# PLANNING AND DEVELOPMENT COMMITTEE

# 17 JULY 2017

Appendices Relating to:

PDC17/24 Planning Proposal (R15-3) - Proposed Alteration to Minimum Lot Sizes Lot 172 DP 753233, 20R Peak Hill Road, Dubbo

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|---|---|
| **Appendix 1** | Planning Proposal - Alteration to Minimum Lot Size - 20R Peak Hill Road, Dubbo |
| **Appendix 2** | Further Information provided by the Proponent |

# Planning Proposal

Amendments to the Minimum Lot Size within
the South West Precinct
Highview Estate


Prepared For:

## HIGHVIEW COUNTRY ESTATES Pty Ltd

December 2015

GEOLYSE

POSTAL ADDRESS PO Box 1842 DUBBO NSW 2830
LOCATION 1st Floor, 62 Wingewarra Street DUBBO NSW 2830
TELEPHONE 02 6884 1525 FACSIMILE 02 6884 1470
EMAIL DUBBO@GEOLYSE.COM WEB SITE WWW.GEOLYSE.COM

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| ***Report Title:*** | *113156_REO_001_Planning Proposal* |
| ***Project:*** | *Amendments to the Minimum Lot Size* |
| ***Client:*** | *Highview Country Estates Pty Ltd* |
| ***Report Ref.:*** | *113156_REO_001_PP* |
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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 maps, plans, and cadastral information contained within this report are prepared for the exclusive use of Highview Country Estates to accompany this report for the land described herein and are 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.

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# Executive Summary

The intention of the Planning Proposal (PP) is to provide for a smaller subdivision lot size to assist with the provision of public recreation areas (bushland), drainage corridors and a perimeter road and local road network within the south west land release area of Dubbo from that currently available under the minimum lot size regime of the *Dubbo Local Environmental Plan 2011*. In particular to assist the provision of;

- Public recreation areas with opportunities for passive and active recreation for residents of the south west of Dubbo. Providing localised drainage areas of sufficient area, width and grade to incorporate cycle ways, footpaths, decorative lakes and parklands;
- Native bushland areas for the protection and enhancement of local flora and fauna;
- Perimeter road network to assist bushfire fighting protection / separation and access from the surrounding bushfire hazard (bushland) areas;

This PP affects the *Minimum Lot Size Map – Sheet LSZ_008A* and *Natural Resource – Biodiversity Map Sheet NRB_008* of the *Dubbo Local Environmental Plan 2011* (DLEP). In particular, the PP affects land holding Lot 172 DP 753233 within the South west of Dubbo bounded by Blackbutt Road to the north, Rifle Range Road to the south Peak Hill Road to the east and Chapmans Road to the west.

No zoning amendments are proposed under this PP.

The PP seeks to amend:

- The minimum lot sizes to provide a range of 2000m$^2$ to 4000m$^2$; and
- The Biodiversity map to facilitate the future road and subdivision layout;

Due to the minor nature of the proposal, approval of the planning amendments is sought from the Director-General of the Department of Planning as part of the Gateway Determination.

Details of the proposal's compliance with the applicable strategic, regional, and local planning instruments, state environmental planning policies, and ministerial directions are contained in the body of this report.

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

# ABBREVIATIONS

| Abbreviation | Full Name |
|---|---|
| PP | Planning Proposal |
| DoP | NSW Department of Planning |
| EP&A Act | *Environmental Planning and Assessment Act 1979* |
| SEPP | State Environmental Planning Policy |
| LEP | Local Environmental Plan |
| EPA | Environmental Protection Authority |
| RMS | Roads and Maritime Services |
| AHD | Australian Height Datum |
| LGA | Local Government Authority |

# Background

## 1.1 INTRODUCTION

Geolyse Pty Ltd has been commissioned by the applicant (Highview Country Estates) to prepare a Planning Proposal (PP) to support a proposed amendment to the *Dubbo Local Environmental Plan 2011*. The PP is lodged in relation to a portion of land identified as Lot 172 DP 753233 within the South west of Dubbo bounded by Blackbutt Road to the north, Rifle Range Road to the south, Chapmans Road to the west and Peak Hill Road to the east.

The site and surrounding land is nearing readiness for development as the existing residential estate developments to the north of this land progress towards the property.

The intention of the PP is to provide for a smaller residential subdivision lot size to assist with the provision of housing sited around existing significant bushland on site supported by drainage corridors and a local road network within the south west land release area of Dubbo from that currently available under the minimum lot size regime of the *Dubbo Local Environmental Plan 2011*.

This PP affects the *Minimum Lot Size Map – Sheet LSZ_008A* and *Natural Resource – Biodiversity Map Sheet NRB_008* of the *Dubbo Local Environmental Plan 2011* (DLEP).

The proposal is considered to be of a minor nature and in this respect approval is sought from the Director-General of the Department of Planning as part of the Gateway Determination.

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 four (4) 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.

## 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 PP area; and
- **Section 6** details how community consultation is to be undertaken with respect to the PP.

# Overview

## 2.1 THE SUBJECT SITE

### 2.1.1 SITE DESCRIPTION AND LOCATION

This Planning Proposal (PP) affects a portion of land identified as Lot 172 DP 753233 within the South west of Dubbo bounded by Blackbutt Road to the north, Rifle Range Road to the south, Chapmans Road to the west and Peak Hill Road to the east.

The site and surrounding land is ready for residential development as the existing residential estate developments to the north of this land continue to progress west and south towards this property. This land is located within the visible transition and south western edge of Dubbo's South Western Urban Development Precinct.

Plate 1 provides an aerial view of the land relative to the City of Dubbo and surrounding development which is the subject of this PP.

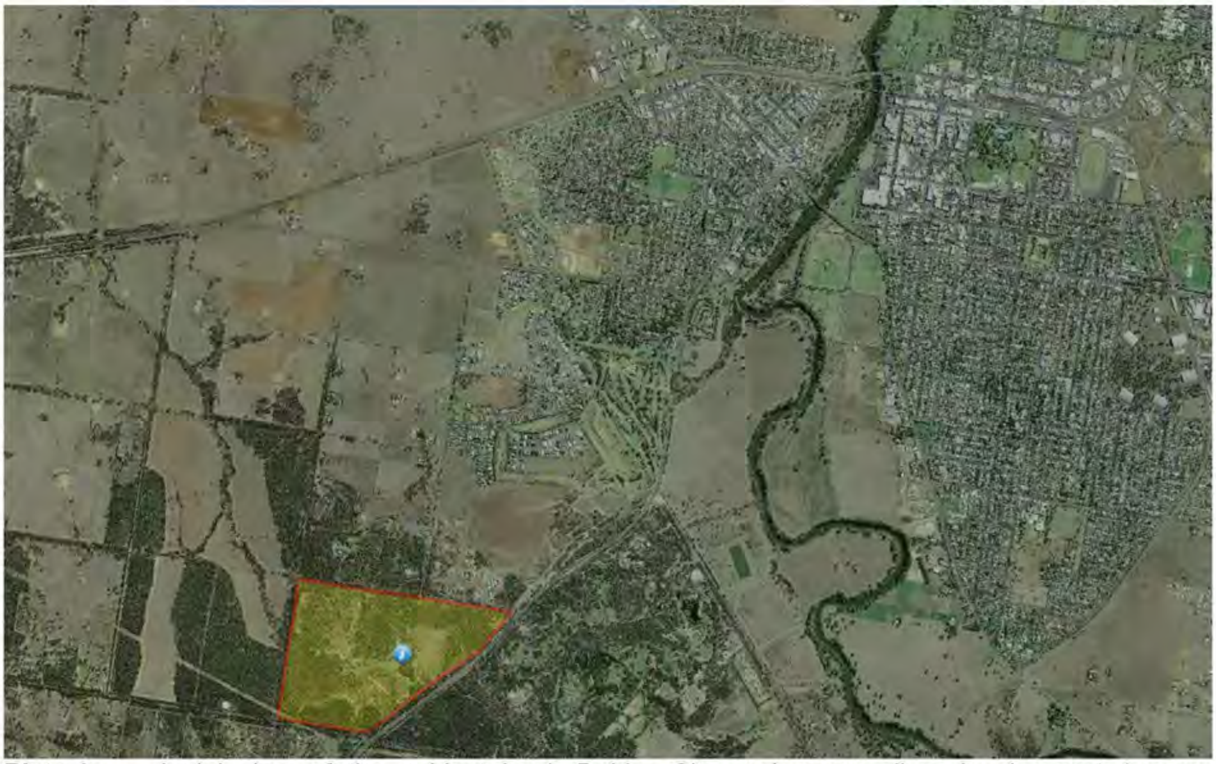

**Plate 1:** Aerial view of the subject land, Dubbo City and surrounding development (source: www.maps.sixnsw.gov.au)

## 2.2 DEVELOPMENT INTENT

The intention of the PP is to provide for a smaller subdivision lot size to assist with the provision of housing sited around existing significant bushland on site supported by drainage corridors and a perimeter road and local road network within the south west land release area of Dubbo from that currently available under the minimum lot size regime of the *Dubbo Local Environmental Plan 2011*. In addition the smaller lot size and intended subdivision layout would provide;

- Public recreation areas with opportunities for passive and active recreation for residents of the south west of Dubbo. Providing localised drainage areas of sufficient area, width and grade to incorporate cycle ways, footpaths, decorative lakes and parklands;
- Native bushland areas for the protection and enhancement of local flora and fauna;
- Perimeter road network to assist bushfire fighting protection / separation and access from the surrounding bushfire hazard (bushland) areas;

This PP affects the *Minimum Lot Size Map – Sheet LSZ_008A* and *Natural Resource – Biodiversity Map Sheet NRB_008* of the *Dubbo Local Environmental Plan 2011* (DLEP).

### 2.2.1 EXISTING MINIMUM LOT SIZE RESTRICTIONS

Upon viewing the existing Minimum Lot Size Map – Sheet LSZ_008A the minimum lot size for the site is that of 10ha

Plate 2 below details the current minimum subdivision allotment size regime within the South west Precinct.

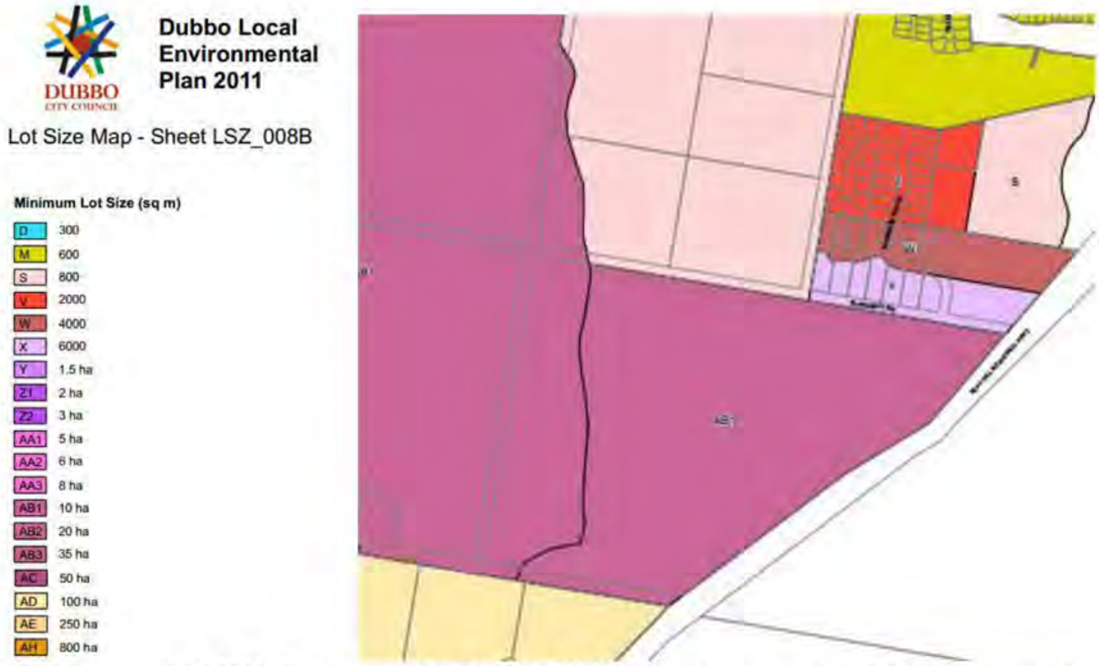


**Plate 2: DLEP 2011 Minimum Lot Size Map LSZ_008A extract (Source: www.legislation.nsw.gov.au)**

### 2.2.2 PROPOSED MINIMUM LOTS SIZE REQUIREMENTS

In accordance with the Lot Size Map LSZ_008B of the *Dubbo Local Environmental Plan 2011* (DLEP), the R5 – Large Lot Residential land is accompanied by a minimum lot size of 10 Ha.

As stated above, the intention of the PP is to provide for a smaller subdivision lot size to assist with the provision of public recreation areas (bushland), drainage corridors, a perimeter road and local road network within the south west land release area of Dubbo from that currently available under the minimum lot size regime.

In this regard an amendment to the abovementioned Lot Size provisions of the DLEP would be required in order for the future development of these sites to be permissible, compliant and ensure the natural qualities of the site for the future.

Plate 3 below shows the proposed minimum lot size amendments within the South West Precinct.


**Plate 3: Proposed lot size plan extract (Geolyse Pty Ltd 113156_04A_TP02)**

### 2.2.3 PROPOSED BIODIVERSITY MAPPING

In accordance with the Natural Resource – Biodiversity Map NRB_008 of the Dubbo Local Environmental Plan 2011 (DLEP), the site is identified as being of 'Moderate Sensitivity'.

The intention of the PP is to provide for a smaller subdivision lot size to assist with the provision of public recreation areas (bushland), drainage corridors and a perimeter road and local road network within the south west land release area, along with amending or 'turning off' the 'moderate sensitivity mapping' shown on *Natural Resource – Biodiversity Map Sheet NRB_008* of the DLEP to exclude that area already assessed in detail to be affected by the indicative lot layout map yet not result in unreasonable impact.

Plate 4 shows the amended biodiversity map for the subject site.


**Plate 4:** **Proposed lot size plan extract (Geolyse Pty Ltd 113156_05A_TP02)**

### 2.2.4 ANTICIPATED DEVELOPMENT TYPOLOGIES

It is anticipated that primarily the PP would facilitate a combination of typical single and two storey developments with the majority of development being single storey in height upon larger residential lots.

The subdivision would be set within a native landscaped setting managed to ensure bushfire hazard separation.

It is envisaged that the perimeter roads and bushland regeneration areas are landscaped with a range of native vegetation and developed with perimeter roads, parking areas and footpaths to provide active and passive recreation areas for residents and visitors.

An indicative lot layout plan for the sites future subdivision have been compiled to give Council an understanding of the anticipated development of land at **Appendix A**.

### 2.2.5 PROPOSED DEVELOPMENT OBJECTIVES

The development of the land is to be developed generally in accordance with the following objectives

- Provide for a residential estate with housing in areas of increased amenity including land adjoining or opposite:
  - Bushland areas; and
  - Drainage land corridors.
- Provide opportunities for community open space integrated into the subdivision design.
- Provide opportunities for an increased range of smaller lot sizes than that permitted whilst retaining the natural bushland of the site.
- Provision of local roads including loop roads for traffic circulation through these areas and bushfire separation and access.

- Provide alternative residential housing development options with sympathetic design to encourage biodiversity

It is noted that future development would be required to be designed in accordance with the objectives of the Dubbo Local Environmental Plan 2011 and Dubbo Development Control Plan 2013, in particular the development controls for privacy, noise and parking provision would be maintained.

In addition to the above objectives it is anticipated that the land would be developed with consideration to the following development objectives:

*R5 zoned land:*

- To provide residential housing in a rural setting while preserving, and minimising impacts on, environmentally sensitive locations and scenic quality.
- To ensure that large residential lots do not hinder the proper and orderly development of urban areas in the future.
- To ensure that development in the area does not unreasonably increase the demand for public services or public facilities.
- To minimise conflict between land uses within this zone and land uses within adjoining zones.
- Provide varied lot sizes and housing product opportunities integrated with community facilities, infrastructure and open space (bushland) areas;

The market is considered to continue to provide attractive, modern, good design, low density housing products that are suitably landscaped to ensure, when the land is developed, that an attractive and well-designed estate has been provided.

*Drainage and bushland areas:*

- Provide landscaped corridors for stormwater drainage and sewer servicing;
- Provide passive and active recreation areas for use by residents of the area;
- Provide a landscaped corridors that facilitates additional pedestrian and cycle permeability through the site and to adjoining transport corridors and walkways;
- Provide a connection through the residential estate to adjoining estates and their recreation areas.

The industry is considered duly able to provide good infrastructure and landscaped areas that would achieve the above objectives.

### 2.2.6 SERVICES

A servicing strategy has been prepared and is provided at **Appendix B** and includes the future provision of local roads, water, sewer, and stormwater and power mains infrastructure to support the future development consistent with the required service providers design requirements and similar to that of surrounding servicing arrangements for adjoining land.

In general, telecommunications, roads, power and water service mains are being constructed/extended from the existing mains located within Blackbutt Road, Rifle Range Road and Peak Hill Road with sewer and stormwater being extended and augmented from their respective downstream mains and a temporary pump station and would be generally located within the proposed drainage corridor within the south western portion of the land to deliver sewer to the mains in the north eastern corner of the site until such time in the future when the pump station is no longer required.

The land is capable of and will be serviced by all available reticulated utilities, including power, telephone, gas, water and sewerage as are available in the greater locality. Necessary provision and upgrading where required to facilitate the development is acknowledged. All services will conform to the requirements of the relevant controlling service authority and/or Council.

### 2.2.7 TRAFFIC & TRANSPORT CONSIDERATION

<u>*R2 zoned land:*</u>

In accordance with Section 1.4 of Councils '*Section 94 Contributions Plan: Urban Roads & Car parking*', the trip generation rate for a low density *'Residential Housing'* is eleven (11) trips per day and for a medium density *'3 bedroom unit'* dwelling six (6) trips per day.

Based upon the above trip generation rates and the lot layout shown upon the supporting plans numbered **113156_04A_TP02** the indicative lot layout plan has an approximate dwelling yield of 138 dwellings and would therefore have the potential to generate approximately 1,518 trips per day.

Once fully constructed the proposed residential estate will be provided with loop roads that connect to the surrounding local collector roads of Blackbutt Road.

The anticipated additional vehicle trips are not considered to have an adverse impact upon traffic congestion within the surrounding road network as they are being designed and constructed to support the additional vehicle trips generated from the development of residential land in the locality. It is considered that the surrounding and future road network is of sufficient capacity to cater for the future increase in vehicle trips once developed.

## 2.3 ENVIRONMENTAL CONSIDERATION

### 2.3.1 TOPOGRAPHY AND SOILS

The subject site has an undulating topography with a ridgeline running to the north east and gradual slope from north east and parallel to Peak Hill Road and a second ridgeline running north parallel to the western boundary. These ridgelines are separated by depressed land with existing dams located within each depression as generally shown within Plate 5 below:


**Plate 5:** Topographic view of the site (source: http://maps.six.nsw.gov.au)

The existing vegetated areas across the site with areas of cleared land have in recent past been regularly maintained for agistment and other interim agricultural grazing. Some stormwater drainage has been constructed and runoff is directed into the existing drainage network being an open grass channels which ultimately discharge to existing agricultural dams on site.

The land subject to this PP, is located within the Goonoo Soil Landscape (Murphy and Lawry 1998). Earthy sands, siliceous sands, red earth and yellow and grey earths occur on the mid to upper slopes. Yellow solodic soils are common on lower slopes and drainage depressions.

This soil type is consistent with being able to sustain urban development such as residential development.

### 2.3.2 SALINITY AND GROUNDWATER

The proposal would have the potential to increase the density of development across the subject sites. The land is partially mapped by the DLEP 2012 Natural Resource Groundwater Vulnerability Map – Sheet CL_008 as having 'Moderately High Vulnerability'. The development intention for the site being for a majority of residential development with supporting road and stormwater management infrastructure. The resultant development would manage stormwater collection and disposal in a controlled fashion reducing the threat to the contamination of groundwater.

A *Salinity Report* by Envirowest Consulting has been prepared for the future residential layout of the site and is provided at **Appendix C**. The objective of this report was to provide detailed information including mitigating options (if required) in relation to dryland and urban salinity processes and groundwater. The report assesses the impact on the environmental processes of salt and water and the impact of existing salt and water process of the site impact on the structural features of the sites development.

The Salinity Report concludes:

*"The risk of ground water contamination from the proposed land-use will be less than the current land-use. A change in land use from treed areas with little groundcover to vegetated areas of lawn and garden offsets any additional nitrogen and phosphorus which may be applied to the site as fertilizers. Washing of cars on permeable areas will not be a significant contributor to nutrient levels. Reuse of greywater will be small volumes or 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 ground water 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.*

*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:*

- *Retaining and maintaining current woodland vegetation where possible. Trees will be retained in reserves and in areas outside the residential area on lots.*
- *Trees will be retained along drainage lines associated with sub soil salinity.*
- *Promote additional plantings of deep rooted vegetation in road reserves and lots.*
- *Stormwater retention basins lined with an impermeable layer.*
- *Design road levels similar to natural soil levels to minimise excavations."*

### 2.3.3 FLORA AND FAUNA

The proposed development would ultimately require the removal of existing vegetation from the site.

The development intention for this site being for residential development with supporting road and stormwater management infrastructure and bushland areas.

The predominant areas proposed for future have been selected to minimise impact upon site by selecting areas which have limited canopy vegetation to locate future housing and therefore is less likely to have the potential to provide a habitat for any fauna species.

A biodiversity report of the site has been undertaken (by Geolyse 2013) and is provided at **Appendix D**. This advice has been reviewed under separate cover by Council of which Council required further assessment be undertaken to consider the impacts of the proposal in their letter dated 21 November 2014.

The requested information has been prepared by Ozark Pty Ltd and is provided as a response letter to Council dated 23 September 2015 at **Appendix D**. This information includes individual responses to the concerns raised, includes 7 – Part Tests of significance, completes ultrasonic bat call detection, identifies that on site assessments were undertaken during autumn and identified hollow bearing tree locations.

The summary of the impact assessment by Ozark identifies:

*"...The proposal has been significantly modified to protect Glossy Black Cockatoo (Calyptorhynchus lathami halmaturinus) TSC Act and EPBC Act feeding habitat and Ironbark woodland. Ironbark Woodland is known habitat for the critically Regent Honeyeater (TSC Act EPBC Act) a species observed in the immediate area in winter 2015. Breeding and feeding habitat for Grey-crowned Babbler (eastern subspecies) TSC Act, has also been protected in the on-site reserve system.*

*While impact to a degraded area of NSW listed Box-gum woodland and hollow trees will occur the ecologist believes a realistic and meaningful conservation outcome has been achieved in the proposed layout."*

### 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 identified as being located on bush fire prone land.

An assessment has been undertaken of the bushfire protection measures required to address the bushfire risk to the future residential development of the site, consistent with the Residential Development specifications of Planning for Bushfire Protection 2006 and is provided at **Appendix E**.

The report advises (among others):

*"The Concept Plan layout provides for a combination of public perimeter roads, public internal roads and fire trails which will be provided to the perimeter of part of the estate. These trails will form part of the Asset Protection Zones and shall be maintained under the Community Title land ownership…"*

*"Street Hydrants shall comply with the specifications of Australian Standard A.S. 2419.2 and have a flow rate of 10 litres / second. Hydrant locations shall be delineated by blue markers placed on the hydrant side of the centreline of the road pavement."*

*"Construction standards shall be applied to the future buildings erected on all lots created in the future subdivision of the residential precinct. The nominated width of the Asset Protection Zones as shown on Figure 9 – Page 19 have been determined in order that the future dwellings constructed on those lots exposed to a bushfire hazard have a maximum Bushfire Attack Level [BAL] rating of 29 kW/m2."*

*"The residual vegetation within Community Lot 1 shall be managed, in accordance with a Fuel management Plan, in order to address the provisions of Section 63 of the Rural Fires Act 1997 and to reduce the hazard to the perimeter of the residential estate."*

The characteristics of the site, as discussed in the attached report, together with the fire protection measures recommended, provide that the future subdivision of the land is suitable in terms of its intended residential land use.

### 2.3.5 FLOODING

The subject sites are not identified as being within a flood planning area as identified by the *Dubbo Local Environmental Plan 2011*. In this regard the proposed rezoning their future development would not be affected by potential flooding nor result in adverse flood impact upon the immediate locality.

### 2.3.6 CONTAMINATION

A Contamination Investigation has been undertaken on site by Envirowest Consulting Pty Ltd and contaminates were found subsequently affecting the sites suitability for future residential use. The Applicant has undertaken a remediation and validation assessment of the site to remediate the site for the proposed residential land-use. The site has been remediated and cleaned of contaminants to ensure it is suitable for residential use and a remediation and validation assessment report is provided at **Appendix F**. A summary from the remediation and validation report is provided below:

> *"Remediation of the site was undertaken by removal of contaminated materials and disposal to Whylandra Landfill. Inert materials such as concrete, bricks and pavers were*

*retained on-site for re-use. Asbestos impacted materials were remediated by excavation and off-site disposal as asbestos waste or sorted to separate asbestos cement fragments from other material. The asbestos cement fragments was disposed as asbestos waste. Hand picking of all locations identified as impacted by asbestos cement fragments was undertaken.*

*Validation of asbestos impacted areas was undertaken by traversing the area on 5m transects. The soil surface was visually assessed to confirm all asbestos cement fragments had been removed. No asbestos cement fragments were identified on the soil surface at the final inspection.*

*Hydrocarbon impacted soil identified at Location 5 was excavated until no evidence of contamination was identified. Excavated material was disposed off-site as general solid waste. The excavation pit was approximately 1m by 1m and 1m deep. Validation of the excavation pit was undertaken by sampling the walls and base of the pit. Soil samples were analysed for TRH and BTEXN. Levels of hydrocarbons in the soil samples were below detection limits and less than the adopted residential land-use thresholds.*

*A waste coal stockpile (Stockpile Y) identified at Location 5 was excavated to 100mm below the base of the stockpile and disposed off-site. Validation of the remediation was undertaken by visually inspecting the footprint for the presence of coal residue. No coal residue was identified in the stockpile footprint after removal.*

*The hydrocarbon and zinc impacted stockpile (Stockpile Q) identified at Location 6 was excavated to 100mm below the base of the stockpile and disposed off-site. A soil sample was collected from the stockpile footprint after removal and analysed for zinc, TRH and BTEXN. Levels of zinc were at environmental background levels and levels of TRH and BTEXN were below detection limits. Levels of contaminants of concern were below the adopted residential land-use thresholds.*

*Refuse was collected from across the site and disposed as general solid waste. Small amounts of refuse (timber, plastic) remain on the site and are expected to be removed at the time of site development.*

*Recommendations:*

*The site is suitable for residential land-use.*

*The historical activities on the site may have resulted in unidentified areas of contamination. The development should be managed in accordance with an unexpected finds protocol for implementation if suspected contamination is identified."*

As detailed above the subject site is suitable for the future residential land uses subject to appropriate management.

## 2.4 SOCIAL AND CULTURAL CONSIDERATION

### 2.4.1 ABORIGINAL ARCHAEOLOGY

Ozark Environmental Management and Heritage conducted a survey of the land to determine the presence and potential impact of the proposal upon aboriginal heritage significance of the area. A heritage impact assessment has been prepared to confirm the results of the survey and due diligence assessment (**Appendix G**) and concludes as follows:

*"On Tuesday 14 April 2015 OzArk Senior Archaeologist Chris Lovell, together with Aboriginal community representatives Shim Smith (Tubba-Gah Aboriginal Corporation) and Terry Toomey (Dubbo Local Aboriginal Land Council), conducted a pedestrian and vehicular survey of the Study Area. Sections of the Study Area with landforms possessing archaeological potential were*

*inspected on foot. All areas of exposure were checked for archaeological material. Two Aboriginal sites were recorded within the Study Area (BR-IF1 and BR-ST1) and two previously recorded sites CR-OS-1 (#36-1-0523) and CR-ST-1 (#36-1-0525) were not able to be located.*

*Recommendations concerning the Study Area are as follows:*

1. *The current assessment determines that no further archaeological investigation is warranted at sites BR-IF1, BR-ST1, CR-OS-1 (#36-1-0523) and CR-ST-1 (#36-1-0525).*
2. *The Proponent should seek to avoid impact to all recorded Aboriginal sites (BR-IF1, BR-ST1) and ensure that CR-OS-1 [#36-1-0523] and CR-ST-1 [#36-1-0525] remain outside the impact area. If sites are to be avoided, they should be identified by suitable, high visibility curtilage to avoid inadvertent impacts during the completion of proposed works.*
3. *The current assessment recommends that long-term management of BR-ST1 will entail its protection and preservation.*
4. *Should impacts to any site be unavoidable, an Aboriginal Heritage Impact Permit (AHIP) must be sought from the Office of Environment and Heritage (OEH) to allow impacts to those sites. Archaeological recommendations for the AHIP application would be:*
    a. *If site BR-IF1 is to be impacted, the site should be salvaged through a surface collection of artefacts under supervision of an archaeologist or trained cultural heritage field workers from the Aboriginal community.*
    b. *Should site CR-ST-1 be located, it is recommended that the tree and scar be archivally recorded prior to any impacts.*
    c. *No program of sub-surface salvage is recommended for BR-IF1 as OzArk and Aboriginal community representatives have assessed the site as having low potential for associated potential archaeological deposits.*
    d. *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 the Aboriginal Heritage Information Management System (AHIMS).*
5. *All land-disturbing activities must be confined to within the assessed Study Area.*
6. *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.*
7. *In the unlikely event that objects are encountered that are suspected to be of Aboriginal origin (including skeletal material), the Unanticipated Finds Protocol (**Appendix 4**) should be followed."*

### 2.4.2 EUROPEAN HERITAGE

The site does not contain any locally listed heritage items as identified by the DLEP. In this regard the proposed rezoning is not considered to adversely affect the heritage significance of the locality.

# Intent and Provisions

## 3.1 OBJECTIVE

The intention of the Planning Proposal (PP) is to provide for a smaller subdivision lot size to assist with the provision of public recreation areas (bushland), drainage corridors and a perimeter road and local road network within the south west land release area of Dubbo from that currently available under the minimum lot size regime of the DLEP, along with amending or 'turning off' the 'moderate sensitivity mapping' shown on *Natural Resource – Biodiversity Map Sheet NRB_008* of the DLEP to exclude that area already considered to be affected by the indicative lot layout map.

## 3.2 EXPLANATION OF PROVISIONS

This PP affects the Minimum Lot Size Map – Sheet LSZ_008A and *Natural Resource – Biodiversity Map Sheet NRB_008* of the Dubbo Local Environmental Plan 2011 (DLEP). In particular, the PP affects land holding Lot 172 DP 753233 within the South West of Dubbo bounded by Blackbutt Road to the north, Rifle Range Road to the south Peak Hill Road to the east and Chapmans Road to the west as shown in Plates 6 and 7.


**Plate 6: Proposed lot size plan extract (Geolyse Pty Ltd 113156_04A_TP02)**


Plate 7: Proposed lot size plan extract (Geolyse Pty Ltd 113156_05A_TP02)

# 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 the PP to ensure confidence can be given to the Gateway determination.

## 4.1 NEED FOR THE PLANNING PROPOSAL

### 4.1.1 RESULT OF ANY STRATEGIC STUDY OR REPORT

The PP is not a result of a strategic study or report but rather the current demand of housing and residential land product within South West of Dubbo.

The PP proposes to provide for a smaller subdivision lot size to assist with the provision of bushland areas, drainage corridors and a perimeter road and local road network within the south west land release area of Dubbo from that currently available under the minimum lot size regime for the site of the DLEP.

The indicative subdivision of the site accommodates the retention of identified ecologically sensitive areas and suitable setbacks and treatment of site hazards namely bushfire and contamination.

### 4.1.2 BEST MEANS OF ACHIEVING THE OBJECTIVES OR INTENDED OUTCOMES, OR IS THERE A BETTER WAY

The desired minimum lot size is not permissible upon the land in accordance with the provisions of the DLEP 2011.

The submission of a PP to amend the existing lot size requirements represents the best method of achieving the desired outcome.

## 4.2 RELATIONSHIP TO STRATEGIC PLANNING FRAMEWORK

### 4.2.1 CONSISTENT WITH THE OBJECTIVES AND ACTIONS OF THE APPLICABLE REGIONAL OR SUB-REGIONAL STRATEGY

There are no overriding Regional or Sub-regional strategies that directly relate to residential development within the Dubbo LGA or Central West Region.

### 4.2.2 CONSISTENT WITH COUNCIL'S LOCAL STRATEGY OR OTHER LOCAL STRATEGIC PLAN

*Dubbo City Urban Development Strategy - Residential Areas Development Strategy 1996-2015*

The purpose of the Dubbo City Residential Areas Development Strategy 1996-2015 (Strategy) is *"to provide a spatial, servicing and development control framework that will assure the timely provision of residential development opportunities which fit the needs of Dubbo and the region it services"*. The Strategy was designed to protect land for future residential development and to facilitate the servicing, staging, and release of this land.

The Strategy divides the Dubbo LGA into thirteen (13) separate precincts including seven urban precincts. The subject site falls within the 'South west Precinct'. The Strategy sets a goal to *'Identify and protect the established residential neighbourhoods and ensure a sufficient supply of suitable land to meet the future residential development needs of the city.'*

The proposed rezoning would be consistent with the strategy for the following reasons:

- An amended minimum lot size distribution would facilitate the timely provision of residential development that fits the current needs of Dubbo and the region it services whilst maintaining bushland features of the site;
- Development of this allotment would continue to complete the south western progression of suburban development of Dubbo;
- The sites are located within the visible transition/south western edge of urban development, being the Rifle Range Road and Peak Hill Road corridor;
- The future construction and the resultant development would have due consideration to the local environmental constraints;
- It is anticipated that the PP would ensure the Dubbo Construction & Development Industry and the Dubbo Real Estate Industry would be provided with a secure and diverse residential and additional commercial land supply that is anticipated to last beyond 5 years;

*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.

The 'Context' also states that the Strategy does not represent the adopted Strategic Land Use Policy for the City and its future growth. In this regard, and due to the fact that the land is located within an expanding part of the residential area of Dubbo, the PP is considered to be generally accommodated within the scheduling, expectations and recommendations of this strategy. Detailed considerations of the PP against the recommendations of the strategy is not considered warranted.

It should be noted that the strategy makes the following statements to which the PP is considered to remain consistent:

*"Residential Development in Dubbo is planned in three sectors, the South East Sector, the North West Sector and the South West Sector.*

*The density of existing residential areas is approximately 7.8 dwellings per hectare; this is a gross figure including roads, schools and local community facilities including open space.*

> *Should development continue at this density, the three sectors could accommodate 10,500 dwellings, sufficient until about 2050.*

*The scheduling for the three sectors if described in Table 2.1 and the location is described in Figure 5.1. …"*

### 4.2.3 CONSISTENT WITH APPLICABLE STATE ENVIRONMENTAL PLANNING POLICIES

*Orana Regional Environmental Plan No. 1 – Siding Spring Observatory*

The only regional/sub-regional strategy relating to the Dubbo Local Government Area is the *Orana Regional Environmental Plan No.1 – Siding Spring Observatory*. The Siding Spring Observatory is located more than 100 kilometres away in Coonabarabran, the future proposed development of the site is not considered to be of a scale that would have the potential to cause an adverse effect upon the operations of the Observatory.

*State Environmental Planning Policy No. 21 – Caravan Parks*

The change in minimum lot size would not enable 'caravan parks' as they are not a permitted use within the R5 land use table. The PP does not include provisions that allow the application of this policy or its development.

*State Environmental Planning Policy No. 36 – Manufactured Home Estates*

The change in zoning would not enable 'manufactured home estate' as they are not a permitted use within the R5 land use table. The PP does not include provisions that allow the application of this policy or its development.

*State Environmental Planning Policy No. 55 – Remediation of Land*

Clause 6 of the *State Environmental Planning Policy No. 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 residential use.

*State Environmental Planning Policy No 65 – Design Quality of Residential Flat Development*

The change in zoning would enable not enable 'Residential Flat Buildings' and 'Shop Top Housing' development. The PP does not include provisions that allow the application of this policy or its development.

*State Environmental Planning Policy (Affordable Rental Housing) 2009*

The provisions of *State Environmental Planning Policy (Affordable Rental Housing) 2009* would continue to apply to the land with future development under this plan being subject to development consent being granted. If the land were to be developed in this manner such development would need to ensure it achieves the relevant provisions of this plan. The PP does not include provisions that contradict or hinder the application of this policy.

*State Environmental Planning Policy (Building Sustainability Index: BASIX) 2004*

The provisions of *State Environmental Planning Policy (Building Sustainability Index: BASIX) 2004* would continue to apply to residential affected development in accordance with the provisions of this policy. The PP does not include provisions that contradict or hinder the application of this policy.

State Environmental Planning Policy (Housing for Seniors or People with a Disability) 2004

The provisions of *State Environmental Planning Policy (Housing for Seniors or People with a Disability) 2004* would continue to apply to the land with future development under this plan being subject to development consent being granted. If the land were to be developed in this manner such development would need to ensure it achieves the relevant provisions of this plan. The PP does not include provisions that contradict or hinder the application of this policy.

State Environmental Planning Policy (Exempt and Complying Development Codes) 2008

The provisions of *State Environmental Planning Policy (Exempt and Complying Development Codes) 2008* would continue to apply to the land generally consistent with that achievable under the current land zoning. The PP does not include provisions that contradict or hinder the application of this policy.

State Environmental Planning Policy (Infrastructure) 2007

The provisions of *State Environmental Planning Policy (Infrastructure) 2007* would continue to apply consistent with that achievable under the current zoning. It should be noted that the subdivision would not be considered traffic generating development as defined by Schedule 3 of the SEPP as indicative lot layout comprises 138 lots and its intersection to Blackbutt Road is in excess of 90 metres from the classified road of the Newell Highway.

Additionally, a Road Traffic Noise Assessment (**Appendix H)** has been undertaken as future allotments would be within 100 meters of the classified road. The report concludes:

*"MAC (Acoustic Consultant) has completed an assessment of potential road traffic noise impacts on the proposed Stage 2, Kintyre Subdivision Lot 172, DP753233 Blackbutt Road, Dubbo NSW.*

*The assessment has qualified the existing ambient environment with respect to road noise, using measured levels to calibrate predictions. Noise predictions identified that some dwellings in close proximity to the Newell Highway will require construction using materials equivalent to category 2 of the guideline (see Figure 6.1 and 6.2 for the mitigation zone). For dwellings outside of the mitigation zone, standard construction materials equivalent to category 1 listed in the guideline may be adopted.*

*It is recommended that noise controls outlined in this report are adopted for future dwellings constructed within the development to achieve relevant internal criteria. Once recommendations are adopted for the project, there would be no noise related issues which would prevent Council approving this project."*

The PP does not include provisions that contradict or hinder the application of this policy.

State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007

The site is not located within any identified resource areas, potential resource areas or transitional areas. There are no known existing mines, petroleum production operations or extractive industries are in the area of the PP or within its vicinity. Given existing development on the site and within the immediate locality the PP would be of minor significance and would not further restrict development potential or create land use conflict beyond existing arrangements.

### 4.2.4 CONSISTENT WITH APPLICABLE S117 (2) MINISTERIAL DIRECTIONS – 3.1 RESIDENTIAL ZONES

The Minister for Planning and Infrastructure, under Section 117(2) 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 section provides an assessment of the PP against the relevant Section 117 directions. Note this section provides the objectives of the relevant direction, a full copy of the directions can be viewed at:

http://www.planning.nsw.gov.au/planningsystem/local.asp.

The following discussion demonstrates the PP's consistency with the relevant Section 117 directions.

*Direction 1.1 – Business and Industrial Zones*

Direction 1.1 – Business and Industrial zones is not applicable as the PP affected land does not proposes or impact such land and is purely for residential estate development.

*Direction 1.3 – Mining, Petroleum Production and Extractive Industries*

Ministerial Direction 1.3 – Mining, Petroleum Production and Extractive Industries is not applicable as the PP affected land does not prohibit the mining of coal or other minerals, production of petroleum, or winning or obtaining of extractive materials or restricting the potential development of such by permitting a land use that is likely to be incompatible with such development.

It is noted that the sites are currently zoned for residential use and are provided with a buffer of existing residential, rural and tourist zoned land.

*Direction 2.1 – Environment Protection Zones*

Ministerial Direction 2.1 – Environment Protection Zones does apply to the PP as the site is mapped by the DLEP 2012 Natural Resource Biodiversity Map NRB_008 as being of 'Moderate' biodiversity significance. The area is known to contain Endangered Ecological Community's (EEC). The indicative lot layout would result in impact to a degraded area of NSW listed Box-gum Woodland and hollow trees, the consulting ecologist believes a realistic and meaningful conservation outcome has been achieved in the proposed layout.

*Direction 2.3 – Heritage Conservation*

Ministerial Direction 2.3 – Heritage Conservation is applicable as the PP affected land includes items, areas, objects and places of indigenous heritage significance.

The PP is considered consistent with the objectives of this direction as the identified heritage items and the relevant development considerations of the DLEP would remain unaffected by the PP. All future development would require due consideration in accordance with these provisions.

*Direction 3.1 – Residential Zones*

Ministerial Direction 3.1 – Residential Zones is considered consistent with the objectives of this direction as the amended minimum lot sizes;

- Would encourage additional choice of housing types to provide for the existing and future housing needs of Dubbo;
- Would make more use of existing and future infrastructure and services of Dubbo;
- Would reduce the consumption of land for housing and associated urban development outside the fringe of Dubbo;
- Future subdivision of the land would accommodate areas of ecological significance and separation from hazards; and
- It is anticipated that future development would be of 'good design' having regard to current modern housing and infrastructure development and construction requirements.

As stated above the PP is located in an area that contains adequate access to services such as sewerage, and water as well as public transport facilities. The future development of the site would make efficient use of these existing services of Dubbo.

*Direction 3.3 – Home Occupations*

Ministerial Direction 3.3 – Home Occupations is applicable as the proposed R5 Large Lot Living Residential zone permits dwelling houses. The objective of this direction is to encourage the carrying out of low-impact small business in dwelling houses The PP maintains existing provisions that enable 'home occupations' to be carried out without the need of development consent.

*Direction 3.4 – Integrating Land Use and Public Transport*

Ministerial Direction 3.4 – Integrating Land Use and Public Transport is applicable as the PP would rezone land for urban residential purposes.

In accordance with the following, the rezoning of the subject site for urban residential purposes must be consistent with the aims and objectives of the following documents.

*"A planning proposal must locate zones for urban purposes and include provisions that give effect to and are consistent with the aims, objectives and principles of:*

*(a) Improving Transport Choice – Guidelines for planning and development (DUAP 2001), and*

*(b) The Right Place for Business and Services – Planning Policy (DUAP 2001)".*

With reference to the abovementioned documents, future occupants of the estate would have access to existing and planned public transport nodes which would traverse south west of Dubbo.

The provision of dwelling house developments in a location serviced by public transport is imperative as future residents could use such services as one of their primary means of transportation around Dubbo.

The development of these sites as opposed to other sites in the LGA would negate the need for new transport routes such as new bus routes and road facilities on the urban fringe.

*Direction 4.4 – Bushfire Prone Land*

Pursuant to Ministerial Direction No. 4.4 – 'Planning for Bushfire, Dubbo City Council is required, prior to the preparation of a planning proposal that effects, or is in proximity to land mapped as bushfire prone land, to consult with the NSW Rural Fire Service [amongst other things], under Section 56 of that Act and take into account any comments so made.

A Bushfire Constraints Assessment has been undertaken and an assessment of the bushfire protection measures required to address the bushfire risk to the future residential development, consistent with the Residential Development specifications of Planning for Bushfire Protection 2006.

The characteristics of the site, as discussed in this report, together with the fire protection measures recommended, provide that the rezoning and subsequent subdivision of the land is suitable in terms of its intended residential land use.

*Direction 4.3 – Flood Prone Land*

Ministerial Direction 4.3 – Flood Prone Land would not apply as the PP does not affect or impact flood prone land as identified by the DLEP.

*Direction 6.1 – Approval and Referral Requirements*

Ministerial Direction 6.1 – Approval and Referral Requirements applies to all Planning Proposals forwarded for Gateway Determination by a local authority.

The proposed amendments to the lot size provisions would trigger a need for concurrence, consultation, or referral to the State Government's Rural Fire Service per direction 4.4 above.

*Direction 6.2 – Reserving Land for Public Purposes*

Ministerial Direction 6.2 – Reserving Land for Public Purposes would not apply as the PP does not propose or affect land zoned for public recreation.

*Direction 6.3 – Site Specific Provisions*

Ministerial Direction 6.3 – Site Specific Provisions applies to all Planning Proposals forwarded for Gateway Determination by a local authority.

The PP does not propose to create any site specific development standards in addition to those currently within the principal environmental planning instrument other than to include a minimum allotment size of 2000m$^2$ and 4000m$^2$ upon the site.

## 4.3 ENVIRONMENTAL, SOCIAL AND ECONOMIC IMPACTS

### 4.3.1 IS THERE ANY LIKELIHOOD THAT CRITICAL HABITAT OR THREATENED SPECIES, POPULATIONS OR ECOLOGICAL COMMUNITIES, OR THEIR HABITATS, WILL BE ADVERSELY AFFECTED AS A RESULT OF THE PROPOSAL?

Detailed consideration of the environmental status of the site and impacts of future residential development of the site have been undertaken and are detailed within the attached supporting reports of this statement. Upon review of these supporting reports it is considered that it would be unlikely that critical habitat or threatened species, populations or ecological communities or their habitats would be adversely affected as a result of the proposal.

### 4.3.2 ARE THERE ANY OTHER LIKELY ENVIRONMENTAL EFFECTS AS A RESULT OF THE PLANNING PROPOSAL AND HOW ARE THEY PROPOSED TO BE MANAGED?

The parcels of land proposed for rezoning largely consist of cleared areas of lesser environmental value. The indicative lot layout plan identifies that the development of the land would step around these higher value areas.

Any future development of these areas would require due consideration of relevant environmental impacts be undertaken during a development application if Council required assurance whether the land is suitable for the proposed use.

### 4.3.3 HAS THE PLANNING PROPOSAL ADEQUATELY ADDRESSED ANY SOCIAL AND ECONOMIC EFFECTS?

Due to the site's location within a residential area, the land has adequate access to public transport and due to its close location to the Dubbo CBD and Delroy Shopping Centre, it is anticipated that future property owners would be within a reasonable vicinity of any required medical, educational, and retail services and facilities along with suitable transport means, including trains, coaches and planes to neighbouring towns and cities.

It is anticipated that the change in land zoning would assist with current anti-social and illegal behaviour that occurs on the property by activating the site with permanent residents. In particular it is hoped that matters such as trespass, illegal dumping of general waste, hazardous waste and stolen cars would be resolved.

## 4.4 STATE AND COMMONWEALTH INTERESTS

### 4.4.1 ADEQUATE PUBLIC INFRASTRUCTURE FOR PROPOSAL?

Adequate public infrastructure would be available to the future allotments. The lots would have the capacity to be serviced by sewer, water, and stormwater infrastructure and would each be connected to electricity and telecommunications infrastructure from the surrounding and existing service mains designed and installed to service the development of these estates.

As detailed above the land would enjoy reasonable access to public transport and are within close proximity of any required medical, educational, and retail services and facilities and all transport means, including trains, coaches and planes to neighbouring towns and cities.

### 4.4.2 VIEWS OF STATE/COMMONWEALTH PUBLIC AUTHORITIES CONSULTED IN ACCORDANCE WITH THE GATEWAY DETERMINATION?

The views of state and commonwealth public authorities would be ascertained in future in accordance with the comments contained in the Gateway Determination.

# Required Instrument Amendments

## 5.1 AMENDED MAPPING REQUIRED

The following DLEP maps would be amended as part of the PP;

- Lot Size Map LSZ_008A of the DLEP 2011. In particular the amended minimum lot sizes would be as show upon supporting plan **113156_04A_TP02 prepared by Geolyse Pty Ltd;**
- Natural Resource – Biodiversity Map Sheet NRB_008 of the DLEP 2011. In particular the moderate significance would be uncoloured over the area accommodated by the indicative lot layout map as shown upon supporting plan **113156_05A_TP02 prepared by Geolyse Pty Ltd**

# Community Consultation

## 6.1 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 amendments to the minimum lot sizes of these site accords with Council's local strategies and policies as detailed above and would be consistent with other R2, zoned land within the Dubbo.

  - *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.

  - *Presents no issues with regard to infrastructure servicing;*

The future residential development of these sites would have access to sewer, water, and stormwater services, and would be connected with electricity and telecommunications facilities.

  - *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 and the '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.

# References

Morgan and Terrey. 1992, Nature Conservation in Western New South Wales. National Park Association, Sydney.

NSW Department of Planning (DoP). 2009a, A Guide to Preparing Local Environmental Plans, DoP, Sydney.

NSW Department of Planning (DoP). 2009a, A Guide to Preparing Planning Proposals, DoP, Sydney.

# Amended Map Drawings

# Appendix A

## EXAMPLE CONCEPT DESIGN, INDICATIVE LOT LAYOUT

# Appendix B

## SITE SERVICING STRATEGY

# Appendix C

## GROUNDWATER AND SALINITY STUDY

# Appendix D

## ECOLOGICAL ASSESSMENT REPORTS

# Appendix E

## BUSHFIRE CONSTRAINTS ASSESSMENT

# Appendix F

## REMEDIATION ACTION PLAN

# Appendix G

**ABORIGINAL ARCHAEOLOGICAL ASSESSMENT**

# Appendix H

## ROAD TRAFFIC NOISE ASSESSMENT


| No | DATE | DRAFTING CHECK | PM CHECK | DETAILS |
|---|---|---|---|---|
| A | 27/02/15 | NS | MT | ISSUED FOR REVIEW |
| B | 21/07/15 | JE | MT | ISSUED FOR REVIEW |
| C | 19/08/15 | JE | MT | LOT LAYOUT AMENDED |
| D | 26/08/15 | JE | MT | LOT LAYOUT AMENDED AND AREAS ADDED |
| E | 21/09/15 | JE | MT | LOT LAYOUT AMENDED |

| CHECKED/APPROVED | NAME | DATE |
|---|---|---|
| APPROVED | MT | 21/09/2015 |
| SURVEY | BARNSON | |
| DESIGNER | PPO/NS | 27/02/2015 |
| DRAFTING | ZD/NS/JE | 21/09/2015 |

APPROVAL AUTHORITY

DUBBO CITY COUNCIL
70 CHURCH STREET
DUBBO
NSW, 2830

CLIENT
HIGHVIEW COUNTRY ESTATES PTY LTD

PROJECT
PROPOSED SUBDIVSION LOT 172 DP753233 BLACKBUTT ROAD, DUBBO

GEOLYSE
DUBBO
dubbo@geolyse.com
www.geolyse.com
1st FLOOR
62 WINGEWARRSTREET
P.O. BOX 1842
DUBBO, NSW 2830
Ph. (02) 8884 1525
Fax. (02) 8884 1470

DRAWING
PROPOSED SUBDIVISION LAYOUT

PERMANENT MARK: - | RL: - | DATUM: A.H.D.
PROJECT NUMBER: 113156 | DRAWING SHEET: 03E_TP01 | ORIGINAL: A1
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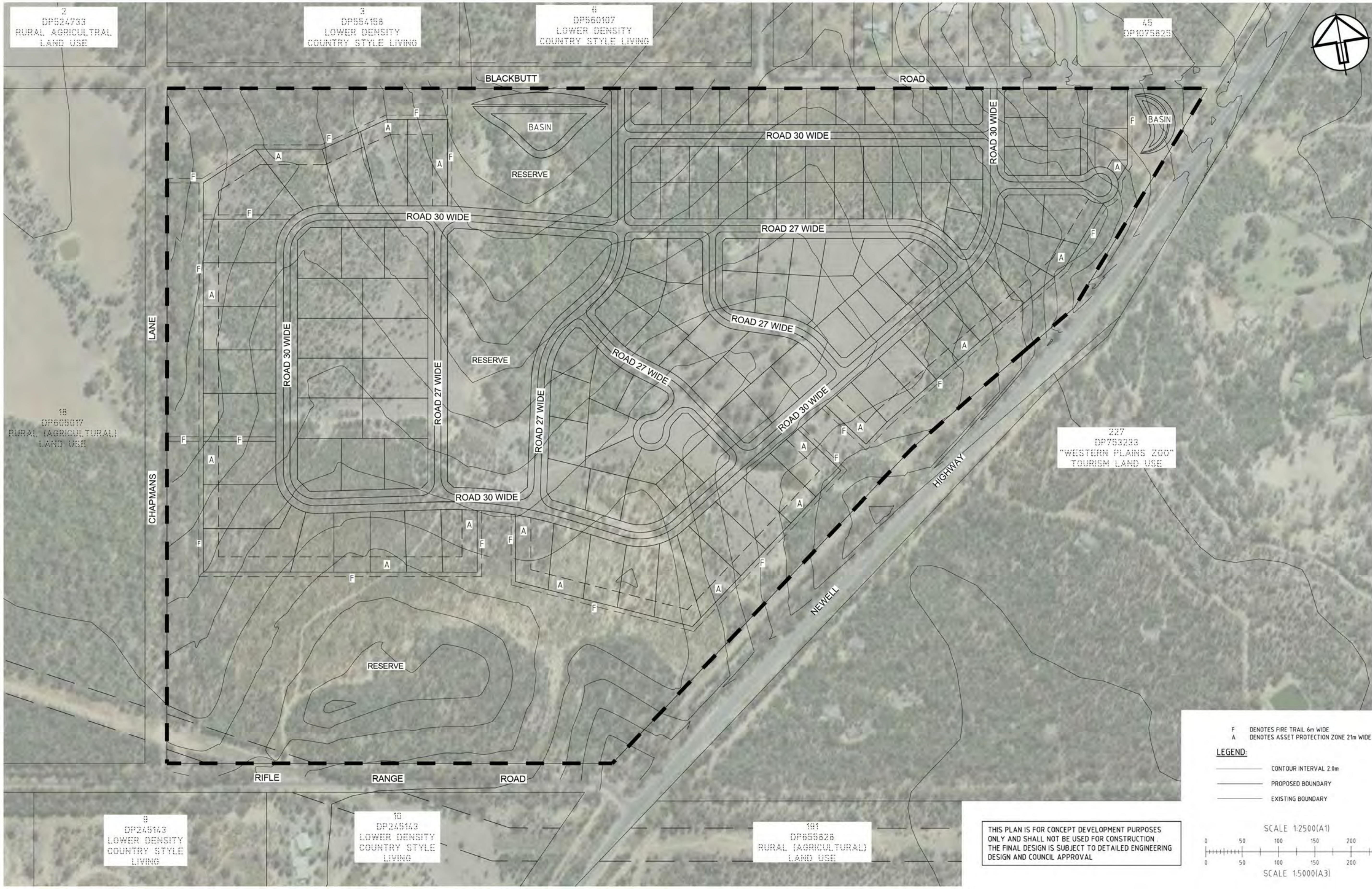


F DENOTES FIRE TRAIL 6m WIDE
A DENOTES ASSET PROTECTION ZONE 21m WIDE

LEGEND:

CONTOUR INTERVAL 2.0m
PROPOSED BOUNDARY
EXISTING BOUNDARY

THIS PLAN IS FOR CONCEPT DEVELOPMENT PURPOSES ONLY AND SHALL NOT BE USED FOR CONSTRUCTION . THE FINAL DESIGN IS SUBJECT TO DETAILED ENGINEERING DESIGN AND COUNCIL APPROVAL

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AUTOCAD FILE: 113156_03E_TP01-TP02.dwg 12D/CIVILCAD FILE: -
STATUS: FOR REVIEW SHEET TP02 OF TP02 REVISION E

# PROPOSED SUBDIVISION LOT 172 DP753233

## BLACKBUTT ROAD, DUBBO

## HIGHVIEW COUNTRY ESTATES PTY LTD

### CONCEPT DEVELOPMENT PLANS

| SCHEDULE OF DRAWINGS | | | |
|---|---|---|---|
| SHEET | TITLE | REV. | DATE |
| 02D_E01 | TITLE SHEET, DRAWING LIST, AND SITE LOCALITY | D | 20/10/2015 |
| 02D_E02 | PROPOSED SUBDIVISION LAYOUT | D | 20/10/2015 |
| 02D_E03 | CONCEPT STORMWATER RETICULATION PLAN | D | 20/10/2015 |
| 02D_E04 | CONCEPT STORMWATER MANAGEMENT PLAN | D | 20/10/2015 |
| 02D_E05 | CONCEPT SEWER RETICULATION PLAN | D | 20/10/2015 |
| 02D_E06 | CONCEPT WATER RETICULATION PLAN | D | 20/10/2015 |


SITE LOCALITY
NOT TO SCALE

| No | DATE | DRAFTING CHECK | PM CHECK | DETAILS |
|---|---|---|---|---|
| A | 10/09/14 | ZD | PPO | ISSUED FOR REVIEW |
| B | 18/09/15 | MY | PPO | REVISED LOT LAYOUT |
| C | 28/09/15 | MY | PPO | REVISED LOT LAYOUT |
| D | 20/10/15 | MY | PPO | LOT AREAS ADDED |

| CHECKED/APPROVED | NAME | DATE |
|---|---|---|
| APPROVED | PPO | 20/10/2015 |
| SURVEY | BARNSON | |
| DESIGNER | PPO | 20/10/2015 |
| DRAFTING | ZD/MY | 20/10/2015 |

APPROVAL AUTHORITY
DUBBO CITY COUNCIL
CIVIC ADMINISTRATION BUILDING
CHURCH STREET
DUBBO NSW 2830

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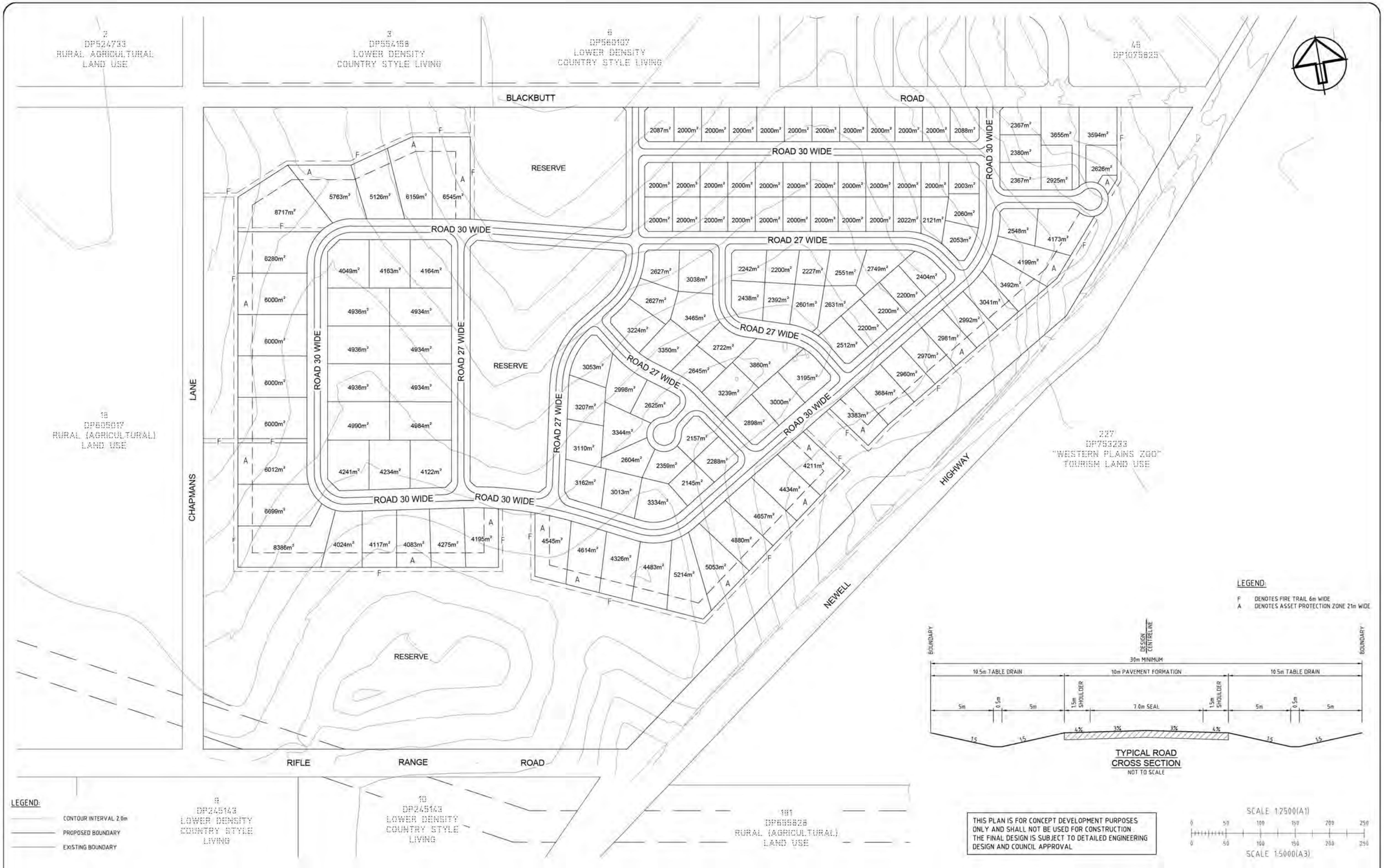


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| D | 20/10/15 | MY | PPO | LOT AREAS ADDED |

| CHECKED/APPROVED | NAME | DATE |
|---|---|---|
| APPROVED | PPO | 20/10/2015 |
| SURVEY | BARNSON | |
| DESIGNER | PPO | 20/10/2015 |
| DRAFTING | ZD/MY | 20/10/2015 |

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DRAWING
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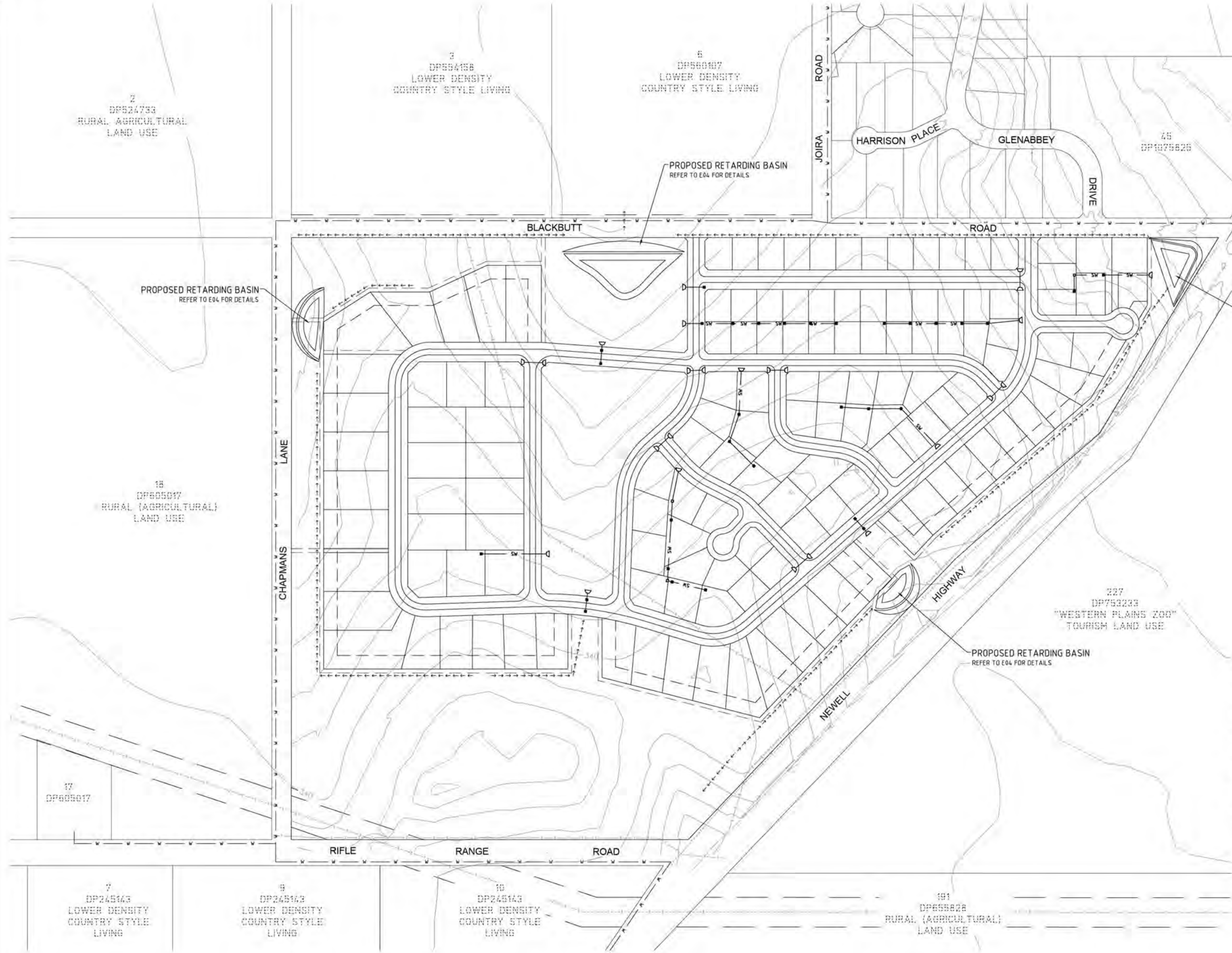


LEGEND:

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- EXISTING BOUNDARY
- PROPOSED STORMWATER LINE & PIT
- EXISTING ELECTRICITY LINE, LOCAL (11KV)
- EXISTING ELECTRICITY LINE, TRANSMISSION (132KV)
- EXISTING TELSTRA LINE (LOCAL)
- EXISTING TELSTRA LINE (OPTIC FIBRE)
- EXISTING TRUNK WATER MAIN
- ← ← ← PROPOSED SWALE DRAIN

THIS PLAN IS FOR CONCEPT DEVELOPMENT PURPOSES ONLY AND SHALL NOT BE USED FOR CONSTRUCTION. THE FINAL DESIGN IS SUBJECT TO DETAILED ENGINEERING DESIGN AND COUNCIL APPROVAL

STORMWATER NOTES:

1. DUBBO CITY COUNCIL ARE TO BE NOTIFIED 48 HOURS PRIOR TO THE COMMENCEMENT OF ANY WORKS.
2. CONTRACTOR IS TO ADEQUATELY INFORM HIMSELF AS TO THE DEPTH AND LOCATION OF ALL EXISTING SERVICES PRIOR TO COMMENCEMENT OF CONSTRUCTION.
3. PIPE IS TO BE LAID AT UNIFORM GRADE BETWEEN INVERT LEVELS SHOWN WITH MINIMUM COVER MAINTAINED UNLESS OTHERWISE APPROVED BY THE SUPERINTENDENT.
4. MINIMUM COVER OVER ALL PIPES SHALL BE 600mm UNLESS OTHERWISE SHOWN OR DIRECTED.
5. CONTRACTOR TO SUPPLY AND INSTALL ALL FITTINGS AND SPECIALS INCLUDING VARIOUS PIPE ADAPTORS TO ENSURE PROPER CONNECTION BETWEEN DISSIMILAR PIPEWORKS.
6. ALL CONNECTIONS TO EXISTING DRAINAGE PITS SHALL BE MADE IN TRADESMAN- LIKE MANNER AND THE INTERNAL WALL OF THE PIT AT THE POINT OF ENTRY SHALL BE CEMENT RENDERED TO ENSURE SMOOTH FINNISH.
7. PRECAST PITS MAY BE USED AS APPROVED BY THE SUPERINTENDENT.
8. THE CONSTRUCTION OF ALL WORKS IS TO BE CARRIED OUT IN ACCORDANCE WITH DUBBO CITY COUNCIL AUSPEC #1 DEVELOPMENT SPECIFICATION SERIES FOR CONSTRUCTION.

SCALE 1:3000(A1)

0 20 40 80 120 160 200

SCALE 1:6000(A3)

| No | DATE | DRAFTING CHECK | PM CHECK | DETAILS |
|---|---|---|---|---|
| A | 10/09/14 | ZD | PPO | ISSUED FOR REVIEW |
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| C | 28/09/15 | MY | PPO | REVISED LOT LAYOUT |
| D | 20/10/15 | MY | PPO | LOT AREAS ADDED |

| CHECKED/APPROVED | NAME | DATE |
|---|---|---|
| APPROVED | PPO | 20/10/2015 |
| SURVEY | BARNSON | |
| DESIGNER | PPO | 20/10/2015 |
| DRAFTING | ZD/MY | 20/10/2015 |

APPROVAL AUTHORITY
DUBBO CITY COUNCIL
CIVIC ADMINISTRATION BUILDING
CHURCH STREET
DUBBO NSW 2830

CLIENT: HIGHVIEW COUNTRY ESTATES PTY LTD

PROJECT: PROPOSED SUBDIVISION LOT 172 DP753233 BLACKBUTT ROAD, DUBBO

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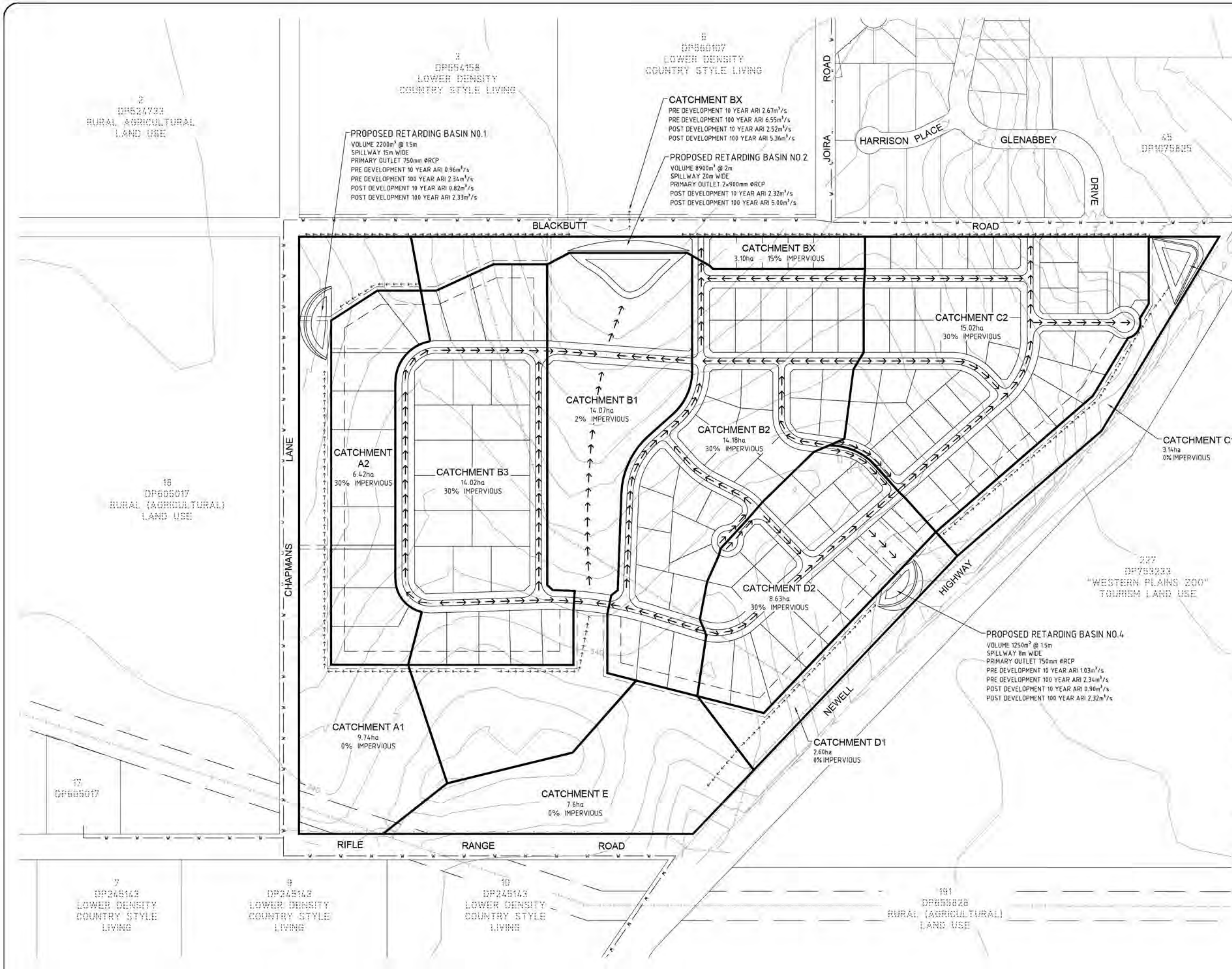
DUBBO
dubbo@geolyse.com
www.geolyse.com
1st FLOOR
62 WINGEWARRA STREET
P.O. BOX 1842
DUBBO, NSW 2830
Ph. (02) 6884 1525
Fax. (02) 6884 1470

DRAWING: CONCEPT STORMWATER RETICULATION PLAN

PERMANENT MARK: - RL: - DATUM: A.H.D.
PROJECT NUMBER: 113156 DRAWING SHEET: 02D_E03 ORIGINAL: A1
AUTOCAD FILE: 113156_02D_E01-E06.dwg 12D/CIVILCAD FILE: -
REVISION: D
STATUS: FOR REVIEW SHEET E03 OF E06




PROPOSED RETARDING BASIN NO.3
VOLUME 3500m³ @ 2m
SPILLWAY 12m WIDE
PRIMARY OUTLET 900mm ⌀RCP
PRE DEVELOPMENT 10 YEAR ARI 1.35m³/s
PRE DEVELOPMENT 100 YEAR ARI 3.17m³/s
POST DEVELOPMENT 10 YEAR ARI 1.30m³/s
POST DEVELOPMENT 100 YEAR ARI 2.79m³/s

LEGEND:

- CONTOUR INTERVAL 2.0m
- PROPOSED BOUNDARY
- EXISTING BOUNDARY
- STORMWATER CATCHMENT AREA
- ELECTRICITY LINE, LOCAL (11KV)
- ELECTRICITY LINE, TRANSMISSION (132KV)
- TELSTRA LINE (LOCAL)
- TELSTRA LINE (OPTIC FIBRE)
- EXISTING TRUNK WATER MAIN
- STORMWATER FLOW DIRECTION
- PROPOSED SWALE DRAIN

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STORMWATER NOTES:

1. DUBBO CITY COUNCIL ARE TO BE NOTIFIED 48 HOURS PRIOR TO THE COMMENCEMENT OF ANY WORKS.
2. CONTRACTOR IS TO ADEQUATELY INFORM HIMSELF AS TO THE DEPTH AND LOCATION OF ALL EXISTING SERVICES PRIOR TO COMMENCEMENT OF CONSTRUCTION.
3. PIPE IS TO BE LAID AT UNIFORM GRADE BETWEEN INVERT LEVELS SHOWN WITH MINIMUM COVER MAINTAINED UNLESS OTHERWISE APPROVED BY THE SUPERINTENDENT.
4. MINIMUM COVER OVER ALL PIPES SHALL BE 600mm UNLESS OTHERWISE SHOWN OR DIRECTED.
5. CONTRACTOR TO SUPPLY AND INSTALL ALL FITTINGS AND SPECIALS INCLUDING VARIOUS PIPE ADAPTORS TO ENSURE PROPER CONNECTION BETWEEN DISSIMILAR PIPEWORKS.
6. ALL CONNECTIONS TO EXISTING DRAINAGE PITS SHALL BE MADE IN TRADESMAN- LIKE MANNER AND THE INTERNAL WALL OF THE PIT AT THE POINT OF ENTRY SHALL BE CEMENT RENDERED TO ENSURE SMOOTH FINNISH.
7. PRECAST PITS MAY BE USED AS APPROVED BY THE SUPERINTENDENT.
8. THE CONSTRUCTION OF ALL WORKS IS TO BE CARRIED OUT IN ACCORDANCE WITH DUBBO CITY COUNCIL AUSPEC #1 DEVELOPMENT SPECIFICATION SERIES FOR CONSTRUCTION.

SCALE 1:3000(A1)
0 20 40 80 120 160 200
SCALE 1:6000(A3)

| No | DATE | DRAFTING CHECK | PM CHECK | DETAILS |
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| CHECKED/APPROVED | NAME | DATE |
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| APPROVED | PPO | 20/10/2015 |
| SURVEY | BARNSON | |
| DESIGNER | PPO | 20/10/2015 |
| DRAFTING | ZD/MY | 20/10/2015 |

APPROVAL AUTHORITY
DUBBO CITY COUNCIL
CIVIC ADMINISTRATION BUILDING
CHURCH STREET
DUBBO NSW 2830

CLIENT: HIGHVIEW COUNTRY ESTATES PTY LTD

PROJECT: PROPOSED SUBDIVISION LOT 172 DP753233 BLACKBUTT ROAD, DUBBO


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Fax. (02) 6884 1470


DRAWING: CONCEPT STORMWATER MANAGEMENT PLAN

PERMANENT MARK: - | RL: - | DATUM: A.H.D.

PROJECT NUMBER: 113156 | DRAWING SHEET: 02D_E04 | ORIGINAL: A1

AUTOCAD FILE: 113156_02D_E04.dwg | 12D/CIVILCAD FILE: - | REVISION: D

STATUS: FOR REVIEW | SHEET E04 OF E06


LEGEND:

- CONTOUR INTERVAL 2.0m
- PROPOSED BOUNDARY
- EXISTING BOUNDARY
- PROPOSED SEWERAGE LINE & MANHOLE
- PROPOSED SEWER RISING MAIN
- ELECTRICITY LINE, LOCAL (11KV)
- ELECTRICITY LINE, TRANSMISSION (132KV)
- TELSTRA LINE (LOCAL)
- TELSTRA LINE (OPTIC FIBRE)
- EXISTING TRUNK WATER MAIN

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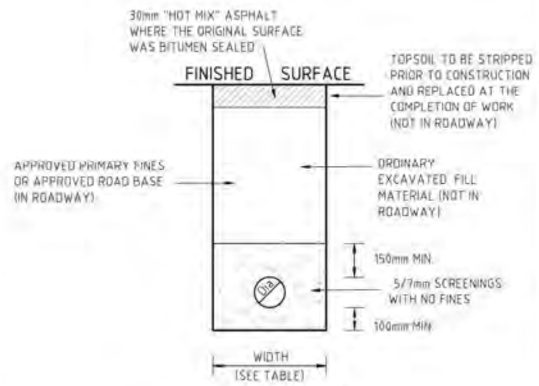
SEWER NOTES:

1. DUBBO CITY COUNCIL ARE TO BE NOTIFIED 48 HOURS PRIOR TO THE COMMENCEMENT OF ANY WORKS
2. ALL SEWER MAINS SHALL BE CLASS SN8 RRJ UPVC PIPE MAX. 3m LENGTHS OR RRJ VC PIPE.
3. CONSTRUCTION OF SEWER MAINS & MANHOLES SHALL BE CARRIED OUT IN ACCORDANCE WITH DUBBO CITY COUNCIL'S AUS-SPEC #1 DEVELOPMENT CONSTRUCTION SPECIFICATION
4. TELSTRA, COUNTRY ENERGY & DUBBO CITY COUNCIL MUST BE CONTACTED & UNDERGROUND SERVICES LOCATED BEFORE WORK COMMENCES.
5. MANHOLES ARE TO BE CONSTRUCTED IN ACCORDANCE WITH DUBBO CITY COUNCIL'S STANDARD DRAWINGS 500B AND 5520. FOR MANHOLES WITHIN THE FOOTPATH AND/OR PUBLIC RESERVES ETC THE MANHOLE LID IS TO BE LEVEL WITH THE FINISHED SURFACE LEVEL AND FOR MANHOLES WITHIN PRIVATE PROPERTY THE LIDS ARE TO BE SET 100mm ABOVE THE FINISHED SURFACE LEVEL. ALL MANHOLE COVERS ARE TO BE "BOLT DOWN ACCESS COVERS (WATER TIGHT TYPE)"
6. DEAD ENDS & JUNCTIONS TO BE SEALED WITH 150mm DIAMETER RRJ SPIGOT ACCESS COUPLING WITH SCREWED CAP.
7. RISERS & SIDELINES TO BE CONSTRUCTED TO PUBLIC WORKS STANDARD DRAWING ST 503D.
8. ALL FOOTPATHS & ROADWAYS ARE TO BE REINSTATED UPON COMPLETION OF WORK.
9. CONTRACTOR TO TAKE CARE WHEN EXCAVATING NEAR TREES.
10. TRENCH STOPS TO BE CONSTRUCTED IN ALL LINES WHICH HAVE GRADIENT EQUAL TO OR STEEPER THAN 1 IN 40. REFER TO DUBBO CITY COUNCIL'S DEVELOPMENT CONSTRUCTION SPECIFICATION AUSPEC #1
11. FOR TYPICAL SECTION DETAILS REFER TO DCC STD 5518.




TYPICAL SECTION
SEWER RETICULATION MAIN
NOT TO SCALE
REFER TO DCC STD 5518

| No | DATE | DRAFTING CHECK | PM CHECK | DETAILS |
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| APPROVED | PPO | 20/10/2015 |
| SURVEY | BARNSON | |
| DESIGNER | PPO | 20/10/2015 |
| DRAFTING | ZD/MY | 20/10/2015 |

APPROVAL AUTHORITY
DUBBO CITY COUNCIL
CIVIC ADMINISTRATION BUILDING
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DUBBO NSW 2830

CLIENT
HIGHVIEW COUNTRY ESTATES PTY LTD

PROJECT
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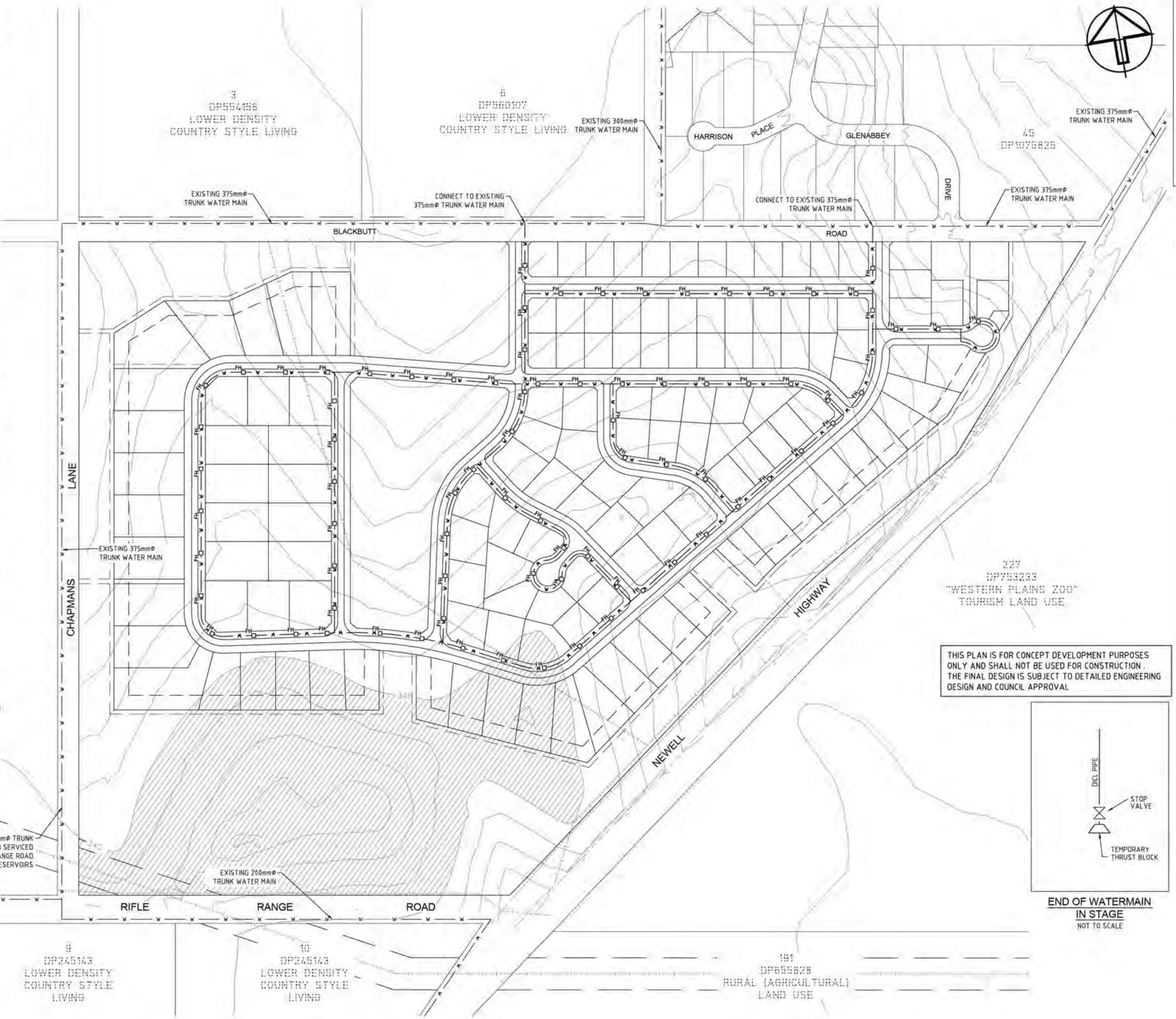
Fax. (02) 6884 1470

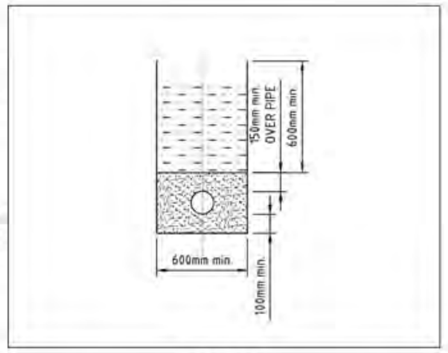

DRAWING
CONCEPT SEWER RETICULATION PLAN

PERMANENT MARK: - | RL: - | DATUM: A.H.D.
PROJECT NUMBER: 113156 | DRAWING SHEET: 02D_E05 | ORIGINAL A1
AUTOCAD FILE: 113156_02D_E01-E06.dwg | 12D/CIVILCAD FILE: - | REVISION D
STATUS: FOR REVIEW | SHEET E05 OF E06

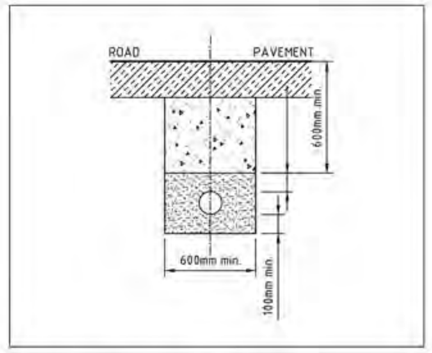
## WATER NOTES:

1. DUBBO CITY COUNCIL ARE TO BE NOTIFIED 48 HOURS PRIOR TO THE COMMENCEMENT OF ANY WORKS
2. WATER MAINS, HYDRANTS & STOP VALVES TO BE CONSTRUCTED IN ACCORDANCE WITH THE REQUIREMENTS OF "DUBBO CITY COUNCIL'S AUSPEC #1 SERIES FOR CONSTRUCTION" & DCC DWG 5357.
3. WATER MAINS TO HAVE MINIMUM 600mm COVER.
4. ALL PIPES & FITTINGS TO BE DUCTILE IRON (DICL K9) UNLESS OTHERWISE SHOWN.
5. DICL PIPES TO BE RACKED AT JOINTS TO MAXIMUM DEFLECTION OF 5 DEGREES IN ACCORDANCE WITH MANUFACTURERS RECOMMENDATION. BENDS ARE TO BE PLACED AS SHOWN.
6. UPVC PIPES TO BE RACKED AT JOINTS TO MAXIMUM DEFLECTION OF 5 DEGREES IN ACCORDANCE WITH MANUFACTURERS RECOMMENDATION. BENDS ARE TO BE PLACED AS SHOWN.
7. ON SWEEPING BENDS CURVATURE TO BE ACHIEVED BY SHORTENING PIPES TO INTRODUCE ADDITIONAL JOINTS.
8. ALL FITTINGS TO BE FUSION BONDED EPOXY (FBE) COATED DUCTILE IRON.
9. HYDRANTS TO BE SPACED AT MAXIMUM OF 60m INTERVALS UNLESS SHOWN OTHERWISE.
10. THRUST BLOCKS TO BE PLACED AT TEES, BENDS, DEAD ENDS & STOP VALVES IN ACCORDANCE WITH THE REQUIREMENTS OF DUBBO CITY COUNCIL SPECIFICATIONS, DCC DWG 5360.
11. ALL PIPES, FITTINGS & MATERIALS SHALL BE NEW & MANUFACTURED & INSTALLED IN ACCORDANCE WITH THE REQUIREMENTS OF DUBBO CITY COUNCIL SPECIFICATIONS.
12. WATER MAINS SHALL BE PRESSURE TESTED BEFORE THE MAIN IS TO BE TAKEN INTO SERVICE. TEST PRESSURE OF 1.5 x PIPE CLASS MUST BE APPLIED AND HELD FOR MINIMUM OF 15 MINUTES.
13. ALL MAINS FOR CONNECTION TO THE PUBLIC WATER SUPPLY SYSTEM SHALL BE DISINFECTED BY DUBBO CITY COUNCIL.
14. PIPE BEDDING MATERIAL TO BE TO THE DCC INSPECTORS SATISFACTION.
15. ALL CONCRETE SHALL BE 15 Mpa& EVIDENCE OF THE SAME SHALL BE SUPPLIED TO THE DCC INSPECTOR.
16. NO OTHER SERVICES OR PLANT WILL BE LOCATED IN OR OVER THE TRENCH CONSTRUCTED TO CONTAIN WATER MAINS.
17. WHERE FLANGED FITTINGS ARE USED, ALL BOLTS & FLANGES SHALL BE TO THE APPROPRIATE AUSTRALIAN STANDARD & PROTECTED AGAINST CORROSION BY CONTINUOUS WRAPPING WITH DENSO- WRAP OR EQUIVALENT TO THE MANUFACTURER'S DIRECTION.
18. SERVICE CONDUIT AND CROSSINGS SHALL BE PROVIDED AS PART OF THE WATER RETICULATION WORKS.
19. MINIMUM SERVICE CROSSING CONDUIT DIAMETER IS 50mm WITH 20mm COPPER SERVICE PROVIDED FOR EACH PROPERTY SERVED.
20. INDIVIDUAL LOT CONNECTIONS, CUTTING INTO EXISTING MAINS & PRV TO BE CARRIED OUT BY DUBBO CITY COUNCIL.
21. TRENCHSTOPS ARE TO BE CONSTRUCTED ON ALL LINES WHICH HAVE GRADIENT STEEPER THAN 1:20 (5%). REFER TO DUBBO CITY COUNCIL SPECIFICATIONS, DCC DWG 5369.
22. CONCRETE BULKHEADS TO BE CONSTRUCTED ON ALL LINES WHICH HAVE GRADIENT STEEPER THAN 1:6 (15%). REFER TO DUBBO CITY COUNCIL SPECIFICATIONS, DCC DWG 5369.
23. CONVEX VERTICAL BENDS ARE TO BE SECURED BY AN ANCHOR BLOCK IN ACCORDANCE WITH DUBBO CITY COUNCIL SPECIFICATIONS, DCC DWG 5360.
24. ARRANGEMENT OF LINES & JOINTS IN CUL-DE-SAC DEAD ENDS TO BE IN ACCORDANCE WITH DUBBO CITY COUNCIL SPECIFICATIONS, DCC DWG 5515
25. ALL FOOTPATHS & ROADS TO BE REINSTATED UPON COMPLETION OF WORK
26. CONTRACTORS TO TAKE CARE WHEN EXCAVATING NEAR TREES

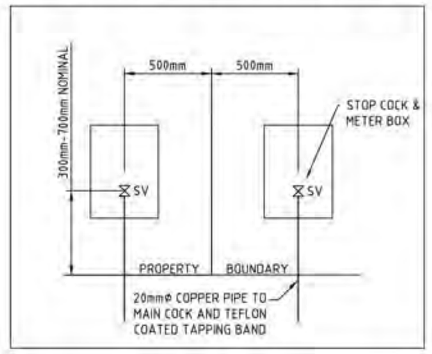



NOT TO SCALE
REFER TO DUBBO CITY COUNCIL STANDARD DRAWING STD 5518




NOT TO SCALE
REFER TO DUBBO CITY COUNCIL STANDARD DRAWING STD 5518




### TYPICAL WATER SERVICE CONNECTIONS TO LOTS

NOT TO SCALE
REFER TO DUBBO CITY COUNCIL STANDARD DRAWING STD 5882

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DICL PIPE
STOP VALVE
TEMPORARY THRUST BLOCK

### END OF WATERMAIN IN STAGE

NOT TO SCALE

**LEGEND:**

- CONTOUR INTERVAL 2.0m
- PROPOSED BOUNDARY
- EXISTING BOUNDARY
- EXISTING TRUNK WATER MAIN
- PROPOSED WATER LINE
- PROPOSED HYDRANT
- ELECTRICITY LINE, LOCAL (11KV)
- ELECTRICITY LINE, TRANSMISSION (132KV)
- TELSTRA LINE (LOCAL)
- TELSTRA LINE (OPTIC FIBRE)
- LOW WATER PRESSURE ZONE

SCALE 1:3000(A1)
0 20 40 80 120 160 200
SCALE 1:6000(A3)

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DRAWING
# CONCEPT WATER RETICULATION PLAN

| | |
|---|---|
| PERMANENT MARK: - | RL: - |
| DATUM: | A.H.D. |
| PROJECT NUMBER: | 113156 |
| DRAWING SHEET: | 02D_E06 |
| ORIGINAL | A1 |
| AUTOCAD FILE: | 113156_02D_E06-E06.dwg |
| 12D/CIVILCAD FILE: | - |
| REVISION | D |
| STATUS: | FOR REVIEW |
| | SHEET E06 OF E06 |

# INFRASTRUCTURE ASSESSMENT

SITE SERVICING STRATEGY

PROPOSED SUBDIVISION OF LOT 172 DP 753233 BLACKBUTT ROAD
DUBBO

PREPARED FOR:

## BAWD HOLDINGS PTY LTD

OCTOBER 2015

GEOLYSE

POSTAL ADDRESS PO BOX 1842 DUBBO NSW 2830
LOCATION 1ST FLOOR, 62 WINGEWARRA STREET DUBBO NSW 2830
TELEPHONE 02 6884 1525 FACSIMILE 02 6884 1470
EMAIL DUBBO@GEOLYSE.COM WEB SITE WWW.GEOLYSE.COM

| | |
|---|---|
| ***Report Title:*** | *Infrastructure Servicing Strategy* |
| ***Project:*** | *Proposed Subdivision, Blackbutt Road, Dubbo* |
| ***Client:*** | *BAWD Holdings Pty Ltd* |
| ***Report Ref.:*** | *113156_SSS_002* |
| ***Status:*** | *Final* |
| ***Issued:*** | *October 2015* |

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 BAWD HOLDINGS 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



## DRAWINGS

# 1.0 INTRODUCTION

## 1.1 BACKGROUND

Bawd Holding Pty Ltd intends to develop a parcel of land on Blackbutt Road for residential purposes. The land is currently zoned R5 Large Lot Residential under the provisions of the Dubbo Local Environmental Plan (LEP) 2011.

The land is described as Lot 172 in DP 753233 and comprises approximately 98.2 ha. The land is bounded by Blackbutt Road along its northern boundary, the Newell Highway along its eastern boundary, Riffle Range Road along its southern boundary and an unformed section of Chapmans Lane to the west.

Kintyre Estate and Kintyre Country Living are located on the northern side of Blackbutt Road opposite part of the frontage of the development site.

The land has several areas of heavy timber cover and there are 2 distinct ridgelines through the property dividing the land into a number of catchments.

It is intended to subdivide Lot 172 into a number of lots ranging in size generally from 2,000m$^2$ up to approximately 8,000m$^2$.

## 1.2 PURPOSE OF REPORT

This Infrastructure Servicing Strategy Report will assess a proposed lot layout on the development site and determine an economic means of providing servicing infrastructure to facilitate the proposed subdivision.

The Report will investigate the provision of the following infrastructure items:

- Road access
- Water supply
- Sewerage reticulation
- Stormwater drainage

The Servicing Strategy will determine a practical means of providing road access, water supply, sewerage reticulation and stormwater drainage to the development site in order to ensure that appropriate services can be constructed to allow the future development of the land for residential purposes.

The recommendations made in this Report will identify the servicing infrastructure components necessary to allow the development of the land and determine a strategy to allow the economic provision of the servicing infrastructure in a timely manner.

# 2.0 SUBDIVSION LOT LAYOUT

An Ecological Constraints and Opportunities Report for the site was prepared by Geolyse in April 2013. The report assessed the site for a range of parameters and determined that a large timbered area located in the middle of the site and further timbered areas around the perimeter of the site should be set aside as a woodland corridor.

Taking the woodland corridor land into consideration, there is approximately 62 ha of the total site area of 98.2 ha available for residential development. It is intended that potential residential lot sizes are to comprise lots approximately 2,000m$^2$ to 5,000m$^2$ located in the north eastern section of the site and 4,000m$^2$ to 8,000m$^2$ in the western section of the site.

The overall lot layout for the development site is indicated on Sheet E02 attached in the **Drawings** Section of this Report.

The proposed lot layout allows for the creation of a total of 138 lots across the site comprising the following lot configurations:

- 106 lots in the north eastern section of the site ranging in size from 2,000m$^2$ to approximately 5,000m$^2$.
- 32 lots in the western section of the site ranging in size from approximately 4,000m$^2$ to approximately 8,700m$^2$.

# 3.0 SUBDIVISION ACCESS

Access to the proposed subdivision will be provided at two (2) locations off Blackbutt Road. Blackbutt Road provides good access to and from Dubbo via the Newell Highway with the major channelised intersection already constructed at the intersection of Blackbutt Road with the Newell Highway.

The intersection of the Newell Highway and Blackbutt Road consists of a channelised right turn lane for southbound vehicles to turn right from the Newell Highway into Blackbutt Road. The speed limit on the Newel Highway is 110km/hour adjacent to the intersection with Blackbutt Road.

Blackbutt Road is controlled by Give Way signs at its intersection with the Newell Highway.

Blackbutt Road is a two lane, two way bitumen sealed road with a sealed width of approximately 8m. The roadway comprises 2 x 3.5m wide travel lanes with 0.5m wide sealed shoulders. Blackbutt Road is centreline marked with double barrier lines and has edgeline marking for its full length.

It is intended that the first road access to the proposed subdivision is created off Blackbutt Road approximately 100m west of its intersection with Glenabbey Drive.

A second road access to the proposed subdivision is to be created approximately 200m west of the intersection of Blackbutt Road and Joira Road. As Blackbutt Road is unformed to the west of the existing intersection with Joira Road, the new subdivision access will require the construction of Blackbutt Road from its intersection with Joira Road.

The 2 subdivision road access points to Blackbutt Road allows loop roads to be created within the subdivision with 2 short cul-de-sacs providing access to the remainder of the lots.

The traffic generated from the proposed subdivision will be estimated based on Dubbo City Council's traffic generation rates.

Dubbo City Council's adopted trip generation rates for residential subdivisions are:

- 11 trips per day per residential lot
- 1 trip per peak hour per residential lot

Based on the proposed 138 lots in the subdivision, the anticipated daily and peak hour traffic generation can be estimated as:

- 1,518 vehicle trips per day
- 138 vehicle trips per hour

# 4.0 WATER SUPPLY

The potable water supply for the proposed subdivision will be provided from Council's Rifle Range Road water reservoirs. The existing water reservoir has a capacity of 10 ML and has a top water level (TWL) of RL354.3m AHD. Council has recently constructed a new reservoir adjacent to the existing reservoir to significantly increase the availability of water to service the future development of large areas of West Dubbo.

The construction of additional water storage capacity at Rifle Range Road was identified in the West Dubbo Servicing Strategy prepared on behalf of Council by Terra Consulting in October 2000.

Typical characteristics of the Rifle Range Reservoirs are listed below:

| | |
|---|---|
| Storage Capacity: | 10.0 ML for each reservoir |
| Top Water Level: | 354.3m AHD |
| Bottom Water Level: | 348.3m AHD |
| Reservoir Height: | 6.0m |

The provision of trunk water reticulation mains in the area surrounding Lot 172 has seen the construction of a 375mm diameter water main from the Rifle Range Road reservoirs eastwards along Rifle Range Road then a reduction to 200mm diameter at the intersection of the unformed section of Chapmans Lane through to the Newell Highway and then southwards along the Newell Highway.

The 375mm diameter water main extends northwards along the unformed section of Chapmans Lane and then eastwards along the unformed section of Blackbutt Road past the intersection with Joira Road and then further eastwards along Blackbutt Road to the Newell Highway and finally northwards along the Newell Highway.

At the intersection of Blackbutt Road and Joira Road a 300mm diameter water main heads northwards along Joira Road and the Kintyre Estate water reticulation is serviced by a connection to the 375mm diameter water in Blackbutt Road at the intersection with Glenabbey Drive.

The trunk water mains surrounding the Lot 172 will allow water reticulation to be provided to the site and facilitate the planned development to occur.

It should be noted that due to the Rifle Range Road reservoir TWL of RL354.3m AHD, any land in the proposed subdivision of Lot 172 above approximately RL340m AHD will have reduced pressure availability service from the reservoir.

The overall water layout for the proposed subdivision and the anticipated low water pressure zone is indicated on Sheet E06 attached in the **Drawings** Section of this Report.

Whilst full reticulated mains water pressure will not be available to lots located above the 340m contour, it will be possible to still develop this land with the provision of additional infrastructure for any lot created in this area that may include:

- Storage tank with low flow potable water top up provided from the reticulated water mains.
- Dedicated storage volume for onsite firefighting requirements.
- Pressure pump system for water reticulation within the dwelling.

The potable water demand criteria to be adopted for the development of the proposed subdivision will be based on Council's Development Design Specification for Water Reticulation and the NSW Public Works Department's Water Supply Investigation Manual.

The peak instantaneous demand and the peak daily demand adopted by these publications are:

- Peak Instantaneous Demand (PID) – 0.10 L/s/ET
- Peak Daily Demand (PDD) – 5000 L/day/ET

In addition to the peak instantaneous demand requirement, an additional allowance of 11.0 L/s should be made for firefighting purposes.

Based on the proposed development of 138 lots within the subdivision, the potable water demands for the subdivision are:

- Peak Instantaneous Demand: 13.8 L/s plus 11.0 L/s for fire purposes
- Peak Daily Demand: 690,000 L or approximately 0.7 ML

# 5.0 SEWERAGE INFRASTRUCTURE

The natural ridgelines located through the centre of the site divide the land into several catchments that will require the provision of sewerage reticulation separately from the existing and future sewerage infrastructure systems. The West Dubbo Servicing Strategy (October 2000) looked at the broad scale provision of sewerage infrastructure to service the development of large areas of West Dubbo.

Part of Lot 172 is located within a sewage catchment that will drain by gravity reticulation to the existing Cootha sewage pump station. This catchment contains approximately 60 lots that can be serviced by the extension of existing sewerage infrastructure to Lot 172.

The servicing of these 60 lots will require the construction of a sewer main extending from the existing sewer main previously constructed across the Dubbo Golf Course to service the former Pioneer Spirit site, now being developed for residential purposes as Huntingdale Estate. This sewer main will follow an alignment along the Newell Highway and Blackbutt Road. Whilst the extension of this sewer main will be approximately 1km in length, there may be an opportunity to provide gravity sewerage to the Kintyre Country Living allowing the existing sewage pump station servicing the facility to be decommissioned.

The proposed gravity sewer main servicing these 60 lots is indicated on Sheet E05 attached in the **Drawings** Section of this Report.

The balance of Lot 172 comprising approximately 78 lots falls within a future sewerage catchment that at present has no infrastructure provided anywhere near Lot 172. Future servicing of this catchment will require a sewer main to be constructed along the valley located between Joira Road and Chapmans Lane. At the current time, the closest sewerage infrastructure that will provide for the future servicing of this catchment is located at Minore Road, a distance approximately 2.3km away.

However, in the short to medium term it is proposed to install two (2) temporary sewage pump stations to service the 78 lots with the rising main discharge from the pump stations being directed to the extension of the sewer main proposed to service the 60 lots on the eastern section of the site.

This aspect of the sewer servicing assessment will require a specific approval from Dubbo City Council as it is not Council's normal procedure to allow the subdivision of land that requires sewage pump stations to service such land.

The 11 western most lots will drain by gravity sewerage reticulation to a small sewage pump station located in the north western corner of the site.

The remaining 67 lots in the central area of the site will drain by gravity reticulation to a sewage pump station located on the extension of Blackbutt Road approximately 250m west of the intersection with Joira Road.

The design criteria for the proposed sewage pump stations is outlined below and is based on the NSW Public Works Manual of Practice for Sewer Design.

Each lot draining to a sewage pump station generates 1 Equivalent Tenement (ET). Therefore the sewage loading draining to each sewage pump station is:

- Western Sewage Pump Station: 11 ET
- Central Sewage Pump Station: 67 ET

Based on the methodology outlined in the PWD's Sewer Design Manual, the calculation of the various design flow rates for each sewage pump station is outlined below:

Average Dry Weather Flow (ADWF) = 0.011 L/s/ET; and

Peak Dry Weather Flow (PDWF) = r x ADWF; and

Peak Wet Weather Flow (PWWF) = PDWF + Storm Allowance (SA) where SA = .058 L/s/ET

Using the design flow rate criteria, the design flow rate information for each sewage pump station is summarised in **Table 5.1**.

**Table 5.1 – Sewage Generation Data**

| Sewage Generation Criteria | Sewage Pump Station Catchment | |
|---|---|---|
| | Western Pump Station | Central Pump Station |
| Equivalent Tenement (ET) Loading | 11 ET | 67 ET |
| Average Dry Weather Flow (ADWF) | 0.12 L/s | 0.74 L/s |
| Peak Dry Weather Flow (PDWF) | 0.79 L/s | 2.58 L/s |
| Storm Allowance (SA) | 0.64 L/s | 3.89 L/s |
| Peak Wet Weather Flow (PWWF) | 1.43 L/s | 6.47 L/s |

The detailed design of the 2 sewage pump stations servicing Lot 172 shall take into account the design loadings indicated in **Table 5.1** to size the wet well capacity, set duty points for the pump sets and optimise the size of the rising mains discharging from the pump stations into the nearest gravity sewer main system.

The long term provision of sewerage infrastructure for the western and central catchments of Lot 172 will redirect sewage flows to a future gravity sewer main that will be required to service the development of land located between Joira Road and Chapmans Lane to the north of Blackbutt Road. The timing for the construction of this future sewer main will be dependent on the development of the individual land parcels in this area.

The overall sewerage infrastructure required to service the development of Lot 172 is indicated on Sheet E05 attached in the **Drawings** Section of this Report.

# 6.0 STORMWATER INFRASTRUCTURE

Stormwater drainage infrastructure will be provided for the proposed subdivision of Lot 172 that will include:

- Interallotment stormwater drainage pipes and inlet pits
- Roadway stormwater drainage and inlet pits
- Retarding basin systems

The design of all stormwater drainage systems will be carried out to the appropriate design criteria specified by Dubbo City Council.

The overall stormwater infrastructure required to service the development of Lot 172 is indicated on Sheet E03 and Sheet E04 attached in the **Drawings** Section of this Report.

The major components of the stormwater drainage infrastructure comprise the retarding basin systems that will limit post development stormwater runoff to pre development levels. Due to the topography of the development site, there are four (4) separate stormwater drainage catchments that are to be developed and each will require the provision of a retarding basin to limit post development runoff.

Each catchment has been assessed to determine the characteristics of the retarding basin servicing the catchment and details of each basin are summarised below:

<u>Retarding Basin No. 1</u>

| | |
|---|---|
| Catchment Serviced: | Catchment A |
| Catchment Area: | 16.16 ha |
| Impervious Catchment: | Sub catchment A1 - 0.0% Sub catchment A2 – 30% |
| Basin Volume: | 2,200m$^3$ at a depth of 1.5m |
| Spillway Width: | 15m |
| Basin Outlet Pipe: | 750mm diameter |
| 10 Year ARI Pre Development Runoff: | 0.96m$^3$/s |
| 100 Year ARI Pre Development Runoff: | 2.34m$^3$/s |
| 10 Year ARI Post Development Runoff: | 0.82m$^3$/s |
| 100 Year ARI Post Development Runoff: | 2.33m$^3$/s |

The proposed basin reduces the post development flows for the 10 year ARI and 100 Year ARI to less than the pre development flows.

<u>Retarding Basin No.2</u>

| | |
|---|---|
| Catchment Serviced: | Catchment B |
| Catchment Area: | 42.27 ha |
| Impervious Catchment: | Sub catchment B1 - 2.0% Sub catchment B2 – 30%<br>Sub catchment B3 – 30% |
| Basin Volume: | 8,900m$^3$ at a depth of 2.0m |
| Spillway Width: | 20m |
| Basin Outlet Pipe: | 2 x 900mm diameter |
| 10 Year ARI Post Development Runoff: | 2.32m$^3$/s |
| 100 Year ARI Post Development Runoff: | 5.00m$^3$/s |

Catchment BX

Catchment BX discharges below the outlet to Retarding Basin No. 2.

The area of Catchment BX is 3.10 ha with 15% impervious area. The combined discharge from Retarding Basin No. 2 and Catchment BX is summarised below:

| | |
|---|---|
| 10 Year ARI Pre Development Runoff: | 2.67m$^3$/s |
| 100 Year ARI Pre Development Runoff: | 6.55m$^3$/s |
| 10 Year ARI Post Development Runoff: | 2.52m$^3$/s |
| 100 Year ARI Post Development Runoff: | 5.36m$^3$/s |

The proposed basin reduces the post development flows for Catchment B and Catchment BX for the 10 year ARI and 100 Year ARI to less than the pre development flows.

Retarding Basin No. 3

| | |
|---|---|
| Catchment Serviced: | Catchment C |
| Catchment Area: | 18.16 ha |
| Impervious Catchment: | Sub catchment C1 – 0.0% Sub catchment C2 – 30% |
| Basin Volume: | 3,500m$^3$ at a depth of 2.0m |
| Spillway Width: | 12m |
| Basin Outlet Pipe: | 900mm diameter |
| 10 Year ARI Pre Development Runoff: | 1.35m$^3$/s |
| 100 Year ARI Pre Development Runoff: | 3.17m$^3$/s |
| 10 Year ARI Post Development Runoff: | 1.30m$^3$/s |
| 100 Year ARI Post Development Runoff: | 2.79m$^3$/s |

The proposed basin reduces the post development flows for the 10 year ARI and 100 Year ARI to less than the pre development flows.

Retarding Basin No. 4

| | |
|---|---|
| Catchment Serviced: | Catchment D |
| Catchment Area: | 11.23 ha |
| Impervious Catchment: | Sub catchment D1 – 0.0% Sub catchment D2 – 30% |
| Basin Volume: | 1,250m$^3$ at a depth of 1.5m |
| Spillway Width: | 8m |
| Basin Outlet Pipe: | 750mm diameter |
| 10 Year ARI Pre Development Runoff: | 1.03m$^3$/s |
| 100 Year ARI Pre Development Runoff: | 2.34m$^3$/s |
| 10 Year ARI Post Development Runoff: | 0.90m$^3$/s |
| 100 Year ARI Post Development Runoff: | 2.32m$^3$/s |

The proposed basin reduces the post development flows for the 10 year ARI and 100 Year ARI to less than the pre development flows.

Catchment E

Catchment E comprises 7.6 ha and is to be left in its undeveloped state and will continue to drain through the south eastern corner of the site.

# 7.0 CONCLUSIONS

Bawd Holding Pty Ltd intends to develop a parcel of land on Blackbutt Road for residential purposes. The land is currently zoned R5 Large Lot Residential under the provisions of the Dubbo Local Environmental Plan (LEP) 2011.

This Infrastructure Servicing Strategy Report has assessed the proposed lot layout on the development site and determined an economic means of providing servicing infrastructure to facilitate the proposed subdivision.

The Report investigated the provision of the following infrastructure items:

- Road access
- Water supply
- Sewerage reticulation
- Stormwater drainage

The Servicing Strategy determined a practical means of providing road access, water supply, sewerage reticulation and stormwater drainage to the development site in order to ensure that appropriate services can be constructed to allow the future development of the land for residential purposes.

The proposed lot layout allows for the creation of a total of 138 lots across the site comprising the following lot configurations:

- 106 lots in the north eastern section of the site ranging in size from 2,000m$^2$ to approximately 5,000m$^2$.
- 32 lots in the western section of the site ranging in size from approximately 4,000m$^2$ to approximately 8,700m$^2$.

Access to the proposed subdivision will be provided at two (2) locations off Blackbutt Road. Blackbutt Road provides good access to and from Dubbo via the Newell Highway with the major channelised intersection already constructed at the intersection of Blackbutt Road with the Newell Highway.

Based on the proposed 138 lots in the subdivision, the anticipated daily and peak hour traffic generation can be estimated as:

- 1,518 vehicle trips per day
- 138 vehicle trips per hour

The potable water supply for the proposed subdivision will be provided from Council's Rifle Range Road water reservoirs.

Based on the proposed development of 138 lots within the subdivision, the potable water demands for the subdivision are:

- Peak Instantaneous Demand: 13.8 L/s plus 11.0 L/s for fire purposes
- Peak Daily Demand: 690,000 L or approximately 0.7 ML

The natural ridgelines located through the centre of the site divide the land into several sewage catchments that will require the provision of sewerage reticulation separately from the existing and future sewerage infrastructure systems.

Part of Lot 172 is located within a sewage catchment that will drain by gravity reticulation to the existing Cootha sewage pump station. This catchment contains approximately 60 lots that can be serviced by the extension of existing sewerage infrastructure to Lot 172.

In the short to medium term it is proposed to install two (2) temporary sewage pump stations to service the 78 lots with the rising main discharge from the pump stations being directed to the extension of the sewer main proposed to service the 60 lots on the eastern section of the site.

The 11 western most lots will drain by gravity sewerage reticulation to a small sewage pump station located in the north western corner of the site.

The remaining 67 lots in the central area of the site drain by gravity reticulation to a sewage pump station located on the extension of Blackbutt Road approximately 250m west of the intersection with Joira Road.

The detailed design of the 2 sewage pump stations shall take into account the design loadings indicated in **Table 5.1** to size the wet well capacity, set duty points for the pump sets and optimise the size of the rising mains discharging from the pump stations into the nearest gravity sewer main system.

The long term provision of sewerage infrastructure for the western and central catchments will redirect sewage flows to a future gravity sewer main that will be required to service the development of land located between Joira Road and Chapmans Lane to the north of Blackbutt Road. The timing for the construction of this future sewer main will be dependent on the development of the individual land parcels in this area.

Stormwater drainage infrastructure will be provided for the proposed subdivision of Lot 172 that will include:

- Interallotment stormwater drainage pipes and inlet pits
- Roadway stormwater drainage and inlet pits
- Retarding basin systems

A series of 4 retarding basins will be provided across the site limiting post development runoff to less than pre development flows.

This Report has determined a strategy to allow the economic provision of the servicing infrastructure in a timely manner. The provision of the various servicing infrastructure components as outlined in this Report will allow the development of approximately 138 residential allotments in compliance with Council's zoning requirements and servicing criteria.

The development of the land is subject to Council's approval and the design of all works shall be carried out in accordance with Council's policies and standards for subdivision development.

# Drawings

# Groundwater and salinity study

Lot 172 DP753233 Blackbutt Road, Dubbo NSW


Ref: R5809s
Date: 8 December 2015

**Envirowest Consulting** Pty Ltd ABN 18 103 955 246
• 9 Cameron Place, PO Box 8158, Orange NSW 2800 • Tel (02) 6361 4954 •
• Fax (02) 6360 3960 • Email admin@envirowest.net.au • Web www.envirowest.net.au •

Environmental
Geotechnical
Asbestos
Services

| | |
|---|---|
| Client: | Highview Country Estates Pty Ltd<br>c/- Geolyse Pty Ltd<br>PO Box 1842<br>Dubbo NSW 2830 |
| Assessor: | Leah Desborough BNatRes (Hons)<br>Senior Environmental Scientist |
| Checked by: | Dave Langston BNEWS<br>Environmental Scientist |
| Authorising Officer: | Greg Madafiglio PhD<br>Senior Environmental Scientist |
| Report number: | R5809s |
| Date: | 8 December 2015 |

# Executive summary

## Background

A change in land-use is proposed for Lot 172 DP753233 Blackbutt Road, Dubbo NSW. The subdivision design will include residential lots, access roads and reserves along the drainage line. A groundwater and soil 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 31 March, 1 April 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 32 boreholes up to 10m in depth. Representative soil samples were collected and analysed for pH, electrical conductivity, colour, dispersion, texture, chlorides and exchangeable sodium percentage. The monitoring wells were installed at depths up to 12m or refusal on rock.

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 unsaturated soil moisture model with daily rainfall inputs from 1980 to 2014. Land-use scenarios modelled were:

- Pasture
- Irrigated lawn
- Trees

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 is vacant. Historical land-use was grazing with some cropping, an army training base and the majority of the trees had been removed from the site. Cypress pine regrowth has occurred across the majority of the site. Some areas were eroded. No bare areas resulting from sheet erosion or salinity were identified. The risk of erosion is low. The Dubbo (LEP) maps indicate the site is located within a vulnerable groundwater area.

Soils on the site comprised topsoil of light brown to dark brown loamy sand. Subsoils were yellow to light yellowish red clayey sand, silty clay, sandy clay and light clay. Gravel was encountered in most boreholes. Drill refusal due to rock was encountered at depths of less than 1m across the site. Groundwater was not identified in the three monitoring wells up to a depth of 12m.

The majority of the site is located within the Kintyre Hydro-geological Landscape with the eastern section within the Cumboogle Hydro-geological Landscape. Lithology of the Kintyre Hydro-geological Landscape consists of Napperby Formation overlying the deeper Purlewaugh Formation. The Kintyre HGL is relatively non-saline in the upper areas and shows moderate salinity in the lower elements of the landscape at changes in geology. Some salinity also occurs along drainage lines and depressions. Groundwater flow is unconfined to semi-confined flows in consolidated rock. Groundwater electrical conductivity is low to moderate.

Lithology of the Cumboogle Hydro-geological Landscape consists of Napperby Formation. Soil salinity is isolated at edges of rises and low hills as well as seasonally at sites adjacent to creek lines and depressions. Low salt loads exist as a result of sandy soils with limited salt stored and infrequent stream flow. Groundwater flow is unconfined to semi-confined in consolidated fractured rock. Groundwater salinity is fresh to brackish.

Subsoils in the majority of the site were classified as non-saline to slightly saline. Moderately saline subsoils were identified from 4m in boreholes constructed adjacent to drainage lines. These locations are consistent with the Kintyre HGL where salinity can occur along drainage lines and depressions. No special design considerations are expected to be required for roads or buidligns due to the depth to saline soils.

Groundwater was not identified on the site to depths of 10m. Infiltration of groundwater over most of the site will not result in mobilisation of salts.

The CLASS modelling indicated infiltration was episodic and similar to rainfall. The land-use scenarios modelled resulted in excess soil moisture of 0.06mm for pasture and 0.03mm for irrigated lawn at 1m depth. Greater excess moisture under the pasture scenario is associated with the dormancy over summer and times of irregular rainfall which are unable to be utilised. The excess moisture under the pasture and lawn scenario did not result in excess soil moisture at the 3m depth. Land-use scenarios of verges, trees and trees plus 1mm utilised all rainfall and additional moisture was did not result in excess soil moisture at 3m depth.

Nutrient and sediment modelling of surface water indicated no change or an improvement following the development.

No groundwater discharge areas were identified on the site. Few potable and stock supply bores have been constructed in the locality indicating the shallow and deeper aquifer is not a reliable source of groundwater.

The majority of Dubbo City Council monitoring bores have been dry since the start of monitoring. Moderate to high saline groundwater has been identified historically in one Dubbo City Council monitoring bore. Recent results indicate groundwater salinity has reduced to low to moderate. Groundwater in other monitoring wells had a low salinity.

The risk of groundwater contamination from the proposed land-use will be less than the current land-use. A change in land-use from disturbed treed areas with little groundcover to vegetated areas of lawn and garden offsets any additional nitrogen and phosphorus which may be applied to the site as fertilizers. 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.

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:

- Retaining and maintaining current woodland vegetation where possible. Trees will be retained in reserves and in areas outside the residential area on lots.
- Trees will be retained along drainage lines associated with subsoil salinity
- Promote additional plantings of deep rooted vegetation in road reserves and lots.
- Stormwater retention basins lined with an impermeable layer.
- Design road levels similar to natural soil levels to minimise excavations.

**Contents**

page

# 1. Introduction

A change in land-use is proposed for Lot 172 DP753233 Blackbutt Road, Dubbo NSW. The subdivision design will include residential lots, access roads, reserves and areas for bushfire protection. 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 Highview Country Estates Pty Limited, to undertake a groundwater investigation and salinity study of Lot 172 DP753233 Blackbutt Road, Dubbo NSW. The objective was to assess the existing conditions and possible future impact of the proposed development on soil, groundwater and salinity.

# 3. Site identification

| | |
|---|---|
| Address | Lot 172 DP753233 Blackbutt Road<br>Dubbo NSW |
| Client | c/- Geolyse<br>PO Box 1842<br>Dubbo NSW 2830 |
| Deposited plans | Lot 172 DP753233 |
| Universal grid reference | UTM Zone 55H, E647249m, N6427634m |
| Locality map | Figure 1 |
| Site plan | Figure 2 |
| Photographs | Figure 15 |
| Area | Approximately 98 hectares |
| Dates of inspection and assessment | 31 March, 1 April and 8 May 2015 |

# 4. Proposed development

The proposed development is a rural-residential subdivision. The plan includes 138 lots ranging in size from 0.2ha to a minimum lot size of 0.87ha (Figure 3). Building envelopes with dwellings are proposed for each lot.

Future land-use of the lots is a single dwelling with lifestyle activities. The lifestyle activities are expected to be cattle or horse grazing at low stocking rates as well as bushland. Planting of deep rooted vegetation is expected to occur on the rural-residential lots.

The building envelope has been estimated to be 2,500m$^2$ for lots larger than 2,500m$^2$ or the size of the lots for lots less than 2,500m$^2$. The building envelopes will have hard surface areas comprising roofs, parking areas and driveways where rainfall will run-off and permeable areas comprising lawns, gardens and pasture where less run-off will occur.

Sealed public roads with earthern culverts will be constructed throughout the subdivision. Intersections along Blackbutt Road will be created to allow access to all lots. Gravel driveways will be constructed from the public roads to allow access to each dwelling site.

The dwellings will be serviced by a reticulated sewerage system.

Trees will be retained on-site in areas of reserve. Tree removal will be required to allow road and dwelling construction. Trees on residential lots outside the building envelopes are expected to be retained.

# 5. Site condition and surrounding environment

## 5.1 Land-use

The current land-use is vacant with semi-improved pasture and bushland.

## 5.2 Vegetation

The majority of the site has a surface covering of native grasses. Introduced grasses and broad-leaved weeds occur around the former dwelling location. Juvenile cypress pines occur across much of the site. Areas of remnant eucalypt trees are located within the central drainage line, north western section and along the southern boundary.

## 5.3 Topography

The site is a mid to upper slope with a gentle inclination of 1 to 5%. The eastern section of the site has a north easterly aspect. The remainder of the site has a predominantly northerly aspect. A hillock is located in the southern section.

Elevation ranges between 311 and 347 metres above sea level. The lowest elevation occurs on the north eastern boundary. No groundwater seepage or discharge areas were observed on the site.

## 5.4 Soils and geology

The site is located within the Goonoo Soil Landscape (Murphy and Lawry 1998). Earthy sands, siliceous sands, red earth and yellow and grey earths occur on the mid to upper slopes. Yellow solodic soils are common on lower slopes and drainage depressions. Typical profiles consist of dark reddish-brown to dark brown loamy sands to sands. A bleached A2 horizon comprising dull yellow sand may be present. The subsoil is typically a yellowish brown to reddish brown sandy loam to sandy clay loam.

The site is underlain by Pilliga Sandstone comprising quartz sandstone, conglomerate, siltstone and shale (Murphy and Lawry 1998). Parent materials are *in situ* and weathered parent rock and derived colluvium and alluvium.

Soils on the site comprised topsoil of light brown to dark brown loamy sand. Subsoils were yellow to light yellowish red clayey sand, silty clay, sandy clay and light clay. Gravel was encountered in most boreholes.

## 5.5 Surface water

The site is located on an upper slope and forms part of the headwaters for a number of drainage lines. Three drainage lines (1st order streams) originate on the site and another 1st order stream is in close proximity to the site. The drainage lines discharge into the Macquarie River located greater than 4km from the site.

Two dams are located on the property. Historical aerial photographs indicate contour banks have been formed across the site to divert surface water flows into the dams.

### 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 414km$^2$ with approximately 17.95 GL consumed per year. Average salinity levels are greater than 1500mg/L.

No groundwater bores are known to be located on the site.

A search of the NSW DPI groundwater database located nineteen bores within 2km of the site. The bores are predominantly located to the north and north west. Water bearing zones were identified from 1.9m and standing water levels at the time of drilling from 1 metre. Several 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 9m. Other bores are licensed for domestic, stock, irrigation, piggery and public/municipal supplies and test bores. Water bearing zones were from depths of 1.9m.

## 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. Hydro-geological landscape data (Figure 4) was reviewed for information regarding the groundwater aquifer including lithology, aquifer type, recharge and discharge characteristics.

### 6.3 Groundwater

No shallow groundwater was identified on the site at depths greater than 10m. 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)

| 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 groundwater salinity class determination (Dubbo City Council Urban Salinity Plan)

| Electrical conductivity (dS/m) | Salinity class |
|---|---|
| 0-2 | Low |
| 2-6 | Moderate |
| 6-15 | High |
| >15 | Extreme |

## 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 5).

## 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 6).

The Dubbo City Urban Salinity Implementation plan indicates the site is located in the Kintyre and Cumboogle hydro-geological landscape which have been classed with an overall salinity hazard of moderate and low respectively.

## 6.6 Moisture 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 treed areas with some pasture. The post development land-use comprised rural-residential lots, roadways and vegetated areas in reserves. The vegetated areas contains trees as offsets for possible over irrigation of lawns. Existing tress will be retained and maintained in the reserve areas.

The model input data was rainfall and evaporation for the inferred climate at the site 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. The scenarios were; unirrigated pasture, unirrigated trees, irrigated lawn and trees with additional moisture and verges which will receive additional infiltration resulting from run-off from hard surfaces.

**Table 3**. Land-use scenario in the soil moisture model

| Land-use scenario | Pre development (ha) | Post development (ha) | Rainfall parameter |
|---|---|---|---|
| Pasture (unirrigated) | 15.02 | 15.1 | 100% Rainfall |
| Dwellings | 0 | 6.6 | 100% Rainfall, runoff hard surfaces to stormwater |
| Irrigated lawns | 0 | 23.8 | Rainfall plus 1mm/day where rainfall is less than 10mm |
| Roads and driveways (sealed) | 0 | 3.1 | 100% Rainfall, runoff hard surfaces to stormwater |
| Tree areas | 82.98 | 0 | 100% rainfall |
| Trees+ with additional moisture | 0 | 43.84 | 100% rainfall<br>Rainfall plus 0.5mm/day (allowance for potential subsurface uptake of moisture) |
| Road verges | 0 | 5.56 | Rainfall x 2 (allowance for road runoff |
| Total | 98 | 98 | |

Other parameters applied in the model are soil type and depth and default values (Table 4).

**Table 4**. Model parameters for CLASS U3M-1D

| Parameter | Data/description |
|---|---|
| Soil profile | Layer 1 2000-6000<br>Layer 2 1300-2000<br>Layer 3 300-1300<br>Layer 4 0-300 (topsoil) |
| Land-use | Pasture, lawn, trees, trees+ |
| Soil hydraulic parameters | Layer 1 Silty clay<br>Layer 2 Sandy clay<br>Layer 3 Sandy clay<br>Layer 4 Sandy clay loam (topsoil)<br>van Genuchten model |
| Time step | Default |
| Root distribution | Pasture and lawn 0.6m, trees 3m |

### 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 disturbed landscapes, sealed and unsealed roads, urban, open area 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.

**Table 5.** Land use areas for nutrient model

| Land-use areas (ha) | Pre | Post |
|---|---|---|
| Disturbed landscapes | 82.38 | 49.25 |
| Remediated gullies | 0 | 0.15 |
| Roads (earth) | 0.6 | 0 |
| Roads (sealed) | 0 | 3.1 |
| Road verge (urban open area) | 0 | 6.92 |
| Improved pasture | 15.02 | 0 |
| Open area | 0 | 8.18 |
| Urban | 0 | 30.4 |
| Total | 98 | 98 |

Land-use on site are as follows;

- *Disturbed landscapes* refers to the majority of the site pre development. The trees which are located on the site are mostly regrowth of less than 20 years. Understorey vegetation is sparse with little groundcover vegetation and minimal leaf litter and twigs. This is expected to remain the land-use on the site outside of building envelopes and roads post development.
- *Remediated gullies* refers to the eroded drainage line and bike track located in the central northern section of the site. This area is expected to be remediated to form a retention basin.
- *Roads (earth)* refers to the farm tracks which traverse the site in the pre development state.
- *Roads (sealed)* is a calculation of bitumen roads that will be on-site post development.
- *Road verge (urban open area)* are the grassed table drains on either side of the road pavement.
- *Improved pasture* is the cleared areas pre-development not classified as disturbed landscapes. Cleared areas post development are classified as urban or open area.
- *Open area* refers to cleared areas on the residential lots post development.
- *Urban* refers to those areas which are expected to be cleared for dwelling construction and will include irrigated lawns and gardens. A reticulated sewer will be constructed throughout the development and on-site effluent application will not occur. An area of 480m$^2$ per lot has been estimated for dwelling and shed construction. Irrigated lawn and garden areas have been estimated as 2,000m$^2$ for lots greater than 2,500m$^2$. Irrigated lawn and garden

areas on lots less than 2,500m$^2$ have been estimated as the total lot size minus the dwelling and shed allowance.

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).

## 6.7 Initial site investigation

An initial site investigation was conducted by collecting information on vegetation, slope, bare areas and other indicators of salinity at 158 locations across the site (Figure 7). This density is in accordance with the recommendations by Lillicrap and McGhie (2002).

## 6.8 Detailed profile descriptions and laboratory analysis

Thirty two boreholes were constructed with an EVH truck mounted hydraulic drilling rig with solid auger on 1 March, 1 April 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 8). Borehole locations were restricted due to accessibility resulting from dense vegetation. Deep boreholes were constructed along drainage lines and low areas of the site to a depth of 7.2m (MW1), 9.9m (MW2) and 12m (MW3). The deep boreholes were located to intercept shallow groundwater. A 50mm diameter monitoring well was installed in BH33 (MW1), BH21 (MW2) and BH13 (MW3). Two boreholes were drilled up to a depth of 9 metres. Soil samples were collected from seven 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 6.** ECe texture based conversion factors (Charman and Murphy 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 7.** Soil salinity ratings based on ECe readings

| 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)

| Concrete piles | | Steel piles | |
|---|---|---|---|
| Chlorides in water (mg/kg) | Soil conditions for low permeability soils or all soils above groundwater | Chlorides in water (mg/kg) | Soil conditions for low permeability soils or all soils 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

| Exchangeable sodium percentage | Ranking |
|---|---|
| <5% | Non-sodic |
| 5-15% | Sodic |
| >15% | Highly sodic |

# 7. Results and discussion

## 7.1 Soil landscape maps

The site is located within the Goonoo Soil Landscape (Murphy *et al.* 1998).

Soil in the Goonoo landscape consists of dark reddish brown loamy sands to 0.2m deep over dark reddish brown sandy loam. Parent material is weathered sandstone, conglomerate, siltstone and shale and colluvium and alluvium. Soil salinity levels are low and localised across the landscape. Soil salinity is generally confined to small isolated occurrences along drainage lines and depressions. Erosion hazard is high when surface cover is low or flows are concentrated.

## 7.2 Hydro-geological landscapes

The majority of the site is located within the Kintyre Hydro-geological Landscape with the eastern section within the Cumboogle Hydro-geological Landscape (DCC2013c). The site and associated hydro-geological landscapes are depicted in Figure 4.

Lithology of the Kintyre Hydro-geological Landscape consists of Napperby Formation comprising siltstone thinly interbedded with fine grained lithic quartz sandstone, minor conglomerate in a coarsening up sequence. This overlays the deeper Purlewaugh Formation. The Kintyre HGL is relatively non-saline in the upper areas and shows moderate salinity in the lower elements of the landscape at changes in geology. Moderate load exists in the landscape originating from storage in the lower colluvium. Some salinity also occurs along drainage lines and depressions. Groundwater flow is unconfined to semi-confined flows in consolidate rock. Water electrical conductivity is low to moderate.

The eastern section of the site is located in the Cumboogle Hydro-geological Landscape. Lithology of the Cumboogle Hydro-geological Landscape consists of Napperby Formation comprising thinly inerbedded siltstone with fine to medium grained lithic quartz sandstone, isolated areas of Tertiary basalt, Devonian granite, rhyolite, trachyte and undifferentiated sandstone, shale and tuff. Soil salinity is isolated at edges of rises and low hills as well as seasonally at sites adjacent to creek lines and depressions. Low salt loads exist as a result of sandy soils with limited salt stored and infrequent stream flow. Groundwater flow is unconfined to semi-confined in consolidated fractured rock. Groundwater salinity is fresh to brackish.

## 7.3 Groundwater

### 7.3.1 OEH registered bores

Twenty 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 north and north west of the site.

Four 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 monitoring, domestic, stock, irrigation, piggery and public/municipal supplies and test bores.

Water-bearing zones (WBZ's) and standing water levels were recorded for 10 bores. The Department of Primary Industries website shows that SWL's and WBZ's in bores (for which data was recorded) were at depths generally greater than 10m (Appendix 3 and Figure 9). The water bearing zones are located in granite, sandstone, shale and serpentine.

A salinity description was recorded for three bores. Two bores licensed for monitoring and located east of the site were considered to contain saline water with descriptions of "6,680", "10,040" and "very salty". The third bore was considered to contain non-saline water with a description of "fair".

### 7.3.2 Dubbo City Council salinity network

Five Dubbo City Council (DCC) monitoring bores are located at less than 2km north of the site (Figure 10 and Appendix 4). Bore depths were 2m to 6m with water bearing zones located in unconfined regolith comprising clay. The majority of bores have been dry since monitoring begun in March 2005.

Bores DCC34 and DCC109 constructed to a depth of 6m have consistently contained water at the time of sampling. Standing water levels in DCC34 and DCC109 have generally been greater than 3m. The salinity class (Table 2b) of groundwater in DCC34 was moderate to high until December 2010 and has been low to moderate since 2010. The salinity class of groundwater in DCC109 has been consistently low (Appendix 4). Groundwater has been recorded in DCC208, the closest bore to the site on one occasion. Salinity class of the groundwater at that time was moderate.

### 7.3.3 On-site groundwater

No groundwater was encountered on site in the newly constructed monitoring wells. MW1 was located in the central northern section of the site (Figure 8) adjacent a drainage line. Groundwater was not encountered the drilling depth of 7.2m.

MW2 was located in the central eastern section of the site adjacent a dam (Figure 7). Groundwater was not encountered the drilling depth of 9.9m.

MW3 was located in the north eastern section of the site (Figure 7). Groundwater was not encountered the drilling depth of 12m.

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 low to moderate groundwater vulnerability rating (Figure 5). A band of moderately high groundwater vulnerability runs through the north eastern section of the site. Low groundwater vulnerability exists to the north and east.

## 7.5 Dubbo LEP (2011) groundwater vulnerability map

The Dubbo LEP (2011) identifies the north eastern and south western sections of the site as having a moderately high groundwater vulnerability area (Figure 6). No groundwater vulnerability rating applies to the remainder of the site.

## 7.6 Initial site investigation

The initial site investigation was conducted on an 80m x 80m grid across the site (Figure 7 and Appendix 5).

The site has a historical land-use of grazing. Historic aerial photography indicates that the majority of the site was cleared of trees in 1964 with some regrowth occurring in 1980 and 1995. The 2003 aerial photograph depicts tree cover on the site similar to that observed during the site investigation. Minor amounts of cropping are expected to have occurred across the site.

The majority of the site has a tree cover dominated by white cypress pine with eucalypts located along the central drainage line and around the boundaries. Groundcover was sparse throughout the treed areas with native grasses and some broadleaved weeds. Minimal leaves and twigs were observed on the ground. Groundcover increased in cleared areas.

Tracks were present across the site with some erosion observed. Erosion was also observed along the drainage line and in an area which had been disturbed by the creation of a bike track.

The majority of the site was very gently inclined with slopes ranging from 1 to 2%. Slope increased to 4% in the southern section.

No indicators of salinity were observed.

**Table 11**. Dubbo City Council salinity network

| **Sampling location (see Figure 10)** | **Depth (m)** | **Date sampled** | **Standing water level (m)** | **EC dS/m** | **Total dissolved solids** (EC x 640) **mg/L** |
|---|---|---|---|---|---|
| DCC34 | 6 | Oct-14 | 2.51 | 4.00 | 2,560 |
| | | Nov-14 | 2.27 | 4.02 | 2,573 |
| | | Dec-14 | 2.35 | 4.25 | 270 |
| DCC108 | 3 | Oct-14 | Dry | - | - |
| | | Nov-14 | Dry | - | - |
| | | Dec-14 | Dry | - | - |
| DCC109 | 6 | Oct-14 | 2.22 | 0.74 | 474 |
| | | Nov-14 | 1.79 | 0.60 | 384 |
| | | Dec-14 | 1.53 | 0.55 | 352 |
| DCC125 | 3 | Oct-14 | Dry | - | - |
| | | Nov-14 | Dry | - | - |
| | | Dec-14 | Dry | - | - |
| DCC126 | 2 | Oct-14 | Dry | - | - |
| | | Nov-14 | Dry | - | - |
| | | Dec-14 | Dry | - | - |

TSTB- too shallow to bail

## 7.7 Soil characteristics

Boreholes were constructed to depths of 2m, 3m, 9m, 10m or drill refusal. Drill refusal due to rock at depths less than 1m 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 light brown to dark brown loamy sand (Table 12). Subsoils were yellow to light yellowish red clayey sand, silty clay, sandy clay and light clay. Gravel was encountered in most boreholes (Appendix 6).

The soil was generally dry throughout the profile. No free water was identified in the boreholes.

### 7.7.2 Salinity (electrical conductivity)

No significant areas of soil salinity were observed in the soil analysis. All topsoils samples were determined to be non-saline. Subsoil salinity was generally non-saline with bands of soil slightly to moderately saline in some boreholes.

Slightly saline soil was identified in Borehole 2 from 1m to 4m with moderately saline soil from 4m to the depth of the borehole at 9m (Table 12). Borehole 2 was constructed at the headwaters for a drainage line which runs north west from the site (Figure 11).

Non-saline to slightly saline soil was identified in Borehole 9 to 8.5m (Table 12). Moderately saline soil identified in the sample collected at 9m.

Non-saline to slightly saline soil was identified in Borehole 13 to 11.5m (Table 12). Moderately saline soil was identified in the sample collected at 12m.

Slightly saline soil was identified in Borehole 21 with a band of moderately saline soil from 4.5m to 5.5m (Table 12). Borehole 21 was constructed at the headwaters for a drainage line which runs east from the site (Figure 11).

Non-saline soil was identified in Borehole 31 to a depth of 4m and slightly saline soil from 4m to the depth of the borehole at 5.3m (Table 12).

Non-saline to slightly saline soil was identified in Borehole 32 (Table 12).

Slightly saline soil was identified in Borehole 33 from 1.5m to 5m. Moderately saline soil was identified from 5m to the depth of the borehole of 7.2m. Boreholes 33 was constructed adjacent the drainage line which runs north from the site (Figures 11 and 12).

**Table 12.** Soil colour, texture, pH, EC and ECe (detailed profile descriptions)

| Borehole No - depth (mm) | Soil colour | Soil texture | pH | EC1:5 | ECe (dS/m) | Emerson aggregate test |
|---|---|---|---|---|---|---|
| 2-100 | Dark brown | Light loamy sand | 4.8 | 0.01 | 0.23 | 2 |
| 2-200 | Dark brown | Loamy sand | 5.0 | 0.01 | 0.23 | 2 |
| 2-300 | Dark brown | Loamy sand | 5.1 | 0.01 | 0.23 | 2 |
| 2-500 | Dark brown | Loamy sand | 5.2 | 0.03 | 0.69 | 2 |
| 2-1000 | Light brown | Clayey sand | 5.4 | 0.10 | 2.30 | 1 |
| 2-1500 | Brownish yellow | Clayey sand | 5.5 | 0.10 | 2.30 | 1 |
| 2-2000 | Light red | Clayey sand with gravel | 5.4 | 0.10 | 2.30 | 2 |
| 2-2500 | Light red | Clayey sand | 5.2 | 0.13 | 2.99 | 2 |
| 2-3000 | Reddish yellow | Clayey sand | 5.0 | 0.18 | 4.14 | 2 |
| 2-3800 | Reddish yellow | Clayey sand | 5.1 | 0.15 | 3.45 | 5 |
| 2-4000 | Reddish yellow | Clayey sand | 4.8 | 0.18 | 4.14 | 5 |
| 2-4500 | Reddish brown | Sandy loam with gravel | 4.5 | 0.43 | 6.02 | 5 |
| 2-5000 | Reddish brown | Sandy loam with gravel | 4.8 | 0.37 | 5.18 | 5 |
| 2-5500 | Reddish yellow | Silty clay with gravel | 4.7 | 0.37 | 3.18 | 5 |
| 2-6000 | Light reddish brown | Silty clay with gravel | 4.8 | 0.48 | 4.12 | 5 |
| 2-6500 | Light reddish brown | Silty clay with gravel | 4.8 | 0.42 | 3.61 | 5 |
| 2-7000 | Light reddish brown | Silty clay with gravel | 4.7 | 0.48 | 4.12 | 5 |
| 2-7500 | Light reddish brown | Silty clay with gravel | 4.6 | 0.50 | 4.30 | 5 |
| 2-8000 | Light reddish brown | Silty clay with gravel | 4.7 | 0.50 | 4.30 | 5 |
| 2-8500 | Light red | Silty clay with gravel | 4.5 | 0.48 | 4.12 | 5 |
| 2-9000 | Light red | Silty clay with trace gravel | 4.8 | 0.35 | 3.01 | 5 |
| 9-100 | Black | Sandy clay loam | 4.7 | 0.01 | 0.08 | 2 |
| 9-200 | Black | Sandy clay loam | 5.0 | 0.01 | 0.08 | 2 |
| 9-300 | Brown | Gravelly clay | 5.3 | 0.04 | 0.30 | 5 |
| 9-500 | Brown | Gravelly clay | 5.8 | 0.12 | 0.90 | 5 |
| 9-1000 | Brownish yellow | Sandy loam | 6.3 | 0.14 | 1.96 | 2 |
| 9-1500 | Yellow | Sandy loam | 6.6 | 0.09 | 1.26 | 2 |
| 9-2000 | Yellow | Sandy loam with gravel | 7.0 | 0.08 | 1.12 | 2 |
| 9-2500 | Yellow | Sandy clayey loam | 7.3 | 0.07 | 0.66 | 2 |
| 9-3000 | Yellowish brown | Sandy clay loam with gravel | 7.2 | 0.09 | 0.85 | 2 |
| 9-3500 | Reddish yellow | Fine sandy clay loam | 7.3 | 0.07 | 0.62 | 2 |
| 9-4000 | Brownish yellow | Sandy loam | 7.2 | 0.12 | 0.90 | 2 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 9-4500 | Yellow | Clayey sand | 7.0 | 0.12 | 2.76 | 2 |
| 9-5000 | Yellow | Clayey sand | 7.0 | 0.16 | 3.68 | 2 |
| 9-5500 | Reddish yellow | Sandy clay loam | 7.1 | 0.20 | 1.90 | 2 |
| 9-6000 | Yellow | Sandy clay loam | 6.8 | 0.16 | 1.52 | 2 |
| 9-6500 | Yellowish brown | Clayey sand with gravel | 7.1 | 0.14 | 3.22 | 2 |
| 9-7000 | Yellowish brown | Clayey sand with gravel | 7.0 | 0.13 | 2.99 | 2 |
| 9-7500 | Yellowish brown | Clayey sand with gravel | 7.1 | 0.12 | 2.76 | 2 |
| 9-8000 | Brownish yellow | Clayey sand with gravel | 7.1 | 0.13 | 2.99 | 2 |
| 9-8500 | Reddish yellow | Clayey sand with gravel | 6.7 | 0.17 | 3.91 | 2 |
| 9-9000 | Brownish yellow | Clayey sand with gravel | 6.6 | 0.22 | 5.06 | 2 |
| 13-100 | Dark brown | Sandy loam | 5.0 | 0.01 | 0..23 | 3 |
| 13-200 | Dark brown | Sandy loam with gravel | 5.3 | 0.05 | 1.15 | 1 |
| 13-300 | Olive brown | Clayey sand with gravel | 5.1 | 0.16 | 3.68 | 1 |
| 13-500 | Strong brown | Sandy clay | 5.3 | 0.36 | 2.70 | 1 |
| 13-1000 | Olive yellow | Sandy clay | 5.9 | 0.38 | 2.85 | 1 |
| 13-1500 | Yellow | Sandy clay with gravel | 6.6 | 0.44 | 3.30 | 1 |
| 13-2000 | Olive yellow | Sandy clay | 6.9 | 0.39 | 2.92 | 3 |
| 13-2500 | Yellow | Sandy clay | 7.1 | 0.33 | 2.47 | 3 |
| 13-3000 | Yellow | Sandy clay | 7.3 | 0.32 | 2.40 | 3 |
| 13-3500 | Yellow | Sandy clay with gravel | 7.0 | 0.33 | 2.47 | 3 |
| 13-4000 | Yellow | Sandy clay with gravel | 6.9 | 0.33 | 2.47 | 5 |
| 13-4500 | Pale yellow | Sandy clay with gravel | 6.7 | 0.34 | 2.55 | 5 |
| 13-5000 | Pale yellow | Sandy clay with gravel | 6.5 | 0.33 | 2.47 | 5 |
| 13-5500 | Yellow | Sandy clay with gravel | 6.4 | 0.33 | 2.47 | 5 |
| 13-6000 | Yellow | Sandy clay with trace gravel | 6.5 | 0.38 | 2.85 | 5 |
| 13-6500 | Brownish yellow | Sandy clay with gravel | 6.6 | 0.38 | 2.85 | 3 |
| 13-7000 | Yellow | Sandy clay with gravel | 6.2 | 0.39 | 2.92 | 5 |
| 13-7500 | Brownish yellow | Sandy clay with gravel | 6.2 | 0.39 | 2.92 | 5 |
| 13-8000 | Brownish yellow | Sandy clay with gravel | 6.1 | 0.42 | 3.15 | 5 |
| 13-8500 | Yellow | Sandy clay with gravel | 6.2 | 0.41 | 3.07 | 5 |
| 13-9000 | Yellow | Sandy clay with gravel | 6.2 | 0.44 | 3.30 | 5 |
| 13-9500 | Pale yellow | Sandy clay with gravel | 6.5 | 0.44 | 3.30 | 5 |
| 13-10000 | Very pale brown | Sandy clay with gravel | 6.1 | 0.44 | 3.30 | 5 |
| 13-10500 | Very pale brown | Sandy clay with gravel | 6.0 | 0.39 | 2.92 | 5 |
| 13-11000 | Light pale brown | Sandy clay with gravel | 5.8 | 0.35 | 2.62 | 5 |
| 13-11500 | Light grey | Sandy clay with gravel | 6.2 | 0.37 | 2.77 | 2 |
| 13-12000 | Black | Sandy clay | 5.5 | 0.67 | 5.02 | 2 |
| 21-100 | Dark brown | Sandy clay loam | 4.4 | 0.01 | 0.10 | 3 |
| 21-200 | Dark brown | Sandy clay loam | 4.8 | 0.01 | 0.10 | 3 |
| 21-300 | Dark brown | Sandy clay loam | 5.1 | 0.01 | 0.10 | 3 |
| 21-500 | Dark Brown | Sandy clay loam | 5.1 | 0.01 | 0.10 | 3 |
| 21-1000 | Brown | Sandy clay loam with gravel | 5.2 | 0.01 | 0.10 | 2 |
| 21-1500 | Brown | Gravelly clayey sand | 5.6 | 0.03 | 0.69 | 2 |
| 21-2000 | Yellowish Brown | Clayey sand with gravel | 5.7 | 0.07 | 1.61 | 1 |
| 21-2500 | Yellowish Brown | Clayey sand with gravel | 6.1 | 0.12 | 2.76 | 2 |
| 21-3000 | Brownish yellow | Clayey sand with gravel | 7.0 | 0.14 | 3.22 | 3 |
| 21-3500 | Brownish yellow | Clayey sand with gravel | 5.8 | 0.11 | 2.53 | 3 |
| 21-4000 | Olive yellow | Clayey sand with gravel | 5.9 | 0.11 | 2.53 | 2 |
| 21-4500 | Yellow | Clayey sand with gravel | 6.7 | 0.20 | 4.60 | 2 |
| 21-5000 | Yellow | Clayey sand | 7.5 | 0.24 | 5.52 | 3 |
| 21-5500 | Yellow | Clayey sand | 6.9 | 0.28 | 6.44 | 6 |
| 21-6000 | Yellow | Sandy clay | 8.6 | 0.26 | 1.95 | 6 |
| 21-6500 | Olive yellow | Sandy clay | 8.4 | 0.32 | 2.40 | 6 |
| 21-7000 | Olive yellow | Sandy clay | 8.2 | 0.32 | 2.40 | 6 |
| 21-7500 | Yellow | Sandy clay | 7.5 | 0.37 | 2.78 | 6 |
| 21-8000 | Olive yellow | Sandy clay | 7.0 | 0.29 | 2.18 | 6 |
| 21-8500 | Olive yellow | Sandy clay | 6.8 | 0.30 | 2.25 | 6 |
| 21-9000 | Brownish yellow | Light clay | 6.2 | 0.25 | 1.88 | 6 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 21-9500 | Brownish yellow | Light clay | 6.4 | 0.23 | 1.73 | 6 |
| 21-9900 | Brownish yellow | Light clay | 6.3 | 0.22 | 1.65 | 3 |
| 31-100 | Dark brown | Sandy loam | 4.5 | 0.02 | 0.46 | 3 |
| 31-300 | Dark brown | Fine sandy loam | 4.4 | 0.01 | 0.14 | 3 |
| 31-500 | Dark brown | Fine sandy loam with gravel | 4.5 | 0.01 | 0.14 | 3 |
| 31-1000 | Dark brown | Fine sandy loam with gravel | 4.8 | 0.01 | 0.14 | 3 |
| 31-1500 | Brownish yellow | Sandy clay loam with gravel | 5.4 | 0.06 | 0.45 | 2 |
| 31-2000 | Brownish yellow | Sandy clay with gravel | 6.2 | 0.07 | 1.61 | 2 |
| 31-2500 | Brownish yellow | Sandy clay with gravel | 6.0 | 0.06 | 1.38 | 1 |
| 31-3000 | Brownish yellow | Fine sandy clay loam | 5.8 | 0.13 | 1.82 | 1 |
| 31-3500 | Brownish yellow | Sandy clay with gravel | 5.4 | 0.15 | 1.12 | 1 |
| 31-4000 | Yellowish brown | Sandy clay | 5.8 | 0.22 | 1.65 | 1 |
| 31-4500 | Light grey | Sandy clay | 5.7 | 0.28 | 2.10 | 2 |
| 31-5000 | White | Sandy clay | 6.1 | 0.34 | 2.55 | 2 |
| 31-5300 | Yellow | Sandy clay | 6.3 | 0.38 | 2.85 | 2 |
| 32-100 | Dark brown | Loamy sand | 4.7 | 0.02 | 0.46 | 3 |
| 32-200 | Dark brown | Loamy sand | 5.7 | 0.02 | 0.46 | 3 |
| 32-300 | Dark brown | Loamy sand | 5.8 | 0.03 | 0.69 | 2 |
| 32-500 | Dark brown | Loamy sand | 5.8 | 0.04 | 0.92 | 2 |
| 32-1000 | Brown | Clayey sand with gravel | 5.6 | 0.10 | 2.30 | 1 |
| 32-1500 | Brown | Clayey sand with gravel | 5.8 | 0.16 | 3.68 | 1 |
| 32-2000 | Brown | Sandy clay with gravel | 6.3 | 0.23 | 1.72 | 1 |
| 32-2500 | Brown | Sandy clay with gravel | 6.7 | 0.20 | 1.50 | 1 |
| 32-3000 | Yellow | Gravelly sandy clay | 7.4 | 0.12 | 2.76 | 1 |
| 33-100 | Dark brown | Loamy sand | 4.7 | 0.04 | 0.92 | 8 |
| 33-200 | Dark brown | Loamy sand | 5.0 | 0.02 | 0.46 | 8 |
| 33-300 | Dark brown | Loamy sand | 5.1 | 0.02 | 0.46 | 8 |
| 33-500 | Dark brown | Loamy sand | 5.3 | 0.02 | 0.46 | 8 |
| 33-1000 | Light brown | Sandy loam | 5.6 | 0.03 | 0.42 | 3 |
| 33-1500 | Light brown | Sandy loam | 5.8 | 0.07 | 0.98 | 3 |
| 33-2000 | Yellowish brown | Clayey sand with gravel | 6.3 | 0.13 | 2.99 | 2 |
| 33-2500 | Yellowish brown | Clayey sand with gravel | 6.7 | 0.27 | 6.21 | 2 |
| 33-3000 | Yellow | Sandy clay | 7.0 | 0.33 | 2.48 | 2 |
| 33-3500 | Yellow | Sandy clay | 7.1 | 0.24 | 1.80 | 2 |
| 33-4000 | Yellow | Sandy clay | 6.6 | 0.31 | 2.33 | 2 |
| 33-4500 | Yellow | Sandy clay | 7.1 | 0.43 | 3.23 | 2 |
| 33-5000 | Olive yellow | Light clay | 7.1 | 0.53 | 4.00 | 2 |
| 33-5500 | Olive yellow | Light clay | 7.2 | 0.53 | 4.00 | 2 |
| 33-6000 | Olive yellow | Light clay | 7.2 | 0.47 | 3.53 | 1 |
| 33-6500 | Olive yellow | Light clay | 7.0 | 0.60 | 4.50 | 1 |
| 33-7000 | Olive Yellow | Light clay | 7.0 | 0.62 | 4.65 | 1 |
| 33-7200 | Olive yellow | Light clay | 7.0 | 0.29 | 2.18 | 1 |

### 7.7.3 pH

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)

| Sample ID | Borehole and depth (mm) (Figure 8) | Chlorides (mg/kg) | ESP (%) | Total cations (meq/100g) |
|---|---|---|---|---|
| MW1-100 | 33-100 | 50 | 22 | 0.20 |
| MW1-500 | 33-1500 | 70 | 35 | 0.24 |
| BH14-100 | 14-100 | 40 | 22 | 0.20 |
| BH14-500 | 14-1000 | 120 | 22 | 0.79 |

ND – Not detected at the laboratory limits

### 7.7.6 Exchangeable sodium percentage
Exchangeable sodium percentage for samples collected from Boreholes 14 and 33 located in the northern section of the site are considered highly 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
No buildings located on the site.

### 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 and land-use scenarios of the CLASS U3M model. Soil moisture at 1m depth (Figure 13) and 3m depth (Figure 14) indicates the variation in soil moisture associated with high episodes of rainfall. High rainfall results in high soil moisture periodically which moves into the profile.

Pasture land-use results in saturated soil at the 1m depth and recharge to the groundwater of 0.06mm over the 35 years modelling time frame. At times of high rainfall when the pasture is dormant little evapotranspiration occurs resulting is recharge. In the pasture land-use rooting depth is limited to less than 1m.

Less excess soil moisture under lawn scenarios was predicted at the 1m depth with recharge of 0.03mm. The lawn land-use maintains high evapotranspiration all year with no times of dormancy (Figure 13 and 14).

At the 3m depth, the CLASS model did not have excess soil moisture from pasture or lawn land-uses. Trees and road verge land-use results in no excess soil moisture available for recharge. The episodic rainfall periods are utilised by evapotranspiration of the trees which are able to retrieve soil moisture from soil depths of up to 3m.

Trees+ land-use scenario does not result in significant excess soil moisture available for recharge. Episodic variation in soil moisture occurs due to rainfall deeper soil moisture is able to be utilised by the trees. During periods of high rainfall the trees have capacity to extract water from up to 3m in the soil profile and utilise recharge from shallower rooted vegetation species.

## 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 or reserve areas. 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 279 kg/year under the median scenarios (Table 15). Reduced pasture area has resulted in a decrease in the nitrogen loss.

**Table 15.** Land-use nitrogen export pre and post development (kg/year)

| Land-use areas | Pre-development | Post-development | Impact |
|---|---|---|---|
| Disturbed landscapes | 988.56 | 591.00 | 397.56 |
| Remediated gullies | 0.00 | 0.90 | -0.90 |
| Improved pasture | 133.68 | 0.00 | 133.68 |
| Open area | 0.00 | 26.18 | -26.18 |
| Roads (sealed) | 0.00 | 18.60 | -18.60 |
| Roads (earth) | 1.32 | 0.00 | 1.12 |
| Urban | 0.00 | 185.44 | -185.44 |
| Road verge (urban open space) | 0.00 | 22.14 | -22.14 |
| **TOTAL** | **1,123.56** | **844.26** | **279.30** |

## 7.11 Phosphorus

Minimal phosphorus is applied to the site. Stock are not currently grazed on the site and pasture improvement is expected to be minimal. Historical land-use of the site for cropping and grazing are expected to have resulted in increased sources of phosphorus. Off-site movement of phosphorus will occur in sediments and susceptible times are when vegetation cover is low.

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.

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 remain similar post development to pre development (Table 16).

**Table 16**. Land-use phosphorus exports pre and post development (kg/year)

| Land-use areas | Pre-development | Post-development | Impact |
|---|---|---|---|
| Disturbed landscapes | 102.15 | 61.07 | 41.08 |
| Remediated gullies | 0.00 | 0.09 | -0.09 |
| Improved pasture | 20.28 | 0.00 | 20.28 |
| Open area | 0.00 | 1.39 | -1.39 |
| Roads (sealed) | 0.00 | 5.58 | -5.58 |
| Roads (earth) | 1.03 | 0.00 | 1.03 |
| Urban | 0.00 | 55.33 | -55.33 |
| Road verge (urban open space) | 0.00 | 1.18 | -1.18 |
| **TOTAL** | **123.46** | **124.64** | **-1.18** |

## 7.12 Sediment

The nutrient balance indicates the development will reduce sediment by 22,898 kg/year under the median scenario (Table 17). Sediments are reduced due to the decrease in contribution from the disturbed area.

**Table 17.** Land-use sediment export pre and post development (kg/year)

| Land-use areas | Pre-development | Post-development | Impact |
|---|---|---|---|
| Disturbed landscapes | 71,670.60 | 42,847.50 | 28,823.10 |
| Remediated gullies | 0.00 | 62.25 | -65.25 |
| Improved pasture | 7,810.40 | 0.00 | 7,810.40 |
| Open area | 0.00 | 1,554.20 | -1,554.20 |
| Roads (sealed) | 0.00 | 589.00 | -589.00 |
| Roads (earth) | 84.00 | 0.00 | 84.00 |
| Urban | 0.00 | 9,120.00 | -9,120.00 |
| Road verge (urban open space) | 0.00 | 2,491.20 | -2,491.20 |
| **TOTAL** | **79,565.00** | **56,667.15** | **22,897.85** |

## 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 owners clean cars in commercial washing bays. Small numbers of cars will be washed on permeable areas resulting in infiltration into the reticulated stormwater system and off-site. Water and detergents infiltrating permeable areas will be utilised by vegetation. 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 saline subsoil was identified at depths greater than 4m in three boreholes. The boreholes were constructed adjacent drainage lines. Drainage lines on the site are located within reserve areas. Some disturbance of the central drainage line will occur during construction of the retention basin in the northern section of the site and of the eastern drainage line during construction of the eastern retention basin. 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

Stormwater runoff on the site will be managed by a combination of a piped reticulation system and/or use of earthern roadside culverts. The road culverts will be designed to avoid large volumes of runoff infiltrating the soil at any one location. During low rainfall events infiltration will occur which will be largely used by vegetation. At times of high rainfall the roadside culverts will enable water to be moved off-site by the intermittent drainage lines and retention basins across the site. These drainage lines will follow the existing surface water flows.

### 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 existence of deep-rooted vegetation on lots, in reserves and along the drainage lines will aid in the extraction of soil moisture within the profile and reduce the occurrence of deep 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.

#### 8.2.2.2 Discharge

No shallow groundwater discharge areas were identified on the site. It is possible the drainage line in the central section of the site is a discharge area at times of high rainfall.

The occurrence of discharge areas on and off site is not expected to increase as infiltration has been demonstrated to decrease post development. The construction of roads will include defined drainage channels which will increase runoff rates and prevent the occurrence of poorly drained areas.

#### 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 R5809s).

*(2) This clause applies to the land identified as "Groundwater vulnerability" on the Natural Resources – Groundwater Vulnerability Map.*

**Response:** The north eastern and south western sections of the site are described as having a moderately high groundwater vulnerability area. No groundwater vulnerability rating applies to the remainder of the site.

*(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 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. Maintained gardens and lawns will have the capacity to utilise the nitrogen applied. The impact of nitrogen inputs post development will be reduced.

A similar phosphorus contribution and a decrease nitrogen and suspended sediment contribution is expected in the post development scenario. Fertilizer use in the residential subdivision is expected to increase compared with the pre development land-use. Fertilizers will be utilised by the actively growing lawns and gardens around each dwelling.

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.

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. 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:**
Bore density in the locality is low indicating the current groundwater supply is not reliable or suitable for potable or stock water supply. Three groundwater bores licensed for stock or domestic and expected to be operational are located within 2km of the site. The investigation area is not expected to be a source of recharge for this groundwater. Groundwater in one bore is unconfined at depths less than 2m. Surrounding residential land-use is expected to have a more significant impact on the bore than the site. A groundwater bore licensed for irrigation is located to the north of the site. The Department of Primary Industry details for this bore indicate it was a test bore. No details are provided that the bore became operational.

Three groundwater bores are located greater than 2km north east of the site. The Department of Primary Industry details for these bores indicate they were test bores for municipal supply. No details are provided that these bores became operational.

Impact on groundwater from nitrogen contamination is expected to be less post development compared to pre-development due to a higher level of stormwater run-off from site. 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.

No industrial activities including bulk storage or use of chemicals will occur in the development.

*(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 recommendations are adopted.

Mitigation measures will be adopted within the development to off-set the unlikely impacts on groundwater quality. The mitigation measures will comprise maintaining the deep rooted vegetation in reserves and along road reserves. The vegetation will intercept groundwater and nutrients and will reduce the potential impact on groundwater quality.

### 8.3 Vegetation

The site contains a combination of sparse native grasses under cypress pine and eucalypts or native and improved grasses and broadleaved weeds in areas cleared of trees. No impact from saline soils and groundwater on the vegetation was observed.

Trees will be removed to allow construction of roads across the site and residential areas on each lot. Trees on other sections of the residential lots are expected to be retained to provide privacy between lots. Trees will be retained within reserve areas. Greater than half the trees are expected to be retained across the site.

Residential areas will be planted to introduced and native garden species including deep rooted perennials. No impact on vegetation is expected from moderately saline soils identified from 4m.

The proposed rural-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. Shallow groundwater was not identified on site. The deeper confined aquifer is not expected to be a reliable source due to the low numbers of existing bores in the area. Recent reports also 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 retained in reserves and on residential lots and additional trees planted along roadways and garden areas.

### 8.4 Infrastructure

Non to slightly saline soils were identified to a depth of 4.0m across the majority of the site which is below the footing depth for residential buildings. Moderately saline soils were identified from 4.0m drainage line areas. Retention basins are proposed for the drainage lines. Roads constructed to cross the drainage lines are expected to be at similar levels to the existing ground surface. No other development within the drainage lines are expected. Excavations that are required to be at depths greater than 4.0m in drainage lines should consider salt protected materials for services and be undertaken in accordance with building in saline areas. Groundwater was not identified on the site. 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 10 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 vacant land-use with cypress pines dominating the site. Groundcover under the cypress pines is minimal and the soil is at risk to erosion. Sediments in runoff contains significant nutrients which has potential to move in surface water flows. An increase in groundcover vegetation around dwellings will provide a biofilter resulting in reduced sediment loads exported.

Stock numbers are expected to be minimal 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. Contribution of nutrients by animals is not expected to change on the site.

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 drainage lines should be restricted to 4m depth 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 to 4m with moderately saline soils in drainage lines from 4m.

## 8.7 Other impacts of the development

Nil

**Table 18.** Impacts of development on water quality (Environmental objectives)

| 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.<br><br>Maintenance of groundcover by minimal cultivation and no grazing are important factors in reducing nitrogen export.<br><br>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.<br><br>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.<br><br>Nutrient modelling indicates phosphorous will remain similar on site post development. |
| pH | 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.<br><br>No cyanobacteria are present in fertilisers. |
| 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. |

# 9. Management recommendation

## 9.1 Design

Recommendations to mitigate impacts on salinity and groundwater are:

- Retaining and maintaining current woodland vegetation where possible. Trees will be retained in reserves and in areas outside the residential area on lots.
- Trees will be retained along drainage lines associated with subsoil salinity.
- Retain and promote additional plantings of deep rooted vegetation in lots.
- Stormwater retention basins lined with an impermeable layer.

- Design road levels similar to natural soil levels to minimise excavations.

### 9.2 Buildings

Soil saturated extract electrical conductivity ($EC_e$) was determined to be less than 3.68 dS/m in the soil samples tested within the expected footing depth range of 0.6m (exposure classification A1). 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 60mm (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 was greater than 4.4. 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 60mm (Appendix 2).

## 10. Conclusions

The site is vacant. Historical land-use was grazing with some cropping, an army training base and the majority of the trees had been removed from the site. Cypress pine regrowth has occurred across the majority of the site. Some areas were eroded. No bare areas resulting from sheet erosion or salinity were identified. The risk of erosion is low. The Dubbo (LEP) maps indicate the site is located within a vulnerable groundwater area.

Soils on the site comprised topsoil of light brown to dark brown loamy sand. Subsoils were yellow to light yellowish red clayey sand, silty clay, sandy clay and light clay. Gravel was encountered in most boreholes. Drill refusal due to rock was encountered at depths of less than 1m across the site. Groundwater was not identified in the three monitoring wells up to a depth of 12m.

The majority of the site is located within the Kintyre Hydro-geological Landscape with the eastern section within the Cumboogle Hydro-geological Landscape. Lithology of the Kintyre Hydro-geological Landscape consists of Napperby Formation overlying the deeper Purlewaugh Formation. The Kintyre HGL is relatively non-saline in the upper areas and shows moderate salinity in the lower elements of the landscape at changes in geology. Some salinity also occurs along drainage lines and depressions. Groundwater flow is unconfined to semi-confined flows in consolidated rock. Groundwater electrical conductivity is low to moderate.

Lithology of the Cumboogle Hydro-geological Landscape consists of Napperby Formation. Soil salinity is isolated at edges of rises and low hills as well as seasonally at sites adjacent to creek lines and depressions. Low salt loads exist as a result of sandy soils with limited salt stored and infrequent stream flow. Groundwater flow is unconfined to semi-confined in consolidated fractured rock. Groundwater salinity is fresh to brackish.

Subsoils in the majority of the site were classified as non-saline to slightly saline. Moderately saline subsoils were identified from 4m in boreholes constructed adjacent to drainage lines. These locations are consistent with the Kintyre HGL where salinity can occur along drainage lines and depressions. No special design considerations are expected to be required for roads or buidligns due to the depth to saline soils.

Groundwater was not identified on the site to depths of 10m. Infiltration of groundwater over most of the site will not result in mobilisation of salts.

The CLASS modelling indicated infiltration was episodic and similar to rainfall. The land-use scenarios modelled resulted in excess soil moisture of 0.06mm for pasture and 0.03mm for irrigated lawn at 1m depth. Greater excess moisture under the pasture scenario is associated with the dormancy over summer and times of irregular rainfall which are unable to be utilised. The excess moisture under the pasture and lawn scenario did not result in excess soil moisture at the 3m depth. Land-use scenarios of verges, trees and trees plus 1mm utilised all rainfall and additional moisture was did not result in excess soil moisture at 3m depth.

Nutrient and sediment modelling of surface water indicated no change or an improvement following the development.

No groundwater discharge areas were identified on the site. Few potable and stock supply bores have been constructed in the locality indicating the shallow and deeper aquifer is not a reliable source of groundwater.

The majority of Dubbo City Council monitoring bores have been dry since the start of monitoring. Moderate to high saline groundwater has been identified historically in one Dubbo City Council monitoring bore. Recent results indicate groundwater salinity has reduced to low to moderate. Groundwater in other monitoring wells had a low salinity.

The risk of groundwater contamination from the proposed land-use will be less than the current land-use. A change in land-use from disturbed treed areas with little groundcover to vegetated areas of lawn and garden offsets any additional nitrogen and phosphorus which may be applied to the site as fertilizers. 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

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:

- Retaining and maintaining current woodland vegetation where possible. Trees will be retained in reserves and in areas outside the residential area on lots.
- Trees will be retained along drainage lines associated with subsoil salinity
- Promote additional plantings of deep rooted vegetation in road reserves and lots.
- Stormwater retention basins lined with an impermeable layer.
- Design road levels similar to natural soil levels to minimise excavations.

## 12. 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.

## 13. References

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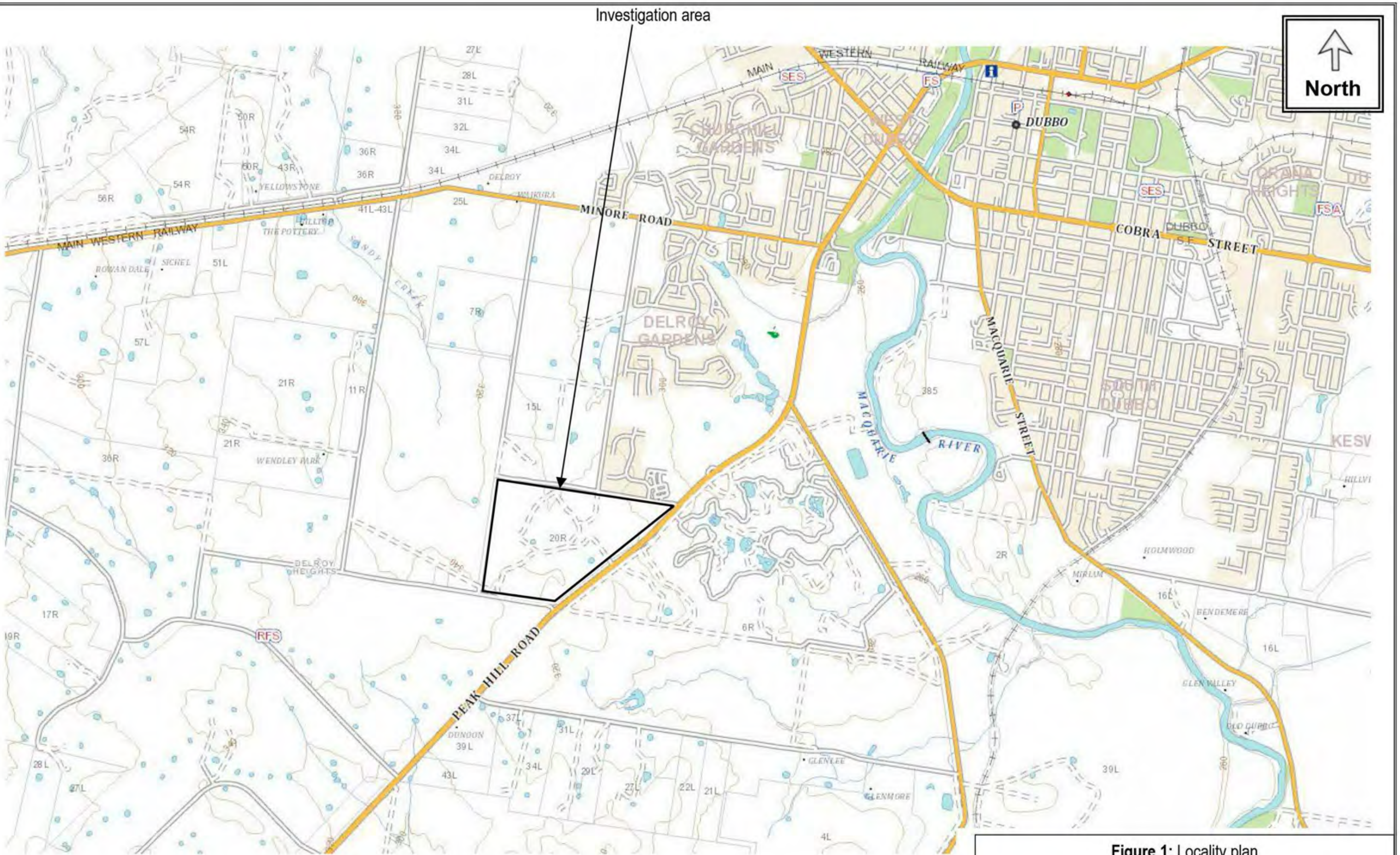
## Figures




| | | |
|---|---|---|
| **Figure 1:** Locality plan | | |
| Lot 172 DP753233 Blackbutt Road, Dubbo NSW | | |
| | Envirowest Consulting Pty Ltd | |
| Job – R5809s | Drawn by: LD | Date: 19/10/2015 |


**Legend**

Lot boundary

**Approximate Scale 1: 8,900**

0 89 178 356m

**Figure 2:** Aerial photograph

Lot 172 DP753233 Blackbutt Road, Dubbo NSW

Envirowest Consulting Pty Ltd

| Job: R5809c | Drawn by: LD | Date: 18/11/2015 |
|---|---|---|

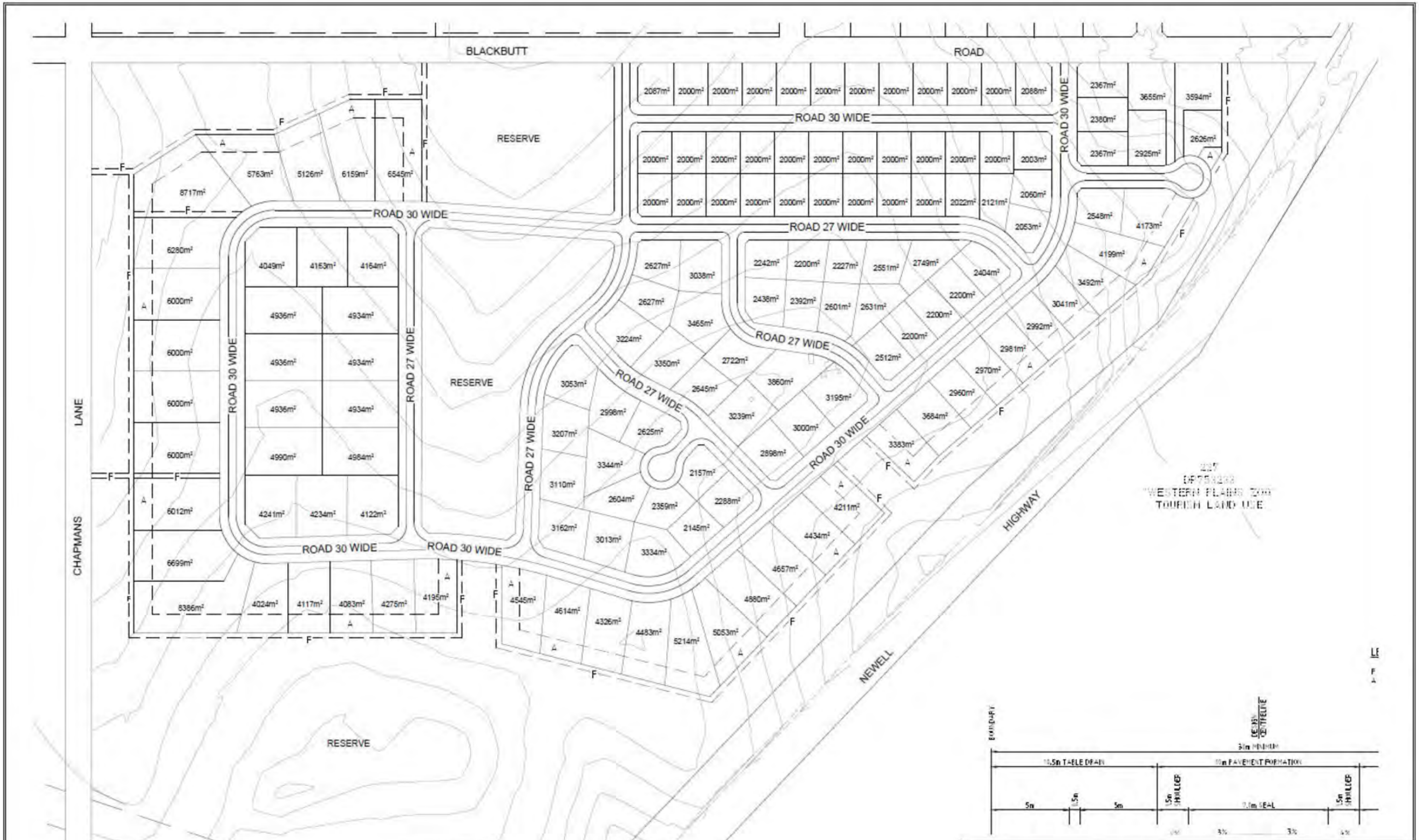
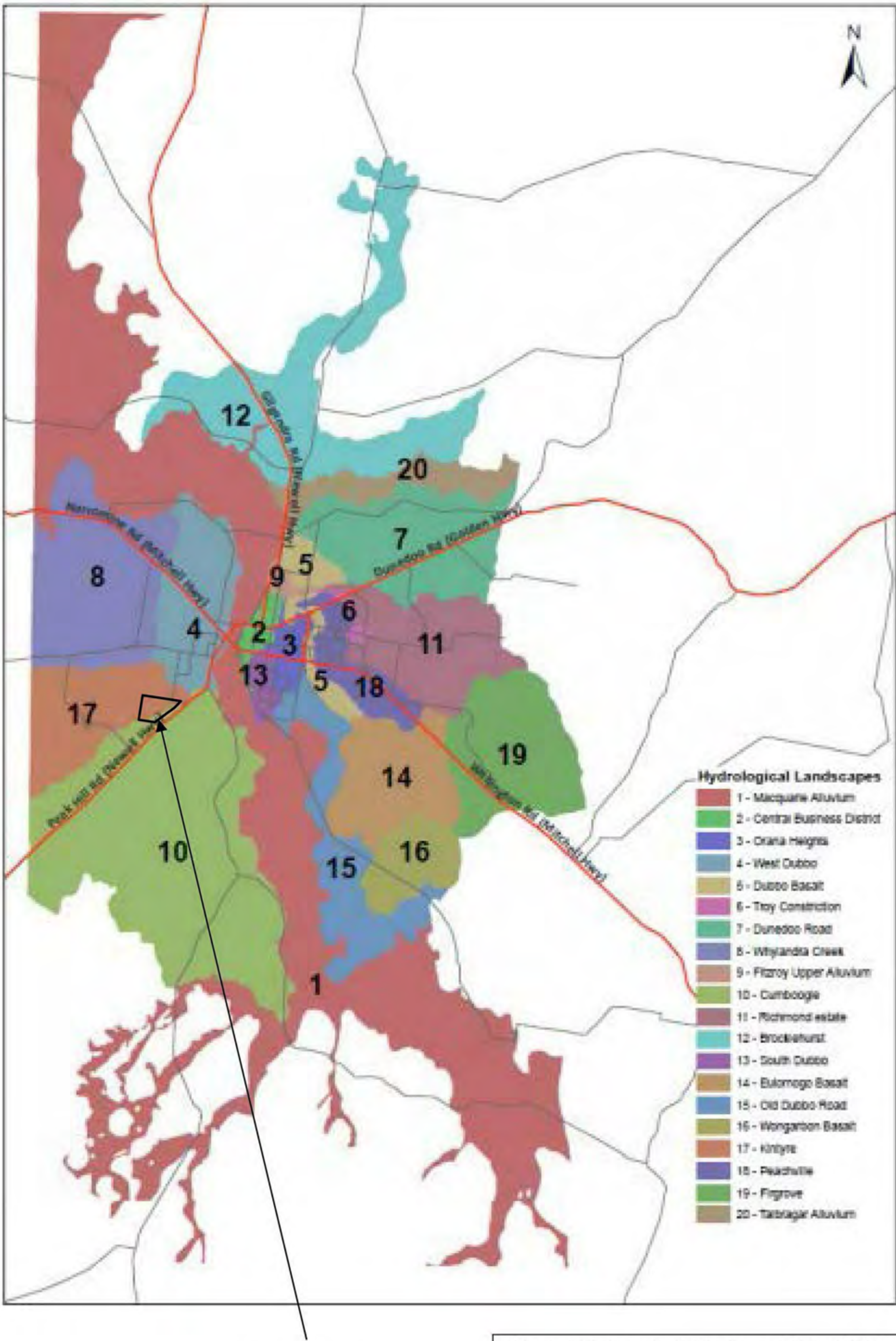



**Figure 3:** Proposed site plan

Lot 172 DP753233 Blackbutt Road, Dubbo NSW

Envirowest Consulting Pty Ltd

| Job: R5809c | Drawn by: Geolyse | Date: 18/11/2015 |
|---|---|---|




Investigation area

| **Figure 4:** Hydro-geological landscapes of the Dubbo area | | |
|---|---|---|
| Lot 172 DP753233 Blackbutt Road, Dubbo NSW | | |
| | Envirowest Consulting Pty Ltd | |
| Job – R5809s | Drawn by: - | Date: 21/10/2015 |

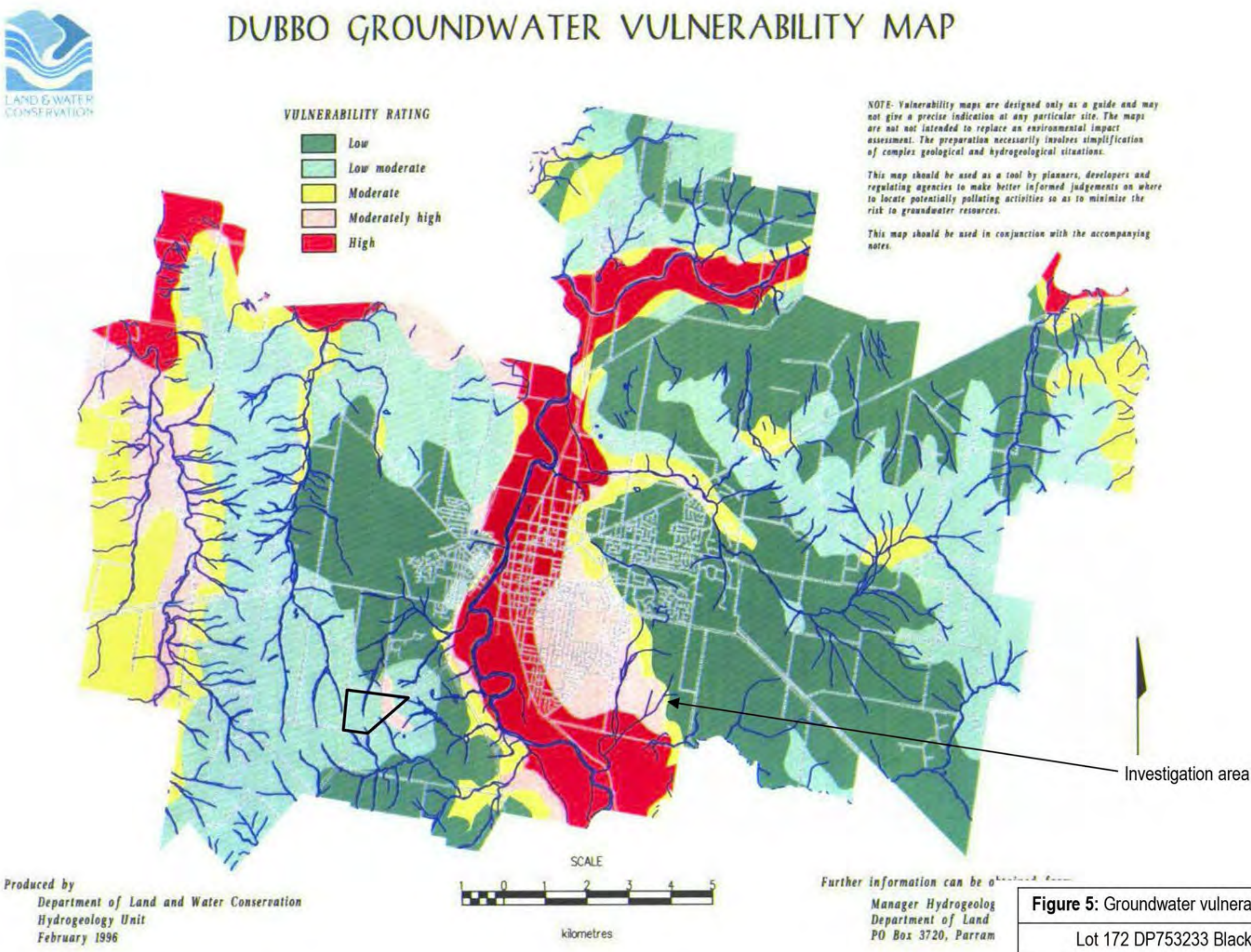



**Figure 5:** Groundwater vulnerability map of Dubbo - DECCW

Lot 172 DP753233 Blackbutt Road, Dubbo NSW

Envirowest Consulting Pty Ltd

Job: R5809s | Drawn by: - | Date: 20/11/2015

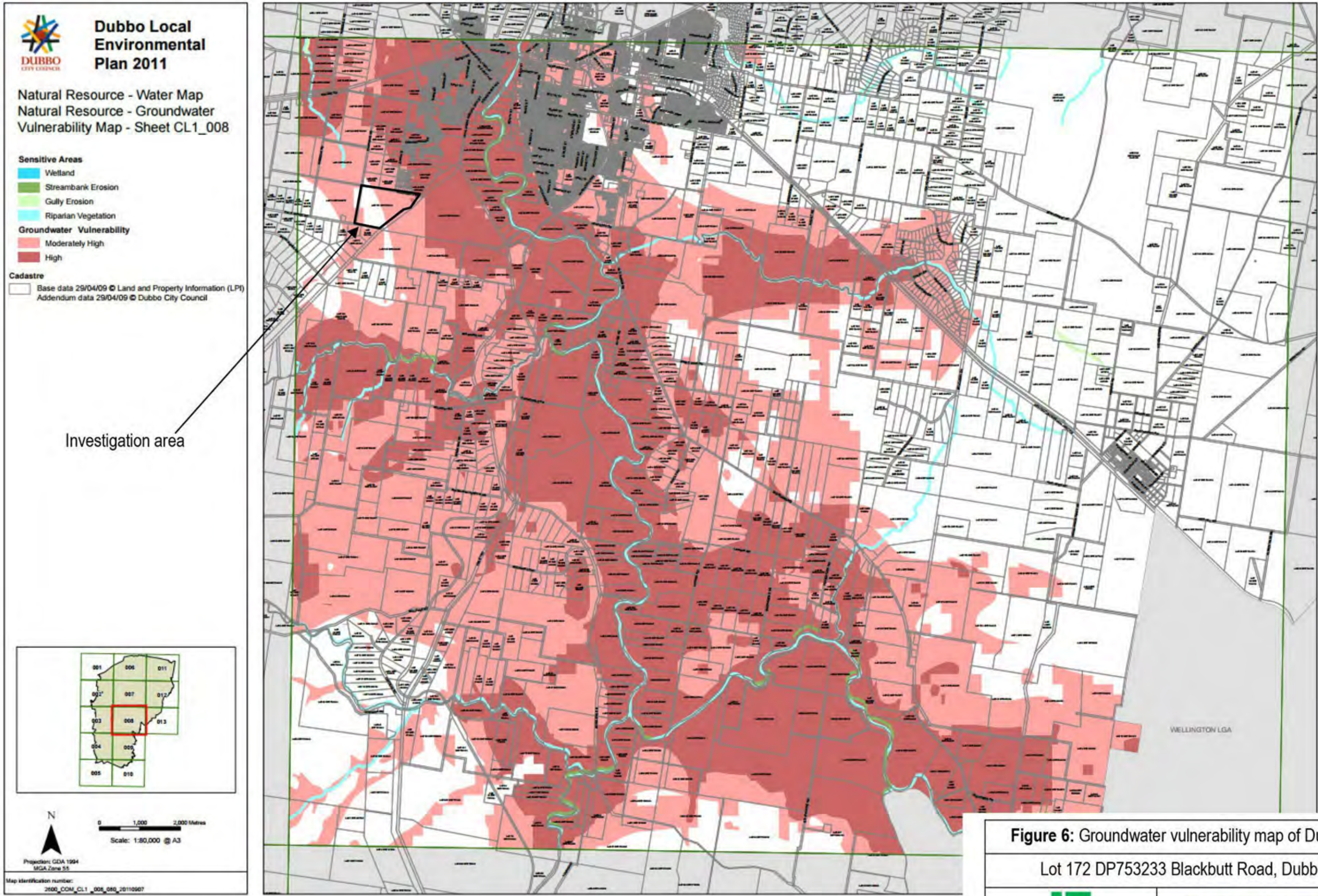
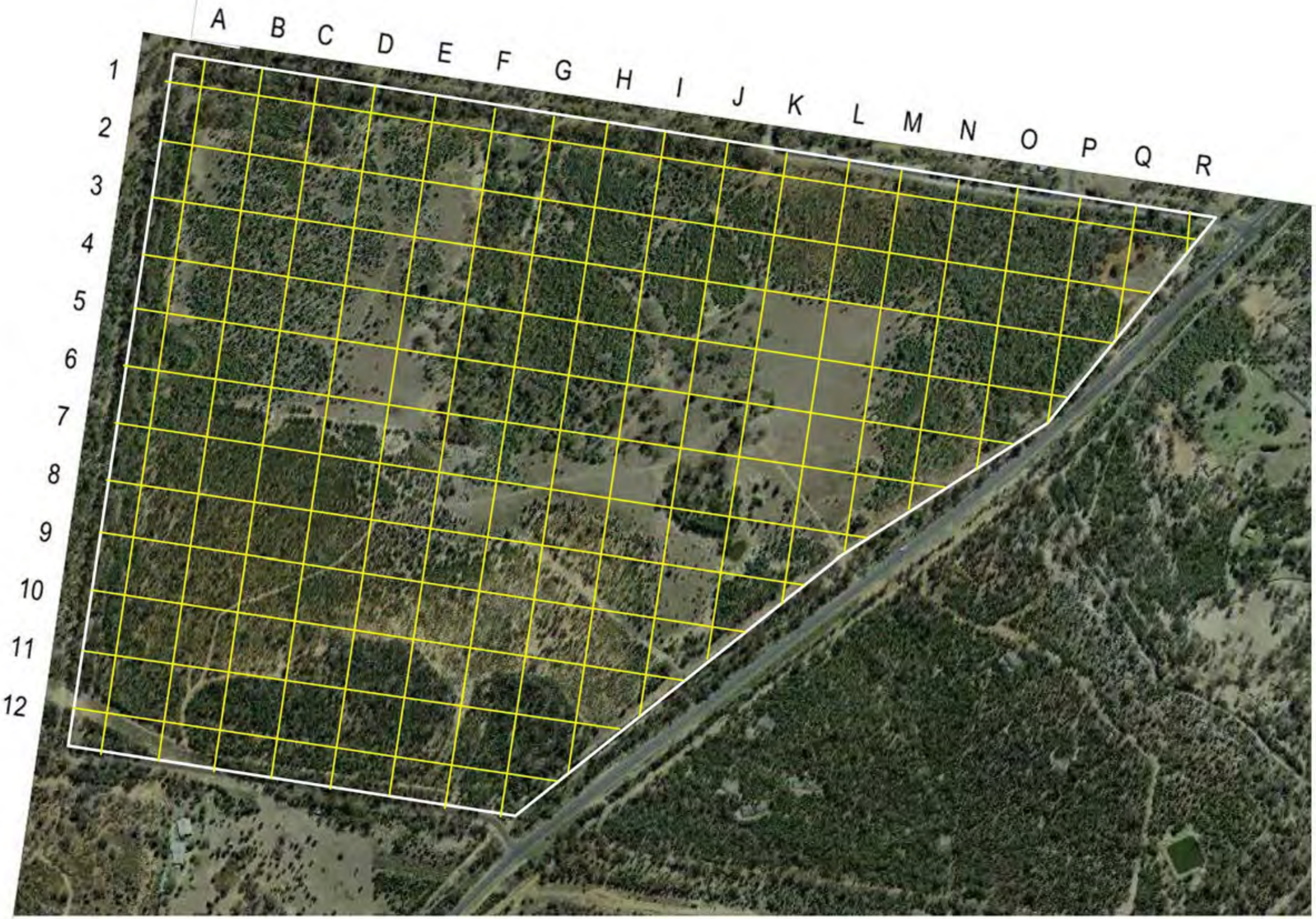



**Figure 6:** Groundwater vulnerability map of Dubbo - DCC

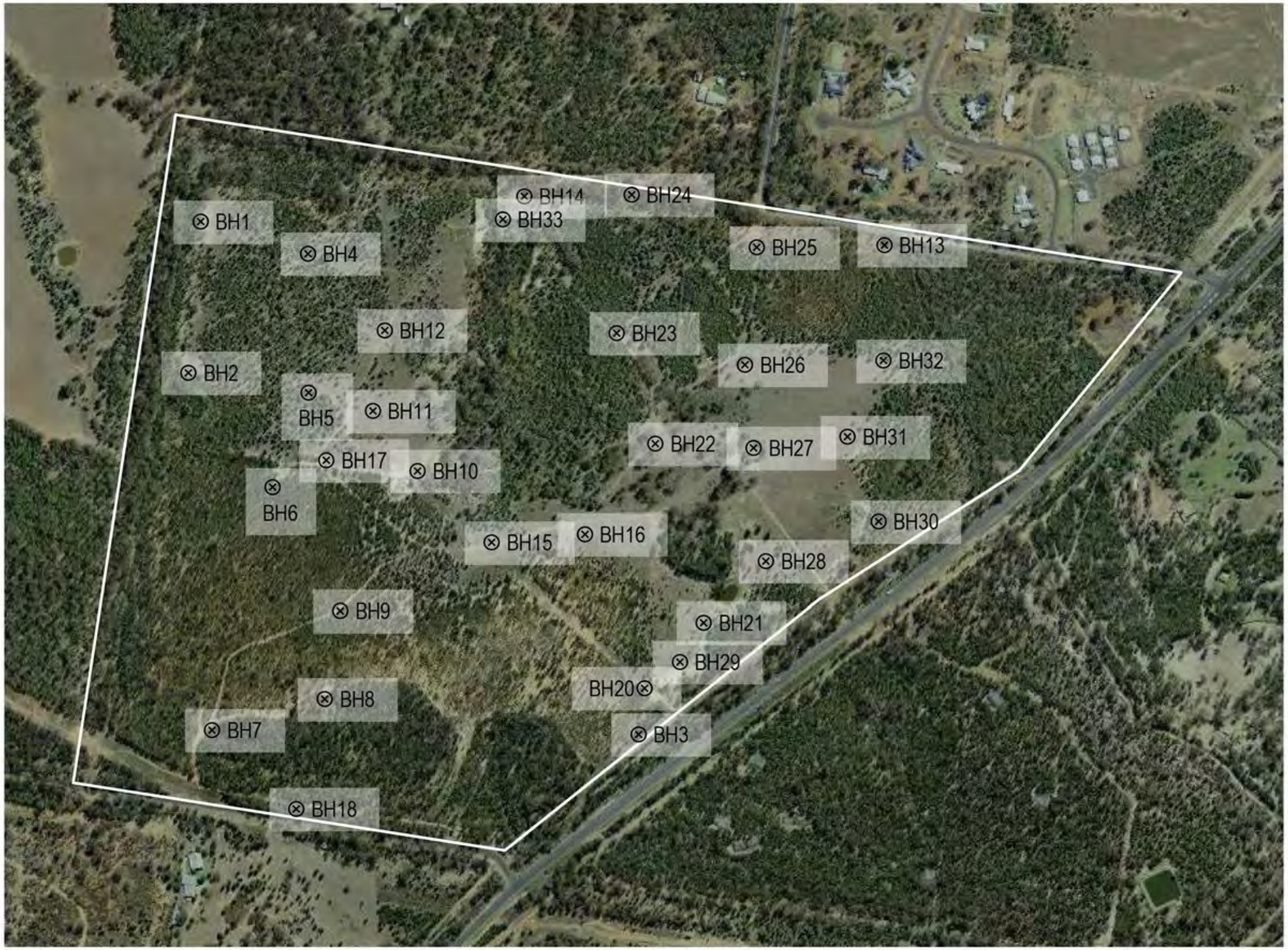
Lot 172 DP753233 Blackbutt Road, Dubbo NSW

| | |
|---|---|
| | Envirowest Consulting Pty Ltd |

| | | |
|---|---|---|
| Job: R5809s | Drawn by: - | Date: 20/11/2015 |



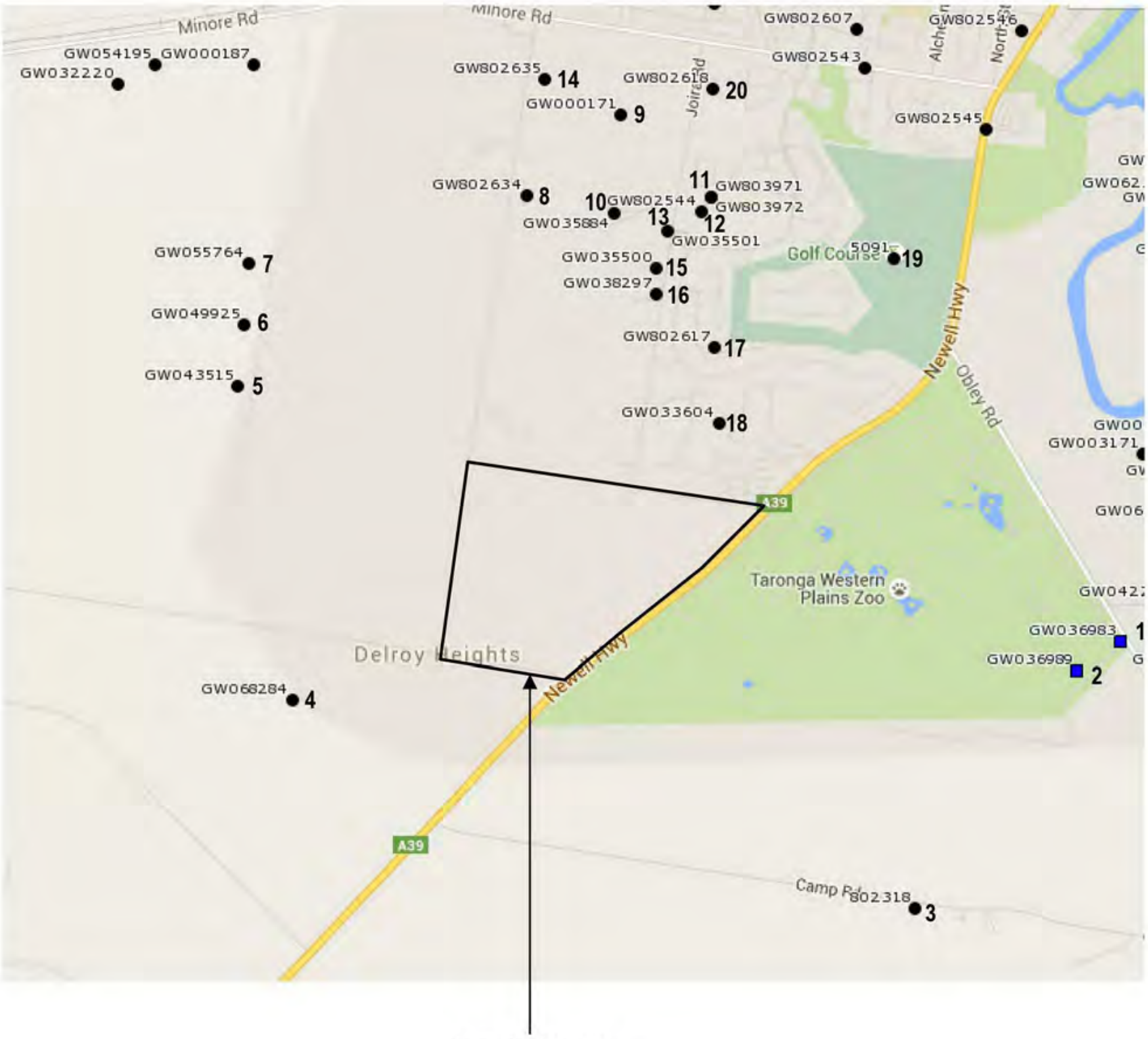

| | | |
|---|---|---|
| **Figure 7:** Initial investigation locations | | |
| Lot 172 DP753233 Blackbutt Road, Dubbo NSW | | |
| | Envirowest Consulting Pty Ltd | |
| Job – R5809s | Drawn by: LD | Date: 18/11/2015 |



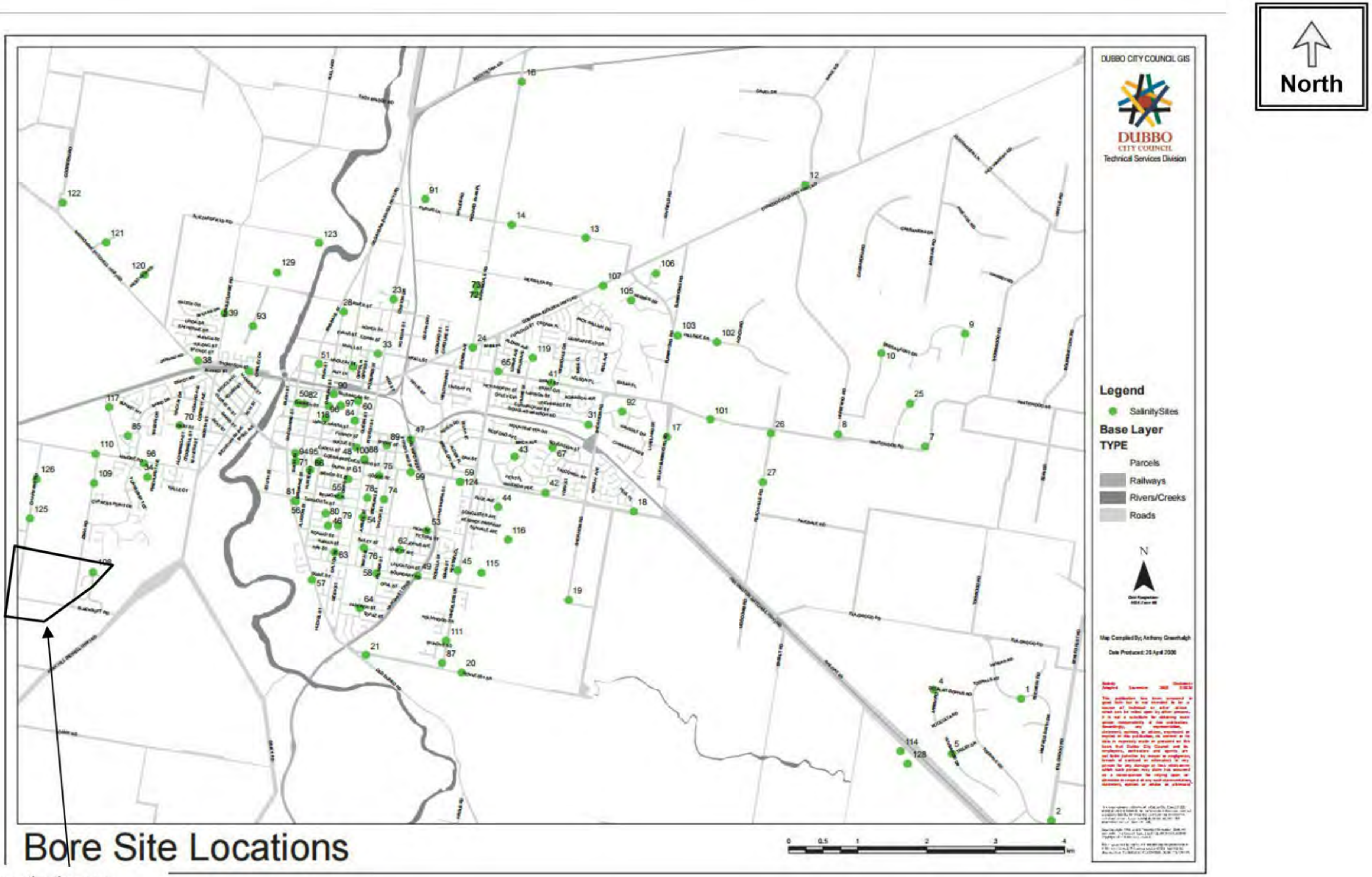

**Approximate Scale 1: 9,500**

0 95 190 380m

| **Figure 8:** Detailed investigation locations | | |
|---|---|---|
| Lot 172 DP753233 Blackbutt Road, Dubbo NSW | | |
| | Envirowest Consulting Pty Ltd | |
| Job: R5809s | Drawn by: LD | Date: 19/11/2015 |

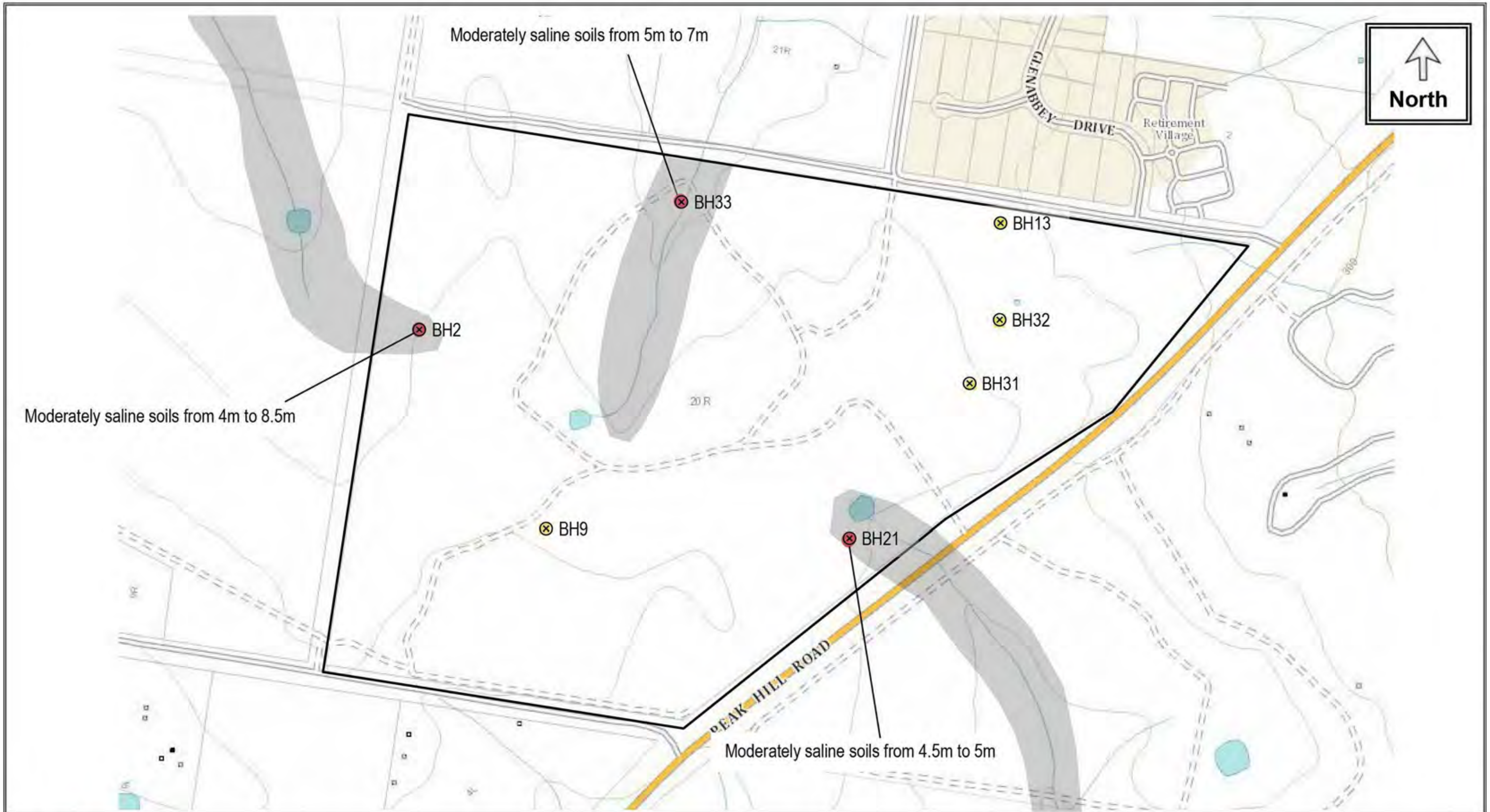



| | | |
|---|---|---|
| **Figure 9:** Location of groundwater bores within 2km of the site | | |
| Lot 172 DP753233 Blackbutt Road, Dubbo NSW | | |
| | Envirowest Consulting Pty Ltd | |
| Job – R5809s | Drawn by: LD | Date: 11/11/2015 |




Investigation area

| | | |
|---|---|---|
| **Figure 10:** Dubbo City Council Salinity Network | | |
| Lot 172 DP753233 Blackbutt Road, Dubbo NSW | | |
| | Envirowest Consulting Pty Ltd | |
| Job: R5809s | Drawn by: LD | Date: 19/11/2015 |




## Legend

Investigation area

Saline soil identified in profile

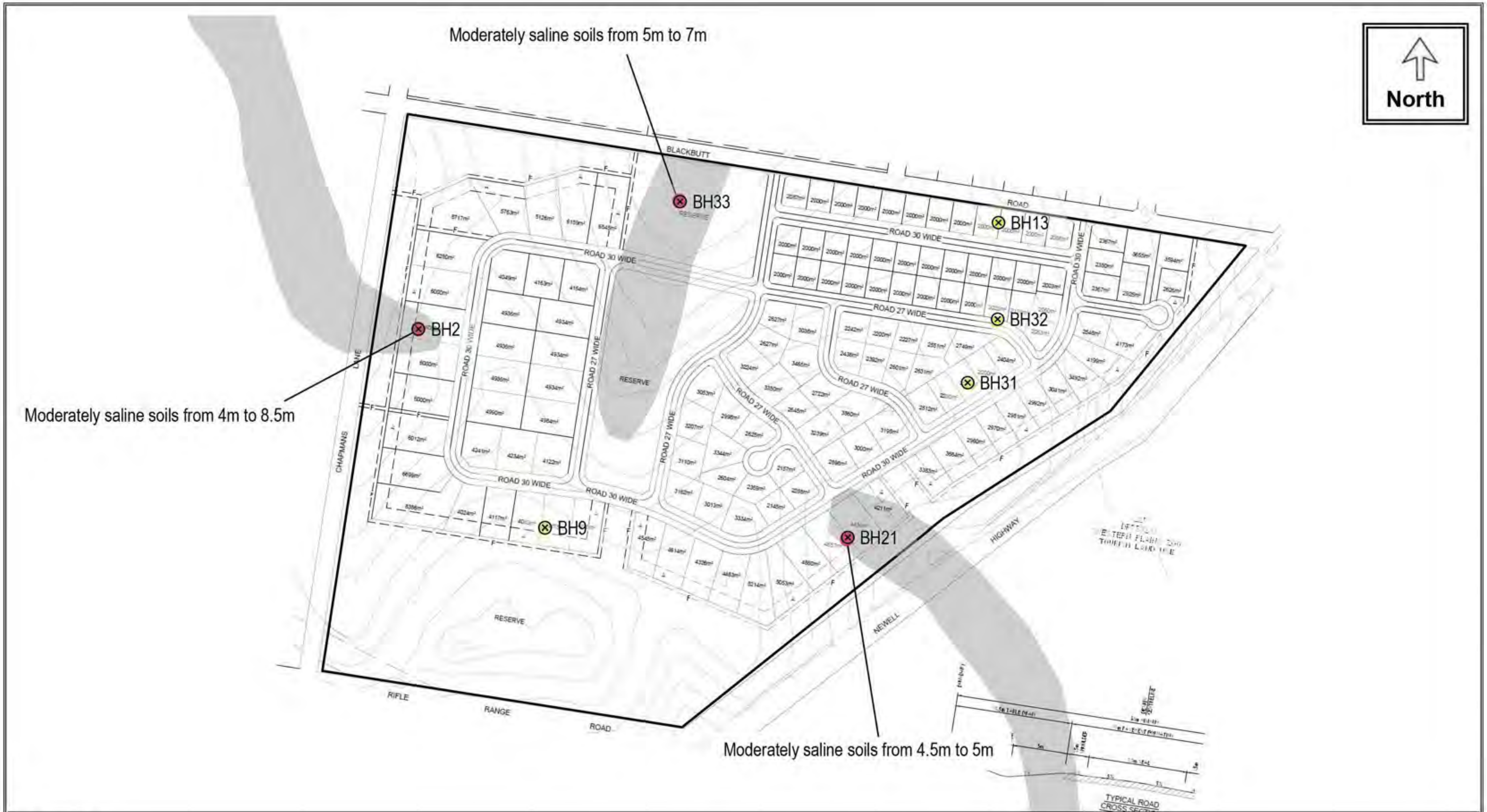
Non-saline to slightly saline soil identified in soil profile to drilling depth

Moderately saline soil expected from 4m under the drainage line

**Approximate Scale 1: 9,500**

0 95 190 380m

| | | |
|---|---|---|
| **Figure 11:** Areas of moderate salinity over topographic plan | | |
| Lot 172 DP753233 Blackbutt Road, Dubbo NSW | | |
| Envirowest Consulting Pty Ltd | | |
| Job: R5809s | Drawn by: LD | Date: 8/12/2015 |




**Legend**

Investigation area

Saline soil identified in profile

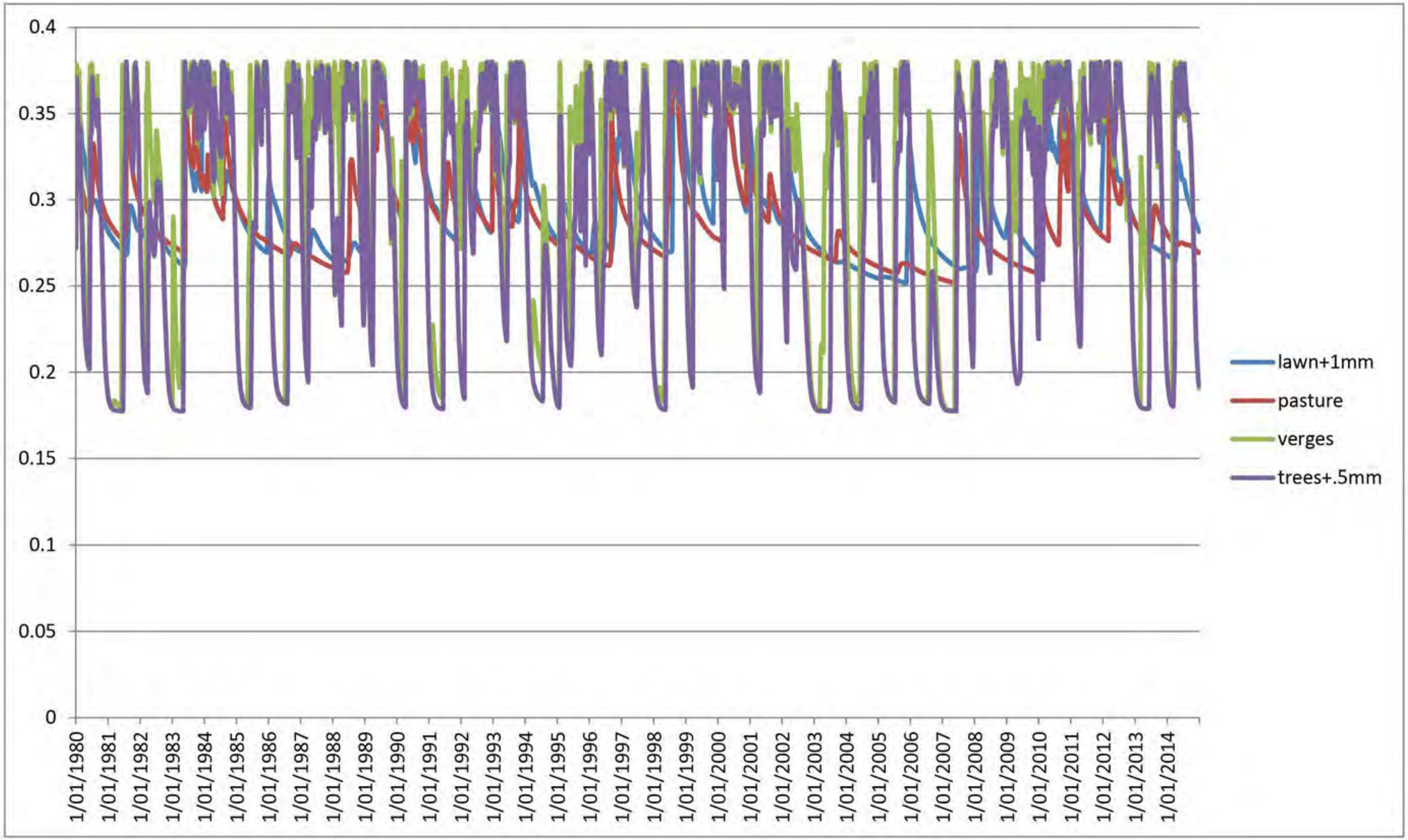
Non-saline to slightly saline soil identified in soil profile to drilling depth

Moderately saline soil expected from 4m under the drainage line

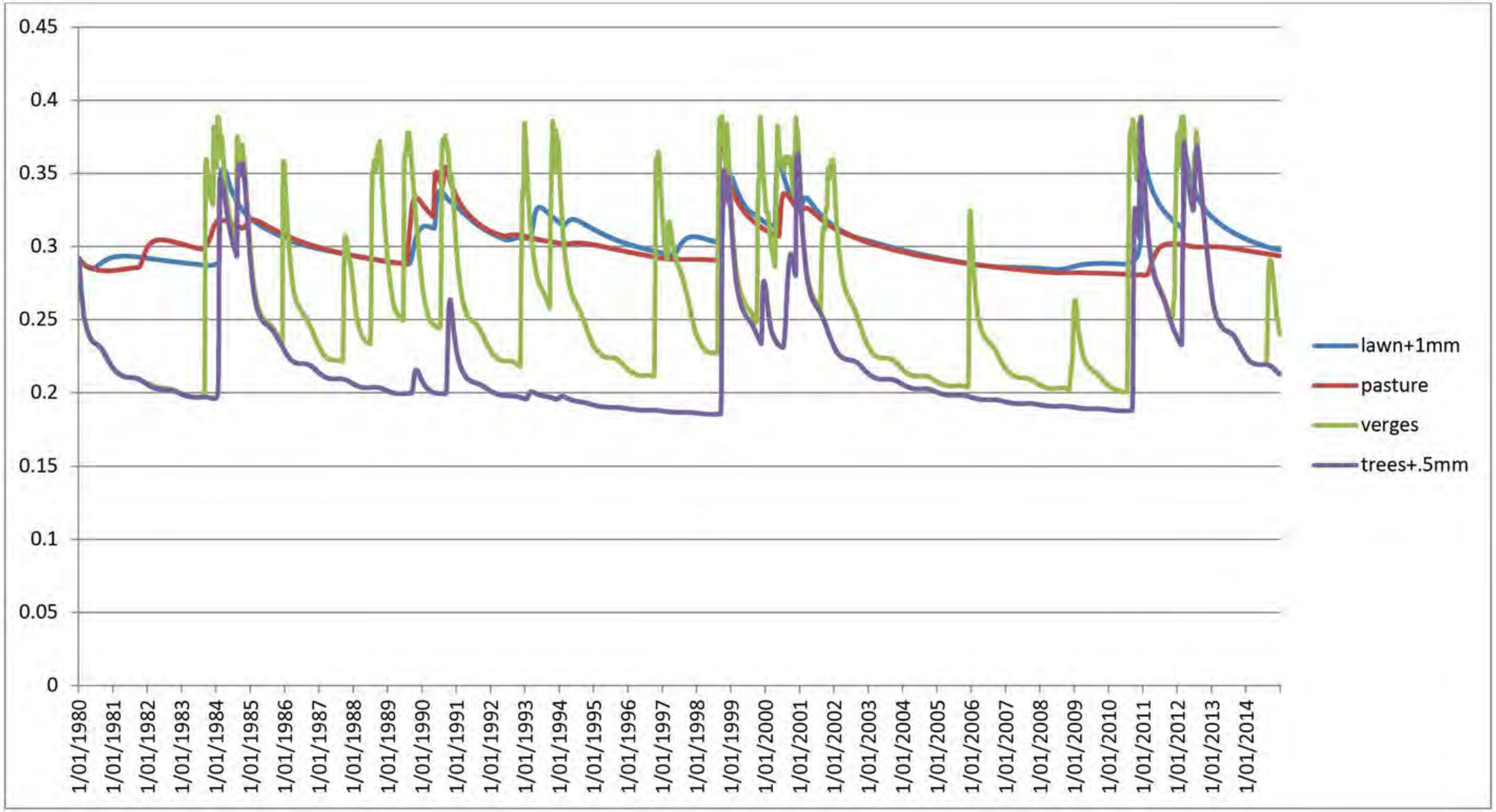
**Approximate Scale 1: 9,500**

0 95 190 380m

| | | |
|---|---|---|
| **Figure 12:** Areas of moderate salinity over proposed development plan | | |
| Lot 172 DP753233 Blackbutt Road, Dubbo NSW | | |
| | Envirowest Consulting Pty Ltd | |
| Job: R5809s | Drawn by: LD | Date: 8/12/2015 |




| **Figure 13.** Soil moisture (%) at 1m in modelling scenarios | | |
|---|---|---|
| Lot 172 DP753233 Blackbutt Road, Dubbo NSW | | |
| | Envirowest Consulting Pty Ltd | |
| Job – R5809s | Drawn by: LD | Date: 19/11/2015 |




| **Figure 14.** Soil moisture (%) at 3m depth in modelling scenarios | | |
|---|---|---|
| Lot 172 DP753233 Blackbutt Road, Dubbo NSW | | |
| | Envirowest Consulting Pty Ltd | |
| Job – R5809s | Drawn by: LD | Date: 19/11/2015 |

**Figure 15.** Photographs of 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 ES1508739 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)

| Land use class | Suspended sediment (kg/ha/yr) | | |
|---|---|---|---|
| | 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 class | Total Nitrogen (kg/ha/yr) | | |
|---|---|---|---|
| | Low | Median | High |
| Native bushland | 0.9 | 2.4 | 4 |
| Disturbed landscapes | 4.2 | 12 | 20 |
| Remediated gullies | 2.1 | 6 | 10 |
| Cropped | 4.2 | 8.9 | 13.5 |
| Pine plantations | 0.8 | 2.9 | 8.3 |
| Improved pasture | 4.2 | 8.9 | 13.5 |
| Unimproved pasture | 1.3 | 3.2 | 5.1 |
| Roads (sealed) | 2 | 6 | 10 |
| Roads (earth) | 1.3 | 2.2 | 3.1 |
| 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 |

| Land use class | Total Phosphorus | | |
|---|---|---|---|
| | 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 | 0.00 | 0.00 |
| Disturbed landscapes | 27185.40 | 16252.50 | 10932.90 |
| Remediated gullies | 0.00 | 24.75 | -24.75 |
| Cropped | 0.00 | 0.00 | 0.00 |
| Pine plantations | 0.00 | 0.00 | 0.00 |
| Improved pasture | 2102.80 | 0.00 | 2102.80 |
| Unimproved pasture | 0.00 | 1145.20 | -1145.20 |
| Roads (sealed) | 0.00 | 434.00 | -434.00 |
| Roads (earth) | 15.00 | 0.00 | 15.00 |
| Urban | 0.00 | 912.00 | -912.00 |
| Urban (open space) | 0.00 | 1107.20 | -1107.20 |
| 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** | **29303.20** | **19875.65** | **9427.55** |

| MEDIAN | PRE | POST | IMPACT |
|---|---|---|---|
| Native bushland | 0.00 | 0.00 | 0.00 |
| Disturbed landscapes | 71670.60 | 42847.50 | 28823.10 |
| Remediated gullies | 0.00 | 65.25 | -65.25 |
| Cropped | 0.00 | 0.00 | 0.00 |
| Pine plantations | 0.00 | 0.00 | 0.00 |
| Improved pasture | 7810.40 | 0.00 | 7810.40 |
| Unimproved pasture | 0.00 | 1554.20 | -1554.20 |
| Roads (sealed) | 0.00 | 589.00 | -589.00 |
| Roads (earth) | 84.00 | 0.00 | 84.00 |
| Urban | 0.00 | 9120.00 | -9120.00 |
| Urban (open space) | 0.00 | 2491.20 | -2491.20 |
| 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** | **79565.00** | **56667.15** | **22897.85** |

| HIGH | PRE | POST | IMPACT |
|---|---|---|---|
| Native bushland | 0.00 | 0.00 | 0.00 |
| Disturbed landscapes | 188650.20 | 112782.50 | 75867.70 |
| Remediated gullies | 0.00 | 171.75 | -171.75 |
| Cropped | 0.00 | 0.00 | 0.00 |
| Pine plantations | 0.00 | 0.00 | 0.00 |
| Improved pasture | 13067.40 | 0.00 | 13067.40 |
| Unimproved pasture | 0.00 | 1881.40 | -1881.40 |
| Roads (sealed) | 0.00 | 713.00 | -713.00 |
| Roads (earth) | 300.00 | 0.00 | 300.00 |
| Urban | 0.00 | 36480.00 | -36480.00 |
| Urban (open space) | 0.00 | 6920.00 | -6920.00 |
| 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** | **202017.60** | **158948.65** | **43068.95** |

**Total Nitrogen kg/yr**

| LOW | PRE | POST | IMPACT |
|---|---|---|---|
| Native bushland | 0.00 | 0.00 | 0.00 |
| Disturbed landscapes | 346.00 | 206.85 | 139.15 |
| Remediated gullies | 0.00 | 0.32 | -0.32 |
| Cropped | 0.00 | 0.00 | 0.00 |
| Pine plantations | 0.00 | 0.00 | 0.00 |
| Improved pasture | 63.08 | 0.00 | 63.08 |
| Unimproved pasture | 0.00 | 10.63 | -10.63 |
| Roads (sealed) | 0.00 | 6.20 | -6.20 |
| Roads (earth) | 0.78 | 0.00 | 0.78 |
| Urban | 0.00 | 66.88 | -66.88 |
| Urban (open space) | 0.00 | 9.00 | -9.00 |
| 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** | **409.86** | **299.88** | **109.99** |

| MEDIAN | PRE | POST | IMPACT |
|---|---|---|---|
| Native bushland | 0.00 | 0.00 | 0.00 |
| Disturbed landscapes | 988.56 | 591.00 | 397.56 |
| Remediated gullies | 0.00 | 0.90 | -0.90 |
| Cropped | 0.00 | 0.00 | 0.00 |
| Pine plantations | 0.00 | 0.00 | 0.00 |
| Improved pasture | 133.68 | 0.00 | 133.68 |
| Unimproved pasture | 0.00 | 26.18 | -26.18 |
| Roads (sealed) | 0.00 | 18.60 | -18.60 |
| Roads (earth) | 1.32 | 0.00 | 1.32 |
| Urban | 0.00 | 185.44 | -185.44 |
| Urban (open space) | 0.00 | 22.14 | -22.14 |
| 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** | **1123.56** | **844.26** | **279.30** |

| HIGH | PRE | POST | IMPACT |
|---|---|---|---|
| Native bushland | 0.00 | 0.00 | 0.00 |
| Disturbed landscapes | 1647.60 | 985.00 | 662.60 |
| Remediated gullies | 0.00 | 1.50 | -1.50 |
| Cropped | 0.00 | 0.00 | 0.00 |
| Pine plantations | 0.00 | 0.00 | 0.00 |
| Improved pasture | 202.77 | 0.00 | 202.77 |
| Unimproved pasture | 0.00 | 41.72 | -41.72 |
| Roads (sealed) | 0.00 | 31.00 | -31.00 |
| Roads (earth) | 1.86 | 0.00 | 1.86 |
| Urban | 0.00 | 304.00 | -304.00 |
| Urban (open space) | 0.00 | 35.29 | -35.29 |
| 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** | **1852.23** | **1398.51** | **453.72** |

**Total Phosphorus kg/yr**

| **LOW** | **PRE** | **POST** | **IMPACT** |
|---|---|---|---|
| Native bushland | 0.00 | 0.00 | 0.00 |
| Disturbed landscapes | 24.71 | 14.78 | 9.94 |
| Remediated gullies | 0.00 | 0.02 | -0.02 |
| Cropped | 0.00 | 0.00 | 0.00 |
| Pine plantations | 0.00 | 0.00 | 0.00 |
| Improved pasture | 7.51 | 0.00 | 7.51 |
| Unimproved pasture | 0.00 | 0.82 | -0.82 |
| Roads (sealed) | 0.00 | 0.93 | -0.93 |
| Roads (earth) | 0.18 | 0.00 | 0.18 |
| Urban | 0.00 | 6.08 | -6.08 |
| Urban (open space) | 0.00 | 0.69 | -0.69 |
| 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** | **32.40** | **23.32** | **9.09** |

| **MEDIAN** | **PRE** | **POST** | **IMPACT** |
|---|---|---|---|
| Native bushland | 0.00 | 0.00 | 0.00 |
| Disturbed landscapes | 102.15 | 61.07 | 41.08 |
| Remediated gullies | 0.00 | 0.09 | -0.09 |
| Cropped | 0.00 | 0.00 | 0.00 |
| Pine plantations | 0.00 | 0.00 | 0.00 |
| Improved pasture | 20.28 | 0.00 | 20.28 |
| Unimproved pasture | 0.00 | 1.39 | -1.39 |
| Roads (sealed) | 0.00 | 5.58 | -5.58 |
| Roads (earth) | 1.03 | 0.00 | 1.03 |
| Urban | 0.00 | 55.33 | -55.33 |
| Urban (open space) | 0.00 | 1.18 | -1.18 |
| 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** | **123.46** | **124.64** | **-1.18** |

| **HIGH** | **PRE** | **POST** | **IMPACT** |
|---|---|---|---|
| Native bushland | 0.00 | 0.00 | 0.00 |
| Disturbed landscapes | 181.24 | 108.35 | 72.89 |
| Remediated gullies | 0.00 | 0.17 | -0.17 |
| Cropped | 0.00 | 0.00 | 0.00 |
| Pine plantations | 0.00 | 0.00 | 0.00 |
| Improved pasture | 33.04 | 0.00 | 33.04 |
| Unimproved pasture | 0.00 | 2.05 | -2.05 |
| Roads (sealed) | 0.00 | 10.54 | -10.54 |
| Roads (earth) | 1.92 | 0.00 | 1.92 |
| Urban | 0.00 | 109.44 | -109.44 |
| Urban (open space) | 0.00 | 1.73 | -1.73 |
| 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** | **216.20** | **232.27** | **-16.07** |

**Appendix 2.** Aggressive soils, extract from Australian Standards, *AS 2870-2011*, 2011

### Exposure classification for concrete in saline soils

| Saturated extract electrical conductivity ($EC_e$), *dS/m* | Exposure classification |
|---|---|
| <4 | A1 |
| 4-8 | A2 |
| 8-16 | B1 |
| >16 | B2 |

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 ($EC_e$)
4. The division between a non-saline and saline soil is generally regarded as an $EC_e$ 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 (expressed as $SO_4$)* | | pH | Soil conditions A** | Soil conditions B† |
| In soil (ppm) | In groundwater (ppm) | | | |
| <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 $SO_4$ = 80ppm $SO_3$

** 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

| Exposure classification | Minimum $f_c'$ MPa | Minimum initial curing requirement |
|---|---|---|
| A1 | 20 | Cure continuously for at least 3 days |
| A2 | 25 | |
| B1 | 32 | Cure continuously for at least 7 days |
| B2 | 40 | |
| C1 | ≥50 | |
| C2 | ≥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 2km of the site – NSW Department of Primary Industries.

| No | 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 |
|---|---|---|---|---|---|---|---|---|---|
| 1 | GW036983 | 650071 | 6427304 | 25.5 | 6680<br>10040 | 11-12<br>12-14 | 7.8 | 1994 | Monitoring |
| 2 | GW036989 | 649849 | 6427161 | 39 | Very salty | 12-13 | 14.35 | 1995 | Monitoring |
| 3 | GW802318 | 649018 | 6425989 | 42 | - | 37 | 21 | 2001 | Stock, domestic, irrigation |
| 4 | GW068284 | 645927 | 6427076 | - | - | - | - | 1989 | Stock/Domestic |
| 5 | GW043515 | 645676 | 6428636 | 118.8 | - | 70.71 | 70.1 | 1972 | Piggery, domestic, stock |
| 6 | GW049925 | 645707 | 6428944 | - | - | - | - | 1978 | Farming |
| 7 | GW055764 | 645809 | 6429251 | 86.9 | - | 62.5-94.9 | 36.6 | 1983 | Stock, domestic |
| 8 | GW802634 | 647136 | 6429570 | 3 | - | 2.25-3 | - | 2005 | Monitoring |
| 9 | GW000171 | 647606 | 6429964 | 100.3 | - | - | - | 1918 | Monitoring |
| 10 | GW035884 | 647573 | 6429471 | 2.3 | - | 1.9 | 0.9 | 1973 | Domestic |
| 11 | GW803971 | 648057 | 6429547 | 9.8 | - | 7.8 | 7.3 | 2009 | Monitoring |
| 12 | GW802544 | 648005 | 6429476 | 3 | - | - | - | 2004 | - |
| 13 | GW035501 | 647833 | 6429375 | 42.7 | - | - | - | 1973 | Domestic/Stock |
| 14 | GW802635 | 647234 | 6430141 | 2 | - | 1.25-2 | - | 2005 | Monitoring |
| 15 | GW035500 | 647778 | 6429191 | 42.7 | - | - | - | - | Domestic/Stock |
| 16 | GW038297 | 647776 | 6429068 | - | - | - | - | 1973 | Stock/domestic |
| 17 | GW802617 | 648057 | 6428795 | 3 | - | 2.25-3 | - | 2005 | Monitoring |
| 18 | GW033604 | 648081 | 6428417 | 81.7 | - | - | - | 1970 | Irrigation, test bore |
| 19 | GW805091 | 648965 | 6429224 | 182 | - | 12.2-15 | 10.34 | 2013 | Test bore (backfilled) |
| | | | | | | 15-29.5 | 10.34 | | |
| | | | | | | 145-146 | 10.34 | | |
| 20 | GW802618 | 648068 | 6430084 | 6 | - | 4-5.5 | 3.55 | 2005 | Monitoring |

**Appendix 5.** Salinity and Standing Water Level (SWL) data from Dubbo City Council Salinity Network

| Dubbo City Council Salinity Network site number (Figure 10) | | DCC34 | DCC108 | DCC109 | DCC125 | DCC126 |
|---|---|---|---|---|---|---|
| **Sampling date** | **Drilled depth (m)** | **6** | **3** | **6** | **3** | **2** |
| Mar-05 | EC(dS/m) | 10.8 | - | 0.7 | - | - |
| | SWL (m) | 3.73 | 0 | 3.55 | 0 | 0 |
| Apr-05 | EC(dS/m) | 10.3 | - | 1.1 | - | - |
| | SWL (m) | 3.93 | 0 | 3.87 | 0 | 0 |
| May-05 | EC(dS/m) | 11 | - | 1.3 | - | - |
| | SWL (m) | 3.92 | 0 | 4 | 0 | 0 |
| Jun-05 | EC(dS/m) | 10.50 | - | 0.80 | - | - |
| | SWL (m) | 3.72 | 0.00 | 4.20 | 0.00 | 0.00 |
| Jul-05 | EC(dS/m) | 8.90 | - | 0.70 | - | - |
| | SWL (m) | 3.02 | 0.00 | 4.24 | 0.00 | 0.00 |
| Aug-05 | EC(dS/m) | 9.00 | - | 0.90 | - | - |
| | SWL (m) | 3.35 | 0.00 | 4.35 | 0.00 | 0.00 |
| Sep-05 | EC(dS/m) | 8.10 | - | 0.40 | - | - |
| | SWL (m) | 3.00 | 0.00 | 3.80 | 0.00 | 0.00 |
| Oct-05 | EC(dS/m) | 3.30 | - | 0.40 | - | - |
| | SWL (m) | 2.22 | 0.00 | 2.11 | 0.00 | 0.00 |
| Nov-05 | EC(dS/m) | 4.30 | - | 0.20 | - | - |
| | SWL (m) | 2.03 | 0.00 | 0.30 | 0.00 | 0.00 |
| Dec-05 | EC(dS/m) | 5.80 | - | 0.10 | - | - |
| | SWL (m) | 2.82 | DRY | 1.75 | DRY | DRY |
| Jan-06 | EC(dS/m) | 6.50 | - | 0.30 | - | - |
| | SWL (m) | 3.11 | DRY | 2.50 | DRY | DRY |
| F eb-06 | EC(dS/m) | 7.50 | - | 0.40 | - | - |
| | SWL (m) | 3.30 | DRY | 3.10 | DRY | DRY |
| Mar-06 | EC(dS/m) | 7.70 | - | 0.40 | - | - |
| | SWL (m) | 3.62 | DRY | 3.50 | DRY | DRY |
| Apr-06 | EC(dS/m) | 8.40 | - | 0.40 | - | - |
| | SWL (m) | 3.86 | DRY | 3.74 | DRY | DRY |
| May-06 | EC(dS/m) | 9.40 | - | 0.60 | - | - |
| | SWL (m) | 3.82 | DRY | 4.02 | DRY | DRY |
| Jun-06 | EC(dS/m) | 9.70 | - | 0.60 | - | - |
| | SWL (m) | 3.38 | DRY | 4.29 | DRY | DRY |
| Jul-06 | EC(dS/m) | 8.90 | - | 0.70 | - | - |
| | SWL (m) | 3.14 | DRY | 3.90 | DRY | DRY |
| Aug-06 | EC(dS/m) | 8.40 | - | 0.70 | - | - |
| | SWL (m) | 3.11 | DRY | 4.54 | DRY | DRY |
| Sep-06 | EC(dS/m) | 8.20 | - | 0.70 | - | - |
| | SWL (m) | 3.44 | DRY | 4.60 | DRY | DRY |
| Oct-06 | EC(dS/m) | 7.90 | - | 0.70 | - | - |
| | SWL (m) | 3.66 | DRY | 4.71 | DRY | DRY |
| Nov-06 | EC(dS/m) | 8.10 | - | TSTB | - | - |
| | SWL (m) | 3.99 | DRY | - | DRY | DRY |
| Dec-06 | EC(dS/m) | 8.80 | - | 0.70 | - | - |
| | SWL (m) | 3.95 | DRY | 5.15 | DRY | DRY |
| Jan-07 | EC(dS/m) | 9.10 | - | 0.70 | - | - |
| | SWL (m) | 4.11 | DRY | 5.12 | DRY | DRY |
| Feb-07 | EC(dS/m) | 9.80 | - | 0.70 | - | - |
| | SWL (m) | 4.07 | DRY | 5.17 | DRY | DRY |
| Mar-07 | EC(dS/m) | 10.00 | 15.6 | DRY | - | - |
| | SWL (m) | 4.17 | DRY | 5.30 | DRY | DRY |

TSTB – Too shallow to bail
FWSW – Flooded with surface water

| Dubbo City Council Salinity Network site number (Figure 10) | | DCC34 | DCC108 | DCC109 | DCC125 | DCC126 |
|---|---|---|---|---|---|---|
| **Sampling date** | **Drilled depth (m)** | **6** | **3** | **6** | **3** | **2** |
| Apr-07 | EC(dS/m) | 9.10 | - | 0.70 | - | - |
| | SWL (m) | 4.10 | DRY | 5.14 | DRY | DRY |
| May-07 | EC(dS/m) | 8.10 | - | 0.80 | - | - |
| | SWL (m) | 4.67 | DRY | 4.83 | DRY | DRY |
| Jun-07 | EC(dS/m) | 9.20 | - | 0.70 | - | - |
| | SWL (m) | 3.72 | DRY | 5.01 | DRY | DRY |
| Jul-07 | EC(dS/m) | 8.90 | - | 0.70 | - | - |
| | SWL (m) | 4.05 | DRY | 5.07 | DRY | DRY |
| Aug-07 | EC(dS/m) | 8.20 | - | 0.40 | - | - |
| | SWL (m) | 3.53 | DRY | 3.82 | DRY | DRY |
| Sep-07 | EC(dS/m) | 8.60 | - | 0.40 | - | - |
| | SWL (m) | 3.48 | DRY | 3.73 | DRY | DRY |
| Oct-07 | EC(dS/m) | 9.20 | - | 0.70 | - | - |
| | SWL (m) | 3.69 | DRY | 4.10 | DRY | DRY |
| Nov-07 | EC(dS/m) | 9.20 | - | 0.80 | - | - |
| | SWL (m) | 3.78 | DRY | 4.35 | DRY | DRY |
| Dec-07 | EC(dS/m) | 9.30 | - | TSTB | - | - |
| | SWL (m) | 3.93 | DRY | 5.09 | DRY | DRY |
| Jan-08 | EC(dS/m) | 9.20 | - | - | - | - |
| | SWL (m) | 4.21 | DRY | DRY | DRY | DRY |
| Feb-08 | EC(dS/m) | 5.20 | - | 0.90 | - | - |
| | SWL (m) | 3.25 | DRY | 1.75 | DRY | DRY |
| Mar-08 | EC(dS/m) | 6.30 | - | 0.30 | - | - |
| | SWL (m) | 3.18 | DRY | 2.40 | DRY | DRY |
| Apr-08 | EC(dS/m) | 6.90 | - | 0.50 | - | - |
| | SWL (m) | 3.37 | DRY | 3.10 | DRY | DRY |
| May-08 | EC(dS/m) | 7.50 | - | 0.30 | - | - |
| | SWL (m) | 3.70 | DRY | 3.62 | DRY | DRY |
| Jun-08 | EC(dS/m) | 7.50 | - | 0.30 | - | - |
| | SWL (m) | 3.28 | DRY | 3.90 | DRY | DRY |
| Jul-08 | EC(dS/m) | 7.10 | - | 0.40 | - | - |
| | SWL (m) | 3.30 | DRY | 3.90 | DRY | DRY |
| Aug-08 | EC(dS/m) | 7.20 | - | 0.40 | - | - |
| | SWL (m) | 3.22 | DRY | 3.78 | DRY | DRY |
| Sep-08 | EC(dS/m) | 5.70 | - | 0.00 | - | - |
| | SWL (m) | 2.34 | DRY | 0.64 | DRY | DRY |
| Oct-08 | EC(dS/m) | 7.10 | - | 0.40 | - | - |
| | SWL (m) | 3.30 | DRY | 3.90 | DRY | DRY |
| Nov-08 | EC(dS/m) | 6.30 | - | 0.10 | - | - |
| | SWL (m) | 2.72 | DRY | 0.40 | DRY | DRY |
| Dec-08 | EC(dS/m) | 7.30 | - | 0.10 | - | - |
| | SWL (m) | 2.84 | DRY | 2.12 | DRY | DRY |
| Jan-09 | EC(dS/m) | 7.77 | - | 0.19 | - | - |
| | SWL (m) | 2.94 | DRY | 2.94 | DRY | DRY |
| Feb-09 | EC(dS/m) | TSTB | - | - | - | - |
| | SWL (m) | 4.31 | DRY | DRY | DRY | DRY |
| Mar-09 | EC(dS/m) | 7.19 | - | 0.39 | - | - |
| | SWL (m) | 3.45 | DRY | 3.64 | DRY | DRY |
| Apr-09 | EC(dS/m) | 7.48 | - | 0.29 | - | - |
| | SWL (m) | 3.57 | DRY | 3.29 | DRY | DRY |

TSTB – Too shallow to bail
FWSW – Flooded with surface water

| Dubbo City Council Salinity Network site number (Figure 10) | | DCC34 | DCC108 | DCC109 | DCC125 | DCC126 |
|---|---|---|---|---|---|---|
| **Sampling date** | **Drilled depth (m)** | **6** | **3** | **6** | **3** | **2** |
| May-09 | EC(dS/m) | - | - | FWSW | - | - |
| | SWL (m) | DRY | DRY | FWSW | DRY | DRY |
| Jun-09 | EC(dS/m) | - | - | 0.70 | - | - |
| | SWL (m) | DRY | DRY | 3.9 | DRY | DRY |
| Jul-09 | EC(dS/m) | 7.15 | - | 0.37 | - | - |
| | SWL (m) | 3.48 | DRY | 4.40 | DRY | DRY |
| Aug-09 | EC(dS/m) | 7.73 | - | 0.49 | - | 7.68 |
| | SWL (m) | 3.39 | DRY | 4.43 | DRY | 1.06 |
| Sep-09 | EC(dS/m) | 8.16 | - | 0.62 | - | - |
| | SWL (m) | 3.25 | DRY | 4.51 | DRY | DRY |
| Oct-09 | EC(dS/m) | 7.34 | - | 0.42 | - | - |
| | SWL (m) | 3.04 | DRY | 4.68 | DRY | DRY |
| Nov-09 | EC(dS/m) | 8.10 | - | 0.53 | - | - |
| | SWL (m) | 3.15 | DRY | 4.72 | DRY | DRY |
| Dec-09 | EC(dS/m) | 8.37 | - | FWSW | - | - |
| | SWL (m) | 2.89 | DRY | FWSW | DRY | DRY |
| Jan-10 | EC(dS/m) | 5.69 | - | - | - | - |
| | SWL (m) | 2.57 | DRY | DRY | DRY | DRY |
| Feb-10 | EC(dS/m) | 1.37 | - | 0.27 | - | - |
| | SWL (m) | 2.38 | DRY | 3.58 | DRY | DRY |
| Mar-10 | EC(dS/m) | 2.26 | - | - | - | - |
| | SWL (m) | 2.26 | DRY | DRY | DRY | DRY |
| Apr-10 | EC(dS/m) | 2.39 | - | - | - | - |
| | SWL (m) | 1.63 | DRY | DRY | DRY | DRY |
| May-10 | EC(dS/m) | 2.51 | - | - | - | - |
| | SWL (m) | 1.86 | DRY | DRY | DRY | DRY |
| Jun-10 | EC(dS/m) | 6.38 | - | 0.28 | - | - |
| | SWL (m) | 1.93 | DRY | 0.57 | DRY | DRY |
| Jul-10 | EC(dS/m) | 6.09 | - | FWSW | - | - |
| | SWL (m) | 1.72 | DRY | FWSW | DRY | DRY |
| Aug-10 | EC(dS/m) | 6.02 | - | FWSW | - | - |
| | SWL (m) | 1.37 | DRY | FWSW | DRY | DRY |
| Sep-10 | EC(dS/m) | 6.24 | - | 0.62 | - | - |
| | SWL (m) | 1.21 | DRY | 0.85 | DRY | DRY |
| Oct-10 | EC(dS/m) | 6.76 | - | 0.30 | - | - |
| | SWL (m) | 2.24 | DRY | 0.87 | DRY | DRY |
| Nov-10 | EC(dS/m) | 6.50 | - | FWSW | - | - |
| | SWL (m) | 1.73 | DRY | FWSW | DRY | DRY |
| Dec-10 | EC(dS/m) | 3.33 | - | 0.25 | - | - |
| | SWL (m) | 2.01 | DRY | 0.58 | DRY | DRY |
| Jan-11 | EC(dS/m) | 0.16 | - | 0.58 | - | - |
| | SWL (m) | 2.30 | DRY | 1.57 | DRY | DRY |
| Feb-11 | EC(dS/m) | 2.29 | - | 0.49 | - | - |
| | SWL (m) | 2.58 | DRY | 2.02 | DRY | DRY |
| Mar-11 | EC(dS/m) | 4.48 | - | 0.29 | - | - |
| | SWL (m) | 2.75 | DRY | 2.55 | DRY | DRY |
| Apr-11 | EC(dS/m) | 4.89 | - | 0.21 | - | - |
| | SWL (m) | 2.48 | DRY | 2.41 | DRY | DRY |
| May-11 | EC(dS/m) | 5.08 | - | 0.26 | - | - |
| | SWL (m) | 2.87 | DRY | 2.69 | DRY | DRY |

TSTB – Too shallow to bail
FWSW – Flooded with surface water

| Dubbo City Council Salinity Network site number (Figure 10) | | DCC34 | DCC108 | DCC109 | DCC125 | DCC126 |
|---|---|---|---|---|---|---|
| **Sampling date** | **Drilled depth (m)** | **6** | **3** | **6** | **3** | **2** |
| Jun-11 | EC(dS/m) | 5.76 | - | 0.32 | - | - |
| | SWL (m) | 3.01 | - | 2.83 | - | - |
| Jul-11 | EC(dS/m) | 6.08 | - | 0.43 | - | - |
| | SWL (m) | 3.42 | DRY | 3.3 | DRY | DRY |
| Aug-11 | EC(dS/m) | 5.23 | - | 0.28 | - | - |
| | SWL (m) | 3.01 | DRY | 2.29 | DRY | DRY |
| Sep-11 | EC(dS/m) | 5.49 | - | 0.33 | - | - |
| | SWL (m) | 2.87 | DRY | 2.43 | DRY | DRY |
| Oct-11 | EC(dS/m) | 5.32 | - | 0.39 | - | - |
| | SWL (m) | 2.69 | DRY | 2.34 | DRY | DRY |
| Nov-11 | EC(dS/m) | - | - | 0.16 | - | - |
| | SWL (m) | DRY | DRY | 0.92 | DRY | DRY |
| Dec-11 | EC(dS/m) | 5.15 | - | 0.16 | - | - |
| | SWL (m) | 3.14 | DRY | 1.30 | DRY | DRY |
| Jan-12 | EC(dS/m) | 5.56 | - | 0.24 | - | - |
| | SWL (m) | 3.15 | DRY | 1.15 | DRY | DRY |
| Feb-12 | EC(dS/m) | 6.70 | - | 0.11 | - | - |
| | SWL (m) | 3.28 | DRY | 0.53 | DRY | DRY |
| Mar-12 | EC(dS/m) | 5.81 | - | 0.27 | - | - |
| | SWL (m) | 3.05 | DRY | 0.80 | DRY | DRY |
| Apr-12 | EC(dS/m) | 6.21 | - | 0.89 | - | - |
| | SWL (m) | 3.18 | DRY | 1.13 | DRY | DRY |
| May-12 | EC(dS/m) | 1.99 | - | 1.65 | - | - |
| | SWL (m) | 1.70 | DRY | 0.80 | DRY | DRY |
| Jun-12 | EC(dS/m) | 3.80 | 3.80 | 0.14 | - | - |
| | SWL (m) | 1.95 | 6.79 | 0.60 | DRY | DRY |
| Jul-12 | EC(dS/m) | 4.51 | - | 0.41 | - | - |
| | SWL (m) | 2.41 | DRY | 0.94 | DRY | DRY |
| Aug-12 | EC(dS/m) | 4.14 | - | 0.28 | - | - |
| | SWL (m) | 2.17 | DRY | 0.76 | DRY | DRY |
| Sep-12 | EC(dS/m) | 3.84 | - | 1.39 | - | - |
| | SWL (m) | 2.28 | DRY | 6.90 | DRY | DRY |
| Oct-12 | EC(dS/m) | 3.24 | - | 0.42 | - | - |
| | SWL (m) | 2.74 | DRY | 1.15 | DRY | DRY |
| Nov-12 | EC(dS/m) | 3.87 | - | 0.46 | - | - |
| | SWL (m) | 1.20 | DRY | 1.30 | DRY | DRY |
| Dec-12 | EC(dS/m) | 3.59 | - | 0.44 | - | - |
| | SWL (m) | 1.99 | DRY | 1.24 | DRY | DRY |
| Jan-13 | EC(dS/m) | - | - | 0.44 | - | - |
| | SWL (m) | DRY | DRY | 2.30 | DRY | DRY |
| Feb-13 | EC(dS/m) | - | - | 0.39 | - | - |
| | SWL (m) | DRY | DRY | 2.29 | DRY | DRY |
| Mar-13 | EC(dS/m) | - | - | - | - | - |
| | SWL (m) | DRY | DRY | 2.25 | DRY | DRY |
| Apr-13 | EC(dS/m) | 4.21 | - | 0.38 | - | - |
| | SWL (m) | 2.49 | DRY | 2.41 | DRY | DRY |
| May-13 | EC(dS/m) | 3.10 | - | 1.15 | - | - |
| | SWL (m) | 2.95 | DRY | 1.65 | DRY | DRY |
| Jun-13 | EC(dS/m) | 1.78 | - | 0.20 | - | - |
| | SWL (m) | 1.30 | DRY | 2.40 | DRY | DRY |

TSTB – Too shallow to bail
FWSW – Flooded with surface water

| Dubbo City Council Salinity Network site number (Figure 10) | | DCC34 | DCC108 | DCC109 | DCC125 | DCC126 |
|---|---|---|---|---|---|---|
| **Sampling date** | **Drilled depth (m)** | **6** | **3** | **6** | **3** | **2** |
| Jul-13 | EC(dS/m) | 3.11 | - | 0.38 | - | - |
| | SWL (m) | 1.86 | DRY | 1.92 | DRY | DRY |
| Aug-13 | EC(dS/m) | 3.63 | - | 0.33 | - | - |
| | SWL (m) | 2.02 | DRY | 1.34 | DRY | DRY |
| Sep-13 | EC(dS/m) | 3.50 | - | 0.80 | - | - |
| | SWL (m) | 2.08 | DRY | 3.98 | DRY | DRY |
| Oct-13 | EC(dS/m) | 3.50 | - | 0.80 | - | - |
| | SWL (m) | 2.08 | DRY | 3.98 | DRY | DRY |
| Nov-13 | EC(dS/m) | 3.61 | - | 0.50 | - | - |
| | SWL (m) | 1.87 | DRY | 1.70 | DRY | DRY |
| Dec-13 | EC(dS/m) | 4.25 | - | 0.39 | - | - |
| | SWL (m) | 2.34 | DRY | 1.36 | DRY | DRY |
| Jan-14 | EC(dS/m) | 1.50 | - | 0.39 | - | - |
| | SWL (m) | 1.78 | DRY | 2.65 | DRY | DRY |
| Feb-14 | EC(dS/m) | 1.42 | - | 0.35 | - | - |
| | SWL (m) | 1.66 | DRY | 2.44 | DRY | DRY |
| Mar-14 | EC(dS/m) | 1.34 | - | 0.55 | - | - |
| | SWL (m) | 1.92 | DRY | 2.39 | DRY | DRY |
| Apr-14 | EC(dS/m) | 2.78 | - | 0.48 | - | - |
| | SWL (m) | 2.21 | DRY | 2.41 | DRY | DRY |
| May-14 | EC(dS/m) | 2.87 | - | 0.58 | - | - |
| | SWL (m) | 2.50 | DRY | 2.09 | DRY | DRY |
| Jun-14 | EC(dS/m) | 2.59 | - | 0.39 | - | - |
| | SWL (m) | 1.89 | DRY | 2.14 | DRY | DRY |
| Jul-14 | EC(dS/m) | 2.89 | - | 0.44 | - | - |
| | SWL (m) | 1.85 | DRY | 2.08 | DRY | DRY |
| Aug-14 | EC(dS/m) | 3.29 | - | 0.59 | - | - |
| | SWL (m) | 1.99 | DRY | 2.22 | DRY | DRY |
| Sep-14 | EC(dS/m) | - | - | - | - | - |
| | SWL (m) | - | - | - | DRY | DRY |
| Oct-14 | EC(dS/m) | 4.0 | - | 0.74 | - | - |
| | SWL (m) | 2.51 | DRY | 2.22 | DRY | DRY |
| Nov-14 | EC(dS/m) | 4.02 | - | 0.60 | - | - |
| | SWL (m) | 2.27 | DRY | 1.79 | DRY | DRY |
| Dec-14 | EC(dS/m) | 4.25 | - | 0.55 | - | - |
| | SWL (m) | 2.35 | DRY | 1.53 | DRY | DRY |

TSTB – Too shallow to bail
FWSW – Flooded with surface water

**Appendix 5.** Initial site investigation characteristics

| Location (Figure 7) | Vegetation | Slope (%) | Vegetation cover (%) | Indicators of salinity | Surface rocks | Trees (within 50m) |
|---|---|---|---|---|---|---|
| A1 | Native grasses, broadleaved weeds | 1-2% SW | 50 | Nil | Nil | Yes, cypress pine and eucalypts |
| A2 | Native grasses, broadleaved weeds | 1-2% SW | 50 | Nil | Nil | Yes, cypress pine and eucalypts |
| A3 | Native grasses, broadleaved weeds | 1-2% SW | 50 | Nil | Nil | Yes, cypress pine and eucalypts |
| A4 | Native grasses, broadleaved weeds | 1-2% W | 50 | Nil | Nil | Yes, cypress pine and eucalypts |
| A5 | Native grasses, broadleaved weeds | 1-2% W | 50 | Nil | Nil | Yes, cypress pine and eucalypts |
| A6 | Native grasses, broadleaved weeds | 1-2% W | 50 | Nil | Nil | Yes, cypress pine and eucalypts |
| A7 | Native grasses, broadleaved weeds | 1-2% NW | 50 | Nil | Nil | Yes, cypress pine and eucalypts |
| A8 | Native grasses, broadleaved weeds | 1-2% NW | 50 | Nil | Nil | Yes, cypress pine and eucalypts |
| A9 | Native grasses, broadleaved weeds | 1-2% NW | 50 | Nil | Nil | Yes, cypress pine and eucalypts |
| A10 | Native grasses, broadleaved weeds | 1-2% NW | 50 | Nil | Nil | Yes, cypress pine and eucalypts |
| A11 | Native grasses, broadleaved weeds | 1-2% NW | 50 | Nil | Nil | Yes, cypress pine and eucalypts |
| A12 | Native grasses, broadleaved weeds | 1-2% NW | 50 | Nil | Nil | Yes, cypress pine and eucalypts |
| B1 | Native grasses, broadleaved weeds | 1-2% SW | 50 | Nil | Nil | Yes, cypress pine and eucalypts |
| B2 | Native grasses, broadleaved weeds | 1-2% SW | 50 | Nil | Nil | Yes, cypress pine and eucalypts |
| B3 | Native grasses, broadleaved weeds | 1-2% SW | 50 | Nil | Nil | Yes, cypress pine |
| B4 | Native grasses, broadleaved weeds | 1-2% W | 50 | Nil | Nil | Yes, cypress pine |
| B5 | Native grasses, broadleaved weeds | 1-2% W | 50 | Nil | Nil | Yes, cypress pine |
| B6 | Native grasses, broadleaved weeds | 1-2% W | 50 | Nil | Nil | Yes, cypress pine |
| B7 | Native grasses, broadleaved weeds | 1-2% NW | 50 | Nil | Nil | Yes, cypress pine |
| B8 | Native grasses, broadleaved weeds | 1-2% NW | 50 | Nil | Nil | Yes, cypress pine |
| B9 | Native grasses, broadleaved weeds | 1-2% NW | 50 | Nil | Nil | Yes, cypress pine |
| B10 | Native grasses, broadleaved weeds | 1-2% NW | 50 | Nil | Nil | Yes, cypress pine |
| B11 | Native grasses, broadleaved weeds | 1-2% NW | 50 | Nil | Nil | Yes, cypress pine |
| B12 | Native grasses, broadleaved weeds | 1-2% NW | 0 | Nil | Nil | Yes, cypress pine |
| C1 | Native grasses, broadleaved weeds | 1-2% NE | 50 | Nil | Nil | Yes, cypress pine and eucalypts |
| C2 | Native grasses, broadleaved weeds | 1-2% NE | 0 | Nil | Nil | Yes, cypress pine and eucalypts |
| C3 | Native grasses, broadleaved weeds | 1-2% NE | 50 | Nil | Nil | Yes, cypress pine |
| C4 | Native grasses, broadleaved weeds | 1-2% NE | 50 | Nil | Nil | Yes, cypress pine |
| C5 | Native grasses, broadleaved weeds | 1-2% NE | 50 | Nil | Nil | Yes, cypress pine |
| C6 | Native grasses, broadleaved weeds | 1-2% NE | 50 | Nil | Nil | Yes, cypress pine |
| C7 | Native grasses, broadleaved weeds | 1-2% NE | 50 | Nil | Nil | Yes, cypress pine |
| C8 | Native grasses, broadleaved weeds | 1-2% NE | 50 | Nil | Nil | Yes, cypress pine |
| C9 | Native grasses, broadleaved weeds | 1-2% NE | 40 | Nil | Nil | Yes, cypress pine |
| C10 | Native grasses, broadleaved weeds | 1-2% N | 50 | Nil | Nil | Yes, cypress pine |
| C11 | Native grasses, broadleaved weeds | 4% N | 50 | Nil | Nil | Yes, cypress pine |
| C12 | Native grasses, broadleaved weeds | 4% N | 50 | Nil | Nil | Yes, cypress pine |
| D1 | Native grasses, broadleaved weeds | 1-2% NE | 50 | Nil | Nil | Yes, cypress pine and eucalypts |
| D2 | Native grasses, broadleaved weeds | 1-2% NE | 50 | Nil | Nil | Yes, cypress pine and eucalypts |
| D3 | Native grasses, broadleaved weeds | 1-2% NE | 50 | Nil | Nil | Yes, cypress pine |
| D4 | Native grasses, broadleaved weeds | 1-2% NE | 95 | Nil | Nil | Yes, cypress pine |
| D5 | Native grasses, broadleaved weeds | 1-2% NE | 0 | Nil | Nil | Yes, cypress pine |

| | | | | | | |
|---|---|---|---|---|---|---|
| D6 | Native grasses, broadleaved weeds | 1-2% NE | 95 | Nil | Nil | Yes, cypress pine |
| D7 | Native grasses, broadleaved weeds | 1-2% NE | 50 | Nil | Nil | Yes, cypress pine |
| D8 | Native grasses, broadleaved weeds | 1-2% NE | 50 | Nil | Nil | Yes, cypress pine |
| D9 | Native grasses, broadleaved weeds | 1-2% NE | 0 | Nil | Nil | Yes, cypress pine |
| D10 | Native grasses, broadleaved weeds | 1-2% N | 50 | Nil | Nil | Yes, cypress pine |
| D11 | Native grasses, broadleaved weeds | 4% N | 50 | Nil | Nil | Yes, cypress pine |
| D12 | Native grasses, broadleaved weeds | 4% N | 50 | Nil | Nil | Yes, cypress pine |
| E1 | Native grasses, broadleaved weeds | 1-2% NE | 50 | Nil | Nil | Yes, cypress pine and eucalypts |
| E2 | Native grasses, broadleaved weeds | 1-2% NE | 80 | Nil | Nil | Yes, cypress pine |
| E3 | Native grasses, broadleaved weeds | 1-2% NE | 80 | Nil | Nil | Yes, cypress pine |
| E4 | Native grasses, broadleaved weeds | 1-2% NE | 50 | Nil | Nil | Yes, cypress pine |
| E5 | Native grasses, broadleaved weeds | 1-2% NE | 80 | Nil | Nil | Yes, cypress pine |
| E6 | Ruderal weeks, soil stockpile | 1-2% N | 0 | Nil | Nil | Yes, cypress pine |
| E7 | Native grasses, broadleaved weeds | 1-2% N | 50 | Nil | Nil | Yes, cypress pine |
| E8 | Native grasses, broadleaved weeds | 1-2% N | 0 | Nil | Nil | Yes, cypress pine |
| E9 | Native grasses, broadleaved weeds | 1-2% N | 50 | Nil | Nil | Yes, cypress pine |
| E10 | Native grasses, broadleaved weeds | 4% N | 50 | Nil | Nil | Yes, cypress pine |
| E11 | Native grasses, broadleaved weeds | 4% N | 50 | Nil | Nil | Yes, cypress pine |
| E12 | Native grasses, broadleaved weeds | 4% N | 50 | Nil | Nil | Yes, cypress pine |
| F1 | Native grasses, broadleaved weeds | 1-2% NE | 50 | Nil | Nil | Yes, cypress pine and eucalypts |
| F2 | Ruderal weeds, sandstone stockpile | - | 0 | Nil | Nil | Yes, cypress pine and eucalypts |
| F3 | Native grasses, broadleaved weeds | Drainage line | 50 | Nil | Nil | Yes, cypress pine and eucalypts |
| F4 | Native grasses, broadleaved weeds | Drainage line | 50 | Nil | Nil | Yes, cypress pine and eucalypts |
| F5 | Native grasses, broadleaved weeds | Drainage line | 50 | Nil | Nil | Yes, cypress pine and eucalypts |
| F6 | Ruderal weeks | Drainage line | 50 | Nil | Nil | Yes, cypress pine and eucalypts |
| F7 | Native grasses, broadleaved weeds | 1-2% N | 90 | Nil | Nil | Yes, cypress pine and eucalypts |
| F8 | Native grasses, broadleaved weeds | 1-2% NE | 70 | Nil | Nil | Yes, cypress pine |
| F9 | Native grasses, broadleaved weeds | 1-2% NE | 50 | Nil | Nil | Yes, cypress pine |
| F10 | Native grasses, broadleaved weeds | 4% NE | 50 | Nil | Nil | Yes, cypress pine |
| F11 | Native grasses, broadleaved weeds | 4% NE | 50 | Nil | Nil | Yes, cypress pine |
| F12 | Native grasses, broadleaved weeds | 4% NE | 50 | Nil | Nil | Yes, cypress pine |
| G1 | Broad leaved weeds, native grasses | 0-1% NW | 0 | Nil | Nil | Yes, cypress pine and eucalypts |
| G2 | Ruderal weeds, sandstone stockpile | 0-1% NW | 0 | Nil | Nil | Yes, cypress pine and eucalypts |
| G3 | Native grasses, broadleaved weeds | 1-2% NW | 50 | Nil | Nil | Yes, cypress pine |
| G4 | Native grasses, broadleaved weeds | 1-2% NW | 50 | Nil | Nil | Yes, cypress pine |
| G5 | Native grasses, broadleaved weeds | 1-2% NW | 50 | Nil | Nil | Yes, cypress pine and eucalypts |
| G6 | Native grasses, broadleaved weeds | 1-2% NW | 50 | Nil | Nil | Yes, cypress pine and eucalypts |
| G7 | Native grasses, broadleaved weeds | 1-2% NW | 80 | Nil | Nil | Yes, cypress pine and eucalypts |
| G8 | Native grasses, broadleaved weeds | 1-2% N | 70 | Nil | Nil | Yes, cypress pine |
| G9 | Native grasses, broadleaved weeds | 4% N | 50 | Nil | Nil | Yes, cypress pine |
| G10 | Native grasses, broadleaved weeds | 4% N | 50 | Nil | Nil | Yes, cypress pine |
| G11 | Native grasses, broadleaved weeds | 4% N | 50 | Nil | Nil | Yes, cypress pine |
| G12 | Native grasses, broadleaved weeds | 4% N | 50 | Nil | Nil | Yes, cypress pine |
| H1 | Native grasses | 0-1% NW | 50 | Nil | Nil | Yes, cypress pine and eucalypts |
| H2 | Native grasses | 0-1% NW | 50 | Nil | Nil | Yes, cypress pine and eucalypts |
| H3 | Native grasses, broadleaved weeds | 1-2% NW | 50 | Nil | Nil | Yes, cypress pine |
| H4 | Native grasses, broadleaved weeds | 1-2% NW | 50 | Nil | Nil | Yes, cypress pine |
| H5 | Native grasses, broadleaved weeds | 1-2% NW | 50 | Nil | Nil | Yes, cypress pine and eucalypts |

| | | | | | | |
|---|---|---|---|---|---|---|
| H6 | Native grasses, broadleaved weeds | 1-2% NW | 50 | Nil | Nil | Yes, cypress pine and eucalypts |
| H7 | Native grasses, broadleaved weeds | 1-2% NW | 0 | Nil | Nil | Yes, cypress pine |
| H8 | Native grasses, broadleaved weeds | 1-2% NE | 90 | Nil | Nil | Yes, cypress pine |
| H9 | Native grasses, broadleaved weeds | 4% NE | 50 | Nil | Nil | Yes, cypress pine |
| H10 | Native grasses, broadleaved weeds | 4% E | 50 | Nil | Nil | Yes, cypress pine |
| H11 | Native grasses, broadleaved weeds | 4% E | 50 | Nil | Nil | Yes, cypress pine |
| H12 | Native grasses, broadleaved weeds | 4% E | 50 | Nil | Nil | Yes, cypress pine |
| I1 | Native grasses, broadleaved weeds | 0-1% NW | 50 | Nil | Nil | Yes, cypress pine and eucalypts |
| I2 | Native grasses, broadleaved weeds | 0-1% NW | 50 | Nil | Nil | Yes, cypress pine |
| I3 | Native grasses, broadleaved weeds | 0-1% NW | 50 | Nil | Nil | Yes, cypress pine |
| I4 | Native grasses, broadleaved weeds | 0-1% NW | 50 | Nil | Nil | Yes, cypress pine and eucalypts |
| I5 | Native grasses, broadleaved weeds | 0-1% NW | 80 | Nil | Nil | Yes, cypress pine and eucalypts |
| I6 | Native grasses, broadleaved weeds | 0-1% NW | 80 | Nil | Nil | Yes, cypress pine and eucalypts |
| I7 | Native grasses, broadleaved weeds | 0-1% NW | 90 | Nil | Nil | Yes, cypress pine and eucalypts |
| I8 | Native grasses, broadleaved weeds | 0-1% N | 50 | Nil | Nil | Yes, cypress pine |
| I9 | Native grasses, broadleaved weeds | 3% NE | 80 | Nil | Nil | Yes, cypress pine |
| I10 | Native grasses, broadleaved weeds | 3% NE | 50 | Nil | Nil | Yes, cypress pine |
| I11 | Native grasses, broadleaved weeds | 3% E | 50 | Nil | Nil | Yes, cypress pine |
| J1 | Native grasses, broadleaved weeds | 0-1% N | 50 | Nil | Nil | Yes, cypress pine and eucalypts |
| J2 | Native grasses, broadleaved weeds | 0-1% N | 50 | Nil | Nil | Yes, cypress pine |
| J3 | Native grasses, broadleaved weeds | 0-1% NW | 0 | Nil | Nil | Yes, cypress pine |
| J4 | Native grasses, broadleaved weeds | 0-1% NW | 80 | Nil | Nil | Yes, cypress pine and eucalypts |
| J5 | Native grasses, broadleaved weeds | 0-1% NW | 90 | Nil | Nil | Yes, cypress pine and eucalypts |
| J6 | Native grasses, broadleaved weeds | 0-1% NW | 0 | Nil | Nil | Yes, cypress pine and eucalypts |
| J7 | Native grasses, broadleaved weeds | 0-1% SE | 50 | Nil | Nil | Yes, cypress pine and eucalypts |
| J8 | Native grasses, broadleaved weeds | 0-1% SE | 90 | Nil | Nil | Yes, cypress pine |
| J9 | Native grasses, broadleaved weeds | 2% NE | 80 | Nil | Nil | Yes, cypress pine |
| J10 | Native grasses, broadleaved weeds | 2% NE | 50 | Nil | Nil | Yes, cypress pine |
| K1 | Native grasses, broadleaved weeds | 0-1% N | 50 | Nil | Nil | Yes, cypress pine and eucalypts |
| K2 | Native grasses, broadleaved weeds | 0-1% N | 50 | Nil | Nil | Yes, cypress pine and eucalypt |
| K3 | Native grasses, broadleaved weeds | 0-1% NW | 95 | Nil | Nil | Yes, cypress pine |
| K4 | Native grasses, broadleaved weeds | 0-1% NW | 95 | Nil | Nil | Yes, cypress pine and eucalypts |
| K5 | Native grasses, broadleaved weeds | 0-1% NW | 95 | Nil | Nil | Yes, cypress pine and eucalypts |
| K6 | Native grasses, broadleaved weeds | 0-1% NW | 0 | Nil | Nil | Yes, cypress pine and eucalypts |
| K7 | Native grasses, broadleaved weeds | 0-1% SE | 70 | Nil | Nil | Yes, cypress pine and eucalypts |
| K8 | Native grasses, broadleaved weeds | 2% E | 80 | Nil | Nil | Yes, cypress pine |
| K9 | Native grasses, broadleaved weeds | 2% E | 20 | Nil | Nil | Yes, cypress pine |
| L1 | Native grasses, broadleaved weeds | 0-1% N | 50 | Nil | Nil | Yes, cypress pine |
| L2 | Native grasses, broadleaved weeds | 0-1% N | 50 | Nil | Nil | Yes, cypress pine |
| L3 | Native grasses, broadleaved weeds | 0-1% NE | 95 | Nil | Nil | Yes, cypress pine |
| L4 | Native grasses, broadleaved weeds | 0-1% NE | 95 | Nil | Nil | Nil |
| L5 | Native grasses, broadleaved weeds | 0-1% E | 95 | Nil | Nil | Yes, cypress pine and eucalypts |
| L6 | Native grasses, broadleaved weeds | 2% SE | 95 | Nil | Nil | Yes, cypress pine and eucalypts |
| L7 | Native grasses, broadleaved weeds | 0-1% SE | 95 | Nil | Nil | Yes, cypress pine and eucalypts |

| | | | | | | |
|---|---|---|---|---|---|---|
| L8 | Native grasses, broadleaved weeds | 0-1% E | 20 | Nil | Nil | Yes, cypress pine |
| M1 | Native grasses, broadleaved weeds | 0-1% N | 50 | Nil | Nil | Yes, cypress pine |
| M2 | Native grasses, broadleaved weeds | 0-1% N | 50 | Nil | Nil | Yes, cypress pine |
| M3 | Native grasses, broadleaved weeds | 0-1% NE | 95 | Nil | Nil | Yes, cypress pine |
| M4 | Native grasses, broadleaved weeds | 0-1% NE | 95 | Nil | Nil | Nil |
| M5 | Native grasses, broadleaved weeds | 0-1% E | 95 | Nil | Nil | Yes, cypress pine |
| M6 | Native grasses, broadleaved weeds | 2% SE | 95 | Nil | Nil | Yes, cypress pine |
| M7 | Native grasses, broadleaved weeds | 0-1% SE | 95 | Nil | Nil | Yes, cypress pine |
| N1 | Native grasses, broadleaved weeds | 0-1% NE | 50 | Nil | Nil | Yes, cypress pine |
| N2 | Native grasses, broadleaved weeds | 0-1% NE | 50 | Nil | Nil | Yes, cypress pine |
| N3 | Native grasses, broadleaved weeds | 0-1% NE | 50 | Nil | Nil | Yes, cypress pine |
| N4 | Native grasses, broadleaved weeds | 0-1% E | 50 | Nil | Nil | Yes, cypress pine |
| N5 | Native grasses, broadleaved weeds | 0-1% E | 50 | Nil | Nil | Yes, cypress pine |
| N6 | Native grasses, broadleaved weeds | 0-1% SE | 50 | Nil | Nil | Yes, cypress pine |
| O1 | Native grasses, broadleaved weeds | 0-1% NE | 50 | Nil | Nil | Yes, cypress pine |
| O2 | Native grasses, broadleaved weeds | 0-1% NE | 50 | Nil | Nil | Yes, cypress pine |
| O3 | Native grasses, broadleaved weeds | 0-1% NE | 50 | Nil | Nil | Yes, cypress pine |
| O4 | Native grasses, broadleaved weeds | 0-1% NE | 50 | Nil | Nil | Yes, cypress pine |
| O5 | Native grasses, broadleaved weeds | 0-1% E | 50 | Nil | Nil | Yes, cypress pine |
| P1 | Native grasses, broadleaved weeds | 0-1% NE | 50 | Nil | Nil | Yes, cypress pine |
| P2 | Native grasses, broadleaved weeds | 0-1% NE | 50 | Nil | Nil | Yes, cypress pine |
| P3 | Native grasses, broadleaved weeds | 0-1% NE | 50 | Nil | Nil | Yes, cypress pine |
| P4 | Native grasses, broadleaved weeds | 0-1% NE | 50 | Nil | Nil | Yes, cypress pine |
| Q1 | Native grasses, broadleaved weeds | 0-1% NE | 0 | Nil | Gravel | Yes, cypress pine |
| Q2 | Native grasses, broadleaved weeds | 0-1% NE | 0 | Nil | Gravel | Yes, cypress pine |
| R1 | Native grasses, broadleaved weeds | 0-1% NE | 0 | Nil | Gravel | Yes, cypress pine |

**Appendix 5.** Field and laboratory sheets

**Salinity assessment**

| **Client:** Highview Country Estates Pty Ltd | | **Job no:** 5809 | **Date:** 01/04/2015 |
|---|---|---|---|
| **Address:** | Lot 172 DP753233 Blackbutt Road, Dubbo NSW | | |
| **Borehole:** | BH 1 | **GPS:** | 646855mE 6428099mN |

**Surface description**

| Slope: | 0– 1% | Aspect: | West |
|---|---|---|---|
| Morphological type | Mid-slope | | |
| Land-use | Grazing | | |
| Disturbance | High | | |
| Erosion: | Nil | | |
| Coarse fragments: | Ironstone | | |
| Surface cover: | Minimal grass | | |
| % surface cover | 5% | | |
| 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 400 | Light grey loamy sand | | D | | | | |
| 400-900 | Dark grey silty clay with trace gravel | | D | | | | |
| 900-2000 | Dark red clayey sand with increasing weathered rock and trace clay | | D | | | | |
| 2000 | End of hole | | | | | | |
| Notes: Nil | | | | | | | |

**Salinity assessment**

| **Client:** Highview Country Estates Pty Ltd | | **Job no:** 5809 | **Date:** 01/04/2015 |
|---|---|---|---|
| **Address:** | Lot 172 DP753233 Blackbutt Road, Dubbo NSW | | |
| **Borehole:** | BH 2 | **GPS:** | 646826mE 6427884 |

**Surface description**

| Slope: | 0-1% | Aspect: | South |
|---|---|---|---|
| Morphological type: | Mid-slope | | |
| Land-use: | Grazing | | |
| Disturbance: | High | | |
| Erosion: | Some erosion along road | | |
| Coarse fragments: | Ironstone | | |
| Surface cover: | Native grasses, pine | | |
| % surface cover | 10% | | |
| 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 400 | Dark brown loamy sand | 100 | D | 4.8 | 0.01 | 0.23 | 2 |
| | | 200 | D | 5.0 | 0.01 | 0.23 | 2 |
| 400 to 800 | Dark brown loamy sand | 300 | D | 5.1 | 0.01 | 0.23 | 2 |
| | | 500 | D | 5.2 | 0.03 | 0.69 | 2 |
| 800 to 1100 | Light brown clayey sand | 1000 | D | 5.4 | 0.10 | 2.30 | 1 |
| 1100 to 1500 | Brownish yellow clayey sand | 1500 | D | 5.6 | 0.10 | 2.30 | 1 |
| 1500 to 2700 | Light red clayey sand | 2000 | D | 5.4 | 0.10 | 2.30 | 2 |
| 2700 to 4000 | Reddish yellow clayey sand | 2500 | D | 5.2 | 0.13 | 0.69 | 2 |
| | | 3000 | D | 5.0 | 0.18 | 4.14 | 2 |
| | | 3500 | D | 5.1 | 0.15 | 3.45 | 5 |
| | | 4000 | D | 4.8 | 0.18 | 4.14 | 5 |
| 4000 to 5100 | Reddish brown sandy clay with gravel | 4500 | D | 4.4 | 0.43 | 6.02 | 5 |
| | | 5000 | D | 4.8 | 0.37 | 5.18 | 5 |
| 5100 to 5700 | Reddish yellow silty clay with gravel | 5500 | D | 4.7 | 0.37 | 3.18 | 5 |
| 5700 to 8400 | Light reddish brown silty clay with gravel | 6000 | D | 4.8 | 0.48 | 4.12 | 5 |
| | | 6500 | D | 4.8 | 0.42 | 3.61 | 5 |
| | | 7000 | D | 4.7 | 0.48 | 4.12 | 5 |
| | | 7500 | D | 4.6 | 0.50 | 4.30 | 5 |
| | | 8000 | D | 4.7 | 0.50 | 4.30 | 5 |
| 8400 to 9000 | Light red silty clay with gravel | 8500 | D | 4.5 | 0.48 | 4.12 | 5 |
| | | 9000 | D | 4.8 | 0.35 | 3.01 | 5 |
| 9000 | End of hole | | | | | | |
| Notes: Nil | | | | | | | |

**Salinity assessment**

| | | | | | |
|---|---|---|---|---|---|
| **Client:** Highview Country Estates Pty Ltd | | **Job no:** | 5809 | **Date:** | 08/05/2015 |
| **Address:** | Lot 172 DP753233 Blackbutt Road, Dubbo NSW | | | | |
| **Borehole:** | BH 3 | **GPS:** | 647461mE 6427345mN | | |

**Surface description**

| | | | |
|---|---|---|---|
| Slope: | 0 -1% | Aspect: | South East |
| Morphological type: | Mid-slope | | |
| Land-use: | Grazing | | |
| Disturbance: | High, side of truck under the powerlines | | |
| Erosion: | Low | | |
| Coarse fragments: | Conglomerate on surface and gravel | | |
| Surface cover: | Native grasses, pine | | |
| % surface cover | 10% | | |
| 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 | Light brown loamy sand | | D | | | | |
| 300 to 400 | Light brown sandy gravel with weathered rock | | D | | | | |
| 400 | End of hole, drill refusal | | | | | | |
| Notes: | | | | | | | |

**Salinity assessment**

| | | | | | |
|---|---|---|---|---|---|
| **Client:** Highview Country Estates Pty Ltd | | **Job no:** | 5809 | **Date:** | 01/04/2015 |
| **Address:** | Lot 172 DP753233 Blackbutt Road, Dubbo NSW | | | | |
| **Borehole:** | BH 4 | **GPS:** | 646999mE 6428049mN | | |

**Surface description**

| | | | |
|---|---|---|---|
| Slope: | 0-1% | Aspect: | East |
| Morphological type: | Mid-slope | | |
| Land-use: | Grazing | | |
| Disturbance: | High | | |
| Erosion: | Nil | | |
| Coarse fragments: | Ironstone | | |
| Surface cover: | Pine and grasses | | |
| % surface cover | 20% | | |
| 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 900 | Light red loamy sand | | D | | | | |
| 900 to 1900 | Light brown silty clay with trace gravel | | D | | | | |
| 1900 to 2100 | Light brown gravelly sand | | D | | | | |
| 2100 | End of hole, drill refusal | | | | | | |
| Notes: | | | | | | | |

**Salinity assessment**

| **Client:** Highview Country Estates Pty Ltd | | **Job no:** 5809 | **Date:** 01/04/2015 |
|---|---|---|---|
| **Address:** | Lot 172 DP753233 Blackbutt Road, Dubbo NSW | | |
| **Borehole:** | BH 5 | **GPS:** | 646998mE 6427846mN |

**Surface description**

| Slope: | 0-1% | Aspect: | North east |
|---|---|---|---|
| Morphological type: | Mid-slope | | |
| Land-use: | Grazing | | |
| Disturbance: | High | | |
| Erosion: | Nil | | |
| Coarse fragments: | Ironstone | | |
| Surface cover: | Grass and pines | | |
| % surface cover | 15% | | |
| 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 500 | Light brown loamy sand | | D | | | | |
| 500 to 2000 | Pale red silty clay with trace gravel | | D | | | | |
| 2000 | End of hole | | | | | | |
| Notes: | | | | | | | |

**Salinity assessment**

| **Client:** Highview Country Estates Pty Ltd | | **Job no:** 5809 | **Date:** 01/04/2015 |
|---|---|---|---|
| **Address:** | Lot 172 DP753233 Blackbutt Road, Dubbo NSW | | |
| **Borehole:** | BH 6 | **GPS:** | 646938mE 6427721mN |

**Surface description**

| | | | |
|---|---|---|---|
| Slope: | 0-1 % | Aspect: | North East |
| Morphological type: | Mid-slope | | |
| Land-use: | Grazing | | |
| Disturbance: | High - road verge | | |
| Erosion: | Some erosion along tracek | | |
| Coarse fragments: | Ironstone | | |
| Surface cover: | Nil | | |
| % surface cover | 0% | | |
| 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 400 | Dark brown loamy sand | | D | | | | |
| 400 to 1400 | Brown silty clay with trace gravel | | D | | | | |
| 1400 to 2800 | Light yellow clayey sand | | D | | | | |
| 2800 to 3000 | White clayey sand with trace gravel | | D | | | | |
| 3000 | End of hole | | | | | | |
| Notes: | | | | | | | |

**Salinity assessment**

| | | | |
|---|---|---|---|
| **Client:** Highview Country Estates Pty Ltd | **Job no:** 5809 | **Date:** 01/04/2015 | |
| **Address:** Lot 172 DP753233 Blackbutt Road, Dubbo NSW | | | |
| **Borehole:** BH 7 | **GPS:** 646847mE 6427389mN | | |

**Surface description**

| | | | |
|---|---|---|---|
| Slope: | 0-1% | Aspect: | North west |
| Morphological type: | Upper slope | | |
| Land-use: | Grazing | | |
| Disturbance: | High - road verge | | |
| Erosion: | Minor | | |
| Coarse fragments: | Ironstone float | | |
| Surface cover: | Nil | | |
| % surface cover | 0% | | |
| 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 500 | Dark brown loamy sand | | D | | | | |
| 500 to 600 | Dark brown sandy gravel | | D | | | | |
| 600 | End of hole, drill refusal | | | | | | |

Notes:

**Salinity assessment**

| | | | | | |
|---|---|---|---|---|---|
| **Client:** Highview Country Estates Pty Ltd | | **Job no:** | 5809 | **Date:** | 01/04/2015 |
| **Address:** | Lot 172 DP753233 Blackbutt Road, Dubbo NSW | | | | |
| **Borehole:** | BH 8 | **GPS:** | 647008mE 6427424mN | | |

**Surface description**

| | | | |
|---|---|---|---|
| Slope: | 0-1% | Aspect: | North |
| Morphological type: | Upper slope | | |
| Land-use: | Grazing | | |
| Disturbance: | High - track verge | | |
| Erosion: | Minor | | |
| Coarse fragments: | Ironstone | | |
| Surface cover: | Pines and native grasses | | |
| % surface cover | 10% | | |
| 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 500 | Light brown loamy sand | | D | | | | |
| 500 to 600 | Light orange sandy gravel with increasing cobbles | | D | | | | |
| 600 | End of hole, drill refusal on rock | | | | | | |
| Notes: | | | | | | | |

**Salinity assessment**

| | | | | | |
|---|---|---|---|---|---|
| **Client:** Highview Country Estates Pty Ltd | | **Job no:** | 5809 | **Date:** | 01/04/2015 |
| **Address:** | Lot 172 DP753233 Blackbutt Road, Dubbo NSW | | | | |
| **Borehole:** | BH 9 | **GPS:** | 647034mE 6427547mN | | |

**Surface description**

| | | | |
|---|---|---|---|
| Slope: | 0-1% | Aspect: | North |
| Morphological type: | Mid-slope | | |
| Land-use: | Grazing | | |
| Disturbance: | High - edge of track | | |
| Erosion: | Minor erosion along track | | |
| Coarse fragments: | Ironstone | | |
| Surface cover: | Pines | | |
| % surface cover | 20% | | |
| 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 200 | Black sandy clay loam | 100 | D | 4.7 | 0.01 | 0.08 | 2 |
| | | 200 | D | 5.0 | 0.01 | 0.08 | 2 |
| 200 to 900 | Brown gravelly clay | 300 | D | 5.3 | 0.04 | 0.30. | 5 |
| | | 500 | D | 5. | 0.12 | 0.90 | 5 |
| 900 to 2200 | Brownish yellow to yellow sandy clay with gravel from 2,000mm | 1000 | D | 6.3 | 0.14 | 1.96 | 2 |
| | | 1500 | D | 6.6 | 0.09 | 1,26 | 2 |
| | | 2000 | D | 6.7 | 0.08 | 1.12 | 2 |
| 2200 to 3800 | Yellow to yellowish brown sandy clay loam with gravel | 2500 | D | 7.4 | 0.07 | 0.66 | 2 |
| | | 3000 | D | 7.3 | 0.09 | 0.85 | 2 |
| | | 3500 | D | 7.3 | 0.07 | 0.62 | 2 |
| 3800 to 4100 | Brownish yellow sandy clay | 4000 | D | 7.2 | 0.12 | 0.90 | 2 |
| 4100 to 5200 | Yellow clayey sand | 4500 | D | 7.0 | 0.12 | 2.76 | 2 |
| | | 5000 | D | 7.0 | 0.16 | 3.68 | 2 |
| 5200 to 6400 | Reddish yellow to yellow sandy clay loam | 5500 | D | 7.1 | 0.20 | 1.90 | 2 |
| | | 6000 | D | 7.0 | 0.1 | 1.52 | 2 |
| 6400 to 9000 | Yellowish brown to reddish yellow clayey sand with rounded river gravel | 6500 | D | 6.8 | 0.14 | 3.22 | 2 |
| | | 7000 | D | 7.1 | 0.13 | 2.99 | 2 |
| | | 7500 | D | 7.1 | 0.12 | 2.76 | 2 |
| | | 8000 | D | 7.0 | 0.13 | 2.99 | 2 |
| | | 8500 | D | 6.7 | 0.17 | 3.91 | 2 |
| | | 9000 | D | 6.6 | 0.22 | 5.06 | 2 |
| 9000 | End of hole | | | | | | |

**Salinity assessment**

| **Client:** Highview Country Estates Pty Ltd | | **Job no:** 5809 | **Date:** 01/04/2015 |
|---|---|---|---|
| **Address:** | Lot 172 DP753233 Blackbutt Road, Dubbo NSW | | |
| **Borehole:** | BH 10 | **GPS:** | 647146mE 6427740mN |

**Surface description**

| | | | |
|---|---|---|---|
| Slope: | 0-1% | Aspect: | North East |
| Morphological type: | Mid-slope | | |
| Land-use: | Grazing | | |
| Disturbance: | High, waste and dumping ground | | |
| Erosion: | Nil | | |
| Coarse fragments: | Ironstone float | | |
| Surface cover: | Native grasses | | |
| % surface cover | 50% | | |
| 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 | Light grey loamy sand with trace gravel | | D | | | | |
| 300 to 1400 | Light grey sandy gravel with trace clay | | D | | | | |
| 1400 to 2000 | White clayey sand with extremely weathered rock | | D | | | | |
| 2000 | End of hole | | | | | | |
| Notes: | | | | | | | |

## Salinity assessment

| **Client:** Highview Country Estates Pty Ltd | **Job no:** 5809 | **Date:** 01/04/2015 |
|---|---|---|
| **Address:** Lot 172 DP753233 Blackbutt Road, Dubbo NSW | | |
| **Borehole:** BH 11 | **GPS:** 647085mE 6427827mN | |

## Surface description

| | | | |
|---|---|---|---|
| Slope: | 0-1% | Aspect: | North east |
| Morphological type: | Mid-slope | | |
| Land-use: | Grazing | | |
| Disturbance: | High | | |
| Erosion: | Nil | | |
| Coarse fragments: | Ironstone | | |
| Surface cover: | Native grasses | | |
| % surface cover | 100% | | |
| 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 600 | Light grey loamy sand | | D | | | | |
| 600 to 1100 | Light brown silty clay | | D | | | | |
| 1100 to 2000 | Light brown clayey sand with weathered rock | | D | | | | |
| 2000 | End of hole, drill refusal | | | | | | |
| Notes: | | | | | | | |

**Salinity assessment**

| | | | |
|---|---|---|---|
| **Client:** Highview Country Estates Pty Ltd | **Job no:** 5809 | **Date:** 01/04/2015 | |
| **Address:** | Lot 172 DP753233 Blackbutt Road, Dubbo NSW | | |
| **Borehole:** | BH 12 | **GPS:** | 647106mE 6427939mN |

**Surface description**

| | | | |
|---|---|---|---|
| Slope: | 0-1% | Aspect: | North East |
| Morphological type: | Mid-slope | | |
| Land-use: | Grazing | | |
| Disturbance: | High | | |
| Erosion: | Nil | | |
| Coarse fragments: | Ironstone | | |
| Surface cover: | Native grasses | | |
| % 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 500 | Light brown loamy sand | | D | | | | |
| 500 to 900 | Light brown sandy gravel with weathered rock | | D | | | | |
| 900 | End of hole, drill refusal | | | | | | |
| Notes: | | | | | | | |

**Salinity assessment**

| **Client:** Highview Country Estates Pty Ltd | **Job no:** 5809 | **Date:** 31/03/2015 |
|---|---|---|
| **Address:** Lot 172 DP753233 Blackbutt Road, Dubbo NSW | | |
| **Borehole:** BH 13 (MW3) | **GPS:** 647819mE 6428039mN | |

**Surface description**

| Slope: | 0-1% | Aspect: | North East |
|---|---|---|---|
| Morphological type: | Mid-slope | | |
| Land-use: | Grazing | | |
| Disturbance: | High | | |
| Erosion: | Minor along track | | |
| Coarse fragments: | Minor ironstone gravel on surface | | |
| Surface cover: | Pines, eucalyptus and native grasses | | |
| % surface cover | 20% | | |
| 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 200 | Dark brown sandy loam | 100 | D | 5.0 | 0.01 | 0.23 | 3 |
| | | 200 | D | 5.3 | 0.05 | 1.15 | 1 |
| 200 to 450 | Olive brown clayey sand with gravel | 300 | D | 5.2 | 0.16 | 3.68 | 1 |
| 450 to 950 | Strong brown sandy clay | 500 | D | 5.3 | 0.36 | 2.70 | 1 |
| 950 to 3200 | Olive yellow to yellow sandy clay | 1000 | D | 5.9 | 0.38 | 2.85 | 1 |
| | | 1500 | D | 6.6 | 0.44 | 3.30 | 1 |
| | | 2000 | D | 6.9 | 0.39 | 2.92 | 3 |
| | | 2500 | D | 7.1 | 0.33 | 2.47 | 3 |
| | | 3000 | D | 7.3 | 0.32 | 2.40 | 3 |
| 3200 to 11100 | Yellow to very pale brown sandy clay with gravel | 3500 | D | 7.0 | 0.33 | 2.47 | 3 |
| | | 4000 | D | 6.9 | 0.33 | 2.47 | 5 |
| | | 4500 | D | 6.7 | 0.34 | 2.55 | 8 |
| | | 5000 | D | 6.6 | 0.33 | 2.47 | 5 |
| | | 5500 | D | 6.4 | 0.33 | 2.47 | 5 |
| | | 6000 | D | 6.5 | 0.38 | 2.85 | 5 |
| | | 6500 | D | 6.6 | 0.38 | 2.92 | 3 |
| | | 7000 | D | 6.2 | 0.39 | 2.92 | 5 |
| | | 7500 | D | 6.2 | 0.42 | 3.15 | 5 |
| | | 8000 | D | 6.2 | 0.41 | 3.07 | 5 |
| | | 8500 | D | 6.2 | 0.44 | 3.30 | 5 |
| | | 9000 | D | 6.5 | 0.44 | 3.30 | 5 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | 10000 | D | 6.1 | 0.44 | 3.30 | 5 |
| | | 10500 | D | 6.0 | 0.39 | 2.92 | 5 |
| | | 11000 | D | 5.9 | 0.35 | 2.62 | 5 |
| 11100 to 11600 | Light grey sandy clay with gravel | 11500 | D | 6.3 | 0.37 | 2.77 | 2 |
| 11600 to 12000 | Black sandy clay (pyritic shale) | 12000 | D | 5.4 | 0.67 | 5.02 | 2 |
| 12000 | End of hole | | | | | | |

Notes:

**Salinity assessment**

| | | | |
|---|---|---|---|
| **Client:** Highview Country Estates Pty Ltd | **Job no:** 5809 | **Date:** 31/07/2015 | |
| **Address:** | Lot 172 DP753233 Blackbutt Road, Dubbo NSW | | |
| **Borehole:** | BH14 | **GPS:** | 647307mE 6428121mN |

**Surface description**

| | | | |
|---|---|---|---|
| Slope: | 0-1% | Aspect: | West |
| Morphological type: | Mid-slope | | |
| Land-use: | Grazing | | |
| Disturbance: | High | | |
| Erosion: | Nil | | |
| Coarse fragments: | Ironstone fragments | | |
| Surface cover: | Native grasses | | |
| % 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 200 | Light brown loamy sand | | D | | | | |
| 200 to 800 | Light grey silty clay with trace gravel | | D | | | | |
| 800 to 3000 | Light brown sandy clay | | D | | | | |
| 3000 | End of hole | | | | | | |
| Notes: | | | | | | | |

**Salinity assessment**

| | | | | | |
|---|---|---|---|---|---|
| **Client:** Highview Country Estates Pty Ltd | | **Job no:** | 5809 | **Date:** | 24/04/2015 |
| **Address:** | Lot 172 DP753233 Blackbutt Road, Dubbo NSW | | | | |
| **Borehole:** | BH15 | **GPS:** | 647249mE 6427634mN | | |

**Surface description**

| | | | |
|---|---|---|---|
| Slope: | 0-1% | Aspect: | North |
| Morphological type: | Mid-slope | | |
| Land-use: | Grazing | | |
| Disturbance: | High | | |
| Erosion: | Minor | | |
| Coarse fragments: | Ironstone | | |
| Surface cover: | Native grasses | | |
| % 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 500 | Light grey loamy sand | | D | | | | |
| 500 to 1400 | Light grey silty clay | | D | | | | |
| 1400 to 2000 | Light brown sandy clay with trace weakened rock | | D | | | | |
| 2200 | Drill refusal | | | | | | |
| Notes: | | | | | | | |

**Salinity assessment**

| | | | | | |
|---|---|---|---|---|---|
| **Client:** Highview Country Estates Pty Ltd | | **Job no:** | 5809 | **Date:** | 08/05/2015 |
| **Address:** | Lot 172 DP753233 Blackbutt Road, Dubbo NSW | | | | |
| **Borehole:** | BH16 | **GPS:** | 647377mE 6427643mN | | |

**Surface description**

| | | | |
|---|---|---|---|
| Slope: | 0-1% | Aspect: | North east |
| Morphological type: | Mid-slope | | |
| Land-use: | Grazing | | |
| Disturbance: | High | | |
| Erosion: | Nil | | |
| Coarse fragments: | Nil | | |
| Surface cover: | Grasses | | |
| % 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 450 | Dark brown loamy sand loam | | D | | | | |
| 450 to 1000 | Light brown loamy sand with trace gravel | | D | | | | |
| 1000 to 1200 | Light grey brown silty clay | | D | | | | |
| 1200 to 1500 | Light red brown sandy clay with trace weathered rock | | D | | | | |
| 1500 | End of hole, drill refusal | | | | | | |
| Notes: | | | | | | | |

**Salinity assessment**

| | | | | | |
|---|---|---|---|---|---|
| **Client:** Highview Country Estates Pty Ltd | | **Job no:** | 5809 | **Date:** | 8/05/2015 |
| **Address:** | Lot 172 DP753233 Blackbutt Road, Dubbo NSW | | | | |
| **Borehole:** | BH17 | **GPS:** | 647019mE 6427759mN | | |

**Surface description**

| | | | |
|---|---|---|---|
| Slope: | 0-1% | Aspect: | South east |
| Morphological type: | Mid-slope | | |
| Land-use: | Grazing | | |
| Disturbance: | High | | |
| Erosion: | Nil | | |
| Coarse fragments: | Surface rocks | | |
| Surface cover: | Grasses | | |
| % surface cover | 90% | | |
| 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 350 | Brown loamy sand | | D | | | | |
| 350 to 500 | Dark brown sandy gravel with moderate weathered rock | | D | | | | |
| 500 | End of hole, drill refusal | | | | | | |
| Notes: | | | | | | | |

**Salinity assessment**

| | | | |
|---|---|---|---|
| **Client:** Highview Country Estates Pty Ltd | **Job no:** 5809 | **Date:** 08/05/2015 | |
| **Address:** | Lot 172 DP753233 Blackbutt Road, Dubbo NSW | | |
| **Borehole:** | BH18 | **GPS:** | 646965mE 642727mN |

**Surface description**

| | | | |
|---|---|---|---|
| Slope: | 0-1% | Aspect: | South east |
| Morphological type: | Mid-slope | | |
| Land-use: | Grazing | | |
| Disturbance: | High | | |
| Erosion: | Low | | |
| Coarse fragments: | Surface float | | |
| Vegetation species: | Grasses | | |
| % surface cover | 70% | | |
| 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 200 | Brown loamy sand loam | | D | | | | |
| 200 to 300 | Dark brown sandy gravel with weathered rock | | D | | | | |
| 300 | End of hole, drill refusal | | | | | | |
| Notes: | | | | | | | |

**Salinity assessment**

| | | | | | |
|---|---|---|---|---|---|
| **Client:** Highview Country Estates Pty Ltd | | **Job no:** | 5809 | **Date:** | 01/04/2015 |
| **Address:** | Lot 172 DP753233 Blackbutt Road, Dubbo NSW | | | | |
| **Borehole:** | BH20 | **GPS:** | 647457mE 6427427mN | | |

**Surface description**

| | | | |
|---|---|---|---|
| Slope: | 0-1% | Aspect: | North east |
| Morphological type: | Mid-slope | | |
| Land-use: | Grazing | | |
| Disturbance: | High | | |
| Erosion: | Minor | | |
| Coarse fragments: | Ironstone | | |
| Surface cover: | Native grasses, pines | | |
| % surface cover | 10% | | |
| 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 650 | Light loamy sand with trace gravel | | D | | | | |
| 650 to 1100 | Light grey clayey sand with trace gravel | | D | | | | |
| 1100 | End of hole, drill refusal | | | | | | |
| Notes: | | | | | | | |

**Salinity assessment**

| | | | | | |
|---|---|---|---|---|---|
| **Client:** Highview Country Estates Pty Ltd | | **Job no:** | 5809 | **Date:** | 31/03/2015 |
| **Address:** | Lot 172 DP753233 Blackbutt Road, Dubbo NSW | | | | |
| **Borehole:** | BH 21 (MW2) | **GPS:** | 647544mE 6427516mN | | |

**Surface description**

| | | | |
|---|---|---|---|
| Slope: | 0-2% | Aspect: | North |
| Morphological type: | Mid-slope | | |
| Land-use: | Grazing | | |
| Disturbance: | High | | |
| Erosion: | Nil | | |
| Coarse fragments: | Minor gravel | | |
| Surface cover: | Native grasses, pine | | |
| % 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 1100 | Dark brown sandy clay loam | 100 | D | 4.4 | 0.01 | 0.10 | 3 |
| | | 200 | D | 4.8 | 0.01 | 0.10 | 3 |
| | | 300 | D | 5.1 | 0.01 | 0.10 | 3 |
| | | 500 | D | 5.1 | 0.01 | 0.10 | 3 |
| | | 1000 | D | 5.2 | 0.01 | 0.10 | 2 |
| 1100 to 4800 | Brownish yellow to yellowish brown clayey sand with gravel | 1500 | D | 5.6 | 0.03 | 0.69 | 2 |
| | | 2000 | D | 5.7 | 0.07 | 1.61 | 1 |
| | | 2500 | D | 6.1 | 0.12 | 2.76 | 2 |
| | | 3000 | D | 7.0 | 0.14 | 3.22 | 3 |
| | | 3500 | D | 5.8 | 0.11 | 2.53 | 3 |
| | | 4000 | M | 5.9 | 0.11 | 2.53 | 2 |
| | | 4500 | M | 6.7 | 0.20 | 4.60 | 2 |
| 4800 to 5700 | Yellow clayey sand | 5000 | M | 7.5 | 0.24 | 5.52 | 3 |
| | | 5500 | M | 6.9 | 0.28 | 6.44 | 6 |
| 5700 to 7200 | Yellow to orange yellow sandy clay | 6000 | M | 8.6 | 0.26 | 1.95 | 6 |
| | | 6500 | M | 8.4 | 0.32 | 2.40 | 6 |
| | | 7000 | M | 8.2 | 0.32 | 2.40 | 6 |
| 7200 to 9900 | Brownish yellow light clay | 7500 | M | 7.5 | 0.37 | 2.78 | 6 |
| | | 8000 | M | 7.0 | 0.29 | 2.18 | 6 |
| | | 8500 | M | 6.8 | 0.30 | 2.25 | 6 |
| | | 9000 | M | 6.2 | 0.25 | 1.88 | 6 |
| | | 9500 | M | 6.4 | 0.23 | 1.73 | 6 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 9900 | End of hole, drill refusal | 9900 | | 6.3 | 0.22 | 1.65 | 3 |
| Notes: | | | | | | | |

**Salinity assessment**

| | | | | | |
|---|---|---|---|---|---|
| **Client:** Highview Country Estates Pty Ltd | | **Job no:** | 5809 | **Date:** | 01/04/2015 |
| **Address:** | Lot 172 DP753233 Blackbutt Road, Dubbo NSW | | | | |
| **Borehole:** | BH22 | **GPS:** | 647480mE 6427768mN | | |

**Surface description**

| | | | |
|---|---|---|---|
| Slope: | 0-1% | Aspect: | North West |
| Morphological type: | Mid-slope | | |
| Land-use: | Grazing | | |
| Disturbance: | High | | |
| Erosion: | Nil | | |
| Coarse fragments: | Moderate – ironstone/quartzite | | |
| Surface cover: | Grasses and eucalyptus | | |
| % surface cover | 30% | | |
| 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 500 | Light brown loamy sand with cobbles | | D | | | | |
| 500 to 2400 | Light red clayey sand with weathered rock | | D | | | | |
| 2400 to 3000 | Light grey/white sandy clay with extremely weathered rock fragments | | D | | | | |
| 3000 | End of hole | | | | | | |
| Notes: | | | | | | | |

**Salinity assessment**

| | | | |
|---|---|---|---|
| **Client:** Highview Country Estates Pty Ltd | | **Job no:** 5809 | **Date:** 01/04/2015 |
| **Address:** | Lot 172 DP753233 Blackbutt Road, Dubbo NSW | | |
| **Borehole:** | BH23 | **GPS:** | 647436mE 6427926mN |

**Surface description**

| | | | |
|---|---|---|---|
| Slope: | 0-2% | Aspect: | North East |
| Morphological type: | Mid-slope | | |
| Land-use: | Grazing | | |
| Disturbance: | High | | |
| Erosion: | Moderate sheet erosion along track | | |
| Coarse fragments: | Moderate ironstone, quartzite | | |
| Surface cover: | Grass/pine | | |
| % surface cover | 10% | | |
| 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 600 | Brown sandy gravel | | D | | | | |
| 600 to 1000 | Light brown silty clay | | D | | | | |
| 1000 to 2000 | Light brown sandy clay with trace gravel | | D | | | | |
| 2000 | End of hole | | | | | | |
| Notes: | | | | | | | |

**Salinity assessment**

| | | | |
|---|---|---|---|
| **Client:** Highview Country Estates Pty Ltd | **Job no:** 5809 | **Date:** 01/04/2015 | |
| **Address:** | Lot 172 DP753233 Blackbutt Road, Dubbo NSW | | |
| **Borehole:** | BH24 | **GPS:** | 647459mE 6428122mN |

**Surface description**

| | | | |
|---|---|---|---|
| Slope: | 0-2% | Aspect: | North |
| Morphological type: | Mid-slope | | |
| Land-use: | Grazing | | |
| Disturbance: | High | | |
| Erosion: | Low | | |
| Coarse fragments: | Ironstone | | |
| Surface cover: | Pine/grasses | | |
| % surface cover | 40% | | |
| 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 450 | Brown loamy sand | | D | | | | |
| 450 to 1400 | Light brown sandy gravel with strongly weathered rock | | D | | | | |
| 1400 to 2200 | Light brown silty clay with trace gravel | | D | | | | |
| 2200 to 3000 | Light grey clayey sand with extremely weathered rock | | D | | | | |
| 3000 | End of hole | | | | | | |
| Notes: | | | | | | | |

**Salinity assessment**

| | | |
|---|---|---|
| **Client:** Highview Country Estates Pty Ltd | **Job no:** 5809 | **Date:** 01/04/2015 |
| **Address:** Lot 172 DP753233 Blackbutt Road, Dubbo NSW | | |
| **Borehole:** BH25 | **GPS:** 647638mE 6428039mN | |

**Surface description**

| | | | |
|---|---|---|---|
| Slope: | 0-1% | Aspect: | North |
| Morphological type: | Mid-slope | | |
| Land-use: | Grazing | | |
| Disturbance: | High | | |
| Erosion: | Minor | | |
| Coarse fragments: | Ironstone | | |
| Surface cover: | Pines | | |
| % surface cover | 30% | | |
| 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 900 | Light brown loamy sand | | D | | | | |
| 900 to 1300 | Light brown sandy gravel | | D | | | | |
| 1300 to 2000 | Light grey sandy clay with trace weathered rock | | D | | | | |
| 2000 | End of hole | | | | | | |
| Notes: | | | | | | | |

**Salinity assessment**

| | | | | | |
|---|---|---|---|---|---|
| **Client:** Highview Country Estates Pty Ltd | | **Job no:** | 5809 | **Date:** | 01/04/2015 |
| **Address:** | Lot 172 DP753233 Blackbutt Road, Dubbo NSW | | | | |
| **Borehole:** | BH26 | **GPS:** | 647609mE 6927875mN | | |

**Surface description**

| | | | |
|---|---|---|---|
| Slope: | 0-1% | Aspect: | North east |
| Morphological type: | Mid-slope | | |
| Land-use: | Grazing | | |
| Disturbance: | High | | |
| Erosion: | Nil | | |
| Coarse fragments: | Ironstone gravel | | |
| Surface cover: | Native grasses | | |
| % surface cover | 90% | | |
| 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 600 | Light brown sandy loam | | D | | | | |
| 600 to 1200 | Light purple clayey sand | | D | | | | |
| 1200 to 1500 | Dark brown/red silty clay with mottling and moderate gravel | | D | | | | |
| 1500 | End of hole, drill refusal | | | | | | |
| Notes: | | | | | | | |

**Salinity assessment**

| | | | |
|---|---|---|---|
| **Client:** Highview Country Estates Pty Ltd | **Job no:** 5809 | **Date:** 01/04/2015 | |
| **Address:** | Lot 172 DP753233 Blackbutt Road, Dubbo NSW | | |
| **Borehole:** | BH27 | **GPS:** | 647621mE 6427758mN |

**Surface description**

| | | | |
|---|---|---|---|
| Slope: | 0-1% | Aspect: | North east |
| Morphological type: | Mid-slope | | |
| Land-use: | Grazing | | |
| Disturbance: | High | | |
| Erosion: | Moderate along track | | |
| Coarse fragments: | Ironstone | | |
| Surface cover: | Grass | | |
| % surface cover | 30% | | |
| 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 800 | Dark brown loamy sand with oversize cobbles | | D | | | | |
| 800 to 900 | Light brown clayey gravel | | D | | | | |
| 900 to 2000 | Light grey sandy clay | | D | | | | |
| 2000 | End of hole | | | | | | |
| Notes: | | | | | | | |

**Salinity assessment**

| **Client:** Highview Country Estates Pty Ltd | | **Job no:** 5809 | **Date:** 01/04/2015 |
|---|---|---|---|
| **Address:** | Lot 172 DP753233 Blackbutt Road, Dubbo NSW | | |
| **Borehole:** | BH28 | **GPS:** | 647634mE 6427598mN |

**Surface description**

| | | | |
|---|---|---|---|
| Slope: | 0-1% | Aspect: | North east |
| Morphological type: | Mid-slope | | |
| Land-use: | Grazing | | |
| Disturbance: | High | | |
| Erosion: | Minor | | |
| Coarse fragments: | Ironstone | | |
| Surface cover: | Pines and native grasses | | |
| % surface cover | 20% | | |
| 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 500 | Light grey sandy loam | | D | | | | |
| 500 to 650 | Light brown sandy gravel with moderate gravel | | D | | | | |
| 650 | End of hole, drill refusal | | | | | | |
| Notes: | | | | | | | |

**Salinity assessment**

| | | | | | |
|---|---|---|---|---|---|
| **Client:** Highview Country Estates Pty Ltd | | **Job no:** | 5809 | **Date:** | 01/04/2015 |
| **Address:** | Lot 172 DP753233 Blackbutt Road, Dubbo NSW | | | | |
| **Borehole:** | BH29 | **GPS:** | 647510mE 6427462mN | | |

**Surface description**

| | | | |
|---|---|---|---|
| Slope: | 0-1% | Aspect: | North East |
| Morphological type: | Mid-slope | | |
| Land-use: | Grazing | | |
| Disturbance: | High | | |
| Erosion: | Nil | | |
| Coarse fragments: | Ironstone cobbles | | |
| Surface cover: | Native grasses | | |
| % surface cover | 90% | | |
| 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 | Light brown loamy sand with trace ironstone cobbles | | D | | | | |
| 300 to 1400 | Medium brown sandy gravel | | D | | | | |
| 1400 to 2000 | White sandy clay with trace weathered rock | | D | | | | |
| 2000 | End of hole | | | | | | |
| Notes: | | | | | | | |

**Salinity assessment**

| | | | | | |
|---|---|---|---|---|---|
| **Client:** Highview Country Estates Pty Ltd | | **Job no:** | 5809 | **Date:** | 01/04/2015 |
| **Address:** | Lot 172 DP753233 Blackbutt Road, Dubbo NSW | | | | |
| **Borehole:** | BH30 | **GPS:** | 647792mE 6427648mN | | |

**Surface description**

| | | | |
|---|---|---|---|
| Slope: | 0-1% | Aspect: | East |
| Morphological type: | Mid-slope | | |
| Land-use: | Grazing | | |
| Disturbance: | High | | |
| Erosion: | Minor | | |
| Coarse fragments: | Ironstone on surface | | |
| Surface cover: | Native grasses and pine | | |
| % surface cover | 20% | | |
| 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 200 | Light brown loamy sand with trace cobble | | D | | | | |
| 600 | End of hole, drill refusal on cobbles | | | | | | |
| Notes: | | | | | | | |

**Salinity assessment**

| | | | |
|---|---|---|---|
| **Client:** Highview Country Estates Pty Ltd | **Job no:** 5809 | **Date:** 01/04/2015 | |
| **Address:** | Lot 172 DP753233 Blackbutt Road, Dubbo NSW | | |
| **Borehole:** | BH31 | **GPS:** | 647749mE 6427769mN |

**Surface description**

| | | | |
|---|---|---|---|
| Slope: | 0-1% | Aspect: | North |
| Morphological type: | Mid-slope | | |
| Land-use: | Grazing | | |
| Disturbance: | High | | |
| Erosion: | Minor | | |
| Coarse fragments: | Ironstone | | |
| Surface cover: | Pine and native grasses | | |
| % surface cover | 40% | | |
| 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 1500 | Dark brown sandy loam with gravel from 500mm | 100 | D | 4.6 | 0.02 | 0.46 | 3 |
| | | 300 | D | 4.6 | 0.01 | 0.14 | 3 |
| | | 500 | D | 4.5 | 0.01 | 0.14 | 3 |
| | | 1000 | D | 4.8 | 0.01 | 0.14 | 3 |
| 1500 to 2500 | Brownish yellow sandy clay with gravel | 1500 | D | 5.4 | 0.06 | 0.45 | 2 |
| | | 2000 | D | 6.9 | 0.07 | 1.61 | 2 |
| | | 2500 | D | 6.0 | 0.06 | 1.38 | 1 |
| 2500 to 3100 | Brownish yellow fine sandy clay loam | 3000 | D | 5.7 | 0.13 | 1.82 | 1 |
| 3100 to 4500 | Brownish yellow silty clay | 3500 | D | 5.4 | 0.15 | 1.12 | 1 |
| | | 4000 | D | 5.6 | 0.22 | 1.65 | 1 |
| 4500 to 5300 | Pale yellow sandy clay | 4500 | D | 5.7 | 0.28 | 2.10 | 2 |
| | | 5000 | M | 6.1 | 0.34 | 2.55 | 2 |
| | | 5300 | M | 6.3 | 0.38 | 2.85 | 2 |
| 5300 | End of hole, drill refusal | | | | | | |
| Notes: | | | | | | | |

**Salinity assessment**

| **Client:** Highview Country Estates Pty Ltd | **Job no:** 5809 | **Date:** 01/04/2015 |
|---|---|---|

| | | | |
|---|---|---|---|
| **Address:** | Lot 172 DP753233 Blackbutt Road, Dubbo NSW | | |
| **Borehole:** | BH32 | **GPS:** | 647809mE 6427877mN |

**Surface description**

| | | | |
|---|---|---|---|
| Slope: | 0-1% | Aspect: | East |
| Morphological type: | Mid-slope | | |
| Land-use: | Grazing | | |
| Disturbance: | High | | |
| Erosion: | Minor | | |
| Coarse fragments: | Ironstone fragments | | |
| Surface cover: | Native grasses and pines | | |
| % surface cover | 20% | | |
| 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 900 | Dark brown loamy sand | 100 | D | 4.7 | 0.02 | 0.46 | 3 |
| | | 200 | D | 5.8 | 0.02 | 0.46 | 3 |
| | | 300 | D | 5.8 | 0.03 | 0.69 | 2 |
| | | 500 | D | 5.8 | 0.04 | 0.92 | 2 |
| 900 to 1800 | Brown clayey sand with gravel and weathered cobbles | 1000 | D | 5.6 | 0.10 | 2.30 | 1 |
| | | 1500 | D | 5.8 | 0.16 | 3.68 | 1 |
| 1800 to 2900 | Brown sandy clay with weathered rock and rounded river gravel | 2000 | D | 6.3 | 0.23 | 1.72 | 1 |
| | | 2500 | D | 6.7 | 0.20 | 1.50 | 1 |
| 2900 to 3000 | Yellow gravelly sandy clay (weathered rock) | 3000 | D | 7.4 | 0.12 | 2.76 | 1 |
| 3000 | End of hole, drill refusal | | | | | | |

Notes:

**Salinity assessment**

| **Client:** Highview Country Estates Pty Ltd | | **Job no:** 5809 | **Date:** |
|---|---|---|---|
| **Address:** | Lot 172 DP753233 Blackbutt Road, Dubbo NSW | | |
| **Borehole:** | BH33 (MW1) | **GPS:** | 647277mE 6428094mN |

**Surface description**

| Slope: | 0-2% | Aspect: | East |
|---|---|---|---|
| Morphological type: | Mid-slope | | |
| Land-use: | Grazing | | |
| Disturbance: | High, bike track with drainage line | | |
| Erosion: | Moderate, due to clearing for bike track | | |
| Coarse fragments: | Ironstone gravel | | |
| Surface cover: | Pine, eucalyptus and native grasses | | |
| % surface cover | 40% | | |
| 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 950 | Dark brown loamy sand with root matter | 100 | D | 4.7 | 0.04 | 0.92 | 8 |
| | | 200 | D | 5.0 | 0.02 | 0.46 | 8 |
| | | 300 | D | 5.1 | 0.02 | 0.46 | 8 |
| | | 500 | D | 5.3 | 0.02 | 0.46 | 8 |
| 950 to 1500 | Light brown sandy loam | 1000 | D | 5.6 | 0.03 | 0.42 | 3 |
| | | 1500 | D | 5.8 | 0.07 | 0.98 | 3 |
| 1500 to 3000 | Yellowish brown clayey sand with gravel | 2000 | D | 6.3 | 0.13 | 2.99 | 2 |
| | | 2500 | D | 6.7 | 0.27 | 6.21 | 2 |
| 3000 to 4800 | Yellow sandy clay | 3000 | D | 7.0 | 0.33 | 2.48 | 2 |
| | | 3500 | D | 7.1 | 0.24 | 1.80 | 2 |
| | | 4000 | D | 6.6 | 0.31 | 2.33 | 2 |
| | | 4500 | M | 7.1 | 0.43 | 3.23 | 2 |
| 4800 to 7200 | Olive yellow light clay | 5000 | M | 7.1 | 0.53 | 4.00 | 2 |
| | | 5500 | M | 7.2 | 0.53 | 4.00 | 2 |
| | | 6000 | M | 7.2 | 0.47 | 3.53 | 1 |
| | | 6500 | M | 7.0 | 0.60 | 4.50 | 1 |
| | | 7000 | M | 7.0 | 0.62 | 4.65 | 1 |
| | | 7200 | M | 7.0 | 0.29 | 2.18 | 1 |
| 7200 | End of hole, drill refusal | | | | | | |
| Notes: | | | | | | | |

## **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 ES1508739 and chain of custody form

ALS Environmental

# CERTIFICATE OF ANALYSIS

| | | | |
|---|---|---|---|
| Work Order | : **ES1508739** | Page | : 1 of 3 |
| Client | : **ENVIROWEST CONSULTING** | Laboratory | : Environmental Division Sydney |
| Contact | : MS LEAH DESBOROUGH | Contact | : Client Services |
| Address | : 9 CAMERON PLACE<br>PO BOX 8158<br>ORANGE NSW, AUSTRALIA 2800 | Address | : 277-289 Woodpark Road Smithfield NSW Australia 2164 |
| E-mail | : leah@envirowest.net.au | E-mail | : sydney@alsglobal.com |
| Telephone | : +61 63614954 | Telephone | : +61-2-8784 8555 |
| Facsimile | : +61 02 63603960 | Facsimile | : +61-2-8784 8500 |
| Project | : 5809-1 | QC Level | : NEPM 2013 Schedule B(3) and ALS QCS3 requirement |
| Order number | : 5809-1 | | |
| C-O-C number | : 5809-1 | Date Samples Received | : 17-APR-2015 |
| Sampler | : ---- | Issue Date | : 24-APR-2015 |
| Site | : 5809-1 | | |
| | | No. of samples received | : 4 |
| Quote number | : SY/542/14 | No. of samples analysed | : 4 |

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

NATA

WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

## *Signatories*

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

| *Signatories* | *Position* | *Accreditation Category* |
|---|---|---|
| Ashesh Patel | Inorganic Chemist | Sydney Inorganics |
| Edwandy Fadjar | Organic Coordinator | Sydney Inorganics |
| Shobhna Chandra | Metals Coordinator | Sydney Inorganics |

## General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Client sample ID | MW1-100 | MW1-500 | BH14-100 | BH14-500 | ---- |
|---|---|---|---|---|---|---|---|---|
| | | | Client sampling date / time | 31-MAR-2015 15:00 | 31-MAR-2015 15:00 | 31-MAR-2015 15:00 | 31-MAR-2015 15:00 | ---- |
| Compound | CAS Number | LOR | Unit | ES1508739-001 | ES1508739-002 | ES1508739-003 | ES1508739-004 | ---- |
| **EA055: Moisture Content** | | | | | | | | |
| Moisture Content (dried @ 103°C) | ---- | 1.0 | % | 1.2 | 2.2 | 6.1 | 3.3 | ---- |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | <10 | <10 | <10 | 40 | ---- |
| **ED045G: Chloride Discrete analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 10 | mg/kg | 50 | 70 | 40 | 120 | ---- |
| **ED093S: Soluble Major Cations** | | | | | | | | |
| Calcium | 7440-70-2 | 10 | mg/kg | <10 | <10 | <10 | 10 | ---- |
| Magnesium | 7439-95-4 | 10 | mg/kg | <10 | 10 | <10 | 50 | ---- |
| Sodium | 7440-23-5 | 10 | mg/kg | 10 | 20 | 10 | 40 | ---- |
| Potassium | 7440-09-7 | 10 | mg/kg | 10 | <10 | <10 | 60 | ---- |

# QUALITY CONTROL REPORT

| | | | |
|---|---|---|---|
| Work Order | : **ES1508739** | Page | : 1 of 4 |
| Client | : **ENVIROWEST CONSULTING** | Laboratory | : Environmental Division Sydney |
| Contact | : MS LEAH DESBOROUGH | Contact | : Client Services |
| Address | : 9 CAMERON PLACE<br>PO BOX 8158<br>ORANGE NSW, AUSTRALIA 2800 | Address | : 277-289 Woodpark Road Smithfield NSW Australia 2164 |
| E-mail | : leah@envirowest.net.au | E-mail | : sydney@alsglobal.com |
| Telephone | : +61 63614954 | Telephone | : +61-2-8784 8555 |
| Facsimile | : +61 02 63603960 | Facsimile | : +61-2-8784 8500 |
| Project | : 5809-1 | QC Level | : NEPM 2013 Schedule B(3) and ALS QCS3 requirement |
| Site | : 5809-1 | | |
| C-O-C number | : 5809-1 | Date Samples Received | : 17-APR-2015 |
| Sampler | : ---- | Issue Date | : 24-APR-2015 |
| Order number | : 5809-1 | | |
| | | No. of samples received | : 4 |
| Quote number | : SY/542/14 | No. of samples analysed | : 4 |

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

*Signatories*

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

| *Signatories* | *Position* | *Accreditation Category* |
|---|---|---|
| Ashesh Patel | Inorganic Chemist | Sydney Inorganics |
| Edwandy Fadjar | Organic Coordinator | Sydney Inorganics |
| Shobhna Chandra | Metals Coordinator | Sydney Inorganics |

## General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Key :
- Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
- CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstract Service is a division of the American Chemical Society.
- LOR = Limit of reporting
- RPD = Relative Percentage Difference
- # = Indicates failed QC

## Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **SOIL**

| | | | | Laboratory Duplicate (DUP) Report | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Laboratory sample ID** | **Client sample ID** | **Method: Compound** | **CAS Number** | **LOR** | **Unit** | **Original Result** | **Duplicate Result** | **RPD (%)** | **Recovery Limits (%)** |
| **EA055: Moisture Content (QC Lot: 3905360)** | | | | | | | | | |
| ES1508739-003 | BH14-100 | EA055-103: Moisture Content (dried @ 103°C) | ---- | 1.0 | % | 6.1 | 5.6 | 8.6 | No Limit |
| ES1508741-010 | Anonymous | EA055-103: Moisture Content (dried @ 103°C) | ---- | 1.0 | % | 13.8 | 14.5 | 5.0 | 0% - 50% |
| **ED040S: Soluble Major Anions (QC Lot: 3908337)** | | | | | | | | | |
| ES1508691-002 | Anonymous | ED040S: Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | 150 | 130 | 12.1 | 0% - 20% |
| **ED045G: Chloride by Discrete Analyser (QC Lot: 3908338)** | | | | | | | | | |
| ES1508691-002 | Anonymous | ED045G: Chloride | 16887-00-6 | 10 | mg/kg | 660 | 670 | 1.6 | 0% - 20% |
| **ED093S: Soluble Major Cations (QC Lot: 3908340)** | | | | | | | | | |
| ME1500573-001 | Anonymous | ED093S: Calcium | 7440-70-2 | 10 | mg/kg | 4260 | 4260 | 0.0 | 0% - 20% |
| | | ED093S: Magnesium | 7439-95-4 | 10 | mg/kg | 2280 | 2290 | 0.0 | 0% - 20% |
| | | ED093S: Sodium | 7440-23-5 | 10 | mg/kg | 3300 | 3330 | 1.0 | 0% - 20% |
| | | ED093S: Potassium | 7440-09-7 | 10 | mg/kg | 1120 | 1120 | 0.0 | 0% - 20% |

## Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **SOIL**

| Method: Compound | CAS Number | LOR | Unit | Method Blank (MB) Report Result | Laboratory Control Spike (LCS) Report: Spike Concentration | Spike Recovery (%) LCS | Recovery Limits (%) Low | Recovery Limits (%) High |
|---|---|---|---|---|---|---|---|---|
| **ED040S: Soluble Major Anions (QCLot: 3908337)** | | | | | | | | |
| ED040S: Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | <10 | 750 mg/kg | 95.4 | 80 | 120 |
| **ED045G: Chloride by Discrete Analyser (QCLot: 3908338)** | | | | | | | | |
| ED045G: Chloride | 16887-00-6 | 10 | mg/kg | <10 | 50 mg/kg | 104 | 75 | 125 |
| | | | | ---- | 5000 mg/kg | 104 | 79 | 117 |
| **ED093S: Soluble Major Cations (QCLot: 3908340)** | | | | | | | | |
| ED093S: Calcium | 7440-70-2 | 10 | mg/kg | <10 | 250 mg/kg | 99.5 | 82 | 118 |
| ED093S: Magnesium | 7439-95-4 | 10 | mg/kg | <10 | 250 mg/kg | 103 | 84 | 114 |
| ED093S: Sodium | 7440-23-5 | 10 | mg/kg | <10 | 250 mg/kg | 88.4 | 80 | 112 |
| ED093S: Potassium | 7440-09-7 | 10 | mg/kg | <10 | 250 mg/kg | 95.7 | 80 | 120 |

## Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **SOIL**

| Laboratory sample ID | Client sample ID | Method: Compound | CAS Number | Matrix Spike (MS) Report: Spike Concentration | SpikeRecovery(%) MS | Recovery Limits (%) Low | Recovery Limits (%) High |
|---|---|---|---|---|---|---|---|
| **ED045G: Chloride by Discrete Analyser (QCLot: 3908338)** | | | | | | | |
| ES1508691-002 | Anonymous | ED045G: Chloride | 16887-00-6 | 1250 mg/kg | 119 | 70 | 130 |

## Matrix Spike (MS) and Matrix Spike Duplicate (MSD) Report

The quality control term Matrix Spike (MS) and Matrix Spike Duplicate (MSD) refers to intralaboratory split samples spiked with a representative set of target analytes. The purpose of these QC parameters are to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **SOIL**

| Laboratory sample ID | Client sample ID | Method: Compound | CAS Number | Matrix Spike (MS) and Matrix Spike Duplicate (MSD) Report: Spike Concentration | Spike Recovery (%) MS | Spike Recovery (%) MSD | Recovery Limits (%) Low | Recovery Limits (%) High | RPDs (%) Value | RPDs (%) Control Limit |
|---|---|---|---|---|---|---|---|---|---|---|
| **ED045G: Chloride by Discrete Analyser (QCLot: 3908338)** | | | | | | | | | | |
| ES1508691-002 | Anonymous | ED045G: Chloride | 16887-00-6 | 1250 mg/kg | 119 | ---- | 70 | 130 | ---- | ---- |

ALS Environmental

# INTERPRETIVE QUALITY CONTROL REPORT

| | | | |
|---|---|---|---|
| **Work Order** | : **ES1508739** | Page | : 1 of 5 |
| Client | : ENVIROWEST CONSULTING | Laboratory | : Environmental Division Sydney |
| Contact | : MS LEAH DESBOROUGH | Contact | : Client Services |
| Address | : 9 CAMERON PLACE<br>PO BOX 8158<br>ORANGE NSW, AUSTRALIA 2800 | Address | : 277-289 Woodpark Road Smithfield NSW Australia 2164 |
| E-mail | : leah@envirowest.net.au | E-mail | : sydney@alsglobal.com |
| Telephone | : +61 63614954 | Telephone | : +61-2-8784 8555 |
| Facsimile | : +61 02 63603960 | Facsimile | : +61-2-8784 8500 |
| Project | : 5809-1 | QC Level | : NEPM 2013 Schedule B(3) and ALS QCS3 requirement |
| Site | : 5809-1 | | |
| C-O-C number | : 5809-1 | Date Samples Received | : 17-APR-2015 |
| Sampler | : ---- | Issue Date | : 24-APR-2015 |
| Order number | : 5809-1 | | |
| | | No. of samples received | : 4 |
| Quote number | : SY/542/14 | No. of samples analysed | : 4 |

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Interpretive Quality Control Report contains the following information:

- Analysis Holding Time Compliance
- Quality Control Parameter Frequency Compliance
- Brief Method Summaries
- Summary of Outliers

# Analysis Holding Time Compliance

This report summarizes extraction / preparation and analysis times and compares each with recommended holding times (USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

| Method / Container / Client Sample ID(s) | | Sample Date | Extraction / Preparation | | | Analysis | | |
|---|---|---|---|---|---|---|---|---|
| | | | Date extracted | Due for extraction | Evaluation | Date analysed | Due for analysis | Evaluation |
| **EA055: Moisture Content** | | | | | | | | |
| **Soil Glass Jar - Unpreserved (EA055-103)** | | | | | | | | |
| MW1-100, | MW1-500, | **31-MAR-2015** | ---- | ---- | ---- | **20-APR-2015** | 14-APR-2015 | × |
| BH14-100, | BH14-500 | | | | | | | |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| **Soil Glass Jar - Unpreserved (ED040S)** | | | | | | | | |
| MW1-100, | MW1-500, | **31-MAR-2015** | **22-APR-2015** | 28-APR-2015 | ✓ | **22-APR-2015** | 20-MAY-2015 | ✓ |
| BH14-100, | BH14-500 | | | | | | | |
| **ED045G: Chloride Discrete analyser** | | | | | | | | |
| **Soil Glass Jar - Unpreserved (ED045G)** | | | | | | | | |
| MW1-100, | MW1-500, | **31-MAR-2015** | **22-APR-2015** | 28-APR-2015 | ✓ | **22-APR-2015** | 20-MAY-2015 | ✓ |
| BH14-100, | BH14-500 | | | | | | | |
| **ED093S: Soluble Major Cations** | | | | | | | | |
| **Soil Glass Jar - Unpreserved (ED093S)** | | | | | | | | |
| MW1-100, | MW1-500, | **31-MAR-2015** | **22-APR-2015** | 27-SEP-2015 | ✓ | **22-APR-2015** | 27-SEP-2015 | ✓ |
| BH14-100, | BH14-500 | | | | | | | |

## Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **SOIL**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

| Quality Control Sample Type | | Count | | Rate (%) | | | Quality Control Specification |
|---|---|---|---|---|---|---|---|
| *Analytical Methods* | *Method* | *QC* | *Regular* | ***Actual*** | ***Expected*** | *Evaluation* | |
| Laboratory Duplicates (DUP) | | | | | | | |
| Cations - soluble by ICP-AES | ED093S | 1 | 5 | **20.0** | **10.0** | ✓ | NEPM 2013 Schedule B(3) and ALS QCS3 requirement |
| Chloride Soluble By Discrete Analyser | ED045G | 1 | 5 | **20.0** | **10.0** | ✓ | NEPM 2013 Schedule B(3) and ALS QCS3 requirement |
| Major Anions - Soluble | ED040S | 1 | 5 | **20.0** | **10.0** | ✓ | NEPM 2013 Schedule B(3) and ALS QCS3 requirement |
| Moisture Content | EA055-103 | 2 | 20 | **10.0** | **10.0** | ✓ | NEPM 2013 Schedule B(3) and ALS QCS3 requirement |
| Laboratory Control Samples (LCS) | | | | | | | |
| Cations - soluble by ICP-AES | ED093S | 1 | 5 | **20.0** | **5.0** | ✓ | NEPM 2013 Schedule B(3) and ALS QCS3 requirement |
| Chloride Soluble By Discrete Analyser | ED045G | 2 | 5 | **40.0** | **10.0** | ✓ | NEPM 2013 Schedule B(3) and ALS QCS3 requirement |
| Major Anions - Soluble | ED040S | 1 | 5 | **20.0** | **5.0** | ✓ | NEPM 2013 Schedule B(3) and ALS QCS3 requirement |
| Method Blanks (MB) | | | | | | | |
| Cations - soluble by ICP-AES | ED093S | 1 | 5 | **20.0** | **5.0** | ✓ | NEPM 2013 Schedule B(3) and ALS QCS3 requirement |
| Chloride Soluble By Discrete Analyser | ED045G | 1 | 5 | **20.0** | **5.0** | ✓ | NEPM 2013 Schedule B(3) and ALS QCS3 requirement |
| Major Anions - Soluble | ED040S | 1 | 5 | **20.0** | **5.0** | ✓ | NEPM 2013 Schedule B(3) and ALS QCS3 requirement |
| Matrix Spikes (MS) | | | | | | | |
| Chloride Soluble By Discrete Analyser | ED045G | 1 | 5 | **20.0** | **5.0** | ✓ | NEPM 2013 Schedule B(3) and ALS QCS3 requirement |

## Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

| Analytical Methods | Method | Matrix | Method Descriptions |
|---|---|---|---|
| Moisture Content | EA055-103 | SOIL | In-house. A gravimetric procedure based on weight loss over a 12 hour drying period at 103-105 degrees C. This method is compliant with NEPM (2013) Schedule B(3) Section 7.1 and Table 1 (14 day holding time). |
| Major Anions - Soluble | ED040S | SOIL | In-house. Soluble Anions are determined off a 1:5 soil / water extract by ICPAES. |
| Chloride Soluble By Discrete Analyser | ED045G | SOIL | In house: Referenced to APHA 21st edition 4500-Cl- E. The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride.in the presence of ferric ions the librated thiocynate forms highly-coloured ferric thiocynate which is measured at 480 nm. Analysis is performed on a 1:5 soil / water leachate. |
| Cations - soluble by ICP-AES | ED093S | SOIL | In house: Referenced to APHA 21st ed., 3120; USEPA SW 846 - 6010 (ICPAES) Water extracts of the soil are analyzed for major cations by ICPAES. The ICPAES technique ionises samples in a plasma, emitting a characteristic spectrum based on metals present. Intensities at selected wavelengths are compared against those of matrix matched standards. This method is compliant with NEPM (2013) Schedule B(3) |

| Preparation Methods | Method | Matrix | Method Descriptions |
|---|---|---|---|
| 1:5 solid / water leach for soluble analytes | EN34 | SOIL | 10 g of soil is mixed with 50 mL of distilled water and tumbled end over end for 1 hour. Water soluble salts are leached from the soil by the continuous suspension. Samples are settled and the water filtered off for analysis. |

# Summary of Outliers

## Outliers : Quality Control Samples

The following report highlights outliers flagged in the Quality Control (QC) Report. Surrogate recovery limits are static and based on USEPA SW846 or ALS-QWI/EN/38 (in the absence of specific USEPA limits). This report displays QC Outliers (breaches) only.

### Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

- **For all matrices, no Method Blank value outliers occur.**
- **For all matrices, no Duplicate outliers occur.**
- **For all matrices, no Laboratory Control outliers occur.**
- **For all matrices, no Matrix Spike outliers occur.**

### Regular Sample Surrogates

- **For all regular sample matrices, no surrogate recovery outliers occur.**

## Outliers : Analysis Holding Time Compliance

This report displays Holding Time breaches only. Only the respective Extraction / Preparation and/or Analysis component is/are displayed.

Matrix: **SOIL**

| *Method* | | Extraction / Preparation | | | Analysis | | |
|---|---|---|---|---|---|---|---|
| **Container** / Client Sample ID(s) | | *Date extracted* | *Due for extraction* | **Days overdue** | *Date analysed* | *Due for analysis* | **Days overdue** |
| **EA055: Moisture Content** | | | | | | | |
| **Soil Glass Jar - Unpreserved** | | | | | | | |
| MW1-100,<br>BH14-100, | MW1-500,<br>BH14-500 | ---- | ---- | ---- | 20-APR-2015 | 14-APR-2015 | **6** |

## Outliers : Frequency of Quality Control Samples

The following report highlights breaches in the Frequency of Quality Control Samples.

- **No Quality Control Sample Frequency Outliers exist.**

# Chain of Custody Form – Ref 5809-1



| | |
|---|---|
| **Ref:** | **5809-1** |
| Investigator: | Envirowest Consulting<br>9 Cameron Place<br>PO Box 8158<br>ORANGE NSW 2800 |
| Telephone: | (02) 6361 4954 |
| **Email:** | **leah@envirowest.net.au** |
| Contact Person: | Leah Desborough |
| **Laboratory:** | Australian Laboratory Services<br>277 Woodpark Road<br>SMITHFIELD NSW 2164 |
| **Quotation #:** | **SY-542-14** |
| **Courier/CN:** | |

| | | | | **Sample matrix** | | | **Sample preservation** | | | **Analysis** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | **ALS Method Code** | | | | |
| | | | | | | | | | | | | | **NT-1S** | **NT-2S** |
| | **Sample ID** | **Container*** | **Sampling Date/Time** | Water | Soil | Sludge | Cool | HNO3/HCl | Unpre-served | | | | CEC | Sulphates & chlorides |
| 1 | MW1-100 | X | 31/3/2015 | | X | | X | | | | | | X | X |
| 2 | MW1-500 | X | 31/3/2015 | | X | | X | | | | | | X | X |
| 3 | BH14-100 | X | 31/3/2015 | | X | | X | | | | | | X | X |
| 4 | BH14-500 | X | 31/3/2015 | | X | | X | | | | | | X | X |

Environmental Division
Sydney
Work Order
**ES1508739**
Telephone : +61-2-8784 8555

| | |
|---|---|
| Investigator: I attest that the proper field sampling procedures were used during the collection of these samples. | Sampler name: Leah Desborough<br>Date : 31/3/2015Time: |
| Relinquished by: (print and signature) Leah Desborough [signature] Date 16/4/2015 Time 17:00 | Received by: (print and signature) Dav.d [signature] Date 17/4 Time 0800 |

Please return completed form to Envirowest Consulting

*A = 200mL solvent rinsed glass jar with Teflon lined lid, B = 2x40mL vials solvent rinsed Teflon lined septum caps, C 1x500mL glass bottles , solvent rinsed, Teflon lined cap, D= 200mL plastic bottle with nitric acid. E = 125ml amber bottle unpreserved

# Ecological Constraints and Opportunities Report

## Proposed Development

## Lot 172 in DP 753233, Newell Highway

Prepared For

## BAWD Property Trust

April 2013

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Proposed Development

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Prepared For:

**BAWD Property Trust**

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GEOLYSE

POSTAL ADDRESS PO Box 1963 ORANGE NSW 2800
LOCATION 154 PEISLEY STREET ORANGE NSW 2800
TELEPHONE 02 6393 5000 FACSIMILE 02 6393 5050
EMAIL ORANGE@GEOLYSE.COM WEB SITE WWW.GEOLYSE.COM

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# Executive Summary


Geolyse was engaged by BAWD Property Trust to undertake an Ecological Constraints and Opportunities Report for the proposed rezoning of Lot 172 in DP 753233, Newell Highway Dubbo (refer to **Drawing EV01**). A flora and fauna survey was undertaken on 10th to 13th December to broadly define vegetation communities and fauna habitats, assess the type and degree of constraints posed by the flora, fauna and ecological communities on site and identify mitigation measures to reduce the extent of impacts of any future development on all species and communities.

The findings of the field survey indicated a total of three threatened bird species being *Stagonopleura guttata* (diamond firetail), *Pomatostomus temporalis* (grey-crowned babbler) and *Climacteris picumnus* (brown treecreeper) (refer to **Appendix C**). Five grey-crowned babbler nests were also identified on site (refer to **Drawing EV02**).

One endangered ecological community grey box grassy woodland EEC was identified in the northwestern corner of the site (refer to **Drawing EV02**). No other threatened flora or vegetation communities were identified during the field investigations. A total of 29 hollow-bearing trees were recorded on site (refer to **Drawing EV02**).

**Woodland Corridor**

It is recommended a woodland corridor be maintained to connect to large tracts of woodland to the north and southeast of the site boundary. The recommended vegetation corridor is based on preferred habitat type of the three threatened birds (eucalypt woodland), riparian habitat and presence of fauna habitat (logs, hollow-bearing trees).

**Conservation Areas**

Areas of high conservation value were identified based on the following; presence of hollow-bearing trees, presence of hollow logs, quality of riparian habitat, habitat corridor function, presence of threatened fauna habitat and presence of endangered ecological communities.

Areas of moderate conservation value were identified based on the following; proximity to high conservation value areas, occurrence of threatened fauna habitat and occurrence of moderate quality fauna habitat.

Areas of low conservation value were identified based on the following; fauna habitat value, absence of hollow-bearing trees or hollow logs and degree of disturbance.

**Development Potential**

The development potential directly correlates to the conservation value of various areas on site (refer to **Drawing EV03**). Areas of high development potential are in low conservation value areas. Conversely, areas of low development potential are in high conservation value areas.

# Introduction

## 1.1 INTRODUCTION

Geolyse was engaged by BAWD Property Trust to undertake an Ecological Constraints and Opportunities Report for the proposed rezoning of Lot 172 in DP 753233, Newell Highway Dubbo. This report aims to outline the ecological constraints and development potential of the site in accordance with State (*Threatened Species Conservation Act 1995*) and Commonwealth legislation (*Environment Protection and Biodiversity Conservation Act 1995*). This report will refer to land located on Lot 172 as the site.

The purpose of this assessment is to:

- broadly define vegetation communities and fauna habitats;
- assess the type and degree of constraints posed by the flora, fauna and ecological communities on site; and
- identify mitigation measures to reduce the extent of impacts of any future development on all species and communities.

## 1.2 SOIL LANDSCAPE

The site is within the Goonoo soil landscape as mapped by Murphy and Lawrie (1998). The landscape is characterised by undulating rises and low hills with slopes ranging from 2 to 10%. The geological unit is Pilliga sandstone with parent rocks of quartz sandstone, conglomerate, siltstone and shale. The associated soils include earthy sands, siliceous sands, sandy red earths and yellow and grey earths. Yellow solodic soils are common on drainage lines. The soil has a low fertility and is highly acidic.

# Methodology

## 2.1 DESKTOP ASSESSMENT

Various sources of published information are available on flora and fauna within the site and locality. These were reviewed in the preparation of this assessment:

- Morgan, G. and Terrey, J. (1992) Nature conservation in western New South Wales. National Parks Association, Sydney.
- Thackway, R. and Cresswell, I.D. (eds.) (1995) An Interim Biogeographic Regionalisation for Australia: A Framework for Establishing the National System of Reserves, Version 4.0. Australian Nature Conservation Agency, Canberra.

A search of the Atlas of New South Wales Wildlife database maintained by NSW Government Office of the Environment and Heritage (OEH) was conducted for all records of threatened flora and fauna within a 10 kilometre radius of the locality. A search of the on-line database maintained by the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (DSEWPC) was completed to identify the presence of nationally listed threatened and migratory species in the locality. These species are listed in **Appendix A**.

All flora and fauna database records were analysed to determine the likelihood that threatened flora and fauna could occur within habitats on the site. It should be noted that the DSEWPC search is based on habitat requirements rather than actual records, and the assessment is based on those listed species considered likely to have habitat available on the site.

## 2.2 FLORA ASSESSMENT

Survey methodology involved the random meander technique, 100m transects and 20m by 20m quadrats to identify vegetation communities and the potential occurrence of threatened species on site over the period of four days being 10 December to 13 December 2012 by two ecologists.

All species observed in addition to physical attributes of the surrounding area were noted during the site inspection (refer to **Appendix B** Observed Flora Species List).

During fieldwork, targeted habitat searches were undertaken for any threatened flora species identified by literature and database searches.

The vegetation structures were delineated from aerial photography and field verification. The conservation status of vegetation communities was assessed based on their condition, occurrence of threatened flora, and assessment of the distribution of the community.

The likelihood of endangered ecological communities (Schedule 1, Part 3 of the TSC Act) occurring in the site was determined by considering the dominant plant species that comprise the vegetation communities and the dominant soils present. This assessment was based on vegetation identification guidelines by Office of Environment and Heritage and ground-truthing.

## 2.3 FAUNA HABITAT ASSESSMENT

Vegetation maps, previous assessments and field surveys were used to identify and assess the distribution of habitat types within the site. The following habitat features were noted:

- nesting or shelter habitats such as tree hollows, leaf litter, bare ground, rocks and logs;
- presence of freshwater aquatic habitats such as streams, swamps and pools, noting their permanency (i.e. permanent, semi-permanent or ephemeral);
- cover abundance of dominant canopy species, and the presence of fire scars and dieback;
- connectivity to adjacent areas of habitat; and
- the extent and nature of previous disturbances.

The presence of flowering eucalypts and other plants were recorded as these may provide foraging resources for threatened species such as the squirrel glider and the regent honeyeater.

## 2.4 FAUNA SURVEYS

Fauna surveys were undertaken on the 10 to 13 December 2012. Bird, reptile and nocturnal surveys were undertaken during the field investigations.

Opportunistic sightings of other fauna were recorded during the vegetation survey.

### 2.4.1 BIRD SURVEY

All bird species seen or heard during the survey were identified by the use of dichotomous keys and commercially available avifauna field guides.

Targeted bird surveys were undertaken over the period of four days 11$^{th}$ to 13$^{th}$ December 2012 and included the following survey methods:

- 16 transects;
- 3 stationary dawn bird surveys;
- 3 stationary dusk bird surveys; and
- 3 stationary midday bird surveys.

### 2.4.2 REPTILE SURVEY

Targeted reptile searches were undertaken in areas of potential habitat such as beneath logs, scrap metal and other shelter resources over the period of four days 11$^{th}$ to 13$^{th}$ December 2012. A total of 4 hours were allocated over the period of four days for reptiles searches.

### 2.4.3 NOCTURNAL SURVEY

The following nocturnal survey methodology was employed over the course of three evenings:

- call playback;
- stationary anabat echolocation was undertaken at three locations; and
- spotlighting was undertaken over 3 person hours per evening.

### 2.4.4 GENERAL OBSERVATIONS

Opportunistic sightings of species and secondary indications (scats, scratches, diggings, tracks etc.) were recorded which included:

- searches for whitewash, prey remains and regurgitation pellets from owls;
- searches for fruit remains from feeding fruit-doves;
- checking trees for scratches consistent with arboreal mammals; and
- searches for characteristic scats.

## 2.5 LIMITATIONS OF SURVEY

Searches for threatened fauna species coincided with the optimum sampling period for reptiles and summer flowering grasses. The summer sampling period was not an optimum time for the detection of spring flowering species such as *Swainsona sericea*. The precautionary principle has therefore been applied and any threatened species that have a moderate to high likelihood of occurring on site have been identified in Appendix A.

# Survey Results

## 3.1 VEGETATION COMMUNITIES

### 3.1.1 INTRODUCTION

The site is characterised by the following vegetation communities (refer to **Drawing EV03**).

- Grey box woodland;
- Mugga ironbark, black cypress pine, bulloak woodland;
- Mugga ironbark, blakely's red gum open woodland;
- *Allocasuarina diminuta* subsp *diminuta* shrubland;
- White cypress pine, black cypress pine forest;
- Bulloak, dwyers red gum, white cypress pine open woodland; and
- Grassland.

### 3.1.2 GREY BOX WOODLAND

Grey box woodland (refer to **Plate 1**) is located in the northwestern corner of the site and represents the smallest vegetation community on site (refer to **Drawing EV02**).

The habitat structure is restricted to an open canopy, scattered to dense shrub layer and absent to scattered groundcover. This community type represents the least disturbed community on site and is devoid of rubbish dumping and noxious weeds.

The canopy is dominated by *Eucalyptus microcarpa* (Grey box) and occasional *Callitris endlicheri* (black cypress pine) and *Callitris glaucophylla* (white cypress pine).

The scattered to dense shrub layer is dominated by *Dillwynia sieberi* (egg and bacon peas) and less frequent occurrence of *Cassinia laevis* (cough bush), regenerating *Callitris endlicheri* (black cypress pine) and *Callitris glaucophylla* (white cypress pine).

The absent to scattered groundcover includes *Dianella* revoluta (blue flax lily), *Lomandra multiflora* (many-flowered matt-rush) and *Lomandra filiformis* (wattle mat-rush).

### 3.1.3 MUGGA IRONBARK, BLACK CYPRESS PINE, BULLOAK WOODLAND

Mugga ironbark, black cypress pine, bulloak woodland (refer to **Plate 2**) is located along the perimeter of the site with a small section associated with the northern drainage line on site (refer to **Drawing EV02**).

The habitat structure is restricted to an open canopy, scattered to moderate shrub layer and absent to scattered groundcover. This community type is relatively undisturbed with the exception of occasional isolated rubbish dumping.

The canopy is dominated by *Eucalyptus sideroxylon* (mugga ironbark), *Callitris endlicheri* (black cypress pine) and *Allocasuarina leuhmannii* (bulloak).

The scattered to moderate shrub layer is dominated by *Cassinia laevis* (cough bush) and regenerating overstorey species with less frequent occurrences of *Acacia penninervis* (mountain hickory).

Groundcover species include *Lomandra multiflora* (many-flowered mat-rush), *Lomandra filiformis* (wattle mat-rush), *Austrostipa scabra* (rough speargrass), *Lachnagrostis aemula* (blown grass) and *Dianella revoluta* (blue flax-lily).

### 3.1.4 MUGGA IRONBARK, BLAKELY'S RED GUM OPEN WOODLAND

The mugga ironbark, blakely's red gum open woodland is located in the central portion of the site (refer to **Drawing EV02**).

The habitat structure is restricted to an open canopy, scattered to dense shrub layer and absent to scattered groundcover (refer to **Plate 3**). This community is highly disturbed by rubbish dumping and weed encroachment.

The canopy is dominated by *Eucalyptus sideroxylon* (mugga ironbark) and *Eucalyptus blakelyi* (blakely's red gum) interspersed with the occasional *Brachychiton populneus* (kurrajong) and *Schinus areira* (pepper tree).

The midstorey is dominated by *Lycium ferrocissimum* (african boxthorn) with occasional *Cassinia laevis* (cough bush).

The groundcover is dominated by *Maireana microphylla* (eastern cotton bush), *Xerochrysum bracteatum* (golden everlasting), *Echium vulgare* (vipers bugloss), *Marrubium vulgare* (white horehound) and *Calotis cuneifolia* (purple burr daisy).

Noxious weeds in this community include *Xanthium spinosum* (bathurst burr), *Sclerolaena birchii* (galvanised burr) and *Lycium ferocissimum* (african boxthorn).

### 3.1.5 ALLOCASUARINA DIMINUTA SUBSP DIMINUTA SHRUBLAND

The *Allocasuarina diminuta* subsp *diminuta* shrubland is located in a single area in the southern portion of the site (refer to **Drawing EV02**).

The habitat structure is restricted to absent to scattered canopy, dense midstorey and isolated groundcover species (refer to **Plate 4**).

The isolated trees forming the canopy include *Eucalyptus blakelyi* (blakely's red gum) and occasional *Callitris endlicheri* (black cypress pine).

The midstorey is dominated by a dense cover of *Allocasuarina diminuta* subsp *diminuta* with occasional regenerating *Callitris endlicheri* (black cypress pine) to a height of two metres. Scattered *Calytrix tetragona* (common fringe myrtle), *Styphelia triflora* (pink five-corners), *Acacia decora* (showy wattle) and *Brachyloma daphnoides* (daphne heath) occur at a height of forty centimetres to one metre.

Isolated *Rytidosperma caespitosum* (ringed wallaby grass) formed the groundcover layer under 40 centimetres on site.

No noxious weeds or rubbish dumping were evident in this community on site.

### 3.1.6 WHITE CYPRESS PINE, BLACK CYPRESS PINE FOREST

The white cypress pine, black cypress pine forest represents the largest vegetation community on site and is scattered throughout the northern and western areas of the site (refer to **Drawing EV02**).

This habitat structure supports a dense canopy, low to moderate midstorey and absent to moderate groundcover (refer to **Plate 5**). Disturbance via rubbish dumping is evident in many areas of this vegetation particularly adjacent to the existing tracks on site.

The canopy is dominated by varying densities of *Callitris endlicheri* (black cypress pine) and *Callitris glaucophylla* (white cypress pine) with the majority of the canopy of juvenile age. In some areas of the canopy, scattered *Allocasuarina luehmannii* (bulloak) occurs.

The low to moderate midstorey is dominated by regenerating canopy species and occasional *Calytrix tetragona* (common myrtle), *Dillwynia sericea* (showy parrot pea) and *Cassinia laevis* (cough bush).

The absent to moderate groundcover supports mainly grass species with occasional forbs. These species include but are not limited to *Rytidosperma caespitosum* (ringed wallaby grass), *Aristida benthamii* var *benthamii* (three awn speargrass), *Austrostipa aristiglumis* (plains grass), *Lachnagrostis aemula* (blowngrass), Cheilanthes sieberi (rock fern), *Einadia nutans* (climbing saltbush), *Eragrostis brownii* (brown's lovegrass) and *Chrysocephalum apiculatum* (common everlasting).

### 3.1.7 BULLOAK, DWYERS RED GUM, WHITE CYPRESS PINE OPEN WOODLAND

The bulloak, dwyers red gum, white cypress pine open woodland occurs in the eastern corner of the site with disturbance associated with an abandoned quarry (refer to **Drawing EV02**).

The habitat structure supports an open canopy, scattered to moderate midstorey and low percentage of groundcover species (refer to **Plate 6**).

The canopy is dominated by *Allocasuarina leuhmannii* (bulloak) interspersed with *Callitris glaucophylla* (white cypress pine) and *Eucalyptus dwyeri* (dwyers red gum).

The scattered to moderate midstorey is dominated by *Cassinia laevis* (cough bush) interspersed with regenerating *Allocasuarina leuhmannii* (bulloak), *Calytrix tetragona* (common fringe myrtle) and *Acacia decora* (showy wattle).

The limited groundcover is dominated by *Gahnia aspera* (serrated tussock) interspersed with *Rytidosperma richardsonii* (straw wallaby grass), *Cheilanthes seiberi* (rock fern), *Lomandra filiformis* (wattle mat-rush), *Juncus subsecundus* (finger rush) and *Chrysocephalum apiculatum* (common everlasting).

### 3.1.8 GRASSLAND

Grassland occurs in scattered pockets amongst wooded communities on site (refer to **Drawing EV02**). Disturbance from various dirt tracks and rubbish dumping occur in this community.

The habitat structure is generally restricted to a groundcover and occasional regenerating cypress pine trees (refer to **Plate 7**).

The occasional isolated canopy species includes *Callitris glaucophylla* (white cypress pine) and *Callitris endlicheri* (black cypress pine).

The grassy groundcover includes but is not limited to *Austrostipa aristiglumis* (plains grass), *Silene gallica* (common catchfly), *Cynodon dactylon* (common couch), *Aira caryophyllea* (silvery hairgrass), *Carthamus lanatus* (saffron thistle), *Xerochrysum bracteatum* (common everlasting), *Cheilanthes sieberi* (rock fern), *Eragrostis australasica* (canegrass), *Juncus subsecundus* (finger rush), *Calotis cuneifolia* (purple burr daisy) and **Glandularia aristigera* (mayne's pest).

Noxious weeds in this community include *Lycium ferocissimum* (african boxthorn) and *Sclerolaena birchii* (galvanised burr).

## 3.2 FAUNA ASSEMBLAGE

### 3.2.1 BIRD SURVEY

A total of 68 birds were observed during the bird survey on site (refer to **Appendix C**). OF the bird species observed, two of these were threatened under the TSC and EPBC Act being *Pomatostomus temporalis* (Grey-crowned Babbler) and *Climacteris picumnus* (brown treecreeper).

### 3.2.2 AMPHIBIAN AND REPTILE SURVEY

A total of two amphibians and five reptiles were observed during the amphibian and reptile survey. None of the observed fauna were listed as threatened (refer to **Appendix C**).

### 3.2.3 NOCTURNAL SURVEY

The nocturnal survey of the site included call playback and spotlighting over three evenings and the use of a stationary anabat for detection of bats utilising the site.

The nocturnal survey identified a total of one mammal *Trichosurus vulpecula* (common brushtail possum) and two nocturnal birds *Podargus strigoides* (tawny frogmouth) and *Aegotheles cristatus* (Australian owlet nightjar).

The stationary anabat echolocation identified the presence of five microchiropteran bats on site being *Tadarida australis* (white-striped bat), *Scotorepens balstoni* (western broad-nosed bat), *Vespedelus vulturnus* (little forest bat), *Chalinolobus gouldii* (gould's wattle bat) and *Chalinolobus morio* (chocolate wattled bat).

### 3.2.4 OPPORTUNISTIC FAUNA SURVEY

The remaining fauna on site were observed opportunistically during other field work. A total of seven mammals were observed with four of those being introduced species (refer to **Appendix C**).

## 3.3 THREATENED SPECIES

Schedules 1, 1A, and 2 of the *Threatened Species Conservation Act 1995* (TSC Act) list species, populations and ecological communities of native flora and fauna considered to be threatened in New South Wales. The status of threatened species, populations or ecological communities listed in Schedules 1, 1A and 2 have been determined by a Scientific Committee as:

- Endangered (Schedule 1);
- Critically Endangered; (Schedule 1A); or
- Vulnerable (Schedule 2).

A number of threatened species have the potential to occur in the site, based on OEH and DSEWPC database records of these species within 10 kilometres of the site.

Based on an assessment of habitat requirements, these species were assessed as to their likelihood of occurrence on site (refer to **Appendix A**).

The likelihood of threatened flora occurring in the site was determined by considering the type and condition of vegetation and habitats, and analysis of database records. No Rare or Threatened Australian Plant (ROTAP) listed species or threatened flora species were found on the site. One endangered ecological community and three threatened fauna species were observed during the site inspection as detailed below.

### 3.3.1 ENDANGERED ECOLOGICAL COMMUNITIES

The grey box woodland on site forms part of the grey box grassy woodland endangered ecological community as listed under the *TSC Act* 1995 and *EPBC Act 1999*.

### 3.3.2 THREATENED FAUNA SPECIES

Three threatened fauna species were identified on the site being *Pomatostomus temporalis* (grey-crowned babbler), *Stagonopleura guttata* (diamond firetail) and *Climacteris picumnus* (brown treecreeper).

### 3.3.3 THREATENED FLORA SPECIES

There were no threatened flora species identified on the site.

# Constraints and Opportunities

## 4.1 INTRODUCTION

The extent of ecological constraints on site is based on several factors including:

- presence or likely occurrence of threatened plant species;
- extent and quality of habitat resources for threatened fauna species; and
- potential wildlife corridor function.

The site provides habitat for a number of threatened fauna and flora species (refer to **Appendix A**). These will need to be assessed during further investigations.

## 4.2 LOSS OF HABITAT

Any future development at the site will result in the loss of grassland, mixed woodland and potentially hollow bearing trees.

The natural process of creating tree hollows is called 'cavitation'. With the increasing age of a tree and increasing diameter of the trunk and boughs, comes an opportunity for the entrance of fungi or invertebrates. Fungal infection of dead heartwood is quite common, with eventual softening of this tissue and then its long term removal by infiltrating rainwater or by ant or termite colonisation. Larvae of wood-boring insects (ie beetles and moths) may initiate the entrance of fungal spores, which begin to rot the interior It is therefore not surprising that hollows within trees take considerable time to form and that large hollow bearing trees are usually old. Once a cavity has begun to form, it is sometimes enlarged by fire which, whilst it may not always destroy the tree, can burn out the central section by charring and 'chimneying' (Bird Observers Club, 2004)

There is a growing shortage of tree hollows in Australia, which are suitable for the nesting, roosting and denning requirements of native fauna. Availability of nest hollows may be one of the factors limiting distribution and density of some species. Substantial clearing of this habitat resource has the potential to push many of the local species below threshold levels at which populations can be sustained.

It is therefore recommended that as many as possible of the hollow bearing trees be retained within any future urban development proposal.

## 4.3 HABITAT FRAGMENTATION AND CORRIDORS

Habitat corridors are integral to providing linkages to remnant areas of vegetation while also contributing to essential ecosystem functioning required for sustaining biodiversity. Corridors promote opportunities for fauna movement and the long-term viability of species as they reduce the effect of isolation of small remnant patches of vegetation.

**Table 4.1 – Summary of Ecological Constraints in the Site**

| Habitat Type | Conservation Value | Threatened Flora Species Habitat | Threatened Fauna Species Habitat | Corridor Function |
|---|---|---|---|---|
| GB | High | High | Moderate | Moderate |
| MI BCP B | Moderate to High | Moderate | High | Moderate to High |
| MI BRG | Moderate | Low | Moderate | High |

**Table 4.1 – Summary of Ecological Constraints in the Site**

| Habitat Type | Conservation Value | Threatened Flora Species Habitat | Threatened Fauna Species Habitat | Corridor Function |
|---|---|---|---|---|
| ADD | Low | Low | Low | Low |
| WCP BCP | Low to Moderate | Moderate | Moderate | Low to Moderate |
| B DRG | Low to Moderate | Moderate | Moderate | Low |
| G | Low | Low | Moderate | Low |

**GB: Grey Box Woodland Endangered Ecological Community**
**MI BCP B: Mugga Ironbark Black Cypress Pine Bulloak Woodland**
**MI BRG: Muggi Ironabark Blakely's Red Gum Open Woodland**
**ADD: *Allocasuarina diminuta subsp diminuta* Shrubland**
**WCP BCP: White Cypress Pine Black Cypress Pine Woodland**
**B DRG: Bulloak, Dwyers Red Gum, White Cypress Pine Open Woodland**
**G: Grassland**

The conservation value of the site has been summarised above (Refer to **Table 4.1**) and is based on the likelihood or presence of threatened flora or fauna occurring in the various vegetation communities. The conservation value of the site has been assessed based on the above constraints in addition to the location of communities with regard to significant vegetation corridors immediately beyond the site boundary. A narrow band of vegetation along the perimeter of the site is ranked as high conservation value based on its connectivity to vegetation beyond the northern, southern and a portion of the western boundary of the site and connectivity of drainage lines and eucalypt woodland habitat within the site (refer to **Drawing EV02**).

Moderate conservation value is assigned to the remaining large areas of eucalypt woodland in the northeastern and southwestern corners of the site based on their fauna and flora habitat value.

The remaining white cypress pine black cypress pine woodland and grassland represents the most disturbed areas of habitat traversed by dirt tracks and housing much of the rubbish dumped on site. These areas are ranked as low conservation value based on their poor connectivity with adjoining vegetation, notable disturbance history and likelihood of supporting threatened flora or fauna species.

Any future development of the site should retain a habitat corridor (refer to **Drawing EV02**) connecting drainage lines and mature woodland vegetation on site to large tracts of woodland beyond the northern and southern boundaries of the site.

Additional issues in regards to habitat corridors that should be considered in the design phase of any future urban development include;

- minimise interface to development;
- minimise disruption to corridor continuity;
- the retained vegetation should be bounded by hard edges (eg) roads rather than backyards to prevent encroachment and narrowing of this habitat corridor; and
- fencing or other barriers to faunal movement should not be placed within the corridors.

## 4.4 EDGE EFFECTS

Edge effects would be minimised by the inclusion of a 50 metre wide buffer around any threatened species habitats. The grey crowned babbler nests have a 50 metre buffer incorporated into the high conservation value area and vegetation corridor (refer to **Drawing EV02**). A 50-100m woodland corridor is recommended to connect the central woodland corridor with neighbouring large tracts of vegetation as indicated on drawing **EV03**. The perimeter woodland corridor also minimises edge effects and allows for efficient establishment (ie fencing) and maintenance (ie. weed control) in the straight line design.

Most edge effects disappear over the first 50 metres into a remnant of native vegetation (Murcia, 1995). Physical changes that have the potential to occur at the interface between any urban development and natural bushland include changes in soil and water conditions and potentially an increase in light penetration to the understorey. However, this can be prevented through effective rehabilitation and ongoing monitoring and management of the reserves.

## 4.5 INDIRECT IMPACTS

Edge effects such as weed incursion and encroachment were evident in the central portion of the site on which the former farmhouse was located. Other areas of disturbance were notable adjacent to the multiple dirt tracks traversing the site in the form of weeds and considerable rubbish dumping.

Of the weeds identified, three noxious weeds *Xanthium spinosum* (bathurst burr), *Sclerolaena birchii* (galvanised burr) and *Lycium ferocissimum* (african boxthorn) were observed mainly within the central portion of the site associated with the former farmhouse location.

It is recommended noxious weeds be removed according to noxious weed guidelines prior to any development and regularly maintained in the proposed vegetation corridor on site.

## 4.6 DEVELOPMENT POTENTIAL

The development potential directly correlates to the conservation value of various areas on site (refer to **Drawing EV03**). Areas of high development potential are in low conservation value areas. Conversely, areas of low development potential are in high conservation value areas. Areas of moderate conservation value represent areas of moderate development potential.

Constraints to the site are related to areas of low development potential (refer to **Drawing EV03**). These are based on areas supporting threatened fauna habitat, high corridor value and threatened flora species habitat. In those areas of moderate conservation value, it is recommended the type of development reflect the moderate conservation value.

## 4.7 MITIGATION MEASURES

The following mitigation measures are based on the flora and fauna surveys undertaken over the Summer season. As a result optimum detection of species during other seasons was unable to be determined. The following mitigation measures are recommended for the site;

- targeted searches for spring flowering flora species;
- targeted searches for diamond firetail breeding habitat (constructed nests);
- avoid development in high conservation value areas (refer to **Drawing EV03**);
- apply moderate constraints to proposed development in moderate conservation value areas (refer to **Drawing EV03**) i.e. retain native vegetation in proposed lots where possible;
- remove noxious weeds according to noxious weed guidelines prior to any development and regularly maintain in the proposed vegetation corridor on site;
- retain all fallen timber in the vegetation corridor and perimeter high conservation value areas to maintain foraging habitat of brown treecreeper and grey-crowned babblers observed on site;
- retain as many hollow-bearing trees as possible; and
- retain woodland corridor to connect large tracts of woodland to the north, south and west of the site boundary as recommended in **Drawing EV03**.

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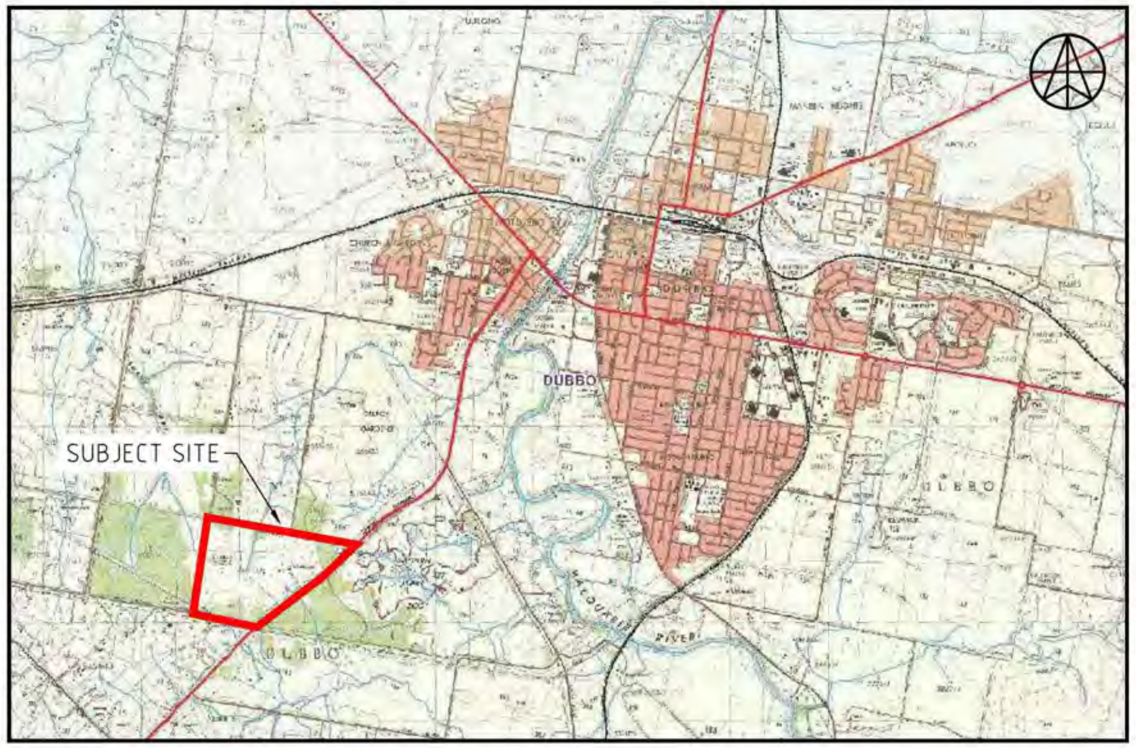
# Drawings

# ECOLOGICAL CONSTRAINTS & OPPORTUNITIES REPORT

## LOT 172 DP753233, DUBBO

## BAWD PROPERTY TRUST

| SCHEDULE OF DRAWINGS | | | |
|---|---|---|---|
| SHEET | TITLE | REV. | DATE |
| 01A_EV01 | TITLE SHEET, DRAWING LIST, AND SITE LOCALITY | B | 22/04/2013 |
| 01A_EV02 | VEGETATION COMMUNITIES ACCORDING TO DOMINANT SPECIES AND SITE ENVIRONS | B | 22/04/2013 |
| 01A_EV03 | CONSERVATION VALUE AND DEVELOPMENT POTENTIAL | B | 22/04/2013 |
| 01A_EV04 | VEGETATION COMMUNITIES ACCORDING TO AUSLIG (AS 3959-2009) | B | 22/04/2013 |




SITE LOCALITY
NOT TO SCALE

GEOLYSE
ORANGE
orange@geolyse.com
www.geolyse.com
154 PEISLEY STREET
P.O. BOX 1963
ORANGE, NSW 2800
Ph. (02) 6393 5000
Fx. (02) 6393 5050

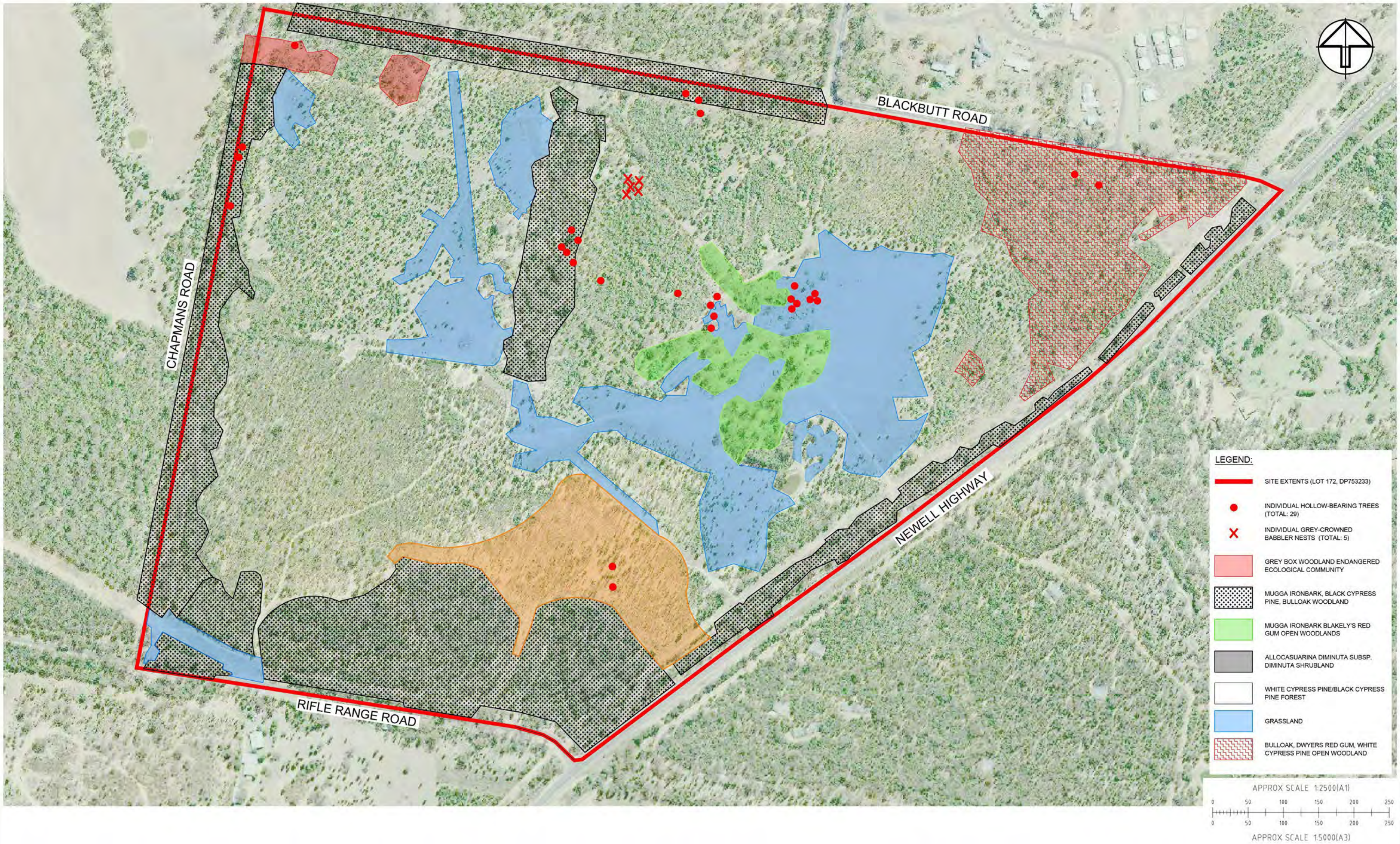
| No | DATE | DRAFTING CHECK | APPROVED BY | DETAILS |
|---|---|---|---|---|
| A | 18/01/13 | MM | TW | ISSUED TO CLIENT |
| B | 22/04/13 | LP | TW | ISSUED TO CLIENT |

PROJECT
ECOLOGICAL CONSTRAINTS & OPPORTUNITIES REPORT
FILE REFERENCE: O:\Projects\Out\Cad\212300_01A_EV01-EV02.dwg

APPROVAL AUTHORITY
DUBBO CITY COUNCIL
70 CHURCH STREET
DUBBO
NSW, 2830

CLIENT
BAWD PROPERTY TRUST

DRAWING
TITLE SHEET, DRAWING LIST, AND SITE LOCALITY
PROJECT NUMBER: 212300 DRAWING NUMBER: 01B_EV01 REV: B
SOURCE: SIX VIEWER

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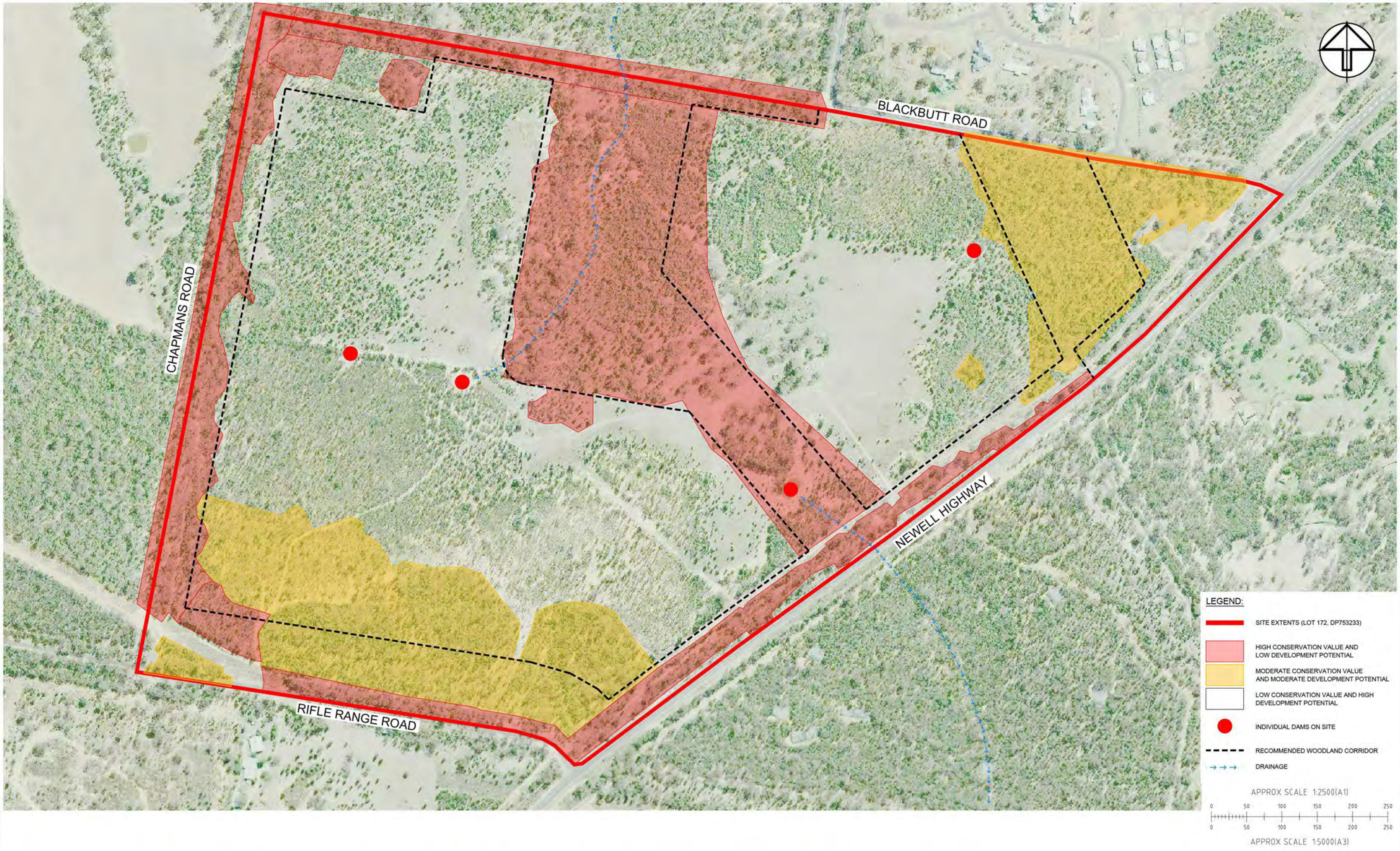
BAWD PROPERTY TRUST

DRAWING
VEGETATION COMMUNITIES ACCORDING TO DOMINANT SPECIES AND SITE ENVIRONS

PROJECT NUMBER: 212300 DRAWING NUMBER: 01B_EV02 REV. B

SOURCE: SIX VIEWER





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APPROVAL AUTHORITY

DUBBO CITY COUNCIL
70 CHURCH STREET
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NSW, 2830

CLIENT

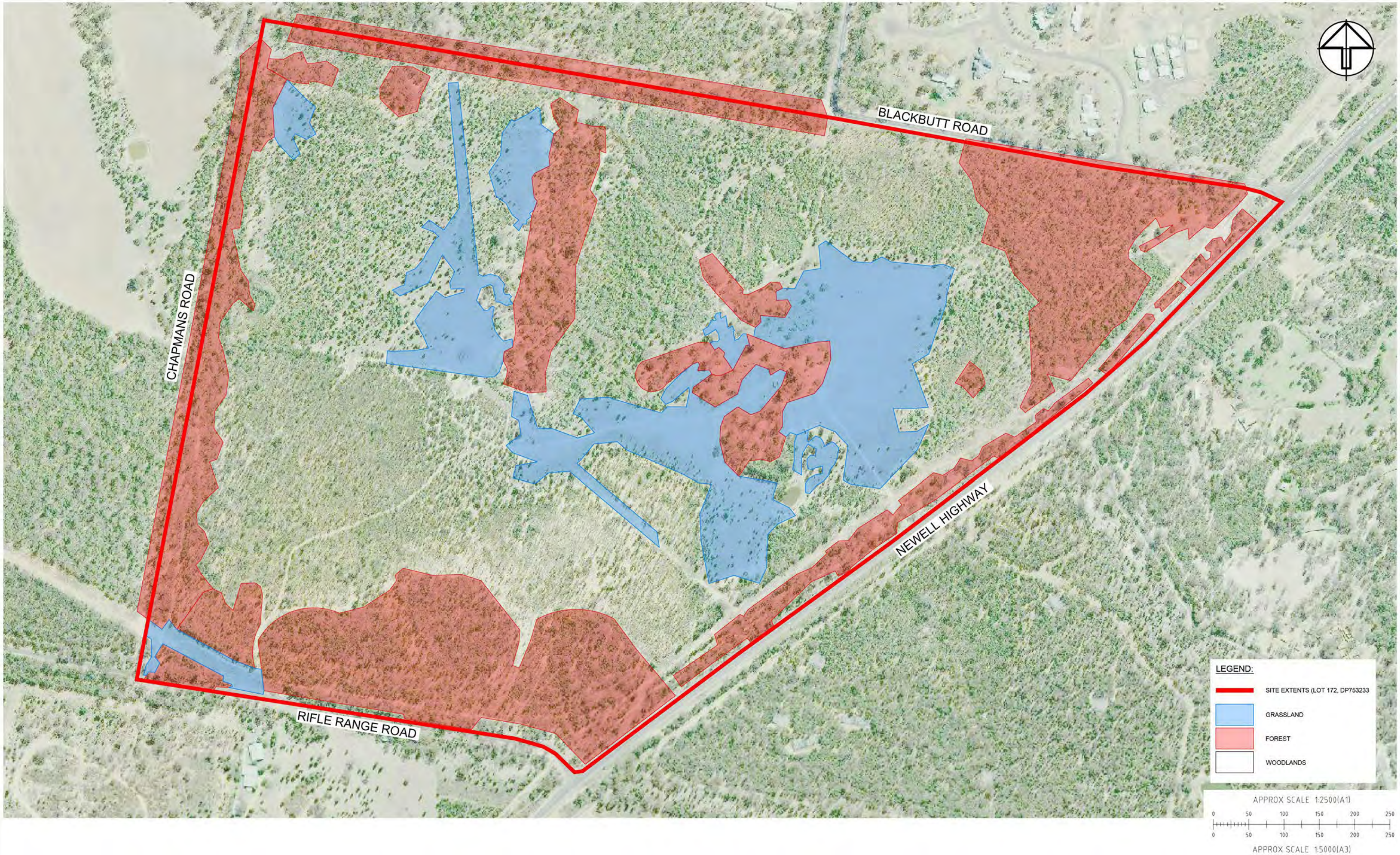
BAWD PROPERTY TRUST

DRAWING

CONSERVATION VALUE AND DEVELOPMENT POTENTIAL

PROJECT NUMBER: 212300 DRAWING NUMBER: 01B_EV03 REV. B

SOURCE: SIX VIEWER

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ECOLOGICAL CONSTRAINTS & OPPORTUNITIES REPORT

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APPROVAL AUTHORITY
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CLIENT
BAWD PROPERTY TRUST

DRAWING
VEGETATION COMMUNITIES ACCORDING TO AUSLIG (AS 3959-2009)

PROJECT NUMBER: 212300 DRAWING NUMBER: 01B_EV04 REV: B

SOURCE: SIX VIEWER

# Plates

**Plate 1:** Grey box woodland

**Plate 2:** Mugga ironbark, black cypress pine, bulloak woodland

**Plate 3:** Mugga ironbark blakely's red gum open woodland

**Plate 4:** *Allocasuarina diminuta subsp diminuta* shrubland

**Plate 5:** White cypress pine black cypress pine forest

**Plate 6:** Bulloak, dwyers red gum, white cypress pine open woodland

Plate 7: Grassland

# Appendix A

## THREATENED AND MIGRATORY SPECIES

**Table A.1 – Threatened and Migratory Species Likelihood on Site**

| Scientific Name | Common Name | Status | | Habitat Requirement | Likelihood of Occurrence | Assessment Required |
|---|---|---|---|---|---|---|
| | | TSC | EPBC | | | |
| **Ecological Communities** | | | | | | |
| Carex Sedgeland of the New England Tableland, Nandewar, Brigalow Belt South and NSW North Coast Bioregions | | E | - | Wetland community dominated by *Carex appressa, Stellaria angustifolia, Scirpus polystachyus,Carex gaudichaudiana, Carex sp. Bendemeer, Carex tereticaulis* and *Isachne globosa*, either as single species or in combinations. Occurs in drainage depressions of 440 to 1360m in altitude. | Low given the unsuitable altitude of drainage depressions on site. | No |
| Fuzzy Box Woodland on alluvial Soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions | | E | - | Canopy dominated by *Eucalyptus conica* (fuzzy box) often with *E. microcarpa* (grey box), *E. melliodora* (yellow box) or *Brachychiton popoluleus* (kurrajong) with occasional *Allocasuarina luehmanni* (bulloak). | Low given the lack of suitable dominant species on site. | No |
| White Box Yellow Box Blakely's Red Gum Grassy Woodland and Derived Native Grassland | | E | CE | Prefers fertile soils on tablelands and western slopes of NSW. This community occurs on altitudes above 170 metres on the lower slopes and tablelands and occupies rainfall zones of between 400 and 800mm per annum. | Moderate given the presence of blakely's red gum on site. | No |
| Grey Box (Eucalyptus microcarpa) grassy woodlands & derived native grasslands of South-eastern Australia | | E | E | Unless in a derived grassland state, canopy is dominated by *Eucalyptus microcarpa* and may be associated with *Allocasuarina luehmannnii, Brachychiton populneus, Callitris glaucophylla, Eucalyptus albens, E. camaldulensis, E. conica, E.populnea, E. melliodora*. Minimum patch size is 0.5ha. | High given the dominance of grey box in the northwestern corner of the site. | Yes |
| Natural grasslands on basalt & fine-textured alluvial plains of northern NSW & southern QLD | | - | CE | Native grassland on fine textured soil often with cracking clay derived from basalt or quaternary alluvium. Flat to low slopes no greater than 5% often associated with weeping myall, coolabah, poplar box or yellow box with increasing slope. | Low given the lack of suitable soil type on site. | No |

**Table A.1 – Threatened and Migratory Species Likelihood on Site**

| Scientific Name | Common Name | Status | | Habitat Requirement | Likelihood of Occurrence | Assessment Required |
|---|---|---|---|---|---|---|
| | | TSC | EPBC | | | |
| Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions | | E | E | Canopy comprises *Acacia pendula* 4-12m high and less frequent occurrences of *Alectryon oleifolius subsp. elongates, Eucalyptus populnea, E. largiflorens* and *Amyema quandang.* | Low given the lack of suitable vegetation on site. | No |
| **Flora** | | | | | | |
| *Bothriochloa biloba* | lobed blue-grass | - | V | Prefers cleared eucalypt forest, grassland often dominated by *Aristida ramosa, Bothriochloa macra, B. decipiens, Dicanthium sericeum* or *Austrostipa aristiglumis.* Favours heavier textured soils such as brown or black clay soils. | Low given the unsuitable soil type on site. | No |
| *Calotis glandulosa* | mauve burr-daisy | V | V | Prefers montane, subalpine or natural temperate grassland and colonises bare areas often along roadsides. Dispersed by animals however unable to persist in heavily grazed areas. | Low given the unsuitable climate type for this species occurrence. | No |
| *Indigofera efoliata* | leafless indigo | E | E | Prefers slight rises amongst ironstone formation in stony red-brown sandy loam. Dies back in unfavourable conditions with aerial parts only growing after significant rainfall. Last known sighting in 1955. | Moderate to high given the suitable soil type on site. | Yes |
| *Homoranthus darwinioides* | | V | V | Gravelly soils supporting shrubby woodland on flat sunny ridge tops, sloping ridges, gentle south facing slopes or slight depression on roadside with loamy soil. | Moderate to high given the suitable habitat supported on site. | Yes |
| *Diuris tricolor* | | V | V | Prefers sclerophyll forest amongst grass, often with *Callitris* species growing on sandy soil on flats or rises. Less frequently occurs on red earths in Bimble Box communities. | High given the suitable habitat supported on site. | Yes |

**Table A.1 – Threatened and Migratory Species Likelihood on Site**

| Scientific Name | Common Name | Status | | Habitat Requirement | Likelihood of Occurrence | Assessment Required |
|---|---|---|---|---|---|---|
| | | TSC | EPBC | | | |
| *Tylophora linearis* | | V | E | This climber prefers dry scrub, open forest and woodlands associated with *Melaleuca uncinata, E. fibrosa, E. sideroxylon, E. albens, Callitris endlicheri* and *Casuarina spp*. Grows in low altitude sedimentary flats. | High given the suitable habitat provided on site. | Yes |
| *Rulingia procumbens* | | V | V | Prostrate shrub with pink flowers favouring sandy habitat in disturbed areas often roadside verges, quarry boundaries, gravel stockpiles or powerline easements. | High given the suitable habitat supported on site. | Yes |
| *Swainsona murrayana* | slender darling pea | V | V | Prefers clay-based soils, ranging from grey, red and brown cracking clays to red-brown earths and loams. Occurs in a range of vegetation types including bladder saltbush, black box and grassland communities on level plains, floodplains and depressions often in association with *Maireana* species. | Low given the unsuitable soil type on site. | No |
| **Reptiles** | | | | | | |
| *Aprasia parapulchella* | pink-tailed worm lizard | V | V | Prefers sloping, open woodland with a predominantly native grassy groundcover especially grassland dominated by *Themeda australis*. Inhabits areas with rock outcrops or partially buried rocks in well-drained soil. Forages on larvae and eggs of ants with which burrows under rocks are shared. | Low to moderate given the absence of associated grass species and rock outcrops on site. | No |
| **Avifauna** | | | | | | |
| *Pyrrholaemus saggitatus* | speckled warbler | V | - | Structure of preferred habitat includes grassy understorey, sparse shrub layer and open canopy of eucalypt regrowth. Nesting occurs in hollow logs or at the base of dense low plants. | Moderate to high given the suitable habitat provided on site. | Yes |
| *Circus assimilis* | spotted harrier | V | - | Prefers grassy open woodland, acacia and mallee remnants, riparian woodland and native grassland. Commonly forages in grassland also over open habitats i.e. wetland edges. Preys on terrestrial mammals. | Moderate given the occurrence of suitable forage habitat however limited by lack of terrestrial mammals identified on site. | No |

**Table A.1 – Threatened and Migratory Species Likelihood on Site**

| Scientific Name | Common Name | Status | | Habitat Requirement | Likelihood of Occurrence | Assessment Required |
|---|---|---|---|---|---|---|
| | | TSC | EPBC | | | |
| *Botaurus poiciloptilus* | Australasian bittern | - | E | Prefers permanent freshwater wetlands with tall dense vegetation. | Low given the ephemeral nature of dams on site with limited fringe vegetation. | No |
| *Xanthomyza phrygia* | regent honeyeater | CE | E, M | Inhabits mainly box-ironbark open forests feeding on mugga ironbark, white box, yellow box, yellow gum and blakely's red gum and mistletoe within river oaks. Favours woodland with high density of mature trees supporting abundant number of bird species. | High given the occurrence of suitable foraging habitat and in some areas mature trees. | Yes |
| *Lathamus discolor* | swift parrot | E | M | Migratory species frequenting eucalypt forest and woodland following winter flowering eucalypts. Breeds in Tasmania. | High when blakely's red gum and mugga ironbark are flowering on site. | Yes |
| *Neophema pulchella* | turquoise parrot | V | - | Prefer edges of eucalypt woodland, timbered ridges and creeks. Nesting occurs in hollows. | Moderate to high given the presence of hollow-bearing trees on site and preferred foraging habitat. | Yes |
| *Polytelis swainsonii* | superb parrot | V | V | Prefer box-cypress pine, box-gum and Boree woodlands and river red gum forest. Nesting occurs in large hollows within tall riparian river red gum forest or woodlands containing blakely's red gum, yellow box, apple box and red box. | Moderate to high foraging potential with low likelihood of nesting habitat on site. | Yes |
| *Daphoenositta chrysoptera* | varied sittella | V | - | Prefers rough barked and mature eucalypt forest and woodland containing mallee, acacia and dead branches. Feeds on insects collected from trees. | Moderate to high given the preferred habitat on site. | Yes |
| *Phaethon rubricauda* | red-tailed tropicbird | V | - | Marine bird breeding in coastal cliffs and under shrubs in tropical areas. Inhabits inland areas as a vagrant especially after storm events. | Low given the lack of preferred habitat on site. | No |
| *Glossopsitta pusilla* | little lorikeet | V | - | Feeds on nectar and pollen and occasional mistletoe. Nests in small hollows (3cm) at height (2-15m) with preference of riparian trees such as *Allocasuarina*. Forages in canopy of open eucalypt forest and woodland. | Moderate to high in eucalypt woodland areas of the site. | Yes |
| *Anseranas semipalmata* | magpie goose | V | - | Prefers shallow (<1m deep) wetlands densely vegetated with rushes and sedges. Forages on grasses, bulbs, rhizomes. Prefers floodplains of large rivers. | Low given the lack of suitable wetland habitat on site. | No |

**Table A.1 – Threatened and Migratory Species Likelihood on Site**

| Scientific Name | Common Name | Status | | Habitat Requirement | Likelihood of Occurrence | Assessment Required |
|---|---|---|---|---|---|---|
| | | TSC | EPBC | | | |
| *Hieraaetus morphnoides* | little eagle | V | - | Prefers open eucalypt forest, she oak or acacia woodland, inland riparian woodland. Nests in tall trees in remnant areas. Preys on birds, reptiles and mammals. | Moderate given the occurrence of suitable forage habitat however limited by lack of terrestrial mammals identified on site. | No |
| *Calyptorhynchus lathami* | glossy black cockatoo | V | - | Prefers dry open forest habitat on low nutrient soils containing *Allocasuarina* species. Require tree hollows for nesting. | Moderate to high in suitable foraging areas on site. | Yes |
| *Rostratula australis* | Australian painted snipe | - | V | Prefers shallow, terrestrial freshwater wetlands, inundated grassland or saltmarsh, dam, rice crops, sewage farms or bore drains. | Moderate to high given the occurrence of a number of dams on site. | Yes |
| *Pomatostomus termporalis temporalis* | grey crowned babbler (eastern subspecies) | V | - | Prefers box-gum woodlands on slopes and open box woodlands on alluvial plains. Constructs dome shaped nests on saplings, shrubs or lower tree branches. | High given the occurrence of twelve individuals and five nests on site. | Yes |
| *Leipoa ocellata* | malleefowl | E | V, M | Mallee communities of higher mean annual rainfall (300-450mm). Less frequent occurrence in eucalypt woodland i.e. inland grey box, ironbark, Bimble box or woodland dominated by mulga or native cypress pine species. Builds nest mounds on the ground 1m in height and 4m in width. | Low given the lack of nests recorded on site. | No |
| *Ninox connivens* | barking owl | V | - | Prefer open woodland supporting tree hollows typically along creeks and rivers containing E. camaldulensis. Also inhabit paperbark swamps. | Moderate given the occurrence of open woodland however absence of preferred riparian habitat and paucity of prey. | No |
| *Melithreptus gularis gularis* | black-chinned honeyeater | V | - | Dry open forest of box and ironbark species particularly mugga ironbark, white box, inland grey box, yellow box and forest red gum. | High given the occurrence of suitable habitat on site. | Yes |
| *Climacteris picumnus* | brown treecreeper | V | - | Prefers rough barked forest inland of the Great Dividing Range supporting a grassy understorey. Also found in river red gum forest bordering wetlands with an open understorey of acacia, cumbungi and grasses. Requires fallen timber for foraging. | High given individuals observed on site. | Yes |

**Table A.1 – Threatened and Migratory Species Likelihood on Site**

| Scientific Name | Common Name | Status | | Habitat Requirement | Likelihood of Occurrence | Assessment Required |
|---|---|---|---|---|---|---|
| | | TSC | EPBC | | | |
| *Melanodryas cucullata* | hooded robin | V | - | Prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas. | High given the suitable habitat provided on site. | Yes |
| *Stagonopleura guttata* | diamond firetail | V | - | Prefers box gum woodlands feeding on seed and stem resources of a grassy understorey. Diamond firetail favours riparian areas nesting in dense shrubs or higher up in globular structures. | Moderate to high given the suitable habitat provided on site. | Yes |
| **Fish** | **FM** | | | | | |
| *Maccullochella macquariensis* | trout cod | E | E | Endemic to the southern Murray-Darling system now restricted to Murray River below Yarrawonga downstream to Tocumwal. | Low given the extent of habitat on site is restricted to an ephemeral dams with absent to scant fringe vegetation. | No |
| *Maccullochella peelii* | murray cod | - | E | Diverse range of habitats from clear rocky streams to slow flowing turbid rivers and billabongs. Prefers structurally complex habitats with rocks, snags, overhanging vegetation and other woody structures. Frequents main river channels with water depth of 5m. | Low given the shallow depth and ephemeral nature of the dam on site. | No |
| **Mammals** | | | | | | |
| *Dasyurus maculatus maculatus* | spot tailed quoll (southeastern mainland population) | - | V | Mainly nocturnal mammal preferring mature wet forest habitat. Suitable den sites include hollow logs, tree hollows, rock outcrops or caves. | Low given the lack of mature wet sclerophyll habitat on site. | No |
| *Pteropus poliocephalus* | grey-headed flying fox | V | V | Rainforest, woodland and forest with Eucalyptus, Melaleuca and Banksia nectar and pollen, fruits of rainforest trees and vines for foraging and breeding (camp sites). | Moderate to high in seasonally favourable conditions. | Yes |
| *Petrogale penicillata* | brush-tailed rock wallaby | E | V | Rock outcrops, cliffs, escarpments preferring caves, ledges facing north. | Low given the lack of preferred habitat on site. | No |
| *Phascolarctos cinereus* | koala | V | - | Feeds on a range of tree species including *Eucalyptus albens, E. tereticornis, E. camaldulensis, E. microcorys, E. viminalis* and *E. robusta*. | Low given the lack of preferred feed trees on site. | No |

**Table A.1 – Threatened and Migratory Species Likelihood on Site**

| Scientific Name | Common Name | Status | | Habitat Requirement | Likelihood of Occurrence | Assessment Required |
|---|---|---|---|---|---|---|
| | | TSC | EPBC | | | |
| *Chalinolobus dwyeri* | large-eared pied bat | V | V | Inhabits mainly dry sclerophyll forest and woodland with records including wet sclerophyll forest and subalpine woodland in gullies. Roosting occurs in abandoned fairy martin mud nests, mine tunnels and caves. | High given the suitable habitat provided on site. | Yes |
| *Saccolaimus flaviventris* | yellow-bellied sheathtail-bat | V | - | Prefers a wide range of habitats including rainforest, wet and dry sclerophyll forest, littoral forest and swamp and shrubland habitat. Roost in tree hollows, buildings or abandoned mammal burrows. | Moderate to high given the occurrence of suitable hollows and foraging habitat on site. | Yes |
| *Nyctophilus corbeni* | south-eastern long-eared bat | V | V | Prefers a variety of vegetation types comprising mallee, bulloke and box eucalypt dominated communities. Commonly inhabits box/ironbark/cypress pine vegetation. Roosts in tree hollows, crevices and under loose bark. Mates in Autumn with offspring born in late Spring to early Summer. | High given the suitable habitat provided on site. | Yes |
| *Chalinolobus picatus* | little pied bat | V | - | Prefers dry open forest, open woodland, mulga woodlands, chenopod shrubland, cypress pine forest, mallee and bimble box. Roosts in caves, tree hollows, buildings, shafts, tunnels, rock outcrops and needs access to open water. | Moderate to high given the ephemeral water and suitable foraging habitat provided on site. | Yes |
| **Migratory Marine Species** | | | | | | |
| *Apus pacificus* | fork-tailed swift | - | M | Aerial species preferring riparian woodland, tea-tree swamps, low scrub, heathland or saltmarsh. Feeding at 1m to 300m above ground on insects. Breeding occurs outside Australia. | Low given the lack of suitable habitat provided on site. | No |
| **Migratory Terrestrial Species** | | | | | | |
| *Haliaeetus leucogaster* | white bellied sea eagle | - | M | Prefer large rivers, lakes, coastal seas and reservoirs. | Low given the lack of preferred habitat on site. | No |
| *Hirundapus caudacutus* | white throated needletail | - | M | Prefers coastal and mountainous regions. Nesting occurs in hollows or rock crevices. | Low given the lack of preferred habitat on site. | No |

**Table A.1 – Threatened and Migratory Species Likelihood on Site**

| Scientific Name | Common Name | Status | | Habitat Requirement | Likelihood of Occurrence | Assessment Required |
|---|---|---|---|---|---|---|
| | | TSC | EPBC | | | |
| *Merops ornatus* | rainbow bee-eater | - | M | Prefers open woodland, cliffs, mangroves, dunes, beaches, parks or gardens preferably in close proximity to water. Nests in long burrows dug for this purpose on flat or sloping ground in banks of rivers, creeks or dams, roadside cutting or quarry walls, gravel mounds or cliff faces. | Moderate to high given the presence of foraging habitat and potential for suitable nesting habitat on dam walls on site. | Yes |
| *Myiagra cyanoleuca* | satin flycatcher | - | M | Prefers eucalypt forest dominated by brown barrel, ribbon gum, mountain gum and narrow-leaved peppermint with understorey of blackwood. In higher altitudes, this species occurs in association with black sally woodland supporting an understorey of tea trees and tree ferns. | Low given the lack of preferred habitat on site. | No |
| *Rhipidura rufifrons* | rufous fantail | - | M | Prefers rainforest or wet sclerophyll forest. | Low given the lack of preferred habitat on site. | No |
| **Migratory Wetland Species** | | | | | | |
| *Ardea alba* | great egret | - | M | Temperate grassland, wooded areas, terrestrial wetlands and tall moist pastures. | Moderate given preferred foraging habitat on site. | Yes |
| *Ardea ibis* | cattle egret | - | M | Inhabits grassland, woodland and wetland habitat in association with grazing livestock. Roosts in trees or vegetation near lakes and swamps. | Moderate given the suboptimal habitat on site and absence of livestock or preferred wetland habitat on site. | No |
| *Calidris acuminata* | sharp-tailed sandpiper | - | M | Forages on mudflats, shallow inland freshwater wetlands, mangroves, rocky shores and beaches. | Low given the lack of suitable habitat no site. | No |
| *Calidris ferruginea* | curlew sandpiper | - | M | Wader prefers intertidal mudflats in sheltered coastal areas including bays, inlets and lagoons. Less frequently inhabits ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand in inland areas. | Low given the lack of suitable habitat no site. | No |
| *Tringa stagnatilis* | marsh sandpiper | - | M | Wader prefers inland shallow freshwater wetlands and ponds vegetated with reeds and grass beside fallen timber or fallen trees | Low given the lack of suitable habitat no site. | No |
| *Numenius minutus* | little curlew | - | M | Inland and coastal grasslands on black soil plains, swamps or flooded areas. Less frequently forage in paddocks, urban lawn and sporting fields. | Moderate given the range of preferred habitat requirements. | No |

**Table A.1 – Threatened and Migratory Species Likelihood on Site**

| Scientific Name | Common Name | Status | | Habitat Requirement | Likelihood of Occurrence | Assessment Required |
|---|---|---|---|---|---|---|
| | | TSC | EPBC | | | |
| *Calidris ruficollis* | red-necked stint | - | M | Sheltered inlets, bays, lagoon sand estuaries in coastal areas. Also in saltmarsh, ephemeral or permanent shallow wetlands, sewage farms, bore drains, damp grassland, dams or soaks. | Moderate to high given the occurrence of suitable dams on site. | Yes |
| *Gallinago hardwickii* | latham's snipe | - | M | Prefers wetland areas of grassland and vegetated swampland. | Low given the lack of preferred habitat on site. | No |
| *Rostratula benghalensis* | painted snipe | - | M | Prefers vegetated swampland. | Low given the lack of preferred habitat supported on site. | No |

**PE: presumed extinct** **E: endangered** **M: migratory**
**CE: critically endangered** **V: vulnerable**

# Appendix B

## OBSERVED FLORA SPECIES LIST

**Table B.1 – Observed Flora Species List**

| Family/ Scientific Name | Common Name |
|---|---|
| **ANARCADIACEAE** | |
| *Schinus areira** | pepper Tree |
| **ASTERACEAE** | |
| **Arctotheca calendula* | capeweed |
| *Calotis cuneifolia* | purple Burr-Daisy |
| *Carthamus lanatus* | saffron thistle |
| *Carthamus dentatus* | toothed thistle |
| *Cassinia laevis* | cough bush |
| *Chrysocephalum apiculatum* | common everlasting |
| *Brachyscome multifida* | cut-leaved daisy |
| *Ozothamnus diosmifolius* | white dogwood |
| **Sonchus oleraceus* | common sowthistle |
| **Taraxacum officinale* | dandelion |
| *Triptilodiscus pygmaeus* | common sunray |
| *Vittadinia cuneata* | fuzzy new holland daisy |
| *Xanthium spinosum** | bathurst burr |
| *Xerochrysum bracteatum* | golden everlasting |
| **BORAGINACEAE** | |
| *Echium plantagineum* | patterson's curse |
| **BRASSICACEAE** | |
| *Sisymbrium orientale** | indian hedge mustard |
| **CARYOPHYLLACEAE** | |
| **Petrorhagia dubia* | hairy pink |
| *Siliene gallica* | common catchfly |
| **CAMPANULACEAE** | |
| *Wahlenbergia communis* | tufted bluebell |
| *Wahlenbergia stricta* | tall Bluebell |
| **CASUARINACEAE** | |
| *Allocasuarina diminuta subsp. diminuta* | |
| *Allocasuarina luehmannii* | bulloak |
| **CHENOPODIACEAE** | |
| *Einadia nutans* | climbing saltbush |
| *Maireana microphylla* | small-leaf bluebush |
| *Sclerolaena birchii* | galvanized burr |
| **CUPRESSACEAE** | |
| *Callitris endlicheri* | black cypress pine |
| *Callitris glaucophylla* | white cypress pine |
| **CYPERACEAE** | |
| **Cyperus eragrostis* | umbrella sedge |
| *Gahnia aspera* | rough saw sedge |

**Table B.1 – Observed Flora Species List**

| Family/ Scientific Name | Common Name |
|---|---|
| *Lepidosperma laterale* | variable sword sedge |
| *Schoenus apogon* | fluke bogrush |
| **DILLENIACEAE** | |
| *Hibbertia obtusifolia* | hoary guinea flower |
| **ERICACEAE** | |
| *Astroloma humifusum* | native cranberry |
| *Brachyloma daphnoides* | daphne heath |
| *Styphelia triflora* | pink five-corners |
| **EUPHORBIACEAE** | |
| *Chamaesyce drummondii* | caustic weed |
| **FABACEAE** | |
| *Glycine clandestina* | twining glycine |
| *Acacia decora* | showy wattle |
| *Acacia penninervis* | mountain hickory |
| *Dillwynia sericea* | showy parrot pea |
| *Dillwynia sieberi* | |
| **FABOIDEAE** | |
| **Trifolium repens* | white clover |
| **GENTIACEAE** | |
| **Centaurium tenuiflorum* | |
| **GOODENIACEAE** | |
| *Goodenia hederacea subsp. hederacea* | |
| **JUNCACEAE** | |
| *Juncus subsecundus* | finger rush |
| *Juncus usitatus* | |
| **LAMIACEAE** | |
| *Marrubium vulgare** | white horehound |
| **LOMANDRACEAE** | |
| *Lomandra filiformis* | wattle mat-rush |
| *Lomandra multiflora* | many-flowered mat-rush |
| *Lomandra longifolia* | spiny-headed mat-rush |
| **LORACEAE** | |
| *Amyema miquelii* | box mistletoe |
| **MARTYNIACEAE** | |
| *Proboscidea Louisiana* | purple-flowered devils claw |
| **MYRSINACEAE** | |
| **Anagallis arvensis* | scarlet pimpernel |
| **MYOPORACEAE** | |
| *Eremophila debilis* | amulla |

**Table B.1 – Observed Flora Species List**

| Family/ Scientific Name | Common Name |
|---|---|
| **MYRTACEAE** | |
| *Calytrix tetragona* | common fringe myrtle |
| *Eucalyptus blakelyi* | blakelys red gum |
| *Eucalyptus camaldulensis* | river red gum |
| *Eucalyptus crebra* | narrow-leaved ironbark |
| *Eucalyptus dwyeri* | dwyers red gum |
| *Eucalyptus macrorhyncha* | red stringybark |
| *Eucalyptus microcarpa* | grey box |
| *Eucalyptus sideroxylon* | mugga ironbark |
| **OXALIDACEAE** | |
| *Oxalis perennans* | |
| **PHORMIACEAE** | |
| *Dianella revoluta* | blueberry lily |
| **PAPAVERACEAE** | |
| *Argemone ochroleuca** | mexican poppy |
| **PLANTAGINACEAE** | |
| **Plantago lanceolata* | plantain |
| **POACEAE** | |
| *Aira caryophyllea* | silvery hairgrass |
| *Aristida ramosa* | purple wiregrass |
| *Aristida echinata* | |
| *Aristida benthamii var benthamii* | three awn speargrass |
| *Aristida leichardtiana* | |
| *Austrodanthonia monticola* | wallaby grass |
| *Austrostipa scabra* | rough speargrass |
| *Austrostipa aristiglumis* | plains grass |
| *Briza minor** | quakers grass |
| *Chloris truncata* | windmill grass |
| *Dichelachne micrantha* | shorthair plumegrass |
| *Elymus scaber* | common wheatgrass |
| *Eragrostis australasica* | canegrass |
| *Lachnagrostis aemula* | blowngrass |
| *Rytidosperma caespitosum* | ringed wallaby grass |
| *Rytidosperma richardsonii* | straw wallaby grass |
| **Avena fatua* | oats |
| *Cynodon dactylon* | common couch |
| *Eragrostis brownii* | browns lovegrass |
| **Eragrostis pilosa* | soft lovegrass |
| **Lolium rigidum* | wimmera ryegrass |
| *Sporobolus creber* | western rat-tail grass |

**Table B.1 – Observed Flora Species List**

| Family/ Scientific Name | Common Name |
|---|---|
| **POLYGONACEAE** | |
| **Acetosella vulgaris* | sheep sorrel |
| **Rumex crispus* | curled dock |
| **PTERIDACEAE** | |
| *Cheilanthes seiberi* | rock fern |
| **SAPINDACEAE** | |
| *Dodonaea heteromorpha* | maple-fruited hop-bush |
| **SCROPHULARIACEAE** | |
| **Verbascum virgatum* | twiggy mullein |
| **SOLANEACEAE** | |
| **Lycium ferossimum* | african boxthorn |
| **Solanum nigrum* | black-berry nightshade |
| **STERCULIACEAE** | |
| *Brachychiton populneus subsp populneus* | kurrajong |
| **VERBENACEAE** | |
| **Glandularia aristigera* | mayne's pest |
| ***Introduced Species** | |

# Appendix C

## OBSERVED FAUNA SPECIES LIST

**Table C.1 – Observed Fauna Species List**

| Scientific Name | Common Name |
|---|---|
| ***Amphibians*** | |
| *Limnodynastes tasmaniensis* | spotted marsh frog |
| *Litoria caerulea* | green tree frog |
| ***Reptiles*** | |
| *Gehyra variegata* | Tree Dtella |
| *Varanus varius* | Lace Monitor |
| *Tiliqua rugosa* | Shingle-back |
| *Tiliqua scincoides* | Blue Tongue |
| *Pseudonaja textilis* | Eastern Brown |
| ***Mammals*** | |
| *Tadarida australis* | white-striped bat |
| *Scotorepens balstoni* | western broad-nosed bat |
| *Vespedelus vulturnus* | little forest bat |
| *Chalinolobus gouldii* | gould's wattle bat |
| *Chalinolobus morio* | chocolate wattled bat |
| *Tachyglossus aculeatus* | Short-beaked Echidna |
| *Trichosurus vulpecula* | Common Brushtail Possum |
| *Macropus giganteus* | eastern grey kangaroo |
| *Macropus rufogriseus* | Red-necked Wallaby |
| *Felis catus* * | feral Cat |
| *Lepus capensis** | Brown Hare |
| *Vulpes vulpes* * | fox |
| *Oryctolagus cuniculus* * | rabbit |
| ***Birds*** | |
| *Threskiornis spinicollis* | Straw-necked Ibis |
| *Milvus migrans* | Black Kite |
| *Elanus axillaris* | Black-shouldered Kite |
| *Falco cenchroides* | Australian Kestrel |
| *Chenonetta jubata* | Wood Duck |
| *Anas superciliosa* | Pacific Black Duck |
| *Coturnix ypsilophora* | Brown Quail |
| *Phaps chalcoptera* | Common Bronzewing |
| *Ocyphaps lophotes* | Crested Pigeon |
| *Geopelia placida* | Peaceful Dove |
| *Cacatua galerita* | Sulphur-crested Cockatoo |
| *Eolophus roseicapilla* | Galah |
| *Platycercus eximius* | eastern rosella |
| *Psephotus haematonotus* | Red-rumped Parrot |

**Table C.1 – Observed Fauna Species List**

| Scientific Name | Common Name |
|---|---|
| *Cuculus pallidus* | Pallid Cuckoo |
| *Ninox boobook* | Southern Boobook |
| *Podargus strigoides* | Tawny Frogmouth |
| *Aegotheles cristatus* | Australian Owlet-nightjar |
| *Dacelo novaeguineae* | Laughing Kookaburra |
| *Hirundo neoxena* | Welcome Swallow |
| *Petrochelidon ariel* | Fairy Martin |
| *Coracina novaehollandiae* | Black-faced Cuckoo-shrike |
| *Lalage tricolor* | White-winged Triller |
| *Petroica phoenicea* | Flame Robin |
| *Petroica goodenovii* | Red-capped Robin |
| *Microeca leucophaea* | Jacky Winter |
| *Pachycephala rufiventris* | Rufous Whistler |
| *Colluricincla harmonica* | Grey Shrike-thrush |
| *Myiagra inquieta* | Restless Flycatcher |
| *Rhipidura albiscapa* | Grey Fantail |
| *Rhipidura leucophrys* | Willy Wagtail |
| *Pomatostomus superciliosus* | White-browed Babbler |
| *Pomatostomus temporalis*[V] | Grey-crowned Babbler |
| *Cinclorhamphus mathewsi* | Rufous Songlark |
| *Malurus cyaneus* | Superb Blue Wren |
| *Chthonicola sagittata* | Speckled Warbler |
| *Gerygone fusca* | Western Gerygone |
| *Smicrornis brevirostris* | Weebill |
| *Acanthiza chrysorrhoa* | Yellow-rumped Thornbill |
| *Acanthiza nana* | Yellow Thornbill |
| *Acanthiza lineata* | Striated Thornbill |
| *Acanthiza pusilla* | Brown Thornbill |
| *Climacteris picumnus*[V] | Brown Treecreeper |
| *Cormobates leucophaeus* | White-throated Treecreeper |
| *Anthochaera carunculata* | Red Wattlebird |
| *Acanthagenys rufogularis* | Spiny-cheeked Honeyeater |
| *Philemon corniculatus* | noisy friarbird |
| *Philemon citreogularis* | Little Friarbird |
| *Manorina melanocephala* | Noisy Miner |
| *Lichenostomus chrysops* | Yellow Faced Honeyeater |
| *Lichenostomus leucotis* | White-eared Honeyeater |
| *Lichenostomus penicillatus* | White-plumed Honeyeater |
| *Dicaeum hirundinaceum* | Mistletoebird |

**Table C.1 – Observed Fauna Species List**

| Scientific Name | Common Name |
|---|---|
| *Pardalotus striatus* | Striated Pardalote |
| *Zosterops lateralis* | Silvereye |
| *Passer domesticus* * | Sparrow |
| *Stagonopleura guttata*[V] | Diamond Firetail |
| *Taeniopygia bichenovii* | Doubled-barred Finch |
| *Taeniopygia guttata* | Zebra Finch |
| *Sturnus vulgaris* * | Common Starling |
| *Corcorax melanorhamphos* | White-winged Chough |
| *Struthidea cinerea* | Apostlebird |
| *Grallina cyanoleuca* | Peewee/Magpie-lark |
| *Cracticus torquatus* | Grey Butcherbird |
| *Cracticus nigrogularis* | Pied Butcherbird |
| *Cracticus tibicen* | Australian Magpie |
| *Strepera graculina* | Pied Currawong |
| *Corvus coronoides* | Australian Raven |
| ***Introduced Species** [V]**Vulnerable Species** | |

Australian Bushfire Protection Planners Pty Ltd
ACN 083085474
Bushfire Mitigation Consultants

# BUSHFIRE CONSTRAINTS ASSESSMENT

# FOR THE PROPOSED

# REZONING OF LAND WITHIN

# LOT 172 in DP 753233

# BLACKBUTT ROAD, DUBBO

***Australian Bushfire Protection Planners Pty Limited***
ACN 083 085 474

32 Old Dog Trap Road,
SOMERSBY 2250 NSW.
Phone: (02) 43622112 Fax: (02) 43622204
Email: abpp@bigpond.net.au

# BUSHFIRE CONSTRAINTS ASSESSMENT

# FOR THE PROPOSED

# REZONING OF LAND WITHIN

# LOT 172 in DP 753233

# BLACKBUTT ROAD, DUBBO

| Assessment Number | Document | Preparation Date | Issue Date | Directors Approval |
|---|---|---|---|---|
| B152429 | Final | 27.08.2015 | 29.08.2015 | *G.L.Swain* |




Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

# EXECUTIVE SUMMARY

*Australian Bushfire Protection Planners Pty Limited*, on behalf of *Bawd Holding Pty Ltd*, has prepared a Bushfire Constraints Assessment Report for the proposed rezoning of the land within the western portion of Lot 172 in DP 753233 Blackbutt Road, Dubbo.

The development site is recorded on Dubbo Bushfire Prone Land Map as containing Category 1 Bushfire Prone Vegetation or the buffer zone to this vegetation.

The inspection of the development site and adjoining lands revealed that the extent of the mapped Category 1 Bushfire Prone Vegetation is generally accurate.

Therefore, pursuant to Ministerial Direction No. 4.4 – *'Planning for Bushfire Protection'* [under Section 117 of the *Environmental Planning & Assessment Act – 1979]*, Dubbo City Council is required, prior to the preparation of a planning proposal that effects, or is in proximity to land mapped as bushfire prone land, to consult with the NSW Rural Fire Service [amongst other things], under Section 56 of that Act and take into account any comments so made.

This Bushfire Constraints Assessment undertakes an assessment of the bushfire protection measures required to address the bushfire risk to the future residential development, consistent with the Residential Development specifications of *Planning for Bushfire Protection 2006.*

The characteristics of the site, as discussed in this report, together with the fire protection measures recommended, provide that the rezoning and subsequent subdivision of the land is suitable in terms of its intended residential land use.

Graham Swain

Graham Swain
Managing Director
***Australian Bushfire Protection Planners Pty Limited.***



Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

# TABLE OF CONTENTS






Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

## SECTION 1

## INTRODUCTION

### 1.1 Statutory Requirements.

This assessment has been prepared having regard to the following legislative and planning requirements:

#### 1.1.1 Legislation.

#### *(a) Environmental Planning and Assessment Act* (EPA Act)

Planning and development within NSW is regulated by the *Environmental Planning & Assessment Act, 1997* (EPA Act).

In relation to the rezoning of land for the construction of residential buildings and the protection against the impacts of bushfires, Ministerial Direction No. 4.4 – *Planning for Bushfire Protection* issued 1st July 2009 [under Section 117(2) of the *Environmental Planning & Assessment Act – 1979*] applies to all Councils that are required to prepare a bushfire prone land map under Section 146 of the *Environmental Planning & Assessment Act*.

Pursuant to Ministerial Direction No. 4.4 – Planning for Bushfire Protection, the relevant planning authority must consult with the Commissioner of the NSW Rural Fire Service following receipt of a gateway determination under Section 56 of the Act, and prior to undertaking community consultation in satisfaction of Section 57 of the Act, and take into account any comments so made:

A planning proposal must:

- Have regard to Planning for Bushfire Protection 2006;
- Introduce controls that avoid placing inappropriate developments in hazardous areas, and;
- Ensure that bushfire hazard reduction is not prohibited within the APZ.

A planning proposal must, where development is proposed, comply with the following provisions, as appropriate:

*(a)* Provide an Asset Protection Zone [APZ] incorporating at a minimum:

- An Inner Protection Area bounded by a perimeter road or reserve which circumscribes the hazard side of the land intended for development and has a building line consistent with the incorporation of an APZ, within the property, and



Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

- An Outer Protection Area managed for hazard reduction and located on the bushland side of the perimeter road.

*(b)* For infill development [that is development within an already subdivided area], where an appropriate APZ cannot be achieved, provide for an appropriate performance standard in consultation with the NSW Rural Fire Service. If the provisions of the draft LEP permit Special Fire Protection Purposes [as defined under Section 100B of the *Rural Fires Act 199]*, the APZ provisions shall be complied with;

*(c)* Contain provisions for two-way access roads which link to perimeter roads and/or to fire trail networks;

*(d)* Contain provisions for adequate water supply for fire fighting purposes;

*(e)* Minimise the perimeter of the area of land interfacing the hazard which may be developed;

*(f)* Introduce controls on the placement of combustible materials in the Inner Protection Area, and;

A planning proposal may be inconsistent with the terms of this direction only if the relevant planning authority can satisfy the Director General of Planning [or an officer of the Department nominated by the Director-General] that Council has obtained written advice from the Commissioner of the NSW Rural Fire Service, to the effect that, notwithstanding the non-compliance, the NSW Rural Fire Service does not object to the progression of the planning proposal.

### 1.1.2 Planning Policies.

***Planning for Bushfire Protection – 2006. (NSW Rural Fire Service)***

This document provides guidance on the planning and development control processes in relation to bushfire protection measures for rural residential, residential subdivision, Special Fire Protection and Industrial Developments in bushfire prone areas. The Commissioner may determine, under Section 100B of the *Rural Fires Act,* additional measures that are considered necessary to protect the development against the impact of bushfire.

### 1.2 Development Proposal.

This Bushfire Constraints Assessment has been prepared at the request of *Bawd Holdings Pty Ltd* for the proposed rezoning of the R5 – Large Lot Residential zoned land within Lot 172 in DP 753233, Blackbutt Road, Dubbo.

The rezoning proposal seeks to amend the minimum 10 hectare lot size required by the current R5 to permit the future subdivision of the land to provide residential lots having a minimum lot size of 2000m$^2$ – refer to Figures 1 & 2 – Subdivision Concept Plan on Page 7 and Page 8.



Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

## *Figure 1 – Subdivision Concept Plan - Blackbutt Road Dubbo.*

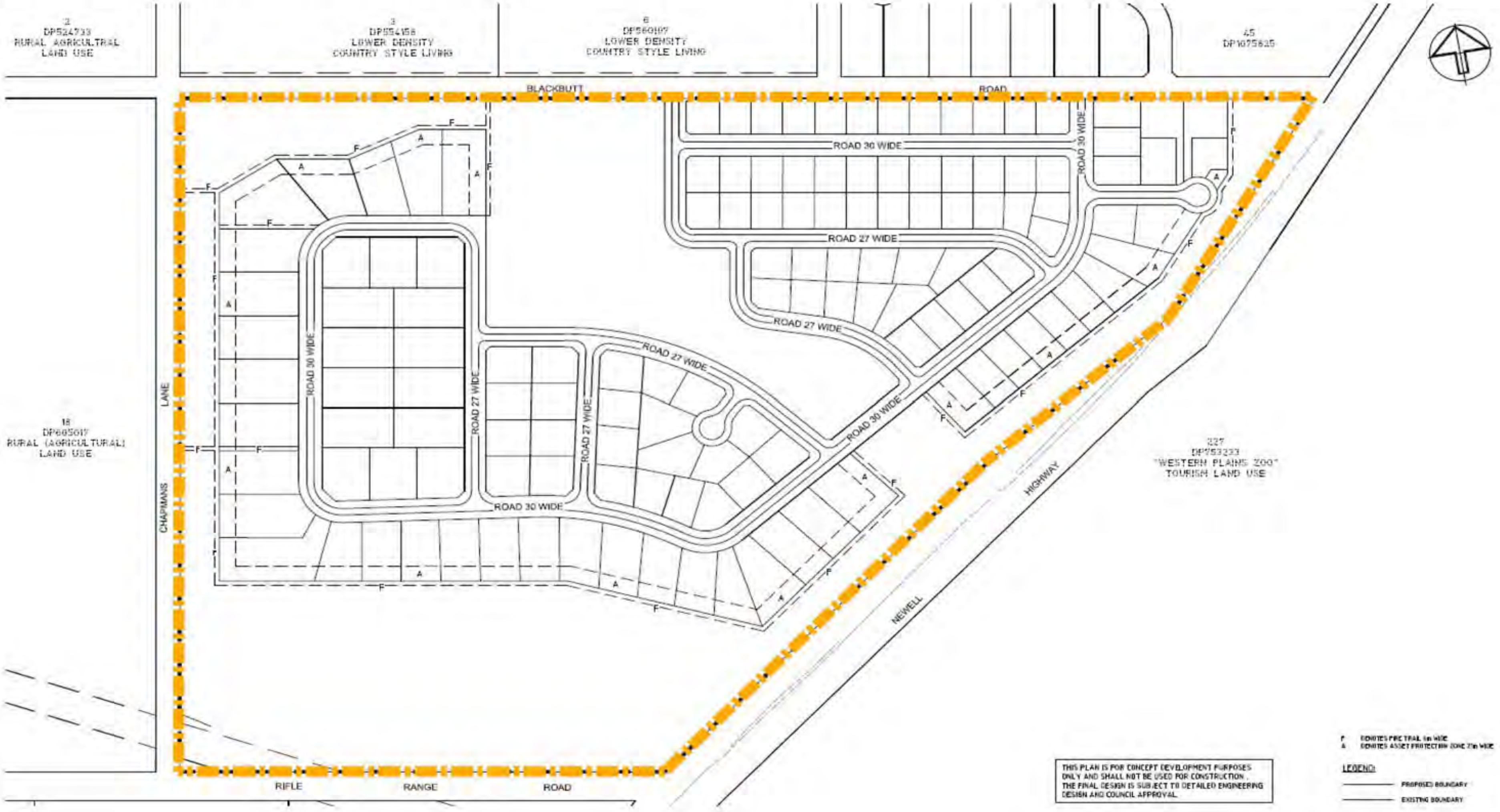
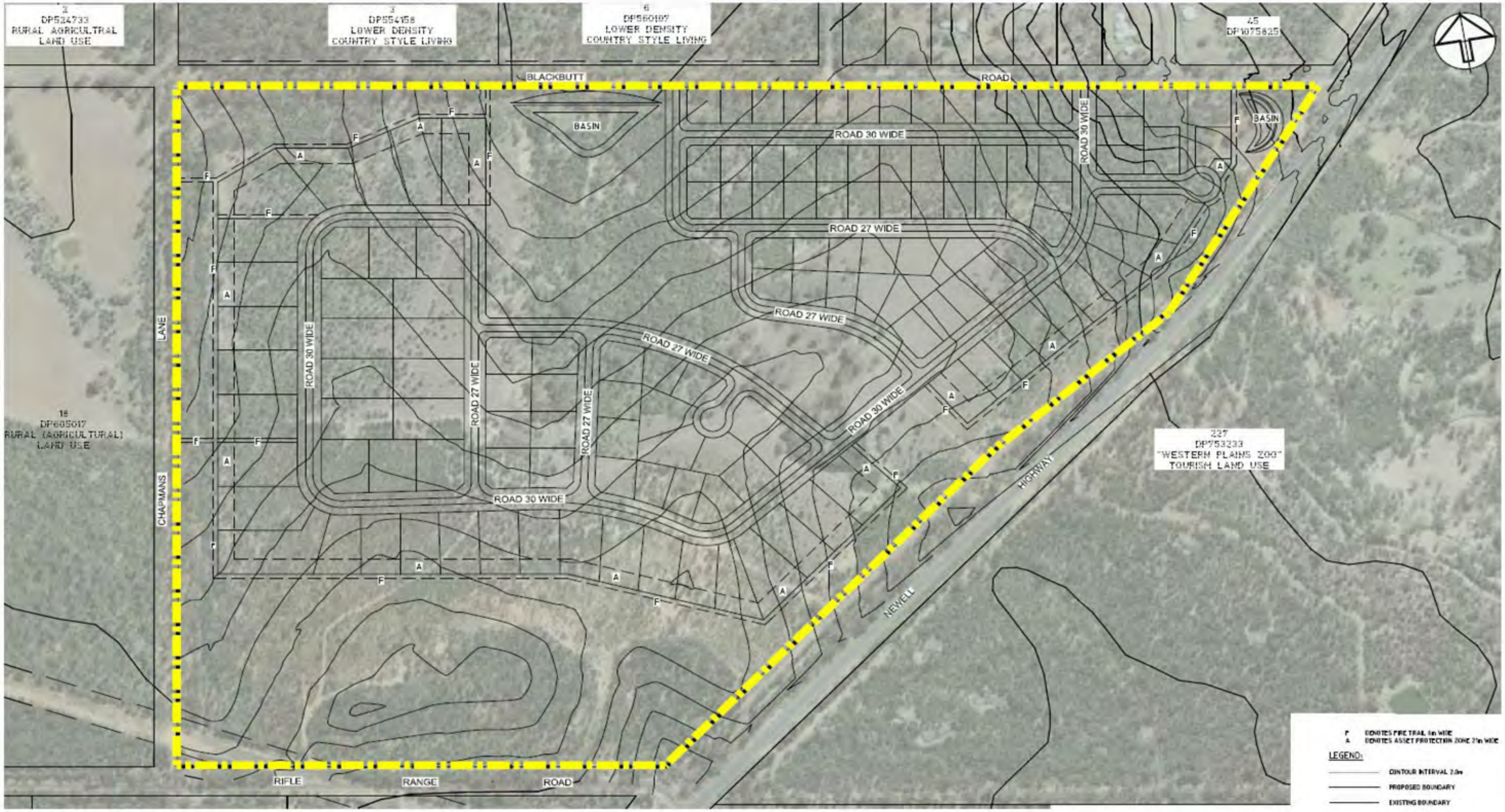


*Figure 2 – Subdivision Concept Plan - Blackbutt Road Dubbo.*







Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

The Subdivision Concept Plan creates one hundred and thirty five [135] residential lots having a minimum area of $2000m^2$.

The land within the Community Lot will be retained for habitat purposes and also managed for bushfire mitigation.

## 1.3 Documentation reviewed in this assessment.

- Subdivision Concept Plan prepared by Geolyse, Project No. 113156, Drawing No. 03C_TP01, dated19.08.2015;
- Aerial Photograph of the development site and surrounding lands;
- Dubbo Bushfire Prone Land Map;
- *Dubbo Local Environmental Plan 2011;*
- *Ecological Constraints & Opportunities Report*
- *Planning for Bushfire Protection 2006* prepared by the NSW Rural Fire Service;
- Australian Standard AS3959 - 2009 *Construction of Buildings in Bushfire Prone Areas*;
- *Rural Fires Regulation 2013.*

## 1.4 Site Inspection.

Graham Swain of *Australian Bushfire Protection Planners Pty Limited* inspected the site and surrounding areas on the 14th January 2015 to assess the topography, slopes and vegetation classification within and adjoining the development site and to validate the proposed subdivision's compliance with the requisite deemed-to-satisfy Asset Protection Zones and access provisions.

Adjoining properties were also inspected to determine the surrounding land use / vegetation communities, land management and the extent of bushfire prone vegetation.




Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

## SECTION 2
## DESCRIPTION OF THE LAND WITHIN THE REZONING PRECINCT

### 2.1 Location.

The rezoning precinct consists of the land within Lot 172 in DP 753233, Blackbutt Road, Dubbo.

***Figure 3 – Location of the rezoning precinct.***


### 2.2 Existing Land Use.

The rezoning precinct contains vacant R5 – Large Lot Residential zoned land.

### 2.3 Adjoining Landuse.

The land to the north of Blackbutt Road is zoned R2 Low Density Residential and contains existing rural residential and residential development with a Seniors Living complex located in the corner of Blackbutt Road and the Newell Highway.

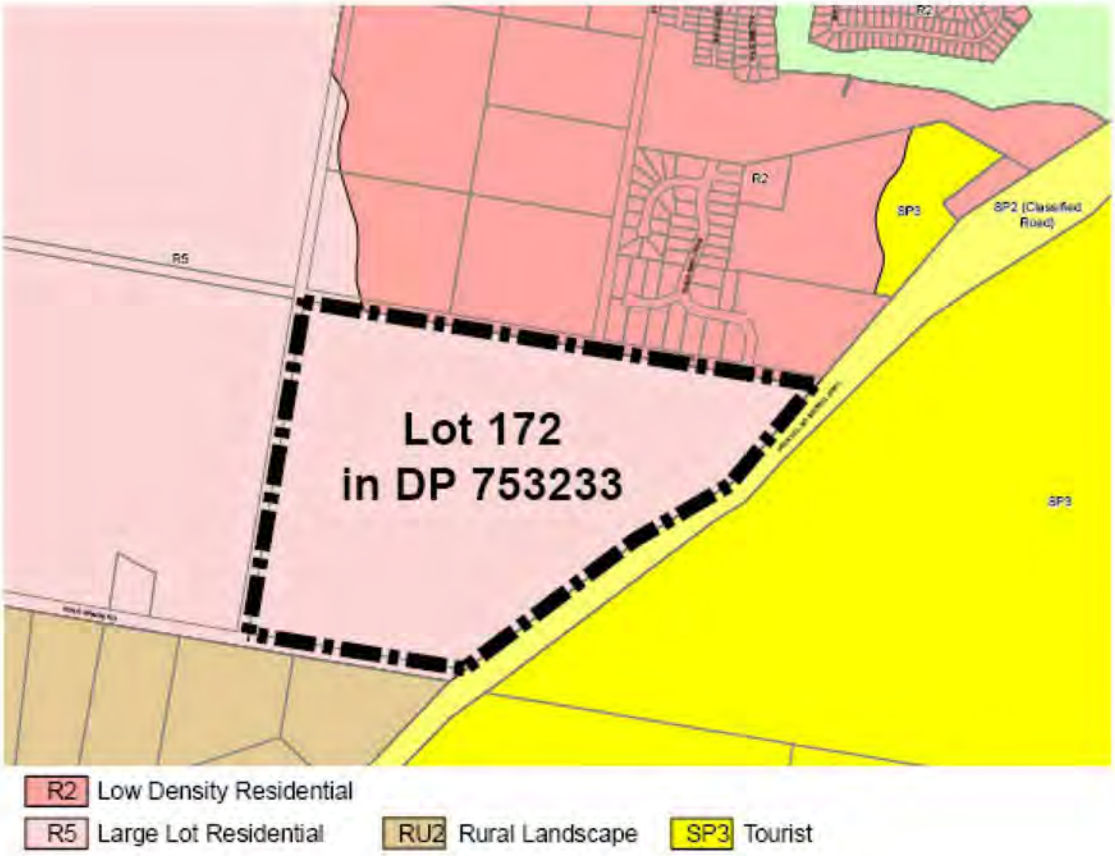
The land to the west is zoned R5 – Large Lot Residential and is currently rural agricultural landuse.

The land to the south is zoned RU2 – Rural Landscape and contains rural residential development. The Western Plains Zoo occupies the land to the east of the development site, beyond the Newell Highway.



Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

***Figure 4 – Extract from the Dubbo Local Environment Plan – 2011 showing the location of the Lot 172 in DP 753233 Blackbutt Road, Dubbo.***




## 2.4 Topography.

Appendix 2 of *Planning for Bushfire Protection 2006* states that slopes should be assessed, over a distance of at least 100m from an asset and that the gradient of the land should be determined which will most significantly influence the fire behaviour to the site. The topography of the land within the proposed residential precinct forms the apex of a broad ridgeline that is orientated northwest to southeast.

The dominant feature of the topography within the rezoning precinct consists of a low ridgeline located in the southern portion of the rezoning precinct and which has an apex of 347 metres. From this apex a ridge runs to the north with a second ridge extending to the northeast across the rezoning precinct, creating a ride valley between the two ridges.

This valley falls approximately 20 metres to the north towards Blackbutt Road with a water course flowing across Blackbutt Road into the property to the north. The land to the east of the north-eastern ridge falls approximately 10 metres to the northeast and east towards the Newell Highway whilst the land to the west of the northern ridge falls approximately 8 metres to the west/northwest towards Chapmans Lane and the adjoining land.



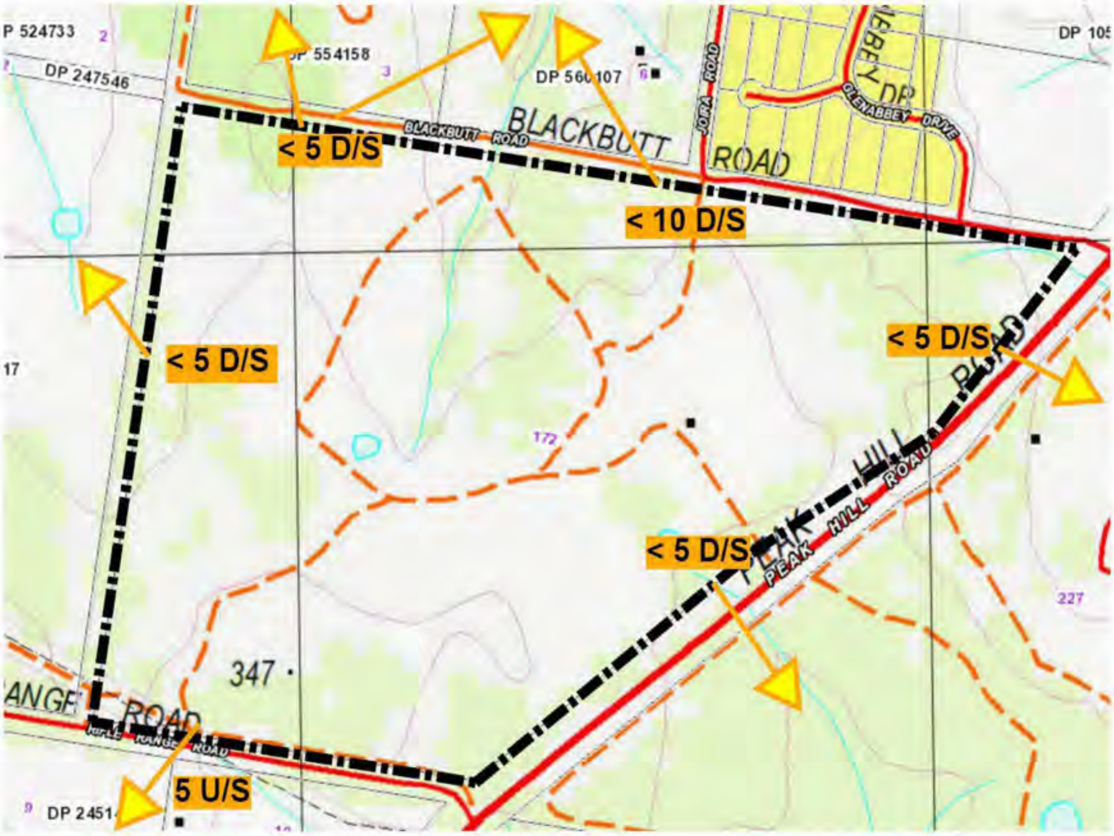
Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

The land to the north of the rezoning precinct, beyond Blackbutt Road, falls to the northeast and northwest at less than 5 degrees into the continuation of the watercourse. The land to the east of the Newell Highway, within the Western Plains Zoo, falls to the southeast at less than 5 degrees and to the northeast, from a ridgeline that is located to the east of the north-eastern corner of the rezoning precinct. Gradients are less than 5 degrees, with the exception of 5 – 10 degrees in the south-western corner of the zoo.

The land to the west of the rezoning precinct, beyond Chapmans Lane, falls to the northwest at less than 5 degrees across the adjoining agricultural land.

The land to the south and southwest of the rezoning precinct, beyond Rifle Range Road, rises at less than 5 degrees to the southwest – *Refer to Figure 5 – Topographic Map below.*

***Figure 5 – Topographic Map.***




## 2.5 Vegetation.

Appendix A2.3 of *Planning for Bushfire Protection 2006* provides a methodology for determining the predominant bushfire prone vegetation for at least 140 metres in all directions from the future development on the site. Vegetation is classified using Table A2.1 of *Planning for Bushfire Protection 2006,* which classifies vegetation types into the following groups:



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(a) *Forests [wet & dry sclerophyll forests];*
(b) *Woodlands;*
(c) *Plantations – being pine plantations not native plantations;*
(d) *Forested Wetlands;*
(e) *Tall Heaths;*
(f) *Freshwater Heaths;*
(g) *Short Heaths;*
(h) *Alpine Complex;*
(i) *Semi – arid Woodlands;*
(j) *Arid Woodlands; and (k) Rainforests.*

### 2.5.1 Vegetation within the rezoning precinct.

The Ecological Constraints and Opportunities Report prepared by Geolyse identifies that the rezoning precinct contains the following vegetation communities:

- Grey Box Woodland [EEC];
- Mugga Ironbark, Black Cypress Pine, Bulloak Woodland;
- Mugga Ironbark Blakely's Red Gum Open Woodlands;
- Allocasuarina Diminuta subsp. Diminuta Shrubland;
- White Cypress Pine/Black Cypress Pine Forest;
- Bullock, Dwyers Red Gum, White Cypress Pine Open Woodland; and
- Grassland.

Figure 6 – Plan of Vegetation Communities on Page 14 provides an extract from the Geolyse Report identifying the vegetation communities within the rezoning precinct

Figure 7 – Plan of Conservation on Page 15 provides an extract from the Geolyse Report identifying the conservation values of the vegetation within the rezoning precinct.

The vegetation on the land to the north of the north-western corner of the rezoning precinct contains unmanaged Mugga Ironbark, Black Cypress and Bulloak Woodland. The residential development located to the north of the eastern portion of the rezoning precinct contains managed remnant vegetation and/or managed landscaped gardens – this vegetation n is not deemed to be bushfire prone.

The Western Plains Zoo land, to the east of the Newell Highway, contains areas of unmanaged Mugga Ironbark, Black Cypress and Bulloak Woodland and Mugga Ironbark Blakely's Red Gum Open Woodlands.

The land to the west of the rezoning precinct contains Mugga Ironbark, Black Cypress Pine, Bulloak Woodland and grassland on the open paddocks.



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***Figure 6 – Plan of Vegetation Communities.***

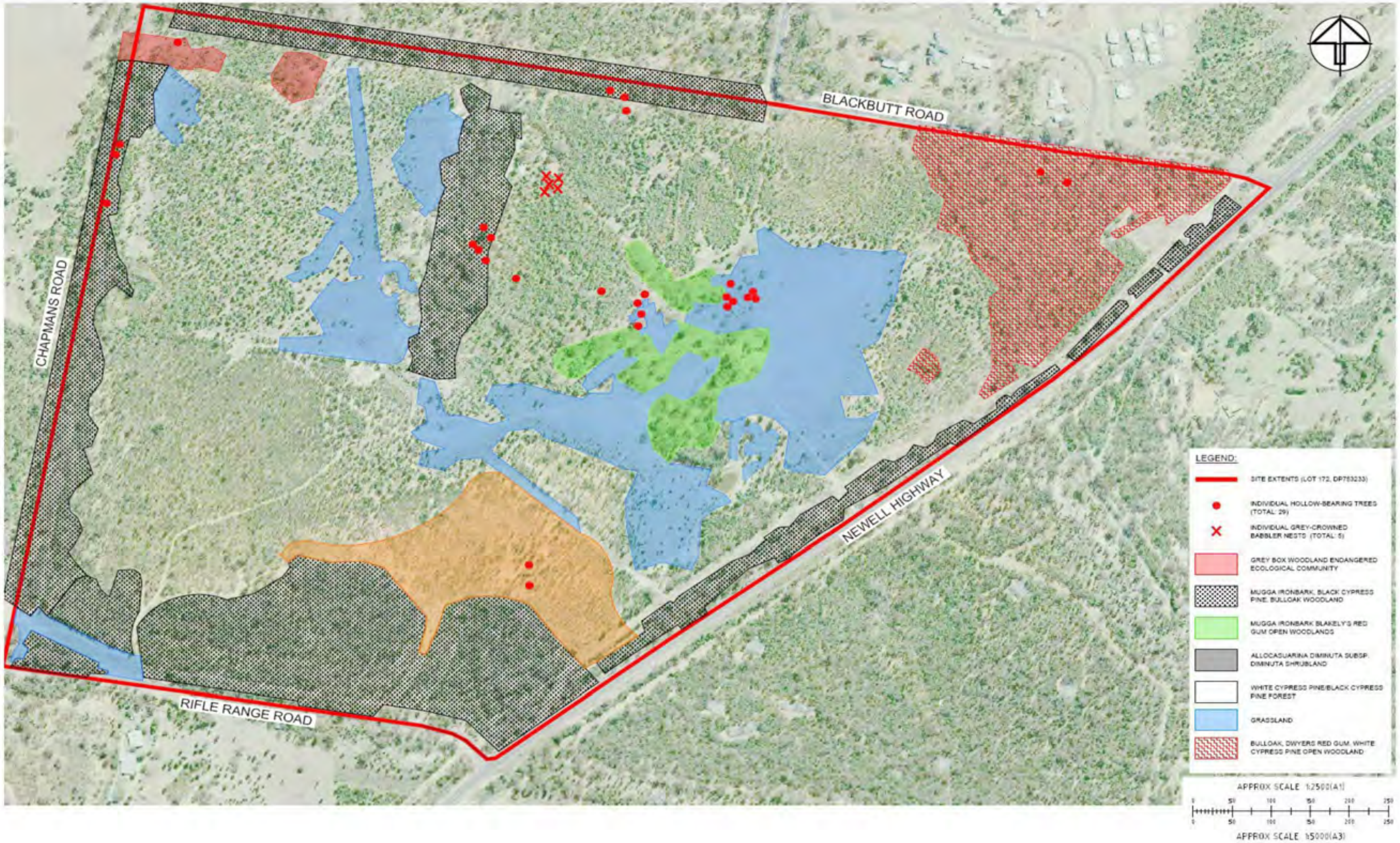





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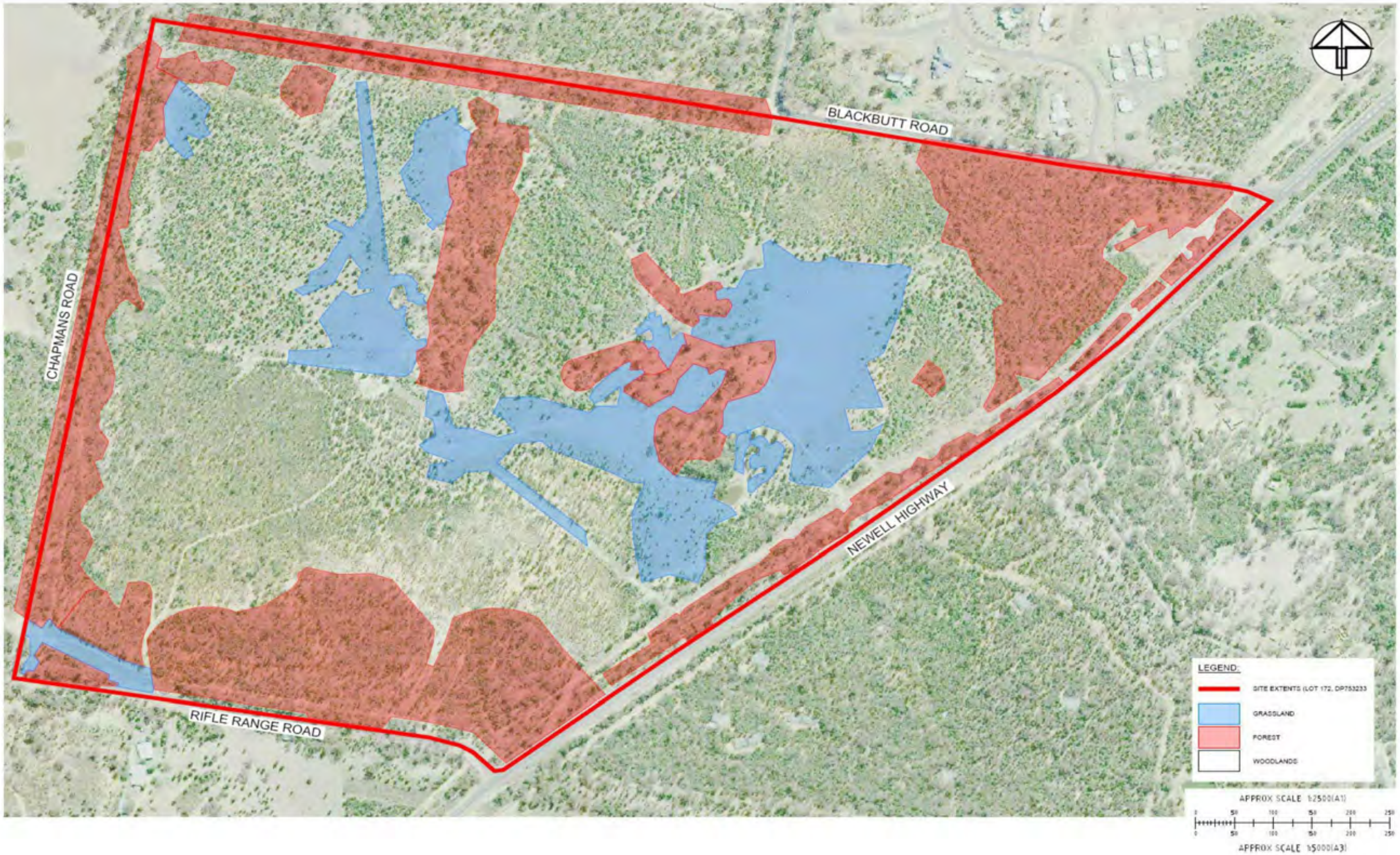
***Figure 7 – Plan of Conservation Values.***







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Email. abpp@bigpond.net.au

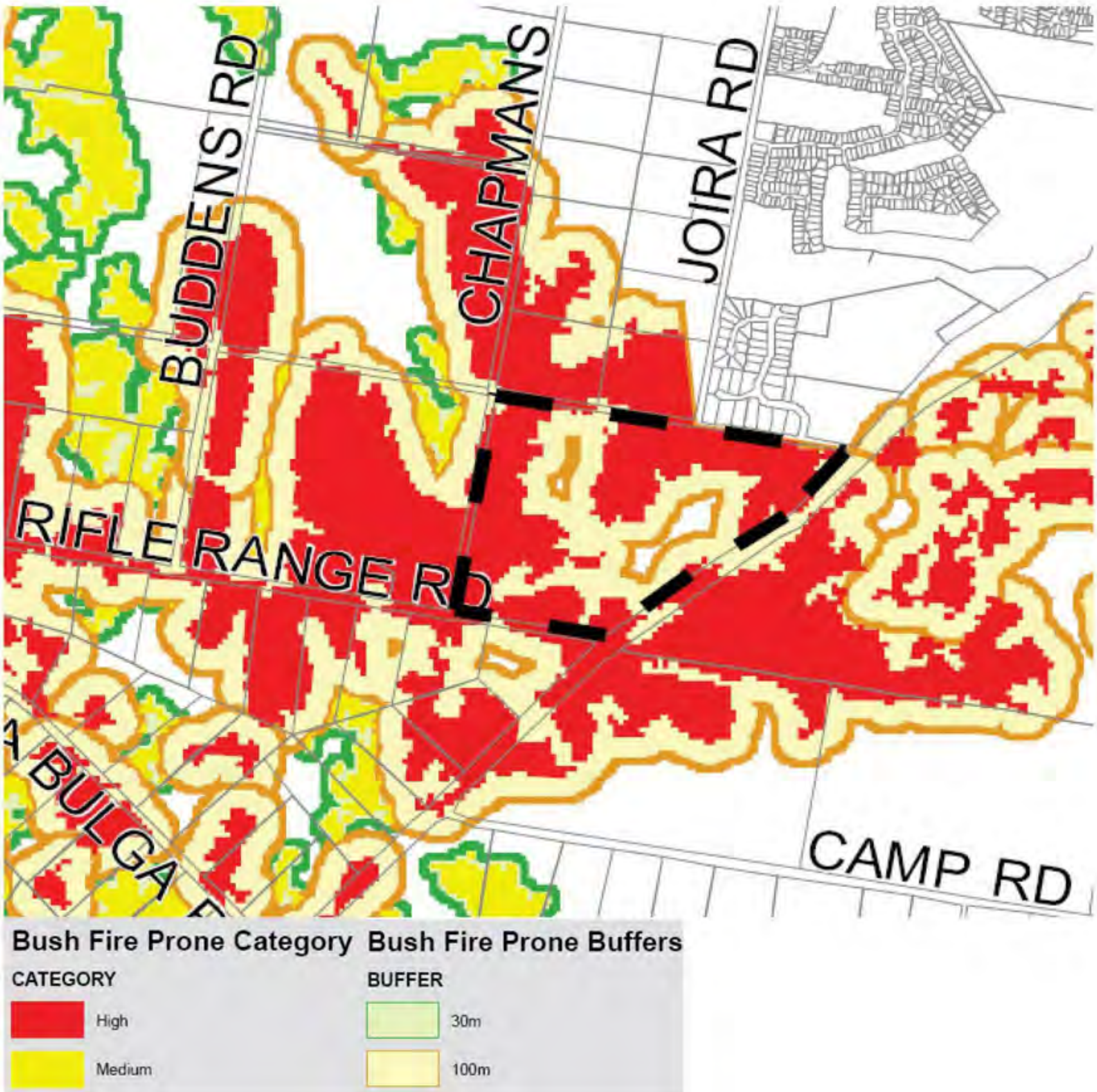
## SECTION 3

## BUSHFIRE PRONE LAND MAP

The Dubbo City Council has prepared a Bushfire Prone Land Map pursuant to the requirements of Section 146 of the *Environmental Planning & Assessment Act 1979*. Figure 8 below provides an extract of the Certified Bushfire Prone Land Map for the rezoning precinct and shows that except for the unmapped grassland vegetation the whole of the site is mapped as containing High [Category 1] and Medium [Category 2] Bushfire Prone Vegetation.

The site inspection and aerial photographs provided in this report show that the Bushfire Prone Land Map accurately records the extent of bushfire prone vegetation is the rezoning precinct and on adjoining lands.

***Figure 8 – Extract from the Dubbo Bushfire Prone Land Map.***







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Email. abpp@bigpond.net.au

## SECTION 4
## BUSHFIRE CONSTRAINTS ASSESSMENT

### 4.1 Introduction.

A planning proposal must, where development is proposed, comply with the following provisions, as appropriate:

*(a)* Provide an Asset Protection Zone [APZ] incorporating at a minimum:

- An Inner Protection Area bounded by a perimeter road or reserve which circumscribes the hazard side of the land intended for development and has a building line consistent with the incorporation of an APZ, within the property, and

- An Outer Protection Area managed for hazard reduction and located on the bushland side of the perimeter road.

*(b)* For infill development [that is development within an already subdivided area], where an appropriate APZ cannot be achieved, provide for an appropriate performance standard in consultation with the NSW Rural Fire Service. If the provisions of the draft LEP permit Special Fire Protection Purposes [as defined under Section 100B of the *Rural Fires Act 199]*, the APZ provisions shall be complied with;

*(c)* Contain provisions for two-way access roads which link to perimeter roads and/or to fire trail networks;

*(d)* Contain provisions for adequate water supply for fire fighting purposes;

*(e)* Minimise the perimeter of the area of land interfacing the hazard which may be developed; and

*(f)* Introduce controls on the placement of combustible materials in the Inner Protection Area.

These requirements are examined in the following sections of this report.

### 4.2 Asset Protection Zones.

Appendix 2 of *Planning for Bushfire Protection 2006* provides the following procedure for determining setback distances (Asset Protection Zones) for residential and rural residential development which is deemed to be bushfire prone:

*(a)* *Determine vegetation formations as follows:*

- Identify all vegetation in all directions from the site for a distance of 140 metres;



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- Consult Table A2.1 to determine the predominant vegetation type; and
- Select the predominant vegetation formation as described in Table A2.1.

(b) *Determine the effective slope of the land under the predominant vegetation Class.*

(c) *Determine the appropriate fire [weather] area in Table A2.2.*

(d) *Consult Table A2.4 and determine the appropriate setback [Asset Protection Zone] for the assessed land use, vegetation formation and slope range.*

The Dubbo Bushfire Prone Land Map identifies that the rezoning precinct contains Category 1 & 2 Bushfire Prone Vegetation and the buffer zone to bushfire prone vegetation. The site inspection confirmed that bushfire prone vegetation occupies the land to the north of the western portion of the rezoning precinct; occupies part of the land to the west and within the Western Plains Zoo to the east.

The Concept Plan layout also identifies that areas of native vegetation will be retained within the habitat areas in the rezoning precinct.

The site inspection also confirmed that for the purpose of determining complying Asset Protection Zones to the future residential development, the structure of the retained vegetation in the rezoning precinct and on the adjoining land represents a 'forest' vegetation community.

Figure 9 on Page 19 below provides an indicative layout of the available Asset Protection Zones to the lots as shown on the Concept Plan.

The width of the Asset Protection Zones have been determined in order to achieve a construction standard of BAL 29 to the future dwellings, pursuant to A.S. 3959 – 2009 – *'Construction of Buildings in Bushfire Prone Areas'*.

The Asset Protection Zones shall be maintained to the standards of an Inner Protection Area [IPA] as defined by *Planning for Bushfire Protection 2006* and the NSW Rural Fire Service's *'Specifications for Asset Protection Zones'*.

The Concept Plan layout provides for a combination of public perimeter roads, public internal roads and fire trails which will be provided to the perimeter of part of the estate. These trails will form part of the Asset Protection Zones and shall be maintained under the Community Title land ownership – refer to Figure 10 on Page 20 showing location of fire trails on the Concept Plan.



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Email. abpp@bigpond.net.au

*__Figure 9 – Indicative layout of recommended Asset Protection Zones to the future lots as proposed by the Concept Plan.__*

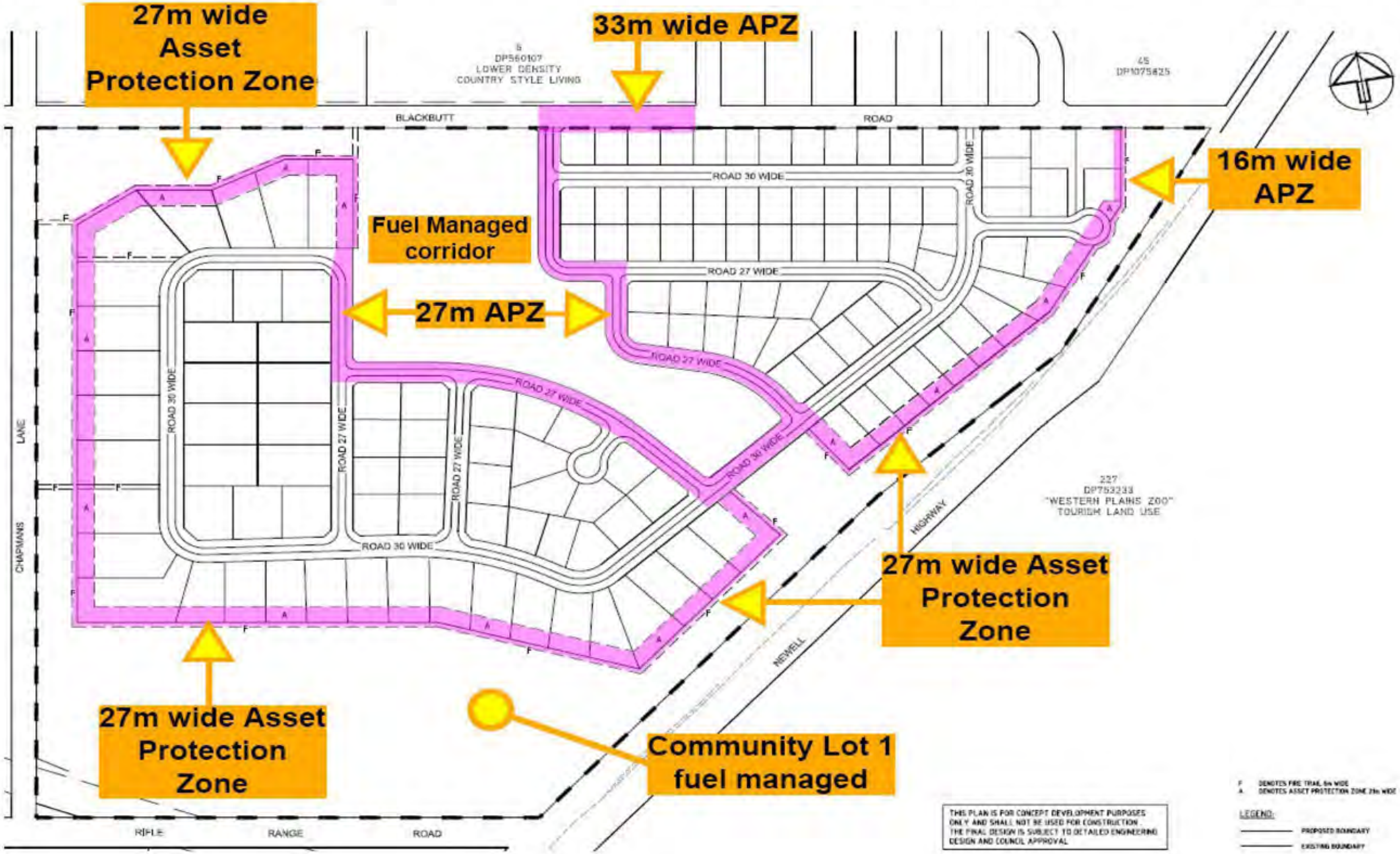





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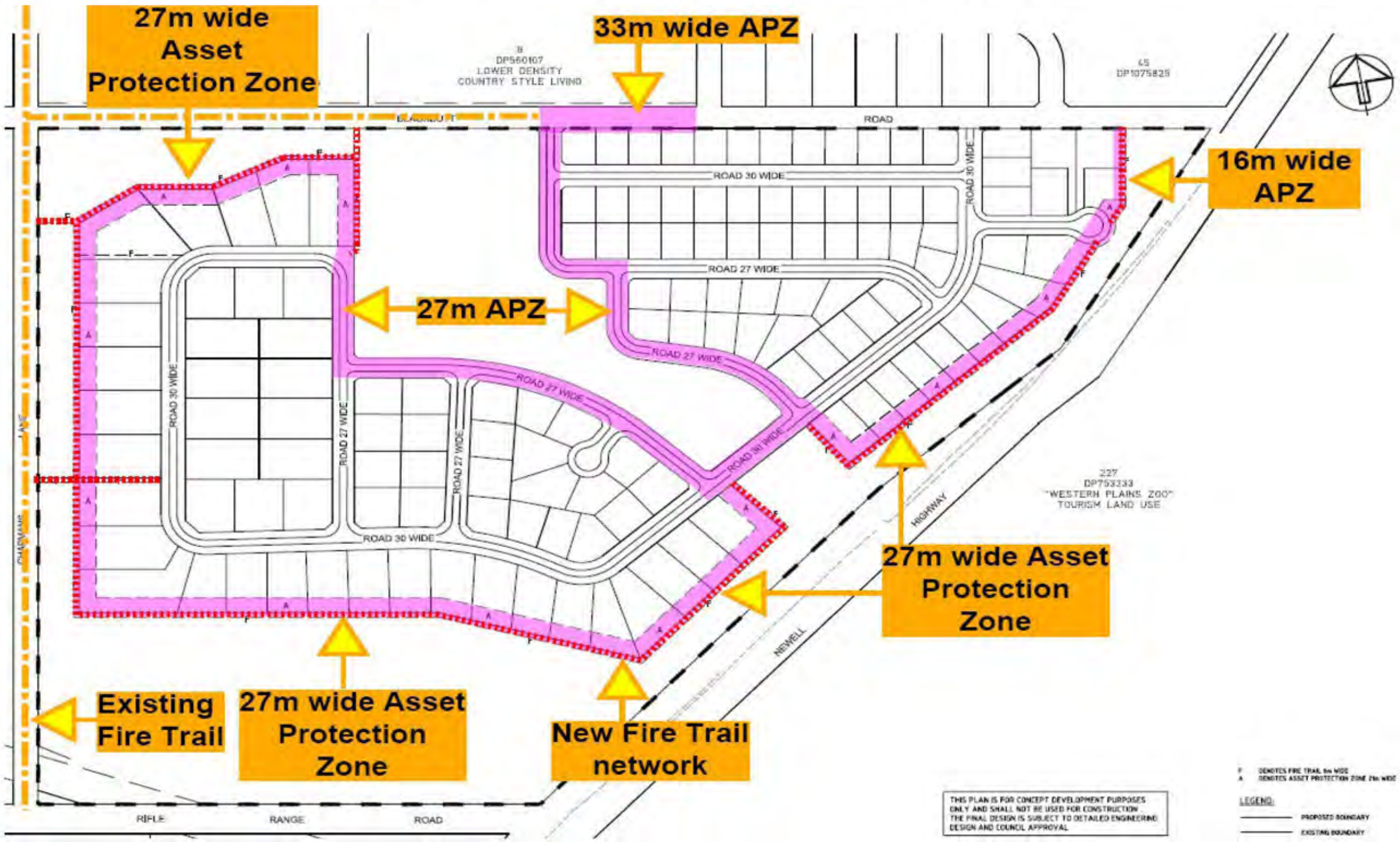
***Figure 10 – Indicative layout of recommended Asset Protection Zones and Fire Trails.***







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## 4.3 Access for Firefighting Operations.

The design and construction of the public roads shall comply with the specifications of Section 4.1.3(1) of *Planning for Bushfire Protection 2006* with the minimum pavement width of 8.0 metres provided to all roads, kerb to kerb with 'No Parking' on one side with the services [hydrants] located on this side of the road.

## 4.4 Water Supplies for Firefighting Operations.

Street Hydrants shall comply with the specifications of Australian Standard A.S. 2419.2 and have a flow rate of 10 litres / second.

Hydrant locations shall be delineated by blue markers placed on the hydrant side of the centreline of the road pavement.

## 4.5 Construction Standards to the future dwellings.

Construction standards shall be applied to the future buildings erected on all lots created in the future subdivision of the residential precinct. The nominated width of the Asset Protection Zones as shown on Figure 9 – Page 19 have been determined in order that the future dwellings constructed on those lots exposed to a bushfire hazard have a maximum Bushfire Attack Level [BAL] rating of 29 $kW/m^2$.

## 4.6 Management of the residual vegetation within Community Lot 1.

The residual vegetation within Community Lot 1 shall be managed, in accordance with a Fuel management Plan, in order to address the provisions of Section 63 of the Rural Fires Act 1997 and to reduce the hazard to the perimeter of the residential estate.



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Email. abpp@bigpond.net.au

## REFERENCES:


- N.S.W Rural Fire Service – *Planning for Bushfire Protection 2006*;
- *Environmental Planning & Assessment Act – 1979;*
- *Rural Fires Act – 1997;*
- *Rural Fires Regulation 2013;*
- NSW Rural Fire Service – *Guideline for Bushfire Prone Land Mapping 2006;*
- *Threatened Species Conservation Act 1995;*
- *Native Vegetation Act;*
- *Bushfire Environmental Assessment Code 2006;*
- Building Code of Australia;
- Australian Standard A.S. 3959-2009 "*Construction of Buildings in Bushfire Prone Areas*";
- *Dubbo Bushfire Prone Land Map.*





Tel. 612 43622112 / 612 43621184
Email. abpp@bigpond.net.au

# Remediation and validation report

Lot 172 DP753233 Blackbutt Road, Dubbo NSW

Ref: R5809val1
Date: 11 December 2015

**Envirowest Consulting** Pty Ltd ABN 18 103 955 246
• 9 Cameron Place, PO Box 8158, Orange NSW 2800 • Tel (02) 6361 4954 •
• Fax (02) 6360 3960 • Email admin@envirowest.net.au • Web www.envirowest.net.au •
Environmental
Geotechnical
Asbestos
Services

| | |
|---|---|
| Client: | Highview Country Estates Pty Ltd<br>c/- Geolyse Pty Ltd<br>PO Box 1842<br>Dubbo NSW 2830 |
| Assessor: | Leah Desborough BNatRes (Hons)<br>Senior Environmental Scientist |
| Checked by: | Greg Madafiglio PhD<br>Senior Environmental Scientist |
| Authorising Officer: | Greg Madafiglio PhD<br>Senior Environmental Scientist |
| Interested authorities: | Dubbo City Council |
| Report number: | R5809val1 |
| Date: | 11 December 2015 |

# Executive summary

## Background

Residential development is proposed for Lot 172 DP753233 Blackbutt Road, Dubbo NSW. A contamination investigation undertaken by Envirowest Consulting Pty Ltd and reported on 4 June 2015 (report number R5809c) identified asbestos, hydrocarbons, zinc and general refuse contamination across the site.

A Remediation Action Plan (RAP) was prepared in July 2015 (report number R5809rap) to develop an effective plan to remediate the site for the proposed residential land-use. The recommended remediation method was excavation of all contaminated materials and transportation to a licensed landfill.

A validation assessment is required to confirm contaminated areas have been remediated successfully.

## Objectives of the investigation

Remediation and validation of Lot 172 DP753233 Blackbutt Road, Dubbo NSW in accordance with the RAP.

## Summary

Remediation of the site was undertaken by removal of contaminated materials and disposal to Whylandra Landfill. Inert materials such as concrete, bricks and pavers were retained on-site for re-use.

Asbestos impacted materials were remediated by excavation and off-site disposal as asbestos waste or sorted to separate asbestos cement fragments from other material. The asbestos cement fragments was disposed as asbestos waste. Hand picking of all locations identified as impacted by asbestos cement fragments was undertaken.

Validation of asbestos impacted areas was undertaken by traversing the area on 5m transects. The soil surface was visually assessed to confirm all asbestos cement fragments had been removed. No asbestos cement fragments were identified on the soil surface at the final inspection.

Hydrocarbon impacted soil identified at Location 5 was excavated until no evidence of contamination was identified. Excavated material was disposed off-site as general solid waste. The excavation pit was approximately 1m by 1m and 1m deep. Validation of the excavation pit was undertaken by sampling the walls and base of the pit. Soil samples were analysed for TRH and BTEXN. Levels of hydrocarbons in the soil samples were below detection limits and less than the adopted residential land-use thresholds.

A waste coal stockpile (Stockpile Y) identified at Location 5 was excavated to 100mm below the base of the stockpile and disposed off-site. Validation of the remediation was undertaken by visually inspecting the footprint for the presence of coal residue. No coal residue was identified in the stockpile footprint after removal.

The hydrocarbon and zinc impacted stockpile (Stockpile Q) identified at Location 6 was excavated to 100mm below the base of the stockpile and disposed off-site. A soil sample was collected from the stockpile footprint after removal and analysed for zinc, TRH and BTEXN. Levels of zinc were at environmental background levels and levels of TRH and BTEXN were below detection limits. Levels of contaminants of concern were below the adopted residential land-use thresholds.

Refuse was collected from across the site and disposed as general solid waste. Small amounts of refuse (timber, plastic) remain on the site and are expected to be removed at the time of site development.

**Recommendations**
The site is suitable for residential land-use.

The historical activities on the site may have resulted in unidentified areas of contamination. The development should be managed in accordance with an unexpected finds protocol for implementation if suspected contamination is identified.

# CONTENTS

## 1. Introduction

Residential development is proposed for Lot 172 DP753233 Blackbutt Road, Dubbo NSW. A contamination investigation undertaken by Envirowest Consulting Pty Ltd and reported on 4 June 2015 (report number R5809c) identified asbestos, hydrocarbons, zinc and general refuse contamination across the site.

A Remediation Action Plan (RAP) was prepared in July 2015 (report number R5809rap) to develop an effective plan to remediate the site for the proposed residential land-use. The recommended remediation method was excavation of all contaminated materials and transportation to a licensed landfill.

A validation assessment is required to confirm contaminated areas have been remediated successfully.

## 2. Scope of work

Envirowest Consulting Pty Ltd was commissioned by Highview Country Estates Pty Limited to supervise remediation and undertake validation assessment of Lot 172 DP753233 Blackbutt Road, Dubbo NSW. The assessment included:

- Validation of the remediated area by visual assessment and sampling in the excavated areas and surrounding soil

The investigation was undertaken according to NSW EPA, WorkCover and NEPC guidelines including *Guidelines for consultants reporting on contaminated sites* and *National Environment Protection (Assessment of Site Contamination) Measure 1999*.

## 3. Site identification

| | |
|---|---|
| Address | Lot 172 DP753233<br>Blackbutt Road<br>Dubbo NSW |
| Owner(s) | Highview Country Pty Limited |
| Deposited plans | Lot 172 DP753233 |
| Australian Map Grid | Zone 55H, E647285m, N6427718m |
| Locality map | Figure 1 |
| Aerial photograph | Figure 2 |
| Photograph(s) | Figure 3 |
| Area | Approximately 98 hectares |

# 4. Site description

## 4.1 Zoning

The site is zoned R5 Large Lot Residential under the Dubbo Local Environmental Plan (2011).

## 4.2 Site visit and description

The site is vacant land located on the outskirts of Dubbo. Remediation and assessment was undertaken between August and November 2015.

## 4.3 Land-use

The site was vacant at the time of inspection on 31 March 2015. Numerous stockpiles of soil, gravel and building materials and refuse were present across the site. The current owner reports the material has been illegally disposed over a number of years. Motor bikes have also used part of the site as a racetrack. The site had formerly been used for grazing.

## 4.4 Summary of council records

Email correspondence with Ray Doyle, Environmental and Health Services Supervisor, Dubbo City Council on 22 April 2015 indicated the site was listed on Councils Register of Potentially Contaminated Sites. The listing was a result of the NSW Fire Brigade informing Council of the presence to friable asbestos in and near the former dwelling. Council reports indicate the dwelling was impacted by fire. Council records also indicated that Council Rangers have been involved in various waste management and dumping incidents on the site as well as small scale landfilling.

## 4.5 Sources of information for historical review and site description

Site inspections 31 March, 6 August, 23 September, 6, 12, 20 and 28 October 2015 by Leah Desborough
NSW EPA records of public notices under the CLM Act 1997
Soil and geological maps
Spatial information exchange historic parish maps
Historical aerial photographs
Dubbo LEP 2011
Envirowest Consulting Pty Ltd (2015) Contamination Investigation
Envirowest Consulting Pty Ltd (2015) Remediation Action Plan

## 4.6 Chronological list of site uses

### 4.6.1 Historical Parish Maps

The 1881 historical parish map indicates the site was owned by WW Baird. The allotment included land to the west. The 1892 historical parish map indicates the site was owned by George Williams. The Newell Highway is located to the east and road reserves to the north and west.

The 1900, 1910, 1919, 1924, 1936 and 1965 historical parish maps indicate the site was owned by Stewart Irvine. The Newell Highway is located to the east and road reserves to the north and west.

### 4.6.2 Aerial photographs

#### 4.6.2.1 1964 aerial photograph

The 1964 aerial photograph depicted the site as mostly cleared of trees with grazing the expected land-use. Woodland areas exist in the southern, central and north eastern sections of the site as well as along the northern drainage line. Infrastructure on the site included contour banks in the southern half, fences dividing the site into paddocks and two dams.

Land surrounding the site appeared to be used for agriculture.

#### 4.6.2.2 1980 aerial photograph
The 1980 aerial photograph depicted the site as similar to the 1964 aerial photograph with the area mostly cleared and grazing the expected land-use. Some regrowth was occurring. A bare area in the north east corner is expected to be the quarry or gravel pit identified on the topographic map (Section 4.5.3). A driveway provides access to the site from the Newell Highway.

#### 4.6.2.3 1995 aerial photograph
The 1995 aerial photograph depicted the site as similar to the 1980 aerial photograph. Regrowth in the south western and north eastern sections had increased. A building was identified at the end of the driveway off the Newell Highway and expected to have been the former dwelling.

#### 4.6.2.4 2003 aerial photograph
The 2003 aerial photograph depicted the site as similar to the 1995 aerial photograph. Regrowth across the site had increased since 1995. The quarry or gravel pit located in the north eastern corner did not appear to be operating. Numerous tracks were present across the site. Debris is present at the southern end of the drainage line and expected to be some of the stockpiles identified at Location 5.

#### 4.6.2.5 2006 aerial photograph
The 2006 aerial photograph depicted the site as similar to the 2003 aerial photograph. Access to the site is obtained from the Newell Highway as well as Blackbutt Road. Several disturbed areas were located in the northern section of the site and expected to be the sandstone stockpiles identified during the site inspection (Stockpiles V and Z). Stockpile T identified in central section of site.

#### 4.6.2.6 2009 aerial photograph
The dwelling had been demolished and the building material remained in stockpiles on site. An area of infrastructure existed to the north west of the demolished dwelling. A dark coloured stockpile is present in the central section of the site and expected to be the coal stockpile (Stockpile Y) identified during the site inspection. Disturbance was identified in the area identified as Location 2 along the northern boundary.

#### 4.6.2.7 2012 aerial photograph
The 2012 aerial photograph depicted the site as similar to the 2009 aerial photograph. Debris around the former dwelling location has become more widespread.

#### 4.6.2.8 2013 aerial photograph
The 2013 aerial photograph depicted the site as similar to the 2012 aerial photograph. Disturbance of the soil at the southern end of the northern drainage line (Location 5) was identified. The disturbance is expected to have resulted in the fill material identified in this area during the site inspection.

### 4.6.3 Topographic map
The topographic map for the investigation area was based on 1980 aerial photography with field revision in 1985. The investigation area was identified as *Newholme*. Seven buildings were identified on the site and are accessed from the Newell Highway. Vegetation was scattered timber, medium timber, scrub and cleared. A quarry or gravel pit was located in the north eastern section.

Five dams are located across the site. Three drainage lines have their headwaters on the site and flow into the Macquarie River.

The Newell Highway (sealed surface, two or more lanes) was located along the eastern boundary. Rifle Range Road (loose surface, two or more lanes) is located along the southern boundary. Blackbutt Road (loose surface, one lane) is located along the northern boundary. A road reserve is present on the western boundary.

### 4.6.4 Land and Property Information

#### 4.6.4.1 Previous title reference – Volume 10355 Folio 25

Volume 10355 Folio 25 was registered to Elsie Edith Coffee wife of Francis William Coffee of Dubbo, fitter and turner on 18 July 1966.

The lot was created from Volume 2386 Folio 221.

#### 4.6.4.2 Previous title reference – Volume 2386 Folio 221

The land was granted as part of a Homestead Grant to Stewart Irvine of Dubbo on 14 January 1903.

The title was transferred to George David Astill of Dubbo, Farmer on 9 December 1938.

Clarence Elwyn Rindfleish of Dubbo, rural worker and Joyce Rindfleish became joint tenants on 22 May 1964.

The title was transferred to Elsie Edith Coffee on 26 January 1966.

### 4.6.5 Interviews

Discussions and email correspondence with the current site owner representative Mr Brett Anderson indicated the site was purchased by the current owner in approximately 2007. Mr Anderson indicated that the former dwelling was demolished following vandalism of the structure. A number of fires have been legally and illegally lit over time around the former dwelling. The NSW Rural Fire Brigade has responded to these fires.

The site was used for Army Reserve Training site for a short period of time. Mr Anderson indicated that no live ammunition was used during the training.

### 4.6.6 Other

No orchards, mines, sheep dips or contaminating industrial activities are known to have been located on the site from the site inspection and site history.

## 4.7 Buildings and infrastructure

The site boundaries are fenced. Degraded fence lines are present across the site.

The existing dwelling was removed prior to 2009. A septic tank was identified to the east of the former dwelling site.

## 4.8 Fuel storage tanks and stockpiles

Numerous stockpiles were identified across the site. Stockpiles comprised building materials (bricks, concrete, asbestos cement sheeting, iron, tiles, fencing), household refuse (furniture, electrical appliances, clothing, linen, glass, plastic, cans, nappies and household rubbish), soil and gravel.

No fuel storage tanks were identified on the site.

## 4.9 Potential contaminants

The Envirowest Consulting Pty Ltd (2015) *Contamination Investigation* identified asbestos cement fragments located in stockpiles, soil and on the surface across the site. Elevated levels of hydrocarbons were identified in Stockpile Y and associated with a hydrocarbon stain at Location 5. Elevated levels of zinc and hydrocarbons were identified in Stockpile Q. Waste has been illegally disposed at various locations across the site.

### 4.10 Relevant complaint history
None known.

### 4.11 Regulatory information
The site is not listed on the NSW EPA register of contaminated sites.

### 4.13 Neighbouring land-use
North – Rural-residential
South – Rural-residential
East – Rural, Taronga Western Plains Zoo
West – Rural

Historical and present neighbouring land-uses are not expected to impact the site.

### 4.14 Integrity assessment
The information obtained is accurate as the review records have allowed. The information available is considered sufficient for the purpose of the assessment and believed to be correct by the investigator.

## 5. Site condition and surrounding environment
### 5.1 Surface cover
The majority of the site has a surface covering of native grasses. Introduced grasses and broad-leaved weeds occur around the former dwelling location. Juvenile cypress pines occur across much of the site. Areas of remnant eucalypt trees are located within the central drainage line, north western section and along the southern boundary.

### 5.2 Topography
The site is a mid-slope with a gentle inclination of 1 to 5%. The eastern section of the site has a north easterly aspect. The remainder of the site has a predominantly northerly aspect.

### 5.3 Soils and geology
The site is located within the Goonoo Soil Landscape (Murphy and Lawry 1998). Earthy sands, siliceous sands, red earth and yellow and grey earths occur on the mid to upper slopes. Yellow solodic soils are common on lower slopes and drainage depressions. Typical profiles consist of dark reddish-brown to dark brown loamy sands to sands. A bleached A2 horizon comprising dull yellow sand may be present. The subsoil is typically a yellowish brown to reddish brown sandy loam to sandy clay loam.

The site is underlain by Pilliga Sandstone comprising quartz sandstone, conglomerate, siltstone and shale (Murphy and Lawry 1998). Parent materials are *in situ* and weathered parent rock and derived colluvium and alluvium.

### 5.4 Water
#### 5.4.1 Surface water
The soil is expected to have a moderate to high permeability. Surface water flows north east in the eastern section and into intermittent drainage lines. Water in other areas of the site flows west and into an intermittent drainage line which traverses the central section of the site in a south to north direction. The drainage lines discharge into the Macquarie River located more than 4km from the site.

Two dams are located on the property. Historical aerial photographs indicate contour banks have been formed across the site to divert surface water flows into the dams.

#### 5.4.2 Groundwater

No groundwater bores are known to be located on the site. Nineteen groundwater bores are located within 2km of the site with the majority located to the north and north west. The bores are licensed for stock, domestic, irrigation and monitoring. Water bearing zones were identified from 1.9m and standing water levels at the time of drilling from 1 metre.

## 6. Previous investigations

### 6.1 Envirowest Consulting Pty Ltd (2015) *Contamination investigation, Lot 172 DP753233 Blackbutt Road, Dubbo NSW* (Reference number R5809c)

An inspection of the site was made on 31 March 2015. The site is located in rural area and has an area of approximately 98 hectares.

The site has a land-use history of agricultural grazing. No contaminating activities are expected from the agricultural land-use.

Illegal disposal of waste has occurred resulting in numerous stockpiles of waste. Waste included building materials (bricks, concrete, asbestos cement sheeting, iron, tiles, fencing), household refuse (furniture, electrical appliances, clothing, linen, glass, plastic, cans, nappies and household rubbish), soil and gravel. Isolated waste was also identified across the site. The waste is an amenity issue and requires removal.

Backfill material was identified in the southern section of the central drainage line. The area impacted by backfill was approximately 2,000m$^2$. Average depth of fill is expected to be 0.8m. Hydrocarbon staining and odour was also identified in a small area (1m$^2$).

Analysis of cement sheeting samples confirmed the presence of asbestos minerals at various locations. The asbestos cement sheeting occurred as various sized fragments and pipe within stockpiles, within fill material and on the surface of the site and is classified as non-friable asbestos. No fire impacted asbestos cement sheeting was identified.

The level of contaminants of concern in the soil samples analysed were below the human health thresholds and ecological thresholds except Locations 5 and 6. Location 5 (Stockpile Y) comprised coal and contained levels of TRH exceeding the health screening levels. The hydrocarbon impacted soil at Location 5 contained levels of hydrocarbons exceeding the health investigation levels. The contamination is expected to be a result of the disposal of fuels, diesel or oil onto the ground surface. The lateral extent of impact as determined by visual inspection was approximately 1m by 1m. Vertical extent as determined by laboratory analysis was 1m.

Levels of zinc and TRH in Location 6 (Stockpile Q) exceeded the adopted thresholds. Stockpile Q had been impacted by fire as indicated by a burnt tyre.

Several stockpiles were identified as containing contaminants exceeding the ecological threshold. The risk to the environment from the elevated levels is considered low.

Remediation of the site is required before the site is suitable for the proposed residential land-use. Remediation should be undertaken in accordance with a Remediation Action Plan prepared by a suitably qualified person.

### 6.2 Envirowest Consulting Pty Ltd (2015) *Remediation action plan, Lot 172 DP753233 Blackbutt Road, Dubbo NSW* (Reference number R5809rap)

Lot 172 is approximately 98ha in size and is located in a rural area of Dubbo. The lot is proposed to be developed for residential land-use. Historical land-use of the site is agricultural grazing. No contaminating activities are expected from the agricultural land-use.

Illegal disposal of waste has occurred resulting in numerous stockpiles of waste. The stockpiles were inspected and samples collected for analysis. Waste included building materials (bricks, concrete, asbestos cement sheeting, iron, tiles, fencing), household refuse (furniture, electrical appliances, clothing, linen, glass, plastic, cans, nappies and household rubbish), soil and gravel. Isolated waste was also identified across the site. The waste is an amenity issue and requires removal.

The asbestos cement sheeting occurred as various sized fragments and pipe within stockpiles, within fill material and on the surface of the site and is classified as non-friable asbestos.

Elevated levels of total recoverable hydrocarbons (TRH) were identified at Location 5 (Stockpile Y) which comprised coal.

Elevated levels of TRH were also identified at the hydrocarbon staining identified at Location 5. The lateral extent of impact as determined by visual inspection was approximately 1m by 1m. Vertical extent as determined by laboratory analysis was 1m.

Elevated levels of zinc and TRH were identified at Location 6 (Stockpile Q). Stockpile Q had been impacted by fire as indicated by a burnt tyre.

Remediation works will be supervised by an Environmental Scientist and comply with EPA guidelines including *Guidelines for Reporting on Contaminated Sites* (OEH 2011) and *Remediation of Contaminated Land State Environmental Planning Policy* (SEP55).

Implementation of the described strategies will ensure the successful remediation of the site for residential land-use.

Identified contamination and remediation methods

| Contamination | Extent | Remediation |
|---|---|---|
| Debris (not impacted by asbestos) | Across site | Removal and disposal to licensed landfill (Whylandra Landfill, Dubbo) |
| Recyclable material | Across site | Removal and disposal to recycler |
| Asbestos cement sheeting fragments in stockpiles and soil | Unable to be estimated | Removal and disposal to licensed landfill (Whylandra Landfill, Dubbo) |
| Asbestos cement sheeting fragments on surface | Unable to be estimated | Hand picking and disposal to licensed landfill (Whylandra Landfill, Dubbo) |
| Hydrocarbon impacted soil (Location 5) | $1m^3$ | Excavation and disposal to licensed landfill (Whylandra Landfill, Dubbo) |
| Hydrocarbon impacted stockpile (Location 5, Stockpile Y) | $20m^3$ | Removal and disposal to licensed landfill (Whylandra Landfill, Dubbo) |
| Hydrocarbon and zinc impacted stockpile (Location 6, Stockpile Q) | $1m^3$ | Removal and disposal to licensed landfill (Whylandra Landfill, Dubbo) |

# 7. Description of contamination

## 7.1 Debris (not impacted by asbestos)

Illegal disposal of waste has occurred resulting in numerous stockpiles of waste located across the site. Waste included building materials (bricks, concrete, iron, tiles, fencing), household refuse (furniture, electrical appliances, clothing, linen, glass, plastic, cans and household rubbish), soil and gravel. Isolated non-putrescible waste was also identified across the site. The waste is an amenity issue.

## 7.2 Asbestos cement sheeting fragments in stockpiles and soil

Asbestos cement sheeting fragments were identified in stockpiles and soil located across the site. The fragments are associated with stockpiles, building material or on the soil surface.

## 7.3 Asbestos cement sheeting fragments on surface

Asbestos cement sheeting fragments were identified on the soil surface at various locations across the site.

## 7.4 Hydrocarbon impacted soil

Hydrocarbon impacted soil was identified at Location 5. The contamination is expected to be a result of the disposal of fuels, diesel or waste oil. The lateral extent of impact as determined by visual inspection was approximately 1m by 1m. Vertical extent as determined by laboratory analysis was 1m.

## 7.5 Hydrocarbon impacted stockpile

A stockpile of coal was identified at Location 5 (Stockpile Y). The stockpile had an estimated volume of $10m^3$. Elevated levels of hydrocarbons were identified in the stockpile.

## 7.6 Hydrocarbon and zinc impacted stockpile

A fire impacted stockpile containing a rubber tyre was identified at Location 6 (Stockpile Q). The stockpile had an estimated volume of $0.5m^3$. Elevated levels of zinc and hydrocarbons were identified in the stockpile.

# 8. Remediation works

The waste material was transported to landfill. Some separation of types of waste occurred for efficient disposal. A detailed description of the methods is presented in the following section and Table 1.

## 8.1 Debris (not impacted by asbestos)

Debris was inspected for asbestos cement fragments by Leah Desborough, Environmental Scientist. Debris identified as not impacted by asbestos was separated into recyclable and non-recyclable material. The recyclable debris including concrete and bricks was stockpiled for re-use on-site. Non-recyclable debris was removed and transported to Whylandra Landfill. Disposal dockets for the non-recyclable material are presented in Appendix 1.

## 8.2 Asbestos cement sheeting fragments in stockpiles and soil – Location 9

Excavation of asbestos impacted stockpiles and soil at Location 9 was undertaken. Excavation of contaminated material and hand picking continued until the visual inspection identified no asbestos cement sheeting on the surface. Asbestos impacted material was removed by licensed asbestos removalist Stockley Excavations in accordance with WorkCover guidelines. The material was transported to Whylandra Landfill as asbestos waste. Disposal dockets are presented in Appendix 1.

### 8.3 Asbestos cement sheeting fragments in stockpiles and soil – Locations 5 and 6

Stockpiles and soil impacted by asbestos cement sheeting in Locations 5 and 6 were excavated to allow separation of asbestos cement sheeting from soil and building debris. Soil was excavated until a visual inspection of the excavated area by Leah Desborough, Environmental Scientist identified no asbestos cement sheeting remaining in the excavation. Excavated material was hand picked to separate asbestos cement sheeting fragments from surrounding material. The surrounding material was stockpiled for re-use on-site or disposed to Whylandra Landfill as general solid waste. The asbestos cement sheeting fragments were disposed to Whylandra Landfill as asbestos waste. Waste disposal dockets are presented in Appendix 1.

### 8.4 Asbestos cement sheeting fragments on surface

Surface asbestos cement fragments were removed by a site walkover and handpicking of asbestos cement fragments. The fragments were placed in a plastic bag and sealed for disposal to Whylandra Landfill. Waste disposal dockets are presented in Appendix 1.

### 8.5 Hydrocarbon impacted soil

The contaminated material was excavated and transported to Whylandra Landfill. Waste disposal dockets are presented in Appendix 1.

### 8.6 Hydrocarbon impacted stockpile

The contaminated material was excavated and transported to Whylandra Landfill. Waste disposal dockets are presented in Appendix 1.

### 8.7 Hydrocarbon and zinc impacted stockpile

The contaminated material was excavated and transported to Whylandra Landfill. Waste disposal dockets are present in Appendix 1.

**Table 1.** Remediation description

| **Location** (Figure 2) | **Description** | **Remediation** |
|---|---|---|
| L1 | Numerous stockpiles dominated by sandstone rubble and gravel. Household (non-putrescible) refuse also located in the area.<br><br>**Stockpile U:** Yellowish red to red sandstone rubble, gravel and sand with some concrete and pavers. | <br><br>Concrete, pavers and sandstone rubble to be re-used on-site. |
| L2 | Northern boundary of site.<br>A bike track has been excavated in the area. Mounds have been created from on-site material. Scattered refuse including rubbish, plastic steel and mesh around the track.<br>Asbestos cement fragments were identified on the soil surface in three areas. | Refuse removed as general solid waste.<br>Asbestos cement fragments hand picked and removed as asbestos waste. |
| L3 | Numerous stockpiles dominated by sandstone rubble and gravel.<br><br>**Stockpile V:** Yellowish red crushed sandstone and rubble with some bricks. | <br><br>Bricks and sandstone rubble to be re-used on-site. |

| | | |
|---|---|---|
| L5 | Central section of the site. Includes a shallow drainage line.<br>Numerous disposal areas. Refuse including clothing, household items, tyre, building material.<br>Asbestos cement sheeting fragments on the surface extend along the shallow drainage line.<br>Hydrocarbon staining and odour identified to a depth of approximately 1,000mm.<br>Fill identified in southern end of drainage line. | Refuse hand picked and removed as general solid waste.<br>Asbestos cement fragments hand picked and removed as asbestos waste.<br>Asbestos impacted material excavated until no asbestos cement fragments are identified in the excavation. Excavated material sorted to separate asbestos cement fragments and recyclable material. Asbestos cement fragments removed as asbestos waste. Recyclable material stockpiled for re-use on-site.<br>Hydrocarbon impacted soil excavated and disposed to Whylandra Landfill |
| | **Stockpile N:** Refuse including household items, iron, concrete and timber.<br>Suspected asbestos cement fragments | Asbestos cement fragments hand picked and removed as asbestos waste.<br>Refuse separated and disposed as general solid waste or stockpiled for re-use on-site. |
| | **Stockpile W:** Building material including iron, concrete.<br>Trace suspected asbestos cement fragments | Asbestos cement fragments hand picked and removed as asbestos waste.<br>Refuse separated and disposed as general solid waste or stockpiled for re-use on-site. |
| | **Stockpile X:** Asbestos cement sheeting including flat sheets and corrugated sheets.<br>Refuse including tyre, timber, plastic, material, vinyl flooring. | Refuse disposed as general solid waste. Asbestos cement fragments excavated and removed as asbestos waste. |
| | **Stockpile Y:** Coal | Excavated and disposed to Whylandra Landfill |
| L6 | Located north of Location 5 and includes a shallow drainage line.<br>Numerous disposal areas. Refuse includes bricks, iron, concrete, Styrofoam, timber and fencing material.<br>Asbestos cement fragments on the surface in various areas. | Asbestos cement fragments hand picked and removed as asbestos waste.<br>Refuse separated and disposed as general solid waste or stockpiled for re-use on-site. |
| | **Stockpile O:** Red sandy clay, vegetated. | No asbestos cement sheeting identified in stockpile. |
| | **Stockpile P:** Refuse including bricks, steel, building material | Refuse separated and disposed as general solid waste or stockpiled for re-use on-site. |
| | **Stockpile Q:** Small refuse stockpile which includes burnt tyres and concrete. | Excavated and disposed to Whylandra Landfill waste |
| | **Stockpile R:** Refuse including asbestos cement fragments. | Asbestos cement fragments hand picked and removed as asbestos waste.<br>Refuse disposed as general solid waste. |
| | **Stockpile S:** Refuse including timber, iron, timber, bricks, asbestos cement fragments. | Asbestos cement fragments hand picked and removed as asbestos waste.<br>Refuse separated and disposed as general solid waste or stockpiled for re-use on-site. |
| | **Stockpile T:** Large partly vegetated stockpile containing soil, pavers, carpet, rocks, concrete, homewares, star pickets and asbestos cement pipe. | One piece of asbestos cement pipe identified in stockpile. Pipe removed and disposed as asbestos waste. |

| | | |
|---|---|---|
| L7 | Numerous stockpiles dominated by sandstone rubble and gravel.<br>A drainage line contains iron and steel refuse including tanks, wash tubs and roofing. | Sandstone rubble to be re-used on-site.<br>Refuse removed and disposed as general solid waste. |
| | **Stockpile Z:** Sandstone rubble, gravel and sand with some concrete, bricks, bluestone gravel and plastic pipe. | Plastic pipe removed as general solid waste.<br>Concrete, bricks and sandstone rubble to be re-used on-site. |
| | **Stockpile AA:** Refuse dominated by iron and steel including tanks, wash tubs and roofing. | Refuse removed and disposed as general solid waste. |
| L8 | Located south of the former dwelling in close proximity to the main access track. Scattered refuse and several stockpiles located across the area. Refuse includes irrigation pipe, glass, plastic, cans, concrete and asbestos cement fragments. | Refuse removed as general solid waste.<br>Asbestos cement fragments hand picked and removed as asbestos waste. |
| | **Stockpile H:** Vegetated stockpile dominated by soil and some refuse including concrete, plastic and rocks. | Removed as general solid waste. |
| | **Stockpile I:** Refuse including tyre, bricks, wire, timber and steel. | Refuse removed and disposed as general solid waste. |
| | **Stockpile J:** Vegetated stockpile of soil | No asbestos cement identified in stockpile. Asbestos cement fragments identified on surface hand picked and disposed as asbestos waste. |
| | **Stockpile K:** Refuse including concrete, iron timber, pavers and steel | Removed as general solid waste. |
| L9 | Former dwelling and associated infrastructure location. A septic tank is located to the east of the former dwelling site. Area contains numerous stockpiles and scattered refuse including asbestos cement sheeting. Ruins of pens located to the north west of former dwelling. An abandoned UST is located to the north of stockpile L. | |
| | **Stockpile A:** Predominantly soil with some coarse basalt gravel and concrete. | Asbestos cement sheeting identified in stockpile. Stockpile excavated and disposed as asbestos waste. |
| | **Stockpile B:** Brown clay with basalt, brick fragments, timber and plastic. | Asbestos cement sheeting identified in stockpile. Stockpile excavated and disposed as asbestos waste. |
| | **Stockpile C:** Refuse including rock, Styrofoam, cardboard, timber, metal, concrete, rubber, bricks asbestos cement sheeting fragments. | Stockpile excavated and disposed as asbestos waste. |
| | **Stockpile D:** Refuse including concrete, tiles, ash, asbestos cement fragments. | Stockpile excavated and disposed as asbestos waste. |
| | **Stockpile E:** Soil, timber, concrete, bitumen | Refuse separated and disposed as general solid waste or stockpiled for re-use on-site. |
| | **Stockpile F:** Refuse including foam, iron, timber, concrete, steel, ash, bricks, insulation and asbestos cement sheeting | Stockpile excavated and disposed as asbestos waste. |

| | | |
|---|---|---|
| | **Stockpile G:** Shallow stockpile up to 200mm deep dominated by sandy clay soil. Vegetated with ruderal weeds. Asbestos cement sheeting fragments identified on the surface. | Asbestos cement fragments hand picked and removed as asbestos waste. Stockpile excavated and asbestos cement fragments hand picked and disposed as asbestos waste. Excavations and hand picking continued until no asbestos fragments identified. |
| | **Stockpile L:** Vegetated soil stockpile with trace brick, glass, bluestone gravel, concrete, steel pipe, timber and asbestos cement fragments. | Asbestos cement fragments hand picked and removed as asbestos waste . |
| | **Stockpile M:** Refuse including, steel, plastic, timber and asbestos cement sheeting fragments. | Stockpile excavated and disposed as asbestos waste. |
| | **Stockpile AB:** Timber with asbestos cement sheeting fragments. | Stockpile excavated and disposed as asbestos waste. |
| L10 | Eastern boundary, asbestos cement telecommunications pit near front gate. Scattered refuse located along boundary. | Remove refuse as general solid waste. Asbestos containing telecommunications pit remains on-site. |
| L11 | Scattered refuse including steel, plastic, timber and glass identified | Removed as general solid waste. |
| L12 | Scattered refuse including cardboard, Styrofoam, plastic, furniture, cans, fridge, carpet, timber and 44 gallon drums identified | Removed as general solid waste. |

# 9. Validation assessment

## 9.1 Data quality objectives (DQO)

The development of data quality objectives is recommended by EPA NSW to provide a systematic framework for site validation. All validation and sampling shall be carried out in accordance with NSW EPA guidelines: *Contaminated Sites – Sampling Design Guidelines, Contaminated Sites – Guidelines for Assessing Service Station Sites* and *Contaminated Sites – Guidelines for Consultants Reporting on Contaminated Sites*.

### 9.1.1 State the problem

A contamination investigation undertaken by Envirowest Consulting Pty Ltd in June 2015 (Report number R5809c) identified debris including asbestos cement fragments and elevated levels of zinc and total recoverable hydrocarbons (TRH) in various locations across Lot 172 DP753233 Blackbutt Road, Dubbo NSW.

The remediation method was to excavate and appropriately dispose the impacted material off-site. Validation sampling is required to determine the success of the remediation.

### 9.1.2 Identify the decision

The proposed land-use is residential and the levels of contaminants following remediation should be less than the assessment criteria listed in Section 11. The decision problem is: *Is the site suitable for the proposed land-use?*

### 9.1.3 Identify the inputs decision

The sampling design for asbestos impacted area is a systematic pattern on an approximately 5m grid pattern. The sampling density for the hydrocarbon stained area and the hydrocarbon and zinc impacted stockpile is a systematic pattern on an approximately 1m grid pattern in impacted areas. The laboratory results were assessed against the land-use of residential with garden/accessible soil (HIL A).

### 9.1.4 Define the boundaries of the study

The investigation areas are those areas which have been identified in the previous investigations of Lot 172 DP753233 Blackbutt Road, Dubbo NSW.

### 9.1.5 Develop a decision rule

Laboratory results were assessed against the land-use of residential with garden/accessible soil (HIL A) (NEPC 1999).

Results of the visual assessment were compared to NEPC (1999) of the soil surface to be free of visible asbestos.

### 9.1.6 Specify acceptable limits on the decision errors

The 95% upper confidence limit of average levels of samples collected is less than the threshold levels.

### 9.1.7 Optimize the design for obtaining data

Soil sampling was undertaken as described in Section 10.2.

The visual assessment was undertaken by traversing the site at 5m transects.

Data quality indicators are described in Appendix 2.

## 9.2 Sampling design

The adopted sampling frequency was considered sufficient to obtain representative data on the results of the remediation.

The adopted sampling frequency was considered sufficient to obtain representative data on the material for waste classification.

### 9.2.1 Debris (not impacted by asbestos)

Debris was systematically visually inspected for the presence of asbestos cement fragments.

### 9.2.2 Asbestos cement sheeting fragments in stockpiles and soil – Location 9

The excavated area was systematically visually inspected by traversing the excavated area on a 5m transect.

### 9.2.3 Asbestos cement sheeting fragments in stockpiles and soil – Locations 5 and 6

The excavated area was systematically visually inspected by traversing the excavated area on a 5m transect. The excavated material was systematically inspected for the presence of asbestos cement fragments.

### 9.2.4 Asbestos cement sheeting fragments on surface

Areas impacted by surface asbestos cement fragments were was systematically visually inspected by traversing the impacted area on a 5m transect.

### 9.2.5 Hydrocarbon impacted soil

The soil in the excavation pit was sampled on a systematic plan of 1m with a sample collected from each wall and the base of the pit.

Material to be excavated was sampled prior to excavation to enable waste classification.

#### 9.2.6 Hydrocarbon impacted stockpile
The contaminated material was associated with coal. The footprint of the stockpile was visually inspected for the presence of coal.

Material to be excavated was sampled prior to excavation to enable waste classification.

#### 9.2.7 Hydrocarbon and zinc impacted stockpile
One soil sample was collected from the footprint of the former hydrocarbon and zinc impacted stockpile.

Material to be excavated was sampled prior to excavation to enable waste classification.

### 9.3 Sampling methods
Detailed soil sampling protocols are presented in Appendix 3. Soil samples were collected from freshly excavated material using a stainless steel trowel. The soil was transferred to a solvent rinsed glass jar with a teflon lid. Discrete samples were collected.

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 deionised water rinsing with clean tap water and allowing to air dry or using a clean towel.

All sample containers were placed and transported in an esky. A chain of custody form accompanied the transport of samples.

### 9.4 Analytes
Samples collected from the hydrocarbon stained area (Location 5) excavation pit were analysed for TRH (C6-C40) as these were identified as the contaminant of concern (Table 2).

Samples collected from the zinc and hydrocarbon stockpile (Stockpile Q) footprint after removal were analysed for TRH (C6-C40), BTEXN and zinc (Table 5).

**Table 2.** Schedule of samples collected

| Laboratory sample id. | Sampling date | Description | Sample depth (mm) | Analysis undertaken |
|---|---|---|---|---|
| HV1 | 28/10/2015 | South east corner of excavation pit for hydrocarbon stain (Location 5) | 800 | TRH (C6-C40), benzene, toluene, ethylbenzene, xylenes, naphthalene (BTEXN) |
| HV2 | 28/10/2015 | South west corner of excavation pit for hydrocarbon stain (Location 5) | 800 | TRH (C6-C40), BTEXN |
| HV3 | 28/10/2015 | North west corner of excavation pit for hydrocarbon stain (Location 5) | 800 | TRH (C6-C40), BTEXN |
| HV4 | 28/10/2015 | North east corner of excavation pit for hydrocarbon stain (Location 5) | 800 | TRH (C6-C40), BTEXN |
| HV5 | 28/10/2015 | Base of excavation pit for hydrocarbon stain (Location 5) | 1,000 | TRH (C6-C40), BTEXN |
| HV6 | 28/10/2015 | Footprint of stockpile Q | 0-100 | Zinc, TRH (C6-C40), benzene, toluene, ethylbenzene, xylenes, naphthalene (BTEXN) |

# 10. Quality assurance and quality control

## 10.1 Sampling design

A systematic sampling pattern was undertaken to validate the site. The asbestos impacted areas were traversed along 5m wide transects and visually assessed for the presence of asbestos cement fragments. Samples were collected from the excavation pit on a 1m grid pattern with a minimum of one sample collected from each wall and the base of the pit.

The footprint of the hydrocarbon impacted stockpile (Location 5, Stockpile Y) was visually assessed for the presence of coal.

One sample was collected from the footprint of the zinc and hydrocarbon stockpile (location 6 Stockpile Q).

The number of locations tested is thought to provide an adequate assurance that the soils sampled are representative of the area sampled. The sampling program was designed to minimise sampling and measurement errors.

Data quality objectives and data quality indicators are presented in Appendix 2.

## 10.2 Field procedures

The collection of samples was undertaken in accordance with industry accepted standard protocols (NEPC 1999). The details of the samples collected are presented in Table 2. Discrete samples were collected and analysed.

Sampling equipment was decontaminated between each sampling event. Samples were stored and transported under refrigeration in insulated containers. Appropriate storage duration was observed. A chain of custody form tracked the samples to the laboratory.

A single sampler was used to collect the samples using standard methods. Soil collected was a fresh sample from the stainless steel trowel. After collection the samples were immediately placed in new glass sampling jars and placed in a cooler.

Two duplicate samples were collected. Details on field sampling procedures are presented in Appendix 3.

## 10.3 Laboratory

Chemical analyses were conducted in the laboratories of ALS, Smithfield, NSW which is NATA registered for the tests undertaken. The laboratories have quality assurance and quality control programs. The quality control program for analysis of samples in each laboratory batch was greater than the recommended frequency of 5%. The laboratory reports including quality control evaluations are presented in the Appendix 4.

## 10.4 Data evaluation

The quality control and quality assurance report is presented in Appendix 2. The quality assurance/quality control reports for the data are presented in the laboratory reports.

It is concluded the analytical results are representative and the data is usable for the purposes of the investigation.

# 11. Assessment criteria

## 11.1 Soil

The proposed land-use is residential and recreational. The appropriate remediation criteria for comparison are residential.

Laboratory results were assessed against the land-use of residential with access to soil. The health investigation levels (HIL) of contaminants in the soil for residential sites, for the substances for which criteria are available, are listed in Table 3 and 4, as recommended in the NEPC (1999).

**Table 3.** Soil assessment criteria (mg/kg) (NEPC 1999) – investigation levels

| Analyte | HIL Residential | EIL Residential |
|---|---|---|
| Zinc | 7,400 | 70 |

HIL – health investigation level

**Table 4.** Soil assessment criteria (mg/kg) (NEPC 2009) – screening levels

| Analyte | HSL Residential / clay soil Discrete | | | | ESL Residential / fine soil | Management limits for TRH in soil / residential |
|---|---|---|---|---|---|---|
| | 0m to <1m | 1m to <2m | 2m to <4m | >4m | | |
| TRH (C6-C10) (F1) | 50 | 90 | 150 | 290 | 180 | 800 |
| TRH (>C10-C16) (F2) | 280 | NL | NL | NL | 120 | 1,000 |
| TRH (>C16-C34) | NA | NA | NA | NA | 1,300 | 3,500 |
| TRH (>C34-C40) | NA | NA | NA | NA | 5,600 | 10,000 |
| Benzene | 0.7 | 1 | 2 | 3 | 65 | - |
| Toluene | 480 | NL | NL | NL | 105 | - |
| Ethylbenzene | NL | NL | NL | NL | 125 | - |
| Xylenes | 110 | 310 | NL | NL | 45 | - |
| Naphthalene | 5 | NL | NL | NL | - | - |

HSL – health screening level, NL – non limiting, NA – not applicable

## 11.2 Asbestos

The assessment criteria for interpretation of asbestos on the soil surface on residential sites is described in Table 7 of *Guideline on Investigation Levels for Soil and Groundwater* (NEPC 1999). The requirement for the soil surface to be free of visible asbestos is applicable for remediation.

# 12. Results and discussion

## 12.1 Debris (not impacted by asbestos)

Debris not impacted by asbestos included general waste such as building materials and domestic waste as well as stockpiles of sandstone rubble. Concrete, bricks and sandstone rubble was generally retained on-site as clean fill for use during site development works. Other debris including domestic refuse, iron, steel, electrical appliances and furniture were disposed to Whylandra Landfill. Minor debris consisting of timber and plastic remains on the site and is expected to be removed during site development works.

### 12.2 Asbestos

Five locations (Locations 2, 5, 6, 8, 9 and 10) were identified as impacted by asbestos containing materials. Asbestos was identified in a telecommunications pit at Location 10 and removal is required to be authorised by the telecommunications company. Remediation at Locations 2, 5, 6, 8 and 9 comprised excavating asbestos impacted materials, separating asbestos impacted material from other debris and hand picking asbestos cement fragments from the surface. Asbestos impacted material was wrapped or bagged and disposed to Whylandra Landfill. Removal works continued until no visible asbestos cement sheeting was identified on the surface, in the excavation or within the stockpiled material.

Potential exists for unexpected asbestos containing materials to be present on the site. Any suspected asbestos identified during construction works should be managed in accordance with the unexpected finds protocol (Appendix 6).

### 12.3 Hydrocarbon impacted soil (Location 5)

The excavation pit measured 1m by 1m and 1m deep. No soil staining or odour was observed in the pit at the time of sampling. Levels of TRH and BTEXN in the samples collected from the base and walls of the pit were below laboratory detection limits and below the adopted threshold (Table 5).

**Table 5.** Soil analysis for pit results (mg/kg)

| Sample id. | Location (Figure 3) | Depth (mm) | TRH (C6-C10) | TRH (C10-C16) | TRH (C16-C34) | TRH (C34-C40) | Benzene | Toluene | Ethyl-benzene | Xylenes | Naphthalene |
|---|---|---|---|---|---|---|---|---|---|---|---|
| HV1 | South east corner | 800 | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| HV2 | South west corner | 800 | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| HV3 | North west corner | 800 | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| HV4 | North east corner | 800 | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| HV5 | Base | 1,000 | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| *HSL – residential / clay soil* | | *0m to <1m* | *50* | *280* | *NA* | *NA* | *0.7* | *480* | *NL* | *NL* | *NL* |
| | | *1m to <2m* | *90* | *NL* | *NA* | *NA* | *1* | *NL* | *NL* | *NL* | *NL* |
| | | *2m to <4m* | *150* | *NL* | *NA* | *NA* | *2* | *NL* | *NL* | *NL* | *NL* |
| | | *>4m* | *290* | *NL* | *NA* | *NA* | *3* | *NL* | *NL* | *NL* | *NL* |
| *ESL – residential / fine soil* | | | *180* | *120* | *1,300* | *5,600* | *65* | *105* | *125* | *45* | - |
| *Management limits for TRH fractions in soil / residential* | | | *800* | *1,000* | *3,500* | *10,000* | - | - | - | - | - |

HSL – health screening level, NL – non limiting, NA – not applicable, ND – not detected

### 12.4 Hydrocarbon impacted stockpile (Location 5, stockpile Y)

The material was excavated and disposed to Whylandra Landfill as general solid waste. Approximately 100mm of soil at the stockpile footprint was also removed. The visual assessment of the stockpile footprint did not identify any residual coal, staining or odours.

### 12.5 Hydrocarbon and zinc impacted stockpile (Location 6, stockpile Q)

The material was excavated and disposed to Whylandra Landfill as general solid waste. Approximately 100mm of soil at the stockpile footprint was also removed. The visual assessment of the stockpile footprint did not identify any residual burnt material. Levels of TRH, BTEXN and zinc in the sample collected from the stockpile footprint were at environmental background levels or below the limit of detection (Table 6).

**Table 6.** Soil analysis for Stockpile Q, Location 6 footprint (mg/kg)

| Sample id. | | TRH (C6-C10) | TRH (C10-C16) | TRH (C16-C34) | TRH (C34-C40) | Benzene | Toluene | Ethyl-benzene | Xylenes | Naphthalene | Zinc |
|---|---|---|---|---|---|---|---|---|---|---|---|
| HV6 | | ND | ND | ND | ND | ND | ND | ND | ND | ND | 17 |
| *HSL – residential / clay soil* | *0m to <1m* | *50* | *280* | *NA* | *NA* | *0.7* | *480* | *NL* | *NL* | *NL* | - |
| | *1m to <2m* | *90* | *NL* | *NA* | *NA* | *1* | *NL* | *NL* | *NL* | *NL* | - |
| | *2m to <4m* | *150* | *NL* | *NA* | *NA* | *2* | *NL* | *NL* | *NL* | *NL* | - |
| | *>4m* | *290* | *NL* | *NA* | *NA* | *3* | *NL* | *NL* | *NL* | *NL* | - |
| *ESL – residential / fine soil* | | *180* | *120* | *1,300* | *5,600* | *65* | *105* | *125* | *45* | - | - |
| *Management limits for TRH fractions in soil / residential* | | *800* | *1,000* | *3,500* | *10,000* | - | - | - | - | - | - |
| *HIL A- residential* | | - | - | - | - | - | - | - | - | - | *7,400* |
| *EIL – residential / fine soil* | | - | - | - | - | - | - | - | - | - | *70* |

HSL – health screening level, HIL – health investigation level, NL – non limiting, NA – not applicable, ND – not detected

# 13. Site characterisation

## 13.1 Environmental contamination

All identified contaminated areas were remediated.

## 13.2 Chemical degradation products

Not applicable.

## 13.3 Exposed populations

Not applicable.

# 14. Conclusions and recommendations

## 14.1 Summary and conclusion

Remediation of the site was undertaken by removal of contaminated materials and disposal to Whylandra Landfill. Inert materials such as concrete, bricks and pavers were retained on-site for re-use.

Asbestos impacted materials were remediated by excavation and off-site disposal as asbestos waste or sorted to separate asbestos cement fragments from other material. The asbestos cement fragments was disposed as asbestos waste. Hand picking of all locations identified as impacted by asbestos cement fragments was undertaken.

Validation of asbestos impacted areas was undertaken by traversing the area on 5m transects. The soil surface was visually assessed to confirm all asbestos cement fragments had been removed. No asbestos cement fragments were identified on the soil surface at the final inspection.

Hydrocarbon impacted soil identified at Location 5 was excavated until no evidence of contamination was identified. Excavated material was disposed off-site as general solid waste. The excavation pit was approximately 1m by 1m and 1m deep. Validation of the excavation pit was undertaken by sampling the walls and base of the pit. Soil samples were analysed for TRH and BTEXN. Levels of hydrocarbons in the soil samples were below detection limits and less than the adopted residential land-use thresholds.

A waste coal stockpile (Stockpile Y) identified at Location 5 was excavated to 100mm below the base of the stockpile and disposed off-site. Validation of the remediation was undertaken by visually inspecting the footprint for the presence of coal residue. No coal residue was identified in the stockpile footprint after removal.

The hydrocarbon and zinc impacted stockpile (Stockpile Q) identified at Location 6 was excavated to 100mm below the base of the stockpile and disposed off-site. A soil sample was collected from the stockpile footprint after removal and analysed for zinc, TRH and BTEXN. Levels of zinc were at environmental background levels and levels of TRH and BTEXN were below detection limits. Levels of contaminants of concern were below the adopted residential land-use thresholds.

Refuse was collected from across the site and disposed as general solid waste. Small amounts of refuse (timber, plastic) remain on the site and are expected to be removed at the time of site development.

### 14.2 Assumptions used in reaching the conclusions

It is assumed the site history is accurate.

### 14.3 Extent of uncertainties in the results

Soil sampling in excavated areas was designed to detect contamination with a radius of 0.6m at a 95% level of confidence.

### 14.4 Suitability of proposed use

The site is suitable for residential land-use.

### 14.5 Limitations and constraints on the use of the site

Identification of areas of contamination during site development works should be managed in accordance with an unexpected finds protocol.

### 14.6 Recommendation for further work

The site is suitable for residential land-use.

The historical activities on the site may have resulted in unidentified areas of contamination. The development should be managed in accordance with an unexpected finds protocol for implementation if suspected contamination is identified.

## 15. Report limitations and intellectual property

This report has been prepared for the use of the client to achieve the objectives given the client requirements and cost constraints. 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 are 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 import 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 remain the intellectual property of Envirowest Consulting Pty Ltd. This report should not be used by persons or for purposes other than stated and not reproduced without permission.

## 16. References


DEC (2006) *Contaminated Sites: Guidelines for the NSW Site Auditors Scheme* (NSW Environment Protection Authority, Chatswood)

EPA (1995) *Contaminated sites: Sampling Design Guidelines* (NSW Environment Protection Authority, Chatswood)

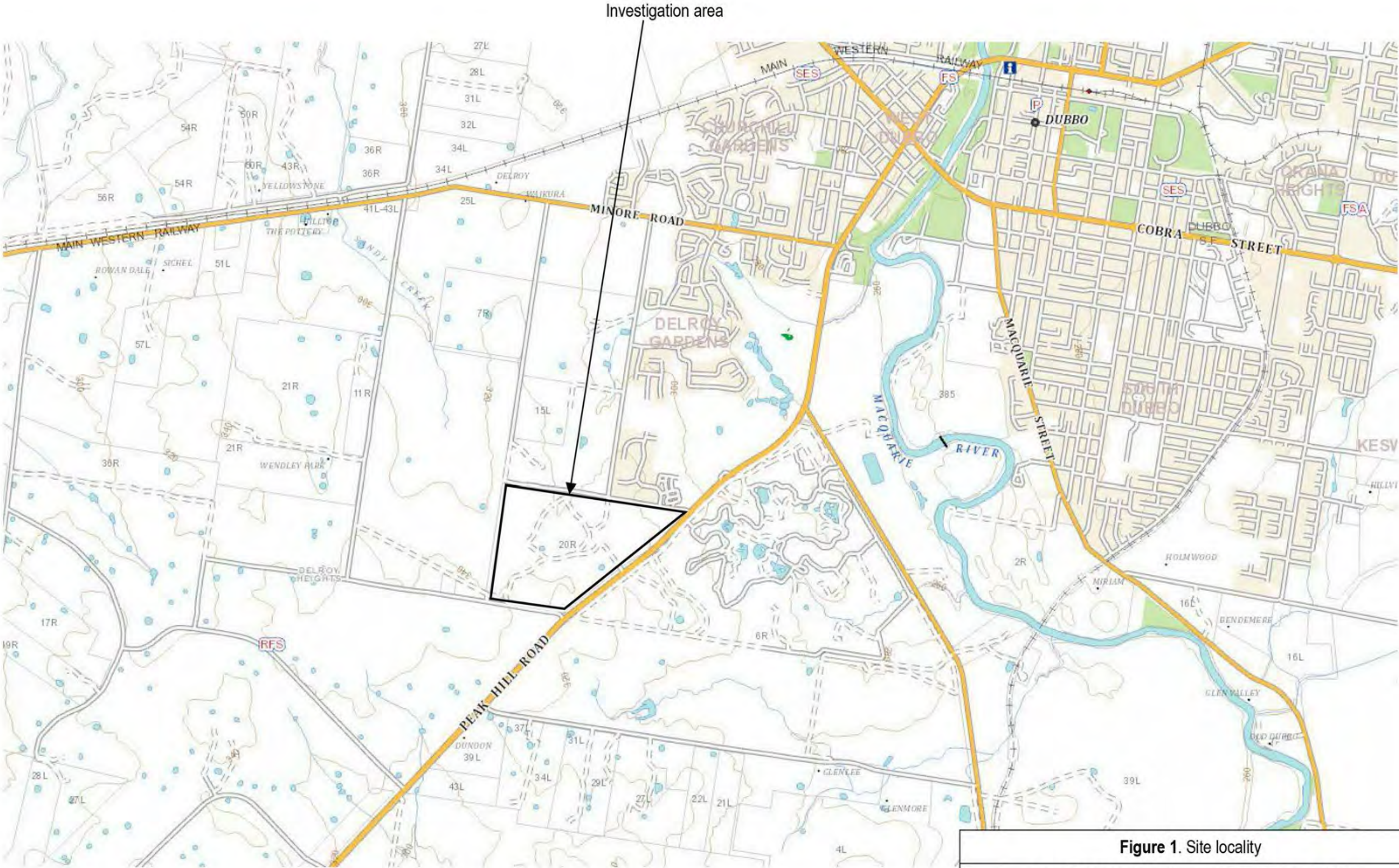
EPA (2011) *Guidelines for Consultants Reporting on Contaminated Sites* (NSW Environment Protection Authority: Chatswood)

EPA (2014) *Waste Classification Guidelines, Part 1: Classifying Waste* (NSW Environment Protection Authority, Sydney South)

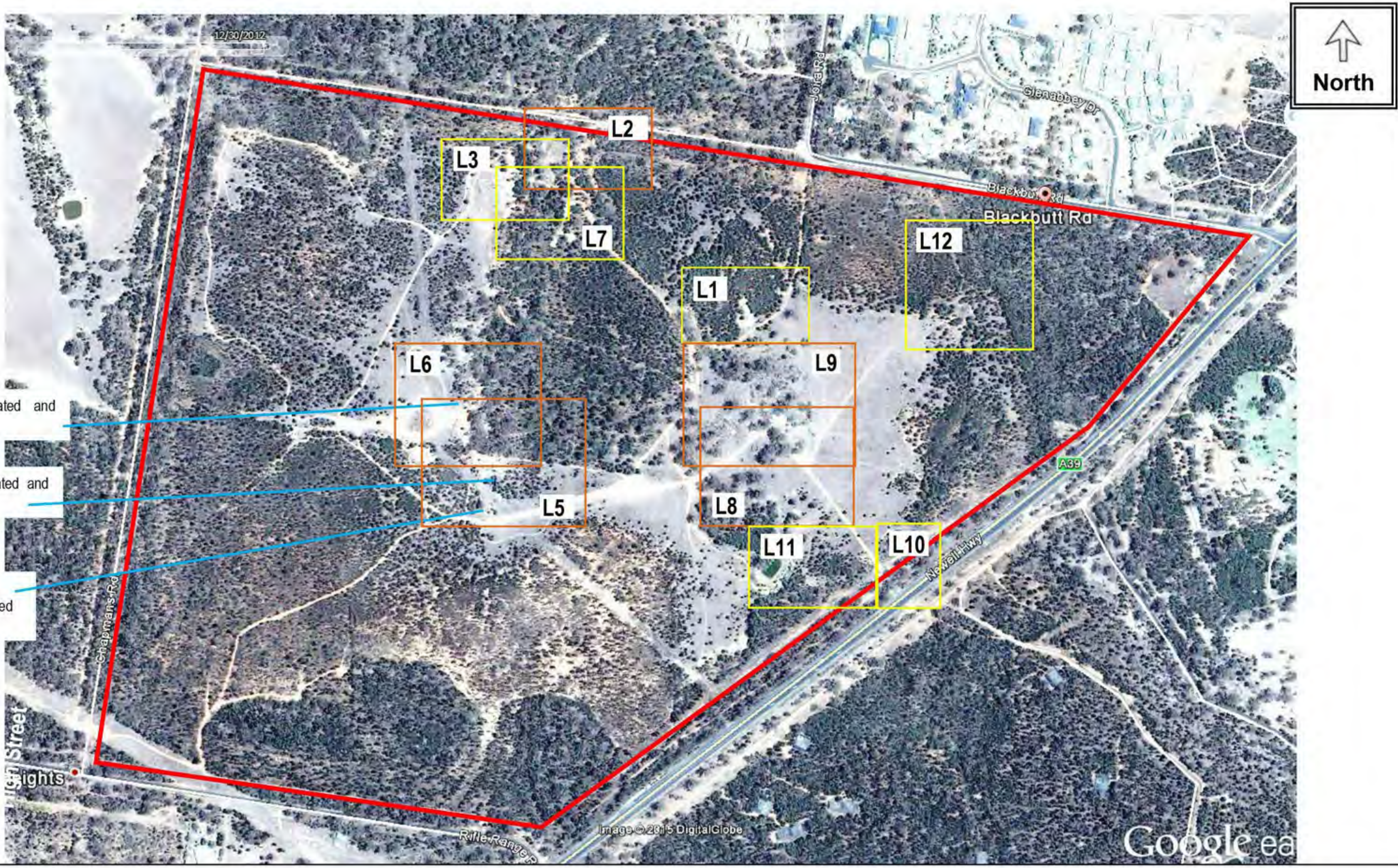
Murphy BW and Lawrie JW (1998) *Soil Landscapes of the Dubbo 1:250,000 Sheet Map* (Soil Conservation Service of NSW, Sydney)

NEPC (1999, revised 2013) *National Environment Protection (Assessment of Site Contamination) Measure 1999* (National Environment Protection Council Service Corporation, Adelaide)

# Figures




| **Figure 1**. Site locality | |
|---|---|
| Lot 172 DP753233 Blackbutt Road, Dubbo NSW | |
| | Envirowest Consulting Pty Ltd |
| Job R5809val1 | Date: 24/11/2015 |




**Legend**

| | |
|---|---|
| Orange box | Asbestos cement fragments and refuse removed |
| Yellow box | Refuse removed |
| L1 | Location number |
| Red line | Lot boundary |

**Figure 2.** Areas of remediation

Lot 172 DP753233 Blackbutt Road, Dubbo NSW

Envirowest Consulting Pty Ltd

Job: R5809val1 | Drawn by: LD | Date: 24/11/2015

**Figure 3.** Photographs of the site

Footprint of Stockpile G, Location 9

South west across former dwelling site (Location 9)

West across footprints of Stockpiles, D, E and F

North west across hydrocarbon staining excavation pit

Footprint of Stockpile Q

Footprint of Stockpile X

# Appendices

**Appendix 1**. Disposal dockets

Admin

DUBBO CITY COUNCIL

ABN 77 296 185 2

PO BOX 81

DUBBO NSW 2830

TAX INVOICE

Docket: WI32194\2
Date: 4/08/2015 2:42
Printed: 30/11/2015 4:54
Operator: SamJ

Customer: Bawd Holdings - Deferred Pay
Vehicle: STOCKLEY
Order No:

---

MIXED WASTE WEIGHED

| | |
|---|---|
| 5800kg @ $72.00/t | $417.60 |
| Subtotal | $379.64 |
| GST | $37.96 |
| Total Including GST | $417.60 |

| | | |
|---|---|---|
| Gross | 23480 kg | |
| Tare | 17680 kg | Edited |
| Net | 5800 kg | |

---

For payment options contact council's customer service centre phone on 6801 4000.

Admin
DUBBO CITY COUNCIL
ABN 77 296 185 2

PO BOX 81
DUBBO NSW 2830

TAX INVOICE

Docket: WI32247\2
Date: 5/08/2015 3:12
Printed: 30/11/2015 5:01
Operator: SamJ

Customer: Bawd Holdings - Deferred Pay
Vehicle: STOCKLEY
Order No:

---

ASBESTOS OVER 1 TONNE
15760kg @ $228.00/t $3593.28

| | |
|---|---|
| Subtotal | $3266.62 |
| GST | $326.66 |
| Total Including GST | $3593.28 |

| | | |
|---|---|---|
| Gross | 33440 kg | |
| Tare | 17680 kg | Edited |
| Net | 15760 kg | |

---

For payment options contact
council's customer service
centre phone on 6801 4000.

Admin
DUBBO CITY COUNCIL
ABN 77 296 185 2

PO BOX 81
DUBBO NSW 2830

TAX INVOICE

Docket: WI32258\2
Date: 6/08/2015 8:40
Printed: 30/11/2015 5:02
Operator: SamJ

Customer: Bawd Holdings - Deferred Pay
Vehicle: STOCKLEY
Order No:

---

ASBESTOS OVER 1 TONNE
19080kg @ $228.00/t $4350.24

| | |
|---|---|
| Subtotal | $3954.76 |
| GST | $395.48 |
| Total Including GST | $4350.24 |

| | | |
|---|---|---|
| Gross | 36740 kg | |
| Tare | 17660 kg | Edited |
| Net | 19080 kg | |

---

For payment options contact
council's customer service
centre phone on 6801 4000.

Admin
DUBBO CITY COUNCIL
ABN 77 296 185 2

PO BOX 81
DUBBO NSW 2830

TAX INVOICE

Docket: WI32277\2
Date: 6/08/2015 11:44
Printed: 30/11/2015 5:05
Operator: SamJ

Customer: Bawd Holdings - Deferred Pay
Vehicle: STOCKLEY
Order No:

---

| | | |
|---|---|---|
| ASBESTOS | OVER 1 TONNE | |
| 25440kg @ $228.00/t | | $5800.32 |
| Subtotal | | $5273.02 |
| GST | | $527.30 |
| Total Including GST | | $5800.32 |

| | | |
|---|---|---|
| Gross | 43080 kg | |
| Tare | 17640 kg | Edited |
| Net | 25440 kg | |

---

For payment options contact
council's customer service
centre phone on 6801 4000.

Admin
DUBBO CITY COUNCIL
ABN 77 296 185 2

PO BOX 81
DUBBO NSW 2830

TAX INVOICE

Docket: WI32295\2
Date: 6/08/2015 1:34
Printed: 30/11/2015 5:06
Operator: SamJ

Customer: Bawd Holdings - Deferred Pay
Vehicle: STOCKLEY
Order No:

---

| | | |
|---|---|---|
| ASBESTOS | OVER 1 TONNE | |
| 23760kg @ $228.00/t | | $5417.28 |
| Subtotal | | $4924.80 |
| GST | | $492.48 |
| Total Including GST | | $5417.28 |

| | | |
|---|---|---|
| Gross | 41380 kg | |
| Tare | 17620 kg | Edited |
| Net | 23760 kg | |

---

For payment options contact
council's customer service
centre phone on 6801 4000.

Admin
DUBBO CITY COUNCIL
ABN 77 296 185 2

PO BOX 81
DUBBO NSW 2830

TAX INVOICE

Docket: WI32312\2
Date: 6/08/2015 4:17
Printed: 30/11/2015 5:07
Operator: SamJ

Customer: Bawd Holdings - Deferred Pay
Vehicle: STOCKLEY
Order No:

---

| | | |
|---|---|---|
| ASBESTOS | OVER 1 TONNE | |
| 26300kg @ $228.00/t | | $5996.40 |
| Subtotal | | $5451.27 |
| GST | | $545.13 |
| Total Including GST | | $5996.40 |

| | | |
|---|---|---|
| Gross | 43880 kg | |
| Tare | 17580 kg | Edited |
| Net | 26300 kg | |

---

For payment options contact
council's customer service
centre phone on 6801 4000.

Admin
DUBBO CITY COUNCIL
ABN 77 296 185 2

PO BOX 81
DUBBO NSW 2830

TAX INVOICE

Docket: WI32316\2
Date: 7/08/2015 8:18
Printed: 30/11/2015 5:08
Operator: SamJ

Customer: Bawd Holdings - Deferred Pay
Vehicle: STOCKLEY
Order No:

---

| | | |
|---|---|---|
| ASBESTOS | OVER 1 TONNE | |
| 26740kg @ $228.00/t | | $6096.72 |
| Subtotal | | $5542.47 |
| GST | | $554.25 |
| Total Including GST | | $6096.72 |

| | | |
|---|---|---|
| Gross | 44540 kg | |
| Tare | 17800 kg | Edited |
| Net | 26740 kg | |

---

For payment options contact
council's customer service
centre phone on 6801 4000.

Admin
DUBBO CITY COUNCIL
ABN 77 296 185 2

PO BOX 81
DUBBO NSW 2830

TAX INVOICE

Docket: WI32342\2
Date: 7/08/2015 11:04
Printed: 30/11/2015 5:09
Operator: SamJ

Customer: Bawd Holdings - Deferred Pay
Vehicle: STOCKLEY
Order No:

---

ASBESTOS OVER 1 TONNE
28560kg @ $228.00/t $6511.68

| | |
|---|---|
| Subtotal | $5919.71 |
| GST | $591.97 |
| Total Including GST | $6511.68 |

| | | |
|---|---|---|
| Gross | 46340 kg | |
| Tare | 17780 kg | Edited |
| Net | 28560 kg | |

---

For payment options contact
council's customer service
centre phone on 6801 4000.

Admin
DUBBO CITY COUNCIL
ABN 77 296 185 2

PO BOX 81
DUBBO NSW 2830

TAX INVOICE

Docket: WI32355\2
Date: 7/08/2015 12:37
Printed: 30/11/2015 5:14
Operator: SamJ

Customer: Bawd Holdings - Deferred Pay
Vehicle: STOCKLEY
Order No:

---

| | | |
|---|---|---|
| ASBESTOS | OVER 1 TONNE | |
| 30280kg @ $228.00/t | | $6903.84 |
| Subtotal | | $6276.22 |
| GST | | $627.62 |
| Total Including GST | | $6903.84 |

| | | |
|---|---|---|
| Gross | 48040 kg | |
| Tare | 17760 kg | Edited |
| Net | 30280 kg | |

---

For payment options contact
council's customer service
centre phone on 6801 4000.

Admin
DUBBO CITY COUNCIL
ABN 77 296 185 2

PO BOX 81
DUBBO NSW 2830

TAX INVOICE

Docket: WI32370\2
Date: 7/08/2015 3:15
Printed: 30/11/2015 5:15
Operator: SamJ

Customer: Bawd Holdings - Deferred Pay
Vehicle: STOCKLEY
Order No:

---

ASBESTOS OVER 1 TONNE
30740kg @ $228.00/t $7008.72

| | |
|---|---|
| Subtotal | $6371.56 |
| GST | $637.16 |
| Total Including GST | $7008.72 |

| | | |
|---|---|---|
| Gross | 48500 kg | |
| Tare | 17760 kg | Edited |
| Net | 30740 kg | |

---

For payment options contact
council's customer service
centre phone on 6801 4000.

Admin
DUBBO CITY COUNCIL
ABN 77 296 185 2

PO BOX 81
DUBBO NSW 2830

TAX INVOICE

Docket: WI32383\2
Date: 8/08/2015 9:26
Printed: 30/11/2015 5:15
Operator: SamJ

Customer: Bawd Holdings - Deferred Pay
Vehicle: STOCKLEY
Order No:

---

ASBESTOS OVER 1 TONNE
31160kg @ $228.00/t $7104.48

| | |
|---|---|
| Subtotal | $6458.62 |
| GST | $645.86 |
| Total Including GST | $7104.48 |

| | | |
|---|---|---|
| Gross | 48880 kg | |
| Tare | 17720 kg | Edited |
| Net | 31160 kg | |

---

For payment options contact
council's customer service
centre phone on 6801 4000.

Admin
DUBBO CITY COUNCIL
ABN 77 296 185 2

PO BOX 81
DUBBO NSW 2830

TAX INVOICE

Docket: WI32392\2
Date: 8/08/2015 10:56
Printed: 30/11/2015 5:16
Operator: SamJ

Customer: Bawd Holdings - Deferred Pay
Vehicle: STOCKLEY
Order No:

---

| | | |
|---|---|---|
| ASBESTOS | OVER 1 TONNE | |
| 29960kg @ $228.00/t | | $6830.88 |
| Subtotal | | $6209.89 |
| GST | | $620.99 |
| Total Including GST | | $6830.88 |

| | | |
|---|---|---|
| Gross | 47660 kg | |
| Tare | 17700 kg | Edited |
| Net | 29960 kg | |

---

For payment options contact
council's customer service
centre phone on 6801 4000.

Admin
DUBBO CITY COUNCIL
ABN 77 296 185 2

PO BOX 81
DUBBO NSW 2830

TAX INVOICE

Docket: WI32400\2
Date: 8/08/2015 12:30
Printed: 30/11/2015 5:17
Operator: SamJ

Customer: Bawd Holdings - Deferred Pay
Vehicle: STOCKLEY
Order No:

---

| | | |
|---|---|---|
| ASBESTOS | OVER 1 TONNE | |
| 25940kg @ $228.00/t | | $5914.32 |
| Subtotal | | $5376.65 |
| GST | | $537.67 |
| Total Including GST | | $5914.32 |

| | | |
|---|---|---|
| Gross | 43640 kg | |
| Tare | 17700 kg | Edited |
| Net | 25940 kg | |

---

For payment options contact
council's customer service
centre phone on 6801 4000.

Admin
DUBBO CITY COUNCIL
ABN 77 296 185 2

PO BOX 81
DUBBO NSW 2830

TAX INVOICE

Docket: WI32577\2
Date: 11/08/2015 9:56
Printed: 30/11/2015 5:18
Operator: SamJ

Customer: Bawd Holdings - Deferred Pay
Vehicle: STOCKLEY
Order No:

---

| | |
|---|---|
| MIXED WASTE WEIGHED | |
| 12120kg @ $72.00/t | $872.64 |
| | |
| Subtotal | $793.31 |
| GST | $79.33 |
| Total Including GST | $872.64 |

| | | |
|---|---|---|
| Gross | 30060 kg | |
| Tare | 17940 kg | Edited |
| Net | 12120 kg | |

BAWD

---

For payment options contact
council's customer service
centre phone on 6801 4000.

Admin
DUBBO CITY COUNCIL
ABN 77 296 185 2

PO BOX 81
DUBBO NSW 2830

TAX INVOICE

Docket: WI32585\2
Date: 11/08/2015 10:45
Printed: 30/11/2015 5:19
Operator: SamJ

Customer: Bawd Holdings - Deferred Pay
Vehicle: STOCKLEY
Order No:

---

MIXED WASTE WEIGHED
17420kg @ $72.00/t $1254.24

| | |
|---|---|
| Subtotal | $1140.22 |
| GST | $114.02 |
| Total Including GST | $1254.24 |

| | | |
|---|---|---|
| Gross | 33440 kg | |
| Tare | 16020 kg | Edited |
| Net | 17420 kg | |

BAWD

---

For payment options contact
council's customer service
centre phone on 6801 4000.

Admin
DUBBO CITY COUNCIL
ABN 77 296 185 2

PO BOX 81
DUBBO NSW 2830

TAX INVOICE

Docket: WI32600\2
Date: 11/08/2015 11:53
Printed: 30/11/2015 5:20
Operator: SamJ

Customer: Bawd Holdings - Deferred Pay
Vehicle: STOCKLEY
Order No:

---

MIXED WASTE WEIGHED
14200kg @ $72.00/t $1022.40

| | |
|---|---|
| Subtotal | $929.45 |
| GST | $92.95 |
| Total Including GST | $1022.40 |

| | | |
|---|---|---|
| Gross | 32120 kg | |
| Tare | 17920 kg | Edited |
| Net | 14200 kg | |

BAWD

---

For payment options contact
council's customer service
centre phone on 6801 4000.

Admin
DUBBO CITY COUNCIL
ABN 77 296 185 2

PO BOX 81
DUBBO NSW 2830

TAX INVOICE

Docket: WI32603\2
Date: 11/08/2015 12:31
Printed: 30/11/2015 5:21
Operator: SamJ

Customer: Bawd Holdings - Deferred Pay
Vehicle: STOCKLEY
Order No:

---

| | |
|---|---|
| MIXED WASTE WEIGHED | |
| 12600kg @ $72.00/t | $907.20 |
| Subtotal | $824.73 |
| GST | $82.47 |
| Total Including GST | $907.20 |

| | | |
|---|---|---|
| Gross | 31360 kg | |
| Tare | 18760 kg | Edited |
| Net | 12600 kg | |

BAWD

---

For payment options contact council's customer service centre phone on 6801 4000.

Admin
DUBBO CITY COUNCIL
ABN 77 296 185 2

PO BOX 81
DUBBO NSW 2830

TAX INVOICE

Docket: WI32605\2
Date: 11/08/2015 12:52
Printed: 30/11/2015 5:21
Operator: SamJ

Customer: Bawd Holdings - Deferred Pay
Vehicle: STOCKLEY
Order No:

---

MIXED WASTE WEIGHED
13580kg @ $72.00/t $977.76

| | |
|---|---|
| Subtotal | $888.87 |
| GST | $88.89 |
| Total Including GST | $977.76 |

| | | |
|---|---|---|
| Gross | 29540 kg | |
| Tare | 15960 kg | Edited |
| | -------- | |
| Net | 13580 kg | |

BAWD

---

For payment options contact
council's customer service
centre phone on 6801 4000.

Admin
DUBBO CITY COUNCIL
ABN 77 296 185 2

PO BOX 81
DUBBO NSW 2830

TAX INVOICE

Docket: WI32610\2
Date: 11/08/2015 1:13
Printed: 30/11/2015 5:22
Operator: SamJ

Customer: Bawd Holdings - Deferred Pay
Vehicle: STOCKLEY
Order No:

---

MIXED WASTE WEIGHED
19940kg @ $72.00/t $1435.68

| | |
|---|---|
| Subtotal | $1305.16 |
| GST | $130.52 |
| Total Including GST | $1435.68 |

| | | |
|---|---|---|
| Gross | 37840 kg | |
| Tare | 17900 kg | Edited |
| | -------- | |
| Net | 19940 kg | |

BAWD

---

For payment options contact
council's customer service
centre phone on 6801 4000.

Admin

DUBBO CITY COUNCIL
ABN 77 296 185 2

PO BOX 81
DUBBO NSW 2830

TAX INVOICE

Docket: WI32615\2
Date: 11/08/2015 1:59
Printed: 30/11/2015 5:23
Operator: SamJ

Customer: Bawd Holdings - Deferred Pay
Vehicle: STOCKLEY
Order No:

---

MIXED WASTE WEIGHED
15000kg @ $72.00/t $1080.00

| | |
|---|---|
| Subtotal | $981.82 |
| GST | $98.18 |
| Total Including GST | $1080.00 |

| | | |
|---|---|---|
| Gross | 33740 kg | |
| Tare | 18740 kg | Edited |
| | -------- | |
| Net | 15000 kg | |

bawd

---

For payment options contact council's customer service centre phone on 6801 4000.

Admin
DUBBO CITY COUNCIL
ABN 77 296 185 2

PO BOX 81
DUBBO NSW 2830

TAX INVOICE

Docket: WI32621\2
Date: 11/08/2015 2:18
Printed: 30/11/2015 5:23
Operator: SamJ

Customer: Bawd Holdings - Deferred Pay
Vehicle: STOCKLEY
Order No:

---

MIXED WASTE WEIGHED
14780kg @ $72.00/t $1064.16

| | |
|---|---|
| Subtotal | $967.42 |
| GST | $96.74 |
| Total Including GST | $1064.16 |

| | | |
|---|---|---|
| Gross | 30720 kg | |
| Tare | 15940 kg | Edited |
| | -------- | |
| Net | 14780 kg | |

bawd

---

For payment options contact
council's customer service
centre phone on 6801 4000.

Admin

DUBBO CITY COUNCIL

ABN 77 296 185 2

PO BOX 81

DUBBO NSW 2830

TAX INVOICE

Docket: WI32627\2
Date: 11/08/2015 2:55
Printed: 30/11/2015 5:25
Operator: SamJ

Customer: Bawd Holdings - Deferred Pay
Vehicle: BSTOCKLEY
Order No:

---

MIXED WASTE WEIGHED

22940kg @ $72.00/t $1651.68

| | |
|---|---|
| Subtotal | $1501.53 |
| GST | $150.15 |
| Total Including GST | $1651.68 |

| | | |
|---|---|---|
| Gross | 40820 kg | |
| Tare | 17880 kg | Edited |
| | -------- | |
| Net | 22940 kg | |

BAWD

---

For payment options contact council's customer service centre phone on 6801 4000.

Admin
DUBBO CITY COUNCIL
ABN 77 296 185 2

PO BOX 81
DUBBO NSW 2830

TAX INVOICE

Docket: WI32636\2
Date: 11/08/2015 3:47
Printed: 30/11/2015 5:25
Operator: SamJ

Customer: Bawd Holdings - Deferred Pay
Vehicle: STOCKLEY
Order No:

---

MIXED WASTE WEIGHED
4740kg @ $72.00/t $341.28

| | |
|---|---|
| Subtotal | $310.25 |
| GST | $31.03 |
| Total Including GST | $341.28 |

| | | |
|---|---|---|
| Gross | 20680 kg | |
| Tare | 15940 kg | Edited |
| Net | 4740 kg | |

BAWD

---

For payment options contact
council's customer service
centre phone on 6801 4000.

Admin
DUBBO CITY COUNCIL
ABN 77 296 185 2

PO BOX 81
DUBBO NSW 2830

TAX INVOICE

Docket: WI32952\2
Date: 17/08/2015 10:04
Printed: 30/11/2015 5:26
Operator: SamJ

Customer: Bawd Holdings - Deferred Pay
Vehicle: STOCKLEY
Order No:

---

MIXED WASTE WEIGHED
9860kg @ $72.00/t $709.92

| | |
|---|---|
| Subtotal | $645.38 |
| GST | $64.54 |
| Total Including GST | $709.92 |

| | | |
|---|---|---|
| Gross | 27700 kg | |
| Tare | 17840 kg | Edited |
| Net | 9860 kg | |

---

For payment options contact
council's customer service
centre phone on 6801 4000.

Admin
DUBBO CITY COUNCIL
ABN 77 296 185 2

PO BOX 81
DUBBO NSW 2830

TAX INVOICE

Docket: WI32971\2
Date: 17/08/2015 11:47
Printed: 30/11/2015 5:26
Operator: SamJ

Customer: Bawd Holdings - Deferred Pay
Vehicle: STOCKLEY
Order No:

---

MIXED WASTE WEIGHED
8780kg @ $72.00/t $632.16

| | |
|---|---|
| Subtotal | $574.69 |
| GST | $57.47 |
| Total Including GST | $632.16 |

| | | |
|---|---|---|
| Gross | 26560 kg | |
| Tare | 17780 kg | Edited |
| Net | 8780 kg | |

---

For payment options contact
council's customer service
centre phone on 6801 4000.

Admin
DUBBO CITY COUNCIL
ABN 77 296 185 2

PO BOX 81
DUBBO NSW 2830

TAX INVOICE

Docket: WI33049\2
Date: 18/08/2015 9:38
Printed: 30/11/2015 5:27
Operator: SamJ

Customer: Bawd Holdings - Deferred Pay
Vehicle: STOCKLEY
Order No:

---

MIXED WASTE WEIGHED
8940kg @ $72.00/t $643.68

| | |
|---|---|
| Subtotal | $585.16 |
| GST | $58.52 |
| Total Including GST | $643.68 |

| | | |
|---|---|---|
| Gross | 26660 kg | |
| Tare | 17720 kg | Edited |
| | -------- | |
| Net | 8940 kg | |

---

For payment options contact
council's customer service
centre phone on 6801 4000.

Admin
DUBBO CITY COUNCIL
ABN 77 296 185 2

PO BOX 81
DUBBO NSW 2830

TAX INVOICE

Docket: WI33065\2
Date: 18/08/2015 11:37
Printed: 30/11/2015 5:28
Operator: SamJ

Customer: Bawd Holdings - Deferred Pay
Vehicle: STOCKLEY
Order No:

---

MIXED WASTE WEIGHED
11780kg @ $72.00/t $848.16

| | |
|---|---|
| Subtotal | $771.05 |
| GST | $77.11 |
| Total Including GST | $848.16 |

| | | |
|---|---|---|
| Gross | 29500 kg | |
| Tare | 17720 kg | Edited |
| Net | 11780 kg | |

---

For payment options contact council's customer service centre phone on 6801 4000.

Admin
DUBBO CITY COUNCIL
ABN 77 296 185 2

PO BOX 81
DUBBO NSW 2830

TAX INVOICE

Docket: WI33087\2
Date: 18/08/2015 2:43
Printed: 30/11/2015 5:28
Operator: SamJ

Customer: Bawd Holdings - Deferred Pay
Vehicle: STOCKLEY
Order No:

---

| | | |
|---|---|---|
| MIXED WASTE | WEIGHED | |
| 6480kg @ $72.00/t | | $466.56 |
| Subtotal | | $424.15 |
| GST | | $42.41 |
| Total Including GST | | $466.56 |

| | | |
|---|---|---|
| Gross | 24180 kg | |
| Tare | 17700 kg | Edited |
| Net | 6480 kg | |

---

For payment options contact
council's customer service
centre phone on 6801 4000.

Admin
DUBBO CITY COUNCIL
ABN 77 296 185 2

PO BOX 81
DUBBO NSW 2830

TAX INVOICE

Docket: WI33105\2
Date: 18/08/2015 4:33
Printed: 30/11/2015 5:29
Operator: SamJ

Customer: Bawd Holdings - Deferred Pay
Vehicle: STOCKLEY
Order No:

---

MIXED WASTE WEIGHED
9540kg @ $72.00/t $686.88

| | |
|---|---|
| Subtotal | $624.44 |
| GST | $62.44 |
| Total Including GST | $686.88 |

| | | |
|---|---|---|
| Gross | 27220 kg | |
| Tare | 17680 kg | Edited |
| Net | 9540 kg | |

---

For payment options contact
council's customer service
centre phone on 6801 4000.

Admin
DUBBO CITY COUNCIL
ABN 77 296 185 2

PO BOX 81
DUBBO NSW 2830

TAX INVOICE

Docket: WI33126\2
Date: 19/08/2015 10:40
Printed: 30/11/2015 5:30
Operator: SamJ

Customer: Bawd Holdings - Deferred Pay
Vehicle: STOCKLEY
Order No:

---

MIXED WASTE WEIGHED
14480kg @ $72.00/t $1042.56

| | |
|---|---|
| Subtotal | $947.78 |
| GST | $94.78 |
| Total Including GST | $1042.56 |

| | | |
|---|---|---|
| Gross | 32300 kg | |
| Tare | 17820 kg | Edited |
| Net | 14480 kg | |

---

For payment options contact
council's customer service
centre phone on 6801 4000.

Admin
DUBBO CITY COUNCIL
ABN 77 296 185 2

PO BOX 81
DUBBO NSW 2830

TAX INVOICE

Docket: WI33144\2
Date: 19/08/2015 12:20
Printed: 30/11/2015 5:31
Operator: SamJ

Customer: Bawd Holdings - Deferred Pay
Vehicle: STOCKLEY
Order No:

---

MIXED WASTE WEIGHED
19580kg @ $72.00/t $1409.76

| | |
|---|---|
| Subtotal | $1281.60 |
| GST | $128.16 |
| Total Including GST | $1409.76 |

| | | |
|---|---|---|
| Gross | 37360 kg | |
| Tare | 17780 kg | Edited |
| Net | 19580 kg | |

---

For payment options contact
council's customer service
centre phone on 6801 4000.

Admin
DUBBO CITY COUNCIL
ABN 77 296 185 2

PO BOX 81
DUBBO NSW 2830

TAX INVOICE

Docket: WI33172\2
Date: 19/08/2015 3:39
Printed: 30/11/2015 5:31
Operator: SamJ

Customer: Bawd Holdings - Deferred Pay
Vehicle: STOCKLEY
Order No:

---

ASBESTOS OVER 1 TONNE
25340kg @ $228.00/t $5777.52

| | |
|---|---|
| Subtotal | $5252.29 |
| GST | $525.23 |
| Total Including GST | $5777.52 |

| | | |
|---|---|---|
| Gross | 43100 kg | |
| Tare | 17760 kg | Edited |
| Net | 25340 kg | |

---

For payment options contact
council's customer service
centre phone on 6801 4000.

Admin
DUBBO CITY COUNCIL
ABN 77 296 185 2

PO BOX 81
DUBBO NSW 2830

TAX INVOICE

Docket: WI33184\2
Date: 20/08/2015 8:43
Printed: 30/11/2015 5:32
Operator: SamJ

Customer: Bawd Holdings - Deferred Pay
Vehicle: STOCKLEY
Order No:

---

ASBESTOS OVER 1 TONNE
27980kg @ $228.00/t $6379.44

| | |
|---|---|
| Subtotal | $5799.49 |
| GST | $579.95 |
| Total Including GST | $6379.44 |

| | | |
|---|---|---|
| Gross | 45720 kg | |
| Tare | 17740 kg | Edited |
| Net | 27980 kg | |

---

For payment options contact
council's customer service
centre phone on 6801 4000.

Admin
DUBBO CITY COUNCIL
ABN 77 296 185 2

PO BOX 81
DUBBO NSW 2830

TAX INVOICE

Docket: WI33239\2
Date: 20/08/2015 2:15
Printed: 30/11/2015 5:33
Operator: SamJ

Customer: Bawd Holdings - Deferred Pay
Vehicle: STOCKLEY
Order No:

---

MIXED WASTE WEIGHED
16620kg @ $72.00/t $1196.64

| | |
|---|---|
| Subtotal | $1087.85 |
| GST | $108.79 |
| Total Including GST | $1196.64 |

| | | |
|---|---|---|
| Gross | 34340 kg | |
| Tare | 17720 kg | Edited |
| Net | 16620 kg | |

---

For payment options contact
council's customer service
centre phone on 6801 4000.

Admin
DUBBO CITY COUNCIL
ABN 77 296 185 2

PO BOX 81
DUBBO NSW 2830

TAX INVOICE

Docket: WI33254\2
Date: 20/08/2015 4:40
Printed: 30/11/2015 5:33
Operator: SamJ

Customer: Bawd Holdings - Deferred Pay
Vehicle: STOCKLEY
Order No:

---

| | |
|---|---|
| MIXED WASTE WEIGHED | |
| 15380kg @ $72.00/t | $1107.36 |
| Subtotal | $1006.69 |
| GST | $100.67 |
| Total Including GST | $1107.36 |

| | | |
|---|---|---|
| Gross | 33100 kg | |
| Tare | 17720 kg | Edited |
| Net | 15380 kg | |

---

For payment options contact
council's customer service
centre phone on 6801 4000.

Admin

DUBBO CITY COUNCIL

ABN 77 296 185 2

PO BOX 81

DUBBO NSW 2830

TAX INVOICE

Docket: WI33257\2
Date: 21/08/2015 8:27
Printed: 30/11/2015 5:34
Operator: SamJ

Customer: Bawd Holdings - Deferred Pay
Vehicle: STOCKLEY
Order No:

---

MIXED WASTE WEIGHED
8080kg @ $72.00/t $581.76

| | |
|---|---|
| Subtotal | $528.87 |
| GST | $52.89 |
| Total Including GST | $581.76 |

| | | |
|---|---|---|
| Gross | 25860 kg | |
| Tare | 17780 kg | Edited |
| | -------- | |
| Net | 8080 kg | |

---

For payment options contact council's customer service centre phone on 6801 4000.

Admin
DUBBO CITY COUNCIL
ABN 77 296 185 2

PO BOX 81
DUBBO NSW 2830

TAX INVOICE

Docket: WI33271\2
Date: 21/08/2015 9:47
Printed: 30/11/2015 5:35
Operator: SamJ

Customer: Bawd Holdings - Deferred Pay
Vehicle: STOCKLEY
Order No:

---

| | |
|---|---|
| MIXED WASTE WEIGHED | |
| 7540kg @ $72.00/t | $542.88 |
| | |
| Subtotal | $493.53 |
| GST | $49.35 |
| Total Including GST | $542.88 |

| | | |
|---|---|---|
| Gross | 25320 kg | |
| Tare | 17780 kg | Edited |
| | -------- | |
| Net | 7540 kg | |

---

For payment options contact
council's customer service
centre phone on 6801 4000.

Admin
DUBBO CITY COUNCIL
ABN 77 296 185 2

PO BOX 81
DUBBO NSW 2830

TAX INVOICE

Docket: WI33293\2
Date: 21/08/2015 11:45
Printed: 30/11/2015 5:35
Operator: SamJ

Customer: Bawd Holdings - Deferred Pay
Vehicle: STOCKLEY
Order No:

---

MIXED WASTE WEIGHED
16300kg @ $72.00/t $1173.60

| | |
|---|---|
| Subtotal | $1066.91 |
| GST | $106.69 |
| Total Including GST | $1173.60 |

| | | |
|---|---|---|
| Gross | 34120 kg | |
| Tare | 17820 kg | Edited |
| | -------- | |
| Net | 16300 kg | |

---

For payment options contact
council's customer service
centre phone on 6801 4000.

Admin
DUBBO CITY COUNCIL
ABN 77 296 185 2

PO BOX 81
DUBBO NSW 2830

TAX INVOICE

Docket: WI33322\2
Date: 21/08/2015 2:48
Printed: 30/11/2015 5:36
Operator: SamJ

Customer: Bawd Holdings - Deferred Pay
Vehicle: STOCKLEY
Order No:

---

MIXED WASTE WEIGHED
15980kg @ $72.00/t $1150.56

| | |
|---|---|
| Subtotal | $1045.96 |
| GST | $104.60 |
| Total Including GST | $1150.56 |

| | | |
|---|---|---|
| Gross | 33720 kg | |
| Tare | 17740 kg | Edited |
| | -------- | |
| Net | 15980 kg | |

---

For payment options contact
council's customer service
centre phone on 6801 4000.

Admin
DUBBO CITY COUNCIL
ABN 77 296 185 2

PO BOX 81
DUBBO NSW 2830

TAX INVOICE

Docket: WI34147\2
Date: 3/09/2015 10:20
Printed: 30/11/2015 5:37
Operator: SamJ

Customer: Bawd Holdings - Deferred Pay
Vehicle: STOCKLEY
Order No:

---

ASBESTOS OVER 1 TONNE
19160kg @ $228.00/t $4368.48

| | |
|---|---|
| Subtotal | $3971.35 |
| GST | $397.13 |
| Total Including GST | $4368.48 |

| | | |
|---|---|---|
| Gross | 36900 kg | |
| Tare | 17740 kg | Edited |
| Net | 19160 kg | |

---

For payment options contact council's customer service centre phone on 6801 4000.

Admin

DUBBO CITY COUNCIL

ABN 77 296 185 2

PO BOX 81

DUBBO NSW 2830

TAX INVOICE

Docket: WI34617\2
Date: 10/09/2015 1:29
Printed: 30/11/2015 5:38
Operator: SamJ

Customer: Bawd Holdings - Deferred Pay
Vehicle: STOCKLEY
Order No:

---

| | | |
|---|---|---|
| ASBESTOS | OVER 1 TONNE | |
| 22480kg @ $228.00/t | | $5125.44 |
| Subtotal | | $4659.49 |
| GST | | $465.95 |
| Total Including GST | | $5125.44 |

| | | |
|---|---|---|
| Gross | 40200 kg | |
| Tare | 17720 kg | Edited |
| Net | 22480 kg | |

---

For payment options contact council's customer service centre phone on 6801 4000.

Admin

DUBBO CITY COUNCIL

ABN 77 296 185 2

PO BOX 81

DUBBO NSW 2830

TAX INVOICE

Docket: WI34624\2
Date: 10/09/2015 2:42
Printed: 30/11/2015 5:38
Operator: SamJ

Customer: Bawd Holdings - Deferred Pay
Vehicle: STOCKLEY
Order No:

---

| | | |
|---|---|---|
| ASBESTOS | OVER 1 TONNE | |
| 22800kg @ $228.00/t | | $5198.40 |
| Subtotal | | $4725.82 |
| GST | | $472.58 |
| Total Including GST | | $5198.40 |

| | | |
|---|---|---|
| Gross | 40500 kg | |
| Tare | 17700 kg | Edited |
| | -------- | |
| Net | 22800 kg | |

---

For payment options contact
council's customer service
centre phone on 6801 4000.

Admin
DUBBO CITY COUNCIL
ABN 77 296 185 2

PO BOX 81
DUBBO NSW 2830

TAX INVOICE

Docket: WI34635\2
Date: 10/09/2015 3:59
Printed: 30/11/2015 5:39
Operator: SamJ

Customer: Bawd Holdings - Deferred Pay
Vehicle: STOCKLEY
Order No:

---

ASBESTOS OVER 1 TONNE
19740kg @ $228.00/t $4500.72

| | |
|---|---|
| Subtotal | $4091.56 |
| GST | $409.16 |
| Total Including GST | $4500.72 |

| | | |
|---|---|---|
| Gross | 37420 kg | |
| Tare | 17680 kg | Edited |
| Net | 19740 kg | |

---

For payment options contact
council's customer service
centre phone on 6801 4000.

**TAX INVOICE REPRINT**

**Dubbo City Council**

PO Box 81
Dubbo NSW 2830
ABN 77 296 185 278

For payment options contact Council's Customer Service centre on:
Phone: (02) 6801 4000

**DELIVERY DOCKET REPRINT**

| | | |
|---|---|---|
| Docket: | WI38119\1 | |
| Date: | 28/10/2015 | 12:05:13PM |
| Printed: | 4/11/2015 | 9:21:50AM |
| Operator: | RJW | |
| Customer: | Bawd Holdings - Deferred Payment Agreement | |
| Vehicle: | BJH072 | |
| Order No: | | |

ASBESTOS

| | | |
|---|---|---|
| | | MINIMUM CHARGE |
| 20KG @ | $37.00/t | $37.00 |
| Subtotal | | $33.64 |
| GST | | $3.36 |
| Total Including GST | | $37.00 |

| | | |
|---|---|---|
| Gross | 2260 | Kg |
| Tare | 0 | Kg |
| Net | 0 | Kg |

**TAX INVOICE REPRINT**

**Dubbo City Council**

PO Box 81
Dubbo NSW 2830
ABN 77 296 185 278

For payment options contact Council's
Customer Service centre on:
Phone: (02) 6801 4000

## DELIVERY DOCKET REPRINT

| | | |
|---|---|---|
| Docket: | WI38149\1 | |
| Date: | 28/10/2015 | 3:29:29PM |
| Printed: | 4/11/2015 | 9:22:27AM |
| Operator: | RJW | |
| Customer: | Bawd Holdings - Deferred Payment Agreement | |
| Vehicle: | TUK118 | |
| Order No: | | |

MIXED WASTE

| | | |
|---|---|---|
| | | WEIGHED |
| 2320KG @ | $72.00/t | $167.04 |
| | Subtotal | $151.85 |
| | GST | $15.19 |
| | Total Including GST | $167.04 |

| | | |
|---|---|---|
| Gross | 5600 | Kg |
| Tare | 3280 | Kg |
| Net | 2320 | Kg |

# TAX INVOICE

Debtor Acc: 477.02
Date: 24/09/2015

DUBBO CITY COUNCIL

Civic Administration Building
P.O. Box 81 Dubbo NSW 2830
T (02) 6801 4000
F (02) 6801 4259
ABN 77 296 185 278

BAWD Property Trust
PO Box 774
DUBBO NSW 2830



| DATE | TAX INVOICE No. | DESCRIPTION | | AMOUNT |
|---|---|---|---|---|
| 24/09/2015 | 171504 | ASBESTOS-OVER 1 TONNE-WI32383 | | |
| | | ASBESTOS-OVER 1 TONNE-WI32383 | 7,104.48 | 102,891.36 |
| | | ASBESTOS-OVER 1 TONNE-WI32370 | 7,008.72 | |
| | | ASBESTOS-OVER 1 TONNE-WI32355 | 6,903.84 | |
| | | ASBESTOS-OVER 1 TONNE-WI32392 | 6,830.88 | |
| | | ASBESTOS-OVER 1 TONNE-WI32342 | 6,511.68 | |
| | | ASBESTOS-OVER 1 TONNE-WI33184 | 6,379.44 | |
| | | ASBESTOS-OVER 1 TONNE-WI32316 | 6,096.72 | |
| | | ASBESTOS-OVER 1 TONNE-WI32312 | 5,996.40 | |
| | | ASBESTOS-OVER 1 TONNE-WI32400 | 5,914.32 | |
| | | ASBESTOS-OVER 1 TONNE-WI32277 | 5,800.32 | |
| | | ASBESTOS-OVER 1 TONNE-WI33172 | 5,777.52 | |
| | | ASBESTOS-OVER 1 TONNE-WI32295 | 5,417.28 | |
| | | ASBESTOS-OVER 1 TONNE-WI32258 | 4,350.24 | |
| | | MIXED WASTE-WEIGHED-WI32627 | 1,651.68 | |
| | | MIXED WASTE-WEIGHED-WI32610 | 1,435.68 | |
| | | MIXED WASTE-WEIGHED-WI33144 | 1,409.76 | |
| | | MIXED WASTE-WEIGHED-WI32585 | 1,254.24 | |
| | | MIXED WASTE-WEIGHED-WI33239 | 1,196.64 | |
| | | MIXED WASTE-WEIGHED-WI33293 | 1,173.60 | |
| | | MIXED WASTE-WEIGHED-WI33322 | 1,150.56 | |
| | | MIXED WASTE-WEIGHED-WI33254 | 1,107.36 | |
| | | MIXED WASTE-WEIGHED-WI32615 | 1,080.00 | |
| | | MIXED WASTE-WEIGHED-WI32621 | 1,064.16 | |
| | | MIXED WASTE-WEIGHED-WI33126 | 1,042.56 | |
| | | MIXED WASTE-WEIGHED-WI32600 | 1,022.40 | |
| | | MIXED WASTE-WEIGHED-WI32605 | 977.76 | |
| | | MIXED WASTE-WEIGHED-WI32603 | 907.20 | |
| | | MIXED WASTE-WEIGHED-WI32577 | 872.64 | |
| | | MIXED WASTE-WEIGHED-WI33065 | 848.16 | |
| | | MIXED WASTE-WEIGHED-WI32952 | 709.92 | |
| | | MIXED WASTE-WEIGHED-WI33105 | 686.88 | |
| | | MIXED WASTE-WEIGHED-WI33049 | 643.68 | |
| | | MIXED WASTE-WEIGHED-WI32971 | 632.16 | |
| | | MIXED WASTE-WEIGHED-WI33257 | 581.76 | |
| | | MIXED WASTE-WEIGHED-WI33271 | 542.88 | |
| | | MIXED WASTE-WEIGHED-WI33087 | 466.56 | |
| | | MIXED WASTE-WEIGHED-WI32636 | 341.28 | |
| | | *GST 9,353.76* | | |
| | | Invoice Total (including GST if applicable) | | 102,891.36 |

# TAX INVOICE

Debtor Acc. 477.02
Date: 24/09/2015

DUBBO
CITY COUNCIL

BAWD Property Trust
PO Box 774
DUBBO NSW 2830

Civic Administration Building
P.O. Box 81 Dubbo NSW 2830
**T** (02) 6801 4000
**F** (02) 6801 4259
**ABN** 77 296 185 278



| | |
|---|---|
| *Total Value non-taxable supply(s)* | 0.00 |
| *Total Value taxable supply(s) excluding GST* | 93,537.60 |
| *Total GST Payable* | 9,353.76 |

| **TOTAL** | **$102,891.36** |
|---|---|

## DUBBO CITY COUNCIL - REMITTANCE ADVICE SLIP

**(Please return this slip with your payment to P.O. Box 81, DUBBO NSW 2830)**

**To:**

BAWD Property Trust
PO Box 774
DUBBO NSW 2830

B PAY

**Biller Code:939074**
**Ref: 00477026**

**Telephone & Internet Banking – BPAY®**
Contact your bank or financial institution to make this payment from your cheque, savings, debit, credit card or transaction account. More info: www.bpay.com.au

| | |
|---|---|
| DUE DATE: | 08/10/2015 |
| ACCOUNT No. | 477.02 |
| AMOUNT DUE: | **$102,891.36** |
| TAX INVOICE No. | 171504 |

**TAX INVOICE**

**Appendix 2.** Quality control and quality assurance 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. |

### 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%.<br>Analysis criterion<br>60% RPD for levels greater than 10 times the PQL<br>85% RPD for levels between 5 to 10 times the PQL<br>100% RPD at levels between 2 to 5 times the PQL<br>Absolute difference, 3.5 times the PQL where levels are, 2 times PQL |
| 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 |

### 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 |
|---|---|
| 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 | Sample injected with a known concentration of contaminants with tested. Frequency of 5%, results to be within +/-40% or discussion required |
| Surrogate spikes | QC monitoring spikes to be added to samples at the extraction process in the laboratory where applicable. Surrogates are closely related to the organic target analyte and not normally found in the natural environment. Frequency of 5%, results to be within +/-40% or discussion required |
| Laboratory control samples | Externally prepared reference material containing representative analytes under investigation. These will be undertaken at one per batch. 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 investigation program. Samples were collected on 28 October 2015. A total of six 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 NEPC (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 laboratories of ALS, Smithfield, 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:

**Laboratory analysis schedule**

| Sample id. (sampling location) | Number of samples | Duplicate | Analyses | Date collected | Substrate | Laboratory report |
|---|---|---|---|---|---|---|
| HV1, HV2, HV3, HV4, HV5 | 5 | 0 | TRH (C6-C40), BTEXN | 28/10/2015 | Soil | ES1534959 |
| HV6 | 1 | 0 | TRH (C6-C40), BTEXN, zinc | 28/10/2015 | Soil | ES1534959 |

**Analytical methods**

| Analyte | Extraction | Laboratory methods |
|---|---|---|
| Metals | USEPA 200.2 Mod | APHA USEPA SW846-6010 |
| Chromium (III) | - | APHA 3500 CR-A&B & 3120 and USEPA SW846-3060A |
| Chromium (VI) | USEPA SW846-3060A | USEPA SW846-3060A |
| Mercury | USEPA 200.2 Mod | APHA 3112 |
| TRH(C6-C9) | USPEA SW846-5030A | USPEA SW 846-8260B |
| TRH(C10-C40) | Tumbler extraction of solids | USEPA SW 846-8270B |
| PAH | Tumbler extraction of solids | USEPA SW 846-8270B |
| OC Pesticides | Tumbler extraction of solids | USEPA SW 846-8270B |
| OP Pesticides | Tumbler extraction of solids | USEPA SW 846-8270B |
| BTEX | Tumbler extraction of solids | USEPA SW 846-8260B |

# 3. Field quality assurance and quality control

No duplicates, 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 | 6 months |
| Mercury, chromium (VI) | 28 days |
| OCP, OPP, 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 batch. 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<br>Sampled with stainless steel spade into lab prepared containers, decontamination between samples, latex gloves worn by sampler |
| Experienced sampler | Yes | Same soil sampler, environmental scientist |
| Documentation correct | Yes | Sampling log completed<br>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, mercury and chromium (VI) less than 28 days, OCP, TPH, PAH, BTEX less than 14 days. Non-conformance exists for chromium (VI) holding time for ES1507659. |

## 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) or USEPA |
| PQL | Yes | Suitable for analytes |
| Same laboratory | Yes | ALS 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<br>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 | No | No field duplicate samples 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 | No | Frequency of 5%, results to be within +/-40%. |
| Laboratory prepared volatile trip spikes | No | No volatile trip spike analysed. |

## 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 | No | Frequency of 5%, results to be within +/-40% or discussion required. Recovery greater than upper data quality objective. |
| Matrix duplicates | No | Frequency of 5%, results to be within +/-40% or discussion required. RPD exceeds LOR based limits. |
| 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 3.** Soil sampling protocols

## 1. Sampling

The samples were collected from the auger tip, spade, hand auger or excavator bucket immediately on withdrawal.

The time between retrieval of the sample and sealing of the sample container was kept to a minimum.

The material was collected using single use disposal gloves or a stainless steel trowel which represented material which had not been exposed to the atmosphere prior to sampling.

All sampling jars were filled as close to the top as possible to minimise the available airspace within the jar.

## 2. Handling, containment and transport

Daily sampling activities will be recorded including sampling locations, numbers, observations, measurements, sampler, date and time and weather condition.

The sampling jars will be new sterile glass jars fitted with plastic lid and airtight Teflon seals, supplied by the laboratories for the purpose of collecting soil samples for analysis. Sample containers will be marked indelibly with the sample ID code to waterproof labels affixed to the body of the container.

All samples will be removed from direct sunlight as soon as possible after sampling and placed in insulated containers. Samples were stored in a refrigerator at 4°C prior to transportation to the laboratory in insulated containers with ice bricks in accordance with AS4482.1.

Handling and transportation to the laboratory will be accompanied with a chain of custody form to demonstrate the specimens are properly received, documents, processed and stored.

Maximum holding time for extraction (AS4482.1) are:

| Analyte | Maximum holding time |
|---|---|
| Metals | 6 months |
| Mercury | 28 days |
| Sulfate | 7 days |
| Organic carbon | 7 days |
| OCP, OPP, PCB | 14 days |
| TPH, BTEX, PAH, phenols | 14 days |

## 3. Decontamination of sampling equipment

Sampling tools will be decontaminated between sampling locations by

- Removing soil adhering to the sampling equipment by scraping, brushing or wiping
- Washing with a phosphate-free detergent
- Rinsing thoroughly with clean water
- Repeating if necessary
- Dry equipment with disposable towels or air

**Appendix 4.** ALS Environmental laboratory report chain of custody form
Report number: ES1534959

# CERTIFICATE OF ANALYSIS

| | | | |
|---|---|---|---|
| Work Order | : **ES1508739** | Page | : 1 of 3 |
| Client | : **ENVIROWEST CONSULTING** | Laboratory | : Environmental Division Sydney |
| Contact | : MS LEAH DESBOROUGH | Contact | : Client Services |
| Address | : 9 CAMERON PLACE<br>PO BOX 8158<br>ORANGE NSW, AUSTRALIA 2800 | Address | : 277-289 Woodpark Road Smithfield NSW Australia 2164 |
| E-mail | : leah@envirowest.net.au | E-mail | : sydney@alsglobal.com |
| Telephone | : +61 63614954 | Telephone | : +61-2-8784 8555 |
| Facsimile | : +61 02 63603960 | Facsimile | : +61-2-8784 8500 |
| Project | : 5809-1 | QC Level | : NEPM 2013 Schedule B(3) and ALS QCS3 requirement |
| Order number | : 5809-1 | | |
| C-O-C number | : 5809-1 | Date Samples Received | : 17-APR-2015 |
| Sampler | : ---- | Issue Date | : 24-APR-2015 |
| Site | : 5809-1 | | |
| | | No. of samples received | : 4 |
| Quote number | : SY/542/14 | No. of samples analysed | : 4 |

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

NATA

WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

## *Signatories*

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

| *Signatories* | *Position* | *Accreditation Category* |
|---|---|---|
| Ashesh Patel | Inorganic Chemist | Sydney Inorganics |
| Edwandy Fadjar | Organic Coordinator | Sydney Inorganics |
| Shobhna Chandra | Metals Coordinator | Sydney Inorganics |

## General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting

## Analytical Results

| Sub-Matrix: **SOIL** (Matrix: **SOIL**) | | | Client sample ID | MW1-100 | MW1-500 | BH14-100 | BH14-500 | ---- |
|---|---|---|---|---|---|---|---|---|
| | | | Client sampling date / time | 31-MAR-2015 15:00 | 31-MAR-2015 15:00 | 31-MAR-2015 15:00 | 31-MAR-2015 15:00 | ---- |
| *Compound* | *CAS Number* | *LOR* | *Unit* | ES1508739-001 | ES1508739-002 | ES1508739-003 | ES1508739-004 | ---- |
| **EA055: Moisture Content** | | | | | | | | |
| **Moisture Content (dried @ 103°C)** | ---- | 1.0 | % | **1.2** | **2.2** | **6.1** | **3.3** | ---- |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| **Sulfate as SO4 2-** | 14808-79-8 | 10 | mg/kg | <10 | <10 | <10 | **40** | ---- |
| **ED045G: Chloride Discrete analyser** | | | | | | | | |
| **Chloride** | 16887-00-6 | 10 | mg/kg | **50** | **70** | **40** | **120** | ---- |
| **ED093S: Soluble Major Cations** | | | | | | | | |
| **Calcium** | 7440-70-2 | 10 | mg/kg | <10 | <10 | <10 | **10** | ---- |
| **Magnesium** | 7439-95-4 | 10 | mg/kg | <10 | **10** | <10 | **50** | ---- |
| **Sodium** | 7440-23-5 | 10 | mg/kg | **10** | **20** | **10** | **40** | ---- |
| **Potassium** | 7440-09-7 | 10 | mg/kg | **10** | <10 | <10 | **60** | ---- |

Environmental

# QUALITY CONTROL REPORT

| | | | |
|---|---|---|---|
| **Work Order** | : **ES1508739** | Page | : 1 of 4 |
| Client | : **ENVIROWEST CONSULTING** | Laboratory | : Environmental Division Sydney |
| Contact | : MS LEAH DESBOROUGH | Contact | : Client Services |
| Address | : 9 CAMERON PLACE<br>PO BOX 8158<br>ORANGE NSW, AUSTRALIA 2800 | Address | : 277-289 Woodpark Road Smithfield NSW Australia 2164 |
| E-mail | : leah@envirowest.net.au | E-mail | : sydney@alsglobal.com |
| Telephone | : +61 63614954 | Telephone | : +61-2-8784 8555 |
| Facsimile | : +61 02 63603960 | Facsimile | : +61-2-8784 8500 |
| Project | : 5809-1 | QC Level | : NEPM 2013 Schedule B(3) and ALS QCS3 requirement |
| Site | : 5809-1 | | |
| C-O-C number | : 5809-1 | Date Samples Received | : 17-APR-2015 |
| Sampler | : ---- | Issue Date | : 24-APR-2015 |
| Order number | : 5809-1 | | |
| | | No. of samples received | : 4 |
| Quote number | : SY/542/14 | No. of samples analysed | : 4 |

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

NATA

WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

## *Signatories*

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

| *Signatories* | *Position* | *Accreditation Category* |
|---|---|---|
| Ashesh Patel | Inorganic Chemist | Sydney Inorganics |
| Edwandy Fadjar | Organic Coordinator | Sydney Inorganics |
| Shobhna Chandra | Metals Coordinator | Sydney Inorganics |

## General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

## *Laboratory Duplicate (DUP) Report*

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **SOIL**

| | | | | Laboratory Duplicate (DUP) Report | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Laboratory sample ID | Client sample ID | Method: Compound | CAS Number | LOR | Unit | Original Result | Duplicate Result | RPD (%) | Recovery Limits (%) |
| **EA055: Moisture Content (QC Lot: 3905360)** | | | | | | | | | |
| ES1508739-003 | BH14-100 | EA055-103: Moisture Content (dried @ 103°C) | ---- | 1.0 | % | 6.1 | 5.6 | 8.6 | No Limit |
| ES1508741-010 | Anonymous | EA055-103: Moisture Content (dried @ 103°C) | ---- | 1.0 | % | 13.8 | 14.5 | 5.0 | 0% - 50% |
| **ED040S: Soluble Major Anions (QC Lot: 3908337)** | | | | | | | | | |
| ES1508691-002 | Anonymous | ED040S: Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | 150 | 130 | 12.1 | 0% - 20% |
| **ED045G: Chloride by Discrete Analyser (QC Lot: 3908338)** | | | | | | | | | |
| ES1508691-002 | Anonymous | ED045G: Chloride | 16887-00-6 | 10 | mg/kg | 660 | 670 | 1.6 | 0% - 20% |
| **ED093S: Soluble Major Cations (QC Lot: 3908340)** | | | | | | | | | |
| ME1500573-001 | Anonymous | ED093S: Calcium | 7440-70-2 | 10 | mg/kg | 4260 | 4260 | 0.0 | 0% - 20% |
| | | ED093S: Magnesium | 7439-95-4 | 10 | mg/kg | 2280 | 2290 | 0.0 | 0% - 20% |
| | | ED093S: Sodium | 7440-23-5 | 10 | mg/kg | 3300 | 3330 | 1.0 | 0% - 20% |
| | | ED093S: Potassium | 7440-09-7 | 10 | mg/kg | 1120 | 1120 | 0.0 | 0% - 20% |

## Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **SOIL**

| | | | | Method Blank (MB) Report | Laboratory Control Spike (LCS) Report | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Spike | Spike Recovery (%) | Recovery Limits (%) | |
| Method: Compound | CAS Number | LOR | Unit | Result | Concentration | LCS | Low | High |
| **ED040S: Soluble Major Anions (QCLot: 3908337)** | | | | | | | | |
| ED040S: Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | <10 | 750 mg/kg | 95.4 | 80 | 120 |
| **ED045G: Chloride by Discrete Analyser (QCLot: 3908338)** | | | | | | | | |
| ED045G: Chloride | 16887-00-6 | 10 | mg/kg | <10 | 50 mg/kg | 104 | 75 | 125 |
| | | | | ---- | 5000 mg/kg | 104 | 79 | 117 |
| **ED093S: Soluble Major Cations (QCLot: 3908340)** | | | | | | | | |
| ED093S: Calcium | 7440-70-2 | 10 | mg/kg | <10 | 250 mg/kg | 99.5 | 82 | 118 |
| ED093S: Magnesium | 7439-95-4 | 10 | mg/kg | <10 | 250 mg/kg | 103 | 84 | 114 |
| ED093S: Sodium | 7440-23-5 | 10 | mg/kg | <10 | 250 mg/kg | 88.4 | 80 | 112 |
| ED093S: Potassium | 7440-09-7 | 10 | mg/kg | <10 | 250 mg/kg | 95.7 | 80 | 120 |

## Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **SOIL**

| | | | | Matrix Spike (MS) Report | | | |
|---|---|---|---|---|---|---|---|
| | | | | Spike | SpikeRecovery(%) | Recovery Limits (%) | |
| Laboratory sample ID | Client sample ID | Method: Compound | CAS Number | Concentration | MS | Low | High |
| **ED045G: Chloride by Discrete Analyser (QCLot: 3908338)** | | | | | | | |
| ES1508691-002 | Anonymous | ED045G: Chloride | 16887-00-6 | 1250 mg/kg | 119 | 70 | 130 |

## Matrix Spike (MS) and Matrix Spike Duplicate (MSD) Report

The quality control term Matrix Spike (MS) and Matrix Spike Duplicate (MSD) refers to intralaboratory split samples spiked with a representative set of target analytes. The purpose of these QC parameters are to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **SOIL**

| | | | | Matrix Spike (MS) and Matrix Spike Duplicate (MSD) Report | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Spike | Spike Recovery (%) | | Recovery Limits (%) | | RPDs (%) | |
| Laboratory sample ID | Client sample ID | Method: Compound | CAS Number | Concentration | MS | MSD | Low | High | Value | Control Limit |
| **ED045G: Chloride by Discrete Analyser (QCLot: 3908338)** | | | | | | | | | | |
| ES1508691-002 | Anonymous | ED045G: Chloride | 16887-00-6 | 1250 mg/kg | 119 | ---- | 70 | 130 | ---- | ---- |

ALS Environmental

# INTERPRETIVE QUALITY CONTROL REPORT

| | | | |
|---|---|---|---|
| Work Order | : **ES1508739** | Page | : 1 of 5 |
| Client | : ENVIROWEST CONSULTING | Laboratory | : Environmental Division Sydney |
| Contact | : MS LEAH DESBOROUGH | Contact | : Client Services |
| Address | : 9 CAMERON PLACE<br>PO BOX 8158<br>ORANGE NSW, AUSTRALIA 2800 | Address | : 277-289 Woodpark Road Smithfield NSW Australia 2164 |
| E-mail | : leah@envirowest.net.au | E-mail | : sydney@alsglobal.com |
| Telephone | : +61 63614954 | Telephone | : +61-2-8784 8555 |
| Facsimile | : +61 02 63603960 | Facsimile | : +61-2-8784 8500 |
| Project | : 5809-1 | QC Level | : NEPM 2013 Schedule B(3) and ALS QCS3 requirement |
| Site | : 5809-1 | | |
| C-O-C number | : 5809-1 | Date Samples Received | : 17-APR-2015 |
| Sampler | : ---- | Issue Date | : 24-APR-2015 |
| Order number | : 5809-1 | | |
| | | No. of samples received | : 4 |
| Quote number | : SY/542/14 | No. of samples analysed | : 4 |

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Interpretive Quality Control Report contains the following information:

- Analysis Holding Time Compliance
- Quality Control Parameter Frequency Compliance
- Brief Method Summaries
- Summary of Outliers

# Analysis Holding Time Compliance

This report summarizes extraction / preparation and analysis times and compares each with recommended holding times (USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

| Method | | Sample Date | Extraction / Preparation | | | Analysis | | |
|---|---|---|---|---|---|---|---|---|
| Container / Client Sample ID(s) | | | Date extracted | Due for extraction | Evaluation | Date analysed | Due for analysis | Evaluation |
| **EA055: Moisture Content** | | | | | | | | |
| **Soil Glass Jar - Unpreserved (EA055-103)** | | | | | | | | |
| MW1-100,<br>BH14-100, | MW1-500,<br>BH14-500 | **31-MAR-2015** | ---- | ---- | ---- | **20-APR-2015** | 14-APR-2015 | × |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| **Soil Glass Jar - Unpreserved (ED040S)** | | | | | | | | |
| MW1-100,<br>BH14-100, | MW1-500,<br>BH14-500 | **31-MAR-2015** | **22-APR-2015** | 28-APR-2015 | ✓ | **22-APR-2015** | 20-MAY-2015 | ✓ |
| **ED045G: Chloride Discrete analyser** | | | | | | | | |
| **Soil Glass Jar - Unpreserved (ED045G)** | | | | | | | | |
| MW1-100,<br>BH14-100, | MW1-500,<br>BH14-500 | **31-MAR-2015** | **22-APR-2015** | 28-APR-2015 | ✓ | **22-APR-2015** | 20-MAY-2015 | ✓ |
| **ED093S: Soluble Major Cations** | | | | | | | | |
| **Soil Glass Jar - Unpreserved (ED093S)** | | | | | | | | |
| MW1-100,<br>BH14-100, | MW1-500,<br>BH14-500 | **31-MAR-2015** | **22-APR-2015** | 27-SEP-2015 | ✓ | **22-APR-2015** | 27-SEP-2015 | ✓ |

## Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **SOIL**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

| Quality Control Sample Type | | Count | | Rate (%) | | | Quality Control Specification |
|---|---|---|---|---|---|---|---|
| *Analytical Methods* | *Method* | *QC* | *Regular* | ***Actual*** | ***Expected*** | *Evaluation* | |
| **Laboratory Duplicates (DUP)** | | | | | | | |
| Cations - soluble by ICP-AES | ED093S | 1 | 5 | **20.0** | **10.0** | ✓ | NEPM 2013 Schedule B(3) and ALS QCS3 requirement |
| Chloride Soluble By Discrete Analyser | ED045G | 1 | 5 | **20.0** | **10.0** | ✓ | NEPM 2013 Schedule B(3) and ALS QCS3 requirement |
| Major Anions - Soluble | ED040S | 1 | 5 | **20.0** | **10.0** | ✓ | NEPM 2013 Schedule B(3) and ALS QCS3 requirement |
| Moisture Content | EA055-103 | 2 | 20 | **10.0** | **10.0** | ✓ | NEPM 2013 Schedule B(3) and ALS QCS3 requirement |
| **Laboratory Control Samples (LCS)** | | | | | | | |
| Cations - soluble by ICP-AES | ED093S | 1 | 5 | **20.0** | **5.0** | ✓ | NEPM 2013 Schedule B(3) and ALS QCS3 requirement |
| Chloride Soluble By Discrete Analyser | ED045G | 2 | 5 | **40.0** | **10.0** | ✓ | NEPM 2013 Schedule B(3) and ALS QCS3 requirement |
| Major Anions - Soluble | ED040S | 1 | 5 | **20.0** | **5.0** | ✓ | NEPM 2013 Schedule B(3) and ALS QCS3 requirement |
| **Method Blanks (MB)** | | | | | | | |
| Cations - soluble by ICP-AES | ED093S | 1 | 5 | **20.0** | **5.0** | ✓ | NEPM 2013 Schedule B(3) and ALS QCS3 requirement |
| Chloride Soluble By Discrete Analyser | ED045G | 1 | 5 | **20.0** | **5.0** | ✓ | NEPM 2013 Schedule B(3) and ALS QCS3 requirement |
| Major Anions - Soluble | ED040S | 1 | 5 | **20.0** | **5.0** | ✓ | NEPM 2013 Schedule B(3) and ALS QCS3 requirement |
| **Matrix Spikes (MS)** | | | | | | | |
| Chloride Soluble By Discrete Analyser | ED045G | 1 | 5 | **20.0** | **5.0** | ✓ | NEPM 2013 Schedule B(3) and ALS QCS3 requirement |

## Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

| Analytical Methods | Method | Matrix | Method Descriptions |
|---|---|---|---|
| Moisture Content | EA055-103 | SOIL | In-house. A gravimetric procedure based on weight loss over a 12 hour drying period at 103-105 degrees C. This method is compliant with NEPM (2013) Schedule B(3) Section 7.1 and Table 1 (14 day holding time). |
| Major Anions - Soluble | ED040S | SOIL | In-house. Soluble Anions are determined off a 1:5 soil / water extract by ICPAES. |
| Chloride Soluble By Discrete Analyser | ED045G | SOIL | In house: Referenced to APHA 21st edition 4500-Cl- E. The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride.in the presence of ferric ions the librated thiocynate forms highly-coloured ferric thiocynate which is measured at 480 nm. Analysis is performed on a 1:5 soil / water leachate. |
| Cations - soluble by ICP-AES | ED093S | SOIL | In house: Referenced to APHA 21st ed., 3120; USEPA SW 846 - 6010 (ICPAES) Water extracts of the soil are analyzed for major cations by ICPAES. The ICPAES technique ionises samples in a plasma, emitting a characteristic spectrum based on metals present. Intensities at selected wavelengths are compared against those of matrix matched standards. This method is compliant with NEPM (2013) Schedule B(3) |

| Preparation Methods | Method | Matrix | Method Descriptions |
|---|---|---|---|
| 1:5 solid / water leach for soluble analytes | EN34 | SOIL | 10 g of soil is mixed with 50 mL of distilled water and tumbled end over end for 1 hour. Water soluble salts are leached from the soil by the continuous suspension. Samples are settled and the water filtered off for analysis. |

# Summary of Outliers

## Outliers : Quality Control Samples

The following report highlights outliers flagged in the Quality Control (QC) Report. Surrogate recovery limits are static and based on USEPA SW846 or ALS-QWI/EN/38 (in the absence of specific USEPA limits). This report displays QC Outliers (breaches) only.

### Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

- **For all matrices, no Method Blank value outliers occur.**
- **For all matrices, no Duplicate outliers occur.**
- **For all matrices, no Laboratory Control outliers occur.**
- **For all matrices, no Matrix Spike outliers occur.**

### Regular Sample Surrogates

- **For all regular sample matrices, no surrogate recovery outliers occur.**

## Outliers : Analysis Holding Time Compliance

This report displays Holding Time breaches only. Only the respective Extraction / Preparation and/or Analysis component is/are displayed.

Matrix: **SOIL**

| *Method* | | *Extraction / Preparation* | | | *Analysis* | | |
|---|---|---|---|---|---|---|---|
| **Container** / Client Sample ID(s) | | *Date extracted* | *Due for extraction* | **Days overdue** | *Date analysed* | *Due for analysis* | **Days overdue** |
| **EA055: Moisture Content** | | | | | | | |
| **Soil Glass Jar - Unpreserved** | | | | | | | |
| MW1-100, | MW1-500, | ---- | ---- | ---- | 20-APR-2015 | 14-APR-2015 | **6** |
| BH14-100, | BH14-500 | | | | | | |

## Outliers : Frequency of Quality Control Samples

The following report highlights breaches in the Frequency of Quality Control Samples.

- **No Quality Control Sample Frequency Outliers exist.**

# Chain of Custody Form – Ref 5809-1



| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Ref:** | **5809-1** | | Sample matrix | | | Sample preservation | | | Analysis | | | | | |
| Investigator: | Envirowest Consulting<br>9 Cameron Place<br>PO Box 8158<br>ORANGE NSW 2800 | | | | | | | | ALS Method Code | | | | | |
| Telephone: | (02) 6361 4954 | | | | | | | | | | | **NT-1S** | **NT-2S** | |
| **Email:** | **leah@envirowest.net.au** | | | | | | | | | | | | | |
| Contact Person: | Leah Desborough | | | | | | | | | | | | | |
| **Laboratory:** | Australian Laboratory Services<br>277 Woodpark Road<br>SMITHFIELD NSW 2164 | | Water | Soil | Sludge | Cool | HNO3/HCl | Unpre-served | | | | CEC | Sulphates & chlorides | |
| **Quotation #:** | **SY-542-14** | | | | | | | | | | | | | |
| **Courier/CN:** | | | | | | | | | | | | | | |
| **Sample ID** | **Container*** | **Sampling Date/Time** | | | | | | | | | | | | |
| 1 MW1-100 | X | 31/3/2015 | | X | | X | | | | | | X | X | |
| 2 MW1-500 | X | 31/3/2015 | | X | | X | | | | | | X | X | |
| 3 BH14-100 | X | 31/3/2015 | | X | | X | | | | | | X | X | |
| 4 BH14-500 | X | 31/3/2015 | | X | | X | | | | | | X | X | |

Environmental Division
Sydney
Work Order
**ES1508739**

Telephone : + 61-2-8784 8555

| | |
|---|---|
| Investigator: I attest that the proper field sampling procedures were used during the collection of these samples. | Sampler name: Leah Desborough<br>Date : 31/3/2015Time: |
| Relinquished by: (print and signature) Leah Desborough — Date 16/4/2015 — Time 17:00 | Received by: (print and signature) David — Date 17/4 — Time 0800 |

Please return completed form to Envirowest Consulting

*A = 200mL solvent rinsed glass jar with Teflon lined lid, B = 2x40mL vials solvent rinsed Teflon lined septum caps, C 1x500mL glass bottles , solvent rinsed, Teflon lined cap, D= 200mL plastic bottle with nitric acid. E = 125ml amber bottle unpreserved

**Appendix 5.** Sampling logs

## Sampling log

| | |
|---|---|
| Client | Highview Country Estates Pty Limited |
| Contact | Brett Anderson |
| Job number | 5809 |
| Location | Lot 172 DP753233 Blackbutt Road, Dubbo NSW |
| Date | 28 October 2015 |
| Investigator(s) | Leah Desborough |
| Weather conditions | Fine and hot |

| Sample id | Matrix | Date | Analysis required | Observations/comments |
|---|---|---|---|---|
| HV1 | Soil | 28/10/2015 | Total recoverable hydrocarbons (TRH C6-C40), benzene, toluene, ethylbenzene, xylenes, naphthalene (BTEXN) | |
| HV2 | Soil | 28/10/2015 | TRH, BTEXN | |
| HV3 | Soil | 28/10/2015 | TRH, BTEXN | |
| HV4 | Soil | 28/10/2015 | TRH, BTEXN | |
| HV5 | Soil | 28/10/2015 | TRH, BTEXN | |
| HV6 | Soil | 28/10/2015 | TRH, BTEXN, zinc | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**Appendix 6.** Unexpected finds protocol

# Unexpected finds procedure

Lot 172 DP753233 Blackbutt Road, Dubbo NSW

Ref: R5809uf
Date: 8 December 2015

Envirowest Consulting Pty Ltd ABN 18 103 955 246
• 9 Cameron Place, PO Box 8158, Orange NSW 2800 • Tel (02) 6361 4954 •
• Fax (02) 6360 3960 • Email admin@envirowest.net.au • Web www.envirowest.net.au •
Environmental
Geotechnical
Asbestos
Services

| | |
|---|---|
| Client: | Highview Country Estates Pty Ltd<br>c/- Geolyse Pty Ltd<br>PO Box 1842<br>Dubbo NSW 2830 |
| Assessor: | Leah Desborough BNatRes (Hons)<br>Senior Environmental Scientist |
| Checked by: | Greg Madafiglio PhD<br>Senior Environmental Scientist |
| Authorising Officer: | Greg Madafiglio PhD<br>Senior Environmental Scientist |
| Interested authorities: | Dubbo City Council |
| Report number: | R5809uf |
| Date: | 8 December 2015 |

## 1. Introduction

Investigations have been undertaken including soil sampling, building material sampling and analysis to evaluate the contamination status of Lot 172 DP753233 Blackbutt Road, Dubbo NSW. The investigations identified the presence of asbestos cement sheeting in stockpiles, soil and on the surface of the site. Remediation of the site was completed in November 2015 with no asbestos cement material identified on the surface of the site following the remediation works.

It is possible but unlikely additional unidentified contamination including asbestos cement sheeting is located on the site. This unidentified contamination may be identified during site development works.

A procedure describing the actions if potential contamination is encountered during excavation/construction activities will enable the find to be managed and controls to be implemented to reduce the risk of impact on human health.

## 2. Scope

Prepare a procedure to enable the identification and management of unexpected contamination identified during site development works.

## 3. Site identification

The site is the 98 hectare property described as Lot 172 DP753233 Blackbutt Road, Dubbo NSW.

## 4. Responsible person

The landowner is responsible for implementation of the unexpected finds procedure. The landowner will appoint an environmental scientist to induct and provide information on hazard identification and responses to earthwork supervisors and personnel which may uncover unexpected hazards.

## 5. Identification of unexpected hazards

Asbestos cement sheeting and fragments are a hazard with potential to be located on the site. Asbestos cement sheeting and fragments can be suspected based on appearance. Other potential hazards identified by appearance and odour include:

- A filled pit or gully
- Demolition waste
- Discoloured soil
- Oil/diesel/tar
- Sheens on water
- An offensive odour
- Underground storage tank

## 6. Training and induction

All excavation/construction personnel are to be inducted on the identification of potential hazards. The induction can be undertaken at the time of general site induction and toolbox meetings. The training will include display of Appendix 1 to alert worker of potential hazards.

## 7. Procedure

If potential contaminated soil/material is encountered during excavation/construction the following procedures will be undertaken:

- Stop work in the potentially hazardous area
- Assess worker safety and determine if evacuation or emergency services need to be contacted
- Delineate the potentially hazardous area and identify by fencing or bunding
- Contact the environmental consultant for advice and request a visit to assess the hazard
- Works can recommence outside the hazardous area

## 8. Recommencement of works

The potential hazards will be assessed by the environmental scientist and a report prepared describing:

- Preliminary assessment of the contamination and need for cleanup
- Preparation of a remediation action plan
- All works to be undertaken in accordance with contaminated site regulations and guidelines
- Remediation works
- Validation of the remediation
- Works can commence on the potentially hazardous area after the environmental scientist has provided a clearance.

**Appendix 1**. Information to assist workers in identifying hazards.

# BE AWARE

# UNEXPECTED HAZARDS INCLUDING ASBESTOS CEMENT FRAGMENTS MAY BE PRESENT

## If you SEEor SMELL anything unusual

## STOP WORK and contact the Site Foreman

## Do not restart working before the area has been investigated and cleared by an Environmental Consultant

ABORIGINAL SCARRED TREE RECORDED WITHIN STUDY AREA.

## ABORIGINAL ARCHAEOLOGICAL ASSESSMENT

# BAWD HOLDINGS PTY LTD PROPOSED SUBDIVISION OF LOT 172 DP753233 BLACKBUTT ROAD DUBBO NSW

DUBBO LOCAL GOVERNMENT AREA

SEPTEMBER 2015

REPORT PREPARED BY

OZARK ENVIRONMENTAL & HERITAGE MANAGEMENT PTY LTD

FOR GEOLYSE PTY LTD

ON BEHALF OF MR BRETT ANDERSON


Environmental and
Heritage Management P/L

OzArk EHM
145 Wingewarra St
(PO Box 2069)
Dubbo NSW 2830

Phone: (02) 6882 0118
Fax: (02) 6882 0630
jodie@ozarkehm.com.au
phil@ozarkehm.com.au
www.ozarkehm.com.au

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# DOCUMENT CONTROLS

| | | | |
|---|---|---|---|
| Proponent | Mr Brett Anderson | | |
| Client | Geolyse Pty Ltd | | |
| Project No / Purchase Order No | | | |
| Document Description | Aboriginal Archaeological Assessment: *BAWD Holdings Pty Ltd Proposed Subdivision of Lot 172 DP753233 Blackbutt Road, Dubbo LGA.* | | |
| | Name | Signed | Date |
| Clients Reviewing Officer | | | |
| Clients Representative Managing this Document | | OzArk Person(s) Managing this Document | |
| Matthew Thorne | | Phillip Cameron | |
| Location | | OzArk Job No. | |
| OzArk EHM Data \ Clients \ Geolyse Consulting – Dubbo \ BAWD_Holdings_March2015 \ Heritage | | #1187 | |
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| Prepared For | | Prepared By | |
| Matthew Thorne<br>Town Planner / Registered Surveyor / Director<br>Geolyse Pty Ltd<br>1st Floor, 62 Wingewarra Street<br>Dubbo NSW 2830<br>P: 02 6884 1525<br>F: 02 6884 1470<br>E: mthorne@geolyse.com | | Dr Chris Lovell<br>Senior Archaeologist<br>OzArk Environmental & Heritage Management Pty. Limited<br>145 Wingewarra Street (PO Box 2069)<br>Dubbo NSW 2830<br>P: 02 6882 0118<br>F: 02 6882 6030<br>E: chris@ozarkehm.com.au | |

**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 Mr Brett Anderson (the Proponent) to complete an Aboriginal Heritage Assessment of Lot 172 DP 753233 located on Blackbutt Road, Dubbo NSW (the Study Area). The Proponent is preparing a Development Application for the residential subdivision of Lot 172 DP 753233 into a low-density housing development. The Study Area encompasses approximately 100 hectares of semi-rural land.

On Tuesday 14 April 2015 OzArk Senior Archaeologist Chris Lovell, together with Aboriginal community representatives Shim Smith (Tubba-Gah Aboriginal Corporation) and Terry Toomey (Dubbo Local Aboriginal Land Council), conducted a pedestrian and vehicular survey of the Study Area. Sections of the Study Area with landforms possessing archaeological potential were inspected on foot. All areas of exposure were checked for archaeological material. Two Aboriginal sites were recorded within the Study Area (BR-IF1 and BR-ST1) and two previously recorded sites CR-OS-1 (#36-1-0523) and CR-ST-1 (#36-1-0525) were not able to be located.

Recommendations concerning the Study Area are as follows:

1. The current assessment determines that no further archaeological investigation is warranted at sites BR-IF1, BR-ST1, CR-OS-1 (#36-1-0523) and CR-ST-1 (#36-1-0525).
2. The Proponent should seek to avoid impact to all recorded Aboriginal sites (BR-IF1, BR-ST1) and ensure that CR-OS-1 [#36-1-0523] and CR-ST-1 [#36-1-0525] remain outside the impact area. If sites are to be avoided, they should be identified by suitable, high visibility curtilage to avoid inadvertent impacts during the completion of proposed works.
3. The current assessment recommends that long-term management of BR-ST1 will entail its protection and preservation.
4. Should impacts to any site be unavoidable, an Aboriginal Heritage Impact Permit (AHIP) must be sought from the Office of Environment and Heritage (OEH) to allow impacts to those sites. Archaeological recommendations for the AHIP application would be:
    a. If site BR-IF1 is to be impacted, the site should be salvaged through a surface collection of artefacts under supervision of an archaeologist or trained cultural heritage field workers from the Aboriginal community.
    b. Should site CR-ST-1 be located, it is recommended that the tree and scar be archivally recorded prior to any impacts.
    c. No program of sub-surface salvage is recommended for BR-IF1 as OzArk and Aboriginal community representatives have assessed the site as having low potential for associated potential archaeological deposits.
    d. 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 the Aboriginal Heritage Information Management System (AHIMS).

5. All land-disturbing activities must be confined to within the assessed Study Area.
6. 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.
7. In the unlikely event that objects are encountered that are suspected to be of Aboriginal origin (including skeletal material), the Unanticipated Finds Protocol (**Appendix 4**) should be followed.

# CONTENTS

## FIGURES



## TABLES



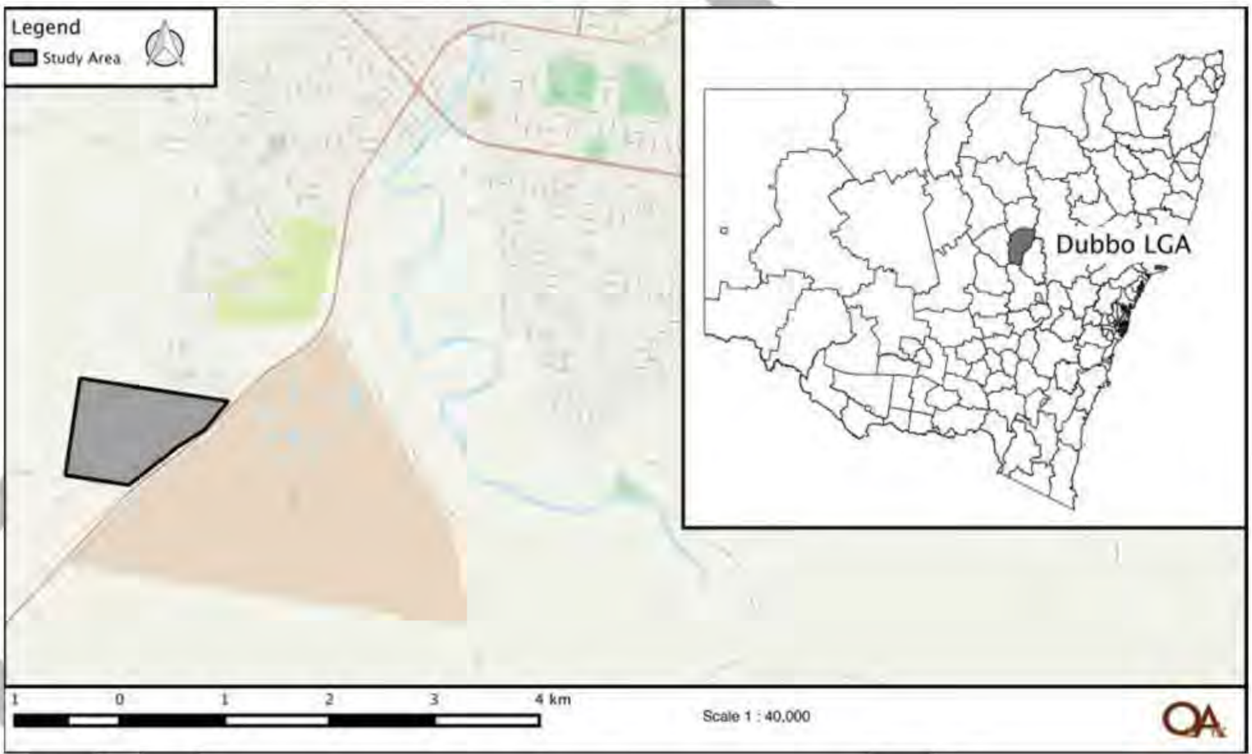
## PLATES

# 1 INTRODUCTION

## 1.1 BRIEF DESCRIPTION OF THE PROPOSAL

OzArk Environmental & Heritage Management (OzArk) have been engaged by Geolyse Pty Ltd (the Client), on behalf of Mr Brett Anderson (the Proponent) to complete an Aboriginal archaeological assessment at the site of a proposed subdivision of approximately 100 hectares of semi-rural land (Lot 172 DP 753233 located on Blackbutt Road (the Study Area), Dubbo NSW) within the Dubbo Local Government Area (LGA) into a low-density housing development (see **Figure** 1-1).

**Figure 1-1: Location map.**




## 1.2 STUDY AREA

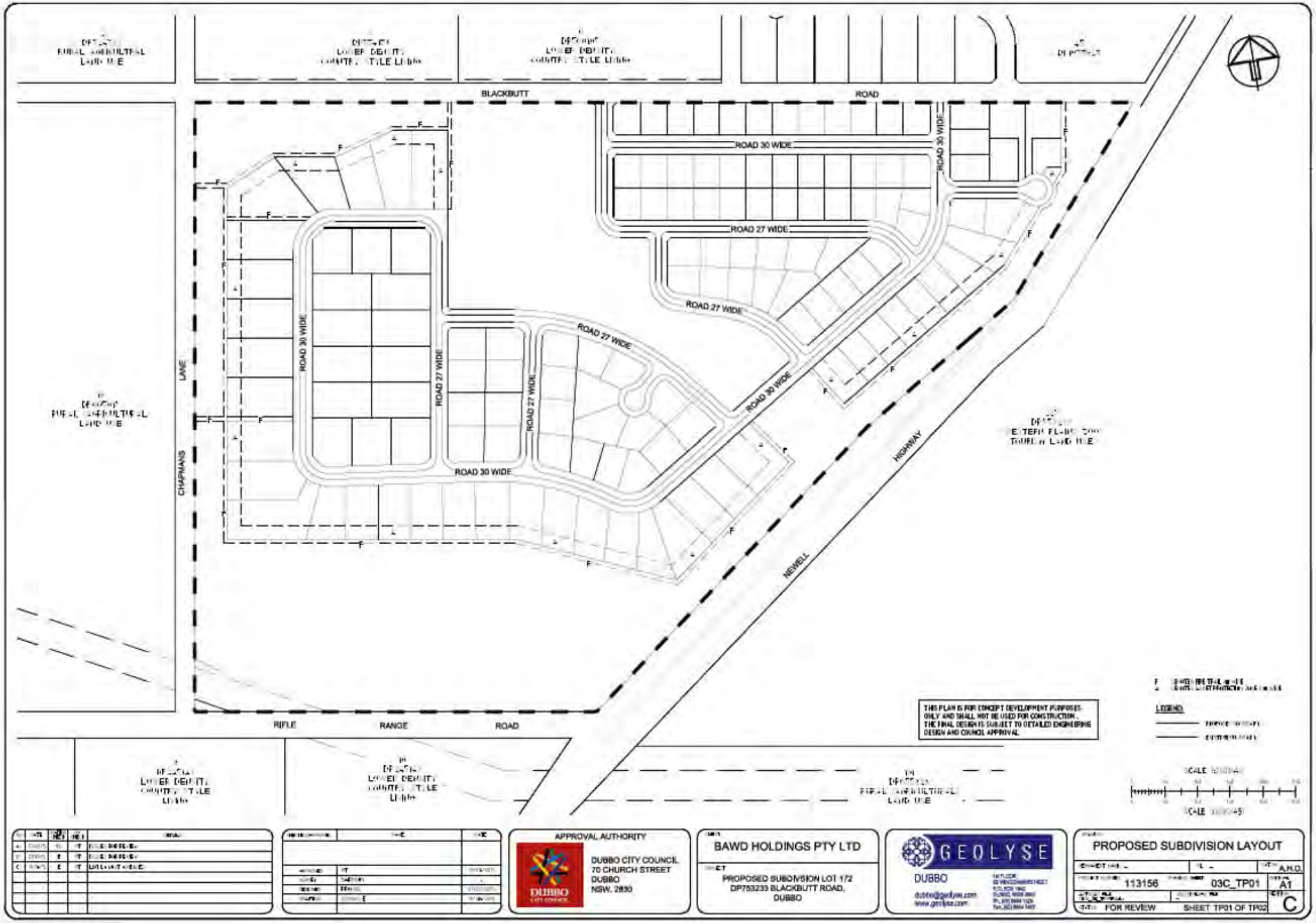
The Study Area comprises an area of ca. 100 hectares encompassing Lot 172 of DP 753233, Boundary Road, Dubbo NSW (**Figure 1-2**). The Study Area is situated on the south-western outskirts of Dubbo township adjacent to the Newell Highway, Blackbutt Road and Rifle Range Road. The eastern boundary is adjacent to the Taronga Western Plains Zoo. Part of the northern boundary is adjacent to a low-density residential housing estate. The remainder of the northern boundary and the southern boundary adjoin several rural-residential lots, and the western boundary adjoins a low intensity rural agricultural property.

**Figure 1-2: Aerial view of the Study Area.**


## 1.3 PROPOSED WORKS

The Proponent seeks to subdivide Lot 172 of DP 753233, Blackbutt Road, Dubbo NSW (the Study Area) into low-density residential lots in keeping with residential zones northwest of the Study Area. The subdivision is designed to create lots of various sizes. **Figure 1-3** provides a concept layout for the proposed subdivision; however it is likely that the final design of the subdivision within the Study Area will be contingent on the findings contained herein. For the purpose of this report, the proposed subdivision will be assessed as causing total destruction to the environment on all lots which are sold as part of the proposed works and all public roads, with areas of native vegetation to be retained and enhanced where possible.

**Figure 1-3: Proposed subdivision layout.**



## 1.4 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.

### 1.4.1 State Legislation

***Environmental Planning and Assessment Act 1979*** (EP&A Act)

This Act established requirements relating to land use and planning. The framework governing environmental and heritage assessment in NSW is contained within the following parts of the EP&A 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 which 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 Office of Environment and Heritage (OEH) Director-General of the location of an Aboriginal object. Identified Aboriginal items and sites are registered on the Aboriginal Heritage Information Management System (AHIMS).

### 1.4.2 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.

### 1.4.3 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.

## 1.5 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* (Due Diligence; DECCW 2010b) and the *Code of Practice for the Investigation of Aboriginal Objects in New South Wales* (Code of Practice; DECCW 2010a).

The current assessment will apply Due Diligence to those portions of the Study Area to which it is determined appropriate, and ensure that those areas which require further investigation as per the Code of Practice 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 Due Diligence (DECCW 2010b) and the Code of Practice (DECCW 2010a) in the completion of an Aboriginal archaeological assessment, in order to meet the following objectives:

**Objective One**: Relocate previously recorded sites CR-OS-1 (#36-1-0523) and CR-ST-1 (#36-1-0525) in order to assess and record their current status and distribution;

**Objective Two**: Identify and record any other Aboriginal objects, sites and sensitive landforms within the Study Area; and

**Objective Three**: 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 14 April 2015.

## 2.3 ABORIGINAL COMMUNITY INVOLVEMENT

Dubbo Local Aboriginal Land Council (DLALC) and Tubba-Gah Aboriginal Corporation were contacted by OzArk on behalf of the Proponent on 1 April 2015 to request attendance for the survey. Terry Toomey attended the fieldwork on behalf of DLALC and Shim Smith on behalf of Tubba-Gah Aboriginal Corporation. A log and copies of correspondence with Aboriginal community stakeholders is presented in **Appendix 1**.

## 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: Chris Lovell.
- Reviewer: Ben Churcher (OzArk Principal Archaeologist, BA[Hons], University of Queensland, Dip Ed, 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

The Study Area falls within the Brigalow Belt South Bioregion, within the Pilliga ecosystem, and is comprised wholly of the Goonoo Slopes landscape unit (Mitchell 2002: 10). The topography of Goonoo Slopes is characterised by extensive undulating to stepped low hills, long westerly slopes and poorly defined drainage networks (Mitchell 2002: 10). General elevation across this landscape type ranges from 300 to 500 meters, with a local relief of up to 30 meters. The topography of the Study Area consists of long low degree hill slopes receding towards an unnamed ephemeral drainage line bisecting the property in a north-south alignment.

## 3.2 GEOLOGY AND SOILS

The geology of the Goonoo Slopes features sandstone, conglomerates, siltstone, shale and coal. Sedimentology of the Goonoo Slopes is defined by stony yellow earths with sandstone outcrops on ridgelines, and yellow harsh texture-contrast soils in shallow valleys (Mitchell 2002: 10). The soil of the Study Area was assessed as a red, coarse, sandy loam that was highly friable. Across the Study Area organic A-Horizons have been highly or entirely eroded, leaving compacted basal deposits exposed.

## 3.3 HYDROLOGY

Hydrological features within the Study Area are limited to an ephemeral unnamed creek running on a north-south alignment bisecting the Study Area. The creek line has been severely impacted by erosion in the northern parts of the Study Area, which exhibits a high level of disturbance and contamination evidenced by construction related waste. A number of similar unnamed ephemeral creeks and drainage lines exist within close proximity to the Study Area, most of which have been dammed for agricultural purposes. The Macquarie River is a first order permanent water source for the region and is located approximately two kilometres east of the Study Area.

## 3.4 VEGETATION

The Study Area exhibits a moderate to high degree of disturbance due to agricultural land use (i.e. vegetation clearing, cultivation, livestock etc.); as such a proportion of the area comprises cleared grasslands (see **Plate 6**). Significant proportions of the Study Area are densely vegetated with White Cyrus Pine regrowth and remnant native Ironbark (see **Plate 7** and **8**) and Box Eucalypt woodland.

## 3.5 CLIMATE

Based on the Köppen classification, the climate consists of a sub-humid climate with mostly hot summers and no dry season. Climate statistics from Dubbo Airport, located approximately four kilometres north of the Study Area, indicate that the area has a mild climate with monthly mean temperatures ranging from 3.1°C to 33.2°C. The locality receives an average annual rainfall of 565.7 millimetres (BOM 2015).

## 3.6 LAND–USE HISTORY AND EXISTING LEVELS OF DISTURBANCE

The Study Area has experienced various levels of ground surface disturbance over the past 150 years. Most of the land has been subjected to land clearance and cultivation prior to purchase by the current landholder. As such, soil profiles have been altered and subsurface archaeological deposits are likely to have been disturbed where present. Livestock grazing is likely to have produced trampling and compaction of the ground surface. Nevertheless, a number of mature native trees exist along the drainage line, and in the southern and eastern portions of the property. Much of the vegetated portions of the Study Area comprise White Cypress Pine regrowth. Other apparent sources of ground surface disturbance include: earth moving, dumping of construction and household waste, erosion of gullies around the drainage line and the erosion of exposures across the remaining Study Area.

## 3.7 CONCLUSION

The landscape of the Study Area is likely to have been hospitable to Aboriginal people. High levels of ground surface disturbance across the entire Study Area, particularly due to vegetation clearance, cultivation and grazing, have affected the intactness of any archaeological deposits. Unobtrusive sites, such as open artefact scatters, are likely to be disturbed where present, and broad-scale vegetation clearance reduces the likelihood that culturally modified trees remain *in situ*.

# 4 ABORIGINAL ARCHAEOLOGY 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 and 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 three group names used within the Dubbo region: Wiradjuri, Dundullimal and Tubba-Gah. The Tubba-Gah and Dundullimal comprise two local sub-groups, 'clans' or mobs within the larger Wirajuri entity. The territory of the Tubba-Gah is thought to lie to the east of the Macquarie River, south of the Talbragar River and north of Eulomogo creek, whereas the Dundullimal are thought to have occupied the area to the west of the Macquarie River, including the locality encompassing the Study Area (Grounds 1983; Kelton 1995: 7-8; Koettig 1985: 21-22). Not all Indigenous community representatives agree with this division, with some arguing that the Tubba-Gah mob inhabited both sides of the Macquarie River.

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 and Dundullimal territories were 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 provided by 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 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 kilometres of Dubbo's city limits. She concluded that sites existed throughout all landscape units surveyed; artefact 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 become smaller and more sporadic near the headwaters of creeks; grinding grooves 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 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 (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.

OzArk (2002) undertook an archaeological survey of the Western Plains Zoo landholding located adjacent to the Study Area, east of the Newell Highway. Twelve new Aboriginal sites were located in addition to twenty-one previously recorded sites. Together they comprised 14 open sites, 15 scarred trees, two isolated finds, one midden and one site complex. Site distributions generally adhered to the predictive model, with: open camp sites predominantly found along creek banks or within 200 metres of the Macquarie River; scarred trees found close to water supplies; a burial site recorded in 1918 located on the gentle slope leading away from the sandy alluvial flats of the Macquarie River and associated with grinding grooves on outcropping sandstone (outcropping was not found elsewhere in the study area, and no other grooves were located); and midden material found at one site located close to the banks of the Macquarie River.

A number of smaller assessments have been undertaken over the years on Blackbutt Road (adjacent to the Study Area) and Obley Road (approximately one kilometre south-east of the Study Area) primarily for road alignment projects. Kelton (1997), Nolan (2000) and OzArk (2003), among others, have contributed to more than 50 recorded AHIMS-listed sites within the locality.

## 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 previously-recorded heritage within the Study Area. The results of this search are summarised here in **Table** 4-1 and presented in detail in **Appendix 2**.

**Table 4-1: Desktop-database search results.**

| Name of Database Searched | Date of Search | Type of Search | Comment |
|---|---|---|---|
| Australian Heritage Database | 30.04.2015 | Dubbo LGA | No places listed within Study Area |
| NSW Heritage Office State Heritage Register and State Heritage Inventory | 30.04.2015 | Dubbo LGA | No places listed within Study Area |
| National Native Title Claims Search | 30.04.2015 | NSW | No Native Title Claims cover the Study Area. |
| OEH AHIMS | 13.04.15 | Lot 172 DP 753233 with one kilometre buffer | 16 sites within the search area.<br>One site within the Study Area. |
| Dubbo Local Environment Plan of 2011 | 30.04.2015 | Schedule 5 | No places listed within Study Area. |
| S170 RMS Heritage and Conservation Register | 30.04.2015 | Western Region | No places listed within Study Area. |

A search of the OEH administered AHIMS database returned 16 records for Aboriginal heritage sites within the designated search area – see **Table 4-2** and **Figure 4-1**. One site CR-OS-1 (#36-1-0523) exists several meters from the southern boundary of Study Area, between the fence line and Rifle Range Road. Another site, CR-ST-1 (#36-1-0525), exists ca. 30 metres from the southwest boundary of the Study Area, on the corner of the Newell Highway and Rifle Range Road.

**Table 4-2: AHIMS site types and frequencies.**

| Site Type | Number | % Frequency |
|---|---|---|
| Open camp site | 6 | 38 |
| Scarred tree | 5 | 31 |
| Isolated find | 5 | 31 |
| **Total** | **16** | **100** |

**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 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 adjacent to 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, providing well-drained potential camping locations adjacent to an ephemeral waterway. Considering these factors, the likelihood of encountering evidence of Aboriginal occupation is considered high. There has, however, been a considerable amount of land use disturbance: clearing, agricultural activities, infrastructure installation, rubbish dumping and erosion. Disturbance is predicted to have impacted upon the presence (in the case of scarred trees) and integrity (in the case of archaeological deposits) of potentially occurring Aboriginal sites. 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 NPW Act via the Omnibus Bill. As of October 2010, Due Diligence (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 Mr Brett Anderson 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 172 DP 753233 Blackbutt 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:**

> **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) No. There are no previously recorded sites within the proposed impact footprint although two sites are within close proximity (see **Section 4.3.1**; **Appendix 2**).

b) No. Discussions with local Aboriginal community representatives Shim Smith and Terry Toomey suggested that there are many sites within the general area, but none necessarily specifically located within the Study Area. During the field assessment, Aboriginal community representatives provided no additional information regarding the cultural significance of the Study Area.

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.

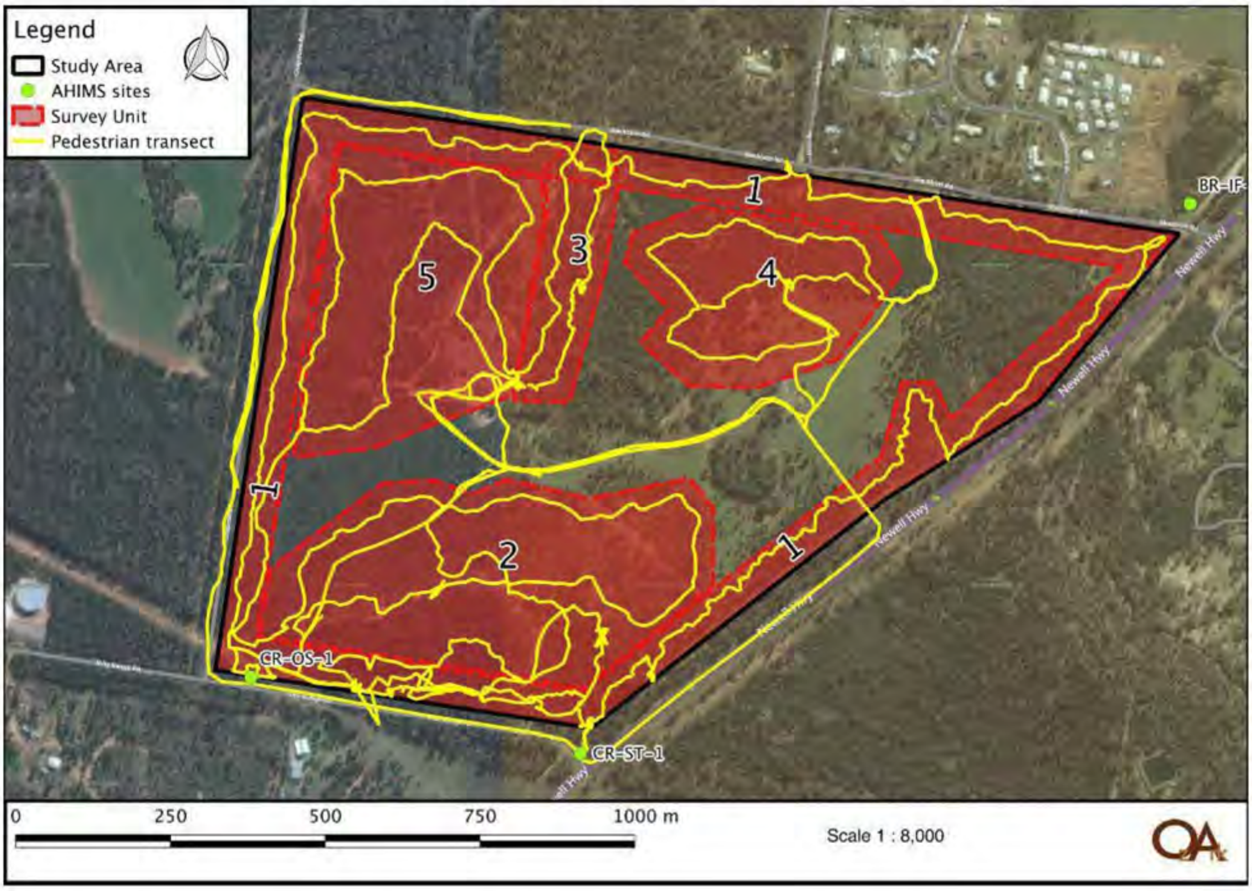
Parts of the Study Area overlap with relevant landscape features. The Proponent elected to apply the precautionary principle and proceed to visual inspection of the Study Area in order to ground-truth the findings of the above desktop level assessment with Aboriginal community participation (see **Section 6**).

# 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 (Burke and Smith 2004) to ground-truth existing levels of disturbance and to locate previously recorded sites CR-OS-1 (#36-1-0523) and CR-ST-1 (#36-1-0525). 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. Survey units were based upon landscape features and arbitrary search areas: the perimeter of the Study Area (survey unit 1); the southern portions of the Study Area (survey unit 2); areas adjacent to the waterway bisecting the Study Area in the north-south orientation (survey unit 3); the north-eastern parts of the Study Area (survey unit 4); the north-western part of the Study Area (survey unit 5). Sections of the Study Area that did not contain relevant landscape features were assessed on vehicle and intermittently on foot as a precautionary measure. 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 locate sites CR-OS-1 (#36-1-0523) and CR-ST-1 (#36-1-0525) as per location coordinates recorded on AHIMS.

**Figure 6-1: Vehicular and pedestrian survey transects of the Study Area and associated survey units.**



## 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 lead 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 near zero in areas of extensive grass cover to good in areas of exposure. Visibility and exposure ranged from 10 to 35 per cent (see **Table 6-1**). Refer to **Plates 6** to **8** for photographs of the Study Area.

**Table 6-1: Survey coverage data.**

| 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) |
|---|---|---|---|---|---|---|
| 1 | Undulating plain | 240,000 | 25 | 10 | 6000 | 2.5 |
| 2 | Undulating plain | 180,000 | 25 | 10 | 4500 | 2.5 |
| 3 | Drainage line | 43,000 | 35 | 20 | 3010 | 7 |
| 4 | Undulating plain | 93,000 | 25 | 10 | 2325 | 2.5 |
| 5 | Undulating plain | 150,000 | 25 | 10 | 3750 | 2.5 |

**Table 6-2: Landform Summary—Sampled Areas.**

| Landform | Landform area (sq m) | Area Effectively Surveyed (sq m) (= Effective Coverage Area) | % of Landform Effectively Surveyed (= Area Effectively Surveyed / Landform x 100) | Number of Sites | Number of Artefacts or Features |
|---|---|---|---|---|---|
| Gentle slope | 663,000 | 16,575 | 2.5 | 1 | 1 |
| Drainage line | 43,000 | 3010 | 7 | 1 | 1 |

### 6.3.2 Aboriginal Sites Recorded

Two Aboriginal sites were recorded during fieldwork (**Table 6-3** and **Figure 6-2**).

**Table 6-3: Survey Results.**

| Site Number | Feature(s) | Survey Unit | Landform |
|---|---|---|---|
| BR-IF1 | Isolated find. Quartz proximal flake fragment | 1 | Undulating plain |
| BR-ST1 | Scarred tree | 3 | Drainage line |

## BR-IF1

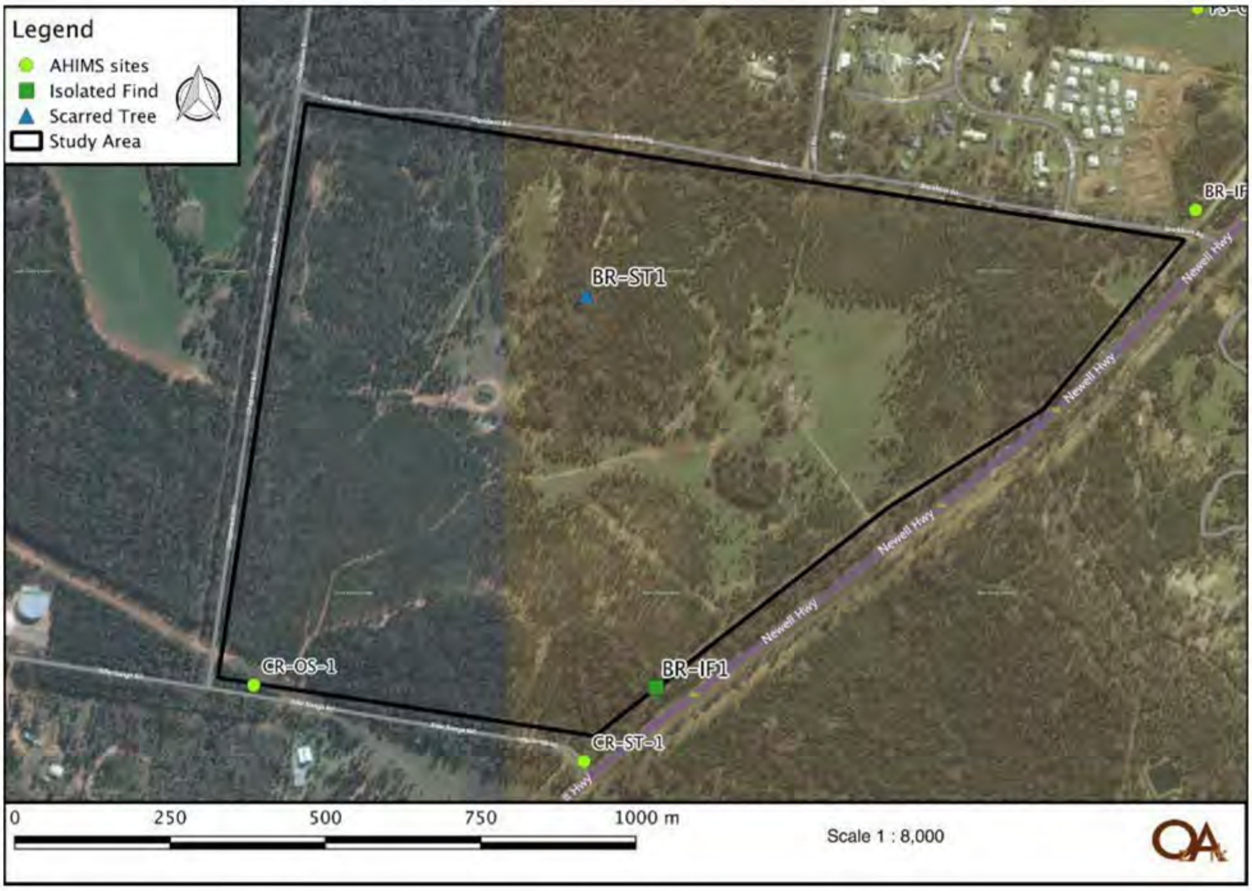
**Site Type**: Isolated Find

**GPS Coordinates**: GDA Zone 55, Easting 647380, Northing 6427282

**Location of Site**: The site is located on a low, sloping gravel roadway exposure running adjacent and parallel to the eastern boundary of the Study Area, approximately 180 metres northeast of the intersection of the Newell Highway and Rifle Range Road.

**Description of Site**: The site consists of a possible quartz proximal flake fragment ca. two centimetres (L) x one centimetres (W) x three millimetres (H) – see **Plate 1**. The site has low archaeological potential due to the disturbed context – i.e. on a gravel roadway subjected to regular vehicular traffic. White Cyprus Pine regrowth exists on either side of the roadway.

**Figure 6-2: Location of newly recorded sites in the Study Area.**




## BR-ST1

**Site Type**: Scarred Tree

**GPS Coordinates**: GDA Zone 55, Easting 647276, Northing 6427911

**Location of Site**: The site is located ca. 20 metres from the eastern bank of a drainage line that bisects the Study Area in a north-south alignment, ca. 260 metres south of where the drainage line intersects Blackbutt Road.

**Description of Site**: The site consists of an Inland Grey Box tree ca. 25 metres high and 60 centimetres in diameter with a single scar ca. one metre above the ground in a westerly orientation (see **Plate 2** and **3**). The scar is elongated ovoid ca. 100 centimetres (L) by 16 centimetres (W) by five centimetres (D) with regrowth ca. 100 centimetres (L) x five centimetres (W) x five centimetres (D). The scarring is consistent with the scarred tree assessment criteria used (see **Appendix 3**) and was recorded as an Aboriginal scarred tree with 75% confidence.

### 6.3.3 Previously recorded Aboriginal sites

During the assessment the location given in AHIMS of two sites CR-OS-1 (#36-1-0523) and CR-ST-1 (#36-1-0525) was visited. Neither site could be located. Scarred tree CR-ST-1 (#36-1-0525) no longer exists at the location provided (see **Figure 4-1** and **Figure 6-3**) within five metres of the intersection of the Newell Highway and Rifle Range Road (Kelton 2001: 40; see **Plate 4**). The tree may have been removed if the recommended consultation processes between DLALC, National Parks and Wildlife Service and the former NSW Roads & Transport Authority were followed (see Kelton 2001: 54); but this is speculation.

Open site CR-OS-1 (#36-1-0523) is described as an open artefact scatter and possible basalt stone procurement site comprising a 30 metres by seven metres scatter of stone artefacts and material between five metres of the (then) bitumen edge of Rifle Range Road and several meters (south) of the fence line defining the southern boundary of the Study Area (Kelton 2001: 45). The area immediately adjacent to the site, within the Study Area, was surveyed and no potential archaeological material detected, despite good GSV (see **Plate 5**).

**Figure 6-3: Photograph of CR-ST-1 from AHIMS site card #36-1-0525.**


### 6.3.4 Aboriginal Community Input

Aboriginal community representatives Shim Smith and Terry Toomey agreed that the areas of greatest Aboriginal archaeological potential were those adjacent to the ephemeral drainage line (survey area 3). Shim Smith located site BR-IF1, but was amenable to descriptor 'possible artefact' rather than 'definite artefact' being applied to the quartz flake.

## 6.4 DISCUSSION

The results of the survey conformed to the regional archaeological context (see **Section 4.2**) and predictive model (see **Section 4.4**). Sites were infrequent, as expected, and one site (BR-ST1) was adjacent to an ephemeral drainage line. Two sites previously recorded a few meters from the boundaries of the Study Area were unable to be located. One site (CR-ST-1) appears to have been removed, and the other site (CR-OS-1) was not detected within the Study Area although may remain extant beyond the current Study Area boundary.

## 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

The results of the significance assessment are summarised in Table 6-4.

*Social or Cultural Value*

The social and cultural value of Aboriginal sites is generally determined through consultation with Aboriginal people. Site BR-IF1 is accorded **low social and cultural value** as the site consists of an isolated find, and because the status of the quartz flake as an artefact was agreed to be indeterminate on the basis of the material type (as agreed by Aboriginal community representative Shim Smith). Site BR-ST1 is accorded **moderate-high social and cultural value** as an Aboriginal scarred tree providing a tangible link to Aboriginal ancestors and cultural practices in accordance with the views of Aboriginal community representative Shim Smith. Previously recorded site CR-ST-1 was originally accorded **low-moderate social and cultural value** by Kelton (2001: 44) in consultation with Aboriginal community representatives, due to its questionable Aboriginal origin. This assessment will remain until the site record is updated on AHIMS as being destroyed. Previously recorded site CR-OS-1 was not accorded a social or cultural value in the original assessment, but rather an overall low-moderate level of significance (Kelton 2001: 46). In the absence of further information, the site is accorded **moderate social and cultural value**.

*Archaeological/Scientific Value*

Site BR-IF1 is accorded **low archaeological value** as an isolated find on a roadway exposure that has experienced high levels of disturbance. Site BR-ST1 is a scarred tree assessed as being of Aboriginal origin. Its location ca. 25 metres from the bank of an ephemeral drainage line, suggesting moderate potential for associated intact sub-surface deposits. Scarred trees are a relatively frequent site type in the local area and the site is therefore accorded **moderate archaeological value**.

Previously located site CR-ST1 was accorded **low archaeological value** due to the questionable Aboriginal cultural origin of the scarring (Kelton 2001:44). This assessment will remain until the site record is updated on AHIMS as being destroyed. Previously located site CR-OS1 was accorded **low-moderate archaeological value** due high levels of disturbance and low integrity of deposits, and due to a scarcity of similar sites in the Dubbo area (Kelton 2001: 46).

*Aesthetic Value*

Site BR-IF1 is accorded **low aesthetic value.** The site comprises a single possible artefact located on a disturbed roadway ca. 30 metres from the Newell Highway. The landscape surrounding site BR-ST1 has been modified and subjected to rubbish dumping with significant erosion, both adjacent to the site and downstream. Nevertheless, the area possesses remnant Eucalyptus woodland vegetation and possesses significant potential for rehabilitation, which would significantly improve its aesthetic value. In its current state, BR-ST1 is assessed as holding **moderate aesthetic value**.

Previously recorded sites CR-ST-1 and CR-OS-1 were not assessed for their aesthetic value. Given that CR-ST-1 no longer exists, it is accorded **no aesthetic value** under the current assessment. Site CR-OS-1 is accorded **low aesthetic value** due to its location along the highly disturbed edge of Rifle Range Road.

*Historic Value*

There are no known historical associations with the sites BR-IF1, BR-ST1 and CR-OS-1. Therefore they are all accorded **low historic value,** while CR-ST-1 is assessed as holding nil historic value as it no longer exists.

**Table 6-4: Significance assessment.**

| Site Name | Social or Cultural Value | Archaeological / Scientific Value | Aesthetic Value | Historic Value |
|---|---|---|---|---|
| BR-IF1 | Low | Low | Low | Low |
| BR-ST1 | Moderate-High | Moderate | Moderate | Low |
| CR-ST-1 | Low-Moderate (from original assessment) | Low (from original assessment) | Nil | Nil |
| CR-OS-1 | Moderate (from original assessment) | Low-Moderate (from original assessment) | Low | Low |

## 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 on all lots sold as part of the proposed works, and along all internal roadways depicted in the current design proposal (see **Figure 1-3**).

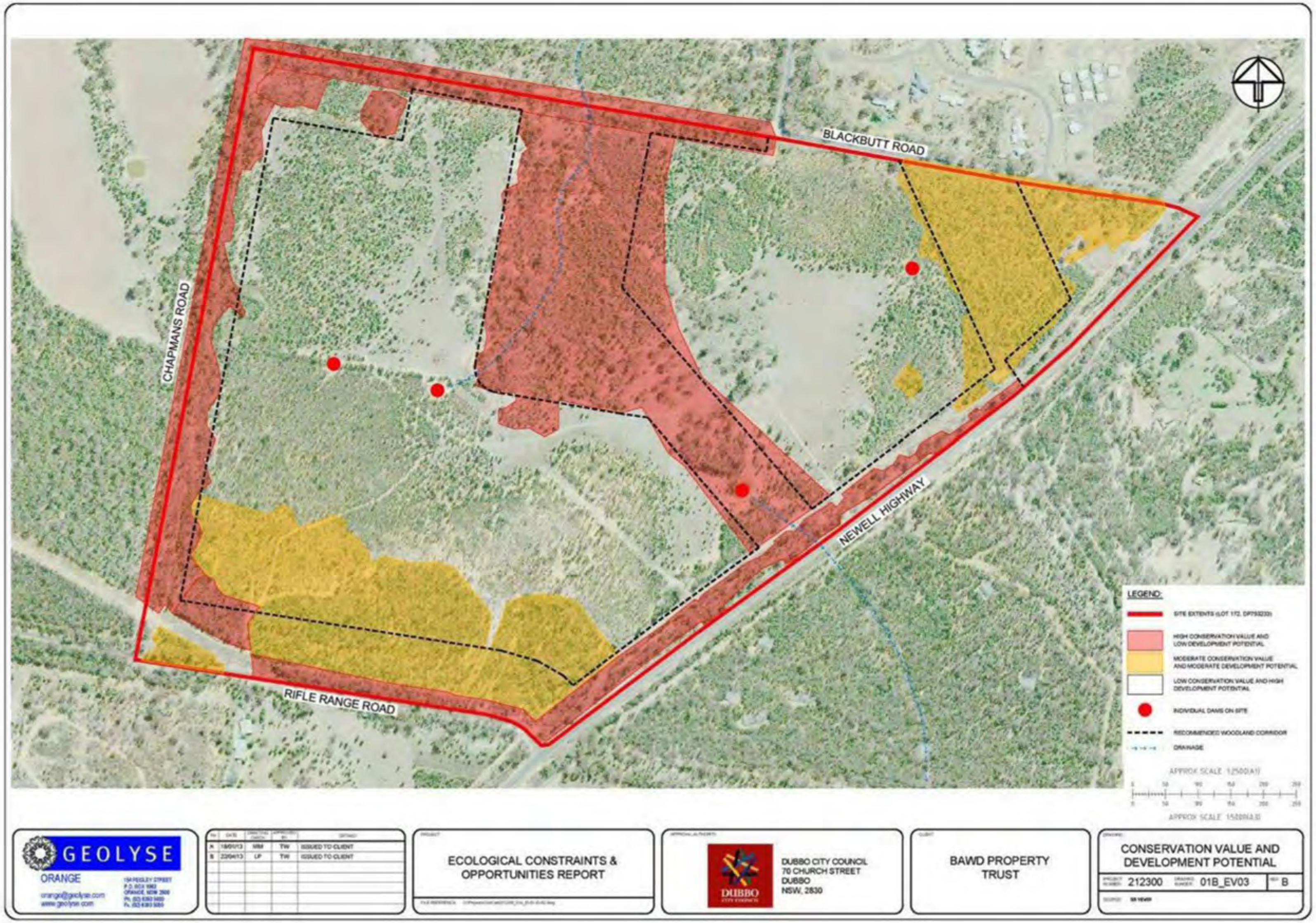
If it is assumed that no works occur within the currently recommended woodland corridor (see **Figure 6-4**) then none of the newly recorded or previously recorded sites would be impacted. The impact assessment in **Table 6-5** assumes that the final design will avoid impact to all sites.

However, it is possible that BR-IF1 could be impacted from continued use of the internal roadway where it is located and that BR-ST1 could be impacted by environmental clean-up and rehabilitation activities occurring within the proposed woodland corridor adjacent to the drainage line. As such, specific management recommendations will be made concerning these sites.

**Table 6-5: Impact assessment.**

| Site Name | Type of Harm (Direct/Indirect / None) | Degree of Harm (Total/Partial / None) | Consequence of Harm (Total/Partial/No Loss of Value) |
|---|---|---|---|
| BR-IF1 | None | None | No loss of value |
| BR-ST1 | None | None | No loss of value |
| CR-ST-1 | None | None | No loss of value |
| CR-OS-1 | None | None | No loss of value |

**Figure 6-4: The recommended woodland corridor in relation to areas of differing conservation and development potential.**



# 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 of the recorded sites and 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.

- Avoid impact 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

None of the sites investigated are likely to be directly impacted by the proposed works. However, BR-IF1 will be impacted by continued use of the dirt road (if it remains a road in the final design), and BR-ST1 could be impacted by environmental clean-up and rehabilitation work in the woodland corridor skirting the drainage line. It is recommended that the Proponent seek to avoid impact to any Aboriginal sites. Should impacts be deemed unavoidable, an AHIP must be sought from the OEH.

Archaeological recommendations for an AHIP application are that BR-IF1 is subject to a salvage program involving the collection of the surface artefact. 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. The current assessment also recommends avoidance of BR-ST1 with suitable curtilage to avoid inadvertent impacts during the completion of any works (e.g. environmental clean-up and rehabilitation) within the vicinity of the site. Long-term management of the site should entail its protection and preservation.

Beyond the management of the sites 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 4** should be followed.

# 8 RECOMMENDATIONS

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 **two Aboriginal sites** were recorded during the assessment.

The following recommendations are made on the basis of these impacts and 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. The current assessment determines that no further archaeological investigation is warranted at sites BR-IF1, BR-ST1, CR-OS-1 (#36-1-0523) and CR-ST-1 (#36-1-0525).
2. The Proponent should seek to avoid impact to all recorded Aboriginal sites (BR-IF1, BR-ST1) and ensure that CR-OS-1 [#36-1-0523] and CR-ST-1 [#36-1-0525] remain outside the impact area. If sites are to be avoided, they should be identified by suitable, high visibility curtilage to avoid inadvertent impacts during the completion of proposed works.
3. The current assessment recommends that long-term management of BR-ST1 will entail its protection and preservation.
4. Should impacts to any site be unavoidable, an AHIP must be sought from OEH to allow impacts to those sites. Archaeological recommendations for the AHIP application would be:
    a. If site BR-IF1 is to be impacted, the site should be salvaged through a surface collection of artefacts under supervision of an archaeologist or trained cultural heritage field workers from the Aboriginal community.
    b. Should site BR-ST-1 be located it is recommended that the tree and scar be archivally recorded prior to any impacts.
    c. No program of sub-surface salvage is recommended for BR-IF1 as OzArk and Aboriginal community representatives have assessed the site as having low potential for associated potential archaeological deposits.
    d. 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.

5. All land-disturbing activities must be confined to within the assessed Study Area.
6. 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.
7. In the unlikely event that objects are encountered that are suspected to be of Aboriginal origin (including skeletal material), the Unanticipated Finds Protocol (**Appendix 4**) should be followed.

# REFERENCES


| | |
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# PLATES

**Plate 1: BR-IF1; possible quartz artefact.**

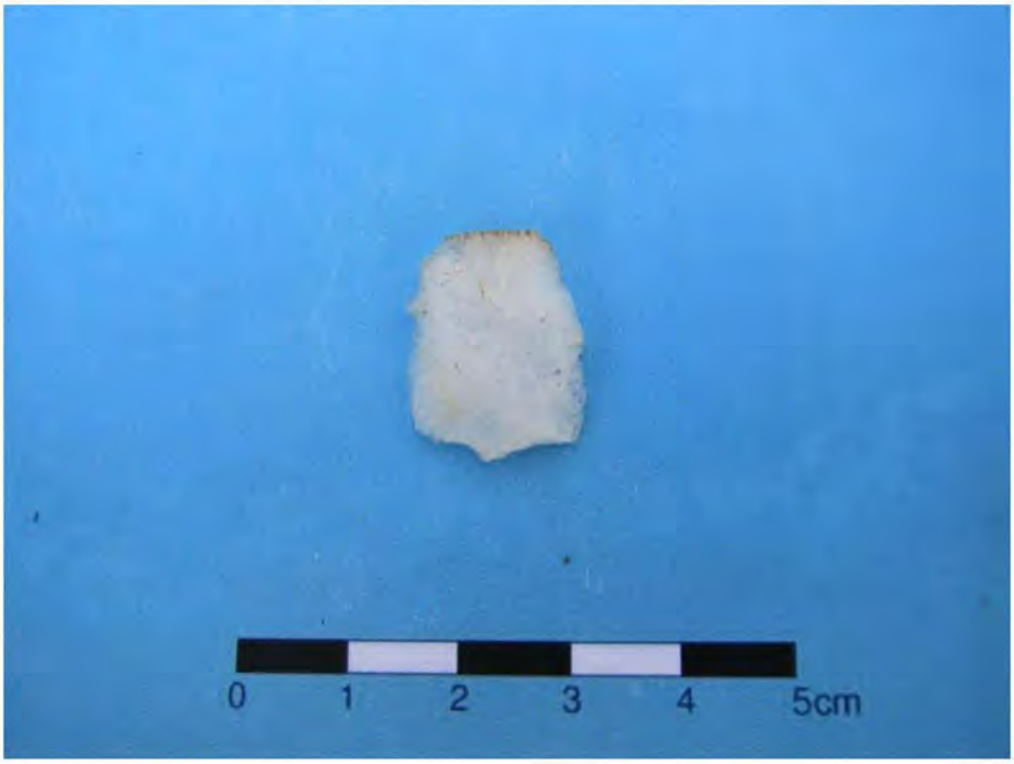


**Plate 2: BR-ST1; view of tree.**

Plate 3: BR-ST1; Scar detail.

Plate 4: Intersection of Newell Highway and Rifle Range Road at location of site CR-ST-1.

**Plate 5: View over fence line toward Rifle Range Road at location of site CR-OS1.**

**Plate 6: Cleared grassland within the Study Area.**

**Plate 7: Remnant Ironbark woodland and White Cyprus Pine regrowth within Study Area.**

**Plate 8: Dense White Cyprus Pine regrowth within the Study Area.**

# APPENDIX 1: COMMUNITY CONSULTATION

## COMMUNITY CONSULTATION LOG

| BAWD Property Trust Subdivision - COMMUNITY CONSULTATION | | | | |
|---|---|---|---|---|
| **Date** | **Organisation /** | **Contact Name** | **Comment** | **OzArk staff/ method** |
| 1.04.2015 | DLALC | Darren Toomey | JKB rang Darren to confirm DLALC had availability on 14th April for a full day survey. He said he'd have someone available. | phone |
| 1.04.2015 | Tubba Gah | Geoffrey Ryan | JKB rang Geoffrey to confirm Tubba Gah had availability on 14th April for a full day survey. He said he'd have someone available. | phone |
| 1.04.2015 | DLALC | Darren Toomey | JKB Sent a letter of invitation of fieldwork for one sites officer on 14th April. | email |
| 1.04.2015 | Tubba Gah | Geoffrey Ryan | JKB Sent a letter of invitation of fieldwork for one sites officer on 14th April. | email |
| 13.04.2015 | Tubba Gah | Geoffrey Ryan | Geoffrey provided his certificate of currency and confirmed Ray Smith is available for the site survey on 14th April. | email |
| 13.04.2015 | Tubba Gah | Geoffery Ryan | CL rang Geoffrey and confirmed that Jim will meet @ OzArk HQ 9am with correct PPE and medications | Phone |
| 13.04.2015 | DLALC | Darren Toomey | CL rang DLALC spoke to Trent who advised Darren will be back in 1 hour. Left number to call back. | Phone |
| 13.04.2015 | DLALC | Darren Toomey | CL rang Darren advised they would have someone here 9am tomorrow, although they are still trying to organise | Phone |

## SAMPLE INVITATION TO FIELDWORK LETTER

OzArk Environmental & Heritage Management Pty Ltd
ABN: 59 104 582 354

1st April 2015

[redacted]

Dear [redacted],

**Re: BAWD Property Trust Subdivision Aboriginal Heritage Assessment: Invitation to Fieldwork.**

OzArk Environment and Heritage Management Pty Limited (OzArk) have been commissioned by Geolyse Pty Limited on behalf of Brett Anderson BAWD Property Trust Pty Limited to complete an archaeological assessment over c. 144 ha for the proposed subdivision of Lot 172 DP753233 Blackbutt Rd Dubbo NSW (**Figure 1**).

OzArk would like to invite one (1) Senior Site Officer from Dubbo Local Aboriginal Land Council to participate in a full-day field assessment, scheduled for Tuesday 14th April 2015.

| | |
|---|---|
| **Assessment date:** | Tuesday 14th April 2015 for full-day. |
| **Time to meet:** | 9:00 am |
| **Location to meet:** | OzArk Office<br>145 Wingewarra St<br>Dubbo, NSW 2830<br><br>*Transport to and from the site will be provided by OzArk. |
| **Duration:** | We have allowance for a full-day field survey - allow for up to 8-10 hours. |
| **Fee offer:** | The fee offered is $[redacted] for participation in the fieldwork for one Site Officer (excl. GST). This fee is all inclusive of travel, travel time, fuel, accommodation, meal expenses and participation in the fieldwork. |
| **Invoices:** | Invoices are to be addressed to:<br>OzArk EHM<br>C/- Sheridan Baker<br>PO Box 2069<br>Dubbo, NSW 2830<br>Sheridan@ozarkehm.com.au |

Dubbo | Queanbeyan | Sydney | Armidale
HEAD OFFICE: 145 Wingewarra St/PO Box 2069 DUBBO NSW 2830

OzArk Environmental & Heritage Management Pty Ltd
ABN: 59 104 582 354

Each attendee is responsible for their own WH&S gear; participants must also ensure they have water and snacks for the duration of the fieldwork.

Personal Protective Equipment (PPE) – your Site Officer will need:

- Long pants and long sleeve (high visibility) shirt;
- High visibility safety vest;
- Steel toe capped boots / gum boots;
- Water / Sunscreen / Hat.

OzArk wishes to stress the importance of Site Officer's equipping themselves with all of the above noted PPE. **Should anyone present on the morning of fieldwork not wearing appropriate PPE, they will be unable to participate on the field survey.** Particular emphasis is placed upon sun protection and adequate drinking water, as well as long pants and fully enclosed footwear.

All representatives should be physically fit and capable of walking throughout the Study Area for several hours. It is the responsibility of each group to identify if any of your personnel have medical conditions / allergies that should be known to other people participating in the dig in the event of an emergency. The OzArk field director will send home anyone who they determine to be 'unfit for work' or who may pose a WH&S risk to themselves or others.

Please note, if you are sending a representative who has any underlying medical conditions or severe allergies, it is important that they have on their person appropriate treatment such as asthma inhalers or EpiPens and notify us accordingly.

Please advise our office by **COB Friday 10th April 2015,** if you are available and wish to participate in the field inspection.

Should you have any queries in relation to the enclosed information please do not hesitate to contact our office.

Kind regards,

Sheridan Baker
Consultation Officer

OzArk Environmental & Heritage Management Pty Ltd

ABN: 59 104 582 354

**Figure 1: Study Area outlined in red and highlighted.**

# RECORDS OF ABORIGINAL SITE OFFICER PARTICIPATION

## Record of Aboriginal Site Officer Participation in Cultural Heritage Fieldwork

**Project Name:**... BAWD Holdings Pty Ltd Proposed Subdivision of Lot 172 DP753233 Blackbutt Road, Dubbo LGA

**Client Name:**... Geolyse Pty Ltd.

**Name of Aboriginal Organisation:** Tubbah Lah

**Name of Representative(s):** Shim Smith

**Mobile Number of Representative(s):**

**Name of Archaeologist:**...... Chris Lovell.

**Address of Archaeologist:**.... 145 Wingewarra St. Dubbo.

**Type of participation:**

- [x] Guided inspection of study area or sites
- [x] Accompanied and participated in the archaeological survey of the study area
- [ ] Undertook a separate inspection of the study area
- [ ] Participated in excavation programme

**Period of participation:**

| Date | Start Time | Finish Time | Break Duration | Total Hours |
|---|---|---|---|---|
| 14.4.15 | 9:00 | 6:10 | 0:30 | 6:40 |
| | | | | |
| | | | | |
| | | | | |
| Total | | | | |

**Issues Discussed / Comments:**

Recorded 1x potential artefact
1x scar tree
Surveyed high potential area no artefact
Surveyed other areas & found

**Signed Aboriginal Representative:**

**Signed Archaeologist:**

OZARK ENVIRONMENTAL & HERITAGE MANAGEMENT P/L –PO Box 2069 Dubbo NSW 2830
Tel: 6882 0118; Fax: 6882 0630; Mob: 0403 763 504 / 0423 198 898;
E-mail: jodie@ozarkehm.com.au / phil@ozarkehm.com.au / cheryl@ozarkehm.com.au
Web: www.ozarkehm.com.au

## Record of Aboriginal Site Officer Participation in Cultural Heritage Fieldwork

**Project Name:**... BAWD Holdings Pty Ltd Proposed Subdivision of Lot 172 DP753233 Blackbutt Road, Dubbo LGA

**Client Name:**...Geolyse Pty Ltd.

**Name of Aboriginal Organisation:** Dubbo LALC

**Name of Representative(s):** Terry Toomey

**Mobile Number of Representative(s):** 6885 1731

**Name of Archaeologist:**...... Chris Lovell

**Address of Archaeologist:**.....145 Wingewarra St. Dubbo

**Type of participation:**

- [x] Guided inspection of study area or sites
- [x] Accompanied and participated in the archaeological survey of the study area
- [ ] Undertook a separate inspection of the study area
- [ ] Participated in excavation programme

**Period of participation:**

| Date | Start Time | Finish Time | Break Duration | Total Hours |
|---|---|---|---|---|
| 14.4.15 | 9:00 | 16:0 | 0:30 | 6:40 |
| | | | | |
| | | | | |
| | | | | |
| **Total** | | | | |

**Issues Discussed / Comments:**

Surveyed high potential areas — no finds
Surveyed other areas — found
1x potential artefact
1x Scarred Tree

* **Signed Aboriginal Representative:** T Toomey

**Signed Archaeologist:**

OZARK ENVIRONMENTAL & HERITAGE MANAGEMENT P/L –PO Box 2069 Dubbo NSW 2830
Tel: 6882 0118; Fax: 6882 0630; Mob: 0403 763 504 / 0423 198 898;
E-mail: jodie@ozarkehm.com.au / phil@ozarkehm.com.au / cheryl@ozarkehm.com.au
Web: www.ozarkehm.com.au

# APPENDIX 2: AHIMS DESKTOP DATABASE SEARCH RESULTS

Office of Environment & Heritage
NSW GOVERNMENT

## AHIMS Web Services (AWS)

**Search Result**

Purchase Order/Reference : #1187

Client Service ID : 168841

OzArk Environmental and Heritage Management

Date: 13 April 2015

PO Box 2069
Dubbo New South Wales 2830

Attention: Chris Lovell

Email: chris@ozarkehm.com.au

Dear Sir or Madam:

**AHIMS Web Service search for the following area at Lot : 172, DP:DP753233 with a Buffer of 1000 meters, conducted by Chris Lovell on 13 April 2015.**

**The context area of your search is shown in the map below. Please note that the map does not accurately display the exact boundaries of the search as defined in the paragraph above. The map is to be used for general reference purposes only.**


A search of the Office of the Environment and Heritage AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

| | |
|---|---|
| 16 | Aboriginal sites are recorded in or near the above location. |
| 0 | Aboriginal places have been declared in or near the above location. * |

# APPENDIX 3: NSW NPWS SCARRED TREE ASSESSMENT CRITERIA

The following *Scarred Tree Assessment Criteria* has been based primarily on criteria set out by the NSW National Parks and Wildlife Service.

These diagnostic criteria are as follows:

1. The scar must not touch the ground (scars resulting from fire, fungal attack or lightning nearly always reach the ground). Such a termination does not necessarily preclude an Aboriginal origin. Ethno-historic accounts of canoe manufacture occasionally demonstrate scarring to ground level. If the scar does run to the ground, the sides must remain relatively parallel (i.e. not triangular or jagged).
2. The ends of the scar should be squared off or evenly tapered. Different shapes at the top and bottom (e.g. pointed at top, squared at bottom; round at top, flaring at bottom) are suggestive of natural processes (e.g. branch loss through tearing etc.).
3. The sides of the scar should be parallel or symmetrical - Few natural scars are likely to have these properties, with the possible exception of fire scars which may be symmetrical but are usually wider at their base. Modern surveyors' marks are typically triangular, and often adzed. These also (regardless of shape) usually have a number carved in the wood, within the scar.
4. The length of the scar must be on the same axis as the tree and not oblique or slanting across the tree or the branch - Scars which are natural in origin tend to have irregular outlines, sometimes have irregular regrowth and may occur against the axis of the tree.
5. The tree should be reasonably old (i.e. over 100 years). The tree upon which the scar is found should be old enough (i.e. of sufficient age) to have been used by Aboriginal people in (at least) a semi-traditional manner. This means the tree should be at least c.100 years old. The age of the scar should also be reflected in the thickness of the regrowth. Young scars (e.g. some natural scars caused by branches falling or birds or horses gnawing, have characteristically thin regrowth).
6. There must be no obvious natural or other artificial cause such as a branch rip, lightning strike, cockatoo chewed bark or healed bark tears from machinery damage or car impact – Any signs that the scar may not be Aboriginal should be carefully assessed.
7. The tree must not be an introduced species – for obvious reasons, the tree upon which the scar is found should be endemic to the region, i.e. this excludes historic (exotic) plantings.

Also helpful, but not within the NPWS criteria are the following points:

1. Axe or adze marks - A scar with cut marks on the original wood is likely to be anthropogenic in nature (i.e. as a result of human actions). The location and shape/size may lend support to the scar's origin. For example stone axe marks would indicate an Aboriginal origin, while steel axe marks post-date the arrival of Europeans. These of course could still have been made by an Aboriginal person in the post-contact era; and

2. The presence of epicormal growth – Many scars of Aboriginal origin tend to have an epicormal shoot originating at the base of the scar. This is a new branch shooting from the point of damage and is part of the trees self-preservation mechanism.

# APPENDIX 4: UNANTICIPATED FINDS PROTOCOL

An Aboriginal artefact is anything that 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).

# Road Traffic Noise Assessment

Proposed Kintyre Subdivision - Stage 2.

Muller Acoustic Consulting

Prepared for : Geolyse Pty Ltd

16 October 2015

# Document Information

## Road Traffic Noise Assessment

Proposed Kintyre Subdivision - Stage 2

**Prepared for:** Geolyse Pty Ltd

1st Floor 62 Wingewarra Street

Dubbo, NSW 2830

**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 |
|---|---|---|---|---|
| MAC150140RP1 | Final | 16 October 2015 | Oliver Muller | OM |

# Contents

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# 1 Introduction

Muller Acoustic Consulting Pty Ltd (MAC) has been commissioned by Geolyse Pty Ltd (Geolyse) to prepare a road traffic noise assessment for Stage 2 of the proposed Kintyre Subdivision (the 'project') Lot 172, DP753233 Blackbutt Road, Dubbo NSW.

This report presents the results, findings and recommendations of the road traffic noise assessment and has been prepared to accompany the project's Development Application (DA).

The assessment has been undertaken in general accordance with the following policies and guidelines:

- Environment Protection Authority (EPA) 2000, NSW Industrial Noise Policy (INP);
- Department of Planning (DPI) 2008, Development Near Rail Corridors and Busy Roads – Interim Guideline;
- Standards Australia AS 1055.1:1997 — Acoustics — Description and measurement of environmental noise — General Procedures;
- Australian Standard AS 3671-1980 Acoustics — road traffic noise intrusion — building site and construction; and
- Standards Australia AS 2107:2000 — 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.*

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# 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 for this assessment were provided by Geolyse and calculate that 2015 traffic volumes for the Newell Highway are 5,430 vehicle per day (AADT). Proposed lots of the project are within 100m of the Newell Highway, therefore a detailed acoustic assessment has been completed.

### 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 2.1 and Figure 2.2 respectively. The screening tests have been adopted in this assessment to provide guidance on building categories for the project.

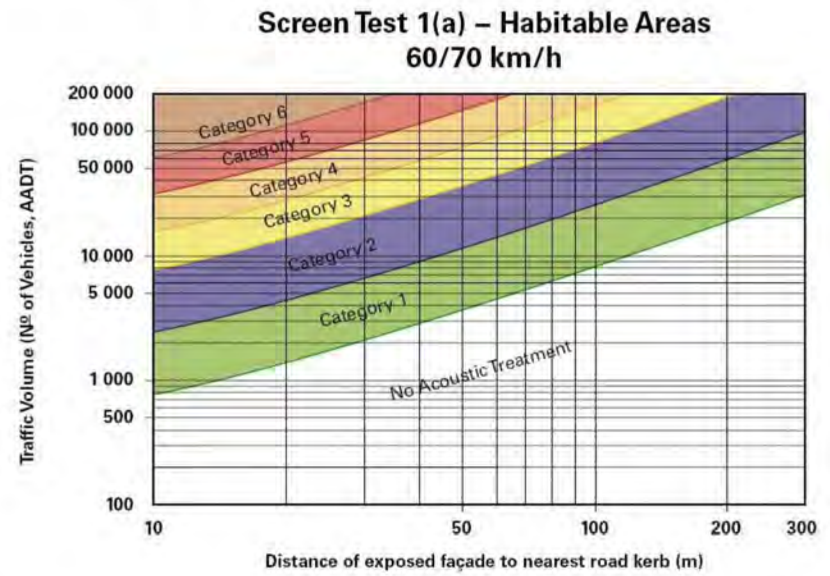



Figure 2.1 Screen test for habitable areas of single/dual occupancy dwellings adjacent to 60/70 km/hr zones.

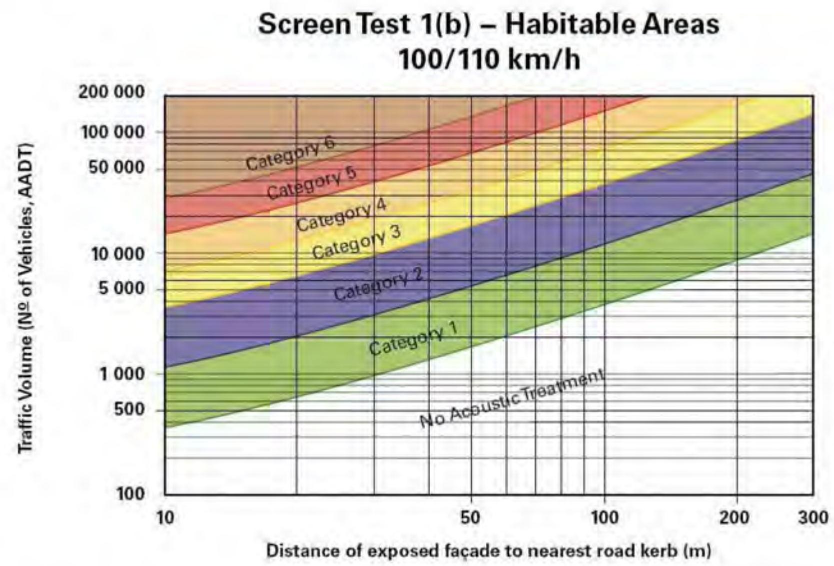



Figure 2.2 Screen test for habitable areas of single/dual occupancy dwellings adjacent to 100/110 km/hr zones.

# 3 Existing Environment

One unattended logger was installed on Lot 172, DP753233 Blackbutt Road from Monday 18 May to Wednesday 27 May 2015 to quantify the influence of road noise. The logger location and locality plan showing the proposed lot layouts with respect to the Newell Highway is presented in Figure 3.1. The logger location was selected considering security and exposure to road traffic. Data from the logger was used to calibrate the noise model.

Instrumentation used was a SVANTEK 977 Type 1 octave sound analyser and was programmed to collect samples at 15 minute intervals with 'Fast' time weighting and 'A' frequency weighting. The analyser was calibrated before and after the monitoring period with no drift in calibration noted. Monitoring was conducted in general accordance with the procedures described in Australian Standard AS 1055-1997 Acoustics - Description and Measurement of Environmental Noise. Data affected by adverse meteorological conditions has been excluded from the results in accordance with methodologies provided in the INP.

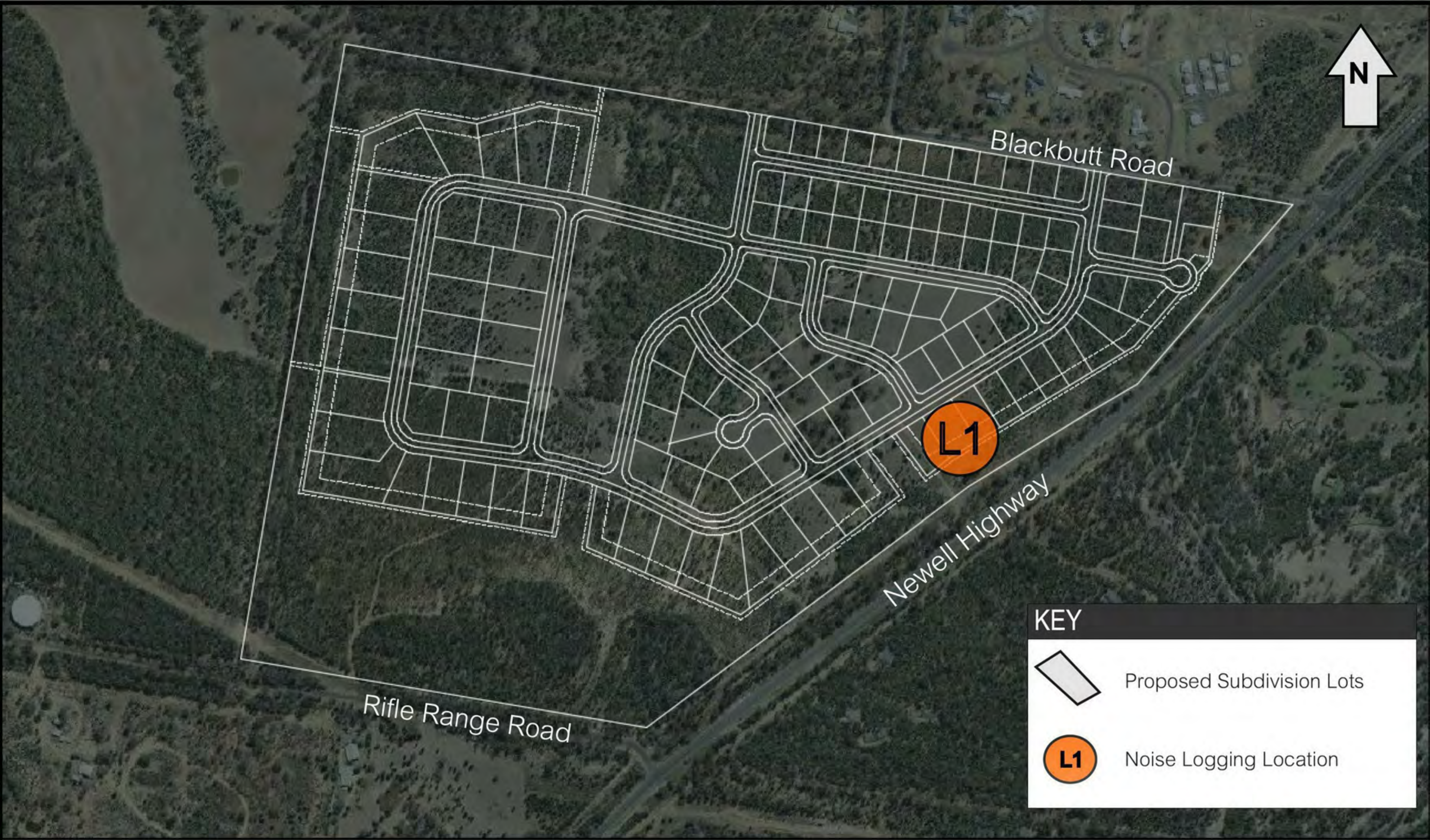
The results of long-term unattended monitoring are provided in Table 1. Appendix B presents the noise logging charts for the assessment period.

**Table 1 Noise Logging Results**

| Measurement Location | Measured Background Noise Level, LA90, dBA | | | Measured LAeq, dBA[1] | |
|---|---|---|---|---|---|
| | Day | Evening | Night | Day | Night |
| L1 | 35 | 31 | 25 | 57 | 55 |

Note 1 : LAeq (period) is the average for the week of data collected.

Note : Road traffic is assessed over two periods, Day 7am to 10pm and Night 10pm to 7am (ie no evening).




MAC
Muller Acoustic Consulting

Figure 3.1 - Locality plan

Kintyre Subdivision - Stage 2

0 250m

# 4 Noise Assessment Methodology

## 4.1 Calculation of Road Traffic Noise

A theoretical assessment of road traffic noise was carried out to predict levels at the ground floor façade of the proposed dwellings within the project 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.

Table 2 summarises the calculation parameters adopted for this assessment.

**Table 2 Calculation Parameters – Newell Highway**

| Assessment Period | AADT Volume[1] | % Heavy Vehicles | Speed Limit (km/hr) |
|---|---|---|---|
| Scenario 1 - Existing 2015 | | | |
| Day | 4344 | 10 | 110 |
| Night | 1086 | 20 | 110 |
| Scenario 2 - Future 2025[2] | | | |
| Day | 5833 | 10 | 110 |
| Night | 1458 | 20 | 110 |

Note 1: AADT supplied by Geolyse.

Note 2: Assumes 3% traffic growth including project related traffic.

## 4.2 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 3, 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.

Table 3 Indicative Building Noise Attenuation

| Building Type | Windows | Internal noise reduction, dBA |
|---|---|---|
| All | Open | 10 |
| Light frame | Single glazed (closed) | 20 |
| Masonry | Single glazed (closed) | 25 |
| | Double glazed (closed) | 30 |

Note : Sourced from ENMM, 2001

# 5 Results

## 5.1 Noise Assessment Validation

Noise predictions for the Newell Highway were compared to measured levels at logging location (L1). This is considered a good practice technique to validate the assumptions made in the assessment. Results of the calibration are presented in Table 4. Noise predictions demonstrate acceptable consistency when compared against measured levels. *Technical Note: Validation is achieved when predictions are within ±<2dB tolerance of measured levels.*

**Table 4 Noise Assessment Validation Results[1]**

| Measurement Location | Predicted level, LAeq, dBA | | Measured LAeq, dBA | | Difference, dB | |
|---|---|---|---|---|---|---|
| | Day | Night | Day | Night | Day | Night |
| L1 | 57.6 | 55.2 | 56.9 | 54.5 | 0.7 | 0.7 |

Note 1 : Free field measurement

## 5.2 Road Noise Prediction Results

The site topography and subdivision plans (Geolyse) (Appendix C) for the proposed project have been reviewed and incorporated into the assessment. Two calculation scenarios have been completed for the project. Scenario 1 represents current traffic noise impacts (at project commencement). The second scenario represents +10yrs (ie 2025) and incorporates future traffic growth as a result of the project.

Figure 4.1 to Figure 4.4 presents the 'free field' noise contours associated for each modelled scenario for day $L_{Aeq(15hr)}$ and night $L_{Aeq(9hr)}$ assessment periods. *Technical Note: Scenario 2 results include hypothetical dwellings situated on the first row of lots fronting the Newell Highway, this reflects 10 years after the opening of the project.*

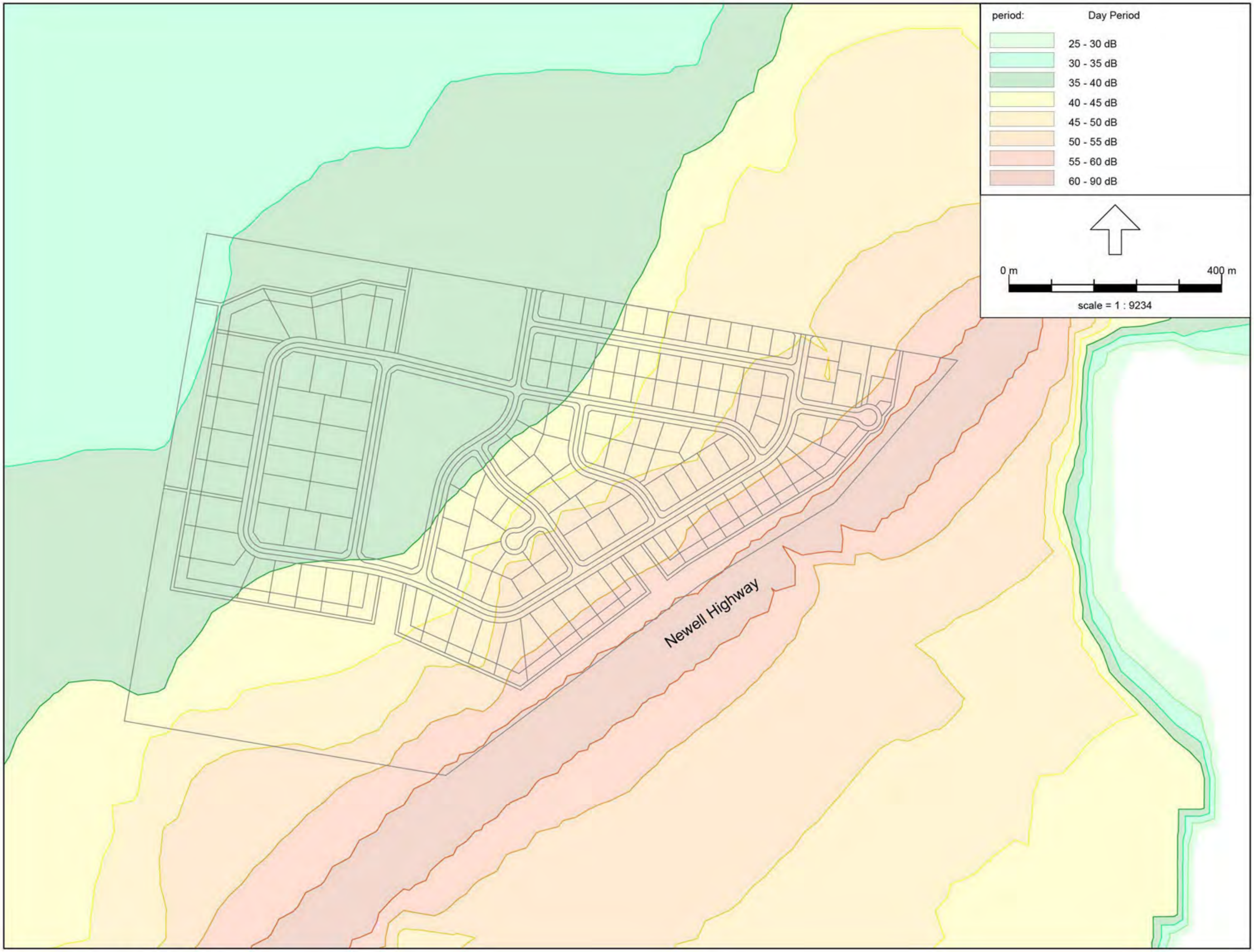



Figure 4.1 Kintyre Stage 2 - Scenario 1, Day LAeq

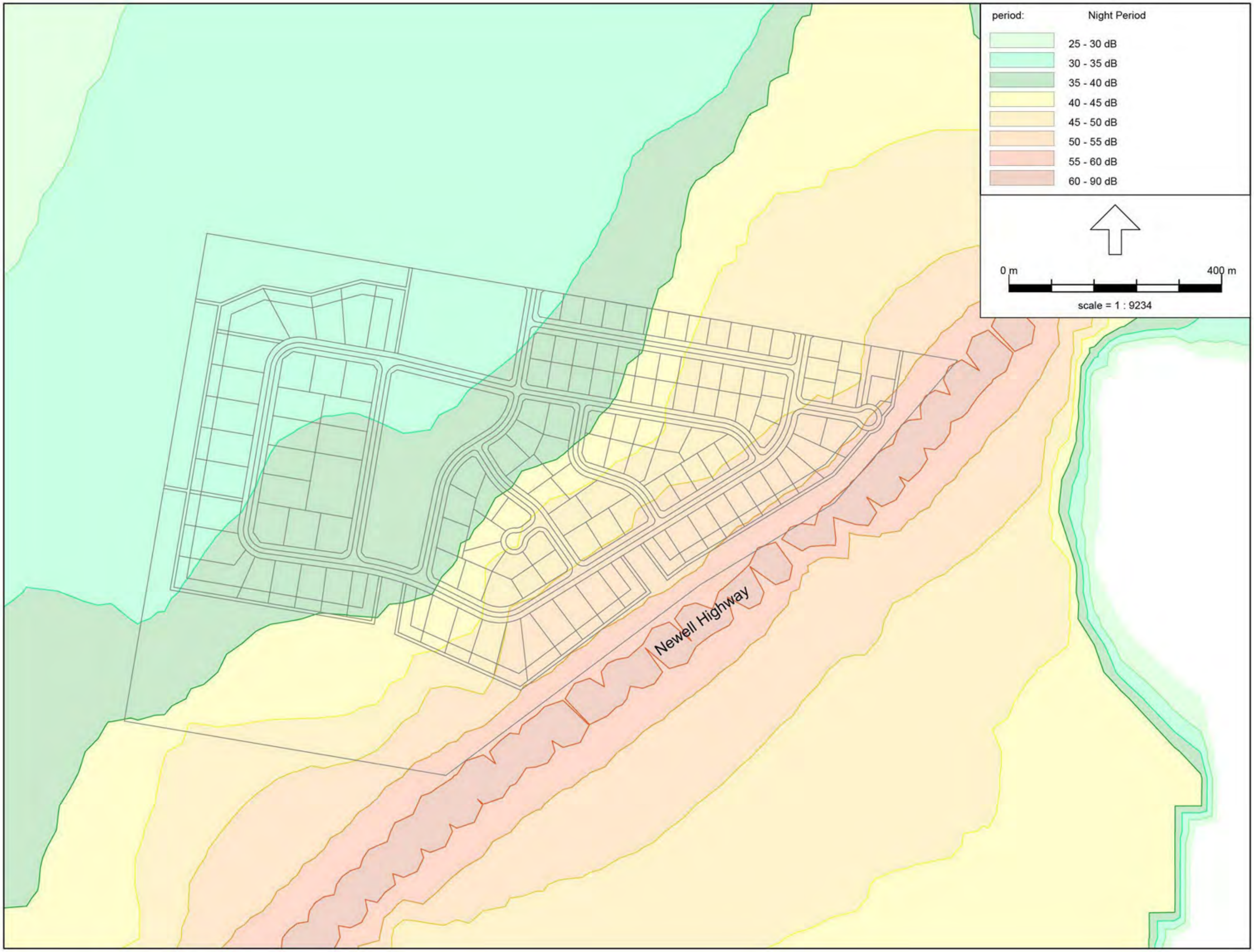



Figure 4.2 Kintyre Stage 2 - Scenario 1, Night LAeq

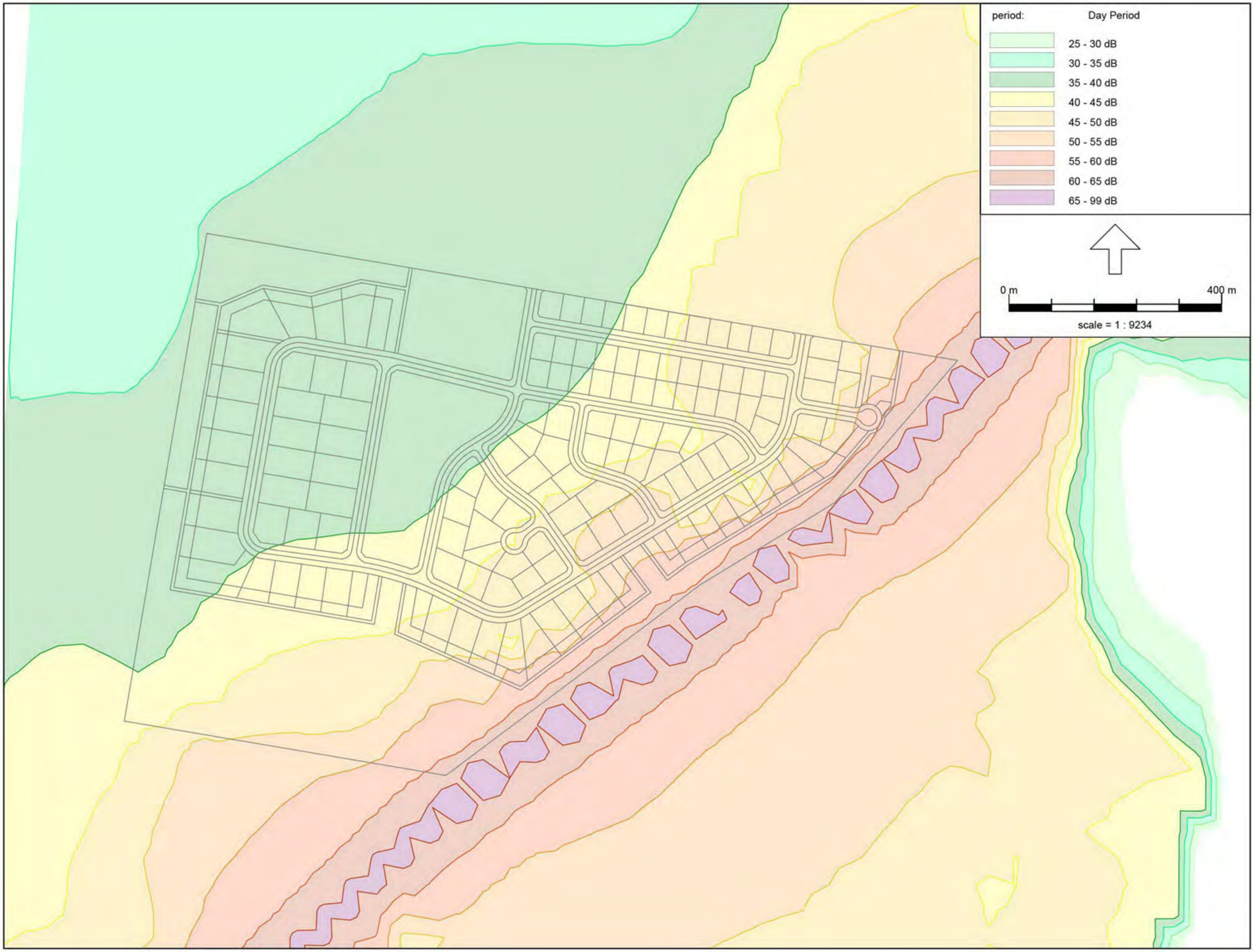



Figure 4.3 Kintyre Stage 2 - Scenario 2, Day LAeq

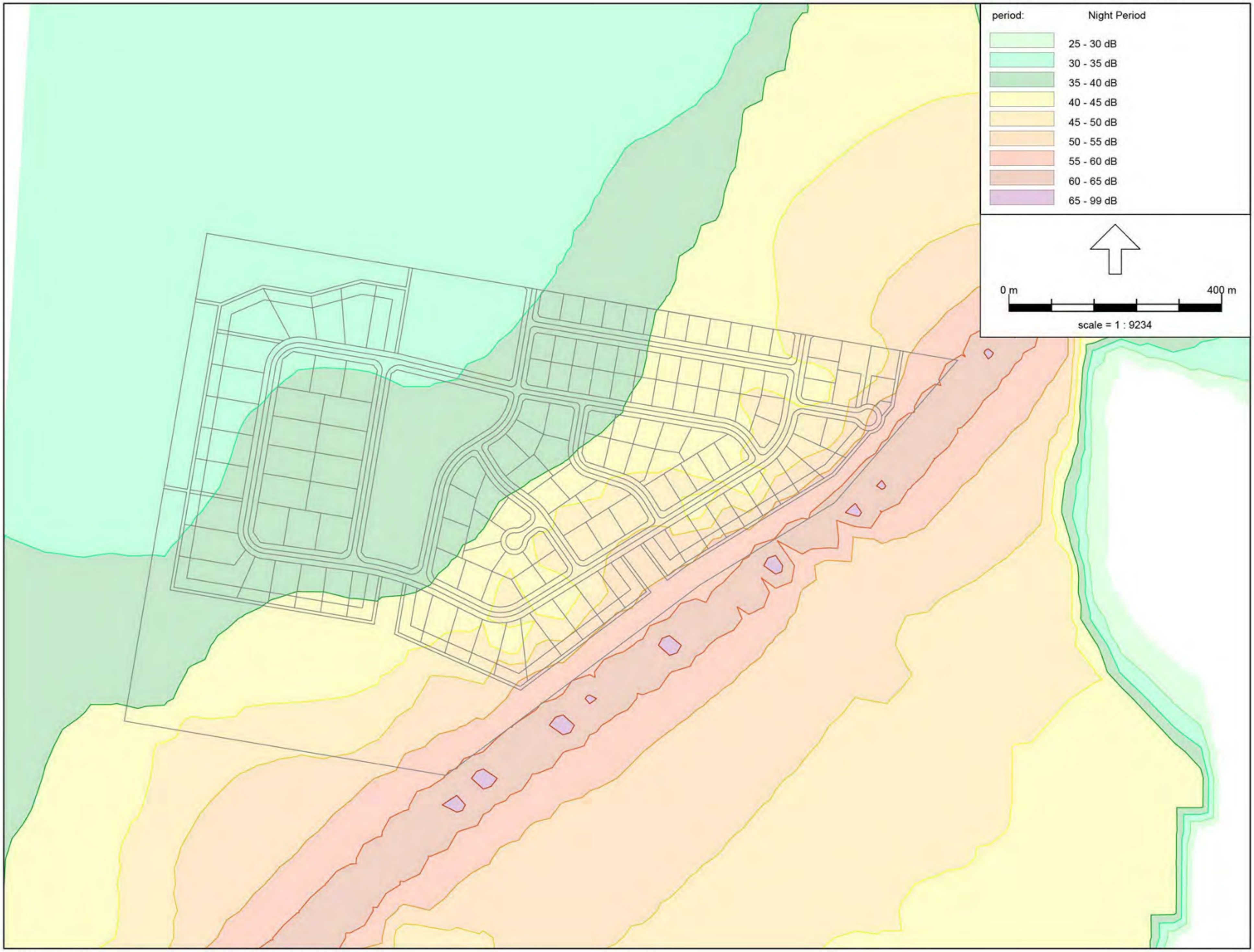



Figure 4.4 Kintyre Stage 2 - Scenario 2, Night LAeq

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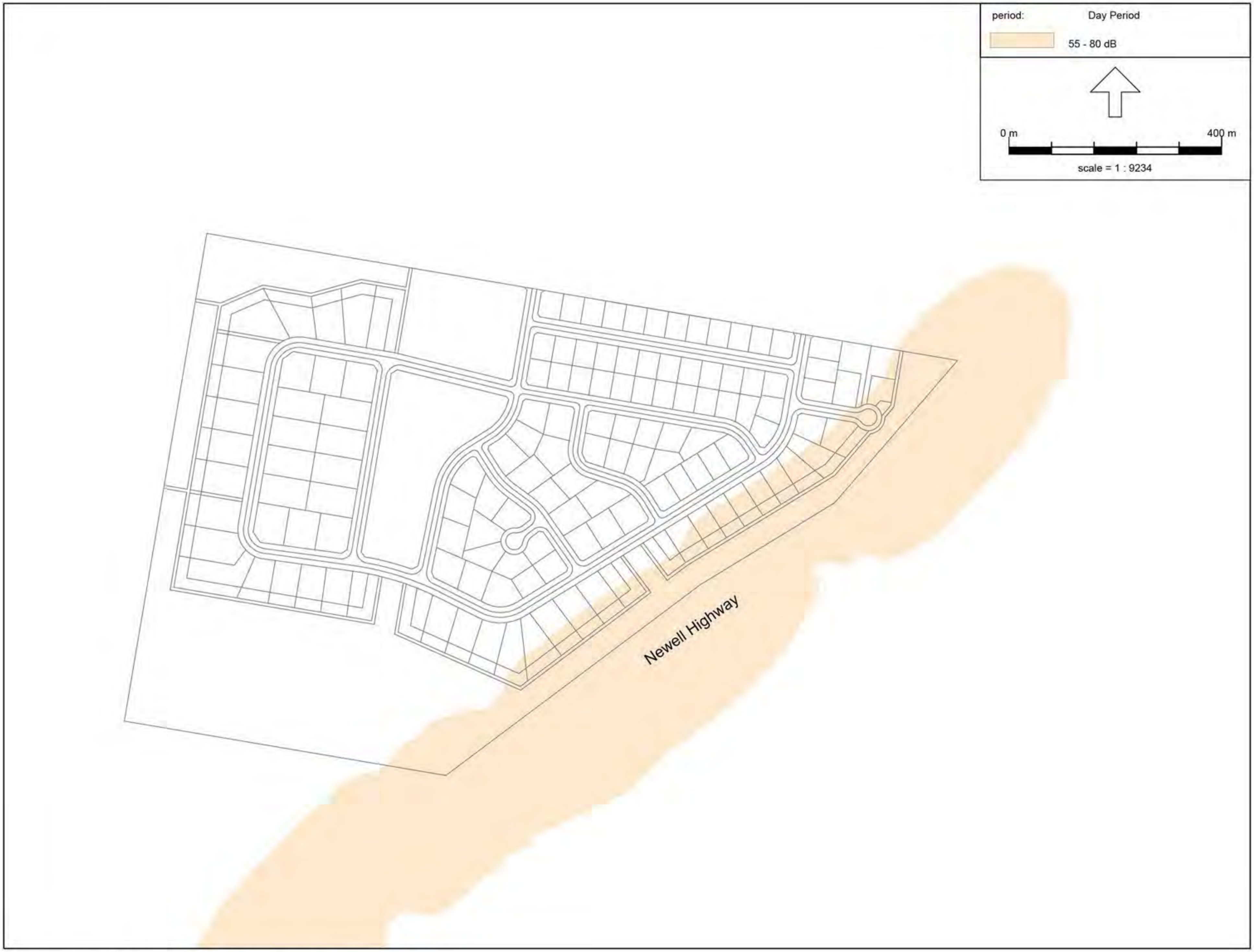


Figure 6.1 Kintyre Stage 2 - Scenario 1, Mitigation Zone for Building Treatment Category 2.


Figure 6.2 Kintyre Stage 2 - Scenario 2, Mitigation Zone for Building Treatment Category 2.

# 6 Discussion and Recommendations

A review of modelling results identifies the Newell Highway as a significant contributor to noise levels at potential dwellings within the south eastern project boundary, especially during the day period. Dwellings situated in close proximity to the Highway are anticipated to require (as a minimum) masonry construction and be upgraded to category 2 treatments as outlined in Appendix C of the guideline (reproduced in Appendix D).

Standard domestic glass is usually inadequate acoustically and can reduce the acoustic reduction performance of building facade overall. 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.

As windows must remain closed for effective noise reduction, alternative means of internal ventilation (eg air conditioning) must be considered to allow windows to remain fully closed (refer to BCA requirements).

Once dwellings are constructed within south eastern lots fronting the Newell Highway, it is anticipated that road traffic will be reduced to <55dBA for lots to the west of the project site (see Figure 4.3 and Figure 4.4).

It is recommended that building orientation within each lot, and the location of habitable rooms (eg sleeping areas) should be optimised wherever practicable to locate houses and sleeping areas as far from the Newell Highway as possible.

Figure 6.1 and 6.2 presents the category 2 construction zone (ie 'mitigation zone') for the project. It is recommended to achieve internal criteria that dwellings within the mitigation zone are constructed of category 2 materials as outlined in Appendix C of the guideline (reproduced in Appendix D).

In particular, this includes :

- Windows/Sliding Doors: Openable with minimum 6mm monolithic glass and full perimeter acoustic seals.

Dwellings located outside the mitigation zone may be constructed of materials equivalent to Category 1 (ie standard construction) to satisfy relevant internal noise criteria.

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# 7 Conclusion

MAC has completed an assessment of potential road traffic noise impacts on the proposed Stage 2, Kintyre Subdivision Lot 172, DP753233 Blackbutt Road, Dubbo NSW.

The assessment has qualified the existing ambient environment with respect to road noise, using measured levels to calibrate predictions. Noise predictions identified that some dwellings in close proximity to the Newell Highway will require construction using materials equivalent to category 2 of the guideline (see Figure 6.1 and 6.2 for the mitigation zone). For dwellings outside of the mitigation zone, standard construction materials equivalent to category 1 listed in the guideline may be adopted.

It is recommended that noise controls outlined in this report are dopted for future dwellings constructed within the development to achieve relevant internal criteria. Once recommendations are adopted for the project, there would be no noise related issues which would prevent Council approving this project.

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# Appendix A – Glossary of Terms

A number of technical terms have been used in this report and are explained in Table A1.

Table A1 Glossary of Terms

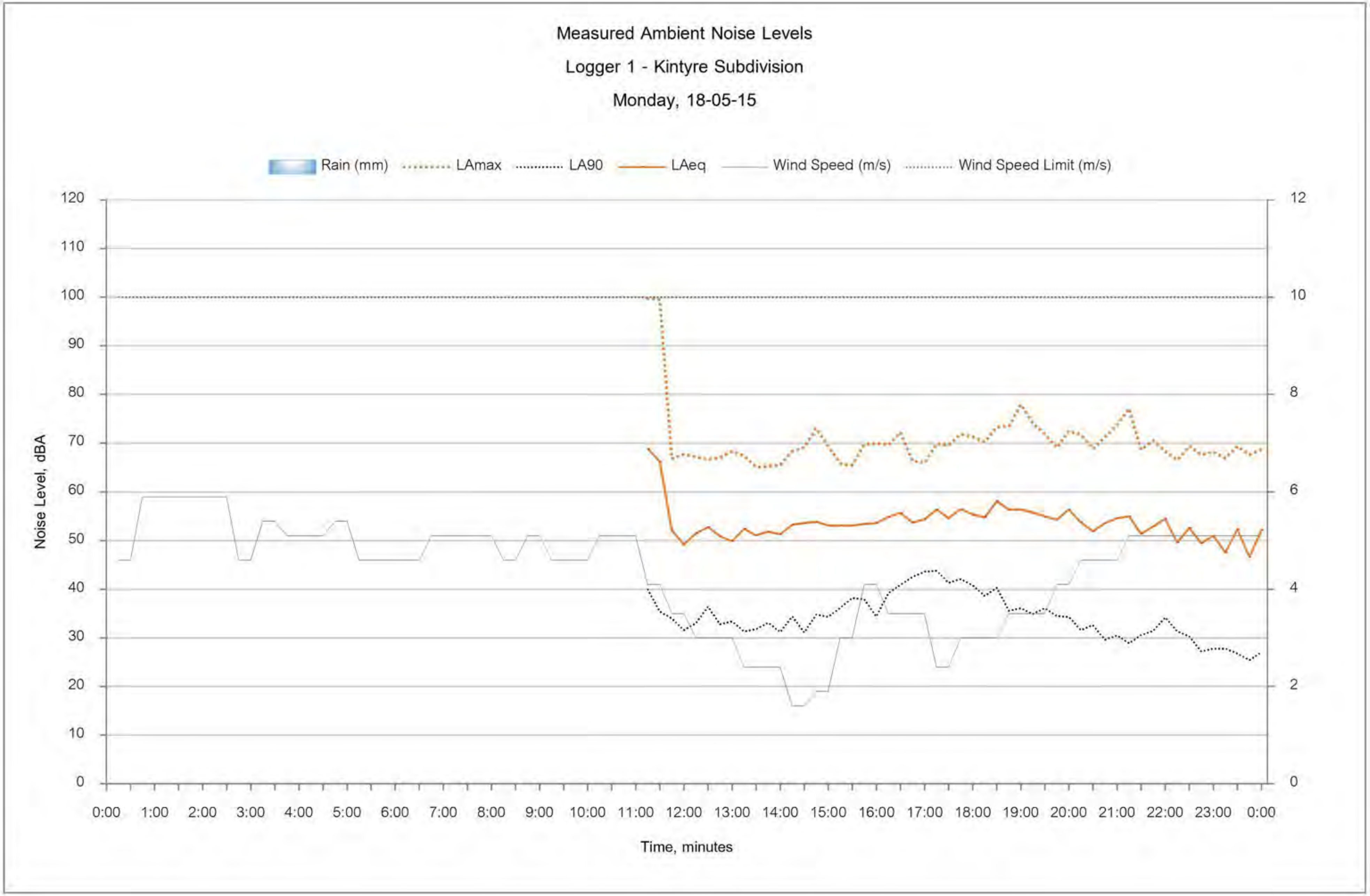
| Term | Description |
|---|---|
| 1/3 Octave | Single octave bands divided into three parts |
| Octave | A division of the frequency range into bands, the upper frequency limit of each band being twice the lower frequency limit. |
| ABL | Assessment Background Level (ABL) is defined in the INP as a 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 level (LW) | This is a measure of the total power radiated by a source. The sound power of a source is a 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. |

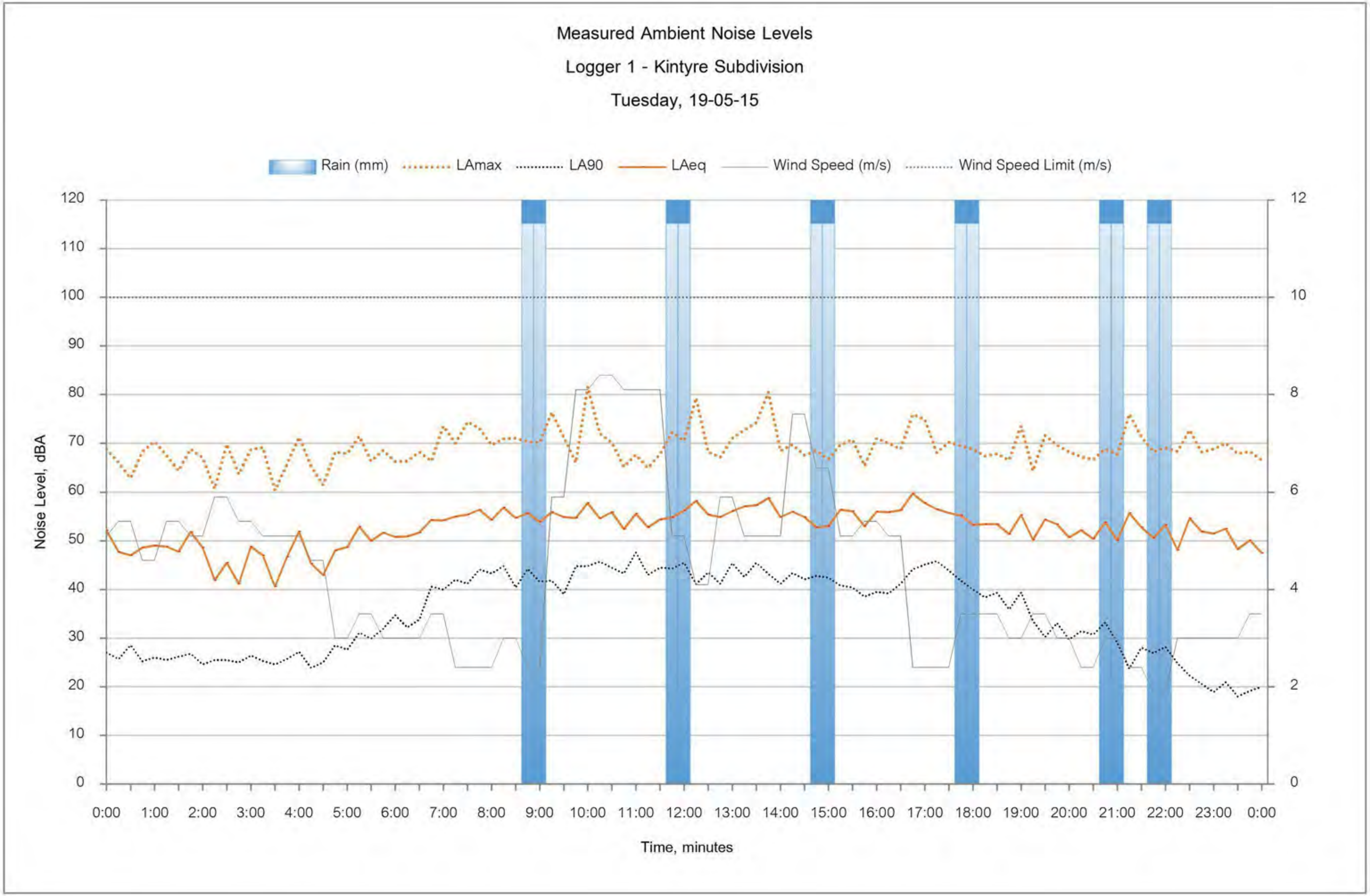
Table A2 provides a list of common noise sources and their typical sound level.

Table A2 Common Noise Sources and Their Typical Sound Pressure Levels (SPL), dBA

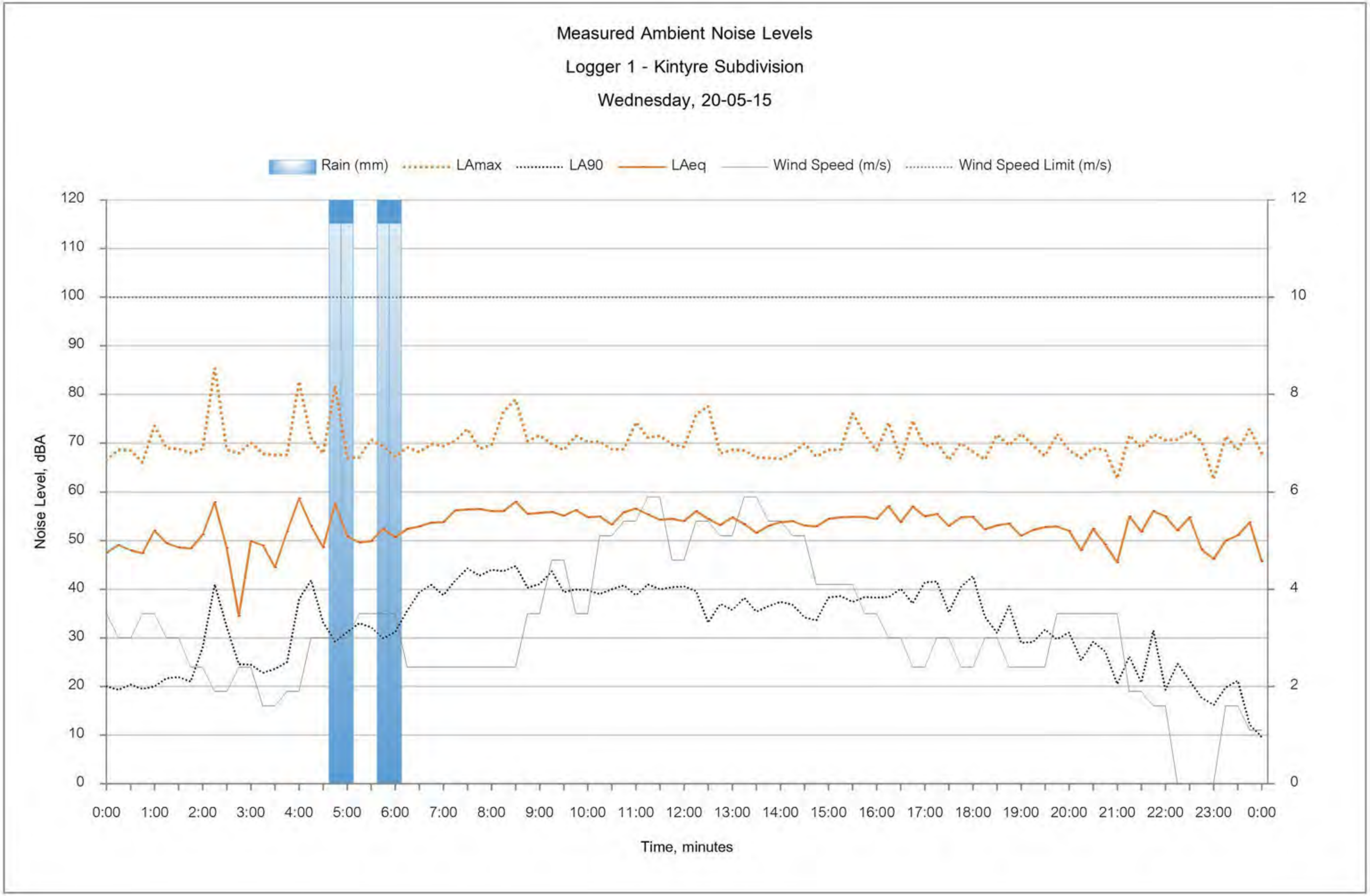
| Source | Typical Sound Level |
|---|---|
| Threshold of pain | 140 |
| Jet engine | 130 |
| Hydraulic hammer | 120 |
| Chainsaw | 110 |
| Industrial workshop | 100 |
| Lawn-mower (operator position) | 90 |
| Heavy traffic (footpath) | 80 |
| Elevated speech | 70 |
| Typical conversation | 60 |
| Ambient suburban environment | 40 |
| Ambient rural environment | 30 |
| Bedroom (night with windows closed) | 20 |
| Threshold of hearing | 0 |

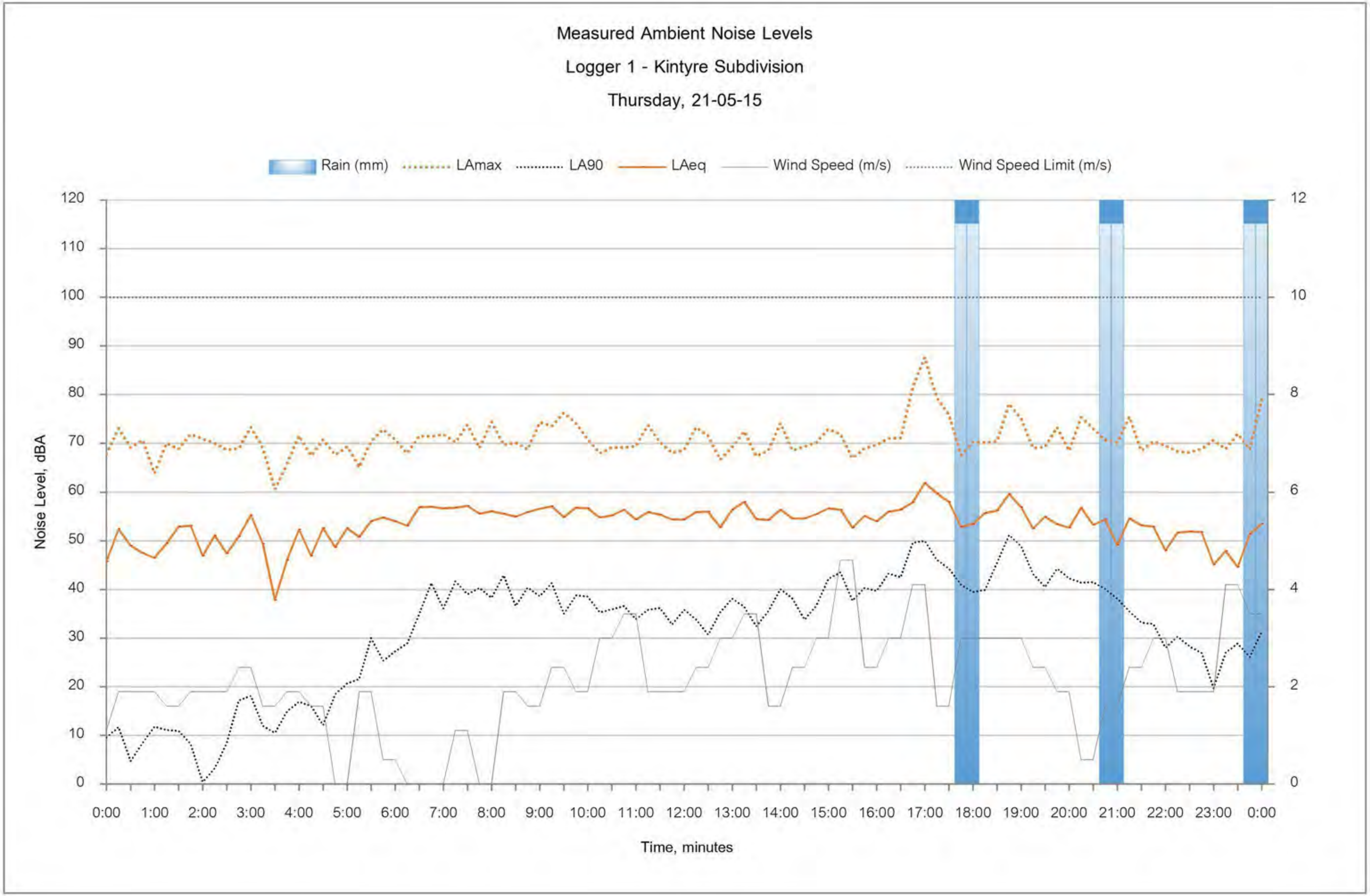
# Appendix B – Noise Logging Data


Measured Ambient Noise Levels
Logger 1 - Kintyre Subdivision
Monday, 18-05-15
Rain (mm)
LAmax
LA90
LAeq
Wind Speed (m/s)
Wind Speed Limit (m/s)
Noise Level, dBA
0
10
20
30
40
50
60
70
80
90
100
110
120
0
2
4
6
8
10
12
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
Time, minutes



Measured Ambient Noise Levels
Logger 1 - Kintyre Subdivision
Tuesday, 19-05-15
Rain (mm)
LAmax
LA90
LAeq
Wind Speed (m/s)
Wind Speed Limit (m/s)
Noise Level, dBA
120
110
100
90
80
70
60
50
40
30
20
10
0
12
10
8
6
4
2
0
0:00 1:00 2:00 3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00 0:00
Time, minutes


Measured Ambient Noise Levels
Logger 1 - Kintyre Subdivision
Wednesday, 20-05-15
Rain (mm)
LAmax
LA90
LAeq
Wind Speed (m/s)
Wind Speed Limit (m/s)
Noise Level, dBA
Time, minutes
120
110
100
90
80
70
60
50
40
30
20
10
0
12
10
8
6
4
2
0
0:00 1:00 2:00 3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00 0:00



Measured Ambient Noise Levels
Logger 1 - Kintyre Subdivision
Thursday, 21-05-15
Rain (mm)
LAmax
LA90
LAeq
Wind Speed (m/s)
Wind Speed Limit (m/s)
Noise Level, dBA
0
10
20
30
40
50
60
70
80
90
100
110
120
0
2
4
6
8
10
12
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
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17:00
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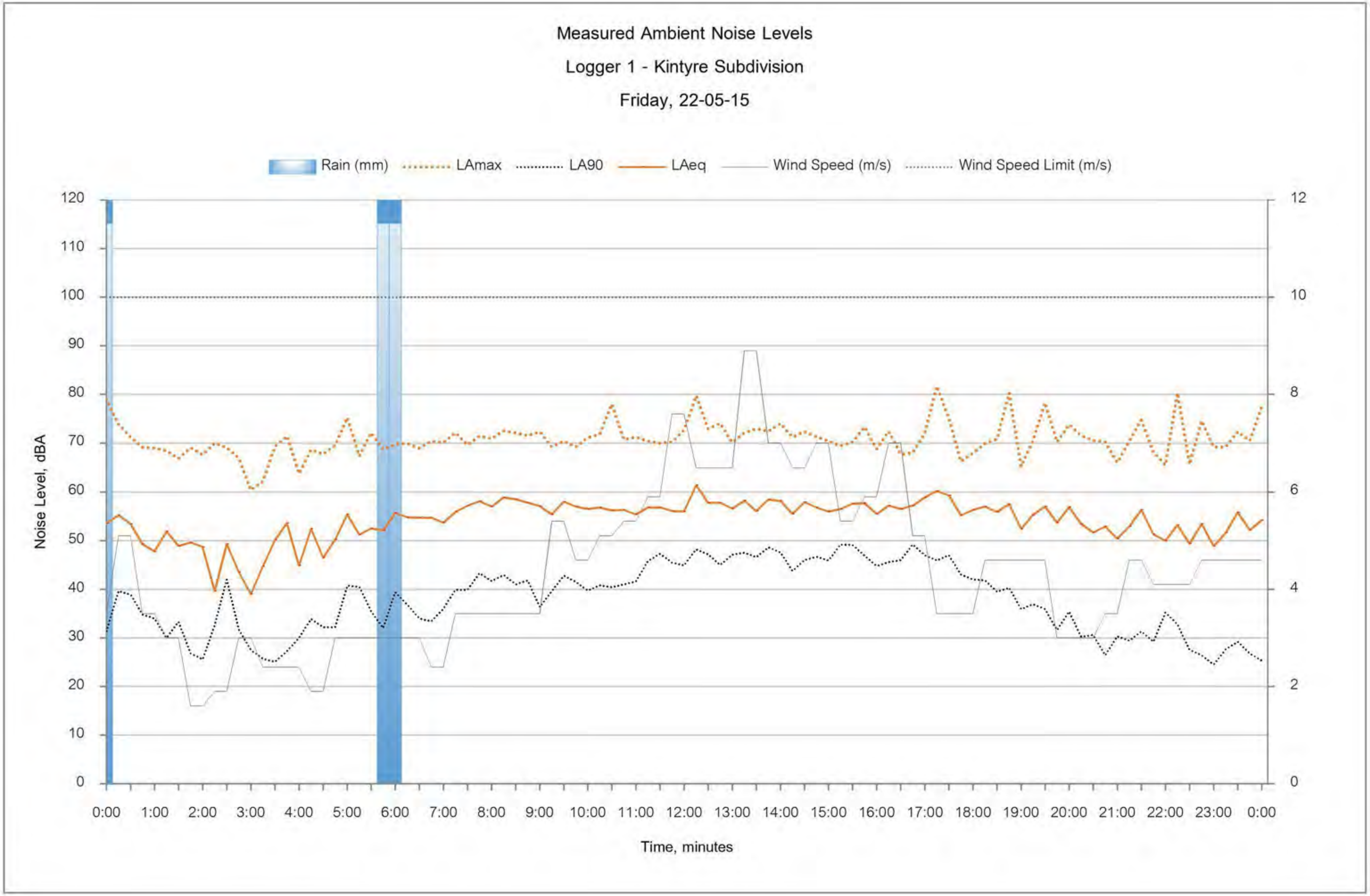
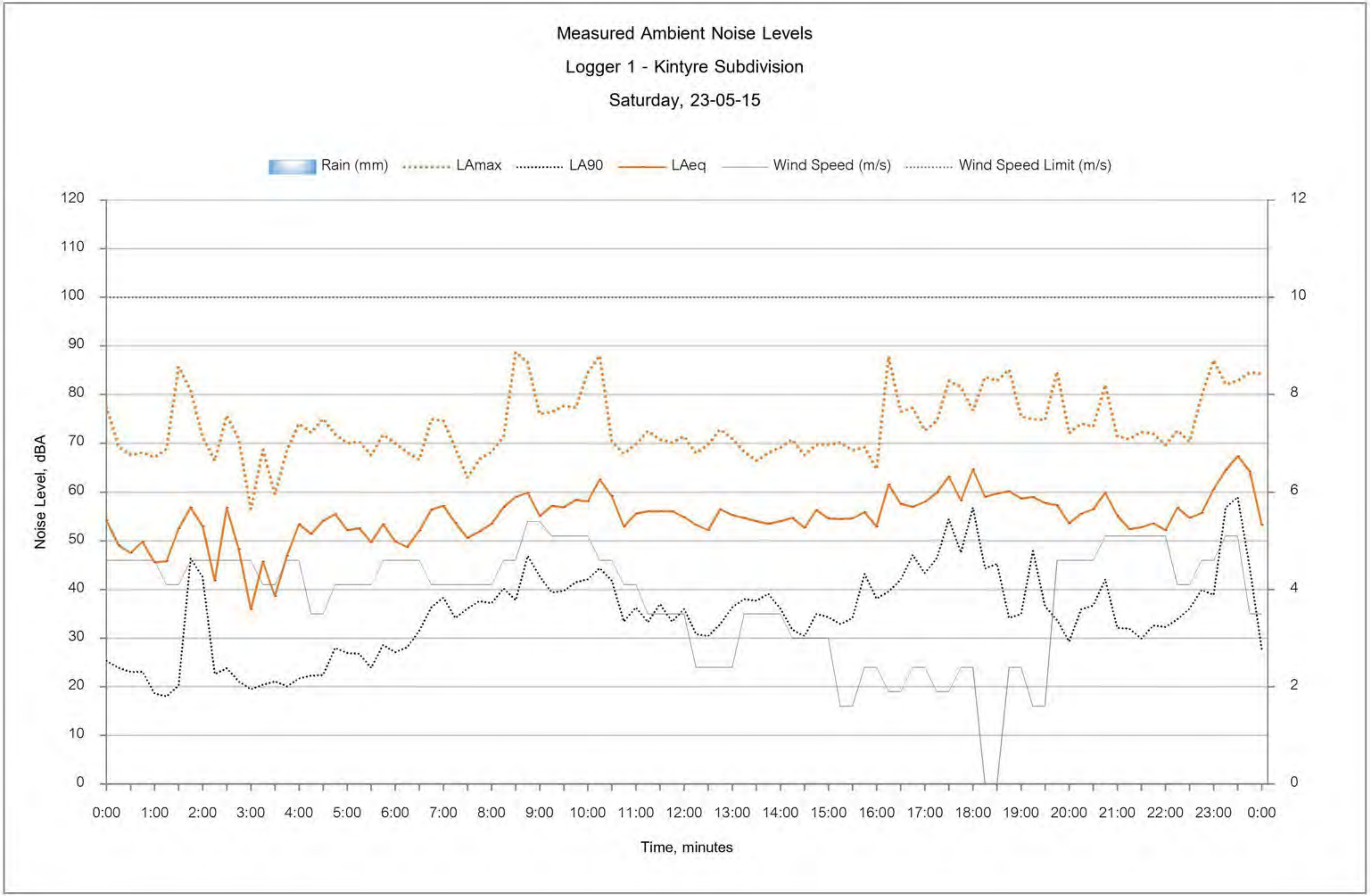
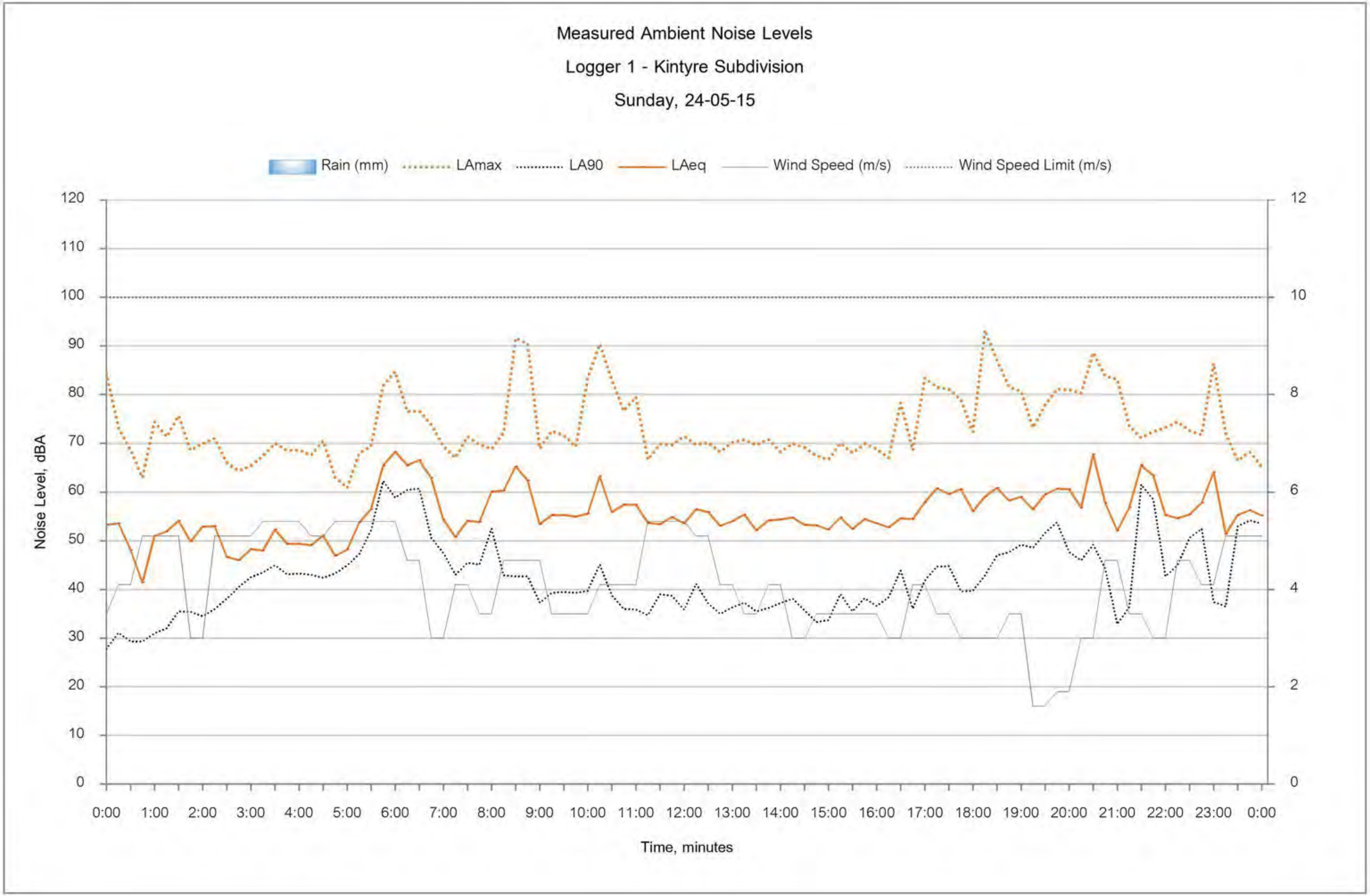
21:00
22:00
23:00
0:00
Time, minutes



Measured Ambient Noise Levels
Logger 1 - Kintyre Subdivision
Friday, 22-05-15
Rain (mm)
LAmax
LA90
LAeq
Wind Speed (m/s)
Wind Speed Limit (m/s)
Noise Level, dBA
120
110
100
90
80
70
60
50
40
30
20
10
0
12
10
8
6
4
2
0
0:00 1:00 2:00 3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00 0:00
Time, minutes



Measured Ambient Noise Levels
Logger 1 - Kintyre Subdivision
Saturday, 23-05-15
Rain (mm)
LAmax
LA90
LAeq
Wind Speed (m/s)
Wind Speed Limit (m/s)
Noise Level, dBA
Time, minutes
0:00 1:00 2:00 3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00 0:00
0 10 20 30 40 50 60 70 80 90 100 110 120
0 2 4 6 8 10 12



Measured Ambient Noise Levels
Logger 1 - Kintyre Subdivision
Sunday, 24-05-15
Rain (mm)
LAmax
LA90
LAeq
Wind Speed (m/s)
Wind Speed Limit (m/s)
Noise Level, dBA
120
110
100
90
80
70
60
50
40
30
20
10
0
12
10
8
6
4
2
0
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
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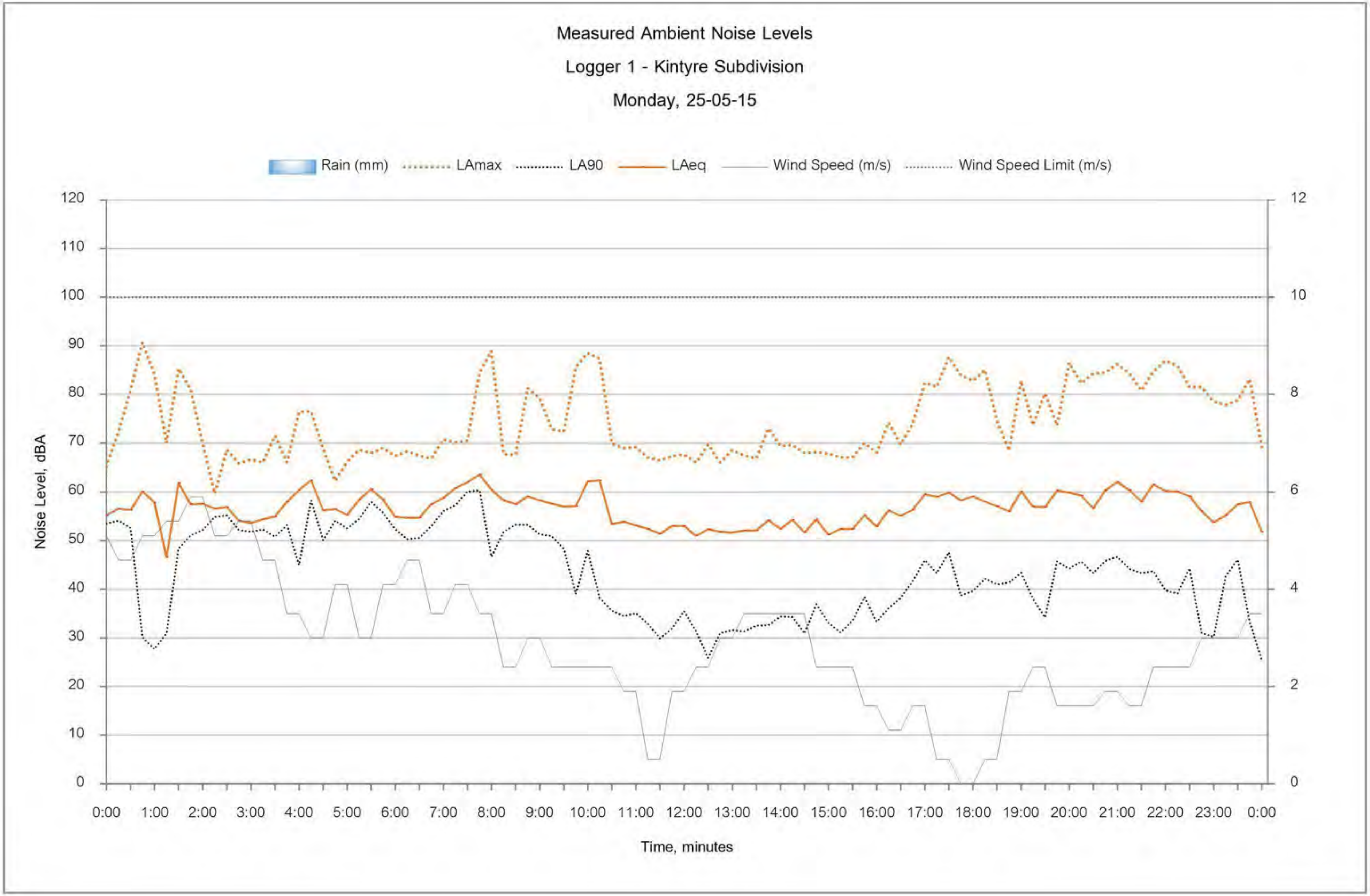
22:00
23:00
0:00
Time, minutes



Measured Ambient Noise Levels
Logger 1 - Kintyre Subdivision
Monday, 25-05-15
Rain (mm)
LAmax
LA90
LAeq
Wind Speed (m/s)
Wind Speed Limit (m/s)
Noise Level, dBA
Time, minutes
120
110
100
90
80
70
60
50
40
30
20
10
0
12
10
8
6
4
2
0
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
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13:00
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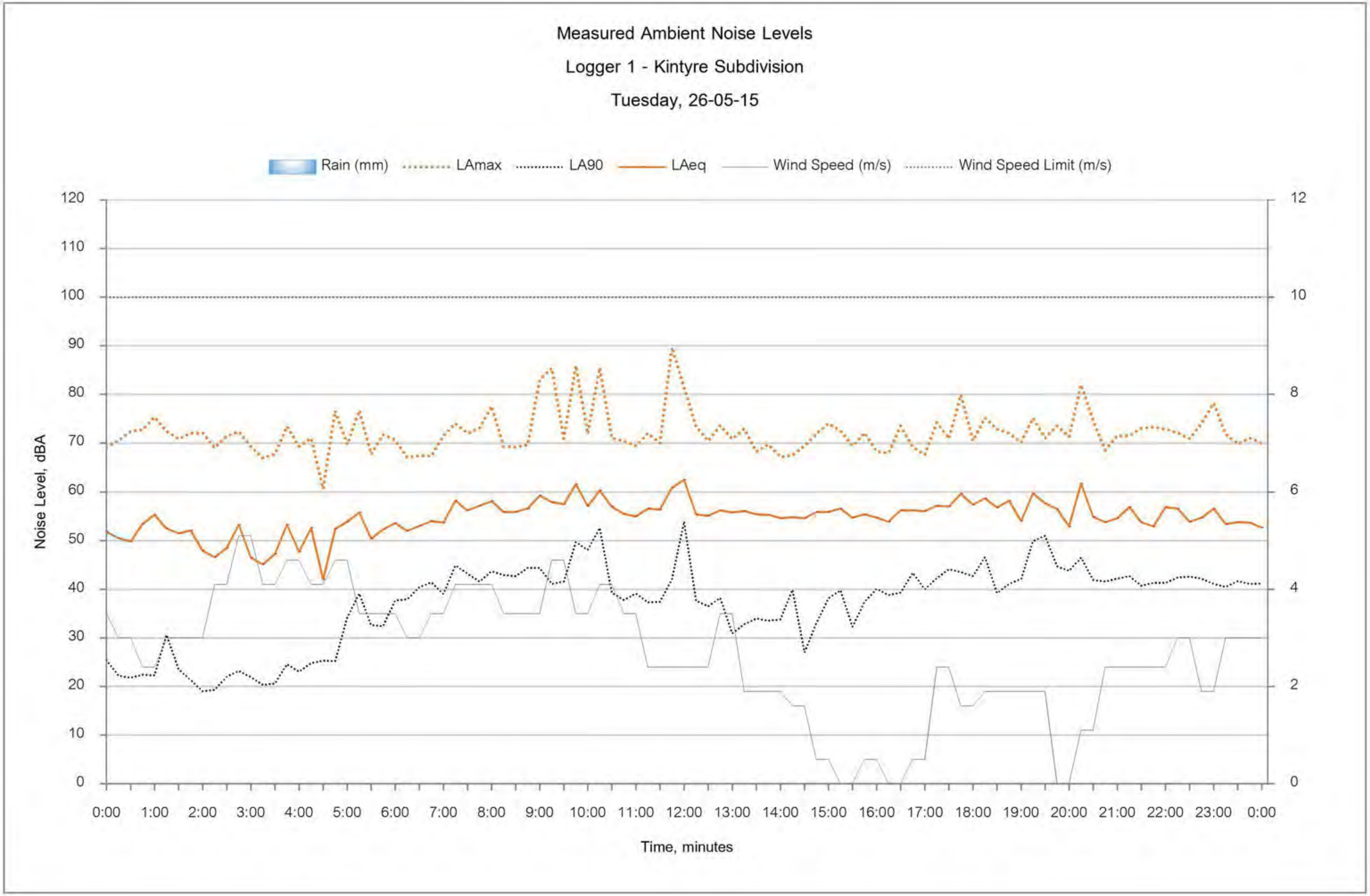
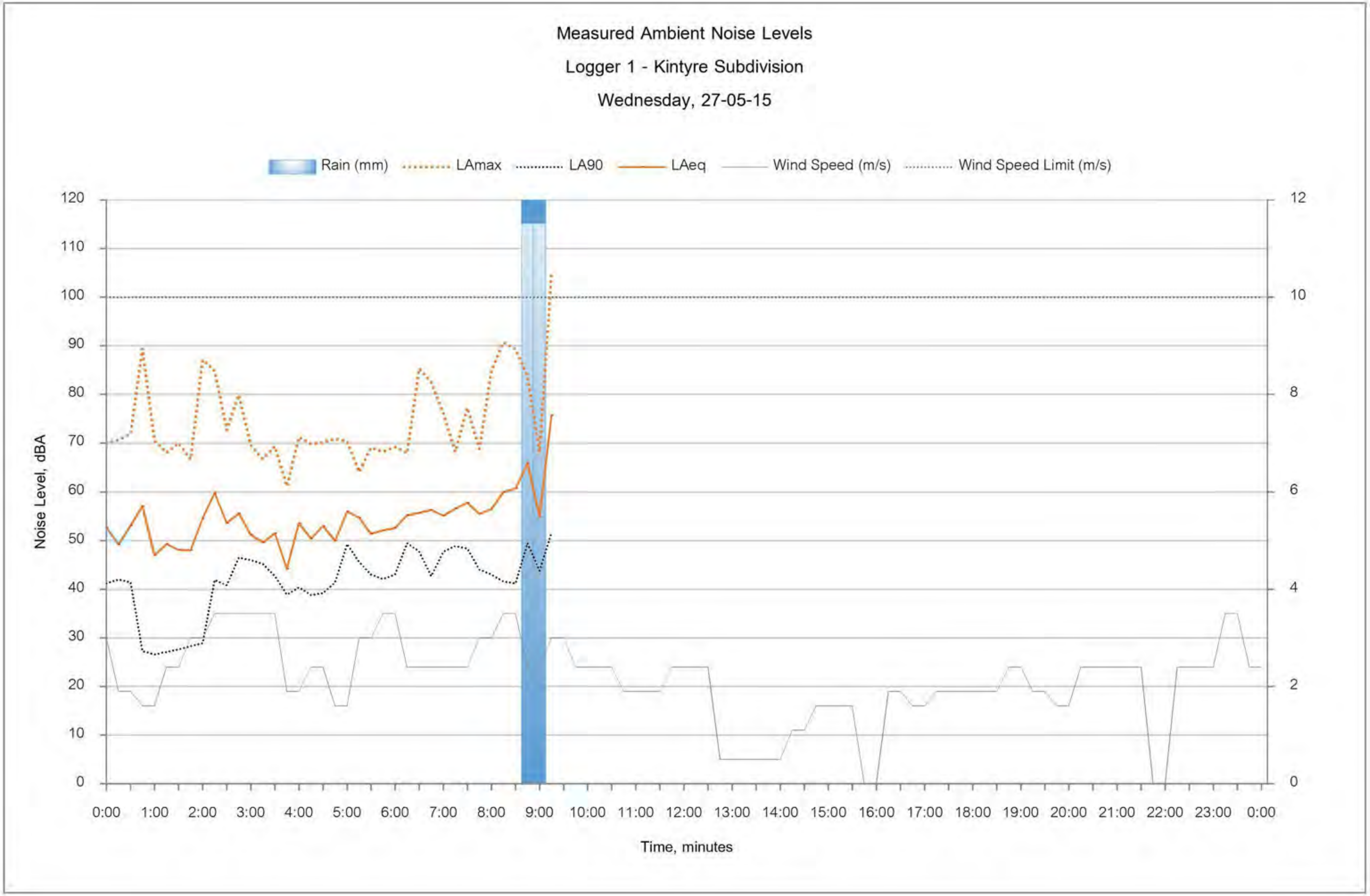
23:00
0:00



Measured Ambient Noise Levels
Logger 1 - Kintyre Subdivision
Tuesday, 26-05-15
Rain (mm)
LAmax
LA90
LAeq
Wind Speed (m/s)
Wind Speed Limit (m/s)
Noise Level, dBA
120
110
100
90
80
70
60
50
40
30
20
10
0
12
10
8
6
4
2
0
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
Time, minutes



Measured Ambient Noise Levels
Logger 1 - Kintyre Subdivision
Wednesday, 27-05-15
Rain (mm)
LAmax
LA90
LAeq
Wind Speed (m/s)
Wind Speed Limit (m/s)
Noise Level, dBA
120
110
100
90
80
70
60
50
40
30
20
10
0
12
10
8
6
4
2
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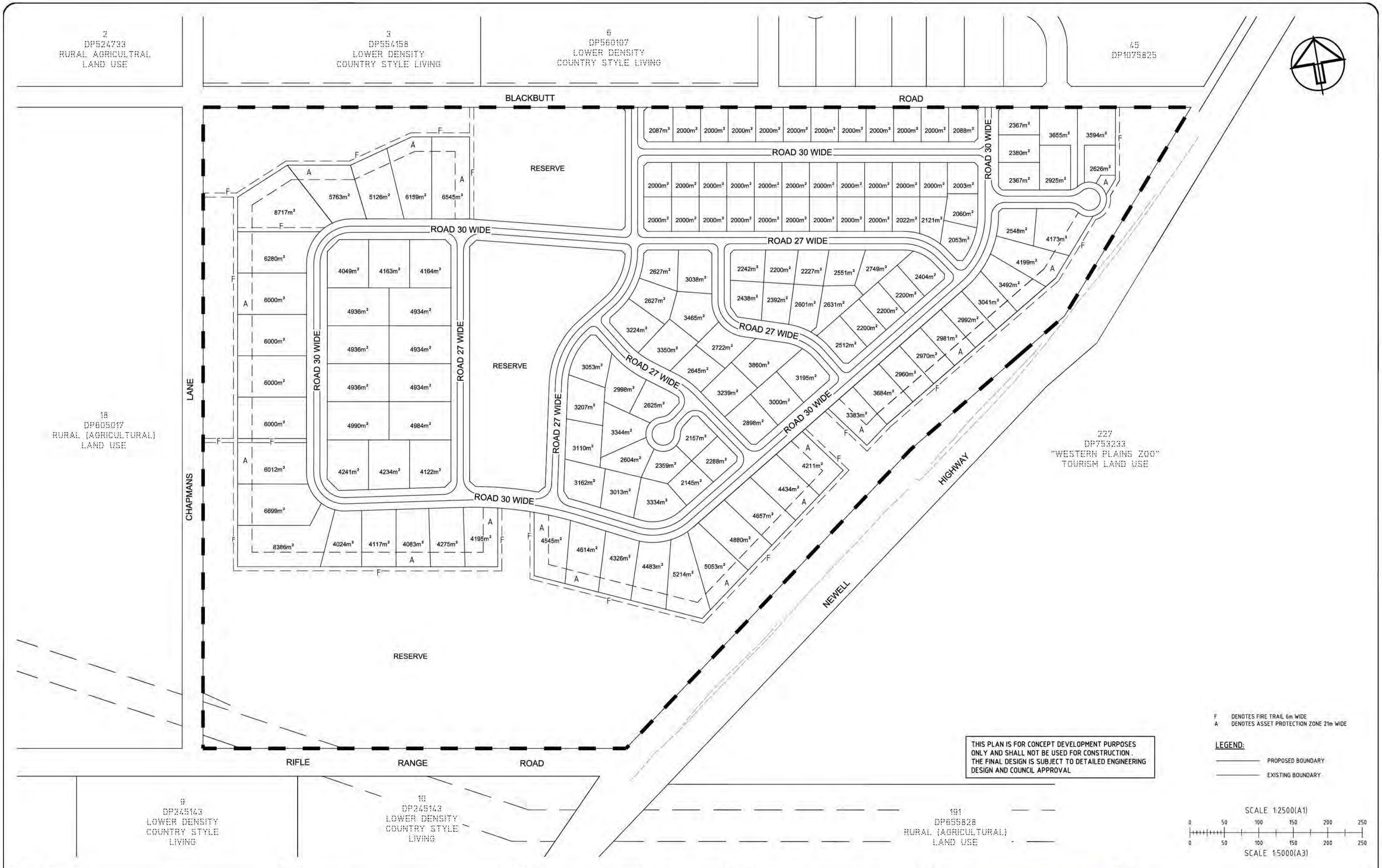
Time, minutes

# Appendix C – Site Plans




| No | DATE | DRAFTING CHECK | PM CHECK | DETAILS |
|---|---|---|---|---|
| A | 27/02/15 | NS | MT | ISSUED FOR REVIEW |
| B | 21/07/15 | JE | MT | ISSUED FOR REVIEW |
| C | 19/08/15 | JE | MT | LOT LAYOUT AMENDED |
| D | 26/08/15 | JE | MT | LOT LAYOUT AMENDED AND AREAS ADDED |
| E | 21/09/15 | JE | MT | LOT LAYOUT AMENDED |

| CHECKED/APPROVED | NAME | DATE |
|---|---|---|
| APPROVED | MT | 21/09/2015 |
| SURVEY | BARNSON | |
| DESIGNER | PPO/NS | 27/02/2015 |
| DRAFTING | ZD/NS/JE | 21/09/2015 |

APPROVAL AUTHORITY

DUBBO CITY COUNCIL
70 CHURCH STREET
DUBBO
NSW, 2830

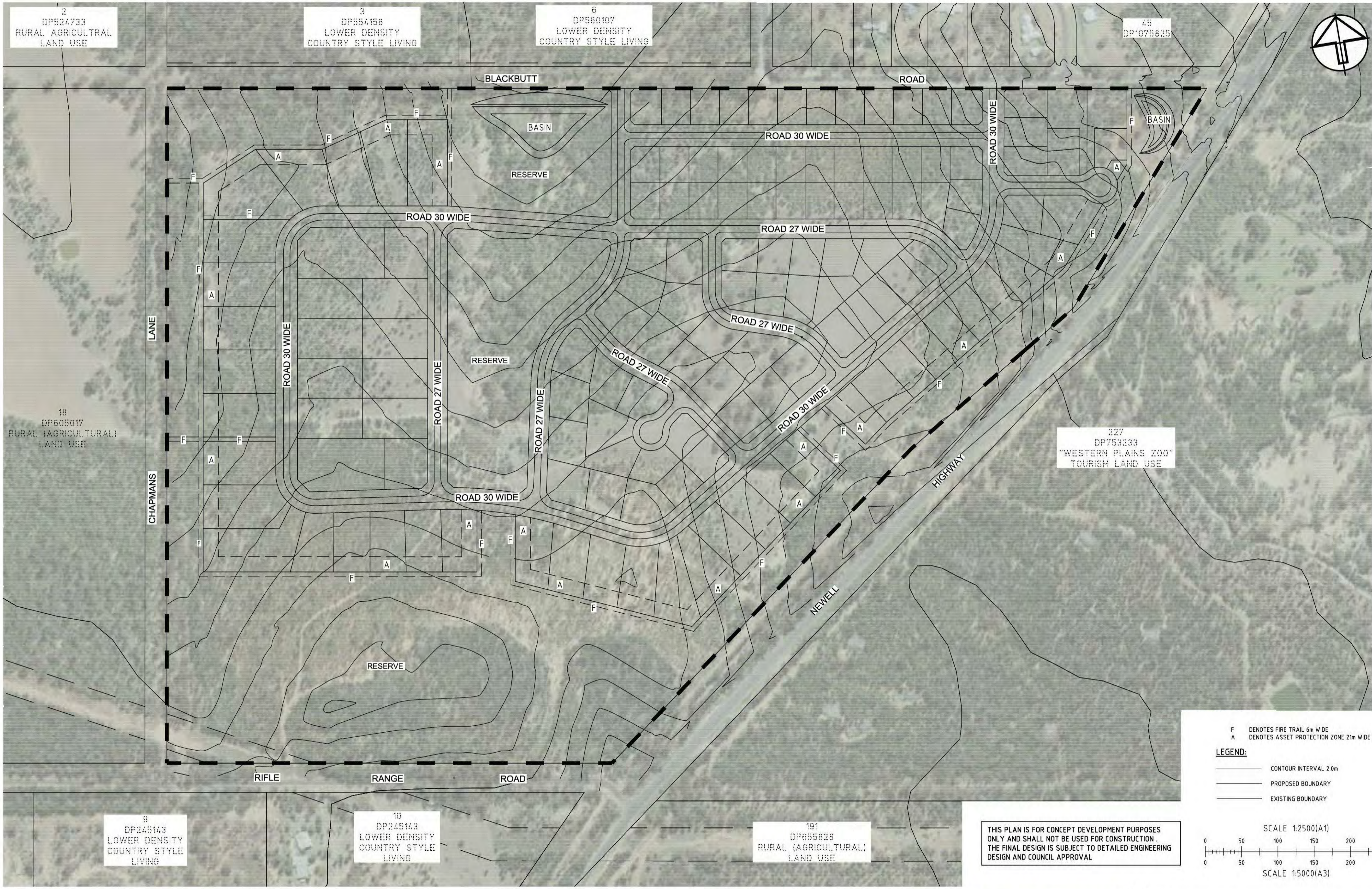
CLIENT
BAWD HOLDINGS PTY LTD

PROJECT
PROPOSED SUBDIVSION LOT 172 DP753233 BLACKBUTT ROAD, DUBBO

GEOLYSE
DUBBO
dubbo@geolyse.com
www.geolyse.com
1st FLOOR
62 WINGEWARRSTREET
P.O. BOX 1842
DUBBO, NSW 2830
Ph. (02) 6884 1525
Fax. (02) 6884 1470

DRAWING
PROPOSED SUBDIVISION LAYOUT

PERMANENT MARK: - | RL: - | DATUM: A.H.D.
PROJECT NUMBER: 113156 | DRAWING SHEET: 03E_TP01 | ORIGINAL: A1
AUTOCAD FILE: 113156_03E_TP01-TP02.dwg | 12D/CIVILCAD FILE: - | REVISION: E
STATUS: FOR REVIEW | SHEET TP01 OF TP02




THIS PLAN IS FOR CONCEPT DEVELOPMENT PURPOSES ONLY AND SHALL NOT BE USED FOR CONSTRUCTION. THE FINAL DESIGN IS SUBJECT TO DETAILED ENGINEERING DESIGN AND COUNCIL APPROVAL

| No | DATE | DRAFTING CHECK | PM CHECK | DETAILS |
|---|---|---|---|---|
| A | 27/02/15 | NS | MT | ISSUED FOR REVIEW |
| B | 21/07/15 | JE | MT | ISSUED FOR REVIEW |
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| D | 26/08/15 | JE | MT | LOT LAYOUT AMENDED AND AREAS ADDED |
| E | 21/09/15 | JE | MT | LOT LAYOUT AMENDED |

| CHECKED/APPROVED | NAME | DATE |
|---|---|---|
| APPROVED | MT | 21/09/2015 |
| SURVEY | BARNSON | |
| DESIGNER | PPO/NS | 27/02/2015 |
| DRAFTING | ZD/NS/JE | 21/09/2015 |

APPROVAL AUTHORITY

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NSW, 2830

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dubbo@geolyse.com
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1st FLOOR
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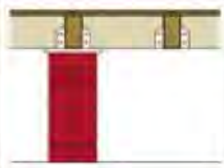
DUBBO, NSW 2830
Ph. (02) 6884 1525
Fax. (02) 6884 1470

DRAWING
# PROPOSED SUBDIVISION LAYOUT

PERMANENT MARK: -
RL: -
DATUM: A.H.D.
PROJECT NUMBER: 113156
DRAWING SHEET: 03E_TP02
ORIGINAL A1
AUTOCAD FILE: 113156_03E_TP01-TP02.dwg
12D/CIVILCAD FILE: -
REVISION E
STATUS: FOR REVIEW
SHEET TP02 OF TP02

# Appendix D – Category 2 Construction 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 |  |

Muller Acoustic Consulting Pty Ltd
PO Box 262, Newcastle NSW 2300
ABN: 36 602 225 132
P: +61 2 4920 1833
www.mulleracoustic.com

MAC
Muller Acoustic Consulting


NOTES:

1. PLAN IS FOR DEVELOPMENT APPLICATION PURPOSES ONLY
2. ALL BOUNDARIES AND AREAS ARE APPROXIMATE ONLY AND ARE SUBJECT TO FINAL SURVEY

| No | DATE | DRAFTING CHECK | PM CHECK | DETAILS |
|---|---|---|---|---|
| A | 12/10/15 | JE | SG | ISSUED FOR REVIEW |

| CHECKED/APPROVED | NAME | DATE |
|---|---|---|
| APPROVED | SG | 12/10/2015 |
| SURVEY | BARNSON | |
| DESIGNER | PPO/NS | 27/02/2015 |
| DRAFTING | JE | 12/10/2015 |

APPROVAL AUTHORITY

DUBBO CITY COUNCIL

DUBBO CITY COUNCIL
70 CHURCH STREET
DUBBO
NSW, 2830

CLIENT
HIGHVIEW COUNTRY ESTATES PTY LTD

PROJECT
PROPOSED SUBDIVSION LOT 172 DP753233 BLACKBUTT ROAD, DUBBO

GEOLYSE
DUBBO
dubbo@geolyse.com
www.geolyse.com
1st FLOOR
62 WINGEWARRSTREET
P.O. BOX 1842
DUBBO, NSW 2830
Ph. (02) 6884 1525
Fax. (02) 6884 1470

DRAWING
EXISTING BIODIVERSITY MAP

PERMANENT MARK: _ | RL: _ | DATUM: A.H.D.
PROJECT NUMBER: 113156 | DRAWING SHEET: 05A_TP01 | ORIGINAL A1
AUTOCAD FILE: 113156_05A_TP01-TP02.dwg | 12D/CIVILCAD FILE: -
STATUS: FOR REVIEW | SHEET TP01 OF TP02 | REVISION A


NOTES:

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| No | DATE | DRAFTING CHECK | PM CHECK | DETAILS |
|---|---|---|---|---|
| A | 12/10/15 | JE | SG | ISSUED FOR REVIEW |

| CHECKED/APPROVED | NAME | DATE |
|---|---|---|
| APPROVED | SG | 12/10/2015 |
| SURVEY | BARNSON | |
| DESIGNER | PPO/NS | 27/02/2015 |
| DRAFTING | JE | 12/10/2015 |

APPROVAL AUTHORITY

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NSW, 2830

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Fax. (02) 6884 1470

DRAWING: PROPOSED BIODIVERSITY MAP

| | | |
|---|---|---|
| PERMANENT MARK: - | RL: - | DATUM: A.H.D. |
| PROJECT NUMBER: 113156 | DRAWING SHEET: 05A_TP02 | ORIGINAL: A1 |
| AUTOCAD FILE: 113156_05A_TP01-TP02.dwg | 12D/CIVILCAD FILE: - | REVISION: A |
| STATUS: FOR REVIEW | SHEET TP02 OF TP02 | |

# Part 1 – Application and Purpose

## 1.1 NAME AND APPLICATION OF THIS PLAN

This Development Control Plan is the 'Highview' Development Control Plan (DCP). It has been prepared pursuant to the provisions of Section 74D of the *Environmental Planning and Assessment Act 1979.*

This DCP was adopted by Council on the (insert date) and came into force on (insert date).

This DCP applies to the land known as 'Highview' being land identified (outlined red) as Lot 172 DP 753233 and within the South-Western Sub District Residential Release Area of the Dubbo Local Government Area as shown in Plate 1 below:


**Plate 1:** Highview aerial photograph (Source: http://maps.six.nsw.gov.au/)

This DCP extends the existing controls for Neighbourhood and Subdivision and Residential Development in the Dubbo DCP.

The release of this land would be generally consistent with that intended and accounted for within Dubbo's *South-Western Sub District Residential Release Area* under the *Dubbo South-West Residential Release Strategy 2011* and *Dubbo's Road Transportation Strategy to 2045*.

## 1.2 PURPOSE OF THIS PLAN

The purpose of this DCP is to:

a. Amend the controls relating to residential development (including subdivision) in the existing DCP to achieve a set of additional controls for the development of Highview Estate.

b. Communicate the planning, design and environmental objectives and controls against which the Consent Authority would assess Development Applications (DAs) within Highview Estate.

c. Provide guidance on the orderly, efficient and environmentally sensitive development of Highview Estate.

d. Promote good quality urban design outcomes within the context of environmental, social and economic sustainability.

## 1.3 SAVINGS AND TRANSITIONAL ARRANGEMENTS

If a development application has been made before the commencement of this DCP in relation to land to which this DCP applies and the application has not been finally determined before that commencement, the application may be determined as if this DCP had not commenced.

# Part 2 – Residential Development & Subdivision

## 2.1 RESIDENTIAL DEVELOPMENT – LARGE LOT LIVING

This section is designed to encourage current 'best practice' solutions to subdivision design. The achievement of pleasant, safe and functional subdivision is the main objective of subdivision design.

The objectives of this section are:
- To facilitate a mix of dwelling sizes complementing the character of the area and that provide accommodation for all sectors of the community; and
- To facilitate new residential accommodation supported by infrastructure that enables habitation;

This section lists subdivision design elements under the following headings:

- Element 1 – Block and lot layout
- Element 2 – Streetscape character and building design
- Element 3 – Building setbacks
- Element 4 – Solar access
- Element 5 – Private open space and landscaping
- Element 6 – Infrastructure
- Element 7 – Visual and acoustic privacy
- Element 8 – Vehicular access and car parking
- Element 9 – Waste management
- Element 10 – Site facilities
- Element 11 – Non-residential uses
- Element 12 – Stormwater management
- Element 13 – Water quality management
- Element 14 – Environmental management
- Element 15 – Site specific infrastructure.

Each design element has been structured so that it contains:

- 'Objectives' for each design element that describe the required outcomes;
- 'Performance criteria' which outlines the range of matters which shall be addressed to satisfy the objectives (i.e. the performance criteria explains how an objective is to be achieved);

| Note: Not all performance criteria will be applicable to every development. |
|---|

- 'Acceptable Solutions' which are specific measures which illustrate one way of meeting both the performance criteria and objectives of an element. They are examples only and are not mandatory; and
- 'References' to relevant clauses of the Dubbo LEP 2011, other relevant legislation, Council policies and literature relevant to the design element.

**References**

* Dubbo City Council (2013). *Dubbo Development Control Plan 2013.* Retrieved from http://www.dubbo.nsw.gov.au/_literature_119282/Development_Control_Plan_2013

**Element 1:** Block and Lot Layout

***Objectives***

- To efficiently utilise land and maintain the bushland character and ecological attributes of the estate.
- To emphasise the natural attributes of the site and reinforce neighbourhood identity through the incorporation of visible features, such as bushland canopies, retention of existing established trees, natural wetlands and vegetation corridors.
- To optimise outlook and proximity to bushland reserves.
- To encourage dwelling sizes, types and design that is subordinate to the bushland character and the topography of the land.
- To encourage variety in dwelling size, type and design that promotes innovative design and creates attractive streetscapes.
- To accommodate a mix of lot sizes and dimensions that maintains the bushland character of estate.
- To establish a clear residential structure that facilitates a 'sense of neighbourhood' and encourages walking and cycling within the estate and connections into adjoining estates.

| **Performance criteria**<br><br>The block and lot layout objectives may be achieved where: | **Acceptable solutions**<br><br>The acceptable solutions illustrate one way of meeting the associated performance criteria: |
|---|---|
| P1 Residential neighbourhoods are focused on elements of the public domain such as a bushland reserves and wetlands that are typically within walking distance. | A1.1 Preferred block orientation is established by the road layout on the structure plan for the Estate. Optimal orientation is east-west, or north south where the road pattern requires.<br><br>Exceptions to the preferred lot orientation may be considered where factors such as areas of ecological importance and the retention of existing vegetation is required. |
| P2 Subdivision layout is to create legible and permeable street hierarchy that responds to the natural topography, bushland character, bushland outlook and optimal solar orientation. | A2.1 An alternative lot orientation may be considered where other amenities such as views and outlook over open space are available, and providing appropriate solar access and overshadowing outcomes can be achieved. |
| P3 Pedestrian connectivity is to be provided within and to residential neighbourhoods with provision for pedestrian and cycle routes connecting to public open space areas and elements of the public domain such as parks and community facilities. | A3.1 Footpaths and fire trails are utilised to provide connectivity through the residential estate. |
| P4 Lot dimensions are to respond to the topography and the required road layout of the estate to ensure the bushland character | A4.1 Minimum lot sizes should comply with the minimum lot size provisions permitted by the Dubbo Local Environmental Plan 2011. |

| | |
|---|---|
| is maintained and enhanced and to create coherent streetscapes with distinctive characters across the neighbourhood. | A minimum lot frontage of 25 metres measured at the front building line/street facing building line as indicated in Figure 1 should be provided to all lots<br><br>A4.2 Where lots are an irregular shape, they are to be large enough and oriented appropriately to enable dwellings to meet the controls of this DCP. |


**Figure 1:** **Front Building Line / Street Facing Building Line & Front Setback**

**Element 2:** Neighbourhood character and building design

***Objectives***

- The bushland landscape is the predominant feature of the estate with the built form being the secondary component of the visual catchment.
- To design residential housing development to complement the streetscape and neighbourhood character;
- To design residential housing in keeping with the desired future streetscape and neighbourhood bushland character;
- To provide allotments that cater for larger dwelling sizes complementing the bushland character of the area;

| **Performance criteria**<br><br>The neighbourhood character and building design objectives may be achieved where: | **Acceptable solutions**<br><br>The acceptable solutions illustrate one way of meeting the associated performance criteria: |
|---|---|
| **P1** The bushland landscape is the predominant feature of the estate with the built form being the secondary component of the visual catchment. | **A1.1** The dwelling is provided with a curtilage of landscaped gardens. |
| **P2** The frontage of buildings and their entrances are readily apparent from the street | **A2.1** Buildings adjacent to a public street have an entrance that faces the street |
| **P3** The development is to be designed to respect and reinforce the positive characteristics of the neighbourhood, including;<br><br>o The bushland setting;<br><br>o Bulk and scale;<br><br>o Built form;<br><br>o Existing Vegetation; and<br><br>o Topography. | **A3.1** Design elements to consider are:<br><br>Landscaping;<br><br>Roof form and pitch;<br><br>Façade articulation and detailing;<br><br>Window and door proportions;<br><br>Solid to void proportions;<br><br>Building materials, patterns, textures and colours;<br><br>Setbacks. |
| **P4** Walls visible from the street are adequately articulated with recesses, windows, projections or variations of colour, texture and materials. | **A4.1** Walls presenting to the street are dominated by windows and provided with suitably sized awnings. |
| **P5** Garages and parking structure are sited and detailed to ensure they do not dominate the street frontage, integrate with features of the dwelling and do not dominate view of the dwelling from the street. | **A5.1** The width of the parking structure facing the street shall not be greater than 30% of the total width of the front of the building when measured at the front building line. |

| | |
|---|---|
| | **A5.2** Garages or parking structures are located in line with or behind the alignment of the front façade/entrance of the dwelling, with a minimum setback of 0.5 m from the front façade/entrance of the dwelling. |
| **P6.1** Vegetation is preferred over fencing to delineate property boundaries.<br><br>**P6.2** Fencing is subordinate to landscaping and the native vegetation consistent with the desired character of the area.<br><br>**P6.3** Front fencing is dominated by landscaping and provides an outlook from the dwelling to the street or open space to promote passive surveillance and safety of the public domain.<br><br>**P6.4** Front fencing greater than 1.0 m in height is setback 2.0 m from the front property boundary to provide a landscaped setback between the front property boundary and the fence. | **A6.1** Fencing along classified roads provides noise attenuation to the dwellings and is screened from public view by vegetation.<br><br>**A6.2** Solid front fences and fencing with less than 50% transparency have a maximum height of 1.2 m.<br><br>**A6.3** Front fencing with greater than 50% transparency have a maximum height of 1.5 m.<br><br>**A6.4** Solid front fencing to classified roads for the purposes of noise attenuation and secondary street frontage fencing may be considered to a height of 1.8 m providing the fencing does not exceed 5 m in length without articulation and is softened with landscaping.<br><br>**A6.5** Fencing style and materials reflect the local streetscape and is dominated by landscaping.<br><br>**A6.6** Fencing on corner allotments does not impede motorist's visibility at the intersection.<br><br>**A6.7** Gates are designed to ensure pedestrian and motorists safety. |
| **P7.1** Waste disposal and collection areas are unobtrusive and located behind the front building line.<br><br>**P7.2** Service structures and mechanical plant are designed as part of the building or are concealed from primary street views. | **A7.1** Structures and areas for waste disposal and building services are located in line with or behind the alignment of the front façade/entrance of the dwelling and screened by landscaping. |
| **P8.1** Balconies and screens are to be integrated into the overall building design and are not to present unnecessary bulk and scale, visual privacy and overshadowing impacts upon adjoining properties | **A8.1** Fenestration and sun control devices are used effectively to shade buildings, reduce glare and assist in maintaining comfortable indoor temperatures and are designed to be part of the overall development design. |

**Element 3: BUILDING SETBACKS**
**Objectives:**

- To ensure that the set-back of a building from the property boundaries, the height and length of walls, site coverage and visual bulk are suitable within the bushland setting.
- To ensure habitable rooms and private open space of dwellings and upon adjoining properties are provided with adequate solar access, ventilation and residential amenity.

| **Performance criteria**<br><br>Building setback objectives may be achieved where: | **Acceptable solutions**<br><br>The acceptable solutions illustrate one way of meeting the associated performance criteria: |
|---|---|
| **P1** The setback of the development from the front boundary of the allotment is consistent with established set-backs, or is consistent with the desired amenity of the locality.<br><br>Development upon corner allotments should address both street frontages. | **A1.1** A minimum setback of 10.0 m from the primary/front property boundary to the front building line is to be provided.<br><br>**A1.2** A minimum setback of 5.0 m from the secondary/side street property boundary to the side building line is to be provided.<br><br>**A1.3** A minimum setback of 5.0 m from the side property boundary to the side building line is to be provided.<br><br>**A1.4** A minimum setback of 6.0 m from the rear property boundary to the rear building line is to be provided. |
| **P2** The location of garages and parking structures does not diminish the attractiveness of the streetscape, does not dominate views of the dwelling from the street and integrates with features of associated dwellings. | **A2.1** Garages and parking structures are to be setback 0.5 m from the front building line of the dwelling. |

**Element 4: Solar Access**
**Objectives:**

- To ensure all development provides an acceptable level of solar access for occupants.
- To ensure development does not significantly impact on the solar access and amenity of adjoining and adjacent allotments.

| **Performance criteria**<br><br>The solar access objectives may be achieved where: | **Acceptable solutions**<br><br>The acceptable solutions illustrate one way of meeting the associated performance criteria: |
|---|---|
| **P1** Development is designed to ensure solar access is provided to habitable rooms, private open space and outdoor clothes drying facilities. | **A1.1** Outdoor clothes drying facilities are located to ensure adequate solar access is provided between the hours of 9.00 am and 3.00 pm on the 22 June (winter solstice) to a plane of 1.0 m above the finished ground level under the outdoor drying facility.<br><br>**A1.2** The glazed areas (windows and doors) of habitable rooms of adjoining development receive a minimum of three hours of solar access between 9.00 am and 3.00 pm on the 22 June (winter solstice).<br><br>**A1.3** Principle private open space areas of adjoining dwellings receive a minimum of three hours solar access over 75% of the main private open space area between 9.00 am and 3.00 pm on the 22 June (winter solstice)<br><br>**A1.4** Landscaping is to have regard to the maintenance of solar access in accordance with the Development Guidelines above, however can provide filtered solar access/overshadowing during (9.00 am and 3.00 pm). |

**Element 5: Private Open Space, Landscaping, Retaining walls and terracing**
**Objectives**:

- To provide outdoor open space that is well-integrated with the development and is of sufficient area to meet the needs of occupants.
- To provide a pleasant, safe and attractive level of residential amenity.
- To ensure landscaping is appropriate in nature and scale for the local environment.
- To protect and minimise disturbance to natural landforms.
- To encourage building design to respond sensitively to the natural topography.

| **Performance criteria**<br><br>The objectives may be achieved where: | **Acceptable solutions**<br><br>The acceptable solutions illustrate one way of meeting the associated performance criteria: |
|---|---|
| **P1.1** Private open space is of an area and dimension that would facilitate its intended use.<br><br>**P1.2** Private open space area is suitably setback and screened from public view.<br><br>**P1.3** Private open space is easily accessible by the occupants and provided with an acceptable level of privacy. | **A1.1** Dwellings are provided with a Principle Private Open Space (PPOS) area, in addition to any general Private Open Space (POS).<br><br>**A1.2** The PPOS has a minimum level area of 30 m2 and a minimum width of 5 m. This area can include covered outdoor areas<br><br>**A1.3** POS is directly accessible from the main living areas of the dwelling.<br><br>**A1.4** All POS is screened from adjoining dwellings and their principle private open space areas to provide visual privacy between properties and their POS areas.<br><br>**A1.5** The height and density of landscaping at maturity assist with the provision of visual privacy between properties and their POS areas. |
| **P2.1** Landscaping enhances and compliments the natural environment and surrounding bushland character, reinstates elements of the natural environment, reduces the visual bulk and scale of development, and compliments the design of the development<br><br>**L2.2** Landscaping is located to not impact infrastructure on the site, adjoining the site including public (or future public) land. Species are selected and located taking into consideration the size of the root zone of the tree at maturity and the likelihood of potential for the tree to shed/drop material | **A2.1** Species are selected and located to ensure visual privacy and solar access of adjoining properties is provided and is predominantly endemic to Dubbo.<br><br>**A2.2** Where possible existing native trees are retained.<br><br>**A2.3** Species selected are suitable for the climate and require minimal watering.<br><br>**A2.4** Landscaping would not adversely impact ground-water levels by over-watering resulting in ground water level increases or the pollution of ground water and water ways. |

| | |
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| **L2.3** Landscaping is undertaken in an environmentally sustainable manner which limits the time and costs associated with maintenance.<br><br>**L2.4** Lightweight construction and pier and beam footings should be used in areas within 4.0 m of an existing canopy tree to be retained.<br><br>**L2.5** Where retaining walls and terracing are visible from a public place, preference is given to the use of natural materials and colours softened by landscaping that does not compromise the structural integrity of the wall and terrace.<br><br>**L2.6** Under croft areas shall be limited to a maximum height of 1.0 m and must be suitably screened from public view by landscaping. | **A2.5** Landscaping is provided with timed watering system and moisture meters to determine and control watering. |

**Element 6: Infrastructure**
**Objectives**

- To encourage residential development in areas where it can take advantage of existing physical and social support infrastructure.
- To ensure infrastructure has the capacity or can be economically extended to accommodate new residential development.
- To efficiently provide development with appropriate physical services.
- To minimise the impact of increased stormwater run-off to drain systems.

| **Performance criteria**<br><br>The infrastructure objectives may be achieved where: | **Acceptable solutions**<br><br>The acceptable solutions illustrate one way of meeting the associated performance criteria: |
|---|---|
| **P1.2** Residential development shall not overload the capacity of public infrastructure including reticulated services, streets, open space and human services.<br><br>**P1.2** Design layout of residential development provides space and facilities to enable efficient and cost-effective provision of telecommunication services.<br><br>**P1.3** The development is connected to reticulated sewerage, water supply and disposal and electricity systems and to Natural gas, telecommunications where available. | **A1.1** Physical infrastructure is to be designed in accordance with Councils adopted version of NATSPEC and relevant policies.<br><br>**A1.2** On site stormwater detention shall be provided with delayed release into the stormwater system.<br><br>**A1.3** Where not serviced by Council sewerage services, an approved effluent disposal system is installed and located so it is not:<br><br>- Situated on flood-affected land;<br><br>- Within or adjacent to drainage lines;<br><br>- Likely to contaminate any surface or ground water supplies.<br><br>**A1.4** Minimal impervious areas shall be provided. |

**Element 7: Visual and acoustic privacy**

**Objectives:**

- To limit overlooking of private open space and views into neighbouring development.
- To substantially contain noise within each dwelling and to minimise noise from shared facility/communal areas near bedrooms of dwellings
- To protect internal living and sleeping areas from inappropriate levels of external noise.

| **Performance criteria**<br><br>The privacy objectives may be achieved where: | **Acceptable solutions**<br><br>The acceptable solutions illustrate one way of meeting the associated performance criteria: |
|---|---|
| **P1.1** Private open spaces and living rooms of adjacent residential accommodation are protected from direct overlooking by an appropriate layout, screening devices, separation and landscaping.<br><br>**P1.2** Balconies and screens are integrated into the building design and are positioned to assist with the maintenance of visual privacy between dwellings and their living areas.<br><br>**P1.3** The impact of upon habitable rooms within the proposed dwelling and adjoining dwellings are minimised. | **A1.1** Privacy screens are to be translucent or perforated with maximum 25% openings or designed to direct views away from living areas of adjoining properties.<br><br>**A1.2** sufficient setback and landscaping is provided between the living areas |
| **P2** Obtrusive noise from building services and equipment is suitable screened and maintained to ensure acoustic privacy is maintained to adjoining dwellings and their living areas | **A2.1** Noise from mechanical plant and equipment (pool filters, air-conditioning and the like) must achieve the relevant requirements of the Protection of the Environment Operations Act 1979. |

**Element 8: Vehicular Access and Car Parking**

**Objective**

- To provide adequate and convenient parking for residents, visitors and service vehicles.
- To ensure street and access ways provide safe and convenient vehicle access to dwellings and can be efficiently managed.
- To avoid parking and traffic difficulties in the development and the neighbourhood.

| **Performance criteria**<br><br>The vehicular and car parking objectives may be achieved where: | **Acceptable solutions**<br><br>The acceptable solutions illustrate one way of meeting the associated performance criteria: |
|---|---|
| **P1** Car parking is provided according to the projected needs of development, the location of the land and the characteristics of the immediate locality. | **A1.1** Dwellings provide 2 car spaces behind the front building line.<br><br>**A1.2** Bed and breakfast accommodation provide onsite vehicle parking at a rate of 1 space per lettable bedroom plus 2 parking spaces required to service the permanent occupants of the dwelling. |
| **P2.1** Car parking facilities are designed and located to conveniently and safely serve users without detriment to pedestrians, cyclists and vehicles using the local road network.<br><br>**P2.2** Enable efficient use of car spaces and access ways including adequate manoeuvrability for vehicles between streets and the site. | **A2.1** The dimension of a car space is to be 5.5 m in length by 2.4 m in width.<br><br>**A2.2** Access ways and drive ways are designed to enable vehicles to enter the designated parking space in no more than two turning movements and leave the space in no more than two turning movements.<br><br>**A2.3** Driveways are to be 3.0 m in width at the property boundary.<br><br>**A2.4** Driveways are not to be within 6.0 m of an intersection. |
| **P3.1** Conform to the adopted street network hierarchy and any relevant local traffic management plans.<br><br>**P3.2** Vehicle parking design and location shall minimise impacts on neighbouring dwellings | **A3.1** Access to properties is to be provided from the minor road when available.<br><br>**A3.2** Access points are located so that stopping sight distances are adequate for the design speed of the road. |
| **P4.1** Car parking facilities are designed and located to conveniently and safely serve users including pedestrians, cyclists and vehicles. | **A4.1** Flood free vehicle access is provided.<br><br>**A4.2** Driveway gates do not open over public land. |
| **P5.1** Public parking areas are broken up with trees and/or buildings and/or different surface treatments. | **A5.1** Car spaces and driveways are formed, defined and drained to a council drainage system, and surfaced with an all-weather seal; or stable smooth, semi-porous paving material laid to the paving standard of light vehicle use. |

**Element 9: Waste Management**

**Objectives**

- To ensure waste disposal is carried out in a manner which is environmentally responsible and sustainable
- To ensure safe collection of waste receptacles

| **Performance criteria**<br><br>The waste management objectives may be achieved where: | **Acceptable solutions**<br><br>The acceptable solutions illustrate one way of meeting the associated performance criteria: |
|---|---|
| **P1.1** Solid and liquid waste is disposed of in an environmentally responsible and legal manner.<br><br>**P1.2** Sufficient area is provided for the storage and collection of waste receptacles at a rate of 3 x 240 litre bins per dwelling.<br><br>**P1.3** Sufficient area is provided for the storage and regular collection of waste generated by other permitted uses within the residential zone<br><br>**P1.4** Adequate space is provided to store waste collection bins in a position which will not adversely impact upon the amenity of the area, adjoining properties or the streetscape. | **A1.1** Waste collection bins are to be located behind the front building line and suitably screened and landscaped.<br><br>**A1.2** Residential accommodation shall participate in Councils garbage and recycling materials collection service.<br><br>**A1.3** Organic waste shall be composted.<br><br>**A1.4** Recycling of wastes such as paper, plastics, glass and aluminium.<br><br>**A1.5** Reuse of waste such as timber.<br><br>**A1.6** Disposal of waste to a Council approved waste facility or transfer station. |

**Element 10 – Site facilities**

**Objective**

- To ensure that site facilities are functional, readily accessed, visually attractive, are subordinate to the bushland character and blend into the development and streetscape and require minimal maintenance.

| **Performance criteria**<br><br>The site facilities objective may be achieved where: | **Acceptable solutions**<br><br>The acceptable solutions illustrate one way of meeting the associated performance criteria: |
|---|---|
| **P1.1** Mail boxes are located for convenient access by residents and the delivery authority in close proximity to the primary entrance to the property.<br><br>**P1.2** Telecommunication facilities are provided to serve the needs of residents do not present visual clutter and are kept to a minimum. | **A1.1** Site facilities are provided to serve the needs of residents, do not present visual clutter, are integrated with the building and landscaping design and are kept to a minimum. |

**Element 11: Non-residential uses**

**Objective:**

- To ensure non-residential development is of a type, scale and character which will maintain an acceptable level of amenity and the bushland character.

| Performance criteria<br><br>The objectives may be achieved where: | Acceptable solutions<br><br>The acceptable solutions illustrate one way of meeting the associated performance criteria: |
|---|---|
| **P1.1** Non-residential use does not result in detrimental impacts to residential amenity having regard to traffic, parking, noise, odour, signage and safety.<br><br>**P1.2** Non-residential use maintains the bushland character. | **A1.1** The scale and character of non-residential buildings is compatible with the surrounding residential nature of the locality and is screened and softened by vegetation.<br><br>**A1.2** Car parking is provided and designed appropriate to the site.<br><br>**A1.3** Traffic can manoeuvre in to and out of the site in a forward direction.<br><br>**A1.4** Hours of operation are to be restricted to normal business hours.<br><br>**A1.5** Noise from the development does not exceed the background noise level (LA90) by more than 5 dB (A) during approved business hours and does not exceed the background noise level at any frequency outside approved business hours.<br><br>**A1.6** Where possible existing native trees are retained.<br><br>**A1.7** Species selected are suitable for the climate and require minimal watering. |

**Element 12: Stormwater Management**

**Objective:**

- To provide major and minor drainage systems which:
  - Adequately protect people and the natural and built environments to an acceptable level of risk and in a cost effective manner in terms of initial costs and maintenance; and
  - Contribute positively to environmental enhancement of catchment areas.
- To manage any water leaving the site (during construction and post construction) with stormwater treatment measures.

| **Performance criteria**<br><br>The objectives may be achieved where: | **Acceptable solutions**<br><br>The acceptable solutions illustrate one way of meeting the associated performance criteria: |
|---|---|
| **P1.1** Post development peak flows (up to 100 year ARI storm events) are limited to 'pre-development' levels. | **A1.1** The system design allows for the safe passage of vehicles at reduced speeds on streets which have been affected by run-off from a 20% AEP event. |
| **P2.1** In areas where there is high salinity, infiltration shall not be used | **A2.1** Subdivision design and layout provides for adequate site drainage. Where site topography prevents the discharge of stormwater directly to the street gutter or a Council controlled piped system, inter-allotment drainage is provided to accept run-off from all existing or future impervious areas that are likely to be directly connected. |
| **P3.1** The stormwater drainage system has the capacity to safely convey stormwater flows resulting from the relevant design storm under normal operating conditions, taking partial minor system blockage into account.<br><br>**P2.2** The design and construction of the storm drainage system are in accordance with the requirements of Australian Rainfall and Runoff 1987 and Aus-Spec (DCC version) Development specification series – design and development specification series – Construction. | **A3.1** The design and construction of the inter-allotment drainage system are in accordance with the requirements of Australian Rainfall and Runoff (1987) and Aus-Spec (DCC version) Development Specification Series – Design and Development Specification Series – Construction. |
| **P3.1** Minor systems for residential areas are designed to cater for the 1 in 100 year storm event. These systems are to be evident as 'self-draining' without impacting on flooding of residential houses etc. | **A3.1** Where residences are proposed in flood affected areas, these shall be protected from flood waters. Ground floors of residences are located at or above the flood planning level to provide protection to life and property in accordance with the accepted level of risk. |

| | |
|---|---|
| **P3.2** Natural streams and vegetation are retained wherever practicable and safe, to maximise community benefit.<br><br>**P3.3** The natural streams and vegetation are incorporated into the stormwater drainage system for the subdivision and open space requirements. | |
| **P4.1** The stormwater drainage network is designed to ensure that there are no flow paths which increase risk to public safety and property.<br><br>**P4.2** While addressing the requirements above, the incorporation of sports grounds and other less flood sensitive land uses into the drainage corridor and the appropriate placement of detention basins. | **A4.1** Flood ways are developed in a manner which ensures that there is a low risk of property damage. |

**Element 13: Water Quality Management**

**Objective:**

- To provide water quality management systems which:
  - Ensure that disturbance to natural stream systems is minimised; and
  - Stormwater discharge to surface and underground receiving waters, during construction and in developing catchments, does not degrade the quality of water in the receiving areas.

| **Performance criteria**<br><br>The objectives may be achieved where: | **Acceptable solutions**<br><br>The acceptable solutions illustrate one way of meeting the associated performance criteria: |
|---|---|
| **P1.1** Adequate provision is made for measures during construction to ensure that the land form is stabilised and erosion is controlled. | **A1.1** An erosion and sediment control plan is to be prepared by properly qualified personnel using the 'Blue Book – Managing Urban Stormwater: Soils and Construction, produced by the NSW Department of Housing.' |
| **P2.1** The system design optimises the interception, retention and removal of water-borne pollutants through the use of appropriate criteria prior to their discharge to receiving waters. | **A2.1** The system design minimises the environmental impact of urban run-off on surfaces receiving water quality and on other aspects of the natural environment, such as creek configuration and existing vegetation which are appropriate and effective in reducing run-off and pollution travel.<br><br>**A2.2** Water pollution control ponds or wetlands are developed for final treatment before discharge to the wider environment and should be sited to minimise impacts on the natural environment. |

**Element 14: Environmental Management**

**Objective:**

- To enhance, improve ad protect the natural elements through sustainable land management practices, as applicable.

| **Performance criteria**<br><br>The objectives may be achieved where: | **Acceptable solutions**<br><br>The acceptable solutions illustrate one way of meeting the associated performance criteria: |
|---|---|
| **P1.1** Existing wildlife habitats are managed, enhanced and protected by adopting environmentally sustainable management principles. | **A1.1** The impact of natural hazards such as fire, flood and wind storms are reduced. |
| **P2.1** Development is located and designed to address prevailing winds and solar orientation. Orient and design developments to eliminate adverse effects of seasonal winds and solar exposure. | **A2.1** Effective erosion and soil management techniques are adopted.<br><br>**A2.2** Limit the amount of land disturbed during construction phase of development.<br><br>**A2.3** Development is appropriately located to avoid contamination of ground water by avoiding the location of potentially polluting land uses such as effluent disposal over the aquifer.<br><br>**A2.4** European and Aboriginal Heritage sites are identified, assessed and preserved. Obtain specialist advice on the presence and preservation of European and Aboriginal heritage sites. |

**Element 15: Site Specific Infrastructure Objectives**

***Transport system***

- The future lot and road layout will connect with the adjoining residential subdivision to the west and future residential subdivision to the north.
- The future lot and road layout vehicular access will connect with Blackbutt Road.
- The road infrastructure, including the internal roads of the residential estate have been designed to cater for the traffic generated by the proposed residential lots.

***Pedestrian pathway network and cycle ways***

- A pedestrian pathway network will be provided within the subdivision utilising bushfire access trails and will include a footpath/cycleway connection to Blackbutt Road.

***Public transport***

- There is potential for bus services to be extended along Blackbutt Road once the estate, supporting the future residential population of the estate and those within the immediate vicinity.

***Stormwater drainage***

- The stormwater drainage systems would ultimately connect with the future residential estates of the north and west for quality treatment prior to discharge into the local drainage system downstream.
- Until such time that this development is constructed and fully connected, there will be overland discharge of stormwater to temporary tail out drains through the estate.

***Sewer and water***

- The sewer reticulation system will ultimately connect with the residential estates of the north and west in future.
- Until such time that this development is constructed and fully connected, a provisional arrangement will be enforced, involving a temporary sewer pump station that would be erected within the north western portion of the estate in the general location of the final sewer pump stations location.

***Groundwater vulnerability***

- Increased runoff would occur under the residential land-use from hard surfaces (roads, driveways, pathways, roof areas). Rainfall and irrigation applied to the lawn areas of the development will be absorbed by evaporation and evapotranspiration. Limited infiltration and therefore limited potential for groundwater recharge would occur.


NOTES:

1. PLAN IS FOR DEVELOPMENT APPLICATION PURPOSES ONLY
2. ALL BOUNDARIES AND AREAS ARE APPROXIMATE ONLY AND ARE SUBJECT TO FINAL SURVEY

SCALE 1:2500(A1)

0 50 100 150 200 250

SCALE 1:5000(A3)

| No | DATE | DRAFTING CHECK | PM CHECK | DETAILS |
|---|---|---|---|---|
| A | 09/10/15 | JE | SG | ISSUED FOR REVIEW |

| CHECKED/APPROVED | NAME | DATE |
|---|---|---|
| APPROVED | SG | 09/10/2015 |
| SURVEY | BARNSON | |
| DESIGNER | PPO/NS | 27/02/2015 |
| DRAFTING | JE | 09/10/2015 |

APPROVAL AUTHORITY

DUBBO CITY COUNCIL
70 CHURCH STREET
DUBBO
NSW, 2830

CLIENT
HIGHVIEW COUNTRY ESTATES PTY LTD

PROJECT
PROPOSED SUBDIVSION LOT 172 DP753233 BLACKBUTT ROAD, DUBBO

GEOLYSE
DUBBO
dubbo@geolyse.com
www.geolyse.com
1st FLOOR
62 WINGEWARRSTREET
P.O. BOX 1842
DUBBO, NSW 2830
Ph. (02) 6884 1525
Fax. (02) 6884 1470

DRAWING
EXISTING LOT SIZE MAP

PERMANENT MARK: _ RL: _ DATUM: A.H.D.
PROJECT NUMBER: 113156 DRAWING SHEET: 04A_TP01 ORIGINAL: A1
AUTOCAD FILE: 113156_04A_TP01-TP02.dwg 12D/CIVILCAD FILE: -
REVISION: A
STATUS: FOR REVIEW SHEET TP01 OF TP02


NOTES:

1. PLAN IS FOR DEVELOPMENT APPLICATION PURPOSES ONLY
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| No | DATE | DRAFTING CHECK | PM CHECK | DETAILS |
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| A | 09/10/15 | JE | SG | ISSUED FOR REVIEW |

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GEOLYSE
DUBBO
dubbo@geolyse.com
www.geolyse.com
1st FLOOR
62 WINGEWARRSTREET
P.O. BOX 1842
DUBBO, NSW 2830
Ph. (02) 6884 1525
Fax. (02) 6884 1470

DRAWING
PROPOSED LOT SIZE MAP

| | | | |
|---|---|---|---|
| PERMANENT MARK: - | RL: - | DATUM: A.H.D. | |
| PROJECT NUMBER: 113156 | DRAWING SHEET: 04A_TP02 | ORIGINAL A1 | |
| AUTOCAD FILE: 113156_04A_TP01-TP02.dwg | 12D/CIVILCAD FILE: - | REVISION A | |
| STATUS: FOR REVIEW | SHEET TP02 OF TP02 | | |

Our Ref: 113156_LEO_007

10 February 2017

The General Manager
Dubbo City Council
PO Box 81
DUBBO NSW 2830

**Attention: Mr Steven Jennings**

Dear Sir,

**ADDENDUM TO PLANNING PROPOSAL - COUNCIL'S REFERENCE R15-3**
**HIGHVIEW COUNTRY ESTATE PTY LTD**

We refer to the above matter and act on behalf of Highview Country Estate Pty Limited (the proponent) in providing this addendum report in support of the proposed rezoning of the subject property. We note the original Planning Proposal was submitted to Council in December 2015.

As advised in the original Planning Proposal submission, the proponent's intention is to amend the existing minimum lot size provisions of the Dubbo Local Environmental Plan 2011 as they apply to the subject land. The proponent's objective to complete the development as a Community Scheme does not create any fundamental amendment to this objective.

This addendum report specifically addresses two key aspects of the development, being:-

1. To provide Council with an updated Infrastructure Assessment – Site Servicing Strategy following additional assessment of the servicing impacts of the development.

2. To provide Council with information relating to the developer's primary operational objectives in terms of land tenure and land management, achieved utilising the Community Scheme model.

The updated Site Servicing Strategy has been prepared as an independent report, Geolyse reference 113156_SSS_004 and is attached to this submission.

In relation to the developer's primary operational objectives and in response to Council's request for the proponent to clarify the development concept and intent, we provide the following information:-

1. The proposed subdivision is to be developed on Lot 172 in DP 753233 and the land parcel is approximately 98.2 hectares in size and is bounded by Blackbutt Road along its northern boundary, the Newell Highway along its eastern boundary, Riffle Range Road along its southern boundary and an unformed section of Chapmans Lane to the west.

2. Access to the subdivision would be from Blackbutt Road only with no access available from any lot directly onto the Newell Highway nor Rifle Range Road. Emergency egress tracks would be provided in accordance with the recommendations of the Bush Fire Assessment.

3. An Ecological Constraints and Opportunities Report for the site was prepared by Geolyse and the report assessed the site for a range of parameters and determined that a large timbered area located in the middle of the site and further timbered areas around the perimeter of the site comprising approximately 36 hectares should be set aside as a woodland corridor.

4. The proponent's intention is to develop the land as a Community Scheme in order to provide opportunity for the appropriate protection and management of the bushland and open spaces areas, both in terms of land management (ecological, bush fire, stormwater management) and amenity opportunities for the residents of the Estate. The residential component of the subdivision would be developed on the remaining 62 hectares of the site and would comprise approximately 137 community development lots with 105 lots ranging in size from approximately 2,000m$^2$ to 5,000m$^2$ with 32 lots ranging in size from approximately 4,000m$^2$ to 8,700m$^2$.

5. A Community Management Statement would be prepared to describe the following:-

- The development concept and by-laws fixing details of the development with particular emphasis on the appropriate use and management of the Community Association land
- Any special rules in relation to Association Property including rules for road usage and use and maintenance of open space corridors
- Mandatory Matters such as garbage collection, fencing, services and statutory easements including clearly specifying who is responsible to own and maintain each service
- Other matters like insurances and election of the committee
- Optional matters such as visitors, use of a lot, security and other local rules
- Any public authority by-laws generated through the development determination process.

6. All internal roads would be Community roads (Open Access Ways) owned and maintained by the Community Association.

7. The development would be provided with a single point of connection into Council's sewer system, a single point of connection for potable water and a separate point of connection for a fire service.

8. All internal sewer, potable water and fire service lines would be owned and maintained by the Community association.

9. The internal water system would include a reservoir to be owned and maintained by the community association.

10. The internal sewer main would need to be located wholly within Lot 1 (Association property).

11. The Council gravity sewer is proposed to be upgraded through the Dubbo golf course and extended through Mick Robertson's Huntingdale Estate and the Kintyre Seniors Village properties (subject to separate agreements) with a point of connection at the north eastern corner of the subject property.

12. The majority of the sewer system would gravity drain to a pump station located towards the north western end of the Blackbutt Road with a rising main discharging to the gravity sewer in the north eastern corner. A section of the development would gravity feed directly to the north western corner sewer connection point.

13. The Community Association would own and manage the open space corridors including the feeding habitat for the glossy black cockatoos.

14. The Community Association would also take on responsibilities in respect to maintaining the fire egress tracks and asset protection zones in and around the open space corridors in accordance with the recommendations of the bushfire report.

15. The Community Association would need to contract garbage collection services.

In respect to the current proposal and any impacts relevant to the Planning Proposal submission dated December 2015, we make the following comments, (with reference to sections of the original report where appropriate):-

1. *Executive Summary* Notwithstanding the details of the proposed servicing of the development as described in the attached Site Servicing Strategy, the issues raised in this addendum submission do not impact the primary objectives of the Planning Proposal, those being to amend the Dubbo Local environmental Plan 2012 to the extent that:-

    - The lot size map provides for a range of minimum lot sizes from 2,000m$^2$ to 4,000m$^2$; and

    - The Biodiversity map is amended to facilitate the future road and subdivision layout;

2. *Section 2.2* The Development Intent remains the same with the exception being the recreational areas would be Community Association Property, not Public Open Space and all internal roads and services would be Community Property owned and maintained by the association

3. *Section 2.2.2* No change to proposed minimum lot sizes

4. *Section 2.2.5* No change to Proposed Development Objectives

5. *Section 2.2.6* Services – see attached Site Servicing Strategy

6. *Sections 3.1 Intent and Provisions - Objective and 2.4* Not affected by the Addendum information

7. *Section 4.1 Justification – Need for the Planning Proposal* Not affected by the Addendum information

8. *Section 4.2 Justification – Relationship to Strategic Planning Framework* Not affected by the Addendum information

9. *Section 4.3 Environmental, Social and Economic Impacts*

   The Environmental Impacts of the development would to an extent be altered, presumably in a positive manner, as the bushland and open space areas would be managed by the Community Association in a structured fashion by the residents who live in the scheme with greater opportunity and intent for active surveillance of those areas. The management obligations of the Association would also be clearly identified in the Management Statement and dictated by the terms of the Community Land Management Act.

   The Economic Impacts of the development would affected by the introduction of the Community Scheme model as all internal roads and services would become privately owned and therefore a funding model, as prescribed under the Community Land Management Act would be developed to determine the level of contributions payable by the residents for the ongoing maintenance and long term replacement of the infrastructure. The ongoing economic impacts of the development to Council would therefore be very limited.

10. *Section 4.4 State and Commonwealth Interests* Not affected by the Addendum information

11. *Section 5.1 Mapping* Not affected by the Addendum information

12. *Community Consultation* Not affected by the Addendum information

We trust the above information is satisfactory for Council's purposes at this stage and ask that you contact the writer should any additional information be required.

Yours faithfully
**Geolyse Pty Ltd**

MGThorne

**MATTHEW THORNE**
**Registered Surveyor**
**Town Planner**

# INFRASTRUCTURE ASSESSMENT
## SITE SERVICING STRATEGY

PREPARED FOR
## HIGHVIEW COUNTRY ESTATES PTY LTD

JANUARY 2017

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

# INFRASTRUCTURE ASSESSMENT

SITE SERVICING STRATEGY

PROPOSED SUBDIVISION OF LOT 172 DP 753233 BLACKBUTT ROAD
DUBBO – HIGHVIEW COUNTRY ESTATE

PREPARED FOR:

## HIGHVIEW COUNTRY ESTATES PTY LTD

JANUARY 2017

GEOLYSE

**POSTAL ADDRESS** PO BOX 1842 DUBBO NSW 2830
**LOCATION** 1ST FLOOR, 62 WINGEWARRA STREET DUBBO NSW 2830
**TELEPHONE** 02 6884 1525 **FACSIMILE** 02 6884 1470
**EMAIL** DUBBO@GEOLYSE.COM **WEB SITE** WWW.GEOLYSE.COM

| | |
|---|---|
| ***Report Title:*** | *Infrastructure Servicing Strategy* |
| ***Project:*** | *Proposed Subdivision, Blackbutt Road, Dubbo* |
| ***Client:*** | *Highview Country Estates Pty Ltd* |
| ***Report Ref.:*** | *113156_SSS_004* |
| ***Status:*** | *Final* |
| ***Issued:*** | *January 2017* |

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 HIGHVIEW COUNTRY ESTATES 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.

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**APPENDIX D**
*Response Received from TWPZ*

# 1.0 INTRODUCTION

## 1.1 BACKGROUND

Highview Country Estates Pty Ltd intends to develop a parcel of land on Blackbutt Road for residential purposes. The land is currently zoned R5 Large Lot Residential under the provisions of the Dubbo Local Environmental Plan (LEP) 2011.

The land is described as Lot 172 in DP 753233 and comprises approximately 98.2 ha. The land is bounded by Blackbutt Road along its northern boundary, the Newell Highway along its eastern boundary, Riffle Range Road along its southern boundary and an unformed section of Chapmans Lane to the west.

Kintyre Estate and Kintyre Country Living are located on the northern side of Blackbutt Road opposite part of the frontage of the development site.

The land has several areas of heavy timber cover and there are 2 distinct ridgelines through the property dividing the land into a number of catchments.

It is intended to subdivide Lot 172 into a number of lots ranging in size generally from 2,000m$^2$ up to approximately 8,000m$^2$.

The subdivision is to be known as Highview Country Estate. It is intended that the subdivision be developed under the provisions of Community Title where all infrastructure services within the site (roads, stormwater drainage, sewer and water reticulation) will be owned and maintained by the subdivision's Community Association.

## 1.2 PURPOSE OF REPORT

This Infrastructure Servicing Strategy Report will assess the proposed lot layout on the development site and determine an economic means of providing servicing infrastructure to facilitate the proposed subdivision.

The Report will investigate the provision of the following infrastructure items:

- Road access
- Water supply
- Sewerage reticulation
- Stormwater drainage

The Servicing Strategy will determine a practical means of providing road access, water supply, sewerage reticulation and stormwater drainage to the development site in order to ensure that appropriate services can be constructed to allow the future development of the land for residential purposes.

The recommendations made in this Report will identify the servicing infrastructure components necessary to allow the development of the land and determine a strategy to allow the economic provision of the servicing infrastructure in a timely manner.

# 2.0 SUBDIVSION LOT LAYOUT

An Ecological Constraints and Opportunities Report for the site was prepared by Geolyse in April 2013. The report assessed the site for a range of parameters and determined that a large timbered area located in the middle of the site and further timbered areas around the perimeter of the site should be set aside as a woodland corridor.

Taking the woodland corridor land into consideration, there is approximately 62 ha of the total site area of 98.2 ha available for residential development. It is intended that potential residential lot sizes are to comprise lots approximately 2,000m$^2$ to 5,000m$^2$ located in the north eastern section of the site and 4,000m$^2$ to 8,000m$^2$ in the western section of the site.

The overall lot layout for the development of Highview Country Estate is indicated on Sheet E02 attached in the **Drawings** Section of this Report.

The proposed lot layout allows for the creation of a total of 137 lots across the site comprising the following lot configurations:

- 105 lots in the north eastern section of the site ranging in size from 2,000m$^2$ to approximately 5,000m$^2$.
- 32 lots in the western section of the site ranging in size from approximately 4,000m$^2$ to approximately 8,700m$^2$.

# 3.0 SUBDIVISION ACCESS

## 3.1 GENERAL

Access to the proposed subdivision will be provided at two (2) locations off Blackbutt Road. Blackbutt Road provides good access to and from Dubbo via the Newell Highway with the major channelised intersection already constructed at the intersection of Blackbutt Road with the Newell Highway.

The intersection of the Newell Highway and Blackbutt Road consists of a channelised right turn lane for southbound vehicles to turn right from the Newell Highway into Blackbutt Road. The speed limit on the Newel Highway is 110km/hour adjacent to the intersection with Blackbutt Road.

Blackbutt Road is controlled by Give Way signs at its intersection with the Newell Highway.

Blackbutt Road is a two lane, two way bitumen sealed road with a sealed width of approximately 8m. The roadway comprises 2 x 3.5m wide travel lanes with 0.5m wide sealed shoulders. Blackbutt Road is centreline marked with double barrier lines and has edgeline marking for its full length.

It is intended that the first road access to the proposed subdivision is created off Blackbutt Road approximately 100m west of its intersection with Glenabbey Drive.

A second road access to the proposed subdivision is to be created approximately 200m west of the intersection of Blackbutt Road and Joira Road. As Blackbutt Road is unformed to the west of the existing intersection with Joira Road, the new subdivision access will require the construction of Blackbutt Road from its intersection with Joira Road.

## 3.2 INTERNAL ROADS

The 2 subdivision road access points to Blackbutt Road allows loop roads to be created within the subdivision with 2 short cul-de-sacs providing access to the remainder of the lots.

The subdivision roads from the point where the new road reserve crosses the southern boundary of Blackbutt Road will be developed under the provisions of Community Title where the road infrastructure within the site will be owned and maintained by the subdivision's Community Association.

The internal roads will comprise a 7m wide bitumen sealed road on a 10m wide road pavement within a 30m wide road reserve. The internal roads will incorporate 10.5m wide tabledrains on each side of the roadway. A Typical Section of the internal roads within the subdivision is indicated on Sheet E02 attached in the **Drawings** Section of this Report.

## 3.3 TRAFFIC GENERATION

The traffic generated from the proposed subdivision will be estimated based on Dubbo Regional Council's traffic generation rates.

Dubbo City Council's adopted trip generation rates for residential subdivisions are:

- 11 trips per day per residential lot
- 1 trip per peak hour per residential lot

Based on the proposed 137 lots in the subdivision, the anticipated daily and peak hour traffic generation can be estimated as:

- 1,507 vehicle trips per day
- 137 vehicle trips per hour

## 3.4 PREVIOUS TRAFFIC STUDIES AND IMPACT OF ADDITIONAL TRAFFIC

A Traffic Assessment was prepared by Geolyse in June 2014 for the development of Huntingdale Estate located to the north of Kintyre Estate and Kintyre Country Living. The Traffic Assessment estimated the traffic generation from the proposed 125 lots in Huntingdale Estate and the existing development of Kintyre Estate and Kintyre Country Living and determined the following traffic volumes would use Blackbutt Road following the completion of all developments:

- Daily Traffic Volume 2,593 trips per day
- Peak Hour Traffic Volume 243 trips per hour

The estimated traffic volumes in June 2014 were taken as a worst case scenario with the full development of Huntingdale Estate occurring prior to a road connection through Grangewood Estate being made to allow some traffic to travel north rather than via Glenabbey Drive and Blackbutt Road.

The development of Highview Country Estate will increase the traffic volumes on Blackbutt Road as outlined below:

- Daily Traffic Volume 4,100 trips per day (58% increase)
- Peak Hour Traffic Volume 380 trips per hour (56% increase)

The operational capacity of Blackbutt Road should be assessed to determine the impact of the additional traffic generated by Highview Country Estate. Based on the methodology outlined in *AUSTROADS Guide to Traffic Engineering Practice – Part 2 Roadway Capacity,* it can be determined that the capacity of Blackbutt Road at a Level of Service B is 800 vehicles per hour.

Based on the hourly capacity of Blackbutt Road, the post development peak hour traffic volume on Blackbutt Road of 380 trips per hour is approximately 48% of the operational capacity at a Level of Service B.

The impact on Blackbutt Road of the additional traffic generated by Highview Country Estate would not be significant as the road would continue to operate at a Level of Service B, noting that any impact will be lessened when a road connection is established through Grangewood Estate this diverting estimated traffic volumes from Blackbutt Road.

## 3.5 NEWELL HIGHWAY AND BLACKBUTT ROAD INTERSECTION

The operation of the intersection of the Newell Highway and Blackbutt Road has been assessed using the SIDRA Intersection Analysis computer modelling program. As per the modelling carried out for the Huntingdale Estate Traffic Report, the Newell Highway traffic volumes for the Year 2025 have been used to allow for the full development of the subject subdivisions.

Additionally, again as a worst case scenario, all traffic generated by Huntingdale Estate is assumed to use Blackbutt Road prior to the establishment of a road link through Grangewood Estate.

The SIDRA program assesses the operation of an intersection based on peak hour traffic volumes and turning movements and includes the parameters of Average Delay, Queue Length and the Level of Service. The SIDRA modelling results for the intersection (including the turning movement diagram) are attached in **Appendix A**.

A summary of the SIDRA modelling results for the operation of the intersection of the Newell Highway and Blackbutt Road including the additional traffic generated by Highview Country Estate is set out below:

<u>Nominal Peak Hour for Blackbutt Road and the Newell Highway Intersection</u>

| | |
|---|---|
| Maximum Delay for right turn from the Newel Highway into Blackbutt Road: | 14.0 secs |
| Maximum Delay for left turn from Blackbutt Road onto the Newell Highway: | 10.7 secs |
| Maximum Queue Length for right turn from the Newell Highway into Blackbutt Road: | 0.9 vehicles |
| Maximum Queue Length for left turn from Blackbutt Road onto the Newell Highway: | 1.0 vehicles |
| Level of Service for all vehicle movements at the intersection: | LOS A |

Allowing for the worst case scenario, the intersection of the Newell Highway and Blackbutt Road continues to operate efficiently with minimal delays and at an overall Level of Service A.

# 4.0 WATER SUPPLY

## 4.1 WATER RESERVOIR AND TRUNK WATER SUPPLY MAINS

The potable water supply for the proposed subdivision will be provided from Council's Rifle Range Road water reservoirs. The existing water reservoir has a capacity of 10 ML and has a top water level (TWL) of RL354.3m AHD. Council has recently constructed a new reservoir adjacent to the existing reservoir to significantly increase the availability of water to service the future development of large areas of West Dubbo.

The construction of additional water storage capacity at Rifle Range Road was identified in the West Dubbo Servicing Strategy prepared on behalf of Council by Terra Consulting in October 2000.

Typical characteristics of the Rifle Range Reservoirs are listed below:

| | |
|---|---|
| Storage Capacity: | 10.0 ML for each reservoir |
| Top Water Level: | 354.3m AHD |
| Bottom Water Level: | 348.3m AHD |
| Reservoir Height: | 6.0m |

The provision of trunk water reticulation mains in the area surrounding Lot 172 has seen the construction of a 375mm diameter water main from the Rifle Range Road reservoirs eastwards along Rifle Range Road then a reduction to 200mm diameter at the intersection of the unformed section of Chapmans Lane through to the Newell Highway and then southwards along the Newell Highway.

The 375mm diameter water main extends northwards along the unformed section of Chapmans Lane and then eastwards along the unformed section of Blackbutt Road past the intersection with Joira Road and then further eastwards along Blackbutt Road to the Newell Highway and finally northwards along the Newell Highway.

At the intersection of Blackbutt Road and Joira Road a 300mm diameter water main heads northwards along Joira Road and the Kintyre Estate water reticulation is serviced by a connection to the 375mm diameter water in Blackbutt Road at the intersection with Glenabbey Drive.

The trunk water mains surrounding the Lot 172 will allow water reticulation to be connected to Highview Country Estate and provide a source of potable water to allow the planned development to occur.

It should be noted that due to the Rifle Range Road reservoir TWL of RL354.3m AHD and losses within the trunk water mains between the reservoir and Blackbutt Road and the elevation of the subdivision, land within the proposed subdivision will have reduced pressure availability and cannot be serviced directly from the reservoir.

## 4.2 WATER DEMANDS

The potable water demand criteria to be adopted for the development of the proposed subdivision will be based on Council's Development Design Specification for Water Reticulation and the NSW Public Works Department's Water Supply Investigation Manual.

The peak instantaneous demand and the peak daily demand adopted by these publications are:

- Peak Instantaneous Demand (PID) – 0.10 L/s/ET
- Peak Daily Demand (PDD) – 5000 L/day/ET

In addition to the peak instantaneous demand requirement, an additional allowance of 11.0 L/s should be made for firefighting purposes.

Based on the proposed development of 137 lots within the subdivision, the potable water demands for the subdivision are:

- Peak Instantaneous Demand: 13.7 L/s plus 11.0 L/s for firefighting purposes
- Peak Daily Demand: 685,000 L or approximately 0.7 ML

## 4.3 COUNCIL WATER SUPPLY PRESSURES

Based on the expected demands within Highview Country Estate, Council has assessed the available pressures within the trunk water main and has advised the following information for 2 scenarios at an offtake point to the west of Joira Road at an approximate ground level of RL320m:

<u>Scenario 1:</u>

| | |
|---|---|
| Flowrate – 0.0 L/s | Residual Pressure – 276 kPa |
| Flowrate – 14.0 L/s | Residual Pressure – 267 kPa |
| Flowrate – 24.0 L/s | Residual Pressure – 261 kPa |

<u>Scenario 2:</u>

| | |
|---|---|
| Flowrate – 0.0 L/s | Residual Pressure – 173 kPa |
| Flowrate – 14.0 L/s | Residual Pressure – 145 kPa |
| Flowrate – 24.0 L/s | Residual Pressure – 134 kPa |

Council has advised that the scenarios relate to the following:

Scenario 1: The West Dubbo pumps at the water treatment plant are operating (the current general situation).

Scenario 2: The West Dubbo pumps at the water treatment plant are turned off (the anticipated future operating situation).

Based on the information provided by Council, there is significant variation in the available pressures within the trunk water main for each of the modelled scenarios. It is expected that this variation in available pressures may also have impacts on the water reticulation networks of surrounding subdivisions.

Based on the water supply pressures provided by Council, it is not possible to provide water reticulation throughout the overall subdivision by connecting to the trunk water main in Blackbutt Road.

## 4.4 SUBDIVISION WATER SUPPLY SYSTEM

Following discussions with Council's Technical Services staff, the methodology for providing reticulated water supply to the Highview Country Estate subdivision will comprise the following components:

1. A metered point of supply from the existing 375mm diameter trunk water main in Blackbutt Road. This offtake will be located just to the west of the intersection of Blackbutt Road and Glenabbey Drive. The metered offtake in this location will be suitable for the supply of potable water to approximately 16 lots to be developed as the first stage of the subdivision.

   The remaining lots within the subdivision will be serviced as outlined in the following points.

2. A 0.7ML reservoir to be constructed on the highpoint in the southern section of the subdivision site adjacent to Rifle Range Road. The approximate ground level at this location is RL346m.

3. A metered point of supply to fill the reservoir connected to the 200mm water main in Rifle Range Road. The top water level of the Highview Reservoir can be set at approximately RL350m thus allowing the Rifle Range Road Reservoir to fill the proposed reservoir.

4. Reticulation mains throughout the subdivision providing water supply for potable purposes and for hydrant supply throughout the subdivision.

Whilst the proposed reservoir is located on the highpoint within the Highview subdivision, lots on the higher elevations surrounding the reservoir site may not achieve full mains water pressures from the reservoir. However, it will be possible to still develop this land with the provision of additional infrastructure for any lot created in this area that may include:

- Storage tank with low flow potable water top up provided from the reticulated water mains.
- Dedicated storage volume for onsite firefighting requirements.
- Pressure pump system for water reticulation within the dwelling.

It is intended that the water reticulation system within Highview Country Estate is operated and maintained by the Community Association of the subdivision. Council will provide a point of connection to the 375mm diameter trunk water main in Blackbutt Road and the Highview water reservoir supply point in Rifle Range Road with the connection points being metered in the normal manner. However, all components of the water reticulation system after the subdivision boundary is crossed (including the water reservoir) is the responsibility of the Community Association.

The overall water layout for the proposed subdivision and the anticipated low water pressure zones determined from the WATSYS modelling is indicated on Sheet E07 attached in the **Drawings** Section of this Report.

## 4.5 WATSYS RETICULATION MODELLING

A WATSYS computer model has been set up to model the operation of the water reticulation network for Highview Country Estate.

The WATSYS reticulation Node diagram is indicated on Sheet E08 attached in the **Drawings** Section of this Report.

The WATSYS data and output files for the modelling runs carried out for the assessment of the reticulation network are attached in **Appendix B**.

The water reticulation network for Stage 1 is supplied with water from Council's 375mm diameter trunk water main in Blackbutt Road. The Node point in the WATSYS model has been designated "BB1".

The Node Point for the proposed reservoir in the WATSYS model has been designated "RES1", noting that the supply main from Rifle Range Road across to the proposed reservoir is not included in the WATSYS model.

Details relating to the individual Nodes in the WATSYS model are indicated in **Table 4.1**.

**Table 4.1 – WATSYS Node Data for Highview Country Estate**

| Node Number | Ground Level (m) | Peak Instantaneous Demand at Node (L/s) |
|---|---|---|
| BB1 | 316.0 | 0.00 |
| RES1 | 346.0 | 0.00 |
| HCE1 | 323.0 | 0.80 |
| HCE2 | 329.0 | 0.80 |
| HCE2A | 326.0 | 0.20 |
| HCE3 | 318.0 | 0.60 |
| HCE3A | 326.0 | 0.20 |
| HCE4 | 322.0 | 0.20 |
| HCE4A | 323.0 | 0.10 |
| HCE5 | 316.0 | 0.50 |
| HCE6 | 327.0 | 1.20 |
| HCE6A | 324.0 | 0.20 |
| HCE7 | 332.0 | 1.00 |
| HCE8 | 330.0 | 0.00 |
| HCE9 | 328.0 | 0.40 |
| HCE10 | 334.0 | 0.40 |
| HCE11 | 333.0 | 1.00 |
| HCE12 | 333.0 | 0.80 |
| HCE13 | 337.0 | 0.80 |
| HCE14 | 330.0 | 0.20 |
| HCE15 | 339.0 | 0.60 |
| HCE16 | 336.0 | 0.50 |
| HC16A | 335.0 | 0.00 |
| HCE17 | 336.0 | 0.50 |

**Table 4.1 – WATSYS Node Data for Highview Country Estate**

| Node Number | Ground Level (m) | Peak Instantaneous Demand at Node (L/s) |
|---|---|---|
| HCE18 | 336.0 | 1.10 |
| HCE19 | 331.0 | 1.00 |
| HCE20 | 326.0 | 0.30 |
| HCE21 | 331.0 | 0.30 |
| | **TOTAL** | **13.70 L/s** |

The WATSYS Node diagram indicated on Sheet E07 and the Node Point data information indicated in **Table 4.1** have been used in the WATSYS model to assess the water reticulation network proposed to service Highview Country Estate.

The WATSYS water reticulation assessment has modelled the reticulation network with an offtake from the 375mm diameter water main in Blackbutt Road to service the 16 lots in Stage 1 and the remainder of the lots from the proposed Highview Estate Reservoir.

A summary of the residual (available) pressure at each Node point for Peak Instantaneous Demand (PID) is indicated in **Table 4.2**.

**Table 4.2 – WATSYS Node Residual Pressures for PID**

| Node Number | Ground Level (m) | Residual Pressure (m) |
|---|---|---|
| BB1 | 316.0 | 25.00 |
| RES1 | 346.0 | 3.00 |
| HCE1 | 323.0 | 25.45 |
| HCE2 | 329.0 | 19.44 |
| HCE2A | 326.0 | 22.44 |
| HCE3 | 318.0 | 22.99 |
| HCE3A | 326.0 | 14.99 |
| HCE4 | 322.0 | 18.99 |
| HCE4A | 323.0 | 17.99 |
| HCE5 | 316.0 | 24.99 |
| HCE6 | 327.0 | 21.44 |
| HCE6A | 324.0 | 24.44 |
| HCE7 | 332.0 | 16.44 |
| HCE8 | 330.0 | 18.45 |
| HCE9 | 328.0 | 20.46 |
| HCE10 | 334.0 | 14.45 |
| HCE11 | 333.0 | 15.45 |
| HCE12 | 333.0 | 15.48 |
| HCE13 | 337.0 | 11.48 |
| HCE14 | 330.0 | 18.48 |
| HCE15 | 339.0 | 9.51 |

**Table 4.2 – WATSYS Node Residual Pressures for PID**

| Node Number | Ground Level (m) | Residual Pressure (m) |
|---|---|---|
| HCE16 | 336.0 | 12.56 |
| HC16A | 335.0 | 13.58 |
| HCE17 | 336.0 | 12.56 |
| HCE18 | 336.0 | 12.53 |
| HCE19 | 331.0 | 17.51 |
| HCE20 | 326.0 | 22.50 |
| HCE21 | 331.0 | 17.53 |

As expected, the WATSYS results presented in **Table 4.2** indicates that not all Nodes within the reticulation network meet Council's minimum requirements for residual pressure. This particularly relates to a series of Nodes clustered around the proposed Highview Estate Reservoir.

The Nodes for the reticulation system for the lots contained in Stage 1 meet Council's minimum pressure requirements.

The WATSYS model will be rerun to determine the residual pressures within the system for PID coupled with a fire flow of 11.0 L/s at Node HCE3A and Node HCE15.

A summary of the residual (available) pressure at each Node point for Peak Instantaneous Demand (PID) and fire flow is indicated in **Table 4.3**.

**Table 4.3 – WATSYS Node Residual Pressures for PID Plus Fire Flow**

| Node Number | Ground Level (m) | Residual Pressure (m) |
|---|---|---|
| BB1 | 316.0 | 25.00 |
| RES1 | 346.0 | 3.00 |
| HCE1 | 323.0 | 24.19 |
| HCE2 | 329.0 | 18.18 |
| HCE2A | 326.0 | 21.18 |
| HCE3 | 318.0 | 22.55 |
| HCE3A | 326.0 | 14.20 |
| HCE4 | 322.0 | 18.55 |
| HCE4A | 323.0 | 17.55 |
| HCE5 | 316.0 | 24.55 |
| HCE6 | 327.0 | 20.10 |
| HCE6A | 324.0 | 23.10 |
| HCE7 | 332.0 | 15.11 |
| HCE8 | 330.0 | 17.13 |
| HCE9 | 328.0 | 19.20 |
| HCE10 | 334.0 | 13.12 |
| HCE11 | 333.0 | 14.10 |
| HCE12 | 333.0 | 14.10 |

**Table 4.3 – WATSYS Node Residual Pressures for PID Plus Fire Flow**

| Node Number | Ground Level (m) | Residual Pressure (m) |
|---|---|---|
| HCE13 | 337.0 | 10.13 |
| HCE14 | 330.0 | 17.22 |
| HCE15 | 339.0 | 8.07 |
| HCE16 | 336.0 | 11.45 |
| HC16A | 335.0 | 12.55 |
| HCE17 | 336.0 | 11.51 |
| HCE18 | 336.0 | 11.44 |
| HCE19 | 331.0 | 16.38 |
| HCE20 | 326.0 | 21.36 |
| HCE21 | 331.0 | 16.43 |

As expected, the WATSYS results presented in **Table 4.3** indicates that not all Nodes within the reticulation network meet Council's minimum requirements for residual pressure. This particularly relates to a series of Nodes clustered around the proposed Highview Estate Reservoir.

The Nodes for the reticulation system for the lots contained in Stage 1 meet Council's minimum pressure requirements.

The development of land within the low pressure zone will still be possible with the provision of additional infrastructure for any lot created in this area that may include:

- Storage tank with low flow potable water top up provided from the reticulated water mains.
- Dedicated storage volume for onsite firefighting requirements.
- Pressure pump system for water reticulation within the dwelling.

The low pressure zone and the lots requiring additional infrastructure and the indicative pipe sizes for the reticulation network are indicated on Sheet E07 attached in the **Drawings** Section of this Report.

# 5.0 SEWERAGE INFRASTRUCTURE

## 5.1 HIGHVIEW COUNTRY ESTATE GRAVITY SEWER

The natural ridgelines located through the centre of the site divide the land into several catchments that will require the provision of sewerage reticulation separately from the existing and future sewerage infrastructure systems. The West Dubbo Servicing Strategy (October 2000) looked at the broad scale provision of sewerage infrastructure to service the development of large areas of West Dubbo.

Part of Lot 172 is located within a sewage catchment that will drain by gravity reticulation to the existing Cootha sewage pump station. This catchment contains approximately 60 lots that can be serviced by the extension of existing sewerage infrastructure to Lot 172.

The servicing of these 60 lots will require the construction of a sewer main extending from the existing sewer main previously constructed across the Dubbo Golf Course to service the former Pioneer Spirit site, now being developed for residential purposes as Huntingdale Estate. This sewer main will follow an alignment parallel to the Newell Highway and across Blackbutt Road. Whilst the extension of this sewer main will be approximately 1km in length, there will be an opportunity to provide gravity sewerage to the Kintyre Country Living allowing the existing sewage pump station servicing the facility to be decommissioned.

The extension of the sewer main to service Highview Country Estate will also provide an opportunity for Huntingdale Estate to utilise the sewer main to service the development of the land in the subdivision.

The proposed gravity sewer main servicing these 60 lots is indicated on Sheet E05 attached in the **Drawings** Section of this Report.

## 5.2 HIGHVIEW COUNTRY ESTATE SEWAGE PUMP STATIONS

The balance of Lot 172 comprising approximately 78 lots falls within a future sewerage catchment that at present has no infrastructure provided anywhere near Lot 172.

However, it is proposed to install two (2) sewage pump stations to service the 78 lots with the rising main discharge from the pump stations being directed to the extension of the sewer main proposed to service the 59 lots on the eastern section of the site.

The 11 western most lots will drain by gravity sewerage reticulation to a small sewage pump station located in the north western corner of the site.

The remaining 67 lots in the central area of the site will drain by gravity reticulation to a sewage pump station located on the extension of Blackbutt Road approximately 250m west of the intersection with Joira Road.

The design criteria for the proposed sewage pump stations is outlined below and is based on the NSW Public Works Manual of Practice for Sewer Design.

Each lot draining to a sewage pump station generates 1 Equivalent Tenement (ET). Therefore the sewage loading draining to each sewage pump station is:

- Western Sewage Pump Station: 11 ET
- Central Sewage Pump Station: 67 ET

Based on the methodology outlined in the PWD's Sewer Design Manual, the calculation of the various design flow rates for each sewage pump station is outlined below:

Average Dry Weather Flow (ADWF) = 0.011 L/s/ET; and

Peak Dry Weather Flow (PDWF) = r x ADWF; and

Peak Wet Weather Flow (PWWF) = PDWF + Storm Allowance (SA) where SA = .058 L/s/ET

Using the design flow rate criteria, the design flow rate information for each sewage pump station is summarised in **Table 5.1**.

**Table 5.1 – Sewage Generation Data**

| Sewage Generation Criteria | Sewage Pump Station Catchment | |
|---|---|---|
| | Western Pump Station | Central Pump Station |
| Equivalent Tenement (ET) Loading | 11 ET | 67 ET |
| Average Dry Weather Flow (ADWF) | 0.12 L/s | 0.74 L/s |
| Peak Dry Weather Flow (PDWF) | 0.79 L/s | 2.58 L/s |
| Storm Allowance (SA) | 0.64 L/s | 3.89 L/s |
| Peak Wet Weather Flow (PWWF) | 1.43 L/s | 6.47 L/s |

The detailed design of the 2 sewage pump stations servicing Lot 172 shall take into account the design loadings indicated in **Table 5.1** to size the wet well capacity, set duty points for the pump sets and optimise the size of the rising mains discharging from the pump stations into the nearest gravity sewer main system.

The operation and maintenance of the proposed sewage pump stations will be the responsibility of the Community Association for Highview Country Estate.

The overall sewerage infrastructure generally required to service the development of Lot 172 is indicated on Sheet E05 attached in the **Drawings** Section of this Report.

## 5.3 ASSESSMENT OF DOWNSTREAM SEWAGE CAPACITY

The extension of a sewer main to provide sewerage reticulation to the proposed Highview Country Estate subdivision has been assessed in terms of the recommendations identified in the West Dubbo Servicing Strategy prepared on behalf of Council by Terra Consulting in October 2000.

Figure 6 from the October 2000 Report provides details of the trunk sewerage servicing requirements for the overall development within West Dubbo and of particular note is Catchment B and its Sub catchments B1 and B2.

Sub catchment B1 applies to the proposed development of Highview Country Estate and provides for the future development of the land within sub catchment B1 generating in the order of 390 ET.

The land encompassed by sub catchment B1 includes the southern section of Grangewood Estate, the land developed as Kintyre Estate and Kintyre Country Living, the land being developed as Huntingdale Estate and the section of land in Highview Country Estate that can be drained by gravity sewerage.

An assessment of the current sewage generation from these land parcels has determined the flowing loadings:

- Southern section of Grangewood 100 lots (ETs)
- Kintyre Estate 23 lots (ETs)
- Kintyre Country Living 140 units (100 ETs)
- Huntingdale Estate 130 lots (ETs)

With regards to the estimated sewage generation, the following points should be noted:

1. Kintyre Estate comprises 43 lots, however, 20 lots are connected to the western sewer main in Grangewood Estate and are not included in the total. The 23 lots indicated in the total are connected to the recently diverted sewer main along the southern boundary of Grangewood and are included in the sub catchment B1 total.

2. Kintyre Country Living comprises 1 and 2 bedroom units similar to duplex style dwellings and contribute an expected two thirds ET per dwelling.

3. Kintyre Country Living is serviced by an onsite sewage pump station that is owned and operated by the Kintyre association. The provision of the pump station provides a degree of buffer storage so that sewage generation is not discharged in general alignment with the peak discharge from other gravity sewer mains.

Based on the ET loadings indicated, the current generation of sewage from sub catchment B1 is approximately 353 ET.

The preliminary sewer layout determined for Highview Country Estate estimated 60 lots could drain via gravity sewer mains through the former Pioneer Spirit site and golf course sewer mains. Including the 60 lots in Highview Estate, the total sewage loading from sub catchment B1 is approximately 413 ET and is in general accord with the recommendations of the West Dubbo Servicing Strategy.

It is interesting to note that the 23 ET over the originally estimated 390 ET for the sub catchment corresponds to the 23 ET recently diverted from Kintyre Estate along the southern boundary of Grangewood Estate.

The additional 23 ETs above the 390 ETs estimated from sub catchment B1 in October 2000 would not prevent the development of Highview Country Estate incorporating the 60 lots that can drain via gravity sewerage.

Notwithstanding the sewage limits within sub catchment B1, the proposed servicing of the remainder of Highview Country Estate with sewage pump stations may still be approved subject to the inclusion of appropriately designed buffer storage at each pump station and limiting the discharge from the pump stations in a controlled manner to be off peak to the generation of sewage into the gravity sewer mains within the sub catchment.

The Pioneer Spirit Servicing Strategy prepared by Terra Consulting indicated at that time that approximately 432 ET's were to be developed by the proposed resort and adjoining land parcels. This compares to the current estimated sewage generation of 413 ET's. The servicing strategy also addressed the downstream capacity of the sewer mains within Grangewood Estate and the Dubbo Golf Course to cater for the increased flows from the catchment.

Details of the existing sewer mains and the assessment of the capacity of the downstream sewerage network is outlined below, noting that the capacity of the existing sewer mains have been reassessed based on the available work as executed plans of the constructed sewers.

There are three different sized gravity sewer mains currently available to service the subject catchment and drain sewage to the Cootha Sewage Pump Station. The various sewer mains are:

i) 150mm diameter sewer main across the southern end of the new Dubbo Golf Course providing a connection to the Grangewood land and draining to the 225mm diameter sewer main across the southern end of the old Dubbo Golf Course.

ii) 225mm diameter sewer main across the southern end of the old Dubbo Golf Course draining across the Newell Highway and connecting to the 375mm diameter trunk sewer main draining to the Cootha Sewage Pump Station.

iii) 375mm trunk sewer main draining sewage from the overall west Dubbo sewerage catchment to the Cootha Sewage Pump Station.

The assessment of the upgrading requirements for each of the existing sewer mains is outlined below:

150mm Diameter Sewer Main

The southern arm of the existing 150mm diameter sewer main across the new Dubbo Golf Course will be required to carry sewage generated from the development Highview Country Estate, Kintyre Country Living and Huntingdale Estate. The sewage generation from this catchment is estimated as 413 ET's.

Based on the PWD design grading criteria, no section of the southern arm of the existing 150mm diameter sewer main has a capacity to cater for the expected 413 ET generated from the catchment. Therefore, it will be necessary to investigate the upgrading of the existing 150mm diameter sewer main to a 225mm diameter sewer main across the new section of the Dubbo Golf Course.

Based on the work as executed plans of the existing 150mm diameter sewer main, the minimum grade on the sewer main is 0.71% between manholes MHC and MHB. If the 150mm sewer main was replaced with a 225mm diameter sewer main, the limiting capacity on this new section of sewer main at the same grade would be 510 ET and would meet the required sewage capacity generated from the catchment.

The next minimum grade on the existing 150mm diameter sewer main is 1.22% between manholes MHB and MHA. If this section of main was replaced with a 225mm diameter sewer main the new capacity on this section of the main would be in excess of 610 ET. The other sections of the 150mm diameter sewer main can similarly be replaced by 225mm diameter sewer mains in order to achieve sufficient capacity on this section of the gravity sewerage system.

The length of 150mm sewer main that requires replacement would be approximately 355m.

225mm Diameter Sewer Main

The existing 225mm diameter sewer main across the southern end of the old Dubbo Golf Course has 3 sections of the main with minimum grades of 0.54%, 0.67% and 0.87% being the section of the main beneath the Newell Highway and the 2 sections of the sewer main immediately downstream respectively.

Based on the PWD design grading criteria, the critical sections of the 225mm diameter sewer main have a capacity of 446 ET, 492 ET and 580 ET respectively. This compares with the revised sewage generation from the catchment draining through the main of 528 ET. All other sections of the 225mm diameter sewer main have capacities exceeding 665 ET.

The three critical sections of the existing 225mm diameter sewer main can be replaced with a 300mm diameter sewer main at the same grades as the existing mains and the limiting capacity of the main would be increased to 989 ET.

The length of 225mm sewer main that will require replacement would be approximately 170m, although the replacement of this sewer main will involve constructing a replacement section of the main beneath the Newell Highway.

Due to the complexity of obtaining approvals from RMS for crossing the Newell Highway with an upgraded sewer main, an alternative solution is to construct an overflow sewer from the 225mm diameter sewer main at the southern end of the old Dubbo Golf Course connecting to the 375mm diameter sewer main that crosses the northern end of the golf course.

An assessment of this alternative indicates that a 150mm diameter cross connection sewer main can be laid at an approximate grade of 0.7% providing a capacity of approximately 164 ET's. Utilising the existing 225mm diameter sewer main, the capacity of the cross connection sewer main exceeds the sewage generation that needs to be catered for from the Highview Country Estate and the associated adjoining sewage catchments.

The length of 150mm diameter cross connection sewer is approximately 200m

375mm Diameter Sewer Main

The existing 375mm diameter sewer main has a minimum grade of 0.25%. Based on the PWD design grading criteria, the limiting capacity of the 375mm diameter sewer main at this grade is 1200 ET. This compares with the revised sewage generation from the catchment draining through the 375mm diameter main of 1088 ET.

Therefore, the capacity of the existing 375mm diameter sewer main is not exceeded and there are no upgrading requirements for this section of the gravity sewerage system.

The gravity sewer main upgrading requirements to service the developments within the catchments are indicated on Sheet E06 attached in the **Drawings** Section of this Report.

## 5.4 BENEFITS TO SURROUNDING DEVELOPMENTS

The construction of the extension of the sewer main to service Highview Country Estate coupled with the various upgrades to existing sewerage reticulation will provide benefits to other developments within the catchment. The benefits to surrounding developments will include:

1. Kintyre Country Living will be able to decommission the existing sewage pump station servicing the facility and connect the internal sewerage reticulation to the gravity sewer main. There will be significant cost savings for Kintyre Country Living by eliminating the operation and maintenance of the sewage pump station.
2. Huntingdale Estate will be able to connect its sewerage reticulation system to the sewer main constructed through its site.
3. The subdivisions within the catchment will benefit by the upgrading of the sewerage reticulation mains as outlined in **Section 5.3** of this Report thus allowing each development to achieve its full potential.

If the developer of Highview Country Estate constructs the extension of the sewer main to its subdivision and upgrades the existing sewerage reticulation network, then other developments within the catchment should contribute to the costs associated with such works.

A methodology will need to be worked out with Council's Technical Services staff to allocate a cost sharing or cost recovery levy to apportion the cost of the works to the developments within the catchment.

# 6.0 STORMWATER INFRASTRUCTURE

Stormwater drainage infrastructure will be provided for the proposed subdivision of Lot 172 that will include:

- Interallotment stormwater drainage pipes and inlet pits
- Roadway stormwater drainage and inlet pits
- Retarding basin systems

The design of all stormwater drainage systems will be carried out to the appropriate design criteria specified by Dubbo Regional Council.

The overall stormwater infrastructure required to service the development of Lot 172 is indicated on Sheet E03 and Sheet E04 attached in the **Drawings** Section of this Report.

The major components of the stormwater drainage infrastructure comprise the retarding basin systems that will limit post development stormwater runoff to pre development levels. Due to the topography of the development site, there are four (4) separate stormwater drainage catchments that are to be developed and each will require the provision of a retarding basin to limit post development runoff.

The piped discharge from each retarding basin system will be limited to less than the capacity of any nearby culverts or drainage structures particularly those culverts crossing the Newell Highway.

Each catchment has been assessed to determine the characteristics of the retarding basin servicing the catchment and details of each basin are summarised below:

Retarding Basin No. 1

| | |
|---|---|
| Catchment Serviced: | Catchment A |
| Catchment Area: | 16.16 ha |
| Impervious Catchment: | Sub catchment A1 - 0.0% Sub catchment A2 – 30% |
| Basin Volume: | 2,200m$^3$ at a depth of 1.5m |
| Spillway Width: | 15m |
| Basin Outlet Pipe: | 2 x 600mm diameter |
| 10 Year ARI Pre Development Runoff: | 0.96m$^3$/s |
| 100 Year ARI Pre Development Runoff: | 2.35m$^3$/s |
| 10 Year ARI Post Development Runoff: | 0.94m$^3$/s |
| 100 Year ARI Post Development Runoff: | 2.12m$^3$/s |

The proposed basin reduces the post development flows for the 10 year ARI and 100 Year ARI to less than the pre development flows.

Whilst there are no existing drainage structures downstream of the outlet from Retarding Basin No. 1, it is anticipated that if the Chapmans Lane road reserve was reconstructed at some point in the future, culverts of a minimum size of 600mm diameter could be installed in conjunction with any future roadworks and the outlet from the retarding basin has been limited to 2 x 600mm diameter pipes.

Retarding Basin No.2

| | |
|---|---|
| Catchment Serviced: | Catchment B |
| Catchment Area: | 42.27 ha |
| Impervious Catchment: | Sub catchment B1 - 2.0% Sub catchment B2 – 30%<br>Sub catchment B3 – 30% |
| Basin Volume: | 8,900m$^3$ at a depth of 2.0m |
| Spillway Width: | 20m |
| Basin Outlet Pipe: | 2 x 750mm diameter |
| 10 Year ARI Post Development Runoff: | 2.06m$^3$/s |
| 100 Year ARI Post Development Runoff: | 5.19m$^3$/s |

Catchment BX

Catchment BX discharges below the outlet to Retarding Basin No. 2.

The area of Catchment BX is 3.10 ha with 15% impervious area. The combined discharge from Retarding Basin No. 2 and Catchment BX is summarised below:

| | |
|---|---|
| 10 Year ARI Pre Development Runoff: | 2.70m$^3$/s |
| 100 Year ARI Pre Development Runoff: | 6.54m$^3$/s |
| 10 Year ARI Post Development Runoff: | 2.24m$^3$/s |
| 100 Year ARI Post Development Runoff: | 5.57m$^3$/s |

The proposed basin reduces the post development flows for Catchment B and Catchment BX for the 10 year ARI and 100 Year ARI to less than the pre development flows.

Whilst there are no existing drainage structures downstream of the outlet from Retarding Basin No. 2, it is anticipated that if the Blackbutt Road road reserve was reconstructed at some point in the future, culverts of a minimum size of 750mm diameter could be installed in conjunction with any future roadworks and the outlet from the retarding basin has been limited to 2 x 750mm diameter pipes.

Retarding Basin No. 3

| | |
|---|---|
| Catchment Serviced: | Catchment C |
| Catchment Area: | 18.16 ha |
| Impervious Catchment: | Sub catchment C1 – 0.0% Sub catchment C2 – 30% |
| Basin Volume: | 3,500m$^3$ at a depth of 2.0m |
| Spillway Width: | 12m |
| Basin Outlet Pipe: | 750mm diameter |
| 10 Year ARI Pre Development Runoff: | 1.24m$^3$/s |
| 100 Year ARI Pre Development Runoff: | 2.90m$^3$/s |
| 10 Year ARI Post Development Runoff: | 0.96m$^3$/s |
| 100 Year ARI Post Development Runoff: | 1.89m$^3$/s |

The proposed basin reduces the post development flows for the 10 year ARI and 100 Year ARI to less than the pre development flows.

Adjacent to the site for the proposed Retarding Basin No. 3, the existing stormwater runoff from the subdivision site crosses the Newell Highway via a 1200mm x 600 RCBC. The outlet from the proposed retarding basin has been limited to a pipe size that is less than the capacity of the box culvert under the Highway.

As post development flows from the retarding basin are less than the pre development flows, the operation of the highway drainage culvert and any other structures downstream are not impacted by the retarding basin.

Retarding Basin No. 4

| | |
|---|---|
| Catchment Serviced: | Catchment D |
| Catchment Area: | 11.23 ha |
| Impervious Catchment: | Sub catchment D1 – 0.0% Sub catchment D2 – 30% |
| Basin Volume: | 1,250m$^3$ at a depth of 1.5m |
| Spillway Width: | 8m |
| Basin Outlet Pipe: | 750mm diameter |
| 10 Year ARI Pre Development Runoff: | 1.06m$^3$/s |
| 100 Year ARI Pre Development Runoff: | 2.42m$^3$/s |
| 10 Year ARI Post Development Runoff: | 0.92m$^3$/s |
| 100 Year ARI Post Development Runoff: | 2.32m$^3$/s |

The proposed basin reduces the post development flows for the 10 year ARI and 100 Year ARI to less than the pre development flows.

Adjacent to the site for the proposed Retarding Basin No. 4, the existing stormwater runoff from the site crosses the Newell Highway via a 1400mm x 600 RCBC. The outlet from the proposed retarding basin has been limited to a pipe size that is less than the capacity of the box culvert under the Highway.

As post development flows from the retarding basin are less than the pre development flows, the operation of the highway drainage culvert and any other structures downstream are not impacted by the retarding basin.

Catchment E

Catchment E comprises 7.6 ha and is to be left in its undeveloped state and will continue to drain through the south eastern corner of the site.

## 6.1 CONSULTATIONS WITH TWPZ

In accordance with the request of Council's Technical Services staff, meetings and site inspections have been held with the Manager – Facilities and Asset Operations at Taronga Western Plains Zoo (TWPZ) in order to make the Zoo aware of the proposed subdivision and to discuss and resolve any concerns the Zoo had particularly in relation to stormwater runoff from the subdivision site.

During the initial site inspection, Zoo staff noted that the discharge of stormwater from Retarding Basin No. 3 would be directed to an existing creekline that flows through the Zoo's Billabong camp area and flows out from the Zoo beneath Obley Road. The catchment for Retarding Basin No. 3 within Highview Country Estate is approximately 18.2 ha.

The discharge from Retarding Basin No. 4 would be directed to the existing creek line that flows through the Zoo's sanctuary area and crosses then recrosses Camp Road. The catchment for Retarding Basin No. 4 within Highview Estate is approximately 11.2ha.

It was noted that for both retarding basins, the catchments on the creek lines within the Zoo are significantly larger than those from within Highview Country Estate.

The Zoo required additional factors relating to the operation of the retarding basin systems to be assessed in addition to the pre and post development discharge from the subdivision retarding basin systems. Issues of particular concern that the Zoo raised included the additional time period taken for the retarding basins to drain out the stored water and the additional volume of water that will be discharged from the subdivision along the existing creek lines.

In accordance with the Zoo's request, additional modelling of the stormwater retarding basin systems was carried out to address the issues raised by the Zoo.

A summary of the results of the additional stormwater modelling is indicated in **Table 6.1**, noting that the Total Discharge Flow Time is taken to be when the retarding basin discharges less than 1 l/s.

**Table 6.1 – Retarding Basin Modelling Parameters**

| Retarding Basin and Design ARI | Development Condition | Peak Discharge Flow | Total Discharge Flow Volume | Total Discharge Flow Time |
|---|---|---|---|---|
| **Retarding Basin No. 3** | | | | |
| 10 Year ARI | Pre Development (existing conditions) | 1.24 $m^3/s$ | 3,820 $m^3$ | 420 mins |
| | Post Development | 0.96 $m^3/s$ | 4,490 $m^3$ | 744 mins |
| | Percentage Comparison | 77% | 118% | 177% |
| 100 Year ARI | Pre Development (existing conditions) | 2.9 $m^3/s$ | 7,830 $m^3$ | 422 mins |
| | Post Development | 1.89 $m^3/s$ | 8,500 $m^3$ | 744 mins |
| | Percentage Comparison | 65% | 109% | 176% |
| **Retarding Basin No. 4** | | | | |
| 10 Year ARI | Pre Development (existing conditions) | 1.06 $m^3/s$ | 2,640 $m^3$ | 314 mins |

**Table 6.1 – Retarding Basin Modelling Parameters**

| Retarding Basin and Design ARI | Development Condition | Peak Discharge Flow | Total Discharge Flow Volume | Total Discharge Flow Time |
|---|---|---|---|---|
| | Post Development | 0.92 $m^3/s$ | 3,040 $m^3$ | 434 mins |
| | Percentage Comparison | 87% | 115% | 138% |
| 100 Year ARI | Pre Development (existing conditions) | 2.42 $m^3/s$ | 5,410 $m^3$ | 314 mins |
| | Post Development | 2.32 $m^3/s$ | 5,800 $m^3$ | 436 mins |
| | Percentage Comparison | 96% | 107% | 139% |

From a review of the information presented in **Table 6.1**, the following conclusions can be determined:

The proposed Basin No. 3 reduces the post development peak flows for the 10 year ARI and 100 Year ARI to 77% and 65% respectively of the pre development flows discharging to the creek line through the Zoo's Billabong Camp area.

The proposed Basin No. 4 reduces the post development peak flows for the 10 year ARI and 100 Year ARI to 87% and 96% respectively of the pre development flows discharging to the creek line through the Zoo's sanctuary area.

The reduction in the peak rate of stormwater discharge from the subdivision will ensure that the hydraulic capacity of any downstream structures are not exceeded following the development of the subdivision.

For Basin No. 3, the total discharge flow volume increases by 18% and 9% for the 10 Year ARI and 100 Year ARI respectively. The total discharge flow time increases by 77% and 76% for the 10 Year ARI and 100 Year ARI respectively.

For Basin No. 4, the total discharge flow volume increases by 16% and 7% for the 10 Year ARI and 100 Year ARI respectively. The total discharge flow time increases by 38% and 39% for the 10 Year ARI and 100 Year ARI respectively.

The volumetric increases in the discharge of stormwater from the proposed subdivision are not significant (maximum increase of 18% from Basin No. 3) given the large lot sizes and rural nature of the proposed subdivision. The increase in the length of time that stormwater discharges from the subdivision into the creek lines through the Zoo is a maximum of 77% from Basin No. 3.

To put this into perspective, the trickle flows from Basin No. 3 as it drains the retained stormwater generated from the proposed subdivision would occur over an additional 5 hours then currently is the case.

The quality of the stormwater runoff discharging from the proposed subdivision will be controlled by the installation of appropriately designed gross pollutant traps (GPTs).

Finally, existing nuisance flows from the land on the western side of the Newell Highway that currently discharges through a number of the smaller culverts beneath the Highway will be reduced as catch drains will be constructed along the rear of the lots backing onto the Highway in order to direct flows to the retarding basins so that stormwater can be discharged from the subdivision from the retarding basins in a controlled manner.

A report providing background details of the proposed subdivision, retarding basin parameters and the additional modelling results and appropriate drawings was prepared and provided to TWPZ in a letter dated 24 October 2016. A full copy of our submission made to TWPZ is attached in **Appendix C**.

Following further discussions with Zoo staff, we have received an emailed response from Ms Kathleen Oke on 20 January 2017 that acknowledges the consultations carried out and based on the advice provided the Zoo will be supportive of the development as long as the parameters outlined to the Zoo are met in the actual design of the subdivision.

Ms Oke's response states in part:

> *Thank you for your time and diligence in going through the proposed development and the impacts that could occur on the TWPZ land. As we raised with you our main concern was the impact of increased water flowing onto our site and the duration of the flow over and onto our site. As we discussed with you the main impact will be on our Billabong camp accommodation facility. You have explained the design and the styles of retention basins that will be used within the development and demonstrated the water flows and volumes that will be expected. As this is a new development we can only take you advice and expert advice and hope that in the long term your expectations are meet (sic).*

A copy of Ms Oke's emailed response in attached in **Appendix D**.

# 7.0 CONCLUSIONS

## 7.1 INTRODUCTION

Highview Country Estates Pty Ltd intends to develop a parcel of land on Blackbutt Road for residential purposes. The land is currently zoned R5 Large Lot Residential under the provisions of the Dubbo Local Environmental Plan (LEP) 2011.

This Infrastructure Servicing Strategy Report has assessed the proposed lot layout on the development site and determined an economic means of providing servicing infrastructure to facilitate the proposed subdivision.

The Report investigated the provision of the following infrastructure items:

- Road access
- Water supply
- Sewerage reticulation
- Stormwater drainage

The Servicing Strategy determined a practical means of providing road access, water supply, sewerage reticulation and stormwater drainage to the development site in order to ensure that appropriate services can be constructed to allow the future development of the land for residential purposes.

The proposed lot layout allows for the creation of a total of 137 lots across the site comprising the following lot configurations:

- 105 lots in the north eastern section of the site ranging in size from 2,000m$^2$ to approximately 5,000m$^2$.
- 32 lots in the western section of the site ranging in size from approximately 4,000m$^2$ to approximately 8,700m$^2$.

## 7.2 ACCESS AND TRAFFIC

Access to the proposed subdivision will be provided at two (2) locations off Blackbutt Road. Blackbutt Road provides good access to and from Dubbo via the Newell Highway with the major channelised intersection already constructed at the intersection of Blackbutt Road with the Newell Highway.

Based on the proposed 137 lots in the subdivision, the anticipated daily and peak hour traffic generation can be estimated as:

- 1,507 vehicle trips per day
- 137 vehicle trips per hour

## 7.3 WATER SUPPLY

The potable water supply for the proposed subdivision will be provided from Council's Rifle Range Road water reservoirs.

Based on the proposed development of 137 lots within the subdivision, the potable water demands for the subdivision are:

- Peak Instantaneous Demand: 13.7 L/s plus 11.0 L/s for fire purposes
- Peak Daily Demand: 685,000 L or approximately 0.7 ML

Stage 1 of the subdivision (16 lots) will be serviced via a metered connection to Council's 375mm diameter water main in Blackbutt Road. The remainder of the subdivision will be serviced by a new on site reservoir with a water supply servicing the new via a metered connection to Council's 200mm diameter water main in Rifle Range Road.

The WATSYS analysis carried out indicates that not all Nodes within the reticulation network meet Council's minimum requirements for residual pressure. This particularly relates to a series of Nodes clustered around the proposed Highview Estate Reservoir.

However, the reticulation system for the lots contained in Stage 1 meet Council's minimum pressure requirements.

The development of land with nominated lots within the low pressure zone will still be possible with the provision of additional infrastructure for any lot created in this area that may include:

- Storage tank with low flow potable water top up provided from the reticulated water mains.
- Dedicated storage volume for onsite firefighting requirements.
- Pressure pump system for water reticulation within the dwelling.

## 7.4 SEWERAGE RETICULATION

The natural ridgelines located through the centre of the site divide the land into several sewage catchments that will require the provision of sewerage reticulation separately from the existing and future sewerage infrastructure systems.

Part of Lot 172 is located within a sewage catchment that will drain by gravity reticulation to the existing Cootha sewage pump station. This catchment contains approximately 60 lots that can be serviced by the extension of existing sewerage infrastructure to Lot 172.

It is proposed to install two (2) sewage pump stations to service the remaining 78 lots with the rising main discharge from the pump stations being directed to the extension of the sewer main proposed to service the 60 lots on the eastern section of the site.

The 11 western most lots will drain by gravity sewerage reticulation to a small sewage pump station located in the north western corner of the site.

The remaining 67 lots in the central area of the site drain by gravity reticulation to a sewage pump station located on the extension of Blackbutt Road approximately 250m west of the intersection with Joira Road.

The detailed design of the 2 sewage pump stations shall take into account the design loadings indicated in **Table 5.1** to size the wet well capacity, set duty points for the pump sets and optimise the size of the rising mains discharging from the pump stations into the nearest gravity sewer main system.

The servicing of 60 lots with a gravity sewer will require the construction of a sewer main extending from the existing sewer main previously constructed across the Dubbo Golf Course to service the former Pioneer Spirit site, now being developed for residential purposes as Huntingdale Estate. This sewer main will follow an alignment parallel to the Newell Highway and across Blackbutt Road. Whilst the extension of this sewer main will be approximately 1km in length, there will be an opportunity to provide gravity sewerage to the Kintyre Country Living allowing the existing sewage pump station servicing the facility to be decommissioned.

The extension of the sewer main to service Highview Country Estate will also provide an opportunity for Huntingdale Estate to utilise the sewer main to service the development of the land in the subdivision.

If the developer of Highview Country Estate constructs the extension of the sewer main to its subdivision and upgrades the existing sewerage reticulation network, then other developments within the catchment should contribute to the costs associated with such works.

A methodology will need to be worked out with Council's Technical Services staff to allocate a cost sharing or cost recovery levy to apportion the cost of the works to the developments within the catchment.

## 7.5 STORMWATER DRAINAGE

Stormwater drainage infrastructure will be provided for the proposed subdivision of Lot 172 that will include:

- Interallotment stormwater drainage pipes and inlet pits
- Roadway stormwater drainage and inlet pits
- Retarding basin systems

A series of 4 retarding basins will be provided across the site limiting post development runoff to less than pre development flows.

The piped discharge from each retarding basin system will be limited to less than the capacity of any nearby culverts or drainage structures particularly those culverts crossing the Newell Highway.

## 7.6 SUMMARY

This Report has determined a strategy to allow the economic provision of the servicing infrastructure in a timely manner. The provision of the various servicing infrastructure components as outlined in this Report will allow the development of approximately 137 residential allotments in compliance with Council's zoning requirements and servicing criteria.

The development of the land is subject to Council's approval and the design of all works shall be carried out in accordance with Council's policies and standards for subdivision development.

# Drawings

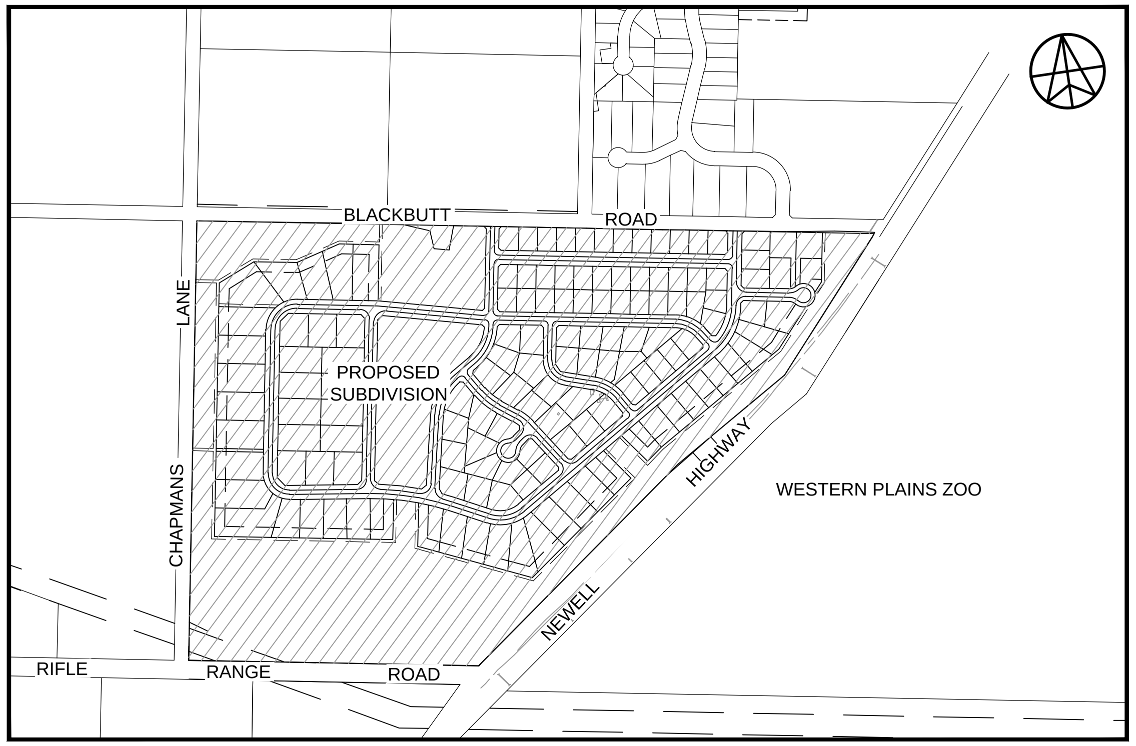
# PROPOSED SUBDIVISION LOT 172 DP753233

## BLACKBUTT ROAD, DUBBO

## HIGHVIEW COUNTRY ESTATES PTY LTD

### CONCEPT DEVELOPMENT PLANS

| SCHEDULE OF DRAWINGS | | | |
|---|---|---|---|
| SHEET | TITLE | REV. | DATE |
| E01 | TITLE SHEET, DRAWING LIST, AND SITE LOCALITY | H | 02/02/2017 |
| E02 | PROPOSED SUBDIVISION LAYOUT | H | 02/02/2017 |
| E03 | CONCEPT STORMWATER RETICULATION PLAN | H | 02/02/2017 |
| E04 | CONCEPT STORMWATER MANAGEMENT PLAN | H | 02/02/2017 |
| E05 | CONCEPT SEWER RETICULATION PLAN | H | 02/02/2017 |
| E06 | SEWERAGE UPGRADING REQUIREMENTS | H | 02/02/2017 |
| E07 | CONCEPT WATER RETICULATION PLAN | H | 02/02/2017 |
| E08 | WATSYS NODE DIAGRAM | H | 02/02/2017 |




SITE LOCALITY
NOT TO SCALE

| No | DATE | DRAFTING CHECK | PM CHECK | DETAILS |
|---|---|---|---|---|
| B | 18/09/15 | MY | PPO | REVISED LOT LAYOUT |
| C | 28/09/15 | MY | PPO | REVISED LOT LAYOUT |
| D | 20/10/15 | MY | PPO | LOT AREAS ADDED |
| E | 12/05/16 | JE | SJH | 340m CONTOUR AND GENERAL AMENDMENTS |
| F | 10/08/16 | AJD | PPO | BASIN OUTLET PIPES RESIZED |
| G | 27/10/16 | AJD | PPO | BASIN DETAILS AMENDED |
| H | 02/02/17 | EG | SJH | SERVICING REVISED & ISSUED FOR DA APPROVAL |

| CHECKED/APPROVED | NAME | DATE |
|---|---|---|
| APPROVED | SJH | 02/02/2017 |
| SURVEY | BARNSON | . |
| DESIGNER | PPO | 2016 |
| DRAFTING | ZD/MY/JE/AJD/EG | 02/02/2017 |

APPROVAL AUTHORITY

DUBBO REGIONAL COUNCIL

CLIENT: HIGHVIEW COUNTRY ESTATES PTY LTD

PROJECT: PROPOSED SUBDIVISION LOT 172 DP753233 BLACKBUTT ROAD, DUBBO


GEOLYSE
DUBBO
dubbo@geolyse.com
www.geolyse.com
1st FLOOR
62 WINGEWARRA STREET
P.O. BOX 1842
DUBBO, NSW 2830
Ph. (02) 6884 1525
Fax. (02) 6884 1470


DRAWING: TITLE SHEET, DRAWING LIST, AND SITE LOCALITY

PERMANENT MARK: - | RL: - | DATUM: A.H.D.

PROJECT NUMBER: 113156 | DRAWING SHEET: 02H_E01 | ORIGINAL A1

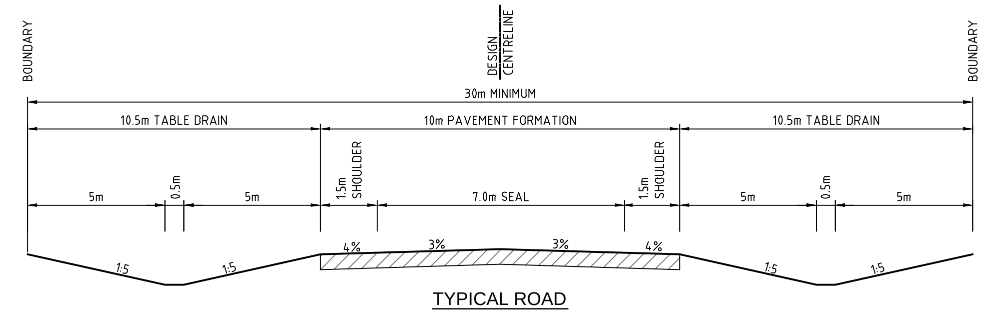
AUTOCAD FILE: 113156_02H_E01-E08.dwg | 12D/CIVILCAD FILE: -

STATUS: FOR APPROVAL | SHEET E01 OF E08 | REVISION H


NOTE
HIGHVIEW COUNTRY ESTATE IS TO BE DEVELOPED UNDER THE PROVISIONS OF COMMUNITY TITLE WHERE ALL INFRASTRUCTURE SERVICES WITHIN THE SITE (ROADS, STORMWATER DRAINAGE, SEWER AND WATER RETICULATION) WILL BE OWNED AND MAINTAINED BY THE SUBDIVISION'S COMMUNITY ASSOCIATION.

LEGEND:

F DENOTES FIRE TRAIL 6m WIDE
A DENOTES ASSET PROTECTION ZONE 21m WIDE




TYPICAL ROAD
CROSS SECTION
NOT TO SCALE

LEGEND:

CONTOUR INTERVAL 2.0m
PROPOSED BOUNDARY
EXISTING BOUNDARY

THIS PLAN IS FOR CONCEPT DEVELOPMENT PURPOSES ONLY AND SHALL NOT BE USED FOR CONSTRUCTION. THE FINAL DESIGN IS SUBJECT TO DETAILED ENGINEERING DESIGN AND COUNCIL APPROVAL.

SCALE 1:2500(A1)
0 50 100 150 200 250
SCALE 1:5000(A3)

| No | DATE | DRAFTING CHECK | PM CHECK | DETAILS |
|---|---|---|---|---|
| B | 18/09/15 | MY | PPO | REVISED LOT LAYOUT |
| C | 28/09/15 | MY | PPO | REVISED LOT LAYOUT |
| D | 20/10/15 | MY | PPO | LOT AREAS ADDED |
| E | 12/05/16 | JE | SJH | 340m CONTOUR AND GENERAL AMENDMENTS |
| F | 10/08/16 | AJD | PPO | BASIN OUTLET PIPES RESIZED |
| G | 27/10/16 | AJD | PPO | BASIN DETAILS AMENDED |
| H | 02/02/17 | EG | SJH | SERVICING REVISED & ISSUED FOR DA APPROVAL |

| CHECKED/APPROVED | NAME | DATE |
|---|---|---|
| APPROVED | SJH | 02/02/2017 |
| SURVEY | BARNSON | - |
| DESIGNER | PPO | 2016 |
| DRAFTING | ZD/MY/JE/AJD/EG | 02/02/2017 |

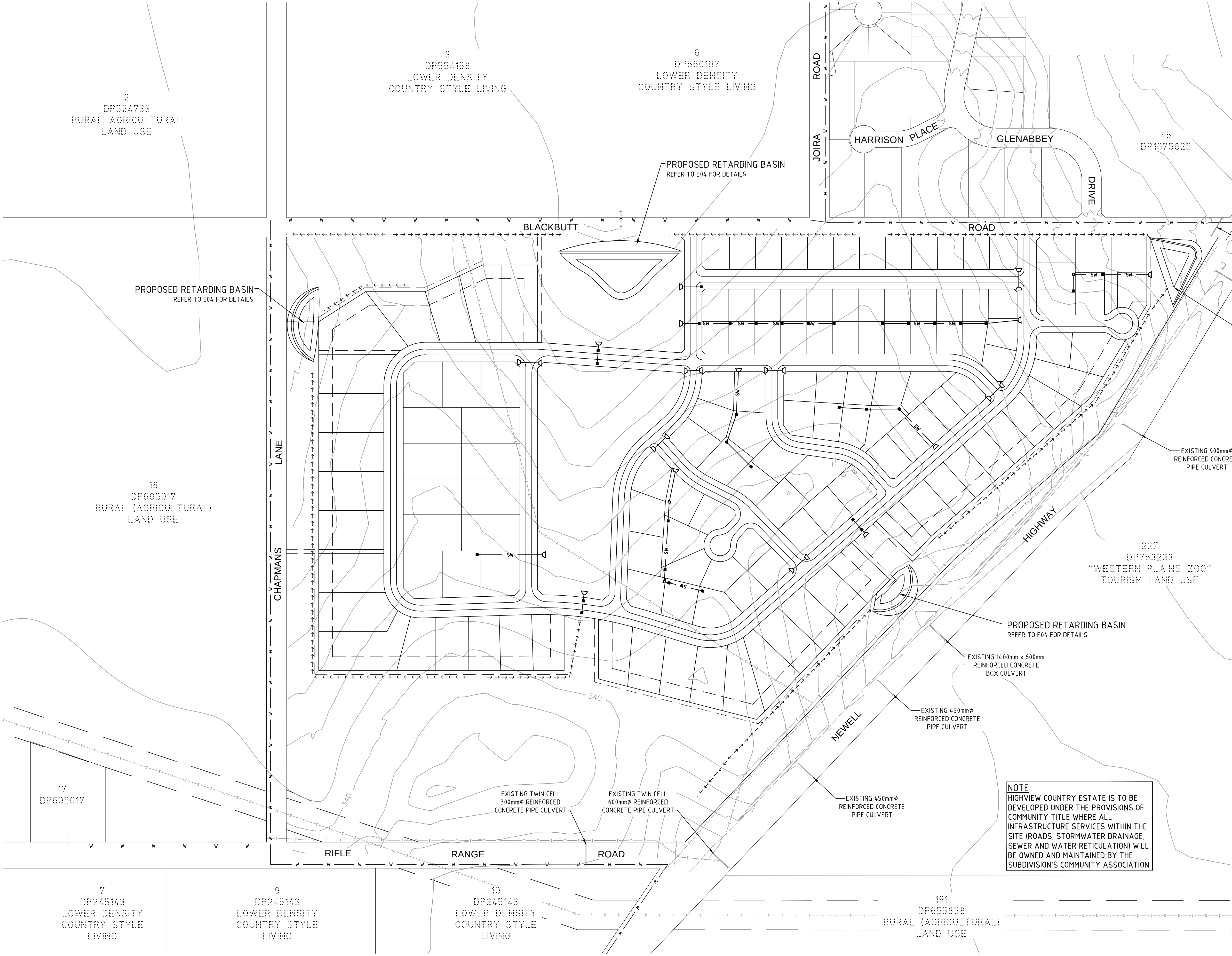
APPROVAL AUTHORITY
DUBBO
REGIONAL COUNCIL

CLIENT
HIGHVIEW COUNTRY ESTATES PTY LTD

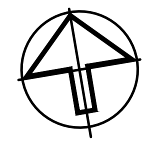
PROJECT
PROPOSED SUBDIVISION LOT 172 DP753233 BLACKBUTT ROAD, DUBBO


GEOLYSE
DUBBO
dubbo@geolyse.com
www.geolyse.com
1st FLOOR
62 WINGEWARRA STREET
P.O. BOX 1842
DUBBO, NSW 2830
Ph. (02) 6884 1525
Fax. (02) 6884 1470


DRAWING
PROPOSED SUBDIVISION LAYOUT
PERMANENT MARK: - RL: - DATUM: A.H.D.
PROJECT NUMBER: 113156 DRAWING SHEET: 02H_E02 ORIGINAL A1
AUTOCAD FILE: 113156_02H_E01-E08.dwg 12D/CIVILCAD FILE: - REVISION H
STATUS: FOR APPROVAL SHEET E02 OF E08




NOTE
HIGHVIEW COUNTRY ESTATE IS TO BE DEVELOPED UNDER THE PROVISIONS OF COMMUNITY TITLE WHERE ALL INFRASTRUCTURE SERVICES WITHIN THE SITE (ROADS, STORMWATER DRAINAGE, SEWER AND WATER RETICULATION) WILL BE OWNED AND MAINTAINED BY THE SUBDIVISION'S COMMUNITY ASSOCIATION.



LEGEND:

- CONTOUR INTERVAL 2.0m
- PROPOSED BOUNDARY
- EXISTING BOUNDARY
- SW — PROPOSED STORMWATER LINE & PIT
- EXISTING ELECTRICITY LINE, LOCAL (11KV)
- EXISTING ELECTRICITY LINE, TRANSMISSION (132KV)
- EXISTING TELSTRA LINE (LOCAL)
- EXISTING TELSTRA LINE (OPTIC FIBRE)
- W — EXISTING TRUNK WATER MAIN
- ← ← ← PROPOSED SWALE DRAIN

THIS PLAN IS FOR CONCEPT DEVELOPMENT PURPOSES ONLY AND SHALL NOT BE USED FOR CONSTRUCTION . THE FINAL DESIGN IS SUBJECT TO DETAILED ENGINEERING DESIGN AND COUNCIL APPROVAL.

STORMWATER NOTES:

1. DUBBO REGIONAL COUNCIL ARE TO BE NOTIFIED 48 HOURS PRIOR TO THE COMMENCEMENT OF ANY WORKS.
2. CONTRACTOR IS TO ADEQUATELY INFORM HIMSELF AS TO THE DEPTH AND LOCATION OF ALL EXISTING SERVICES PRIOR TO COMMENCEMENT OF CONSTRUCTION.
3. PIPE IS TO BE LAID AT UNIFORM GRADE BETWEEN INVERT LEVELS SHOWN WITH MINIMUM COVER MAINTAINED UNLESS OTHERWISE APPROVED BY THE SUPERINTENDENT.
4. MINIMUM COVER OVER ALL PIPES SHALL BE 600mm UNLESS OTHERWISE SHOWN OR DIRECTED.
5. CONTRACTOR TO SUPPLY AND INSTALL ALL FITTINGS AND SPECIALS INCLUDING VARIOUS PIPE ADAPTORS TO ENSURE PROPER CONNECTION BETWEEN DISSIMILAR PIPEWORKS.
6. ALL CONNECTIONS TO EXISTING DRAINAGE PITS SHALL BE MADE IN TRADESMAN- LIKE MANNER AND THE INTERNAL WALL OF THE PIT AT THE POINT OF ENTRY SHALL BE CEMENT RENDERED TO ENSURE SMOOTH FINNISH.
7. PRECAST PITS MAY BE USED AS APPROVED BY THE SUPERINTENDENT.
8. THE CONSTRUCTION OF ALL WORKS IS TO BE CARRIED OUT IN ACCORDANCE WITH DUBBO REGIONAL COUNCIL AUSPEC #1 DEVELOPMENT SPECIFICATION SERIES FOR CONSTRUCTION.

SCALE 1:3000(A1)

0 20 40 80 120 160 200

0 20 40 80 120 160 200

SCALE 1:6000(A3)

| No | DATE | DRAFTING CHECK | PM CHECK | DETAILS |
|---|---|---|---|---|
| B | 18/09/15 | MY | PPO | REVISED LOT LAYOUT |
| C | 28/09/15 | MY | PPO | REVISED LOT LAYOUT |
| D | 20/10/15 | MY | PPO | LOT AREAS ADDED |
| E | 12/05/16 | JE | SJH | 340m CONTOUR AND GENERAL AMENDMENTS |
| F | 10/08/16 | AJD | PPO | BASIN OUTLET PIPES RESIZED |
| G | 27/10/16 | AJD | PPO | BASIN DETAILS AMENDED |
| H | 02/02/17 | EG | SJH | SERVICING REVISED & ISSUED FOR DA APPROVAL |

| CHECKED/APPROVED | NAME | DATE |
|---|---|---|
| APPROVED | SJH | 02/02/2017 |
| SURVEY | BARNSON | |
| DESIGNER | PPO | 2016 |
| DRAFTING | ZD/MY/JE/AJD/EG | 02/02/2017 |

APPROVAL AUTHORITY

DUBBO REGIONAL COUNCIL

CLIENT

HIGHVIEW COUNTRY ESTATES PTY LTD

PROJECT

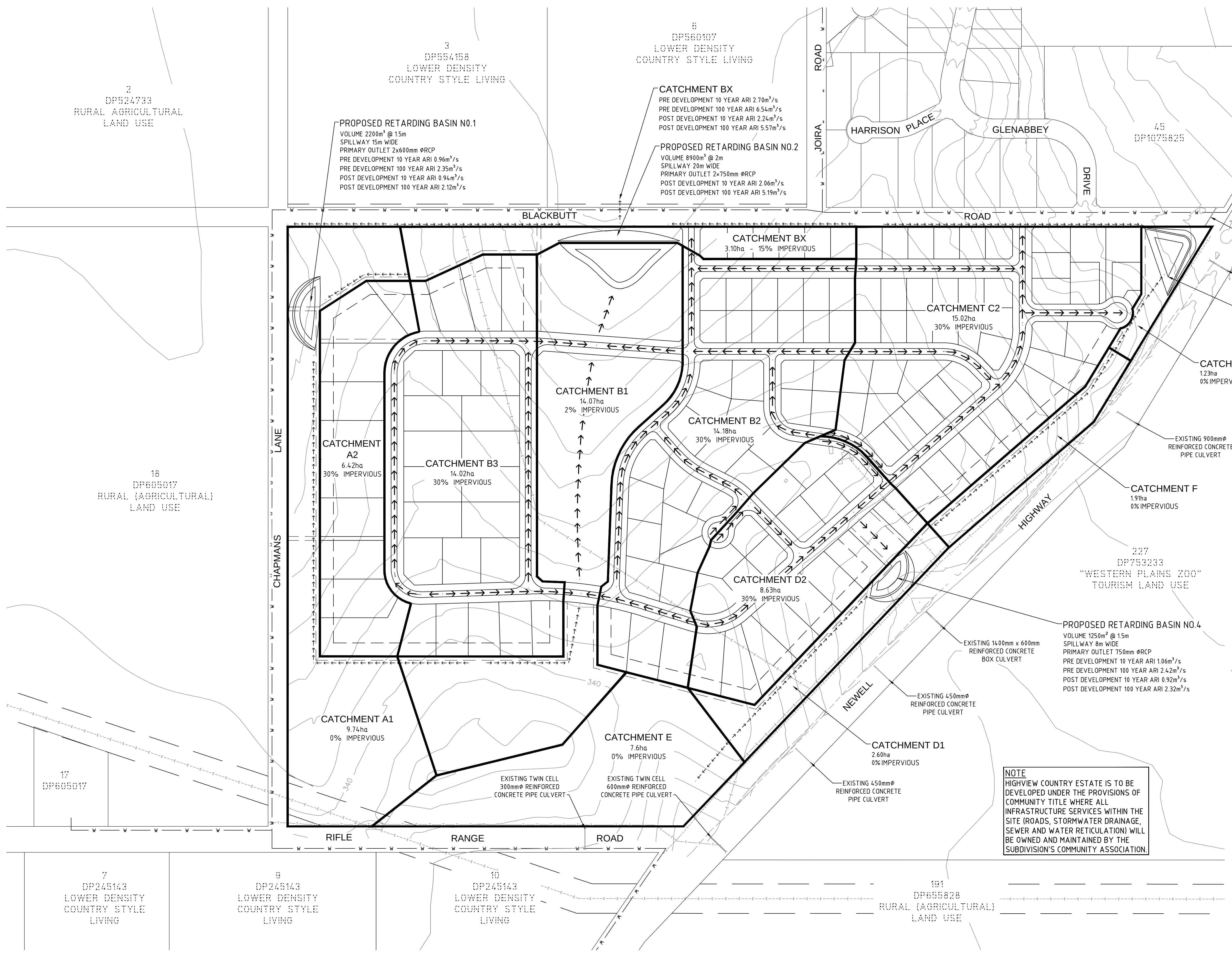
PROPOSED SUBDIVISION LOT 172 DP753233 BLACKBUTT ROAD, DUBBO


GEOLYSE
DUBBO
dubbo@geolyse.com
www.geolyse.com
1st FLOOR
62 WINGEWARRA STREET
P.O. BOX 1842
DUBBO, NSW 2830
Ph. (02) 6884 1525
Fax. (02) 6884 1470


DRAWING

CONCEPT STORMWATER RETICULATION PLAN

| | | |
|---|---|---|
| PERMANENT MARK: - | RL: - | DATUM: A.H.D. |
| PROJECT NUMBER: 113156 | DRAWING SHEET: 02H_E03 | ORIGINAL A1 |
| AUTOCAD FILE: 113156_02H_E01-E08.dwg | 12D/CIVILCAD FILE: - | REVISION H |
| STATUS: FOR APPROVAL | SHEET E03 OF E08 | |




## LEGEND:

- CONTOUR INTERVAL 2.0m
- PROPOSED BOUNDARY
- EXISTING BOUNDARY
- STORMWATER CATCHMENT AREA
- ELECTRICITY LINE, LOCAL (11KV)
- ELECTRICITY LINE, TRANSMISSION (132KV)
- TELSTRA LINE (LOCAL)
- TELSTRA LINE (OPTIC FIBRE)
- EXISTING TRUNK WATER MAIN
- STORMWATER FLOW DIRECTION
- PROPOSED SWALE DRAIN

THIS PLAN IS FOR CONCEPT DEVELOPMENT PURPOSES ONLY AND SHALL NOT BE USED FOR CONSTRUCTION. THE FINAL DESIGN IS SUBJECT TO DETAILED ENGINEERING DESIGN AND COUNCIL APPROVAL.

## STORMWATER NOTES:

1. DUBBO REGIONAL COUNCIL ARE TO BE NOTIFIED 48 HOURS PRIOR TO THE COMMENCEMENT OF ANY WORKS.
2. CONTRACTOR IS TO ADEQUATELY INFORM HIMSELF AS TO THE DEPTH AND LOCATION OF ALL EXISTING SERVICES PRIOR TO COMMENCEMENT OF CONSTRUCTION.
3. PIPE IS TO BE LAID AT UNIFORM GRADE BETWEEN INVERT LEVELS SHOWN WITH MINIMUM COVER MAINTAINED UNLESS OTHERWISE APPROVED BY THE SUPERINTENDENT.
4. MINIMUM COVER OVER ALL PIPES SHALL BE 600mm UNLESS OTHERWISE SHOWN OR DIRECTED.
5. CONTRACTOR TO SUPPLY AND INSTALL ALL FITTINGS AND SPECIALS INCLUDING VARIOUS PIPE ADAPTORS TO ENSURE PROPER CONNECTION BETWEEN DISSIMILAR PIPEWORKS.
6. ALL CONNECTIONS TO EXISTING DRAINAGE PITS SHALL BE MADE IN TRADESMAN- LIKE MANNER AND THE INTERNAL WALL OF THE PIT AT THE POINT OF ENTRY SHALL BE CEMENT RENDERED TO ENSURE SMOOTH FINNISH.
7. PRECAST PITS MAY BE USED AS APPROVED BY THE SUPERINTENDENT.
8. THE CONSTRUCTION OF ALL WORKS IS TO BE CARRIED OUT IN ACCORDANCE WITH DUBBO REGIONAL COUNCIL AUSPEC #1 DEVELOPMENT SPECIFICATION SERIES FOR CONSTRUCTION.

NOTE
HIGHVIEW COUNTRY ESTATE IS TO BE DEVELOPED UNDER THE PROVISIONS OF COMMUNITY TITLE WHERE ALL INFRASTRUCTURE SERVICES WITHIN THE SITE (ROADS, STORMWATER DRAINAGE, SEWER AND WATER RETICULATION) WILL BE OWNED AND MAINTAINED BY THE SUBDIVISION'S COMMUNITY ASSOCIATION.

SCALE 1:3000(A1)
0 20 40 80 120 160 200
SCALE 1:6000(A3)

| No | DATE | DRAFTING CHECK | PM CHECK | DETAILS |
|---|---|---|---|---|
| B | 18/09/15 | MY | PPO | REVISED LOT LAYOUT |
| C | 28/09/15 | MY | PPO | REVISED LOT LAYOUT |
| D | 20/10/15 | MY | PPO | LOT AREAS ADDED |
| E | 12/05/16 | JE | SJH | 340m CONTOUR AND GENERAL AMENDMENTS |
| F | 10/08/16 | AJD | PPO | BASIN OUTLET PIPES RESIZED |
| G | 27/10/16 | AJD | PPO | BASIN DETAILS AMENDED |
| H | 02/02/17 | EG | SJH | SERVICING REVISED & ISSUED FOR DA APPROVAL |

| CHECKED/APPROVED | NAME | DATE |
|---|---|---|
| APPROVED | SJH | 02/02/2017 |
| SURVEY | BARNSON | - |
| DESIGNER | PPO | 2016 |
| DRAFTING | ZD/MY/JE/AJD/EG | 02/02/2017 |

APPROVAL AUTHORITY
DUBBO REGIONAL COUNCIL

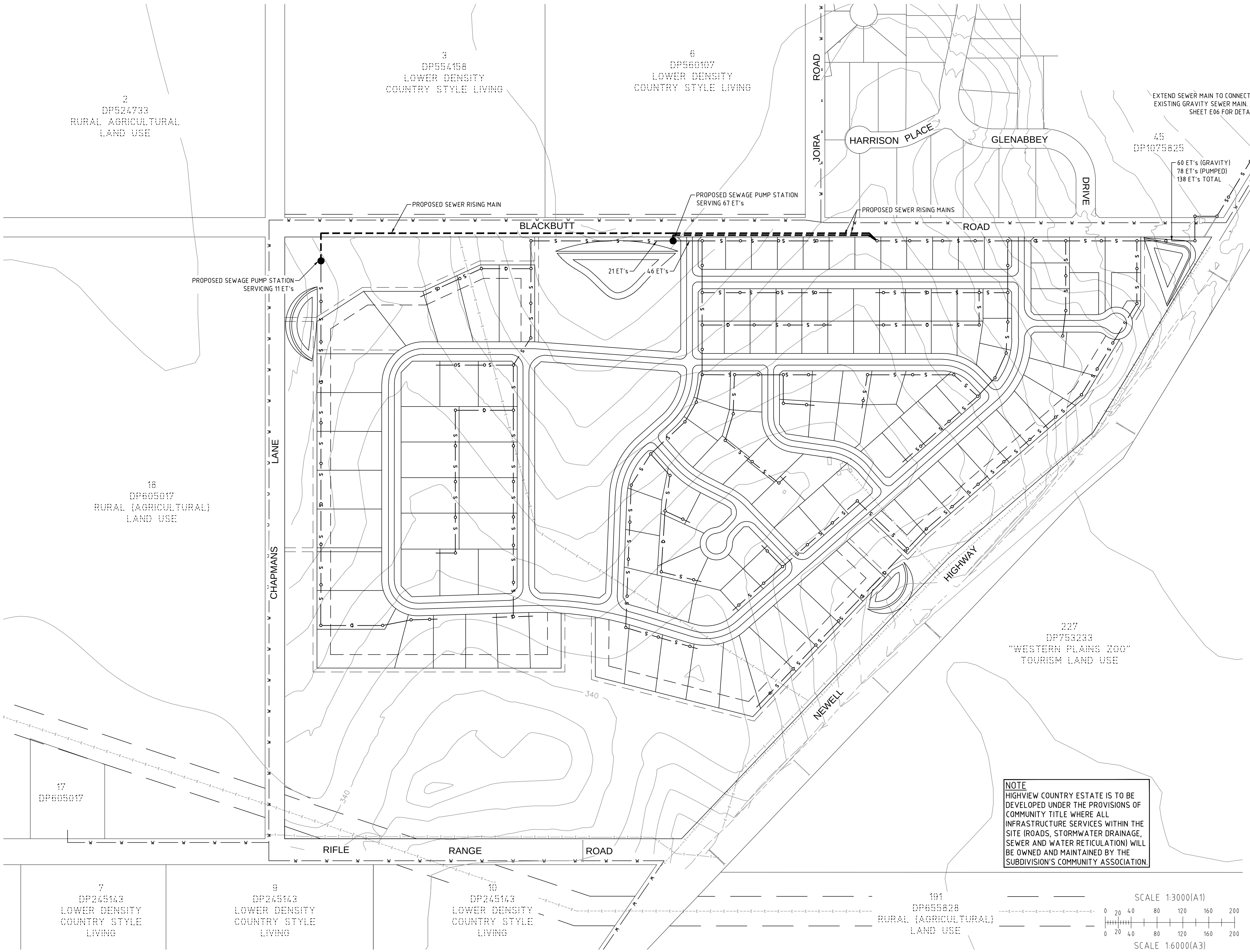
CLIENT
HIGHVIEW COUNTRY ESTATES PTY LTD

PROJECT
PROPOSED SUBDIVISION LOT 172 DP753233 BLACKBUTT ROAD, DUBBO

GEOLYSE
DUBBO
dubbo@geolyse.com
www.geolyse.com
1st FLOOR
62 WINGEWARRA STREET
P.O. BOX 1842
DUBBO, NSW 2830
Ph. (02) 6884 1525
Fax. (02) 6884 1470

DRAWING
# CONCEPT STORMWATER MANAGEMENT PLAN

PERMANENT MARK: - | RL: - | DATUM: A.H.D.
PROJECT NUMBER: 113156 | DRAWING SHEET: 02H_E04 | ORIGINAL A1
AUTOCAD FILE: 113156_02H_E01-E08.dwg | 12D/CIVILCAD FILE: - | REVISION H
STATUS: FOR APPROVAL | SHEET E04 OF E08




NOTE

HIGHVIEW COUNTRY ESTATE IS TO BE DEVELOPED UNDER THE PROVISIONS OF COMMUNITY TITLE WHERE ALL INFRASTRUCTURE SERVICES WITHIN THE SITE (ROADS, STORMWATER DRAINAGE, SEWER AND WATER RETICULATION) WILL BE OWNED AND MAINTAINED BY THE SUBDIVISION'S COMMUNITY ASSOCIATION.

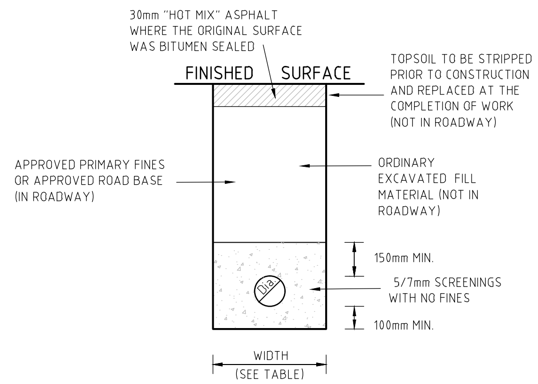
LEGEND:

- CONTOUR INTERVAL 2.0m
- PROPOSED BOUNDARY
- EXISTING BOUNDARY
- PROPOSED SEWERAGE LINE & MANHOLE
- PROPOSED SEWER RISING MAIN
- ELECTRICITY LINE, LOCAL (11KV)
- ELECTRICITY LINE, TRANSMISSION (132KV)
- TELSTRA LINE (LOCAL)
- TELSTRA LINE (OPTIC FIBRE)
- EXISTING TRUNK WATER MAIN

THIS PLAN IS FOR CONCEPT DEVELOPMENT PURPOSES ONLY AND SHALL NOT BE USED FOR CONSTRUCTION . THE FINAL DESIGN IS SUBJECT TO DETAILED ENGINEERING DESIGN AND COUNCIL APPROVAL.

SEWER NOTES:

1. DUBBO REGIONAL COUNCIL ARE TO BE NOTIFIED 48 HOURS PRIOR TO THE COMMENCEMENT OF ANY WORKS
2. ALL SEWER MAINS SHALL BE CLASS SN8 RRJ UPVC PIPE MAX. 3m LENGTHS OR RRJ VC PIPE.
3. CONSTRUCTION OF SEWER MAINS & MANHOLES SHALL BE CARRIED OUT IN ACCORDANCE WITH DUBBO REGIONAL COUNCIL'S AUS-SPEC #1 DEVELOPMENT CONSTRUCTION SPECIFICATION
4. TELSTRA, COUNTRY ENERGY & DUBBO REGIONAL COUNCIL MUST BE CONTACTED & UNDERGROUND SERVICES LOCATED BEFORE WORK COMMENCES.
5. MANHOLES ARE TO BE CONSTRUCTED IN ACCORDANCE WITH DUBBO REGIONAL COUNCIL'S STANDARD DRAWINGS 500B AND 5520. FOR MANHOLES WITHIN THE FOOTPATH AND/OR PUBLIC RESERVES ETC THE MANHOLE LID IS TO BE LEVEL WITH THE FINISHED SURFACE LEVEL AND FOR MANHOLES WITHIN PRIVATE PROPERTY THE LIDS ARE TO BE SET 100mm ABOVE THE FINISHED SURFACE LEVEL. ALL MANHOLE COVERS ARE TO BE "BOLT DOWN ACCESS COVERS (WATER TIGHT TYPE)"
6. DEAD ENDS & JUNCTIONS TO BE SEALED WITH 150mm DIAMETER RRJ SPIGOT ACCESS COUPLING WITH SCREWED CAP.
7. RISERS & SIDELINES TO BE CONSTRUCTED TO PUBLIC WORKS STANDARD DRAWING ST.503D.
8. ALL FOOTPATHS & ROADWAYS ARE TO BE REINSTATED UPON COMPLETION OF WORK.
9. CONTRACTOR TO TAKE CARE WHEN EXCAVATING NEAR TREES.
10. TRENCH STOPS TO BE CONSTRUCTED IN ALL LINES WHICH HAVE GRADIENT EQUAL TO OR STEEPER THAN 1 IN 40. REFER TO DUBBO REGIONAL COUNCIL'S DEVELOPMENT CONSTRUCTION SPECIFICATION AUSPEC #1
11. FOR TYPICAL SECTION DETAILS REFER TO DRC STD 5518.




TYPICAL SECTION
SEWER RETICULATION MAIN
NOT TO SCALE
REFER TO DRC STD 5518

| No | DATE | DRAFTING CHECK | PM CHECK | DETAILS |
|---|---|---|---|---|
| B | 18/09/15 | MY | PPO | REVISED LOT LAYOUT |
| C | 28/09/15 | MY | PPO | REVISED LOT LAYOUT |
| D | 20/10/15 | MY | PPO | LOT AREAS ADDED |
| E | 12/05/16 | JE | SJH | 340m CONTOUR AND GENERAL AMENDMENTS |
| F | 10/08/16 | AJD | PPO | BASIN OUTLET PIPES RESIZED |
| G | 27/10/16 | AJD | PPO | BASIN DETAILS AMENDED |
| H | 02/02/17 | EG | SJH | SERVICING REVISED & ISSUED FOR DA APPROVAL |

| CHECKED/APPROVED | NAME | DATE |
|---|---|---|
| APPROVED | SJH | 02/02/2017 |
| SURVEY | BARNSON | . |
| DESIGNER | PPO | 2016 |
| DRAFTING | ZD/MY/JE/AJD/EG | 02/02/2017 |

APPROVAL AUTHORITY

DUBBO REGIONAL COUNCIL

CLIENT

HIGHVIEW COUNTRY ESTATES PTY LTD

PROJECT

PROPOSED SUBDIVISION LOT 172 DP753233 BLACKBUTT ROAD, DUBBO


GEOLYSE
DUBBO
dubbo@geolyse.com
www.geolyse.com
1st FLOOR
62 WINGEWARRA STREET
P.O. BOX 1842
DUBBO, NSW 2830
Ph. (02) 6884 1525
Fax. (02) 6884 1470


DRAWING

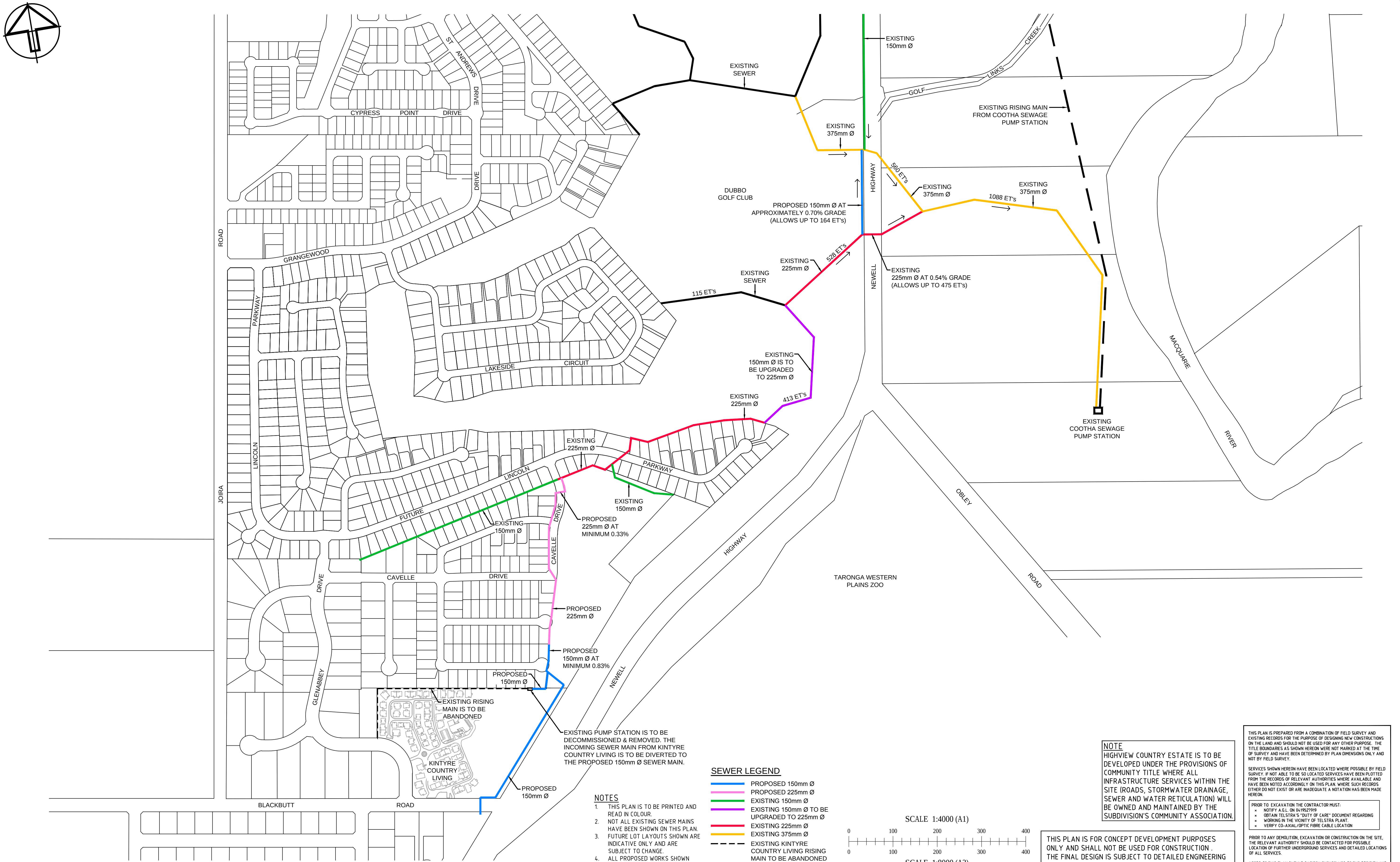
CONCEPT SEWER RETICULATION PLAN

PERMANENT MARK: - | RL: - | DATUM: A.H.D.

PROJECT NUMBER: 113156 | DRAWING SHEET: 02H_E05 | ORIGINAL: A1

AUTOCAD FILE: 113156_02H_E01-E08.dwg | 12D/CIVILCAD FILE: - | REVISION: H

STATUS: FOR APPROVAL | SHEET E05 OF E08




NOTES

1. THIS PLAN IS TO BE PRINTED AND READ IN COLOUR.
2. NOT ALL EXISTING SEWER MAINS HAVE BEEN SHOWN ON THIS PLAN.
3. FUTURE LOT LAYOUTS SHOWN ARE INDICATIVE ONLY AND ARE SUBJECT TO CHANGE.
4. ALL PROPOSED WORKS SHOWN ARE SUBJECT TO DETAILED CIVIL ENGINEERING DESIGN.

SEWER LEGEND

- PROPOSED 150mm Ø
- PROPOSED 225mm Ø
- EXISTING 150mm Ø
- EXISTING 150mm Ø TO BE UPGRADED TO 225mm Ø
- EXISTING 225mm Ø
- EXISTING 375mm Ø
- EXISTING KINTYRE COUNTRY LIVING RISING MAIN TO BE ABANDONED
- EXISTING COOTHA SEWAGE PUMP STATION RISING MAIN

SCALE 1:4000 (A1)

0 100 200 300 400

SCALE 1:8000 (A3)

NOTE

HIGHVIEW COUNTRY ESTATE IS TO BE DEVELOPED UNDER THE PROVISIONS OF COMMUNITY TITLE WHERE ALL INFRASTRUCTURE SERVICES WITHIN THE SITE (ROADS, STORMWATER DRAINAGE, SEWER AND WATER RETICULATION) WILL BE OWNED AND MAINTAINED BY THE SUBDIVISION'S COMMUNITY ASSOCIATION.

THIS PLAN IS FOR CONCEPT DEVELOPMENT PURPOSES ONLY AND SHALL NOT BE USED FOR CONSTRUCTION . THE FINAL DESIGN IS SUBJECT TO DETAILED ENGINEERING DESIGN AND COUNCIL APPROVAL.

THIS PLAN IS PREPARED FROM A COMBINATION OF FIELD SURVEY AND EXISTING RECORDS FOR THE PURPOSE OF DESIGNING NEW CONSTRUCTIONS ON THE LAND AND SHOULD NOT BE USED FOR ANY OTHER PURPOSE. THE TITLE BOUNDARIES AS SHOWN HEREON WERE NOT MARKED AT THE TIME OF SURVEY AND HAVE BEEN DETERMINED BY PLAN DIMENSIONS ONLY AND NOT BY FIELD SURVEY.

SERVICES SHOWN HEREON HAVE BEEN LOCATED WHERE POSSIBLE BY FIELD SURVEY. IF NOT ABLE TO BE SO LOCATED SERVICES HAVE BEEN PLOTTED FROM THE RECORDS OF RELEVANT AUTHORITIES WHERE AVAILABLE AND HAVE BEEN NOTED ACCORDINGLY ON THIS PLAN. WHERE SUCH RECORDS EITHER DO NOT EXIST OR ARE INADEQUATE A NOTATION HAS BEEN MADE HEREON.

PRIOR TO EXCAVATION THE CONTRACTOR MUST:
- NOTIFY A.G.L. ON 0419527919
- OBTAIN TELSTRA'S "DUTY OF CARE" DOCUMENT REGARDING
- WORKING IN THE VICINITY OF TELSTRA PLANT.
- VERIFY CO-AXIAL/OPTIC FIBRE CABLE LOCATION

PRIOR TO ANY DEMOLITION, EXCAVATION OR CONSTRUCTION ON THE SITE, THE RELEVANT AUTHORITY SHOULD BE CONTACTED FOR POSSIBLE LOCATION OF FURTHER UNDERGROUND SERVICES AND DETAILED LOCATIONS OF ALL SERVICES.

USERS OF THIS PLAN SHOULD SATISFY THEMSELVES OF THE POSITION AND EXTENT OF SERVICES IN THE AREA OF PROPOSED WORKS.

| No | DATE | DRAFTING CHECK | PM CHECK | DETAILS |
|---|---|---|---|---|
| B | 18/09/15 | MY | PPO | REVISED LOT LAYOUT |
| C | 28/09/15 | MY | PPO | REVISED LOT LAYOUT |
| D | 20/10/15 | MY | PPO | LOT AREAS ADDED |
| E | 12/05/16 | JE | SJH | 340m CONTOUR AND GENERAL AMENDMENTS |
| F | 10/08/16 | AJD | PPO | BASIN OUTLET PIPES RESIZED |
| G | 27/10/16 | AJD | PPO | BASIN DETAILS AMENDED |
| H | 02/02/17 | EG | SJH | SERVICING REVISED & ISSUED FOR DA APPROVAL |

| CHECKED/APPROVED | NAME | DATE |
|---|---|---|
| APPROVED | SJH | 02/02/2017 |
| SURVEY | BARNSON | . |
| DESIGNER | PPO | 2016 |
| DRAFTING | ZD/MY/JE/AJD/EG | 02/02/2017 |

APPROVAL AUTHORITY

DUBBO REGIONAL COUNCIL

CLIENT

HIGHVIEW COUNTRY ESTATES PTY LTD

PROJECT

PROPOSED SUBDIVISION LOT 172 DP753233 BLACKBUTT ROAD, DUBBO


GEOLYSE
DUBBO
dubbo@geolyse.com
www.geolyse.com
1st FLOOR
62 WINGEWARRA STREET
P.O. BOX 1842
DUBBO, NSW 2830
Ph. (02) 6884 1525
Fax. (02) 6884 1470

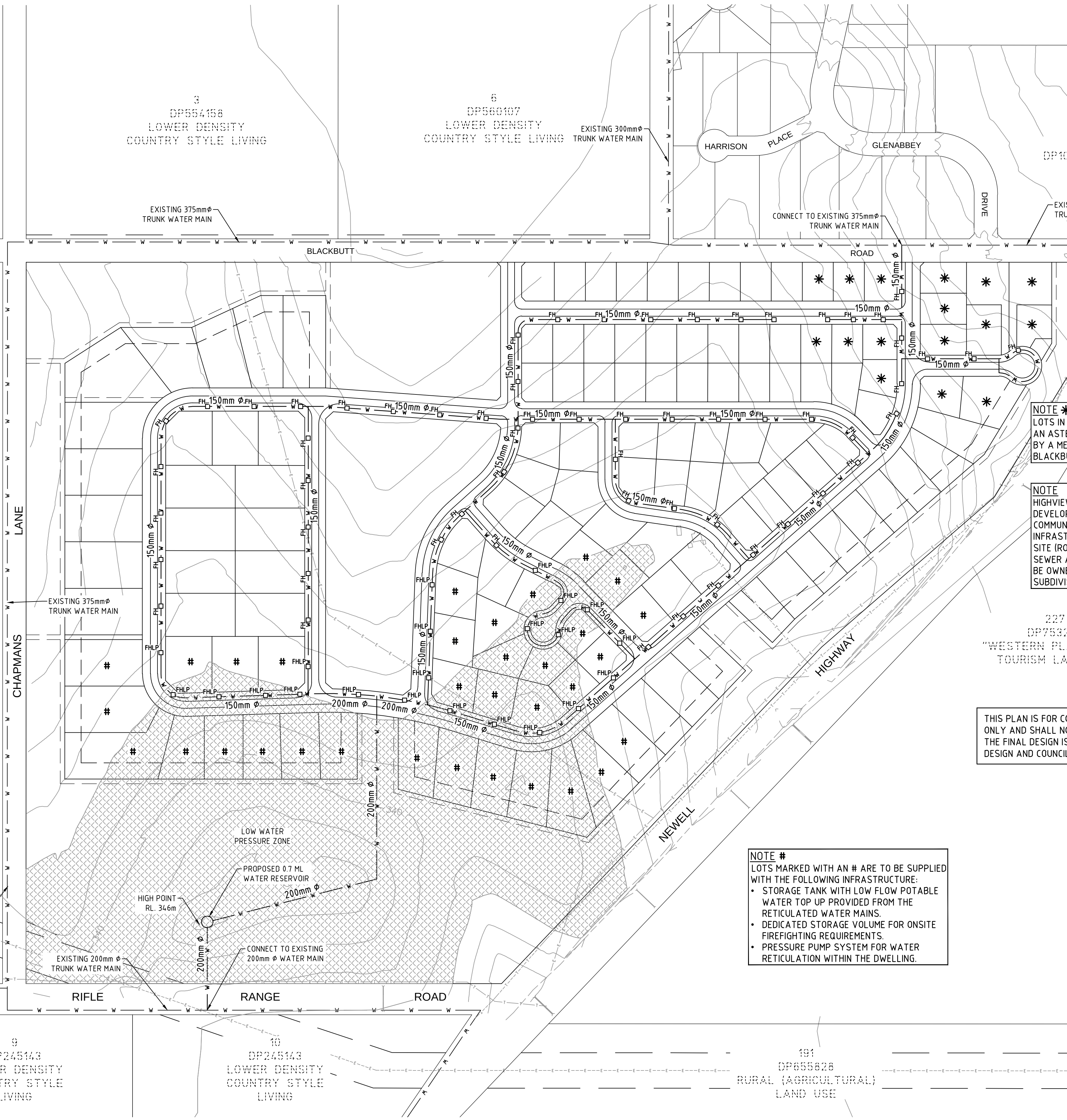

DRAWING

SEWERAGE UPGRADING REQUIREMENTS

| | | | |
|---|---|---|---|
| PERMANENT MARK: - | RL: - | DATUM: A.H.D. | |
| PROJECT NUMBER: 113156 | DRAWING SHEET: 02H_E06 | ORIGINAL A1 | |
| AUTOCAD FILE: 113156_02H_E01-E08.dwg | 12D/CIVILCAD FILE: - | REVISION H | |
| STATUS: FOR APPROVAL | SHEET E06 OF E08 | | |

## WATER NOTES:

1. DUBBO REGIONAL COUNCIL ARE TO BE NOTIFIED 48 HOURS PRIOR TO THE COMMENCEMENT OF ANY WORKS
2. WATER MAINS, HYDRANTS & STOP VALVES TO BE CONSTRUCTED IN ACCORDANCE WITH THE REQUIREMENTS OF "DUBBO REGIONAL COUNCIL'S AUSPEC #1 SERIES FOR CONSTRUCTION" & DRC DWG 5357.
3. WATER MAINS TO HAVE MINIMUM 600mm COVER.
4. ALL PIPES & FITTINGS TO BE DUCTILE IRON (DICL K9) UNLESS OTHERWISE SHOWN.
5. DICL PIPES TO BE RACKED AT JOINTS TO MAXIMUM DEFLECTION OF 5 DEGREES IN ACCORDANCE WITH MANUFACTURERS RECOMMENDATION. BENDS ARE TO BE PLACED AS SHOWN.
6. UPVC PIPES TO BE RACKED AT JOINTS TO MAXIMUM DEFLECTION OF 5 DEGREES IN ACCORDANCE WITH MANUFACTURERS RECOMMENDATION. BENDS ARE TO BE PLACED AS SHOWN.
7. ON SWEEPING BENDS CURVATURE TO BE ACHIEVED BY SHORTENING PIPES TO INTRODUCE ADDITIONAL JOINTS.
8. ALL FITTINGS TO BE FUSION BONDED EPOXY (FBE) COATED DUCTILE IRON.
9. HYDRANTS TO BE SPACED AT MAXIMUM OF 60m INTERVALS UNLESS SHOWN OTHERWISE.
10. THRUST BLOCKS TO BE PLACED AT TEES, BENDS, DEAD ENDS & STOP VALVES IN ACCORDANCE WITH THE REQUIREMENTS OF DUBBO REGIONAL COUNCIL SPECIFICATIONS, DRC DWG 5360.
11. ALL PIPES, FITTINGS & MATERIALS SHALL BE NEW & MANUFACTURED & INSTALLED IN ACCORDANCE WITH THE REQUIREMENTS OF DUBBO REGIONAL COUNCIL SPECIFICATIONS.
12. WATER MAINS SHALL BE PRESSURE TESTED BEFORE THE MAIN IS TO BE TAKEN INTO SERVICE. TEST PRESSURE OF 1.5 x PIPE CLASS MUST BE APPLIED AND HELD FOR MINIMUM OF 15 MINUTES.
13. ALL MAINS FOR CONNECTION TO THE PUBLIC WATER SUPPLY SYSTEM SHALL BE DISINFECTED BY DUBBO REGIONAL COUNCIL.
14. PIPE BEDDING MATERIAL TO BE TO THE DRC INSPECTORS SATISFACTION.
15. ALL CONCRETE SHALL BE 15 Mpa& EVIDENCE OF THE SAME SHALL BE SUPPLIED TO THE DRC INSPECTOR.
16. NO OTHER SERVICES OR PLANT WILL BE LOCATED IN OR OVER THE TRENCH CONSTRUCTED TO CONTAIN WATER MAINS.
17. WHERE FLANGED FITTINGS ARE USED, ALL BOLTS & FLANGES SHALL BE TO THE APPROPRIATE AUSTRALIAN STANDARD & PROTECTED AGAINST CORROSION BY CONTINUOUS WRAPPING WITH DENSO- WRAP OR EQUIVALENT TO THE MANUFACTURER'S DIRECTION.
18. SERVICE CONDUIT AND CROSSINGS SHALL BE PROVIDED AS PART OF THE WATER RETICULATION WORKS.
19. MINIMUM SERVICE CROSSING CONDUIT DIAMETER IS 50mm WITH 20mm COPPER SERVICE PROVIDED FOR EACH PROPERTY SERVED.
20. INDIVIDUAL LOT CONNECTIONS, CUTTING INTO EXISTING MAINS & PRV TO BE CARRIED OUT BY DUBBO REGIONAL COUNCIL.
21. TRENCHSTOPS ARE TO BE CONSTRUCTED ON ALL LINES WHICH HAVE GRADIENT STEEPER THAN 1:20 (5%). REFER TO DUBBO REGIONAL COUNCIL SPECIFICATIONS, DRC DWG 5369.
22. CONCRETE BULKHEADS TO BE CONSTRUCTED ON ALL LINES WHICH HAVE GRADIENT STEEPER THAN 1:6 (15%). REFER TO DUBBO REGIONAL COUNCIL SPECIFICATIONS, DRC DWG 5369.
23. CONVEX VERTICAL BENDS ARE TO BE SECURED BY AN ANCHOR BLOCK IN ACCORDANCE WITH DUBBO REGIONAL COUNCIL SPECIFICATIONS, DRC DWG 5360.
24. ARRANGEMENT OF LINES & JOINTS IN CUL-DE-SAC DEAD ENDS TO BE IN ACCORDANCE WITH DUBBO REGIONAL COUNCIL SPECIFICATIONS, DRC DWG 5515
25. ALL FOOTPATHS & ROADS TO BE REINSTATED UPON COMPLETION OF WORK
26. CONTRACTORS TO TAKE CARE WHEN EXCAVATING NEAR TREES




NOTE ✱
LOTS IN STAGE 1 (DENOTED WITH AN ASTERISK) ARE TO BE SERVICED BY A METERED CONNECTION TO THE BLACKBUTT ROAD WATER MAIN.

NOTE
HIGHVIEW COUNTRY ESTATE IS TO BE DEVELOPED UNDER THE PROVISIONS OF COMMUNITY TITLE WHERE ALL INFRASTRUCTURE SERVICES WITHIN THE SITE (ROADS, STORMWATER DRAINAGE, SEWER AND WATER RETICULATION) WILL BE OWNED AND MAINTAINED BY THE SUBDIVISION'S COMMUNITY ASSOCIATION.

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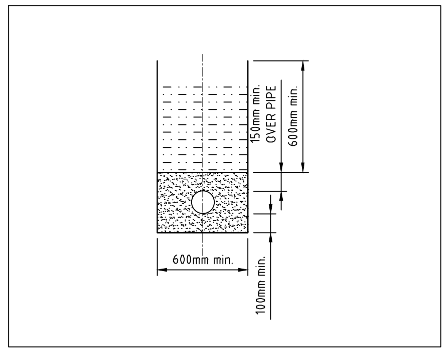
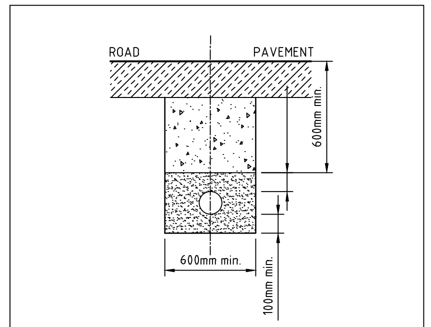
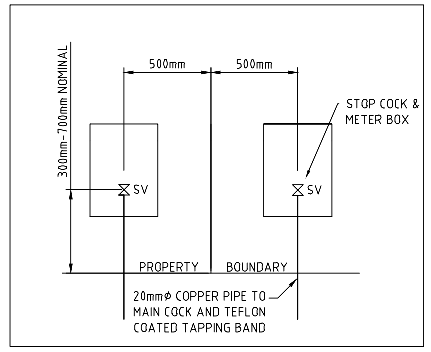
NOTE #
LOTS MARKED WITH AN # ARE TO BE SUPPLIED WITH THE FOLLOWING INFRASTRUCTURE:
- STORAGE TANK WITH LOW FLOW POTABLE WATER TOP UP PROVIDED FROM THE RETICULATED WATER MAINS.
- DEDICATED STORAGE VOLUME FOR ONSITE FIREFIGHTING REQUIREMENTS.
- PRESSURE PUMP SYSTEM FOR WATER RETICULATION WITHIN THE DWELLING.



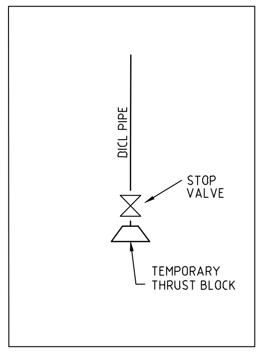

NOT TO SCALE
REFER TO DUBBO REGIONAL COUNCIL STANDARD DRAWING STD 5518




NOT TO SCALE
REFER TO DUBBO REGIONAL COUNCIL STANDARD DRAWING STD 5518




TYPICAL WATER SERVICE CONNECTIONS TO LOTS
NOT TO SCALE
REFER TO DUBBO REGIONAL COUNCIL STANDARD DRAWING STD 5882




END OF WATERMAIN IN STAGE
NOT TO SCALE

LEGEND:

- CONTOUR INTERVAL 2.0m
- PROPOSED BOUNDARY
- EXISTING BOUNDARY
- EXISTING TRUNK WATER MAIN
- PROPOSED WATER LINE
- FH PROPOSED FIRE HYDRANT
- FHLP PROPOSED FIRE HYDRANT IN THE LOW WATER PRESSURE ZONE
- ELECTRICITY LINE, LOCAL (11KV)
- ELECTRICITY LINE, TRANSMISSION (132KV)
- TELSTRA LINE (LOCAL)
- TELSTRA LINE (OPTIC FIBRE)
- LOW WATER PRESSURE ZONE

SCALE 1:3000(A1)
0 20 40 80 120 160 200
SCALE 1:6000(A3)

| No | DATE | DRAFTING CHECK | PM CHECK | DETAILS |
|---|---|---|---|---|
| B | 18/09/15 | MY | PPO | REVISED LOT LAYOUT |
| C | 28/09/15 | MY | PPO | REVISED LOT LAYOUT |
| D | 20/10/15 | MY | PPO | LOT AREAS ADDED |
| E | 12/05/16 | JE | SJH | 340m CONTOUR AND GENERAL AMENDMENTS |
| F | 10/08/16 | AJD | PPO | BASIN OUTLET PIPES RESIZED |
| G | 27/10/16 | AJD | PPO | BASIN DETAILS AMENDED |
| H | 02/02/17 | EG | SJH | SERVICING REVISED & ISSUED FOR DA APPROVAL |

| CHECKED/APPROVED | NAME | DATE |
|---|---|---|
| | | |
| APPROVED | SJH | 02/02/2017 |
| SURVEY | BARNSON | . |
| DESIGNER | PPO | 2016 |
| DRAFTING | ZD/MY/JE/AJD/EG | 02/02/2017 |

APPROVAL AUTHORITY
DUBBO REGIONAL COUNCIL

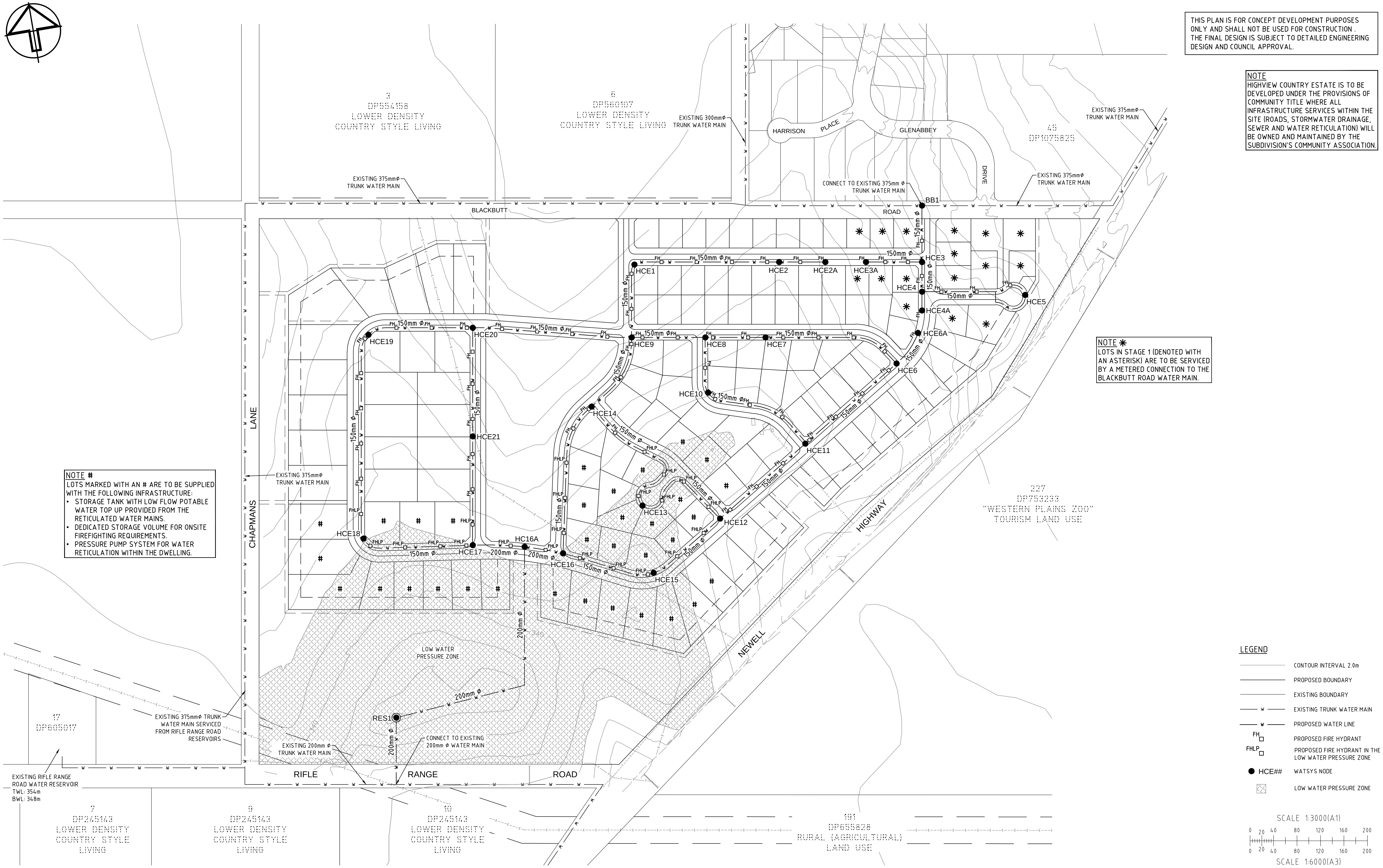
CLIENT
HIGHVIEW COUNTRY ESTATES PTY LTD

PROJECT
PROPOSED SUBDIVISION LOT 172 DP753233 BLACKBUTT ROAD, DUBBO


GEOLYSE
DUBBO
dubbo@geolyse.com
www.geolyse.com
1st FLOOR
62 WINGEWARRA STREET
P.O. BOX 1842
DUBBO, NSW 2830
Ph. (02) 6884 1525
Fax. (02) 6884 1470


DRAWING
# CONCEPT WATER RETICULATION PLAN

PERMANENT MARK: - | RL: - | DATUM: A.H.D.
PROJECT NUMBER: 113156 | DRAWING SHEET: 02H_E07 | ORIGINAL A1
AUTOCAD FILE: 113156_02H_E01-E08.dwg | 12D/CIVILCAD FILE: - | REVISION H
STATUS: FOR APPROVAL | SHEET E07 OF E08




THIS PLAN IS FOR CONCEPT DEVELOPMENT PURPOSES ONLY AND SHALL NOT BE USED FOR CONSTRUCTION. THE FINAL DESIGN IS SUBJECT TO DETAILED ENGINEERING DESIGN AND COUNCIL APPROVAL.

NOTE

HIGHVIEW COUNTRY ESTATE IS TO BE DEVELOPED UNDER THE PROVISIONS OF COMMUNITY TITLE WHERE ALL INFRASTRUCTURE SERVICES WITHIN THE SITE (ROADS, STORMWATER DRAINAGE, SEWER AND WATER RETICULATION) WILL BE OWNED AND MAINTAINED BY THE SUBDIVISION'S COMMUNITY ASSOCIATION.

NOTE ✳

LOTS IN STAGE 1 (DENOTED WITH AN ASTERISK) ARE TO BE SERVICED BY A METERED CONNECTION TO THE BLACKBUTT ROAD WATER MAIN.

NOTE #

LOTS MARKED WITH AN # ARE TO BE SUPPLIED WITH THE FOLLOWING INFRASTRUCTURE:
- STORAGE TANK WITH LOW FLOW POTABLE WATER TOP UP PROVIDED FROM THE RETICULATED WATER MAINS.
- DEDICATED STORAGE VOLUME FOR ONSITE FIREFIGHTING REQUIREMENTS.
- PRESSURE PUMP SYSTEM FOR WATER RETICULATION WITHIN THE DWELLING.

LEGEND

CONTOUR INTERVAL 2.0m
PROPOSED BOUNDARY
EXISTING BOUNDARY
EXISTING TRUNK WATER MAIN
PROPOSED WATER LINE
FH PROPOSED FIRE HYDRANT
FHLP PROPOSED FIRE HYDRANT IN THE LOW WATER PRESSURE ZONE
HCE## WATSYS NODE
LOW WATER PRESSURE ZONE

SCALE 1:3000(A1)
0 20 40 80 120 160 200
0 20 40 80 120 160 200
SCALE 1:6000(A3)

| No | DATE | DRAFTING CHECK | PM CHECK | DETAILS |
|---|---|---|---|---|
| B | 18/09/15 | MY | PPO | REVISED LOT LAYOUT |
| C | 28/09/15 | MY | PPO | REVISED LOT LAYOUT |
| D | 20/10/15 | MY | PPO | LOT AREAS ADDED |
| E | 12/05/16 | JE | SJH | 340m CONTOUR AND GENERAL AMENDMENTS |
| F | 10/08/16 | AJD | PPO | BASIN OUTLET PIPES RESIZED |
| G | 27/10/16 | AJD | PPO | BASIN DETAILS AMENDED |
| H | 02/02/17 | EG | SJH | SERVICING REVISED & ISSUED FOR DA APPROVAL |

| CHECKED/APPROVED | NAME | DATE |
|---|---|---|
| APPROVED | SJH | 02/02/2017 |
| SURVEY | BARNSON | |
| DESIGNER | PPO | 2016 |
| DRAFTING | ZD/MY/JE/AJD/EG | 02/02/2017 |

APPROVAL AUTHORITY

DUBBO REGIONAL COUNCIL

CLIENT

HIGHVIEW COUNTRY ESTATES PTY LTD

PROJECT

PROPOSED SUBDIVISION LOT 172 DP753233 BLACKBUTT ROAD, DUBBO

GEOLYSE

DUBBO

dubbo@geolyse.com
www.geolyse.com

1st FLOOR
62 WINGEWARRA STREET
P.O. BOX 1842
DUBBO, NSW 2830
Ph. (02) 6884 1525
Fax. (02) 6884 1470

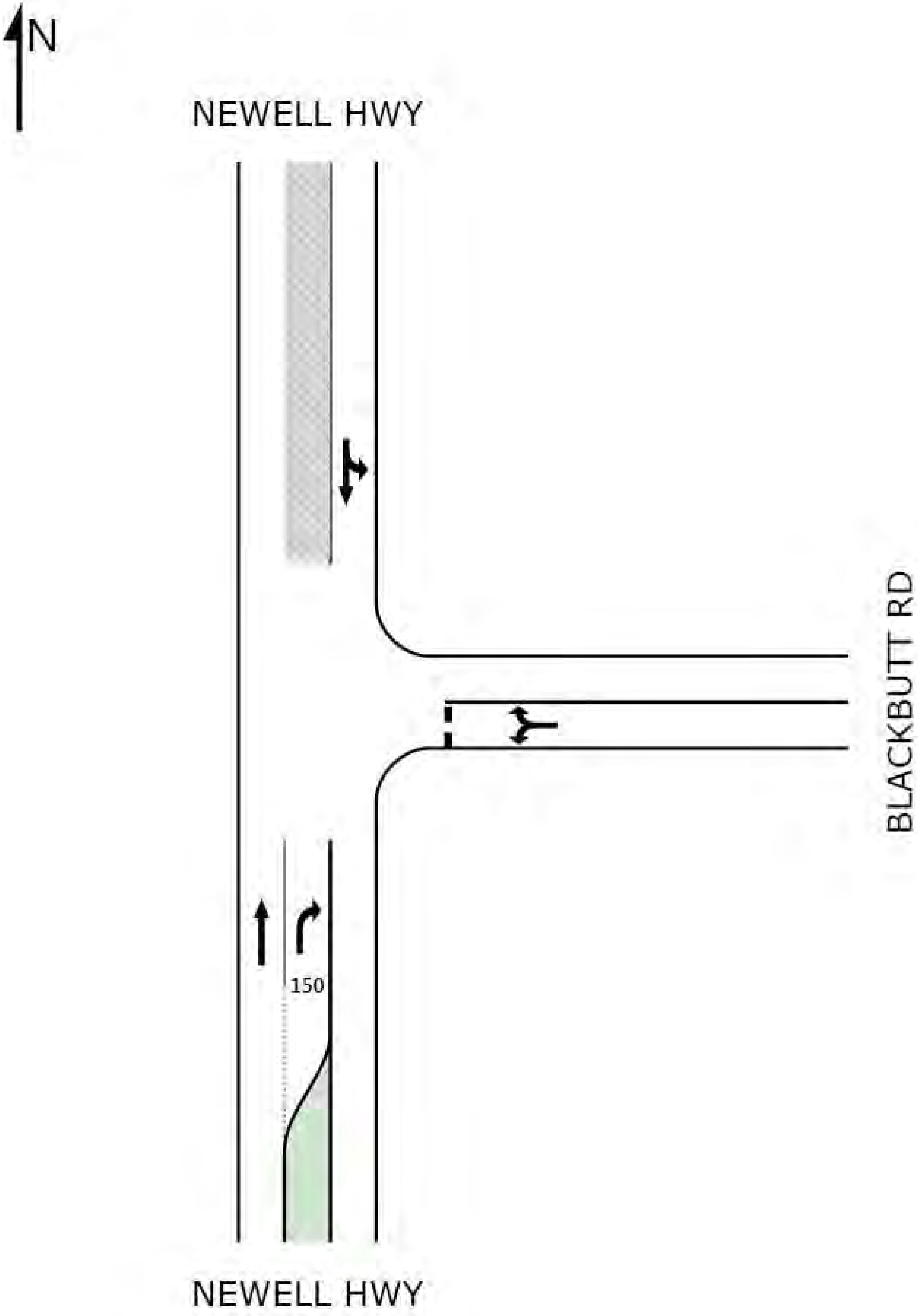
DRAWING

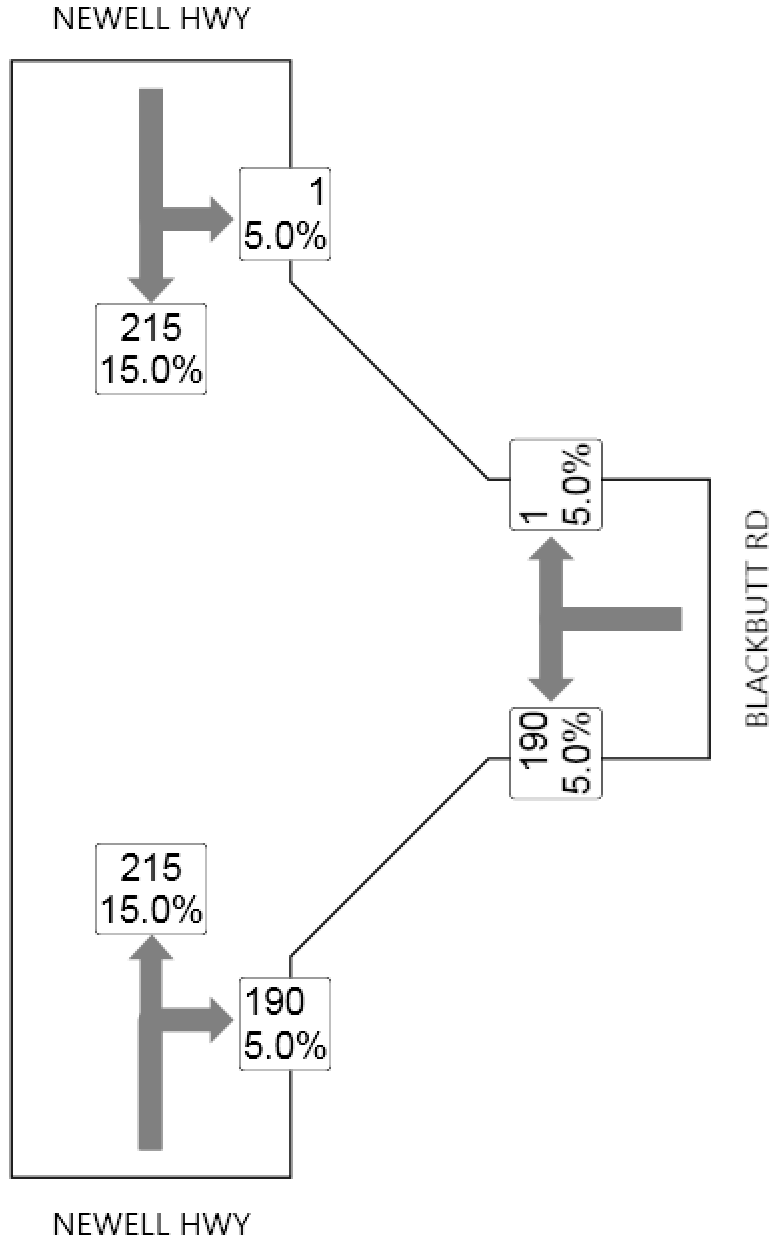
WATSYS NODE DIAGRAM

PERMANENT MARK: -
RL: -
DATUM: A.H.D.
PROJECT NUMBER: 113156
DRAWING SHEET: 02H_E08
ORIGINAL: A1
AUTOCAD FILE: 113156_02H_E01-E08.dwg
12D/CIVILCAD FILE: -
REVISION: H
STATUS: FOR APPROVAL
SHEET E08 OF E08

# Appendix A

## SIDRA MODELLING RESULTS


N
NEWELL HWY
BLACKBUTT RD
150
NEWELL HWY

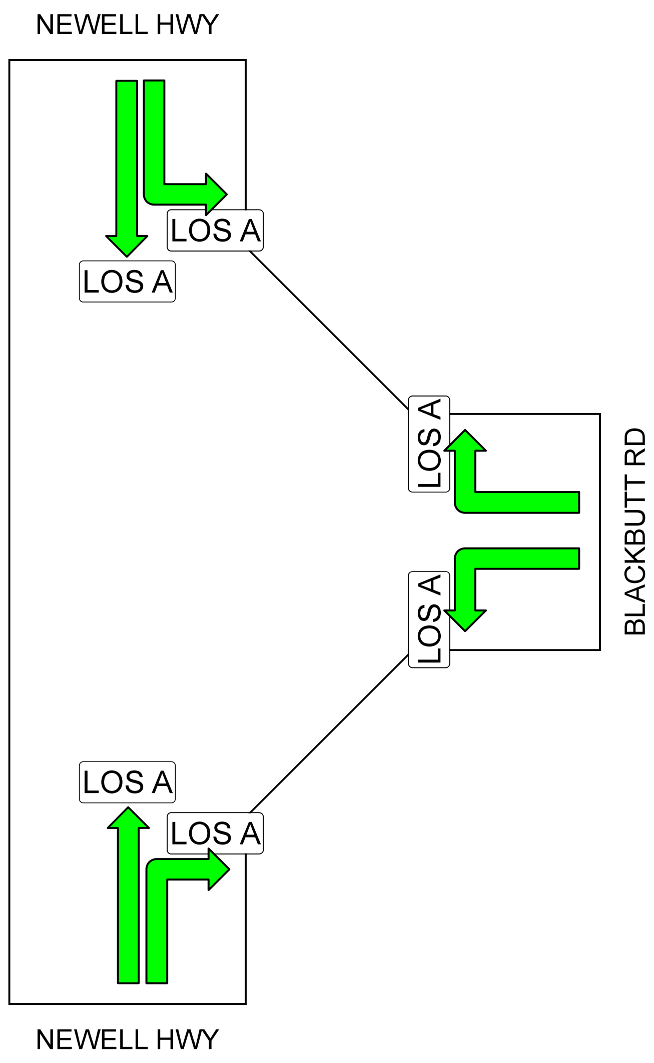

NEWELL HWY
1
5.0%
215
15.0%
1
5.0%
BLACKBUTT RD
190
5.0%
215
15.0%
190
5.0%
NEWELL HWY

# LEVEL OF SERVICE

**Level of Service Method: Delay (RTA NSW)**

**Site: Blackbutt Rd Newell Hwy Int**

New Site
Giveway / Yield (Two-Way)




Colour code based on Level of Service

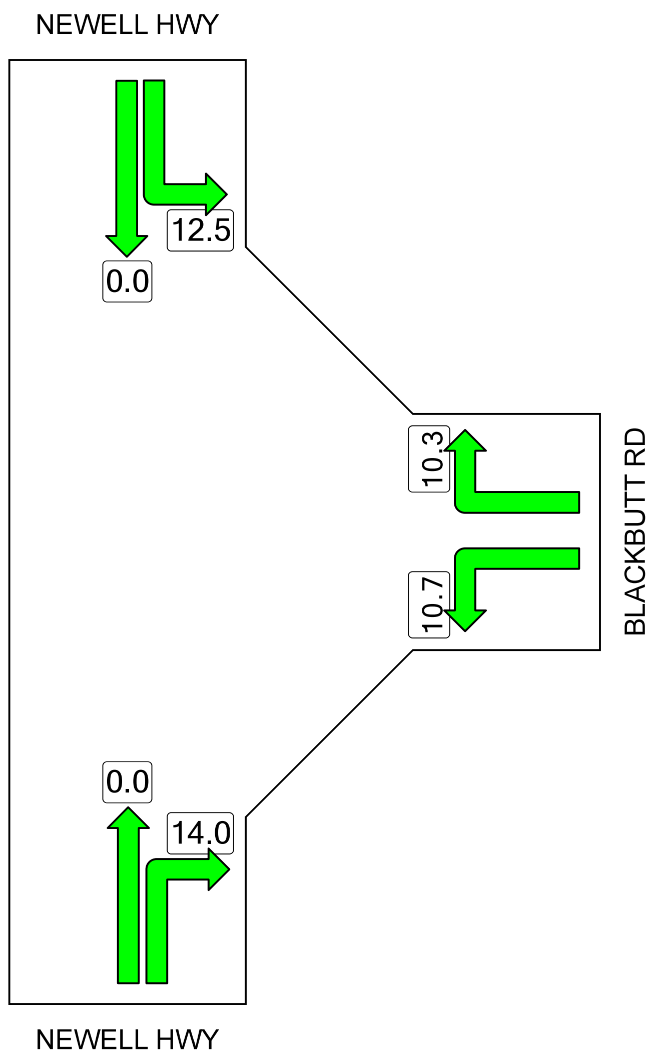
LOS A LOS B LOS C LOS D LOS E LOS F Continuous

# DELAY (AVERAGE)

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

**Site: Blackbutt Rd Newell Hwy Int**

New Site
Giveway / Yield (Two-Way)




Colour code based on Level of Service

LOS A LOS B LOS C LOS D LOS E LOS F Continuous

Level of Service Method used in this display: Delay (RTA NSW)

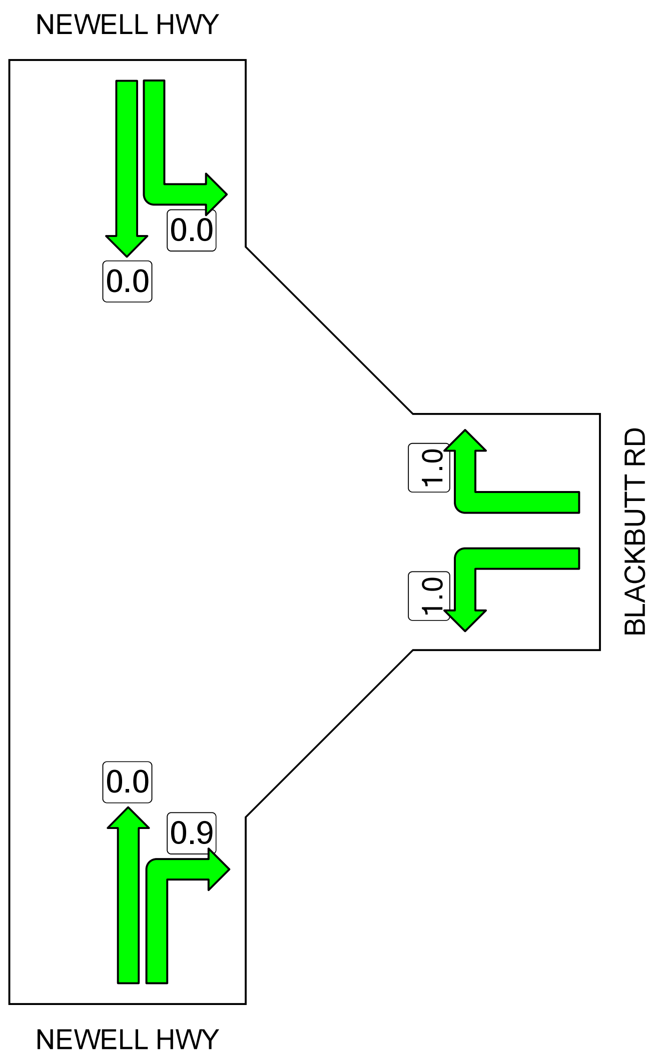
Processed: Wednesday, 10 August 2016 12:21:52 PM
SIDRA INTERSECTION 5.0.5.1510
Project: O:\Synergy\Projects\Transfer\113073_Orange\Internal\SIDRA\113073_SIDRA.sip
8000782, Geolyse, SINGLE

# QUEUE

**Site: Blackbutt Rd Newell Hwy Int**

**Largest 95% Back of Queue for any lane used by movement (vehicles)**

New Site
Giveway / Yield (Two-Way)




Colour code based on Queue Storage Ratio

[ < 0.6 ] [ 0.6 – 0.7 ] [ 0.7 – 0.8 ] [ 0.8 – 0.9 ] [ 0.9 – 1.0 ] [ > 1.0] Continuous

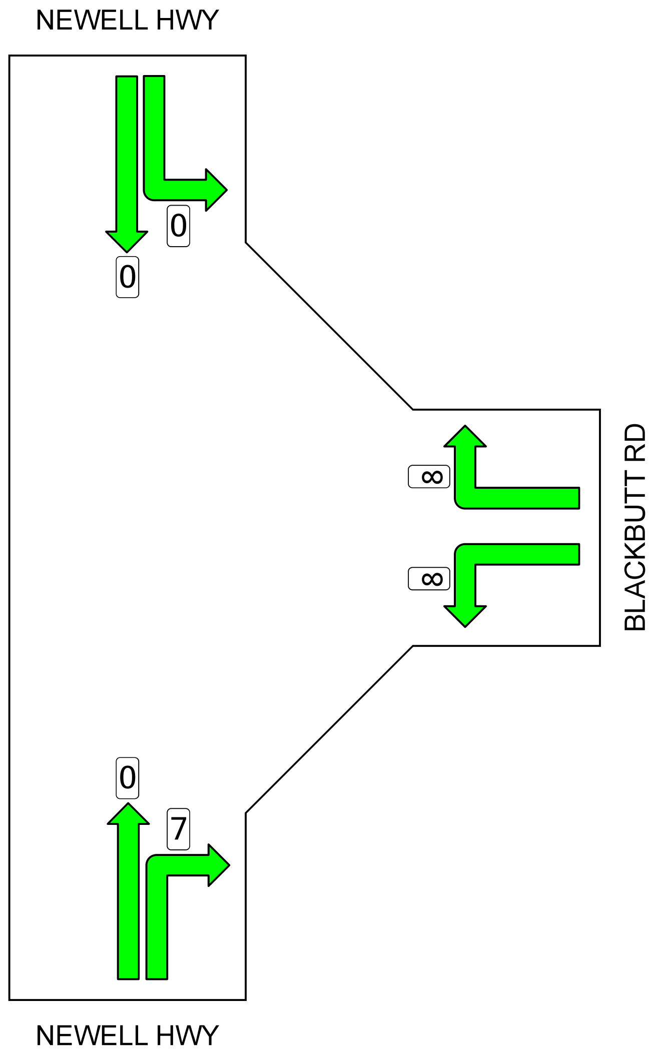
Processed: Wednesday, 10 August 2016 12:21:52 PM
SIDRA INTERSECTION 5.0.5.1510
Project: O:\Synergy\Projects\Transfer\113073_Orange\Internal\SIDRA\113073_SIDRA.sip
8000782, Geolyse, SINGLE

# QUEUE DISTANCE

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

**Site: Blackbutt Rd Newell Hwy Int**

New Site
Giveway / Yield (Two-Way)




Colour code based on Queue Storage Ratio

[ < 0.6 ] [ 0.6 – 0.7 ] [ 0.7 – 0.8 ] [ 0.8 – 0.9 ] [ 0.9 – 1.0 ] [ > 1.0] Continuous

# Appendix B

## WATSYS MODELLING RESULTS

```
/ANALYSIS FOR HIGHVIEW COUNTRY ESTATE WATER RETICULATION NETWORK FOR PID
/WATER SUPPLIED VIA RIFLE RANGE ROAD WATER RESERVOIR AND NEW ONSITE RESERVOIR

**UCODE
:SJH

**TLTITLE
'HIGHVIEW COUNTRY ESTATE WATER RETICULATION SYSTEM'
**TYPE
,,'L/S',1000

**RESERVOIR
'WATRES',BB1,341,,,,
'HCERES',RES1,349,,,,

**PIPES
/      NODES          LENGTH          DIAMETER          ROUGHNESS        FITTING
/  U/S       D/S       (m)              (mm)              K(mm)            K
  BB1        HCE3      100              150                0.3             0.6
  HCE3       HCE3A     100              150                0.3             0.6
  HCE3       HCE4       50              150                0.3             0.6
  HCE4       HCE4A      40              150                0.3             0.6
  HCE4       HCE5      200              150                0.3             0.6
  RES1       HC16A     450              200                0.3             0.6
  HCE1       HCE2      250              150                0.3             0.6
  HCE2       HCE2A      80              150                0.3             0.6
  HCE6       HCE6A      60              150                0.3             0.6
  HCE6       HCE7      240              150                0.3             0.6
  HCE7       HCE8      100              150                0.3             0.6
  HCE8       HCE9      120              150                0.3             0.6
  HCE8       HCE10     100              150                0.3             0.6
  HCE10      HCE11     180              150                0.3             0.6
  HCE11      HCE12     200              150                0.3             0.6
  HCE12      HCE13     200              150                0.3             0.6
  HCE13      HCE14     270              150                0.3             0.6
  HCE14      HCE9      150              150                0.3             0.6
  HCE16      HCE14     260              150                0.3             0.6
  HCE15      HCE12     170              150                0.3             0.6
  HCE16      HCE15     150              150                0.3             0.6
  HC16A      HCE16      60              200                0.3             0.6
  HC16A      HCE17      90              200                0.3             0.6
  HCE17      HCE18     190              150                0.3             0.6
  HCE19      HCE20     200              150                0.3             0.6
  HCE21      HCE20     180              150                0.3             0.6
  HCE9       HCE20     270              150                0.3             0.6
  HCE17      HCE21     180              150                0.3             0.6
  HCE9       HCE1      130              150                0.3             0.6
  HCE11      HCE6      200              150                0.3             0.6
  HCE18      HCE19     360              150                0.3             0.6


**DEMANDS
/      NODE            DEMAND (L/S)
       BB1                0.00
       RES1               0.00
       HCE1               0.80
       HCE2               0.80
       HCE2A              0.20
       HCE3               0.60
       HCE3A              0.20
```

```
      HCE4                  0.20
      HCE4A                 0.10
      HCE5                  0.50
      HCE6                  1.20
      HCE6A                 0.20
      HCE7                  1.00
      HCE8                  0.00
      HCE9                  0.40
      HCE10                 0.40
      HCE11                 1.00
      HCE12                 0.80
      HCE13                 0.80
      HCE14                 0.20
      HCE15                 0.60
      HCE16                 0.50
      HC16A                 0.00
      HCE17                 0.50
      HCE18                 1.10
      HCE19                 1.00
      HCE20                 0.30
      HCE21                 0.30

**GLEVELS
/    NODE              LEVEL (m)
     BB1                 316.0
     RES1                346.0
     HCE1                323.0
     HCE2                329.0
     HCE2A               326.0
     HCE3                318.0
     HCE3A               326.0
     HCE4                322.0
     HCE4A               323.0
     HCE5                316.0
     HCE6                327.0
     HCE6A               324.0
     HCE7                332.0
     HCE8                330.0
     HCE9                328.0
     HCE10               334.0
     HCE11               333.0
     HCE12               333.0
     HCE13               337.0
     HCE14               330.0
     HCE15               339.0
     HCE16               336.0
     HC16A               335.0
     HCE17               336.0
     HCE18               336.0
     HCE19               331.0
     HCE20               326.0
     HCE21               331.0

**END
```

'WATSYS' OUTPUT (dynamic) file: hcepid.OUT
For job run on Date:- 30-JAN-2017
Time:- 10:44
Associated files: Input data: hcepid.DAT
OUTPUT (data): hcepid.ODT
INTEGRATED FLOWS: hcepid.ITG
TRACED ITEMS: None

1TIME 1:12-00 AM SET BY - NORMAL TIME INCREMENT EXECUTION TERMINATED
**** ( 0.00)
****

| | | SUPPLY AREA NUMBERS |
|---|---|---|
| | TOTAL | 1 |
| SUB-SYSTEM DEMANDS (L/S ) | 13.700 | 13.700 |
| FRACTION OF BASIC DEMAND RATE | 1.000 | 1.000 |

RESERVOIRS
==========

| LABEL | LOCATION NODE NO. | WATER LEVEL RL M | SURFACE AREA SQ M | OUTFLOW RATE (TO SYSTEM) L/S | INFLOW RATE (FROM SYSTEM) L/S | INTERVAL OUTFLOW CU M | OVERFLOW RATE L/S | RECEIVING OVERFLOW L/S |
|---|---|---|---|---|---|---|---|---|
| WATRES | BB1 | 341.00 | 1.000E+20 | 1.600 | | | | |
| HCERES | RES1 | 349.00 | 1.000E+20 | 12.100 | | | | |

PIPE FLOWS
==========

| LINE NO. | U/S NODE NO. | D/S NODE NO | FLOW L/S | VELOCITY M/SEC | LINE LOSS M | FITTING LOSS M | PIPE LOSS M | PIPE LOSS M/1000 | REYNOLDS NO | FRICTION FACTOR |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | BB1 | HCE3 | 1.600 | 0.091 | 0.01 | 0.00 | 0.01 | 0.09 | 1.35E+04 | 0.0319 |
| 2 | HCE3 | HCE3A | 0.200 | 0.011 | 0.00 | 0.00 | 0.00 | 0.00 | 1.69E+03 | 0.0537 |
| 3 | HCE3 | HCE4 | 0.800 | 0.045 | 0.00 | 0.00 | 0.00 | 0.03 | 6.77E+03 | 0.0368 |
| 4 | HCE4 | HCE4A | 0.100 | 0.006 | 0.00 | 0.00 | 0.00 | 0.00 | 8.47E+02 | 0.0737 |
| 5 | HCE4 | HCE5 | 0.500 | 0.028 | 0.00 | 0.00 | 0.00 | 0.01 | 4.23E+03 | 0.0413 |
| 6 | RES1 | HC16A | 12.100 | 0.385 | 0.42 | 0.00 | 0.41 | 0.92 | 7.68E+04 | 0.0242 |
| 7 | HCE1 | HCE2 | 1.000 | 0.057 | 0.01 | 0.00 | 0.01 | 0.04 | 8.46E+03 | 0.0350 |
| 8 | HCE2 | HCE2A | 0.200 | 0.011 | 0.00 | 0.00 | 0.00 | 0.00 | 1.69E+03 | 0.0537 |
| 9 | HCE6 | HCE6A | 0.200 | 0.011 | 0.00 | 0.00 | 0.00 | 0.00 | 1.69E+03 | 0.0537 |
| 10 | HCE6 | HCE7 | -0.393 | -0.022 | 0.00 | 0.00 | 0.00 | -0.01 | 3.33E+03 | 0.0440 |
| 11 | HCE7 | HCE8 | -1.393 | -0.079 | -0.01 | 0.00 | -0.01 | -0.07 | 1.18E+04 | 0.0327 |
| 12 | HCE8 | HCE9 | -1.857 | -0.105 | -0.01 | 0.00 | -0.01 | -0.12 | 1.57E+04 | 0.0310 |
| 13 | HCE8 | HCE10 | 0.464 | 0.026 | 0.00 | 0.00 | 0.00 | 0.01 | 3.93E+03 | 0.0421 |
| 14 | HCE10 | HCE11 | 0.064 | 0.004 | 0.00 | 0.00 | 0.00 | 0.00 | 5.43E+02 | 0.0930 |
| 15 | HCE11 | HCE12 | -1.943 | -0.110 | -0.03 | 0.00 | -0.03 | -0.13 | 1.64E+04 | 0.0308 |
| 16 | HCE12 | HCE13 | -0.124 | -0.007 | 0.00 | 0.00 | 0.00 | 0.00 | 1.05E+03 | 0.0628 |
| 17 | HCE13 | HCE14 | -0.924 | -0.052 | -0.01 | 0.00 | -0.01 | -0.03 | 7.82E+03 | 0.0356 |
| 18 | HCE14 | HCE9 | 1.960 | 0.111 | 0.02 | 0.00 | 0.02 | 0.13 | 1.66E+04 | 0.0307 |
| 19 | HCE16 | HCE14 | 3.084 | 0.174 | 0.08 | 0.00 | 0.08 | 0.30 | 2.61E+04 | 0.0286 |
| 20 | HCE15 | HCE12 | 2.620 | 0.148 | 0.04 | 0.00 | 0.04 | 0.22 | 2.22E+04 | 0.0293 |
| 21 | HCE16 | HCE15 | 3.220 | 0.182 | 0.05 | 0.00 | 0.05 | 0.32 | 2.72E+04 | 0.0285 |
| 22 | HC16A | HCE16 | 6.803 | 0.217 | 0.02 | 0.00 | 0.02 | 0.31 | 4.32E+04 | 0.0258 |
| 23 | HC16A | HCE17 | 5.297 | 0.169 | 0.02 | 0.00 | 0.02 | 0.19 | 3.36E+04 | 0.0266 |
| 24 | HCE17 | HCE18 | 2.415 | 0.137 | 0.04 | 0.00 | 0.04 | 0.19 | 2.04E+04 | 0.0297 |
| 25 | HCE19 | HCE20 | 0.315 | 0.018 | 0.00 | 0.00 | 0.00 | 0.01 | 2.66E+03 | 0.0468 |
| 26 | HCE21 | HCE20 | 2.082 | 0.118 | 0.03 | 0.00 | 0.03 | 0.14 | 1.76E+04 | 0.0304 |
| 27 | HCE9 | HCE20 | -2.097 | -0.119 | -0.04 | 0.00 | -0.04 | -0.15 | 1.77E+04 | 0.0304 |
| 28 | HCE17 | HCE21 | 2.382 | 0.135 | 0.03 | 0.00 | 0.03 | 0.18 | 2.02E+04 | 0.0298 |
| 29 | HCE9 | HCE1 | 1.800 | 0.102 | 0.01 | 0.00 | 0.01 | 0.11 | 1.52E+04 | 0.0312 |
| 30 | HCE11 | HCE6 | 1.007 | 0.057 | 0.01 | 0.00 | 0.01 | 0.04 | 8.52E+03 | 0.0350 |
| 31 | HCE18 | HCE19 | 1.315 | 0.074 | 0.02 | 0.00 | 0.02 | 0.06 | 1.11E+04 | 0.0331 |

| NODE NO | DISCHARGE L/S | TOTAL HEAD RL M | RESIDUAL HEAD M |
|---|---|---|---|
| BB1 | 0.000 | 341.00 | 25.00 |
| HCE1 | 0.800 | 348.45 | 25.45 |
| HCE2 | 0.800 | 348.44 | 19.44 |
| HCE3 | 0.600 | 340.99 | 22.99 |
| HCE4 | 0.200 | 340.99 | 18.99 |
| HCE5 | 0.500 | 340.99 | 24.99 |
| HCE6 | 1.200 | 348.44 | 21.44 |
| HCE7 | 1.000 | 348.44 | 16.44 |
| HCE8 | 0.000 | 348.45 | 18.45 |
| HCE9 | 0.400 | 348.46 | 20.46 |
| RES1 | 0.000 | 349.00 | 3.00 |
| HC16A | 0.000 | 348.58 | 13.58 |
| HCE10 | 0.400 | 348.45 | 14.45 |
| HCE11 | 1.000 | 348.45 | 15.45 |
| HCE12 | 0.800 | 348.48 | 15.48 |
| HCE13 | 0.800 | 348.48 | 11.48 |
| HCE14 | 0.200 | 348.48 | 18.48 |
| HCE15 | 0.600 | 348.51 | 9.51 |
| HCE16 | 0.500 | 348.56 | 12.56 |
| HCE17 | 0.500 | 348.56 | 12.56 |
| HCE18 | 1.100 | 348.53 | 12.53 |
| HCE19 | 1.000 | 348.51 | 17.51 |
| HCE20 | 0.300 | 348.50 | 22.50 |
| HCE21 | 0.300 | 348.53 | 17.53 |
| HCE2A | 0.200 | 348.44 | 22.44 |
| HCE3A | 0.200 | 340.99 | 14.99 |
| HCE4A | 0.100 | 340.99 | 17.99 |
| HCE6A | 0.200 | 348.44 | 24.44 |

****************************************************************************************************************************
**

```
/ANALYSIS FOR HIGHVIEW COUNTRY ESTATE WATER RETICULATION NETWORK FOR PID PLUS
FIRE FLOW
/WATER SUPPLIED VIA RIFLE RANGE ROAD WATER RESERVOIR AND NEW ONSITE RESERVOIR

**UCODE
:SJH

**TLTITLE
'HIGHVIEW COUNTRY ESTATE WATER RETICULATION SYSTEM'
**TYPE
,,'L/S',1000

**RESERVOIR
'WATRES',BB1,341,,,,
'HCERES',RES1,349,,,,

**PIPES
/      NODES            LENGTH          DIAMETER          ROUGHNESS        FITTING
/  U/S       D/S         (m)              (mm)              K(mm)             K
  BB1        HCE3        100               150               0.3              0.6
  HCE3       HCE3A       100               150               0.3              0.6
  HCE3       HCE4         50               150               0.3              0.6
  HCE4       HCE4A        40               150               0.3              0.6
  HCE4       HCE5        200               150               0.3              0.6
  RES1       HC16A       450               200               0.3              0.6
  HCE1       HCE2        250               150               0.3              0.6
  HCE2       HCE2A        80               150               0.3              0.6
  HCE6       HCE6A        60               150               0.3              0.6
  HCE6       HCE7        240               150               0.3              0.6
  HCE7       HCE8        100               150               0.3              0.6
  HCE8       HCE9        120               150               0.3              0.6
  HCE8       HCE10       100               150               0.3              0.6
  HCE10      HCE11       180               150               0.3              0.6
  HCE11      HCE12       200               150               0.3              0.6
  HCE12      HCE13       200               150               0.3              0.6
  HCE13      HCE14       270               150               0.3              0.6
  HCE14      HCE9        150               150               0.3              0.6
  HCE16      HCE14       260               150               0.3              0.6
  HCE15      HCE12       170               150               0.3              0.6
  HCE16      HCE15       150               150               0.3              0.6
  HC16A      HCE16        60               200               0.3              0.6
  HC16A      HCE17        90               200               0.3              0.6
  HCE17      HCE18       190               150               0.3              0.6
  HCE19      HCE20       200               150               0.3              0.6
  HCE21      HCE20       180               150               0.3              0.6
  HCE9       HCE20       270               150               0.3              0.6
  HCE17      HCE21       180               150               0.3              0.6
  HCE9       HCE1        130               150               0.3              0.6
  HCE11      HCE6        200               150               0.3              0.6
  HCE18      HCE19       360               150               0.3              0.6


**DEMANDS
/      NODE             DEMAND (L/S)
       BB1                 0.00
       RES1                0.00
       HCE1                0.80
       HCE2                0.80
       HCE2A               0.20
       HCE3                0.60
```

```
       HCE3A              11.20
       HCE4                0.20
       HCE4A               0.10
       HCE5                0.50
       HCE6                1.20
       HCE6A               0.20
       HCE7                1.00
       HCE8                0.00
       HCE9                0.40
       HCE10               0.40
       HCE11               1.00
       HCE12               0.80
       HCE13               0.80
       HCE14               0.20
       HCE15              11.60
       HCE16               0.50
       HC16A               0.00
       HCE17               0.50
       HCE18               1.10
       HCE19               1.00
       HCE20               0.30
       HCE21               0.30


**GLEVELS
/    NODE              LEVEL (m)
     BB1                 316.0
     RES1                346.0
     HCE1                323.0
     HCE2                329.0
     HCE2A               326.0
     HCE3                318.0
     HCE3A               326.0
     HCE4                322.0
     HCE4A               323.0
     HCE5                316.0
     HCE6                327.0
     HCE6A               324.0
     HCE7                332.0
     HCE8                330.0
     HCE9                328.0
     HCE10               334.0
     HCE11               333.0
     HCE12               333.0
     HCE13               337.0
     HCE14               330.0
     HCE15               339.0
     HCE16               336.0
     HC16A               335.0
     HCE17               336.0
     HCE18               336.0
     HCE19               331.0
     HCE20               326.0
     HCE21               331.0

**END
```

'WATSYS' OUTPUT (dynamic) file: hcepidf.OUT
For job run on Date:- 30-JAN-2017
Time:- 12:06
Associated files: Input data: hcepidf.DAT
OUTPUT (data): hcepidf.ODT
INTEGRATED FLOWS: hcepidf.ITG
TRACED ITEMS: None

1TIME 1:12-00 AM SET BY - NORMAL TIME INCREMENT EXECUTION TERMINATED
**** ( 0.00)
****

| | TOTAL | SUPPLY AREA NUMBERS 1 |
|---|---|---|
| SUB-SYSTEM DEMANDS (L/S ) | 35.700 | 35.700 |
| FRACTION OF BASIC DEMAND RATE | 1.000 | 1.000 |

RESERVOIRS
==========

| LABEL | LOCATION NODE NO. | WATER LEVEL RL M | SURFACE AREA SQ M | OUTFLOW RATE (TO SYSTEM) L/S | INFLOW RATE (FROM SYSTEM) L/S | INTERVAL OUTFLOW CU M | OVERFLOW RATE L/S | RECEIVING OVERFLOW L/S |
|---|---|---|---|---|---|---|---|---|
| WATRES | BB1 | 341.00 | 1.000E+20 | 12.600 | | | | |
| HCERES | RES1 | 349.00 | 1.000E+20 | 23.100 | | | | |

PIPE FLOWS
==========

| LINE NO. | U/S NODE NO. | D/S NODE NO | FLOW L/S | VELOCITY M/SEC | LINE LOSS M | FITTING LOSS M | PIPE LOSS M | PIPE LOSS M/1000 | REYNOLDS NO | FRICTION FACTOR |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | BB1 | HCE3 | 12.600 | 0.713 | 0.45 | 0.02 | 0.43 | 4.33 | 1.07E+05 | 0.0250 |
| 2 | HCE3 | HCE3A | 11.200 | 0.634 | 0.36 | 0.01 | 0.34 | 3.44 | 9.48E+04 | 0.0252 |
| 3 | HCE3 | HCE4 | 0.800 | 0.045 | 0.00 | 0.00 | 0.00 | 0.03 | 6.77E+03 | 0.0368 |
| 4 | HCE4 | HCE4A | 0.100 | 0.006 | 0.00 | 0.00 | 0.00 | 0.00 | 8.47E+02 | 0.0737 |
| 5 | HCE4 | HCE5 | 0.500 | 0.028 | 0.00 | 0.00 | 0.00 | 0.01 | 4.23E+03 | 0.0413 |
| 6 | RES1 | HC16A | 23.100 | 0.735 | 1.45 | 0.02 | 1.44 | 3.19 | 1.47E+05 | 0.0232 |
| 7 | HCE1 | HCE2 | 1.000 | 0.057 | 0.01 | 0.00 | 0.01 | 0.04 | 8.46E+03 | 0.0350 |
| 8 | HCE2 | HCE2A | 0.200 | 0.011 | 0.00 | 0.00 | 0.00 | 0.00 | 1.69E+03 | 0.0537 |
| 9 | HCE6 | HCE6A | 0.200 | 0.011 | 0.00 | 0.00 | 0.00 | 0.00 | 1.69E+03 | 0.0537 |
| 10 | HCE6 | HCE7 | -1.283 | -0.073 | -0.01 | 0.00 | -0.01 | -0.06 | 1.09E+04 | 0.0332 |
| 11 | HCE7 | HCE8 | -2.283 | -0.129 | -0.02 | 0.00 | -0.02 | -0.17 | 1.93E+04 | 0.0300 |
| 12 | HCE8 | HCE9 | -4.341 | -0.246 | -0.07 | 0.00 | -0.07 | -0.56 | 3.67E+04 | 0.0274 |
| 13 | HCE8 | HCE10 | 2.058 | 0.116 | 0.01 | 0.00 | 0.01 | 0.14 | 1.74E+04 | 0.0305 |
| 14 | HCE10 | HCE11 | 1.658 | 0.094 | 0.02 | 0.00 | 0.02 | 0.09 | 1.40E+04 | 0.0316 |
| 15 | HCE11 | HCE12 | 0.541 | 0.031 | 0.00 | 0.00 | 0.00 | 0.01 | 4.58E+03 | 0.0404 |
| 16 | HCE12 | HCE13 | -2.405 | -0.136 | -0.04 | 0.00 | -0.04 | -0.19 | 2.04E+04 | 0.0297 |
| 17 | HCE13 | HCE14 | -3.205 | -0.181 | -0.09 | 0.00 | -0.09 | -0.32 | 2.71E+04 | 0.0285 |
| 18 | HCE14 | HCE9 | 2.060 | 0.117 | 0.02 | 0.00 | 0.02 | 0.14 | 1.74E+04 | 0.0305 |
| 19 | HCE16 | HCE14 | 5.464 | 0.309 | 0.23 | 0.00 | 0.23 | 0.87 | 4.62E+04 | 0.0267 |
| 20 | HCE15 | HCE12 | -2.146 | -0.121 | -0.03 | 0.00 | -0.03 | -0.15 | 1.82E+04 | 0.0303 |
| 21 | HCE16 | HCE15 | 9.454 | 0.535 | 0.38 | 0.01 | 0.37 | 2.48 | 8.00E+04 | 0.0255 |
| 22 | HC16A | HCE16 | 15.419 | 0.491 | 0.10 | 0.01 | 0.09 | 1.46 | 9.79E+04 | 0.0238 |
| 23 | HC16A | HCE17 | 7.682 | 0.245 | 0.04 | 0.00 | 0.03 | 0.39 | 4.88E+04 | 0.0254 |
| 24 | HCE17 | HCE18 | 3.422 | 0.194 | 0.07 | 0.00 | 0.07 | 0.36 | 2.90E+04 | 0.0282 |
| 25 | HCE19 | HCE20 | 1.322 | 0.075 | 0.01 | 0.00 | 0.01 | 0.06 | 1.12E+04 | 0.0330 |
| 26 | HCE21 | HCE20 | 3.460 | 0.196 | 0.07 | 0.00 | 0.07 | 0.37 | 2.93E+04 | 0.0282 |
| 27 | HCE9 | HCE20 | -4.482 | -0.254 | -0.16 | 0.00 | -0.16 | -0.60 | 3.79E+04 | 0.0273 |
| 28 | HCE17 | HCE21 | 3.760 | 0.213 | 0.08 | 0.00 | 0.08 | 0.43 | 3.18E+04 | 0.0279 |
| 29 | HCE9 | HCE1 | 1.800 | 0.102 | 0.01 | 0.00 | 0.01 | 0.11 | 1.52E+04 | 0.0312 |
| 30 | HCE11 | HCE6 | 0.117 | 0.007 | 0.00 | 0.00 | 0.00 | 0.00 | 9.88E+02 | 0.0647 |
| 31 | HCE18 | HCE19 | 2.322 | 0.131 | 0.06 | 0.00 | 0.06 | 0.18 | 1.97E+04 | 0.0299 |

| NODE NO | DISCHARGE L/S | TOTAL HEAD RL M | RESIDUAL HEAD M |
|---|---|---|---|
| BB1 | 0.000 | 341.00 | 25.00 |
| HCE1 | 0.800 | 347.19 | 24.19 |
| HCE2 | 0.800 | 347.18 | 18.18 |
| HCE3 | 0.600 | 340.55 | 22.55 |
| HCE4 | 0.200 | 340.55 | 18.55 |
| HCE5 | 0.500 | 340.55 | 24.55 |
| HCE6 | 1.200 | 347.10 | 20.10 |
| HCE7 | 1.000 | 347.11 | 15.11 |
| HCE8 | 0.000 | 347.13 | 17.13 |
| HCE9 | 0.400 | 347.20 | 19.20 |
| RES1 | 0.000 | 349.00 | 3.00 |
| HC16A | 0.000 | 347.55 | 12.55 |
| HCE10 | 0.400 | 347.12 | 13.12 |
| HCE11 | 1.000 | 347.10 | 14.10 |
| HCE12 | 0.800 | 347.10 | 14.10 |
| HCE13 | 0.800 | 347.13 | 10.13 |
| HCE14 | 0.200 | 347.22 | 17.22 |
| HCE15 | 11.600 | 347.07 | 8.07 |
| HCE16 | 0.500 | 347.45 | 11.45 |
| HCE17 | 0.500 | 347.51 | 11.51 |
| HCE18 | 1.100 | 347.44 | 11.44 |
| HCE19 | 1.000 | 347.38 | 16.38 |
| HCE20 | 0.300 | 347.36 | 21.36 |
| HCE21 | 0.300 | 347.43 | 16.43 |
| HCE2A | 0.200 | 347.18 | 21.18 |
| HCE3A | 11.200 | 340.20 | 14.20 |
| HCE4A | 0.100 | 340.55 | 17.55 |
| HCE6A | 0.200 | 347.10 | 23.10 |

********************************************************************************************************************************
**

# Appendix C

## Stormwater Drainage Report Submitted to TWPZ

1st Floor, 62 Wingewarra Street
PO Box 1842
DUBBO NSW 2830

02 6887 4500
02 6887 4599

dubbo@geolyse.com
geolyse.com

Our Ref: 113156_LEO_006

24 October 2016

The Manager
Taronga Western Plains Zoo
Obley Road
DUBBO NSW 2830

**Attention: Ms Kathleen Oke**

Dear Ms Oke

**HIGHVIEW COUNTRY ESTATES PTY LTD – PROPOSED SUBDIVISION OF LAND ON BLACKBUTT ROAD DUBBO**

Reference is made to our recent meeting to discuss the proposed development of a residential subdivision on Blackbutt Road, Dubbo. Following an inspection of the Zoo's land particularly along it's frontage to the Newell Highway, concern was raised in regards to the potential increase in stormwater runoff from the subdivision and through the Zoo's land via two (2) large culverts draining beneath the Newell Highway and then along 2 creek lines within the Zoo.

Following consideration of the issues that have been raised, we are now pleased to provide the following information for your consideration of the potential issues and the methods of mitigation of the concerns raised regarding drainage from the proposed subdivision.

**Background**

The proposed subdivision is to be developed on Lot 172 DP753233 and the land parcel is approximately 98.2ha in size and is bounded by Blackbutt Road along its northern boundary, the Newell Highway along its eastern boundary, Riffle Range Road along its southern boundary and an unformed section of Chapmans Lane to the west.

Access to the subdivision will be from Blackbutt Road only with no access available from any lot directly onto the Newell Highway.

An Ecological Constraints and Opportunities Report for the site was prepared by Geolyse and the report assessed the site for a range of parameters and determined that a large timbered area located in the middle of the site and further timbered areas around the perimeter of the site comprising approximately 36ha should be set aside as a woodland corridor.

The residential subdivision to be developed on the remaining 62 ha of the site will comprise approximately 137 lots with 105 lots ranging in size from approximately 2,000m$^2$ to 5,000m$^2$ with 32 lots ranging in size from approximately 4,000m$^2$ to 8,700m$^2$. The overall lot layout with indicative lot sizes is shown on the attached **Drawing Sheet E02**.

## Stormwater Drainage

As the Zoo is aware, there are a number of drainage culverts under the Newell Highway directing stormwater runoff from the western side of the Highway to the eastern side. The various culverts are indicated on a number of the attached plans and include the following culverts located between Rifle Range Road and Blackbutt Road:

i) Twin cell 600mm diameter pipe culvert

ii) 450mm diameter pipe culvert

iii) 450mm diameter pipe culvert

iv) 1400mm x 600mm box culvert. This culvert will drain the discharge from the proposed Retarding Basin No. 4 beneath the Newell Highway.

v) 900mm diameter pipe culvert.

vi) 1200mm x 600mm box culvert. This culvert will drain the discharge from the proposed Retarding Basin No. 3 beneath the Newell Highway.

The development of the proposed subdivision will require the provision of stormwater drainage systems to the requirements of Dubbo Regional Council. Stormwater drainage infrastructure provided for the proposed subdivision of Lot 172 will include:

- Interallotment stormwater drainage pipes and inlet pits
- Roadway stormwater drainage and inlet pits
- Retarding basin systems

The overall stormwater drainage infrastructure required to service the development of Lot 172 is indicated on the attached **Drawing Sheet E03** and **Sheet E04**.

The major components of the stormwater drainage infrastructure comprise the retarding basin systems that will limit post development stormwater runoff to pre development levels. Due to the topography of the development site, there are four (4) separate stormwater drainage catchments that are to be developed and each will require the provision of a retarding basin to limit post development runoff.

The piped discharge from each retarding basin system will be limited to less than the capacity of any nearby culverts or drainage structures particularly those culverts crossing the Newell Highway.

Each of the catchments has been assessed to determine the characteristics of the retarding basin servicing the catchment and details of the retarding basins of interest to the Zoo and draining to the Newell Highway are summarised below:

Retarding Basin No. 3

| | |
|---|---|
| Catchment Serviced: | Catchment C |
| Catchment Area: | 18.16 ha |
| Basin Volume: | 3,500$m^3$ at a depth of 2.0m |
| Spillway Width: | 12m |

| | |
|---|---|
| Basin Outlet Pipe: | 750mm diameter |
| 10 Year ARI Pre Development Runoff: | 1.24$m^3/s$ |
| 100 Year ARI Pre Development Runoff: | 2.90$m^3/s$ |
| 10 Year ARI Post Development Runoff: | 0.96$m^3/s$ |
| 100 Year ARI Post Development Runoff: | 1.89$m^3/s$ |

Adjacent to the site for the proposed Retarding Basin No. 3, the existing stormwater runoff from the site crosses the Newell Highway via a 1200mm x 600 RCBC. The outlet from the proposed retarding basin has been limited to a pipe size that is less than the capacity of the box culvert under the Highway.

<u>Retarding Basin No. 4</u>

| | |
|---|---|
| Catchment Serviced: | Catchment D |
| Catchment Area: | 11.23 ha |
| Basin Volume: | 1,250$m^3$ at a depth of 1.5m |
| Spillway Width: | 8m |
| Basin Outlet Pipe: | 750mm diameter |
| 10 Year ARI Pre Development Runoff: | 1.06$m^3/s$ |
| 100 Year ARI Pre Development Runoff: | 2.42$m^3/s$ |
| 10 Year ARI Post Development Runoff: | 0.92$m^3/s$ |
| 100 Year ARI Post Development Runoff: | 2.32$m^3/s$ |

Adjacent to the site for the proposed Retarding Basin No. 4, the existing stormwater runoff from the site crosses the Newell Highway via a 1400mm x 600 RCBC. The outlet from the proposed retarding basin has been limited to a pipe size that is less than the capacity of the box culvert under the Highway.

**<u>Basin Operation</u>**

The locations of the proposed retarding basins on Highview Country Estate and discharging beneath the Newell Highway together with an available map image and an aerial image of features within the Zoo are indicated on the attached **Drawing Sheet C001** and **C002**.

The discharge from Retarding Basin No. 3 is directed to the existing creek line that flows through the Zoo's Billabong camp area and flows out from the Zoo beneath Obley Road. The catchment for Retarding Basin No. 3 within Highview Country Estate is approximately 18.2 ha.

The discharge from Retarding Basin No. 4 is directed to the existing creek line that flows through the Zoo's sanctuary area and crosses then recrosses Camp Road. The catchment for Retarding Basin No. 4 within Highview Estate is approximately 11.2ha.

It should be noted that for both retarding basins, the catchments on the creek lines within the Zoo are significantly larger than those from within Highview Country Estate.

However, as discussed at our recent meeting, there are additional factors that the Zoo wants to consider for the operation of the retarding basins, namely the additional time period taken for the retarding basins to drain out the stored water and the additional volume of water that will be discharged from the subdivision.

Additional detailed modelling of the stormwater retarding basin systems have been carried out to determine the parameters that the Zoo has requested to be assessed.

A summary of the results of the additional stormwater modelling is indicated in **Table 1**, noting that the Total Discharge Flow Time is taken to be when the retarding basin discharges less than 1 l/s.

**Table 1 – Retarding Basin Modelling Parameters**

| Retarding Basin and Design ARI | Development Condition | Peak Discharge Flow | Total Discharge Flow Volume | Total Discharge Flow Time |
|---|---|---|---|---|
| **Retarding Basin No. 3** | | | | |
| 10 Year ARI | Pre Development (existing conditions) | 1.24 $m^3/s$ | 3,820 $m^3$ | 420 mins |
| | Post Development | 0.96 $m^3/s$ | 4,490 $m^3$ | 744 mins |
| | Percentage Comparison | 77% | 118% | 177% |
| 100 Year ARI | Pre Development (existing conditions) | 2.9 $m^3/s$ | 7,830 $m^3$ | 422 mins |
| | Post Development | 1.89 $m^3/s$ | 8,500 $m^3$ | 744 mins |
| | Percentage Comparison | 65% | 109% | 176% |
| **Retarding Basin No. 4** | | | | |
| 10 Year ARI | Pre Development (existing conditions) | 1.06 $m^3/s$ | 2,640 $m^3$ | 314 mins |
| | Post Development | 0.92 $m^3/s$ | 3,040 $m^3$ | 434 mins |
| | Percentage Comparison | 87% | 115% | 138% |
| 100 Year ARI | Pre Development (existing conditions) | 2.42 $m^3/s$ | 5,410 $m^3$ | 314 mins |
| | Post Development | 2.32 $m^3/s$ | 5,800 $m^3$ | 436 mins |
| | Percentage Comparison | 96% | 107% | 139% |

From a review of the information presented in **Table 1**, the following conclusions can be determined:

The proposed Basin No. 3 reduces the post development peak flows for the 10 year ARI and 100 Year ARI to 77% and 65% respectively of the pre development flows discharging to the creek line through the Zoo's Billabong Camp area.

The proposed Basin No. 4 reduces the post development peak flows for the 10 year ARI and 100 Year ARI to 87% and 96% respectively of the pre development flows discharging to the creek line through the Zoo's sanctuary area.

The reduction in the peak rate of stormwater discharge from the subdivision will ensure that the hydraulic capacity of any downstream structures are not exceeded following the development of the subdivision.

For Basin No. 3, the total discharge flow volume increases by 18% and 9% for the 10 Year ARI and 100 Year ARI respectively. The total discharge flow time increases by 77% and 76% for the 10 Year ARI and 100 Year ARI respectively.

For Basin No. 4, the total discharge flow volume increases by 16% and 7% for the 10 Year ARI and 100 Year ARI respectively. The total discharge flow time increases by 38% and 39% for the 10 Year ARI and 100 Year ARI respectively.

The volumetric increases in the discharge of stormwater from the proposed subdivision are not significant (maximum increase of 18% from Basin No. 3) given the large lot sizes and rural nature of the proposed subdivision. The increase in the length of time that stormwater discharges from the subdivision into the creek lines through the Zoo is a maximum of 77% from Basin No. 3.

To put this into perspective, the trickle flows from Basin No. 3 as it drains the retained stormwater generated from the proposed subdivision would occur over an additional 5 hours then currently is the case.

The quality of the stormwater runoff discharging from the proposed subdivision will be controlled by the installation of appropriately designed gross pollutant traps (GPTs).

Finally, existing nuisance flows from the land on the western side of the Highway that currently discharges through a number of the smaller culverts beneath the Highway will be reduced as catch drains will be constructed along the rear of the lots backing onto the Highway in order to direct flows to the retarding basins so that stormwater can be discharged from the subdivision from the retarding basins in a controlled manner.

We trust that the provision of this information is of assistance for the Zoo to consider the possible impacts from the proposed development of the Highview Country Estate subdivision on the western side of the Newell Highway. The developer of the subdivision will ensure that the any potential impacts on the operation of the Zoo are minimised by the appropriate design and construction of stormwater drainage systems that are compliant with Council's design criteria and the modelling results outlined in this report.

We look forward to receiving any comments from the Zoo at your earliest convenience, however, in the meantime if there are any questions or clarification of any issues, please do not hesitate to contact our Dubbo office.

Yours faithfully
**Geolyse Pty Ltd**

**STEPHEN J HOYNES**
**Manager – Engineering / Director**

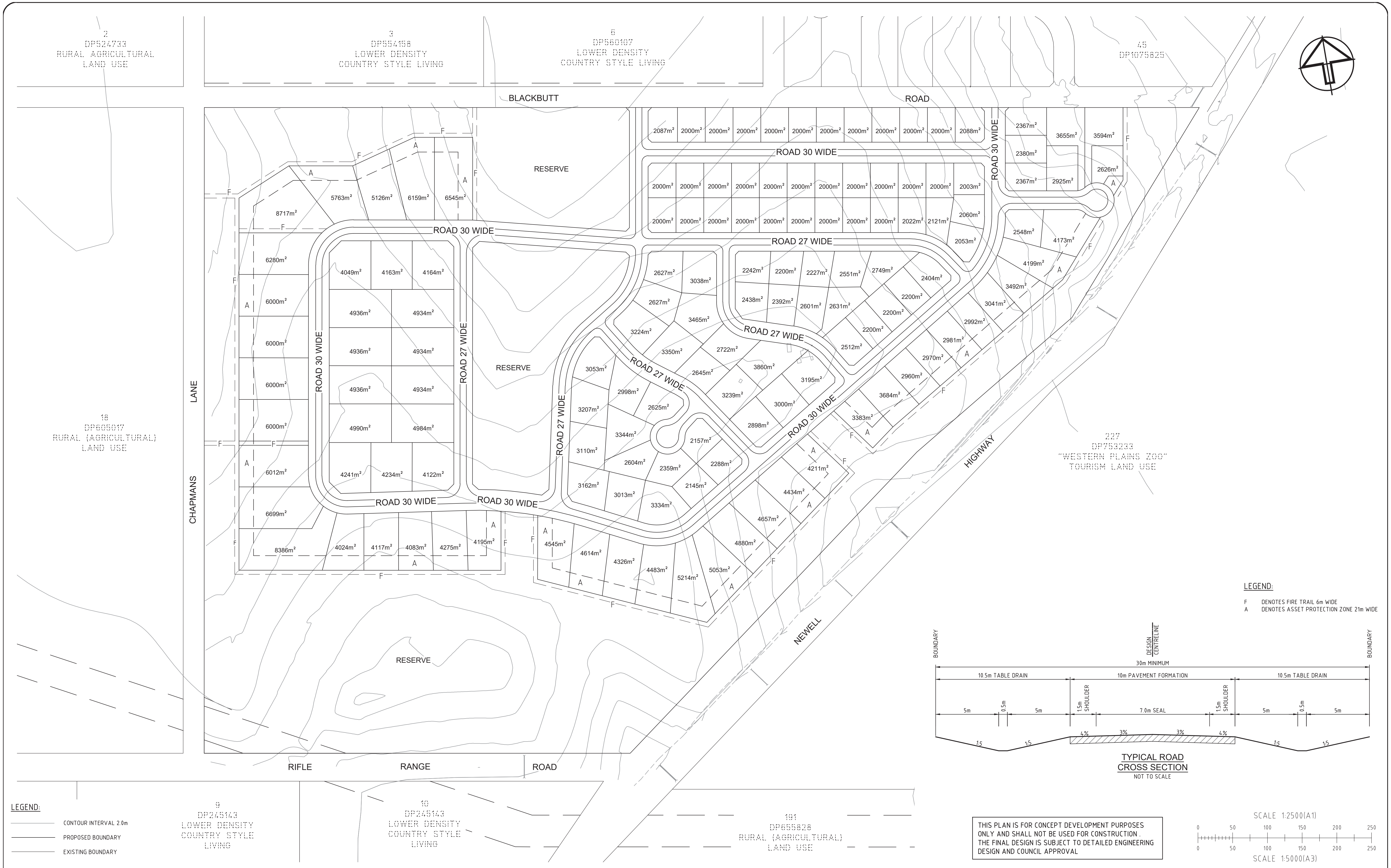
No. of Attachments: Drawing Sheet E02 - Proposed Subdivision Layout

Drawing Sheet E03 – Concept Stormwater Reticulation Plan

Drawing Sheet E04 – Concept Stormwater Management Plan

Drawing Sheet C001 – Existing Creek Lines Through Taronga Western Plains Zoo Map Image

Drawing Sheet C002 – Existing Creek Line Through Taronga Western Plains Zoo Aerial Image




THIS PLAN IS FOR CONCEPT DEVELOPMENT PURPOSES ONLY AND SHALL NOT BE USED FOR CONSTRUCTION. THE FINAL DESIGN IS SUBJECT TO DETAILED ENGINEERING DESIGN AND COUNCIL APPROVAL

| No | DATE | DRAFTING CHECK | PM CHECK | DETAILS |
|---|---|---|---|---|
| A | 10/09/14 | ZD | PPO | ISSUED FOR REVIEW |
| B | 18/09/15 | MY | PPO | REVISED LOT LAYOUT |
| C | 28/09/15 | MY | PPO | REVISED LOT LAYOUT |
| D | 20/10/15 | MY | PPO | LOT AREAS ADDED |
| E | 12/05/16 | JE | SH | 340m CONTOUR AND GENERAL AMENDMENTS |
| F | 10/08/16 | AJD | PPO | BASIN OUTLET PIPES RESIZED |
| G | 27/10/16 | AJD | PPO | BASIN DETAILS AMENDED |

| CHECKED/APPROVED | NAME | DATE |
|---|---|---|
| APPROVED | SH | 27/10/2016 |
| SURVEY | BARNSON | - |
| DESIGNER | PPO | 27/10/2016 |
| DRAFTING | ZD/MY/JE/AJD | 27/10/2016 |

APPROVAL AUTHORITY
DUBBO CITY COUNCIL
CIVIC ADMINISTRATION BUILDING
CHURCH STREET
DUBBO NSW 2830

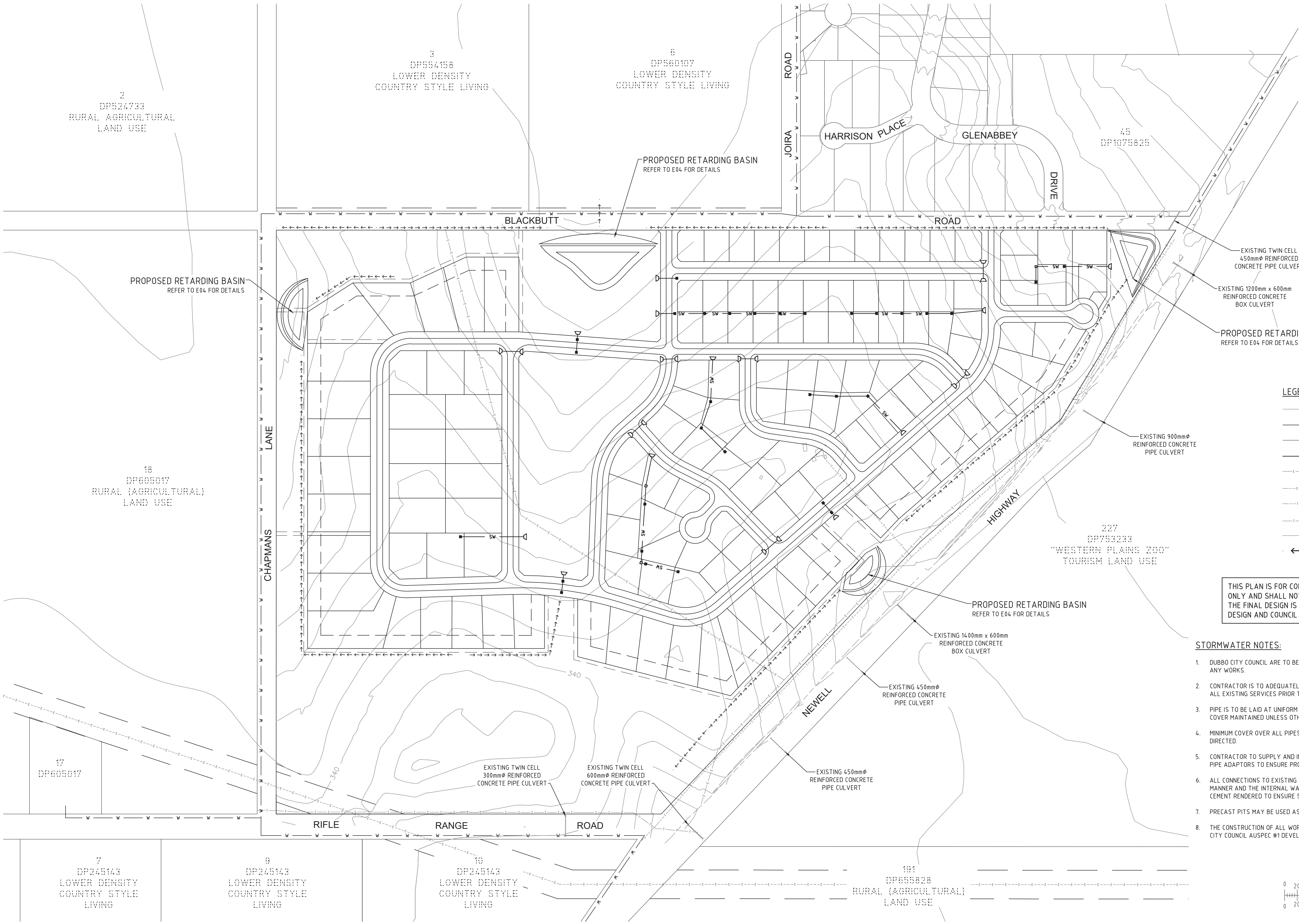
CLIENT
HIGHVIEW COUNTRY ESTATES PTY LTD

PROJECT
PROPOSED SUBDIVISION LOT 172 DP753233 BLACKBUTT ROAD, DUBBO

GEOLYSE
DUBBO
dubbo@geolyse.com
www.geolyse.com
1st FLOOR
62 WINGEWARRA STREET
P.O. BOX 1842
DUBBO, NSW 2830
Ph. (02) 6884 1525
Fax. (02) 6884 1470

DRAWING
PROPOSED SUBDIVISION LAYOUT

PERMANENT MARK: -
RL: -
DATUM: A.H.D.
PROJECT NUMBER: 113156
DRAWING SHEET: 02G_E02
ORIGINAL: A1
AUTOCAD FILE: 113156_02G_E01-E06.dwg
12D/CIVILCAD FILE: -
REVISION: G
STATUS: FOR REVIEW
SHEET E02 OF E06




LEGEND:

- CONTOUR INTERVAL 2.0m
- PROPOSED BOUNDARY
- EXISTING BOUNDARY
- PROPOSED STORMWATER LINE & PIT
- EXISTING ELECTRICITY LINE, LOCAL (11KV)
- EXISTING ELECTRICITY LINE, TRANSMISSION (132KV)
- EXISTING TELSTRA LINE (LOCAL)
- EXISTING TELSTRA LINE (OPTIC FIBRE)
- EXISTING TRUNK WATER MAIN
- PROPOSED SWALE DRAIN

THIS PLAN IS FOR CONCEPT DEVELOPMENT PURPOSES ONLY AND SHALL NOT BE USED FOR CONSTRUCTION . THE FINAL DESIGN IS SUBJECT TO DETAILED ENGINEERING DESIGN AND COUNCIL APPROVAL

STORMWATER NOTES:

1. DUBBO CITY COUNCIL ARE TO BE NOTIFIED 48 HOURS PRIOR TO THE COMMENCEMENT OF ANY WORKS.
2. CONTRACTOR IS TO ADEQUATELY INFORM HIMSELF AS TO THE DEPTH AND LOCATION OF ALL EXISTING SERVICES PRIOR TO COMMENCEMENT OF CONSTRUCTION.
3. PIPE IS TO BE LAID AT UNIFORM GRADE BETWEEN INVERT LEVELS SHOWN WITH MINIMUM COVER MAINTAINED UNLESS OTHERWISE APPROVED BY THE SUPERINTENDENT.
4. MINIMUM COVER OVER ALL PIPES SHALL BE 600mm UNLESS OTHERWISE SHOWN OR DIRECTED.
5. CONTRACTOR TO SUPPLY AND INSTALL ALL FITTINGS AND SPECIALS INCLUDING VARIOUS PIPE ADAPTORS TO ENSURE PROPER CONNECTION BETWEEN DISSIMILAR PIPEWORKS.
6. ALL CONNECTIONS TO EXISTING DRAINAGE PITS SHALL BE MADE IN TRADESMAN- LIKE MANNER AND THE INTERNAL WALL OF THE PIT AT THE POINT OF ENTRY SHALL BE CEMENT RENDERED TO ENSURE SMOOTH FINISH.
7. PRECAST PITS MAY BE USED AS APPROVED BY THE SUPERINTENDENT.
8. THE CONSTRUCTION OF ALL WORKS IS TO BE CARRIED OUT IN ACCORDANCE WITH DUBBO CITY COUNCIL AUSPEC #1 DEVELOPMENT SPECIFICATION SERIES FOR CONSTRUCTION.

SCALE 1:3000(A1)

0 20 40 80 120 160 200

0 20 40 80 120 160 200

SCALE 1:6000(A3)

| No | DATE | DRAFTING CHECK | PM CHECK | DETAILS |
|---|---|---|---|---|
| A | 10/09/14 | ZD | PPO | ISSUED FOR REVIEW |
| B | 18/09/15 | MY | PPO | REVISED LOT LAYOUT |
| C | 28/09/15 | MY | PPO | REVISED LOT LAYOUT |
| D | 20/10/15 | MY | PPO | LOT AREAS ADDED |
| E | 12/05/16 | JE | SH | 340m CONTOUR AND GENERAL AMENDMENTS |
| F | 10/08/16 | AJD | PPO | BASIN OUTLET PIPES RESIZED |
| G | 27/10/16 | AJD | PPO | BASIN DETAILS AMENDED |

| CHECKED/APPROVED | NAME | DATE |
|---|---|---|
| | | |
| APPROVED | SH | 27/10/2016 |
| SURVEY | BARNSON | . |
| DESIGNER | PPO | 27/10/2016 |
| DRAFTING | ZD/MY/JE/AJD | 27/10/2016 |

APPROVAL AUTHORITY

DUBBO CITY COUNCIL
CIVIC ADMINISTRATION
BUILDING
CHURCH STREET
DUBBO NSW 2830

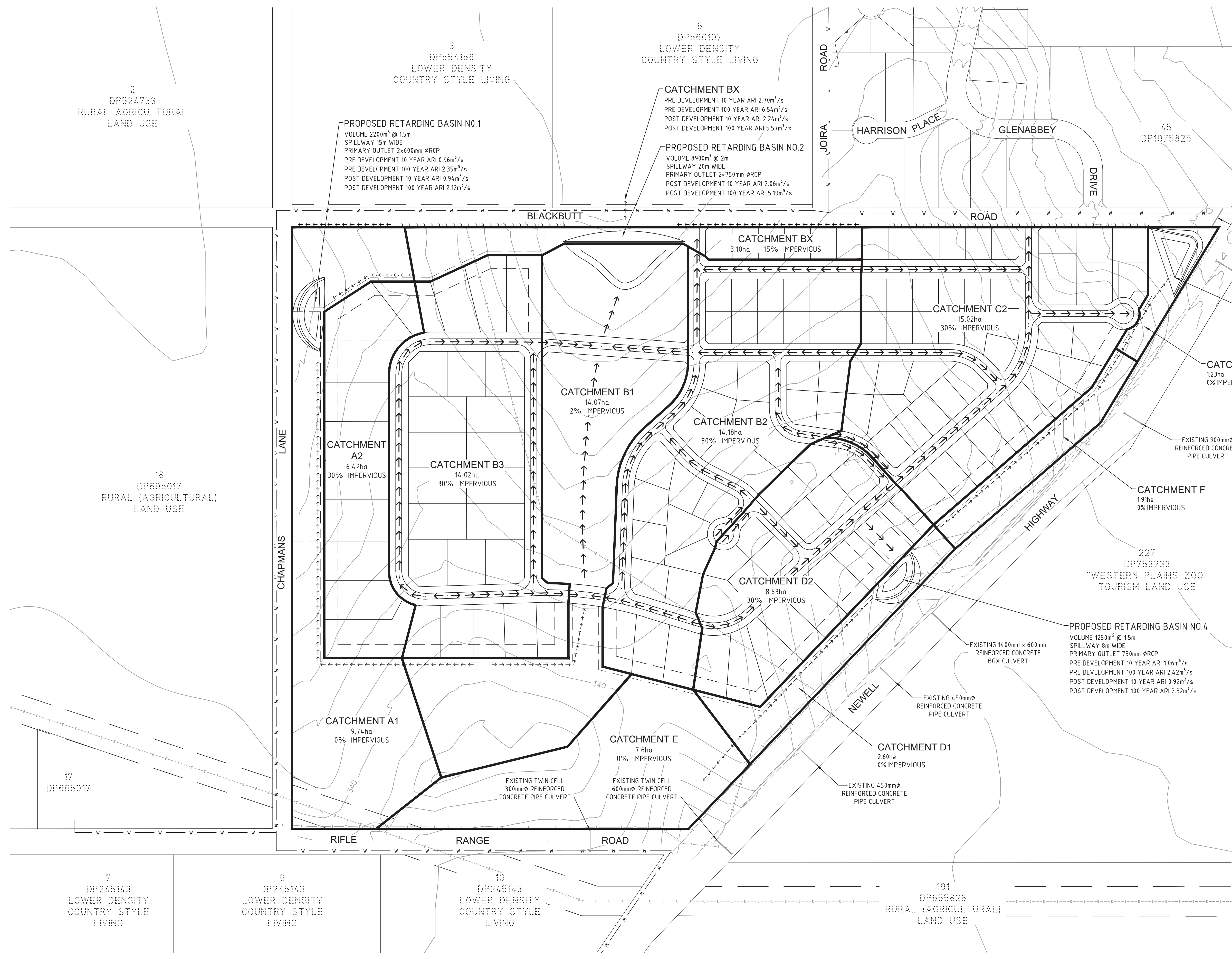
CLIENT
HIGHVIEW COUNTRY ESTATES PTY LTD

PROJECT
PROPOSED SUBDIVISION LOT 172
DP753233 BLACKBUTT ROAD,
DUBBO


GEOLYSE
DUBBO
dubbo@geolyse.com
www.geolyse.com
1st FLOOR
62 WINGEWARRA STREET
P.O. BOX 1842
DUBBO, NSW 2830
Ph. (02) 6884 1525
Fax. (02) 6884 1470


DRAWING
# CONCEPT STORMWATER RETICULATION PLAN

| PERMANENT MARK: - | RL: - | DATUM: A.H.D. |
|---|---|---|
| PROJECT NUMBER: 113156 | DRAWING SHEET: 02G_E03 | ORIGINAL A1 |
| AUTOCAD FILE: 113156_02G_E01-E06.dwg | 12D/CIVILCAD FILE: - | REVISION G |
| STATUS: FOR REVIEW | SHEET E03 OF E06 | |




LEGEND:

- CONTOUR INTERVAL 2.0m
- PROPOSED BOUNDARY
- EXISTING BOUNDARY
- STORMWATER CATCHMENT AREA
- ELECTRICITY LINE, LOCAL (11KV)
- ELECTRICITY LINE, TRANSMISSION (132KV)
- TELSTRA LINE (LOCAL)
- TELSTRA LINE (OPTIC FIBRE)
- EXISTING TRUNK WATER MAIN
- STORMWATER FLOW DIRECTION
- PROPOSED SWALE DRAIN

THIS PLAN IS FOR CONCEPT DEVELOPMENT PURPOSES ONLY AND SHALL NOT BE USED FOR CONSTRUCTION. THE FINAL DESIGN IS SUBJECT TO DETAILED ENGINEERING DESIGN AND COUNCIL APPROVAL

STORMWATER NOTES:

1. DUBBO CITY COUNCIL ARE TO BE NOTIFIED 48 HOURS PRIOR TO THE COMMENCEMENT OF ANY WORKS.
2. CONTRACTOR IS TO ADEQUATELY INFORM HIMSELF AS TO THE DEPTH AND LOCATION OF ALL EXISTING SERVICES PRIOR TO COMMENCEMENT OF CONSTRUCTION.
3. PIPE IS TO BE LAID AT UNIFORM GRADE BETWEEN INVERT LEVELS SHOWN WITH MINIMUM COVER MAINTAINED UNLESS OTHERWISE APPROVED BY THE SUPERINTENDENT.
4. MINIMUM COVER OVER ALL PIPES SHALL BE 600mm UNLESS OTHERWISE SHOWN OR DIRECTED.
5. CONTRACTOR TO SUPPLY AND INSTALL ALL FITTINGS AND SPECIALS INCLUDING VARIOUS PIPE ADAPTORS TO ENSURE PROPER CONNECTION BETWEEN DISSIMILAR PIPEWORKS.
6. ALL CONNECTIONS TO EXISTING DRAINAGE PITS SHALL BE MADE IN TRADESMAN- LIKE MANNER AND THE INTERNAL WALL OF THE PIT AT THE POINT OF ENTRY SHALL BE CEMENT RENDERED TO ENSURE SMOOTH FINNISH.
7. PRECAST PITS MAY BE USED AS APPROVED BY THE SUPERINTENDENT.
8. THE CONSTRUCTION OF ALL WORKS IS TO BE CARRIED OUT IN ACCORDANCE WITH DUBBO CITY COUNCIL AUSPEC #1 DEVELOPMENT SPECIFICATION SERIES FOR CONSTRUCTION.

SCALE 1:3000(A1)

0 20 40 80 120 160 200

SCALE 1:6000(A3)

| No | DATE | DRAFTING CHECK | PM CHECK | DETAILS |
|---|---|---|---|---|
| A | 10/09/14 | ZD | PPO | ISSUED FOR REVIEW |
| B | 18/09/15 | MY | PPO | REVISED LOT LAYOUT |
| C | 28/09/15 | MY | PPO | REVISED LOT LAYOUT |
| D | 20/10/15 | MY | PPO | LOT AREAS ADDED |
| E | 12/05/16 | JE | SH | 340m CONTOUR AND GENERAL AMENDMENTS |
| F | 10/08/16 | AJD | PPO | BASIN OUTLET PIPES RESIZED |
| G | 27/10/16 | AJD | PPO | BASIN DETAILS AMENDED |

| CHECKED/APPROVED | NAME | DATE |
|---|---|---|
| APPROVED | SH | 27/10/2016 |
| SURVEY | BARNSON | - |
| DESIGNER | PPO | 27/10/2016 |
| DRAFTING | ZD/MY/JE/AJD | 27/10/2016 |

APPROVAL AUTHORITY

DUBBO CITY COUNCIL
CIVIC ADMINISTRATION BUILDING
CHURCH STREET
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CLIENT
HIGHVIEW COUNTRY ESTATES PTY LTD

PROJECT
PROPOSED SUBDIVISION LOT 172 DP753233 BLACKBUTT ROAD, DUBBO


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dubbo@geolyse.com
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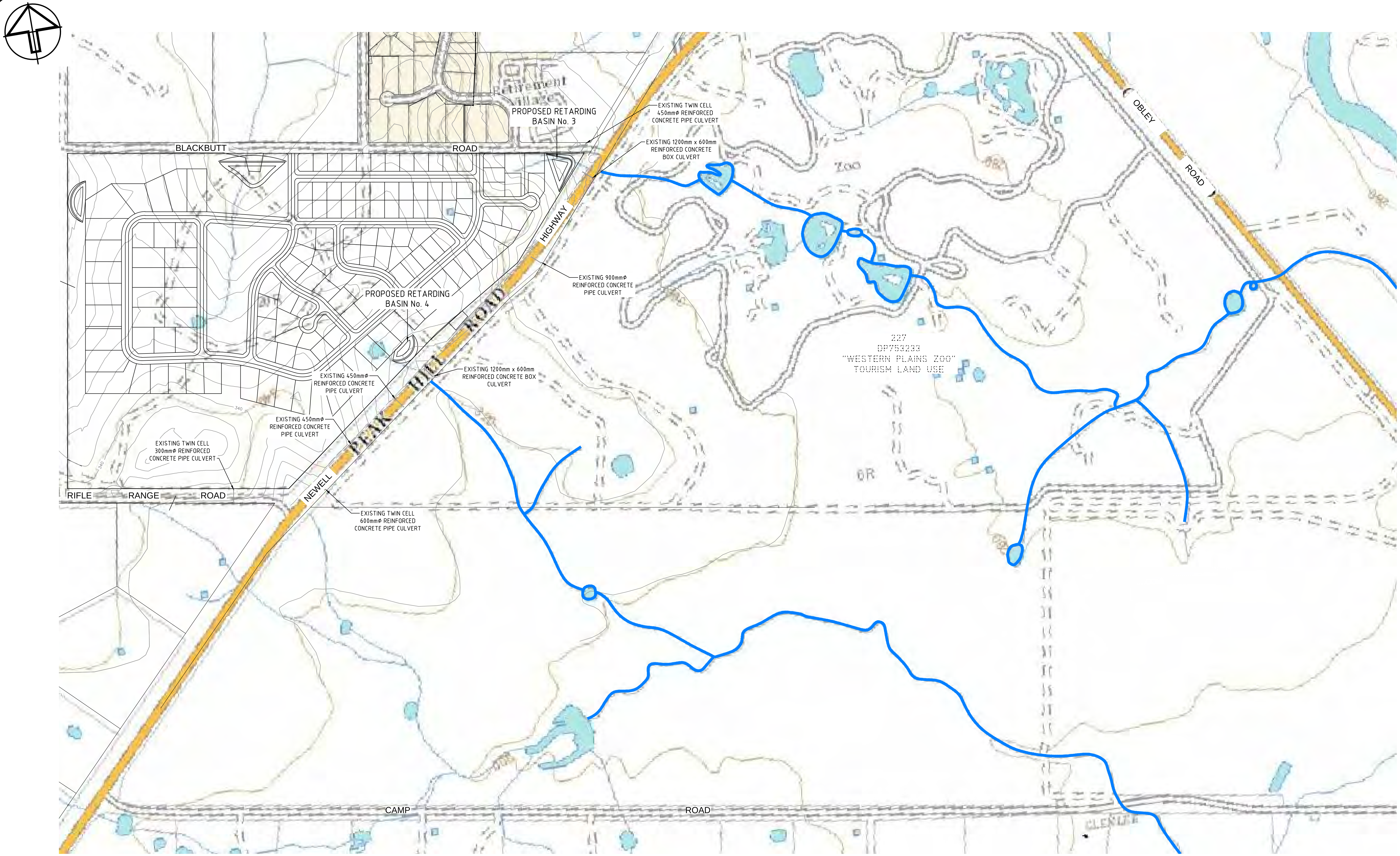
DUBBO, NSW 2830
Ph. (02) 6884 1525
Fax. (02) 6884 1470


DRAWING
CONCEPT STORMWATER MANAGEMENT PLAN

| | | | |
|---|---|---|---|
| PERMANENT MARK: - | RL: - | | DATUM: A.H.D. |
| PROJECT NUMBER: 113156 | DRAWING SHEET: 02G_E04 | | ORIGINAL A1 |
| AUTOCAD FILE: 113156_02G_E01-E06.dwg | 12D/CIVILCAD FILE: - | | REVISION G |
| STATUS: FOR REVIEW | SHEET E04 OF E06 | | |




| REV. | DATE | DFTD. | APPD. | DETAILS |
|---|---|---|---|---|
| A | 12/10/16 | NS | SJH | ISSUED FOR REVIEW |

| | FILE | INITIALS | DATE |
|---|---|---|---|
| SURVEY | BARNSON | | |
| DESIGN | | | |
| DRAINS/ HEC-RAS MODELLING | | | |
| ENGINEERING/ SURVEYING APPROVAL | | SJH | 12/10/16 |

MASTER SCALE

SCALE 1:5000 (A1)

0 100 200 300 400 500

0 100 200 300 400 500

SCALE 1:10000 (A3)

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

APPROVAL AUTHORITY: DUBBO REGIONAL COUNCIL

CLIENT: HIGHVIEW COUNTRY ESTATES PTY LTD

PROJECT: PROPOSED SUBDIVISION LOT 172 DP 753233, BLACKBUTT ROAD, DUBBO


GEOLYSE
DUBBO
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Fax. (02) 6884 1470


DRAWING: EXISTING CREEK LINES THROUGH TARONGA WESTERN PLAINS ZOO, MAP IMAGE

| PROJECT NUMBER 113156 | DRAWING FILE 113156_06A_C001-C002.dwg | SIZE A1 |
|---|---|---|
| SURVEY MARK | R.L. | DATUM A.H.D. |
| IMAGE SOURCE SIX MAPS | | SET 06A |
| STATUS FOR REVIEW | SHEET C001 OF C002 | |


| REV. | DATE | DFTD. | APPD. | DETAILS |
|---|---|---|---|---|
| A | 12/10/16 | NS | SJH | ISSUED FOR REVIEW |

| | FILE | INITIALS | DATE |
|---|---|---|---|
| SURVEY | BARNSON | | |
| DESIGN | | | |
| DRAINS/ HEC-RAS MODELLING | | | |
| ENGINEERING/ SURVEYING APPROVAL | | SJH | 12/10/16 |

MASTER SCALE

SCALE 1:1000 (A1)

0 20 40 60 80 100

0 20 40 60 80 100

SCALE 1:2000 (A3)

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

APPROVAL AUTHORITY: DUBBO REGIONAL COUNCIL

CLIENT: HIGHVIEW COUNTRY ESTATES PTY LTD

PROJECT: PROPOSED SUBDIVISION
LOT 172 DP 753233, BLACKBUTT ROAD, DUBBO


GEOLYSE

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DUBBO, NSW 2830
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Fax. (02) 6884 1470


DRAWING: EXISTING CREEK LINES THROUGH TARONGA WESTERN PLAINS ZOO, AERIAL IMAGE

PROJECT NUMBER 113156 | DRAWING FILE 113156_06A_C001-C002.dwg | SIZE A1

SURVEY MARK | R.L. | DATUM A.H.D. | SET 06A

IMAGE SOURCE GOOGLE EARTH

STATUS FOR REVIEW | SHEET C002 OF C002

# Appendix D

## RESPONSE RECEIVED FROM TWPZ

## Stephen Hoynes

**From:** Dubbo <dubbo@geolyse.com>
**Sent:** Wednesday, 25 January 2017 9:49 AM
**To:** Dubbo document control
**Subject:** FW: Highway Country Estates - Proposed subdivision of land - Blackbutt Road

**From:** Oke, Kathleen [mailto:koke@zoo.nsw.gov.au]
**Sent:** 20 January 2017 3:50 PM
**To:** dubbo@geolyse.com
**Subject:** Highway Country Estates - Proposed subdivision of land - Blackbutt Road

Good afternoon Stephen.

I do apologise for the delay in getting this response to you.

Thank you for your time and diligence in going through the proposed development and the impacts that could occur on the TWPZ land. As we raised with you our main concern was the impact of increased water flowing onto our site and the duration of the flow over and onto our site. As we discussed with you the main impact will be on our Billabong camp accommodation facility. You have explained the design and the styles of retention basins that will be used within the development and demonstrated the water flows and volumes that will be expected. As this is a new development we can only take you advice and expert advice and hope that in the long term your expectations are meet.

I thank you for the opportunity to view the documents and appreciate the detail you have provided us.

With kind regards,

Kath


**Kathleen Oke**
Manager - Facilities and Asset Operations
Taronga Western Plains Zoo

**Taronga Conservation Society Australia**
Obley Road Dubbo NSW 2830
**T** 02 68 811421
**E** koke@zoo.nsw.gov.au
**W** taronga.org.au


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