black Rat, Ship Rat [84]

Sus scrofa Pig [6]

Vulpes vulpes Red Fox, Fox [18]

Plants

Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]

Lycium ferocissimum African Boxthorn, Boxthorn [19235]

Opuntia spp. Prickly Pears [82753]

Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780] Type of Presence

Status

Species or species habitat likely to occur within area

Species or species habitat likely to occur within area

Species or species habitat likely to occur within area

Species or species habitat likely to occur within area

Species or species habitat likely to occur within area

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Species or species habitat likely to occur within area

Species or species habitat likely to occur within area

Species or species habitat likely to occur within area

Species or species habitat likely to occur within area

Species or species habitat may occur within

Name

Rubus fruticosus aggregate Blackberry, European Blackberry [68406]

Delta Arrowhead, Arrowhead, Slender Arrowhead [68483]

Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]

Senecio madagascariensis

Fireweed, Madagascar Ragwort, Madagascar Groundsel [2624]

Tamarix aphylla

Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]

Type of Presence

area

Status

Species or species habitat likely to occur within area

Species or species habitat likely to occur within area

Species or species habitat likely to occur within area

Species or species habitat likely to occur within area

Species or species habitat likely to occur within area

Coordinates

-32.27388 148.63869

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World Heritage and Register of National Estate properties, Wetlands of International Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped: - migratory and

- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area

- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

non-threatened seabirds which have only been mapped for recorded breeding sites
 seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Department of Environment, Climate Change and Water, New South Wales

-Department of Sustainability and Environment, Victoria -Department of Primary Industries, Parks, Water and Environment, Tasmania -Department of Environment and Natural Resources, South Australia -Parks and Wildlife Service NT, NT Dept of Natural Resources, Environment and the Arts -Environmental and Resource Management, Queensland -Department of Environment and Conservation, Western Australia -Department of the Environment, Climate Change, Energy and Water -Birds Australia -Australian Bird and Bat Banding Scheme -Australian National Wildlife Collection -Natural history museums of Australia -Museum Victoria -Australian Museum -SA Museum -Queensland Museum -Online Zoological Collections of Australian Museums -Queensland Herbarium -National Herbarium of NSW -Royal Botanic Gardens and National Herbarium of Victoria -Tasmanian Herbarium -State Herbarium of South Australia -Northern Territory Herbarium -Western Australian Herbarium -Australian National Herbarium, Atherton and Canberra -University of New England -Ocean Biogeographic Information System -Australian Government, Department of Defence -State Forests of NSW -Geoscience Australia -CSIRO

-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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BIRDLIFE INTERNATIONAL-IMPORTANT BIRD AREAS

ATLAS OF LIVING AUSTRALIA

5KM CIRCLE

44 species recorded: 206 results for [all records] - within 5.0 km of point (-32.274452, 148.63289) State Conservation Endangered.

Name of species	Number of records
Australian Painted Snipe Rostratula australis	4
Barking Owl Ninox (Hieracoglaux) connivens	7
Bindjulang Dasyurus maculatus	2
Black Callitris Callitris endlicheri	5
Black-chinned Honeyeater Melithreptus (Eidopsarus) gularis gularis	1
Blue-billed Duck Oxyura australis	3
Brolga Grus (Mathewsia) rubicunda	1
Brown Treecreeper (eastern Subspecies) Climacteris (Climacteris) picumnus victoriae	2
Bush Stone-curlew Burhinus (Burhinus) grallarius	3
Diamond Firetail Stagonopleura (Stagonopleura) guttata	3
Emu # Dromaius novaehollandiae #	4
Flame Robin Petroica (Littlera) phoenicea	1
Glossy Black-cockatoo Calyptorhynchus (Calyptorhynchus) lathami	16
Golden Sun Moth Synemon plana	1
Grey Falcon Falco (Hierofalco) hypoleucos	1
Grey-crowned Babbler Pomatostomus (Pomatostomus) temporalis temporalis	12
Homoranthus Darwinioides Homoranthus darwinioides	1
Ingram's Zieria Zieria ingramii	1
Leafless Indigo Indigofera efoliata	9
Little Eagle Hieraaetus (Hieraaetus) morphnoides	16
Little Lorikeet Glossopsitta pusilla	17
Magpie Goose Anseranas semipalmata	3
Major Mitchell's Cockatoo Lophochroa leadbeateri	3
Malleefowl Leipoa ocellata	11
Mauve Burr-daisy Calotis glandulosa	2
Painted Honeyeater Grantiella picta	3
Pale-headed Snake Hoplocephalus bitorquatus	1
Red-tailed Tropicbird Phaethon rubricauda	1
Regent Honeyeater Anthochaera (Xanthomyza) phrygia	12
River Red Gum # Eucalyptus camaldulensis #	3
Rulingia Procumbens Rulingia procumbens	2
Silky Glycine Glycine canescens	1
Speckled Warbler Chthonicola sagittata	19
Spotted Harrier Circus assimilis	6
Spotted-throat Cowslip Diuris tricolor	3
Square-tailed Kite Lophoictinia isura	3
Stripe-faced Dunnart Sminthopsis macroura	9
Superb Parrot Polytelis swainsonii	4

Swamp Bush-pea # Pultenaea glabra #	1
Swift Parrot Lathamus discolor	2
Varied Sittella Daphoenositta (Neositta) chrysoptera	4
Weeping Myall Acacia pendula	1
White-browed Treecreeper Climacteris (Climacterobates) affinis affinis	1
White-fronted Chat Epthianura (Epthianura) albifrons	1
Grand Total	206

Not listed under TSC or EPBC Act in the Dubbo LGA



10KM CIRCLE

51 species: 519 results for [all records] - within 10.0 km of point (-32.274452, 148.63289) State Conservation Endangered

Name of species	Number of records
Acacia pendula Weeping Myall	2
Anseranas semipalmata Magpie Goose	8
Anthochaera (Xanthomyza) Phrygia Regent Honeyeater	14
Burhinus (Burhinus) grallarius Bush Stone-curlew	4
Calidris (Erolia) ferruginea Curlew Sandpiper	2
Callitris endlicheri Black Callitris	8
Calotis glandulosa Mauve Burr-daisy	2
Calyptorhynchus (Calyptorhynchus) lathami Glossy Black-cockatoo	16
Chalinolobus picatus Little Pied Bat	3

Chthonicola sagittata Speckled Warbler	68
Circus assimilis Spotted Harrier	21
Climacteris (Climacteris) picumnus victoriae Brown Treecreeper (eastern Subspecies)	4
Climacteris (Climacterobates) affinis affinis White-browed Treecreeper	1
Daphoenositta (Neositta) chrysoptera Varied Sittella	20
Dasyurus maculatus Bindjulang	2
Diuris tricolor Spotted-throat Cowslip	8
Dromaius novaehollandiae Emu	18
Epthianura (Epthianura) albifrons White-fronted Chat	14
Eucalyptus camaldulensis River Red Gum	5
Falco (Hierofalco) hypoleucos Grey Falcon	1
Geophaps (Geophaps) scripta Squatter Pigeon	1
Glossopsitta pusilla Little Lorikeet	45
Glycine canescens Silky Glycine	2
Grantiella picta Painted Honeyeater	4
Grus (Mathewsia) rubicunda Brolga	2
Hamirostra melanosternon Black-breasted Buzzard	2
Hieraaetus (Hieraaetus) morphnoides Little Eagle	76
Homoranthus darwinioides Homoranthus Darwinioides	1
Hoplocephalus bitorquatus Pale-headed Snake	1
Indigofera efoliata Leafless Indigo	11
Lathamus discolor Swift Parrot	2
Leipoa ocellata Malleefowl	13
Lophochroa leadbeateri Major Mitchell's Cockatoo	5
Lophoictinia isura Square-tailed Kite	4
Melanodryas (Melanodryas) cucullata cucullata Hooded Robin	1
Melithreptus (Eidopsarus) gularis gularis Black-chinned Honeyeater	1
Neophema (Neophema) pulchella Turquoise Parrot	1
Ninox (Hieracoglaux) connivens Barking Owl	11
Oxyura australis Blue-billed Duck	5
Pachycephala (Timixos) inornata Gilbert's Whistler	5
Petroica (Littlera) phoenicea Flame Robin	10
Phaethon rubricauda Red-tailed Tropicbird	5
Polytelis swainsonii Superb Parrot	7
Pomatostomus (Pomatostomus) temporalis temporalis Grey-crowned Babbler	36
Pultenaea glabra Swamp Bush-pea	1
Rostratula australis Australian Painted Snipe	12
Rulingia procumbens Rulingia Procumbens	3
Sminthopsis macroura Stripe-faced Dunnart	9
Stagonopleura (Stagonopleura) guttata Diamond Firetail	20
Synemon plana Golden Sun Moth	1
Zieria ingramii Ingram's Zieria	1
Grand Total	519


ATLAS OF GROUNDWATER DEPENDENT ECOSYSTEMS



DUBBO CITY COUNCIL NOXIOUS WEED LIST

African boxthorn		Locally Controlled Weed				
Lycium ferocissimum	4	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread and the plant must not be sold, propagated or knowingly distributed				
African feather grass		Restricted Plant				
Pennisetum macrourum	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with				
African turnip weed - eastern	_	Restricted Plant				
Sisymbrium thellungii		The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with				
African turnip weed - western	5	Restricted Plant				
Sisymbrium runcinatum	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with				
Alligator weed		Regionally Prohibited Weed				
Alternanthera philoxeroides	2	The plant must be eradicated from the land and that land must be kept free of the plant				
Anchored water hyacinth		State Prohibited Weed				
Eichhornia azurea	1	The plant must be eradicated from the land and that land must be ke free of the plant				
Annual ragweed		Restricted Plant				
Ambrosia artemisiifolia	5	The requirements in the Noxious Weeds Act 1993 for a notifiable we must be complied with				
Arrowhead	4	Locally Controlled Weed				
Sagittaria montevidensis	4	The plant must not be sold, propagated or knowingly distributed				
Artichoke thistle		Restricted Plant				
Cynara cardunculus	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with				
Asparagus - climbing asparagus fern	4	Locally Controlled Weed				
Asparagus plumosus		The plant must not be sold, propagated or knowingly distributed				
Asparagus - ground asparagus	4	Locally Controlled Weed				
Asparagus aethiopicus	_	The plant must not be sold, propagated or knowingly distributed				
Asparagus weeds	4	Locally Controlled Weed				
Asparagus species		The plant must not be sold, propagated or knowingly distributed				
Athel pine		Restricted Plant				
Tamarix aphylla	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with				
Bear-skin fescue		Restricted Plant				
Festuca gautieri	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with				
Black knapweed		State Prohibited Weed				
Centaurea nigra	1	The plant must be eradicated from the land and that land must be kept free of the plant				
Black willow		Regionally Prohibited Weed				
Salix nigra	2	The plant must be eradicated from the land and that land must be kept free of the plant				
Blackberry		Locally Controlled Weed				
Rubus fruticosus species aggregate	4	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread and the plant must not be sold, propagated or knowingly distributed				

Blue heliotrope		Locally Controlled Weed				
Heliotropium amplexicaule	4	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread				
Boneseed		State Prohibited Weed				
Chrysanthemoides monilifera subsp. monilifera	1	The plant must be eradicated from the land and that land must be kept free of the plant				
Bridal creeper		Locally Controlled Weed				
Asparagus asparagoides	4	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread and the plant must not be sold, propagated or knowingly distributed				
Bridal veil creeper		State Prohibited Weed				
Asparagus declinatus	1	The plant must be eradicated from the land and that land must be kept free of the plant				
Broomrapes		State Prohibited Weed				
Orobanche species	1	The plant must be eradicated from the land and that land must be kept free of the plant				
Burr ragweed		Restricted Plant				
Ambrosia confertiflora	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with				
Cabomba		Restricted Plant				
Cabomba species	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with				
Cape broom		Locally Controlled Weed				
Genista monspessulana	4	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread and the plant must not be sold, propagated or knowingly distributed				
Cat's claw creeper	2	Regionally Prohibited Weed				
Dolichandra unguis-cati		The plant must be eradicated from the land and that land must be kept free of the plant				
Cayenne snakeweed		Restricted Plant				
Stachytarpheta cayennensis	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with				
Chilean needle grass	_	Locally Controlled Weed				
Nassella neesiana	4	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread and the plant must not be sold, propagated or knowingly distributed				
Chinese violet		State Prohibited Weed				
Asystasia gangetica subsp. micrantha	1	The plant must be eradicated from the land and that land must be kept free of the plant				
Clockweed		Restricted Plant				
Gaura parviflora	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with				
Columbus grass		Locally Controlled Weed				
Sorghum x almum	4	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread				
Coolatai grass		Regionally Controlled Weed				
Hyparrhenia hirta	3	The plant must be fully and continuously suppressed and destroyed and the plant must not be sold, propagated or knowingly distributed				
Corn sowthistle		Restricted Plant				
Sonchus arvensis	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with				
Dodder	5	Restricted Plant				

Cuscuta species		The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with		
Espartillo - broad kernel		Restricted Plant		
Amelichloa caudata	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with		
Espartillo - narrow kernel		Restricted Plant		
Amelichloa brachychaeta	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with		
Eurasian water milfoil		State Prohibited Weed		
Myriophyllum spicatum	1	The plant must be eradicated from the land and that land must be kept free of the plant		
European hackberry		Locally Controlled Weed		
Celtis australis	4	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread		
Fine-bristled burr grass		Restricted Plant		
Cenchrus brownii	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with		
Fireweed		Locally Controlled Weed		
Senecio madagascariensis	4	The plant must not be sold, propagated or knowingly distributed		
Flax-leaf broom	1	Locally Controlled Weed		
Genista linifolia	4	The plant must not be sold, propagated or knowingly distributed		
Fountain grass		Restricted Plant		
Cenchrus setaceus	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with		
Frogbit		State Prohibited Weed		
Limnobium laevigatum	1	The plant must be eradicated from the land and that land must be kept free of the plant		
Gallon's curse		Restricted Plant		
Cenchrus biflorus	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with		
Gamba grass		Restricted Plant		
Andropogon gayanus	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with		
Giant reed	1	Locally Controlled Weed		
Arundo donax	4	The plant must not be sold, propagated or knowingly distributed		
Glaucous starthistle		Restricted Plant		
Carthamus leucocaulos	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with		
Golden thistle		Restricted Plant		
Scolymus hispanicus	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with		
Green cestrum		Regionally Controlled Weed		
Cestrum parqui	3	The plant must be fully and continuously suppressed and destroyed		
Grey sallow		Regionally Prohibited Weed		
Salix cinerea	2	The plant must be eradicated from the land and that land must be kept free of the plant		
Harrisia cactus		Locally Controlled Weed		
<i>Harrisia</i> species	4	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread and the plant must not be sold, propagated or knowingly distributed		
Hawkweeds	1	State Prohibited Weed		

Hieracium species		The plant must be eradicated from the land and that land must be kept free of the plant
Honey locust		Regionally Controlled Weed
Gleditsia triacanthos	3	The plant must be fully and continuously suppressed and destroyed and the plant must not be sold, propagated or knowingly distributed
Horsetails		State Prohibited Weed
Equisetum species	1	The plant must be eradicated from the land and that land must be kept free of the plant
Hydrocotyl		State Prohibited Weed
Hydrocotyl ranunculoides	1	The plant must be eradicated from the land and that land must be kept free of the plant
Hymenachne		State Prohibited Weed
<i>Hymenachne amplexicaulis</i> and hybrids	1	The plant must be eradicated from the land and that land must be kept free of the plant
Johnson grass		Locally Controlled Weed
Sorghum halepense	4	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread and the plant must not be sold, propagated or knowingly distributed
Karroo thorn		State Prohibited Weed
Acacia karroo	1	The plant must be eradicated from the land and that land must be kept free of the plant
Kidney-leaf mud plantain		State Prohibited Weed
Heteranthera reniformis	1	The plant must be eradicated from the land and that land must be kept free of the plant
Kochia		State Prohibited Weed
Bassia scoparia	1	The plant must be eradicated from the land and that land must be kept free of the plant
Koster's curse	1	State Prohibited Weed
Clidemia hirta		The plant must be eradicated from the land and that land must be kept free of the plant
Lagarosiphon		State Prohibited Weed
Lagarosiphon major	1	The plant must be eradicated from the land and that land must be kept free of the plant
Leafy elodea	1	Locally Controlled Weed
Egeria densa	4	The plant must not be sold, propagated or knowingly distributed
Lippia		Locally Controlled Weed
Phyla canescens	4	The plant must not be sold, propagated or knowingly distributed except incidentally in hay or lucerne
Long-leaf willow primrose		Regionally Controlled Weed
Ludwigia longifolia	3	The plant must be fully and continuously suppressed and destroyed and the plant must not be sold, propagated or knowingly distributed
Mesquite		Regionally Prohibited Weed
Prosopis species	2	The plant must be eradicated from the land and that land must be kept free of the plant
Mexican feather grass		State Prohibited Weed
Nassella tenuissima	1	The plant must be eradicated from the land and that land must be kept free of the plant
Mexican poppy		Restricted Plant
Argemone mexicana	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with
Miconia	1	State Prohibited Weed

Miconia species		The plant must be eradicated from the land and that land must be kept free of the plant				
Mikania vine		State Prohibited Weed				
Mikania micrantha	1	The plant must be eradicated from the land and that land must be kept free of the plant				
Mimosa		State Prohibited Weed				
Mimosa pigra	1	The plant must be eradicated from the land and that land must be kept free of the plant				
Mossman River grass		Restricted Plant				
Cenchrus echinatus	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with				
Mother-of-millions		Locally Controlled Weed				
Bryophyllum species	4	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread and the plant must not be sold, propagated or knowingly distributed				
Pampas grass		Regionally Controlled Weed				
Cortaderia species	3	The plant must be fully and continuously suppressed and destroyed and the plant must not be sold, propagated or knowingly distributed				
Parkinsonia		Regionally Prohibited Weed				
Parkinsonia aculeata		The plant must be eradicated from the land and that land must be kept free of the plant				
Parthenium weed		State Prohibited Weed				
Parthenium hysterophorus	1	The plant must be eradicated from the land and that land must be kept free of the plant				
Pond apple		State Prohibited Weed				
Annona glabra	1	The plant must be eradicated from the land and that land must be kept free of the plant				
Prickly acacia		State Prohibited Weed				
Acacia nilotica	1	The plant must be eradicated from the land and that land must be kept free of the plant				
Prickly pear - common pear		Locally Controlled Weed				
Opuntia stricta	4	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread and the plant must not be sold, propagated or knowingly distributed				
Prickly pear - Hudson pear		Locally Controlled Weed				
Cylindropuntia rosea	4	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread and the plant must not be sold, propagated or knowingly distributed				
Prickly pear - smooth tree pear		Locally Controlled Weed				
Opuntia monacantha	4	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread and the plant must not be sold, propagated or knowingly distributed				
Prickly pear - tiger pear		Locally Controlled Weed				
Opuntia aurantiaca	4	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread and the plant must not be sold, propagated or knowingly distributed				
Prickly pear - velvety tree pear		Locally Controlled Weed				
Opuntia tomentosa	4	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread and the plant must not be sold, propagated or knowingly distributed				
Red rice	5	Restricted Plant				

Oryza rufipogon		The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with
Rhus tree		Locally Controlled Weed
Toxicodendron succedaneum	4	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread and the plant must not be sold, propagated or knowingly distributed
Rubber vine		State Prohibited Weed
Cryptostegia grandiflora	1	The plant must be eradicated from the land and that land must be kept free of the plant
Sagittaria	1	Locally Controlled Weed
Sagittaria platyphylla] 4	The plant must not be sold, propagated or knowingly distributed
Salvinia		Regionally Prohibited Weed
Salvinia molesta	2	The plant must be eradicated from the land and that land must be kept free of the plant
Scotch broom		Locally Controlled Weed
Cytisus scoparius	1 4	The plant must not be sold, propagated or knowingly distributed
Senegal tea plant		State Prohibited Weed
Gymnocoronis spilanthoides	1	The plant must be eradicated from the land and that land must be kept free of the plant
Serrated tussock		Locally Controlled Weed
Nassella trichotoma	4	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread and the plant must not be sold, propagated or knowingly distributed
Siam weed		State Prohibited Weed
Chromolaena odorata	1	The plant must be eradicated from the land and that land must be kept free of the plant
Silk forage sorghum		Locally Controlled Weed
<i>Sorghum</i> species hybrid cultivar "Silk"	4	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread
Silverleaf nightshade		Locally Controlled Weed
Solanum elaeagnifolium	4	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread and the plant must not be sold, propagated or knowingly distributed
Smooth-stemmed turnip		Restricted Plant
Brassica barrelieri subsp. oxyrrhina	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with
Soldier thistle		Restricted Plant
Picnomon acarna	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with
Spongeplant		State Prohibited Weed
Limnobium spongia	1	The plant must be eradicated from the land and that land must be kept free of the plant
Spotted knapweed		State Prohibited Weed
Centaurea stoebe subsp. micranthos	1	The plant must be eradicated from the land and that land must be kept free of the plant
Texas blueweed		Restricted Plant
Helianthus ciliaris	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with
Tree-of-heaven		Locally Controlled Weed
Ailanthus altissima	4	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread and the plant must not be sold, propagated or knowingly distributed
Tropical soda apple	1	State Prohibited Weed

Solanum viarum		The plant must be eradicated from the land and that land must be kept free of the plant			
Water caltrop		State Prohibited Weed			
Trapa species	1	The plant must be eradicated from the land and that land must be kept free of the plant			
Water hyacinth		Regionally Prohibited Weed			
Eichhornia crassipes	2	The plant must be eradicated from the land and that land must be kept free of the plant			
Water lettuce		State Prohibited Weed			
Pistia stratiotes	1	The plant must be eradicated from the land and that land must be kept free of the plant			
Water soldier		State Prohibited Weed			
Stratiotes aloides	1	The plant must be eradicated from the land and that land must be kept free of the plant			
Willows		Locally Controlled Weed			
Salix species	4	The plant must not be sold, propagated or knowingly distributed			
Witchweeds		State Prohibited Weed			
Striga species	1	The plant must be eradicated from the land and that land must be kept free of the plant			
Yellow burrhead		State Prohibited Weed			
Limnocharis flava	1	The plant must be eradicated from the land and that land must be kept free of the plant			
Yellow nutgrass		Restricted Plant			
Cyperus esculentus	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with			

Common Name	Scientific Name	Habitat and Ecology (OEH Species Profile and /or EPBC SPRAT Profile)	TSC Act Status	EPBC Act Status	OEH Threatened Species Search	DSEWPaC Protected Matters Search	Potential to occur
Australasian Bittern	Botaurus poiciloptilus	 Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (Typha spp.) and spikerushes (Eleoacharis spp.). Hides during the day amongst dense reeds or rushes and feed mainly at night on frogs, fish, yabbies, spiders, insects and snails. Feeding platforms may be constructed over deeper water from reeds trampled by the bird; platforms are often littered with prey remains. Breeding occurs in summer from October to January; nests are built in secluded places in densely-vegetated wetlands on a platform of reeds; there are usually six olive-brown eggs to a clutch. 	Endangered	Endangered	Known	Species or species habitat may occur within Area	Unlikely
Ausfeld's Wattle	Acacia ausfeldii	Found to the east of Dubbo in the Mudgee-Ulan-Gulgong area of the NSW South Western Slopes bioregion, with some records in the adjoining Brigalow Belt South, South Eastern Highlands and the Sydney Basin bioregions. Populations are recorded from Yarrobil National Park, Goodiman State Conservation Area and there is a 1963 record from Munghorn Gap Nature Reserve. A large population is also known from Tuckland State Forest to the northwest of Gulgong. Established plants are likely to be killed by fire, as mature and juvenile plants have a single-stemmed growth form. Associated species include Eucalyptus albens, E. blakelyi and Callitris spp., with an understorey dominated by Cassinia spp. and grasses.	Vulnerable		Known		Potential
Bilby	Macrotis lagotis	Once widespread in arid, semi-arid and relatively fertile areas, the Bilby is now restricted to arid regions and remains a threatened species. The Bilby prefers arid habitats because of the spinifex grass and acacia shrub.	Presumed extinct	Vulnerable			No
Barking Owl	Ninox connivens	Nesting occurs during mid-winter and spring. Female incubates for 5 weeks, roosts outside the hollow when chicks are 4 weeks old, then fledging starts 2 weeks later. Young are dependent for several months Territorial pairs respond strongly to recordings of Barking Owl calls from up to 6 kilometres away, though humans rarely hear this response farther than 1.5 kilometres. Because disturbance reduces the pair's foraging time, and can pull the female off her eggs even on cold nights, recordings should not be broadcast unnecessarily nor during the nesting season.	Vulnerable		Known		Likely. Pair known to occupy territory adjacent to the Macquarie River. Hunting ground may exist in the Subject Site. Hollow bearing trees adjacent to a permanent watercourse (breeding habitat) does not occur in the Subject Site.

Common Name	Scientific Name	Habitat and Ecology (OEH Species Profile and /or EPBC SPRAT Profile)	TSC Act Status	EPBC Act Status	OEH Threatened Species Search	DSEWPaC Protected Matters Search	Potential to occur
Black Falcon	Falco subniger	The Black Falcon is widely, but sparsely, distributed in New South Wales, mostly occurring in inland regions. Some reports of 'Black Falcons' on the tablelands and coast of New South Wales are likely to be referable to the Brown Falcon. In New South Wales there is assumed to be a single population that is continuous with a broader continental population, given that falcons are highly mobile, commonly travelling hundreds of kilometres (Marchant & Higgins 1993). The Black Falcon occurs as solitary individuals, in pairs, or in family groups of parents and offspring.	Vulnerable		Known		Potential
Black- breasted Buzzard	Hamirostra melanosternon	Lives in a range of inland habitats, especially along timbered watercourses which is the preferred breeding habitat. Also hunts over grasslands and sparsely timbered woodlands. Not a powerful hunter, despite its size, mostly taking reptiles, small mammals, birds, including nestlings, and carrion. Also specialises in feeding on large eggs, including those of emus, which it cracks on a rock. Breeds from August to October near water in a tall tree. The stick nest is large and flat and lined with green leaves. Normally two eggs are laid.	Vulnerable		Predicted		Potential. Hunting ground may exist in the Subject Site, however tall trees near water (breeding habitat) do not occur in the Subject Site.
Black-chinned Honeyeater (eastern subspecies)	Melithreptus gularis gularis	Occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts, especially Mugga Ironbark (<i>Eucalyptus sideroxylon</i>), White Box (<i>E. albens</i>), Inland Grey Box (<i>E. microcarpa</i>), Yellow Box (<i>E. melliodora</i>) and Forest Red Gum (<i>E. tereticornis</i>). Also inhabits open forests of smooth-barked gums, stringybarks, ironbarks and tea-trees. A gregarious species usually seen in pairs and small groups of up to 12 birds. Feeding territories are large making the species locally nomadic. Recent studies have found that the Black-chinned Honeyeater tends to occur in the largest woodland patches in the landscape as birds forage over large home ranges of at least 5 hectares Breeds solitarily or co-operatively, with up to five or six adults, from June to December. The nest is placed high in the crown of a tree, in the uppermost lateral branches, hidden by foliage. It is a compact, suspended, cup-shaped nest. Two or three eggs are laid and both parents and occasionally helpers feed the young.	Vulnerable		Known		Potential.
Black-necked Stork	Ephippiorhynchus asiaticus	Black-necked Storks are mainly found on shallow, permanent, freshwater terrestrial wetlands, and surrounding marginal vegetation, including swamps, floodplains, watercourses and	Endangered		Predicted		Unlikely. Wetland habitat suitable for this species

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		billabongs, freshwater meadows, wet heathland, farm dams and shallow floodwaters, as well as extending into adjacent grasslands, paddocks and open savannah woodlands. They also forage within or around estuaries and along intertidal shorelines, such as saltmarshes, mudflats and sandflats, and mangrove vegetation.					does not occur in the Subject Site.
		Breeding activity has been recorded in fate spring and summer. Breeding activity has been recorded in most months, with activities from nest construction to fledging of young recorded from May to January. Most activity, however, takes place between June and December, and clutches present May to September. In NSW, Storks usually nest in a tall, live and isolated paddock tree, but also in other trees, including paperbarks, or even lower shrubs within wetlands. The nest is a large platform, 1-2 metres in diameter, made in a live or dead tree, in or near a freshwater swamp. The clutch-size of nests in NSW is not properly known, but nests have been observed with from one to three young in the nest. Broods of four young have been recorded in northern Queensland.					
Black-tailed Godwit	Limosa limosa	 Primarily a coastal species. Usually found in sheltered bays, estuaries and lagoons with large intertidal mudflats and/or sandflats. Further inland, it can also be found on mudflats and in water less than 10 cm deep, around muddy lakes and swamps. Individuals have been recorded in wet fields and sewerage treatment works. Forages for insects, crustaceans, molluscs, worms, larvae, spiders, fish eggs, frog eggs and tadpoles in soft mud or shallow water. Roosts and loafs on low banks of mud, sand and shell bars. Frequently recorded in mixed flocks with Bar-tailed Godwits. 	Vulnerable		Predicted		Unlikely, Suitable habitat for this species does not occur in the Subject Site.
Blue-billed Duck	Oxyura australis	The Blue-billed Duck prefers deep water in large permanent wetlands and swamps with dense aquatic vegetation. The species is completely aquatic, swimming low in the water along the edge of dense cover. It will fly if disturbed, but prefers to dive if approached. Blue-billed Ducks will feed by day far from the shore, particularly if dense cover is available in the central parts of the wetland. They feed on the bottom of swamps eating seeds, buds, stems, leaves, fruit and small aquatic insects such as the larvae of midges, caddisflies and dragonflies. Blue-billed Ducks are partly migratory, with short-distance movements between breeding swamps and overwintering lakes	Vulnerable		Known		Unlikely. Suitable habitat for this species does not occur in the Subject Site.

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		with some long-distance dispersal to breed during spring and early summer. Blue-billed Ducks usually nest solitarily in Cumbungi over deep water between September and February. They will also nest in trampled vegetation in Lignum, sedges or Spike-rushes, where a bowl-shaped nest is constructed. The most common clutch size is five or six. Males take no part in nest-building or incubation. Young birds disperse in April-May from their breeding swamps in inland NSW to non-breeding areas on the Murray River system and coastal lakes.					
Brolga	Grus rubicunda	Though Brolgas often feed in dry grassland or ploughed paddocks or even desert claypans, they are dependent on wetlands too, especially shallow swamps, where they will forage with their head entirely submerged. They feed using their heavy straight bill as a 'crowbar' to probe the ground or turn it over, primarily on sedge roots and tubers. They will also take large insects, crustaceans, molluscs and frogs. The nest comprises a platform of grasses and sticks, augmented with mud, on an island or in the water. Two eggs are laid from winter to autumn.	Vulnerable		Known		Unlikely, Suitable habitat for this species does not occur in the Subject Site.
Brown Treecreeper (eastern subspecies)	Climacteris picumnus victoriae	Found in eucalypt woodlands (including Box-Gum Woodland) and dry open forest of the inland slopes and plains inland of the Great Dividing Range; mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more shrub species; also found in mallee and River Red Gum (<i>Eucalyptus</i> <i>camaldulensis</i>) Forest bordering wetlands with an open understorey of acacias, saltbush, lignum, cumbungi and grasses; usually not found in woodlands with a dense shrub layer; fallen timber is an important habitat component for foraging; also recorded, though less commonly, in similar woodland habitats on the coastal ranges and plains. Sedentary, considered to be resident in many locations throughout its range; present in all seasons or year-round at many sites; territorial year-round, though some birds may disperse locally after breeding. Gregarious and usually observed in pairs or small groups of eight to 12 birds; terrestrial and arboreal in about equal proportions; active, noisy and conspicuous while foraging on trunks and branches of trees and amongst fallen timber; spend much more time foraging on the ground and fallen logs than other treecreepers. When foraging in trees and on the ground, they peck and probe for	Vulnerable		Known		Likely

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		insects, mostly ants, amongst the litter, tussocks and fallen timber, and along trunks and lateral branches; up to 80% of the diet is comprised of ants; other invertebrates (including spiders, insects larvae, moths, beetles, flies, hemipteran bugs, cockroaches, termites and lacewings) make up the remaining percentage; nectar from Mugga Ironbark (<i>Eucalyptus sideroxylon</i>) and paperbarks, and sap from an unidentified eucalypt are also eaten, along with lizards and food scraps; young birds are fed ants, insect larvae, moths, craneflies, spiders and butterfly and moth larvae. Hollows in standing dead or live trees and tree stumps are essential for nesting. The species breeds in pairs or co-operatively in territories which range in size from 1.1 to 10.7 ha (mean = 4.4 ha). Each group is composed of a breeding pair with retained male offspring and, rarely, retained female offspring. Often in pairs or cooperatively breeding groups of two to five birds.					
Bush Stone- curlew	Burhinus grallarius	Inhabits open forests and woodlands with a sparse grassy groundlayer and fallen timber. Largely nocturnal, being especially active on moonlit nights. Feed on insects and small vertebrates, such as frogs, lizards and snakes. Nest on the ground in a scrape or small bare patch. Two eggs are laid in spring and early summer.	Endangered		Known		Unlikely.
Cattle Egret	Ardea ibis	The Cattle Egret is widespread and common according to migration movements and breeding localities surveys. Two major distributions have been located; from north-east Western Australia to the Top End of the Northern Territory and around south-east Australia. The Cattle Egret breeds in coastal areas.		Migratory > Listed		Species or species habitat may occur within area	Potential.
Curlew Sandpiper	Calidris (Erolia) ferruginea	In Australia, Curlew Sandpipers occur around the coasts and are also quite widespread inland, though in smaller numbers. Records occur in all states during the non-breeding period, and also during the breeding season when many non-breeding one year old birds remain in Australia rather than migrating north. They are occasionally recorded in the Tablelands and are widespread in the Riverina and south-west NSW, with scattered records elsewhere. Curlew Sandpipers forage on mudflats and nearby shallow water.	Endangered	Migratory > Marine> Listed			Unlikely. Previously recorded in 10km radius however suitable habitat for this species does not occur in the Subject Site.
Diamond Firetail	Stagonopleura guttata	Usually encountered in flocks of between five to 40 birds, occasionally more. Found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum <i>Eucalyptus pauciflora</i> Woodlands. Also occurs in open forest, mallee, Natural Temperate Grassland, and in secondary grassland derived from other communities.	Vulnerable		Known		Likely. Habitat within the Subject Site may be suitable for this species. Requires shrubby

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		Often found in riparian areas (rivers and creeks), and sometimes in lightly wooded farmland. Feeds exclusively on the ground, on ripe and partly-ripe grass and herb seeds and green leaves, and on insects (especially in the breeding season). Groups separate into small colonies to breed, between August and January. Nests are globular structures built either in the shrubby understorey, or higher up, especially under hawk's or raven's nests. Birds roost in dense shrubs or in smaller nests built especially for roosting. Appears to be sedentary, though some populations move locally					understorey.
		especially those in the south. Has been recorded in some towns and near farm houses.					
Eastern Pygmy- possum	Cercartetus nanus	The Eastern Pygmy-possum is found in south-eastern Australia, from southern Queensland to eastern South Australia and in Tasmania. In NSW it extends from the coast inland as far as the Pilliga, Dubbo, Parkes and Wagga Wagga on the western slopes. Found in a broad range of habitats from rainforest through sclerophyll (including Box-Ironbark) forest and woodland to heath, but in most areas woodlands and heath appear to be preferred, except in north-eastern NSW where they are most frequently encountered in rainforest. Feeds largely on nectar and pollen collected from banksias, eucalypts and bottlebrushes; an important pollinator of heathland plants such as banksias; soft fruits are eaten when flowers are unavailable. Shelters in tree hollows, rotten stumps, holes in the ground, abandoned bird-nests, Ringtail Possum (Pseudocheirus peregrinus) dreys or thickets of vegetation, (e.g. grass-tree skirts); nest-building appears to be restricted to breeding females; tree hollows are favoured but spherical nests have been found under the bark of eucalypts and in shredded bark in tree forks.	Vulnerable		Predicted		Unlikely.
Fork-tailed Swift	Apus pacificus	The Fork-tailed Swift is a non-breeding visitor to all states and territories of Australia (Higgins 1999). In NSW, the Fork-tailed Swift is recorded in all regions. Many records occur east of the Great Divide, however, a few populations have been found west of the Great Divide. These are widespread but scattered further west of the line joining Bourke and Dareton. Sightings have been recorded at Milparinka, the Bulloo River and Thurloo Downs (Higgins 1999).		Migratory > Listed		Species or species habitat may occur within area	Potential. Suitable habitat for this species does not occur in the Subject Site.
Flame Robin	Petroica phoenicea	Breeds in upland tall moist eucalypt forests and woodlands, often	Vulnerable		Known		Potential. Habitat

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		on ridges and slopes. Prefers clearings or areas with open understoreys. The groundlayer of the breeding habitat is dominated by native grasses and the shrub layer may be either sparse or dense. Occasionally occurs in temperate rainforest, and also in herbfields, heathlands, shrublands and sedgelands at high altitudes. In winter, birds migrate to drier more open habitats in the lowlands (ie valleys below the ranges, and to the western slopes and plains). Often occurs in recently burnt areas; however, habitat becomes unsuitable as vegetation closes up following regeneration. In winter lives in dry forests, open woodlands and in pastures and native grasslands, with or without scattered trees. In winter, occasionally seen in heathland or other shrublands in coastal areas. Birds forage from low perches, from which they sally or pounce onto small invertebrates which they take from the ground or off tree trunks, logs and other coarse woody debris. Flying insects are often taken in the air and sometimes gleans for invertebrates from foliage and bark. In their autumn and winter habitats, birds often sally from fence- posts or thistles and other prominent perches in open habitats. Occur singly, in pairs, or in flocks of up to 40 birds or more; in the non-breeding season they will join up with other insectivorous birds in mixed feeding flocks. Breeds in spring to late summer. Nests are often near the ground and are built in sheltered sites, such as shallow cavities in trees, stumps or banks. Builds an open cup nest made of plant materials and spider webs. Eggs are oval in shape and are pale bluish- or greenish-white and marked with brownish blotches; clutch size is three or four eggs.					within the Subject Site may be suitable for this species. Requires shrubby understorey.
Freckled Duck	Stictonetta naevosa	Prefer permanent freshwater swamps and creeks with heavy growth of Cumbungi, Lignum or Tea-tree. During drier times they move from ephemeral breeding swamps to more permanent waters such as lakes, reservoirs, farm dams and sewage ponds. Generally rest in dense cover during the day, usually in deep water. Feed at dawn and dusk and at night on algae, seeds and vegetative parts of aquatic grasses and sedges and small invertebrates. Nesting usually occurs between October and December but can take place at other times when conditions are favourable.	Vulnerable		Predicted		Unlikely. Suitable habitat for this species does not occur in the Subject Site.

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		Nests are usually located in dense vegetation at or near water level.					
Fuzzy Box Woodland on alluvial Soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions	Fuzzy Box Woodland on alluvial Soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions	Community occurs on brown loam or clay, alluvial or colluvial soils on prior streams and abandoned channels or slight depressions on undulating plains or flats of the western slopes. Community often occurs upslope from River Red Gum communities above frequently inundated areas of the floodplain. It also occurs on colluvium soils on lower slopes and valley flats. Less than 5% of the original extent is estimated to remain. Shrubs include Wilga, Deane's Wattle, Hop Bush, Cassia, Water Bush and Sifton Bush.	Endangered Ecological Community		Known		Yes. Known to occur in Subject Site.
Golden Sun Moth	Synemon plana	The Golden Sun Moth's NSW populations are found in the area between Queanbeyan, Gunning, Young and Tumut. The species' historical distribution extended from Bathurst (central NSW) through the NSW Southern Tablelands, through to central and western Victoria, to Bordertown in eastern South Australia. Occurs in Natural Temperate Grasslands and grassy Box-Gum Woodlands in which groundlayer is dominated by wallaby grasses Austrodanthonia spp. Grasslands dominated by wallaby grasses are typically low and open - the bare ground between the tussocks is thought to be an important microhabitat feature for the Golden Sun Moth, as it is typically these areas on which the females are observed displaying to attract males.	Endangered	Critically Endangered			No. One previous record in proximity to the Subject Site is likely to be incorrect. No suitable habitat for this species occurs in the Subject Site.
Gilbert's Whistler	Pachycephala inornata	The Gilbert's Whistler occurs in a range of habitats within NSW, though the shared feature appears to be a dense shrub layer. It is widely recorded in mallee shrublands, but also occurs in box- ironbark woodlands, Cypress Pine and Belah woodlands and River Red Gum forests. Though at this stage it is only known to use this habitat along the Murray, Edwards and Wakool Rivers. Within the mallee the species is often found in association with an understorey of spinifex and low shrubs including wattles, hakeas, sennas and hop-bushes. In woodland habitats, the understorey comprises dense patches of shrubs, particularly thickets of regrowth <i>Callitris</i> pine. Parasitic 'cherries' (<i>Exocarpus</i> species) appear to be an important habitat component in Belah and Red Gum communities, though in the latter case other dense shrubs, such as Lignum and wattles, are also utilised. The Gilbert's Whistler forages on or near the ground in shrub	Vulnerable		Known		Unlikely.

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5		thickets and in tops of small trees. Its food consists mainly of spiders and insects such as caterpillars, beetles and ants, and occasionally, seeds and fruits are eaten.					
		The movements of this species are poorly known but it is believed that generally it does not make any regular large-scale movements and pairs may hold and defend territories all year round.					
Great Egret, White Egret	Ardea alba	Great Egrets prefer shallow water, particularly when flowing, but may be seen on any watered area, including damp grasslands. Great Egrets can be seen alone or in small flocks, often with other egret species, and roost at night in groups. The Great Egret usually feeds alone. It feeds on molluscs, amphibians, aquatic insects, small reptiles, crustaceans and occasionally other small animals, but fish make up the bulk of its diet. The Great Egret usually hunts in water, wading through the shallows, or standing motionless before stabbing at prey. Birds have also been seen taking prey while in flight.		Migratory > Listed		Species or species habitat likely to occur within area	Potential
Glossy Black- cockatoo	Calyptorhynchus lathami	Inhabits open forest and woodlands of the coast and the Great Dividing Range up to 1000 metres in which stands of she-oak species, particularly Black She-oak (<i>Allocasuarina littoralis</i>), Forest She-oak (<i>A. torulosa</i>) or Drooping She-oak (<i>A. verticillata</i>) occur. In the Riverina area, again usually associated with woodlands containing Drooping She-oak but also recorded in open woodlands dominated by Belah (Casuarina cristata). Feeds almost exclusively on the seeds of several species of she- oak (Casuarina and Allocasuarina species), shredding the cones with the massive bill. Dependent on large hollow-bearing eucalypts for nest sites. One or two eggs are laid between March and August.	Vulnerable	Endangered (Only South- Australian Sub- species).	Known		Potential. Goonoo SCA is a stronghold for this species.
Greater Long- eared Bat	Nyctophilus timoriensis/corbeni (South-eastern form)	The South-eastern Long-eared Bat occurs in a range of inland woodland vegetation types, including box, ironbark and cypress pine woodlands. The species also occurs in Bulloke woodland, Brigalow woodland, Belah woodland, Smooth-barked Apple, <i>Angophora leiocarpa,</i> woodland; River Red Gum, <i>Eucalyptus camaldulensis</i> , forests lining watercourses and lakes, Black Box, <i>Eucalyptus largiflorens,</i> woodland, dry sclerophyll forest.	Vulnerable	Endangered	Predicted	Species or species habitat may occur within Area	Potential. Some trees with small hollows or decorating bark in the Subject Site.
Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar		Inland Grey Box Woodland occurs on fertile soils of the western slopes and plains of NSW. The community generally occurs where average rainfall is 375- 800 mm pa and the mean maximum annual temperature is 22- 26°C. There is a correlation between the distribution of <i>Eucalyptus microcarpa</i> communities and soils of Tertiary and Quaternary	Endangered Ecological Community	Endangered	Known	Community may occur within area	Yes. Known to occur in the Subject Site on undulating land and footslopes

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Peneplain, Nandewar and Brigalow Belt South Bioregions/Gr ey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia		alluvial origin, largely corresponding with the Red Brown Earths. The majority of remnant patches of Inland Grey Box Woodland survive with trees largely intact but with the shrub or ground layers degraded to varying degrees through grazing or pasture modification. Some species that are part of the community appear intolerant to heavy grazing by domestic stock and are confined to the least disturbed remnants.					
Grey Falcon	Falco hypoleucos	Usually restricted to shrubland, grassland and wooded watercourses of arid and semi-arid regions, although it is occasionally found in open woodlands near the coast. Also occurs near wetlands where surface water attracts prey. Preys primarily on birds, especially parrots and pigeons, using high-speed chases and stoops; reptiles and mammals are also taken. Like other falcons it utilises old nests of other birds of prey and ravens, usually high in a living eucalypt near water or a watercourse; peak laying season is in late winter and early spring; two or three eggs are laid.	Endangered		Known		Potential to have hunting areas within the Subject Site.
Grey-crowned Babbler (eastern subspecies)	Pomatostomus temporalis temporalis	Inhabits open Box-Gum Woodlands on the slopes, and Box- Cypress-pine and open Box Woodlands on alluvial plains. Flight is laborious so birds prefer to hop to the top of a tree and glide down to the next one. Birds are generally unable to cross large open areas. Live in family groups that consist of a breeding pair and young from previous breeding seasons. A group may consist of up to fifteen birds. All members of the family group remain close to each other when foraging. A soft 'chuck' call is made by all birds as a way of keeping in contact with other group members. Feed on invertebrates, either by foraging on the trunks and branches of eucalypts and other woodland trees or on the ground, digging and probing amongst litter and tussock grasses Build and maintain several conspicuous, dome-shaped stick nests about the size of a football. A nest is used as a dormitory for roosting each night. Nests are usually located in shrubs or sapling eucalypts, although they may be built in the outermost leaves of	Vulnerable		Known		Yes. Known. Suitable habitat for this species is known to occur in the Subject Site

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		low branches of large eucalypts. Nests are maintained year round, and old nests are often dismantled to build new ones. Breed between July and February. Usually two to three eggs are laid and incubated by the female. During incubation, the adult male and several helpers in the group may feed the female as she sits on the nest. Young birds are fed by all other members of the group. Territories range from one to fifty hectares (usually around ten hectares) and are defended all year. Territorial disputes with neighbouring groups are frequent and may last up to several hours, with much calling, chasing and occasional fighting					
Homoranthus darwinioides	Homoranthus darwinioides	Rare in the central tablelands and western slopes of NSW, occurring from Putty to the Dubbo district. It is found west of Muswellbrook between Merriwa and Bylong, and north of Muswellbrook to Goonoo SF. The species has been collected from Lee's Pinch, but not relocated at its original locality north of Mt Coricudgy above the headwaters of Widden Brook. Goonoo SF is established as a definite locality. Grows in in various woodland habitats with shrubby understoreys, usually in gravely sandy soils. Landforms the species has been recorded growing on include flat sunny ridge tops with scrubby woodland, sloping ridges, gentle south-facing slopes, and a slight depression on a roadside with loamy sand. Associated species include Callitris endlicheri, Eucalyptus crebra, E. fibrosa, E. trachyphloia, E. beyeri subsp. illaquens, E. dwyeri, E. rossii, Leptospermum divaricatum, Melaleuca uncinata, Calytrix tetragona, Allocasuarina spp. and Micromyrtus spp. Flowers in spring or from March to December. The species has been cultivated in Sydney from Rylstone cuttings and at Burrendong Arboretum near Wellington. Forms small shrubs or shrublets, often in tangled masses. It has a localised distribution and may be the dominant undershrub at some sites. Its abundance in populations ranges from rare (only one plant at site) to very locally abundant.	Vulnerable	Vulnerable	Known		Potential to occur in the Subject Site. Known to occur in Goonoo SCA.
Lathams Snipe	Gallinago hardwickii	Latham's Snipe is a non-breeding visitor to south-eastern Australia. The distribution of Latham's Snipe is naturally fragmented (although, because of the mobility of the species, this is unlikely to have any effect on survival). The distribution is fragmented because the preferred habitat (ie freshwater wetlands) occurs in patches throughout the non-breeding grounds (Weston 2006, pers. comm.).		Listed		Species or species habitat may occur within area	Unlikely. Suitable habitat for this species does not occur in the Subject Site.
Hooded Robin (south-eastern	Melanodryas	Prefers lightly wooded country, usually open eucalypt woodland,	Vulnerable		Known		Unlikely

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form)	cucullata cucullata	acacia scrub and mallee, often in or near clearings or open areas.					
		Requires structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses.					
		Often perches on low dead stumps and fallen timber or on low- hanging branches, using a perch-and-pounce method of hunting insect prey.					
		Territories range from around 10 ha during the breeding season, to 30 ha in the non-breeding season.					
		May breed any time between July and November, often rearing several broods.					
		The nest is a small, neat cup of bark and grasses bound with webs, in a tree fork or crevice, from less than 1 metre to 5 metres above the ground.					
		The nest is defended by both sexes with displays of injury-feigning, tumbling across the ground.					
		A clutch of two to three is laid and incubated for fourteen days by the female. Two females often cooperate in brooding.					
Keith's Zieria		Grows in dry sclerophyll forest on light sandy soils. All known populations have been recorded in Eucalyptus-Callitris woodland or open forest with a shrubby to heathy understorey. Mostly from gentle slopes in red-brown and yellow-brown sandy loams, often with a rocky surface. Associated and understorey species include Eucalyptus crebra, Eucalyptus fibrosa, Eucalyptus dwyeri, Eucalyptus beyeriana, Eucalyptus microcarpa, Callitris endlicheri, Allocasuarina diminuta, Allocasuarina distyla, Allocasuarina verticillata, Leptospermum divaricatum, Leptospermum parvifolium, Acacia triptera, Acacia gladiiformis, Acacia brownii, Grevillea floribunda, Grevillea triternata, Hakea decurrens, Boronia glabra, Philotheca salsolifolia, Leucopogon attenuatus, Melaleuca uncinata, Melaleuca erubescens, Kunzea parvifolia, Calytrix tetragona, Brachyloma daphnoides, Melichrus urceolatus, Cassinia aculeata, Dodonaea viscosa subsp. spatulata, Dodonaea peduncularis, Dodonaea heteromorpha, Dillwynia sericea, Hibbertia riparia, Dampiera lanceolata, Dianella longifolia, Prostanthera species and Goodenia species. Flowering time is in spring and plants bear fruit in summer. Plants can produce flowers and fruits any time between July and March. Grows only in small localised populations within the north-east and central areas of Goonoo State Forest. Population sizes vary from 6 to 80 individuals. The age structure within populations may be	Endangered	Endangered	Known		Unlikely.

Common Name	Scientific Name	Habitat and Ecology (OEH Species Profile and /or EPBC SPRAT Profile)	TSC Act Status	EPBC Act Status	OEH Threatened Species Search	DSEWPaC Protected Matters Search	Potential to occur
Koala	Phascolarctos cinereus	Inhabit eucalypt woodlands and forests. Feed on the foliage of more than 70 eucalypt species and 30 non- eucalypt species, but in any one area will select preferred browse species. Inactive for most of the day, feeding and moving mostly at night. Spend most of their time in trees, but will descend and traverse open ground to move between trees. Home range size varies with quality of habitat, ranging from less than two ha to several hundred hectares in size. Generally solitary, but have complex social hierarchies based on a dominant male with a territory overlapping several females and sub-ordinate males on the periphery. Females breed at two years of age and produce one young per year.	Vulnerable		Known	Species or species Known to occur within Area	Potential
Leafless Indigo	Indigofera efoliata	Indigofera efoliata occurs in the central western slopes of NSW, from Dubbo to Geurie (Ayres et al., 1996). In August 1955, the species was recorded along the Dubbo to Minore railway line and road, on Wallaringa and Geurie properties and in Goonoo State Forest (DECC, 2005). Forty eight sites were searched in November 1997, but no plants were found. There are only two early records that contain precise locality details, both of which have been either heavily grazed or cleared of native vegetation, with one site now supporting a dense cover of weeds (Mackay & Gross, 1998). The species is very rare and considered to be possibly extinct (DECC, 2005). The species occurs within the Central West (NSW) Natural Resource Management Regions (DECC, 2005). Indigofera efoliata prefers stony ground in red-brown sandy loam on a slight rise, among ironstone formation (Harden, 1991; Ayres et al., 1996; Mackay & Gross, 1998). It appears to inhabit Yellow- box (Eucalyptus melliodora) woodland (Mackay & Gross, 1998), E. crebra–Callitris glaucophylla tall woodland (DECC, 2005). The average annual rainfall where the species has been recorded is between 475 and 600 mm (Mackay & Gross, 1998).	Endangered	Endangered	Known		Unlikely.
Large-eared Pied Bat	Chalinolobus dwyeri	Found mainly in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands. It is generally rare with a very patchy distribution in NSW. There are scattered records from the New England Tablelands and North West Slopes.	Vulnerable	Vulnerable	Predicted	Species or species habitat may occur within Area	Unlikely
Little Eagle	Hieraaetus morphnoides	Occupies open eucalypt forest, woodland or open woodland. Sheoak or acacia woodlands and riparian woodlands of interior	Vulnerable		Known		Potential have hunting grounds

Common Name	Scientific Name	Habitat and Ecology (OEH Species Profile and /or EPBC SPRAT Profile)	TSC Act Status	EPBC Act Status	OEH Threatened Species Search	DSEWPaC Protected Matters Search	Potential to occur
		NSW are also used. Nests in tall living trees within a remnant patch, where pairs build a large stick nest in winter. Lays two or three eggs during spring, and young fledge in early summer. Preys on birds, reptiles and mammals, occasionally adding large insects and carrion.					in the Subject Site
Little Lorikeet	Glossopsitta pusilla	Feeds mostly on nectar and pollen, occasionally on native fruits such as mistletoe, and only rarely in orchards Gregarious, travelling and feeding in small flocks (<10), though often with other lorikeets. Flocks numbering hundreds are still occasionally observed and may have been the norm in past centuries. Roosts in treetops, often distant from feeding areas. Nests in proximity to feeding areas if possible, most typically selecting hollows in the limb or trunk of smooth-barked Eucalypts. Entrance is small (3 cm) and usually high above the ground (2–15 m). These nest sites are often used repeatedly for decades, suggesting that preferred sites are limited. Riparian trees often chosen, including species like Allocasuarina. Nesting season extends from May to September. In years when flowering is prolific, Little Lorikeet pairs can breed twice, producing 3-4 young per attempt. However, the survival rate of fledglings is unknown. Forages primarily in the canopy of open Eucalyptus forest and woodland, yet also finds food in Angophoras, Melaleucas and other tree species. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity. Isolated flowering trees in open country, e.g. paddocks, roadside remnants and urban trees also help sustain viable populations of the species.	Vulnerable		Known		Potential
Little Pied Bat	Chalinolobus picatus	Occurs in dry open forest, open woodland, mulga woodlands, chenopod shrublands, cypress-pine forest, mallee, Bimbil box. Roosts in caves, rock outcrops, mine shafts, tunnels, tree hollows and buildings. Can tolerate high temperatures and dryness but need access to nearby open water. Feeds on moths and possibly other flying invertebrates.	Vulnerable		Known		Potential.
Magpie Goose	Anseranas semipalmata	Mainly found in shallow wetlands (less than 1 metre deep) with dense growth of rushes or sedges. Equally at home in aquatic or terrestrial habitats; often seen	Vulnerable		Known		Unlikely. Suitable habitat for this species does not occur in the

Common Name	Scientific Name	Habitat and Ecology (OEH Species Profile and /or EPBC SPRAT Profile)	TSC Act Status	EPBC Act Status	OEH Threatened Species Search	DSEWPaC Protected Matters Search	Potential to occur
		 walking and grazing on land; feeds on grasses, bulbs and rhizomes. Activities are centred on wetlands, mainly those on floodplains of rivers and large shallow wetlands formed by run-off; breeding can occur in both summer and winter dominated rainfall areas and is strongly influenced by water level; most breeding now occurs in monsoonal areas; nests are formed in trees over deep water; breeding is unlikely in south-eastern NSW. Often seen in trios or flocks on shallow wetlands, dry ephemeral swamps, wet grasslands and floodplains; roosts in tall vegetation. 					Subject Site.
Major Mitchell's Cockatoo	Lophochroa leadbeateri	 Inhabits a wide range of treed and treeless inland habitats, always within easy reach of water. Feeds mostly on the ground, especially on the seeds of native and exotic melons and on the seeds of species of saltbush, wattles and cypress pines. Normally found in pairs or small groups, though flocks of hundreds may be found where food is abundant. Nesting, in tree hollows, occurs throughout the second half of the year; nests are at least 1 kilometre apart, with no more than one pair every 30 square kilometres. 	Vulnerable		Known		Potential to occur in the Subject Site.
Malleefowl	Leipoa ocellata	 Predominantly inhabit mallee communities, preferring the tall, dense and floristically-rich mallee found in higher rainfall (300 - 450 mm mean annual rainfall) areas. Utilises mallee with a spinifex understorey, but usually at lower densities than in areas with a shrub understorey. Less frequently found in other eucalypt woodlands, such as Inland Grey Box, Ironbark or Bimble Box Woodlands with thick understorey, or in other woodlands such dominated by Mulga or native Cypress Pine species. Prefers areas of light sandy to sandy loam soils and habitats with a dense but discontinuous canopy and dense and diverse shrub and herb layers. Although Malleefowl will occupy areas within five years of fire, they prefer older age classes, with little breeding in areas less than 20 years after fire, and in one study the highest densities recorded in long unburnt mallee (60 to 80 years post fire). A pair may occupy a range of between 50 and 500 ha, overlapping with those of their neighbours. Mainly forage in open areas on seeds of acacias and other native shrubs (<i>Cassia, Beyeria, Bossiaea</i>), buds, flowers and fruits of herbs and various shrubs, insects (cockroaches, ants, soil invertebrates), and cereals if available. 	Endangered	Endangered	Predicted	Species or species habitat known to occur within area	No. Suitable habitat for this species does not occur in the Subject Site. No mallee habitat in the Subject Site or adjacent mallee habitat.

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		Incubate eggs in large mounds that contain considerable volumes of sandy soil. The litter within the mounds must be dampened for it to decompose and provide heat for incubation of eggs. Up to 34 eggs may be laid in a single season, though usually between 15 and 24 (and clutches smaller in dry years). The male monitors the temperature within the egg chamber using its bill, and regularly works the mound during the breeding season to maintain a constant temperature around 34 degrees. The chicks hatch after between 49 and 96 days (average around 60) and can walk as soon as they emerge from the mound, can run quickly within two hours and can fly within 24 hours.					
Masked Owl	Tyto novaehollandiae	Roosts and breeds in moist eucalypt forested gullies, using large tree hollows or sometimes caves for nesting. Lives in dry eucalypt forests and woodlands from sea level to 1100 m. A forest owl, but often hunts along the edges of forests, including roadsides. The typical diet consists of tree-dwelling and ground mammals, especially rats. Pairs have a large home-range of 500 to 1000 hectares.	Vulnerable		Known		Potential. Suitable breeding habitat (large hollow bearing trees and tall forest trees) for this species does not occur in the Subject Site. Potential to hunt in the Subject Site.
Murray Cod	Maccullochella peelii peelii	The Murray Cod is the largest freshwater fish found in Australia. It is a long lived predator species that is highly territorial and aggressive. It occurs naturally in the waterways of the Murray– Darling Basin in a wide range of warm water habitats that range from clear, rocky streams to slow flowing turbid rivers and billabongs. The upper reaches of the Murray and Murrumbidgee Rivers are considered too cold to contain suitable habitat.	FM Act	Vulnerable		Species or species habitat may occur within Area	No. The works will not occur in proximity likely habitat
Mauve Burr- daisy	Calotis glandulosa	Found in montane and subalpine grasslands in the Australian Alps. Found in subalpine grassland (dominated by Poa spp.), and montane or natural temperate grassland dominated by Kangaroo Grass (Themeda australis) and Snow Gum (Eucalyptus pauciflora) Woodlands on the Monaro and Shoalhaven area.	Vulnerable	Vulnerable	Known		No
Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain,		This EEC is known from parts of the Local Government Areas of Berrigan, Bland, Bogan, Carrathool, Conargo, Coolamon, Coonamble, Corowa, Forbes, Gilgandra, Griffith, Gwydir, Inverell, Jerilderee, Lachlan, Leeton, Lockhart, Moree Plains, Murray, Murrumbidgee, Narrabri, Narranderra, Narromine, Parkes, Urana, Wagga Wagga and Warren, and but may occur elsewhere in these bioregions.	Endangered Ecological Community	Endangered	Known	Community may occur within area	No

Common Name	Scientific Name	Habitat and Ecology (OEH Species Profile and /or EPBC SPRAT Profile)	TSC Act Status	EPBC Act Status	OEH Threatened Species Search	DSEWPaC Protected Matters Search	Potential to occur
Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions							
Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland		Native tussock grasslands, such as the Natural grasslands on basalt and fine-textured alluvial plains of northern NSW and southern Queensland, once occurred over a large area of Australia (DEWR 2007). The species composition of tussock grasslands varies throughout its range and is influenced by factors such as rainfall, soil, geology and land use history. These influences may vary the expression of the ecological community over short periods or across small distances (Butler 2007 unpublished).	Natural Temperate Grassland of the Southern Tablelands (NSW Act)	Critically Endangered		Community may occur within area	No
Painted Honeyeater	Grantiella picta	Inhabits Boree, Brigalow and Box-Gum Woodlands and Box- Ironbark Forests. A specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias. Prefers mistletoes of the genus Amyema. Insects and nectar from mistletoe or eucalypts are occasionally eaten. Nest from spring to autumn in a small, delicate nest hanging within the outer canopy of drooping eucalypts, she-oak, paperbark or mistletoe branches.	Vulnerable		Known		Potential.
Painted Snipe	Rostratula australis	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds. The nest consists of a scrape in the ground, lined with grasses and leaves. Breeding is often in response to local conditions; generally occurs from September to December. Forages nocturnally on mud-flats and in shallow water. Feeds on worms, molluscs, insects and some plant-matter.	Vulnerable	Vulnerable	Known	Species or species habitat may occur within Area	No
Pale-headed Snake	Hoplocephalus bitorquatus	Found mainly in dry eucalypt forests and woodlands, cypress woodland and occasionally in rainforest or moist eucalypt forest. Favours streamside areas, particularly in drier habitats. Shelter during the day between loose bark and tree-trunks, or in hollow trunks and limbs of dead trees.	Vulnerable		Predicted		Unlikely. Suitable habitat for this species does not occur in the Subject Site.

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		The main prey is tree frogs although lizards and small mammals are also taken.					-
Pink-tailed Legless Lizard	Aprasia parapulchella	The Pink-tailed Worm Lizard is only known from the Central and Southern Tablelands, and the South Western Slopes. There is a concentration of populations in the Canberra/Queanbeyan Region. Other populations have been recorded near Cooma, Yass, Bathurst, Albury and West Wyalong. This species is also found in the Australian Capital Territory. Inhabits sloping, open woodland areas with predominantly native grassy groundlayers, particularly those dominated by Kangaroo Grass (Themeda australis). Sites are typically well-drained, with rocky outcrops or scattered, partially-buried rocks. Commonly found beneath small, partially-embedded rocks and appear to spend considerable time in burrows below these rocks; the burrows have been constructed by and are often still inhabited by small black ants and termites. Feeds on the larvae and eggs of the ants with which it shares its burrows. It is thought that this species lays two eggs inside the ant nests during summer; the young first appear in March.	Vulnerable	Vulnerable	Not identified in Central West Sub CMAs Pilliga or Talbragar Valley		No. However previously recorded near Dubbo. Suitable habitat for this species in the Central West CMA is known to occur on trachyte soils where small flat basalt rocks litter the surface.
Painted Snipe	Rostratula benghalensis (sensu lato)	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber.	Endangered	Endangered		Species or species habitat may occur within area	No
Philotheca ericifolia	Philotheca ericifolia	Known only from the upper Hunter Valley and Pilliga to Peak Hill districts of NSW. The records are scattered over a range of over 400 kilometres between West Wyalong and the Pilliga Scrub. Site localities include Pilliga East State Forest, Goonoo State Forest, Hervey Range, Wingen Maid Nature Reserve, Toongi, Denman, Rylstone district and Kandos Weir. Grows chiefly in dry sclerophyll forest and heath on damp sandy flats and gullies. It has been collected from a variety of habitats including heath, open woodland, dry sandy creek beds, and rocky ridge and cliff tops. Associated species include Melaleuca uncinata, Eucalyptus crebra, E. rossii, E. punctata, Corymbia trachyphloia, Acacia triptera, A. burrowii, Beyeria viscosa, Philotheca australis, Leucopogon muticus and Calytrix tetragona. Flowering time is in the spring. Fruits are produced from November to December.		Vulnerable (Commonwe alth listed only)			No. Not identified in searches however known to have once occurred near Dubbo.

Common Name	Scientific Name	Habitat and Ecology (OEH Species Profile and /or EPBC SPRAT Profile)	TSC Act Status	EPBC Act Status	OEH Threatened Species Search	DSEWPaC Protected Matters Search	Potential to occur
		 Noted as being a "moisture-loving plant", with plants common on the sides of a particular spur of the Hervey Ranges where soakage from the high background provides sufficient moisture for the plants. Also recorded growing in a recently burnt site (wildfire) and within a regeneration zone resulting from clearing. Populations comprise from 3-12 adult plants to approx. 200 plants (mostly seedlings in one population). Also described as uncommon, scattered, common, locally occasional and locally frequent. Populations in Pilliga State Forest consist of hundreds or thousands of individuals. A very large population occurs in Lincoln State Forest near Gilgandra. 					
Pine Donkey Orchid	Diuris tricolor	 The Pine Donkey Orchid grows in sclerophyll forest among grass, often with native Cypress Pine (<i>Callitris spp.</i>). It is found in sandy soils, either on flats or small rises. Also recorded from a red earth soil in a Bimble Box community in western NSW. Usually recorded as common and locally frequent in populations, however only one or two plants have also been observed at sites. The species has been noted as growing in large colonies. Disturbance regimes are not known, although the species is usually recorded from disturbed habitats. Associated species include <i>Callitris glaucophylla, Eucalyptus populnea, Eucalyptus intertexta</i>, Ironbark and <i>Acacia</i> shrubland. The understorey is often grassy with herbaceous plants such as <i>Bulbine</i> species. Flowers from September to November or generally spring. The species is a tuberous, deciduous terrestrial orchid and the flowers have a pleasant, light sweet scent. 	Vulnerable		Known		Likely. Recorded in similar grassland in proximity to the Subject Site
Powerful Owl	Ninox connivens	Territorial pairs respond strongly to recordings of Barking Owl calls from up to 6 km away, though humans rarely hear this response farther than 1.5 km. Because disturbance reduces the pair's foraging time, and can pull the female off her eggs even on cold nights, recordings should not be broadcast unnecessarily nor during the nesting season. Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. Is flexible in its habitat use and hunting can extend in to closed forest and more open areas. Sometimes able to successfully breed along timbered watercourses in heavily cleared habitats (e.g. western NSW) due to the higher density of prey on these fertile soils.	Vulnerable		Predicted		Unlikely. Suitable habitat for this species does not occur in the Subject Site.

Common Name	Scientific Name	Habitat and Ecology (OEH Species Profile and /or EPBC SPRAT Profile)	TSC Act Status	EPBC Act Status	OEH Threatened Species Search	DSEWPaC Protected Matters Search	Potential to occur
		Roost in shaded portions of tree canopies, including tall midstorey trees with dense foliage such as Acacia and Casuarina species. During nesting season, the male perches in a nearby tree overlooking the hollow entrance. Preferentially hunts small arboreal mammals such as Squirrel Gliders and Ringtail Possums, but when loss of tree hollows decreases these prey populations it becomes more reliant on birds, invertebrates and terrestrial mammals such as rodents and rabbits. Can catch bats and moths on the wing, but typically hunts by sallying from a tall perch. Requires very large permanent territories in most habitats due to sparse prey densities. Monogamous pairs hunt over as much as 6000 hectares, with 2000 hectares being more typical in NSW habitats. Two or three eggs are laid in hollows of large, old trees. Living eucalypts are preferred though dead trees are also used. Nest sites are used repeatedly over years by a pair, but they may switch sites if disturbed by predators (e.g. goannas). Nesting occurs during mid-winter and spring. Female incubates for 5 weeks, roosts outside the hollow when chicks are 4 weeks old, then fledging starts two weeks later. Young are dependent for several months					
Regent Honeyeater	Anthochaera phrygia	The Regent Honeyeater is a flagship threatened woodland bird whose conservation will benefit a large suite of other threatened and declining woodland fauna. The species inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak. Regent Honeyeaters inhabit woodlands that support a significantly high abundance and species richness of bird species. These woodlands have significantly large numbers of mature trees, high canopy cover and abundance of mistletoes. Every few years non-breeding flocks are seen foraging in flowering coastal Swamp Mahogany and Spotted Gum forests, particularly on the central coast and occasionally on the upper north coast. Birds are occasionally seen on the south coast. In the last 10 years Regent Honeyeaters have been recorded in urban areas around Albury where woodlands tree species such as Mugga Ironbark and Yellow Box were planted 20 years ago. The Regent Honeyeater is a generalist forager, which mainly feeds on the nectar from a wide range of eucalypts and mistletoes. Key eucalypt species include Mugga Ironbark, Yellow Box, Blakely's Red Gum, White Box and Swamp Mahogany. Also utilises: <i>E.</i> <i>microcarpa, E. punctata, E. polyanthemos, E. mollucana,</i> <i>Corymbia robusta, E. crebra, E. caleyi, Corymbia maculata,</i>	Critically Endangered	Endangered	Known	Species or species habitat may occur within Area	Likely. Over- wintering feeding resources. Breeding habitat does not occur in the Subject Site

Common Name	Scientific Name	Habitat and Ecology (OEH Species Profile and /or EPBC SPRAT Profile)	TSC Act Status	EPBC Act Status	OEH Threatened Species Search	DSEWPaC Protected Matters Search	Potential to occur
		E.mckieana, E. macrorhyncha, E. laevopinea, and Angophora floribunda. Nectar and fruit from the mistletoes A. miquelii, A. pendula, A. cambagei are also eaten during the breeding season. When nectar is scarce lerp and honeydew comprise a large proportion of the diet. Insects make up about 15% of the total diet and are important components of the diet of nestlings. A shrubby understorey is an important source of insects and nesting material.					
Ruff	Philomachus pugnax	The Ruff is a rare but regular visitor to Australia, being recorded in all States and Territories. In Australia the Ruff is found on generally fresh, brackish of saline wetlands with exposed mudflats at the edges. It is found in terrestrial wetlands including lakes, swamps, pools, lagoons, tidal rivers, swampy fields and flood lands. They are occasionally seen on sheltered coasts, in harbours, estuaries, seashores and are known to visit sewage farms and salt works. They are sometimes found on wetlands surrounded by dense vegetation including grass, sedges, saltmarsh and reeds. They have been observed on sand spits and other sandy habitats including shingles. The Ruff forages on exposed mudflats, in shallow water and occasionally on dry mud. They have been observed foraging in dry waterside plants and in swampy areas next to aeration tanks in sewage farms. They prefer to roost amongst shorter vegetation (Higgins & Davies 1996).		Marine Migratory			No. Previously recorded in the Dubbo LGA. No suitable habitat for this species exists in the Subject Site
Rainbow Bee- eater	Merops ornatus	The Rainbow Bee-eater occurs mainly in open forests and woodlands, shrublands, and in various cleared or semi-cleared habitats, including farmland and areas of human habitation (Higgins 1999). It usually occurs in open, cleared or lightly-timbered areas that are often, but not always, located in close proximity to permanent water (Badman 1979; Boekel 1976; Fry 1984; Roberts 1979; Storr 1984a, 1984b, 1985a). It also occurs in inland and coastal sand dune systems, and in mangroves in northern Australia, and has been recorded in various other habitat types including heathland, sedgeland, vine forest and vine thicket, and on beaches (Higgins 1999). The Rainbow Bee-eater occurs in open woodlands and shrublands, including mallee, and in open forests that are usually dominated by eucalypts. It also occurs in grasslands (Gibson 1986; Jones 1986; Leach 1988; Longmore 1978; McEvey & Middleton 1968; Saunders & Ingram 1995; Woinarski et al. 1988, 1989) and, especially in arid or semi-arid areas, in riparian, floodplain or wetland vegetation assemblages (Badman 1989; Gee et al. 1996; Gibson 1986; Gibson & Cole 1988; Henle 1989; Longmore 1978; Storr 1977; Woinarski et al. 1988).		Migratory JAMBA		Species or species habitat may occur within area	Potential. Suitable breeding habitat (deep sandy banks near waterways) for this species does not occur in the Subject Site. Potential to hunt in the Subject Site, however more likely to occur near rivers and flowing creeks.
Red-tailed	Phaethon	Marine	Vulnerable				No

Common Name	Scientific Name	Habitat and Ecology (OEH Species Profile and /or EPBC SPRAT Profile)	TSC Act Status	EPBC Act Status	OEH Threatened Species Search	DSEWPaC Protected Matters Search	Potential to occur
Tropicbird	rubricauda	Breeds in coastal cliffs and under bushes in tropical Australia. Nests on cliffs of the northern hills and southern mountains on the main island at Lord Howe Island.					
Scarlet Robin	Petroica boodang	The Scarlet Robin lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs. This species lives in both mature and regrowth vegetation. It occasionally occurs in mallee or wet forest communities, or in wetlands and tea-tree swamps. Scarlet Robin habitat usually contains abundant logs and fallen timber: these are important components of its habitat. The Scarlet Robin breeds on ridges, hills and foothills of the western slopes, the Great Dividing Range and eastern coastal regions; this species is occasionally found up to 1000 meters in altitude. The Scarlet Robin is primarily a resident in forests and woodlands, but some adults and young birds disperse to more open habitats after breeding. In autumn and winter many Scarlet Robins live in open grassy woodlands, and grasslands or grazed paddocks with scattered trees. Birds forage from low perches, fence-posts or on the ground, from where they pounce on small insects and other invertebrates which are taken from the ground, or off tree trunks and logs; they sometimes forage in the shrub or canopy layer. Scarlet Robin pairs defend a breeding territory and mainly breed between the months of July and January; they may raise two or three broods in each season. This species' nest is an open cup made of plant fibres and cobwebs and is built in the fork of tree usually more than 2 meters above the ground; nests are often found in a dead branch in a live tree, or in a dead tree or shrub. In autumn and winter, the Scarlet Robin joins mixed flocks of other small insectivorous birds which forage through dry forests and woodlands.	Vulnerable		Predicted		Potential.
Satin Flycatcher	Myiagra cyanoleuca	Satin Flycatchers inhabit heavily vegetated gullies in eucalypt- dominated forests and taller woodlands, and on migration, occur in coastal forests, woodlands, mangroves and drier woodlands and open forests (Blakers et al. 1984; Emison et al. 1987; Officer 1969). Satin Flycatchers mainly inhabit eucalypt forests, often near wetlands or watercourses. They generally occur in moister, taller forests than the Leaden Flycatcher, Myiagra rebecula, often occurring in gullies		Listed		Species or species habitat may occur in the Subject Site	Potential

Common Name	Scientific Name	Habitat and Ecology (OEH Species Profile and /or EPBC SPRAT Profile)	TSC Act Status	EPBC Act Status	OEH Threatened Species Search	DSEWPaC Protected Matters Search	Potential to occur
Rufous Fantail	Rhipidura rufifrons	The Rufous Fantail occurs in coastal and near coastal districts of northern and eastern Australia (Lindsey 1992). Rhipidura rufifrons rufifrons has breeding populations occurring from about the South Australia-Victoria border, through south and central Victoria, on and east of the Great Divide in New South Wales (NSW), and north to about the NSW-Queensland border; and R. r. intermedia has breeding populations occurring on and east of the Great Divide, from about the NSW-Queensland border, north to the Cairns-Atherton region, Queensland (Higgins et al. 2006). Both subspecies winter farther north from Cape York Peninsula in Queensland to Torres Strait and southern Papua New Guinea. The two subspecies intergrade in a zone between the Queensland- NSW border ranges and the Clarence-Orara rivers in NSW (Scodde & Mason 1999).		Listed		Species or species habitat known to occur within area	Potential
Sharp-tailed Sandpiper	Calidris acuminata	The Sharp-tailed Sandpiper spends the non-breeding season in Australia with small numbers occurring regularly in New Zealand. Most of the population migrates to Australia, mostly to the south- east and are widespread in both inland and coastal locations and in both freshwater and saline habitats. Many inland records are of birds on passage (Cramp 1985; Higgins & Davies 1996).		Marine Migratory			Unlikely.
Silky Swainson-pea	Swainsona sericea	Silky Swainson-pea has been recorded from the Northern Tablelands to the Southern Tablelands and further inland on the slopes and plains. There is one isolated record from the far north- west of NSW. Its stronghold is on the Monaro. Also found in South Australia, Victoria and Queensland. Found in Natural Temperate Grassland and Snow Gum Eucalyptus pauciflora Woodland on the Monaro. Found in Box-Gum Woodland in the Southern Tablelands and South West Slopes. Sometimes found in association with cypress-pines Callitris spp. Habitat on plains unknown. Regenerates from seed after fire.	Vulnerable		Known		Unlikely.
Silver Perch	Bidyanus bidyanus	Silver Perch were once widespread and abundant throughout most of the Murray-Darling river system. They have now declined to low numbers or disappeared from most of their former range. Only one remaining secure and self-sustaining population occurs in NSW in the central Murray River downstream of Yarrawonga weir, as well as several anabranches and tributaries	Vulnerable (FM Act)				No. Habitat suitable for this species will not be impacted.
Sloane's Froglet	Crinia sloanei	It is typically associated with periodically inundated areas in grassland, woodland and disturbed habitats.	Vulnerable		Predicted		Unlikely
Speckled Warbler	Pyrrholaemus saggitatus	The Speckled Warbler lives in a wide range of <i>Eucalyptus</i> dominated communities that have a grassy	Vulnerable		Known		Yes. Known to occur in similar

Common Name	Scientific Name	Habitat and Ecology (OEH Species Profile and /or EPBC SPRAT Profile)	TSC Act Status	EPBC Act Status	OEH Threatened Species Search	DSEWPaC Protected Matters Search	Potential to occur
		understorey, often on rocky ridges or in gullies. Typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy. Large, relatively undisturbed remnants are required for the species to persist in an area. The diet consists of seeds and insects, with most foraging taking place on the ground around tussocks and under bushes and trees. Pairs are sedentary and occupy a breeding territory of about ten hectares, with a slightly larger home-range when not breeding. The rounded, domed, roughly built nest of dry grass and strips of bark is located in a slight hollow in the ground or the base of a low dense plant, often among fallen branches and other litter. A side entrance allows the bird to walk directly inside. A clutch of 3-4 eggs is laid, between August and January, and both parents feed the nestlings. The eggs are a glossy red-brown, giving rise to the unusual folk names 'Blood Tit' and 'Chocolate bird'. Some cooperative breeding occurs. The species may act as host to the Black-eared Cuckoo. Speckled Warblers often join mixed species feeding flocks in winter, with other species such as Yellow-rumped, Buff-rumped, Brown and Striated Thornbill.					habitat in the Central West.
Spotted Harrier	Circus assimilis	Occurs in grassy open woodland including acacia and mallee remnants, inland riparian woodland, and grassland and shrub steppe. It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands. Builds a stick nest in a tree and lays eggs in spring (or sometimes autumn), with young remaining in the nest for several months. Preys on terrestrial mammals (egg bandicoots, bettongs, and rodents), birds and reptile, occasionally insects and rarely carrion.	Vulnerable		Known		Potential to have hunting ground in the Subject Site.
Spotted-tailed Quoll	Dasyurus maculatus	Use 'latrine sites', often on flat rocks among boulder fields and rocky cliff-faces; these may be visited by a number of individuals; latrine sites can be recognised by the accumulation of the sometimes characteristic 'twisty-shaped' faeces deposited by animals. Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Individual animals use hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces as den sites.	Vulnerable	Endangered	Known		Potential. Habitat may occur in the Subject Site however the lack of timber and ground debris probably excludes this species.

Common Name	Scientific Name	Habitat and Ecology (OEH Species Profile and /or EPBC SPRAT Profile)	TSC Act Status	EPBC Act Status	OEH Threatened Species Search	DSEWPaC Protected Matters Search	Potential to occur
		Mostly nocturnal, although will hunt during the day; spends most of the time on the ground, although also an excellent climber and may raid possum and glider dens and prey on roosting birds. Consumes a variety of prey, including gliders, possums, small wallabies, rats, birds, bandicoots, rabbits and insects; also eats carrion and takes domestic fowl. Females occupy home ranges up to about 750 hectares and males up to 3500 hectares; usually traverse their ranges along densely vegetated creek lines. Average litter size is five; both sexes mature at about one year of					
Scant Pomaderris	Pomaderris queenslandica	age. Widely scattered but not common in north-east NSW and in Queensland. It is only known from a few locations on the New England Tablelands and North West Slopes, including near Torrington and Coolatai, and also from several locations on the NSW north coast. Found in moist eucalypt forest or sheltered woodlands with a shrubby understorey, and occasionally along creeks.	Endangered		Known		Potential to occur in the Subject Site. Known to occur in Goonoo SCA.
Square-tailed Kite	Lophoictinia isura	Found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses. In arid north-western NSW, has been observed in stony country with a ground cover of chenopods and grasses, open acacia scrub and patches of low open eucalypt woodland. Is a specialist hunter of passerines, especially honeyeaters, and most particularly nestlings, and insects in the tree canopy, picking most prey items from the outer foliage? Appears to occupy large hunting ranges of more than 100kilometer2. Breeding is from July to February, with nest sites generally located along or near watercourses, in a fork or on large horizontal limbs.	Vulnerable		Known		Potential to have hunting territory within the Subject Site.
Squirrel Glider	Petaurus norfolcensis	Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas. Prefers mixed species stands with a shrub or Acacia midstorey. Live in family groups of a single adult male one or more adult females and offspring. Require abundant tree hollows for refuge and nest sites. Diet varies seasonally and consists of Acacia gum, eucalypt sap, nectar, honeydew and manna, with invertebrates and pollen	Vulnerable		Predicted		Unlikely to occur in the Subject Site.

Common Name	Scientific Name	Habitat and Ecology (OEH Species Profile and /or EPBC SPRAT Profile)	TSC Act Status	EPBC Act Status	OEH Threatened Species Search	DSEWPaC Protected Matters Search	Potential to occur
, 		providing protein.			2		
Stripe-faced Dunnart	Sminthopsis macroura	Native dry grasslands and low dry shrublands, often along drainage lines. During periods of hot weather they shelter in cracks in the soil, in grass tussocks or under rocks and logs.	Vulnerable		Predicted		Unlikely. The lack of understorey, woody debris precludes this species from occurring in the Subject Site
Superb Parrot	Polytelis swainsonii	Inhabit Box-Gum, Box-Cypress-pine and Boree Woodlands and River Red Gum Forest. In the Riverina the birds nest in the hollows of large trees (dead or alive) mainly in tall riparian River Red Gum Forest or Woodland. On the South West Slopes nest trees can be in open Box-Gum Woodland or isolated paddock trees. Species known to be used are Blakely's Red Gum, Yellow Box, Apple Box and Red Box. Nest in small colonies, often with more than one nest in a single tree. Breed between September and January. May forage up to 10 kilometres from nesting sites, primarily in grassy box woodland. Feed in trees and understorey shrubs and on the ground and their diet consists mainly of grass seeds and herbaceous plants. Also eaten are fruits, berries, nectar, buds, flowers, insects and grain.	Vulnerable	Vulnerable	Known	Species or species habitat likely to occur within area	Likely
Swift Parrot	Lathamus discolor	 Migrates to the Australian south-east mainland between March and October. On the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Favoured feed trees include winter flowering species such as Swamp Mahogany <i>Eucalyptus robusta</i>, Spotted Gum <i>Corymbia maculata</i>, Red Bloodwood <i>C. gummifera</i>, Mugga Ironbark <i>E. sideroxylon</i>, and White Box <i>E. albens</i>. Commonly used lerp infested trees include Inland Grey Box <i>E. microcarpa</i>, Grey Box <i>E. moluccana</i> and Blackbutt <i>E. pilularis</i>. Return to some foraging sites on a cyclic basis depending on food availability. Following winter they return to Tasmania where they breed from September to January, nesting in old trees with hollows and feeding in forests dominated by Tasmanian Blue Gum <i>Eucalyptus globulus</i>. 	Endangered	Endangered	Known	Species or species habitat likely to occur within Area	Potential to occur. Feeding resources may occur in the Subject Site, however Breeding habitat is in Tasmania
Turquoise	Neophema pulchella	Lives on the edges of eucalypt woodland adjoining clearings,	Vulnerable		Known		Potential to occur

Common Name	Scientific Name	Habitat and Ecology (OEH Species Profile and /or EPBC SPRAT Profile)	TSC Act Status	EPBC Act Status	OEH Threatened Species Search	DSEWPaC Protected Matters Search	Potential to occur
Parrot		timbered ridges and creeks in farmland. Usually seen in pairs or small, possibly family, groups and have also been reported in flocks of up to thirty individuals. Prefers to feed in the shade of a tree and spends most of the day on the ground searching for the seeds or grasses and herbaceous plants, or browsing on vegetable matter. Forages quietly and may be quite tolerant of disturbance. However, if flushed it will fly to a nearby tree and then return to the ground to browse as soon as the danger has passed. Nests in tree hollows, logs or posts, from August to December. It lays four or five white, rounded eggs on a nest of decayed wood dust.					on the edge of the forested portions of the Subject Site adjoining grassy areas. Breeding habitat does not occur in the Subject Site.
Trout Cod	Maccullochella macquariensis	The Trout Cod is endemic to the southern Murray-Darling river system, including the Murrumbidgee and Murray Rivers, and the Macquarie River in central NSW. The species was once widespread and abundant in these areas but has undergone dramatic declines in its distribution and abundance over the past century. The last known reproducing population of Trout Cod is confined to the Murray River below Yarrawonga downstream to Tocumwal.	Endangered FM Act	Endangered		Species or species habitat may occur within area	No
Varied Sittella	Daphoenositta chrysoptera	Inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland. Feeds on arthropods gleaned from crevices in rough or decorticating bark, dead branches, standing dead trees and small branches and twigs in the tree canopy. Builds a cup-shaped nest of plant fibres and cobwebs in an upright tree fork high in the living tree canopy, and often re-uses the same fork or tree in successive years. Generation length is estimated to be 5 years.	Vulnerable		Known		Likely.
White Box- Yellow Box- Blakely's Red Gum Grassy Woodland and Derived Native Grassland		 Characterised by the presence or prior occurrence of White Box, Yellow Box and/or Blakely's Red Gum. The trees may occur as pure stands, mixtures of the three species or in mixtures with other trees, including wattles. Commonly co-occurring eucalypts include Apple Box (<i>E. bridgesiana</i>), Red Box (<i>E. polyanthemos</i>), Candlebark (<i>E. rubida</i>), Snow Gum (<i>E. pauciflora</i>), Argyle Apple (<i>E. cinerea</i>), Brittle Gum (<i>E. mannifera</i>), Red Stringybark (<i>E. macrorhyncha</i>), Grey Box (<i>E. microcarpa</i>), Cabbage Gum (<i>E. amplifolia</i>) and others. The understorey in intact sites is characterised by native grasses and a high diversity of herbs; the most commonly encountered include Kangaroo Grass (<i>Themeda australis</i>) Poa Tussock (<i>Poa</i>) 	EEC	Critically Endangered	Known	Community likely to occur within area	Yes. Known to on areas of higher ground in the Dubbo area.
Common Name	Scientific Name	Habitat and Ecology (OEH Species Profile and /or EPBC SPRAT Profile)	TSC Act Status	EPBC Act Status	OEH Threatened Species Search	DSEWPaC Protected Matters Search	Potential to occur
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		sieberiana), wallaby grasses (Austrodanthonia spp.), spear- grasses (Austrostipa spp.), Common Everlasting (Chrysocephalum apiculatum), Scrambled Eggs (Goodenia pinnatifida), Small St John's Wort (Hypericum gramineum), Narrow-leafed New Holland Daisy (Vittadinia muelleri) and blue-bells (Wahlenbergia spp.).					
		Shrubs are generally sparse or absent, though they may be locally common.					
		Remnants generally occur on fertile lower parts of the landscape where resources such as water and nutrients are abundant.					
		Sites with particular characteristics, including varying age classes in the trees, patches of regrowth, old trees with hollows and fallen timber on the ground are very important as wildlife habitat.					
		Sites in the lowest parts of the landscape often support very large trees which have leafy crowns and reliable nectar flows - sites important for insectivorous and nectar feeding birds.					
		Sites that retain only a grassy groundlayer and with few or no trees remaining are important for rehabilitation, and to rebuild connections between sites of better quality.					
		Remnants support many species of threatened fauna and flora. Retention of remnants is important as they contribute to productive farming systems (stock shelter, seed sources, sustainable grazing and water-table and salinity control).					
		The fauna of remnants (insectivorous birds, bats, etc.) can contribute to insect control on grazing properties.					
		Some of the component species (e.g. wattles, she-oaks, native legumes) fix nitrogen that is made available to other species in the community, while fallen timber and leaves recycle their nutrients.					
		Disturbed remnants are considered to form part of the community, including where the vegetation would respond to assisted natural regeneration.					
		Regularly observed in the saltmarsh of Newington Nature Reserve (with occasional sightings from other parts of Sydney Olympic Park and in grassland on the northern bank of the Parramatta River). Current estimates suggest this population consists of 8 individuals.					
White-fronted Chat	Epthianura albifrons	Regularly observed in the saltmarsh and on the sandy shoreline of a small island of Towra Point Nature Reserve. This population is estimated to comprise 19-50 individuals.	Endangered population		Known		habitat for this species does not
		The Newington and Towra Point populations are thought to be disjunct from each other (and from the nearest populations outside Sydney Metropolitan CMA).					Subject Site.
		Gregarious species, usually found foraging on bare or grassy ground in wetland areas, singly or in pairs. They are insectivorous,					

Common Name	Scientific Name	Habitat and Ecology (OEH Species Profile and /or EPBC SPRAT Profile)	TSC Act Status	EPBC Act Status	OEH Threatened Species Search	DSEWPaC Protected Matters Search	Potential to occur
		feeding mainly on flies and beetles caught from or close to the ground. Have been observed breeding from late July through to early March, with 'open-cup' nests built in low vegetation. Nests in the Sydney region have also been seen in low isolated mangroves. Nests are usually built about 23 cm above the ground (but have been found up to 2.5 metres above the ground). Two to three eggs are laid in each clutch, and the complete nesting cycle from nest-building to independent young is approximately 50 days. Birds can breed at one year of age and are estimated to live for five years.					
White-bellied Sea-Eagle	Haliaeetus leucogaster	The White-bellied Sea-Eagle is distributed along the coastline (including offshore islands) of mainland Australia and Tasmania. It also extends inland along some of the larger waterways, especially in eastern Australia. The inland limits of the species are most restricted in south-central and south-western Australia, where it is confined to a narrow band along the coast (Barrett et al. 2003; Bilney & Emison 1983; Blakers et al. 1984; Marchant & Higgins 1993). Recent analysis indicates that the distribution of the sea- eagle may shift in response to climatic conditions, with an apparent decreased occupancy of inland sites (and increased occupancy of coastal sites) during drought conditions (Shephard et al. 2005a). Breeding has been recorded from only a relatively small area of the total distribution. Breeding records are patchily distributed, mainly along the coastline, and especially the eastern coast, extending from Queensland to Victoria, and to Tasmania. Breeding has also been recorded at some sites further inland, e.g. around the Murray, Murrumbidgee and Lachlan Rivers in northern Victoria and south-west NSW, and at other large drainage systems and water storages (Marchant & Higgins 1993). Although known breeding sites are widely dispersed, the species could potentially breed throughout much of its range (Birds Australia 2006c, pers. comm.).		Listed		Species or species habitat likely to occur within area	Unlikely. Suitable habitat for this species does not occur in the Subject Site.
White-throated Needletail	Hirundapus caudacutus	The White-throated Needletail is widespread in eastern and south- eastern Australia (Barrett et al. 2003; Blakers et al. 1984; Higgins 1999). In eastern Australia, it is recorded in all coastal regions of Queensland and NSW, extending inland to the western slopes of the Great Divide and occasionally onto the adjacent inland plains. Further south on the mainland, it is widespread in Victoria, though more so on and south of the Great Divide, and there are few records in western Victoria outside the Grampians and the South West. The species occurs in adjacent areas of south-eastern South Australia, where it extends west to the Yorke Peninsula and		Listed			Potential.

Common Name	Scientific Name	Habitat and Ecology (OEH Species Profile and /or EPBC SPRAT Profile)	TSC Act Status	EPBC Act Status	OEH Threatened Species Search	DSEWPaC Protected Matters Search	Potential to occur
		the Mount Lofty Ranges. It is widespread in Tasmania (Barrett et al. 2003; Blakers et al. 1984; Higgins 1999). White-throated Needletails only occur as vagrants in the Northern Territory (recorded in the Top End, including around Darwin, Katherine and Mataranka and Tennant Creek; and further south around Alice Springs) and in Western Australia (at disparate sites from the Mitchell Plateau in the Kimberley, south to the Nullarbor Plain and Augusta in the South West, and west to Barrow Island, the Houman Abrolhos and the Swan River Plain) (Barrett et al. 2003; Blakers et al. 1984; Brooker et al. 1979; Sedgwick 1978; Slater 1964; Storr 1987; Storr et al. 1986; Wheeler 1959). The species is also a vagrant to various outlying islands, including Norfolk, Lord Howe, Macquarie, Christmas and Cocos-Keeling Islands (Barrand 2005; Green 1989; McAllan et al. 2004; Schodde et al. 1983; Stokes et al. 1984; Warham 1961a).					
Yellow-bellied Sheathtail-bat	Saccolaimus flaviventris	Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows. When foraging for insects, flies high and fast over the forest canopy, but lower in more open country. Forages in most habitats across its very wide range, with and without trees; appears to defend an aerial territory. Breeding has been recorded from December to mid-March, when a single young is born. Seasonal movements are unknown; there is speculation about a migration to southern Australia in late summer and autumn.	Vulnerable		Known		Potential.
	Commersonia procumbens	Grows in sandy sites, often along roadsides. Recorded in <i>Eucalyptus dealbata</i> and <i>Eucalyptus</i> <i>sideroxylon</i> communities, <i>Melaleuca uncinata</i> scrub, under mallee eucalypts with a <i>Calytrix tetragona</i> understorey, and in a recently burnt Ironbark and <i>Callitris</i> area. Also in <i>Eucalyptus</i> <i>fibrosa</i> subsp. <i>nubila</i> , <i>Eucalyptus dealbata</i> , <i>Eucalyptus</i> <i>albens</i> and <i>Callitris</i> glaucophylla woodlands north of Dubbo. Other associated species include Acacia triptera, Callitris endlicheri, Eucalyptus melliodora, Allocasuarina diminuta, Philotheca salsolifolia, Xanthorrhoea species, Exocarpus cupressiformis, Leptospermum parvifolium and Kunzea parvifolia. Fruiting period is summer to autumn. Flowers from August to December. Appears to produce seed which persists for some time in the seed bank. Large numbers of seedlings have been observed germinating after fire at sites where the species was not apparent above ground before the fires. Clusters of individuals may be	Vulnerable	Vulnerable	Known	Species or species habitat likely to occur within area	Unlikely. Suitable soil for this species does not occur in the Subject Site. Known to occur along the Golden Highway on red sandy ridges.

Common Name	Scientific Name	Habitat and Ecology (OEH Species Profile and /or EPBC SPRAT Profile)	TSC Act Status	EPBC Act Status	OEH Threatened Species Search	DSEWPaC Protected Matters Search	Potential to occur
		 clonal. The species is often found as a pioneer species of disturbed habitats. It has been recorded colonising disturbed areas such as roadsides, the edges of quarries and gravel stockpiles and a recently cleared easement under power lines. Has been recorded in populations of 50+ individuals of various ages, 28 plants on the western side of the road and 58 plants on the sunnier eastern side. Populations may comprise a single cohort of individuals, or have a multi-aged structure where some individuals appear to be old with thickened runners. 					
	Tylophora linearis	Grows in dry scrub and open forest. Recorded from low-altitude sedimentary flats in dry woodlands of Eucalyptus fibrosa, Eucalyptus sideroxylon, Eucalyptus albens, Callitris endlicheri, Callitris glaucophylla and Allocasuarina luehmannii. Also grows in association with Acacia hakeoides, Acacia lineata, Melaleuca uncinata, Myoporum species and Casuarina species. Flowers in spring, with flowers recorded in November or May with fruiting probably 2 to 3 months later. Very low number of confirmed populations and has been recorded in very low abundances.	Vulnerable	Endangered	Known	Species or species habitat may occur within area	Potential. Disturbance most likely precludes this species from occurring in the Subject Site. Known to occur in Goonoo SCA.

Family	Common Name	Scientific Name	Stratum (weed)	Stratum (Native)	Weed	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Recorded
	Cat Head	Emex australis	Lower			x	x	х	х	х	x	x	x
Myrsinaceae	Scarlet/ Blue Pimpernal	Anagallis arvensis *	Lower		*								
Scrophulariaceae	Broomrape	Orobanche minor *	Lower		*	ī ī			-				
Asteraceae	Cape Weed	Arctotheca calendula *	Lower		*	x		х					х
	Khaki Weed	Alternanthera pungens	Lower		*	x	x		х	х	x	x	х
Asteraceae	Nodding Thistle	Carduus nutans subsp. nutans	Lower		*#	1		x					х
Asteraceae	Saffron Thistle	Carthamus lanatus *	Lower		*			х	x	х	x	x	x
Asteraceae	Maltese Cockspur	Centaurea melitensis*	Lower		*	x				x	x	x	х
Asteraceae	Spear Thistle	Cirsium vulgare *	Lower		*								
Asteraceae	Flax-leaf Fleabane	Conyza bonariensis	Lower		*		х	х	х	х	x		х
	Lucerne	Medicago sativa *	Lower			х	х	х			x	x	х
Asteraceae		Hedypnois rhagadioloides ssp. cretica *	Lower		*								
Asteraceae	Flat weed	Hypochaeris glabra *	Lower		*					х	x		х
Asteraceae	Flat weed hairy	Hypochaeris radicata*	Lower		*		x						x
Asteraceae	Hawkweed	Leotodon taraxacoides*	Lower		*								
Asteraceae	Varigated Thistle	Silybum marianum *	Lower		*						x		х
Asteraceae		Sisymbrium erysimoides	Lower		*								
Asteraceae	Scourweed	Sisyrinchium sp. A sensu	Lower		*								
Asteraceae	Prickley Cow Thistle	Sonchus asper	Lower		*								
Asteraceae	Common Sow Thistle	Sonchus oleraceus	Lower		*								
Asteraceae	Stagger Weed	Stachys arvensis	Lower		*								
Asteraceae	Skeleton Weed	Chondrilla juncea	Lower		*		х	х	х		x	x	х
Boraginaceae		Amsinckia intermedia	Lower		*								
Boraginaceae	Paterson's Curse	Echium plantagineum *	Lower		*								
Boraginaceae	Vipers Bugloss	Echium vulgare*	Lower		*								
Boraginaceae	Potato Weed	Heliotropium europaeum*	Lower		*								
Brassicaceae	Turnip	Brassica rapa subsp. sylvestris*	Lower		*								
Brassicaceae	Brassica	Brassica tournefortii *	Lower		*								
Brassicaceae	Shepherd's Purse	Capsella bursa-pastoris*	Lower		*		х		x	x	x	x	х
Brassicaceae	Argentine Peppercress	Lepidium africanum*	Lower		*								
Brassicaceae	Peppercress	Lepidium bonariense*	Lower		*	x		x	_		x		х
Caryophyllaceae		Silene gallica var. gallica *	Lower		*								

Caryophyllaceae		Stellaria media *	Lower	*				x			x	x
Caryophyllaceae	Proliferous Pink	Petrorhagia nanteuilii	Lower	*	x	х	x	х	x		x	ĸ
Cucurbitaceae	Paddy Melon	Cucumis myriocarpus subsp. leptodermis	Lower	*	E					x	×	ĸ
Fabaceae - Faboideae	Haresfoot clover	Trifolium arvense *	Lower	*	x	х	x	x	x		x x	x
Fabaceae - Faboideae		Trifolium campestre *	Lower	* -	x		=				x	ĸ
Fabaceae - Faboideae		Trifolium dubium *	Lower	*								
Fabaceae - Faboideae	White Clover	Trifolium repens *	Lower	*	x	X	х			x	X	x
Fabaceae - Faboideae		Trifolium subterraneum *	Lower	*								
Fabaceae (Faboideae)		Medicago arabica*	Lower	*								
Fabaceae (Faboideae)		Medicago minima *	Lower	*				_				
Geraniaceae	1	Geranium spp.*	Lower	*	x						x	ĸ
Juncaceae		Juncus bufonius *	Lower	*								
Lamiaceae		Lamium amplexicaule *	Lower	*								
Lamiaceae	White Horehound	Marrubium vulgare*	Lower	*								
Lamiaceae	Pennyroyal	Mentha pulegium*	Lower	*								
Lamiaceae	Vervain	Salvia verbenaca*	Lower	*								
Malvaceae	Spiked Malvastrum	Malvastrum americanum	Lower	*								
Oxalidaceae	Oxalis	Oxalis corniculata*	Lower	*	x		x	x	x	x	x x	ĸ
Solanaceae	Blackberry Nightshade	Solanum nigram	Lower	*	x					x	X	x
Urticaceae	Small Nettle	Urtica urens*	Lower	*	1.1							
Verbenaceae	Purpletop	Verbena bonariensis*	Lower	*								
Asteraceae.	Nagoora Burr	Xanthium pungens*	Lower	*#								
Asteraceae	Tall Fleabane	Conzya alibida	Lower							x	x	ĸ
Cyperaceae	Bull Rush	Typha	Lower (sedge)									
Papaveraceae	Mexican Poppy	Argemone ochroleuca*	Lower	*								
	African Lovegrass	Eragrostis curvula	Lower (Grass)	*	x	х	х	х	х	x	x	ĸ
Poaceae	Great Brome	Bromus diandrus	Lower (Grass)	*								
Poaceae	Praire Grass	Bromus cartharticus*	Lower (Grass)	*								
Poaceae	Soft Brome	Bromus molliformis *	Lower (Grass)	*								
Poaceae	Small Quaker Grass	Briza minor*	Lower (Grass)	*								
Poaceae	Quaker Grass	Briza major*	Lower (Grass)	*								
Poaceae	Stinkgrass	Eragrostis cilianensis*	Lower (Grass)	*	x	х	x	х		x	x	ĸ
Poaceae	Barley Grass	Hordeum leporinum *	Lower (Grass)	*			x			x	X	x
Poaceae	Oats	Avena fatua*	Lower (Grass)	*		х	x	х		x	X	x
Poaceae	Golden Top	Lamarckia aurea *	Lower (Grass)	*								
Poaceae	Perennial Rye	Lolium perennens	Lower (Grass)	*						x	x	ĸ
Poaceae	Wimera Ryegrass	Lolium rigidum*	Lower (Grass)	*						x	x	x

Poaceae	Squirrel Tail Fescue	Vulpia bromoides *	Lower (Grass)		*							1
Poaceae	Rhodes Grass	Chloris virgata	Lower (Grass)		*							
Poaceae		Vulpia myuros *	Lower (Grass)		*					í		
Cactaceae	Prickley Pear	Opuntia stricta*	Mid		*#							
Solanaceae	African Boxthorn	Lycium ferocissimum*	Mid		*#		x			3	ĸ	x
Anacardiaceae	Pepper Tree	Schinus molle	Upper									x
Apiaceae	Native Carrot	Daucus glochidiatus		Lower								
Amaranthaceae	Hairy Joyweed	Alternanthera nana		Lower								
Anthericaceae	Twining Fringe Lily	Thysanotus patersonii		Lower				x				x
Anthericaceae	Common Fringe Lily	Thysanotus tuberosus		Lower								
Asparagaceae		Dichopogon fimbriatus		Lower				х		x	X	x
Asphodelaceae		Bulbine bulbosa		Lower								
Asphodelaceae	Leek Lily	Bulbine semibarbata		Lower								
Asteraceae		Asteraceae sp.		Lower								
Asteraceae	Purple Burr-daisy	Calotis cuneifolia		Lower								
Asteraceae	Showy Burr-daisy	Calotis cymbacantha		Lower								
Asteraceae	Yellow Burr-daisy	Calotis lappulacea		Lower								
Asteraceae	Bogan Flea	Calotis hispidula		Lower		x	х				X	x
Asteraceae		Cassinia arcuata		Lower								
Asteraceae		Cassinia arculeata		Lower				x			x	x
Asteraceae		Cassinia leavis		Lower								
Asteraceae	Common Sneezeweed	Centipeda cunninghamii		Lower								
Asteraceae		Chrysocephalum apiculatum		Lower								
Asteraceae	Bears Ear	Cymbonotus preissianus		Lower								
Asteraceae		Cynoglossum australe		Lower			x	x	x	x	X	x
Asteraceae	Small Orange Sunray	Hyalosperma semisterile		Lower								
Asteraceae		Hydrocotyle laxiflora		Lower								
Asteraceae	Yam Daisy	Microseris lanceolata		Lower								
Asteraceae	Sunray	Rhodanthe diffusa ssp. leucactina		Lower								
Asteraceae	Tall Grounsel	Senecio quadridentatus		Lower								
Asteraceae	Common Sunray	Triptilodiscus pygmaeus		Lower								
Asteraceae		Vittadinia cervicularis var. cervicularis		Lower								
Asteraceae		Vittadinia cuneata var. cuneata		Lower		x	x			x	x	x
Asteraceae		Vittadinia cuneata var. hirsute		Lower							x	
Asteraceae	Golden Everlasting	Xerochrysum bracteata		Lower								
Asteraceae	Sticky Everlasting	Xerochrysum viscosa		Lower								

Asteraceae	Fuzzy New Holland Daisy	Vittadinia cuneata var. cuneata	Lower							
Boraginaceae		Cynoglossum suaveolens	Lower							
Brassicaceae		Brassica nigra	Lower							
Brassicaceae		Lepdiium sp.	Lower							
Campanulaceae		Wahlenbergia communis	Lower							
Campanulaceae		Wahlenbergia gracilis	Lower							
Campanulaceae		Wahlenbergia stricta ssp stricta	Lower							
Caryophyllaceae	Mouse-ear Chickweed	Cerastium glomeratum	Lower	x						х
Centrolepidaceae		Centrolepis strigosa subsp. strigosa	Lower					x		х
Colchicaceae	Early nancy	Wurmbea dioica	Lower							
Convolvulaceae	Kidney Weed	Dichondra repens	Lower							
Crassulaceae	Dense Stonecrop	Crassula colorata	Lower		K.	x	X	x	x	х
Crassulaceae	Australian Stonecrop	Crassula sieberiana	Lower							
Cyperaceae		Cyperus sp.	Lower							
Cyperaceae		Carex inversa	Lower	x						х
Cyperaceae	Tall sedge	Carex appressa	Lower							
Cyperaceae	Rough Sas Sedge	Gahnia aspera	Lower							
Cyperaceae	Common Bog Rush	Shoenus apogon	Lower							
Dilleniaceae	Guinea flower	Hibbertia sp.	Lower	х	1	x			x	х
Droseraceae	Sundew	Drosera peltata	Lower							
Euphorbiaceae	Caustic Weed	Euphorbia drummondii	Lower							
Fabaceae - Faboideae	Slender Tick-trefoil	Desmodium varians	Lower							x
Fabaceae - Faboideae	Kneed Swainson-pea	Swainsona reticulata	Lower							
Fabaceae - Faboideae	Leafy Stenophylla	Templetonia stenophylla	Lower	x	ĸ				x	х
Fabaceae - Faboideae	Woolly Clover	Trifolium tomentosum	Lower							
Fabaceae - Faboideae	Twining Glycine	Glycine clandestina	Lower							
Fabaceae - Faboideae		Glycine latifolia	Lower							
Fabaceae - Faboideae		Glycine tabacina	Lower)	ĸ					x
Fabaceae - Faboideae		Glycine tomentosa / canescens	Lower							
Fabaceae - Faboideae	Burr Medic	Medicago polymorpha	Lower	x						
Fumariaceae	Narrow-leaved Fumitory	Fumaria densiflora	Lower	x						х
Geraniaceae	Blue Crowfoot	Erodium crinitum	Lower							х
Geraniaceae		Geranium homeanum	Lower							
Geraniaceae		Geranium retorsum	Lower							
Geraniaceae		Geranium solanderi var. solanderi	Lower							
Geraniaceae	Native Storkebill	Pelagonium australe	Lower							

Goodeniaceae		Goodenia hederacea ssp. hederacea	Lower								
Haloragaceae		Gonocarpus elatus [Hill Raspwort]	Lower								
Haloragaceae	Toothed Raspwort	Halogaris odontocarpa	Lower								
Hypoxidaceae	Tiny Star	Hypoxis glabella var. glabella	Lower							Ĩ	
Juncaceae		Juncas arcutus	Lower					Î			
Juncaceae		Juncas arculeata	Lower								
Juncaceae		Juncus aridicola	Lower								
Juncaceae		Juncas sp.	Lower								
Junaginaceae	Water Ribbons	Triglochin procera	Lower						x		
Lamiaceae	Austral Bugle	Ajuga australis	Lower			Í		Î		Ì	х
Lamiaceae	Native Pennyroyal	Mentha satureioides	Lower								
Linaceae		Linum marginale	Lower								
Lobeliaceae	Rock Isotome	Isotoma axillaris	Lower								
Lomandraceae		Lomandra filiformis ssp. coriacea	Lower								
Lomandraceae	Spiky-headed Matt Rush	Lomandra longifolia	Lower								
Lomandraceae	Many-flowered matt Rush	Lomandra multiflora subsp. Multiflora	Lower								
Malvaceae	Small-flowered mallow	Malva parvifolia	Lower								
Malvaceae		Sida corrugata	Lower								
Myoporaceae	Winter Apple	Eremophila debilis	Lower								
Orchidaceae	Pink Fingers	Caladenia carnea	Lower								
Orchidaceae	Tiger Orchid	Diuris sulphurea	Lower								
Orchidaceae		Microtis unifolia	Lower								
Orchidaceae		Pterostylis bicolor	Lower						x		
Orchidaceae	Midget Greenhood	Pterostylis mutica	Lower								х
Orchidaceae	Dwarf Greenhood	Pterostylis nana	Lower								
Orchidaceae	Autumn Greenhood	Pterostylis revoluta	Lower								
Oxalidaceae		Oxalis perennans	Lower								
Oxalidaceae		Oxalis radicosa	Lower (grass)							x	
Phormiaceae		Daniella revoluta subsp.	Lower (grass)					x	x		
Plantaginaceae	Small Sago Weed	Plantago turrifera	Lower (grass)								
Poaceae	Purple Wiregrass	Aristida jerichoensis	Lower (grass)					x			
Poaceae	Plains Grass	Austrostipa aristiglumis	Lower (grass)		x						x
Poaceae	Tall Speargrass	Austrostipa bigeniculata	Lower (grass)	x		x	x	x	x	x	х
Poaceae	Three awned Grass	Aristida ramosa	Lower (grass)					x			х
Poaceae	Wallaby Grass	Austrodanthonia erianthia	Lower (grass)							x	x
Poaceae	Common Wallaby Grass	Austrodanthonia caespitosa	Lower (grass)						x		

Poaceae		Austrodanthonia sp.	 Lower (grass)		x	х	x	x		x	x
Poaceae	Wallaby Grass	Austrodanthonia bipartita	Lower (grass)							x	х
Poaceae	Dense Foxtail Grass	Austrostipa densiflora	Lower (grass)	x	x		х	x		x	
Poaceae	Rough Spear Grass	Austrostipa scabra subs scabra	Lower (grass)				x	x	x	x	x
Poaceae		Austrostipa ramosa	Lower (grass)	x	х	х	x	x	x	x	х
Poaceae	Spear Grass	Austrostipa sp.	Lower (grass)	x	x	х	x	x		x	х
Poaceae	Slender Bamboo Grass	Austrostipa verticillata	Lower (grass)	Х			x			x	x
Poaceae	Red-Leg Grass	Bothriochloa macra	Lower (grass)								х
Poaceae	Short Chloris	Chloris truncata	Lower (grass)				х		x		
Poaceae	Tall Chloris	Chloris ventricosa	Lower (grass)								x
Poaceae		Cynodon dactylon	Lower (grass)	х	x						
Poaceae	Queensland Bluegrass	Dichanthium serecium	Lower (grass)								х
Poaceae		Dichelachne micrantha	Lower (grass)								
Poaceae	Cotton Panic	Digitaria brownii	Lower (grass)								
Poaceae		Digitaria sp.	Lower (grass)								
Poaceae	Awnless barnyard Grass	Echinochloa colona	Lower (grass)	x		x	x	x	x		
Poaceae	Common Wheatgrass	Elymus scaber	Lower (grass)								х
Poaceae	Slender bottlewashers	Ennaepogon gracilis	Lower (grass)				х				
Poaceae	Curly Windmill Grass	Enteropogon acicularis	Lower (grass)	х	х	х	х	х	x	x	х
Poaceae	Brown Lovegrass	Eragrostis brownii	Lower (grass)								х
Poaceae	Purple Love Grass	Eragrostis lacunaria	Lower (grass)				х				
Poaceae	Hairy Panic	Panicum effusum	Lower (grass)								x
Poaceae		Poa sieberiana	 Lower (grass)								
Poaceae	Western Rat's Tail Grass	Sporobolus crebra	Lower (sedge)								
Poaceae		Thyridolepis mitchelliana	Lower (sedge)								
Poaceae	Five-minute Grass	Tripogon Ioliformis	Lower (sedge)						x		
Polygonaceae	Slender Dock	Rumex brownii	Lower (sedge)								х
Portulacaceae	Pigweed	Portulaca loeracea	Lower (sedge)						x		
Pteridaceae	Rock Fern	Cheilanthes austrotenuifolia	Lower (sedge)								х
Pteridaceae	Mulga Fern	Cheilanthes sieberi	Lower (sedge)								
Rubiaceae		Pomax umbellata	Lower (sedge)						x		
Solanaceae	Narrawa Burr	Solanum cinereum	Lower (sedge)								х
Violaceae	Slender violet-bush	Hybanthus monopetalus	Lower (aquatic)								
Casuarinaceae	Hill Oak	Allocasuarina verticillata	Mid								
Chenopodiaceae	Climbing Saltbush	Einadia hastata	Mid								
Chenopodiaceae	Creeping Saltbush	Einadia nutans subs. Nutans	Mid		x			x	x		
Chenopodiaceae		Enchylaena tomentosa	Mid								х
Chenopodiaceae	Eastern Cotton Bush	Maireana microphylla.	Mid						x		

			1	1	1	í í	1	1	1	1	1	1
Chenopodiaceae	Galvanised Burr	Sclerolaena birchii		Mid						x	X	X
Fabaceae - Mimosoideae		Acacia cheelii		Mid					х			х
Fabaceae - Mimosoideae		Acacia deanei subsp. deanei		Mid								х
Fabaceae - Mimosoideae	Western Golden Wattle	Acacia decora		Mid								
Fabaceae - Mimosoideae	Currawang	Acacia doratoloxyn		Mid								
Fabaceae - Mimosoideae		Acacia implexa?		Mid								
Fabaceae - Mimosoideae	Boree	Acacia vestita		Mid								
Fabaceae - Mimosoideae		Acacia lineata		Mid								
Fabaceae - Mimosoideae	Mudgee Wattle	Acacia spectabilis		Mid								
Fabaceae - Mimosoideae	Sword-leaf Wattle	Acacia gladiformis		Mid								
Fabaceae (Caesalpinioideae)	Pepper-leaved Senna	Senna barclayana			*				x	x		
Fabaceae (Faboideae)		Mirbelia pungens		Mid								
Fabaceae (Faboideae)	Small-leaf Bush-pea	Pultenaea foliolosa		Mid								
Fabaceae (Faboideae)		Pultenaea microphylla		Mid								
Fabaceae (Faboideae)	Senna	Senna artemisioides subsp. zygophylla		Mid								
Fabaceae (Faboideae)	Silver cassia	Senna artemisioides		Mid								
Pittosporaceae	Butterbush	Pittosporum angustifolium		Mid								
Proteaceae	Hooked Needlewood	Hakea tephrosperma		Mid								
Sapindaceae		Dodonaea boroniifolia		Mid								
Sapindaceae	Hopbush	Dodonaea sp.		Mid								
Sapindaceae	Narrow-leafed hopbush	Dodonaea viscosa subsp. augustissim		Mid								
Sapindaceae		Dodonaea viscosa subsp. cuneata		Mid								
Santalaceae	Cherry Ballart	Exocarpus cupressiformis		Mid								
Cupressaceae	White Cypress Pine	Callitris endlicheri		Upper								
Cupressaceae	Black Cypress Pine	Callitris glaucophylla		Upper								
Myrtaceae	White Box	Eucalyptus albens		Upper								х
Myrtaceae	Fuzzy Box	Eucalyptus conica		Upper								
Myrtaceae	Tumbledown Red Gum	Eucalyptus dealbata		Upper			Î					
Myrtaceae	Dwyer's Red Gum	Eucalyptus Dwyeri		Upper			Ĩ					
Myrtaceae	Yellow Box	Eucalyptus melliodora		Upper								
Myrtaceae	Inland Grey Box	Eucalyptus microcarpa		Upper								
Malvaceae	Kurrajong	Brachychiton populneus subs. populneus		Upper								x

TOTAL Species / Plot				30	27	27	25	28	41	29
Total species	76									
Native Plant Species (NPS)	44		Natives	16	14	12	13	18	19	21
No. Non-native	46		Weeds	14	13	15	12	10	22	8
% NPS	57.89	Green = > 50% natives	% Natives	53.3%	51.9%	44.4%	52.0%	64.3%	46.3%	72.4%
% non-native	60.53		% Weeds	46.7%	48.1%	55.6%	48.0%	35.7%	53.7%	27.6%

Plot	Dominate stratum	U1	BB Score	U2	BB Score	U3	BB Score	M1	BB Score	M2	BB Score	M3	BB Score	۲1	BB Score	L 2	BB Score	L3	BB Score	<i>Biometric</i> community (best fit) First Choice	<i>Biometric</i> community (best fit) Second Choice
1	Lower													Chloris truncata	4	Enteropogon acicularis	2	Eragrostis cilianensis*	2	CW130 Derived tussock grasslands of the central western plains and lower slopes of NSW (Benson 250)	Formerly CW144 Inland Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion (Benson 82)
2	Lower							Lycium ferocissimum*	0.1					Enteropogon acicularis	3	Chloris truncata	2	Eragrostis cilianensis*	2	CW130 Derived tussock grasslands of the central western plains and lower slopes of NSW (Benson 250)	Formerly CW144 Inland Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion (Benson 82)
3	Lower													Bothrichloa maccra	3	Enteropogon acicularis	2	Eragrostis cilianensis*	2	CW130 Derived tussock grasslands of the central western plains and lower slopes of NSW (Benson 250)	Formerly CW144 Inland Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion (Benson 82)
4	Lower													Austrostipa sp.	3	Enteropogo n acicularis	2	Chloris truncata	2	CW130 Derived tussock grasslands of the central western plains and lower slopes of NSW (Benson 250)	Formerly CW213 White Box - White Cypress Pine - Inland Grey Box woodland on the western slopes of NSW (Benson 267)
5	Lower													Austrostipa sp.	3	Enteropogo n acicularis	2	Chloris truncata	2	CW130 Derived tussock grasslands of the central western plains and lower slopes of NSW (Benson 250)	Formerly CW213 White Box - White Cypress Pine - Inland Grey Box woodland on the western slopes of NSW (Benson 267)
6	Lower							Lycium ferocissimum*	0.1					Austrostipa aristiglumis	3	Enteropogon acicularis	2	Chloris truncata	2	CW130 Derived tussock grasslands of the central western plains and lower slopes of NSW (Benson 250)	Formerly CW138 Fuzzy Box - Inland Grey Box on alluvial brown loam soils of the NSW South Western Slopes Bioregion and southern BBS Bioregion (Benson 201)

Plot	Dominate stratum	U1	BB Score	U2	BB Score	U3	BB Score	M1	BB Score	M2	BB Score	M3	BB Score	L1	BB Score	L 2	BB Score	L3	BB Score	<i>Biometric</i> community (best fit) First Choice	<i>Biometric</i> community (best fit) Second Choice
7	Lower													Chloris truncata	5	Enteropogon acicularis	4	Austrostipa sp.	2	CW130 Derived tussock grasslands of the central western plains and lower slopes of NSW (Benson 250)	Formerly CW138 Fuzzy Box - Inland Grey Box on alluvial brown loam soils of the NSW South Western Slopes Bioregion and southern BBS Bioregion (Benson 201)

Key to Table

BB Score: Braun Banquet Score L: Lower stratum

U: Upper Stratum M: Middle stratum

Braun Banquet Score	Cover
0	Absent from quadrant
0.1	Represented by a solitary item (<5% cover)
0.5	Represented by a few (<5) items (<5% cover)
1	Represented by >5 items (<5% cover)
2	Represented by many (>5) items (5-25% cover)
3	Represented by many (>5) items (25 - 50% cover)
4	Represented by many (>5) items (50-75% cover)
5	Represented by many (>5) items (75-100% cover)

Family	Class	Scientific Name	Common Name	Legal Status	Subject Site	Native	Non-native
Mammalia	Carnivora	Vulpes vulpes	Red Fox		x		x
Amphibia	Myobatrachidae	Crinia signifera	Common Eastern Froglet	Р	x	х	9
Amphibia	Myobatrachidae	Limnodynastes peroni	Striped Marsh Frog	Р	x	x	
Reptilia	Agamidae	Pogona barbata	Bearded Dragon	Р	x	х	
Reptilia	Elapidae	Pseudonaja textilis	Eastern Brown Snake	Р	X	х	
Reptilia	Scincidae	Ctenotus taeniolatus	Copper-tailed Skink	Р	x	х	
Reptilia	Scincidae	Menetia greyii	Dwarf Skink	Р	X	х	
Reptilia	Scincidae	Morethia boulengeri	South-eastern Morethia Skink	Р	X	х	i ja se
Aves	Suliformes	Great Cormorant	Phalacrocorax carbo	Р	x	х	i ja se
Aves	Suliformes	Little Black Cormorant	Phalacrocorax sulcirostris	Р	x	х	i i i i i i i i i i i i i i i i i i i
Aves	Motacillidae	Anthus australis	Australasian Pipit	Р	x	х	
Aves	Artamidae	Gymnorhina tibicen	Australian Magpie	Р	X	х	
Aves	Corvidae	Corvus coronoides	Australian Raven	Р	x	х	
Aves	Anatidae	Tadorna tadornoides	Australian Shelduck	Р	x	х	0
Aves	Campephagidae	Coracina novaehollandiae	Black-faced Cuckoo-shrike	Р	x	х	
Aves	Anatidae	Anas castanea	Chestnut Teal	Р	x	х	
Aves	Sturnidae	Sturnus vulgaris	Common Starling	Р	x	х	() ()
Aves	Cacatuidae	Eolophus roseicapilla	Galah	Р	x	х	
Aves	Anatidae	Anas gracilis	Grey Teal	Р	x	2	x
Aves	Passeridae	Passer domesticus	House Sparrow	<u>.</u>	x	х	10
Aves	Monarchidae	Grallina cyanoleuca	Magpie-lark	Р	x	х	i ja da
Aves	Charadriidae	Vanellus miles	Masked Lapwing	Р	x	х	4 F
Aves	Sturnidae	Aplornis metallica	Metallic Starling		x		x
Aves	Falconidae	Falco cenchroides	Nankeen Kestrel	Р	x	х	
Aves	Anatidae	Anas superciliosa	Pacific Black Duck	Р	X	х	
Aves	Artamidae	Cracticus nigrogularis	Pied Butcherbird	Р	x	х	92
Aves	Threskiornithidae	Threskiornis spinicollis	Straw-necked Ibis	Р	x	х	
Aves	Cacatuidae	Cacatua galerita	Sulphur-crested Cockatoo	Р	x	х	
Aves	Ptilonorhynchidae	Amblyornis newtonianus	Superb Fairy-wren	Р	x	х	6 D 6
Aves	Ardeidae	Egretta novaehollandiae	White-faced Heron	Р	x	x	
Aves	Rhipiduridae	Rhipidura leucophrys	Willie Wagtail	Р	x	x	
					31	28	3

7-PART TEST CRITERIA

7-Part Test Criteria	Fuzzy Box Woodland White Box Woodland Inland Grey Box Woodland	Barking Owl	Black Falcon Grey Falcon Little Eagle Spotted Harrier Square-tailed Kite	Aquatic Ecological Community in the Natural Drainage System of the Lowland Catchment of the Lachlan River EEC (NSW FM Act).
a) in the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.	Not relevant.	Local population: Barking Owls occur in the Dubbo area, with breeding habitat known to occur in large hollow bearing trees adjacent to watercourses. As no impact will occur to suitable riparian large hollow bearing trees known to be used for breeding, the proposal is unlikely to disrupt a local population of Barking Owls.	Local population: These species of bird of prey are known to occur in the Dubbo area. Due to the mobile nature of these species, hunting grounds in cleared (semi-suburban) and riparian habitat cannot be considered critical to the survival of this species, as similar habitat along the riparian zone is abundant in the locality (Macquarie River). It is likely that these birds of prey may hunt on open ground associated with the floodplain. Vehicle movement and noise associated with the Proposal may impact birds hunting, however the short nature of this noise is unlikely to disrupt a viable local population of the species such that they are placed at a risk of extinction Breeding sites for these birds of prey are likely to occur in tall trees associated with riparian environments outside the Subject Site near the Macquarie or Talbragar River. No likely breeding trees would be removed. Furthermore, no breeding sites have been	Not relevant

7-Part Test Criteria	Fuzzy Box Woodland White Box Woodland Inland Grey Box Woodland	Barking Owl	Black Falcon Grey Falcon Little Eagle Spotted Harrier Square-tailed Kite	Aquatic Ecological Community in the Natural Drainage System of the Lowland Catchment of the Lachlan River EEC (NSW FM Act).
			previously recorded by the species in the Subject Site. Habitat critical to the survival of these species \is unlikely to occur in the Subject Site given the less disturbed habitats are available in the locality. Thus a viable local population of the species is unlikely to be placed at risk of extinction.	
b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.	Not relevant.	Not relevant	Not relevant	Not relevant
 c) in the case of an endangered ecological community or CE ecological community, whether the action proposed: (i) is likely to have an adverse effect on the extent of the ecological community such that its occurrence is likely to be placed at risk of extinction, or (ii) is likely to substantially 	Although no EEC exists in the Subject Site, this 7-Part test has been provided as a 'precautionary approach' to characterise the impacts to derived grassland that would have formally comprised part of all three EECs. The Proposal would not place this EEC at risk of local extinction. Existing agricultural practises including ploughing and grazing have already reduced the extent and viability of this community.	Not relevant	Not relevant	Eulomogo Creek drains into the Macquarie River that forms part of the listing for this aquatic EEC. The EEC will not become locally extinct as the works will only affect small areas of its extent.

7-Part Test Criteria	Fuzzy Box Woodland White Box Woodland Inland Grey Box Woodland	Barking Owl	Black Falcon Grey Falcon Little Eagle Spotted Harrier Square-tailed Kite	Aquatic Ecological Community in the Natural Drainage System of the Lowland Catchment of the Lachlan River EEC (NSW FM Act).
and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,				
 d) in relation to habitat of a threatened species, population or ecological community: (i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and (ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and (iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality. 	The Subject Site has already had habitat removed, fragmented and now exists in a derived grassland state.	Any component of habitat/resource is considered important. The Subject Site contains likely hunting grounds for the Barking Owl. It is unlikely that the Proposal would isolate and decrease the availability of quality habitat to the extent that the species is likely to decline. It is unlikely that the action will adversely affect habitat critical to the survival of the species.	Any component of habitat / resource is considered important. The Subject Site contains likely hunting grounds and potential breeding resources. Due to grassy habitat within the Subject Site, no roost or breeding sites will be impacted. It is unlikely that the Proposal would isolate and decrease the availability of quality habitat to the extent that the species is likely to decline. It is unlikely that the action will adversely affect habitat critical to the survival of the species	The EEC extends beyond the Subject Site and is in a degraded state. Recovery of this EEC will occur once the works have completed.
e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).	Critical habitat does not occur in the locality.	Critical habitat has not been declared for this species and at present there are no habitats listed as critical in the locality.	Critical habitat has not been declared for these species and at present there are no habitats listed as critical in the locality.	Critical habitat does not occur in the locality.
f) whether the actions proposed is consistent	There are no recovery or threat abatement plans for this EEC.	Two recovery plans relevant to this species exist:	There are no recovery or threat abatement plans for these	There is no recovery plan for this EEC.

7-Part Test Criteria	Fuzzy Box Woodland White Box Woodland Inland Grey Box Woodland	Barking Owl	Black Falcon Grey Falcon Little Eagle Spotted Harrier Square-tailed Kite	Aquatic Ecological Community in the Natural Drainage System of the Lowland Catchment of the Lachlan River EEC (NSW FM Act).
with the objectives or actions of a recovery plan or threat abatement plan.		Draft Recovery Plan for the Barking Owl Recovery Plan for the Large Forest Owls Seven large hollow bearing trees suitable as a breeding site will be removed, however as noted its location next to a busy road make it highly unlikely to be used. Impact will occur in the short term to likely hunting territory.	species. Vegetation removal contributes to the threats facing this species. However habitat restoration and rehabilitation is consistent with the recovery plans for these species.	
g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.	KTPs such as clearing of native vegetation, will be exacerbated by the Proposal. Predation by the European red fox (<i>Vulpes</i> <i>vulpes</i>) and Predation by the feral cat (<i>Felis catus</i>), have or are currently occurring with Subject Site.	As per left hand column	As per left hand column	The alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands has been listed as a KTP in Schedule 3 of the TSC Act. Even though the creek flow will not be altered in the long- term, construction works in the vicinity of the creek may impact its viability in the short term. Degradation of native riparian vegetation along NSW waterways has been listed as a KTP in Schedule 6 of the FM Act. The clearing of riparian vegetation and machinery access to the riparian zone increases erosion and siltation, and may impact habitat including reproductive sites for species in this aquatic ecological community. This clearing is however minimal. The clearing of native vegetation has been listed as a KTP in

7-Part Test Criteria	Fuzzy Box Woodland White Box Woodland Inland Grey Box Woodland	Barking Owl	Black Falcon Grey Falcon Little Eagle Spotted Harrier Square-tailed Kite	Aquatic Ecological Community in the Natural Drainage System of the Lowland Catchment of the Lachlan River EEC (NSW FM Act).
				Schedule 3 of the TSC Act
Conclusion	The proposal will remove a component of a derived grassland that would have formally comprised this EEC. The Proposal is not likely to significantly impact a locally occurring population of this EEC such that it is placed at risk of local extinction. A SIS is not warranted. It would however be appropriate to offset the loss of vegetation following recommendations in this report.	A local population being placed at risk of extinction is unlikely due to the large amount of surrounding analogous habitat adjoining the Subject Site. A Species Impact Statement is not required	A local population being placed at risk of extinction is unlikely due to the large amount of surrounding analogous habitat adjoining the Subject Site. A Species Impact Statement is not required.	Recommendations in this report will ensure a high level of soil and sediment controls are implemented. A SIS is not required.

DOE ASSESSMENTS OF SIGNIFICANCE - MIGRATORY SPECIES

Criteria: An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:	White-throated Needletail, Fork-tailed Swift, Rainbow Bee-eater, Cattle Egret, Great Egret.
	All species are predicted to have occasional habitat in the Subject Site.
	Fork-tailed Swift (Apus pacificus) and White-throated Needletail (Hirundapus caudacutus)
	The White-throated Needletail and Fork-tailed Swift are aerial species for which the Subject Site will not represent 'important habitat' and no impacts are expected due to the ability of this species to forage over a wide variety of land use, including human infrastructure and large water bodies and wetland areas in Dubbo.
substantially modify (including by fragmenting altering fire	Great Egret (Ardea alba) and Cattle Egret (Bubulcus ibis)
regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species	These species are predicted to occur, within or nearby to the Subject Site during periods of inundation. Furthermore the Cattle Egret is predicted to occur during the non-breeding period when cattle are stocked. There is no record of either in the Subject Site. Any such impacts involving habitat would be minor and may be mitigated by the habitat creation and enhancement activities noted above for other wetland species. The proposed action would have minimal effects on any local population of these species.
	Rainbow Bee-eater Merops ornatus
	The Macquarie River is a known place for congregation of flocks and is core breeding habitat for the species. The Rainbow Bee-eater is most often found in open forests, woodlands and shrublands, and cleared areas, usually near water. It will use disturbed sites with sandy soils such as river banks, quarries, cuttings and mines or exposed sites on cleared flats to build its nesting tunnels. Providing that recommendations in this report are followed there will be no impact to individual birds or a long term decrease in the population.
result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species, or	The local area has a history of clearing and habitat modification, which has benefited a number of feral and invasive flora and fauna species. The proponent proposes to ensure the spread of weeds and feral fauna is not enhanced by the project that will contribute to the overall enhancement of habitat for all species.
seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	It is unlikely that the Proposal would interfere with an ecologically significant proportion of any of these species. It is unlikely that these species would be significantly impacted by the Project. Referral to the DoE is not required.



APPENDIX G – Contamination Investigation, prepared by Envirwest Pty Ltd

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Contamination Investigation

Former Lot 399 DP1199356 and Lot 503 DP1152321 Boundary Road, Dubbo NSW



Ref: R10925c Date: 7 June 2019

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Interested authorities:	Dubbo Regional Council
Report number:	R10925c
Date:	7 June 2019

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Summary report

Address:	Former Lot 399 DP1199356 and Lot 503 DP1152321 Boundary Road, Dubbo NSW
Date of works	14/05/2019

Introduction

A residential subdivision is proposed at former Lot 399 DP1199356 and Lot 503 DP1152321 Boundary Road, Dubbo NSW. The site has historically been used for agricultural grazing.

Previous investigations were undertaken on the site in 2015. No contaminants were identified from the soil sampling and site inspection. Stockpiles were identified on the site which were recommended to be removed and footprints validated. Additional investigations are required on the site to confirm no contaminating activities have occurred on the site since 2015 and the stockpiles have been removed.

Scope

Envirowest Consulting Pty Ltd was commissioned to undertake a contamination investigation, in accordance with the contaminated land management planning guidelines, from the *Contaminated Land Management Act* 1997 and the *State Environmental Policy No.* 55 (SEPP 55), at Lot 399 DP1199356 and former Lot 503 DP1152321 Boundary Road, Dubbo NSW. The objective was to identify past potentially contaminating activities, identify potential contamination types, discuss the site condition, provide an assessment of site contamination and assess the need for further investigation or suitability for proposed residential and recreational land-use.

Summary

Land-use on the site was vacant paddocks with earthworks occurring in the western section of the site. Surface cover on the site was predominately vegetated with bare areas in the western section of the site due to earthworks and areas of removed stockpiles. No evidence of the previously identified nursery area remained during the site inspection.

Historical aerial photographs and historical review of the site indicate the site has been used for agricultural grazing.

Stockpiles previously identified on-site had been removed or reportedly burnt. Ash was identified in the northern area of the site with scrap metal remaining. A small stockpile footprint previously located in the south western section of the site was visually assessed. The stockpile had been removed from the site and earthworks for a drainage line had begun within this area.

Stockpiles were identified during the site inspection in the south eastern and north western section of the site and appear to be from earthworks on-site. The stockpiles were similar colour and material to that identified on-site and vehicular tracks are evident from adjacent earthworks and stockpiles. An earthworks compound was identified in the central area of the site.

Additional contaminating activities have not been identified on the site following the previous contamination investigation. The levels of all substances analysed in the soil samples collected from the stockpile footprints were below the adopted residential and recreational land-use thresholds.

Recommendations

Removal of scrap metal is required.

Statement of suitability

The site is suitable for residential and recreational land-use.

This is an accurate summary of the report titled: Contamination investigation – Former Lot 399 DP1199356 and Lot 503 DP1152321 Boundary Road, Dubbo NSW (Report number R10925c)

Produced by: Envirowest Consulting Pty Ltd Dated: 7/6/2019 Name: Gregory Madafiglio Certification details: CEnvP

Contents

	Page
Summary report	
1. Intróduction	5
2. Scope of work	5
3. Site identification	5
4. Site history	5
5. Site condition and environment	7
6. Data Quality Objectives	8
7. Sampling analysis plan and sampling methodology	9
8. Quality assurance and quality control	10
9. Conceptual site model	11
10. Assessment criteria	12
11. Results and discussion	13
12. Site characterisation	15
13. Conclusions and recommendations	17
14. Report limiations and intellectual property	17
15. References	
Figures	
Figure 1. Locality map	
Figure 2. Aerial photograph (2019)	
Figure 3. Site layout	
Figure 4. Northern stockpile sampling locations	
Figure 5. Central and southern stockpile sampling locations	
Figure 6. Photographs of the site	
Appendices	263
Appendix 1. Sample analysis, quality assurance and quality control (QAQC) report	
Appendix 2. Field sampling log	
Appendix 3. Soil analysis results – SGS report numbers SE193038 and chain of custody fo	rm

1. Introduction

A residential subdivision is proposed at former Lot 399 DP1199356 and Lot 503 DP1152321 Boundary Road, Dubbo NSW. The site has historically been used for agricultural grazing.

Previous investigations were undertaken on the site in 2015. No contaminants were identified from the soil sampling and site inspection. Stockpiles were identified on the site which were recommended to be removed and footprints validated. Additional investigations are required on the site to confirm no contaminating activities have occurred on the site following the previous investigations and the stockpiles have been removed.

2. Scope of work

Envirowest Consulting Pty Ltd was commissioned by Maas Group Properties to undertake a contamination investigation, in accordance with the contaminated land management planning guidelines, from the *Contaminated Land Management Act 1997* and the *State Environmental Policy No. 55 (SEPP 55)*, at former Lot 399 DP1199356 and Lot 503 DP1152321 Boundary Road, Dubbo NSW. The objective was to identify past potentially contaminating activities, identify potential contamination types, discuss the site condition, provide an assessment of site contamination and assess the need for further investigation or suitability for proposed residential and recreational land-use.

Address	Boundary Road Dubbo NSW			
Client	Maas Group Properties			
Deposited plans	Formally Lot 399 DP1199356 and Lot 503 DP1152321			
Locality map	Figure 1			
Site plan	Figure 3			
Photographs	Figure 6			
Area	Approximately 140ha			

3. Site identification

4. Site history

4.1 Zoning

The site is zoned R2 Low Density Residential and RE1 Public Recreation under the Dubbo Local Environmental Plan (2011).

4.2 Land-use

The site has historically been used for grazing of stock on improved pastures. Subdivision earthworks had begun on the site at the time of inspection. The site is located in a developing residential area on the south eastern fringes of the city of Dubbo.

4.3 Summary of council records

An updated contamination report has been requested from Dubbo Regional Council to demonstrate previously identified areas on site have been remediated and stockpiles removed. Additionally, an assessment has been requested to confirm no contaminating activities have occurred on the site following the contamination investigation in 2015.

4.4 Sources of information

- Site inspection 14 May 2019 by Envirowest Consulting Pty Ltd
- NSW EPA records of public notices under the CLM Act 1997
- Soil and geological maps
- Historical aerial photographs
- NSW Planning and Environment planning viewer

4.5 Chronological list of site uses

4.5.1 Historical aerial photographs

The 1964, 1980, 2006, 2009, 2010, 2012 and 2013 aerial photographs depict the site as grazing land. Two dams are visible on the site in the 2006, 2012 and 2013 aerial photographs in the central and north eastern section. A nursery area is visible in the aerial photographs from 2006. The nursery area was used to propagate trees for landscaping on the adjoining subdivision.

Earthworks had begun in the western section of the site in the 2017 aerial photograph. The nursery area is no longer visible in the 2018 aerial photograph.

Additional stockpiles are evident in the south eastern and north western sections of the site in the 2018 aerial photograph. The stockpiles appear similar colour material to that identified on site and vehicular tracks are evident between earthworks on-site and stockpiles.

4.5.3 Other sources

The Historical Parish Maps (1884 and 1893) identify the owner of the site as J. O. Norton. Historical Parish Maps (1895 to 1958) list The Corporation of the Bank of Australasia as the owner of the property.

4.6 Buildings and infrastructure

No buildings were located on the site at the time of site inspection or identified from historical photographs. Earthworks including road construction for the proposed residential subdivision had begun at the time of inspection.

4.7 Potential contaminants

Based on historical activities and site inspection, potential contaminants of the stockpile footprint have been identified as;

- Heavy metals (arsenic, cadmium, chromium, copper, nickel, lead, zinc and mercury)
- Organochlorine pesticides (OCP)
- Total recoverable hydrocarbons (TRH)
- Benzene, toluene, ethylbenzene, xylenes, naphthalene (BTEXN)
- Polycyclic aromatic hydrocarbons (PAH)

Potential contaminants of concern from the general site area were;

- Heavy metals (arsenic, cadmium, chromium, copper, nickel, lead and zinc)
- Organochlorine pesticides (OCP)

4.9 Relevant complaint history

None known

4.10 Contaminated site register

The site is not listed on the NSW EPA register of contaminated sites.

4.11 Investigation history

4.11.1 Envirowest Consulting Pty Ltd (2015) *Preliminary contamination investigation Hillview Estate* Lot 399 DP1199356 and Lot 503 DP1152321, Dubbo NSW (R5737c.1)

An inspection of the site was made on 22 and 23 April 2015. The site is located in a developing residential area on the south eastern fringes of Dubbo and has an area of approximately 140ha.

The site has an agricultural land-use history of grazing. There is no evidence of orchards, mines, sheep dips, mixing sheds or contaminating industrial activities on the site from the review of site history or site walkover. The use of agricultural pesticides over the area in the past is expected to be low.

The contamination status of the site was assessed from a soil sampling and laboratory analysis program. Two-hundred and eighty discrete soil samples were collected over the site and combined to form seventy composite samples. The soil samples were analysed for arsenic, cadmium, chromium, copper, lead, nickel, zinc and organochlorine pesticides (OCP). Three discrete samples were collected from a nursery area in the south western section. The discrete soil samples were analysed for arsenic, cadmium, chromium, copper, lead, nickel, zinc, OCP, total recoverable hydrocarbons (TRH) (C6-C40), benzene, toluene, ethylbenzene, xylenes and naphthalene (BTEXN).

The soil sampling program did not detect elevated levels of the analysed metals, OCP or TRH. The levels of all substances evaluated were below the EPA investigation threshold for residential and recreational land-use with access to soil. In conclusion, no contamination was found.

Several stockpiles were located across the site. The stockpiles consisted of soil and timber and trace general refuse. No asbestos was identified in the stockpiles on site. The stockpiles are an amenity hazard.

The stockpiles were recommended to be removed and an assessment of the stockpile footprint recommended following removal.

4.12 Neighbouring land-use

North – Rural South – Rural East – Rural West – Residential

Historical and present neighbouring land-uses are not expected to impact on the site.

4.13 Integrity assessment

The site history was obtained from a site inspection and history review. The information is consistent with the current site condition and to the best of the assessor's knowledge is accurate.

5. Site condition and environment

5.1 Surface cover

Surface cover on the site included vegetated pasture grasses in the eastern section and bare areas from recent earthworks in the western section of the site.

5.2 Topography

The site is a mid-slope with a gentle inclination of less than 6% and a predominant south west aspect. The site has several raised rocky outcrops located in the eastern and northern section of the site. The site drops off in the south eastern corner of the site to a wet drainage area. Eulomogo Creek traverses the south eastern corner of the site.

5.3 Soils and geology

The site is within the Bunglegumbie and Wongarbon Soil Landscape (Murphy *et al.* 1998). Soil in the Bunglegumbie landscape consists of red-brown earths comprises dark brown sandy loam topsoil with bleached silty loam to reddish brown medium clay subsoil. Red earths comprise dark reddish brown loamy sands over a reddish brown fine sandy clay loam. The soil has a moderate fertility and generally low erodibility.

Soil in the Wongarbon Soil Landscape (Muphy *et al.* 1998) consists of Euchrozems and red and brown cracking clays. The soil has a moderate to high fertility and a moderate to high erodibility

The site is underlain by Ballimore formation which comprises quartz sandstone, lithic sandstone, conglomerate, ferruginous sandstone, siltstone and undifferentiated olivine basalt and dolerite (Murphy *et al.* 1998).

5.4 Hydrology

5.4.1 Surface water

The Eulomogo Creek traverses the south eastern section of the site. The drainage line empties into the Macquarie River approximately 1.1km west of the site.

5.4.2 Groundwater

Five groundwater bores were located on the site. The bores were licensed for stock and domestic supplies and monitoring. Stock and domestic bores had water bearing zones from 20m in gravel and coarse sand. Standing water levels were 19.8m. Monitoring bores were up to 10m deep and installed to monitor the unconfined groundwater. The standing water level in one bore was 8.6m and was not encountered in two.

6. Data Quality Objectives

6.1 State the problem

A residential subdivision is proposed for the site. Stockpiles were identified during previous investigations and the stockpile footprints require assessment following removal. Additionally the site requires investigation to ensure no contaminating activities have occurred on the site since 2015 and determine suitability for the proposed land-use.

6.2 Identify the decision

The proposed land-use is residential and recreational and the levels of contaminants should be less than the thresholds listed in Section 10. The decision problem is, do the levels of potential contaminants exceed the assessment criteria listed in Section 10.

6.3 Identify the inputs decision

Investigation of the site is required to identify any potential contaminants remaining from the unknown source of the stockpiles and to determine any contaminating activities on the site since 2015.

6.4 Define the boundaries of the study

The investigation area is former Lot 399 DP1199356 and Lot 503 DP1152321 (Figure 2).

6.5 Develop a decision rule

The guidelines for soil were the residential land-use health investigation levels (HIL), health screening levels (HSL), ecological investigation levels (EIL) and ecological screening levels (ESL) (Section 10).

6.6 Specify acceptable limits on the decision errors.

The 95% upper confidence limit of average levels of samples collected is less than the threshold levels and the levels are less than 250% of the relevant thresholds.

6.7 Optimize the design for obtaining data

Soil sampling was undertaken as described in Section 7.

Quality assurance and quality control objective and indicators are described in Section 8.

7. Sampling analysis plan and sampling methodology

7.1 Sampling strategy

No contaminating activities are known to have occurred over the site since 2015. Sampling of the general site was not considered required.

7.1.1 Sampling design

The stockpile footprints were assessed on a systematic sampling pattern to assess the probable location of contamination. A site walkover was undertaken across the remainder of the site.

7.1.2 Sampling locations

Twenty-nine discrete samples were collected from the stockpile footprints on an approximate 20m grid pattern.

The sampling locations are described in Figure 5.

7.1.3 Sampling density

The sampling density can detect a potential hot spot across the site with a radius of 12m at a 95% level of confidence.

7.1.4 Sampling depth

Any contaminants present are generally immobile and expected to be contained in the 0-100mm soil layer which was the target sampling depth as minimal soil disturbance has occurred.

7.2 Analytes

Soil samples collected from the stockpile footprints were evaluated for arsenic, cadmium, chromium, copper, lead, nickel, zinc, mercury, organochlorine pesticides (OCP), total recoverable hydrocarbons (TRH), benzene, toluene, ethylbenzene xylene, naphthalene (BTEXN) and polycyclic aromatic hydrocarbons (PAH). These were identified as the contaminants of concern possibly present due to the unknown source of the fill.

7.3 Sampling methods

Soil samples were taken using a stainless steel hand shovel. Soil was taken at each individual sampling location below the vegetated and detrital layer.

Soil samples were transferred directly to a solvent rinsed glass jar with a Teflon lid.

Tools were decontaminated between sampling locations to prevent cross contamination by: brushing to remove caked or encrusted material, washing in detergent and tap water, rinsing in an organic solvent, rinsing with clean tap water and allowing to air dry or using a clean towel.

Sample ID	Depth	Location	Analysis undertaken
BR101	0-100mm	Central stockpile footprint	Arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), lead (Pb), nickel (Ni), zinc (Zn), mercury (Hg), organochlorine pesticides (OCP), total recoverable hydrocarbons (TRH), benzene, toluene, ethylbenzene, xylenes, naphthalene (BTEXN), polycyclic hydrocarbons (PAH)
BR102	0-100mm	Central stockpile footprint	As, Cd, Cr (total), Cu, Pb, Ni, Zn, Hg, OCP, TRH, BTEXN, PAH
BR103	0-100mm	Central stockpile footprint	As, Cd, Cr (total), Cu, Pb, Ni, Zn, Hg, OCP, TRH, BTEXN, PAH
BR104	0-100mm	Northern stockpile footprint	As, Cd, Cr (total), Cu, Pb, Ni, Zn, Hg, OCP, TRH, BTEXN, PAH
BR105	0-100mm	Northern stockpile footprint	As, Cd, Cr (total), Cu, Pb, Ni, Zn, Hg, OCP, TRH, BTEXN, PAH
BR106	0-100mm	Northern stockpile footprint	As, Cd, Cr (total), Cu, Pb, Ni, Zn, Hg, OCP, TRH, BTEXN, PAH
BR107	0-100mm	Northern stockpile footprint	As, Cd, Cr (total), Cu, Pb, Ni, Zn, Hg, OCP, TRH, BTEXN, PAH
BR108	0-100mm	Northern stockpile footprint	As, Cd, Cr (total), Cu, Pb, Ni, Zn, Hg, OCP, TRH, BTEXN, PAH
BR109	0-100mm	Northern stockpile footprint	As, Cd, Cr (total), Cu, Pb, Ni, Zn, Hg, OCP, TRH, BTEXN, PAH
BR110	0-100mm	Northern stockpile footprint	As, Cd, Cr (total), Cu, Pb, Ni, Zn, Hg, OCP, TRH, BTEXN, PAH
BR111	0-100mm	Northern stockpile footprint	As, Cd, Cr (total), Cu, Pb, Ni, Zn, Hg, OCP, TRH, BTEXN, PAH
BR112	0-100mm	Northern stockpile footprint	As, Cd, Cr (total), Cu, Pb, Ni, Zn, Hg, OCP, TRH, BTEXN, PAH
BR113	0-100mm	Northern stockpile footprint	As, Cd, Cr (total), Cu, Pb, Ni, Zn, Hg, OCP, TRH, BTEXN, PAH
BR114	0-100mm	Northern stockpile footprint	As, Cd, Cr (total), Cu, Pb, Ni, Zn, Hg, OCP, TRH, BTEXN, PAH
BR115	0-100mm	Northern stockpile footprint	As, Cd, Cr (total), Cu, Pb, Ni, Zn, Hg, OCP, TRH, BTEXN, PAH
BR116	0-100mm	Northern stockpile footprint	As, Cd, Cr (total), Cu, Pb, Ni, Zn, Hg, OCP, TRH, BTEXN, PAH
BR117	0-100mm	Northern stockpile footprint	As, Cd, Cr (total), Cu, Pb, Ni, Zn, Hg, OCP, TRH, BTEXN, PAH
BR118	0-100mm	Northern stockpile footprint	As, Cd, Cr (total), Cu, Pb, Ni, Zn, Hg, OCP, TRH, BTEXN, PAH
BR119	0-100mm	Northern stockpile footprint	As, Cd, Cr (total), Cu, Pb, Ni, Zn, Hg, OCP, TRH, BTEXN, PAH
BR120	0-100mm	Southern stockpile footprint	As, Cd, Cr (total), Cu, Pb, Ni, Zn, Hg, OCP, TRH, BTEXN, PAH
BR121	0-100mm	Southern stockpile footprint	As, Cd, Cr (total), Cu, Pb, Ni, Zn, Hg, OCP, TRH, BTEXN, PAH
BR122	0-100mm	Southern stockpile footprint	As, Cd, Cr (total), Cu, Pb, Ni, Zn, Hg, OCP, TRH, BTEXN, PAH
BR123	0-100mm	Southern stockpile footprint	As, Cd, Cr (total), Cu, Pb, Ni, Zn, Hg, OCP, TRH, BTEXN, PAH
BR124	0-100mm	Southern stockpile footprint	As, Cd, Cr (total), Cu, Pb, Ni, Zn, Hg, OCP, TRH, BTEXN, PAH
BR125	0-100mm	Southern stockpile footprint	As, Cd, Cr (total), Cu, Pb, Ni, Zn, Hg, OCP, TRH, BTEXN, PAH
BR126	0-100mm	Southern stockpile footprint	As, Cd, Cr (total), Cu, Pb, Ni, Zn, Hg, OCP, TRH, BTEXN, PAH
BR127	0-100mm	Southern stockpile footprint	As, Cd, Cr (total), Cu, Pb, Ni, Zn, Hg, OCP, TRH, BTEXN, PAH
BR128	0-100mm	Southern stockpile footprint	As, Cd, Cr (total), Cu, Pb, Ni, Zn, Hg, OCP, TRH, BTEXN, PAH
BR129	0-100mm	Southern stockpile footprint	As, Cd, Cr (total), Cu, Pb, Ni, Zn, Hg, OCP, TRH, BTEXN, PAH

 Table 1. Schedule of samples and analysis

8. Quality assurance and quality control

8.1 Sampling design

The sampling program is intended to provide data as to the presence and levels of contaminants. Discrete soil samples were collected on a systematic grid pattern of 20 metres. This sampling density will enable the detection of an area with an elevated concentration on a radius of 12 metres with a 95% confidence level.

8.2 Field

The collection of samples was undertaken in accordance with accepted standard protocols (NEPC 1999). All samples within the site were analysed for arsenic, cadmium, chromium, copper, lead, nickel, zinc, mercury (heavy metals), organochlorine pesticides (OCP), total recoverable hydrocarbons (TRH), benzene, toluene, ethylbenzene, xylene, naphthalene (BTEXN), polycyclic aromatic hydrocarbons (PAH).

Sampling equipment was decontaminated between each sampling event. The appropriate storage conditions and duration were observed between sampling and analysis. A chain of custody form accompanied the samples to the laboratory (Appendix 4).

A single sampler was used to collect the samples using standard methods. Soil collected was a fresh sample from a hand shovel. After collection the samples were immediately placed in new glass sampling jars and placed in a cooler.

Two intra-laboratory samples were collected. The frequency of field duplicates is within than the NEPM (1999) recommendation of 5%. No field blank, rinsate, trip blank or matrix spikes were submitted for analysis. Some samples from all batches did not contain contaminants which confirm the absence of cross contamination during transport and storage.

A field sampling log is presented in Appendix 3.

8.3 Laboratory

Chemical analysis was conducted by SGS Laboratories, Alexandria, which is NATA accredited for the tests undertaken. The laboratory has quality assurance and quality control programs in place, which include internal replication and analysis of spike samples and recoveries.

Method blanks, matrix duplicates and laboratory control samples were within acceptance criteria. The quality assurance and quality control report is presented together with the laboratory report as Appendix 3.

8.4 Data evaluation

The laboratory quality control report indicates the data variability is within acceptable industry limits. The data is considered representative and usable for the purposes of the investigation. Data quality indicators are presented in Appendix 1.

9. Conceptual site model

9.1 Sources of contamination

Potential exists for contaminating activities to have been undertaken on site which may impact on the suitability for the proposed land-use. The presence of stockpiles may have resulted in application of contaminants.

9.2 Contaminants of concern

Based on historical activities and site inspection the contaminants of concern are:

- Heavy metals (arsenic, cadmium, chromium, copper, nickel, lead, zinc, mercury)
- Organochlorine pesticides (OCP)
- Total recoverable hydrocarbons (TRH
- Benzene, toluene, ethylbenzene, xylenes and naphthalene (BTEXN)
- Polycyclic aromatic hydrocarbons (PAH)

9.3 Potential receptors

The proposed land-use of the site is residential and recreational. The site has historically been used for grazing.
Human receptors include:

- On-site works during proposed site works
- Residents
- Recreational users of open space
- Intrusive maintenance workers

Ecological receptors include

- Flora and fauna on the site and adjacent to the site
- Aquatic flora and fauna receptors on-site and off-site

9.4 Exposure pathways

Pathways for exposure to contaminants are:

- Dermal contact following soil disturbance
- Ingestion after soil disturbance
- Inhalation of dust after soil disturbance
- Surface water and sediment runoff into waterways
- Leaching of contaminants into the groundwater
- Direct contact of flora and fauna with the soil

9.5 Source receptor linkages

Potential source pathway receptor linkages are identified to enable evaluation of any adverse impact on human health or ecology.

The proposed land-use of the site is residential and human receptors to the investigation area are likely. Proposed users of the site may have a risk of exposure if contaminants are present and the soil is disturbed.

Source/contaminants	Transport	Potential exposure pathways	Receptors
Unknown source of stockpiles (heavy metals, OCP, TRH, BTEXN, PAH)	■Wind ■Sedimentation ■Groundwater	 Direct contact (ingestion and absorption) (human and environment) Inhalation Runoff Leaching 	 On-site workers during construction Residents Recreational users Ecosystem

Potential, Dunknown/unlikely

10. Assessment criteria

A residential subdivision is proposed for the site. The laboratory results were assessed against residential with access to soil and recreational land-use. The health and ecological-based investigation levels of contaminants in the soil for residential and recreational sites, for the substances for which criteria are available, are listed in Table 2, as recommended in the NEPM (1999).

The NEPM (1999) provides health screening levels (HSL) for hydrocarbons in soil. The HSLs have been developed to be protective of human health for soil types, depths below surface and apply to exposure to hydrocarbons through the predominant vapour exposure pathway. The appropriate HSL for the site is listed in Table 2. TRH>C16 have physical properties which make the TRH fractions non-volatiles and therefore these TRH fractions are not limiting for vapour intrusion.

Ecological investigation levels (EIL) have been developed for the protection of terrestrial ecosystems for selected metals and organic substances in the soil in the guideline (NEPC 1999). Ecological screening levels (ESL) assess the risk to terrestrial ecosystems from petroleum hydrocarbons in the soil. The EILs and ESLs consider the properties of the soil and contaminants and the capacity of the local ecosystem to accommodate increases in contaminant levels.

EILs vary with land-use and apply to contaminants up to 2m depth below the surface. The EILs for residential and recreational land-use are listed in Table 2.

ESLs are dependent on land-use, soil types and are applicable to contaminants up to 2m below the surface. The appropriate ESL for the site is residential and recreational as listed in Table 2.

Management limits have been developed to assess petroleum hydrocarbons following evaluation of human health and ecological risks (NEPC 1999). Management units are applicable as screening levels after consideration of relevant ESLs and HSLs. The appropriate management limit for the site is listed in Table 2.

Typical CEC values for soils in the locality include 10cmol(+)/kg. pH values of between 6 and 7, organic carbon of 4% and clay content of 20 to 30% (Espade, 2019). The proposed land-use is residential and recreational. The contaminants have been identified in the soil for at least two years and are considered aged.

Analyte	HIL A Residential	HIL C Recreational	EIL Urban Residential and public open space	HSL Residential- clay soil 0 to <1m	HSL Recreational- clay soil 0 to <1m	ESL Residential and public open space- Fine soil	Management limits for TRH in fine soil / Residential, parkland and public open space
Arsenic	100	300	100	-	-	-	-
Cadmium	20	90	-	-	-	-	-
Chromium (total)	-	-	-	-	-	-	-
Chromium (VI)	100	300	-	-	-		
Copper	6,000	17,000	130	-	-	-	-
Lead	300	600	1,100	-	-	-	-
Nickel	400	1,200	170	-	-	-	-
Zinc	7,400	30,000	270	-	-	-	-
Mercury	40	80	-	-	-	-	-
OCP (DD's)	240	400	180	-	-	-	-
TRH (C6-C10)	-	-	-	50	NL	180	800
TRH (C10-C16)	-	-	-	280	NL	120	1,000
TRH (>C16-C34)	-	-	-	NA	NA	1,300	3,500
TRH (>C34-C40)	-	-	-	NA	NA	5,600	10,000
Benzene	-	-	-	0.7	NL	65	-
Toluene	-	-	-	480	NL	105	-
Ethylbenzene	-	-	-	NL	NL	125	-
Xylenes	-	-	-	110	NL	45	-
Naphthalene	-	-	-	5	NL	-	-
Benzo(a)pyrene	-	-	-	-	-	0.7	-
Total PAH	300	300	-	-	-	-	-
Carcinogenic PAH	3	3	-	-	-	-	-

Table 2. Investigation levels – residential and recreational (mg/kg) (NEPC 1999)

NL= No limit, NA= Not applicable

Analyte	Rationale	ACL (mg/kg)	ABC (mg/kg)	EIL (mg/kg)
Zinc	CEC 10cmol/kg, pH 5.5	270	0	270
Copper	pH 5.5	130	0	130
Nickel	CEC 10cmol/kg	170	0	170
Lead	Generic	1,100	0	1,100
Arsenic	Aged	100	0	100
DDT	Aged	180	0	180

Table 3. ElL Calculation sheet, residential/recreational land-use

ACL - added contaminant limit, ABC-ambient background concentration, EIL-Ecological investigation limit (ACL+ABC)

11. Results and discussion

The site was inspected on the 14 May 2019. Land-use on the site was vacant paddocks with earthworks occurring in the western section of the site.

Surface cover on the site was predominately vegetated with bare areas in the western section of the site due to earthworks and areas of removed stockpiles. No evidence of the previously identified nursery area remained during the site inspection.

Historical aerial photographs and historical review of the site indicate the site has been used for agricultural grazing. Additional contaminating activities have not been identified on the site following the previous contamination investigation.

Stockpiles previously identified on-site had been removed or reportedly burnt. Ash was identified in the northern area of the site with scrap metal remaining. A small stockpile previously located in the south western section of the site was visually assessed. The stockpile had been removed from the site and earthworks for a drainage line had begun within this area.

Stockpiles were identified during the site inspection in the south eastern and north western section of the site and appear to be from earthworks on-site. The stockpiles were similar colour and material to that identified on-site and vehicular tracks are evident from adjacent earthworks and stockpiles. An earthworks compound was identified in the central area of the site.

The levels of all substances analysed in the soil samples (Tables 4 and 5) collected from the stockpile footprints were below the adopted residential and recreational land-use thresholds (NEPC 1999).

Sample I.D.	Location	Arsenic	Cadmium	Chromium (total)	Copper	Lead	Nickel	Zinc	Mercury	OCP DD's	Total PAH	Carcinogenic PAH
BR101	Central stockpile footprint	6	ND	24	13	8	20	15	ND	ND	ND	ND
BR102	Central stockpile footprint	5	ND	29	17	8	23	19	ND	ND	ND	ND
BR103	Central stockpile footprint	5	ND	29	15	8	21	18	ND	ND	ND	ND
BR104	Northern stockpile footprint	5	0.3	25	17	60	11	290	ND	ND	ND	ND
BR105	Northern stockpile footprint	6	ND	34	21	38	18	280	ND	ND	ND	ND
BR106	Northern stockpile footprint	4	ND	79	22	250	31	71	ND	ND	ND	ND
BR107	Northern stockpile footprint	3	ND	64	20	28	29	54	ND	ND	ND	ND
BR108	Northern stockpile footprint	5	ND	21	18	11	22	80	ND	ND	ND	ND
BR109	Northern stockpile footprint	4	ND	16	12	10	7.8	64	ND	ND	ND	ND
BR110	Northern stockpile footprint	4	ND	44	22	7	27	42	ND	ND	ND	ND
BR111	Northern stockpile footprint	3	ND	64	22	9	31	38	ND	ND	ND	ND
BR112	Northern stockpile footprint	4	ND	25	12	8	12	56	ND	ND	ND	ND
BR113	Northern stockpile footprint	5	ND	42	20	8	24	34	ND	ND	ND	ND
BR114	Northern stockpile footprint	3	ND	44	19	7	25	33	ND	ND	ND	ND
BR115	Northern stockpile footprint	6	ND	37	20	7	30	37	ND	ND	ND	ND
BR116	Northern stockpile footprint	5	ND	76	19	10	26	27	ND	ND	ND	ND
BR117	Northern stockpile footprint	5	ND	55	19	9	24	38	ND	ND	ND	ND
BR118	Northern stockpile footprint	5	ND	100	23	11	32	37	ND	ND	3.6	0.5
BR119	Northern stockpile footprint	4	ND	29	15	7	16	25	ND	ND	ND	ND
BR120	Southern stockpile footprint	4	ND	13	3.8	4	6.4	7.6	ND	ND	ND	ND
BR121	Southern stockpile footprint	3	ND	20	7.6	5	8.9	15	ND	ND	ND	ND
BR122	Southern stockpile footprint	4	ND	22	10	5	17	18	ND	ND	ND	ND
BR123	Southern stockpile footprint	2	ND	19	9.8	7	11	17	ND	ND	ND	ND
BR124	Southern stockpile footprint	2	ND	14	4.8	4	5.6	8.2	ND	ND	ND	ND
BR125	Southern stockpile footprint	3	ND	12	4.6	4	4.9	10	ND	ND	ND	ND
BR126	Southern stockpile footprint	4	ND	16	2.9	4	2.6	5.2	ND	ND	ND	ND
BR127	Southern stockpile footprint	2	ND	15	7.0	7	6.8	17	ND	ND	ND	ND
BR128	Southern stockpile footprint	2	ND	13	5.1	5	4.7	11	ND	ND	ND	ND
BR129	Southern stockpile footprint	4	ND	16	7.0	5	11	19	ND	ND	ND	ND
HIL A – F	Residential	100	20	-	6,000	300	400	7,400	40	240	300	3
HILC-F	Recreational	300	90	-	17,000	600	1,200	30,000	80	400	300	3
EIL – Urt open spa	oan Residential and public ace	100	-	-	130	1,100	170	400	-	180	-	-

ND - not detected, HIL - health investigation level, EIL - ecological investigation level

Table 5. Analytical results and threshold concentrations for hydrocarbons (mg/kg)

Sample id.	Location	TRH (C6-C10)	TRH (>C10-C16)	TRH (>C16-C34)	TRH (>C34-C40)	Benzene	Toluene	Ethylbenzene	Xylenes	Naphthalene	Benzo(a)pyrene
BR101	Central stockpile footprint	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BR102	Central stockpile footprint	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BR103	Central stockpile footprint	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BR104	Northern stockpile footprint	ND	ND	160	ND	ND	ND	ND	ND	ND	ND
BR105	Northern stockpile footprint	ND	74	91	ND	ND	ND	ND	ND	ND	ND
BR106	Northern stockpile footprint	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BR107	Northern stockpile footprint	ND	25	ND	ND	ND	ND	ND	ND	ND	ND
BR108	Northern stockpile footprint	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BR109	Northern stockpile footprint	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BR110	Northern stockpile footprint	ND	74	150	ND	ND	ND	ND	ND	ND	ND
BR111	Northern stockpile footprint	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BR112	Northern stockpile footprint	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BR113	Northern stockpile footprint	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BR114	Northern stockpile footprint	ND	82	230	ND	ND	ND	ND	ND	ND	ND
BR115	Northern stockpile footprint	ND	74	190	ND	ND	ND	ND	ND	ND	ND
BR116	Northern stockpile footprint	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BR117	Northern stockpile footprint	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BR118	Northern stockpile footprint	ND	84	260	ND	ND	ND	ND	ND	ND	0.4
BR119	Northern stockpile footprint	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BR120	Southern stockpile footprint	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BR121	Southern stockpile footprint	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BR122	Southern stockpile footprint	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BR123	Southern stockpile footprint	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BR124	Southern stockpile footprint	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BR125	Southern stockpile footprint	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BR126	Southern stockpile footprint	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BR127	Southern stockpile footprint	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BR128	Southern stockpile footprint	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BR129	Southern stockpile footprint	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
HSL A – re	sidential clay soil 0m to <1m	50	280	NA	NA	0.7	480	NL	110	5	-
HSL – recr	eational 0m to <1m	NL	NL	NA	NA	NL	NL	NL	NL	NL	-
ElL – resid	ential and recreational	-	-	-	-	-	-	-	-	370	-
ESL – resid	dential/recreational fine soil	180	120	1,300	5,600	65	105	125	45	-	0.7
Manageme recreation	ent limits – residential/ al	800	1,000	3,500	10,000	-	-	-	-	-	-

12. Site characterisation

12.1 Environmental contamination

Not applicable as no contamination was detected

12.2 Chemical degradation production

Not applicable as no contamination was detected

12.3 Exposed population

Not applicable as no contamination was detected

13. Conclusions and recommendations

13.1 Summary

An inspection of the site was made on 14 May 2019. The site is approximately 140ha in area. Land-use on the site was vacant paddocks with earthworks occurring in the western section of the site. Surface cover on the site was predominately vegetated with bare areas in the western section of the site due to earthworks and areas of removed stockpiles. No evidence of the previously identified nursery area remained during the site inspection.

Historical aerial photographs and historical review of the site indicate the site has been used for agricultural grazing.

Stockpiles previously identified on-site had been removed or reportedly burnt. Ash was identified in the northern area of the site with scrap metal remaining. A small stockpile footprint previously located in the south western section of the site was visually assessed. The stockpile had been removed from the site and earthworks for a drainage line had begun within this area.

Stockpiles were identified during the site inspection in the south eastern and north western section of the site and appear to be from earthworks on-site. The stockpiles were similar colour and material to that identified on-site and vehicular tracks are evident from adjacent earthworks and stockpiles. An earthworks compound was identified in the central area of the site.

Additional contaminating activities have not been identified on the site following the previous contamination investigation. The levels of all substances analysed in the soil samples collected from the stockpile footprints were below the adopted residential and recreational land-use thresholds.

13.2 Assumptions in reaching the conclusions

It is assumed the sampling sites are representative of the site. An accurate history has been obtained and typical management practices were adopted.

13.3 Extent of uncertainties

The analytical data relate only to the locations sampled. Soil conditions can vary both laterally and vertically and it cannot be excluded that unidentified contaminants may be present. The sampling density was designed to detect a hot spot in the field area within a radius of approximately 12 metres and with a 95% level of confidence.

13.4 Suitability for proposed use of the site

The site is suitable for the residential and recreational land-use.

13.5 Limitations and constraints on the use of the site

No constraints are recommended.

13.6 Recommendation for further work

Scrap metal was identified remaining in the northern area of the site. The scrap metal requires removal as it is an amenity hazard.

14. Report limitations and intellectual property

This report has been prepared for the use of the client to achieve the objectives given the clients requirements. The level of confidence of the conclusion reached is governed by the scope of the investigation and the availability and quality of existing data. Where limitations or uncertainties are known, they are identified in the report. No liability can be accepted for failure to identify conditions or issues which arise in the future and which could not reasonably have been predicted using the scope of the investigation and the information obtained.

The investigation identifies the actual subsurface conditions only at those points where samples are taken, when they are taken. Data derived through sampling and subsequent laboratory testing is interpreted by geologists, engineers or scientists who then render an opinion about overall subsurface conditions, the nature and extent of the contamination, its likely impact on the proposed development and appropriate remediation measures. Actual conditions may differ from those inferred to exist, because no professional, no matter how well qualified, and no sub-surface exploration program, no matter how comprehensive, can reveal what is hidden by earth, rock or time. The actual interface between materials may be far more gradual or abrupt than a report indicates. Actual conditions in areas not sampled may differ from predictions. It is thus important to understand the limitations of the investigation and recognise that we are not responsible for these limitations.

This report, including data contained and its findings and conclusions, remains the intellectual property of Envirowest Consulting Pty Ltd. A licence to use the report for the specific purpose identified is granted for the persons identified in that section after full payment for the services involved in preparation of the report. This report should not be used by persons or for purposes other than those stated and should not be reproduced without the permission of Envirowest Consulting Pty Ltd.

15. References

EPA (2017) Contaminated Sites: Guidelines for the NSW Site Auditors Scheme (NSW Department of Environment and Conservation, Chatswood)

Environment.nsw.gov.au, 'Espade | NSW Environment & Heritage' Version 2. N.p., 2015. Web. 3 June 2019.

Environment Protection Authority (1995) *Contaminated sites: Sampling Design Guidelines* (NSW Environment Protection Authority, Chatswood)

Murhy, BW., and Lawrie, JW (1998) *Soil Landscapes of the Dubbo 1:250,000 Sheet* (Soil Conservation Service of NSW, Sydney)

NEPC (1999 revised 2013) National Environment Protection (Assessment of Site Contamination) Measure 1999 (National Environment Protection Council Service Corporation, Adelaide) Figures



	Figure 1: Locality map	D		
Former Lot 399 DP11	199356 and Lot 503 DF	21152321, Dubbo NSW		
	Envirowest Consulting Pty Ltd			
Job: R10925c	Drawn by: AA	Date: 6/6/2019		



Figu	re 2: Aerial photograph	(2019)		
Former Lot 399 DP11	199356 and Lot 503 DF	21152321, Dubbo NSW		
	Envirowest Consulting Pty Ltd			
Job: R10925c	Drawn by: AA	Date: 6/6/2019		

Northern stockpiles Central stockpiles mage Southern stockpiles Legend Lot boundary Removed stockpiles previously identified (\cdot, \cdot, \cdot) Figure 3: Site layout Former Lot 399 DP1199356 and Lot 503 DP1152321, Dubbo NSW Stockpiles identified during 14 May 2019 inspection

	Envirowest Consulting Pty Ltd				
Job: R10925c	Drawn by: AA	Date: 6/6/2019			



Legend

 \otimes Sampling locations

Approximate	Scale	1:	1,200
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0

48m

12 24

Figure 4: Sampling locations northern stockpile footprint

Former Lot 399 DP1199356 and Lot 503 DP1152321, Dubbo NSW

	Envirowest Co	onsulting Pty Ltd
Job: R10925c	Drawn by: AA	Date: 6/6/2019



Figure 5: Sampling lo	ocations central and sou	thern stockpile footprint		
Former Lot 399 DP1	199356 and Lot 503 DP	1152321, Dubbo NSW		
	Envirowest Consulting Pty Ltd			
Job: R10925c	Drawn by: AA	Date: 6/6/2019		

Figure 6. Photographs of the site



Northern stockpile footprint



Looking south east across site



Scrap steel remaining in northern stockpile footprint



Southern stockpile footprint

Appendices

Appendix 1. Sample analysis, quality assurance and quality control (QAQC) report

1. Data quality indicators (DQI) requirements

1.1 Completeness

A measure of the amount of usable data for a data collection activity. Greater than 95% of the data must be reliable based on the quality objectives. Where greater than two quality objectives have less reliability than the acceptance criterion the data may be considered with uncertainty.

1.1.1 Field

Consideration	Requirement
Locations and depths to be sampled	Described in the sampling plan. The acceptance criterion is 95% data retrieved compared with proposed. Acceptance criterion is 100% in crucial areas.
SOP appropriate and compiled	Described in the sampling plan.
Experienced sampler	Sampler or supervisor
Documentation correct	Sampling log and chain of custody completed

1.1.2 Laboratory

Consideration	Requirement
Samples analysed	Number according to sampling and quality plan
Analytes	Number according to sampling and quality plan
Methods	EPA or other recognised methods with suitable PQL
Sample documentation	Complete including chain of custody and sample description
Sample holding times	Metals 6 months, OCP, PAH, TPH, PCB 14 days

1.2 Comparability

The confidence that data may be considered to be equivalent for each sampling and analytical event. The data must show little or no inconsistencies with results and field observations.

1.2.1 Field

Consideration	Requirement
SOP	Same sampling procedures to be used
Experienced sampler	Sampler or supervisor
Climatic conditions	Described as may influence results
Samples collected	Sample medium, size, preparation, storage, transport

1.2.2 Laboratory

Consideration	Requirement
Analytical methods	Same methods, approved methods
PQL	Same
Same laboratory	Justify if different
Same units	Justify if different

1.3 Representativeness

The confidence (expressed qualitatively) that data are representative of each media present on the site.

1.3.1 Field

Consideration	Requirement
Appropriate media sampled	Sampled according to sampling and quality plan or in accordance with
	the EPA (1995) sampling guidelines.
All media identified	Sampling media identified in the sampling and quality plan. Where
	surface water bodies on the site sampled.

1.3.2 Laboratory

Consideration	Requirement
Samples analysed	Blanks

1.4 Precision

A quantitative measure of the variability (or reproduced of the data). Is measured by standard deviation or relative percent difference (RPD). A RPD analysis is calculated and compared to the practical quantitation limit (PQL) or absolute difference AD.

- Levels greater than 10 times the PQL the RPD is 50%
- Levels between 5 and 10 times the PQL the RPD is 75%
- Levels between 2 and 5 times the PQL the RPD is 100%
- Levels less than 2 times the PQL, the AD is less than 2.5 times the PQL

Data not conforming to the acceptance criterion will be examined for determination of suitability for the purpose of site characterisation.

1.4.1 Field

Consideration	Requirement
Field duplicates	Frequency of 5%, results to be within RPD or discussion required
·	indicate the appropriateness of SOP

1.4.2 Laboratory

Consideration	Requirement
Laboratory and inter lab duplicates	Frequency of 5%, results to be within RPD or discussion required.
	Inter laboratory duplicates will be one sample per batch.
Field duplicates	Frequency of 5%, results to be within RPD or discussion required
Laboratory prepared volatile trip spikes	One per sampling batch, results to be within RPD or discussion
	required

1.5 Accuracy

A quantitative measure of the closeness of the reported data to the true value.

1.5.1	Field
-------	-------

Consideration	Requirement
SOP	Complied
Inter laboratory duplicates	Frequency of 5%.
	Analysis criterion
	60% RPD for levels greater than 10 times the PQL
	85% RPD for levels between 5 to 10 times the PQL
	100% RPD at levels between 2 to 5 times the PQL
	Absolute difference, 3.5 times the PQL where levels are, 2 times PQL

1.5.2 Laboratory

Recovery data (surrogates, laboratory control samples and matrix spikes) data subject to the following control limits:

- 60 to 140% acceptable data
- 20-60% discussion required, may be considered acceptable
- 10-20% data should considered as estimates
- 10% data should be rejected

Consideration	Requirement
Field blanks	Frequency of 5%, <5 times the PQL, PQL may be adjusted
Rinsate blanks	Frequency of 5%, <5 times the PQL, PQL may be adjusted
Method blanks	Frequency of 5%, <5 times the PQL, PQL may be adjusted
Matrix spikes	Frequency of 5%, results to be within +/-40% or discussion required
Matrix duplicates	Frequency of 5%, results to be within +/-40% or discussion required
Surrogate spikes	Frequency of 5%, results to be within +/-40% or discussion required
Laboratory control samples	It is to be within +/-40% or discussion required
Laboratory prepared spikes	Frequency of 5%, results to be within +/-40% or discussion required

2. Laboratory analysis summary

One analysis batch was undertaken over the preliminary investigation program. Soil samples were collected on 14 May 2019. A total of twenty-nine soil samples were submitted for analytical testing. The samples were collected in the field by an environmental scientist from Envirowest Consulting Pty Ltd, placed into laboratory prepared receptacles as recommended in NEPM (1999). The samples preservation and storage was undertaken using standard industry practices (NEPC 1999). A chain of custody form accompanied transport of the samples to the laboratory.

The samples were analysed at the laboratory of SGS, Alexandria, NSW which is National Association of Testing Authorities (NATA) accredited for the tests undertaken. The analyses undertaken, number of samples tested and methods are presented in the following tables:

Sample id. (sampling	Number of	Duplicate	Analyses	Date	Substrate	Laboratory
location)	samples			collected		report
BR101, BR102, BR103,	29	2	As, Cd, Cr	14/5/2019	Soil	SE193038
BR104, BR105, BR106,			(total), Cu, Pb,			
BR107, BR108, BR109,			Ni, Zn, OCP,			
BR110, BR111, BR112,			TRH, BTEXN,			
BR113, BR114, BR115,			PAH			
BR116, BR117, BR118,						
BR119, BR120, BR121,						
BR122, BR123, BR124,						
BR125, BR126, BR127,						
BR128, BR129, BR130						
Analytical methods						
Analyte		Extraction		Laboratory me	ethods	
Metals		USEPA 200.2 Mod		APHA USEPA	SW846-6010	
Chromium (III)		-		APHA 3500 CF	R-A&B & 3120	and USEPA
				SW846-3060A		
Chromium (VI)		USEPA SW846-3060/	4	USEPA SW846	5-3060A	
Mercury		USEPA 200.2 Mod		APHA 3112		
TRH(C6-C9)		USPEA SW846-5030/	4	USPEA SW 84	6-8260B	
TRH(C10-C40), PAH		Tumbler extraction of	solids	USEPA SW 84	6-8270B	
PCB		Tumbler extraction of	solids	USEPA SW 84	6-8270B	
OC Pesticides		Tumbler extraction of	solids	USEPA SW 84	6-8270B	
BTEX		Tumbler extraction of	solids	USEPA SW 84	6-8260B	

Laboratory analysis schedule

3. Field quality assurance and quality control

Two intra laboratory duplicate samples were collected for the investigation. The frequency was greater than the recommended frequency of 5%. Table A5.1 outlines the samples collected and differences in

Laboratory report

SE193038

Soil

Date collected Substrate

14/5/2019

replicate analyses. Relative differences were deemed to pass if they were within the acceptance limits of +/- 40% for replicate analyses or less than 5 times the detection limit.

Field duplicate fielduelicy			
Sample id.	Number of samples	Duplicate	Frequency (%)
BR101, BR102, BR103,	29	2	7
BR104, BR105, BR106,			
BR107, BR108, BR109,			

Field duplicate frequency

BR110, BR111, BR112, BR113, BR114, BR115, BR116, BR117, BR118, BR119, BR120, BR121, BR122, BR123, BR124, BR125, BR126, BR127, BR128, BR129

|--|

	BR104, I	DA	BR124, I	BR124, DB	
	Relative difference (%)	Pass/Fail	Relative difference (%)	Pass/Fail	
Arsenic	33	Pass	40	Pass	
Cadmium	29	Pass	NA	-	
Chromium	0	Pass	7	Pass	
Copper	13	Pass	8	Pass	
Lead	70	Pass*	0	Pass	
Nickel	12	Pass	7	Pass	
Zinc	4	Pass	9	Pass	
OCP	NA	-	NA	-	
TRH	NA	-	NA	-	
BTEXN	NA	-	NA	-	
PAH	NA	-	NA	-	

NA – relative difference unable to be calculated as results are less than laboratory detection limit, *difference expected due to non-homogenised sample and results less than 5 times threshold.

No trip blanks or spikes were submitted for analysis. This is not considered to create significant uncertainty in the analysis results because of the following rationale:

- The fieldwork was completed within a short time period and consistent methods were used for soil sampling.
- Soil samples were placed in insulated cooled containers after sampling to ensure preservation during transport and storage.
- The samples were placed in single use jars using clean sampling tools and disposable gloves from material not in contact with other samples. This reduces the likelihood of cross contamination.
- Samples in the analysis batch contain analytes below the level of detection. It is considered unlikely that contamination has occurred as a result of transport and handling.

4. Laboratory quality assurance and quality control

Sample holding times are recommended in NEPM (1999). The time between collection and extraction for all samples was less than the criteria listed below:

Analyte	Maximum holding time	
Metals, cyanide	6 months	
OCP, TRH, PCB, BTEX, PAH	14 days	

The laboratory interpretative reports are presented with individual laboratory report. Assessment is made of holding time, frequency of control samples and quality control samples. No significant outliers exist for the sampling batches. The laboratory report also contains a detailed description of preparation methods and analytical methods.

The results, quality report, interpretative report and chain of custody are presented in the attached appendices. The quality report contains the laboratory duplicates, spikes, laboratory control samples, blanks and where appropriate matrix spike recovery (surrogate).

5. Data quality indicators (DQI) analysis

5.1 Completeness

A measure of the amount of usable data for a data collection activity (total to be greater than 95%).

The data set was found to be complete based on the scope of work. No critical areas of contamination were omitted from the data set.

5.1.1 Field

Consideration	Accepted	Comment
Locations to be sampled	Yes	In accordance with sampling methodology, described in the report. Sampling locations described in figures.
Depth to be sampled	Yes	In accordance with sampling methodology
SOP appropriate and compiled	Yes	In accordance with sampling methodology Sampled with stainless steel spade into lab prepared containers, decontamination between samples latex doves worn by sampler
Experienced sampler	Yes	Same soil sampler, environmental scientist
Documentation correct	Yes	Sampling log completed Chain of custody completed

5.1.2 Laboratory

Consideration	Accepted	Comment
Samples analysed	Yes	All critical samples analysed in accordance with chain of custody and analysis plan.
Analytes	Yes	All analytes in accordance with chain of custody and analysis plan
Methods	Yes	Analysed in NATA accredited laboratory with recognised methods and suitable PQL
Sample documentation	Yes	Completed including chain of custody and sample results and quality results report for each batch
Sample holding times	Yes	Metals less than 6 months. OCP, TRH, PCB, BTEX less than 14 days

5.2 Comparability

The confidence that data may be considered to be equivalent for each sampling and analytical event.

The data sets were found to be acceptable.

5.2.1 Field

Consideration	Accepted	Comment
SOP	Yes	Same sampling procedures used and sampled on one date
Experienced sampler	Yes	Experienced scientist
Climatic conditions	Yes	Described in field sampling log
Samples collected	Yes	Suitable size, storage and transport

5.2.2 Laboratory

Consideration	Accepted	Comment
Analytical methods	Yes	Same methods all samples, in accordance with NEPM (1999)
PQL	Yes	Suitable for analytes
Same laboratory	Yes	SGS Environmental is NATA accredited for the test
Same units	Yes	

5.3 Representativeness

The confidence (expressed qualitatively) that data are representative of each media present on the site.

The data sets were found to be acceptable.

5.3.1 Field

Consideration	Accepted	Comment
Appropriate media sampled	Yes	Sampled according to sampling and quality plan
All media identified	Yes	Soil
		Sampling media identified in the sampling and quality plan

5.3.2 Laboratory

Consideration	Accepted	Comment
Samples analysed	Yes	Undertaken in NATA accredited laboratory. No blanks analysed. Samples in the analysis batch contain analytes below the level of detection. It is considered unlikely that contamination has occurred as a result of transport and handling.

5.4 Precision

A quantitative measure of the variability (or reproduced of the data).

The data sets were found to be acceptable.

5.4.1 Field

Consideration	Accepted	Comment	
SOP	Yes	Complied	
Field duplicates	Yes	Collected	

5.4.2 Laboratory

Consideration	Accepted	Comment
Laboratory and inter lab duplicates	Yes	Frequency of 5%, results to be within +/-40% or discussion required.
Field duplicates	Yes	Results to be within +/-40% or discussion required
Laboratory prepared volatile trip spikes	NA	Not analysed due to preliminary nature of assessment

5.5 Accuracy

A quantitative measure of the closeness of the reported data to the true value.

The data sets were found to be acceptable.

5.5.1 Field

Consideration	Accepted	Comment
SOP	Yes	Complied
Field blanks	NA	Frequency of 5%, <5 times the PQL, PQL may be adjusted
Rinsate blanks	NA	Frequency of 5%, <5 times the PQL, PQL may be adjusted

5.5.2 Laboratory

Consideration	Accepted	Comment
Method blanks	Yes	Frequency of 5%, <5 times the PQL, PQL may be adjusted
Matrix spikes	Yes	Frequency of 5%, results to be within +/-40% or discussion required.
Matrix duplicates	Yes	Frequency of 5%, results to be within +/-40% or discussion required
Surrogate spikes	Yes	Frequency of 5%, results to be within +/-40% or discussion required
Laboratory control samples	Yes	Frequency of 5%, results to be within +/-40% or discussion required
Laboratory prepared spikes	Yes	Frequency of 5%, results to be within +/-40% or discussion required

No trip blanks, field spikes or sample rinsates were submitted for analysis. This is not considered to create significant uncertainty in the analysis results because of the following rationale:

- The fieldwork methods used for soil sampling were consistent throughout the project with all in situ samples collected from material which had not been subject to exposure.
- The fieldwork was completed within a short time period and consistent methods were used for soil sampling.
- Soil samples were placed in insulated cooled containers as quickly as possible, with the containers filled to minimize headspace. The sample containers were sealed immediately after the sample was collected and chilled in an esky containing ice.
- The samples were stored in a refrigerator and transported with ice bricks to ensure preservation during transport and storage.
- The samples were placed in single use jars using clean sampling tools and disposable gloves from material not in contact with other samples. This reduces the likelihood of cross contamination.
- Samples in the analysis batches contained analytes below the level of detection. It is considered unlikely that contamination has occurred as a result of transport and handling.

6. Conclusion

All media appropriate to the objectives of this investigation have been adequately analysed and no area of significant uncertainty exist. It is concluded the data is usable for the purposes of the investigation.

Appendix 2. Field sampling log

Sampling log Client	Mass Group Properties
Contact	Steve Guy
Job number	10925
Location	Former Lot 399 DP1199356 and Lot 503 DP1152321 Boundary Road, Dubbo NSW
Date	14 May 2019
Investigator(s)	Ashleigh Adams
Weather conditions	Mild and fine

Sample id	Matrix	Date	Analysis required	Observations/comments
BR101	Soil	14/05/2019	Arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), lead (Pb), nickel (Ni), zinc (Zn), mercury (Hg), organochlorine pesticides (OCP), total recoverable hydrocarbons (TRH), benzene, toluene, ethylbenzene, xylenes, naphthalene (BTEXN), polycyclic aromatic hydrocarbons (PAH)	Central stockpile
BR102	Soil	14/05/2019	As, Cd, Cr (total), Cu, Pb, Ni, Zn, Hg, OCP, TRH, BTEXN, PAH	Central stockpile
BR103	Soil	14/05/2019	As, Cd, Cr (total), Cu, Pb, Ni, Zn, Hg, OCP, TRH, BTEXN, PAH	Central stockpile
BR104	Soil	14/05/2019	As, Cd, Cr (total), Cu, Pb, Ni, Zn, Hg, OCP, TRH, BTEXN, PAH	Northern stockpile
BR105	Soil	14/05/2019	As, Cd, Cr (total), Cu, Pb, Ni, Zn, Hg, OCP, TRH, BTEXN, PAH	Northern stockpile
BR106	Soil	14/05/2019	As, Cd, Cr (total), Cu, Pb, Ni, Zn, Hg, OCP, TRH, BTEXN, PAH	Northern stockpile
BR107	Soil	14/05/2019	As, Cd, Cr (total), Cu, Pb, Ni, Zn, Hg, OCP, TRH, BTEXN, PAH	Northern stockpile
BR108	Soil	14/05/2019	As, Cd, Cr (total), Cu, Pb, Ni, Zn, Hg, OCP, TRH, BTEXN, PAH	Northern stockpile
BR109	Soil	14/05/2019	As, Cd, Cr (total), Cu, Pb, Ni, Zn, Hg, OCP, TRH, BTEXN, PAH	Northern stockpile
BR110	Soil	14/05/2019	As, Cd, Cr (total), Cu, Pb, Ni, Zn, Hg, OCP, TRH, BTEXN, PAH	Northern stockpile
BR111	Soil	14/05/2019	As, Cd, Cr (total), Cu, Pb, Ni, Zn, Hg, OCP, TRH, BTEXN, PAH	Northern stockpile
BR112	Soil	14/05/2019	As, Cd, Cr (total), Cu, Pb, Ni, Zn, Hg, OCP, TRH, BTEXN, PAH	Northern stockpile
BR113	Soil	14/05/2019	As, Cd, Cr (total), Cu, Pb, Ni, Zn, Hg, OCP, TRH, BTEXN, PAH	Northern stockpile
BR114	Soil	14/05/2019	As, Cd, Cr (total), Cu, Pb, Ni, Zn, Hg, OCP, TRH, BTEXN, PAH	Northern stockpile
BR115	Soil	14/05/2019	As, Cd, Cr (total), Cu, Pb, Ni, Zn, Hg, OCP, TRH, BTEXN, PAH	Northern stockpile
BR116	Soil	14/05/2019	As, Cd, Cr (total), Cu, Pb, Ni, Zn, Hg, OCP, TRH, BTEXN, PAH	Northern stockpile
BR117	Soil	14/05/2019	As, Cd, Cr (total), Cu, Pb, Ni, Zn, Hg, OCP, TRH, BTEXN, PAH	Northern stockpile
BR118	Soil	14/05/2019	As, Cd, Cr (total), Cu, Pb, Ni, Zn, Hg, OCP, TRH, BTEXN, PAH	Northern stockpile
BR119	Soil	14/05/2019	As, Cd, Cr (total), Cu, Pb, Ni, Zn, Hg, OCP, TRH, BTEXN, PAH	Northern stockpile
BR120	Soil	14/05/2019	As, Cd, Cr (total), Cu, Pb, Ni, Zn, Hg, OCP, TRH, BTEXN, PAH	Southern stockpile
BR121	Soil	14/05/2019	As, Cd, Cr (total), Cu, Pb, Ni, Zn, Hg, OCP, TRH, BTEXN, PAH	Southern stockpile
BR122	Soil	14/05/2019	As, Cd, Cr (total), Cu, Pb, Ni, Zn, Hg, OCP, TRH, BTEXN, PAH	Southern stockpile
BR123	Soil	14/05/2019	As, Cd, Cr (total), Cu, Pb, Ni, Zn, Hg, OCP, TRH, BTEXN, PAH	Southern stockpile
BR124	Soil	14/05/2019	As, Cd, Cr (total), Cu, Pb, Ni, Zn, Hg, OCP, TRH, BTEXN, PAH	Southern stockpile
BR125	Soil	14/05/2019	As, Cd, Cr (total), Cu, Pb, Ni, Zn, Hg, OCP, TRH, BTEXN, PAH	Southern stockpile
BR126	Soil	14/05/2019	As, Cd, Cr (total), Cu, Pb, Ni, Zn, Hg, OCP, TRH, BTEXN, PAH	Southern stockpile
BR127	Soil	14/05/2019	As, Cd, Cr (total), Cu, Pb, Ni, Zn, Hg, OCP, TRH, BTEXN, PAH	Southern stockpile
BR128	Soil	14/05/2019	As, Cd, Cr (total), Cu, Pb, Ni, Zn, Hg, OCP, TRH, BTEXN, PAH	Southern stockpile
BR129	Soil	14/05/2019	As, Cd, Cr (total), Cu, Pb, Ni, Zn, Hg, OCP, TRH, BTEXN, PAH	Southern stockpile
DA	Soil	14/05/2019	As, Cd, Cr (total), Cu, Pb, Ni, Zn, Hg, OCP, TRH, BTEXN, PAH	Duplicate of BR104
DB	Soil	14/05/2019	As, Cd, Cr (total), Cu, Pb, Ni, Zn, Hg, OCP, TRH, BTEXN, PAH	Duplicate of BR124

Appendix 3. Soil analysis results – SGS report number SE193038 and chain of custody form



ANALYTICAL REPORT





CLIENT DETAILS		LABORATORY DE	TAILS	
Contact	Ashleigh Adams	Manager	Huong Crawford	
Client	ENVIROWEST CONSULTING PTY LIMITED	Laboratory	SGS Alexandria Environmental	
Address	PO BOX 8158 ORANGE NSW 2800	Address	Unit 16, 33 Maddox St Alexandria NSW 2015	
Telephone	61 2 63614954	Telephone	+61 2 8594 0400	
Facsimile	(Not specified)	Facsimile	+61 2 8594 0499	
Email	ashleigh@envirowest.net.au	Email	au.environmental.sydney@sgs.com	
Project	10925	SGS Reference	SE193038 R0	
Order Number	10925	Date Received	21/5/2019	
Samples	31	Date Reported	28/5/2019	

COMMENTS -

Accredited for compliance with ISO/IEC 17025 - Testing. NATA accredited laboratory 2562(4354).

SIGNATORIES

Akheeqar Beniameen Chemist



Kamrul Ahsan Senior Chemist

kinter

Ly Kim Ha Organic Section Head

SGS Australia Pty Ltd ABN 44 000 964 278 Environment, Health and Safety

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SE193038 R0

VOC's in Soil [AN433] Tested: 22/5/2019

			BR101	BR102	BR103	BR104	BR105
			SOIL	SOIL	SOIL	SOIL	SOIL
PARAMETER	UOM	LOR	14/5/2019 SE193038.001	14/5/2019 SE193038.002	14/5/2019 SE193038.003	14/5/2019 SE193038.004	14/5/2019 SE193038.005
Benzene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Toluene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Ethylbenzene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
m/p-xylene	mg/kg	0.2	<0.2	<0.2	<0.2	<0.2	<0.2
o-xylene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total Xylenes	mg/kg	0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Total BTEX	mg/kg	0.6	<0.6	<0.6	<0.6	<0.6	<0.6
Naphthalene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1

			BR106	BR107	BR108	BR109	BR110
PARAMETER	UOM	LOR	SOIL - 14/5/2019 SE193038.006	SOIL - 14/5/2019 SE193038.007	SOIL - 14/5/2019 SE193038.008	SOIL - 14/5/2019 SE193038.009	SOIL - 14/5/2019 SE193038.010
Benzene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Toluene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Ethylbenzene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
m/p-xylene	mg/kg	0.2	<0.2	<0.2	<0.2	<0.2	<0.2
o-xylene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total Xylenes	mg/kg	0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Total BTEX	mg/kg	0.6	<0.6	<0.6	<0.6	<0.6	<0.6
Naphthalene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1

			BR111	BR112	BR113	BR114	BR115
PARAMETER	UOM	LOR	SOIL - 14/5/2019 SE193038.011	SOIL - 14/5/2019 SE193038.012	SOIL - 14/5/2019 SE193038.013	SOIL 14/5/2019 SE193038.014	SOIL 14/5/2019 SE193038.015
Benzene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Toluene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Ethylbenzene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
m/p-xylene	mg/kg	0.2	<0.2	<0.2	<0.2	<0.2	<0.2
o-xylene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total Xylenes	mg/kg	0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Total BTEX	mg/kg	0.6	<0.6	<0.6	<0.6	<0.6	<0.6
Naphthalene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1

			BR116	BR117	BR118	BR119	BR120
			SOIL -	SOIL	SOIL	SOIL -	SOIL
PARAMETER	UOM	LOR	14/5/2019 SE193038.016	14/5/2019 SE193038.017	14/5/2019 SE193038.018	14/5/2019 SE193038.019	14/5/2019 SE193038.020
Benzene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Toluene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Ethylbenzene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
m/p-xylene	mg/kg	0.2	<0.2	<0.2	<0.2	<0.2	<0.2
o-xylene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total Xylenes	mg/kg	0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Total BTEX	mg/kg	0.6	<0.6	<0.6	<0.6	<0.6	<0.6
Naphthalene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1



SE193038 R0

VOC's in Soil [AN433] Tested: 22/5/2019 (continued)

			BR121	BR122	BR123	BR124	BR125
			SOIL	SOIL	SOIL	SOIL	SOIL
			-	-	-	-	-
PARAMETER	UOM	LOR	SE193038.021	SE193038.022	SE193038.023	SE193038.024	SE193038.025
Benzene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Toluene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Ethylbenzene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
m/p-xylene	mg/kg	0.2	<0.2	<0.2	<0.2	<0.2	<0.2
o-xylene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total Xylenes	mg/kg	0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Total BTEX	mg/kg	0.6	<0.6	<0.6	<0.6	<0.6	<0.6
Naphthalene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1

			BR126	BR127	BR128	BR129	DA
			SOIL - 14/5/2019	SOIL - 14/5/2019	SOIL - 14/5/2019	SOIL - 14/5/2019	SOIL - 14/5/2019
PARAMETER	UOM	LOR	SE193038.026	SE193038.027	SE193038.028	SE193038.029	SE193038.030
Benzene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Toluene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Ethylbenzene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
m/p-xylene	mg/kg	0.2	<0.2	<0.2	<0.2	<0.2	<0.2
o-xylene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total Xylenes	mg/kg	0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Total BTEX	mg/kg	0.6	<0.6	<0.6	<0.6	<0.6	<0.6
Naphthalene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1

			DB
PARAMETER	UOM	LOR	SOIL - 14/5/2019 SE193038.031
Benzene	mg/kg	0.1	<0.1
Toluene	mg/kg	0.1	<0.1
Ethylbenzene	mg/kg	0.1	<0.1
m/p-xylene	mg/kg	0.2	<0.2
o-xylene	mg/kg	0.1	<0.1
Total Xylenes	mg/kg	0.3	<0.3
Total BTEX	mg/kg	0.6	<0.6
Naphthalene	mg/kg	0.1	<0.1



SE193038 R0

Volatile Petroleum Hydrocarbons in Soil [AN433] Tested: 22/5/2019

			BR101	BR102	BR103	BR104	BR105
			SOIL	SOIL	SOIL	SOIL	SOIL
			- 14/5/2019	- 14/5/2019	- 14/5/2019	- 14/5/2019	- 14/5/2019
PARAMETER	UOM	LOR	SE193038.001	SE193038.002	SE193038.003	SE193038.004	SE193038.005
TRH C6-C9	mg/kg	20	<20	<20	<20	<20	<20
Benzene (F0)	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
TRH C6-C10	mg/kg	25	<25	<25	<25	<25	<25
TRH C6-C10 minus BTEX (F1)	mg/kg	25	<25	<25	<25	<25	<25

			BR106	BR107	BR108	BR109	BR110
			SOIL	SOIL	SOIL	SOIL	SOIL
			- 14/5/2019	- 14/5/2019	- 14/5/2019	- 14/5/2019	- 14/5/2019
PARAMETER	UOM	LOR	SE193038.006	SE193038.007	SE193038.008	SE193038.009	SE193038.010
TRH C6-C9	mg/kg	20	<20	<20	<20	<20	<20
Benzene (F0)	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
TRH C6-C10	mg/kg	25	<25	<25	<25	<25	<25
TRH C6-C10 minus BTEX (F1)	mg/kg	25	<25	<25	<25	<25	<25

			BR111	BR112	BR113	BR114	BR115
			SOIL	SOIL	SOIL	SOIL	SOIL
			14/5/2019	14/5/2019	14/5/2019	14/5/2019	14/5/2019
PARAMETER	UOM	LOR	SE193038.011	SE193038.012	SE193038.013	SE193038.014	SE193038.015
TRH C6-C9	mg/kg	20	<20	<20	<20	<20	<20
Benzene (F0)	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
TRH C6-C10	mg/kg	25	<25	<25	<25	<25	<25
TRH C6-C10 minus BTEX (F1)	mg/kg	25	<25	<25	<25	<25	<25

			BR116	BR117	BR118	BR119	BR120
			SOIL	SOIL	SOIL	SOIL	SOIL
			14/5/2019	14/5/2019	14/5/2019	- 14/5/2019	- 14/5/2019
PARAMETER	UOM	LOR	SE193038.016	SE193038.017	SE193038.018	SE193038.019	SE193038.020
TRH C6-C9	mg/kg	20	<20	<20	<20	<20	<20
Benzene (F0)	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
TRH C6-C10	mg/kg	25	<25	<25	<25	<25	<25
TRH C6-C10 minus BTEX (F1)	mg/kg	25	<25	<25	<25	<25	<25

			BR121	BR122	BR123	BR124	BR125
			SOIL	SOIL	SOIL	SOIL	SOIL
			- 14/5/2019	- 14/5/2019	- 14/5/2019	- 14/5/2019	- 14/5/2019
PARAMETER	UOM	LOR	SE193038.021	SE193038.022	SE193038.023	SE193038.024	SE193038.025
TRH C6-C9	mg/kg	20	<20	<20	<20	<20	<20
Benzene (F0)	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
TRH C6-C10	mg/kg	25	<25	<25	<25	<25	<25
TRH C6-C10 minus BTEX (F1)	mg/kg	25	<25	<25	<25	<25	<25

			BR126	BR127	BR128	BR129	DA
			SOIL	SOIL	SOIL	SOIL	SOIL
							-
			14/5/2019	14/5/2019	14/5/2019	14/5/2019	14/5/2019
PARAMETER	UOM	LOR	SE193038.026	SE193038.027	SE193038.028	SE193038.029	SE193038.030
TRH C6-C9	mg/kg	20	<20	<20	<20	<20	<20
Benzene (F0)	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
TRH C6-C10	mg/kg	25	<25	<25	<25	<25	<25
TRH C6-C10 minus BTEX (F1)	mg/kg	25	<25	<25	<25	<25	<25



Volatile Petroleum Hydrocarbons in Soil [AN433] Tested: 22/5/2019 (continued)

			DB
			SOIL
			- 14/5/2019
PARAMETER	UOM	LOR	SE193038.031
TRH C6-C9	mg/kg	20	<20
Benzene (F0)	mg/kg	0.1	<0.1
TRH C6-C10	mg/kg	25	<25
TRH C6-C10 minus BTEX (F1)	mg/kg	25	<25



TRH (Total Recoverable Hydrocarbons) in Soil [AN403] Tested: 22/5/2019

			BR101	BR102	BR103	BR104	BR105
			SOIL	SOIL	SOIL	SOIL	SOIL
PARAMETER			-	-	-	-	-
	UOM	LOR	SE193038.001	SE193038.002	SE193038.003	SE193038.004	SE193038.005
TRH C10-C14	mg/kg	20	<20	<20	<20	<20	28
TRH C15-C28	mg/kg	45	<45	<45	<45	89	120
TRH C29-C36	mg/kg	45	<45	<45	<45	110	<45
TRH C37-C40	mg/kg	100	<100	<100	<100	<100	<100
TRH >C10-C16	mg/kg	25	<25	<25	<25	<25	74
TRH >C10-C16 - Naphthalene (F2)	mg/kg	25	<25	<25	<25	<25	74
TRH >C16-C34 (F3)	mg/kg	90	<90	<90	<90	160	91
TRH >C34-C40 (F4)	mg/kg	120	<120	<120	<120	<120	<120
TRH C10-C36 Total	mg/kg	110	<110	<110	<110	200	150
TRH C10-C40 Total (F bands)	mg/kg	210	<210	<210	<210	<210	<210

			BR106	BR107	BR108	BR109	BR110
PARAMETER	UOM	LOR	SOIL - 14/5/2019 SE193038.006	SOIL - 14/5/2019 SE193038.007	SOIL - 14/5/2019 SE193038.008	SOIL - 14/5/2019 SE193038.009	SOIL - 14/5/2019 SE193038.010
TRH C10-C14	mg/kg	20	<20	<20	<20	<20	41
TRH C15-C28	mg/kg	45	<45	62	<45	<45	130
TRH C29-C36	mg/kg	45	<45	<45	<45	47	89
TRH C37-C40	mg/kg	100	<100	<100	<100	<100	<100
TRH >C10-C16	mg/kg	25	<25	25	<25	<25	74
TRH >C10-C16 - Naphthalene (F2)	mg/kg	25	<25	25	<25	<25	74
TRH >C16-C34 (F3)	mg/kg	90	<90	<90	<90	<90	150
TRH >C34-C40 (F4)	mg/kg	120	<120	<120	<120	<120	<120
TRH C10-C36 Total	mg/kg	110	<110	<110	<110	<110	260
TRH C10-C40 Total (F bands)	mg/kg	210	<210	<210	<210	<210	220

			BR111	BR112	BR113	BR114	BR115
			SOIL	SOIL	SOIL	SOIL	SOIL
PARAMETER	UOM	LOR	- 14/5/2019 SE193038.011	- 14/5/2019 SE193038.012	- 14/5/2019 SE193038.013	- 14/5/2019 SE193038.014	- 14/5/2019 SE193038.015
TRH C10-C14	mg/kg	20	<20	<20	<20	53	42
TRH C15-C28	mg/kg	45	<45	<45	<45	180	170
TRH C29-C36	mg/kg	45	<45	46	<45	150	120
TRH C37-C40	mg/kg	100	<100	<100	<100	<100	<100
TRH >C10-C16	mg/kg	25	<25	<25	<25	82	74
TRH >C10-C16 - Naphthalene (F2)	mg/kg	25	<25	<25	<25	82	74
TRH >C16-C34 (F3)	mg/kg	90	<90	<90	<90	230	190
TRH >C34-C40 (F4)	mg/kg	120	<120	<120	<120	<120	<120
TRH C10-C36 Total	mg/kg	110	<110	<110	<110	370	320
TRH C10-C40 Total (F bands)	mg/kg	210	<210	<210	<210	310	270



SE193038 R0

TRH (Total Recoverable Hydrocarbons) in Soil [AN403] Tested: 22/5/2019 (continued)

			BR116	BR117	BR118	BR119	BR120
			SOIL	SOIL	SOIL	SOIL	SOIL
			14/5/2019	14/5/2019			14/5/2019
PARAMETER	UOM	LOR	SE193038.016	SE193038.017	SE193038.018	SE193038.019	SE193038.020
TRH C10-C14	mg/kg	20	<20	<20	57	<20	<20
TRH C15-C28	mg/kg	45	<45	<45	220	<45	<45
TRH C29-C36	mg/kg	45	<45	<45	130	<45	<45
TRH C37-C40	mg/kg	100	<100	<100	<100	<100	<100
TRH >C10-C16	mg/kg	25	<25	<25	84	<25	<25
TRH >C10-C16 - Naphthalene (F2)	mg/kg	25	<25	<25	84	<25	<25
TRH >C16-C34 (F3)	mg/kg	90	<90	<90	260	<90	<90
TRH >C34-C40 (F4)	mg/kg	120	<120	<120	<120	<120	<120
TRH C10-C36 Total	mg/kg	110	<110	<110	400	<110	<110
TRH C10-C40 Total (F bands)	mg/kg	210	<210	<210	340	<210	<210

PARAMETER			BR121	BR122	BR123	BR124	BR125
	UOM	LOR	SOIL - 14/5/2019 SE193038.021	SOIL - 14/5/2019 SE193038.022	SOIL - 14/5/2019 SE193038.023	SOIL - 14/5/2019 SE193038.024	SOIL - 14/5/2019 SE193038.025
TRH C10-C14	mg/kg	20	<20	<20	<20	<20	<20
TRH C15-C28	mg/kg	45	<45	<45	<45	<45	<45
TRH C29-C36	mg/kg	45	<45	<45	<45	<45	<45
TRH C37-C40	mg/kg	100	<100	<100	<100	<100	<100
TRH >C10-C16	mg/kg	25	<25	<25	<25	<25	<25
TRH >C10-C16 - Naphthalene (F2)	mg/kg	25	<25	<25	<25	<25	<25
TRH >C16-C34 (F3)	mg/kg	90	<90	<90	<90	<90	<90
TRH >C34-C40 (F4)	mg/kg	120	<120	<120	<120	<120	<120
TRH C10-C36 Total	mg/kg	110	<110	<110	<110	<110	<110
TRH C10-C40 Total (F bands)	mg/kg	210	<210	<210	<210	<210	<210

			BR126	BR127	BR128	BR129	DA
			SOIL	SOIL	SOIL	SOIL	SOIL
			14/5/2019		14/5/2019		14/5/2019
PARAMETER	UOM	LOR	SE193038.026	SE193038.027	SE193038.028	SE193038.029	SE193038.030
TRH C10-C14	mg/kg	20	<20	<20	<20	<20	<20
TRH C15-C28	mg/kg	45	<45	<45	<45	<45	220
TRH C29-C36	mg/kg	45	<45	<45	<45	<45	120
TRH C37-C40	mg/kg	100	<100	<100	<100	<100	<100
TRH >C10-C16	mg/kg	25	<25	<25	<25	<25	<25
TRH >C10-C16 - Naphthalene (F2)	mg/kg	25	<25	<25	<25	<25	<25
TRH >C16-C34 (F3)	mg/kg	90	<90	<90	<90	<90	300
TRH >C34-C40 (F4)	mg/kg	120	<120	<120	<120	<120	<120
TRH C10-C36 Total	mg/kg	110	<110	<110	<110	<110	340
TRH C10-C40 Total (F bands)	mg/kg	210	<210	<210	<210	<210	300



TRH (Total Recoverable Hydrocarbons) in Soil [AN403] Tested: 22/5/2019 (continued)

			DB
			SOIL
DADAMETER	104	LOB	14/5/2019
	UOM	LUK	SE195038.031
TRH C10-C14	mg/kg	20	<20
TRH C15-C28	mg/kg	45	<45
TRH C29-C36	mg/kg	45	<45
TRH C37-C40	mg/kg	100	<100
TRH >C10-C16	mg/kg	25	<25
TRH >C10-C16 - Naphthalene (F2)	mg/kg	25	<25
TRH >C16-C34 (F3)	mg/kg	90	<90
TRH >C34-C40 (F4)	mg/kg	120	<120
TRH C10-C36 Total	mg/kg	110	<110
TRH C10-C40 Total (F bands)	mg/kg	210	<210



PAH (Polynuclear Aromatic Hydrocarbons) in Soil [AN420] Tested: 22/5/2019

			BR101	BR102	BR103	BR104	BR105
			SOIL	SOIL	SOIL	SOIL	SOIL
			14/5/2019	14/5/2019			14/5/2019
PARAMETER	UOM	LOR	SE193038.001	SE193038.002	SE193038.003	SE193038.004	SE193038.005
Naphthalene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
2-methylnaphthalene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
1-methylnaphthalene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	0.1	<0.1	<0.1	<0.1	0.2	<0.1
Pyrene	mg/kg	0.1	<0.1	<0.1	<0.1	0.2	<0.1
Benzo(a)anthracene	mg/kg	0.1	<0.1	<0.1	<0.1	0.1	<0.1
Chrysene	mg/kg	0.1	<0.1	<0.1	<0.1	0.1	<0.1
Benzo(b&j)fluoranthene	mg/kg	0.1	<0.1	<0.1	<0.1	0.2	<0.1
Benzo(k)fluoranthene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)pyrene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Indeno(1,2,3-cd)pyrene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo(ah)anthracene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(ghi)perylene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Carcinogenic PAHs, BaP TEQ <lor=0< td=""><td>TEQ (mg/kg)</td><td>0.2</td><td><0.2</td><td><0.2</td><td><0.2</td><td><0.2</td><td><0.2</td></lor=0<>	TEQ (mg/kg)	0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Carcinogenic PAHs, BaP TEQ <lor=lor< td=""><td>TEQ (mg/kg)</td><td>0.3</td><td><0.3</td><td><0.3</td><td><0.3</td><td><0.3</td><td><0.3</td></lor=lor<>	TEQ (mg/kg)	0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Carcinogenic PAHs, BaP TEQ <lor=lor 2<="" td=""><td>TEQ (mg/kg)</td><td>0.2</td><td><0.2</td><td><0.2</td><td><0.2</td><td><0.2</td><td><0.2</td></lor=lor>	TEQ (mg/kg)	0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Total PAH (18)	mg/kg	0.8	<0.8	<0.8	<0.8	<0.8	<0.8
Total PAH (NEPM/WHO 16)	mg/kg	0.8	<0.8	<0.8	<0.8	<0.8	<0.8

			BR106	BR107	BR108	BR109	BR110
			SOIL	SOIL	SOIL	SOIL	SOIL
				14/5/2019	14/5/2019	14/5/2019	14/5/2019
PARAMETER	UOM	LOR	SE193038.006	SE193038.007	SE193038.008	SE193038.009	SE193038.010
Naphthalene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
2-methylnaphthalene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
1-methylnaphthalene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	0.1	0.2	<0.1	<0.1	<0.1	<0.1
Pyrene	mg/kg	0.1	0.2	<0.1	<0.1	<0.1	<0.1
Benzo(a)anthracene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Chrysene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(b&j)fluoranthene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(k)fluoranthene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)pyrene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Indeno(1,2,3-cd)pyrene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo(ah)anthracene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(ghi)perylene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Carcinogenic PAHs, BaP TEQ <lor=0< td=""><td>TEQ (mg/kg)</td><td>0.2</td><td><0.2</td><td><0.2</td><td><0.2</td><td><0.2</td><td><0.2</td></lor=0<>	TEQ (mg/kg)	0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Carcinogenic PAHs, BaP TEQ <lor=lor< td=""><td>TEQ (mg/kg)</td><td>0.3</td><td><0.3</td><td><0.3</td><td><0.3</td><td><0.3</td><td><0.3</td></lor=lor<>	TEQ (mg/kg)	0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Carcinogenic PAHs, BaP TEQ <lor=lor 2<="" td=""><td>TEQ (mg/kg)</td><td>0.2</td><td><0.2</td><td><0.2</td><td><0.2</td><td><0.2</td><td><0.2</td></lor=lor>	TEQ (mg/kg)	0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Total PAH (18)	mg/kg	0.8	<0.8	<0.8	<0.8	<0.8	<0.8
Total PAH (NEPM/WHO 16)	mg/kg	0.8	<0.8	<0.8	<0.8	<0.8	<0.8



SE193038 R0

PAH (Polynuclear Aromatic Hydrocarbons) in Soil [AN420] Tested: 22/5/2019 (continued)

			BR111	BR112	BR113	BR114	BR115
			SOIL	SOIL	SOIL	SOIL	SOIL
			14/5/2019	14/5/2019			14/5/2019
PARAMETER	NOU	LOR	SE193038.011	SE193038.012	SE193038.013	SE193038.014	SE193038.015
Naphthalene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
2-methylnaphthalene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
1-methylnaphthalene	mg/kg	0.1	0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Pyrene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)anthracene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Chrysene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(b&j)fluoranthene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(k)fluoranthene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)pyrene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Indeno(1,2,3-cd)pyrene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo(ah)anthracene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(ghi)perylene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Carcinogenic PAHs, BaP TEQ <lor=0< td=""><td>TEQ (mg/kg)</td><td>0.2</td><td><0.2</td><td><0.2</td><td><0.2</td><td><0.2</td><td><0.2</td></lor=0<>	TEQ (mg/kg)	0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Carcinogenic PAHs, BaP TEQ <lor=lor< td=""><td>TEQ (mg/kg)</td><td>0.3</td><td><0.3</td><td><0.3</td><td><0.3</td><td><0.3</td><td><0.3</td></lor=lor<>	TEQ (mg/kg)	0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Carcinogenic PAHs, BaP TEQ <lor=lor 2<="" td=""><td>TEQ (mg/kg)</td><td>0.2</td><td><0.2</td><td><0.2</td><td><0.2</td><td><0.2</td><td><0.2</td></lor=lor>	TEQ (mg/kg)	0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Total PAH (18)	mg/kg	0.8	<0.8	<0.8	<0.8	<0.8	<0.8
Total PAH (NEPM/WHO 16)	mg/kg	0.8	<0.8	<0.8	<0.8	<0.8	<0.8

			BR116	BR117	BR118	BR119	BR120
			SOIL	SOIL	SOIL	SOIL	SOIL
				14/5/2019	14/5/2019	14/5/2019	14/5/2019
PARAMETER	UOM	LOR	SE193038.016	SE193038.017	SE193038.018	SE193038.019	SE193038.020
Naphthalene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
2-methylnaphthalene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
1-methylnaphthalene	mg/kg	0.1	<0.1	<0.1	0.2	<0.1	<0.1
Acenaphthylene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	0.1	<0.1	<0.1	0.2	<0.1	<0.1
Anthracene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	0.1	<0.1	<0.1	0.7	<0.1	<0.1
Pyrene	mg/kg	0.1	<0.1	<0.1	0.7	<0.1	<0.1
Benzo(a)anthracene	mg/kg	0.1	<0.1	<0.1	0.2	<0.1	<0.1
Chrysene	mg/kg	0.1	<0.1	<0.1	0.2	<0.1	<0.1
Benzo(b&j)fluoranthene	mg/kg	0.1	<0.1	<0.1	0.4	<0.1	<0.1
Benzo(k)fluoranthene	mg/kg	0.1	<0.1	<0.1	0.2	<0.1	<0.1
Benzo(a)pyrene	mg/kg	0.1	<0.1	<0.1	0.4	<0.1	<0.1
Indeno(1,2,3-cd)pyrene	mg/kg	0.1	<0.1	<0.1	0.2	<0.1	<0.1
Dibenzo(ah)anthracene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(ghi)perylene	mg/kg	0.1	<0.1	<0.1	0.2	<0.1	<0.1
Carcinogenic PAHs, BaP TEQ <lor=0< td=""><td>TEQ (mg/kg)</td><td>0.2</td><td><0.2</td><td><0.2</td><td>0.5</td><td><0.2</td><td><0.2</td></lor=0<>	TEQ (mg/kg)	0.2	<0.2	<0.2	0.5	<0.2	<0.2
Carcinogenic PAHs, BaP TEQ <lor=lor< td=""><td>TEQ (mg/kg)</td><td>0.3</td><td><0.3</td><td><0.3</td><td>0.6</td><td><0.3</td><td><0.3</td></lor=lor<>	TEQ (mg/kg)	0.3	<0.3	<0.3	0.6	<0.3	<0.3
Carcinogenic PAHs, BaP TEQ <lor=lor 2<="" td=""><td>TEQ (mg/kg)</td><td>0.2</td><td><0.2</td><td><0.2</td><td>0.5</td><td><0.2</td><td><0.2</td></lor=lor>	TEQ (mg/kg)	0.2	<0.2	<0.2	0.5	<0.2	<0.2
Total PAH (18)	mg/kg	0.8	<0.8	<0.8	3.6	<0.8	<0.8
Total PAH (NEPM/WHO 16)	mg/kg	0.8	<0.8	<0.8	3.5	<0.8	<0.8



PAH (Polynuclear Aromatic Hydrocarbons) in Soil [AN420] Tested: 22/5/2019 (continued)

			BR121	BR122	BR123	BR124	BR125
			SOIL	SOIL	SOIL	SOIL	SOIL
			14/5/2019	14/5/2019			14/5/2019
PARAMETER	UOM	LOR	SE193038.021	SE193038.022	SE193038.023	SE193038.024	SE193038.025
Naphthalene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
2-methylnaphthalene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
1-methylnaphthalene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Pyrene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)anthracene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Chrysene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(b&j)fluoranthene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(k)fluoranthene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)pyrene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Indeno(1,2,3-cd)pyrene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo(ah)anthracene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(ghi)perylene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Carcinogenic PAHs, BaP TEQ <lor=0< td=""><td>TEQ (mg/kg)</td><td>0.2</td><td><0.2</td><td><0.2</td><td><0.2</td><td><0.2</td><td><0.2</td></lor=0<>	TEQ (mg/kg)	0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Carcinogenic PAHs, BaP TEQ <lor=lor< td=""><td>TEQ (mg/kg)</td><td>0.3</td><td><0.3</td><td><0.3</td><td><0.3</td><td><0.3</td><td><0.3</td></lor=lor<>	TEQ (mg/kg)	0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Carcinogenic PAHs, BaP TEQ <lor=lor 2<="" td=""><td>TEQ (mg/kg)</td><td>0.2</td><td><0.2</td><td><0.2</td><td><0.2</td><td><0.2</td><td><0.2</td></lor=lor>	TEQ (mg/kg)	0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Total PAH (18)	mg/kg	0.8	<0.8	<0.8	<0.8	<0.8	<0.8
Total PAH (NEPM/WHO 16)	mg/kg	0.8	<0.8	<0.8	<0.8	<0.8	<0.8

			BR126	BR127	BR128	BR129	DA
			SOIL	SOIL	SOIL	SOIL	SOIL
				14/5/2019	14/5/2019	14/5/2019	14/5/2019
PARAMETER	UOM	LOR	SE193038.026	SE193038.027	SE193038.028	SE193038.029	SE193038.030
Naphthalene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
2-methylnaphthalene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
1-methylnaphthalene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Anthracene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	0.2
Pyrene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	0.2
Benzo(a)anthracene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	0.1
Chrysene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	0.1
Benzo(b&j)fluoranthene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	0.2
Benzo(k)fluoranthene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(a)pyrene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Indeno(1,2,3-cd)pyrene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenzo(ah)anthracene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzo(ghi)perylene	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Carcinogenic PAHs, BaP TEQ <lor=0< td=""><td>TEQ (mg/kg)</td><td>0.2</td><td><0.2</td><td><0.2</td><td><0.2</td><td><0.2</td><td><0.2</td></lor=0<>	TEQ (mg/kg)	0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Carcinogenic PAHs, BaP TEQ <lor=lor< td=""><td>TEQ (mg/kg)</td><td>0.3</td><td><0.3</td><td><0.3</td><td><0.3</td><td><0.3</td><td><0.3</td></lor=lor<>	TEQ (mg/kg)	0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Carcinogenic PAHs, BaP TEQ <lor=lor 2<="" td=""><td>TEQ (mg/kg)</td><td>0.2</td><td><0.2</td><td><0.2</td><td><0.2</td><td><0.2</td><td><0.2</td></lor=lor>	TEQ (mg/kg)	0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Total PAH (18)	mg/kg	0.8	<0.8	<0.8	<0.8	<0.8	0.9
Total PAH (NEPM/WHO 16)	mg/kg	0.8	<0.8	<0.8	<0.8	<0.8	0.9


ANALYTICAL RESULTS

PAH (Polynuclear Aromatic Hydrocarbons) in Soil [AN420] Tested: 22/5/2019 (continued)

			DB
			SOIL
		1.05	14/5/2019
PARAME I ER	UOM ma/ka	0.1	<0.1
2-methylnanhthalene	mg/kg	0.1	<0.1
	mg/kg	0.1	<0.1
	mg/kg	0.1	<0.1
	ing/kg	0.1	-0.1
Acenaphthene	mg/kg	0.1	<0.1
Fluorene	mg/kg	0.1	<0.1
Phenanthrene	mg/kg	0.1	<0.1
Anthracene	mg/kg	0.1	<0.1
Fluoranthene	mg/kg	0.1	<0.1
Pyrene	mg/kg	0.1	<0.1
Benzo(a)anthracene	mg/kg	0.1	<0.1
Chrysene	mg/kg	0.1	<0.1
Benzo(b&j)fluoranthene	mg/kg	0.1	<0.1
Benzo(k)fluoranthene	mg/kg	0.1	<0.1
Benzo(a)pyrene	mg/kg	0.1	<0.1
Indeno(1,2,3-cd)pyrene	mg/kg	0.1	<0.1
Dibenzo(ah)anthracene	mg/kg	0.1	<0.1
Benzo(ghi)perylene	mg/kg	0.1	<0.1
Carcinogenic PAHs, BaP TEQ <lor=0< td=""><td>TEQ (mg/kg)</td><td>0.2</td><td><0.2</td></lor=0<>	TEQ (mg/kg)	0.2	<0.2
Carcinogenic PAHs, BaP TEQ <lor=lor< td=""><td>TEQ (mg/kg)</td><td>0.3</td><td><0.3</td></lor=lor<>	TEQ (mg/kg)	0.3	<0.3
Carcinogenic PAHs, BaP TEQ <lor=lor 2<="" td=""><td>TEQ (mg/kg)</td><td>0.2</td><td><0.2</td></lor=lor>	TEQ (mg/kg)	0.2	<0.2
Total PAH (18)	mg/kg	0.8	<0.8
Total PAH (NEPM/WHO 16)	mg/kg	0.8	<0.8



ANALYTICAL RESULTS

SE193038 R0

Total Recoverable Elements in Soil/Waste Solids/Materials by ICPOES [AN040/AN320] Tested: 23/5/2019

			BR101	BR102	BR103	BR104	BR105
			SOIL	SOIL	SOIL	SOIL	SOIL
			-	-	-	-	-
PARAMETER	UOM	LOR	SE193038.001	SE193038.002	SE193038.003	SE193038.004	SE193038.005
Arsenic, As	mg/kg	1	6	5	5	5	6
Cadmium, Cd	mg/kg	0.3	<0.3	<0.3	<0.3	0.3	<0.3
Chromium, Cr	mg/kg	0.3	24	29	29	25	34
Copper, Cu	mg/kg	0.5	13	17	15	17	21
Lead, Pb	mg/kg	1	8	8	8	60	38
Nickel, Ni	mg/kg	0.5	20	23	21	11	18
Zinc, Zn	mg/kg	2	15	19	18	290	280

1			BR106	BR107	BR108	BR109	BR110
PARAMETER			SOIL	SOIL	SOIL	SOIL	SOIL
	UOM	LOR	- 14/5/2019 SE193038.006	- 14/5/2019 SE193038.007	- 14/5/2019 SE193038.008	- 14/5/2019 SE193038.009	- 14/5/2019 SE193038.010
Arsenic, As	mg/kg	1	4	3	5	4	4
Cadmium, Cd	mg/kg	0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Chromium, Cr	mg/kg	0.3	79	64	21	16	44
Copper, Cu	mg/kg	0.5	22	20	18	12	22
Lead, Pb	mg/kg	1	250	28	11	10	7
Nickel, Ni	mg/kg	0.5	31	29	22	7.8	27
Zinc, Zn	mg/kg	2	71	54	80	64	42

			BR111	BR112	BR113	BR114	BR115
			SOIL	SOIL	SOIL	SOIL	SOIL
			14/5/2019	14/5/2019	14/5/2019	14/5/2019	14/5/2019
PARAMETER	UOM	LOR	SE193038.011	SE193038.012	SE193038.013	SE193038.014	SE193038.015
Arsenic, As	mg/kg	1	3	4	5	3	6
Cadmium, Cd	mg/kg	0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Chromium, Cr	mg/kg	0.3	64	25	42	44	37
Copper, Cu	mg/kg	0.5	22	12	20	19	20
Lead, Pb	mg/kg	1	9	8	8	7	7
Nickel, Ni	mg/kg	0.5	31	12	24	25	30
Zinc, Zn	mg/kg	2	38	56	34	33	37

			BR116	BR117	BR118	BR119	BR120
PARAMETER			SOIL	SOIL	SOIL	SOIL	SOIL
			14/5/2019	14/5/2019	14/5/2019	14/5/2019	14/5/2019
	UOM	LOR	SE193038.016	SE193038.017	SE193038.018	SE193038.019	SE193038.020
Arsenic, As	mg/kg	1	5	5	5	4	4
Cadmium, Cd	mg/kg	0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Chromium, Cr	mg/kg	0.3	76	55	100	29	13
Copper, Cu	mg/kg	0.5	19	19	23	15	3.8
Lead, Pb	mg/kg	1	10	9	11	7	4
Nickel, Ni	mg/kg	0.5	26	24	32	16	6.4
Zinc, Zn	mg/kg	2	27	38	37	25	7.6



ANALYTICAL RESULTS

SE193038 R0

Total Recoverable Elements in Soil/Waste Solids/Materials by ICPOES [AN040/AN320] Tested: 23/5/2019

			BR121	BR122	BR123	BR124	BR125
			SOIL	SOIL	SOIL	SOIL	SOIL
			- 14/5/2019		- 14/5/2019		- 14/5/2019
PARAMETER	UOM	LOR	SE193038.021	SE193038.022	SE193038.023	SE193038.024	SE193038.025
Arsenic, As	mg/kg	1	3	4	2	2	3
Cadmium, Cd	mg/kg	0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Chromium, Cr	mg/kg	0.3	20	22	19	14	12
Copper, Cu	mg/kg	0.5	7.6	10	9.8	4.8	4.6
Lead, Pb	mg/kg	1	5	5	7	4	4
Nickel, Ni	mg/kg	0.5	8.9	17	11	5.6	4.9
Zinc, Zn	mg/kg	2	15	18	17	8.2	10

			BR126	BR127	BR128	BR129	DA
PARAMETER			SOIL	SOIL	SOIL	SOIL	SOIL
	UOM	LOR	- 14/5/2019 SE193038.026	- 14/5/2019 SE193038.027	- 14/5/2019 SE193038.028	- 14/5/2019 SE193038.029	14/5/2019 SE193038.030
Arsenic, As	mg/kg	1	4	2	2	4	7
Cadmium, Cd	mg/kg	0.3	<0.3	<0.3	<0.3	<0.3	0.4
Chromium, Cr	mg/kg	0.3	16	15	13	16	25
Copper, Cu	mg/kg	0.5	2.9	7.0	5.1	7.0	15
Lead, Pb	mg/kg	1	4	7	5	5	78
Nickel, Ni	mg/kg	0.5	2.6	6.8	4.7	11	9.8
Zinc, Zn	mg/kg	2	5.2	17	11	19	280

			DB
PARAMETER		105	SOIL - 14/5/2019
Arsenic As	ma/ka	1	32193038.031
	ingrkg	1	3
Cadmium, Cd	mg/kg	0.3	<0.3
Chromium, Cr	mg/kg	0.3	15
Copper, Cu	mg/kg	0.5	5.2
Lead, Pb	mg/kg	1	4
Nickel, Ni	mg/kg	0.5	6.0
Zinc, Zn	mg/kg	2	9.0



SE193038 R0

Mercury in Soil [AN312] Tested: 23/5/2019

			BR101	BR102	BR103	BR104	BR105
			SOIL	SOIL	SOIL	SOIL	SOIL
			14/5/2019	14/5/2019	14/5/2019	14/5/2019	14/5/2019
PARAMETER	UOM	LOR	SE193038.001	SE193038.002	SE193038.003	SE193038.004	SE193038.005
Mercury	mg/kg	0.05	<0.05	<0.05	<0.05	<0.05	<0.05

			BR106	BR107	BR108	BR109	BR110
			SOIL	SOIL	SOIL	SOIL	SOIL
			- 14/5/2019	- 14/5/2019	- 14/5/2019	- 14/5/2019	- 14/5/2019
PARAMETER	UOM	LOR	SE193038.006	SE193038.007	SE193038.008	SE193038.009	SE193038.010
Mercury	mg/kg	0.05	<0.05	<0.05	<0.05	<0.05	<0.05

			BR111	BR112	BR113	BR114	BR115
			SOIL	SOIL	SOIL	SOIL	SOIL
PARAMETER	UOM	LOR	- 14/5/2019 SE193038.011	- 14/5/2019 SE193038.012	- 14/5/2019 SE193038.013	- 14/5/2019 SE193038.014	- 14/5/2019 SE193038.015
Mercury	mg/kg	0.05	<0.05	<0.05	<0.05	<0.05	<0.05

			BR116	BR117	BR118	BR119	BR120
			SOIL	SOIL	SOIL	SOIL	SOIL
			- 14/5/2019	- 14/5/2019	- 14/5/2019		- 14/5/2019
PARAMETER	UOM	LOR	SE193038.016	SE193038.017	SE193038.018	SE193038.019	SE193038.020
Mercury	mg/kg	0.05	<0.05	<0.05	<0.05	<0.05	<0.05

			BR121	BR122	BR123	BR124	BR125
			SOIL	SOIL	SOIL	SOIL	SOIL
			14/5/2019	14/5/2019	14/5/2019	14/5/2019	14/5/2019
PARAMETER	UOM	LOR	SE193038.021	SE193038.022	SE193038.023	SE193038.024	SE193038.025
Mercury	mg/kg	0.05	<0.05	<0.05	<0.05	<0.05	<0.05

			BR126	BR127	BR128	BR129	DA
			SOIL	SOIL	SOIL	SOIL	SOIL
				14/5/2019	14/5/2019		14/5/2019
PARAMETER	UOM	LOR	SE193038.026	SE193038.027	SE193038.028	SE193038.029	SE193038.030
Mercury	mg/kg	0.05	<0.05	<0.05	<0.05	<0.05	<0.05

			DB
			SOIL
			- 14/5/2019
PARAMETER	UOM	LOR	SE193038.031
Mercury	mg/kg	0.05	<0.05



SE193038 R0

Moisture Content [AN002] Tested: 23/5/2019

			BR101	BR102	BR103	BR104	BR105
			SOIL	SOIL	SOIL	SOIL	SOIL
			14/5/2019		14/5/2019		14/5/2019
PARAMETER	UOM	LOR	SE193038.001	SE193038.002	SE193038.003	SE193038.004	SE193038.005
% Moisture	%w/w	0.5	15	19	17	17	18

			BR106	BR107	BR108	BR109	BR110
			SOIL	SOIL	SOIL	SOIL	SOIL
			- 14/5/2019	- 14/5/2019	- 14/5/2019	- 14/5/2019	- 14/5/2019
PARAMETER	UOM	LOR	SE193038.006	SE193038.007	SE193038.008	SE193038.009	SE193038.010
% Moisture	%w/w	0.5	13	15	18	16	17

			BR111	BR112	BR113	BR114	BR115
			SOIL	SOIL	SOIL	SOIL	SOIL
PARAMETER	UOM	LOR	- 14/5/2019 SE193038.011	- 14/5/2019 SE193038.012	- 14/5/2019 SE193038.013	- 14/5/2019 SE193038.014	- 14/5/2019 SE193038.015
% Moisture	%w/w	0.5	14	17	21	15	12

			BR116	BR117	BR118	BR119	BR120
			SOIL	SOIL	SOIL	SOIL	SOIL
			- 14/5/2019	- 14/5/2019	- 14/5/2019		- 14/5/2019
PARAMETER	UOM	LOR	SE193038.016	SE193038.017	SE193038.018	SE193038.019	SE193038.020
% Moisture	%w/w	0.5	13	16	17	11	6.0

			BR121	BR122	BR123	BR124	BR125
			SOIL	SOIL	SOIL	SOIL	SOIL
			14/5/2019	14/5/2019	14/5/2019	14/5/2019	14/5/2019
PARAMETER	UOM	LOR	SE193038.021	SE193038.022	SE193038.023	SE193038.024	SE193038.025
% Moisture	%w/w	0.5	8.4	7.3	7.7	5.6	6.7

			BR126	BR127	BR128	BR129	DA
			SOIL	SOIL	SOIL	SOIL	SOIL
				14/5/2019	14/5/2019		14/5/2019
PARAMETER	UOM	LOR	SE193038.026	SE193038.027	SE193038.028	SE193038.029	SE193038.030
% Moisture	%w/w	0.5	4.1	6.8	6.6	7.2	16

			DB
			SOIL
			- 14/5/2019
PARAMETER	UOM	LOR	SE193038.031
% Moisture	%w/w	0.5	5.5



METHOD	METHODOLOGY SUMMARY
AN002	The test is carried out by drying (at either 40°C or 105°C) a known mass of sample in a weighed evaporating basin. After fully dry the sample is re-weighed. Samples such as sludge and sediment having high percentages of moisture will take some time in a drying oven for complete removal of water.
AN040/AN320	A portion of sample is digested with nitric acid to decompose organic matter and hydrochloric acid to complete the digestion of metals. The digest is then analysed by ICP OES with metals results reported on the dried sample basis. Based on USEPA method 200.8 and 6010C.
AN040	A portion of sample is digested with Nitric acid to decompose organic matter and Hydrochloric acid to complete the digestion of metals and then filtered for analysis by ASS or ICP as per USEPA Method 200.8.
AN312	Mercury by Cold Vapour AAS in Soils: After digestion with nitric acid, hydrogen peroxide and hydrochloric acid, mercury ions are reduced by stannous chloride reagent in acidic solution to elemental mercury. This mercury vapour is purged by nitrogen into a cold cell in an atomic absorption spectrometer or mercury analyser. Quantification is made by comparing absorbances to those of the calibration standards. Reference APHA 3112/3500
AN403	Total Recoverable Hydrocarbons: Determination of Hydrocarbons by gas chromatography after a solvent extraction. Detection is by flame ionisation detector (FID) that produces an electronic signal in proportion to the combustible matter passing through it. Total Recoverable Hydrocarbons (TRH) are routinely reported as four alkane groupings based on the carbon chain length of the compounds: C6-C9, C10-C14, C15-C28 and C29-C36 and in recognition of the NEPM 1999 (2013), >C10-C16 (F2), >C16-C34 (F3) and >C34-C40 (F4). F2 is reported directly and also corrected by subtracting Naphthalene (from VOC method AN433) where available.
AN403	Additionally, the volatile C6-C9 fraction may be determined by a purge and trap technique and GC/MS because of the potential for volatiles loss. Total Recoverable Hydrocarbons - Silica (TRH-Si) follows the same method of analysis after silica gel cleanup of the solvent extract. Aliphatic/Aromatic Speciation follows the same method of analysis after fractionation of the solvent extract over silica with differential polarity of the eluent solvents.
AN403	The GC/FID method is not well suited to the analysis of refined high boiling point materials (ie lubricating oils or greases) but is particularly suited for measuring diesel, kerosene and petrol if care to control volatility is taken. This method will detect naturally occurring hydrocarbons, lipids, animal fats, phenols and PAHs if they are present at sufficient levels, dependent on the use of specific cleanup/fractionation techniques. Reference USEPA 3510B, 8015B.
AN420	(SVOCs) including OC, OP, PCB, Herbicides, PAH, Phthalates and Speciated Phenols (etc) in soils, sediments and waters are determined by GCMS/ECD technique following appropriate solvent extraction process (Based on USEPA 3500C and 8270D).
AN420	Carcinogenic PAHs may be expressed as Benzo(a)pyrene equivalents by applying the BaP toxicity equivalence factor (NEPM 1999, June 2013, B7). These can be reported as the individual PAHs and as a sum of carcinogenic PAHs. The sum is reported three ways, the first assuming all <lor <="" <lor="" all="" and="" are="" assuming="" half="" lor="" lor.<="" results="" second="" td="" the="" third="" zero,=""></lor>
AN433	VOCs and C6-C9 Hydrocarbons by GC-MS P&T: VOC's are volatile organic compounds. The sample is presented to a gas chromatograph via a purge and trap (P&T) concentrator and autosampler and is detected with a Mass Spectrometer (MSD). Solid samples are initially extracted with methanol whilst liquid samples are processed directly. References: USEPA 5030B, 8020A, 8260.



FOOTNOTES

NATA accreditation does not cover the performance of this service. 4.4 Indicative data, theoretical holding time exceeded.

Not analysed. NVL Not validated. IS Insufficient sample for analysis. INR Sample listed, but not received.

UOM LOR î↓

Unit of Measure. Limit of Reporting. Raised/lowered Limit of Reporting.

Unless it is reported that sampling has been performed by SGS, the samples have been analysed as received. Solid samples expressed on a dry weight basis.

Where "Total" analyte groups are reported (for example, Total PAHs, Total OC Pesticides) the total will be calculated as the sum of the individual analytes, with those analytes that are reported as <LOR being assumed to be zero. The summed (Total) limit of reporting is calculated by summing the individual analyte LORs and dividing by two. For example, where 16 individual analytes are being summed and each has an LOR of 0.1 mg/kg, the "Totals" LOR will be 1.6 / 2 (0.8 mg/kg). Where only 2 analytes are being summed, the "Total" LOR will be the sum of those two LORs.

Some totals may not appear to add up because the total is rounded after adding up the raw values.

If reported, measurement uncertainty follow the ± sign after the analytical result and is expressed as the expanded uncertainty calculated using a coverage factor of 2, providing a level of confidence of approximately 95%, unless stated otherwise in the comments section of this report.

Results reported for samples tested under test methods with codes starting with ARS-SOP, radionuclide or gross radioactivity concentrations are expressed in becquerel (Bq) per unit of mass or volume or per wipe as stated on the report. Becquerel is the SI unit for activity and equals one nuclear transformation per second.

Note that in terms of units of radioactivity:

- a. 1 Bq is equivalent to 27 pCi
- b. 37 MBq is equivalent to 1 mCi

For results reported for samples tested under test methods with codes starting with ARS-SOP, less than (<) values indicate the detection limit for each radionuclide or parameter for the measurement system used. The respective detection limits have been calculated in accordance with ISO 11929.

The QC and MU criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here: www.sgs.com.au.pv.sgsvr/en-gb/environment.

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STATEMENT OF QA/QC PERFORMANCE

CLIENT DETAILS		LABORATORY DETAIL	LS	
Contact	Ashleigh Adams	Manager	Huong Crawford	
Client	ENVIROWEST CONSULTING PTY LIMITED	Laboratory	SGS Alexandria Environmental	
Address	PO BOX 8158 ORANGE NSW 2800	Address	Unit 16, 33 Maddox St Alexandria NSW 2015	
Telephone	61 2 63614954	Telephone	+61 2 8594 0400	
Facsimile	(Not specified)	Facsimile	+61 2 8594 0499	
Email	ashleigh@envirowest.net.au	Email	au.environmental.sydney@sgs.com	
Project	10925	SGS Reference	SE193038 R0	
Order Number	10925	Date Received	21 May 2019	
Samples	31	Date Reported	28 May 2019	

COMMENTS .

All the laboratory data for each environmental matrix was compared to SGS' stated Data Quality Objectives (DQO). Comments arising from the comparison were made and are reported below.

The data relating to sampling was taken from the Chain of Custody document. This QA/QC Statement must be read in conjunction with the referenced Analytical Report. The Statement and the Analytical Report must not be reproduced except in full.

All Data Quality Objectives were met with the exception of the following:

Duplicate

Total Recoverable Elements in Soil/Waste Solids/Materials by ICPOES

1 item

Samples clearly labelled	Yes	Complete documentation received	Yes	
Sample container provider	SGS	Sample cooling method	Ice Bricks	
Samples received in correct containers	Yes	Sample counts by matrix	31 Soil	
Date documentation received	21/5/2019	Type of documentation received	COC	
Samples received in good order	Yes	Samples received without headspace	Yes	
Sample temperature upon receipt	16°C	Sufficient sample for analysis	Yes	
Turnaround time requested	Standard			

SGS Australia Pty Ltd ABN 44 000 964 278

SAMPLE SUMMARY

Environment, Health and Safety

Unit 16 33 Maddox St Alexandria NSW 2015 PO Box 6432 Bourke Rd BC Alexandria NSW 2015

NSW 2015 Australia NSW 2015 Australia t +61 2 8594 0400 www.sgs.com.au f +61 2 8594 0499

Member of the SGS Group



SGS holding time criteria are drawn from current regulations and are highly dependent on sample container preservation as specified in the SGS "Field Sampling Guide for Containers and Holding Time" (ref: GU-(AU)-ENV.001). Soil samples guidelines are derived from NEPM "Schedule B(3) Guideline on Laboratory Analysis of Potentially Contaminated Soils". Water sample guidelines are derived from "AS/NZS 5667.1 : 1998 Water Quality - sampling part 1" and APHA "Standard Methods for the Examination of Water and Wastewater" 21st edition 2005.

Extraction and analysis holding time due dates listed are calculated from the date sampled, although holding times may be extended after laboratory extraction for some analytes. The due dates are the suggested dates that samples may be held before extraction or analysis and still be considered valid.

Extraction and analysis dates are shown in Green when within suggested criteria or Red with an appended dagger symbol (†) when outside suggested criteria. If the sampled date is not supplied then compliance with criteria cannot be determined. If the received date is after one or both due dates then holding time will fail by default.

Mercury In Soll							Method:	ME-(AU)-[ENV]AN312
Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
BR101	SE193038.001	LB174461	14 May 2019	21 May 2019	11 Jun 2019	23 May 2019	11 Jun 2019	28 May 2019
BR102	SE193038.002	LB174461	14 May 2019	21 May 2019	11 Jun 2019	23 May 2019	11 Jun 2019	28 May 2019
BR103	SE193038.003	LB174461	14 May 2019	21 May 2019	11 Jun 2019	23 May 2019	11 Jun 2019	28 May 2019
BR104	SE193038.004	LB174461	14 May 2019	21 May 2019	11 Jun 2019	23 May 2019	11 Jun 2019	28 May 2019
BR105	SE193038.005	LB174461	14 May 2019	21 May 2019	11 Jun 2019	23 May 2019	11 Jun 2019	28 May 2019
BR106	SE193038.006	LB174461	14 May 2019	21 May 2019	11 Jun 2019	23 May 2019	11 Jun 2019	28 May 2019
BR107	SE193038.007	LB174461	14 May 2019	21 May 2019	11 Jun 2019	23 May 2019	11 Jun 2019	28 May 2019
BR108	SE193038.008	LB174461	14 May 2019	21 May 2019	11.lun 2019	23 May 2019	11.lun 2019	28 May 2019
BR109	SE193038.009	LB174461	14 May 2019	21 May 2019	11 Jun 2019	23 May 2019	11 Jun 2019	28 May 2019
BR110	SE193038.010	LB174461	14 May 2019	21 May 2019	11 Jun 2019	23 May 2019	11 Jun 2019	28 May 2019
BR111	SE103038.011	LB174461	14 May 2010	21 May 2010	11 Jun 2019	23 May 2019	11 Jun 2019	28 May 2019
DR111	SE102020.012	10174461	14 May 2010	21 May 2010	11 Jun 2010	23 May 2010	11 Jun 2019	20 May 2010
DR112	GE100000.012	LD174401	14 May 2019	21 May 2019	11 Jun 2019	23 May 2019	11 Jun 2019	20 May 2019
BRI13	SE 193038.013	LB174401	14 May 2019	21 May 2019	11 Jun 2019	23 May 2019	11 Jun 2019	28 May 2019
BRII4	SE 193038.014	LB174401	14 May 2019	21 May 2019	11 Jun 2019	23 May 2019	11 Jun 2019	28 May 2019
BR115	SE193038.015	LB174461	14 May 2019	21 May 2019	11 Jun 2019	23 May 2019	11 Jun 2019	28 May 2019
BR116	SE193038.016	LB174461	14 May 2019	21 May 2019	11 Jun 2019	23 May 2019	11 Jun 2019	28 May 2019
BR117	SE193038.017	LB174461	14 May 2019	21 May 2019	11 Jun 2019	23 May 2019	11 Jun 2019	28 May 2019
BR118	SE193038.018	LB174461	14 May 2019	21 May 2019	11 Jun 2019	23 May 2019	11 Jun 2019	28 May 2019
BR119	SE193038.019	LB174461	14 May 2019	21 May 2019	11 Jun 2019	23 May 2019	11 Jun 2019	28 May 2019
BR120	SE193038.020	LB174677	14 May 2019	21 May 2019	11 Jun 2019	27 May 2019	11 Jun 2019	28 May 2019
BR121	SE193038.021	LB174677	14 May 2019	21 May 2019	11 Jun 2019	27 May 2019	11 Jun 2019	28 May 2019
BR122	SE193038.022	LB174677	14 May 2019	21 May 2019	11 Jun 2019	27 May 2019	11 Jun 2019	28 May 2019
BR123	SE193038.023	LB174677	14 May 2019	21 May 2019	11 Jun 2019	27 May 2019	11 Jun 2019	28 May 2019
BR124	SE193038.024	LB174677	14 May 2019	21 May 2019	11 Jun 2019	27 May 2019	11 Jun 2019	28 May 2019
BR125	SE193038.025	LB174677	14 May 2019	21 May 2019	11 Jun 2019	27 May 2019	11 Jun 2019	28 May 2019
BR126	SE193038.026	LB174677	14 May 2019	21 May 2019	11 Jun 2019	27 May 2019	11 Jun 2019	28 May 2019
BR127	SE193038.027	LB174677	14 May 2019	21 May 2019	11 Jun 2019	27 May 2019	11 Jun 2019	28 May 2019
BR128	SE193038.028	LB174677	14 May 2019	21 May 2019	11 Jun 2019	27 May 2019	11 Jun 2019	28 May 2019
BR129	SE193038.029	LB174677	14 May 2019	21 May 2019	11 Jun 2019	27 May 2019	11 Jun 2019	28 May 2019
DA	SE193038.030	LB174677	14 May 2019	21 May 2019	11 Jun 2019	27 May 2019	11 Jun 2019	28 May 2019
DB	SE193038.031	LB174677	14 May 2019	21 May 2019	11 Jun 2019	27 May 2019	11 Jun 2019	28 May 2019
Moisture Content							Method:	ME-(AU)-[ENV]AN002
Sample Name	Sample No	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
DD101	SE102029-001	1.0174462	14 May 2010	21 May 2010	29 May 2010	22 May 2010	29 May 2010	28 May 2019
BR102	SE102020.007	1 8174462	14 May 2010	21 May 2010	20 May 2010	22 May 2010	20 May 2010	28 May 2019
BR102	SE102020	10174402	14 May 2010	21 May 2019	20 May 2019	23 May 2019	20 May 2019	20 May 2010
DR103	SE103030.003	10174402	14 May 2019	21 May 2019	20 May 2019	23 May 2019	28 May 2019	20 May 2010
DR104	SE 193030.004	LD174402	14 May 2019	21 May 2019	28 May 2019	23 May 2019	20 May 2019	20 May 2019
DR100	SE 193038.003	LD174402	14 May 2019	21 May 2019	20 May 2019	23 May 2013	28 May 2019	20 May 2019
DR 100	SE 193038.000	LD174402	14 May 2019	21 May 2019	28 May 2019	23 May 2019	28 May 2019	28 May 2019
DR107	SE 193036.007	LD174402	14 May 2019	21 May 2019	28 May 2019	23 May 2019	20 May 2019	20 May 2019
BR108	SE 193038.008	LB174462	14 May 2019	21 May 2019	28 May 2019	23 May 2019	28 May 2019	28 May 2019
BR109	SE193038.009	LB174462	14 May 2019	21 May 2019	28 May 2019	23 May 2019	28 May 2019	28 May 2019
BRITU	SE193038.010	LB174462	14 May 2019	21 May 2019	28 May 2019	23 May 2019	28 May 2019	28 May 2019
BR111	SE193038.011	LB174462	14 May 2019	21 May 2019	28 May 2019	23 May 2019	28 May 2019	28 May 2019
BR112	SE193038.012	LB174462	14 May 2019	21 May 2019	28 May 2019	23 May 2019	28 May 2019	28 May 2019
BR113	SE193038.013	LB174462	14 May 2019	21 May 2019	28 May 2019	23 May 2019	28 May 2019	28 May 2019
BR114	SE193038.014	LB174462	14 May 2019	21 May 2019	28 May 2019	23 May 2019	28 May 2019	28 May 2019
BR115	SE193038.015	LB174462	14 May 2019	21 May 2019	28 May 2019	23 May 2019	28 May 2019	28 May 2019
BR116	SE193038.016	LB174462	14 May 2019	21 May 2019	28 May 2019	23 May 2019	28 May 2019	28 May 2019
BR117	SE193038.017	LB174462	14 May 2019	21 May 2019	28 May 2019	23 May 2019	28 May 2019	28 May 2019
BR118	SE193038.018	LB174462	14 May 2019	21 May 2019	28 May 2019	23 May 2019	28 May 2019	28 May 2019
BR119	SE193038.019	LB174462	14 May 2019	21 May 2019	28 May 2019	23 May 2019	28 May 2019	28 May 2019
BR120	SE193038.020	LB174678	14 May 2019	21 May 2019	28 May 2019	27 May 2019	01 Jun 2019	28 May 2019
BR121	SE193038.021	LB174678	14 May 2019	21 May 2019	28 May 2019	27 May 2019	01 Jun 2019	28 May 2019
BR122	SE193038.022	LB174678	14 May 2019	21 May 2019	28 May 2019	27 May 2019	01 Jun 2019	28 May 2019
BR123	SE193038.023	LB174678	14 May 2019	21 May 2019	28 May 2019	27 May 2019	01 Jun 2019	28 May 2019
BR124	SE193038.024	LB174678	14 May 2019	21 May 2019	28 May 2019	27 May 2019	01 Jun 2019	28 May 2019

14 May 2019

14 May 2019

21 May 2019

21 May 2019

28 May 2019

28 May 2019

27 May 2019

27 May 2019

01 Jun 2019

01 Jun 2019

BR125

BR126

SE193038.025

SE193038.026

LB174678

LB174678

28 May 2019

28 May 2019



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Extraction and analysis holding time due dates listed are calculated from the date sampled, although holding times may be extended after laboratory extraction for some analytes. The due dates are the suggested dates that samples may be held before extraction or analysis and still be considered valid.

Extraction and analysis dates are shown in Green when within suggested criteria or Red with an appended dagger symbol (†) when outside suggested criteria. If the sampled date is not supplied then compliance with criteria cannot be determined. If the received date is after one or both due dates then holding time will fail by default.

Moisture Content (continu	ed)						Method:	ME-(AU)-[ENV]AN002
Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
BR127	SE193038.027	LB174678	14 May 2019	21 May 2019	28 May 2019	27 May 2019	01 Jun 2019	28 May 2019
BR128	SE193038.028	LB174678	14 May 2019	21 May 2019	28 May 2019	27 May 2019	01 Jun 2019	28 May 2019
BR129	SE193038.029	LB174678	14 May 2019	21 May 2019	28 May 2019	27 May 2019	01 Jun 2019	28 May 2019
DA	SE193038.030	LB174678	14 May 2019	21 May 2019	28 May 2019	27 May 2019	01 Jun 2019	28 May 2019
DB	SE193038.031	LB174678	14 May 2019	21 May 2019	28 May 2019	27 May 2019	01 Jun 2019	28 May 2019
PAH (Polynuclear Aromati	ic Hydrocarbons) in Soil						Method:	ME-(AU)-IENVIAN420
Sample Name	Sample No	OC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
BP101	SE193038.001	LB174356	14 May 2019	21 May 2019	28 May 2019	22 May 2010	01 10 2010	27 May 2019
BR102	SE193038.002	LB174356	14 May 2010	21 May 2019	28 May 2019	22 May 2019	01 101 2019	27 May 2019
DR102	SE103030.002	1 0174356	14 May 2010	21 May 2010	20 May 2010	22 May 2010	01 Jul 2019	27 May 2015
BR104	SE193038.004	LB174356	14 May 2010	21 May 2010	28 May 2019	22 May 2010	01 101 2019	27 May 2019
BR105	SE193038.005	LB174356	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01. Jul 2019	27 May 2019
BR106	SE193038.006	LB174356	14 May 2019	21 May 2010	28 May 2019	22 May 2010	01 101 2019	27 May 2019
BR107	SE193038.007	LB174356	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01. Jul 2019	27 May 2019
BR108	SE193038.008	LB174356	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01. Jul 2019	27 May 2019
BR109	SE193038.009	LB174356	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 101 2019	27 May 2019
BR110	SE193038.010	LB174356	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01. Jul 2019	27 May 2019
BR111	SE193038.011	LB174356	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	27 May 2019
BR112	SE193038.012	LB174356	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01. Jul 2019	27 May 2019
BR113	SE193038.013	LB174356	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01. Jul 2019	27 May 2019
BR114	SE193038.014	LB174356	14 May 2019	21 May 2019	28 May 2019	22 May 2010	01 Jul 2019	27 May 2019
BR115	SE193038.015	LB174356	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01. Jul 2019	27 May 2019
BR116	SE193038.016	LB174356	14 May 2019	21 May 2010	28 May 2019	22 May 2019	01 Jul 2019	27 May 2010
BR117	SE193038.017	LB174356	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01. Jul 2019	27 May 2019
BR118	SE193038.018	LB174356	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	27 May 2019
BR119	SE193038.019	LB174356	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	27 May 2019
BR120	SE193038.020	LB174356	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	27 May 2019
BR121	SE193038.021	LB174363	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01.lul 2019	27 May 2019
BR122	SE193038.022	LB174363	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	27 May 2019
BR123	SE193038.023	LB174363	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	27 May 2019
BR124	SE193038.024	LB174363	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	27 May 2019
BR125	SE193038.025	LB174363	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	27 May 2019
BR126	SE193038.026	LB174363	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	27 May 2019
BR127	SE193038.027	LB174363	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	27 May 2019
BR128	SE193038.028	LB174363	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	27 May 2019
BR129	SE193038.029	LB174363	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	27 May 2019
DA	SE193038.030	LB174363	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	27 May 2019
DB	SE193038.031	LB174363	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	27 May 2019
Total Recoverable Elemen	nts in Soil/Waste Solids/Ma	terials by ICPOES					Method: ME-(AL)-IENVIAN040/AN320
Sample Name	Sample No	OC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
BR101	SE193038.001	LB174460	14 May 2019	21 May 2019	10 Nov 2019	23 May 2019	10 Nov 2019	28 May 2019
BR102	SE193038.002	LB174460	14 May 2019	21 May 2019	10 Nov 2019	23 May 2019	10 Nov 2019	28 May 2019
BR103	SE193038.003	LB174460	14 May 2019	21 May 2019	10 Nov 2019	23 May 2019	10 Nov 2019	28 May 2019
BR104	SE193038.004	LB174460	14 May 2019	21 May 2019	10 Nov 2019	23 May 2019	10 Nov 2019	28 May 2019
BR105	SE193038.005	LB174460	14 May 2019	21 May 2019	10 Nov 2019	23 May 2019	10 Nov 2019	28 May 2019
BR106	SE193038.006	LB174460	14 May 2019	21 May 2019	10 Nov 2019	23 May 2019	10 Nov 2019	28 May 2019
BR107	SE193038.007	LB174460	14 May 2019	21 May 2019	10 Nov 2019	23 May 2019	10 Nov 2019	28 May 2019
BR108	SE193038.008	LB174460	14 May 2019	21 May 2019	10 Nov 2019	23 May 2019	10 Nov 2019	28 May 2019
BR109	SE193038.009	LB174460	14 May 2019	21 May 2019	10 Nov 2019	23 May 2019	10 Nov 2019	28 May 2019
BR110	SE193038.010	LB174460	14 May 2019	21 May 2019	10 Nov 2019	23 May 2019	10 Nov 2019	28 May 2019
BR111	SE193038.011	LB174460	14 May 2019	21 May 2019	10 Nov 2019	23 May 2019	10 Nov 2019	28 May 2019
BR112	SE193038.012	LB174460	14 May 2019	21 May 2019	10 Nov 2019	23 May 2019	10 Nov 2019	28 May 2019
BR113	SE193038.013	LB174460	14 May 2019	21 May 2019	10 Nov 2019	23 May 2019	10 Nov 2019	28 May 2019
BR114	SE193038.014	LB174460	14 May 2019	21 May 2019	10 Nov 2019	23 May 2019	10 Nov 2019	28 May 2019
BR115	SE193038.015	LB174460	14 May 2019	21 May 2019	10 Nov 2019	23 May 2019	10 Nov 2019	28 May 2019
BR116	SE193038.016	LB174460	14 May 2019	21 May 2019	10 Nov 2019	23 May 2019	10 Nov 2019	28 May 2019
BR117	SE193038.017	LB174460	14 May 2019	21 May 2019	10 Nov 2019	23 May 2019	10 Nov 2019	28 May 2019
BR118	SE193038.018	LB174460	14 May 2019	21 May 2019	10 Nov 2019	23 May 2019	10 Nov 2019	28 May 2019
BR119	SE193038.019	LB174460	14 May 2019	21 May 2019	10 Nov 2019	23 May 2019	10 Nov 2019	28 May 2019



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Extraction and analysis holding time due dates listed are calculated from the date sampled, although holding times may be extended after laboratory extraction for some analytes. The due dates are the suggested dates that samples may be held before extraction or analysis and still be considered valid.

Extraction and analysis dates are shown in Green when within suggested criteria or Red with an appended dagger symbol (†) when outside suggested criteria. If the sampled date is not supplied then compliance with criteria cannot be determined. If the received date is after one or both due dates then holding time will fail by default.

Total Recoverable Eleme	nts in Soil/Waste Solids/Ma	terials by ICPOES (continued)				Method: ME-(AL)-[ENV]AN040/AN320
Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
BR120	SE193038.020	LB174676	14 May 2019	21 May 2019	10 Nov 2019	27 May 2019	10 Nov 2019	28 May 2019
BR121	SE193038.021	LB174676	14 May 2019	21 May 2019	10 Nov 2019	27 May 2019	10 Nov 2019	28 May 2019
BR122	SE193038.022	LB174676	14 May 2019	21 May 2019	10 Nov 2019	27 May 2019	10 Nov 2019	28 May 2019
BR123	SE193038.023	LB174676	14 May 2019	21 May 2019	10 Nov 2019	27 May 2019	10 Nov 2019	28 May 2019
BR124	SE193038.024	LB174676	14 May 2019	21 May 2019	10 Nov 2019	27 May 2019	10 Nov 2019	28 May 2019
BR125	SE193038.025	LB174676	14 May 2019	21 May 2019	10 Nov 2019	27 May 2019	10 Nov 2019	28 May 2019
BR126	SE193038.026	LB174676	14 May 2019	21 May 2019	10 Nov 2019	27 May 2019	10 Nov 2019	28 May 2019
BR127	SE193038.027	LB174676	14 May 2019	21 May 2019	10 Nov 2019	27 May 2019	10 Nov 2019	28 May 2019
BR128	SE193038.028	LB174676	14 May 2019	21 May 2019	10 Nov 2019	27 May 2019	10 Nov 2019	28 May 2019
BR129	SE193038.029	LB174676	14 May 2019	21 May 2019	10 Nov 2019	27 May 2019	10 Nov 2019	28 May 2019
DA	SE193038.030	LB174676	14 May 2019	21 May 2019	10 Nov 2019	27 May 2019	10 Nov 2019	28 May 2019
DB	SE193038.031	LB174676	14 May 2019	21 May 2019	10 Nov 2019	27 May 2019	10 Nov 2019	28 May 2019
TRH (Total Recoverable I	Hydrocarbons) in Soil						Method:	ME-(AU)-IENVIAN403
Sample Name	Sample No.	OC Ref	Sampled	Pecoived	Extraction Due	Extracted	Analysis Duo	Analyzod
DB101	SE102020.001	L D174256	14 May 2010	21 May 2010	29 May 2010	22 May 2010	Analysis Due	24 May 2010
PP102	SE102029.002	LB174356	14 May 2010	21 May 2019	20 May 2019	22 May 2019	01 Jul 2019	24 May 2019
DR102	SE103038.002	LB174350	14 May 2019	21 May 2019	20 May 2019	22 May 2019	01 Jul 2019	24 May 2019
DR103	SE193038.003	10174350	14 May 2019	21 May 2019	20 May 2019	22 May 2019	01 Jul 2019	24 May 2019
DR104	SE193038.004	LD174356	14 May 2019	21 May 2019	26 May 2019	22 May 2019	01 Jul 2019	28 May 2019
BR105	SE 193038.005	LD174356	14 May 2019	21 May 2019	26 May 2019	22 May 2019	01 Jul 2019	26 May 2019
DR107	SE 193038.000	LD174350	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	24 May 2019
DR107	SE193038.007	LD174356	14 May 2019	21 May 2019	20 May 2019	22 May 2019	01 Jul 2019	20 May 2019
DR100	SE 193030.000	10174350	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	24 May 2019
DR109	SE193036.009	LD174356	14 May 2019	21 May 2019	20 May 2019	22 May 2019	01 Jul 2019	24 May 2019
DD111	SE102020 011	1 0174356	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	20 May 2019
DD112	SE102020.012	LB174350	14 May 2019	21 May 2019	20 May 2019	22 May 2019	01 Jul 2019	24 May 2019
DR112	SE103030.012	1 0174356	14 May 2019	21 May 2019	20 May 2019	22 May 2019	01 Jul 2019	24 May 2019
DR114	SE 193030.013	10174350	14 May 2010	21 May 2019	20 May 2019	22 May 2010	01 101 2010	24 May 2019
DR114	SE193036.014	LD174356	14 May 2019	21 May 2019	20 May 2019	22 May 2019	01 Jul 2019	20 May 2019
DR115	SE102020.016	LB174356	14 May 2019	21 May 2019	20 May 2019	22 May 2019	01 Jul 2019	20 May 2019
DR110	SE103030.010	1 0174356	14 May 2010	21 May 2010	20 May 2010	22 May 2010	01 Jul 2019	24 May 2010
BR118	SE103038.018	18174356	14 May 2010	21 May 2019	28 May 2019	22 May 2013	01 Jul 2019	28 May 2019
BR119	SE103038.010	LB174356	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	24 May 2019
BR120	SE193038.020	LB174356	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	24 May 2019
BR121	SE193038.021	LB174363	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01.1012019	24 May 2019
BR122	SE193038.022	LB174363	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	24 May 2019
BR123	SE193038.023	LB174363	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01.Jul 2019	24 May 2019
BR124	SE193038 024	LB174363	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01.Jul 2019	24 May 2019
BR125	SE193038 025	LB174363	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01.1012019	24 May 2019
BR126	SE193038.026	LB174363	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	24 May 2019
BR127	SE193038 027	LB174363	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01. Jul 2019	24 May 2019
BR128	SE193038.028	1 B174363	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	24 May 2019
BR129	SE193038.029	LB174363	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	24 May 2019
DA	SE193038.030	LB174363	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	28 May 2019
DB	SE193038.031	LB174363	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	24 May 2019
VOC's in Soil			1	1211	/		Method:	ME-(ALI)-IENVIAN433
Sample Name	Sample No.	OC Ref	Sampled	Pecoived	Extraction Due	Extracted	Analysis Duo	Analyzed
BB101	SE102028-001	L B17/355	14 May 2019	21 May 2019	28 May 2019	22 May 2010	Analysis Due	27 May 2019
DR101	SE103030.001	1 0174355	14 May 2010	21 May 2010	20 May 2010	22 May 2010	01 Jul 2019	27 May 2010
DR102	SE103038.002	1 0174355	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	27 May 2019
BR104	SE102020 004	18174255	14 May 2010	21 May 2010	20 May 2010	22 May 2010	01 012010	27 May 2010
BR104	SE10000000	18174355	14 May 2019	21 May 2019	20 May 2019	22 May 2019	01 Jul 2019	27 May 2019
BR106	SE103038.000	1817/255	14 May 2010	21 May 2010	28 May 2019	22 May 2010	01 Jul 2010	27 May 2010
BR107	SE10000007	18174955	14 May 2010	21 May 2019	20 May 2010	22 May 2010	01 01 2010	27 May 2013
BR108	SE103030.007	1 817/355	14 May 2010	21 May 2010	20 May 2010	22 May 2010	01.002010	27 May 2010
BR109	SE103038.000	1817/255	14 May 2010	21 May 2010	28 May 2010	22 May 2010	01 Jul 2010	27 May 2010
BR110	SE102020 010	1 817/355	14 May 2010	21 May 2010	20 May 2010	22 May 2010	01 Jul 2010	27 May 2019
BR111	SE193038.011	18174355	14 May 2019	21 May 2010	28 May 2019	22 May 2019	01.1012019	27 May 2019
BR112	SE103038.017	1 8174355	14 May 2010	21 May 2010	28 May 2010	22 May 2010	01.1012010	27 May 2010
1. 1. 1. 1. 1. E.	0210000012	20114000	11 may 2010	21 11/14 2010	20 may 2010	an intray 2010	010012010	21 11149 2010



Methods ME (ALIS IEAB (AALIS)

SGS holding time criteria are drawn from current regulations and are highly dependent on sample container preservation as specified in the SGS "Field Sampling Guide for Containers and Holding Time" (ref: GU-(AU)-ENV.001). Soil samples guidelines are derived from NEPM "Schedule B(3) Guideline on Laboratory Analysis of Potentially Contaminated Soils". Water sample guidelines are derived from "AS/NZS 5667.1 : 1998 Water Quality - sampling part 1" and APHA "Standard Methods for the Examination of Water and Wastewater" 21st edition 2005.

Extraction and analysis holding time due dates listed are calculated from the date sampled, although holding times may be extended after laboratory extraction for some analytes. The due dates are the suggested dates that samples may be held before extraction or analysis and still be considered valid.

Extraction and analysis dates are shown in Green when within suggested criteria or Red with an appended dagger symbol (†) when outside suggested criteria. If the sampled date is not supplied then compliance with criteria cannot be determined. If the received date is after one or both due dates then holding time will fail by default.

VOC's in Soil (continued)

VOC S IN Soil (continued)							Metriod:	ME-(AU)-[ENV]AN433
Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
BR113	SE193038.013	LB174355	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	27 May 2019
BR114	SE193038.014	LB174355	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	27 May 2019
BR115	SE193038.015	LB174355	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	27 May 2019
BR116	SE193038.016	LB174355	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	27 May 2019
BR117	SE193038.017	LB174355	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	27 May 2019
BR118	SE193038.018	LB174355	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	27 May 2019
BR119	SE193038.019	LB174355	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	27 May 2019
BR120	SE193038.020	LB174355	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	27 May 2019
BR121	SE193038.021	LB174362	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	27 May 2019
BR122	SE193038.022	LB174362	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	27 May 2019
BR123	SE193038.023	LB174362	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	27 May 2019
BR124	SE193038.024	LB174362	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	28 May 2019
BR125	SE193038.025	LB174362	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	28 May 2019
BR126	SE193038.026	LB174362	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	28 May 2019
BR127	SE193038.027	LB174362	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	28 May 2019
BR128	SE193038.028	LB174362	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	27 May 2019
BR129	SE193038.029	LB174362	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	27 May 2019
DA	SE193038.030	LB174362	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	27 May 2019
DB	SE193038.031	LB174362	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01.Jul 2019	27 May 2019

/olatile Petroleum Hydrocarbons in Soil							Method: ME-(AU)-[ENV]AN433	
Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
BR101	SE193038.001	LB174355	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	27 May 2019
BR102	SE193038.002	LB174355	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	27 May 2019
BR103	SE193038.003	LB174355	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	27 May 2019
BR104	SE193038.004	LB174355	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	27 May 2019
BR105	SE193038.005	LB174355	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	27 May 2019
BR106	SE193038.006	LB174355	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	27 May 2019
BR107	SE193038.007	LB174355	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	27 May 2019
BR108	SE193038.008	LB174355	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	28 May 2019
BR109	SE193038.009	LB174355	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	27 May 2019
BR110	SE193038.010	LB174355	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	27 May 2019
BR111	SE193038.011	LB174355	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	27 May 2019
BR112	SE193038.012	LB174355	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	27 May 2019
BR113	SE193038.013	LB174355	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	27 May 2019
BR114	SE193038.014	LB174355	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	27 May 2019
BR115	SE193038.015	LB174355	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	27 May 2019
BR116	SE193038.016	LB174355	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	27 May 2019
BR117	SE193038.017	LB174355	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	27 May 2019
BR118	SE193038.018	LB174355	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	27 May 2019
BR119	SE193038.019	LB174355	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	27 May 2019
BR120	SE193038.020	LB174355	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	28 May 2019
BR121	SE193038.021	LB174362	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	27 May 2019
BR122	SE193038.022	LB174362	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	27 May 2019
BR123	SE193038.023	LB174362	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	27 May 2019
BR124	SE193038.024	LB174362	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	28 May 2019
BR125	SE193038.025	LB174362	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	28 May 2019
BR126	SE193038.026	LB174362	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	28 May 2019
BR127	SE193038.027	LB174362	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	28 May 2019
BR128	SE193038.028	LB174362	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	27 May 2019
BR129	SE193038.029	LB174362	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	27 May 2019
DA	SE193038.030	LB174362	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	27 May 2019
DB	SE193038.031	LB174362	14 May 2019	21 May 2019	28 May 2019	22 May 2019	01 Jul 2019	27 May 2019



Surrogate results are evaluated against upper and lower limit criteria established in the SGS QA/QC plan (Ref: MP-(AU)-[ENV]QU-022). At least two of three routine level soil sample surrogate spike recoveries for BTEX/VOC are to be within 70-130% where control charts have not been developed and within the established control limits for charted surrogates. Matrix effects may void this as an acceptance criterion. Water sample surrogate spike recoveries are to be within 40-130%. The presence of emulsions, surfactants and particulates may void this as an acceptance criterion.

Result is shown in Green when within suggested criteria or Red with an appended reason identifier when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

PAH (Polynuclear Aromatic Hydrocarbons) in Soll

Method: ME-(AU)-[ENV]AN420

Deservator	Comple Name	Consula Norseleon	1 Indian	Criteria	Decouvery 9/
ralameter	Sample Name	Sample Number	Units	Griteria	Recovery 76
2-fluorobiphenyl (Surrogate)	BR101	SE193038.001	%	70 - 130%	88
	BR102	SE193038.002	%	70 - 130%	90
	BR103	SE193038.003	%	70 - 130%	92
	BR104	SE193038.004	%	70 - 130%	98
	BR105	SE193038.005	%	70 - 130%	96
	BR106	SE193038.006	%	70 - 130%	98
	BR107	SE193038.007	%	70 - 130%	98
	BR108	SE193038.008	%	70 - 130%	100
	BB109	SE193038.009	%	70 - 130%	108
	BR110	SE193038 010	96	70 - 130%	96
	BR110	SE103038.010	70 0/	70 120%	100
	DRITI DR112	SE183038.011	70	70 - 130%	100
	BRIIZ	SE 193038.012	70	70 - 130%	94
	BRII3	SE 193038.013	%	70 - 130%	90
	BR114	SE193038.014	%	70 - 130%	112
	BR115	SE193038.015	%	70 - 130%	100
	BR116	SE193038.016	%	70 - 130%	98
	BR117	SE193038.017	%	70 - 130%	100
	BR118	SE193038.018	%	70 - 130%	98
	BR119	SE193038.019	%	70 - 130%	96
	BR120	SE193038.020	%	70 - 130%	98
	BR121	SE193038.021	%	70 - 130%	88
	BR122	SE193038.022	%	70 - 130%	92
	BR123	SE193038.023	%	70 - 130%	92
	BR124	SE193038 024	%	70 - 130%	88
	BR125	SE193038 025	%	70 - 130%	86
	PP126	SE102020 026	02	70 120%	94
	DR120	SE 103030.020	/0	70 - 130%	94
	BR127	SE195036.027	70	70 - 130%	00
	BR128	SE 193038.028	%	70 - 130%	90
	BR129	SE193038.029	%	70 - 130%	90
	DA	SE193038.030	%	70 - 130%	90
	DB	SE193038.031	%	70 - 130%	86
d14-p-terphenyl (Surrogate)	BR101	SE193038.001	%	70 - 130%	94
	BR102	SE193038.002	%	70 - 130%	98
	BR103	SE193038.003	%	70 - 130%	96
	BR104	SE193038.004	%	70 - 130%	100
	BR105	SE193038.005	%	70 - 130%	96
	BR106	SE193038.006	%	70 - 130%	100
	BR107	SE193038.007	%	70 - 130%	108
	BR108	SE193038.008	%	70 - 130%	90
	BR109	SE193038.009	%	70 - 130%	98
	BR110	SE193038.010	%	70 - 130%	84
	BR111	SE193038 011	%	70 - 130%	98
	BR112	SE103038.012	96 04	70 - 130%	90
	PP112	SE103038.012	96	70 120%	02
	BRIIS	SE193038.013	70	70 - 130%	92
	BR114	SE 193038.014	%	70 - 130%	94
	BRTIS	SE193038.015	%	70 - 130%	100
	BR116	SE193038.016	%	70 - 130%	98
	BR117	SE193038.017	%	70 - 130%	102
	BR118	SE193038.018	%	70 - 130%	102
	BR119	SE193038.019	%	70 - 130%	102
	BR120	SE193038.020	%	70 - 130%	102
	BR121	SE193038.021	%	70 - 130%	92
	BR122	SE193038.022	%	70 - 130%	98
	BR123	SE193038.023	%	70 - 130%	96
	BR124	SE193038.024	%	70 - 130%	96
	BR125	SE193038.025	%	70 - 130%	102
	BR126	SE193038 026	%	70 - 130%	94
	BR127	SE193038 027	%	70 - 130%	90
	BD130	SE103030.027	20 02	70 130%	04
	DD1120	SE 10000,020	70	70 100%	34
	BK129	SE 193038.029	%	70 - 130%	98
	DA	SE193038.030	%	70 - 130%	96



Surrogate results are evaluated against upper and lower limit criteria established in the SGS QA/QC plan (Ref: MP-(AU)-[ENV]QU-022). At least two of three routine level soil sample surrogate spike recoveries for BTEX/VOC are to be within 70-130% where control charts have not been developed and within the established control limits for charted surrogates. Matrix effects may void this as an acceptance criterion. Water sample surrogate spike recoveries are to be within 40-130%. The presence of emulsions, surfactants and particulates may void this as an acceptance criterion.

Result is shown in Green when within suggested criteria or Red with an appended reason identifier when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

PAH (Polynuclear Aromatic Hydrocarbons) in Soli (continued)

Method: ME-(AU)-[ENV]AN420

Parameter	Sample Name	Sample Number	Units	Criteria	Recovery %
d14-p-terphenyl (Surrogate)	DB	SE193038.031	%	70 - 130%	102
d5-nitrobenzene (Surrogate)	BR101	SE193038.001	%	70 - 130%	86
	BR102	SE193038.002	%	70 - 130%	72
	BR103	SE193038.003	%	70 - 130%	84
	BR104	SE193038.004	%	70 - 130%	86
	BR105	SE193038.005	%	70 - 130%	98
	BR106	SE193038.006	%	70 - 130%	90
	BR107	SE193038.007	%	70 - 130%	92
	BR108	SE193038.008	%	70 - 130%	90
	BR109	SE193038.009	%	70 - 130%	82
	BR110	SE193038.010	%	70 - 130%	76
	BR111	SE193038.011	%	70 - 130%	90
	BR112	SE193038.012	%	70 - 130%	96
	BR113	SE193038.013	%	70 - 130%	82
	BR114	SE193038.014	%	70 - 130%	76
	BR115	SE193038.015	%	70 - 130%	94
	BR116	SE193038.016	%	70 - 130%	92
	BR117	SE193038.017	%	70 - 130%	74
	BR118	SE193038.018	%	70 - 130%	90
	BR119	SE193038.019	%	70 - 130%	92
	BR120	SE193038.020	%	70 - 130%	92
	BR121	SE193038.021	%	70 - 130%	96
	BR122	SE193038.022	%	70 - 130%	92
	BR123	SE193038.023	%	70 - 130%	98
	BR124	SE193038.024	%	70 - 130%	96
	BR125	SE193038.025	%	70 - 130%	94
	BR126	SE193038.026	%	70 - 130%	102
	BR127	SE193038.027	%	70 - 130%	96
	BR128	SE193038.028	%	70 - 130%	98
	BR129	SE193038.029	%	70 - 130%	98
	DA	SE193038.030	%	70 - 130%	98
	DB	SE193038.031	%	70 - 130%	102
MOCIA In Ball				Marthaut M	
VOC'S IN SOIL	Parent de la las sectos	2010-00-00-00-00-00-00-00-00-00-00-00-00-	2004300.v	Method: M	E-(AU)-[ENV]AN433
Parameter	Sample Name	Sample Number	Unite	Criteria	Recoverv %
D	Salliple Nallie		Unita	Albert Development	
Bromonuorobenzene (Surrogate)	BR101	SE193038.001	%	60 - 130%	73
Bromonuorobenzene (Surrogate)	BR101 BR102	SE193038.001 SE193038.002	%	60 - 130% 60 - 130%	73 71
Bromonuorobenzene (Surrogate)	BR101 BR102 BR103	SE193038.001 SE193038.002 SE193038.003	% % %	60 - 130% 60 - 130% 60 - 130%	73 71 71
Bromonuorobenzene (Surrogate)	BR101 BR102 BR103 BR104	SE193038.001 SE193038.002 SE193038.003 SE193038.004	% % % %	60 - 130% 60 - 130% 60 - 130% 60 - 130%	73 71 71 74
Bromonuorobenzene (Surrogate)	BR101 BR102 BR103 BR104 BR105	SE193038.001 SE193038.002 SE193038.003 SE193038.004 SE193038.005	% % % %	60 - 130% 60 - 130% 60 - 130% 60 - 130% 60 - 130%	73 71 71 74 73
Bromonuorobenzene (Surrogate)	BR101 BR102 BR103 BR104 BR105 BR106	SE193038.001 SE193038.002 SE193038.003 SE193038.004 SE193038.005 SE193038.006	% % % % %	60 - 130% 60 - 130% 60 - 130% 60 - 130% 60 - 130% 60 - 130%	73 71 71 74 73 74
Bromonuorobenzene (Surrogate)	BR101 BR102 BR103 BR104 BR105 BR106 BR107	SE193038.001 SE193038.002 SE193038.003 SE193038.004 SE193038.005 SE193038.006 SE193038.006	% % % % %	60 - 130% 60 - 130% 60 - 130% 60 - 130% 60 - 130% 60 - 130% 60 - 130%	73 71 71 74 73 74 74 74
Bromonuorobenzene (Surrogate)	BR101 BR102 BR103 BR104 BR105 BR106 BR107 BR108	SE193038.001 SE193038.002 SE193038.003 SE193038.004 SE193038.005 SE193038.006 SE193038.007 SE193038.008	% % % % % %	60 - 130% 60 - 130%	73 71 71 74 73 74 74 74 71
Bromonuorobenzene (Surrogate)	BR101 BR102 BR103 BR104 BR105 BR106 BR106 BR107 BR108 BR109	SE193038.001 SE193038.002 SE193038.003 SE193038.004 SE193038.005 SE193038.006 SE193038.007 SE193038.008 SE193038.009	% % % % % %	60 - 130% 60 - 130%	73 71 71 74 73 74 74 74 71 75
Bromonuorobenzene (Surrogate)	BR101 BR102 BR103 BR104 BR105 BR106 BR107 BR108 BR109 BR110	SE193038.001 SE193038.002 SE193038.003 SE193038.004 SE193038.005 SE193038.006 SE193038.006 SE193038.007 SE193038.008 SE193038.009 SE193038.010	% % % % % % %	60 - 130% 60 - 130%	73 71 71 74 73 74 74 71 75 73
Bromonuorobenzene (Surrogate)	BR101 BR102 BR103 BR104 BR105 BR106 BR107 BR108 BR109 BR110 BR111	SE193038.001 SE193038.002 SE193038.002 SE193038.003 SE193038.004 SE193038.006 SE193038.006 SE193038.007 SE193038.008 SE193038.009 SE193038.010 SE193038.011	% % % % % % %	60 - 130% 60 - 130%	73 71 71 74 73 74 74 74 71 75 73 73
Bromonuorobenzene (Surrogate)	BR101 BR102 BR103 BR104 BR105 BR106 BR106 BR107 BR108 BR109 BR110 BR111 BR111 BR112	SE193038.001 SE193038.002 SE193038.002 SE193038.004 SE193038.004 SE193038.006 SE193038.006 SE193038.007 SE193038.009 SE193038.010 SE193038.011 SE193038.011	% % % % % % % %	60 - 130% 60 - 130%	73 71 71 74 73 74 74 74 71 75 73 73 73 72
Eromonuorobenzene (Surrogate)	BR101 BR102 BR103 BR104 BR105 BR106 BR106 BR107 BR108 BR109 BR110 BR111 BR111 BR112 BR113	SE193038.001 SE193038.002 SE193038.002 SE193038.004 SE193038.005 SE193038.006 SE193038.006 SE193038.007 SE193038.008 SE193038.009 SE193038.010 SE193038.011 SE193038.012 SE193038.013	5 mms % % % % % % % % % %	60 - 130% 60 - 130%	73 71 71 74 73 74 74 74 71 75 73 73 73 73 72 72
Eromonuorobenzene (Surrogate)	BR101 BR102 BR103 BR104 BR105 BR106 BR106 BR107 BR108 BR109 BR110 BR111 BR111 BR112 BR113 BR114	SE193038.001 SE193038.002 SE193038.002 SE193038.004 SE193038.005 SE193038.006 SE193038.006 SE193038.007 SE193038.009 SE193038.010 SE193038.011 SE193038.012 SE193038.013 SE193038.014	5 mms % % % % % % % % % % %	60 - 130% 60 - 130%	73 71 71 74 73 74 74 74 71 75 73 73 73 73 73 72 72 72 73
Eromonuorobenzene (Surrogate)	BR101 BR102 BR103 BR104 BR105 BR106 BR106 BR107 BR108 BR109 BR110 BR110 BR111 BR111 BR112 BR113 BR114 BR115	SE193038.001 SE193038.002 SE193038.002 SE193038.003 SE193038.004 SE193038.005 SE193038.006 SE193038.007 SE193038.008 SE193038.009 SE193038.010 SE193038.011 SE193038.011 SE193038.013 SE193038.014 SE193038.015	5 mms % % % % % % % % % % % %	60 - 130% 60 - 130%	73 71 71 74 73 74 74 74 74 71 75 73 73 73 73 72 72 72 73 71
Eromonuorobenzene (Surrogate)	BR101 BR102 BR103 BR104 BR105 BR106 BR107 BR106 BR107 BR108 BR109 BR110 BR110 BR111 BR111 BR112 BR113 BR114 BR115 BR116	SE193038.001 SE193038.002 SE193038.002 SE193038.004 SE193038.005 SE193038.006 SE193038.006 SE193038.007 SE193038.008 SE193038.009 SE193038.010 SE193038.011 SE193038.011 SE193038.012 SE193038.014 SE193038.015 SE193038.016	5 mms % % % % % % % % % % % % % %	60 - 130% 60 - 130%	73 71 71 74 73 74 74 74 71 75 73 73 73 73 72 72 73 72 72 73 71 70
eromonuorobenzene (Surrogate)	BR101 BR102 BR103 BR104 BR105 BR106 BR107 BR106 BR107 BR108 BR109 BR110 BR111 BR111 BR112 BR113 BR113 BR114 BR115 BR116 BR116 BR117	SE193038.001 SE193038.002 SE193038.002 SE193038.004 SE193038.005 SE193038.006 SE193038.006 SE193038.007 SE193038.009 SE193038.009 SE193038.010 SE193038.011 SE193038.011 SE193038.014 SE193038.014 SE193038.016 SE193038.016 SE193038.017	5 mms % % % % % % % % % % % % % %	60 - 130% 60 - 130%	73 71 71 74 73 74 74 74 71 75 73 73 73 72 72 73 72 73 71 70 72
Eromonuorobenzene (Surrogate)	BR101 BR102 BR103 BR104 BR105 BR106 BR107 BR108 BR107 BR108 BR109 BR110 BR111 BR112 BR112 BR113 BR114 BR115 BR115 BR116 BR117 BR118	SE193038.001 SE193038.002 SE193038.002 SE193038.004 SE193038.005 SE193038.006 SE193038.006 SE193038.007 SE193038.009 SE193038.010 SE193038.011 SE193038.012 SE193038.013 SE193038.014 SE193038.015 SE193038.016 SE193038.017 SE193038.018	5 mms % % % % % % % % % % % % % % %	60 - 130% 60 - 130%	73 71 71 74 73 74 74 74 74 71 75 73 73 73 72 72 72 72 73 73 71 70 72 72 73 73 71 70 72
Eromonuorobenzene (Surrogate)	BR101 BR102 BR103 BR104 BR105 BR106 BR107 BR108 BR109 BR110 BR111 BR112 BR113 BR113 BR114 BR115 BR115 BR115 BR116 BR117 BR118 BR119	SE193038.001 SE193038.002 SE193038.002 SE193038.004 SE193038.005 SE193038.006 SE193038.006 SE193038.007 SE193038.009 SE193038.010 SE193038.011 SE193038.011 SE193038.013 SE193038.014 SE193038.016 SE193038.017 SE193038.018 SE193038.019	5 mms % % % % % % % % % % % % % % % % %	60 - 130% 60 - 130%	73 71 71 74 73 74 74 74 74 71 75 73 73 73 73 72 72 72 72 73 71 70 72 73 71 70 72 75 76
Eromonuorobenzene (Surrogate)	BR101 BR102 BR103 BR104 BR105 BR106 BR106 BR107 BR108 BR109 BR110 BR111 BR112 BR113 BR114 BR113 BR114 BR115 BR116 BR116 BR116 BR117 BR118 BR119 BR119 BR120	SE193038.001 SE193038.002 SE193038.002 SE193038.004 SE193038.005 SE193038.006 SE193038.006 SE193038.007 SE193038.009 SE193038.010 SE193038.010 SE193038.011 SE193038.012 SE193038.013 SE193038.014 SE193038.015 SE193038.016 SE193038.018 SE193038.019 SE193038.019 SE193038.019	5 mms % % % % % % % % % % % % % % % % % %	60 - 130% 60 - 130%	73 71 71 74 73 74 74 74 74 73 74 73 73 73 73 73 73 72 73 71 70 72 75 76 72
Eromonuorobenzene (Surrogate)	BR101 BR102 BR103 BR104 BR105 BR106 BR106 BR107 BR108 BR109 BR110 BR110 BR111 BR112 BR113 BR114 BR115 BR114 BR115 BR116 BR115 BR116 BR117 BR118 BR119 BR119 BR121	SE193038.001 SE193038.002 SE193038.002 SE193038.004 SE193038.005 SE193038.006 SE193038.006 SE193038.007 SE193038.008 SE193038.009 SE193038.010 SE193038.011 SE193038.012 SE193038.013 SE193038.014 SE193038.015 SE193038.016 SE193038.016 SE193038.018 SE193038.019 SE193038.020 SE193038.021	% %	60 - 130% 60 - 130%	73 71 71 74 73 74 74 71 75 73 73 73 73 72 72 72 73 71 70 72 75 76 72 89
Eromonuorobenzene (Surrogate)	BR101 BR102 BR103 BR104 BR105 BR106 BR106 BR106 BR107 BR108 BR109 BR110 BR110 BR111 BR111 BR112 BR113 BR114 BR115 BR116 BR115 BR116 BR117 BR118 BR118 BR119 BR119 BR119 BR119 BR119 BR119 BR119 BR110 BR110 BR111 BR111 BR111 BR111 BR111 BR111 BR111 BR111 BR112 BR121 BR122 BR122 BR122 BR122	SE193038.001 SE193038.002 SE193038.003 SE193038.004 SE193038.005 SE193038.006 SE193038.006 SE193038.007 SE193038.009 SE193038.010 SE193038.011 SE193038.011 SE193038.013 SE193038.014 SE193038.015 SE193038.016 SE193038.016 SE193038.017 SE193038.018 SE193038.019 SE193038.020 SE193038.021 SE193038.021	5 mms % % % % % % % % % % % % % % % % % %	60 - 130% 60 - 130%	73 71 71 74 73 74 74 71 75 73 73 73 72 72 73 71 70 72 75 76 76 72 89 89 87
Eromonuorobenzene (Surrogate)	BR101 BR102 BR103 BR104 BR105 BR106 BR106 BR107 BR108 BR109 BR110 BR110 BR110 BR111 BR112 BR113 BR114 BR115 BR116 BR115 BR116 BR117 BR118 BR117 BR118 BR119 BR119 BR120 BR121 BR121 BR122 BR123	SE193038.001 SE193038.002 SE193038.003 SE193038.004 SE193038.005 SE193038.005 SE193038.006 SE193038.007 SE193038.009 SE193038.010 SE193038.010 SE193038.011 SE193038.012 SE193038.013 SE193038.015 SE193038.016 SE193038.016 SE193038.017 SE193038.018 SE193038.018 SE193038.019 SE193038.020 SE193038.021 SE193038.022 SE193038.022	5 ms % % % % % % % % % % % % % % % % % % %	60 - 130% 60 - 130%	73 71 74 73 74 73 74 73 74 73 73 73 73 73 73 72 73 71 70 72 75 76 72 89 87 90
Eromonuorobenzene (Surrogate)	BR101 BR102 BR103 BR104 BR105 BR106 BR106 BR107 BR108 BR109 BR110 BR110 BR110 BR111 BR112 BR111 BR112 BR113 BR114 BR115 BR116 BR115 BR116 BR117 BR116 BR117 BR118 BR117 BR118 BR119 BR119 BR120 BR121 BR122 BR123 BR124	SE193038.001 SE193038.002 SE193038.002 SE193038.003 SE193038.005 SE193038.005 SE193038.006 SE193038.007 SE193038.008 SE193038.009 SE193038.010 SE193038.011 SE193038.011 SE193038.012 SE193038.014 SE193038.015 SE193038.016 SE193038.016 SE193038.018 SE193038.019 SE193038.020 SE193038.021 SE193038.021 SE193038.021 SE193038.023 SE193038.023	5 mms % % % % % % % % % % % % % % % % % %	60 - 130% 60 - 130%	73 71 71 74 73 74 74 74 71 75 73 73 73 73 73 73 73 73 73 73 73 73 73
Eromonuorobenzene (Surrogate)	BR101 BR102 BR103 BR104 BR105 BR106 BR106 BR107 BR108 BR107 BR108 BR109 BR110 BR110 BR111 BR112 BR111 BR112 BR113 BR114 BR115 BR115 BR116 BR115 BR116 BR117 BR118 BR117 BR118 BR117 BR118 BR119 BR120 BR121 BR121 BR122 BR122 BR123 BR124 BR125	SE193038.001 SE193038.002 SE193038.002 SE193038.003 SE193038.004 SE193038.005 SE193038.006 SE193038.007 SE193038.008 SE193038.009 SE193038.010 SE193038.011 SE193038.011 SE193038.012 SE193038.013 SE193038.015 SE193038.016 SE193038.016 SE193038.017 SE193038.018 SE193038.020 SE193038.020 SE193038.021 SE193038.021 SE193038.022 SE193038.023 SE193038.024 SE193038.024	% %	60 - 130% 60 - 130%	73 71 74 73 74 73 74 73 74 73 73 73 73 73 73 73 73 73 73 73 73 72 73 71 70 72 75 76 72 78 89 87 89



Surrogate results are evaluated against upper and lower limit criteria established in the SGS QA/QC plan (Ref: MP-(AU)-[ENV]QU-022). At least two of three routine level soil sample surrogate spike recoveries for BTEX/VOC are to be within 70-130% where control charts have not been developed and within the established control limits for charted surrogates. Matrix effects may void this as an acceptance criterion. Water sample surrogate spike recoveries are to be within 40-130%. The presence of emulsions, surfactants and particulates may void this as an acceptance criterion.

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VOC's in Soll (continued) Method: ME-(AU)-[ENV]AN433 Parameter Sample Nur Criteria Recovery % Uni Bromofluorobenzene (Surrogate) BR127 SE193038.027 % 60 - 130% 90 BR128 SE193038.028 % 60 - 130% 86 % BR129 SE193038.029 60 - 130% 86 DA SE193038 030 % 60 - 130% 87 DB SE193038.031 60 - 130% 87 % 82 BR101 SE193038.001 % d4-1.2-dichloroethane (Surrogate) 60 - 130% BR102 SE193038.002 % 60 - 130% 80 BR103 SE193038.003 60 - 130% 79 % BR104 % 85 SE193038.004 60 - 130% BR105 SE193038.005 % 60 - 130% 78 BR106 SE193038.006 60 - 130% 78 % 82 % BR107 SE193038.007 60 - 130% BR108 SE193038.008 % 60 - 130% 82 BR109 SE193038.009 % 60 - 130% 81 % BR110 SE193038.010 60 - 130% 82 BR111 SE193038 011 % 60 - 130% 77 SE193038.012 BR112 60 - 130% 79 % BR113 SE193038.013 % 83 60 - 130% BR114 SF193038.014 % 60 - 130% 85 BR115 SE193038.015 60 - 130% 76 % % 79 BR116 SE193038.016 60 - 130% BR117 SE193038.017 % 60 - 130% 81 BR118 SE193038.018 60 - 130% 82 % % 77 BR119 SE193038.019 60 - 130% BR120 SE193038.020 % 60 - 130% 82 BR121 SE193038.021 % 60 - 130% 79 BR122 SE193038.022 % 60 - 130% 76 BR123 SE193038.023 % 60 - 130% 78 BR124 SE193038.024 % 60 - 130% 76 79 BR125 SE193038.025 % 60 - 130% BR126 SE193038.026 % 60 - 130% 79 BR127 SE193038.027 60 - 130% 81 % BR128 SE193038.028 % 77 60 - 130% BR129 SE193038.029 % 60 - 130% 76 DA SE193038.030 60 - 130% 78 % DB SE193038.031 % 60 - 130% 76 d8-toluene (Surrogate) BR101 SE193038.001 % 60 - 130% 71 BR102 SE193038.002 60 - 130% 81 % BR103 SE193038.003 % 81 60 - 130% **BR104** SE193038 004 % 60 - 130% 84 BR105 SE193038.005 % 60 - 130% 73 BR106 SE193038.006 % 60 - 130% 70 BR107 SE193038.007 % 60 - 130% 92 BR108 SE193038.008 60 - 130% 73 % BR109 % 72 SE193038.009 60 - 130% BR110 SE193038 010 % 60 - 130% 81 BR111 SE193038.011 60 - 130% 112 % BR112 SE193038.012 % 60 - 130% 73 **BR113** SF193038.013 % 60 - 130% 110 BR114 SE193038.014 % 60 - 130% 84 BR115 SE193038.015 % 60 - 130% 72 **BR116** SE193038 016 % 60 - 130% 73 BR117 SE193038.017 60 - 130% 70 % **BR118** SE193038.018 % 60 - 130% 74 BR119 SE193038.019 % 60 - 130% 70 BR120 SE193038.020 % 60 - 130% 76 BR121 % 93 SE193038.021 60 - 130% BR122 SE193038.022 % 60 - 130% 90 BR123 SE193038.023 60 - 130% 94 % BR124 SE193038.024 % 90 60 - 130%

BR125

SE193038.025

%

60 - 130%

94



Surrogate results are evaluated against upper and lower limit criteria established in the SGS QA/QC plan (Ref: MP-(AU)-[ENV]QU-022). At least two of three routine level soil sample surrogate spike recoveries for BTEX/VOC are to be within 70-130% where control charts have not been developed and within the established control limits for charted surrogates. Matrix effects may void this as an acceptance criterion. Water sample surrogate spike recoveries are to be within 40-130%. The presence of emulsions, surfactants and particulates may void this as an acceptance criterion.

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and an and fourningal			-	INIGHT ICALL TVIC	fred frankling
Parameter	Sample Name	Sample Number	Units	Criteria	Recovery %
d8-toluene (Surrogate)	BR126	SE193038.026	%	60 - 130%	92
	BR127	SE193038.027	%	60 - 130%	94
	BR128	SE193038.028	%	60 - 130%	88
	BR129	SE193038.029	%	60 - 130%	90
	DA	SE193038.030	%	60 - 130%	88
	DB	SE193038.031	%	60 - 130%	90
Dibromofluoromethane (Surrogate)	BR101	SE193038.001	%	60 - 130%	74
	BR102	SE193038.002	%	60 - 130%	72
	BR103	SE193038.003	%	60 - 130%	71
	BR104	SE193038.004	%	60 - 130%	71
	BR105	SE193038.005	%	60 - 130%	73
	BB106	SE193038.006	%	60 - 130%	71
	BB107	SE193038 007	%	60 - 130%	73
	PP109	SE102029.009	96	60 120%	74
	DR100	SE 103030.000	76	60 130%	74
	BRIDS	SE 193038.009	70	60 - 130%	73
	BR110	SE193038.010	%	60 - 130%	73
	BR111	SE193038.011	%	60 - 130%	73
	BR112	SE193038.012	%	60 - 130%	72
	BR113	SE193038.013	%	60 - 130%	74
	BR114	SE193038.014	%	60 - 130%	75
	BR115	SE193038.015	%	60 - 130%	71
	BR116	SE193038.016	%	60 - 130%	72
	BR117	SE193038.017	%	60 - 130%	71
	BR118	SE193038.018	%	60 - 130%	73
	BR119	SE193038.019	%	60 - 130%	70
	BB120	SE193038.020	%	60 - 130%	73
	BR121	SE193038.021	%	60 - 130%	76
	PP122	SE103038.021	04	60 120%	74
	DR122	SE 183030.022	70	00 - 130%	77
	BR123	SE 193038.023	%	60 - 130%	74
	BR124	SE 193038.024	%	60 - 130%	14
	BR125	SE193038.025	%	60 - 130%	11
	BR126	SE193038.026	%	60 - 130%	74
	BR127	SE193038.027	%	60 - 130%	78
	BR128	SE193038.028	%	60 - 130%	72
	BR129	SE193038.029	%	60 - 130%	73
	DA	SE193038.030	%	60 - 130%	78
	DB	SE193038.031	%	60 - 130%	74
atile Patroleum Hydrocarbons in Soil				Method: ME	
	O-mate Neme		11-24-	Celteria	(AO) [EIVV]Pa
rameter	Sample Name	Sample Number	Units	Criteria	Recovery
romofluorobenzene (Surrogate)	BR101	SE193038.001	%	60 - 130%	73
	BR102	SE193038.002	%	60 - 130%	71
	BR103	SE193038.003	%	60 - 130%	71
	BR104	SE193038.004	%	60 - 130%	74
	BR105	SE193038.005	%	60 - 130%	73
	BR106	SE193038.006	%	60 - 130%	74
	BR107	SE193038.007	%	60 - 130%	74
	BB108	SE193038.008	%	60 - 130%	71
	BR109	SE193038.009	%	60 - 130%	75
	PP110	SE193038.010	94	60 - 120%	72
	BRIN	SE 193038.010	70	00 - 130%	73
	BRIII BB440	SE 193038.011	70	60 100%	73
	BRIIZ	SE193038.012	%	60 - 130%	12
	BR113	SE193038.013	%	60 - 130%	72
	BR114	SE193038.014	%	60 - 130%	73
	BR115	SE193038.015	%	60 - 130%	71
	BR116	SE193038.016	%	60 - 130%	70
	BR117	SE193038.017	%	60 - 130%	72
	BR118	SE193038.018	%	60 - 130%	75
	BR119	SE193038.019	%	60 - 130%	76
	BR120	SE193038.020	%	60 - 130%	72
		0.400,000,000,000,000,000	5.2%	261,578 (J. 1222) S	
	BR121	SE193038.021	%	60 - 130%	89



Surrogate results are evaluated against upper and lower limit criteria established in the SGS QA/QC plan (Ref: MP-(AU)-[ENV]QU-022). At least two of three routine level soil sample surrogate spike recoveries for BTEX/VOC are to be within 70-130% where control charts have not been developed and within the established control limits for charted surrogates. Matrix effects may void this as an acceptance criterion. Water sample surrogate spike recoveries are to be within 40-130%. The presence of emulsions, surfactants and particulates may void this as an acceptance criterion.

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Volatile Petroleum Hydrocarbons in Soll (continued)

Method: ME-(AU)-[ENV]AN433

Bromofluorobenzene (Surrogate) BR122 SE193038.022 % 60 - 130	
	87
BR123 SE193038.023 % 60 - 130	90
	07
	00
BR(25) SE(93036.025) 76 00-130	0 89
BR126 SE193038.026 % 60-130	87
BR127 SE193038.027 % 60-130	90
BR128 SE193038.028 % 60 - 130	86
BR129 SE193038.029 % 60 - 130'	86
DA SE193038.030 % 60-130	87
DB SE193038.031 % 60-130	87
d4-1,2-dichloroethane (Surrogate) BR101 SE193038.001 % 60 - 130	82
BR102 SE193038.002 % 60 - 130	80
BR103 SF193038.003 % 60-130	79
BP104 SE193038.004 % 60 - 130	85
	70
	70
BR106 SE193038.006 % 60-130	18
BR107 SE193038.007 % 60 - 130	82
BR108 SE193038.008 % 60 - 130	82
BR109 SE193038.009 % 60 - 130'	81
BR110 SE193038.010 % 60-130	82
BR111 SE193038.011 % 60 - 130	77
BR112 SE193038.012 % 60 - 130	79
BR113 SE193038.013 % 60 - 130	83
BR114 SE193038.014 % 60-130	85
BR115 SE193038.015 % 60-130	76
BP116 SE193038.016 % 60 - 130	79
BP117 SE10000117 % 60_100	
	00
	02
BR(19 SE193036.019 % 00-130	11
BR(20 SE193038.020 % 00-130	82
BR121 SE 193038.021 % 60 - 130	79
BR122 SE193038.022 % 60 - 130	76
BR123 SE193038.023 % 60-130	78
BR124 SE193038.024 % 60 - 130'	76
BR125 SE193038.025 % 60 - 130	i 79
BR126 SE193038.026 % 60 - 130	79
BR127 SE193038.027 % 60 - 130	81
BR128 SE193038.028 % 60 - 130	77
BR129 SE193038.029 % 60-130	76
DA SE193038.030 % 60-130	78
DB SE193038.031 % 60-130	76
d8-toluene (Surronate) BR101 SE193038.001 % 60 - 130	71
	91
	01
	01
	04
BR105 SE193038.005 % 60 - 130	13
BR106 SE193038.006 % 60-130	0
BR107 SE193038.007 % 60 - 130	92
BR108 SE193038.008 % 60-130	73
BR109 SE193038.009 % 60 - 130	72
BR110 SE193038.010 % 60 - 130	81
BR111 SE193038.011 % 60 - 130	112
BR112 SE193038.012 % 60 - 130	73
BR113 SE193038.013 % 60 - 130	110
BR114 SE193038.014 % 60-130	84
BR115 SE193038.015 % 60 - 130	72
BR116 SF193038.016 % 60 - 130	73
BP117 SE10000017 04 60 100	70
BP110 CE1000011 // 0 00-150	74
Divito 35130050.010 % 001-130 DD110 0513000.010 % 01-130	70
	70
DN120 SE193038.020 % 60-130	/0



Surrogate results are evaluated against upper and lower limit criteria established in the SGS QA/QC plan (Ref: MP-(AU)-[ENV]QU-022). At least two of three routine level soil sample surrogate spike recoveries for BTEX/VOC are to be within 70-130% where control charts have not been developed and within the established control limits for charted surrogates. Matrix effects may void this as an acceptance criterion. Water sample surrogate spike recoveries are to be within 40-130%. The presence of emulsions, surfactants and particulates may void this as an acceptance criterion.

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Volatile Petroleum Hydrocarbons in Soll (continued) Method: ME-(AU)-[ENV]AN433 Parameter Sample Nur Criteria Recovery % San Uni d8-toluene (Surrogate) BR121 SE193038.021 % 60 - 130% 93 BR122 SE193038.022 % 60 - 130% 90 % BR123 SE193038.023 60 - 130% 94 **BR124** SE193038 024 % 60 - 130% 90 BR125 SE193038.025 60 - 130% 94 % % 92 BR126 SE193038.026 60 - 130% BR127 SE193038.027 % 60 - 130% 94 BR128 SE193038.028 60 - 130% 88 % BR129 % 90 SE193038.029 60 - 130% DA SE193038.030 % 60 - 130% 88 SE193038.031 60 - 130% 90 DB % BR101 % 74 Dibromofluoromethane (Surrogate) SE193038.001 60 - 130% BR102 SE193038.002 % 60 - 130% 72 BR103 SE193038.003 60 - 130% 71 % % 71 BR104 SE193038.004 60 - 130% BR105 SE193038 005 % 60 - 130% 73 BR106 SE193038.006 60 - 130% 71 % % 73 BR107 SE193038.007 60 - 130% BR108 SE193038.008 % 60 - 130% 74 BR109 SE193038.009 % 60 - 130% 73 % 73 BR110 SE193038.010 60 - 130% BR111 SE193038.011 % 60 - 130% 73 BR112 SE193038.012 % 60 - 130% 72 % 74 BR113 SE193038.013 60 - 130% BR114 SE193038.014 % 60 - 130% 75 BR115 SE193038.015 60 - 130% 71 % % 72 BR116 SE193038.016 60 - 130% BR117 SE193038.017 % 60 - 130% 71 BR118 SE193038.018 60 - 130% 73 % % 70 BR119 SE193038.019 60 - 130% BR120 SE193038.020 % 60 - 130% 73 BR121 SE193038.021 % 60 - 130% 76 % BR122 SE193038.022 60 - 130% 74 BR123 SE193038.023 % 60 - 130% 77 BR124 SE193038.024 % 60 - 130% 74 BR125 SE193038.025 % 60 - 130% 77 BR126 SE193038.026 % 60 - 130% 74 BR127 SE193038.027 60 - 130% 78 % BR128 72 SE193038.028 % 60 - 130% BR129 SE193038 029 % 60 - 130% 73 DA SE193038.030 60 - 130% 78 % DB SE193038.031 % 60 - 130% 74



METHOD BLANKS

Blank results are evaluated against the limit of reporting (LOR), for the chosen method and its associated instrumentation, typically 2.5 times the statistically determined method detection limit (MDL).

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Mercury in Soil			Meth	od: ME-(AU)-[ENV]AN31
Sample Number	Parameter	Units	LOR	Result
LB174461.001	Mercury	mg/kg	0.05	<0.05
LB174677.001	Mercury	mg/kg	0.05	<0.05
DAU (Dolumusion: Aramatia Undragarhana) in Sol			Math	HE ALD TENDONIC
PAH (Polynuclear Aromatic Hydrocarbons) in So			Meth	DO: ME-(AU)-[ENV]AN42
Sample Number	Parameter	Units	LOR	Result
LB174356.001	Naphthalene	mg/kg	0.1	<0.1
	2-methylnaphthalene	mg/kg	0.1	<0.1
	1-methylnaphthalene	mg/kg	0.1	<0.1
	Acenaphthylene	mg/kg	0.1	<0.1
	Acenaphthene	mg/kg	0.1	<0.1
	Fluorene	mg/kg	0.1	<0.1
	Phenanthrene	mg/kg	0.1	<0.1
	Anthracene	mg/kg	0.1	<0.1
	Fluoranthene	mg/kg	0.1	<0.1
	Pyrene	mg/kg	0.1	<0.1
	Benzo(a)anthracene	mg/kg	0.1	<0.1
	Chrysene	mg/kg	0.1	<0.1
	Benzo(a)pyrene	mg/kg	0.1	<0.1
	Indeno(1,2,3-cd)pyrene	mg/kg	0.1	<0.1
	Dibenzo(ah)anthracene	mg/kg	0.1	<0.1
	Benzo(ghi)perylene	mg/kg	0.1	<0.1
	Total PAH (18)	mg/kg	0.8	<0.8
Surrogates	d5-nitrobenzene (Surrogate)	%	-	80
	2-fluorobiphenyl (Surrogate)	%	-	80
	d14-p-terphenyl (Surrogate)	%	-	80
LB174363.001	Naphthalene	mg/kg	0.1	<0.1
	2-methylnaphthalene	mg/kg	0.1	<0.1
	1-methylnaphthalene	mg/kg	0.1	<0.1
	Acenaphthylene	mg/kg	0.1	<0.1
	Acenaphthene	mg/kg	0.1	<0.1
	Fluorene	mg/kg	0.1	<0.1
	Phenanthrene	mg/kg	0.1	<0.1
	Anthracene	mg/kg	0.1	<0.1
	Fluoranthene	mg/kg	0.1	<0.1
	Pyrene	mg/kg	0.1	<0.1
	Benzo(a)anthracene	mg/kg	0.1	<0.1
	Chrysene	mg/kg	0.1	<0.1
	Benzo(a)pyrene	mg/kg	0.1	<0.1
	Indeno(1,2,3-cd)pyrene	mg/kg	0.1	<0.1
	Dibenzo(ah)anthracene	mg/kg	0.1	<0.1
	Benzo(ghi)perylene	mg/kg	0.1	<0.1
	Total PAH (18)	mg/kg	0.8	<0.8
Surrogates	d5-nitrobenzene (Surrogate)	%	-	102
	2-fluorobiphenyl (Surrogate)	%	-	94
	d14-p-terphenyl (Surrogate)	%	2	98
Total Recoverable Elements in Soil/Waste Solids	Materials by ICPOES		Method: ME-	(AU)-[ENV]AN040/AN32
Sample Number	Parameter	Units	LOR	Result
LB174460.001	Arsenic, As	ma/ka	1	<1
	Cadmium, Cd	ma/ka	0.3	<0.3
	Chromium, Cr	ma/ka	0.3	<0.3
	Copper, Cu	ma/ka	0.5	<0.5
	Nickel, Ni	ma/ka	0.5	<0.5
	l ead. Pb	ma/ka	1	<1
	Zinc. Zn	ma/ka	2	<2.0
L B174676.001	Arsenic. As	marka	1	1
	Cadmium Cd	malka	03	<0.3
	Chromium Cr	malka	0.3	<0.3
		mg/kg	0.5	<0.5
	Nickel Ni	mg/kg	0.5	-0.0
		тд/кд	0.0	-0.5
	Lead, MD	mg/kg	1	<1



METHOD BLANKS

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Result is shown in Green when within suggested criteria or Red with an appended dagger symbol (†) when outside suggested criteria.

Total Recoverable E	lements in Soil/Waste Solids/Mat	erials by ICPOES (continued)		Method: ME-	(AU)-[ENV]AN040/AN320
Sample Number		Parameter	Units	LOR	Result
LB174676.001		Zinc, Zn	mg/kg	2	<2.0
TRH (Total Recovera	able Hydrocarbons) in Soil			Meth	od: ME-(AU)-[ENV]AN403
Sample Number		Parameter	Units	LOR	Result
LB174356.001		TRH C10-C14	mg/kg	20	<20
		TRH C15-C28	mg/kg	45	<45
		TRH C29-C36	mg/kg	45	<45
		TRH C37-C40	mg/kg	100	<100
		TRH C10-C36 Total	mg/kg	110	<110
LB174363.001		TRH C10-C14	mg/kg	20	<20
		TRH C15-C28	mg/kg	45	<45
		TRH C29-C36	mg/kg	45	<45
		TRH C37-C40	mg/kg	100	<100
		TRH C10-C36 Total	mg/kg	110	<110
VOC's in Soil				Meth	od: ME-(AU)-[ENV]AN433
Sample Number		Parameter	Units	LOR	Result
LB174355.001	Monocyclic Aromatic	Benzene	mg/kg	0.1	<0.1
	Hydrocarbons	Toluene	mg/kg	0.1	<0.1
		Ethylbenzene	mg/kg	0.1	<0.1
		m/p-xylene	mg/kg	0.2	<0.2
		o-xylene	mg/kg	0.1	<0.1
	Polycyclic VOCs	Naphthalene	mg/kg	0.1	<0.1
	Surrogates	Dibromofluoromethane (Surrogate)	%	12	77
		d4-1,2-dichloroethane (Surrogate)	%	-	83
		d8-toluene (Surrogate)	%	-	95
		Bromofluorobenzene (Surrogate)	%	-2	71
	Totals	Total BTEX	mg/kg	0.6	<0.6
LB174362.001	Monocyclic Aromatic	Benzene	mg/kg	0.1	<0.1
	Hydrocarbons	Toluene	mg/kg	0.1	<0.1
		Ethylbenzene	mg/kg	0.1	<0.1
		m/p-xylene	mg/kg	0.2	<0.2
		o-xylene	mg/kg	0.1	<0.1
	Polycyclic VOCs	Naphthalene	mg/kg	0.1	<0.1
	Surrogates	Dibromofluoromethane (Surrogate)	%	-	78
		d4-1,2-dichloroethane (Surrogate)	%	12	79
		d8-toluene (Surrogate)	%	-	97
		Bromofluorobenzene (Surrogate)	%	-	89
	Totals	Total BTEX	mg/kg	0.6	<0.6
Volatile Petroleum H	ydrocarbons in Soil			Meth	od: ME-(AU)-[ENV]AN433
Sample Number		Parameter	Units	LOR	Result
LB174355.001		TRH C6-C9	mg/kg	20	<20
	Surrogates	Dibromofluoromethane (Surrogate)	%	-	77
		d4-1,2-dichloroethane (Surrogate)	%	-	83
		d8-toluene (Surrogate)	%	-20	95
LB174362.001		TRH C6-C9	mg/kg	20	<20
	Surrogates	Dibromofluoromethane (Surrogate)	%	-	78
		d4-1,2-dichloroethane (Surrogate)	%	-	79
		d8-toluene (Surrogate)	%	-	97



The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: MAD = 100 x SDL / Mean + LR

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

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Mercury in Soll							Meth	od: ME-(AU)-	-[ENVJAN31
Original	Duplicate		Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE193038.010	LB174461.014		Mercury	ma/ka	0.05	<0.05	< 0.05	200	0
SE193038.019	LB174461.024		Mercury	ma/ka	0.05	<0.05	<0.05	200	0
SE193038.029	LB174677.014		Mercury	mg/kg	0.05	<0.05	<0.05	200	0
			5/30/13298.5 ■1	0.00 0 0.0 0 0					
Moisture Content							Meth	od: ME-(AU)-	-[ENV]AN002
Original	Duplicate		Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE193038.010	LB174462.011		% Moisture	%w/w	0.5	17	17	36	S1
SE193038.019	LB174462.021		% Moisture	%w/w	0.5	11	11	39	3
SE193038.029	LB174678.011		% Moisture	%w/w	0.5	7.2	6.8	44	5
SE193245.006	LB174678.020		% Moisture	%w/w	0.5	15	16	36	9
PAH (Polynuclear	Aromatic Hydrocarbo	ons) in Soil					Meth	od: ME-(AU)-	-[ENV]AN42
Original	Duplicate		Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE193038.010	LB174356.014		Naphthalene	mg/kg	0.1	<0.1	<0.1	200	0
			2-methylnaphthalene	mg/kg	0.1	<0.1	<0.1	200	0
			1-methylnaphthalene	mg/kg	0.1	<0.1	<0.1	200	0
			Acenaphthylene	mg/kg	0.1	<0.1	<0.1	200	0
			Acenaphthene	mg/kg	0.1	<0.1	<0.1	200	0
			Fluorene	mg/kg	0.1	<0.1	<0.1	200	0
			Phenanthrene	mg/kg	0.1	<0.1	<0.1	200	0
			Anthracene	mg/kg	0.1	<0.1	<0.1	200	0
			Fluoranthene	mg/kg	0.1	<0.1	<0.1	200	0
			Pyrene	mg/kg	0.1	<0.1	<0.1	200	0
			Benzo(a)anthracene	mg/kg	0.1	<0.1	<0.1	200	0
			Chrysene	mg/kg	0.1	<0.1	<0.1	200	0
			Benzo(b&j)fluoranthene	mg/kg	0.1	<0.1	<0.1	200	0
			Benzo(k)fluoranthene	mg/kg	0.1	<0.1	<0.1	200	0
			Benzo(a)pyrene	mg/kg	0.1	<0.1	<0.1	200	0
			Indeno(1,2,3-cd)pyrene	mg/kg	0.1	<0.1	<0.1	200	0
			Dibenzo(ah)anthracene	mg/kg	0.1	<0.1	<0.1	200	0
			Benzo(ghi)perylene	mg/kg	0.1	<0.1	<0.1	200	0
			Carcinogenic PAHs, BaP TEQ <lor=0< td=""><td>mg/kg</td><td>0.2</td><td><0.2</td><td><0.2</td><td>200</td><td>0</td></lor=0<>	mg/kg	0.2	<0.2	<0.2	200	0
			Carcinogenic PAHs, BaP TEQ <lor=lor< td=""><td>mg/kg</td><td>0.3</td><td><0.3</td><td><0.3</td><td>134</td><td>0</td></lor=lor<>	mg/kg	0.3	<0.3	<0.3	134	0
			Carcinogenic PAHs, BaP TEQ <lor=lor 2<="" td=""><td>mg/kg</td><td>0.2</td><td><0.2</td><td><0.2</td><td>175</td><td>0</td></lor=lor>	mg/kg	0.2	<0.2	<0.2	175	0
			Total PAH (18)	mg/kg	0.8	<0.8	<0.8	200	0
		Surrogates	d5-nitrobenzene (Surrogate)	mg/kg	3	0.4	0.4	30	8
			2-fluorobiphenyl (Surrogate)	mg/kg	e	0.5	0.5	30	6
			d14-p-terphenyl (Surrogate)	mg/kg	2	0.4	0.5	30	15
SE193038.020	LB174356.025		Naphthalene	mg/kg	0.1	<0.1	<0.1	200	0
			2-methylnaphthalene	mg/kg	0.1	<0.1	<0.1	200	0
			1-methylnaphthalene	mg/kg	0.1	<0.1	<0.1	200	0
			Acenaphthylene	mg/kg	0.1	<0.1	<0.1	200	0
			Acenaphthene	mg/kg	0.1	<0.1	<0.1	200	0
			Fluorene	mg/kg	0.1	<0.1	<0.1	200	0
			Phenanthrene	mg/kg	0.1	<0.1	<0.1	200	0
			Anthracene	mg/kg	0.1	<0.1	<0.1	200	0
			Fluoranthene	mg/kg	0.1	<0.1	<0.1	200	0
			Pyrene	mg/kg	0.1	<0.1	<0.1	200	0
			Benzo(a)anthracene	ma/ka	0.1	<0.1	<0.1	200	0
			Chrysene	mg/kg	0.1	<0.1	<0.1	200	0
			Benzo(b&i)fluoranthene	ma/ka	0.1	<0.1	<0.1	200	0
			Benzo(k)fluoranthene	ma/ka	0.1	<0.1	<0.1	200	0
			Benzo(a)pyrene	ma/ka	0.1	<0.1	<0.1	200	0
			Indeno(1,2,3-cd)pyrene	ma/ka	0.1	<0.1	<0.1	200	0
			Dibenzo(ah)anthracene	ma/ka	0.1	<0.1	<0.1	200	0
			Benzo(ahi)pervlene	ma/ka	0.1	<0.1	<0.1	200	0
			Carcinogenic PAHs. BaP TEO OR=0</td <td>ma/ka</td> <td>0.1</td> <td><0.2</td> <td><0.2</td> <td>200</td> <td>0</td>	ma/ka	0.1	<0.2	<0.2	200	0
			Carcinogenic PAHs, BaP TEO OR=1 OR</td <td>malka</td> <td>0.2</td> <td><0.2</td> <td><0.2</td> <td>134</td> <td>0</td>	malka	0.2	<0.2	<0.2	134	0
			Carcinogenic PAHs, BaP TEO <i or="LOR/2</td"><td>malka</td><td>0.0</td><td><0.0</td><td><0.3</td><td>175</td><td>0</td></i>	malka	0.0	<0.0	<0.3	175	0
			Total PAH (18)	mg/kg	0.2	<0.2	<0.2	200	0
		Sumonates	d5-nitrohenzene (Surrogate)	malka	0.0	0.0	0.0	200	2
		Sunogates	do milobenzene (ourrogate)	тулу	13	0.5	0.5	30	2



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r run (r olynuciear	recinade nydrocarbi	ana) in aoir (commu					Meth	WIL-(AU)	[=140]P09420
Original	Duplicate		Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE193038.020	LB174356.025	Surrogates	2-fluorobiphenyl (Surrogate)	mg/kg	æ	0.5	0.5	30	0
			d14-p-terphenyl (Surrogate)	mg/kg	9	0.5	0.5	30	2
SE193038.031	LB174363.016		Naphthalene	mg/kg	0.1	<0.1	<0.1	200	0
			2-methylnaphthalene	mg/kg	0.1	<0.1	<0.1	200	0
			1-methylnaphthalene	mg/kg	0.1	<0.1	<0.1	200	0
			Acenaphthylene	mg/kg	0.1	<0.1	<0.1	200	0
			Acenaphthene	ma/ka	0.1	<0.1	<0.1	200	0
			Fluorene	ma/ka	0.1	<0.1	<0.1	200	0
			Phenanthrene	ma/ka	0.1	<0.1	<0.1	200	0
			Anthrasona	ma/kg	0.1	-0.1	-0.1	200	0
			Anturacene	mg/kg	0.1	<0.1	<0.1	200	0
			Fluoranmene	mg/kg	0.1	<0.1	<0.1	200	0
			Pyrene	mg/kg	0.1	<0.1	<0.1	200	0
			Benzo(a)anthracene	mg/kg	0.1	<0.1	<0.1	200	0
			Chrysene	mg/kg	0.1	<0.1	<0.1	200	0
			Benzo(b&j)fluoranthene	mg/kg	0.1	<0.1	<0.1	200	0
			Benzo(k)fluoranthene	mg/kg	0.1	<0.1	<0.1	200	0
			Benzo(a)pyrene	mg/kg	0.1	<0.1	<0.1	200	0
			Indeno(1,2,3-cd)pyrene	mg/kg	0.1	<0.1	<0.1	200	0
			Dibenzo(ah)anthracene	mg/kg	0.1	<0.1	<0.1	200	0
			Benzo(ghi)perylene	mg/kg	0.1	<0.1	<0.1	200	0
			Carcinogenic PAHs, BaP TEQ <lor=0< td=""><td>mg/kg</td><td>0.2</td><td><0.2</td><td><0.2</td><td>200</td><td>0</td></lor=0<>	mg/kg	0.2	<0.2	<0.2	200	0
			Carcinogenic PAHs, BaP TEQ <lor=lor< td=""><td>ma/ka</td><td>0.3</td><td><0.3</td><td><0.3</td><td>134</td><td>0</td></lor=lor<>	ma/ka	0.3	<0.3	<0.3	134	0
			Carcinogenic PAHs, BaP TEQ <i 2<="" or="" td=""><td>ma/ka</td><td>0.2</td><td><0.2</td><td><0.2</td><td>175</td><td>0</td></i>	ma/ka	0.2	<0.2	<0.2	175	0
			Total PAH (18)	ma/ka	0.8	<0.8	<0.8	200	0
		Surrogator	dE pitrobonzono (Surrogato)	mg/kg	0.0	0.5	0.5	200	0
		Sunogates	2 fluorobiobond (Surrogate)	mg/kg		0.0	0.5	20	5
			2-huorobiphenyi (Surrogate)	mg/kg		0.4	0.5	30	0
			a 14-p-terprienyi (Suriogate)	ing/kg	-	0.5	0.5	30	U
Total Recoverable	Elements in Soil/Wa	ste Solids/Materials	s by ICPOES				Method: ME-	(AU)-[ENV]A	N040/AN320
Original	Duplicate		Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE193038.010	LB174460.014		Arsenic, As	mg/kg	1	4	3	59	17
			Cadmium, Cd	mg/kg	0.3	<0.3	<0.3	200	0
			Chromium. Cr	ma/ka	0.3	44	49	31	10
			Copper Cu	ma/ka	0.5	22	22	32	2
			Nickel Ni	ma/ka	0.5	27	28	32	5
			Lead Ph	ma/ka	1	7	7	45	1
			Zine Zn	mg/kg	2	40	20	-15	0
05100000 010	10171100.001			ing/kg	Z	42	36	30	9
SE193038.019	LB1/4460.024		Arsenic, As	mg/kg	1	4	4	55	1
			Cadmium, Cd	mg/kg	0.3	<0.3	<0.3	200	0
			Chromium, Cr	mg/kg	0.3	29	30	32	3
			Copper, Cu	mg/kg	0.5	15	15	33	6
			Nickel, Ni	mg/kg	0.5	16	17	33	5
			Lead, Pb	mg/kg	1	7	8	44	11
			Zinc, Zn	mg/kg	2	25	26	38	5
SE193038.029	LB174676.014		Arsenic, As	mg/kg	1	4	3	59	51
			Cadmium, Cd	mg/kg	0.3	<0.3	<0.3	200	0
			Chromium, Cr	ma/ka	0.3	16	14	33	15
			Copper, Cu	ma/ka	0.5	7.0	6.0	38	16
			Nickel Ni	ma/ka	0.5	11	50	36	74 @
			Lead Ph	mg/kg	1	5	5.0	51	140
			Zine 7.	mg/kg	2	10	10	41	10
05100015 000	10171070.000		Zinc, Zh	mg/kg	2	19	10	41	19
SE 193245.006	LB1/46/6.023		Zinc, Zh	mg/kg	2	210	220	31	4
TRH (Total Recov	rerable Hydrocarbons) in Soil					Meth	od: ME-(AU)-	[ENV]AN40:
Original	Duplicate		Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE193038 010	LB174356 014		TBH C10-C14	ma/ka	20	41	45	77	9
0210000010	10174000.014		TRH C15_C28	mg/kg	20	120	100	66	14
				під/кд	40	100	120	00	14
			TDU 007 040	mg/кg	45	89	82	83	8
			TRH C37-C40	mg/kg	100	<100	<100	200	0
			TRH C10-C36 Total	mg/kg	110	260	240	/3	8
			11311 (*10 C40 Total (Elbordo)	malka	210	220	-210	120	6
			TRH C10-C40 Total (F ballus)	Шулку	210	220	~210	130	U



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THE TOTAL PORT PORCOV	orable riyaroodroons	y in our (continued)				_	IVICITI		Frank harde
Original	Duplicate		Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE193038.010	LB174356.014	TRH F Bands	TRH >C10-C16 - Naphthalene (F2)	mg/kg	25	74	84	62	13
			TRH >C16-C34 (F3)	mg/kg	90	150	110	98	27
			TRH >C34-C40 (F4)	mg/kg	120	<120	<120	200	0
SE193038.020	LB174356.025		TRH C10-C14	mg/kg	20	<20	<20	200	0
			TRH C15-C28	mg/kg	45	<45	<45	200	0
			TRH C29-C36	mg/kg	45	<45	<45	200	0
			TRH C37-C40	mg/kg	100	<100	<100	200	0
			TRH C10-C36 Total	mg/kg	110	<110	<110	200	0
			TRH C10-C40 Total (F bands)	mg/kg	210	<210	<210	200	0
		TRH F Bands	TRH >C10-C16	mg/kg	25	<25	<25	200	0
			TRH >C10-C16 - Naphthalene (F2)	mg/kg	25	<25	<25	200	0
			TRH >C16-C34 (F3)	mg/kg	90	<90	<90	200	0
			TRH >C34-C40 (F4)	mg/kg	120	<120	<120	200	0
SE193038.031	LB174363.016		TRH C10-C14	mg/kg	20	<20	<20	200	0
			TRH C15-C28	mg/kg	45	<45	<45	200	0
			TRH C29-C36	mg/kg	45	<45	<45	200	0
			TRH C37-C40	mg/kg	100	<100	<100	200	0
			TRH C10-C36 Total	mg/kg	110	<110	<110	200	0
			TRH C10-C40 Total (F bands)	mg/kg	210	<210	<210	200	0
		TRH F Bands	TRH >C10-C16	mg/kg	25	<25	<25	200	0
			TRH >C10-C16 - Naphthalene (F2)	mg/kg	25	<25	<25	200	0
			TRH >C16-C34 (F3)	mg/kg	90	<90	<90	200	0
			TRH >C34-C40 (F4)	mg/kg	120	<120	<120	200	0
VOC's in Soil							Moth	od: ME (ALD	TENN/IAN/I3
VOC 5 11 301	-		-				NUCL I	ou. IVIL-(HO)	Trian braato
Original	Duplicate	The second second second	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE193038.010	LB174355.014	Monocyclic	Benzene	mg/kg	0.1	<0.1	<0.1	200	0
		Aromatic	Toluene	mg/kg	0.1	<0.1	<0.1	200	0
			Ethylbenzene	mg/kg	0.1	<0.1	<0.1	200	0
			m/p-xylene	mg/kg	0.2	<0.2	<0.2	200	0
			o-xylene	mg/kg	0.1	<0.1	<0.1	200	0
		Polycyclic	Naphthalene	mg/kg	0.1	<0.1	<0.1	200	0
		Surrogates	Dibromofluoromethane (Surrogate)	mg/kg	2	3.6	3.6	50	2
			d4-1,2-dichloroethane (Surrogate)	mg/kg	82	4.1	3.9	50	4
			d8-toluene (Surrogate)	mg/kg		4.0	3.7	50	8
			Bromofluorobenzene (Surrogate)	mg/kg	E n Lintes	3.6	3.6	50	1
		Totals	Total Xylenes	mg/kg	0.3	<0.3	<0.3	200	0
			Total BTEX	mg/kg	0.6	<0.6	<0.6	200	0
SE193038.020	LB174355.025	Monocyclic	Benzene	mg/kg	0.1	<0.1	<0.1	200	0
		Aromatic	Toluene	mg/kg	0.1	<0.1	<0.1	200	0
			Ethylbenzene	mg/kg	0.1	<0.1	<0.1	200	0
			m/p-xylene	mg/kg	0.2	<0.2	<0.2	200	0
			o-xylene	mg/kg	0.1	<0.1	<0.1	200	0
		Polycyclic	Naphthalene	mg/kg	0.1	<0.1	<0.1	200	0
		Surrogates	Dibromofluoromethane (Surrogate)	mg/kg	22	3.6	3.7	50	1
			d4-1,2-dichloroethane (Surrogate)	mg/kg	2	4.1	4.2	50	1
			d8-toluene (Surrogate)	mg/kg	5	3.8	3.6	50	5
			Bromofluorobenzene (Surrogate)	mg/kg	e	3.6	3.6	50	1
		Totals	Total Xylenes	mg/kg	0.3	<0.3	<0.3	200	0
			Total BTEX	mg/kg	0.6	<0.6	<0.6	200	0
SE193038.031	LB174362.016	Monocyclic	Benzene	mg/kg	0.1	<0.1	<0.1	200	0
		Aromatic	Toluene	mg/kg	0.1	<0.1	<0.1	200	0
			Ethylbenzene	mg/kg	0.1	<0.1	<0.1	200	0
			m/p-xylene	mg/kg	0.2	<0.2	<0.2	200	0
			o-xylene	mg/kg	0.1	<0.1	<0.1	200	0
		Polycyclic	Naphthalene	mg/kg	0.1	<0.1	<0.1	200	0
		Surrogates	Dibromofluoromethane (Surrogate)	mg/kg	2	3.7	3.7	50	2
			d4-1,2-dichloroethane (Surrogate)	mg/kg	2	3.8	4.0	50	4
			d8-toluene (Surrogate)	mg/kg		4.5	4.6	50	3
			Bromofluorobenzene (Surrogate)	mg/kg		4.3	4.4	50	2
		Totals	Total Xylenes	ma/ka	0.3	<0.3	<0.3	200	0



The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: MAD = 100 x SDL / Mean + LR

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in Green when within suggested criteria or Red with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

VOC's in Soil (con	tinued)						Meth	od: ME-(AU)-	ENVJAN433
Original	Duplicate		Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE193038.031	LB174362.016	Totals	Total BTEX	mg/kg	0.6	<0.6	<0.6	200	0
Volatile Petroleum	Hydrocarbons in So						Meth	od: ME-(AU)-	ENVJAN433
Original	Duplicate		Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE193038.010	LB174355.014		TRH C6-C10	mg/kg	25	<25	<25	200	0
			TRH C6-C9	mg/kg	20	<20	<20	200	0
		Surrogates	Dibromofluoromethane (Surrogate)	mg/kg	-	3.6	3.6	30	2
			d4-1,2-dichloroethane (Surrogate)	mg/kg		4.1	3.9	30	4
			d8-toluene (Surrogate)	mg/kg	4	4.0	3.7	30	8
			Bromofluorobenzene (Surrogate)	mg/kg	5	3.6	3.6	30	1
		VPH F Bands	Benzene (F0)	mg/kg	0.1	<0.1	<0.1	200	0
			TRH C6-C10 minus BTEX (F1)	mg/kg	25	<25	<25	200	0
SE193038.020	LB174355.025		TRH C6-C10	mg/kg	25	<25	<25	200	0
			TRH C6-C9	mg/kg	20	<20	<20	200	0
		Surrogates	Dibromofluoromethane (Surrogate)	mg/kg		3.6	3.7	30	1
			d4-1,2-dichloroethane (Surrogate)	mg/kg	9	4.1	4.2	30	1
			d8-toluene (Surrogate)	mg/kg	2	3.8	3.6	30	5
			Bromofluorobenzene (Surrogate)	mg/kg	5	3.6	3.6	30	1
		VPH F Bands	Benzene (F0)	mg/kg	0.1	<0.1	<0.1	200	0
			TRH C6-C10 minus BTEX (F1)	mg/kg	25	<25	<25	200	0
SE193038.031	LB174362.016		TRH C6-C10	mg/kg	25	<25	<25	200	0
			TRH C6-C9	mg/kg	20	<20	<20	200	0
		Surrogates	Dibromofluoromethane (Surrogate)	mg/kg		3.7	3.7	30	2
			d4-1,2-dichloroethane (Surrogate)	mg/kg	æ	3.8	4.0	30	4
			d8-toluene (Surrogate)	mg/kg	2	4.5	4.6	30	3
			Bromofluorobenzene (Surrogate)	mg/kg	8	4.3	4.4	30	2
		VPH F Bands	Benzene (F0)	mg/kg	0.1	<0.1	<0.1	200	0
			TRH C6-C10 minus BTEX (F1)	mg/kg	25	<25	<25	200	0



Method: ME-(AU)-[ENV]AN420

Laboratory Control Standard (LCS) results are evaluated against an expected result, typically the concentration of analyte spiked into the control during the sample preparation stage, producing a percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA /QC plan (Ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in Green when within suggested criteria or Red with an appended dagger symbol (†) when outside suggested criteria.

Mercury in Soll						Method: ME-(A	U)-[ENV]AN312
Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB174461.002	Mercury	mg/kg	0.05	0.17	0.2	70 - 130	85
LB174677.002	Mercury	mg/kg	0.05	0.16	0.2	70 - 130	82

PAH (Polynuclear Aromatic Hydrocarbons) in Soil

Sample Number	1	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB174356.002		Naphthalene	mg/kg	0.1	3.8	4	60 - 140	96
		Acenaphthylene	mg/kg	0.1	4.2	4	60 - 140	105
		Acenaphthene	mg/kg	0.1	3.8	4	60 - 140	95
		Phenanthrene	mg/kg	0.1	4.1	4	60 - 140	103
		Anthracene	mg/kg	0.1	3.7	4	60 - 140	93
		Fluoranthene	mg/kg	0.1	3.7	4	60 - 140	93
		Pyrene	mg/kg	0.1	3.9	4	60 - 140	97
		Benzo(a)pyrene	mg/kg	0.1	4.0	4	60 - 140	101
	Surrogates	d5-nitrobenzene (Surrogate)	mg/kg		0.4	0.5	40 - 130	80
		2-fluorobiphenyl (Surrogate)	mg/kg	-	0.4	0.5	40 - 130	86
		d14-p-terphenyl (Surrogate)	mg/kg		0.4	0.5	40 - 130	84
LB174363.002		Naphthalene	mg/kg	0.1	4.2	4	60 - 140	104
		Acenaphthylene	mg/kg	0.1	4.1	4	60 - 140	103
		Acenaphthene	mg/kg	0.1	4.5	4	60 - 140	113
		Phenanthrene	mg/kg	0.1	4.2	4	60 - 140	105
		Anthracene	mg/kg	0.1	4.2	4	60 - 140	104
		Fluoranthene	mg/kg	0.1	3.9	4	60 - 140	98
		Pyrene	mg/kg	0.1	4.3	4	60 - 140	108
		Benzo(a)pyrene	mg/kg	0.1	4.6	4	60 - 140	115
	Surrogates	d5-nitrobenzene (Surrogate)	mg/kg	528	0.5	0.5	40 - 130	100
		2-fluorobiphenyl (Surrogate)	mg/kg	-	0.5	0.5	40 - 130	92
		d14-p-terphenyl (Surrogate)	mg/kg	-	0.5	0.5	40 - 130	92
Total Recoverable	Elements in SollA	Vaste Solids/Materials by ICPOES				Method	ME-(AU)-IEN	VIAN040/AN320
Sample Number		Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
L B174460.002		Arsenic As	ma/ka	1	320	336.32	79 - 120	94
LDTI TIOUOLE		Cadmium Cd	mg/kg	03	420	416.6	69 - 131	102
		Chromium Cr	mg/kg	0.3	32	35.2	80 - 120	92
		Conner Cu	mg/kg	0.5	300	370.46	80 - 120	82
		Nickel Ni	mg/kg	0.5	170	210.88	79 - 120	82
		Lead Ph	mg/kg	1	an	107.87	79 - 120	83
		Zinc Zn	malka	2	260	301.27	80 - 121	87
L B174676 002		Arephic As	mg/kg	1	320	336 32	79 - 120	96
LBH IOTO.OOL		Cadmium Cd	marka	03	420	416.6	69 - 131	102
		Chromium Cr	mg/kg	0.3	32	35.2	80 - 120	91
		Copper Cu	mg/kg	0.5	320	370.46	80 - 120	86
		Nickel Ni	mg/kg	0.5	190	210.99	79 - 120	95
		Lead Ph	mg/kg	1	90	107.87	79 - 120	83
		Zinc Zn	mg/kg	2	270	301.27	90 - 121	90
TDU (Tatal Davis	and the later of the		ingrig	2	210	501.27		JU IS INTER REALIZON
Sample Number	erable Hydrocarbo	Decementary (Control of the control	Hurite	LOP	Decult	Eveneted	Critoria W	Deservery %
1 B174356 002	_	TRH C10-C14	Units	20	24	AD	60 - 140	oc
LD174000.002		TDU 015-014	mg/kg	20	<45	40	60 - 140	80
		TRIL C10-C20	mg/kg	45	<45 - 45	40	60 - 140	00
		TRI C23-C30	mg/kg	40	-40	40	60 - 140	33
	TRH F Dallus		mg/kg	20	-00	40	60 - 140	70
		TRH >C16-C34 (F3)	mg/kg	90	<90	40	60 - 140	78
1 0174262 002		TEL C10 C14	mg/kg	120	~120	20	60 140	05
LB1/4303.002			mg/kg	20	38	40	60 - 140	95
			mg/kg	45	×45	40	60 - 140	88
	TOULD		mg/kg	45	<45	40	60 - 140	/5
	TRH F Bands		mg/Kg	25	36	40	60 - 140	90
		1KH 2C16-C34 (F3)	mg/kg	90	<90	40	60 - 140	/8
		TBU - 624 649 (E4)	12000-00000	100	-100	00	00 110	00

Sample Number

Parameter



Laboratory Control Standard (LCS) results are evaluated against an expected result, typically the concentration of analyte spiked into the control during the sample preparation stage, producing a percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA /QC plan (Ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in Green when within suggested criteria or Red with an appended dagger symbol (†) when outside suggested criteria.

Sample Numbe	r	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB174355.002	Monocyclic	Benzene	mg/kg	0.1	1.9	2.9	60 - 140	66
	Aromatic	Toluene	mg/kg	0.1	1.8	2.9	60 - 140	63
		Ethylbenzene	mg/kg	0.1	2.2	2.9	60 - 140	76
		m/p-xylene	mg/kg	0.2	5.1	5.8	60 - 140	89
		o-xylene	mg/kg	0.1	2.4	2.9	60 - 140	82
	Surrogates	Dibromofluoromethane (Surrogate)	mg/kg	~	3.7	5	60 - 140	73
		d4-1,2-dichloroethane (Surrogate)	mg/kg	123	4.0	5	60 - 140	79
		d8-toluene (Surrogate)	mg/kg	- 29	3.6	5	60 - 140	73
		Bromofluorobenzene (Surrogate)	mg/kg	1980	4.7	5	60 - 140	94
LB174362.002	Monocyclic	Benzene	mg/kg	0.1	2.2	2.9	60 - 140	76
	Aromatic	Toluene	mg/kg	0.1	2.3	2.9	60 - 140	79
		Ethylbenzene	mg/kg	0.1	2.3	2.9	60 - 140	80
		m/p-xylene	mg/kg	0.2	4.6	5.8	60 - 140	79
		o-xylene	mg/kg	0.1	2.3	2.9	60 - 140	81
	Surrogates	Dibromofluoromethane (Surrogate)	mg/kg	1425	4.0	5	60 - 140	80
		d4-1,2-dichloroethane (Surrogate)	mg/kg	- 20	4.1	5	60 - 140	82
		d8-toluene (Surrogate)	mg/kg	100	4.9	5	60 - 140	98
		Bromofluorobenzene (Surrogate)	mg/kg		4.5	5	60 - 140	90
Volatile Petroleun	Hydrocarbons in S	Soll				1	Method: ME-(A	U)-[ENV]AN43
Sample Numbe	7	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB174355.002		TRH C6-C10	mg/kg	25	<25	24.65	60 - 140	85
		TRH C6-C9	mg/kg	20	20	23.2	60 - 140	87
	Surrogates	Dibromofluoromethane (Surrogate)	mg/kg	-	3.7	5	60 - 140	73
		d4-1,2-dichloroethane (Surrogate)	mg/kg	242	4.0	5	60 - 140	79
		d8-toluene (Surrogate)	mg/kg	- 23	3.6	5	60 - 140	73
		Bromofluorobenzene (Surrogate)	mg/kg	1752	4.7	5	60 - 140	94
	VPH F Bands	TRH C6-C10 minus BTEX (F1)	mg/kg	25	<25	7.25	60 - 140	104
LB174362.002		TRH C6-C10	mg/kg	25	<25	24.65	60 - 140	87
		TRH C6-C9	mg/kg	20	21	23.2	60 - 140	90
	Surrogates	Dibromofluoromethane (Surrogate)	mg/kg	1752	4.0	5	60 - 140	80
		d4-1,2-dichloroethane (Surrogate)	mg/kg	-	4.1	5	60 - 140	82
		d8-toluene (Surrogate)	mg/kg	249	4.9	5	60 - 140	98
		Bromofluorobenzene (Surrogate)	mg/kg	58	4.5	5	60 - 140	90
	VPH F Bands	TRH C6-C10 minus BTEX (F1)	mg/kg	25	<25	7.25	60 - 140	106



MATRIX SPIKES

Matrix Spike (MS) results are evaluated as the percentage recovery of an expected result, typically the concentration of analyte spiked into a field sub-sample during the sample preparation stage. The original sample's result is subtracted from the sub-sample result before determining the percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA/QC plan (ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in Green when within suggested criteria or Red with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

Mercury in Soll						Meth	hod: ME-(AL	J)-[ENV]AN312
QC Sample	Sample Number	Parameter	Units	LOR	Result	Original	Spike	Recovery%
SE193038.001	LB174461.004	Mercury	mg/kg	0.05	0.18	<0.05	0.2	86
SE193038.020	LB174677.004	Mercury	mg/kg	0.05	0.18	< 0.05	0.2	85

Total Recoverab	le Elements in Soil/	Waste Solids/Mater	ials by ICPOES				Method: ME	-(AU)-[ENV]	AN040/AN320
QC Sample	Sample Numbe	er	Parameter	Units	LOR	Result	Original	Spike	Recovery%
SE193038.001	LB174460.004		Arsenic, As	mg/kg	1	49	6	50	86
			Cadmium, Cd	mg/kg	0.3	50	<0.3	50	99
			Chromium, Cr	mg/kg	0.3	70	24	50	94
			Copper, Cu	mg/kg	0.5	62	13	50	98
			Nickel, Ni	mg/kg	0.5	68	20	50	95
			Lead, Pb	mg/kg	1	53	8	50	90
			Zinc, Zn	mg/kg	2	64	15	50	98
SE193038.020	LB174676.004		Arsenic, As	mg/kg	1	48	4	50	88
			Cadmium, Cd	mg/kg	0.3	49	<0.3	50	99
			Chromium, Cr	mg/kg	0.3	62	13	50	99
			Copper, Cu	mg/kg	0.5	54	3.8	50	101
			Nickel, Ni	mg/kg	0.5	55	6.4	50	98
			Lead, Pb	mg/kg	1	52	4	50	96
			Zinc, Zn	mg/kg	2	57	7.6	50	98
TRH (Total Reco	overable Hydrocarb	ons) in Soll					Met	hod: ME-(AU)-[ENV]AN403
QC Sample	Sample Numbe	er	Parameter	Units	LOR	Original	Spike	Recovery%	5
SE193038.002	LB174356.026		TRH C10-C14	mg/kg	20	<20	40	88	
			TRH C15-C28	mg/kg	45	<45	40	75	
			TRH C29-C36	mg/kg	45	<45	40	88	
			TRH C37-C40	mg/kg	100	<100	-	2	
			TRH C10-C36 Total	mg/kg	110	<110	-	5	
			TRH C10-C40 Total (F bands)	mg/kg	210	<210			
		TRH F Bands	TRH >C10-C16	mg/kg	25	<25	40	83	
			TRH >C10-C16 - Naphthalene (F2)	mg/kg	25	<25	-	2	
			TRH >C16-C34 (F3)	mg/kg	90	<90	40	73	
			TRH >C34-C40 (F4)	mg/kg	120	<120	-		
SE193038.021	LB174363.018		TRH C10-C14	mg/kg	20	<20	40	60	
			TRH C15-C28	mg/kg	45	<45	40	133	
			TRH C29-C36	mg/kg	45	<45	40	130	
			TRH C37-C40	mg/kg	100	<100			
			TRH C10-C36 Total	mg/kg	110	<110	-		
			TRH C10-C40 Total (F bands)	mg/kg	210	<210	-	-	
		TRH F Bands	TRH >C10-C16	mg/kg	25	<25	40	83	
			TRH >C10-C16 - Naphthalene (F2)	mg/kg	25	<25	-	5	
			TRH >C16-C34 (F3)	mg/kg	90	<90	40	133	
			TRH >C34-C40 (F4)	mg/kg	120	<120	-	2	
VOC's in Soil							Met	hod: ME-(AU)-[ENV]AN433
QC Sample	Sample Numbe	er	Parameter	Units	LOR	Result	Original	Spike	Recovery%
SE193038.001	LB174355.004	Monocyclic	Benzene	mg/kg	0.1	1.9	<0.1	2.9	65
		Aromatic	Toluene	mg/kg	0.1	1.8	<0.1	2.9	63
			Ethylbenzene	mg/kg	0.1	1.9	<0.1	2.9	65
			m/p-xylene	mg/kg	0.2	4.6	<0.2	5.8	79
			o-xylene	mg/kg	0.1	2.1	<0.1	2.9	71
		Polycyclic	Naphthalene	mg/kg	0.1	<0.1	<0.1		
		Surrogates	Dibromofluoromethane (Surrogate)	mg/kg		4.0	3.7	×	79
			d4-1,2-dichloroethane (Surrogate)	mg/kg	0	4.3	4.1	2	85
			d8-toluene (Surrogate)	mg/kg		4.0	3.5	5	80
			Bromofluorobenzene (Surrogate)	mg/kg		4.7	3.7		93
		Totals	Total Xylenes	mg/kg	0.3	6.7	<0.3	-	1640
			Total BTEX	mg/kg	0.6	12	<0.6	2	225
SE193038.021	LB174362.004	Monocyclic	Benzene	mg/kg	0.1	2.1	<0.1	2.9	73
		Aromatic	Toluene	mg/kg	0.1	2.2	<0.1	2.9	76

Ethylbenzene

m/p-xylene

77

76

2.2

4.4

<0.1

<0.2

2.9

5.8

0.1

0.2

mg/kg

mg/kg



MATRIX SPIKES

Matrix Spike (MS) results are evaluated as the percentage recovery of an expected result, typically the concentration of analyte spiked into a field sub-sample during the sample preparation stage. The original sample's result is subtracted from the sub-sample result before determining the percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA/QC plan (ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in Green when within suggested criteria or Red with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

V003 III 001 (00	Humboy						TTIST	iou. mic free	/ Low of Participation
QC Sample	Sample Numbe	r	Parameter	Units	LOR	Result	Original	Spike	Recovery%
SE193038.021	LB174362.004	Monocyclic	o-xylene	mg/kg	0.1	2.3	<0.1	2.9	78
		Polycyclic	Naphthalene	mg/kg	0.1	<0.1	<0.1	-	(.)
		Surrogates	Dibromofluoromethane (Surrogate)	mg/kg	14	3.8	3.8	2	76
			d4-1,2-dichloroethane (Surrogate)	mg/kg	151	4.0	4.0	3	79
			d8-toluene (Surrogate)	mg/kg		4.6	4.6	×	92
			Bromofluorobenzene (Surrogate)	mg/kg	~	4.4	4.4	8	89
		Totals	Total Xylenes	mg/kg	0.3	6.7	<0.3	2	(22)
			Total BTEX	mg/kg	0.6	13	<0.6	8	
Volatile Petroleur	m Hydrocarbons In S	Soll					Meth	od: ME-(AL)-[ENV]AN433
QC Sample	Sample Numbe	r	Parameter	Units	LOR	Result	Original	Spike	Recovery%
SE193038.001	LB174355.004		TRH C6-C10	mg/kg	25	<25	<25	24.65	82
			TRH C6-C9	mg/kg	20	<20	<20	23.2	83
		Surrogates	Dibromofluoromethane (Surrogate)	mg/kg	256	4.0	3.7	3	79
			d4-1,2-dichloroethane (Surrogate)	mg/kg		4.3	4.1		85
			d8-toluene (Surrogate)	mg/kg	~	4.0	3.5	4	80
			Bromofluorobenzene (Surrogate)	mg/kg	4	4.7	3.7	2	93
		VPH F	Benzene (F0)	mg/kg	0.1	1.9	<0.1	3	-
		Bands	TRH C6-C10 minus BTEX (F1)	mg/kg	25	<25	<25	7.25	109
SE193038.021	LB174362.004		TRH C6-C10	mg/kg	25	<25	<25	24.65	85
			TRH C6-C9	mg/kg	20	21	<20	23.2	89
		Surrogates	Dibromofluoromethane (Surrogate)	mg/kg	22	3.8	3.8	3	76
			d4-1,2-dichloroethane (Surrogate)	mg/kg		4.0	4.0		79
			d8-toluene (Surrogate)	mg/kg		4.6	4.6		92
			Bromofluorobenzene (Surrogate)	mg/kg	-	4.4	4.4	-	89
		VPH F	Benzene (F0)	mg/kg	0.1	2.1	<0.1	2	220
		Bands	TRH C6-C10 minus BTEX (F1)	ma/ka	25	<25	<25	7.25	108



The original result is the analyte concentration of the matrix spike. The Duplicate result is the analyte concentration of the matrix spike duplicate.

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: MAD = 100 x SDL / Mean + LR

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in Green when within suggested criteria or Red with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

No matrix spike duplicates were required for this job.



Samples analysed as received.

Solid samples expressed on a dry weight basis.

QC criteria are subject to internal review according to the SGS QA/QC plan and may be provided on request or alternatively can be found here: https://www.sgs.com.au/~/media/Local/Australia/Documents/Technical Documents/MP-AU-ENV-QU-022 QA QC Plan.pdf

- * NATA accreditation does not cover the performance of this service .
- ** Indicative data, theoretical holding time exceeded.
- Sample not analysed for this analyte.
- IS Insufficient sample for analysis.
- LNR Sample listed, but not received.
- LOR Limit of reporting.
- QFH QC result is above the upper tolerance.
- QFL QC result is below the lower tolerance.
- ① At least 2 of 3 surrogates are within acceptance criteria.
- ② RPD failed acceptance criteria due to sample heterogeneity.
- ③ Results less than 5 times LOR preclude acceptance criteria for RPD.
- ④ Recovery failed acceptance criteria due to matrix interference.
- (6) Recovery failed acceptance criteria due to the presence of significant concentration of analyte (i.e. the concentration of analyte exceeds the spike level).
- 6 LOR was raised due to sample matrix interference.
- O LOR was raised due to dilution of significantly high concentration of analyte in sample.
- Image: Image:
- Recovery failed acceptance criteria due to sample heterogeneity.
- IOR was raised due to high conductivity of the sample (required dilution).
- 1 Refer to Analytical Report comments for further information.

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BR116	A	14/05/2019		Х		Х		X	X				
BR117	A	14/05/2019		Х		Х		X	X				
BR118	A	14/05/2019		Х		Х		X	X				
BR119	A	14/05/2019		Х		Х		X	X				
BR120	A	14/05/2019		Х		Х		X	X				
BR121	A	14/05/2019		Х		Х		X	X				
BR122	A	14/05/2019		Х		Х		X	X				
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Sample ID	Container*	Sampling Date/Time							TRH, META		
BR125	A	14/05/2019		Х		X		Х	X		
BR126	A	14/05/2019		Х		Х		X	X		
BR127	A	14/05/2019		X		Х		X	X		
BR128	A	14/05/2019		X		Х		X	X		
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APPENDIX H – Road and Traffic Noise Assessment, Muller Acoustic Consulting

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Road Traffic Noise Assessment

Proposed Southlakes Estate Dubbo, NSW.



Prepared for: MAAS Group Properties July 2019 MAC170403RP1V01

Document Information

Road Traffic Noise Assessment

Proposed Southlakes Estate, Dubbo, NSW

Prepared for: MAAS Group Properties

Prepared by: Muller Acoustic Consulting Pty Ltd PO Box 262, Newcastle NSW 2300 ABN: 36 602 225 132 P: +61 2 4920 1833 www.mulleracoustic.com

Document ID	Status	Date	Prepared	Signed
MAC170403RP1V01	Final	11 July 2019	Oliver Muller	al

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Contents

1	INTR	ODUCTION	5	
2	NOIS	E POLICY AND GUIDELINES	7	
2	.1	DEVELOPMENT NEAR RAIL CORRIDORS AND BUSY ROADS - INTERIM GUIDELINES	7	
	2.1.1	ROAD NOISE SCREENING TEST	7	
3	NOIS	E ASSESSMENT METHODOLOGY	9	
3	.1	CALCULATION OF ROAD TRAFFIC NOISE	9	
3	.2	INDICATIVE ATTENUATION LEVELS	9	
4	RESU	JLTS	1	
4	.1	ROAD NOISE PREDICTION RESULTS	1	
5	REC	DMMENDATIONS	5	
6	DISC	USSION	9	
6	.1	ROAD NOISE AND AT DWELLING TREATMENTS	9	
7	CON	CLUSION	1	
APPENDIX A – GLOSSARY OF TERMS				
APPENDIX B – PROJECT PLANS				

APPENDIX C - CATEGORY 2 BUILDING MATERIALS





1 Introduction

Muller Acoustic Consulting Pty Ltd (MAC) has been engaged by MAAS Group Properties to prepare a Road Traffic Noise Assessment for the proposed residential Southlakes Estate subdivision (the 'project') Dubbo, NSW. The assessment has been completed to identify potential lots that may require noise attenuation measures to satisfy relevant internal noise criteria. It is acknowledged that several key aspects of this assessment are based on preliminary information which is yet to be finalised. Therefore, this report should be considered as a preliminary feasibility assessment for this stage of the development.

The assessment has been undertaken in general accordance with the following policies and guidelines:

- Environment Protection Authority (EPA) 2017, NSW Noise Policy for Industry (NPI);
- Department of Planning (DPI) 2008, Development Near Rail Corridors and Busy Roads Interim Guideline;
- Australian Standard AS 1055:2018 Acoustics Description and measurement of environmental noise — General Procedures;
- Australian Standard AS:3671-1980 Acoustics road traffic noise intrusion building site and construction; and
- Australian Standard AS 2107:2016— Acoustics Recommended design sound levels and reverberation times for building interiors.

A glossary of terms, definitions and abbreviations used in this report is provided in Appendix A.

Technical Note: The EPA's Road Noise Policy (RNP) (EPA, 2011) is designed to quantify the noise intrusion from the road network on existing receptors. As this project is related to the construction of a new subdivision, the RNP is not applicable to this assessment.





2 Noise Policy and Guidelines

2.1 Development Near Rail Corridors and Busy Roads – Interim Guidelines

Guidance for the specification of internal noise levels of habitable rooms is prescribed in Department of Planning's (DoP) Development near Rail Corridors and Busy Roads – Interim Guidelines (2008) ('the guideline').

The guideline outlines internal criterion levels for Clause 102 (Road) of the State Environmental Planning Policy (SEPP) for Infrastructure (Infrastructure SEPP):

"If the development is for the purpose of a building for residential use, the consent authority must be satisfied that appropriate measures will be taken to ensure that the following LAeq levels are not exceeded:

- in any bedroom in the building: 35 dBA at any time 10pm–7am; and
- anywhere else in the building (other than a garage, kitchen, bathroom or hallway): 40dBA at any time."

Table 3.1 of the guideline clarifies that the above noise criteria are to be determined as an LAeq(15hr) for the day and LAeq(9hr) for the night period.

The guideline assists in the planning, design and assessment of development in, or adjacent to, rail corridors and busy roads and supports the Infrastructure SEPP. The guidelines are mandatory for residential developments proposed adjacent to busy roads with an Annual Average Daily Traffic (AADT) of greater than 40,000 vehicles or for projects where traffic noise impacts are anticipated.

Traffic volumes from (Dubbo Regional Council, 2019) identified that traffic volumes for the Southern Distributor in 2055 would be approximately 5,800 vehicles per day which has been adopted for this assessment.

2.1.1 Road Noise Screening Test

Section 5.3.2 of the guideline provides screening tests for single and dual occupancy dwellings. The screening tests provide varying categories of noise control treatments for dwellings taking into consideration distance to the road and amount of traffic. The guideline presents two screen tests for a 60/70 km/hr zone and 100/110 km/hr zone that are reproduced in **Figure 1** and **Figure 2** respectively. The screening tests have been adopted in this assessment to provide guidance on building categories for the project.





Figure 1 Screen test for habitable areas of single/dual occupancy dwellings adjacent to 60/70 km/hr zones.



Screen Test 1(b) - Habitable Areas

Figure 2 Screen test for habitable areas of single/dual occupancy dwellings adjacent to 100/110 km/hr zones.



3 Noise Assessment Methodology

3.1 Calculation of Road Traffic Noise

A theoretical assessment of road traffic noise was carried out to predict levels at the future lots within the project site using the Calculation of Road Traffic Noise (CRTN) algorithm, as developed by the UK Department of Transport. This method incorporates consideration of traffic flow volume, average speed, percentage of heavy vehicles, and road gradient and includes attenuation via spherical spreading (or cylindrical in the case of a line source such as a road), soft ground, atmospheric absorption and screening from buildings or barriers. Hourly AADT distributions are required for modelling, however were not available for this assessment. Therefore, hourly flow distributions of the AADT were assumed as 80% for day and 20% for night. These are typical industry accepted proportions. Heavy traffic volumes were assumed to be 2% for both day and night periods (Dubbo Regional Council, 2019).

Table 1 summarises the calculation parameters adopted for this assessment.

Assessment Period	AADT Volume ¹	% Heavy Vehicles	Speed Limit (km/hr)
Day	4640	2	70
Night	1160	2	70

Note 1: Dubbo Regional Council, 2019.

3.2 Indicative Attenuation Levels

The Environmental Noise Management Manual (ENMM) (2001) provides a summary of indicative attenuation from standard building types. The indicative attenuation levels are summarised in **Table 2**, which provides typical performance of buildings with respect to noise reduction. A light frame residence with single glazing would be expected to provide a reduction of 20dBA from external to internal with windows closed. Where windows are closed, the fresh air requirements outlined in the Building Code of Australia are to be satisfied.

	Windows	Internal hoise reduction, dBA
All	Open	10
Light frame	Single glazed (closed)	20
Masonry	Single glazed (closed)	25

Note: Sourced from ENMM, 2001.





4 Results

4.1 Road Noise Prediction Results

The subdivision plans and indicative position of the Southern Distributor (Premise, 2019) (**Appendix B**) for the proposed project have been reviewed and incorporated into the assessment.

The initial calculation scenario for this assessment includes 'free field' predictions to day and night road noise levels. **Figure 3** and **Figure 4** presents the 'free field' noise contours for each modelled day LAeq(15hr) and night LAeq(9hr) assessment periods.









5 Recommendations

A review of modelling results identifies the Southern Distributor as a significant contributor to noise levels at several lots along the southern project boundary. Notwithstanding several lots along the southern boundary were identified to exceed the relevant internal noise criteria. Therefore, the following noise controls should be considered to ameliorate noise levels for future dwellings within the Noise Management Zone (**Figure 5** and **Figure 6**), it is noted that one or a combination of controls may be considered:

- Dwellings along the southern boundary within the of the project site should be constructed of materials that provide improved attenuation compared to standard materials; or/and
- Construction of a noise barrier or earth mound along the southern project boundary (or a combination of earth mound and barrier).

It is noted that for this assessment the location of the Southern Distributor is indicative only as the final position and alignment is still being finalised. Furthermore, the model has assumed the Southern Distributor to be situated at the existing ground level, although the final elevation may be situated within a cutting. Additionally, the model has not included attenuation associated with dwellings that will be constructed at the project site, generally the dwellings fronting the Southern Distributor will provide a level of attenuation to remaining lots within the development. Therefore, results of the modelling should be considered conservative.

As this assessment has relied on preliminary information, the precise number of exceedances may be quantified in more detail assessment at a later stage of the development and noise control measures may be specifically tailored to the project. This may include refinement of any potential barriers (including rear boundary residential fences), including specific location and optimal height. Additionally, the assessment could take into consideration the final position and elevation of the Southern Distributor along with contemporary traffic flows available.









6 Discussion

6.1 Road Noise and at Dwelling Treatments

Standard domestic glass is usually inadequate acoustically and can reduce the acoustic attenuation performance of the overall building facade. Upgrade options include thicker laminated glass or double-glazed laminated windows with an air gap between panels. The frames and air gaps should be adequately sealed to optimise noise reduction. This is especially pertinent to dwellings of two storey construction. It is recommended that for buildings where noise modelling identifies exceedances of internal noise criteria, are to be constructed adopting materials that meet (or exceed) Category 2 glazing specifications as per Appendix C of the guideline (see **Appendix C**). In particular, this includes:

 Windows/Sliding Doors: Openable with minimum 6.38mm laminated glass and full perimeter acoustic seals.

As windows must remain closed for effective noise reduction, alternative means of internal ventilation (eg air conditioning or wall ventilators) must be considered to allow windows to remain fully closed (refer to BCA requirements).





7 Conclusion

Muller Acoustic Consulting Pty Ltd has completed an assessment of potential road traffic noise impacts for the proposed residential subdivision to be established at Southlakes Estate, Dubbo, NSW. The assessment has quantified future road noise levels from the proposed Southern Distributor.

Noise predictions identified that several lots near the Southern Distributor will experience road noise levels that would exceed recommended internal noise criteria. Hence, future dwellings within the vicinity of the southern project boundary would be required to be constructed using glazing materials equivalent up to Category 2 of the guideline.

It is recommended that a more detailed assessment be completed when more contemporary data for the Southern Distributor is available. Notwithstanding, the development of the Southlakes Estate is a feasible option with respect to traffic noise emissions albeit with the inclusion of several noise control measures outlined in this report.

Therefore, based on the findings of this report, with the inclusion of several noise control measures, there are no noise related issues which would prevent Council approving the proposed project.





Appendix A – Glossary of Terms



A number of technical terms have been used in this report and are explained in Table A1.

Table A1 Gloss	sary of Terms
Term	Description
1/3 Octave	Single octave bands divided into three parts
Octave	A division of the frequency range into bands, the upper frequency limit of each band being
	twice the lower frequency limit.
ABL	Assessment Background Level (ABL) is defined in the NPI as a single figure background level
	for each assessment period (day, evening and night). It is the tenth percentile of the measured
	LA90 statistical noise levels.
Ambient Noise	The noise associated with a given environment. Typically a composite of sounds from many
	sources located both near and far where no particular sound is dominant.
A Weighting	A standard weighting of the audible frequencies designed to reflect the response of the human
	ear to noise.
dBA	Noise is measured in units called decibels (dB). There are several scales for describing noise,
	the most common being the 'A-weighted' scale. This attempts to closely approximate the
	frequency response of the human ear.
dB(Z), dB(L)	Decibels Linear or decibels Z-weighted.
Hertz (Hz)	The measure of frequency of sound wave oscillations per second - 1 oscillation per second
	equals 1 hertz.
LA10	A noise level which is exceeded 10 % of the time. It is approximately equivalent to the average
	of maximum noise levels.
LA90	Commonly referred to as the background noise, this is the level exceeded 90 % of the time.
LAeq	The summation of noise over a selected period of time. It is the energy average noise from a
	source, and is the equivalent continuous sound pressure level over a given period.
LAmax	The maximum root mean squared (rms) sound pressure level received at the microphone
	during a measuring interval.
RBL	The Rating Background Level (RBL) is an overall single figure background level representing
	each assessment period over the whole monitoring period. The RBL is used to determine the
	intrusiveness criteria for noise assessment purposes and is the median of the ABL's.
Sound power	This is a measure of the total power radiated by a source. The sound power of a source is a
level (LW)	fundamental location of the source and is independent of the surrounding environment. Or a
	measure of the energy emitted from a source as sound and is given by :
	= 10.log10 (W/Wo)
	Where : W is the sound power in watts and Wo is the sound reference power at 10-12 watts.



Source	Typical Sound Level
Threshold of pain	140
Jet engine	130
Hydraulic hammer	120
Chainsaw	110
Industrial workshop	100
Lawn-mower (operator position)	90
Heavy traffic (footpath)	80
Elevated speech	70
Typical conversation	60
Ambient suburban environment	40
Ambient rural environment	30
edroom (night with windows closed)	20
Threshold of hearing	0

Table A2 provides a list of common noise sources and their typical sound level.

Figure A1 – Human Perception of Sound







Appendix B – Project Plans





Appendix C – Category 2 Building Materials



Category No.	Building Element	Standard Constructions	sample
2	Windows/Sliding Doors	Openable with minimum 6mm monolithic glass and full perimeter acoustic seals	
	Frontage Facade	Timber Frame or Cladding Construction: 6mm fibre cement sheeting or weatherboards or plank cladding externally, 90mm deep timber stud or 92mm metal stud, 13mm standard plasterboard internally with R2 insulation in wall cavity.	
		Brick Veneer Construction: 110mm brick, 90mm timber stud frame or 92mm metal stud, minimum 50mm clearance between masonry and stud frame, 10mm standard plasterboard internally.	
		Double Brick Cavity Construction: 2 leaves of 110mm brickwork separated by 50mm gap	
	Roof	Pitched concrete or terracotta tile or metal sheet roof with sarking, 10mm plasterboard ceiling fixed to ceiling joists, R2 insulation batts in roof cavity.	
	Entry Door	40mm solid core timber door fitted with full perimeter acoustic seals	
	Floor	1 layer of 19mm structural floor boards, timber joist on piers	
		Concrete slab floor on ground	

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APPENDIX I – Aboriginal Archaeological Assessment, prepared by OzArk Environmental and Heritage Management Pty Ltd

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Environmental and Heritage Management P/L

PHOTOGRAPH OF LOT 399 DP 199356 BOUNDARY ROAD, DUBBO NSW.

ABORIGINAL ARCHAEOLOGICAL ASSESSMENT

SUBDIVISION OF LOT 399 DP 1199356 AND LOT 503 DP 1152321 BOUNDARY ROAD, DUBBO NSW

DUBBO LOCAL GOVERNMENT AREA JUNE 2015

> REPORT PREPARED BY OZARK ENVIRONMENTAL & HERITAGE MANAGEMENT PTY LTD FOR GEOLYSE PTY LTD ON BEHALF OF MAAS GROUP PROPERTIES PTY LTD

OzArk EHM

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Client	Geolyse Pty Ltd			
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Clients Representative Managing th	OzArk Person(s) Managing this Document			
Steven Guy		Phil Cameron		
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Enquiries should be addressed to OzArk Environmental & Heritage Management Pty Ltd.

Acknowledgement

OzArk acknowledge Traditional Owners of the area on which this assessment took place and pay respect to their beliefs, cultural heritage and continuing connection with the land. We also acknowledge and pay respect to the post-contact experiences of Aboriginal people with attachment to the area and to the elders, past and present, as the next generation of role models and vessels for memories, traditions, culture and hopes of local Aboriginal people.

EXECUTIVE SUMMARY

OzArk Environmental & Heritage Management (OzArk) was commissioned by Geolyse (the Client) on behalf of MAAS Group Properties (MAAS) (the Proponent) to complete an Aboriginal Heritage Assessment of Lot 399 in DP 1199356 and Lot 503 DP 1152321, Boundary Road, Dubbo NSW, to support a Development Application for the residential subdivision of this land. The Study Area encompasses approximately 140 hectares of semi-rural land comprising Lot 399 DP 1199356 and Lot 503 DP 1152321. The subdivision intends to subdivide the lot into a low-density housing development named "Keswick Estate - Hill View".

On Thursday 16th April 2015 OzArk Senior Archaeologist, Chris Lovell, conducted pedestrian and vehicular surveys across the Study Area. High amounts of vegetation prevented ground surface visibility (GSV) across the majority of the Study Area. All areas of exposure were checked for archaeological material and no new sites were recorded within the Study Area. Previously recorded site K-OS-4 (#36-1-0189) was unable to be relocated.

Recommendations concerning the Study Area are as follows:

- 1. No further archaeological investigation is warranted at site K-OS-4;
- Avoid impacts to site K-OS-4 and provide a clearly demarcated 15m buffer around the site boundaries identified in Figure 1.4 (relative to coordinates GDA94 Zone 55 653903, 6427014) to avoid inadvertent impacts during the completion of any works;
- 3. Long-term management of site K-OS-4 should entail its protection and preservation;
- 4. Should impacts to K-OS-4 be unavoidable, the area encompassing the location of the site should be cleared of vegetation to allow for better ground surface visibility followed by a targeted pedestrian survey by someone with expertise in locating and identifying Aboriginal objects;
- 5. It is recommended that Aboriginal community consultation and fieldwork participation occur during the attempted relocation of K-OS-4;
- If K-OS-4 is relocated, an Aboriginal Heritage Impact Permit (AHIP) must be sought from the OEH and Aboriginal community consultation must be undertaken. Archaeological recommendations for the AHIP application would be:
 - Under supervision of an archaeologist or trained cultural heritage monitors from the Aboriginal community, site K-OS-4 should be salvaged through surface collection of artefacts;
 - b. No program of sub-surface salvage is recommended for K-OS-4 as OzArk have assessed the site as possessing low potential for associated potential archaeological deposits;
- 7. Upon completion of salvage works, artefacts may be moved to a place of safekeeping agreed upon by Aboriginal stakeholders, or should it be elected that the artefacts be

reburied on site in an area not to be impacted, or subsequent to the completion of proposed works, the coordinates of the re-located artefacts should be recorded on AHIMS;

- 8. All land-disturbing activities must be confined to within the assessed Study Area.
- 9. Work crews involved in the initial and all subsequent ground breaking construction should be made aware of the legislative protection requirements for all Aboriginal sites and objects.
- 10. In the unlikely event that objects are encountered that are suspected to be of Aboriginal origin (including skeletal material), the Unanticipated Finds Protocol (**Appendix 2**) should be followed.
CONTENTS

1	Intr	rodu	ction	.1		
	1.1	Brief Description of The Proposal				
	1.2	Stu	ıdy Area	.1		
	1.3	Pro	oposed Works	.3		
	1.4	Ba	ckground	.3		
	1.5	Re	levant Legislation	.4		
	1.	5.1	State Legislation	.4		
	1.5	5.2	Commonwealth Legislation	.6		
	1.	5.3	Applicability to the Project	.6		
	1.6	As	sessment Approach	.6		
2	The	e Aro	chaeological Assessment	.7		
	2.1	Pu	rpose and Objectives	.7		
	2.	1.1	Aboriginal Archaeological Assessment Objectives	.7		
	2.2	Da	te of Archaeological Assessment	.7		
	2.3	Ab	original Community Involvement	.7		
	2.4	Oz	Ark Involvement	.7		
	2.4	4.1	Field Assessment	.7		
	2.4	4.2	Reporting	.7		
3	Lar	ndsc	ape Context	.8		
	3.1	Το	pography	.8		
	3.2	Ge	ology and Soils	.8		
	3.3	Hy	drology	.9		
	3.4	Ve	getation	.9		
	3.5	Cli	mate1	0		
	3.6	Lai	nd–Use History and Existing Levels of Disturbance1	10		
	3.7	Co	nclusion1	1		
4	Ab	origi	nal Archaeological Background1	12		
	4.1	Eth	no-Historic Sources of Regional Aboriginal Culture1	12		
	4.2	Re	gional Archaeological Context1	13		

	4.3	Loo	al Archaeological Context	15
	4.3	3.1	Desktop Database Searches Conducted	15
	4.4	Pre	dictive Model for Site Location	16
5	Ар	plica	tion of the Due Diligence Code of Practice	18
	5.1	Inti	oduction	18
	5.2	De	fences under the NPW Regulations 2009	18
	5.3	Ap	olication of the Due Diligence Code of Practice to the Proposed Development	18
6	Re	sults	of Aboriginal Archaeological Assessment	20
	6.1	Sa	mpling Strategy and Field Methods	20
	6.2	Pro	ject Constraints	21
	6.3	Re	sults	21
	6.3	3.1	Effective Survey Coverage	21
	6.3	3.2	Aboriginal Sites Recorded	22
	6.3	3.3	Aboriginal Sites Re-located	22
	6.4	Dis	cussion	22
	6.5	As	sessment of Significance	23
	6.	5.1	Introduction	23
	6.	5.2	Assessed Significance of the Recorded Sites	24
	6.6	Lik	ely Impacts to Aboriginal Heritage from The Proposal	25
7	Ma	inag	ement and Mitigation: Aboriginal Heritage	26
	7.1	Ge	neral Principles for the Management of Aboriginal Sites	26
	7.2	Ма	nagement and Mitigation of Recorded Aboriginal Sites	26
8	Re	com	mendations	28
	8.1	Ab	original Heritage	28
	Sear	rch F	Results	37
	AHI	NS S	Site Cards	38

FIGURES

Figure 1.1: Location map and Study Area	1
Figure 1.2: Aerial view of the Study Area in relation to Dubbo township	2
Figure 1.3: Aerial view of the Study Area	2
Figure 1.4: Location of K-OS-4 and Kelton's (1995) original location sketch showing s	site
dimensions, relative to coordinates: GDA94 Zone 55 653903, 6427014	4
Figure 3.1: Michell's landscapes classification of the Study Area	9
Figure 3.2: Aerial view of Study Area	10
Figure 4.1: Location of AHIMS sites within the search area	16
Figure 6.1: Vehicular and pedestrian survey transects of the Study Area and associated sur	vey
units	20
Figure 8.1: Map showing the locations of photographs taken within the Study Area	32

TABLES

Table 4-1: Desktop-Database Search Results	15
Table 4-2: AHIMS Site Types and Frequencies.	15
Table 6-1: Survey Coverage Data	22
Table 6-2: Significance Assessment	25
Table 6-3: Impact Assessment	25

PLATES

Plate 1: Photograph from location 1 (see Figure 8.1) – area of low archaeological potential
inanceted during vehicle transport
Inspected during vehicle transect
Plate 2: Photograph from location 2 (see Figure 8.1) - area of low archaeological potential
inspected during vehicle transect
Plate 3: Photograph from location 3 (see Figure 8.1) - area of low archaeological potential
inspected during vehicle transect
Plate 4: Photograph from location 4 (see Figure 8.1) - view to the southeast toward survey unit
1, hilltop / ridge top
Plate 5: Photograph from location 5 (see Figure 8.1) - survey unit 1, hilltop / ridge top
Plate 6: Photograph from location 6 (see Figure 8.1) - survey unit 1, hilltop / ridge top, view to
the southwest toward the Macquarie River
Plate 7: Photograph from location 7 (see Figure 8.1) - survey unit 3, elevated crest adjacent to
Eulomogo Creek waterway

viii

Plate 8: Photograph from location 8 (see Figure 8.1) – survey unit 2, Eulomogo Creek waterwa	<i>y</i>
	6
Plate 9: Photograph location 9 (see Figure 8.1) – survey unit 4, gentle slope encompassing sit	te
K-OS-4	6

APPENDICES

Appendix 1: AHIMS Desktop Database Search	37
Appendix 2: Unanticipated Finds Protocol	44

1 INTRODUCTION

1.1 BRIEF DESCRIPTION OF THE PROPOSAL

OzArk Environmental and Heritage Management (OzArk) have been engaged by Geolyse (the Client), on behalf of MAAS Property Group (the Proponent) to complete an Aboriginal archaeological assessment at the site of a proposed subdivision of approximately 140 hectares of semi-rural land (Lot 399 DP 1199356 and Lot 503 DP 1152321) located on Boundary Road, Dubbo) within the Dubbo Local Government Area (LGA) into a low-density housing development (see **Figure 1.1**).



Figure 1.1: Location map and Study Area.

1.2 STUDY AREA

The Study Area includes an area of ca. 140 hectares encompassing Lot 399 of DP 1199356 and Lot 503 DP 1152321, Boundary Road, Dubbo NSW (**Figure 1.2** and **Figure 1.3**). The Study Area is situated on the south eastern outskirts of Dubbo township adjacent to Boundary Road and Hennessy Drive. The northern, eastern and southern boundaries adjoin low intensity agricultural properties and the western boundary is adjacent to a large construction site encompassing a new residential housing development. A drainage easement runs from the southwest to northeast corner of the Study Area following an ephemeral secondary drainage line. This area is omitted from the current assessment.



Figure 1.2: Aerial view of the Study Area in relation to Dubbo township

Figure 1.3: Aerial view of the Study Area



1.3 PROPOSED WORKS

The Proponent is preparing a Development Application for the residential subdivision of Lot 399 in DP 1199356, Boundary Road, Dubbo NSW. The Proponent seeks to subdivide 140 hectares of semi-rural land into a low-density housing development named "Keswick Estate - Hill View". For the purpose of this report, the proposed subdivision will be assessed as causing total destruction to the environment within the Study Area.

1.4 BACKGROUND

Archaeological field surveys of Lot 399 DP 1199356 and Lot 503 DP 1152321 were conducted by Jim Kelton and Matthew Delaney of West Central Archaeological Services between the 17th and 19th July 1995 for the then proposed "Keswick housing subdivision" (Kelton 1995:1). One Aboriginal site was identified and recorded within the current Study Area: open artefact scatter site K-OS-4 (#36-1-0189), described as a 240m x 50m (i.e. 12,000m²) scatter of between 50 and 100 stone artefacts within a heavily disturbed cultivation paddock (Kelton 1995:40-42) – see **Figure 1.4**. Site integrity was considered to be extremely low due to high levels of past disturbance concomitant with intensive agricultural activities since the late nineteenth century. Seven artefacts were recorded including bifacially knapped basalt axe blank, three 'multipurpose hammerstones' and quartzite and chert flakes or flaked pieces. The site was accorded low scientific and educational significance due to the high level of disturbance and scarcity of surface material. Kelton (1995:50) recommended that impacts to site K-OS-4 be avoided, if possible, and that a 15m buffer zone be established around the identified site boundary – see **Figure 1.4**.





1.5 RELEVANT LEGISLATION

Cultural heritage is managed by a number of state and national acts. Baseline principles for the conservation of heritage places and relics can be found in the *Burra Charter* (Australia ICOMOS 2013). The *Burra Charter* has become the standard of best practice in the conservation of heritage places in Australia, and heritage organisations and local government authorities have incorporated the inherent principles and logic into guidelines and other conservation planning documents. The *Burra Charter* generally advocates a cautious approach to changing places of heritage significance. This conservative notion embodies the basic premise behind legislation designed to protect our heritage, which operates primarily at a state level.

A number of Acts of parliament provide for the protection of heritage at various levels of government.

1.5.1 State Legislation

Environmental Planning and Assessment Act 1979 (EP&A Act)

The EP&A Act establishes requirements relating to land use and planning. The framework governing environmental and heritage assessment in NSW is contained within the following parts of the Act:

- Part 4: Local government development assessments, including heritage. May include schedules of heritage items;
- Part 4.1: Approvals process for state significant development;
- **Part 5**: Environmental impact assessment on any heritage items which may be impacted by activities undertaken by a state government authority or a local government acting as a self-determining authority; and
- Part 5.1: Approvals process for state significant infrastructure.

National Parks and Wildlife Act 1974 (NPW Act)

Amended during 2010, the NPW Act provides for the protection of Aboriginal objects (sites, objects and cultural material) and Aboriginal places. Under the Act (S.5), an Aboriginal object is defined as: any deposit, object or material evidence (not being a handicraft for sale) relating to indigenous and non-European habitation of the area that comprises NSW, being habitation both prior to and concurrent with the occupation of that area by persons of European extraction, and includes Aboriginal remains.

An Aboriginal place is defined under the NPW Act as an area that has been declared by the Minister administering the Act as a place of special significance for Aboriginal culture. It may or may not contain physical Aboriginal objects.

As of 1 October 2010, it is an offence under Section 86 of the NPW Act to 'harm or desecrate an object the person knows is an Aboriginal object'. It is also a strict liability offence to 'harm an Aboriginal object' or to 'harm or desecrate an Aboriginal place', whether knowingly or unknowingly. Section 87 of the Act provides a series of defences against the offences listed in Section 86, viz.:

- The harm was authorised by and conducted in accordance with the requirements of an Aboriginal Heritage Impact Permit (AHIP) under Section 90 of the Act;
- The defendant exercised 'due diligence' to determine whether the action would harm an Aboriginal object; or
- The harm to the Aboriginal object occurred during the undertaking of a 'low impact activity' (as defined in the regulations).

Under Section 89A of the Act, it is a requirement to notify the OEH Director-General of the location of an Aboriginal object. Identified Aboriginal items and sites are registered on AHIMS.

1.5.2 Commonwealth Legislation

Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act)

Amendments in 2003 established the National Heritage List and the Commonwealth Heritage List, both administered by the Commonwealth Department of the Environment. Ministerial approval is required under the EPBC Act for proposals involving significant impacts to National/Commonwealth heritage places.

1.5.3 Applicability to the Project

The current project will be assessed under Part 4 of the EP&A Act. Any Aboriginal sites within the Study Area are afforded legislative protection under the NPW Act. There are no Commonwealth or National heritage listed places within the Study Area, and as such, the EPBC Act does not apply.

1.6 ASSESSMENT APPROACH

The current assessment will blend use of the *Due Diligence Code of Practice for the Protection* of Aboriginal Objects in New South Wales (DECCW 2010b) and the *Code of Practice for the Investigation of Aboriginal Objects in New South Wales* (DECCW 2010a).

The current assessment will apply *Due Diligence* (DECCW 2010b) to those portions of the Study Area to which it is determined appropriate based on levels of prior disturbance, and ensure that those areas which require further investigation as per the *Code of Practice for the Investigation of Aboriginal Objects in New South Wales* (DECCW 2010a) are examined as such.

2 THE ARCHAEOLOGICAL ASSESSMENT

2.1 PURPOSE AND OBJECTIVES

The purpose of the current study is to identify and assess heritage constraints relevant to the proposed works.

2.1.1 Aboriginal Archaeological Assessment Objectives

The current assessment will apply the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (DECCW 2010b) and/or the *Code of Practice for the Investigation of Aboriginal Objects in New South Wales* (DECCW 2010a), in the completion of an Aboriginal archaeological assessment, in order to meet the following objectives:

<u>Objective One</u> :	Relocate previously recorded site K-OS-4 (#36-1-0189) in order to
	assess and record its current status and distribution;
<u>Objective Two</u> :	Identify and record Aboriginal objects, sites and sensitive landforms within the Study Area;
<u>Objective Three</u> :	Assess the likely impacts of the proposed works to any recorded sites and provide management recommendations.

2.2 DATE OF ARCHAEOLOGICAL ASSESSMENT

The fieldwork component of this assessment was undertaken by OzArk on Thursday 16th April 2015.

2.3 ABORIGINAL COMMUNITY INVOLVEMENT

At the request of the Proponent, Aboriginal community consultation was not undertaken as part of this study.

2.4 OZARK INVOLVEMENT

2.4.1 Field Assessment

The fieldwork component of the current project was undertaken by:

- Fieldwork Director: Phil Cameron (BSc, Ass Dip App Sci, MECANSW, Macquarie University); and
- Archaeologist: Chris Lovell (PhD, BA [Hons], BSc, University of Queensland).

2.4.2 Reporting

The reporting component of the current project was undertaken by:

- Report Author: Dr Chris Lovell (PhD, BA [Hons], BSc, University of Queensland); and
- Reviewer: Dr Jodie Benton (PhD, BA [Hons], BSc, University of Sydney);

3 LANDSCAPE CONTEXT

An understanding of the environmental contexts of a Study Area is requisite in any Aboriginal archaeological investigation (DECCW 2010a). It is a particularly important consideration in the development and implementation of survey strategies for the detection of archaeological sites. In addition, natural geomorphic processes of erosion and/or deposition, as well as humanly activated landscape processes, influence the degree to which these material culture remains are retained in the landscape as archaeological sites; and the degree to which they are preserved, revealed and/or conserved in present environmental settings.

3.1 TOPOGRAPHY

Low hills with long slopes characterise the locality. The Study Area is located on the undulating plain above the Macquarie River floodplain at approximately 280m Australian Height Datum (AHD) in the north to 270m AHD in the south of the property. The Study Area comprises mostly elevated floodplain terraces, with some low to mid slopes and terraces (average slope < 20°) of adjacent low volcanic and sandstone hills, and some upper slopes and ridge lines of adjacent hills with slopes between zero and 45° (Kelton 1995:2).

3.2 GEOLOGY AND SOILS

Mitchell's landscapes classification suggests the Study Area falls predominantly within the Goonoo Slopes (Figure 3.1) characterised by: extensive undulating to stepped low hills with long slopes on sub-horizontal Triassic/Jurassic quartz sandstone, conglomerates, siltstone, shale and some coal; and stony yellow earths with sandstone outcrop on ridgelines to yellow harsh texture-contrast soils in shallow valleys (Mitchell 2002). The northern tip of the Study Area is within Dubbo Basalts, and the southern portion falls within the Macquarie Alluvial Plains. Volcanic rock outcrops dominated by basalts of various textures occur in the northeastern corner of the study area.



Figure 3.1: Michell's landscapes classification of the Study Area

3.3 HYDROLOGY

The Study Area is located within the Talbragar Valley sub region of the Central West Catchment Management Area (CMA) situated within the larger Brigalow Belt South Bioregion (BBSB) (Thackway and Cresswell 1995). Eulomogo creek intercepts the south-eastern portion of the Study Area. Two small dams exist on the northern portion of the Study Area. All surface water drains south into adjoining disturbed agricultural land, then into the Macquarie River approximately 1.2 kilometres to the south.

3.4 VEGETATION

Grey Box (*Eucalytpus microcarpa*), Yellow Box (*E. melliodora*) and Rough-barked Apple (*Angophora floribunda*) occur on valley floors, while River Red Gum (*E. camaldulensis*) lines the Macquarie River and River Oak (*Casuarina cunninghamiana*) the tributaries. Fuzzy Box (*E. conica*) is also known to occur along foot slopes and alluvial areas near the Macquarie River. Riverine woodland vegetation has been dramatically altered since European settlement, and few isolated native trees remain in the Study Area.

3.5 CLIMATE

Based on the Köppen classification, the climate consists of a sub-humid climate with mostly hot summers and no dry season. The Study Area is located within the elevated eastern bioregion boundary area with a more temperate climate consisting of warm, rather than hot, summers. Mean annual temperatures are lower in this area than in the flatter country to the north and west. The Study Area has an average rainfall of 583.9 millimetres, which occurs throughout the year. The average maximum temperature is 33°C and the average minimum temperature 17.9°C (BOM 2015). Temperatures are considered to have been relatively stable over the past 10,000 years.

3.6 LAND-USE HISTORY AND EXISTING LEVELS OF DISTURBANCE

The Study Area is located on a disturbed relatively flat foot slope. After European occupation it was cleared and grazed, and after WW2 likely ploughed regularly in seasonally favourable conditions. Council has constructed drainage channels within the property. Apart from isolated trees, there are no relatively undisturbed vegetated areas in the Study Area. The majority of land incorporated within the Study Area and locality is subject to continued or historical agricultural practices, infrastructure provision and low density rural housing, and as such exhibits a wide range of land-use associated disturbance levels. Satellite imagery of the Subject Site (**Figure 3.2**) appears to demonstrate moderate levels of broad scale disturbance associated with agricultural land clearance for grazing and cropping. Further afield, large tracts of remnant vegetation and conservation networks occur.



Figure 3.2: Aerial view of Study Area.

11

3.7 CONCLUSION

The current Study Area includes landforms that would have provided Aboriginal people with access to resources and views over resource areas. The Eulomogo Creek waterway would have supported a wide range of plants and animals used by Aboriginal people, as would the floodplain of the Macquarie River immediately south. The elevated hills overlooking these areas, especially facing to the south and west, would have offered well-drained vantage points for Aboriginal occupation. Land use history has certainly impacted archaeological deposits over the Study Area, with prior ploughing activities, clearing and erosion causing the most damage. Clearing will have removed trees that may have held Aboriginal scars, while ploughing and erosion will have impacted occupation sites.

4 ABORIGINAL ARCHAEOLOGICAL BACKGROUND

4.1 ETHNO-HISTORIC SOURCES OF REGIONAL ABORIGINAL CULTURE

According to Tindale's (1974) map of tribal boundaries the Dubbo area falls within the northern limits of Wiradjuri country, as defined by the limits of the Wiradjuri 'tribal'/language group. Wiradjuri country is bound by Wongaibon country to the west and Wailwan country to the north. Wailwan country begins at Gilgandra, runs across to Nyngan, up the eastern side of the Bogan River to Brewarrina, across to Walgett and down to Coonabarabran. According to Horton (1994), Wiradjuri country extends somewhat further north and west to encompass Gilgandra, Nyngan and most of the Bogan River. The Wiradjuri are typically described as a large language group or tribal nation extending over a considerable area of New South Wales, comprising numerous sub-groups. Use of the term 'tribe' and the delineation of 'tribal boundaries' on maps is considered problematic, despite the fact that distinctive ethno-linguistic groups are known to exist (Bowdler 1983:22). The current report is framed in terms of to two group names used within the Dubbo region: Wiradjuri and Tubba-Gah. The Tubba-Gah comprise a local subgroup, 'clan' or mob within the larger Wirajuri entity that are historically linked to the locality encompassing the Study Area (Kelton 1995:7-8; Koettig 1985:21-22). The territory thought to have been traversed by the Tubba-Gah lies to the east of the Macquarie River, south of the Talbragar River and north of Eulomogo creek.

Little recorded information survives concerning the life of Aboriginal people in the Dubbo area following European settlement (Koettig 1985:19). The most important historical resources are the oral histories passed from parent to child by local Indigenous inhabitants. The current caretakers of this knowledge are involved in a project to record that information. When it becomes available, this resource stands to replace existing documents as the most valuable written resource describing Aboriginal cultural practices at the time of European settlement.

Early accounts of contact between European and Aboriginal people in the Macquarie River area were provided by Oxley (1820) and Sturt (1833) and later by Garnsey (1942) who was born in Dubbo in 1874. Garnsey's interest in Aboriginal cultures led him to record information gleaned from his father and from Aboriginal elders in the Dubbo area. His work remains a useful account of everyday life and religious/ceremonial practices.

According to early accounts, Tubba-Gah territory was rich in animal and plant food resources (Koettig 1985). Garnsey's (1942:6) description of camp life suggests that many activities were performed communally, for the benefit of the mob. Campsites comprised a series of bark or bush shelters arranged in a semi-circle opening to the east, arranged around a central fire, with men occupying shelters to the north, women in the centre, and children to the south. Camps moved frequently over short distances due to alterations in social relations and weather, and in response to hygiene concerns, among other factors. Longer distance movements tended to be

linked to participation in large-scale gatherings (e.g. ceremony or warfare) or alterations in resource availability. Garnsey (1942:16-23) also provides detailed descriptions of ceremonial practices related to alterations in social status and passages from infancy to adulthood. These descriptions of are a composite of various verbal accounts, the accuracy of which is difficult to ascertain. Garnsey (1942:14) suggests that the 'mob' structure began to break down during the 1890s when only older men appeared to retain the tribal markings and knowledge associated with ceremonial practice. Oral histories of traditional custodians are likely to elaborate upon and refute aspects of these early accounts.

4.2 REGIONAL ARCHAEOLOGICAL CONTEXT

Prior to 1985, no systematic archaeological studies had been undertaken in the Dubbo region. During the late nineteenth and early twentieth centuries interested locals and amateurs, including Milne and Gresser, and to a lesser extent Garnsey, recorded a number of sites and collected artefacts, contributing to the body of archaeological data available to researchers today. A number of archaeological studies have since been conducted within the Dubbo region over the last 30 years (Balme 1986; Koettig 1985; OzArk EHM 2006; Pearson 1981; Purcell 2000). These provide baseline data for placing past Aboriginal sites within a regional landscape context.

Pearson (1981) worked primarily in the Upper Macquarie region. The proximity of this area to the current Study Area, and general topographic similarities, render the findings relevant to the Dubbo region. Pearson divided the archaeological sites he recorded into two main categories: occupation sites and non-occupation sites (including grinding grooves, scarred or carved trees, ceremonial and burial sites, etc.). Analysis of site locations produced a site prediction model with occupation occurring in areas with: access to water, good drainage, level ground, adequate fuel and appropriate localised weather patterns for summer or winter occupation. Occupation sites were most frequently found on low ridge tops, creek banks, gently undulating hills and river flats and usually in open woodland vegetation (Pearson 1981:101). The location of non-occupation sites was dependent upon a variety of factors relating to site function. For instance, grinding grooves were found where appropriate sandstone outcropping occurred, as close to occupation sites as possible. The location of scarred trees displayed no obvious patterning, other than proximity to watercourses where camps were more frequently located. Pearson suggested that these patterns would differ on the drier plains to the west – towards Dubbo and beyond – where dependence upon larger, more permanent water supplies was greater.

Koettig (1985:81-82) examined evidence of Aboriginal occupation within five kilometers of Dubbo's city limits. She concluded that sites existed throughout all landscape units surveyed; artifact scatters, scarred trees and grinding grooves were the most frequently occurring site types; and that site location and size were determined by various environmental and social

factors. Of the environmental factors, proximity to water, geological formation and availability of food resources were most important. As such, her site prediction model suggested that: all site types would occur along watercourses; stone arrangements would occur most frequently on knolls or prominent landscape features; larger campsites would occur most frequent along permanent watercourses, near springs or wetlands, and small campsites could be found anywhere; scarred trees could occur anywhere, but particularly in remnant native woodland; campsites would occur where appropriate sandstone existed; quarries would occur wherever there were suitable stone sources; and shell middens would occur only along the Macquarie River.

The North-Central Rivers study undertaken by Balme (1986) examined site location in terms of preservation. Balme (1986:182) found that, other than historic impacts, site distributions were most affected by geomorphic processes affecting site preservation and leading to site exposure. In addition, there was little scope for the assessment of site chronologies as so few datable contexts had been located. Balme also concluded that sites recorded on the Aboriginal Heritage Information Management System (AHIMS) register from ethnographic accounts were unlikely to be relocated. In an assessment of the Pilliga and Goonoo State Forests, Purcell (2000) recorded 47 and 106 Aboriginal sites respectively. Purcell (2000:31) found that sites were more frequently located within alluvium landforms, demonstrating that 91.5% of sites were recorded within 200-300 meters of water.

OzArk EHM (2006) assessed Indigenous heritage resources within the Dubbo Local Government Area (LGA) to assist Dubbo City Council with planning. This study aimed to: consolidate previous surveys and assessments of Indigenous heritage; set a baseline for further study; and survey areas zoned for future expansion. Approximately 1,120 hectares of land was surveyed including two areas located within 3km west of the Study Area. During the survey, 26 new Aboriginal sites were recorded, and 8 of 12 previously recorded sites were relocated. Proportions of newly located sites by type were similar to those found in previous studies. Fewer scarred trees were found than expected, likely due to intensive agricultural practices and associated tree clearance around Dubbo city compared to the broader Dubbo LGA. No new grinding groove sites were found, which was probable given this site type comprised only 3.61% of previously located sites within the Dubbo LGA. Scarred tree distribution adhered to the predictive model, exclusively following waterways and fence-lines, although this probably reflected land clearing practices more than Indigenous site patterning. Isolated finds and open sites followed a similar pattern, largely limited to watercourse edges and elevated terraces within 500 meters of the Macquarie River and other permanent to semi-permanent waterways. No real pattern emerged in terms of site size or quality, perhaps because surface manifestations do not adequately reflect site size or complexity. Subsequently, OzArk EHM

15

(2014) undertook an archaeological assessment of Lot 710 DP 1041906 comprising approximately 15 ha, located 500m west of the present Study Area. One new open site comprising two silcrete artefacts and associated potential archaeological deposit was recorded approximately 300m from the Macquarie River.

4.3 LOCAL ARCHAEOLOGICAL CONTEXT

4.3.1 Desktop Database Searches Conducted

A desktop search was conducted on the following databases to identify any potential previouslyrecorded heritage within the Study Area. The results of this search are summarised here in **Table 4-1** and presented in detail in **Appendix 1**.

Name of Database Searched	Date of Search	Type of Search	Comment
Australian Heritage Database	28.04.15	Dubbo LGA	No places listed within Study Area
NSW Heritage Office State Heritage Register and State Heritage Inventory	28.04.15	Dubbo LGA	No places listed within Study Area
National Native Title Claims Search	28.04.15	NSW	No Native Title Claims cover the Study Area.
Office of Environment and Heritage (OEH) Aboriginal Heritage Information Management System (AHIMS);	15.04.15	10 x 10 km centred on the Study Area	26 sites within the search area. 1 site within the Study Area.
Dubbo Local Environment Plan of 2011	28.04.15	Schedule 5	No places listed within Study Area.
S170 RMS Heritage and Conservation Register	28.04.15	Western Region	No places listed within Study Area.

Table 4-1: Desktop-Database Search Results.

A search of the OEH administered AHIMS database returned 26 records for Aboriginal heritage sites within the designated search area – see **Table 4-2** and **Figure 4.1**. One site K-OS-4 (#36-1-0189) was within the Study Area.

Site Type	Number	% Frequency	
Open camp site	12	46	
Scarred tree	10	38	
Axe grinding groove	2	8	
Isolated find	2	8	
Total	26	100	

Table 4-2: AHIMS Site Types and Frequencies.



Figure 4.1: Location of AHIMS sites within the search area

4.4 PREDICTIVE MODEL FOR SITE LOCATION

Across Australia, numerous archaeological studies in widely varying environmental zones and contexts have demonstrated a high correlation between the permanence of a water source and the permanence and/or complexity of Aboriginal occupation. Site location is also affected by the availability of and/or accessibility to a range of other natural resources including: plant and animal foods; stone and ochre resources and rock shelters; as well as by their general proximity to other sites/places of cultural/mythological significance. Consequently sites tend to be found along permanent and ephemeral water sources, along access or trade routes or in areas that have good flora/fauna resources and appropriate shelter.

In formulating a predictive model for Aboriginal archaeological site location within any landscape it is also necessary to consider post-depositional influences on Aboriginal material culture. In all but the best preservation conditions very little of the organic material culture remains of ancestral Aboriginal communities survives to the present. Generally it is the more durable materials such as stone artefacts, stone hearths, shell, and some bones that remain preserved in the current landscape. Even these however may not be found in their original depositional context since these may be subject to either (a) the effects of wind and water erosion/transport - both over short and long time scales or (b) the historical impacts associated with the introduction of European farming practices including: grazing and cropping; land

17

degradation associated with exotic pests such as goats and rabbits and the installation of farm related infrastructure including water-storage, utilities, roads, fences, stockyards and residential quarters. Scarred trees may survive for up to several hundred years but rarely beyond.

The proximity of the current Study Area to major resource areas – Eulomogo Creek and the Macquarie River – makes it favourable in terms of access to food and water. The landforms that comprise much of the Study Area are elevated and relatively flat in places, offering excellent vantage to the east and south as well as providing well-drained potential camping locations. Considering these factors, and the previously recorded Aboriginal site, the likelihood of encountering evidence of Aboriginal occupation is considered high. There has, however, been a considerable amount of land use disturbance – clearing, ploughing, infrastructure installation and erosion. Disturbance is predicted to have impacted upon the presence (in the case of scarred trees) or the integrity (in the case of archaeological deposits) of any potentially occurring Aboriginal sites, as was recorded by Kelton in 1995. As such, the most likely site types to be encountered in the Study Area are predicted to be:

- Open camp sites: may be located on elevated ground, however, due to the high level of disturbance within the Study Area this site type, if present, has a high likelihood of being disturbed and/or of low integrity;
- Isolated finds: may occur anywhere, especially in disturbed locations;
- *Scarred Trees:* have a lower likelihood of occurring due to high levels of land clearance, although some individual mature trees may be present, and may bear scars;
- Axe grinding grooves: have a low likelihood of occurring given the rarity of this site type, and requirements for suitable sandstone outcropping near to occupation sites; and
- *Ceremonial sites:* do not necessarily follow landform predictability; overall a rare site type with a low likelihood of being present and remaining extant.

5 APPLICATION OF THE DUE DILIGENCE CODE OF PRACTICE

5.1 INTRODUCTION

In late 2010, changes were made to the National Parks and Wildlife Act 1974 (NPW Act 1974) via the Omnibus Bill. As of October 2010, the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW* (DECCW 2010b) was instituted to assist developers to exercise the appropriate level of caution when carrying out activities that could cause harm to Aboriginal heritage.

5.2 DEFENCES UNDER THE NPW REGULATIONS 2009

The first step before application of the Due Diligence process itself is to determine whether the proposed activity is a "low impact activity" for which there is a defence in the NPW regulations 2009. The exemptions are listed in Section 7.5 of the Regulations (DECCW 2010b:6). The activities of MAAS Group Properties do not fall into any of these exemption categories. Therefore the Due Diligence process must be applied. Relevant to this process is the assessed levels of previous land-use disturbance. The regulations (DECCW 2010b:18) define disturbed land as follows:

Land is disturbed if it has been the subject of a human activity that has changed the land's surface, being changes that remain clear and observable.

Examples include ploughing, construction of rural infrastructure (such as dams and fences), construction of roads, trails and tracks (including fire trails and tracks and walking tracks), clearing vegetation, construction of buildings and the erection of other structures, construction or installation of utilities and other similar services (such as above or below ground electrical infrastructure, water or sewerage pipelines, stormwater drainage and other similar infrastructure) and construction of earthworks.

5.3 APPLICATION OF THE DUE DILIGENCE CODE OF PRACTICE TO THE PROPOSED DEVELOPMENT

To follow the generic Due Diligence process, a series of steps in a question answer flowchart format (DECCW 2010b:10) are applied to the project impacts and Study Area and the responses documented. The following paragraphs address this due diligence for the proposed subdivision of Lot 399 DP 1199356 and Lot 503 DP 1152321 Boundary Road, Dubbo NSW.

Step 1: Will the activity disturb the ground surface or any culturally modified trees?

Yes the activity will disturb the ground. Go to Step 2.

Step 2: Are there any:

19

a) Relevant confirmed site records or other associated landscape feature information on AHIMS? and/or

b) Any other sources of information of which a person is already aware? and/or

c) Landscape features that are likely to indicate presence of Aboriginal objects?

- a) Yes (see Appendix 1).
- b) No. Aboriginal community consultation is not a formal requirement of the Due Diligence process (DECCW 2010b:3). The Proponent may wish to consider undertaking consultation to assist in informing decision-making.
- c) Landscape features noted here include (DECCW 2010b:12):
 - within 200 metres of waters, or
 - located within a sand dune system, or
 - located on a ridge top, ridge line or headland, or
 - located within 200 metres below or above a cliff face, or
 - within 20 metres of or in a cave, rock shelter, or a cave mouth

and is on land that is not disturbed land (see Section 5.2) then you must go to Step 3.

Parts of the Study Area overlap with relevant landscape features. The Proponent elected to apply the precautionary principle and proceed to visual inspection of the Project Site in order to ground-truth the findings of the above desktop level assessment.

6 RESULTS OF ABORIGINAL ARCHAEOLOGICAL ASSESSMENT

6.1 SAMPLING STRATEGY AND FIELD METHODS

Standard archaeological field survey and recording methods were employed in this study (see Burke and Smith 2004) to ground-truth existing levels of disturbance and to relocate previously recorded site K-OS-4 (#36-1-0189). A combination of vehicle and pedestrian survey were utilised (see **Figure 6.1**). Sections of the Study Area with landforms possessing archaeological potential were inspected on foot. These landscape features included: the tops of low hills or ridges (survey unit 1); a waterway i.e. Eulomogo Creek (survey unit 2); and an elevated crest adjacent to the waterway (survey unit 3). Sections of the Study Area that did not contain relevant landscape features were assessed on vehicle and intermittently on foot as a precautionary measure. In most instances, the vehicle travelled very slowly along the Study Area with frequent stops made to inspect on foot. Areas of low archaeological potential were sample surveyed, but all sections of the Study Area remained within visual range. A handheld differential GPS was utilised to relocate site K-OS-4 (#36-1-0189) as per location coordinates recorded on AHIMS and by Kelton (1995) – i.e. survey unit 4.





6.2 **PROJECT CONSTRAINTS**

There were no significant constraints in completing the assessment.

6.3 RESULTS

6.3.1 Effective Survey Coverage

Two of the key factors influencing the effectiveness of archaeological survey are ground surface visibility (GSV) and exposure. These factors are quantified in order to ensure that the survey data provides adequate evidence for the evaluation of the archaeological materials across the landscape. For the purposes of the current assessment, these terms are used in accordance with the definitions provided in the *Code of Practice* (DECCW 2010a). GSV is defined as:

... the amount of bare ground (or visibility) on the exposures which might reveal artefacts or other archaeological materials. It is important to note that visibility, on its own, is not a reliable indicator of the detectability of buried archaeological material. Things like vegetation, plant or leaf litter, loose sand, stone ground or introduced materials will affect the visibility. Put another way, visibility refers to 'what conceals' (DECCW 2010a:39).

Exposure is defined as:

... different to visibility because it estimates the area with a likelihood of revealing buried artefacts or deposits rather than just being an observation of the amount of bare ground. It is the percentage of land for which erosion and exposure was sufficient to reveal archaeological evidence on the surface of the ground. Put another way, exposure refers to 'what reveals' (DECCW 2010a:37).

GSV and exposure across the Study Area ranged from none in areas of extensive grass cover to poor within areas of exposure. Visibility and exposure ranged from <5 to 15 per cent (see **Table 6-1**). Refer to **Plates 1** to **9** for photographs of the Study Area and associated survey units.

22

Survey Unit	Landform	Survey Unit Area (sq m)	Visibility %	Exposure %	Effective Coverage Area (sq m) (≃ Survey Unit Area x Visibility % x Exposure %)	Effective Coverage % (= Effective Coverage Area / Survey Unit Area x 100)	Number of sites
1	Hilltop / ridge top	50,000	15	<5	225	0.45	0
2	Waterway	23,000	10	<5	69	0.3	0
3	Elevated crest adjacent to waterway	30,000	15	<5	135	0.45	0
4	Gentle slope	14,500	1	<5	4.35	0.03	0

Table 6-1: Survey Coverage Data.

6.3.2 Aboriginal Sites Recorded

No new Aboriginal sites were recorded during this heritage assessment.

6.3.3 Aboriginal Sites Re-located

Kelton (1995:40-42) recorded site K-OS-4 (#36-1-0189) comprising a 12,000m² open artefact scatter of between 50-100 stone artefacts, situated along the southern boundary of the Study Area – see Section 1.4 and **Figure 1.4**. Pedestrian transects were conducted in the area and constituted survey unit 4 – see Section 6.1 and **Figure 6.1**. Very low GSV and exposure existed throughout survey unit 4 due to extensive grass cover (see **Table 6-1** and **Plates 8** and **9**). As a result, site K-OS-4 was unable to be relocated during this heritage assessment.

6.4 DISCUSSION

The predictive model (see Section 4.4) suggested that the location of, and landforms within, the Study Area were favourable to Aboriginal occupation. All landforms possessing archaeological potential were inspected on foot throughout the Study Area and all areas of exposure encountered were checked for archaeological material. Despite this, no new Aboriginal sites were recorded. GSV was variable across the Study Area, but generally much higher in survey units 1-3 than in survey unit 4 (see **Table 6-1** and **Plates 1** to 7). As such, the most likely explanation for the lack of discernable archaeological material in the remainder of the Study Area (i.e. other than survey unit 4) is the high degree of land-use disturbance linked to decades of vegetation clearance, ploughing, infrastructure installation and erosion. For instance, the absence of scarred trees is certainly due to the lack of endemic trees of sufficient age for Aboriginal cultural scarring throughout the Study Area due to land clearance.

23

6.5 ASSESSMENT OF SIGNIFICANCE

6.5.1 Introduction

The appropriate management of cultural heritage items is usually determined on the basis of their assessed significance as well as the likely impacts of any proposed developments. Scientific, cultural and public significance are identified as baseline elements of significance assessment, and it is through the combination of these elements that the overall cultural heritage values of a site, place or area are resolved.

Social or Cultural Value

This area of assessment concerns the importance of a site or features to the relevant cultural group: in this case the Aboriginal community. Aspects of social value include assessment of sites, items, and landscapes that are traditionally significant or that have contemporary importance to the Aboriginal community. This importance involves both traditional links with specific areas, as well as an overall concern by Aboriginal people for their sites generally and the continued protection of these. This type of value may not be in accord with interpretations made by the archaeologist: a site may have low archaeological value but high social value, or vice versa.

Archaeological/Scientific Value

Assessing a site in this context involves placing it into a broader regional framework, as well as assessing the site's individual merits in view of current archaeological discourse. This type of value relates to the ability of a site to answer current research questions and is also based on a site's condition (integrity), content and representativeness.

The overriding aim of cultural heritage management is to preserve a representative sample of the archaeological resource. This will ensure that future research within the discipline can be based on a valid sample of the past. Establishing whether or not a site can contribute to current research also involves defining 'research potential' and 'representativeness'. Questions regularly asked when determining significance are: can this site contribute information that no other site can? Is this site representative of other sites in the region?

Aesthetic Value

This refers to the sensory, scenic, architectural and creative aspects of the place. It is often closely linked with the social values. It may consider form, scale, colour, texture and material of the fabric or landscape, and the smell and sounds associated with the place and its use (Australia ICOMOS 2013).

Historic Value

Historic value refers to the associations of a place with a historically important person, event, phase or activity in an Aboriginal community. Historic places do not always have physical evidence of their historical importance (such as structures, planted vegetation or landscape modifications). They may have 'shared' historic values with other (non-Aboriginal) communities.

Places of post-contact Aboriginal history have generally been poorly recognised in investigations of Aboriginal heritage. Consequently the Aboriginal involvement and contribution to important regional historical themes is often missing from accepted historical narratives. This means it is often necessary to collect oral histories along with archival or documentary research to gain a sufficient understanding of historic values.

6.5.2 Assessed Significance of the Recorded Sites

Social or Cultural Value

All Aboriginal sites hold significance to the local Aboriginal community in the Dubbo region, providing tangible links to the occupation of the land by their ancestors. Site K-OS-4 (#36-1-0189) was previously assessed as holding **moderate to low social or cultural value** in consultation with Aboriginal community representatives (Kelton 1995:42). As no Aboriginal community representatives were present during the current field inspection, no information was documented regarding the Aboriginal social or cultural value of the Study Area.

Archaeological/Scientific Value

Site K-OS-4 (#36-1-0189) was previously assessed as holding **low archaeological value** due to poor levels of representativeness and high levels of past disturbance yielding low site integrity (Kelton 1995:41-42). This assessment is unlikely to have been altered had the site been relocated, although significance is hard to comment on when the site cannot be found.

Aesthetic Value

Site K-OS-4 (#36-1-0189) was not previously assessed for its aesthetic value. The landscape surrounding the site has been highly modified, significantly reducing the area's aesthetic value. As such, the site likely possesses **low aesthetic value**.

Historic Value

Site K-OS-4 (#36-1-0189) was not previously assessed for its historic value. The site can be assessed as holding **low historic value**, with no apparent relationship with known historic Aboriginal sites.

The results of the significance assessment are summarised in Table 6-2.

24

Site Name	Social or Cultural Value	Archaeological / Scientific Value	Aesthetic Value	Historic Value
K-OS-4	Moderate to Low	Low	Low	Low

Table 6-2: Significance Assessment.

6.6 LIKELY IMPACTS TO ABORIGINAL HERITAGE FROM THE PROPOSAL

The final design of the proposed works has not been finalised prior to the conclusion of this report. Impacts to the Study Area will be assessed as causing total destruction to the environment within the Study Area. Under this scenario, K-OS-4 will be directly impacted and will experience total harm and total loss of value (see **Table 6-3**).

Table 6-3: Impact Assessment.

Site Name	Type of Harm	Degree of Harm	Consequence of Harm
	(Direct/Indirect / None)	(Total/Partial / None)	(Total/Partial/No Loss of Value)
K-0S-4	Direct	Total	Total

7 MANAGEMENT AND MITIGATION: ABORIGINAL HERITAGE

7.1 GENERAL PRINCIPLES FOR THE MANAGEMENT OF ABORIGINAL SITES

Appropriate management of cultural heritage items is primarily determined on the basis of their assessed significance as well as the likely impacts of the proposed development. Section 6.5.2 and Section 6.6 describe, respectively, the significance / potential of the recorded sites and the likely impacts of the development. The following management options are general principles, in terms of best practice and desired outcomes, rather than mitigation measures against individual site disturbance.

- <u>Avoid impact</u> by altering the development proposal or in this case by avoiding impact to a recorded Aboriginal site. If this can be done, then a suitable curtilage around the site must be provided to ensure its protection both during the short-term construction phase of development and in the long-term use of the area. If plans are altered, care must be taken to ensure that impacts do not occur to areas not previously assessed.
- If impact is unavoidable then approval to disturb sites must be sought from OEH and will depend on many factors including the site's assessed significance. Aboriginal community consultation will also need to occur following the OEH Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010 (ACHCRs). If granted, the local Aboriginal communities may wish to collect or relocate any evidence of past Aboriginal occupation (Aboriginal object), whether temporarily or permanently, if necessary. The fate of all artefacts remains within the statutory control of the OEH. A care and control permit may be issued to local Aboriginal groups or, with Aboriginal community consent, to other parties, for educational or display purposes.

7.2 MANAGEMENT AND MITIGATION OF RECORDED ABORIGINAL SITES

Under the current development proposal, site K-OS-4 will undergo total harm and total loss of value. It is recommended that the Proponent seek to avoid impact to any Aboriginal sites. As such, and following Kelton (1995:50), the current assessment recommends avoidance of K-OS-4 with suitable curtilage (e.g. a 15m buffer clearly demarcated) to avoid inadvertent impacts during the completion of any works within the vicinity of the site. Long-term management of the site should entail its protection and preservation.

Should impacts be deemed unavoidable, the area encompassing the location of the site should be cleared of vegetation to allow for better ground surface visibility, and a targeted pedestrian survey performed by someone with expertise in locating and identifying Aboriginal objects. Aboriginal community consultation and field participation is recommended during the attempted relocation. If K-OS-4 is relocated, an AHIP must be sought from the OEH. Archaeological recommendations for an AHIP application would be that K-OS-4 is subject to a salvage program involving the collection of surface artefacts. No program of sub-surface salvage by excavation is recommended as the site has been assessed as having low potential for associated sub-surface deposits. Artefacts may be moved to a place of safekeeping agreed upon by Aboriginal stakeholders, or should it be elected that the artefacts be reburied on site in an area not to be impacted, the coordinates of the re-located artefacts should be recorded on an Aboriginal Site Impact Recording Form (ASIRF) with AHIMS.

Beyond the management of site K-OS-4 discussed above, there are no further constraints to the proposed works on the grounds of Aboriginal cultural heritage. Should objects of suspected Aboriginal origin be uncovered during the construction phase of proposed works, the Unanticipated Finds Protocol set out in **Appendix 2** should be followed.

8 RECOMMENDATIONS

8.1 ABORIGINAL HERITAGE

Under Section 91 of the NPW Act (as amended in 1974) it is mandatory that all Aboriginal sites recorded under any auspices be registered with OEH AHIMS. As a professional in the field of cultural heritage management it is the responsibility of OzArk to ensure this process is undertaken. To this end it is noted that **no Aboriginal sites** were recorded during the assessment.

The following recommendations are made with regard to:

- Legal requirements under the terms of the NPW Act (as amended in 1974) whereby it is illegal to damage, deface or destroy an Aboriginal place or object without the prior written consent of OEH;
- The findings of the current investigations undertaken within the Study Area; and
- The interests of the Aboriginal community.

Recommendations concerning the Study Area are as follows:

- 1. No further archaeological investigation is warranted at site K-OS-4;
- Avoid impacts to site K-OS-4 and provide a clearly demarcated 15m buffer around the site boundaries identified in Figure 1.4 (relative to coordinates GDA94 Zone 55 653903, 6427014) to avoid inadvertent impacts during the completion of any works;
- 3. Long-term management of site K-OS-4 should entail its protection and preservation;
- 4. Should impacts to K-OS-4 be unavoidable, the area encompassing the location of the site should be cleared of vegetation to allow for better ground surface visibility followed by a pedestrian survey performed by someone with expertise in locating and identifying Aboriginal objects;
- 5. It is recommended that Aboriginal community consultation and fieldwork participation occur during the attempted relocation of K-OS-4;
- If K-OS-4 is relocated, an Aboriginal Heritage Impact Permit (AHIP) must be sought from the OEH and Aboriginal community consultation must be undertaken. Archaeological recommendations for the AHIP application would be:
 - Under supervision of an archaeologist or trained cultural heritage monitors from the Aboriginal community, site K-OS-4 should be salvaged through surface collection of artefacts;
 - b. No program of sub-surface salvage is recommended for K-OS-4 as OzArk have assessed the site as possessing low potential for associated potential archaeological deposits;

- 7. Upon completion of salvage works, artefacts may be moved to a place of safekeeping agreed upon by Aboriginal stakeholders, or should it be elected that the artefacts be reburied on site in an area not to be impacted, or subsequent to the completion of proposed works, the coordinates of the re-located artefacts should be recorded on AHIMS;
- 8. All land-disturbing activities must be confined to within the assessed Study Area.
- 9. Work crews involved in the initial and all subsequent ground breaking construction should be made aware of the legislative protection requirements for all Aboriginal sites and objects.
- 10. In the unlikely event that objects are encountered that are suspected to be of Aboriginal origin (including skeletal material), the Unanticipated Finds Protocol (**Appendix 2**) should be followed.

REFERENCES

Australia ICOMOS

2013 The Burra Charter: The Australia Icomos Charter for Places of Cultural Significance, 2013. In *Australia ICOMOS: International Council on Monuments and Sites* [electronic document]. Available from: http://australia.icomos.org/publications/charters/ [accessed 28th April 2015].

Balme, J.

1986 North Central Rivers Archaeological Project. Report to: National Parks and Wildlife Service, NSW.

BOM

2015 Bureau of Meteorology [website]. Available from: http://www.bom.gov.au/ [accessed 29th April 2015].

Bowdler, S.

1983 Aboriginal Sites on the Crown Timber Lands of NSW. Report to: Forestry Commission of NSW.

Burke, Heather and Claire Smith

2004 The Archaeologist's Field Handbook. Sydney: Allen & Unwin.

DECCW

- 2010a Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales. Sydney: Department of Environment, Climate Change and Water.
- 2010b Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales. Sydney: Department of Environment, Climate Change and Water.

Garnsey, E.J.

1942 A Treatise on the Aborigines of Dubbo and District: Their Camp-Life, Habits and Customs. Dubbo: Dubbo Museum and Historical Society.

Horton, David (ed.)

1994 The Encyclopaedia of Aboriginal Australia. Canberra: Aboriginal Studies Press.

Kelton, Jim

1995 An Archaeological Survey for the Proposed Keswick Housing Subdivision, Dubbo, NSW Cowra: Central West Archaeological Services.

Koettig, M.

1985 Assessment of Aboriginal Sites in the Dubbo City Area. Report to: Dubbo City Council.

Mitchell, Peter

2002 Descriptions for NSW (Mitchell) Landscapes, Version 2. Department of Environment & Climate Change. Available from: http://www.environment.nsw.gov.au/resources/conservation/landscapesdescriptions.pdf.

Oxley, J.

1820 Journals of Two Expeditions into the Interior of New South Wales: Undertaken by Order of the British Government in the Years 1817-1818. London: Murray.

OzArk EHM

2006 Aboriginal Heritage Study: Dubbo Local Government Area. Report to: Dubbo City Council.

2014 Aboriginal Archaeological Assessment: Lot 710 Dp 1041906 Hennessy Drive Subdivision, Dubbo NSW. Report to: Geolyse Pty Ltd.

Pearson, M.

1981 Seen through Different Eyes: Changing Land Use and Settlement Patterns in the Upper Macquarie River Region of NSW from Prehistoric Times to 1860. [PhD thesis] Submitted to the Department of Prehistory and Anthropology, The Australian National University.

Purcell, P.

2000 DECCW Aboriginal Cultural Heritage Assessment, Brigalow Belt South, Stage 1. Report to: Resource and Conservation Assessment Council.

Sturt, Charles

1833 *Two Expeditions into the Interior of Southern Australia*. London: Smith, Elder and Co.

Thackway, R. and D. Cresswell (eds.)

1995 An Interim Biogeographic Regionalisation for Australia: A Framework for Setting Priorities in the National Reserves System Cooperative Program. Canberra: Australian Nature Conservation Agency.

Tindale, Norman B.

1974 Aboriginal Tribes of Australia: Their Terrain, Environmental Controls, Distribution, Limits, and Proper Names. Berkeley: University of California Press.

31

PLATES



Figure 8.1: Map showing the locations of photographs taken within the Study Area

Plate 1: Photograph from location 1 (see Figure 8.1) – area of low archaeological potential inspected during vehicle transect.




Plate 2: Photograph from location 2 (see Figure 8.1) – area of low archaeological potential inspected during vehicle transect.

Plate 3: Photograph from location 3 (see Figure 8.1) – area of low archaeological potential inspected during vehicle transect.



Plate 4: Photograph from location 4 (see Figure 8.1) – view to the southeast toward survey unit 1, hilltop / ridge top.



Plate 5: Photograph from location 5 (see Figure 8.1) – survey unit 1, hilltop / ridge top.





Plate 6: Photograph from location 6 (see Figure 8.1) – survey unit 1, hilltop / ridge top, view to the southwest toward the Macquarie River.

Plate 7: Photograph from location 7 (see Figure 8.1) – survey unit 3, elevated crest adjacent to Eulomogo Creek waterway.





Plate 8: Photograph from location 8 (see Figure 8.1) – survey unit 2, Eulomogo Creek waterway

Plate 9: Photograph location 9 (see Figure 8.1) – survey unit 4, gentle slope encompassing site K-OS-4



APPENDIX 1: AHIMS DESKTOP DATABASE SEARCH

SEARCH RESULTS



AHIMS SITE CARDS

Box 1967, Hurstville NSW 2220, Tel: (02)	d Wildlife Service
Standard Site Recording Form	Revised 5/88
	NPWS Code
1:250,000 map sheet:	L HEAD OFFICE USE ONLY
250K250	K NEWS Sile po:
AMG Grid reference 653790 mE 6420	6 8 30 mN
Full reference - please	Site types:
Nr:	Accessioned by: Date:
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TE POSITION & EN	VIRONMENT	OFFICE USE ONLY: NPWS site no:
Land form a. beach	/hill slope/ridge top. etc: Flood pl	a: Flat b. site aspect: 360° c. stope: Nil
mark on diagram pro	vided or on your own sketch the positio	n of the site: e. Describe briefly:
7	rite	\bigcap
	5/11	
	and the second s	1 Gop
Local rock type:	Sandstone 9	Land use/effect: Grazing / hultion tion
Distance from drinkin	ngwater. 100 m	Source: Eulomogo Creek
Resource Zone asso	ciated with site (estuarine, riverine, lo	rest etc): Open Woodland Kiverini
Vegetation. E.	uc - dry sche	leroph U
Edible plants noted:	_ 0	701
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OU pxploitable res	ources (river pebbles, ochre, etc):	re la
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sociated artelacts.		
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brs, recognisable		
arried.		
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ne arrangements,		
ra rings, mia mias), thological sites, rock		
es, engraved groove		
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propriate	Attach annotated photos (stereo whe	ere useful) showing scale, particularly for art sites.
		1



	64 268 54
	Open Arteract Scatter Site
	Site Name / No: $K = 0S = 4$ Date: $78 / 7/95$ Grid Ref.
1.	Landform Unit: <u>Eleoaded flood</u> Plain (hill slope, ridge top, floodplain etc)
2.	Nature of deposit:
3.	Erosion - On Site: Sheet Rilling Gully
	- Environment: & Cleased - open woodlast
4	Site Exposure / Extent: 240 x 50 m. Area 2 Mal. m ² (artefacts visible)
4.	Surface Visibility (est.): <5% 5-10% 20-50% 50-70% 75-100%
5.	Present Landuse: Grazing / Cultication
6.	Type of Archaeological Store Material Material Present: Pebbles Cover, Flaker, axe, Hammer Stres
7.	Artefacts in situ ? Probatt to No because ((erosion occurring etc)
8.	Artefact Density: / artufact _/m 2 Max.
9,	Total Number of artefacts:
	Estimated Number of artefacts: 50-100 100-200 <500 >500
10.	Raw Material %s: Quarty it 80% Quarty 15%. Busalt 5476
11.	Site complex characteristics: (associated hearths, knapping floors, ST's etc)

					64	+26834	
Sit	e Nan	ne/N	0:	K- 05	4	Date	e: 18/7/45
Artefact	Dime L	nsions W	; (cm) T	Material	Colour	Cortex (%)	Comments
Hammerstone/ Pick.	135	65	34	Quatitle	Braun	99% Wate wor	Abrasia at Robble (River)
Hennestner	<i>ħ</i> 5	55	35	Questzile	Brown	992 water worr	Abrasic et opposite ents + one Edet surface
Hannustne Pick.	126	74	48	Chart	Grey/brown	80 %	Abrasin one end. Opposite and broken 2 Reg flake scors on 2 opposite and.
Axe blank/ trimmed/ Knapped	104	72	35	Basalt	Gry/black	nil	bitacial knapped.
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Flake	. 68	60	16	Chent	Grey/green	202	I reg Plake seor
Flaked P.	48	40	18	Q /3 ite	quy/brown	hil 5% (water weer)	bulk Iney Plake Sca.

APPENDIX 2: UNANTICIPATED FINDS PROTOCOL

An Aboriginal artefact is anything which is the result of past Aboriginal activity. This includes stone (artefacts, rock engravings etc.), plant (culturally scarred trees) and animal (if showing signs of modification; i.e. smoothing, use). Human bone (skeletal) remains may also be uncovered while onsite.

Cultural heritage significance is assessed by the Aboriginal community and is typically based on traditional and contemporary lore, spiritual values, and oral history, and may also take into account scientific and educational value.

Protocol to be followed in the event that previously unrecorded or unanticipated Aboriginal object(s) are encountered:

- 1. All ground surface disturbance in the area of the finds should cease immediately the finds are uncovered.
 - a) The discoverer of the find(s) will notify machinery operators in the immediate vicinity of the find(s) so that work can be halted; and
 - b) The site supervisor will be informed of the find(s).
- 2. If there is substantial doubt regarding an Aboriginal origin for the finds, then gain a qualified opinion from an archaeologist as soon as possible. This can circumvent proceeding further along the protocol for items which turn out not to be archaeological. If a quick opinion cannot be gained, or the identification is positive, then proceed to the next step.
- 3. Immediately notify the following authorities or personnel of the discovery:
 - a) OEH; and
 - b) Relevant Aboriginal Community Representatives.
- 4. Facilitate, in co-operation with the appropriate authorities and relevant Aboriginal community representatives:
 - a) The recording and assessment of the finds;
 - b) Fulfilling any legal constraints arising from the find(s). This will include complying with OEH directions; and
 - c) The development and conduct of appropriate management strategies. Strategies will depend on consultation with stakeholders and the assessment of the significance of the find(s).
- 5. Where the find(s) are determined to be Aboriginal Objects, any re-commencement of construction related ground surface disturbance may only resume in the area of the find(s) following compliance with any consequential legal requirements and gaining written approval from OEH (as required).



APPENDIX J – Employment Lands Strategy, prepared by Dubbo Regional Council

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EMPLOYMENT LANDS STRATEGY



Revision 3 Dated 2 July 2019

Contents

PAR	TONE	
-AL	OOK AT DUBBO TODAY	4
1.	Introduction	4
1.1	Snapshot of Dubbo	5
1.2	What are Employment Lands?	6
1.3	Importance of Employment Lands	6
1.4	Objectives of the Strategy	6
1.5	Relationships to other plans and policies	7
2.	Demographic Profile	11
2.1	Dubbo's existing population	11
2.2	Age Profile	12
2.3	Education	14
2.4	Income	14
2.5	Expenditure	15
З.	Employment Profile	16
3.1	Employment generation by industry	16
3.2	Employment self-sufficiency and self-	
	containment	17
3.3	Unemployment	19
3.4	Socio-economic key findings	19
4.	Commercial Centres Hierarchy	20
5.	Dubbo's existing employment lands	23
6.	Dubbo's Industrial Candidate Areas	26
6.1	Industrial Candidate Area (ICA 1) rezoning Blueridge (previously Mitchell/Eulomogo)	27
6.2	ICA 2 Airport Precinct (previously Mitchell/	
	Rosedale)	28
6.3	Industrial Candidate Area (ICA 3) rezoning	
	Brocklehurst (previously Mendooran/	
2 114	Talbragar)	29
6.4	Industrial Candidate Area (ICA 4)	20
	Yarrandale/Boothenba	30
-	E TIMO	

PART TWO – DUBBO'S GROWTH TO 2031

7.	Economic trends and drivers	31
8.	Population Projections	33
9.	Employment Projections	34
10.	Commercial Floorspace Demand Projections	35
11.	Employment Land Projections	36
11.1	Employment sector projections	36
11.2	Forecast demand for industrial zoned land	37
11.3	Forecast demand for special purpose zone	d
	land	39

PART THREE – STRATEGY AND FRAMEWORK 40

12.	Introduction	40
13.	Planning Principles	40
14.	Dubbo's Employment Land Precincts	41
14.1	Central Business District	41
14.1.1	B3 Commercial Core	41

14.1.2	B4 Mixed Use	45
14.2	Orana Mall Precinct	47
14.3	Neighbourhood Centres	49
14.3.1	Myall Street	51
14.3.2	Websdale Drive	52
14.3.3	Southlakes	53
14.3.4	Boundary Road	54
14.3.5	Tamworth Street	55
14.3.6	Delroy	56
14.3.7	Victoria Street	57
14.3.8	Bourke Street	58
14.3.9	North West Urban Release Area	
	Neighbourhood Centre	59
14.4	Enterprise Corridors	61
14.4.1	Bourke Street	61
14.4.2	Victoria Street	63
14.5.	Bulky Good Precincts	65
14.5.1	Cobra Street	65
14.5.2	West Dubbo	67
14.6	Cobbora Road and Erskine Street	
	Commercial Precinct	69
14.7	Health, Well-being and Education Precinct	: 71
14.8	Airport Precinct	77
14.9	Industrial Precincts	81
14.9.1	Jannali and Depot Roads	81
14.9.2	East Dubbo Light Industrial	83
14.9.3	North Dubbo Industrial	86
14.9.4	South Dubbo Industrial	89
14.9.5	Basalt Road	92
14.10	Blueridge	95
14.11	Brocklehurst	99
14.12	Yarrandale Road	102
14.13	Tourist	105
14.13.1	Zoo and Camp Road	105
14.13.2	Central Tourist Strips	111
14.13.3	Tourist Spot Zonings	114
14.14	Infrastructure	116
14.14.1	Council Infrastructure	116
14.14.2	NSW Railway and Kokoda Place	118

PART FOUR - IMPLEMEN

31

PLEMENTATION	120
	400

15.	Implementing the Strategy	120
16.	Monitoring	123

LIST OF FIGURES

Figure 1:	Study Area (former Dubbo LGA)	4
Figure 2:	Dubbo's road hierarchy map with employment lands	9
Figure 3:	Dubbo Estimated Resident Population	11
Figure 4:	Population by Age Bracket for former	
152	Dubbo LGA)	12
Figure 5:	Population by Life Stage	13

Figure 6:	Dubbo Highest Qualification 2016	14
Figure 7:	People who work in Dubbo but reside elsewhere 2016	17
Figure 8:	People who reside in Dubbo but work	
	elsewhere 2016	18
Figure 9:	Unemployment rates comparison	
	2013-2016	19
Figure 10:	Commercial centres hierarchy	22
Figure 11:	Dubbo's existing employment lands	23
Figure 12:	Industrial Candidate Areas	26
Figure 13:	Industrial Candidate Area 1 - Blueridge	27
Figure 14:	Industrial Candidate Area 2 - Airport	
	Precinct	28
Figure 15:	ICA 3 Brocklehurst Precinct (previously	
	named Mendooran/Talbragar)	29
Figure 16:	Yarrandale Road Precinct previous	
	ICA 4	30
Figure 17:	Forecast Population Age Group	33
Figure 14:	Industrial Candidate Area 2 - Airport	
	Precinct	81
Figure 18:	Timeline of Camp Road 1	08

LIST OF TABLES

Table 1:	Dubbo's Population by age cohort	13
Table 2:	Dubbo Medium Personal/Household	
	Income	14
Table 3:	Medium household income compariso	on
	2016	14
Table 4:	Trade Area and Retail Expenditure	15
Table 5:	Dubbo's employment generation by industry 2006-2016	16
Table 6:	Summary of Dubbo's Employment Lar	nd,
	by precinct	24
Table 7:	Summary of Employment Land Zoned	
	Areas	25
Table 8:	Dubbo's Population Projections	33
Table 9:	Dubbo's Employment Projections by	
	Industry	34
Table 10:	Total Floorspace Demand by Retail Sto	ore
	Type in Dubbo	35
Table 11:	Floorspace Demand versus Supply	
	(GLA)	35
Table 12:	Employment Sector Projections	36
Table 13:	Projected demand for additional zone	b
	industrial land by 2031	38
Table 14:	Projected demand for additional speci	al
	purpose zoned land by 2031	39

LIST OF PRECINCT MAPS

Precinct Map 1:	Central Business District	42
Precinct Map 2:	Central Business District B3	43
Precinct Map 3:	Orana Mall Precinct	48
Precinct Map 4:	Neighbourhood Centres	50
Precinct Map 5:	Southlakes Neighbourhood Centre	53
Precinct Map 6:	Boundary Road Neighbourhood Centre	54
Precinct Map 7:	Tamworth Street Neighbourhood Centre	55
Precinct Map 8:	Delroy Neighbourhood Centre	56

Precinct Map 9:	Victoria Street Neighbourhood Centre	57
Precinct Map 10:	Bourke Street Neighbourhood Centre	58
Precinct Map 11:	Bourke Street Enterprise Corrido	or62
Precinct Map 12:	Victoria Street Enterprise Corrido	or64
Precinct Map 13:	Cobra Street B5 Business	
	Development	66
Precinct Map 14:	West Dubbo B5 Business	
	Development	68
Precinct Map 15:	Cobbora Road and Erskine Stree	t
	Commercial Precinct	70
Precinct Map 16:	Health, Well-being and Education	n
	Precinct	72
Precinct Map 17:	Airport Precinct	78
Precinct Map 18:	Jannali and Depot Roads	82
Precinct Map 19:	East Dubbo Light Industrial Precinct	84
Precinct Map 20:	North Dubbo Industrial Precinct	87
Precinct Map 21:	South Dubbo Industrial Precinct	90
Precinct Map 22	Basalt Road Heavy Industrial	
	Precinct	93
Precinct Map 23:	Blueridge Precinct	96
Precinct Map 24:	Brocklehurst precinct	100
Precinct Map 25:	Yarrandale Road Industrial	
	Precinct	103
Precinct Map 26:	Zoo and Camp Road Precinct	106
Precinct Map 27:	Central Tourist Strips	112
Precinct Map 28:	Tourist Spot Zoning	115
Precinct Map 29:	Council owners SP2	
	Infrastructure Land	117
Precinct Map 30:	NSW Railway and Kokoda	119

LIST OF PRECINCT GUIDANCE MAPS

Precinct Guidance Map 1:	Central Business Distric	ct 43
Precinct Guidance Map 2:	Central Business Distric expansion – option 1	-t 43
Precinct Guidance Map 3:	Myall Street Neighbourhood Centre	51
Precinct Guidance Map 4:	Websdale Drive Neighbourhood Centre	52
Precinct Guidance Map 5:	North West Urban Relea Area Neighbourhood Centre	ase 59
Precinct Guidance Map 6:	Health, Well-being and Education Precinct Guidance	75
Precinct Guidance Map 7:	West Dubbo Commercial Zone	79
Precinct Guidance Map 8:	ICA 2 - Airport Precinct	80
Precinct Guidance Map 9:	Investigation Area	85
Precinct Guidance Map 10:	Investigation Area	88
Precinct Guidance Map 11:	ICA 1 - Blueridge	98
Precinct Guidance Map 12:	ICA 3 Brocklehurst	
	Precinct	101
Precinct Guidance Map 13:	Yarrandale Road	104

PART ONE – A LOOK AT DUBBO TODAY

1. Introduction

This Strategy aims to ensure the City of Dubbo has an appropriate level of commercial, industrial, institutional and tourist zoned land in the future which is situated in locations that can best meet the long-term requirements of Dubbo and the Region.

Traditionally, the supply and demand for employment lands and the associated siting of such land use activities have been considered in isolation in the planning system. However, over time, commercial and industrial land use activities have shifted focus which has resulted in the traditional relationship between commercial and industrial development not keeping pace with overall land use planning trends.

The Employment Lands Strategy will replace the existing Dubbo Commercial Areas Development Strategy, the Dubbo Institutional Areas Development Strategy and the Dubbo Industrial Areas Development Strategy, which were adopted by the former Dubbo City Council in 1997 as key components of the Dubbo Urban Areas Development Strategy.

The Employment Lands Strategy is exclusively focused within the former Dubbo Local Government Area (LGA), as shown in Figure 1. Wellington retains a Settlement Strategy adopted in 2012 by the former Wellington Council which addresses commercial, industrial, residential and institutional in one document. This settlement strategy will remain inforce and will not be impacted by the Employment Lands Strategy.



Figure 1: Study Area (former Dubbo LGA)

1.1 Snapshot of Dubbo

A snapshot of the former Dubbo LGA is provided below.



1.2 What are Employment Lands?

For the purposes of this Strategy, employment lands include all land zoned predominately for activities resulting in employment, including the following land use zones:

- B1 Neighbourhood Centre
- B2 Local Centre
- B3 Commercial Core
- B4 Mixed Use
- B5 Business Development

- B6 Enterprise Corridor
- B7 Business Park
- IN2 Light Industrial
- IN3 Heavy Industrial
- SP2 Infrastructure
- SP3 Tourist

1.3 Importance of Employment Lands

Employment lands are critical to the short, medium and long term economic and social viability of communities. It is important to maintain an adequate supply of employment land to ensure a diverse range of jobs are available for residents.

Independent property and economic consultants, Hill PDA, were engaged by Council to prepare the Dubbo Commercial Floorspace Inventory and Analysis, which was completed in 2014, and the Dubbo Employment Lands Review, which was completed in 2018.

The Dubbo Commercial Floorspace Inventory and Analysis examines the supply and demand for commercial employment land through to the year 2031, and includes detailed retail supply/demand analysis and a comparative assessment of Dubbo's retail and commercial areas.

An addendum to the study was prepared in December 2014 and again in September 2016 to update the data and demand modelling based on revised population projections and other information which was not available when the study was originally prepared. The Dubbo Employment Lands Review examines the supply and demand for industrial and special purpose (tourist and institutional) zoned land to the year 2031.

The key findings of the studies and their subsequent addendums directly inform and relate to the Dubbo Employment Lands Strategy.

1.4 Objectives of the Strategy

The objectives of the Employment Lands Strategy are:

- To facilitate and promote the orderly and sustainable provision of employment lands in Dubbo;
- To review the characteristics of the Dubbo commercial hierarchy and its role in ensuring the continued orderly and economic development of commercially-zoned land;
- To review the location and characteristics of the Industrial Candidate Areas and their effectiveness;
- To review the location and characteristics of institutional activities in the City including the importance of health and education facilities.
- To review the location, function and supply and demand for tourist land.
- To ensure the City maintains a suitable supply of employment land having regard to projected floorspace requirements during the life of the Strategy;
- To facilitate options and initiatives for the renewal of employment land precincts to attract business investment; and
- To facilitate the preparation of structure plans for key employment land precincts.

1.5 Relationships to other plans and policies



Dubbo Mining Areas Land Use Strategy 2015



Community Strategic Plan



Dubbo Local Environmental Plan 2011



Dubbo's Road Transportation Strategy to 2045



Dubbo CBD Precincts Plan



Regional Economic Development Strategy





Dubbo Urban Areas Development Strategy



Central West & Orana Regional Plan



Dubbo Economic Development Strategy

1.5.1 Dubbo 2040 Community Strategic Plan

The Dubbo 2040 Community Strategic Plan was adopted by Dubbo Regional Council on 25 June 2018. The Plan is separated into a number of themes, strategic goals and outcomes in respect to how the community would like the Dubbo Regional Local Government Area to look in the year 2040. The Employment Lands Strategy is directly aligned with the themes within the 2040 Community strategic Plan, specifically housing, infrastructure, economy and liveability. This Strategy is also consistent with numerous strategic outcomes and actions as included in the 2040 Community Strategic Plan.

1.5.2 Dubbo Urban Areas Development Strategy

The Dubbo Urban Areas Development Strategy (UADS) includes the Industrial Areas Development Strategy, Commercial Areas Development Strategy and the Institutional Areas Development Strategy. If adopted by Council, this Employment Lands Strategy will replace these strategies which have been in operation since 1997. In preparation of this Employment Lands Strategy, an extensive review of these strategies has been undertaken with respect to analysing background information, review of existing precincts and their respective roles, objectives, opportunities, issues and controls.

The Commercial Areas Development Strategy highlights the importance of the role of the CBD as the primary commercial area of Dubbo at the top of the commercial centres hierarchy given its regional catchment of over 120,000 persons. This strategy intends to review the commercial centres hierarchy to ensure it meets Dubbo's current and future needs.

1.5.3 Dubbo Local Environmental Plan 2011

The Dubbo Local Environmental Plan 2011 guides land use and development across Dubbo. The LEP controls and determines development through the use of land use zones which each have a set of objectives and permissibility tables. Employment lands in Dubbo are zoned either Business, Industrial or Special Purpose.

1.5.4 Dubbo Economic Development Strategy

The Dubbo Economic Development Strategy was adopted by Council in 2012 to promote a sustainable, forwardmoving economy through business investment, increased population and employment growth.

The Employment Lands Strategy is closely aligned with the Dubbo Economic Development Strategy, which ensures there is an adequate supply of available land for commercial, industrial and tourist purposes that support a diverse local and regional economy and promotes growth.

1.5.5 Dubbo CBD Precincts Plan

Dubbo's CBD Precinct Plan is underpinned by the Dubbo Commercial Areas Development Strategy (CADS) which places the Dubbo CBD at the top of the City's commercial hierarchy. The CBD Precinct Plan will guide future development and growth within the CBD promoting and facilitating activity within the CBD in order to make it a vibrant and attractive centre for all.

This Strategy will replace the Dubbo Commercial Areas Development Strategy, the Dubbo Industrial Areas Development Strategy and the Dubbo Institutional Areas Development Strategy.

1.5.6 Dubbo's Road Transportation Strategy to 2045

The Dubbo City Planning and Transportation Strategy 2045 is underpinned by the Dubbo Urban Areas Development Strategy. The Transportation Strategy was undertaken to review future transportation hierarchies based on Council's Residential Urban Release Areas created with the adoption of the Dubbo Local Environmental Plan 2011. The Employment Lands Strategy has considered the Transportation Strategy with respect to future road networks.



Figure 2: Dubbo's road hierarchy map with employment lands



1.5.7 Central West and Orana Regional Plan 2036

The Central West and Orana Regional Plan 2036 was released by the Minister for Planning and Housing in June 2017. The Plan effectively provides a blueprint for the future growth and development of the Central West and Orana Regions through the provision of four (4) overarching goals as provided below:

- The most diverse regional economy in NSW
- A stronger, healthier environment and diverse heritage
- Quality freight, transport and infrastructure networks
- Dynamic, vibrant and healthy communities.

The Regional Plan has a number of strategic directions for the future growth and development of the Region as provided below:

Direction 1: Protect the region's diverse and productive agricultural land Direction 2: Grow the agribusiness sector and supply chains Direction 3: Develop advanced manufacturing and food processing sectors Direction 4: Promote and diversify regional tourism markets Direction 5: Improve access to health and aged care services Direction 6: Expand education and training opportunities Direction 7: Enhance the economic self-determination of Aboriginal communities Direction 8: Sustainably manage mineral resources Direction 9: Increase renewable energy generation Direction 10: Promote business and industrial activities in employment lands Direction 11: Sustainably manage water resources for economic opportunities Direction 12: Plan for greater land use compatibility Direction 13: Protect and manage environmental assets Direction 14: Manage and conserve water resources for the environment Direction 15: Increase resilience to natural hazards and climate change Direction 16: Respect and protect Aboriginal heritage assets Direction 17: Conserve and adaptively re-use heritage assets Direction 18: Improve freight connections to markets and global gateways Direction 19: Enhance road and rail freight links Direction 20: Enhance access to air travel and public transport Direction 21: Coordinate utility infrastructure investment Direction 22: Manage growth and change in regional cities and strategic and local centres Direction 23: Build the resilience of towns and villages Direction 24: Collaborate and partner with Aboriginal communities Direction 25: Increase housing diversity and choice Direction 26: Increase housing choice for seniors Direction 27: Deliver a range of accommodation options for seasonal, itinerate and mining workforces Direction 28: Manage rural residential development Direction 29: Deliver healthy built environment and better urban design

The applicable Directions are further discussed in each Employment Land precinct.

1.5.8 Dubbo Mining Areas Land Use Strategy 2015

The Dubbo Mining Areas Land Use Strategy 2015 was adopted by the former Dubbo City Council on 20 April 2015. This Strategy aims to promote growth in the mining and mining technology and services industry, to ensure the impacts of mining are adequately managed to maintain the unique quality of life residents enjoy and the environmental values of the former Dubbo Local Government Area and to develop Dubbo as a major mining service centre, supporting the long term growth and development of the industry in the Orana region and across Western NSW.

The Employment Lands Strategy is also consistent with the principles for industrial land identification included in the Central West and Orana Regional Plan. The Dubbo 2040 Community Strategic Plan was adopted by Dubbo Regional Council on 25 June 2018.

1.5.9 Central Orana Regional Economic Development Strategy

The Central Orana Regional Economic Development Strategy 2018-2022, which comprises the Dubbo Regional and Narromine Shire Local Government Areas, was developed to identify economic development opportunities that capitalise on its function economic region. The Strategy was adopted by Department of Premier and Cabinet in 2018.

2. Demographic Profile 2.1 Dubbo's existing population

ABS Census records and estimated resident population data has shown that Dubbo has been experiencing steady population growth over the past decade. As of 2016, the former Dubbo LGA had a population of 42,831. When compared to the 2004 population of 38,996, Dubbo had a population growth of 3,865 people or 9% over a 12 year period.

Figure 3 shows the Estimated Resident Population (ERP) of Dubbo from 2001 to 2017. ERP is the official ABS measure of the population according to a usual residence population concept.



Dubbo Estimated Resident Population

Figure 3: Dubbo Estimated Resident Population Source: ABS, Regional Population Growth, Cat.32180

2.2 Age Profile

Dubbo has an ageing population, which is consistent with demographic trends. This is evident with the number of persons over 65 years which comprises 15% of the population shown in Figure 4, compared to 12% in 2006 (Remplan, 2006). The proportion of persons aged 15 to 65 years remained stable at 64% and persons aged under 15 years decreased from 24% of the population in 2006 to 21% of the population in 2016. Despite this, persons in the working age bracket of 15 to 65 years increased over the period.



Figure 4: Population by Age Bracket for former Dubbo LGA) Source: Remplan 2018

AGE COHORT	2006	2016	Increase % (2006-16)
0-14 years	9,039	8,847	-2.17%
15-24 years	5,197	5,226	0.55%
25-34 years	4,577	5,718	19.95%
35-49 years	8,093	7,662	-5.63%
50-65 years	6,153	7,668	19.76%
66-84 years	4,021	5,269	23.69%
85+ years	544	871	37.54%
Total	37,624	41,261	8.81%

FORMER DUBBO LGA

Table 1: Dubbo's Population by age cohort Source: Remplan, 2018

Understanding the population by life stage within the former Dubbo LGA provides valuable insights into the region's requirements for amenity, services, infrastructure, investment and education and employment opportunities.

The largest life stage group in the former Dubbo LGA is "Working Age (30 to 64 years)" representing 43.7% of the overall population.



Figure 5: Population by Life Stage Source: Remplan 2018

2.3 Education

Education levels across the community are a key indicator of the propensity of residents to be engaged in the work force, and are also an important factor influencing levels of social wellbeing in the region.

In the former Dubbo LGA, the largest "highest qualification attained" cohort is "Certificate Level", representing 19.1% percent of the overall population.



2.4 Income

An analysis of income data is important in order to determine the relative wealth of the former Dubbo LGA which assists in understanding ability to spend and whether there is the potential for significant capital investment by people within the former Dubbo LGA or whether external investment should be sought.

\$/Weekly	2001	2006	2011	2016	2001-16 (Change) %
Median total personal income	\$386	\$462	\$578	\$687	43.8% increase
Median total household income	\$754	\$965	\$1,094	\$1,265	40.4% increase

Table 2: Dubbo Medium Personal/Household Income Source: Remplan 2018

When comparing Dubbo's household income to the Orana Region, NSW and Australia, Dubbo has a lower median income than that of NSW and Australia, however is higher than the Orana region.

2016 (\$/weekly)	Dubbo	Orana Region	NSW	Australia
Median total	\$1,265	\$1,116	\$1,486	\$1,438
household income				

Table 3: Medium household income comparison 2016 Source: Remplan 2018

2.5 Expenditure

Dubbo has a large catchment area, particularly with respect to providing commercial retail and services to the Orana region. As such, when discussing expenditure, the trade catchment needs to be considered.

There are three (3) main trade areas identified for the Dubbo Regional LGA as follows:

- A Primary Trade Area for 'everyday' shopping (i.e. supermarkets and convenience goods) which comprises the former Dubbo LGA
- A Secondary Trade Area for 'comparative' goods shopping (i.e. bulky goods, clothing, department stores). This area comprises the Gilgandra and Narromine LGAs and the northern parts of Parkes, Cabonne and the majority of the former Wellington LGA; and
- Tertiary Trade Area for 'regional' shopping on an infrequent basis. This area comprises the Bourke, Brewarrina, Walgett, Coonamble, Warrumbungle, Warren and Bogan LGAs and a proportion of Cobar and Lachlan LGAs.

Trade Area	Retail Expenditure (2016	
Primary Trade Area	\$616 million	
Secondary and Tertiary Trade Areas	\$779 million	
Total	\$1.4 billion	

Table 4: Trade Area and Retail Expenditure Source: Remplan 2018

3. Employment Profile

3.1 Employment generation by industry

In 2016, there was an estimated 19,762 people employed in Dubbo. Health care and social assistance is the largest sector, followed by retail trade and education and training. When compared to the Orana Region and NSW, Dubbo has a higher percentage of people employed in service industries such as health care and social services, accommodation and food services, electricity, gas, water and waste services and arts and recreation services, highlighting the position of Dubbo as a major regional service centre.

Table 5 shows a breakdown of employment generation by industry for Dubbo between 2006 and 2016. The green highlight shows Dubbo's top three (3) employment industries, and blue depicting the lowest three (3) employment industries.

				2006-2016		2011-2016	
Industry	2006	2011	2016*	Growth	Growth %	Growth	Growth %
Agriculture, Forestry & Fishing	642	578	646	4	1%	68	12%
Mining	30	89	68	38	127%	-21	-24%
Manufacturing	1,308	1,228	1,281	-27	-2%	53	4%
Electricity, Gas, Water & Waste Services	242	293	288	46	19%	-5	-2%
Construction	1,033	1,047	1,531	498	48%	484	46%
Wholesale Trade	829	734	674	-155	-19%	-60	-8%
Retail Trade	2,382	2,232	2,269	-113	-5%	37	2%
Accommodation & Food Services	1,170	1,231	1,474	304	26%	243	20%
Transport, Postal & Warehousing	803	758	812	9	1%	54	7%
Information Media & Telecommunications	278	196	196	-82	-29%	0	0%
Financial & Insurance Services	483	458	396	-87	-18%	-62	-14%
Rental, Hiring and Real Estate Services	260	264	246	-14	-5%	-18	-7%
Professional, Scientific & Technical Services	719	766	873	154	21%	107	14%
Administrative & Support Services	372	386	512	140	38%	126	33%
Public Administration & Safety	1,295	1,354	1,432	137	11%	78	6%
Education & Training	1,520	1,629	1,833	313	21%	204	13%
Health Care & Social Assistance	2,367	2,821	3,289	922	39%	468	17%
Arts & Recreation Services	199	261	324	125	63%	63	24%
Other Services	766	785	924	158	21%	139	18%
Inadequately described/Not stated	140	87	694	554	-	607	-
Total	16,838	17,197	19,762	2,924	17%	2,565	15%

Table 5: Dubbo's employment generation by industry 2006-2016

Source: HillPDA 2017, ABS working profile 2006, 2011 and 2016 *amalgamation of SA2s that comprise the former LGA

Top three employment industries Lowest three employment industries

3.2 Employment self-sufficiency and self-containment

The measurements of self-sufficiency and containment are useful for assessing the health of a particular geographical area.

In November 2018, there was an estimated 20,802 jobs in Dubbo. Of this, approximately 17,369 workers, or 83.4% resided in the former Dubbo LGA, with 3,433, or 16.6% residing outside the former Dubbo LGA. Of those who live elsewhere, they predominantly come from surrounding areas including Narromine, Wellington and Gilgandra and the Central West, as shown in Figure 7.

In comparison, only 1,106 residents worked in another LGA for their usual employment (shown in Figure 8).



Figure 7: People who work in Dubbo but reside elsewhere 2016 Source: Remplan 2018



Figure 8: People who reside in Dubbo but work elsewhere 2016 Source: Remplan 2018

Self- sufficiency	Self-sufficiency is calculated by dividing the number of jobs generated within Dubbo City by the number of employed residents.
	Dubbo city had a self-sufficiency rate of 103% indicating that there were 1.19 jobs provided for every employed resident.
	Dubbo city generated significantly more employment opportunities in 2016 than the surrounding LGAs, further highlighting the cities importance as a regional economic generator.
Self- containment	Self-containment measures the proportion of local residents that live and work within the same geographical area.
	Dubbo city has a self-containment of approximately 92%, being the highest rate of the surrounding LGAs.
	The high containment rate is typical of regional areas where the longer travel distances, when compared to capital city, tend to influence local residents to live and work in the same LGA.

3.3 Unemployment

Historically, Dubbo has experienced an unemployment rate lower than the state of New South Wales. Dubbo also has a more steady unemployment rate in comparison to the Orana region, which tends to fluctuate more significantly over time. A comparison of Dubbo's unemployment to that of NSW and the Orana region is shown in Figure 9.

Within the Dubbo labour force, approximately 66.48% are employed full time, 28.77% are employed part time, and 4.75% are away from work. The unemployment rate in Dubbo increased from 2.6% in March 2013 to 3.3% in 2016. However, it remains lower than NSW which remained steady 5.7% over the same period.

The low unemployment rate within Dubbo indicates that any growth in population would lead to increased generation of employment and associated demand for appropriately zoned land.



Figure 9: Unemployment rates comparison 2013-2016 Source: ABS, Labour Force, Cat 6291.0.55.001, 2016

3.4 Socio-economic key findings

- Dubbo has had steady population growth over a long period. This is in contrast to population trends for regional communities localised within the Orana Region which are either steady or declining.
- Dubbo has a low unemployment rate, high self-sufficiency rate and high self-containment rate which demonstrates Dubbo's ability to generate employment opportunities for residents living in Dubbo whilst also attracting residents from other LGAs. It also would imply that any increases within the primary working age cohorts would likely see a corresponding increase in employment opportunities and demand for employment lands.
- Dubbo's population is ageing.
- Dubbo is a major service centre for regional NSW highlighted by the three largest employment sectors in health care and social assistance, retail trade and education and training. These outperform the total overall percentage of employment in the Orana region and NSW.
- Industrial (mining, manufacturing, utility services and construction), accommodation and food services, health care and social assistance, and education and training industries employee over half of the residents in Dubbo.

4. Commercial Centres Hierarchy

The Commercial Centres Hierarchy is based on the existing and well established Commercial Centre Hierarchy, which was first developed in the former Dubbo Commercial Areas Strategy, 1997. The Hierarchy was developed to reflect the size of the city's local and regional population catchment that has access to a range of commercial areas and shopping enterprises, whilst managing the overall economic impacts of including more commercial floorspace. The Hierarchy has been reviewed and updated with this Strategy.

The existing Hierarchy focuses on B1, B2 and B3 zones and does not extend into the other commercial zones including B5, B6 and B7 zones. The revised Hierarchy now includes Specialised Activity Centres and Employment Clusters to take account of all predominantly commercial zones and their overall role in the Hierarchy, particularly with respect to their relationship to the principal, major and neighbourhood centres.

The Hierarchy also ensures that residents in retail catchment areas and across the Local Government Area have easy access to the higher order centres, as well as the convenience that lower order centres and neighbourhood centres offer in locations close to residential areas.

The Hierarchy below provides a clear description as to the role, function and where each precincts fit within the prescribed commercial activity centres Hierarchy.

Hierarchy	Centre names	Role and function in the Hierarchy
Principal Centre (Regional)	Central Business District	The Principal Centre (Regional) is the highest order centre for Dubbo. It provides a range of services including commercial, business, retail, food and drink, visitor, social, civic, cultural, tourist and entertainment to Dubbo and attracts visitors and businesses from a significant portion of the Orana and north-western region of New South Wales.
		Dubbo has one (1) Principal Centre which is the Central Business District (CBD). It is a well-established and diverse commercial area. It delivers core commercial and business services to the Dubbo community and visitors as well providing a unique blend of shopping, retail, dining and entertainment experiences.
		The CBD should be protected so as it remains as Dubbo's core and most important commercial, retail, business and entertainment precinct with a view that no other commercial precincts undermine its role and effectiveness.
Major Centre (Sub-Regional)	Orana Mall	The Major Centre (Sub-Regional) is the second order centre for Dubbo. The Major Centre (Sub-Regional) provides a range of business and retail needs for the City and the region. The Centre typically serves a wider catchment than that of a neighbour centre.
		Dubbo has one (1) Major Centre being Orana Mall. Orana Mall is a self- contained indoor shopping centre providing approximately 23,667m ² floor space area and is the largest shopping centre in Dubbo. It is located approximately 2.2 km east of the Dubbo CBD. The centre is anchored by a Woolworths supermarket and Big W and a variety of over 50 speciality shops. The centre services both East Dubbo and a wider sub-regional area.
		Orana Mall should support and complement Dubbo's CBD as the Principal Centre by providing retail functions servicing the sub-regional area.

Undermining the Hierarchy has potential implications for the viability of existing centres including business viability, employment and future investment.

Hierarchy	Centre names	Role and function in the Hierarchy
Local Centres (Neighbourhood)	Myall Street, Websdale Drive, Southlakes (undeveloped), Boundary Road, Tamworth Street, Delroy (Minore Road), Victoria	The Local Centres (Neighbourhood) are third order centres for Dubbo. They are small scale centres that can provide a variety of retail uses, business premises or community uses that serve the needs of the nearby residential and/or business community. These centres provide a more convenient alternative to the CBD for day to day convenience shopping.
	Street and Bourke Street	Dubbo has six existing local centres and two areas zoned to allow future neighbourhood centre developments. The existing local centres include a variety of tenancies such as post office, hairdressers, butchers, convenience store, newsagent, drycleaners, cafes and take-away food and drink premises. Of the six existing local centres, three contain supermarkets.
Specialised Activity Centre	Airport, Health, Well-Being and Education Precinct	A Specialised Activity Centre is an area which provides an important economic and employment role which generates benefits to both the local community and broader region.
		Specialised Precincts can include clusters of similar industries which can benefit from each other through shared synergies and infrastructure which would normally be unviable on an individual scale.
		Dubbo has two Specialised Precincts which include the Airport Precinct and Health, Well-Being and Education Precinct. The Precincts each provide their own unique benefit to Dubbo and the surrounding region. Each of these Precincts involve significant infrastructure such as the airport, hospital and Universities.
Commercial Employment Clusters	Cobra Street, West Dubbo Bourke Street, Victoria Street Cobbora Road and Erskine Street, Blueridge Business Park	Commercial Employment Clusters consist of moderately sized clusters of similarly zoned land providing commercial services somewhat different to those in the other commercial activity centres Hierarchy. These clusters can accommodate a range of industries, bulky goods retailing and business activities either directly along, or easily accessible from major transport routes. These clusters are usually located outside of the commercial activity centres due to business requirements for additional floor space area, activity or potential impact of the activity. Commercial Employment Clusters provide a range of industries which typically require larger floor areas for warehousing, showroom, delivery, parking, access and manoeuvring areas typically not able to be achieved in the core commercial activity centres. They also allow clustering of like industries to enable viable economic activity.
		Dubbo has six identified Commercial Employment Clusters spread throughout the urban area. Five are located in relatively close proximity to the CBD with one located on the Dubbo's eastern urban periphery.
Rural Centres	Wongarbon	Services a rural community. Wongarbon is considered a satellite community of Dubbo.



Figure 10: Commercial centres hierarchy



Major Centre (Subregional)

Local Centres (Neighbourhood) Commercial Employment Clusters



5. Dubbo's existing employment lands




Precinct	Zone	Vacant Land Area (ha)	Occupied Land Area (ha)	Total Land Area (ha)	Number of Allotments	Total GFA (m²)
Central Business District	B3	2.6	68.4	71	660	249,196
	B4	0.7	35.3	36	421	16,600
	Total	3.3	103.7	107	1081	265,796
Orana Mall Precinct	B2	0	6.88	6.88	1	23,700
	B6	0	2.9	2.9	5	9,230
	SP3	0	2	2	2	9,525
	Total	0	11.78	11.78	8	42,455
Neighbourhood Centres	B1	2.67	4.28	6.97	8	13,299
Enterprise Corridors	B6	0.27	25.61	25.88	57	24,340
Bulky Goods	B5	2.2	10.09	12.29	17	35,303
Cobbora Road and Erskine	B5	3.67	8.33	12	16	23,022
Street Commercial Precinct	B6	0	6.61	6.61	69	13,100
	Total	3.67	14.94	18.61	85	36,122
Health & Education Precinct	SP2	29.28	43.59	72.87	8	175,393
	SP3	0	1.7	1.7	16	4,615
	Total	29.28	45.29	74.57	24	180,008
Airport Precinct	SP2	13.1	312	325.1	2	23,415
	IN2	192.46	30.77	223.22	29	40,458
	IN3	26.85	66.73	93.58	10	3,235
	Total	232.4	409.5	641.9	41	67,108
Jannali Road & Depot Road	IN2	14.7	21.6	36.3	70	49,706
East Dubbo Light Industrial	IN2	28.2	65	93.2	125	107,461
North Dubbo Industrial	IN2	7.4	50.3	57.7	173	76,433
South Dubbo Industrial	IN2	5.5	17.8	23.3	35	44,966
Basalt Road	IN3	129	77.01	206.01	3	2,700
Blueridge	B5	27.06	9.94	37	40	20,754
	B7	46.74	35.26	82	24	7,429
	IN2	49.3	5.1	54.4	2	500
	Total	123.1	50.3	173.4	66	28,683
Brocklehurst	IN2	6.09	25.7	31.79	33	11,546
	IN3	138.31	246.1	384.41	19	5,308
	Total	144.4	272.1	416.5	59	16,854
Yarrandale Road	IN2	103.99	42.08	146.07	36	33,655
	IN3	391.98	247.7	639.68	73	148,651
	Total	495.97	289.78	785.75	109	182,306
Zoo and Camp Road Tourist	SP3	449.3	649.9	1099.2	46	17,720
Central Tourist Strips	SP3	5.3	25.1	30.4	131	79,241
Tourist Spot Zoninas	SP3	0	0.47	0.47	4	1,800
Council Infrastructure	SP2	0	825	825	12	5,275
Rail & Kokoda Place Precinct	SP2	0.2	4.9	5.1	7	7,879
Total	sound field	1,676.86	2,974.45	4,651,31	2,161	1,285,455

Table 6: Summary of Dubbo's Employment Land, by precinct

Zone	Vacant Land Area (ha)	Occupied Land Area (ha)	Total Land Area (ha)	Total GFA (m²)
Commercial zoned land	85.91	213.64	299.51	435,973
Light Industrial zoned land	407.635	258.345	665.98	364,725
Heavy Industrial zoned land	686.135	637.545	1,323.68	159,894
Tourist zoned land	454.6	679.17	1,133.77	112,901
Special Purpose zoned land	42.58	1,185.49	1,228.07	211,962
TOTAL EMPLOYMENT LAND	1,676.86	2,974.45	4,651.31	1,285,455

Table 7: Summary of Employment Land Zoned Areas

6. Dubbo's Industrial Candidate Areas

The Dubbo Industrial Areas Development Strategy (IADS) 1996-2015 identified four Industrial Candidate Areas (ICAs) and provided a detailed analysis of each regarding a range of issues such as the nature of proposed land uses, distance from City facilities, relationship to transport networks, suitability regarding size and cost, environmental issues (such as flooding), separation from residential areas and other potential conflicts. The four identified ICAs as depicted in Figure 12 and are discussed further below.



Figure 12: Industrial Candidate Areas



6.1 ICA 1 Blueridge (previously Mitchell/Eulomogo)

ICA 1 was identified within the strategy for the development of a business park and prestige light industrial park consisting of light manufacturing, warehouse and distribution and high-tech industries. This was primarily as a result of the location of the land adjacent to the Mitchell Highway. The precinct is now zoned B5 Business Development, B7 Business Park and IN2 Light Industrial under the provisions of the Dubbo LEP 2011.

Blueridge Business Park, which forms a part of ICA 1, as seen in Figure 13, has become a growth area for light industrial and larger format commercial uses as a result of the larger lot sizes, close proximity to Dubbo's centre, infrastructure and access to the Mitchell Highway.

At the present time, not all land within ICA 1 had been rezoned with approximately 36 hectares of the identified ICA not zoned for industrial. Further discussion and guidance on the remaining ICA 1 land is provided in Chapter 14.10 Blueridge Precinct.



Figure 13: Industrial Candidate Area 1 - Blueridge

Key:

Outline of ICA's which have been rezoned
 Outline of ICA's which have not been rezoned
 RU1 Primary Production
 R2 Low Density Residential
 R5 Large Lot Residential
 IN2 Light Industry
 IN3 Heavy Industry
 SP2 Infrastructure
 RE1 Public Recreation
 RE2 Private Recreation

6.2 ICA 2 Airport Precinct (previously Mitchell/Rosedale)

The Airport Precinct is located within ICA 2 as seen in Figure 14. ICA 2 was identified as a long term industrial expansion area given its location and access to the airport and highway. Its identified role was to allow development and industries related to the airport including air freight and transport, road transport as well as compatible light industrial and agricultural services.

Some of ICA 2 has been zoned industrial under previous Local Environmental Plans with approximately 222 hectares of identified ICA not zoned for industrial. Further discussion and guidance on the remaining ICA 2 land is provided in Chapter 14.8 Airport Precinct.



Figure 14: Industrial Candidate Area 2 - Airport Precinct



6.3 ICA 3 Brocklehurst (previously Mendooran/Talbragar)

The Brocklehurst precinct (previously known as Mendooran/Talbragar) is located within ICA 3 as shown in Figure 15. ICA 3 was identified within the strategy to provide industrial area for large scale primary processing and food manufacturers with a potential to take problem industries.

Some of ICA 3 has been rezoned under previous Local Environmental Plans with approximately 865 hectares of the identified ICA not zoned for industrial. There has been minimal industrial development within the IN3 zoned land over recent years and therefore still a sufficient supply of IN3 zoned land is available in this precinct. Some portion of the IN3 zoned land has been developed as a quarry with expansions to the west currently being undertaken. Further discussion and guidance on the remaining ICA 3 land is provided in Chapter 14.11 Brocklehurst.



Figure 15: ICA 3 Brocklehurst Precinct (previously named Mendooran/Talbragar)

Key:



6.4 ICA 4 Yarrandale/Boothenba

The Yarrandale Road precinct is located within ICA 4 as shown in Figure 16. The principal strategic feature of this area is the existing road and rail transport functions including major heavy industrial uses such as the

Dubbo Regional Livestock Markets and Fletcher International Exports (abattoirs). Most of ICA 4 has been rezoned with approximately 193 hectares of the identified ICA not zoned for industrial. The development of land in the IN3 Heavy Industrial zone has been somewhat slow with the land east of Yarrandale Road currently being used for agriculture, including irrigation and grazing. Further discussion and guidance on the remaining ICA 4 land is provided in Chapter 14.12 Yarrandale Road.



Figure 16: Yarrandale Road Precinct previous ICA 4

Key:
Outline of ICA's which have been rezoned
Outline of ICA's which have not been rezoned
RU1 Primary Production
R2 Low Density Residential
R5 Large Lot Residential
IN2 Light Industry
IN3 Heavy Industry
SP2 Infrastructure
RE1 Public Recreation
RE2 Private Recreation
E3 Environmental Management

PART TWO - DUBBO'S GROWTH TO 2031

7. Economic trends and drivers

(GLOBAL AND AUSTRALIAN ECONOMY]

MACRO TRENDS Global economic conditions: The global economy has been undergoing a mild and somewhat unsteady recovery since the global financial crisis. The Reserve Bank of Australia (May 2018) has recently reported that the global economic conditions have improved over the past two years and growth forecasts for the major economies have been revised higher.

> Domestic economy: The Australian Government's intervention, including lowering interest rates, direct payments to households and individuals and significant infrastructure expenditure helped to mitigate the impacts of the global financial crisis. The Reserve Bank of Australia (May 2018) has recently reported overall conditions in the domestic economy are positive, supported by low interest rates and continued strength in the global economy.

> Non-mining investment: A key development over 2017 was the strong pick-up in non-mining investment, led by strong growth in non-residential construction (RBA 2018).

LOCAL TRENDS Dubbo's role as a major service centre: Dubbo has seen significant investment and growth of several large key services, which will further emphasise Dubbo as a major service centre in the Central West and Orana region. Those services seeing significant investment includes the Dubbo City Regional Airport, Dubbo Base Hospital, TAFE Western's Dubbo campus and the announcement of the inland rail maintenance facility and western region institute of sport,

both to be located in Dubbo. The above investments will play a role in both attracting short and long term visitation to the city as well as assist with population and employment growth through an increase in short term construction and long term employment opportunities.

Growing population: Dubbo has seen a steady, but sustained population growth over the decade. Dubbo's population growth is also ageing and further growth is likely to place pressure on the local health care and social services sector.

Tourism: Dubbo City has a strong tourism industry which has seen an increase in both visitor numbers and expenditure over the last 5 year period. Occupancy rates for motel, hotel and serviced apartments have been trending up. Over the last 5 year period, domestic and international visitors to Dubbo has increased by 26% and overall tourist expenditure in the city has increased by 39%. Accommodation occupancy rates have also increased on average from 67% to 75% between 2009 and 2018.

Dubbo's tourism industry is underpinned by the Taronga Western Plains Zoo being a major tourist attraction for the region. The Zoo has experienced significant investment over the last decade, having seen approximately \$52 Million worth of development since 2008. Of this, \$17 Million worth of development was approved in 2018 alone highlighting the significant short term investment trend of the Zoo.

NBN: The introduction of high speed internet to Dubbo creates productivity, provides local businesses access to potential markets as well as encourages metro business to relocate or decentralise to regional areas.

Mining and renewable energy: The growth of mining and renewable energy will be a significant economic generator providing construction and operational jobs. Given Dubbo's role as the regions major service centre, there is likely to be flow-on demand for accommodation, retail, commercial and industry services.

GENERAL RETAIL AND COMMERCIAL TRENDS

Convenience shopping: Since the 1950-60s, there has been a move from traditional high street retailing to the development of shopping centres where convenience shopping and parking was prioritised. Shopping centres also tend to provide a wide variety of retailers usually anchored by a supermarket. Shopping centres have the potential to undermine existing high street retailers.

There now appears to be a trend for supermarkets being located in smaller centres (such as neighbourhood centres) in close proximity to residential growth areas on the urban periphery. Dubbo has seen this through the development of the Delroy Shopping Centre and the creation of the Southlakes Estate neighbourhood centre zone.

Bulky goods/large format retail: Large format retail has grown in popularity since the 1980s with stores occupying large floor space requiring high turnover on low price/cost products. There is usually a focus on hardware, whitegoods, furniture, homewares and the like by brands such as Bunnings, Harvey Norman, and The Good Guys. Bulky goods typically cluster on highway or main roads in peripheral locations outside of core commercial centres where larger lots and lower land prices are available. Recently, there appears to be a trend where non-bulky good retailers including fast food outlets (such as McDonald's and KFC) are being attracted to these bulky goods locations.

Internet shopping: Internet shopping and online sales has increased in popularity due to the prices, convenience and range of goods available. It is estimated that online sales in Australia would equate to 16% growth between 2011 and 2021 (HillPDA, 2014). Given Dubbo's role as a major regional service centre, it has an extensive population catchment attracting shoppers from as far as Narrabri, Walgett, Bourke and Cobar as a result of their limited retail offering. As there are extensive distances from these towns to Dubbo, internet shopping provides convenience for outlying towns. However, internet shopping presents both opportunities and threats.

International retailers: Large international brands are increasingly taking an interest in Australia to expand market share and the consumer's increasing demand for international products. This will force traditional Australian retailers to compete with domestic and international business models.

De-industrialisation: There has been a general trend towards the decline of traditional manufacturing and industrial jobs. This global trend is being driven by the greater efficiencies of technology, mechanisation and cheaper labour costs in emerging countries.

New Economy: The increasing affluence of NSW's population and growth of the New Economy (otherwise referred to as a knowledge and ideas based economy) is expected to strengthen demand for commercial floorspace especially in key locations close to tertiary education and transport links. The key long term trend in office development has therefore been the growth in the service and knowledge sectors. These sectors relate to public service and public sector administration, banking, insurance and finance, private sector administration, business services (law, accountancy and consultancy) and consumer services (health, education, media etc.). Traditionally, commercial office space has been located within commercial centres where it could cluster with a centre's retail, civic and community facilities.

8. Population Projections

Council, in partnership with consultants, Remplan, have developed a system of population forecasts through to the year 2036. Table 8 shows an overview of Dubbo's population projections comparing Remplan's, KPMG and Department of Planning and Environment. For the purposes of undertaking projections within this strategy, population projections by Remplan have been developed using a Forecast Profile for the former Dubbo City Council area. The models used to create the Forecast Profile have been developed using a 'bottom-up' approach for nine (9) individual planning areas to produce population, dwelling and housing forecasts for Dubbo through to 2036.

Compared to the projections prepared by KPMG in 2012 and the projections released by the Department of Planning and Environment in 2014 for the former Dubbo LGA, the Remplan forecasts included in the model are considered the most accurate as they have been developed from the ground-up using an extensive range of local inputs in addition to official data and policy inputs.

	2011	2016	2021	2026	2031	2036	2041	2046	2051	2056
REMPLAN (2016)	40,246	42,831	44,135	46,145	48,425	51,278	52,983^	55,274^	57,613^	59,912^
KPMG (2013 Mid series)	42,050	44,195	46,235	48,150	49,945	51,545	53,684^	55,476^	57,280^	59,118^
DoPE (2016)	49,100	51,050	52,750	54,750	55,550	56,600	57,514			

Table 8: Dubbo's Population Projections

^ Not official – continuation of trend only Source: Remplan, 2016 & KPMG, 2013 & DoPE, 2014

Projections show that growth in middle aged (45-64) and older age (65+) will increase, while the proportion of younger age groups will stabilise or reduce. There will soon be more people aged 65 and over than people aged 15 years or younger, with over 65's representing a fifth of the total population. Figure 17 shows the significant increase in the 65-84 years age cohort between 2016 and 2031.



Figure 17: Forecast Population Age Group Source: Remplan 2018

9. Employment Projections

Employment in Dubbo City is projected to have 27,635 jobs in 2031, an increase of 7,924 or 29% compared to 2016. Key industries of growth includes health care and social assistance, public administration and safety, construction and wholesale trade. These key growth industries have a strong correlation to Dubbo's ageing population, population growth and its role as a service centre for the Orana region.

Industry	2011	2016	2021	2026	2031	Growth 2016-31	% Growth
Agriculture, Forestry & Fishing	579	609	604	601	597	-12	-2%
Mining	162	229	343	416	486	257	112%
Manufacturing	1,231	1,236	1425	1,509	1,607	371	30%
Electricity, Gas, Water & Waste Services	280	214	404	474	534	320	150%
Construction	1,366	1,531	2,123	2,424	2,703	1,172	77%
Wholesale Trade	751	1,009	1,326	1,545	1,787	778	77%
Retail Trade	2,310	2,904	2,932	3,067	3,200	296	10%
Accommodation & Food Services	1,343	1,377	1,562	1,639	1,696	319	23%
Transport, Postal & Warehousing	891	756	1,042	1,133	1,202	446	59%
Information Media & Telecommunications	210	255	208	192	181	-74	-29%
Financial & Insurance Services	444	419	346	301	249	-170	-41%
Rental, Hiring & Real Estate Services	261	341	266	244	215	-126	-37%
Professional, Scientific & Technical Services	798	835	860	876	907	72	9%
Administrative & Support Services	459	643	852	999	1,167	524	81%
Public Administration & Safety	1,387	1,263	1,967	2,264	2,552	1,289	102%
Education & Training	1,709	1,818	2,018	2,137	2,253	435	24%
Health Care & Social Assistance	2,719	2,863	3,442	3,762	4,068	1,205	42%
Arts & Recreation Services	284	345	463	527	597	252	73%
Other Services	865	1,064	1,293	1,448	1,632	568	53%
Total	18,049	19,711	23,474	25,557	27,635	7,924	29%

Represents an increase in industry sector employment

Represents a decrease in industry sector employment

Table 9: Dubbo's Employment Projections by Industry Source: Remplan, 2014 & HillPDA, 2017

10. Commercial Floorspace Demand Projections

This chapter reviews the occupied and vacant floorspace across the commercial areas of Dubbo and estimates the likely demand based on population and expenditure projections.

Demand for retail floorspace in Dubbo in 2016 is equivalent to around 163,025m² Gross Lettable Area (GLA) of retail floorspace. This is set to increase to 185,489m² by 2031. Projected demand for retail store type is shown in Table 10.

Retail Store Type	2016	2021	2026	2031
Supermarkets & Grocery Stores	21,830	23,246	24,591	25,836
Take-away Liquor Stores	2,764	2,924	3,077	3,218
Specialty Food Stores	3,822	4,016	4,199	4,368
Fast-Food Stores	4,807	5,048	5,276	5,486
Restaurants, Hotels and Clubs	12,780	13,509	14,202	14,841
Department Stores	22,531	23,369	24,133	24,794
Clothing Stores	15,494	16,107	16,666	17,153
Bulky Goods Stores	46,553	48,653	50,577	52,258
Other Personal & Household Goods Retailing	25,007	26,399	27,708	28,899
Selected Personal Services	7,436	7,861	8,265	8,638
Total	163,024	171,133	178,694	185,489

Table 10: Total Floorspace Demand by Retail Store Type in Dubbo Source: HillPDA, 2016

Table 11 compares demand for retail floorspace over the 2016 to 2031 period to the existing supply to determine the extent to which there is existing and projected over or undersupply of retail floorspace by retail store type.

	SUPPLY	LY DEMAND				
Retail Store Type	2016	2016	2021	2026	2031	
Supermarkets and Grocery Stores	18,274	-3,556	-4,972	-6,317	-7,562	
Speciality Food Stores	6,579	2,757	2,563	2,380	2,211	
Restaurants, Liquor, Take Aways, Hotels & Clubs	16,360	-3,991	-5,121	-6,195	-7,185	
Department and Discount Department Stores	18,998	-3,533	-4,371	-5,135	-5,796	
Speciality Non Food	37,371	-3,130	-5,135	-7,003	-8,681	
Selected Personal Services	7,155	-281	-706	- <mark>1</mark> ,110	-1,483	
Bulky Goods Stores	45,077	322	-1,778	-3,702	-5,383	
Total	151,612	-11,412	-19,520	-27,082	-33,879	



Represents oversupply

Table 11: Floorspace Demand versus Supply (GLA) * Based on floorspace audit in 2016 Source: HillPDA, 2016 Comparing retail floorspace supply to demand indicates that Dubbo currently has an undersupply of retail floorspace in the order of 11,412m² GLA in 2016, increasing to 33,879m² by 2031. This is largely attributable to unmet demand for specialty non-food stores, bulky goods stores, department stores/discount department stores and restaurants and cafes.

In addition to the retail floorspace demand identified above there would be further demand for non-retail shopfront floorspace which do not 'capture' household retail expenditure. Such uses include banks, real estate agents, commercial services and so on. Non-retail shopfront floor space typically makes up around 5% to 7% of retail shopfront space in a retail centre but can be as high as 30% in strip shopping centres. It is considered healthy for a further 3% to 4% of shop front premises to be vacant to ensure a reasonable supply for future tenants.

11. Employment Land Projections 11.1 Employment sector projections

It is forecast that Dubbo's industrial precincts are likely to accommodate around 3,486 additional jobs in 2031, while its special purpose precincts would accommodate an additional 2,087 jobs. The employment sector breakdown of where these jobs are expected to be located are shown in Table 12.

Industry	Industrial precincts	Special purpose precincts
Agriculture, Forestry & Fishing	-1	-1
Mining	103	0
Manufacturing	367	7
Electricity, Gas, Water & Waste Services	256	48
Construction	820	23
Wholesale Trade	739	0
Retail Trade	59	6
Accommodation & Food Services	6	303
Transport, Postal & Warehousing	401	36
Information Media & Telecommunications	-11	0
Financial & Insurance Services	0	0
Rental, Hiring & Real Estate Services	-19	0
Professional, Scientific & Technical Services	14	1
Administrative & Support Services	10	0
Public Administration & Safety	258	258
Education & Training	22	348
Health Care & Social Assistance	6	1,024
Arts & Recreation Services	227	5
Other Services	227	28
Total	3,486	2,087

Table 12: Employment Sector Projections Source: HillPDA 2017

11.2 Forecast demand for industrial zoned land

It is forecast that around 331,000m² of additional employment floorspace would be required in Dubbo's industrial precincts by the year 2031 to meet projected demand.

Typically, the building area of industrial developments does not encompass the entirety of the developable land of the parcel they reside within, predominantly as a result of the operational requirements for vehicle manoeuvring areas, parking areas, loading and unloading areas and the like. As such, a ratio of 0.5 and 0.75 has been applied to the projected additional industrial floorspace demand to account for the undeveloped area of land.

Using this methodology, it is forecast that Dubbo is likely to absorb an additional 44 hectares to 66 hectares of industrial zoned land to accommodate the projected demand in employment floorspace over the next 13 years.

It is considered appropriate to provide an additional supply of land (or contingency) above that projected in the interests of price competition. Without some level of vacancies, land values could become inflated undermining further economic growth and investment. A healthy additional supply of land (or contingency level) is considered to range between 20% and 40%. Given that the above projections are based on employed residents, the majority of industries have a self-containment rate of around 85 to 95% and that industry engagement identified that market rents were already quite low, a contingency level of 20% has been applied.

With this taken into account, a minimum of 53 hectares to 80 hectares of industrial zoned land would be required to meet future demand to 2031.

Currently, Dubbo has 724 hectares of vacant/undeveloped industrial zoned land, representing an oversupply.

Projected demand by industry by the year 2031 is shown in Table 13.

Industry	Additional floor space (m²)	Additional land required at 0.5 (ha)	Additional land required at 0.75 (ha)
Agriculture, Forestry & Fishing	-240	-0.05	-0.03
Mining	20,560	4.1	2.7
Manufacturing	33,056	6.6	4.4
Electricity, Gas, Water & Waste Services	20,480	4.1	2.7
Construction	41,020	8.2	5.5
Wholesale Trade	81,301	16.3	10.8
Retail Trade	2,368	0.5	0.3
Accommodation & Food Services	319	0.1	0.0
Transport, Postal & Warehousing	96,336	19.3	12.8
Information Media & Telecommunications	-444	-0.1	-0.1
Rental, Hiring & Real Estate Services	-567	-0.1	-0.1
Professional, Scientific & Technical Ser.	432	0.1	0.1
Administrative & Support Services	314	0.1	0.0
Public Administration & Safety	9,023	1.8	1.2
Education & Training	761	0.2	0.1
Health Care & Social Assistance	271	0.1	0.0
Arts & Recreation Services	11,340	2.3	1.5
Other Services	14,768	3.0	2.0
Sub total	331,099	66.2	44.1
Additional supply (20%)		79.5	53.0

Table 13: Projected demand for additional zoned industrial land by 2031 Source: Hill PDA 2017

11.3 Forecast demand for special purpose zoned land

It is forecast that around 98,830m² of additional floorspace would be required in the special purpose precincts by the year 2031 to meet projected demand.

The methodology used for the industrial lands above has been applied to the special purpose zones within Dubbo. However, analysis of the floorspace audit revealed that achievable floor space ratios within these zones ranged between 0.6:1 and 1:1. As such, these ratios were applied.

It is forecast that Dubbo City is likely to require between 10 hectares and 20 hectares of additional special purpose zoned land to accommodate the projected demand in employment floorspace over the next 13 years.

It is considered prudent to provide an additional supply of land above that projected. As such, an additional 20% has been applied to the projected demand.

With this taken into account, an additional 12 hectares to 24 hectares of special purpose zoned land would be required in the year 2031.

Currently, Dubbo has 452 hectares of vacant/undeveloped special purpose zoned land within the LGA, representing an oversupply.

Industry	Additional floorspace (m²)	Additional land required at 0.5 (Ha)	Additional land required at 1 (Ha)
Agriculture, Forestry & Fishing	-240	-0.05	-0.02
Manufacturing	668	0.1	0.1
Electricity, Gas, Water & Waste Services	3,840	0.8	0.4
Construction	1,172	0.2	0.1
Retail Trade	237	0	0
Accommodation and Food Services	15,153	3	1.5
Transport, Postal and Warehousing	8,563	1.7	0.9
Professional, Scientific and Technical Services	43	0	0
Public Administration and Safety	9,023	1.8	0.9
Education and Training	12,180	2.4	1.2
Health Care and Social Assistance	46,091	9.2	4.6
Arts and Recreation Services	252	0.1	0
Other Services	1,846	0.4	0.2
Sub total	98,828	19.8	9.9
Additional 20%		23.7	11.9

Table 14: Projected demand for additional special purpose zoned land by 2031 Source: HillPDA 2017

PART THREE – STRATEGY AND FRAMEWORK

12. Introduction

Parts One and Two of this Strategy have informed where Dubbo is today and where we will be in the year 2031. Part Three brings together Parts One and Two to provide guidance as to how each respective employment lands precinct is best served to respond to identified trends and demand for floorspace and employment lands.

13. Planning Principles

The following Strategic Planning Policy Principles have been designed to enable the overall vision for the Dubbo Employment Lands Strategy to be achieved and provide guidance for future employment land development in Dubbo.

- 1. Strategically important employment lands are protected from incompatible rezoning's, incompatible uses and land use conflict.
- 2. Maintain Dubbo as the major employment and service centre of the Orana region.
- 3. Maintain and support the CBD as Dubbo's primary service and retail centre.
- 4. Structure Plans are prepared for undeveloped employment lands which consider opportunities and constraints to provide overarching guidance for development.
- 5. Ensure an adequate supply of appropriately located and serviced employment lands are maintained to facilitate Dubbo's short-term, medium-term and long-term growth.
- 6. Investigate opportunities for additional employment lands in West Dubbo to balance where Dubbo's residential development will occur in the future.
- 7. Infrastructure is appropriately planned to encourage sustainable development of employment lands.
- 8. Any proposals for new employment lands are adequately planned for to meet the long-term needs of Dubbo's industry and community.
- 9. Facilitate revitalisation of existing employment lands precincts to meet the changing needs of industry.
- 10. Encourage the clustering of industries which share similar synergies.
- 11. Proposed commercial zones are supported by an Economic Impact Assessment to ensure the activity centres hierarchy is protected and maintained.
- 12. Preserve employment land that can accommodate relatively large floor plates (larger sized lots) with access to main road networks or rail infrastructure.
- 13. Maintain the efficiency of Dubbo's key transport corridors.
- 14. Enable the development of dwelling houses in a manner which is cognisant with Council's focus of small scale tourist related uses in the Camp Road precinct.

14. Dubbo's Employment Land Precincts

14.1 Central Business District

The Central Business District (CBD) precinct consists of land zoned B3 Commercial Core and B4 Mixed Use. The precinct is Dubbo's primary commercial precinct and is supported by the adjoining B4 Mixed Use development to the east, which provides a mixture of commercial, tourist, accommodation and residential development.

14.1.1 B3 Commercial Core

Rationale

The CBD comprises 71 hectares of B3 Commercial Core zoned land being bounded by Cobra Street, Darling Street, Bligh Street and Erskine Street. The CBD is considered to be a principle activity centre and contains two large shopping centres on Macquarie Street including Dubbo Square and the Riverdale Shopping Centre.

Dubbo Square contains 12,700m² of gross floor area of retail floor space anchored by major retail chains including Target (5,476m²) and Coles (3,723m²). Riverdale Shopping Centre is situated on the northern end of Macquarie Street and anchored by retail chains Woolworths (2,727m²) and Reading cinemas (2,058m²). It provides a further 1,060m² of floor space in 10 specialty retailers.

Outside of these two shopping centres, the major retail and commercial shopping includes Myer (7,000m²) and Brennan's Mitre Ten (5,960m²) and also includes major employer Dubbo RSL (16,100m²).

Physical Characteristics

Land Area: 71 ha Vacant Area: 2.6 ha Occupied Area: 68.4 ha Gross Floor Area: 249,196m²

Opportunities

- The CBD Precincts Plan is maintained and implemented.
- Planning controls are reviewed to encourage urban renewal and new residential investment in the CBD.
- Encourage the conservation of heritage buildings.
- Encourage better utilisation and connection between the shop fronts and the river frontages.
- Alternative forms of transport should be encouraged for access around the CBD area including nonmotorised and renewable options.
- Consider how access and manoeuvrability for vehicles, pedestrians, cyclists and disabled can be improved throughout the precinct.
- Provide for suitable links between the CBD Precinct, Cultural Precinct, the Macquarie River Corridor and open space areas.
- Encourage the provision of public spaces that allow for further activation of the CBD.
- Facilitate alternative and short-term activities (such as placemaking) that add to the vibrancy and activity in the CBD.
- Encourage through urban design guidelines, the provision of mixed use and shop top housing to increase activity.
- Ensure new developments in the CBD that are consistent with the scale and importance of heritage items.
- Ensure Council policies encourage short-term activities and existing retailers.
- Ensure new buildings in the CBD area have active street frontages.
- Regulate development within the flood plain to be sympathetic to environmental constraints.
- Ensure development on main transport corridors do not impact on traffic efficiency.
- Ensure the CBD is maintained as the primary centre within the commercial centres hierachy.



Precinct Map 1: Central Business District B3





Precinct Guidance Map 2: Central Business District expansion - option 2

Key:

Outline of Investigation Area R1 General Residential R2 Low Density Residential B1 Neighbourhood Centre B3 Commercial Core B6 Enterprise Corridor SP2 Infrastructure SP3 Tourist RE1 Public Recreation RE2 Private Recreation Recreational Waterways

Precinct Guidance

Based on future demand projections out to the year 2031, Dubbo will have an undersupply of retail floorspace in the vicinity of 33,879m². The retail store types with the largest projected undersupply in the year 2031 includes supermarkets & grocery stores, speciality food stores, restaurants & cafes and department/discount stores. To ensure appropriately zoned commercial floorspace can be provided over the medium and long terms, investigations should be made with respect to identifying opportunities to expand the CBD. Such investigations could include an expansion into West Dubbo as shown in Precinct Guidance 1 and 2.

Alignment to Regional Plan 2036

Direction 10: Promote business and industrial activities in employment lands Direction 12: Plan for greater land use compatibility Direction 17: Conserve and adaptively re-use heritage assets Direction 22: Manage growth and change in regional cities and strategic and local centres Direction 23: Build the resilience of towns and villages Direction 27: Deliver a range of accommodation options for seasonal, itinerate and mining workforces Direction 29: Deliver healthy built environment and better urban design

- Strategically important employment lands are protected from incompatible rezoning's, incompatible uses and land use conflict;
- Maintain Dubbo as the major employment and service centre of the Orana region.
- Maintain and support the CBD as Dubbo's primary service and retail centre.
- Ensure an adequate supply of appropriately located and serviced employment lands are maintained to facilitate short-term, medium-term and long-term growth.
- Facilitate revitalisation of existing employment lands precincts to meet the changing needs of industry.
- Maintain the efficiency of Dubbo's key transport corridors

14.1.2 B4 Mixed Use

Rationale

Adjoining the CBD is approximately 36 hectares of B4 Mixed Use zoned land. This area accommodates a diverse range of uses including residential, accommodation, commercial, education, medical and health uses.

This area is intended for small scale commercial uses which provides an area for up-start businesses to operate from until they reach a size which is more conducive to the B3 Commercial Core Area. Currently, to ensure commercial uses do not significantly impact residential living, gross floor areas for commercial development is limited in size under Local Environmental Planning provisions. In this regard, business and office premises are limited to a maximum gross floor area of 200m² and retail uses 150m². Whilst the precinct is still dominated by residential development, since the gazettal of the Dubbo Local Environmental Plan 2011 there has been a reasonable distribution between residential and commercial related development lodged with Council.

Physical Characteristics

Land Area: 36 ha Vacant Area: 0.7 ha Occupied Area: 35.3 ha Gross Floor Area: 16,600m²

Opportunities

- Promote urban revitalisation and redevelopment as a mixed used area which supports the CBD as the primary commercial precinct.
- Protect and revitalise the heritage qualities of the area.
- To aid non-private transport convenience in the way of encouraging pedestrians, cyclist and public transport in the precinct by reinforcing appropriately developed land uses and improving the amenity of the area (i.e. shade, seating and better amenity).
- To provide and maintain appropriate pedestrian and non-motorised related transport links between the CBD and adjoining residential zone.
- Continue to monitor the effectiveness of the commercial related gross floor area restrictions provisions within the Dubbo Local Environmental Plan 2011.
- Avoid unsuitable development which would adversely impact on residential and small-scale commercial uses.
- Planning controls are reviewed to encourage urban renewal.
- Provide suitable linkages between the adjoining CBD Precinct, Cultural Precinct, Open Space and Recreational Precincts.
- Ensure development located on Cobra Street does not impact on traffic efficiency.

Alignment to Regional Plan 2036

Direction 10: Promote business and industrial activities in employment lands

Direction 12: Plan for greater land use compatibility

Direction 17: Conserve and adaptively re-use heritage assets

Direction 22: Manage growth and change in regional cities and strategic and local centres

Direction 23: Build the resilience of towns and villages

Direction 27: Deliver a range of accommodation options for seasonal, itinerate and mining workforces

Direction 29: Deliver healthy built environment and better urban design



Precinct Map 2: Central Business District B3



- Maintain and support the CBD as Dubbo's primary services and retail centre
- Facilitate revitalisation of existing employment lands precincts to meet the changing needs of industry.

14.2 Orana Mall Precinct

Rationale

The Orana Mall precinct comprises B2 Local Centre, B6 Enterprise Corridor and SP3 Tourist zones. The precinct is adjoined by public open space, recreational areas and residential development.

Orana Mall is a self-contained indoor shopping centre providing 23,667m² of floor space anchored by major retail chains Big W (8,205m²) and Woolworths (3,794m²) and contains over 50 specialty stores. The Orana Mall shopping centre is the second largest commercial centre in Dubbo which underwent significant expansion and redevelopment in 2015.

The precinct has good exposure to major transport routes being Wheelers Lane and Wellington Road (Mitchell Highway). Wide variety of uses include vehicle services, accommodation, food and drink, emergency services and health services.

The Orana Mall Precinct is a second order centre in Dubbo, prescribed as a 'Major Centre (Sub-Regional)' within the Commercial Centres Hierarchy, which sits below the CBD as the 'Principal Centre (Regional)'. It's role is to support and complement Dubbo's CBD as the Principal Centre by providing retail functions servicing the sub-regional area.

Physical Characteristics

Land Area: 11.78 ha Vacant Area: 0 ha Occupied Area: 11.78 ha Gross Floor Area: 42,455m²

Opportunities

- Facilitate non-private transport convenience in the way of encouraging pedestrians and cyclists in the precinct by enhancing the pedestrian and cyclist access to the site whilst encouraging the use of the public (bus) transportation system.
- Encourage the precinct to develop a distinct character that compliments rather than undermines the CBD precincts character and role.
- Encourage aesthetically pleasing development along Wheelers Lane, Windsor Parade and Wellington Road to compliment the open space parklands and major transport route into Dubbo.
- Maintain the efficiency of Wheelers Lane and Wellington Road by encouraging vehicle access on Windsor Parade.
- Ensure this precinct maintains its place within the Commercial Activity Hierarchy.
- Ensure planning controls are maintained which prohibits the shopping centre floorspace expanding where the CBD would be undermined.
- Ensure the precinct does not expand further through the rezoning of additional land.
- Opportunity to facilitate pedestrian linkage between the precinct, adjoining residential areas and adjoining open space/recreational areas.
- Maintain public transport links between the precinct and the CBD.

Alignment to Regional Plan 2036

Direction 10: Promote business and industrial activities in employment lands

Direction 12: Plan for greater land use compatibility

Direction 17: Conserve and adaptively re-use heritage assets

Direction 22: Manage growth and change in regional cities and strategic and local centres

Direction 23: Build the resilience of towns and villages

Direction 27: Deliver a range of accommodation options for seasonal, itinerate and mining workforces

Direction 29: Deliver healthy built environment and better urban design



Precinct Map 3: Orana Mall Precinct



Outline of Precinct R1 General Residential R2 Low Density Residential B2 Local Centre B6 Enterprise Corridor IN2 Light Industrial



- Maintain Dubbo as the major employment and serviced centre of the Orana region.
- Maintain and support the CBD as Dubbo's primary serviced and retail centre.
- Ensure an adequate supply of appropriately located and serviced employment lands are maintained to facilitate Dubbo's short-term, medium-term and long-term growth.
- Encourage the clustering of industries which share similar synergies.
- Maintain the efficiency of Dubbo's key transport corridors

14.3 Neighbourhood Centres

Rationale

Dubbo has eight (8) neighbourhood centres zoned B1 Neighbourhood Centre, spread throughout the urban area. The location of each neighbourhood centre is shown in Precinct Map 3. These are smaller scale centres which provide a variety of retail, business and community uses that serve the day-to-day needs of the local residential population.

Neighbourhood Centres provide convenient shopping to local residential and employment populations. They are generally small scale centres that provide a variety of retail uses, business premises or community uses. They are third order centres within the Dubbo commercial centers hierachy.

Neighbourhood Centre	Land Area	Vacant Area	Occupied Area	Gross Floor Area
Myall Street	0.55ha	0.27ha	0.28ha	730m ²
Websdale Drive	0.4ha	0.4ha	Oha	814m ²
Southlakes	2ha	2ha	Oha	0m² *
Boundary Road	1.1ha	Oha	1.1ha	2440m ²
Tamworth Street	0.5ha	Oha	0.5ha	2,481m ²
Delroy	1.3ha	Oha	1.3ha	4,400m ²
Victoria Street	0.8ha	Oha	0.8ha	1,500m²
Bourke Street	0.3ha	Oha	0.3ha	846m²
Total	6.95ha	2.67ha	4.28ha	13,229m ²

* Southlakes is currently undeveloped, however has provision for up to 5,000m² GFA

Alignment to Regional Plan 2036

Direction 10: Promote business and industrial activities in employment lands

Direction 12: Plan for greater land use compatibility

Direction 17: Conserve and adaptively re-use heritage assets

Direction 22: Manage growth and change in regional cities and strategic and local centres

Direction 23: Build the resilience of towns and villages

Direction 27: Deliver a range of accommodation options for seasonal, itinerate and mining workforces

Direction 29: Deliver healthy built environment and better urban design



Precinct Map 4: Neighbourhood Centres



14.3.1 Myall Street

Rationale

The Myall Street neighbourhood centre is located on the corner of Myall Street and John Glenn Place in East Dubbo. The centre has a frontage to Myall Street, a rear car park and vacant land which could accommodate further development. It comprises 730m² of retail floor space in 5 tenancies and currently contains one vacant tenancy. The tenancies currently comprise a hair salon, butcher, Mini-Mart and laundrette.

Opportunities

- Prepare site specific Development Control Plan for Neighbourhood Centres.
- Encourage the formalisation of the off-street car park at the rear of the neighbourhood shopping centre.
- Support the centre as a public transport node for East Dubbo linking to other major commercial centres including the CBD.
- Encourage the revitalisation of the shopping centre.
- Potential for beautification and activation of the front paved area.



Precinct Guidance Map 3: Myall Street Neighbourhood Centre



Existing B1 Neighbourhood Centre

Recommended Residential Zone

Key: Outline of Investigation Area B1 Neighbourhood Centre R1 General Residential R2 Low Density Residential RE1 Public Recreation

Precinct Guidance

Consideration should be given as to whether this entire parcel is required to be zoned B1 Neighbourhood Centre, noting the total area is 0.55ha. Investigations should be made with respect to rezoning the vacant area north of the existing car parking area, potentially to a residential zone.

- Maintain and support the CBD as Dubbo's primary service and retail centre
- Facilitate revitalisation of existing employment lands precincts to meet the changing needs of industry

14.3.2 Websdale Drive

Rationale

The Websdale Drive neighnourhood centre is located within Eastridge, East Dubbo. Development consent was granted by Council in 2009 for a 1,000m² supermarket, however to date, this site remains vacant and undeveloped. The Myall Street neighbourhood centre is located approximately 830 metres to the south west.

Opportunities

- Prepare site specific Development Control Plan for Neighbourhood Centres.
- Investigate East Dubbo's demand for a neighbourhood facility or the possible rezoning of the area to suit the demand of East Dubbo.
- Development of adjoining sites for medium density residential.





Existing B1 Neighbourhood Centre

Recommended Residential Zone

Precinct Guidance Map 4: Websdale Drive Neighbourhood Centre

Key: Outline of Investigation Area B1 Neighbourhood Centre R1 General Residential R2 Low Density Residential RE1 Public Recreation

Precinct Guidance

The Websdale Drive B1 zoned land benefits from a reasonable size catchment with some 3,000 residents offering higher spending capacity located within a 1km distance. On this basis Websdale Drive offers an opportunity to service the local community north of the Myall Street B1 neighbourhood shopping precinct.

However, it is considered that the Myall Street neighbourhood shops are not performing to their full potential and the construction of a neighbourhood shop upon Websdale Drive could further diminish Myall Street's ability to undergo revitalisation. Ultimately, it is considered that two neighbourhood shops are not required to service the East Dubbo residential catchment. It is therefore recommended that consideration be given to rezoning the Websdale Drive B1 Neighbourhood Centre zone to a suitable residential zone being R1 General Residential, or R2 Low Density Residential.

Such consideration for rezoning could also give due regards to the use and function of the RE1 Public Recreation land to the west.

Planning Principles

• Maintain and support the CBD as Dubbo's primary service and retail centre

14.3.3 Southlakes

Rationale

The Southlake's neighbourhood centre is zoned B1 Neighbourhood Centre in the Dubbo LEP 2011, situated on Boundary Road in south-east Dubbo. The site is currently undeveloped and no Development Applications have been submitted. The proposed centre will have an approximate trade area of 10,000 residents by 2031. The centre has a size requirement of up to 5,000m² Gross Floor Area.

Opportunities

- Prepare site specific Development Control Plan for Neighbourhood Centres.
- Encourage the appropriate development of the neighbourhood centre in terms of built form, scale and design which compliments the adjoining residential estates.
- Encourage non-private transportation mechanisms such as pedestrian, cyclist and public transport.
- Manage land use conflict between future commercial and residential uses.



Precinct Map 5: Southlakes Neighbourhood Centre



Planning Principles

Maintain and support the CBD as Dubbo's primary service and retail centre.

14.3.4 Boundary Road

Rationale

The Boundary Road neighbourhood centre is located in South Dubbo adjacent to the junction with Fitzroy Street. It includes the South Dubbo Tavern (1,040m²), a medical centre (520m²) and a further 10 specialty shops (880m²) including Australia Post, chemist, florist and a number of food and drink premises.

Opportunities

- Encourage revitalisation of the shopping centre and streetscape.
- Encourage access of non-motorised transportation such as pedestrian, cyclist linkages from adjoining residential areas to the centre.
- Identify improved parking and traffic management in the precinct.
- Extended trading hours for the food and drink and business premises.
- Protect and support the role of the centre in providing convenience shopping to the local catchment area.
- Act as a transportation node for the immediate area.
- Prepare site specific Development Control Plan for Neighbourhood Centres.
- Minimise land use conflicts with adjoining residential areas.



Precinct Map 6: Boundary Road Neighbourhood Centre



Outline of Precinct R1 General Residential



- Maintain and support the CBD as Dubbo's primary service and retail centre
- Facilitate revitalisation of existing employment lands precincts to meet the changing needs of industry.

14.3.5 Tamworth Street

Rationale

This Tamworth Street neighbourhood centre is situated in South Dubbo between Jubilee and Sterling Streets. It provides 2,481m² of retail floor space in 13 tenancies and is anchored by an IGA supermarket (1,030m²). It also contains a variety of convenience focused uses such as hairdressers, newsagent, food and drink premise (coffee shop) and a pharmacy.

Opportunities

- Encourage non-private transportation mechanisms such as pedestrian, cyclist and public transport.
- Improve the amenity of the streetscape.
- Identify improved parking and traffic management in the area.
- Protect and support the role of the centre in providing convenience shopping to the local catchment area.
- Prepare site specific Development Control Plan for Neighbourhood Centres.
- Minimise land use conflicts with adjoining residential areas.



Precinct Map 7: Tamworth Street Neighbourhood Centre



Outline of Precinct R1 General Residential R2 Low Density Residential B1 Neighbourhood Centre RE1 Public Recreation

- Maintain and support the CBD as Dubbo's primary service and retail centre.
- Facilitate revitalisation of existing employment lands precincts to meet changing needs of industry

14.3.6 Delroy

Rationale

Delroy Park is a new neighbourhood centre serving the surrounding residential catchment in West Dubbo. Delroy Park comprises 4,400m² of shopfront floor space of which 3,800m² (86%) relates to retail floor space. Delroy Park is anchored by Woolworths (2,500m²) and contains other retailers including a chemist, liquor store, bakery, Australia Post and a medical centre. It is a modern and well used centre having been constructed in 2010.

The centre serves as a convenience centre primarily for West Dubbo residents. With continued residential growth in south West Dubbo, the performance of Delroy Park will continue to improve with increased patronage.

Opportunities

- Encourage non-private transportation mechanisms such as pedestrian, cyclist and public transport.
- Act as a transportation node for the immediate area.
- Protect and support the role of the centre in providing convenience shopping to the local catchment area.
- Prepare site specific Development Control Plan for Neighbourhood Centres.



Precinct Map 8: Delroy Neighbourhood Centre



Outline of Precinct R1 General Residential R2 Low Density Residential B1 Neighbourhood Centre



Planning Principles

Maintain and support the CBD as Dubbo's primary service and retail centre.

14.3.7 Victoria Street

Rationale

The Victoria Street neighbourhood centre is located in West Dubbo adjacent to the Victoria Street/Whylandra Street intersection. Victoria Street provides around 1,500m² of Gross Floor Area (retailing) anchored by an IGA Supermarket (300m²). The Victoria Street neighbourhood shops underwent external refurbishment to the shop fronts including rebranding, with this somewhat improving its streetscape appearance.

Opportunities

- Encourage non-private transportation mechanisms such as pedestrian, cyclist and public transport.
- Improve the amenity of the streetscape.
- Identify improved parking and traffic management in the area.
- Protect and support the role of the centre. .
- Prepare site specific Development Control Plan for Neighbourhood Centres. .
- Minimise land use conflicts with adjoining residential areas.
- Improve vehicle access to rear carparking areas.



Precinct Map 9: Victoria Street Neighbourhood Centre

Outline of Precinct R1 General Residential

Key

B1 Neighbourhood Centre **B6 Enterprise Corridor**



SP2 Infrastructure SP3 Tourist

14.3.8 Bourke Street

Rationale

Bourke Street is a neighbourhood centre situated just north of the Dubbo CBD. The site comprises seven tenancies and is located on a major transport link, being the Newell Highway (Bourke Street). It performs the role of a local shopping centre providing convenience goods and services to North Dubbo residents, employees in the nearby industrial area and passing motorists.

Opportunities

- Protect and support the role of the CBD by providing local convenience shopping and services.
- Parking, traffic and pedestrian movement is managed with a view to improving. Pedestrian access is currently hindered due to it being adjacent to the Newell Highway.
- Revitalisation of the streetscape appearance would assist with further patronage and investment.
- Consolidation of development.
- Prepare site specific Development Control Plan for Neighbourhood Centres.

Precinct Guidance

Given its relatively close proximity to the CBD, the role of the Bourke Street Neighbourhood Centre should remain as local convenience centre providing goods and services for local residents, local workers and passing motorists. Consolidation and revitalisation should be considered over expansion in at least the short to medium term. Patronage would be improved with improved pedestrian access, however consideration would need to be given to manage the safety of pedestrians and motorists against the overall efficiency of the highway.



Precinct Map 10: Bourke Street Neighbourhood Centre



Outline of Precinct R1 General Residential B1 Neighbourhood Centre SP2 Infrastructure



- Maintain and support the CBD as Dubbo's primary service and retail centre.
- Facilitate revitalisation of existing employment lands precincts to meet the changing needs of industry.

14.3.9 North West Urban Release Area Neighbourhood Centre

Rationale

The North West Urban Release Area is located on the North Western fringe of Dubbo's urban area. It is identified as a residential growth area which is expected to see continued development and growth over the next 30 years.

Opportunities

- Prepare site specific Development Control Plan for Neighbourhood Centres.
- Investigate provision for convenience shopping for future local residential growth area.
- Encourage the appropriate development of the neighbourhood centre in terms of built form, scale and design which compliments the future adjoining residential estate.
- Encourage non-private transportation mechanisms such as pedestrian, cyclist and public transport.
- Future neighbourhood centre to be in a suitable location that enables effective access and linkages.
- Investigation of a mixed use zone to support the precinct.
- Future neighbourhood centre and mixed use zones are supported with suitable vehicle, pedestrian and cycle linkage.



Precinct Guidance Map 5: North West Urban Release Area Neighbourhood Centre

Key:


a) Neighbourhood Centre

This area will see approximately 2,600 dwellings developed over the next 30 years with an estimated population catchment of 7,500 people. Given the trend of smaller supermarkets to be located on residential fringe areas to provide convenience shopping, the anticipated population catchment would likely warrant a neighbourhood shopping centre to be provided within the North-West Urban Release Area. It is therefore recommended that consideration be given to providing a future B1 Neighbourhood Centre zone within a suitable location once a sufficient level of residential development has been developed which would warrant local convenience shopping.

b) Mixed zone use

Noting the significant residential growth of this area over the next 30, it recommended that a mixed use zone, such as the B4 Mixed Use zone, be investigated for this precinct. A mixed use zone in this location could provide compatible small-scale commercial development allowing opportunities for people to work close to their homes whilst also providing services to support this precinct. Any future mixed use zone should be considered as part of any future Structure Planning process with a view to allow a sufficient level of residential development to materialise within the north-western residential precinct to ensure such zone can succeed through the support of a suitable population catchment.

Any future investigation of a mixed use zone in this precinct should be considered within the Structure Planning process for the North-West Urban Release Area, particularly noting its relationship to the recommended B1 Neighbourhood Centre as well as future transport links within the Transportation Strategy.

Additionally, planning controls relating to the maximum floor space requirements for commercial uses including retail, business and office premises, should be considered in relation to providing sufficient employment opportunities and services for this area.

- Maintain and support the CBD as Dubbo's primary service and retail centre.
- Investigate opportunities for additional employment lands in West Dubbo to balance where Dubbo's residential development will occur in the future.
- Any proposals for new employment lands are adequately planned for to meet the long-term needs of Dubbo's industry and community.
- Proposed commercial zones are supported but an economic impact assessment to ensure the activity centred hierarchy is protected and maintained.

14.4 Enterprise Corridors

Dubbo has two (2) B6 Enterprise Corridor precincts which are located along Victoria Street in West Dubbo and Bourke Street in North Dubbo.

14.4.1 Bourke Street

Rationale

Bourke Street B6 Enterprise Corridor Precinct comprises Dubbo's 'auto-alley' with a significant number of automotive related uses. Tenancies in this area are dominated by vehicle sales, vehicle servicing, vehicle smash repairs and retail automotive shops. The precinct has seen some redevelopment, particularly to the existing vehicle sales premium, with construction of new showroom.

Physical Characteristics

Land Area: 21.06ha Vacant Area: 0.27ha Occupied Area: 20.79ha Gross Floor Area: 6,770m²

Opportunities

- Encourage the use of rear or side lanes for delivery access.
- Identify areas of land use conflicts (light industrial and residential) to help limit the impacts of these conflicts.
- Investigate the viability of expanding the B6 Enterprise Corridor east into River Street.
- Potential for revitalisation and beautification.
- Potential for redevelopment given its prominent exposure on a major transport route.
- Regulate development within the flood plain to be sympathetic to the environmental constraints.
- Investigate opportunities to integrate the proposed River Street bridge with Bourke Street (Newell Highway).
- Encourage high quality development along Bourke Street as a main entry point to the City.
- Investigate opportunities to resolve parking and traffic issues.
- Ensure development on main transport corridors do not impact on traffic efficiency.
- Ensure the CBD is not undermined through inappropriate development.

Alignment to Regional Plan 2036

Direction 10: Promote business and industrial activities in employment lands

Direction 12: Plan for greater land use compatibility

- Direction 17: Conserve and adaptively re-use heritage assets
- Direction 22: Manage growth and change in regional cities and strategic and local centres
- Direction 23: Build the resilience of towns and villages

Direction 27: Deliver a range of accommodation options for seasonal, itinerate and mining workforces

Direction 29: Deliver healthy built environment and better urban design



Precinct Map 11: Bourke Street Enterprise Corridor



Investigate an expansion of the B6 Enterprise Corridor zoning east along River Street. The investigation will need to be supported by economic studies considering the demand and supply of this type of employment lands.

This is further expanded on in the North Dubbo Industrial precinct.

- Maintain Dubbo as the major employment and service centre of the Orana region.
- Ensure an adequate supply of appropriately located and serviced employment lands are maintained to facilitate short-term, medium-term and long-term growth.
- Facilitate revitalisation of existing employment lands precincts to meet the changing needs of industry.
- Maintain the efficiency of Dubbo's key transport corridors
- Preserve employment land that can accommodate relatively large floor plates (larger sized lots) with access to main road networks or rail infrastructure.

14.4.2 Victoria Street

Rationale

The Victoria Street B6 Enterprise Corridor Precinct contains a large proportion of automotive related uses including vehicle sales, servicing and hire. This is primarily as a result of its good visual exposure on a major transport route (Mitchell Highway).

Physical Characteristics

Land Area: 4.82ha Vacant Area: 0ha Occupied Area: 4.82ha Gross Floor Area: 17,570m²

Opportunities

- Support the existing character of the precinct as a vehicle sales and hire precinct.
- Monitor potential vehicle conflicts as Victoria Street functions as a highway.
- Ensure development does not impact on traffic efficiency of Victoria Street (Mitchell Highway).
- Develop a long term traffic management and parking plan for this strip.
- Improve the amenity of the streetscape through revitalisation and redevelopment.
- Monitor adjoining land uses with a view to minimise potential of land use conflicts.
- Encourage high quality development along Victoria Street as a main entry point to the city.
- Ensure the CBD is not undermined through inappropriate development.
- Commercial and light industrial development withe side or rear vehicle access through residential streets have due regard to impact on amenity.

Alignment to Regional Plan 2036 Direction 10: Promote business and industrial activities in employment lands Direction 12: Plan for greater land use compatibility Direction 17: Conserve and adaptively re-use heritage assets Direction 22: Manage growth and change in regional cities and strategic and local centres

Direction 23: Build the resilience of towns and villages

Direction 27: Deliver a range of accommodation options for seasonal, itinerate and mining workforces

Direction 29: Deliver healthy built environment and better urban design



Precinct Map 12: Victoria Street Enterprise Corridor



This precinct has a small number of dwellings which are operating under existing use rights. Additionally, the precinct adjoins an established residential area to the north and south.

It is recommended that a buffer be created between the precinct and the adjoining residential areas. Given the residential areas are established, a buffer will assist with minimising land use conflicts. Additionally, it is recommended that opportunities to remove existing dwellings from the precinct are taken to minimise land use conflict.

- Maintain Dubbo as the major employment and service centre of the Orana region
- Ensure an adequate supply of appropriately located and serviced employment lands are maintained to facilitate Dubbo's short-term, medium-term and long-term growth.
- Facilitate revitalisation of existing employment lands precincts to meet the changing needs of industry.
- Maintain the efficiency of Dubbo's key transport corridors.

14.5. Bulky Good Precincts

14.5.1 Cobra Street

Rationale

Cobra Street B5 Business Development zone is a Major Activity Centre comprising of approximately 10 hectares of land. The site contains predominantly bulky goods retailing including Harvey Norman, The Good Guys and Fantastic Furniture. These major retailers attract a wider audience from the Orana region. The precinct has good exposure and access to the Mitchell Highway (Cobra Street).

Physical Characteristics

Land Area: 10ha Vacant Area: 2.2ha Occupied Area: 7.8ha Gross Floor Area: 26,552m²

Opportunities

- Encourage interconnections of parking areas at rear.
- Establish a character for ready-made household-bulky goods.
- Adjoining light industrial to the south could be a supportive industry to this precinct.
- Lot areas are of a sufficient size to allow large format bulky retailers to be developed.
- Ensure high quality development is maintained along the road frontage.
- Ensure development does not impact on the traffic efficiency of Cobra Street.
- Ensure the CBD is not undermined through inappropriate development.
- Service and transport vehicle access is from Hawthorn Street where available.

Alignment to Regional Plan 2036

Direction 10: Promote business and industrial activities in employment lands

Direction 12: Plan for greater land use compatibility

Direction 17: Conserve and adaptively re-use heritage assets

- Direction 22: Manage growth and change in regional cities and strategic and local centres
- Direction 23: Build the resilience of towns and villages

Direction 27: Deliver a range of accommodation options for seasonal, itinerate and mining workforces

Direction 29: Deliver healthy built environment and better urban design



Precinct Map 13: Cobra Street B5 Business Development



ial R2 Low

R2 Low Density Residential B5 Business Development IN2 Light Industrial SP2 Infrastructure SP3 Tourism RE1 Public Recreation

- Maintain the efficiency of Public is key transport corridors
- Maintain the efficiency of Dubbo's key transport corridor

14.5.2 West Dubbo

Rationale

West Dubbo B5 Business Development zone contains approximately 2.29 hectares of land. The precinct contains a wide variety of uses including retail auto parts supply, light industrial uses, car wash, auto repair workshops, warehouses, emergency services (fire station), car sales and self-storage units.

Physical Characteristics

Land Area: 2.29ha Vacant Area: Oha Occupied Area: 2.29ha Gross Floor Area: 8751m²

Opportunities

- Minimise land use conflict arising between existing commercial and light industrial uses and nearby residential land uses.
- Investigate suitable zone for the precinct.
- Ensure development does not impact on traffic efficiency along Whylandra Street.
- Ensure the CBD is not undermined through inappropriate development.

Alignment to Regional Plan 2036 Direction 10: Promote business and industrial activities in employment lands Direction 12: Plan for greater land use compatibility Direction 17: Conserve and adaptively re-use heritage assets Direction 22: Manage growth and change in regional cities and strategic and local centres Direction 23: Build the resilience of towns and villages Direction 27: Deliver a range of accommodation options for seasonal, itinerate and mining workforces



Precinct Map 14: West Dubbo B5 Business Development



Outline of Precinct R1 General Residential

R2 Low Density Residential B5 Business Development



Precinct Guidance

This precinct was identified for bulky goods industry in the Commercial Areas Development Strategy. However, the precinct now contains a wide variety to uses ranging from commercial to light industrial and is developed with limited potential to develop further. Given this strategy recommends that a B5 Business Development zone be investigated within the Airport Precinct it is considered appropriate for that area to become the primary consolidated area for bulky good uses in West Dubbo. Given its isolated location with unfavourable vehicle access from the highway, particularly for larger trucks and service vehicles, it is not an ideal location for the development of bulky good uses. Given the location of this precinct to the CBD, access to the highway and adjoins residential development, it would suit uses which have minimal impact on noise sensitive receivers, do not require large vehicle access from the highway and uses which support the CBD operations requiring a large floorspace.

It is recommended that consideration of a zone, such as B6 Enterprise Corridor, which is more conducive to the existing uses and that would encourage bulky good businesses to consolidate to existing or proposed B5 Business Development zones, be investigated.

- Maintain Dubbo as the major employment and service centre of the Central West region.
- Facilitate revitalisation of existing employment lands precincts to meet the changing needs of industry.
- Maintain the efficiency of Dubbo's key transport corridors.

14.6 Cobbora Road and Erskine Street Commercial Precinct

Rationale

The precinct is zoned B5 Business Development and B6 Enterprise Corridor and is located immediately north of the CBD. The 12ha bulky goods precinct and 6.61ha Enterprise Corridor at Cobbora Road/Erskine Street is focused on the provision of wholesale trade related goods which may also sell to the public. The area is located over a major transport route, Erskine Street (Newell Highway and Golden Highway) and therefore businesses enjoy good exposure.

Physical Characteristics

Land Area: 18.61 ha Vacant Area: 3.67ha Occupied Area: 14.94 ha Gross Floor Area: 36,122 m²

Opportunities

- Minimise land use conflict arising between commercial land use activities and residential land uses.
- Monitor potential vehicle conflicts on Erskine Street.
- Redevelopment of redundant and non-used railway sites.
- Beautification of the streetscape amenity.
- Regulate development within the flood plain to be sympathetic to the environmental constraints.
- Ensure the CBD is not undermined through inappropriate development.
- Uses with access on Mansour and Young Streets have due regard to residential development.

Alignment to Regional Plan 2036

Direction 10: Promote business and industrial activities in employment lands

Direction 12: Plan for greater land use compatibility

Direction 17: Conserve and adaptively re-use heritage assets

- Direction 22: Manage growth and change in regional cities and strategic and local centres
- Direction 23: Build the resilience of towns and villages

Direction 27: Deliver a range of accommodation options for seasonal, itinerate and mining workforces

Direction 29: Deliver healthy built environment and better urban design

















R1 General Residential B1 Neighbourhood Centre **B3** Commercial Core



Erskine Street

Bour



Cobbora Road

14.7 Health, Well-being and Education Precinct

Rationale

The Health, Well-being and Education Precinct is zoned SP2 Infrastructure and SP3 Tourist and is located just under two kilometres or a three minute drive to the north-east of the Dubbo Railway Station. The precinct is bounded by the northern side of Cobbora Road and western side of McGrane Tony Place/Yarrandale Road. The Myall Street and Cobbora Road SP3 Tourist site is located to the south of Cobbora Road and north of Myall Street, containing self-serviced apartments and residential dwellings.

The precinct has seen significant development over recent years, particularly with the redevelopment of the Dubbo Base Hospital.

The precinct contains Dubbo Base Hospital, Dubbo Private Hospital, Charles Sturt University, Lourdes Hospital, Dubbo Collage Senior Campus and Sydney University of Rural Health. There is also TAFE Western, Macquarie Homestay and Manera Heights Apartments, Western College of Adult Education and Manera Plaza medical specialists all located in close proximity which support this precinct. The major land uses of health, aged care, education and accommodation related services, provided a combined floor area of 180,008m².

Physical Characteristics

Land Area: 74.57ha Vacant Area: 29.28ha Occupied Area: 45.29ha Gross Floor Area: 180,008m²

Opportunities

- Creation of synergies between the various health, aged care, education and recreational uses.
- Facilitate the expansion of more private health and education related development within the precinct.
- Development of sporting facilities within the large undeveloped areas integrating with existing health and education facilities.
- Recognise the important relationship between the Health, Well-being and Education Precinct and the regional, sub-regional and urban locality.
- Provide appropriate infrastructure to facilitate the growth of the precinct.
- Ensure the transportation network is appropriate to encourage efficiency and ease of linkage within and to the precinct.
- Encourage non-private transportation methods such as pedestrian, cycling and public transportation systems.
- Encourage provision of services to support existing and future users of the Health, Well-being and Education Precinct such as accommodation and medical related business and industry private food services.
- Ensure an attractive and distinctive environment is provided for tourists and tourist operations.
- Support the Health, Well-being and Education Precinct with providing short-term accommodation.
- Provide interconnected transportation systems linking to the CBD.
- Activation of the area through onsite village style living which could include accommodation and support services including convenience shopping, food and drink.
- Resolve amenity conflicts with adjoining uses.
- Investigate provision of a Neighbourhood Centre to fulfill the daily needs of precinct users.

Alignment to Regional Plan 2036

Direction 5: Improve access to health and aged care services Direction 6: Expand education and training opportunities Direction 10: Promote and industrial activities in employment lands Direction 19: Enhance road and rail freight links Direction 20: Enhance access to air travel and public transport



a) Mixed Use Zone

With health care and social assistance and education and training being Dubbo's number one and number three largest employment sectors respectively, the Health, Well-being and Education Precinct is one of Dubbo's most important Employment Lands Precincts, both with respect to the number of jobs generated and its service catchment being of a regional scale. The precinct includes Dubbo Base Hospital, Lourdes Hospital, Holy Spirit Aged Care, Charles Sturt University, Sydney University School of Rural Health, Dubbo Private Hospital and Dubbo College Senior Campus.

The Dubbo Base Hospital is currently undergoing significant redevelopment with continued government funding which is expanding the range of services, such as the development of the Western Cancer Centre. The redevelopment will cement the hospital as a major referral centre servicing Western NSW.

Additionally, significant sporting facilities including cycle track and velodrome and Western Region Institute of Sport complex are now planned in the precinct. These uses will create further opportunities for not only a regional sporting hub, but infrastructure, development and services to support this hub.

It is recommended that investigations be undertaken to create a suitable zone over the existing residential area located between the Dubbo Base Hospital site and Lourdes Hospital, with the vision to create opportunities for the Health, Well-being and Education precinct. Any potential zone should consider opportunities that include expanding and facilitating private health, education, accommodation and support services such as food and drink premises.

Noting the vision of this recommendation, consideration should be given to ensuring development of this area does not expand significantly outside of health, aged care, well-being, education and accommodation related development.

b) Site Specific Development Control Plan (DCP)

A site-specific Development Control Plan (DCP) should be implemented for the proposed mixed use zone area within Leonard and Caroline Street. This guidance is expected to provide future development in the area and a set of standards in which to measure that the amenity of the neighbourhood is protected. Some of the standards will include suitable provision of parking, landscaping, front street appearance, traffic and set-backs.

c) Macquarie Home Stay

Dubbo Macquarie Home Stay is currently being constructed on the land identified below. It provides affordable accommodation for those needing to be located in close proximity to the Dubbo Base Hospital. The land was residue as a result of the Yarrandale Road realignment and is zoned RE2 Private Recreation. Given stage 1 of the development has been constructed on the site and its intrinsic relationship to the adjoining Health, Wellbeing and Education Precinct, consideration should be given to zoning it SP3 Tourist. Such zone would allow Macquarie Home Stay to remain as a permissible land use but also allow any vacant or residue land to continue providing accommodation related development to support this precinct.

d) Precinct Plan

Discussions with stakeholders within the precinct indicate a desire for Council to further engage with property owners to provide synergy between all existing and future infrastructure and services and facilitate provision for future development which support the precinct. It is therefore recommended that a precinct plan be developed for the Health, Well-being and Education Precinct analysing constraints and opportunities with the ultimate aim of providing synergy between the existing and future health, aged care, education, sporting facilities, commercial and retail uses and facilitate further uses and development which supports the precinct. There is opportunity to provide future development guidance through the preparation of a precinct plan in consultation with stakeholders that takes a holistic view of opportunities for this precinct. As part of the precinct planning process, consideration should be given to facilitating zones which reflect the recommendations of any future adopted precinct plan.

Additionally, whilst the SP2 Infrastructure zone best suits the requirements of the existing health, aged care and education facilities including Charles Sturt University and Dubbo College Senior Campus, any opportunities for uses outside of these could be supported and facilitated through a land use zoning change in line with any future adopted precinct plan.

e) Neighbourhood Centre

Investigations should be undertaken into the economic feasibility of allowing a neighbourhood centre in a consolidated area within the precinct to provide convenience shopping for visitors, residents and student population. Noting the intended growth of this precinct over the next decade, a neighbourhood centre would provide support and assist with the appropriate growth management of this precinct.

It is suggested that the area shown in blue on Precinct Map 6 could be suitable for this type of land use. The area is located centrally within the precinct allowing for greater accessibility. It is recommended that further investigations be made once the Precinct Plan is developed.

f) Myall Street and Cobborah Road Land Use

The area bounded by Myall Street, Cobbora Road and Barden Avenue has the opportunity to provide a significant supporting role to the Health, Well-being and Education Precinct. Noting the identified infrastructure planned in this precinct and number of employees which will be required to support such infrastructure, this area would suit provision for accommodation for both short and medium term stays as well providing higher density accommodation to support longer term stays and workers.

It is recommended that two separate zones be investigated for this area to provide a distinction between the short and medium term accommodation and higher density residential development and ensure the different forms of development are consolidated into defined areas. In this respect, the following comments are made:

i) The area contains an existing area zoned SP3 Tourist which comprises serviced apartments with approval to extend further east. Noting the significant growth potential of this precinct, consideration should be given to further extending this zone east along Cobbora Road (Golden Highway). It is considered that this is a long term action given there would appear to be a sufficient supply of SP3 Tourist zoned land in this location. However, it is recommended that development and growth of accommodation services within the existing SP3 Tourist zoned land be monitored with the zoning extension to be undertaken as required to support this precinct.

It is considered that the SP3 Tourist would be best located fronting Cobbora Road as identified in Precinct Guidance Map 6. The existing land zoned SP3 Tourist should be maintained with a view with this area to be developed prior to considering the SP3 Tourist land expansion.

ii) The existing residential zoned land not identified for SP3 Tourist, should be considered for higher density residential, such as R1 General Residential with a view to facilitate and support the workforce and student populations in this precinct. The higher density residential zone is better suited to this location given its access onto Myall Street and Barden Avenue which contain lower traffic volumes and therefore more appropriate for residential related vehicle access as well as not interfering with the traffic efficiency of the highway.

Both of the items identified above should be considered in conjunction with the preparation and adoption of the Precinct Plan.



- Strategically important employment lands are protected from incompatible rezoning's, incompatible uses and land use conflict.
- Maintain and support the CBD as Dubbo's primary service and retail centre.
- Structure Plans are prepared for undeveloped employment lands which consider opportunities and constraints to provide overarching guidance for development.
- Ensure an adequate supply of appropriately located and serviced employment lands are maintained to facilitate Dubbo's short-term, medium-term and long-term growth.
- Infrastructure is appropriately planned to encourage sustainable development of employment lands.
- Any proposals for new employment lands are adequately planned for to meet the long-term needs of Dubbo's industry and community.
- Facilitate revitalisation of existing employment lands precincts to meet the changing needs of industry.
- Encourage the clustering of industries which share similar synergies.
- Maintain the efficiency of Dubbo's key transport corridors

14.8 Airport Precinct

Rationale

The precinct provides a total of approximately 67,107m² Gross Floor Area (GFA) of employment floor space, of which IN2 Light industrial zoned land comprised 27,330m² GFA containing transport, postal and warehousing uses while a further 8,450m² includes uses occupied by wholesale trade uses.

The precinct provides an additional 23,415m² GFA of employment floor space zoned SP2 Infrastructure, of which all was occupied by the Dubbo Regional Airport and Orana Juvenile Justice Centre.

The principle feature of this precinct is the Dubbo City Regional Airport which is one of the leading regional airports in Australia. The Dubbo City Regional Airport is strategically vital to the region, serving not only Western NSW but a large area of the Central West and north-west of the State. The Airport is the largest airport facility in the Orana and Central West Regions and provides services for a catchment in excess of 200,000 persons. The Airport also has significant general aviation activity with a total of 6,234 movements. The general aviation movements comprise charter, flight training, air-freight, air ambulance, aerial agriculture, parachuting, military and VIP flights. The Airport is also used for the purposes of refuelling transiting aircraft.

The airport precinct has recently seen significant interest from emergency services seeking to construct emergency services facilitates in conjunction with existing airport facilities and infrastructure. The Rural Fire Services, State Emergency Services and Volunteer Rescue Association have either commenced or are planning emergency services facilities on the land with the Rural Flying Doctor Services undertaking an aeromedical facility.

Rural-Residential uses are present within the precinct reducing the development potential of these lots for industrial purposes while increasing potential for land use conflicts. Rural-Residential uses comprised 25% of the precinct (77.8 hectares).

Physical Characteristics

Land Area: 641.9 ha Vacant Area: 232.4 ha Occupied Area: 409.5 ha Gross Floor Area: 67,108m²

Opportunities

- Enhance transportation links between key industrial areas and arterial roads.
- Uses are supported with the appropriate provision of infrastructure.
- Development which supports the Dubbo City Regional Airport as regionally significant infrastructure is encouraged.
- Monitor land uses and the potential for conflict.
- Encourage high quality development which does not impact the function of the airport.
- Structure plan be prepared to provide guidance for undeveloped land.
- Maintain the Dubbo City Regional Airport Masterplan.
- Development maintains the efficiency of Narromine Road (Mitchell Highway).
- Ensure Dubbo City Regional Airport is maintained as the regions major airport.
- Ensure surrounding development does not impact the airports Obstacle Limitation Surface.

Alignment to Regional Plan 2036

Direction 20: Enhance access to air travel and public transport Direction 21: Coordinate utility infrastructure investment Direction 22: Manage the growth and change in regional cities and strategic and local centres



Precinct Map 17: Airport Precinct



Outline of Precinct RU1 Primary Production R2 Low Density Residential R5 Large Lot Residential IN2 Light Industry IN3 Heavy Industry SP2 Infrastructure RE1 Public Recreation

a) Commercial Zone

Dubbo's employment lands have largely focused towards Dubbo's east being where the majority of residential development has occurred over the last 20 years. However, with a projected undersupply of commercial floorspace and the future of Dubbo's residential development moving to the west, a commercial land supply should be considered in West Dubbo to meet demand over the long term.

The B5 Business Development zone allows a variety of permissible uses which would support and service the West Dubbo population catchment, nearby industrial zones and Dubbo City Regional Airport. The B5 Business Development zone is flexible in allowing a mixture of large format commercial uses including bulky goods, warehouse and distribution centres as well as a range of light industrial uses including industrial training facilities, freight transport, passenger, transport and truck depots. This provides a good mixture of uses given its location adjacent to the Mitchell Highway.

Analysis in Part 2 of this report has shown that to meet the required industrial land supply demand in 2031, 53 to 80 hectares of industrial zoned land should be available for development. As there is currently 724 hectares of vacant/ undeveloped industrial zoned land within the former Dubbo City Council area, there is an ample supply of industrial zoned land available to cater for future demands.

It is desirable for bulky goods uses to be consolidated and clustered together into defined areas. The land as shown below, is considered suitable as it provides one large parcel rather than creating several smaller pieces of land. This rezoning would also have minimal impact on the supply of industrial zoned land or jobs, particularly noting that the current Dubbo Local Environmental Plan 2011 permits several light industrial uses within the B5 Business Development zone.

Key:

Outline of Investigation Area RU1 Primary Production R2 Low Residential R5 Large Lot Residential IN2 Light Industrial IN3 Heavy Industry B5 Business Development

Prior to the rezoning of this land, an Economic Impact Assessment should be undertaken to ensure its impact on the employment land hierarchy is not significantly impacted.





Recommended B5 Business Development

Precinct Guidance Map 7: West Dubbo Commercial Zone

b) Structure Planning

Existing IN2 Light Industrial

It is recommended that a structure plan be developed for the Airport Precinct. The airport land is currently subject to significant development of government related emergency services facilities with further opportunity for development in the future. Of the developed land within this precinct, 64% is attributed to transport, postal and warehousing uses with a further 20% attributed to wholesale trade uses.

Structure planning should be undertaken for this precinct to provide overarching guidance as to how the undeveloped land can be furthered in conjunction with existing development.

Future planning considerations within this precinct should consider opportunities to provide greater support to the Airport land through provision of air transport, warehousing and distribution and emergency services related development.

c) ICA 2 Airport Precinct (previously Mitchell/Rosedale)

The ICA 2 is located within the Airport Precinct as seen in Figure 14. ICA 2 was identified as a long term industrial expansion area given its location and access to the airport and highway. Its identified role was to allow the development of industries relating to the airport and its access to a highway. Such uses include air freight and transport, road transport as well as compatible light industrial and agricultural services.

Some of ICA 2 has been zoned industrial under previous Local Environmental Plans with approximately 222 hectares of identified ICA not zoned for industrial. Dubbo has a significant level of industrial zoned land with approximately 724 hectares of vacant/undeveloped land with 53 to 80 hectares required to meet future demand to the year 2031. Additionally, this precinct has approximately 232.4 hectares of vacant area. Given the oversupply of land both within the City and this precinct, consideration for ICA 2 should be investigated as a long term action.



Precinct Guidance Map 8: Industrial Candidate Area 2 - Airport Precinct

Key:

Outline of ICA's which have been rezoned Outline of ICA's which have not been rezoned RU1 Primary Production R2 Low Density Residential R5 Large Lot Residential IN2 Light Industry IN3 Heavy Industry SP2 Infrastructure RE1 Public Recreation

- Strategically important employment lands are protected from incompatible rezoning's, incompatible uses and land use conflict.
- Maintain Dubbo as the major employment and service centre of the Orana region
- Structure plans are prepared for undeveloped employment lands which consider opportunities and contraints to provide overarching guidance for development.
- Ensure an adequate supply of appropriately located and serviced employment lands are maintained to facilitate short-term, medium-term and long-term growth.
- Investigate opportunities for additional employment lands in West Dubbo to balance where Dubbo's residential development will occur in the future.
- Infrastructure is appropriately planned to encourage sustainable development of employment lands.
- Any proposals for new employment lands are adequately planned for to meet the long-term needs of industries and growth management directions of the City of Dubbo.
- Encourage the clustering of industries which share similar synergies.
- Proposed commercial zones are supported by an Economic Impact Assessment to ensure the activity centres hierarchy is maintained.
- Preserve employment land that can accommodate relatively large floor plates (larger sized lots) with access to main road networks or rail infrastructure.

14.9 Industrial Precincts

Rationale

There are four (4) distinct light industrial precincts spread throughout Dubbo as shown in precinct Map 12. These are discussed individually below.

14.9.1 Jannali and Depot Roads

Rationale

The precinct is zoned IN2 General Industrial and located approximately two and a half kilometres or a four minute drive to the north west of Dubbo Railway Station. The precinct has good connectivity and access to Dubbo town centre via Victoria Street and the Newell Highway.

In total the precinct comprises 36.2 hectares of industrial zoned land with 8.1 hectares or 22% being vacant or developed land as of 2017. All of the vacant lots were located within the northern section of the precinct along Jannali Road.

The precinct provides approximately 49,290m² GFA of employment floor space, of which 13,340m² or 27% can be attributed to transport, postal and warehousing uses. The next largest industry, by total floor space, was construction which occupied around 14,353m² GFA or 29%.

Physical Characteristics

Land Area: 36.3 ha Vacant Area: 14.7 ha Occupied Area: 21.6 ha Gross Floor Area: 49,706m²

Opportunities

- Enhance transportation links between key industrial areas and arterial roads.
- Support industrial uses with appropriate provision of infrastructure.
- Monitor adjoining land uses and the potential for conflict.
- Industrail lots with direct access to railway infrastructure.
- Lots within the precinct have access to Jannali Road and Depot Road rather than directly onto the highway.
- Precinct contains a mixture of small and large sized lots allowing a range of different industrial uses.
- Larger sizes lots on Jannali Road should be protected when possible.

Alignment to Regional Plan 2036

Direction 2: Grow the agribusiness sector and supply chains Direction 3: Develop advanced manufacturing and food processing sectors Direction 8: Sustainably manage mineral resources Direction 10: Promote business and industrial activities in employment lands Direction 19: Enhance road and rail freight links



Precinct Map 18: Jannali and Depot Roads

Key: **Outline of Precinct R2 Low Density Residential**

IN2 Light Industrial SP2 Infrastructure

RE1 Public Recreation

14.9.2 East Dubbo Light Industrial

Rationale

The precinct provides approximately 107,461m² GFA of floorspace, of which around 10,400m² or 10% is vacant floorspace. Major land uses within the precinct, by total floorspace, were attributed to construction, occupying 23,970m² or 22% of total GFA, followed by transport and warehousing which occupied around 21,630m² or 20% of total GFA.

The precinct comprises a total of 93.8 hectares of industrial zoned land with 23.9 hectares or 25% being vacant or undeveloped land as of 2017. However, much of this vacant land is attributed to land identified for the Inland Rail Maintenance Facility, which will occupy a footprint of approximately 25 hectares. Of this 25 hectares, with 18 hectares is zoned IN2 Light Industrial. The remaining area is zoned a combination of SP2 Infrastructure, RE1 Public Recreation and RE2 Private Recreation, some outside of the precinct identified within the precinct.

Physical Characteristics

Land Area: 93.2 ha Vacant Area: 28.2 ha Occupied Area: 65 ha Gross Floor Area: 107,461m²

Opportunities

- Most of the precinct has a good buffer between residential uses minimising land use conflict. This buffer should be maintained.
- Provide high quality aesthetically pleasing development along Wheelers Lane.
- Investigate the zoning of industrial land on Wheelers Lane to consider if any commercial zoning may be suitable.
- Ensure development does not interfere with the efficiency of Wheelers Lane.
- Monitor and manage land use conflicts with adjoining residential areas and dwellings in the precinct.
- Support the development of the Inland Rail Maintenance Facility once operational.
- Protect existing buffers on Mountbatten and Douglas Mawson Drivws to existing residential areas.

Alignment to Regional Plan 2036

Direction 2: Grow the agribusiness sector and supply chains Direction 3: Develop advanced manufacturing and food processing sectors Direction 8: Sustainably manage mineral resources Direction 10: Promote business and industrial activities in employment lands Direction 19: Enhance road and rail freight links



Precinct Map 19: East Dubbo Light Industrial Precinct



B1 Neighbourhood Centre B2 Local Centre B5 Business Development B6 Enterprise Corridor IN2 Light Industrial SP2 Infrastructure SP3 Tourist RE1 Public Recreation RE2 Private Recreation



Precinct Guidance Map 9: Investigation Area

a) Commercial Zone

It is recommended that an investigation of the IN2 Light Industrial zoned land, as identified in the Precinct Guidance Map 9, be investigated with a view to rezoning to a suitable commercial zone. The existing development within this area has appeared to become more closely aligned with that of a commercial zone. Given the locality is within close proximity to a residential area and Wheelers Lane, this would appear to be beneficial and presents an opportunity to support this trend. Noting that traffic volumes on Wheelers Lane are typically expected to increase over the long-term, there is an opportunity for commercial uses, integrating with light industrial uses. Additionally, given traffic volumes on Wheelers Lane, industrial development is not ideal as any increase in this form of development has the potential to impact the efficiency of Wheelers Lane.

b) Inland Rail Maintenance Facility

The Inland Rail Maintenance Facility is regionally significant infrastructure and expected to be fully operational by 2023. The proposed footprint extends outside of the precinct onto land zoned RE1 Public Recreation and RE2 Private Infrastructure. Additionally, the proposal includes the realignment of rail corridor. Once construction works are completed and operations commence, consideration should be given to investigating realigning the zoning over the footprint area to fit the use.

- Maintain Dubbo as the major employment and service centre of the Orana region.
- Ensure an adequate supply of appropriately located and serviced employment lands are maintained to facilitate short-term, medium-term and long-term growth.
- Facilitate revitalisation of existing employment lands precincts to meet the changing needs of industry.
- Proposed commercial zones are supported by an economic impact assessment to ensure the activity centred hierarchy is protected and maintained.
- Preserve employment land that can accommodate relatively large floor plates (larger sized lots) with access to main road networks or rail infrastructure.
- Maintain the efficiency of Dubbo's key transport corridors.

14.9.3 North Dubbo Industrial

Rationale

The precinct provides approximately 67,020m² GFA of employment floor space, of which around 285m² or less than 1% was vacant floor space.

Major land use activities within the precinct, by total floor space, were attributed to transport, postal and warehousing industries, occupying 19,510m² or 29% of total GFA following by construction industries which occupied around 14,740m² or 22% of total GFA.

Just less than five hectares of land is occupied by residential uses which are located within the southern proportion of the precinct. As such, there is potential for land use conflicts within this part of the precinct.

Physical Characteristics

Land Area: 57.7 ha Vacant Area: 7.4 ha Occupied Area: 50.3 ha Gross Floor Area: 76,433 ha

Opportunities

- Enhance transportation links between key industrial areas and arterial roads.
- Support industrial uses with appropriate provision of infrastructure.
- Monitor adjoining land uses and the potential for conflict.
- Encourage high quality infill development with appropriate built form, bulk and design
- Regulate development within the flood plain to be sympathetic to the environmental constraints.
- Potential for River Street to become a more prominent transport route.

Alignment to Regional Plan 2036

Direction 2: Grow the agribusiness sector and supply chains Direction 3: Develop advanced manufacturing and food processing sectors Direction 8: Sustainably manage mineral resources Direction 10: Promote business and industrial activities in employment lands Direction 19: Enhance road and rail freight links



Precinct Map 20: North Dubbo Industrial Precinct



Outline of Precinct R1 General Residential R2 Low Density Residential





RE1 Public Recreation E3 Environmental Management W2 Recreational Waterways



Precinct Guidance Map 10: Investigation Area

a) Land use conflict

The industrial precinct continues to have a number of residential dwellings operating under existing use rights, additionally the precinct adjoins an established residential area. Industrial and residential uses in this context can typically result in land use conflicts. To reduce opportunities for land use conflict, it is recommended that opportunities to remove residential land uses within this area are undertaken.

Additionally, it is recommended that a buffer be investigated between the industrial precinct and the adjoining residential area to the south. The residential area is established and a buffer will assist with minimising land use conflicts.

b) River Street B6 rezoning investigation

Investigate the reduction of IN2 Light Industrial zoning in this precinct by the rezoning of a portion of River Street to B6 Enterprise Corridor. The existing uses in this area tend to align closer to that of a B6 Enterprise Corridor zone rather than IN2 Light Industrial. The investigation will need to be supported by economic studies considering the demand and supply of employment lands.

- Maintain Dubbo as the major employment and service centre of the Orana region.
- Ensure an adequate supply of appropriately located and serviced employment lands are maintained to facilitate short-term, medium-term and long-term growth.
- Facilitate revitalisation of existing employment lands precincts to meet the changing needs of industry.

14.9.4 South Dubbo Industrial

Rationale

The precinct provided approximately 44,966m² GFA of employment floor space, of which around 7,544m² or 17% was vacant floor space. The majority of this vacant floor space (6,500m² or 86%) was located within the former RAAF sub-precinct and was attributed to one of the two of the large hangars. The other hangar is being used for storage.

Major land uses within the precinct, by total floor space, were attributed to public administration and safety, occupying 8,310m² or 18% of total GFA and transport, postal and warehousing industries which occupied around 8,095m² or 18% of total GFA.

Physical Characteristics

Land Area: 23.3 ha Vacant Area: 5.5 ha Occupied Area: 17.8 ha Gross Floor Area: 44,966m²

Opportunities

- Provision of a buffer between the industrial development and adjacent residential development to minimise land use conflict.
- Monitor adjoining land uses and potential land use conflict.
- Provide support to the B5 Business Development zone located immediately to the north.
- Protect and enhance the heritage qualities of the RAAF Base site.
- Industrial related vehicle access considers the adjoining residential zone.

Alignment to Regional Plan 2036

Direction 2: Grow the agribusiness sector and supply chains Direction 3: Develop advanced manufacturing and food processing sectors Direction 8: Sustainably manage mineral resources Direction 10: Promote business and industrial activities in employment lands Direction 19: Enhance road and rail freight links



Precinct Map 21: South Dubbo Industrial Precinct

 Key:

 Outline of Precinct

 R1 General Residential

R2 Low Density Residential IN2 Light Industrial SP2 Infrastructure RE1 Public Recreation E3 Environmental Management

It is recommended that a buffer be created between the industrial precinct and the adjoining residential area to the South/South East. The residential area is established and a buffer will assist with minimising land use conflicts.

- Maintain Dubbo as the major employment and service centre of the Orana region.
- Ensure an adequate supply of appropriately located and serviced employment lands are maintained to facilitate short-term, medium-term and long-term growth.
- Facilitate revitalisation of existing employment lands precincts to meet the changing needs of industry.

14.9.5 Basalt Road **Rationale**

Basalt Road precinct is comprised of three lots, each zoned IN3 – Heavy Industrial. The precinct is located just under nine kilometres or an 11 minute drive to the south east of Dubbo Railway Station. The precinct is accessed via Basalt Road or Sheraton Road.

In total the precinct comprises 206.01 hectares of industrial zoned land with 129 hectares or 63% being vacant or undeveloped land. An extractive industry (quarry) is located within the western proportion of the precinct occupying 42.2 hectares of land. Immediately to the north another extractive industry (quarry) has commenced operations, however outside of the precinct.

Physical Characteristics

Land Area: 206.01 ha Vacant Area: 129 ha Occupied Area: 77.01 ha Gross Floor Area: 2,700m²

Opportunities

- Support industrial uses with appropriate planning and provision of infrastructure.
- Monitor adjoining land uses and potential conflict.
- Future quarry operation will need to consider functioning transport route.
- Quarry operations do not extend further west which would impact residential growth areas.
- Consider environmental issues, particularly along Eulomogo Creek.

Alignment to Regional Plan 2036

Direction 2: Grow the agribusiness sector and supply chains Direction 3: Develop advanced manufacturing and food processing sectors Direction 8: Sustainably manage mineral resources Direction 10: Promote business and industrial activities in employment lands Direction 19: Enhance road and rail freight links



Basalt Road Heavy Industrial Precinct contains an existing quarrying activity which has access onto Sheraton Road. The area should be monitored in terms of future quarry approval and respective life expectancies, given the significant residential development currently occurring and planned to occur to the west of the precinct.

In the long term this precinct may form part of Blueridge Commercial Park if future rezoning occurs as part of the identified ICA which would connect the two (2) precincts.

The long term function of this precinct should be investigated further particularly with respect to the existing quarry on the subject land (and immediately north) the potential for any further quarries on the eastern portion of the precinct, expanding residential estates to the west and the growth of Blueridge Business Park to the north.

- Maintain Dubbo as the major employment and service centre of the Orana region.
- Structure Plans are prepared for undeveloped employment lands which consider opportunities and constraints to provide overarching guidance to development.
- Infrastructure is appropriately planned to encourage sustainable development of employment lands.
- Encourage the clustering of industries which share similar synergies

14.10 Blueridge

Rationale

Blueridge Estate includes land zoned B5 Business Development to the north and B7 Business Park to the south. The B5 zone is 37 hectares in size with approximately 9.94 hectares of land occupied by a mixture of bulky goods retailers, light industry, office premises, business premises, child care centres, depot and warehouses and two gymnasiums.

The southern portion of Blueridge Estate, zoned B7 Business Park, is largely vacant with 82 hectares of land currently available for development. Recent development in this locality has largely been attributed to light industrial development.

There are two (2) dwellings located on the southern and eastern portions of the precinct, which would appear to original homesteads prior to the land being fragmented.

The eastern part of the Blueridge Business Park precinct is zoned IN2 Light Industry. This area is comprised of approximately 54.4 hectares of land. Development has occurred within the precinct.

Physical Characteristics

Land Area: 173.4ha Vacant Area: 123.1ha Occupied Area: 50.3ha Gross Floor Area: 28,683m²

Opportunities

- Infrastructure is planned to allow development on vacant land to continue in a sustained manner.
- Good supply of land to enable the continued growth of Blueridge.
- Encourage high quality development with appropriate built form, bulk and design.
- Existing zone allows a wide variety of uses to re-locate to this precinct.
- Good transport linkages between the precinct and the adjoining highway and CBD.
- Future development has good road connections to allow future expansion onto other land within the precinct.
- Consider long term transport routes and their impact on the highway ensuring the efficiency of the Mitchell Highway.
- Ensure the CBD is not undermined through inappropriate use.
- Review existing Structure Plan for the precinct.
- Monitor land uses as Blueridge Business Park expands with a view to ensure the precinct does not significantly undermine the commercial centres hierarchy.

Alignment to Regional Plan 2036

Direction 2: Grow the agribusiness sector and supply chains Direction 3: Develop advanced manufacturing and food processing sectors Direction 8: Sustainably manage mineral resources Direction 10: Promote business and industrial activities in employment lands Direction 19: Enhance road and rail freight links


Precinct Guidance

a) Structure Plan

It is recommended that the existing Structure Plan be prepared for this precinct is reviewed to ensure it is consistent with current and future planning trends and adopted land use Strategies. The Structure Plan review should be completed in the short term to allow for the continued development of the precinct in a sustainable manner.

b) ICA 1 Blueridge Precinct

The ICA 1 is located within the Blueridge Precinct as seen in Precinct Guidance Map 11. ICA 1 was identified within the strategy for the development of a business park and prestige light industrial park consisting of light manufacturing, warehouse and distribution and high-tech industries. This was primarily as a result of the location of the land adjacent to the Mitchell Highway. The precinct is now zoned B5 Business Development, B7 Business Park and IN2 Light Industrial under the provisions of the Dubbo LEP 2011. Blueridge Business Park, has become a growth area for light industrial and larger format commercial uses as a result of the larger lot sizes, close proximity to Dubbo's centre, infrastructure and access to the Mitchell Highway.

At the present time, not all land within ICA 1 has been rezoned under previous Local Environmental Plans with approximately 268 hectares of identified ICA not zoned for industrial. Dubbo has a significant level of industrial zoned land with approximately 724 hectares of vacant/undeveloped land with 53 to 80 hectares required to meet future demand to the year 2031. Given the oversupply of land both within the City and this precinct, consideration for ICA 1 should be investigated as a long term action. In the long term, dependant on the further rezoning investigations, Blueridge and Basalt Road Precincts may become integrated into single larger precinct.



Precinct Guidance Map 11: Industrial Candidate Area 1 - Blueridge

Kev:

ney.
Outline of ICA's which have been rezoned
Outline of ICA's which have not been rezoned
RU1 Primary Production
R2 Low Density Residential
R5 Large Lot Residential
IN2 Light Industry
IN3 Heavy Industry
SP2 Infrastructure
RE1 Public Recreation
RE2 Private Recreation

Planning Principles

14.11 Brocklehurst

Rationale

The precinct provides approximately 16,854m² GFA of employment floor space. Major land use within the precinct, by total floor space, were attributed to manufacturing industries, occupying 5,080m² or 37% of the total GFA followed by retail industries which occupied around 2,080m² or 18% of total GFA.

An existing extractive industry (quarry) is located within the precinct which has been granted approval to extend into the adjoining RU1 zone to the East of the precinct.

A large proportion of the precinct is vacant (approximately 35%). The precinct has a large frontage to existing railway infrastructure. The IN3 zoned land has minimal noise sensitive recievers in the locality therefore suiting industry which create amenity issues.

Residential uses occupies just over 24 hectares of land within the precinct.

Physical Characteristics

Land Area: 416.5ha Vacant Area: 144.4ha Occupied Area: 272.1ha Gross Floor Area: 16,854m²

Opportunities

- Industrial uses are supported with the appropriate provision of infrastructure.
- Monitor adjoining land uses and the potential for conflict, particularly with the nearby village of Brocklehurst.
- Aesthetically pleasing development is provided along major arterial roads.
- Heavy industrial land has direct access to railway infrastructure.
- Opportunity for development requiring access to rail infrastructure and large lots.
- Maintain traffic efficiency of the Newell Highway.
- Structure plan is prepared to provide overarching guidance for undeveloped land.
- Large amount of vacant land will form buffer to residential uses.

Alignment to Regional Plan 2036

Direction 2: Grow the agribusiness sector and supply chains Direction 3: Develop advanced manufacturing and food processing sectors Direction 8: Sustainably manage mineral resources Direction 10: Promote business and industrial activities in employment lands Direction 19: Enhance road and rail freight links



Precinct Guidance

A large proportion of the Brocklehurst Precinct is currently undeveloped.

a) Structure Plan

It is recommended that a structure plan be prepared to provide overarching guidance for the long term development of this precinct. This structure plan should be completed in the short-term to facilitate development of the precinct in an sustainable manner.

b) ICA 3 Brocklehurst

ICA 3 is located within the Brocklehurst Precinct as shown in Precinct Guidance Map 12. ICA 3 was identified within the strategy to provide industrial area for large scale primary processing and food manufacturers with a potential to take problem industries. The precinct contains IN2 Light Industrial and IN3 Heavy Industrial.

Some of ICA 3 has been rezoned under previous Local Environmental Plans with approximately 865 hectares of the identified ICA not zoned for industrial. There has been minimal industrial development within the IN3 zoned land over recent years and therefore still a sufficient supply of IN3 zoned land is available in this precinct. Dubbo has a significant level of industrial zoned land with approximately 724 hectares of vacant/undeveloped land with 53 to 80 hectares required to meet future demand to the year 2031. Given the oversupply of land both within the City and this precinct, consideration for ICA 3 should be investigated as a long term action.

Some portion of the IN3 zoned land has been developed as a quarry with expansions to the west currently being undertaken. Development of this quarry should be monitored.





Precinct Guidance Map 12: ICA 3 Brocklehurst Precinct (previously named Mendooran/Talbragar)

Planning Principles

- Maintain Dubbo as the major employment and service centre of the Orana region.
- Structure plans are prepared for strategically important undeveloped employment lands
- Ensure an adequate supply of appropriately located and serviced employment lands are maintained to facilitate short-term, medium-term and long-term growth.
- Infrastructure is appropriately planned to encourage sustainable development of employment lands.
- Facilitate revitalisation of existing employment lands precincts to meet the changing needs of industry.
- Encourage the clustering of industries which share similar synergies

14.12 Yarrandale Road

Rationale

The precinct provided approximately 182,306m² GFA of employment floor space. Major land use within the precinct, by total floor space, were attributed to transport, postal and warehousing industries, occupying 77,745m² or 43% of total GFA followed by wholesale industries which occupied around 46,775m² or 26% of total GFA.

The precinct contains regional significant infrastructure through the Dubbo Regional Livestock Markets and the Fletcher International abattoirs. The area, in particular Purvis Lane, has seen substantial development with a focus on heavy vehicle maintenance, sales and service and also transport warehouse and distribution. There are opportunities facilitate the growth of these industries further within this precinct.

The precinct generally contains transport networks suitable for large vehicle access, particularly from the Newell Highway.

Physical Characteristics

Land Area: 785.75ha Vacant Area: 495.97ha Occupied Area: 289.78ha Gross Floor Area: 182,306m²

Opportunities

- Enhance transportation links between key industrial areas and arterial roads.
- Support industrial uses with appropriate provision of infrastructure.
- Monitor adjoining land uses and potential conflict.
- Development which supports existing infrastructure such as railway, intermodal rail and road-train access.
- Structure plan to provide overarching guidance as to how the precinct can be developed in the future.
- Opportunities for development to take advantage of livestock infrastructure including Dubbo Regional Markets and Fletcher International Exports (abattoirs).
- Opportunities to facilitate further growth of heavy vehicle maintenance, sales and service and also transport warehouse and distribution in the precinct.
- Undertake improvement to road networks (Purvis Lane in particular) to facilitate growth in the heavy vehicle related development.
- Regulate development within the flood plain to be sympathetic to the environmental constraints.
- Opportunities to remove dwellings from the precinct where required to reduce potential amenity issues.

Alignment to Regional Plan 2036

Direction 2: Grow the agribusiness sector and supply chains Direction 3: Develop advanced manufacturing and food processing sectors Direction 8: Sustainably manage mineral resources Direction 10: Promote business and industrial activities in employment lands Direction 19: Enhance road and rail freight links



Precinct Map 25: Yarrandale Road Industrial Precinct

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103

Outline of Precinct RU2 Rural Landscape R2 Low Density Residential IN2 Light Industrial IN3 Heavy Industrial RE1 Private Recreation SP2 Infrastructure E3 Environmental Management W2 Recreational Waterways

Key:

Precinct Guidance

a) Structure Plan

It is recommended that a structure plan be developed for Yarrandale Road Precinct. The area currently has substantial development along the west of Yarrandale Road and along Purvis Lane. However, there is a significant area of land zoned for industrial purposes which remains undeveloped. Structure plans should be prepared to provide overarching guidance for the future development of the precinct.

b) ICA 4 Yarrandale Road Precinct

ICA 4 is located within the Yarrandale Road Precinct as seen in Precinct Guidance Map 11. ICA 4 was identified given its location and access to existing road and rail infrastructure.

At the present time, not all land within ICA 4 has been rezoned under previous Local Environmental Plans with approximately 193 hectares of identified ICA not zoned for industrial. Dubbo has a significant level of industrial zoned land with approximately 724 hectares of vacant/undeveloped land with 53 to 80 hectares required to meet future demand to the year 2031. Given the oversupply of land both within the City and this precinct, consideration for ICA 4 should be investigated as a long term action.



Precinct Guidance Map 13: Yarrandale Road Precinct previous ICA 4

Planning Principles

- Maintain Dubbo as the major employment and service centre of the Orana region
- Structure Plans are prepared for undeveloped employment lands which consider opportunities and constraints to provide overarching guidance to development; Ensure an adequate supply of appropriately located and serviced employment lands are maintained to facilitate short-term, medium-term and long-term growth.
- Infrastructure is appropriately planned to encourage sustainable development of employment lands.
- Facilitate revitalisation of existing employment lands precincts to meet the changing needs of industry.
- Encourage the clustering of industries which share similar synergies.
- Preserve employment land that can accommodate relatively large floor plates (larger sized lots) with access to main road networks or rail infrastructure.
- Maintain the efficiency of Dubbo's key transport corridors.

14.13 Tourist 14.13.1 Zoo and Camp Road Rationale

This precinct contains the Taronga Western Plains Zoo which has traditionally underpinned Dubbo's tourism industry as a major tourism attractor for the region. The Zoo has seen significant capital investment over the last decade with improvement to the visitor experience facilities as well as providing several accommodation options.

Development and investment along Camp Road has been mixed and hasn't reached its projected strategic objective. Since 1998, a total of 46 Development Applications have been lodged on the SP3 Tourist zoned land south of Camp Road. 57% (26) of these Applications were tourist related, 33% residential related and 10% subdivision or infrastructure related. The take-up of the tourist related development has been low with only 15 of the approved 26 Applications proceeding to operational status. However, of those 15 that did proceed, only 8 of the 25 properties on Camp Road are currently operating a tourist related development. These operational uses includes recreational paintball, bed and breakfast accommodation, short to medium stay cabin accommodation, recreational pony rides, vineyard and observatory. Additionally, a function centre has recently re-opened after undergoing renovations by a new owner.

Analysis of development and investment trends on Camp Road since 1998 shows the start of a sharp downward trend around 2010-2012. Since 2010, only 4 Development Applications have been approved, with 3 proceeding to operate and only 3 currently operating. The downward trend coincides with the commencement of a major financial outlay from the state government at the zoo.

The land south of Camp Road was envisaged in the Dubbo Commercial Areas Strategy 1997 as an area suitable for tourist and accommodation related development. Over the last two decades, this precinct has experienced both short and long term structural changes and consequently requires reconsideration of the overarching role of this precinct.

Given that over the last two decades this precinct has experienced structural changes, the overarching role of the SP3 Tourist zoned land along Camp Road will need to be reconsidered through consideration of the opportunities and issues discussed in detail over the following chapter. Noting that whilst it has been identified that tourist related development has stagnated, small-scale rural based tourist development still has a significant role to play along Camp Road and a focus on tourist should be maintained. Opportunities for the introduction of dwellings as a permissible form development to facilitate and support the development of small-scale rural based tourist development should be investigated.

Physical Characteristics

Land Area: 1,099.2ha Vacant Area: 449.3ha Occupied Area: 649.9ha Gross Floor Area: 17,720m²

Opportunities

- Enable development of land on Camp Road whilst protecting biodiversity and cultural heritage.
- Ensure the precinct provides a buffer to the land zoned RU1 Primary Production to the south.
- Ensure agricultural activities to the south are protected from incompatible development.
- Ensure buffers between existing development including the zoo, vineyard, function centre, observatory, Morris Park Speedway and Paintball are sufficient so as not prejudice operations.
- The zoo is maintained as a significant attraction and is protected from incompatible development which would impact existing and future operations.
- Investigate suitable land uses for Camp Road to ensure activity and development are compatible and amenity impacts are minimised.
- Consider how existing and future development will be treated as a result of Camp Road being identified as a freightway in the Road Transportation Strategy to 2045.
- Consider position of Camp Road for unique or niche rural based accommodation in order to compete with the Zoo and centrally located accommodation.
- Topography provides natural noise mitigation for Morris Park Speedway activities.
- Investigate opportunities to improve linkages from the precinct to the CBD.



Precinct Map 26: Zoo and Camp Road Precinct

Key:

Outline of Precinct RU1 Primary Production RU2 Rural Lifestyle R1 General Residential R2 Low Density Residential R5 Large Lot Residential RE1 Public Recreation RE2 Private Recreation SP2 Infrastructure SP3 Tourist E3 Environmental Management W2 Recreational Waterway

Issues

A summary of issues which could be surmised as to why Camp Road has not succeeded as a core tourist and accommodation area are as follows:

- Taronga Western Plains Zoo. The Zoo, which underpins Dubbo's tourism industry as a major tourist attraction for the region, has seen significant investment over the last decade with approximately \$52 Million worth of development being approved since 2008. Of this, \$17 Million worth of development was approved in 2018 alone highlighting the significant short term investment in the Zoo. Additionally, the Zoo commenced investing in onsite accommodation with approximately \$12.4 Million being invested since 2013. The Zoo's significant investment in accommodation around 2013 directly coincides with a downward investment trend on Camp Road as shown in Figure 18.
- The Zoo's accommodation provides experience and animal interactions as well providing discounted package deals for visitors making the viability of private operators on Camp Road more difficult to compete with.
- Local Planning Provisions. The former Dubbo LEP 1998 Urban Areas made provision for dwellings to only be a permissible form of development when ancillary to a tourist or visitor accommodation use. Following on from the Dubbo LEP 1998, the Dubbo LEP 2011 made in accordance with the standard instrument, made dwelling houses and bed and breakfast accommodation prohibited.
- Camp Road suffers from distance to the CBD. Dubbo's existing accommodation in the CBD and along tourist strips benefit from access to city services such as restaurants, cafes and entertainment, have passing traffic visibility as well as good access to then Dubbo City Regional Airport and train station.
- A level of smaller scale accommodation have been developed on Camp Road. Discussions with property owners indicate provision of accommodation along Camp Road is difficult and viability is questionable given its distance from the CBD, competition with the zoo's varied and integrated accommodation, competition with centrally located accommodation service providers, lack of embellishment and lack of visibility. It also competes with rural based accommodation such as farm stays and bed and breakfasts permissible in rural zones located throughout the LGA.
- Projections out to the year 2031 show Dubbo would require an additional 15,153m² of accommodation floor space. Two mixed use developments planned in the Dubbo CBD have the capacity for approximately 15,000m² of serviced apartment floorspace and the Cattleman's Country Motor Inn continues to expand with another 19 units currently under construction. Additionally, it is recommended that additional SP3 Tourist zoned land be investigated adjacent to the Health, Well-being and Education Precinct to capture visitor stays in close proximity to this growth area.
- Viability of tourist activity operations. The precinct contains some varied forms of tourist operations which appear to be operating effectively including the observatory, vineyard, Morris Park Speedway, the paintball field and recreational pony rides. However, discussions with property owners indicate there is difficulty in both proceeding with tourist ventures and then maintaining a viable tourist operation. Property owners stated that it was difficult to operate year round, there was a need to supplement the operations income, difficulty in accessing finance to undertake development, lack of visibility, distance from the CBD and the need for private transport. The general consensus was there was a negative position towards Camp Road being a viable location for a full-time tourist attraction.
- The general view of the property owners was that the future of Camp Road was not large scale full-time tourist activities, rather unique smaller scale tourist activities operating on a part-time or seasonal basis. Additionally, property owners expressed they would be more inclined to invest in tourist related activities if:
 - They were able to finance against equity in their dwellings which they currently having difficulty achieving as dwellings are a prohibited use;
 - There was greater activation and embellishment of the area increasing patronage along Camp Road; and
 - Subdivide lots excess to their needs in order to access additional finance.



Cost of works (\$)

Figure 18: Timeline of Camp Road

Precinct Guidance

a) Future Role of Camp Road

The role of Camp Road is to provide a suitable strip of land which allows small-scale rural based tourist development not suitable for central urban areas which are compatible with semi-rural style residential living. The precinct should enable semi-rural style residential development to facilitate the activation and embellishment of the area in order to support small-scale rural based tourist development.

b) Land Use Zone

It is recommended that the SP3 Tourist zoned land south of Camp Road be investigated further with respect to analysing whether this is the most appropriate zone based on the future role of the precinct and Council's objectives for the land.

c) Dwellings

It is recommended that dwellings become a permissible form of development on the land south of Camp Road. It is considered that dwellings will be restricted a Minimum Lot Size (MLS) for the SP3 zoned land. The MLS will be established in further Strategic Work upon adoption of a Structure Plan.

d) Review of lot sizes

As the land is currently zoned SP3 Tourist and dwellings are prohibited, the land does not have any minimum lot size provisions. As the Strategy recommends that the role of the Camp Road precinct change with dwellings being considered as a permissible form of development, a review of the minimum lot size provisions should be undertaken. In this regard, it is recommended that Council facilitate the subdivision of large lots to both allow more manageable land parcels and excise unused land for additional capital. Noting that many property owners in this precinct continue to highlight issues with the ability to generate capital to undertake tourist related development ventures. This was predominantly as a result of dwellings being made a prohibited form of development in the SP3 Tourist zone complicating matters from a finance perspective with lending institutions. Given the area also lacks embellishment, somewhat as a result of stagnated development, new dwellings and property owners into the area could assist with embellishment of the precinct. Existing development which could potentially suffer through inappropriate buffers should be considered with determination of a minimum lot size.

e) Morris Park Speedway

Morris Park Speedway has operated on the south eastern side of Camp Road since the early 1960's. Being a motorsport activity it is a significant noise generator. However, noise is somewhat mitigated with the natural topography assisting with noise reduction. Noise studies have shown that the 55 dB(A) noise contour is not a major constraint for the precinct. It is recommended that areas subject to noise impacts generated by Morris Park be formalised through planning provisions in the Dubbo Local Environmental Plan 2011.

f) Amenity

Given that Camp Road already contains 15 dwellings (including managers residences), major recreational facilities could potentially result in adverse amenity issues on existing residents in the locality. It is therefore considered this is not the most appropriate precinct for major recreational facilities which includes the likes to theme parks and sport stadiums. Consideration should be given to removing this form of development from the Camp Road precinct. The current provisions of the Dubbo Local Environmental Plan 2011 permit major recreational facilities in the RU1 Primary Production zone, which forms the largest zone percentage wise in the Dubbo Regional Local Government Area.

It is therefore recommended that investigations be made with respect to removing recreational facilities (major) as a permissible use in the SP3 Tourist zone and making them a permissible land use in the RU2 Rural Landscape zone to provide additional options.

g) Road Transportation Strategy

Camp Road is identified as functioning as a future Distributor Road within the Dubbo Road Transportation Strategy to 2045. Whilst this strategy expects the southern freightway to be developed around the year 2045, Council is currently undertaking a further review of the Strategy and the demand for any future Distributor Road through the Camp Road precinct. On the basis of current analysis, this shows that the Camp Road link is identified as a 'very long term' project and may not be required until at least 2060, but more likely towards 2070. However, this will continue to be reviewed in accordance with five (5) year reviews of the transportation strategy.

h) Structure Plan

It is recommended that the draft Camp Road Structure Plan be finalised. The Structure Plan should provide overarching guidance for future development of this area by identifying constraints and existing development. It should also identify opportunities for future tourist and semi-rural lifestyle style development with a view to minimise land use conflicts in the precinct and consider an appropriate minimum lot size. The structure plan should identify existing development which could potentially suffer as a result of incompatible development through inappropriate buffers.

Alignment to Regional Plan 2036

Direction 1: Protect the region's diverse and productive agricultural land Direction 4: Promote and diversify regional tourism markets Direction 10: Promote business and industrial activities in employment lands Direction 12: Plan for greater land use compatibility Direction 25: Increase housing diversity and choice Direction 28: Manage rural residential development

Planning Principles

- Strategically important employment lands are protected from incompatible rezoning's, incompatible uses and land use conflict.
- Maintain Dubbo as the major employment and service centre of the Orana region.
- Structure Plans are prepared for undeveloped employment lands which consider opportunities and constraints to provide overarching guidance for development.
- Ensure an adequate supply of appropriately located and serviced employment lands are maintained to facilitate Dubbo's short-term, medium-term and long-term growth.
- Infrastructure is appropriately planned to encourage sustainable development of employment lands.
- Enable the development of dwelling houses in a manner which is cognisant with Council's focus of small scale tourist related uses in the precinct.

14.13.2 Central Tourist Strips

Rationale

This tourist precinct is zoned SP3 Tourist and located along the Highway corridors leading into Dubbo. The zones run along the south of Cobra Street and along east and west of Whylandra Street. This precinct contains a high proportion of accomodation related development which benefits from a significant level of passing trade.

Physical Characteristics

Land Area: 30.4 ha Vacant Area: 5.3 ha Occupied Area: 25.1 ha Gross Floor Area: 79,241m²

Opportunities

- Maintain and enhance the established use of the precinct as a traveller service corridor.
- Ensure an attractive and distinctive environment for tourist and tourist operations.
- Manage the traffic volumes of the corridor without compromising passing trade.
- Resolve amenity conflicts with adjoining uses.
- Potential to support the CBD Precinct.
- Good exposure to highway corridor benefiting business requiring passing trade.
- Monitor and manage vehicle access and parking issues.
- Preserve and maintain heritage qualities on the RAAF Base site.

Alignment to Regional Plan 2036

Direction 1: Protect the region's diverse and productive agricultural land

Direction 4: Promote and diversify regional tourism markets

- Direction 10: Promote business and industrial activities in employment lands
- Direction 12: Plan for greater land use compatibility

Direction 25: Increase housing diversity and choice

Direction 28: Manage rural residential development



Precinct Map 27: Central Tourist Strips



RE2 Private Recreation E3 Environmental Management W2 Recreational Waterways

Precinct Guidance

In respect to existing structure at the former RAAF Base located within this precinct, this strategy acknowledges that the owners of the land have the ability to lodge a Development Application for adaptive re-use of heritage listed buildings under Clause 5.10 Heritage Conservation of the Dubbo Local Environmental Plan 2011. This clause allows Council to consider a Development Application for a use which may not ordinarily be permissible on the land, subject to the adaptive re-use and conservation of the heritage building.

However, any development for an adaptive re-use under Clause 5.10 Heritage Conservation that results in a business or commercial use must be accompanied by an Economic Impact Assessment (EIA), which has been prepared by a suitably qualified and experienced professional, justifying the proposed activity.

Planning Principles

- Maintain Dubbo as the major employment and service centre of the Orana region.
- Ensure an adequate supply of appropriately located and serviced employment lands are maintained to facilitate short-term, medium-term and long-term growth.
- Facilitate revitalisation of existing employment lands precincts to meet the changing needs of industry.

14.13.3 Tourist Spot Zonings

Rationale

The Dubbo Local Government Area contains several smaller sites zoned SP3 Tourist outside of the major strips and precincts. The SP3 Tourist sites include Bourke Street and Myall Street/Wheelers Lane.

The Bourke Street SP3 Tourist site is located on the corner of Bourke and Macleay Street's containing accommodation services.

The Myall and Wheelers Lane contains accommodation services and a restaurant.

A Development Application has been approved for the former RAAF Base partly contained within this precinct. The Development Application inclusive of five stages has been approved subject to conditions of consent. The consent approves a mixed development incorporating residential, industrial and tourist land uses.

Council Facility	Land Area (ha)	Vacant Area		
		0.1		

Physical Characteristics

Council Facility	Land Area (ha)	Vacant Area	Occupied Area	Gross Floor Area
Bourke Street	0.2 ha	0 ha	0.2 ha	1,085m²
Myall Street/ Wheelers Lane	0.27 ha	0 ha	0.27 ha	715m²
Total	0.47 ha	Oha	0.47 ha	1,800m²

Opportunities

- Ensure an attractive and distinctive environment for tourist and tourist operations.
- Myall Street/Wheelers Lane - Support the Health, Well-being and Education Precinct in providing shortterm accommodation.
- Manage amenity conflicts with adjoining uses.
- Bourke Street Recognise the relationship between the adjoining B1 neighbourhood centre and this area. .

Alignment to Regional Plan 2036

Direction 1: Protect the region's diverse and productive agricultural land

Direction 4: Promote and diversify regional tourism markets

Direction 10: Promote business and industrial activities in employment lands

Direction 12: Plan for greater land use compatibility

Direction 25: Increase housing diversity and choice

Direction 28: Manage rural residential development



Precinct Map 28: Tourist Spot Zoning

 Key:

 Outline of Precinct

 R1 General Residential

 R2 Low Density Residential

 B1 Neighbourhood Centre







14.14 Infrastructure 14.14.1 Council Infrastructure

Rationale

The Dubbo Regional Council owns a variety of facilities zoned SP2 Infrastructure used to service the Dubbo urban area. The facilities include the Whylandra Waste and Recycling Centre, Dubbo Water Treatment Facility and Boothenba Waste Water Treatment Facility. Whylandra Waste and Recycling Centre is located around 13.8 kilometres or a 13 minute drive to the north west of Dubbo Railway Station. With the facilities distance from Dubbo City contributing to its appropriateness for use as waste disposal/land fill.

The Dubbo Water Treatment Facility is zoned SP2 – Infrastructure and is located just under three kilometres or a seven minute drive to the south of Dubbo Railway Station. The facility fronts Macquarie Street, giving it good connectivity to other parts of Dubbo City.

The Boothenba Waste Water Treatment Facility is zoned SP2 Infrastructure and is located around five and a half kilometres or a seven minute drive to the north of Dubbo Railway Station.

Council Facility	Land Area (ha)	Vacant Area	Occupied Area	Gross Floor Area
Whylandra Waste and Recycling Centre	0.2 ha	0 ha	0.2 ha	1,085m²
Water Treatment Facility	0.27 ha	0 ha	0.27 ha	715m ²
Boothenba Waste Water Treatment Facility	0.47 ha	Oha	0.47 ha	1,800m²
Total	825ha	Oha	825ha	5,275m²

Physical Characteristics

Opportunities

- Consolidate infrastructure within existing SP2 Lands.
- Monitor population growth in respect to the demand for infrastructure facility.
- Support appropriate waste facilities to support the growth of the Dubbo Urban area.
- Provide appropriate infrastructure for the facility to function efficiently.

Alignment to Regional Plan 2036

Direction 1: Protect the region's diverse and productive agricultural land Direction 13: Protect and manage environmental assets Direction 21: Coordinate utility infrastructure investment







Planning Principles

Key:

Outline of Precinct

RU1 Primary Production

RU4 Primary Production Small Lots

RU2 Rural Landscape

R1 General Residential



B2 Local Centre

B3 Commercial Core

- **B7** Business Park **IN2** Light Industrial
- **IN3 Heavy Industrial** SP2 Infrastructure SP3 Tourist **RE1** Public Recreation **RE2** Private Recreation
- E3 Environmental Managemen W2 Recreational Waterways



14.14.2 NSW Railway and Kokoda Place

Rationale

SP2 Infrastructure zoned land outside of the major precincts and Councils ownership includes NSW Rail and Essential Energy.

The NSW Rail land is zoned SP2 Infrastructure and is in the immediate locality of the Dubbo Railway Station. The land is separated into four isolated areas which are connected by the SP2 Infrastructure zoning.

The land located at Kokoda Place is zoned SP2 Infrastructure and is a one minute drive or 1 kilometre from the Dubbo Railway Station. The precinct contains an Army Reserve building and several railway support buildings.

Physical Characteristics

Council Facility	Land Area (ha)	Vacant Area	Occupied Area	Gross Floor Area
NSW Rail	4ha	0.2ha	3.8ha	6228m ²
Kokoda Place	1.1ha	Oha	1.1ha	1,651m ²
Total	5.1ha	0.2ha	4.9ha	7,879m²

Opportunities

- Support the importance of the rail infrastructure for the economic prosperity of Dubbo.
- Provide appropriate infrastructure for the facility to function efficiently.
- Consolidate infrastructure within existing SP2 Lands.
- Monitor population growth in respect to the demand for this facility.
- Kokoda Place supports the community uses nature of the area.

Alignment to Regional Plan 2036

Direction 1: Protect the region's diverse and productive agricultural land Direction 13: Protect and manage environmental assets Direction 21: Coordinate utility infrastructure investment



Precinct Map 30: NSW Railway and Kokoda Place SP2 Infrastructure Land



Precinct Guidance

Kokoda Place sub-precinct would appear to be used by the Army Reserve as a training facility and is zoned SP2 Infrastructure (Railway). As the use is not relevant to the railway or the rail corridor investigations should be made for a more appropriate zone for this lot.

Planning Principles

Infrastructure is appropriately planned to encourage sustainable development of employment lands.

PART FOUR – IMPLEMENTATION 15. Implementing the Strategy

The Employment Land Strategy aims to ensure adequate demand and supply of commercial, industrial and special zoned land to facilitate the concentric growth of Dubbo employment lands. Implementation requires council staff, stakeholders and state agencies to commit to achieving the outcomes and recommendations made within the strategy. Dubbo Regional Council will play the primary role of facilitating the objectives and implementation of this document, utilising statutory and strategic controls.

Recommendations made within this strategy allow future rezoning, structure plans and the general growth of employment lands progress in an orderly manner.

This section of the strategy will identify each recommendation, the reasons for the recommendations and will outline a basic implementation strategy for each key recommendation. Time frames for implementation are described as short, medium or long term. As the nature of population, employment lands and planning trends are constantly changing, Council wishes to focus on facilitating a flexible and practical approach to achieving these recommendations.

The anticipated phasing time frames within the table are as follows:

Short Term, 2019-2021, this timeframe is anticipated to be completed within a 2 year period. These actions are considered a priority to direct the immediate growth of employment lands.

Medium Term, 2022-2027, this timeframe is anticipated to be completed within a 5 year period. These actions are considered to be relatively major actions which require further analysis and investigation before delivery.

Long Term, 2028-2031, this timeframe is anticipated to be completed within a 3 year period. These actions are considered to be major actions or relate to population trends which need to be monitored prior to delivery of these actions. Noting that these actions are based on current population and land demand and supply projections, it is recommended that further reviews of this strategy investigate these actions to ensure their continued appropriateness for Dubbo's employment growth.

Precinct Guidance	Comment	Anticipated Phasing
CBD Expansion	Investigate opportunities to expand the CBD to ensure sufficient retail floorspace supply is provided.	Long Term
Websdale Road B1 Neighbourhood Centre rezoning	Investigate the rezoning of the B1 zone to a residential zone.	Short Term
North West Urban Release Area Neighbourhood Centre	Investigate provision of a neighbourhood centre zone in the North-West urban release area.	Long Term
North West Urban Release Area Mixed Use zone	Investigate a mixed use zone in the NW URA.	Long Term
Myall Street Neighbourhood Centre – rezoning investigations of undeveloped land	Investigations with respect to the undeveloped area at the rear of the neighbourhood shop should be undertaken with potential to rezone to residential.	Short to Medium Term
West Dubbo – B5 Business Development zone	Investigate an appropriate zone for this precinct.	Short Term
Bourke Street – B6 Expansion East into River Street	Investigations should be made into the viability of expanding the B6 Enterprise Corridor east along River Street.	Short to Medium Term
Victoria Street Enterprise Corridor	Investigate buffer between precinct and residential areas. Also investigate opportunities to remove residential dwellings from the precinct.	Ongoing

Precinct Guidance	Comment	Anticipated Phasing
Health, Well-being and Education Precinct – Mixed Use zone	Investigate a B4 mixed use zone for the R2 land adjacent to the Health, Well-being and Education Precinct to support the significant development occurring.	Short Term
Health, Well-being and Education – Site Specific Development Control Plan	Preparation of a development control plan for the mixed use zone.	Short Term
Health, Well-being and Education – Neighbourhood Centre	Investigate provision of a Neighbourhood Centre.	Short to Medium Term
Health, Well-being and Education Precinct – SP3 Tourist zone	Investigate extending the SP3 Tourist zone along Cobbora Road.	Long Term
Health, Well-being and Education Precinct – Macquarie Home Stay	Investigate rezoning the land which Macquarie Homestay is located on, to SP3 Tourist.	Short Term
Health and Education – Precinct Plan	Prepare a Precinct Plan over the Health, Well-being and Education Precinct to provide overarching guidance for the future development of this precinct.	Short Term
Airport Precinct – Commercial zone	Investigate a commercial zone in West Dubbo	Medium to Long Term
Airport Precinct – Structure Plan	Prepare a Structure Plan over the Airport Precinct to provide overarching guidance for the development of this precinct.	Short Term
Airport Precinct – Industrial Candidate Area	Investigate whether any further industrial zoned land is required in this precinct.	Long term
East Dubbo Industrial Precinct – Wheelers Lane	Investigate rezoning the IN2 Light Industrial zoned land on western side of Wheelers Lane to a commercial zone.	Long Term
East Dubbo Light Industrial – Inland Rail Maintenance Facility	Investigate zoning of land once Inland Rail Maintenance Facility is operational.	Medium Term
North Industrial Precinct – Land use conflict	Investigate opportunities to create a buffer between the industrial and residential precincts. Also investigate opportunities to remove residential dwellings from the precinct.	Ongoing
Basalt Road Precinct – Monitor Quarry Development	Quarry developments are monitored.	Ongoing
Blueridge – Structure Plan	Review existing Blueridge over the Structure Plan to provide overarching guidance for the development of this precinct.	Short Term
Blueridge Precinct – Industrial Candidate Area	Investigate whether any further industrial zoned land is required in this precinct.	Long Term
Brocklehurst Precinct – Structure Plan	Prepare a Structure Plan over the Brocklehurst Precinct to provide overarching guidance for the development of this precinct.	Short Term
Brocklehurst Precinct – Industrial Candidate Area	Investigate whether any further industrial zoned land is required in this precinct.	Long Term
Yarrandale Road Precinct – Structure Plan	Prepare a Structure Plan over the Yarrandale Road Precinct to provide overarching guidance for the development of this precinct.	Short Term
Yarrandale Road Precinct – Industrial Candidate Area	Investigate whether any further industrial zoned land is required in this precinct.	Long Term

Precinct Guidance	Comment	Anticipated Phasing
Zoo and Camp Road Precinct - Land use zone	Investigate if SP3 Tourist is the most appropriate zone based on the future role of the precinct.	Short Term
Zoo and Camp Road Precinct - Dwellings	Implement the recommendation that dwellings become a permissible form of development on the land south of Camp Road	Short Term
Zoo and Camp Road Precinct - Review of lot sizes	Investigate a suitable minimum lot size for the precinct.	Short Term
Zoo and Camp Road Precinct - Morris Park Speedway	Implement changes into the Dubbo Local Environmental Plan 2011 to formalise areas subject to noise impacts.	Short Term
Zoo and Camp Road Precinct - Amenity	Implement changes into the Dubbo Local Environmental Plan 2011 to remove recreational facilities (major).	Short Term
Zoo and Camp Road Precinct - Road Transportation Strategy	Review the Dubbo Road Transportation Strategy every five (5) years.	Long Term
Zoo and Camp Road Precinct - Structure Plan	Finalise Draft Structure Plan over the Zoo and Camp Road Precinct to provide overarching guidance for the development of this precinct.	Short Term
Central Tourist Strips – Former RAAF Stores Depot	Consideration of an Economic Impact Assessment for adaptive reuse.	Short to Medium Term
Railway and Kokoda Place – Kokoda Place rezoning	Investigate the rezoning of this land to a more appropriate zone.	Short Term

16. Monitoring

It is recommended this strategy generally be reviewed every 5 years to investigate changes in the economy, legislation, policies, community and development trends whilst examining demand and supply forecasts. The economy of Dubbo will be monitored by investigation of the employment characteristics and analysis of the forecasts. Planning legislation changes and planning trends will be monitored to facilitate the most modern and dynamic planning principals are implemented correctly and where appropriate. The communities vision for employment lands forms a critical component of public exhibition to encourage integration of Council policies and community views and aspirations.

The monitoring process is key in ensuring that the employment land strategy represents a living document creating synergies with Dubbo's employment lands. The process will support the document ensuring relevant population demographics, legislation, employment trends and forecast are discussed to achieve the orderly growth of employment lands in the former Dubbo LGA.

Document Control Table

Revision	Purpose	Date
1	Draft Issued for Public Exhibition	24 September 2019
2	Amendments for Council Adoption	25 February 2019
3	Amendment for Department Planning, Industry and Environment Endorsement	2 July 2019

Adopted by Council on 11 March 2019

Endorsed by Department Planning, Industry and Environment on 18 September 2019

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APPENDIX K – Economic Impact Analysis, prepared by PPM Consulting

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Gastro Pub at Southlakes – Economic Impact Analysis

FINAL – Prepared for Umwelt by PPM Consulting

Date: 7 February 2020

Contents

Executive Summary	3
1. Introduction	5
2. The Proposed Development	6
2.1 Regional and Local Context	6
2.2 Local Employment by Industry	8
2.3 Strategic Planning Overview	9
3. Statement on Previous Studies	10
4. Trade Area Analysis	11
4.1 Current and Projected Demand for Land	11
4.2 Current and Projected Over/Undersupply of Land	11
4.3 Additional Expenditure from Southlakes Residents	12
5. Competition – Existing Facilities	13
5.1 Existing and Proposed Restaurants and Bars	13
5.2 Gaming Venues	16
5.3 Packaged Alcohol Retailers	16
5.4 A Comment on Competition	17
6. Market Gap	20
7. Economic Impacts	21
7.1 Gastro Pub	21
7.2 Gaming Venue	21
7.3 Package Alcohol Sales	22
7.4 Employment Impact	23
8. Conclusion	25
About PPM Consulting	26
Disclaimer	27

Executive Summary

This report presents an independent assessment of the economic impacts and net community benefits relating to a gastronomic pub (gastro pub) proposed to be located within the planned neighbourhood centre in the Southlakes Estate located in East Dubbo, NSW.

Proposed Development

- The development site is on the extension of Boundary Road, which is currently unformed, and is proposed to extend to Sheraton Road.
- The proposed site of the gastro pub is within the Estate's neighbourhood shopping centre which was approved by the Dubbo Regional Council (DRC) in February 2018.
- The gastro pub, which will consist of a restaurant, bar, gaming area with 12 electronic gaming machines (EGMs) and a small packaged alcohol sales area, is proposed to consist of 580m² of gross leasable area (GLA) (the space leased to the tenant), with 520m² available as gross floor area (GFA) (the space available for productive activities).

Current Floorspace Inventory

- The DRC released their final employment strategy for the local government area (LGA) in July 2019. This analysis showed that there is a current shortage of 3,991m² of gross floor area for restaurants, liquor, take-aways, hotels and clubs.
- This shortage is expected to increase to 7,185m² in 2031.

Competition

- There are currently 19 hotel, club and small bar venues located in the Dubbo city centre.
- In addition, a gastro pub would compete with the 33 restaurants that currently licenced.
- The gastro pub would also compete with the 8 packaged alcohol outlets within a 15 minute drive of the site.
- In a dynamic economy, competition plays a vital role in keeping prices in check and offerings and amenity suitable for the paying public.

Market Gap

- There are no pubs, clubs, restaurants or packaged alcohol venues within a 15 minute walk of the proposed gastro pub. In this sense, the proposed gastro pub will be a local offering.
- While there are current competing businesses in the Dubbo city centre, there is a large shortage of commercial space for restaurants, cafes, hotels and clubs, as well as packaged alcohol retailers.
- In addition, it is estimated that there will be 5,200 new residents in Southlakes, which is estimated to increase spending on cafes and restaurants by 31 per cent by 2028.

Economic Impacts

- It is expected that, following the establishment of the proposed gastro pub, there would still be a floorspace shortage in the sector of over 6,500m² in 2031.
- It is expected that an addition of 12 EGMs (an increase of 1.8 per cent on the 662 in the LGA currently) would have little to no impact on current gaming venues.
- The packaged alcohol retail space is likely to be no more than 20 per cent of the GLA of the venue, meaning that the maximum floorspace dedicated to packaged alcohol sales is likely to be no more than 116m². This small space would be competing against all other packaged alcohol sellers in the Dubbo city centre, including large format store Dan Murphys. It is therefore likely that the gastro pub will serve as a convenience retail outlet for local residents, and will therefore have a negligible effect on current package alcohol stores.
- It is estimated that construction of the gastro pub (at a cost of \$754,000) will create 8 full time equivalent (FTE) jobs during construction.
- It is estimated that the gastro pub would sustain 19 direct FTE jobs and an additional 7 jobs throughout the rest of the economy, totalling 26 FTE jobs.

Conclusion

- The proposed gastro pub at Southlakes would add to the Dubbo restaurant, hotel and gaming sector, as well as provide a local outlet for package alcohol.
- At the local level, the proposal would service the 5,200 new local residents in the Southlakes Estate, but would also be accessible by car within a 15 minute drive from most of the Dubbo city centre.
- There is a large shortage of floorspace for restaurants, liquor, take-aways, hotels and clubs in Dubbo. As the proposed gastro pub would only be small as far as gross floorspace is concerned (580m² including restaurant, bar, gaming venue and packaged alcohol sales), it would only have a very small impact on reducing that under-supply.
- Due to the relatively small size of the proposed gastro pub, the large shortage of floorspace and the relatively small increase in the number of EGMs, it is very unlikely that currently existing venues would be adversely affected by the operation of the proposal.
- The analysis provided in this report suggests that not only is the proposed gastro pub not likely to adversely affect current businesses, it will have a positive overall effect on the Dubbo economy.

1. Introduction

The purpose of this report is to provide an economic impact assessment of a proposed new gastro pub as part of the proposed new neighbourhood shopping centre in the Southlakes Estate in East Dubbo.

The gastro pub would consist of a restaurant, bar, gaming area with 12 electronic gaming machines (EGMs) and a small packaged alcohol outlet.

This report has been prepared under instruction from Umwelt, on behalf of MAAS Group Properties.

This report is presented as follows:

- Chapter 2 provides an overview of the proposal, including the local and regional context of the subject site, key demographic and employment data and a brief review of relevant planning documentation.
- Chapter 3 provides a statement on the ongoing relevance of the previous MacroPlan Dimasi report prepared for the proposed neighbourhood centre (of which the proposed gastro pub will be a part) in October 2016.
- Chapter 4 provides an analysis of the trade area, including the current and projected demand for land, the current and projected over- and undersupply of land in the Dubbo area, and the additional expenditure that is likely to come from new Southlakes Estate residents.
- Chapter 5 analyses the existing competitive environment, including all current bars, hotels, clubs and restaurants. This chapter also looks at the number and profitability of gaming venues within the local government area. The packaged liquor market in Dubbo is also analysed. Finally, commentary is provided with regards to the nature of competition and the consequences of restricting competition in cities such as Dubbo.
- Chapter 6 assesses the market gap, and includes drive and walking distance to the proposed gastro pub.
- Chapter 7 identifies the economic impacts of the proposed gastro pub, gaming venue and packaged alcohol sales store, including the employment and other impacts that would flow if the proposal became operational.
- Chapter 8 makes some concluding remarks about the proposal and its impact on the Dubbo economy.

2. The Proposed Development

2.1 Regional and Local Context

The proposed gastro pub is located within the Dubbo Regional Council (DRC) Local Government Area (LGA). Dubbo was amalgamated with Wellington Council in May 2016. For the purposes of the 2016 Census of Population and Housing, the council is referred to as the Western Plains Regional Council.

At the time of the Census in 2016, DRC had a population of 50,077, which is expected to grow to 57,980 by 2036. Dubbo also serves a large catchment beyond its LGA boundaries.

Table 1 shows some key demographic data for the DRC LGA.

Table 1: Key Demographic and Economic Data fo	or Dubbo Regional Council LGA
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Population (2016 Census)	50,077
Projected population (2036)	57,980
Projected population growth	7,903
Over-18 population (2016)	37,827
Median Age (years)	37
Median Household Weekly Income (\$)	1,272
Average Household Size (persons)	2.5
Population of Dubbo – South (Inner Dubbo)*	16,951
Average Annual Spend on Cafes and Restaurants (\$)	822.94

* Dubbo – South SA2 census district

Source: 2016 Census of Population and Housing, Western Plains Regional LGA, GapMaps,

The proposed gastro pub is south-east of the Dubbo central business district (CBD), shown in Figure 1.



Figure 1: Southlakes Within Dubbo

Source: GapMaps
The development site is on the extension of Boundary Road, which is currently unformed, and is proposed to extend to Sheraton Road. The site of the gastro pub is within the planned neighbourhood shopping centre. Figure 2 presents the current masterplan of the Southlakes Estate. The gastro pub is proposed to be part of the neighbourhood centre (represented on the masterplan in yellow).



Figure 2: Southlakes Estate Masterplan

Source: MAAS Group Properties

The gastro pub, which will consist of a bistro, bar, gaming area with 12 electronic gaming machines (EGMs) and a small packaged alcohol outlet, is shown in yellow in Figure 3 and consists of 580m² of gross leasable area (GLA) (the space leased to the tenant), with 520m² available as gross floor area (GFA) (the space available for productive activities).



Figure 3: Gastro Pub Within the Neighbourhood Centre

Source: MAAS Group Properties

2.2 Local Employment by Industry

Employment in the Dubbo LGA is dominated by the Health Care and Social Assistance industry, with 15.4 per cent of all employed persons working in the industry.

Retail trade is the second largest employing industry, with 10.9 per cent of workers engaged in this industry.

Education and training is the third largest employing industry, with 9.3 per cent of workers engaged in this industry.

Construction is the fourth largest employing industry, at 8.5 per cent of workers, while Public Administration and Safety is fifth largest with 7.7 per cent of workers.

Accommodation and Food Services represents 1,645 workers, or 7.4 per cent of employed persons. This is the sixth largest employer in the Dubbo LGA and is slightly higher than the proportion of workers in this industry for the whole of NSW (7.1 per cent).

Table 2 shows employment by industry for the Dubbo Regional Council LGA.

	Number	Per Cent (%)
Agriculture, Forestry and Fishing	1,138	5.1%
Mining	247	1.1%
Manufacturing	1,289	5.8%
Electricity, Gas, Water and Waste Services	285	1.3%
Construction	1,881	8.5%
Wholesale Trade	684	3.1%
Retail Trade	2,423	10.9%
Accommodation and Food Services	1,645	7.4%
Transport, Postal and Warehousing	886	4.0%
Information Media and Telecommunications	202	0.9%
Financial and Insurance Services	388	1.8%
Rental, Hiring and Real Estate Services	255	1.2%
Professional, Scientific and Technical Services	913	4.1%
Administrative and Support Services	602	2.7%
Public Administration and Safety	1,716	7.7%
Education and Training	2,061	9.3%
Health Care and Social Assistance	3,407	15.4%
Arts and Recreation Services	346	1.6%
Other Services	977	4.4%
Inadequately described/Not stated	784	3.5%
Total	22,142	

Table 2: Employment by Industry, Dubbo Regional Council LGA

Source: 2016 Census of Population and Housing, Western Plains Regional LGA

2.3 Strategic Planning Overview

The key document that has been reviewed in order to understand the potential role and function of a gastro pub in the Southlakes Estate neighbourhood centre is the *Employment Lands Strategy* (Revision 3, 2 July 2019) for the DRC. This strategy was endorsed by the Department of Planning, Industry and Environment on 18 September 2019.

The Employment Lands Strategy was extensively informed by work undertaken by Hill PDA in 2017.

Southlake's neighbourhood centre is zoned B1 Neighbourhood Centre in the Dubbo Local Environment Plan (LEP) 2011, situated on Boundary Road in south-east Dubbo. The site is currently undeveloped and no Development Applications have been submitted. The proposed centre will have an approximate trade area of 10,000 residents by 2031. The centre has a size requirement of up to 5,000m² GFA.

It is intended that DRC will continue to maintain and support the CBD as Dubbo's primary service and retail centre, but will facilitate the appropriate development of Southlakes in terms of built form, scale and design which compliments the adjoining residential estates.

3. Statement on Previous Studies

MacroPlanDimasi prepared an Economic Impact Assessment for the proposed neighbourhood centre supermarket in October 2016.

PPM Consulting concludes that this assessment remains valid today. The best publicly available information, including information from Council, suggests that nothing has changed in the Dubbo supermarket context that was not anticipated by the original Economic Impact Assessment report and therefore there has been no change that would invalidate the report.

If anything, the MacroPlan Dimasi report now underestimates the positive impacts of the neighbourhood centre, as:

- The ongoing floorspace shortage for supermarkets has remained the same or has worsened as the population has increased.
- The Hillview Estate (now Southlakes), which at the time was to accommodate 1,645 lots (or 4,113 residents at the current densities in Dubbo), is now expected to house 5,200 residents (an increase of more than 25 per cent).
- With a higher population, it is expected that the estimated annual retail expenditure for the main trade area would be higher than projected in 2016.
- The market gap is likely to have increased due to the increase in expected population, meaning that the conclusion that a supermarket of at least 3,500m² could be supported on the subject site before 2021 remains valid.
- The estimated 5 per cent impact across the network of centres in east Dubbo and southeast Dubbo and the Dubbo CBD is likely to now be an over-estimate.
- The specific impacts identified on the Orana Mall are also likely to be over-estimates, even though it was found that these impacts would be very minor.
- The conclusion that there is no prospect that any existing centre will suffer any impact which will threaten its ability to provide a level of service at least equivalent to that which it was providing at the time of the report remains valid.
- The estimates of increases in jobs by 169 ongoing FTE jobs and 167 short-term FTE jobs during construction remains valid.

Overall, it is PPM Consulting's view that there is no reason why both the Council and the proponent should not continue to rely on the MacroPlan Dimasi report of October 2016.

4. Trade Area Analysis

4.1 Current and Projected Demand for Land

Currently there are 12,780m² of gross lettable floorspace (GLA) for restaurants, hotels and clubs in the Dubbo LGA. Demand is projected to increase for this floorspace to 14,841m² by 2031. This is an increase of 2,061m² or 16.1 per cent.

Take-away liquor stores have a current estimated demand (in 2016) for $2,764m^2$ of GLA. Demand is projected to increase to $3,218m^2$ or by 16.4 per cent in the 11 years to 2031.

Table 3 shows the total current (2016) and projected floorspace demand by retail stores in the Dubbo LGA.

able 3: Total Floorspace Demand by Retail Store Type in Dubbo (m²)							
Retail Store Type	2016	2021	2026	2031			
Supermarkets and Grocery Stores	21,830	23,246	24,591	25,836			
Take-away Liquor Stores	2,764	2,924	3,077	3,218			
Specialty Food Stores	3,822	4,016	4,199	4,368			
Fast-Food Stores	4,807	5,048	5,276	5,486			
Restaurants, Hotels and Clubs	12,780	13,509	14,202	14,841			
Department Stores	22,531	23,369	24,133	24,794			
Clothing Stores	15,494	16,107	16,666	17,153			
Bulky Goods Stores	46,553	48,653	50,577	52,258			
Other Personal and Household Goods Retailing	25,007	26,399	27,708	28,899			
Selected Personal Services	7,436	7,861	8,265	8,638			
Total m ²	163,024	171,133	178,694	185,489			

Source: Employment Lands Strategy (Revision 3, 2 July 2019), Dubbo Regional Council

4.2 Current and Projected Over/Undersupply of Land

Restaurants, Liquor, Take-Aways, Hotels and Clubs were projected to face a shortage in 2016 of 3,991m². This is projected to increase to 7,185m² by 2031.

Table 4 shows the floorspace demand and supply for the Dubbo LGA to 2031. Red shaded cells represent an undersupply of land.

Т	able	4:	Floors	pace D)emand	and	Supr	٥lv	,
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	Supply	Demand			
Retail Store Type	2016	2016	2021	2026	2031
Supermarkets and Grocery Stores	18,274	-3,556	-4,972	-6,317	-7,562
Specialty Food Stores	6,579	2,757	2,563	2,380	2,211
Restaurants, Liquor, Take-Aways, Hotels & Clubs	16,360	-3,991	-5,121	-6,195	-7,185
Department and Discount Department Stores	18,998	-3,533	-4,371	-5,135	-5,796
Specialty Non Food	37,371	-3,130	-5,135	-7,003	-8,681
Selected Personal Services	7,155	-281	-706	-1,110	-1,483
Bulky Goods Stores	45,077	322	-1,778	-3,702	-5,383
Total m2	151,612	-11,412	-19,520	-27,082	-33,879

Source: Employment Lands Strategy (Revision 3, 2 July 2019), Dubbo Regional Council

4.3 Additional Expenditure from Southlakes Residents

The Southlakes development is expected to be built out by 2028, with an estimated population of 5,200 people.

According to GapMaps, the estimated annual expenditure on cafes and restaurants for Inner Dubbo is \$822.94 per person (shown in Table 1).

Table 5 shows the increased expenditure the new and future residents of the Southlakes Estate would bring to the cafes and restaurant sector in Dubbo.

Table 5: Impact of Increased Population on Annual Café and Restaurant Spend

	Population	Per Capita Spend	Total Spend
Current Spend	16,951	822.94	13,949,617
Increased Spend	5,200	822.94	4,279,276
Projected Spend	22,151	822.94	18,228,893
Total Increased Spend			30.7%

Source: GapMaps, MAAS Group Properties, PPM Consulting

As shown in Table 5, the increased population (assuming expenditure on cafes and restaurants remains the same for new residents as is currently the case) would increase spending on cafes and restaurants by \$4.3 million per year from 2028. This is an increase of 31 per cent.

5. Competition – Existing Facilities

5.1 Existing and Proposed Restaurants and Bars

There are currently 19 venues listed as having a licenced club, hotel or small bar licence in the vicinity of the proposed gastro pub at Southlakes. There are a further 33 on-premises licenced venues (most of which are motel restaurants, some of which currently do not operate).

Figure 4 shows the distribution of alcohol outlets (clubs, hotels, restaurants and packaged alcohol retailers) in the Dubbo City area.



Figure 4: Alcohol Outlets, Dubbo City

Source: Liquor and Gaming LiveData - https://livedata.liquorandgaming.nsw.gov.au/LGA/122-Dubbo-Regional

Table 6 shows the current club, hotel and small bar venues operating in Dubbo City against the proposed gastro pub would compete.

Name of Venue	Туре
Dubbo City Bowling Club	Licenced Club
Dubbo RSL Memorial Club	Licenced Club
Club Dubbo	Licenced Club
Macquarie Club (Dubbo)	Licenced Club
Dubbo Golf Club	Licenced Club
Western Star Hotel	Hotel
Castlereagh Hotel	Hotel
Pastoral Hotel	Hotel
Garden Hotel	Hotel
Railway Junction	Hotel
Amaroo Hotel	Hotel
Dubbo Monkey Bar	Hotel
Commercial Hotel	Hotel
Milestone Hotel	Hotel
Westside Hotel Motel	Hotel
Macquarie Inn Hotel	Hotel
South Dubbo Tavern	Hotel
Auctioneer Coffee	Small Bar
The Establishment Bar	Small Bar

Table 6: Club, Hotel and Small Bar Venues in Dubbo City

Source: Liquor and Gaming LiveData - https://livedata.liquorandgaming.nsw.gov.au/LGA/122-Dubbo-Regional

Table 7 shows the 33 restaurants and cafes that have liquor licences in Dubbo City.

Name of Venue	Туре
Western Plains Zoo	On-Premises Licence
Dubbo Mainstay Motor Lodge	On-Premises Licence
Mad Mex Dubbo	On-Premises Licence
Cascades Motor Inn	On-Premises Licence
Blue Gum Motor Inn	On-Premises Licence
Homestead Motel	On-Premises Licence
Veldt Restaurant	On-Premises Licence
Golden West Motor Inn	On-Premises Licence
Blue Lagoon Motor Inn	On-Premises Licence
The Countryman Motor Inn	On-Premises Licence
Australian Heritage Motor Inn	On-Premises Licence
Shearing Shed Motor Inn	On-Premises Licence
Grill and Bare Café Restaurant	On-Premises Licence
Rose Garden Thai Restaurant	On-Premises Licence
Tillys Restaurant	On-Premises Licence
Two Doors Tapas and Wine Bar	On-Premises Licence
Press Restaurant	On-Premises Licence
Royal India Restobar	On-Premises Licence
Old Bank Restaurant	On-Premises Licence
Hogs Breath Café	On-Premises Licence
Café Cherry Beans	On-Premises Licence
Westbury	On-Premises Licence
Fu Lee Wah	On-Premises Licence
CSC	On-Premises Licence
Dubbo Regional Theatre and Convention Centre	On-Premises Licence
The Gallery Dubbo	On-Premises Licence
Endeavour Court Motor Inn	On-Premises Licence
Happy Chinese Restaurant	On-Premises Licence
Cattlemans Restaurant	On-Premises Licence
Rose Garden Thai Restaurant	On-Premises Licence
Akuna Motor Inn	On-Premises Licence
Dubbo Sports World	On-Premises Licence
Devils Elbow Brewery	On-Premises Licence

Table 7: Club, Hotel and Small Bar Venues in Dubbo City

Source: Liquor and Gaming LiveData - https://livedata.liquorandgaming.nsw.gov.au/LGA/122-Dubbo-Regional

There are currently no proposed new hotel venues. A review of council planning information suggests that there are currently no proposed new restaurants or packaged alcohol retailers.

5.2 Gaming Venues

There are currently 24 clubs and hotels in the DRC area. This is slightly more than the number of clubs and hotels in the CBD as it includes clubs and hotels in other parts of the LGA.

Table 8 shows the number of EGMs and average profit per EGM for the DRC area. As can be seen, there are currently 662 EGMs in Dubbo, across 24 venues. These venues have an average profit of \$28,011 – although club profit is lower than hotel profit (\$25,563 compared with \$32,401).

Net Profit (\$)	EGMs (no.)*	Premises (no.)	Average Profit Per EGM
\$10,864,404.10	425	10	25,563.30
\$7,679,144.90	237	14	32,401.46
\$18,543,549.00	662	24	28,011.40
	Net Profit (\$) \$10,864,404.10 \$7,679,144.90 \$18,543,549.00	Net Profit (\$) EGMs (no.)* \$10,864,404.10 425 \$7,679,144.90 237 \$18,543,549.00 662	Net Profit (\$)EGMs (no.)*Premises (no.)\$10,864,404.1042510\$7,679,144.9023714\$18,543,549.0066224

Table 8: EGM Numbers and Profits, Dubbo Regional Council Area

* As at 3 June 2019

Source: Liquor and Gaming NSW

5.3 Packaged Alcohol Retailers

Table 9 identifies the 8 packaged alcohol retailers that would be in direct competition with a proposed off-licence at Southlakes.

Table 9: Packaged Alcohol Retailers, Dubbo City

Name of Venue	Туре	Distance from Southlands Estate (Km)*
BWS Orana Mall	Packaged Liquor	1.7
Ashcroft's IGA	Packaged Liquor	1.7
ALDI	Packaged Liquor	3.1
BWS – Macquarie St	Packaged Liquor	3.7
Sids Bottle Shop	Packaged Liquor	3.3
Liquorland	Packaged Liquor	3.4
West Dubbo Liquor Barn	Packaged Liquor	4.3
Dan Murphys	Packaged Liquor	2.1

*Distance measured in a straight line.

Source: Liquor and Gaming LiveData - https://livedata.liquorandgaming.nsw.gov.au/LGA/122-Dubbo-Regional

All of the venues are within a 15 minutes drive of the Southlakes Estate. None of the venues are within a 15 minute walk of the Southlakes Estate.

There are currently no proposed new packaged alcohol retailers

5.4 A Comment on Competition

Major British Study of Restrictions of Commercial Space

Cheshire, Hilber and Kaplanis in *Evaluating the effects of planning policies on the retail* sector: or do town centre first policies deliver the goods? (Spatial Economics Research Centre, London School of Economics, 2011) found that British land use policies may lower total factor productivity (TFP) in the retailing industry by:

- restricting the total availability of land for retail, thereby increasing space costs
- directly limiting store size
- concentrating retail development on specific central locations.

The researchers used unique store-specific data to estimate the impact of space on retail productivity and the specific effects of planning restrictiveness and micromanagement of store locations.

The research found that total factor productivity (TFP) rises with store size and that planning policy directly reduces productivity both by reducing store sizes and forcing retail onto less productive sites. The results suggest that since the late 1980s British planning policies have imposed a loss of TFP of at least 20 per cent.

Planning policies in NSW are similarly restrictive, establishing town centre hierarchies, restricting new town centres, restricting the size of town centres, restricting what can go into town centres and curtailing growth.

The research found that these restrictive "town centre first" policies should be removed, especially:

- eliminating the 'needs' and 'sequential' tests and allowing supermarket development on larger sites close to major highways as it would produce major efficiency gains in the sector.
- "town centre first" policies are unlikely to deliver on the two explicit goals of improving access to shops for poorer households and encouraging the use of public transport for sustainability.
 - By reducing productivity and raising prices in shops notably supermarkets these policies adversely affect the poor, since poorer households spend higher proportions of their incomes on supermarket purchases.
 - Since warehouses are located close to major roads, these policies push retail logistics to more and longer journeys in smaller trucks in more congested conditions. They also push the majority of shoppers using cars to more frequent and time-consuming trips in more congested conditions.

The implications of this research for NSW, and indeed for the proposed neighbourhood centre at the Southlakes Estate, are profound. The findings suggest that restricting the size and growth of centres, and concentrating growth in current centres, would likely result in an increase in prices, more cars and trucks on the road and more congestion around the designated centres. Restriction of this nature, if they were imposed, would not only be bad for the current and potential residents of Southlakes, but also the wider catchment area.

Competing Town Centres

The Department of Planning, Industry and Environment (the Department) has a longstanding (albeit in draft) policy position when it comes to competition between centres.

The *Centres Policy: Planning for Retail and Commercial Development* has been in draft form since 2009 and provides guidance to planning authorities. The (draft) Centres Policy is based on six planning principles:

- Retail and commercial activity should be located in centres to ensure the most efficient use of transport and other infrastructure, proximity to labour markets, and to improve the amenity and liveability of those centres.
- The planning system should be flexible enough to enable centres to grow, and new centres to form.
- The market is best placed to determine the need for retail and commercial development. The role of the planning system is to regulate the location and scale of development to accommodate market demand.
- The planning system should ensure that the supply of available floorspace always accommodates the market demand, to help facilitate new entrants into the market and promote competition.
- The planning system should support a wide range of retail and commercial premises in all centres and should contribute to ensuring a competitive retail and commercial market.
- Retail and commercial development should be well designed to ensure they contribute to the amenity, accessibility, urban context and sustainability of centres.

Recent residential development in the area has resulted in an increase in population without a commensurate increase in the amount of retail space and other amenities. The proposed neighbourhood centre will bring the retail and other commercial services that are needed today by current residents of the area.

A Note on The Harper Review

The Commonwealth Government's Competition Policy Review (Harper Review) released its final report on 31 March 2015. The key focus of the report, with regards to planning and land use controls, is on the constraints to land use and its impact on competition.

At page 44, the Harper Review states:

Land is an important input to the production of goods and services and a source of amenity for consumers. Even small policy improvements in this area could yield large benefits to the economy.

Planning systems by their nature create barriers to entry, diversification or expansion, including through limiting the number, size, operating model and mix of businesses. This can reduce the responsiveness of suppliers to the needs of consumers.

Planning regulations should work in the long-term interests of consumers. They should not restrict competition unless the benefits of the restriction to the community as a whole outweigh the costs,

and the objectives of the regulations can only be achieved by restricting competition. Subjecting planning regulations to the public interest test will ensure they do not inappropriately limit entry to markets.

Comment

It is clear that, even if a new commercial or retail development is expected to have an effect on current businesses, this is no reason to prevent the new venture from coming to fruition. Competition is a good thing, and would be welcomed by consumers, as additional choice is offered. Competition could result in better products, better and more innovative service delivery and cheaper goods and services for consumers. For current businesses, competition can be both a threat and an opportunity, but it is not up to planners to protect current businesses from competition (and thereby preventing the benefits of competition flowing to consumers). Current businesses competing with new businesses can find cheaper and better ways to do business, new offerings to consumers and can innovate in both products and service delivery. Stymying competition leads to higher prices for consumers, lower levels of service, further drive times, more congestion and less choice. Therefore, competition should be welcomed by planners, rather than look for it to be managed.

6. Market Gap

Unlike in assessments of supermarket market gap, clubs, hotels, restaurants and individual small packaged alcohol retailers-licences are too small by themselves to have a wide-spread effect on the market as a whole.

Figure 5 shows Southlakes represented by the red dot towards the centre of the map. The first line around the red dot shows how far a person would reach in a 15 minute walk, while the outer line (all shaded space) shows the range for a 15 minute drive.



Figure 5: 15 Minute Walk and Drive Distances from Southlakes

Source: GapMaps

As can be seen, there are no pubs, clubs, restaurants or packaged alcohol venues or retailers within a 15 minute walking distance. In this sense, the proposed neighbourhood centre and proposed gastro pub will truly service their neighbourhood.

More broadly, residents who drive would be able to reach all licenced venues and packaged alcohol retailers in the Dubbo city centre, meaning that the gastro pub would be competing directly with all other venues in the city.

As discussed in Chapters 4 and 5, while there are current competing businesses in the Dubbo city centre, there is a large shortage of commercial space for restaurants, cafes, hotels and clubs, as well as packaged alcohol retailers. Also, as discussed, the increased population is estimated to increase the total spending on cafes and restaurants by 31 per cent by 2028. The next chapter brings together the data from Chapters 4, 5 and 6 to look at the impact that the gastro pub is expected to have on the Dubbo restaurant, hotel and packaged alcohol retail community.

Gastro Pub at Southlakes - Economic Impact Assessment

7. Economic Impacts

7.1 Gastro Pub

The proposed gastro pub would be 580m² of GLA. It is expected that 20 per cent of that would be used for sale of packaged alcohol. Therefore, 464m² of GLA would be left available for a restaurant, bar and gaming venue.

In the context of floorspace supply and demand, there was a 3,991m² shortage of floorspace in the sector in 2016. This is expected to grow to 5,121m² by 2021 and 7,185m² by 2031. Table 10 shows that, if the gastro pub is established, there would still be a shortage of 6,721m² of Restaurants, Liquor, Take-Aways, Hotels & Clubs floorspace in 2031.

Table 10: Floorspace Demand and Supply

	Supply		Dem	and	
Retail Store Type	2016	Projected Floorspace Shortage 2016	Projected Floorspace Shortage After Gastro Pub 2021	Projected Floorspace Shortage 2031	Projected Floorspace Shortage After Gastro Pub 2031
Restaurants, Liquor, Take- Aways, Hotels & Clubs	16,360	5,121	4,657	7,185	6,721

Source: Employment Lands Strategy (Revision 3, 2 July 2019), Dubbo Regional Council, PPM Consulting

Given the increased expenditure on cafes and restaurants that is estimated to come from new residents (\$4.3 million or an increase of 31 per cent), and the large existing floorspace shortage, it is very unlikely that 464m² of new restaurant, bar and gaming floorspace would have a significant impact on other traders.

7.2 Gaming Venue

The gastro pub is also proposed to have 12 EGMs. There are currently 24 gaming venues in the DRC area, with a total of 662 EGMs. The average profit per EGM is \$28,011, while the average hotel EGM profit is \$32,401.

As shown in Table 11, an additional 12 EGMs would take the total number of EGMs in the DRC area to 674, an increase of 1.8 per cent. Based on the average profit for hotel EGMs, the new EGMS could make a profit of \$388,817 per year, assuming that average profit per EGM remains constant. The total net profit for EGMs in the DRC area would be \$18,932,366 – an increase of 2.1 per cent.

Assuming that average profit per EGM remains static, the average profit for EGMs in the DRC area would increase slightly to \$28,011, while the average profit per hotel EGM would remain at \$32,401 per year.

Venue Type	Net Profit (\$)	EGMs (no.)*	Premises (no.)	Average Profit Per EGM (\$)	
Clubs	\$10,864,404.10	425	10	25,563.30	
Hotels	\$7,679,144.90	237	14	32,401.46	
Total	\$18,543,549.00	662	24	28,011.40	
Proposed New EGMS	388,817.46	12	1	32,401.46	
Total After New EGMs	18,932,366.46	674	25	28,089.56	
New EGMs (% of Total)	2.1	1.8	4.0		
Hotels Including Southlakes	8,067,962.36	249	15	32,401.46	

Table 11: Effect of Proposed Increase in EGMs

* as at 3 June 2019

Source: Liquor and Gaming NSW

It is very unlikely, therefore, that an increase in EGMs by 12 would have a significant effect on the profitability of existing EGM venues in the DRC area.

7.3 Package Alcohol Sales

The proposed gastro pub would also sell packaged alcohol. Given that 20 per cent of the 580m² of GLA would be for this purpose, the packaged alcohol retail space would be 116m².

The 116m² of retail space would be competing against all other packaged alcohol sellers in the Dubbo city centre, including discount large format store Dan Murphys.

As can be seen in Table 12, the projected floorspace shortage would remain significant, with a projected 5,005m² shortfall in 2021 and a 7,069m² shortfall in 2031.

Therefore, it is likely that the gastro pub will serve as a convenience retail outlet for local residents, rather than a destination store.

Table 12: Floorspace Demand and Supply

	Supply	Demand				
Retail Store Type	2016	Projected Floorspace Shortage 2016	Projected Floorspace Shortage After Packaged Alcohol Retail 2021	Projected Floorspace Shortage 2031	Projected Floorspace Shortage After Packaged Alcohol Retail 2031	
Restaurants, Liquor, Take- Awavs, Hotels & Clubs	16,360	5,121	5,005	7,185	7,069	

Source: Employment Lands Strategy (Revision 3, 2 July 2019), Dubbo Regional Council, PPM Consulting

7.4 Employment Impact **Construction Impact**

The development of the proposed gastro pub will have an impact on employment in the

local area. The construction phase will support short-term construction jobs (during the life of the construction) and temporary additional jobs throughout the economy, as the wages of construction workers find their way into the businesses in the local area.

Table 13 shows the employment impacts of construction. It is assumed that construction will take one year to complete. It is expected that the building will cost between \$1,300 and \$1,500 per square metre to construct. As the external shell of the building will be built as part of the proposed neighbourhood shopping centre, the lower construction estimate has been used - \$754,000. As can be seen, it is estimated that 3 direct full-time equivalent (FTE) jobs and 8 FTE jobs in total would be created during the construction phase.

Table 13: Employment Impact From Construction

	(no.)	(no.)	Impact (no.)
Construction Impact (\$754,000)	3	5	8

Source: ABS, MacroPlan Dimasi, PPM Consulti

Ongoing Impact

The proposed gastro pub is estimated to have 464m² of hotel, bar and gaming space and 116m² of packaged alcohol retail space.

Using the ABS retail expenditure benchmark of 30 jobs per thousand square metres in supermarkets (as the packaged alcohol outlet will be similar to a small supermarket) and 33 jobs per thousand square metres in non-retail, it is estimated that the gastro pub will create 19 new FTE ongoing jobs. This is shown in Table 14.

	Jobs per 1,000m2	GLA Employme (ne	
Supermarket	30	116	3.5
Non-retail	33	464	15.0
Total			18.5

Table 14: Employment Impact From Ongoing Operations

Source: ABS, MacroPlan Dimasi, PPM Consulting

As noted in Chapter 7, it is unlikely that the proposed gastro pub will impact current local businesses, therefore the estimated employment impact is an increase of 19 net new full time equivalent jobs.

It is expected that the direct jobs will stimulate the rest of the economy, resulting in a further indirect increase in employment. The extent of this increase is shown in Table 15, where it is estimated that an additional 7 ongoing FTE jobs would be created in the rest of the economy, bringing the anticipated total employment impact of the proposed gastro pub to 26 ongoing FTE jobs.

Table 15: Ongoing Employment Impact

	Direct Employment	Indirect Employment	Total Employment
	(no.)	(no.)	Impact (no.)
Ongoing Impact	19	7	26
Source: ABS, MacroPlan Dimasi,	PPM Consulting		

Other Impacts

The proposed development would generate a range of additional economic benefits, including:

- Increased choice and amenity for the population of the area.
- Increased competition, potentially resulting in an improvement in offerings from all venues in the area.
- Increased competition, potentially leading to innovations in service delivery.
- More convenient access to a restaurant, gaming and packaged alcohol for those living in the Southlakes Estate.
- Reduced travel time for the those living in the Southlakes Estate, and the potential increase in walking. This may have the benefit of reducing fuel expenses as well as helping to combat health issues through increased walking (although this could be negated by consuming the offerings of the gastro pub).
- An opportunity for the creation of a new local business, which will likely reinvest in the local area.
- Providing jobs within the Southlakes Estate, which may be taken up by local residents, potentially reducing fuel use and traffic in Dubbo.

8. Conclusion

The proposed gastro pub at the Southlakes Estate would add to the Dubbo restaurant, hotel and gaming sector, as well as provide a local outlet for packaged alcohol. At the local level, the proposal would service the 5,200 new local residents in the Southlakes Estate, but would also be accessible by car within a 15 minute drive from most of the Dubbo city centre.

There is a large shortage of floorspace for restaurants, liquor, take-aways, hotels and clubs in Dubbo. As the proposed gastro pub would only be small as far as gross floorspace is concerned (580m² including restaurant, bar, gaming venue and packaged alcohol sales), it is anticipated that it will have only a very small impact on reducing that under-supply.

There are currently 19 licenced hotels, clubs and small bars in the Dubbo city centre, and a further 33 licenced cafes and restaurants. There are 24 gaming venues in the DRC area, with 662 EGMs and a profit in 2018-19 of \$18.5 million.

There are 8 packaged alcohol retailers, but none in a reasonable walking distance of the Southlakes Estate.

Due to the relatively small size of the proposed gastro pub, the large shortage of floorspace, the relatively small increase in the number of EGMs, it is very unlikely that current venues would be adversely affected by the operation of the proposal.

The Dubbo economy is expected to benefit from an increase in 8 short-term construction jobs and a net increase of 26 FTE ongoing jobs. In addition, competition brings benefits including great convenience for locals and innovation in offerings and service.

The analysis provided in this report suggests that not only is the proposed gastro pub not likely to adversely affect current businesses, it will have a positive overall effect on the Dubbo economy.

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- viability reports
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Martin Musgrave has been a valued senior contributor in the following organisations:

- the Department of Planning and Environment
- the Urban Development Institute of Australia (National and Victorian Division)
- the Property Council of Australia (Residential Development Council)
- the Large Format Retail Association
- the Department of Premier and Cabinet (Victoria)
- the Department of the Prime Minister and Cabinet
- the Roads and Traffic Authority (NSW) (now known as RMS)
- the Hunter Valley Research Foundation (now known as the Hunter Research Foundation)

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APPENDIX L – Social Impact Assessment, prepared by Umwelt (Australia) Pty Ltd

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February 2020

SOUTHLAKES ESTATE GASTRONOMIC PUB

Social Impact Assessment

FINAL

Prepared by Umwelt (Australia) Pty Limited on behalf of Maas Group Properties Southlakes Pty Ltd

Project Director: Project Manager: Date:

Karen Lamb V2 Rhiannon Jaeger 12 February 2020



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Table of Contents

1.0	Intro	Introduction and Project Overview				
	1.1	Introdu	uction	1		
	1.2	Project	t Overview	2		
	1.3	Regula	6			
		1.3.1	State Government	6		
		1.3.2	Local Government	8		
2.0	SIA A	SIA Approach and Methodology				
	2.1	SIA Pri	10			
	2.2	SIA Ap	proach	11		
	2.3	Partici	Participants/Stakeholders in the SIA			
3.0	Social Profile			12		
	3.1	Social a	and Community Context	17		
	3.2	Econor	Economic, Income and Social Vulnerability			
	3.3	Housin	Housing, Household Composition and Family Composition			
4.0	Asse	Assessment and Prediction of Social Impacts				
	4.1	Predict	ted Impacts	22		
		4.1.1	Social Amenity	22		
		4.1.2	Cultural and Community Significance	23		
		4.1.3	Problem Behaviours	23		
		4.1.4	Health and Safety	25		
		4.1.5	Sense of Community and Place	26		
		4.1.6	Social Equity	26		
		4.1.7	Intergenerational Impact	27		
		4.1.8	Economic	27		
	4.2	Summa	ary of Positive and Negative Social Impacts	28		
5.0	Socia	Social Impact Monitoring and Management				
	5.1	Manag	gement and Mitigation	30		
	5.2	5.2 Monitoring and Evaluation				
6.0	References			32		



1.0 Introduction and Project Overview

1.1 Introduction

Southlakes Estate is a residential housing estate located in South Eastern Dubbo, NSW. The estate currently has approximately 400 – 450 built residences with further land releases planned from March 2020. Built on land identified by the Dubbo Regional Council as an urban release area under the Dubbo Local Environment Plan (LEP) 2011, the development is managed by Maas Group Properties Southlakes Pty Ltd (Maas).

In 2017, Maas submitted a proposal to Dubbo Regional Council to rezone land on a section of Boundary Road in Southlakes Estate. The proposal sought to amend the Dubbo LEP to rezone several lots to B1 Neighbourhood Centre to allow for the inclusion of a neighbourhood commercial centre in the estate. Following approval of the Gateway Determination in August 2017, the proposal was returned to the former Department of Planning and Environment (DPE, now Department of Planning, Industry and Environment, DPIE) by Dubbo Regional Council for assessment and drafting of the LEP in February 2018. The subsequent LEP was approved and published in June 2018.

Following the approval of the modifications to the LEP to facilitate the neighbourhood shopping centre, it was requested by potential proponents that the neighbourhood shopping centre include a gastronomic pub (gastro pub) to create a community meeting place and further economic opportunities within the estate. Pubs are prohibited on B1 Neighbourhood Centre zoned land in the Dubbo Development Control Plan (DCP) 2013, and therefore, a modification to the 2018 LEP approval is requested to allow for the inclusion of a gastronomic pub ("gastro pub").

This Social Impact Assessment (SIA) report has been prepared by Umwelt Australia Pty Ltd (Umwelt) to assist Maas in assessing the social impacts associated with the inclusion of the proposed gastro pub within the neighbourhood shopping centre at the Southlakes Estate. An Economic Impact Assessment (EIA) has been undertaken by PPM Consulting Pty Ltd (PPM Consulting) to assess the impact the gastro pub would have on the local economy, and to complement a previous EIA undertaken by MicroPlan Dimasi in 2016. The outcomes of this recent EIA are included within relevant sections of the SIA.

The purpose of the SIA is to provide an assessment of the potential social impacts associated with the addition of the gastro pub to the neighbourhood shopping centre in the Southlakes Estate. Specifically, assessing the impact on people's way of life (how they live, work, play and interact with one another on a day to day basis), the culture of the affected community (its shared beliefs, customs and values) and the nature of the affected community (its cohesion, interactions, stability, character, services and facilities) (Dubbo Regional Council, 2013). The SIA has been completed in line with Dubbo Regional Council's Development Control Plan (DCP), which states that undertaking an SIA for a development application will:

- Assist in establishing the full facts about the development and to support decision making about the appropriateness of a development proposal;
- Minimise adverse impacts and maximise beneficial impacts of the development;
- Assess the potential impacts of the development on future generations;
- Inform the community and facilitate participation by the community in the planning and development assessment process;
- Facilitate the consideration of alternative development proposals; and



• Enhance existing data to inform the planning and development assessment process (Dubbo Regional Council, 2013).

The SIA program has been designed to:

- Profile key communities, both in proximity to and, associated with the proposal.
- Scope and assess the potential social issues/impacts and opportunities associated with the proposal.
- Develop strategies to address the identified issues/impacts and opportunities and monitor and manage social impacts associated with the proposal.

This report has been prepared by Umwelt as part of the broader development for Southlakes Estate, following best practice SIA methodology. In 2017, the NSW DPE (now DPIE) released the *Social Impact Assessment Guideline for State Significant mining, petroleum production and extractive industry development* (DPE, 2017) (SIA Guideline); it is noted that this proposal does not adhere to the SIA Guideline, however, the SIA takes the SIA Guideline into account in the identification and assessment of social impacts.

It is a requirement of both the SIA Guideline and the Dubbo DCP that an SIA must be prepared by a suitably qualified professional with qualifications and experience in social planning (Dubbo Regional Council, 2013; DPE, 2017). This SIA was prepared and approved for publication by Karen Lamb, Principal Social Consultant with Umwelt. Karen's experience is outlined in Appendix A.

The report has been structured according to a number of key sections as outlined below:

Section 1.0 introduces the SIA, its objectives and the proposed project.

Section 2.0outlines the methodological approach adopted for the assessment, including the data and information sourced to develop the social baseline profile and the identification of relevant stakeholders.

Section 3.0 outlines the geographical context of the Southlakes Estate in Dubbo, NSW and provides a social baseline for the area, including regional issues and aspirations.

Section 4.0 assesses and predicts the likely social impacts that may result due to the Project.

Section 5.0 defines strategies to manage negative impacts and enhance positive impacts should the Project be approved and proceed.

1.2 Project Overview

Southlakes Estate has established growth progression in South-Eastern Dubbo and has encouraged greater flexibility and choice in residential land for homeowners.

As discussed in **Section 1.1**, the estate currently has approximately 400-450 built houses with a land release in March 2020 expected to release another 400 lots. It is anticipated that there will be a total of 2,080 lots by the planned delivery date in 2028, resulting in an approximate population of 5,200 people based on the average occupancy of dwellings in the area (2.5 people in Dubbo SSC) (ABS, 2016).

There is an approved medical centre and childcare centre on separate lots within the estate alongside the abovementioned proposed neighbourhood shopping centre. The neighbourhood shopping centre's primary tenant would be a supermarket, followed by the proposed gastro pub. There is also floor space reserved for specialty stores and café/restaurants. On the eastern side of the development there is 9,010 square metres



of carparking to be accessed via Boundary Road (which is due for construction in 2020) and accommodate approximately 300 car spaces with further car parking to accommodate approximately 46 cars to connect it to future residential and family health precincts. It is expected that the neighbourhood shopping centre development will act as a 'town square' for the residents in the estate, with pedestrian access via a bridge link for homes east of the site.

Immediately in the vicinity of the site there is expected to be clusters of residential development, including a resort style townhouse development to the west of the site that is planned to be developed in February 2022, and a similar development immediately to the south. A parkland area will border the development to the east, beyond which are more residential housing lots. Refer to Figure 1.2.

It is proposed that construction of the neighbourhood shopping centre will commence mid-2021 and begin with the infrastructure surrounding the development. Conversations with potential proponents and operators of the primary businesses in the development will be ongoing throughout this time.

The gastro pub itself will contain a number of bars and an eatery, with the focus of the pub being on the dining aspects. The pub will also contain approximately 12 gaming machines to ensure continued feasibility of the business within periods of decreased patronage. Patrons at the gastro pub will use the car parking spaces of the broader development to be accessed via Boundary Road.



Locality Map

- Roads



C Southlakes Estate Neighbourhood Centre Precinct

Property Boundary

Southlakes Estate (MAAS)

Existing Releases

Future Development Proposed Gastro Pub FIGURE 1.2 Development Plan



1.3 Regulatory Context

1.3.1 State Government

The development site is under the provision of the Dubbo DCP (2013) and the Southlakes Estate Development Control Plan 2 (2018). Development assessment in New South Wales (NSW) is regulated under the *Environmental Planning and Assessment Act 1979* (EP&A Act) and the corresponding *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation), along with other subsidiary plans, policies and environmental planning instruments (EPIs).

As a licensed venue supplying food, liquor and gaming services, the proposed gastro pub is required to adhere to the conditions and provisions set out in NSW legislation, specifically under:

- The Liquor Act 2007 (NSW)
- The Food Act 2003 (NSW)
- Food Regulation 2015 (NSW)
- Gaming Machines Regulation 2010 (NSW)

Key documentation of what these regulations related to in this assessment is presented in Table 1.1.

Regulatory and/or Planning Instrument	How Considered
Environmental Planning and Assessment Act 1979 Environmental Planning and Assessment Regulation 2000	Assessment of social impacts of the Project in line with the requirements of the EP&A Act and EP&A Regulation. Any additional requirements are understood to be considered within the corresponding documents.

Table 1.1 Consideration of Regulatory Context



Regulatory and/or Planning Instrument	How Considered
Dubbo Regional Council Local	Aims of the LEP:
Environment Plan (LEP) (2011)	 a. to achieve a city structure that centralises the central business district by shifting the residential development emphasis to West Dubbo,
	 to ensure the Dubbo central business district remains the primary commercial centre for the greater region,
	 c. to ensure tourism opportunities are provided in appropriate locations in close proximity to the Taronga Western Plains Zoo, established accommodation nodes and service and support facilities,
	 to provide high quality open space to meet a wide range of active and passive recreational needs,
	 to ensure environmental and cultural heritage is adequately protected to ensure its conservation,
	 f. to ensure adequate provision is made for the development, establishment and enhancement of cultural, research and medical institutions,
	 g. to ensure land zoned for industrial purposes is protected from inappropriate development,
	 to ensure rural lands are kept in large holdings to ensure sustainable agriculture can be undertaken without detrimental impact,
	 to ensure development and land management practices do not further exacerbate the impact of salinity or result in new salinity outbreaks,
	 to ensure urban stormwater is managed to maintain quality and not detrimentally impact on downstream development,
	 k. to ensure the floodplains of the Macquarie and Talbragar Rivers are adequately protected from inappropriate development and to ensure the impact of flooding on people and the built and natural environment is minimised.
Dubbo Development Control Plan (DCP) (2013)	 Assessment of the development principles in terms of residential developments, commercial developments, industrial developments and rural developments.
	• Assessment of access and mobility of a development, including parking.
	• Assessment of the economic and social impacts of a development.
	Assessment of heritage conservation principles.
	Assessment of environmental management.
Southlakes Estate Development Control Plan 2 (2018)	 Provide guidance to developers/applicants/builders in the design of development proposals for land to which this Plan applies.
	 Communicate the planning, design and environmental objectives and controls against which the Consent Authority will assess development applications in the Southlakes Estate.
	 Provide guidance on the orderly, efficient and environmentally sensitive development of the Southlakes Estate.
	 Promote quality urban design outcomes within the context of environmental, social and economic sustainability.



Regulatory and/or Planning Instrument	How Considered
The Liquor Act 2007 (NSW)	Objectives of the Act:
	 to regulate and control the sale, supply and consumption of liquor in a way that is consistent with the expectations, needs and aspirations of the community,
	 to facilitate the balanced development, in the public interest, of the liquor industry, through a flexible and practical regulatory system with minimal formality and technicality,
	 to contribute to the responsible development of related industries such as the live music, entertainment, tourism and hospitality industries.
The Food Act 2003 (NSW)	Objectives of the Act:
	 to ensure food for sale is both safe and suitable for human consumption,
	• to prevent misleading conduct in connection with the sale of food,
	• to provide for the application in this State of the Food Standards Code.
Food Regulation 2015 (NSW)	The Regulation makes provision with respect to the following matters:
	 prescribing food safety schemes in relation to dairy businesses, meat businesses, plant products businesses, seafood businesses, vulnerable persons food businesses and egg businesses,
	 prescribing fees and levies in relation to licences for those businesses and charges for the inspection and auditing of those businesses,
	 prescribing other fees and charges for the purposes of the Food Act 2003,
	 prescribing modifications of the Australia New Zealand Food Standards Code in its application to food businesses and food handlers in New South Wales,
	 prescribing enforcement agencies for the purposes of the Act,
	 prescribing offences under the Act and regulations for which penalty notices may be issued,
	• other matters of an administrative or savings and transitional nature.
Gaming Machines Regulation	Outlines:
2010 (NSW)	 the general regulation and management of gaming machines
	 responsible gambling practices and harm minimisation techniques
	gaming related licences and fees
	 other miscellaneous provisions related to progression gaming machines, player cards and accounts, gaming machine tickets, and inter-venue linked gaming systems.

1.3.2 Local Government

The site is lies in the Dubbo Regional Council LGA, planning in the Dubbo Regional LGA is guided by the Community Strategic Plan (Dubbo Regional Council, 2018), the plan has the following vision:

In 2040 we will celebrate our quality of life, the opportunities available for us to grow as a community, our improved natural environment, and being recognised as the inland capital of regional NSW.



The plan outlines a number of community values that can be summarised into five common themes including housing, infrastructure, economy, community leadership and liveability. Under each of these themes are a number of strategic objectives and activities. Strategies that relate to this development include:

- New business and industry are established in the Local Government Area
- Business and industry are encouraged to grow, diversify and upskill workers
- Neighbourhood shopping centres are located to provide attractive and convenient services and facilities to support new and established neighbourhoods without adversely impacting on the Dubbo Central Business District (Dubbo Regional Council, 2018).



2.0 SIA Approach and Methodology

SIA is an approach to predicting and assessing the likely consequences of a proposed action in social terms and developing options and opportunities to improve social outcomes. Best practice SIA is participatory and involves understanding impacts from the perspectives of those involved in a personal, community, social or cultural sense, to provide a complete picture of potential impacts, their context and meaning.

The following sections provide further details on the types of engagement mechanisms/methods undertaken so that stakeholder views have been adequately identified and addressed.

2.1 SIA Principles and Ethical Conduct

The generally agreed international principles relating to SIA (Vanclay, 2003) identify social impacts as the matters affecting, directly or indirectly:

- people's **way of life**, that is: how they live, work, play and interact with one another on a day to day basis
- the community, that is: its cohesion, stability, character, services and facilities
- access to and use of infrastructure, services and facilities, whether provided by local, state, or federal governments, or by for-profit or not-for-profit organisations or volunteer groups
- their culture, that is: their shared beliefs, customs, values and language or dialect
- their **health and wellbeing:** health is a state of complete physical, mental, social and spiritual wellbeing and not merely the absence of disease or infirmity
- their **surroundings**, such as: the quality of the air and water people use, the availability and quality of the food they eat, the level of hazard or risk, dust and noise they are exposed to, the adequacy of sanitation, their physical safety, and their access to and control over resources
- their **personal and property rights**, particularly whether people are economically affected or experience personal disadvantage which may include a violation of their civil liberties
- their **political and decision-making system**, such as the extent to which people are able to participate in decisions that affect their lives, the level of democratisation that is taking place, and the resources provided for this purpose
- their **fears and aspirations**, that is: their perceptions about their safety, their fears about the future of their community, and their aspirations for their future and the future of their children.

As is the case with any type of change, some individuals or groups within the community may benefit, while others may experience negative impacts. If negative impacts are predicted, it is the role of the SIA to determine how such impacts may be addressed effectively to reduce the degree of social disruption to those affected. If positive impacts are predicted, the aim of the SIA is to maximise these opportunities and identify how they might be further enhanced. Monitoring and evaluation are also key components of an SIA process to identify any unanticipated impacts that may arise in the future as a result of a project.


2.2 SIA Approach

A best practice approach to SIA has been adopted for the Project, that integrates local, international and NSW social guideline requirements. In line with best practice, the SIA has involved a number of key phases of work that includes:

- Profiling: to define the baseline social context in which the Project is based
- Scoping: to identify key social impacts/issues relevant to the Project
- Assessment and Prediction of Impacts: to evaluate and predict the positive and negative social impacts based on key impact characteristics (extent, duration, vulnerability/sensitivity, severity)
- Strategy Development: to identify strategies to minimise negative impacts and enhance positive impacts associated with the Project

Engagement was undertaken to afford a participatory approach to assessment and has involved near neighbours in the scoping of Project issues and identification of strategies to address negative impacts and enhance the positive project impacts. The following sections provide further details on the types of engagement mechanisms/methods undertaken so that stakeholder views have been adequately identified and addressed.

2.3 Participants/Stakeholders in the SIA

SIA involves the cooperation and coordination of several 'social partners' or 'stakeholders'. A stakeholder identification process was undertaken prior to commencement of the Project. As Burdge (2004) outlines, stakeholders may be affected groups or individuals that:

- live nearby the project
- have an interest in the proposed action or change
- use or value a project
- are interested in its use
- may be forced to relocate as a result of the Project.

Stakeholders have been identified through review of the Southlakes Master Plan (Maas Group Properties Southlakes, 2019) and relevant publicly available maps. Near neighbours to the proposed development were consulted via the distribution of a community information sheet introducing the proposed development.



3.0 Social Profile

A baseline social profile gathers knowledge of secondary sources to increase understanding of the existing social environment in which a project is proposed and to provide a foundation from which impacts associated with proposed development may be predicted.

Data sources used in the preparation of this baseline Profile include:

- Data collected by REMPLAN (REMPLAN, 2016)
- ABS Census data (ABS, 2016)
- Social Health Atlas (PHIDU, 2018) and other social indicators
- Local and State Government Reports
- Review of relevant media.

The profile outlines:

- Key demographic factors in the area such as family and household composition, industry and employment, and community health and wellbeing.
- Current issues of concern in the region.
- Services and facilities in the locality.

The primary community of interest for the purposes of this assessment is primarily the locality of Dubbo South (SA2) within the Dubbo State Suburb (SSC) and Dubbo Regional Local Government Area (LGA). Data has been analysed at the locality level (REMPLAN) to enhance granularity of data to account for different socio-economic profiles across areas in the Dubbo SSC. **Table 3.1** provides a summary of key demographic statistics for the localities of interest. Data from NSW and Dubbo Regional LGA has also been included for comparative purposes.



Table 3.1 Key Population Demographic Information

	Dubbo South SA2	Dubbo SSC ¹	Dubbo Regional LGA ²	NSW
		Demographic		
Population (2016)	16,942	38,943	50,075	7,480,231
Estimated Resident Population (2018)	-	-	53,240	7,988,241
Gender (Female / Male) (%)	52.7 / 47.3	51.9 / 48.1	50.9 / 49.1	50.7 / 49.3
Youth 0 - 15 (%)	21.7	22.5	22	19.7
Proportion aged 18-34 (%)	15.8	15.7	15.3	16.2
Male, aged 55-64 (%)	11.0	11.4	12.0	11.7
Seniors 65+ (%)	17.1	15.8	16.6	16.3
Median age (Years)	36	36	37	38
Indigenous (%)	12.3	14.6	15.5	2.9
Religious affiliation (%)	73.6	73.1	71.2	65.7
Economic, income and social vulnerability				
Unemployment (%)	5.1	5.5	5.9	6.3
Labour force participation (%)	62.9	62.4	59.3	59.2
Worked full-time (%)	63.6	62.7	61.9	59.2
Worked part time (%)	26.7	26.8	27.1	29.7
Top Industry of employment (%)	Hospitals (except Psychiatric Hospitals) – 5.3	Hospitals (except Psychiatric Hospitals) – 4.8	Hospitals (except Psychiatric Hospitals) – 4.5	Hospitals (except Psychiatric Hospitals) – 3.5
Persons employed in Accommodation and food services (%)	8.1	7.7	7.4	7.1

¹ Equivalent to Dubbo Locality, REMPLAN.

² Equivalent to Dubbo Region, REMPLAN.



	Dubbo South SA2	Dubbo SSC ¹	Dubbo Regional LGA ²	NSW
Learning or Earning (ages 15-24) ³ (%)	-	-	76.8	85
Did voluntary work through an organisation or group (last 12 months) (%)	19.9	19.4	19.9	18.1
Median weekly household income	\$1,327	\$1,341	\$1,272	\$1,486
Median rent	\$275	\$265	\$250	\$380
Less than \$650 gross weekly income (%)	21.3	20.1	22	19.7
Occupied dwellings with no registered vehicles (%)	7.1	6.2	6.3	9.2
SEIFA Index of Relative Socioeconomic Advantage and Disadvantage ⁴ (State Rank – Decile ⁵)	5	5	5	-
	Household	and Family composition		
Families with children (%)	40.5	40.8	40.2	45.7
Families with no children (%)	38.1	37.9	38.4	36.6
Single parent family (%)	19.7	19.7	19.6	16
Family households (%)	66.8	70.9	70.6	72
Lone person households (%)	29.7	25.8	26.4	23.8
Group households (%)	3.5	3.3	3.1	4.2
Housing				
Private dwellings (2011)	6,844	-	19,748	2,864,531
Private dwellings (2016)	7,416	16,379	21,066	3,059,599

³ The data comprise the number of 15 to 24-year-old people who were engaged in school, work or further education/ training, expressed as a proportion of all those aged 15 to 24 years.

⁴ The SEIFA Index of Relative Socioeconomic disadvantage (IRSAD), prepared by the ABS, summarises variables that indicate either relative advantage or disadvantage. This index ranks areas on a continuum from most disadvantaged to most advantaged.

⁵ All areas are ordered from lowest to highest score, with the lowest 10% of areas given a decile number of 1, the next lowest 10% of areas given a decile number of 2 and so on, up to the highest 10% of areas which are given a decile number of 10. This means that areas are divided up into ten equal sized groups, depending on their score. A decile score of 1 represents the most disadvantaged areas, while a decile of 10 represents the most advantaged areas



	Dubbo South SA2	Dubbo SSC ¹	Dubbo Regional LGA ²	NSW
Increase in private dwellings 2011-2016 (%)	8.4	-	6.7	6.8
Private Dwelling Occupancy rate (%)	89.7	89.9	89.2	90.1
Separate House (%)	80.3	83.3	84.6	66.4
Home owned outright or with a mortgage (%)	60.4	63.2	65.2	63.1
Rented (%)	35.7	32.7	30.7	31.8
Homelessness (%)	0.3	-	0.37	0.5
Dwellings with one or more registered motor vehicles (%)	88.9	89.5	89.4	87.1
		Education		
Qualifications of Bachelors degree or higher (%)	17.2	15.2	13.7	23.4
Highest educational attainment Year 12	11.7	11.7	11.2	15.3
Highest educational attainment Year 10	15.8	16.4	16.2	11.5
Highest educational attainment 9 or below	9.5	10.2	10.6	8.4
SEIFA Index of Education and Occupation ⁶ (State Rank – Decile ⁷)	5	3	5	-
Safety, health and health risk-factors				
Harmful use of alcohol ⁸	-	-	20.7	16.7
Smokers ⁹	H	-	20.5	16

⁶ The SEIFA Index of Education and Occupation (IEO), prepared by the ABS, reflects the general level of education and occupation-related skills of people within an area.

⁷ All areas are ordered from lowest to highest score, with the lowest 10% of areas given a decile number of 1, the next lowest 10% of areas given a decile number of 2 and so on, up to the highest 10% of areas which are given a decile number of 10. This means that areas are divided up into ten equal sized groups, depending on their score. A decile score of 1 represents the most disadvantaged areas, while a decile of 10 represents the most advantaged areas

⁸ People aged 15+ who consumed >2 standard alcoholic drinks per day on average (modelled estimates)

⁹ People aged 18+ who were current smokers (ASR per 100) (2014-15)



	Dubbo South SA2	Dubbo SSC ¹	Dubbo Regional LGA ²	NSW
High or very high psychological distress (ASR per 100) (2014-15)	-	-	12.6	11
Persons aged 18 or over who undertook no or low exercise in the previous week (ASR per 100) (2014-15)	-	-	70.6	67.9
Persons aged 18 or over who were obese (ASR per 100) (2014-15)	-	-	40.4	28.2
People aged 18 years and over who felt very safe/safe walking alone in local area after dark (ASR per 100) (2014)	-	-	49.6	53.4



3.1 Social and Community Context

As of the 2016 ABS Census, Dubbo South (SA1) was home to 16,942 (approximately 34%) of the 50,075 residents of the Dubbo Regional LGA. Population projections from the NSW Government indicate that the population of the LGA is expected to increase by 5,523 people to 56,927 between 2016 and 2031, and continuing up to 58,777 by 2041 (**Figure 3.1**).



Figure 3.1 Dubbo Regional LGA Population Projections

Source: NSW State and Local Government Area 2019 Population and Household Projections

Given the current development of further residential dwellings as part of the Southlakes Estate (see **Section 1.2**) and the designation of Dubbo South by Council as a key area of future residential development (Dubbo Regional Council, 2013), it is anticipated that a significant proportion of this growth will occur in Dubbo South. In line with this assumption, Federal Government projections for the Dubbo South SA2 indicate that the population is set to rise to 21,561 people in 2031, an increase of 3,763 people since 2017 (see **Figure 3.2**). Based on the number of residential lots in the Southlakes housing development, it is estimated that there will be 5,200 new residents, indicating that the population in the area may increase faster than currently projected (refer to **Section 1.2**).





Figure 3.2 Dubbo South SA2 Population Projections

Source: Australian Government: Australian Institute of Health & Welfare - GEN Aged Care Data

More residents in Dubbo South are female than male (52.7%), compared to a relatively equal gender balance across Dubbo Regional LGA (50.9%) and NSW (50.7%). The median age in Dubbo South is 36 years, slightly younger than the NSW median (38 years), but consistent with Dubbo SSC (36 years) and the broader LGA (37 years).

Similarly, the proportion of the population in key age brackets (as identified in Table 3.1) in Dubbo South is equivalent to the age distribution in Dubbo SSC, the Dubbo Regional LGA, and across the state. Although minor, there appears to be some evidence of lower proportions of key vulnerable age groups in Dubbo South than in the surrounding area and/or NSW more broadly, most notably a lower proportion of men aged 55-64 (11.0%) compared to the LGA (12.0%) and NSW (11.7%).

A high proportion of the Dubbo South population are Indigenous in comparison to NSW (12.3% and 2.9% respectively), however there is a lower percentage of Indigenous people in the locality compared to the Dubbo SSC (14.6%) and the Dubbo Regional LGA (15.5%).

Consistent with rates typically seen in country NSW, religious affiliation is higher in Dubbo South (73.6%), Dubbo SSC (73.1%) and Dubbo Regional LGA (71.2%) compared to NSW as a whole (65.7%).

3.2 Economic, Income and Social Vulnerability

In 2016, the unemployment rate in the Dubbo Regional LGA (5.9%) was slightly lower than in NSW (6.3%), with more substantially low unemployment observed in the Dubbo SSC (5.5%) and in Dubbo South (5.1%). Based on the 2016 Census, labour force participation is highest in Dubbo South (62.9%), higher than the Dubbo LGA (59.3%) and NSW more broadly (59.2%).



However, the proportion of residents learning or earning is lower in Dubbo Regional LGA (76.8%) than across NSW (85.0%), there is a smaller proportion of the community with a qualification of a Bachelors degree or higher (17.2% compared to 23.4% in NSW), and a smaller proportion that have graduated Year 12 (11.7% and 15.3% respectively).

Of note, 8.1% of resident workers are employed in accommodation and food services (compared to 7.1% across NSW), indicating that the accommodation and food market is a key employer in the Dubbo South area. Overall, hospitals are the major employer in all catchments, and in NSW. A higher proportion of employed persons in Dubbo South work full time than in NSW (63.6% compared to 59.2%).

In regard to market competition, there are currently 19 hotel, club and small bar venues in inner Dubbo. In addition, a gastro pub would compete with the 33 restaurants that are currently licenced, as well as the 8 packaged alcohol outlets within a 15 minute drive of the site. In a dynamic economy, competition plays a vital role in keeping prices in check and offerings and amenity suitable for the paying public.

Regarding market gap, there are no pubs, clubs, restaurants or packaged alcohol venues within a 15 minute walk of the proposed gastro pub. In this sense, the proposed gastro pub will be a local offering. While there are current competing businesses in inner Dubbo, there is a large shortage of commercial space for restaurants, cafes, hotels and clubs, as well as packaged alcohol retailers. As noted in **Section 3.1**, population growth in the area is set to continue, prompting the need to cater to this increasing shortage.

A relatively high proportion of Dubbo South residents indicated that they volunteered for an organisation or group in the 12 months leading up to the 2016 Census (19.9%), compare to NSW (18.1%). Dubbo South has marginally lower levels of homelessness (0.3%) compared to Dubbo Regional LGA (0.4%) and NSW (0.5%), and a lower proportion of dwellings with no registered vehicles (7.1%) in comparison to NSW (9.2%).

Dubbo South has an average median weekly household income in line with the state average (\$1,327 compared to \$1,486), while the median rent in the area is lower than the state average (\$275 and \$380 respectively) suggesting that residents may have more disposable income than in other areas.

The SEIFA Index for areas is a measure compiled by the ABS which provides a summary of various social indicators to give an indication of the social strengths of an area. The index of Relative Socioeconomic Advantage and Disadvantage score for Dubbo South, Dubbo SSC and the Dubbo Regional LGA fell within the 5th decile for all similar geographical catchments across the state, indicating moderate levels of advantage and disadvantage.

Results of the General Social Survey undertaken by the ABS in 2014 indicate that a slightly lower proportion of persons in the Dubbo Regional LGA felt safe / very safe walking alone in their local area at night compared to NSW (ASR per 100 of 49.6 compared to 53.2 in NSW).

A review of the crime statistics in the Dubbo Regional LGA indicates the following:

- Non-domestic violence related assaults were reported at the rate of 792.9/100,000 population in 2018, with a stable 12-month trend.
- Break and enters for both dwellings (1,269/100,000) and non-dwellings (493.4/100,000) declined over the 24-month trend. Whereas stealing from a motor vehicle (1455.2/100,000) and stealing from a dwelling (503/100,000) both increased over a 12-month period.
- Incidents of harassment, threatening behaviour and private nuisance were recorded at a rate of 1,282.4/100,000 and increased over a 24-month period and incidents of offensive conduct (109.4/100,000) and offensive language (96/100,000) remained low.



- Offences relating to liquor were recorded at a rate of 88.3/100,000 and have declined over a 60-month period.
- Incidents of betting and gaming offences were reported at a rate of 0/100,000 in 2019 with a decline over a 24-month period.

However, it is important to note that these offences are reported at an LGA level and BOCSAR heat maps suggest that none of these reported offences occurred in the area of Southlakes Estate.

3.3 Housing, Household Composition and Family Composition

The demographics of Dubbo South indicate that residents of the area are predominately families (66.8% of households), with a higher proportion of lone person households (29.7%) than broader Dubbo Regional LGA (26.4%) and the state (23.8%). There are more single parent families in the Dubbo Regional LGA (19.6%) than in NSW (16.0%), and fewer families with children (40.2% compared to 45.7%).

Dubbo South has experienced a greater increase in residential developments between 2016 and 2011 than the LGA and NSW (8.4% increase compared to 6.7% and 6.8% respectively). This is due to the development of the Southlakes Estate, in line with Council designation of the area as a key opportunity area for future residential growth in their 2013 Development Control Plan (Dubbo Regional Council, 2013). As noted in **Section 3.1**, population growth is anticipated to continue as new lots become available for development.



4.0 Assessment and Prediction of Social Impacts

A key component of the SIA is the process of understanding, from a community perspective, community issues, values and uses associated with the area of the proposed development, and specifically the perceived impacts and opportunities associated with the Project.

This section provides an assessment of the perceived and predicted social impacts that may occur as a result of the project. The SIA has utilised data from a number of sources to develop a layered picture of the potential social impacts arising from the Project.

Impact predictions are assessed according to a number of key impact characteristics, namely:

Extent – geographical area affected by the impact (or the proportion of people or population groups affected)

Duration - the timeframe over which the impact occurs

Severity - scale or degree of change from the existing condition as a result of an impact

Sensitivity – Susceptibility or vulnerability of people, receivers or receiving environments to adverse changes caused by the impact, including value or importance to the community.

The assessment is undertaken using a consequence and likelihood framework i.e. assessing the consequence of a given social impact factor (e.g. catastrophic, major, negligible) against the likelihood that it will occur (e.g. almost certain, likely, possible), to determine the overall risk assessment of the social impact as 'low', 'moderate' or 'high', see Table 4.1 below. Both positive and negative impacts are considered in this regard, with slight adjustments made to the approach to reflect positive impacts e.g. level of concern becomes level of interest, severity become scale of improvement or benefit, sensitivity becomes importance of the improvement or benefit and the equity of its distribution etc.

	Consequence Level					
		1	2	3	4	5
		Minimal	Minor	Moderate	Major	Catastrophic
ory	A. Almost certain	HIGH	HIGH	EXTREME	EXTREME	EXTREME
ateg	B. Likely	MODERATE	HIGH	HIGH	EXTREME	EXTREME
o poo	C. Possible	LOW	MODERATE	HIGH	EXTREME	EXTREME
ikelih	D. Unlikely	LOW	LOW	MODERATE	HIGH	HIGH
	E. Rare	LOW	LOW	MODERATE	HIGH	HIGH

Table 4.1 Social Risk Matrix

Source: SIA Guidelines (DPE, 2017)

Impact themes considered as part of this assessment include:

• Social amenity in the construction and operational phases



- Cultural and community significance
- Problem behaviours including alcoholism and gambling
- Crime and safety, and health and wellbeing
- Sense of community and place
- Social equity
- Intergenerational impact
- Economic impact

Each of these themes are discussed in the sections below, at the conclusion of each impact theme for each of the options, a table is presented which summarises the social impacts.

4.1 Predicted Impacts

As noted in **Section 2.3** community information sheets were provided to approximately 403 stakeholders with residences in Southlakes Estate. Stakeholders were given the opportunity to provide feedback on the proposal via contact details provided on the information sheet, however, no residents made contact to discuss the project.

Analysis of queries, concerns and objections raised by residents in response to the distribution of the community information sheet, alongside responses noted from the telephone interviews were analysed to establish the key positive and negative impacts perceived by the community in relation to the proposed development.

4.1.1 Social Amenity

It is common for communities around such facilities to experience impacts to their social amenity and lifestyle during the construction and operation phases. This is most likely to take the form of increased noise and traffic. However, as there are no established houses in the vicinity of the site the impact on social amenity is expected to be lessened.

4.1.1.1 Construction

As discussed in **Section 1.2**, construction of the neighbourhood shopping centre precinct, including the gastro pub is expected to commence in mid-2021. It is anticipated that in February 2020, construction of a residential development to the west of the site will commence. Therefore, there may be a small number of nearby residents that are impacted by noise from the construction of the neighbourhood shopping centre. However, it should be noted that there will be a buffer located between the site and the residential developments mentioned that will lessen the noise carried from the construction on site and these residents will be forewarned with regards to construction of the proposed development.

Access to the site by trucks and other vehicles used in the construction phase will be via Boundary Road. There are no residential properties that are accessed directly via Boundary Road therefore traffic in the construction phase is not expected to have a large impact on the amenity of residents.

Impacts on the social amenity of the community in the construction phase are unlikely and would be of minimal consequence, therefore it is expected it will be of **low** impact.



4.1.1.2 Operational

As seen in Figure 1.2 the neighbourhood shopping centre site is bordered by buffer land on the east and west sides that is expected to decrease noise disruption from the operation of the gastro pub and other shops within the neighbourhood shopping centre. The large parking area is also located to the west of the development. It is unlikely that those in the resort style townhouses to the west of the site will experience any noise disruption from the gastro pub as it is on the east of the site. It is also unlikely that residents to the east of the gastro pub will experience noise disruption as there is a parkland area and landscaping between the two areas.

The residential areas to the south, west and east of the site are accessed via roads on the opposite sides of the lots and the road system for the residential lots on the east is not connected to the road system around the development. Access to the development via Boundary Road is east of the estate and will not traverse any clusters of residential developments. Therefore, it is unlikely that the traffic to the neighbour centre, and specifically the gastro pub, will have an impact on the accessibility or amenity of the residents in these homes. Similarly, it is unlikely that residents will experience noise from pedestrian activity of patrons of the gastro pub due to the nature of the establishment; it is also expected that the gastro pub's operating hours will be focused around meal times with the establishment unlikely to be open past midnight.

It is also important to note, that land or house sales in the estate have been undertaken with the knowledge that the neighbourhood shopping centre was included in the master plan.

For these reasons, it has been determined that the development will have a **low** negative impact on the social amenity of the community if not mitigated as it is unlikely to have an impact and any impact would be of minor consequence.

4.1.2 Cultural and Community Significance

As noted in **Section 3.0**, the proportion of Indigenous persons in Dubbo South is high compared to NSW, but lower than Dubbo SSC and the broader Dubbo Regional LGA.

Review of the National Heritage List (Department of the Environment and Energy, 2019) and items listed under the NSW Heritage Act (NSW Government, 1977) indicate that there are no known places of cultural significance in proximity to the development. The closest site of heritage significance is the Dubbo RAAF Stores Depot that is approximately 2km to the west of the proposed development and it is not anticipated that the development will have any impact on the site given the nature of the gastro pub. A media review of articles over the past five years relevant to the region did not identify any known significant community sites. It is hypothesized that there would be little modern community significance in proximity to the site as the current residential development is relatively new.

Therefore, it is assumed that the development will have a **low** impact on cultural or community significance in the area as it would be rare to have an impact and any impact would be minimal.

4.1.3 Problem Behaviours

4.1.3.1 Gambling

The Dubbo Regional LGA and broader Central West region have been highlighted as having a high level of spending on gambling. Figures show an increase in total revenue collected from gaming machines in the central west, with gaming machines across Orange, Bathurst and Dubbo bringing in \$86.5 million in revenue over the course of the 2018-2019 financial year (Mudgee Guardian, 2019).



In 2018, players lost almost \$38 million in Dubbo and Wellington, with an average profit per machine of \$54,516 (Daily Liberal, 2019a). Given these high numbers and the associated potential for impacts of gambling addiction on players and their families in the area, there has been a high level of community concern around gambling. A recent proposal from Dubbo Regional Council to investigate the plausibility of developing a casino in Dubbo was met with strong community opposition, with Dubbo Mayor Ben Shields withdrawing his support of the proposal as a result (Daily Liberal, 2019b).

It has been established that men, younger people, people of a lower socio-economic status or low level of education, and Aboriginal people are at higher risk of problem gambling than the general population (Buth, Wurst, & Thon, 2017) (Victorian Responsible Gambling Foundation, 2015). In Dubbo South, as outlined in **Section 3.0**, there is generally a lower representation of these groups than across the state. Specifically, there is a higher percentage of females than males; a median age only slightly below the state median and an age distribution that is reasonably consistent across age groups; and a SEIFA Index of Relative Socioeconomic Advantage and Disadvantage score indicating an average level of advantage and disadvantage. Furthermore, the absence of betting and gambling incidents as reported by the police in the Dubbo Regional LGA suggests that the community is not predisposed or currently experiencing legal impacts related to gambling compliance and illegal gambling. However, there is a smaller proportion of the community with a qualification of a Bachelors degree or higher than in NSW, a smaller proportion that have graduated Year 12, and a high Indigenous population when compared to NSW.

Based on the demographics of the population living nearby to the gastro pub and, in turn, having access to the gaming machines, there is a relatively moderate risk of problem gambling. The addition of 12 gaming machines at the gastro pub is primarily to ensure economic viability of the establishment in the eatery's off-peak times and is therefore unlikely to have a negative impact on the community. However, if there were instances of problem gambling behaviour it would be of moderate impact to the broader community, therefore, the presence of gaming machines in the neighbourhood precinct is determined to be of **moderate** negative impact without mitigations in place. A range of proposed mitigation measures are outlined in **Section 5.1** and it is anticipated that with the implementation of these measures the resulting impact would be **low**.

4.1.3.2 Alcoholism

As outlined in **Section 3.0**, the harmful use of alcohol is higher in the Dubbo Regional LGA than in the state of NSW (20.7% compared to 16.7%), however, offences relating to liquor in the region had declined over a 60-month period and were reported at a rate of 88.3/100,000 which resulted in the LGA being ranked only 78th in the state.

Literature states that men in the 55-64 year age group are most likely to exceed the lifetime alcohol risk guidelines (31%). Compared to NSW and the broader Dubbo Regional LGA, the Dubbo South SA2 has lower proportion of men within this age group. Other risk factors include living in outer regional or remote areas, people living in these areas being 1.4 times as likely to exceed alcohol consumption guidelines as those in major cities (23% and 16% respectively); and living in low socio-economic areas, wherein people were 1.3 times more likely to exceed guidelines.

The demographics of Dubbo South indicate that residents of the area are predominately families, with a high proportion of participation in the labour force and an average median weekly household income in line with the state average. The median rent in the area is lower than the state average which suggests more disposable income than in other areas. There is also a high rate of religious affiliation which has been shown in some studies to be a protective factor against gambling and alcoholism (Victorian Responsible Gambling Foundation, 2015).



It appears that the expected patrons of the gastro pub are reasonably susceptible to risk factors related to alcoholism. However, the social makeup of the Dubbo South area is predominately families in the middle decile of socio-economic ranking. Therefore, it is unlikely that the proposed development itself would directly result in an increase in alcoholism in the community. However, if the problem behaviours associated with alcoholism were to be experienced by the community it would be a moderate impact. Therefore alcoholism has been ranked as a **moderate** negative impact if not managed effectively with this ranking declining to **low** with the implementation of proposed management measures outlined in **Section 5.1**.

4.1.4 Health and Safety

4.1.4.1 Crime/ Safety

The Dubbo Crime Prevention Plan (Dubbo Regional Council, 2011) outlines the two key priority areas of crime to focus on in the LGA as malicious damage to property and theft from motor vehicle.

A review of relevant crime statistics (detailed in **Section 1.2)** shows that crime rates in the Dubbo Regional LGA area are reasonably high compared to other LGAs in the area, however, the crime rates of most types of crime that would be associated with an establishment such as the gastro pub have remained at stable levels over the past two – five years. Heat maps of reported crime show areas of Dubbo North and Dubbo East have the most incidents in the LGA, and that Dubbo South has had a very low level of crime.

The development is not expected to increase crime in the area as relevant Crime Prevention Through Environmental Design (CPTED) principles have been employed in the design of the development. The CPTED principles influence the design of buildings to discourage crime by:

- increasing the perception of risk to criminals by increasing the possibility of detection, challenge and capture
- increasing the effort required to commit crime by increasing the time, energy or resources which need to be expended
- reducing the potential rewards of crime by minimising, removing or concealing 'crime benefits'
- removing conditions that create confusion about required norms of behaviour (Department of Urban Affairs and Planning, 2001).

Each of these concepts have been incorporated in the design and planning of the neighbourhood shopping centre and the gastro pub, including designing the establishment to be a modest facility that does not promote gaming machines and alcohol, incorporating the use of surveillance cameras at appropriate locations and encouraging the operating hours of the gastro pub to focus on dining which will see the establishment being closed at opportune hours for crime.

In 2014, a slightly lower proportion of persons in the Dubbo Regional LGA felt safe / very safe walking alone in their local area at night compared to NSW. It is anticipated that anti-social behaviour and crime may decrease in areas nearby the development due to the introduction of surveillance cameras and increased activity at the development. Perceived crime will potentially be lowered due to residents feeling safer from the security measures put in place at the development.

It is unlikely that the establishment will directly increase crime in the area, however, the impacts of crime on the community are major, therefore it has been determined that the development has the potential to



have a **high** impact on crime unless mitigated. If mitigated using measures suggested in **Section 5.1**, the impact would be of moderate consequence and therefore be classed as **moderate**.

4.1.4.2 Health

It is expected that the elements included in the design of Southlakes Estate as a whole will promote a healthy lifestyle for residents. As shown in **Section 3.0**, there are higher rates of obesity and lower levels of exercise undertaken by residents of the Dubbo Regional LGA when compared to levels across the state of NSW. The design of the gastro pub and surrounding neighbourhood shopping centre includes a bridge link that connects the development to the walking and jogging paths to the east and provides access for the residents in that precinct of the estate. It is anticipated that the proximity of the development to the surrounding residential pockets in the estate will encourage the community to walk to the services located at the neighbourhood shopping centre as an alternative to driving to similar nearby facilities. The current closest facility that can be likened to the neighbourhood shopping centre is the Orana Mall Shopping Centre, which is approximately 2.5km from the site, with the nearest eateries similar to the proposed gastro pub being over 1km from the estate.

The establishment will also promote community wellbeing, defined as the satisfaction of living standards and relationships with others in the community, by creating a meeting place and encouraging interaction between community members. This concept is further discussed in **Section 4.1.5**.

Therefore, it is determined that the development will have a **moderate** positive impact on the health of the community as it is likely to have an impact but will be of minimal consequence to the overall health of residents.

4.1.5 Sense of Community and Place

As discussed in **Section 4.1.4.2**, it is anticipated that the development will have a positive impact on the social cohesion in the surrounding community. The gastro pub, due to the focus on dining, will provide a meeting place for residents in the community whether families, professionals or retirees. The proximity to the residential pockets of the estate allows residents to easily access the facility and meet other people in the area. A review of the demographics in the area (outlined in **Section 3.0**) shows that the majority of the households in the immediate area of the estate are families and almost a third are lone person households. Therefore, the focus on dining at the establishment will allow the high proportion of resident families to use the facility and provide a space to facilitate social opportunities for residents living alone.

To date, development in this area has been primarily residential, therefore there is no existing community meeting place to encourage interaction or networking of residents in the area. For this reason, it is anticipated that the gastro pub will have a **high** positive impact on the sense of community in the estate as community networking is likely to occur and will be of moderate consequence.

It is recommended that residents in the existing areas of the estate, and those that purchase land or houses during the construction of the gastro pub are kept informed of the progress of the development and are provided the opportunity to be involved in the decision-making process surrounding aspects of the gastro pub.

4.1.6 Social Equity

Social equity discusses the fair distribution and access of facilities, housing and employment and provision of a range of lifestyle opportunities for all members of the community (Dubbo Regional Council, 2013).



In terms of accessibility, the gastro pub will use the infrastructure and facilities that will be constructed as part of the broader neighbourhood shopping centre precinct including car parking, pedestrian and cycle paths and other supporting infrastructure. Directly adjacent to the proposed location for the gastro pub there is expected to be approximately 46 car spaces, with an additional larger car park area that will contain approximately 300 car parking spaces on the southern side of the neighbourhood shopping centre to the gastro pub. Car parking is provided at a rate suitable to the development with 5.8 square meters of carpark designated per 100 square meters of the centre as per **Section 2.2.5** in the DCP (Dubbo Regional Council, 2013). There will be a number of accessible car parking spaces available and the development will contain kerb ramps, accessible walkways, handrails and other aids as per Section 3.1.8 in the DCP (Dubbo Regional Council, 2013).

As discussed in **Section 4.1.8**, the development is considered to be a positive employment opportunity for the community with an Economic Impact Assessment (EIA) undertaken by PPM Consulting estimating that the gastro pub would create eight (8) full time equivalent (FTE) jobs during construction and 26 FTE jobs in the operational phase.

The accommodation and food service industry is already an important feature of the local economy, employing 8.1% of the workforce in Dubbo South. For comparison, 7.1% of the workforce across NSW are employed in the industry.

Due to the nature of the development and the construction concurring with surrounding residential developments, it is not expected that the development will have a negative impact on accessibility for residents and patrons. Conversely, it is anticipated that the development will positively impact the social equity of the area by improving access to eateries and community meeting places for all members of the community. Therefore, it has been determined that the gastro pub will have a **high** positive impact on the community as it is likely to have a minor impact on social equity.

4.1.7 Intergenerational Impact

Intergenerational impact considers the effect of the development on present and future generations (Dubbo Regional Council, 2013). The development will bring ongoing opportunity for the community and nearby residents to be involved with the functioning of aspects of a gastro pub, including employment opportunities. The design of the neighbourhood shopping centre and the gastro pub itself allow for adaptations to building use and changing demographics in the community.

The concept of a gastro pub is relatively new, whilst gastro pubs have been reported as early as 1980 in the United Kingdom, the trend caught on in the 2000's in the United States and has made its way to Australia in the 2010's (Washington Post, 2009). The introduction of this concept in a regional centre like Dubbo shows the establishment is modernising dining and hospitality in the area and is encouraging pubs to focus on aspects other than alcohol which will be beneficial for the younger generations.

It is expected that the gastro pub will have a **moderate** positive impact on current and future generations in the community as it is likely the development will have an impact; however, the impact is anticipated to be minimal.

4.1.8 Economic

The EIA undertaken for the development identified an existing shortage of 3,991 square meters of gross floor space for restaurants, liquor, take-aways, hotels and clubs that is expected to increase to 7,185 square meters by 2031. The addition of the gastro pub will reduce this shortage by 580 square meters.



The development is not expected to impact negatively on similar establishments in the vicinity of the site as it is expected to be a local offering as the only establishment of its kind within a 15-minute walk. The small packaged alcohol sale space is not expected to compete with bigger stores such as Dan Murphys that are in the Dubbo area, it is likely that this store will also act as a local convenience outlet.

It has been established that the gastro pub is likely to create eight (8) FTE jobs during construction and 26 FTE jobs in the operational phase, 19 of these being directly sustained by the development and an additional seven (7) being indirectly experienced in the rest of the economy.

Overall, it is anticipated that the gastro pub is likely to have a moderate, positive impact on the economy in the area and therefore has been identified as a **high** impact.

4.2 Summary of Positive and Negative Social Impacts

Overall it is considered that the development:

- Is consistent with the regulatory and business development framework, including state government legislation and the Dubbo Regional Council's strategic plans (summarised in **Section 1.3**);
- Is an appropriate development in relation to the projected changes to population, largely due to the continuing development of Southlakes Estate, and the demographics in the region;
- Is unlikely to have an impact on the social amenity of the community in the construction or operational phase;
- Is unlikely to have an impact on the cultural heritage or community significance in the area;
- Will create access to dining facilities and encourage community networking through acting as a centre for community interaction;
- Would be a benefit contributing to the overall sense of place and community sustainability of the Dubbo South community;
- Will have a positive impact on the economy and employment opportunities in the region.

Table 4.2 below summarises the level of impact each potential impact of the development has been determined to have on the community.



Table 4.2 Impact Assessment Ranking

Impact	Ranking	Mitigated Ranking
Social Amenity - Construction	Low	Low
Social Amenity - Operational	Low	Low
Cultural & Community Significance	Low	Low
Gambling	Moderate	Low
Alcoholism	Moderate	Low
Crime/ Safety	High	Moderate
Health	Moderate (positive)	Moderate (positive)
Sense of Community & Place	High (positive)	High (positive)
Social Equity	High (positive)	High (positive)
Intergenerational Impact	Moderate (positive)	Moderate (positive)
Economic	High (positive)	High (positive)



5.0 Social Impact Monitoring and Management

5.1 Management and Mitigation

This section provides a summary of potential strategies that may be implemented in response to the predicted impacts outlined in **Section 4.0** - namely those ranked as moderate and high.

Table 5.1 summarises the key strategies that could potentially be implemented to either address a potential negative impact or enhance the positive impacts associated with the Project.

Table 5.1 Strategies to Address Key Impacts Associated with the Project

Impact/Opportunity Area	Strategies		
Gambling	 Place the gambling room in the bar area of the establishment, away from the dining area where minors are authorised to be and have access to the room away from the main entrance to the establishment Do not promote the gaming machines and place machines so they cannot be seen from outside the establishment Ensure sufficient supervision by an attendant and ensure attendants have their Responsible Conduct of Gambling accreditation and are encouraged to report concerning behaviour to superiors Encourage managers to recommend support services to patrons that are recognised to be exhibiting problem behaviour Provide true information on the chances of winning a major prize and the Gambling Help line phone number in various places in the establishment 		
Alcoholism	 Ensure all bar staff have their Responsible Service of Alcohol accreditation and adhere to the laws in relation to responsible service of alcohol Avoid drink promotions that may contribute to drunkenness or problem behaviours Record incidents and issues at or near the establishment and revise policies and procedures in line with these incidents Set operating hours that discourage higher alcohol consumption, i.e. closing time at midnight or before and centre around dining times Provide appropriate amount of seating to encourage dining and discourage alcohol consumption 		
Crime/ Safety	 Install surveillance cameras to deter opportune criminals Have sufficient lighting and access routes to carparking Ensure employees report suspicious behaviour and liaise with local law enforcement 		
Sense of Community & Place	 Encourage the involvement of the community and proximal residents in the opening and promotion of the establishment It is suggested that the gastro pub has an opening event that invites the community to encourage networking amongst the residents Include recognition of local symbols or heritage in the building design 		
Social Equity	 Ensure relevant mobility aids are included in the establishment to enable access by all community members Provide employment opportunities to the community Establish the development as a community meeting place and promote the services available to the community 		



Impact/Opportunity Area	Strategies
Intergenerational Impact	 Consider sustainable building principles such as the use of solar power or recycled materials in the building design Promote the concept of a gastro pub and the dining opportunities associated with it to the younger generations
Economic	 Encourage the operator to employ local residents and procure local services in the construction of the development

5.2 Monitoring and Evaluation

A key aspect of any social impact assessment is the development of a framework to monitor a project's impact over time. Southlakes will continue consultation with residents surrounding the development and key stakeholders in local government throughout the development process and construction of the development. Southlakes will endeavour to minimise disturbance to stakeholders as per the strategies outlined in **Section 5.1** and will continue to monitor this disturbance and take reasonable steps required if the social impacts are heightened at any stage of the development.



6.0 References

ABS. (2016). 2016 Census Community Profiles.

Burdge, R. J. (2004). A Community Guide to Social Impact Assessment. Middleton: Social Ecology Press.

- Buth, S., Wurst, F., & Thon, N. (2017). Comparative Analysis of Potential Risk Factors for at-Risk Gambling, Problem Gambling and Gambling Disorders among Current Gamblers.
- Daily Liberal. (2019a, May 27). Dubbo and Wellington pokie profits up, gambling critics claim 'social disaster'. Retrieved from https://www.dailyliberal.com.au/story/6183068/pokie-profits-at-almost-38-million-in-dubboregion-labelled-social-disaster/
- Daily Liberal. (2019b, December 3). DubVegas: Dubbo mayor Ben Shields says he won't support casino proposal. Retrieved from https://www.dailyliberal.com.au/story/6523181/mayor-withdraws-support-for-dubvegasafter-community-response/

Department of the Environment and Energy. (2019). National Heritage List.

Department of Urban Affairs and Planning. (2001). Crime preventionand the assessment of development applications.

- DPE. (2017). Social Impact Assessment Guideline for State Significant mining, petroleum production and extractive industry development.
- Dubbo Regional Council. (2011). Dubbo Crime Prevention Plan 2011-2014.

Dubbo Regional Council. (2013). Development Control Plan.

Dubbo Regional Council. (2018). Community Strategic Plan.

Maas Group Properties Southlakes. (2019). Southlakes Master Plan.

Mudgee Guardian. (2019, June 12). Poker machines, gambling addiction and the clubs and pubs who profit | List. Retrieved from https://www.mudgeeguardian.com.au/story/6213109/generally-nothing-good-is-happeningin-a-vip-gaming-lounge-at-3am/

NSW Government. (1977). Heritage Act.

REMPLAN. (2016). Dubbo Regional Community Profile.

- Vanclay, F. (2003). International Principles for Social Impact Assessment .
- Victorian Responsible Gambling Foundation. (2015). Risk Factors for Problem Gambling: Environmental, Geographic, Social, Cultural, Demographic, Socio-Economic, Family And Household.
- Washington Post. (2009). New York Develops a Taste for Gastropubs.



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